

COMMONWEALTH of VIRGINIA

Board of Education Agenda

Date of Meeting: February 17, 2011 **Time:** 9 a.m.
Location: Jefferson Conference Room, 22nd Floor, James Monroe Building
101 North 14th Street, Richmond, Virginia



9:00 a.m. FULL BOARD CONVENES

Moment of Silence

Pledge of Allegiance

Election of the Office of Vice President of the Board of Education, 2011-2013

Approval of Minutes of the January 13, 2011, Meeting of the Board

**Resolution of Recognition Presented to the Virginia Recipients of the 2010
Milken Family Foundation National Educator Awards:**

- Joel Christopher Robins, Deep Creek Elementary School, Chesapeake City Public Schools
- Sean Patrick Griffin, Belmont Station Elementary School, Loudoun County Public Schools

Public Comment

Action/Discussion Items

- A. Final Review of Revisions to Criteria for the *Virginia Index of Performance*, Virginia's Incentive Program to Encourage and Recognize Outstanding Achievement (HB 1172/SB 145)
- B. Final Review of Revisions of Industry, Professional, or Trade Association Certification Examinations and Occupational Competency Assessments to Meet the Requirements for the Board of Education's Career and Technical Education and Advanced Mathematics and Technology Seals and the Student-Selected Verified Credit
- C. Final Review of a Recommendation of the Advisory Board on Teacher Education and Licensure (ABTEL) to Approve the Criteria for Identifying Alternative Routes to Teacher Licensure as "Low Performing" or "At Risk of Becoming Low Performing" Required by Title II of the Higher Education Opportunity Act

Action/Discussion Items (continued)

- D. Final Review of the Proposed Addition of Asian Students as a Subgroup for the Purposes of Calculating Adequate Yearly Progress (AYP) in Virginia's Consolidated State Application Accountability Plan Under the *No Child Left Behind Act of 2001*
- E. First Review of Recommended Cut Scores for the Grade 3, Virginia Studies, U. S. History to 1965, and U. S. History: 1865 to the Present Standards of Learning Tests Based on the 2008 History Standards
- F. First Review of a Recommendation of the Advisory Board on Teacher Education and Licensure (ABTEL) to Approve a Cut Score and implementation Dates for the Praxis Braille Proficiency Test
- G. First Review of a Recommendation of the Advisory Board on Teacher Education and Licensure (ABTEL) to Approve a Cut Score for the Praxis Technology Education Assessment
- H. First Review of a Recommendation of the Advisory Board on Teacher Education and Licensure to Approve a Cut Score for the Praxis Art: Content Knowledge Assessment
- I. First Review of Guidelines to Implement the Provisions of Section 22.1-302 (A) of the *Code of Virginia* Pertaining to the Employment of Substitute Teachers
- J. First Review of Virginia's Proposed Revised Textbook Review Process
- K. First Review of Proposed English Language Proficiency Performance Targets for Annual Measurable Achievement Objectives (AMAOs) 1 (Progress) and 2 (Proficiency) through 2013-2014 in Virginia's Consolidated State Application Accountability Plan Under the *No Child Left Behind Act of 2001* (NCLB)

Reports

- L. Annual Report of the Virginia Advisory Committee for Career and Technical Education
- M. Report on Virginia's College and Career Readiness Initiative and *College and Career Ready Mathematics Performance Expectations*

DISCUSSION OF CURRENT ISSUES - by Board of Education Members and Superintendent of Public Instruction

ADJOURNMENT

PUBLIC NOTICE

The Board of Education members will meet for dinner at 6:30 p.m. at the Crowne Plaza Hotel on Wednesday, February 16, 2011. Items for the Board agenda may be discussed informally at that dinner. No votes will be taken, and it is open to the public. The Board president reserves the right to change the times listed on this agenda depending upon the time constraints during the meeting.

GUIDELINES FOR PUBLIC COMMENT

1. The Board of Education is pleased to receive public comment at each of its regular monthly meetings. In order to allow the Board sufficient time for its other business, the total time allotted to public comment will generally be limited to thirty (30) minutes. Individuals seeking to speak to the Board will be allotted three (3) minutes each.
2. Those wishing to speak to the Board should contact Dr. Margaret Roberts, Executive Assistant for Board Relations at (804) 225-2924. Normally, speakers will be scheduled in the order that their requests are received until the entire allotted time slot has been used. Where issues involving a variety of views are presented before the Board, the Board reserves the right to allocate the time available so as to ensure that the Board hears from different points of view on any particular issue.
3. Speakers are urged to contact Dr. Roberts in advance of the meeting. Because of time limitations, those persons who have not previously registered to speak prior to the day of the Board meeting cannot be assured that they will have an opportunity to appear before the Board.
4. In order to make the limited time available most effective, speakers are urged to provide multiple written copies of their comments or other material amplifying their views.

Board of Education Agenda Item

Item: A

Date: February 17, 2011

Topic: Final Review of Revisions to Criteria for the Virginia Index of Performance, Virginia’s Incentive Program to Encourage and Recognize Outstanding Achievement (HB 1172/SB 145)

Presenter: Dr. Deborah L. Jonas, Executive Director for Research and Strategic Planning

Telephone Number: 804-225-2067

E-Mail Address: deborah.jonas@doe.virginia.gov

Origin:

Topic presented for information only (no board action required)

Board review required by
 State or federal law or regulation
 Board of Education regulation
 Other: _____

Action requested at this meeting

Action requested at future meeting:

Previous Review/Action:

No previous board review/action

Previous review/action: Board accepted the proposal for first review on January 13, 2011.

Background Information:

The *Regulations Establishing Standards for Accrediting Public Schools in Virginia* (8VAC 20-131-325) authorize the Board of Education to establish guidelines for recognizing and rewarding school accountability performance.

In July 2007, the Board of Education established the *Virginia Index of Performance (VIP)* incentive program to recognize and reward fully accredited schools and school divisions that make significant progress toward achieving specific measurable goals and objectives established by the Board of Education and supported by the Governor.

The Virginia Standards of Accreditation (SOA) recognize student achievement as a fundamental component in determining the accreditation status of Virginia’s public schools. For more than a decade in Virginia, student performance has been measured by achievement on the Standards of Learning (SOL) tests or additional assessments approved by the Board of Education. Schools achieve fully accredited status primarily by meeting pass rates established for all students in four core academic content areas. Beginning in 2011-2012, schools with a graduating class must also meet certain graduation benchmarks in order to be fully accredited.

From its inception, the VIP program was intended to provide schools and divisions with incentives to strive for higher levels of achievement for all children. VIP was designed to measure the extent to which students are progressing towards advanced proficiency levels in reading, mathematics, science, and history and social science, recognize achievement of other key indicators of school success, and to encourage schools' and divisions' efforts to provide Virginia's students with excellent educational opportunities. Schools and school divisions become eligible for VIP awards by meeting applicable state and federal achievement benchmarks (school accreditation and adequate yearly progress or AYP) for two consecutive years.

Summary of Major Elements

In 2010, HB 1172 and SB 145 were passed and enrolled into the *Code of Virginia*. The bill codified provisions in the Standards of Accreditation § [22.1-253.13:9](#) that established the VIP program. Additionally, the legislation directed the Board to include in its guidelines for the VIP incentive program performance objectives and measures that promote student achievement in science, technology, engineering, and mathematics (STEM).

The current VIP award requirements encourage school divisions to increase the percent of students earning advanced proficiency on state mathematics and science assessments, and provide incentives for schools to meet additional Virginia performance objectives.

The proposed revisions were developed to retain the previously established program objectives while adding components that provide additional incentives for school divisions and schools to promote student achievement in the STEM areas and college and career readiness in general. The proposed revisions also make changes to the awards by renaming the VIP Competence to Excellence Award as the Distinguished Achievement Award, and eliminating the Rising Star award. As well, this proposal provides an opportunity for schools with no tested grades to earn VIP awards.

The proposed revisions would retain the approach to determining VIP awards adopted by the Board in 2009. Based on this approach, the VIP program uses a weighted methodology to calculate a VIP achievement index based on SOL test results in each content area (English, mathematics, science, and history and social science), and provides opportunities for schools and school divisions to apply additional or "bonus" points to the content area indices by meeting additional VIP indicators.

The VIP Base Index weights the proficiency levels on statewide assessments as follows:

- Advanced proficient: 100
- Proficient: 75
- Basic: 25
- Fail: 0

The weighted index is applied to all assessments taken in the school or division. Separate base scores are calculated for each content area—English, mathematics, science, and history and social science—using the following formula:

$$(\# \text{ Advanced Proficient scores} \times 100) + (\# \text{ Proficient scores} \times 75) + (\# \text{ Basic scores} \times 25)$$

Total tests administered

Schools and divisions may earn additional VIP bonus points based on criteria established by the Board. When earned, they can be added to a school or division’s VIP index points in one or more content areas to meet award criteria.

Table 1 shows the proposed criteria, additional indicators for the revised VIP program, and defines the proposed requirements for earning each proposed VIP award. Items marked with an asterisk (*) are STEM indicators that are part of the VIP program; modified indicators are shown in italics; new indicators are identified with italics and underlined.

Table 1: Proposed Criteria, Indicators, and Award Requirements, Virginia Index of Performance

VIP Criteria	VIP Awards		
	<i>Board of Education Distinguished Achievement Award</i>	Board of Education Excellence Award	Governor’s Award for Educational Excellence
Eligibility and VIP Index			
A. Eligibility – Schools must have met accreditation and AYP benchmarks for two consecutive years; school divisions must have made AYP for two consecutive years	All Schools and School Divisions	All Schools and School Divisions	All Schools and School Divisions
B. Number of index points on the weighted VIP index, using the established weightings in each of the following content areas: a) English/reading (combined reading and writing); b) mathematics*; c) science*; and d) history and social science. <i><u>Schools with no grades in which tests are administered earn index points based on test data used to make federal and state accountability determinations. All non-test criteria, such as bonus points for foreign language instructional services and the Governor’s Nutrition and Physical Activity Scorecard program, will be determined based on the individual school’s data.</u></i>	At least 75 in each content area, including additional index points where applicable	At least 80 in each content area, including additional index points where applicable	At least 80 in each content area
C. <i><u>No significant testing irregularities were verified during the applicable school year</u></i>	<i><u>All Schools and School Divisions</u></i>	<i><u>All Schools and School Divisions</u></i>	<i><u>All Schools and School Divisions</u></i>

VIP Criteria	VIP Awards		
	<i>Board of Education Distinguished Achievement Award</i>	Board of Education Excellence Award	Governor's Award for Educational Excellence
Additional index points available, and award threshold if applicable			
For Elementary Schools			
D. Students passing the Grade 3 state reading assessment (percent passing increases annually, state goal 95%)	3	3	At least 95%
E. Students passing the Grade 5 state reading and writing assessments (percent passing increases annually, state goal 95%)	1	1	Increases annually or is at least 95%
F. School offers foreign language instruction in the elementary grades	1	1	<u>Yes</u>
For Middle Schools			
G. Students enrolled in Algebra I by Grade 8* (percent participating increases annually, state goal 50%)	2	2	<i>At least 50%</i>
H. Students passing the Grade 8 state reading and writing assessments (percent passing increases annually, state goal 95%)	1	1	Increases annually or is at least 95%
For High Schools			
I. High school students enrolled in one or more AP, IB, or dual enrollment courses (increases annually, state goal 30%)	1	1	<i>At least 30%</i>
J. High school students earning career and technical industry certifications, state licenses, or successful national occupational assessment credentials (number or percent increases annually) <u>OR</u> <i>Students who participate in advanced coursework in the STEM areas, including Advanced Placement courses, International Baccalaureate courses, and dual enrollment courses* (Percent increases annually).</i>	1	1	Number or percent of CTE credentials increases annually <u>OR</u> <i>The percent of students participating in advanced coursework in STEM areas increases annually</i>

VIP Criteria	VIP Awards		
	Board of Education Distinguished Achievement Award	Board of Education Excellence Award	Governor's Award for Educational Excellence
Additional index points available, and award threshold if applicable			
K. <i>Students who graduate high school in four, five, or six years with a standard or advanced studies diploma (based on the federal graduation indicator; percent increases annually, state goal 85%)</i>	<i>At least 85% or increases annually</i>	<i>At least 85%</i>	<i>At least 85%</i>
L. High school graduates earning an Advanced Studies Diploma out of the total number of Board of Education-approved diplomas awarded (increases annually, state goal 60%)	1	1	<i>At least 60%</i>
M. <u>Students in each subgroup who graduate from high school with a Standard or Advanced Studies Diploma (increases annually, state goal 85%)</u>	1	1	<u>Increases annually, or is at least 85%</u>
N. <u>Students who graduate from high school having taken Calculus, Chemistry, and Physics* (increases annually)</u>	1	1	<u>Increases annually</u>
O. <u>Students who graduate from high school having earned advanced proficient scores on each of the state end-of-course assessments in English reading, English writing, and Algebra II* (increases annually)</u>	1	1	<u>Increases annually</u>
P. Students who drop out of high school (10% or less, based on the four-year dropout rate)	10% or less	10% or less	10% or less
For All Schools and School Divisions			
Q. Increase participation in the Governor's Nutrition and Physical Activity Scorecard Awards program (schools must earn an award; divisions increase program participation)	1	1	1

VIP Criteria	VIP Awards		
	<i>Board of Education Distinguished Achievement Award</i>	Board of Education Excellence Award	Governor's Award for Educational Excellence
Additional index points available, and award threshold if applicable			
R. Increase the percentage of students in each subgroup earning higher levels of proficiency on state assessments (increase required for subgroups used to make federal accountability determinations in mathematics and reading)	1	1	1
For School Divisions Only			
S. Eligible schools participate in the Virginia Preschool Initiative for at-risk four-year-olds.	1	1	Yes
T. <i><u>Students in the division enroll in Board of Education-approved Governor's STEM Academies or a Regional Academic Year Governor's School with a focus on STEM*</u></i>	1	1	<u>Yes</u>
U. Schools offer foreign language instruction in the elementary grades (number increases annually, state goal 100%)	1	1	<i>Increases annually or equals 100%</i>
V. Increase the percentage of schools that are fully accredited and making Adequate Yearly Progress (annual increase, state goal 100%)	1	1	1

*Indicates STEM components of the VIP program

NOTE: Items listed in *italics* are proposed modifications from the current VIP program; items listed in *italics and underlined* are proposed changes that are new to the VIP program.

Superintendent's Recommendation:

The Superintendent of Public Instruction recommends that the Board of Education adopt the proposed revised criteria for the *Virginia Index of Performance*, Virginia's incentive program to encourage and recognize outstanding achievement, and authorize the department to implement changes to eligibility for awards issued in 2011-2012 and the remaining criteria for awards issued in 2012-2013.

Impact on Resources:

The Department can absorb the costs to adjust the awards criteria for the VIP program.

Timetable for Further Review/Action:

If adopted, the Department will implement changes consistent with the implementation timeline.

Board of Education Agenda Item

Item: B.

Date: February 17, 2011

Topic: Final Review of Revisions of Industry, Professional, or Trade Association Certification Examinations and Occupational Competency Assessments to Meet the Requirements for the Board of Education's Career and Technical Education and Advanced Mathematics and Technology Seals and the Student-Selected Verified Credit.

Presenter: Mr. Lan Neugent, Assistant Superintendent for Technology and Career Education

Telephone Number: 804-786-2260

E-Mail Address: Lan.Neugent@doe.virginia.gov

Origin:

Topic presented for information only (no board action required)

Board review required by

State or federal law or regulation

Board of Education regulation

Other:

Action requested at this meeting Action requested at future meeting: _____

Previous Review/Action:

No previous board review/action

Previous review/action

date September 28, 2000; April 26, 2001; April 24 & 25, 2002; May 28, 2003; June 25, 2003; February 25, 2004; February 23, 2005; November 30, 2005, November 29, 2006, January 10, 2008, January 15, 2009, and January 14, 2010.

action Additions and/or deletions were made to the list of board-approved examinations, assessments, and licensures.

Background Information:

The *Regulations Establishing Standards for Accrediting Public Schools in Virginia*, requirements for graduation 8 VAC 20-131-50.I.3, provide students who demonstrate academic excellence and/or outstanding achievement the opportunity to earn the Board of Education's Career and Technical Education Seal.

8 VAC 20-131-50.I.3 - "The Board of Education's Career and Technical Education Seal will be awarded to students who earn a Standard or Advanced Studies Diploma and complete a prescribed sequence of courses in a career and technical education concentration or specialization that they choose and maintain a "B" or better average in those courses; or (i) pass an examination or occupational competency assessment in a career and technical education concentration or specialization that confers certification or an occupational competency credential from a recognized industry, trade or professional association or (ii) acquire a professional license in that career and technical education field from the Commonwealth of Virginia. The Board shall approve all professional licenses and examinations used to satisfy these requirements."

The *Regulations Establishing Standards for Accrediting Public Schools in Virginia*, requirements for graduation 8 VAC 20-131-50.I.4, provide students who demonstrate academic excellence and/or outstanding achievement the opportunity to earn the Board of Education’s Seal of Advanced Mathematics and Technology.

8 VAC 20-131-50.I.4 – “The Board of Education’s Seal of Advanced Mathematics and Technology will be awarded to students who earn either a Standard or Advanced Studies Diploma and (i) satisfy all of the mathematics requirements for the Advanced Studies Diploma (four units of credit including Algebra II; two verified units of credit) with a “B” average or better, and (ii) either (a) pass an examination in a career and technical education field that confers certification from a recognized industry, or trade or professional association, (b) acquire a professional license in a career and technical education field from the Commonwealth of Virginia, or (c) pass an examination approved by the Board that confers college-level credit in a technology or computer science area. The Board of Education shall approve all professional licenses and examinations used to satisfy these requirements.”

The *Regulations Establishing Standards for Accrediting Public Schools in Virginia* make the following provisions relative to students earning verified units of credit:

8 VAC 20-131-110.C Standard and verified units of credit

The Board may from time to time approve additional tests for the purpose of awarding verified credit. Such additional tests, which enable students to earn verified units of credit, must, at a minimum, meet the following criteria:

1. The test must be standardized and graded independently of the school or school division in which the test is given;
2. The test must be knowledge-based;
3. The test must be administered on a multi-state or international basis, or administered as part of another state’s accountability assessment program; and
4. To be counted in a specific academic area, the test must measure content that incorporates or exceeds the SOL content in the course for which verified credit is given.

8 VAC 20-131-50.B.2 (Footnotes 5 and 6 and C., Footnote 5) Requirements for graduation

Verified Credits Required

Student Selected Test ⁵

⁵ A student may utilize additional assessments for earning verified credit in computer science, technology, career and technical education, or other areas as prescribed by the Board in 8VAC 20-131-110.

⁶Students who complete a career and technical education program sequence and pass an examination or occupational competency assessment in a career and technical education field that confers certification or an occupational competency credential from a recognized industry, or trade or professional association or acquires a professional license in a career and technical education field from the Commonwealth of Virginia may substitute the certification, competency credential, or license for (i) the student selected verified credit and (ii) either a science or history and social science verified credit when the certification, license, or credential confers more than one verified credit. The examination or occupational competency assessment must be approved by the Board of Education as an additional test to verify student achievement.

Summary of Major Elements:

The attached list of industry, professional, trade association certifications, or occupational competency assessments meets the Board's requirements as noted in 8 VAC 20-131-50.I.3, 8 VAC 20-131-50.I.4, 8 VAC 20-131-110, and 8 VAC 20-131-50.B.4 (Footnotes 5 and 6 and C., Footnote 5) for the Career and Technical Education Seal, the Seal of Advanced Mathematics and Technology, and student-selected verified credit.

The 58 additional industry certification examinations and occupational competency assessments in bold print have been identified as meeting criteria to satisfy requirements for the Career and Technical Education Seal and student-selected verified credit. Six of these examinations have been identified as meeting criteria to satisfy requirements for the Advanced Mathematics and Technology Seal. A list of previously approved examinations and recommended additional examinations is attached.

Industry, professional, and trade association certifications are continually being revised or discontinued to stay current with technology and new techniques. These changes may be such that individual certifications are no longer available, no longer meet the Board of Education's criteria for diploma seals or student-selected verified credit, or require additional criteria such as work experience beyond high school. Changes have been made in 13 of the certifications that were previously approved by the Board. A list of certification examinations that are recommended for deletion from the Board-approved list is attached.

As a result of the proposed additions and deletions to this list there are:

- 277 credentials eligible for student-selected verified credit;
- 272 credentials eligible for the Career and Technical Education Seal; and
- 35 credentials eligible for the Advanced Mathematics and Technology Seal.

Superintendent's Recommendation:

The Superintendent of Public Instruction recommends that the Board of Education approve the revised list of industry certification examinations, occupational competency assessments, and licenses to meet the requirements for the Board of Education's Career and Technical Education and Advanced Mathematics and Technology Seals and the student-selected verified credit.

Impact on Resources:

Federal Carl Perkins funds may be used to help teachers and programs become certified. State funds will be used to assist students to become certified or pass an occupational competency assessment.

Timetable for Further Review/Action:

After final approval, a Superintendent's Memorandum will notify school divisions of these additions to and deletions from the approved list of industry certifications, occupational competency assessments, and licenses.

Board of Education Approved Industry Certifications, Occupational Competency Assessments, and Licensure				
February 17, 2011 (Proposed)				
Name of Credential	Issuing Organization	Meets Board of Education Criteria		
		Student Selected Verified Credit	Career and Technical Education Seal	Advanced Mathematics and Technology Seal
AGRICULTURAL EDUCATION				
Agricultural Biotechnology Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Agriculture Mechanics Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Agribusiness Examination	New York State Department of Education	X	X	
Animal Systems Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Commercial Pesticide Applicator Certification	Virginia Department of Agriculture and Consumer Services	X	X	
Floriculture-Greenhouse Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Floriculture Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Forestry Products & Processing Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Greenhouse Operators Certification Program	Southeast Greenhouse Growers Association	X	X	
Horticulture-Landscaping Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Horticulture-Olericulture and Pomology Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Natural Resource Systems Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Outdoor Power Equipment Certifications (Pass any one Outdoor Power Equipment exam)	Equipment and Engine Training Council	X	X	
Power Equipment Technology Examination	SkillsUSA	X	X	
Pet Sitters Certification	National Association Professional Pet Sitters	X	X	
Production Agriculture Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Private Applicator Certification	Virginia Department of Agriculture and Consumer Services	X	X	
Registered Technician Certification	Virginia Department of Agriculture and Consumer Services	X	X	
Small Engine Technology Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	

NOTE: New industry certification credentials and occupational competency assessments are printed in bold.

Board of Education Approved Industry Certifications, Occupational Competency Assessments, and Licensure				
February 17, 2011 (Proposed)				
Name of Credential	Issuing Organization	Meets Board of Education Criteria		
		Student Selected Verified Credit	Career and Technical Education Seal	Advanced Mathematics and Technology Seal
Small Animal Science Examination	National Occupational Competency Testing Institute (NOCTI)	X	X	
Small Animal Care Examination	New York State Department of Education	X	X	
BUSINESS AND INFORMATION TECHNOLOGY				
Accounting-Basic Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Accounting - Complete Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Administrative Assisting Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Administrative Services Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Adobe Certified Associate (Pass any one test in this program)	Adobe Systems Incorporated	X	X	X
Apple Pro Certification Program (Pass any one exam in this program)	Apple, Inc.	X	X	X
Banking and Related Services Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Business Financial Management Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Business and Information Technology Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	X
Brainbench Network Administration Certifications (Pass any one test in this category)	Brainbench	X	X	X
Brainbench Systems Administration Certifications (Pass any one test in this category)	Brainbench	X	X	X
(Pass any one test in this category)				
Brainbench Software Development Certifications (Pass any one test in this category)	Brainbench	X	X	X
Brainbench Web Design and Development Certifications (Pass any one test in this category)	Brainbench	X	X	X

NOTE: New industry certification credentials and occupational competency assessments are printed in bold.

Board of Education Approved Industry Certifications, Occupational Competency Assessments, and Licensure				
February 17, 2011 (Proposed)				
Name of Credential	Issuing Organization	Meets Board of Education Criteria		
		Student Selected Verified Credit	Career and Technical Education Seal	Advanced Mathematics and Technology Seal
Brainbench Web Administration Certifications (Pass any one test in this category)	Brainbench	X	X	X
Brainbench Desktop Publishing Certifications (Pass any one test in this category)	Brainbench	X	X	X
Certified Internet Web Professional (CIW) Program (Pass any one exam in this program)	ProsoftTraining	X	X	X
Certified Novell Administrator (CNA)	Novell	X	X	X
Computer Programming Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	X
Computer Programming Examination	SkillsUSA	X	X	X
Financial and Investment Planning Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Financial Literacy Certification (WISE)	Working in Support of Education (WISE)	X	X	
Fundamental Business Concepts	ASK Institute (DECA/MarkED)	X	X	
General Management Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Human Resources Management Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
IC3 Certification	Certiport	X	X	X
Linux+ Certification	CompTIA	X	X	X
Microsoft Certified Professional (Pass any one Microsoft Professional exam)	Microsoft	X	X	X
Microsoft Technology Associate (MTA) Program (Pass any one exam)	Microsoft	X	X	X
Microsoft Office Specialist (MOS)--(Pass any one MOS exam of any version)	Microsoft	X	X	
Network+ Certification	CompTIA	X	X	X
Oracle Certification Program Examinations (Pass any one Oracle certification exam)	Oracle Corporation	X	X	X
Virtual Enterprise Assessment	National Occupational Competency Testing Institute (NOCTI) and Certiport	X	X	
WISE Financial Literacy Certification	Working in Support of Education (WISE)	X	X	

NOTE: New industry certification credentials and occupational competency assessments are printed in bold.

Board of Education Approved Industry Certifications, Occupational Competency Assessments, and Licensure				
February 17, 2011 (Proposed)				
Name of Credential	Issuing Organization	Meets Board of Education Criteria		
		Student Selected Verified Credit	Career and Technical Education Seal	Advanced Mathematics and Technology Seal
CAREER AND TECHNICAL EDUCATION GENERIC CREDENTIALS				
Digital Literacy Certification Test (must be taken in combination with the Virginia Workplace Readiness Assessment)	Microsoft	X	X	
National Career Readiness Certificate	ACT, WorkKeys®	X	X	
Virginia Workplace Readiness Assessment/IC3 Certification Exams (pass Virginia Workplace Readiness Assessment and any one of three IC3 exams)	National Occupational Competency Testing Institute (NOCTI) and Certiport	X	X	
Workplace Readiness Skills for the Commonwealth Examination	Career and Technical Education Consortium of States (CTECS)	X	X	
FAMILY AND CONSUMER SCIENCES EDUCATION				
Broad Field Family and Consumer Sciences Examination	American Association of Family and Consumer Sciences (AAFCS)	X	X	
Commercial Foods Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Commercial Baking Examination	SkillsUSA	X	X	
Culinary Arts Prep Cook-Level 1 Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Culinary Arts Cook-Level 2 Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Culinary Arts Examination	American Association of Family and Consumer Sciences (AAFCS)	X	X	
Culinary Arts Examination	SkillsUSA	X	X	
Early Childhood Care and Education Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Early Childhood Education Examination	American Association of Family and Consumer Sciences (AAFCS)	X	X	
Education Careers Examination	American Association of Family and Consumer Sciences (AAFCS)	X	X	
Education and Training Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	

NOTE: New industry certification credentials and occupational competency assessments are printed in bold.

Board of Education Approved Industry Certifications, Occupational Competency Assessments, and Licensure				
February 17, 2011 (Proposed)				
Name of Credential	Issuing Organization	Meets Board of Education Criteria		
		Student Selected Verified Credit	Career and Technical Education Seal	Advanced Mathematics and Technology Seal
Family Services Examination	American Association of Family and Consumer Sciences (AAFCS)	X	X	
Fashion, Textiles, and Apparel Examination	American Association of Family and Consumer Sciences (AAFCS)	X	X	
Hospitality Management--Food and Beverage Option Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Hospitality Management--Lodging Option Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Interior Design Examination	American Association of Family and Consumer Sciences (AAFCS)	X	X	
Nutrition Examination	American Association of Family and Consumer Sciences (AAFCS)	X	X	
ParaPro	Educational Testing Service	X	X	
Personal and Family Finance Certification	American Association of Family & Consumer Sciences (AAFCS)	X	X	
ProStart Program Certification (Levels I and/or 2)	Education Foundation of the National Restaurant Association	X	X	
Retail Commercial Baking Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Restaurant, Food and Beverage Services Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
ServeSafe Certification	Education Foundation of the National Restaurant Association	X	X	
START Certification (Hospitality Skills)	American Hotel and Lodging Association (AH&LA)	X	X	
HEALTH AND MEDICAL SCIENCES EDUCATION				
Certified Clinical Medical Assistant Examination	National Healthcareer Association	X	X	
Certified Dental Assistant: Infection Control Examination (ICE)	Dental Assisting National Board, Inc.	X	X	
Certified Dental Assistant: Radiation Health & Safety Examination (RHS)	Dental Assisting National Board, Inc.	X	X	
Certified Veterinary Assistant	Animal Care Technologies	X	X	
Dental Assisting Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Diagnostic Services Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	

NOTE: New industry certification credentials and occupational competency assessments are printed in bold.

Board of Education Approved Industry Certifications, Occupational Competency Assessments, and Licensure				
February 17, 2011 (Proposed)				
Name of Credential	Issuing Organization	Meets Board of Education Criteria		
		Student Selected Verified Credit	Career and Technical Education Seal	Advanced Mathematics and Technology Seal
EMS First Responder Certification	Department of Health, Office of Emergency Medical Services	X	X	
Emergency Medical Technician	Department of Health, Office of Emergency Medical Services	X	X	
Health Assisting Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Health Informatics Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Home Health Aide Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Medical Assisting Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Medical Assisting Examination	SkillsUSA	X	X	
National Health Care Foundation Skills Standards Assessment	National Consortium on Health Science & Technical Education	X	X	
NRDA Certification (Dental Assisting)	National Allied Health Registry/National Association for Health Professionals	X	X	
NRDA Certification (Medical Assisting)	National Allied Health Registry/National Association for Health Professionals	X	X	
Nurse Aide	Virginia Board of Nursing	X	X	
Nurse Assisting Examination	SkillsUSA	X	X	
Nursing Assisting Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Practical Nursing Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Practical Nursing Examination	SkillsUSA	X	X	
Therapeutic Services Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Virginia Pharmacy Technician Examination	Virginia Board of Pharmacy	X	X	
MARKETING				
Concepts of Finance Examination	ASK Institute (DECA/MarkED)	X	X	
Concepts of Entrepreneurship and Management Examination	ASK Institute (DECA/MarkED)	X	X	
Fundamental Marketing Concepts	ASK Institute (DECA/MarkED)	X	X	
Lodging Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	

NOTE: New industry certification credentials and occupational competency assessments are printed in bold.

Board of Education Approved Industry Certifications, Occupational Competency Assessments, and Licensure				
February 17, 2011 (Proposed)				
Name of Credential	Issuing Organization	Meets Board of Education Criteria		
		Student Selected Verified Credit	Career and Technical Education Seal	Advanced Mathematics and Technology Seal
Lodging Management Program Certification (Levels 1 and/or 2)	American Hotel and Lodging Association (AH&LA)	X	X	
National Professional Certification in Customer Service	National Retail Federation Foundation	X	X	
Retail Trades Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Retail Management Examination	National Retail Federation Foundation	X	X	
Recreation, Amusements, and Attractions Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Sales Certification	National Retail Federation Foundation	X	X	
Travel and Tourism Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
MILITARY SCIENCE				
Armed Services Vocational Aptitude Battery Examination	United States Military Entrance Processing Command	X	X	
JROTC Skills for Success Assessment	Department of Defense	X	X	
TECHNOLOGY EDUCATION				
3D Visualization & Animation Examination	SkillsUSA	X	X	
ADDA Architectural Drafting Examination	American Design Drafting Association	X	X	
ADDA Mechanical Drafting Examination	American Design Drafting Association	X	X	
ADDA Mechanical Drafting Apprentice Examination	American Design Drafting Association	X	X	
ADDA Architectural Drafting Apprentice Examination	American Design Drafting Association	X	X	
AutoCAD Certifications (Pass any one exam)	Brainbench	X	X	
Autodesk Application Certification Program (Pass any one exam)	Autodesk	X	X	
Autodesk Certification Program (Pass any one exam at fundamentals level)	Autodesk	X	X	
Automated Manufacturing Technology Examination	SkillsUSA	X	X	
Architectural Drafting Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	

NOTE: New industry certification credentials and occupational competency assessments are printed in bold.

Board of Education Approved Industry Certifications, Occupational Competency Assessments, and Licensure				
February 17, 2011 (Proposed)				
Name of Credential	Issuing Organization	Meets Board of Education Criteria		
		Student Selected Verified Credit	Career and Technical Education Seal	Advanced Mathematics and Technology Seal
Architectural Drafting Examination	SkillsUSA	X	X	
Certified SolidWorks Professional (Pass any one exam)	SolidWorks Corporation	X	X	
Certified SolidWorks Associate Examination	SolidWorks Corporation	X	X	
Electronic Technology Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Electronics Application & Technology Examination	SkillsUSA	X	X	
Engineering Technology Examination	SkillsUSA	X	X	
Manufacturing Technology Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Pre-Engineering Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Pre-Skills Assessment for Mastercam Assessment	Mastercam--Administered by National Occupational Competency Testing Institute (NOCTI)	X	X	
Project Lead the Way End-of-Course Tests (Pass any one end-of-course exam)	Project Lead The Way	X	X	X
Robotics Examination	SkillsUSA	X	X	
STARS Certification Examination	Digital Quest, Inc.	X	X	
Technical Drafting Examination	SkillsUSA	X	X	
TRADE AND INDUSTRIAL EDUCATION				
A+ Certification (Pass any one exam from 2009 certification program)	CompTIA	X	X	X
Access Certification	American Culinary Federation, Inc. (ACF)	X	X	
Advertising Design Examination	PrintED Co-brand, SkillsUSA	X	X	
Advertising and Design Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Audio-Radio Production Examination	SkillsUSA	X	X	
Audio-Visual Communications Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Automotive Technician Core Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Automotive Technician Standard Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	

NOTE: New industry certification credentials and occupational competency assessments are printed in bold.

Board of Education Approved Industry Certifications, Occupational Competency Assessments, and Licensure				
February 17, 2011 (Proposed)				
Name of Credential	Issuing Organization	Meets Board of Education Criteria		
		Student Selected Verified Credit	Career and Technical Education Seal	Advanced Mathematics and Technology Seal
Automotive Technician Advanced Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Automotive Technician Examination (ASE)-(Pass any one exam from Automobile Technician Test Series)	National Institute for Automotive Service Excellence	X	X	
Aviation Maintenance (Secondary) Examination	SkillsUSA	X	X	
Basic Installer Exam, Mobile Electronics Certified Professional	Consumer Electronics Association	X	X	
BICSI Registered Installer Certification, Level 1	BICSI (International Telecommunications Association)	X	X	
Broadcasting and Journalism Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Building Construction Occupations Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Building Trades Maintenance Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
CAD Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
CAD/CAM Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Cabinetmaking Examination	SkillsUSA	X	X	
Cabinetmaking Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Carpentry Examination	SkillsUSA	X	X	
Carpentry Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Carpentry Level One, National Construction Career Test	National Center for Construction Education & Research (NCCER)	X	X	
Certified Computer Service Technician	Electronics Technicians Association, International (ETA)	X	X	X
Certified Electronics Technician Associate (CET)	Electronics Technicians Association, International (ETA)	X	X	
Certified Satellite Dish Installer	Electronics Technicians Association, International (ETA)	X	X	
CISCO CCNA Academy End-of-Course Examinations (Pass any two end-of-course exams, Levels 1-4)	CISCO Systems	X	X	X

NOTE: New industry certification credentials and occupational competency assessments are printed in bold.

Board of Education Approved Industry Certifications, Occupational Competency Assessments, and Licensure				
February 17, 2011 (Proposed)				
Name of Credential	Issuing Organization	Meets Board of Education Criteria		
		Student Selected Verified Credit	Career and Technical Education Seal	Advanced Mathematics and Technology Seal
CISCO Certified Networking Associate (Pass any one exam in CCNA certification program)	CISCO Systems	X	X	X
Collision Repair Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Collision Repair and Refinishing Technician (ASE)- (Pass any one exam from Collision Repair & Refinish Test Series)	National Institute for Automotive Service Excellence	X	X	
Collision Repair/Refinishing Technology Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Computer Maintenance Technology Examination	SkillsUSA	X	X	X
Computer Networking Fundamentals Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	X
Computer Repair Technology Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	X
CNC Milling and Turning Technology Examination	SkillsUSA	X	X	
Construction Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Construction Masonry-Blocklaying Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Construction Masonry-Bricklaying Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Construction Technology Test	National Center for Constructional Education & Research (NCCER)	X	X	
Computer Technology Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	X
CompTIA Strata Fundamentals of IT Technology Certification	Certiport	X	X	X
Copper Based Cabling Certification	RBT Systems, Inc.	X	X	
Core: Introductory Craft Skills, National Construction Career Test	National Center For Construction Education & Research (NCCER)	X	X	
Cosmetology Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Cosmetology Examination	SkillsUSA	X	X	
Criminal Justice Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Criminal Justice Examination/CSI	SkillsUSA	X	X	
Customer Service Examination	SkillsUSA	X	X	

NOTE: New industry certification credentials and occupational competency assessments are printed in bold.

Board of Education Approved Industry Certifications, Occupational Competency Assessments, and Licensure				
February 17, 2011 (Proposed)				
Name of Credential	Issuing Organization	Meets Board of Education Criteria		
		Student Selected Verified Credit	Career and Technical Education Seal	Advanced Mathematics and Technology Seal
Data Cabling Installer Certification (DCIC)	Electronics Technicians Association, International (ETA)	X	X	
Design and PreConstruction Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Diesel Engine Mechanics Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Drafter Certification	American Design Drafting Association	X	X	
Electrical Construction Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Electrical Occupations Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Electrical, National Construction Career Test	National Center For Construction Education & Research (NCCER)	X	X	
Electronics Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Electronics Module: DC (EM1)	Electronics Technicians Association, International (ETA)	X	X	
Electronics Module: AC (EM2)	Electronics Technicians Association, International (ETA)	X	X	
Electronics Module: Analog (EM3)	Electronics Technicians Association, International (ETA)	X	X	
Electronics Module: DC (EM4)	Electronics Technicians Association, International (ETA)	X	X	
Electronics Module: Comprehensive (EMS)	Electronics Technicians Association, International (ETA)	X	X	
EPA Technician Certification (Levels I, II, or III)	Environmental Protection Agency (Authorized Entity)	X	X	
Fiber Optic Network Cabling Certification	RBT Systems, Inc.	X	X	
Fiber Optics Installer Certification	Electronics Technicians Association, International (ETA)	X	X	
Firefighter I Certification	Virginia Department of Fire Programs	X	X	
Firefighter II Certification	Virginia Department of Fire Programs	X	X	
General Drafting and Design Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Graphic Communications Examination	PrintED Co-brand, SkillsUSA	X	X	
Graphic Communication Technology Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	

NOTE: New industry certification credentials and occupational competency assessments are printed in bold.

Board of Education Approved Industry Certifications, Occupational Competency Assessments, and Licensure				
February 17, 2011 (Proposed)				
Name of Credential	Issuing Organization	Meets Board of Education Criteria		
		Student Selected Verified Credit	Career and Technical Education Seal	Advanced Mathematics and Technology Seal
Graymark Cabling Installation Certification	Graymark International	X	X	
Heating, Electrical, Air Conditioning Technology (HEAT) Examination (Pass any one exam)	HVAC Excellence	X	X	
Heating, Ventilation, Air Conditioning (HVAC) Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Heating, Ventilation, Air Conditioning & Refrigeration (HVAC/R) Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Heavy Equipment Operations Level One	National Center For Construction Education & Research (NCCER)	X	X	
HVAC, National Construction Career Test	National Center For Construction Education & Research (NCCER)	X	X	
HVAC Excellence Certification Program (Pass any one exam in this program)	HVAC Excellence	X	X	
Industrial Maintenance Mechanic Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Industrial Electronics Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Installer (or Service) Core Certification (HVAC)	North American Technician Excellence, Inc. (NATE)	X	X	
Internetworking Examination	SkillsUSA	X	X	
IT Essentials 1 Examination (PC Hardware and Software)	Cisco Systems	X	X	X
MSSC Certified Production Technician (CPT) Program (Pass any one CPT examination)	Manufacturing Skill Standards Council (MSSC)	X	X	
Machining Skills--Level I (Pass any one Machining (Level 1) examination with performance component)	National Institute for Metalworking Skills (NIMS)	X	X	
Major Appliance Repair Examination	SkillsUSA	X	X	
Marine Service Technology Examination	SkillsUSA	X	X	
Masonry Examination	SkillsUSA	X	X	
Maintenance Operations Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Masonry Level One, National Construction Career Test	National Center For Construction Education & Research (NCCER)	X	X	
Motorcycle Service Technology Examination	SkillsUSA	X	X	

NOTE: New industry certification credentials and occupational competency assessments are printed in bold.

Board of Education Approved Industry Certifications, Occupational Competency Assessments, and Licensure				
February 17, 2011 (Proposed)				
Name of Credential	Issuing Organization	Meets Board of Education Criteria		
		Student Selected Verified Credit	Career and Technical Education Seal	Advanced Mathematics and Technology Seal
National Automotive Student Skills Standards Assessments (Pass any one exam from automotive service, automotive refinishing, collision repair, or diesel engine areas)	ASE-AYES-SkillsUSA Co-brand, SkillsUSA	X	X	
Nail Care Examination	SkillsUSA	X	X	
Performing Arts Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Photography Examination	SkillsUSA	X	X	
Plumbing Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Plumbing Examination	SkillsUSA	X	X	
Precision Machining Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Protective Services Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
PrintED Certification Program (Pass any one exam)	Graphic Arts Education and Research Foundation	X	X	
Residential Wiring Examination	SkillsUSA	X	X	
Residential Air-Conditioning and Heating Certification	Air Conditioning and Refrigeration Institute	X	X	
Residential Construction Academy Examination (Pass any one test from available examinations)	Home Builders Institute (Examinations are administered by National Occupational Competency Testing Institute (NOCTI))	X	X	
SENSE Training Program Certification (Level 1, Entry-Level Welder)	American Welding Society (AWS)	X	X	
Screen Printing Examination	PrintED Co-brand, SkillsUSA	X	X	
SkillsUSA Workforce Ready System (Pass any one test from available examinations)	SkillsUSA	X	X	
Student Electronics Technician Certification (SET)	Electronics Technicians Association, International (ETA)	X	X	
Telecommunications Electronics Technician Certification	Electronics Technicians Association, International (ETA)	X	X	
Television Broadcasting Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Television Video Production Examination	SkillsUSA	X	X	
Technical Drafting Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	

NOTE: New industry certification credentials and occupational competency assessments are printed in bold.

Board of Education Approved Industry Certifications, Occupational Competency Assessments, and Licensure				
February 17, 2011 (Proposed)				
Name of Credential	Issuing Organization	Meets Board of Education Criteria		
		Student Selected Verified Credit	Career and Technical Education Seal	Advanced Mathematics and Technology Seal
Visual Arts Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Visual Communications Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Welding Examination	SkillsUSA	X	X	
Welding Assessment	National Occupational Competency Testing Institute (NOCTI)	X	X	
Welding, National Construction Career Test	National Center For Construction Education & Research (NCCER)	X	X	
LICENSE				
Barbers	Board of Barbers and Cosmetology (Virginia Department of Professional and Occupational Regulation)	X	X	
Cosmetology	Board of Barbers and Cosmetology (Virginia Department of Professional and Occupational Regulation)	X	X	
Licensed Practical Nurse	Virginia Board of Nursing	X	X	
Nail Technician	Board of Barbers and Cosmetology (Virginia Department of Professional and Occupational Regulation)	X	X	
Pilot's License-Airplane Single Engine Land	Federal Aviation Administration	X	X	
Real Estate Salesperson	Virginia Real Estate Board (Dept. of Professional & Occupational Regulation)	X	X	
EXAMINATION				
Advanced Placement Computer Science A	The College Board	Passing Score = 3		Passing Score = 3
College Level Examination Program (CLEP): Information Systems and Computer Applications	The College Board	Passing Score = 52		Passing Score = 52
International Baccalaureate Computer Science (Standard Level)	The International Baccalaureate Organization	Passing Score = 3		Passing Score = 3
International Baccalaureate Computer Science (Higher Level)	The International Baccalaureate Organization	Passing Score = 3		Passing Score = 3
International Baccalaureate Information Technology in a Global Society (IB6613) (Standard Level)	The International Baccalaureate Organization	Passing Score = 3		Passing Score = 3

NOTE: New industry certification credentials and occupational competency assessments are printed in bold.

Board of Education Approved Industry Certifications, Occupational Competency Assessments, and Licensure				
February 17, 2011 (Proposed)				
Name of Credential	Issuing Organization	Meets Board of Education Criteria		
		Student Selected Verified Credit	Career and Technical Education Seal	Advanced Mathematics and Technology Seal
Deletions				
Fundamentals of Wireless LANs Examination	Cisco Systems			
Java Programming Examination	Cisco Systems			
Microsoft Certified Application Specialist (MCAS)- (Pass any one MCAS exam)	Microsoft			
Fundamentals of Unix Examination	Cisco Systems			
A+ Certification (Pass any one exam from 2006 certification program)	CompTIA			
Basic Principles of Construction: Residential Construction Academy Examination	Delmar Thomson Learning/Home Builders Institute			
Carpentry: Residential Construction Academy Examination	Delmar Thomson Learning/Home Builders Institute			
Electrical Principles: Residential Construction Academy Examination	Delmar Thomson Learning/Home Builders Institute			
House Wiring: Residential Construction Academy Examination	Delmar Thomson Learning/Home Builders Institute			
HVAC: Residential Construction Academy Examination	Delmar Thomson Learning/Home Builders Institute			
IT Essentials 2 Examination (Network Operating Systems)	Cisco Systems			
Plumbing: Residential Construction Academy Examination	Delmar Thomson Learning/Home Builders Institute			
Advanced Placement Computer Science AB	The College Board			

NOTE: New industry certification credentials and occupational competency assessments are printed in bold.

Board of Education Agenda Item

Item: _____ C. _____

Date: February 17, 2011

Topic: Final Review of a Recommendation of the Advisory Board on Teacher Education and Licensure (ABTEL) to Approve the Criteria for Identifying Alternative Routes to Teacher Licensure as “Low Performing” or “At Risk of Becoming Low Performing” Required by Title II of the Higher Education Opportunity Act

Presenter: Mrs. Patty S. Pitts, Assistant Superintendent for Teacher Education and Licensure

Telephone Number: (804) 371-2522 **E-Mail Address:** Patty.Pitts@doe.virginia.gov

Origin:

Topic presented for information only (no board action required)

Board review required by
 State or federal law or regulation
 Board of Education regulation
 Other: _____

Action requested at this meeting Action requested at future meeting: _____

Previous Review/Action:

No previous board review/action

Previous review/action
date: January 13, 2011
action: First Review of a Recommendation of the Advisory Board on Teacher Education and Licensure (ABTEL) to Approve the Criteria for Identifying Alternative Routes to Teacher Licensure as “Low Performing” or “At Risk of Becoming Low Performing” Required by Title II of the Higher Education Opportunity Act

Background Information:

In October 1998, the U.S. Congress enacted Title II provisions to the Higher Education Act (HEA) authorizing federal grant programs to improve the recruitment, retention, preparation, and support of new teachers. Title II also included accountability measures in the form of reporting requirements for institutions and states on teacher preparation and licensing. Section 207 of Title II reporting requirements mandates that the U.S. Secretary of Education collect data on standards for teacher certification and licensure, as well as data on the performance of teacher preparation programs. The law requires the Secretary to use these data in submitting its annual report on the quality of teacher preparation to Congress. In addition, states were required to develop criteria, procedures, and processes from which institutions would be identified as “low performing” or “at-risk of becoming low-

performing.” The following statement is an excerpt from the Title II “Reference and Reporting Guide for Preparing State and Institutional Reports on the Quality of Teacher Preparation,” April 19, 2000:

To receive funds under this act, a state, not later than two years after the date of Enactment of the Higher Education Amendments of 1998, shall have in place a procedure to identify, and assist, through the provision of technical assistance, low-performing programs of teacher preparation within institutions of higher education. Such state shall provide the U.S. Secretary an annual list of such low-performing institutions that includes an identification of those institutions at-risk of being placed on such list. Such levels of performance shall be determined solely by the state and may include criteria based upon information collected pursuant to this title. Such assessment shall be described in the report under section 207(b).

On September 26, 2001, the Board of Education approved Virginia’s definitions for “low-performing” and “at-risk of becoming low-performing” institutions of higher education with teacher preparation programs, beginning with approved program reviews on July 1, 2003. The *Regulations Governing the Review and Approval of Education Programs in Virginia*, effective September 21, 2007, separated the accreditation and program approval processes; therefore, revisions were needed in Virginia’s definitions for “low-performing” and “at-risk of becoming low-performing institutions.” On November 20, 2008, the Board of Education approved revisions to the definitions to align with the accrediting bodies’ designations.

Title II HEA, was reauthorized on August 14, 2008. Section 205 of Title II of the Higher Education Opportunity Act mandates that the Department of Education collect data on state assessments, other requirements, and standards for teacher certification and licensure, as well as data on the performance of teacher preparation programs. The law requires the Secretary to use these data in submitting an annual report on the quality of teacher preparation to the Congress.

New reporting mandates subsequently approved require states to report criteria identifying alternative routes to teacher licensure as “low performing” or “at risk of becoming low performing,” beginning in October 2011. The Career Switcher Alternate Route to Licensure Program is defined as the alternative route to licensure for Virginia.

The approval process requires that Career Switcher Programs must be certified by the Virginia Department of Education, verifying that the program meets all requirements set forth in the *Licensure Regulations for School Personnel*. Approved education programs offered at Virginia colleges and universities must have national accreditation or be accredited by a process approved by the Board of Education as stipulated in the *Regulations Governing the Review and Approval of Education Programs in Virginia*. The criteria to identify programs as “at risk of becoming low-performing” or “low-performing” have been developed to address the specific requirements and the approval processes of the programs.

Career Switcher Alternate Route to Licensure Program

The Career Switcher Alternate Route to Licensure Program was created in response to a resolution of the 1999 General Assembly. The General Assembly requested the Board of Education to study alternative licensure programs and models in other states and develop an alternative pathway to teaching for individuals who have not completed a teacher preparation curriculum but have considerable life experiences, career achievements, and academic backgrounds that are relevant for teaching in pre-K through grade 12. During the 2000 session of the General Assembly, funds were appropriated to develop and pilot the first Career Switcher Program. In the summer of 2000, the Board of Education implemented the first Career Switcher Program for military personnel who were interested in becoming teachers. The program was later expanded to individuals in other professions interested in pursuing a career in education.

Currently, there are six Career Switcher Programs offered by the following program providers: George Mason University, Old Dominion University, Regent University, Shenandoah University, Virginia Community College System, and the Western Virginia Public Education Consortium.

The requirements for the alternate Career Switcher Program are set forth in the *Licensure Regulations for School Personnel*. This alternate route does not apply to individuals seeking a license with endorsements in special education. Programs are required to meet the requirements outlined in the regulations to be certified by the Department of Education. Prerequisites to applying for the program include: an application process; a baccalaureate degree from a regionally accredited college or university; the completion of requirements for an endorsement in a teaching area or the equivalent through verifiable experience or academic study; at least five years of full-time work experience or its equivalent; and Virginia qualifying scores on the professional teacher's assessments as prescribed by the Board of Education.

The programs, including partnerships and matrices to ensure alignment with regulations, were reviewed and certified by the Department of Education in 2008. The programs have a 100 percent pass rate on licensure assessments as individuals are required to meet these qualifying scores before admission into the program.

Summary of Major Elements

In order to comply with the new Title II reporting requirements, Virginia must define criteria to identify alternative routes to teacher licensure as “low performing” or “at risk of becoming low performing.” On November 15, 2010, the Advisory Board on Teacher Education and Licensure approved a recommendation to the Board of Education to approve the following criteria for identifying alternative routes to teacher licensure as “low performing” or “at risk of becoming low performing” required by Title II of the Higher Education Act.

- Programs shall be reviewed for compliance with Board of Education regulations and certified every seven years. [If regulations are revised within the seven-year period, the program must align the program with the new regulations.] For program certification, the following requirements must be documented:
 - alignment of program requirements and competencies with the regulations;

- capacity to offer each of the components of the program; and
 - structured and integrated field experiences in diverse school settings as specified in the regulations.
- Programs shall be required to submit the accountability measurement of partnership and collaborations based on PreK-12 school needs for review by the Department of Education biennially.
 - Programs must submit candidate progress and performance on prescribed Board of Education licensure assessments. [All candidates must meet all prescribed licensure assessments prior to admission into the program; therefore, the requirement is that 100 percent of program candidates pass licensure assessments prior to admission to the program.]
 - Programs must submit evidence of employer job satisfaction with candidates completing the program. The indicator of achievement of this standard shall include documentation that the Career Switcher Program has two years of evidence regarding candidate performance based on employer surveys.

An alternative route program (Career Switcher Program) shall be designated “at risk of becoming low performing” if the program is reviewed and found to meet certification requirements but has weaknesses, excluding the mandatory program entry requirements. The program provider must submit evidence of compliance within one year of notification of this finding.

An alternative route program that does not correct the weaknesses within one year of receiving the designation of “at risk of becoming low performing” will be designated as “low performing.” If a program fails to maintain certification, enrolled candidates shall be permitted to complete their programs of study. The Career Switcher Program shall not be allowed to admit new candidates. Candidates shall be notified of program approval status.

Superintendent's Recommendation:

The Superintendent of Public Instruction recommends that the Board of Education approve the recommendation from the Advisory Board on Teacher Education and Licensure to approve the criteria for identifying alternative routes to teacher licensure as “low performing” or “at risk of becoming low performing” required by Title II of the Higher Education Opportunity Act.

Impact on Resources:

There is a minimal impact on resources.

Timetable for Further Review/Action:

N/A

Board of Education Agenda Item

Item: _____ D. _____

Date: February 17, 2011

Topic: Final Review of the Proposed Addition of Asian Students as a Subgroup for the Purposes of Calculating Adequate Yearly Progress (AYP) in Virginia's Consolidated State Application Accountability Plan under the *No Child Left Behind Act of 2001*

Presenter: Mrs. Shelley Loving-Ryder, Assistant Superintendent for Student Assessment and School Improvement

Telephone Number: (804) 225-2102

E-Mail Address: Shelley.Loving-Ryder@doe.virginia.gov

Origin:

Topic presented for information only (no board action required)

Board review required by
 State or federal law or regulation
 Board of Education regulation
 Other: _____

Action requested at this meeting Action requested at future meeting: _____ (date)

Previous Review/Action:

No previous board review/action

Previous review/action:
Date: January 28, 2003
Action: Initial approval of Virginia's Accountability Workbook
Date: January 13, 2011
Action: First Review of the Proposed Addition of Asian Students as a Subgroup for the Purposes of Calculating Adequate Yearly Progress (AYP) in Virginia's Consolidated State Application Accountability Plan under the *No Child Left Behind Act of 2001*

Background Information:

The Elementary and Secondary Education Act (ESEA) as amended by the *No Child Left Behind Act of 2001* (NCLB) requires state educational agencies (SEA) to submit individual or consolidated state applications to the United States Department of Education (USED) for approval. In 2002, the Virginia Board of Education submitted and received USED approval for its initial Consolidated State Application under NCLB. A major component of the consolidated application is Virginia's Consolidated State Application Accountability Workbook. Virginia received USED approval for its accountability workbook in June 2003. Additional amendments have been made to Virginia's workbook each year since then.

Virginia's Consolidated State Accountability Workbook states that Virginia's major racial and ethnic categories represent groups in which the number of students exceeds five percent of the student population. When the workbook was initially written, those groups were Black, White, and Hispanic. Since that time, the Asian student population has grown to exceed five percent of the student population

on a consistent basis. While the Asian student population has exceeded five percent of the total student population since 2008-2009, the request to include Asians as a subgroup for the purposes of calculating Adequate Yearly Progress (AYP) has been delayed pending the implementation of new federally mandated race and ethnicity categories in 2010-2011.

The new federally mandated categories allow individuals to identify with one or more races and also to indicate if they are Hispanic. Students indicating they are Hispanic are counted in the Hispanic group regardless of their race and are not counted in any of the other race categories. The table below shows the distribution of students in Fall Membership in each category for several years. Of particular note is that the number of Asian students, as a percentage of the school population, has exceeded five percent for several years even with the implementation of the new federal race/ethnicity codes.

Virginia's School Population Disaggregated by Race/Ethnicity

School Year	% White	% Black	% Hispanic	% Asian	% American Indian	% Hawaiian	% Other/ Two+	Total Student Enrollment
2008-2009	56.53	25.71	8.96	5.60	0.30	0.11	2.80	1,236,109
2009-2010	56.38	25.15	9.29	5.88	0.32	0.12	2.86	1,214,786
2010-2011	54.51	23.73	11.28	5.91	0.34	0.14	4.09	1,220,845

Note: "Other" in 2008-2009 and 2009-2010 means "unspecified". "Two+" refers to "two or more races" in 2010-2011.

Summary of Major Elements:

Given that the Asian subgroup has exceeded five percent of Virginia's student population over a period of years, the Board is asked to consider adding the Asian subgroup to those groups included in AYP calculations for schools, school divisions, and the state. The Asian subgroup would be included in AYP calculations for the first time for the 2012-2013 school year based on assessments administered in 2011-2012. Action by the Board in early 2011 will notify school divisions of the additional category for AYP calculations in time to prepare for the change and will not complicate the major changes and releases planned for summer and fall 2011. AYP calculations for the 2012-2013 school year will use the most recent three years of data available for Asian students.

Superintendent's Recommendation:

The Superintendent of Public Instruction recommends that the Board of Education approve a proposed amendment to Virginia's Consolidated State Application Accountability Plan to add Asian students as a subgroup to be used in AYP calculations for the first time in the 2012-2013 school year, based on assessments administered in 2011-2012.

Impact on Resources:

The provisions of the Elementary and Secondary Education Act (ESEA) require the Department of Education to collect and analyze data related to determining Adequate Yearly Progress (AYP) for all schools and school divisions in the state. These requirements will continue to have an impact on the agency's resources.

Timetable for Further Review/Action:

Upon approval by the Board of Education, the addition of Asian students as a subgroup for AYP will be communicated to USED as an amendment to Virginia's accountability workbook.

pass/advanced.

Superintendent's Recommendation:

The Superintendent of Public Instruction recommends that the Board of Education accept for first review proposed cut scores representing the achievement levels of pass/proficient and pass/advanced for the Grade 3, Virginia Studies, U.S. History to 1865 and U.S. History: 1865 to the Present SOL tests.

Impact on Resources:

N/A

Timetable for Further Review/Action:

This item will be presented to the Board of Education for final review at the March 24, 2011, meeting.

Summary and Background Information on Proposed Cut Scores for Grade 3 and Content Specific History Tests Based on 2008 Standards of Learning

	Proficient				Advanced		
	Background Information		Standard Setting Summary		Background Information	Standard Setting Summary	
Test Name *	Proficient Cut Score for Previous History Test**	Proficient Cut Score for New Test to Maintain Previous Level of Rigor	Round 3 Median for Proficient	Articulation Committee Recommendation	Advanced Cut Score for Previous Test**	Round 3 Median for Advanced	Articulation Committee Recommendation
Grade 3 History	27	18 (-9)	22	23	35	35	35
Virginia Studies	25	19 (-6)	20	21	35	32	32
US History I	25	26 (+1)	18	22	36	33	34
US History II	23	18 (-5)	22	22	34	36	34
Civics & Economics	21	21 (0)	21	21	34	33.5	33

* All tests have 40 items

** Test based on the 2001 History Standards of Learning

Board of Education Agenda Item

Item: F.

Date: February 17, 2011

Topic: First Review of a Recommendation of the Advisory Board on Teacher Education and Licensure (ABTEL) to Approve a Cut Score and Implementation Dates for the Praxis Braille Proficiency Test

Presenter: Mrs. Patty S. Pitts, Assistant Superintendent for Teacher Education and Licensure

Telephone Number: (804) 371-2522

E-Mail Address: Patty.Pitts@doe.virginia.gov

Origin:

Topic presented for information only (no board action required)

Board review required by
 State or federal law or regulation
 Board of Education regulation
 Other: _____

Action requested at this meeting Action requested at future meeting: March 24, 2011

Previous Review/Action:

No previous board review/action

Previous review/action
date: October 22, 2009
action: First Review of the Advisory Board on Teacher Education and Licensure's Recommendation Regarding the Certification of Braille Instructors in Response to the Virginia General Assembly House Bill 2224

date: November 17, 2009
action: Final Review of the Advisory Board on Teacher Education and Licensure's Recommendation Regarding the Certification of Braille Instructors in Response to the Virginia General Assembly House Bill 2224

date: June 24, 2010
action: First Review of a Recommendation of the Advisory Board on Teacher Education and Licensure (ABTEL) to Approve a Braille Assessment for Teachers Seeking an Initial License with an Endorsement in Special Education-Visual Impairments

date: July 22, 2010
action: Final Review of a Recommendation of the Advisory Board on Teacher Education and Licensure (ABTEL) to Approve a Braille Assessment for Teachers Seeking an Initial License with an Endorsement in Special Education-Visual Impairments

Background Information:

The 2009 Virginia General Assembly enacted the following House Bill 2224, Chapter 202, regarding Braille certification:

§ 1. That by December 31, 2009, the Advisory Board on Teacher Education and Licensure, in consultation with the Department for the Blind and Vision Impaired, shall make recommendations to the Board of Education and the Chairmen of the House Committee on Education and the Senate Committee on Education and Health regarding the certification of Braille instructors.

In consultation with the Department for the Blind and Vision Impaired, the Advisory Board on Teacher Education and Licensure (ABTEL) began discussions regarding Braille instruction, certification, and licensure. On April 20, 2009, the Advisory Board approved a committee to research the policy issues and make recommendations to the full Advisory Board.

ABTEL's committee on Braille convened July 8 and August 5, 2009. At the meeting on August 5, 2009, Dr. Edward C. Bell, director of the Professional Development and Research Institute on Blindness, Louisiana Technology University, and Mr. Michael Kasey, National Federation of the Blind, met with the committee.

The Advisory Board on Teacher Education and Licensure met on September 20-21, 2009, to review the committee's report and make a recommendation to the Board of Education. The Advisory Board received the report of the committee including research on Braille instruction, authority regarding Braille instruction, licensure assessments, the current teacher work force with endorsements in Special Education-Visual Impairments, Virginia's consortium to prepare teachers of visual impairments, requirements of other states, and available Braille assessments.

On September 20-21, 2009, the Advisory Board on Teacher Education and Licensure approved the following recommendation to the Board of Education:

The Advisory Board unanimously recommends to the Board of Education that a reliable, valid, and legally defensible assessment available statewide (to be determined) demonstrating Braille proficiency prescribed by the Virginia Board of Education be required for individuals seeking an initial license with an endorsement in Special Education-Visual Impairments. [The Department of Education shall follow policies and procedures relative to the procurement of such an assessment.] Additionally, contingent upon available funding, opportunities for licensed teachers with the endorsement in Special Education-Visual Impairments will be afforded additional professional development in the teaching of Braille through the Virginia Department of Education and the Department for the Blind and Vision Impaired. The Advisory Board supports the Virginia Board of Education's efforts to include teachers of visual impairments in the *Standards of Quality* funding formula.

The Board of Education approved the Advisory Board on Teacher Education and Licensure's recommendation on Braille certification in response to the 2009 Virginia General Assembly House Bill 2224 on November 17, 2009.

At the request of the Advisory Board on Teacher Education and Licensure, a committee was convened on March 29, 2010, to recommend a Braille assessment to be considered as a requirement for individuals seeking an initial license with an endorsement in Special Education-Visual Impairments.

After reviewing available assessments, the committee unanimously recommended the Braille Proficiency Test owned by the Texas Education Agency and administered by the Educational Testing Service (ETS). The Braille-only test was developed by the Educational Testing Service for Texas. The state of Mississippi also has adopted this test.

On April 19, 2010, the Advisory Board on Teacher Education and Licensure voted unanimously to recommend that the Virginia Board of Education approve the Braille Proficiency Test administered by the Educational Testing Service as the required assessment for individuals seeking an initial Virginia license with an endorsement in Special Education-Visual Impairments. The committee's rationale included the following: (1) the Braille Proficiency Test developed by the Educational Testing Service is a reliable, valid, and legally defensible assessment; (2) the test appears to cover the appropriate knowledge and skills for Braille; (3) the test would be available after a state-specific standard setting study; and (4) the test is accessible across the state.

On July 22, 2010, The Board of Education approved ABTEL's recommendation that the Braille Proficiency Test administered by the Educational Testing Service be the required assessment for individuals seeking an initial Virginia license with an endorsement in Special Education-Visual Impairments. The Board also authorized Department of Education staff to begin the standard-setting process for the test.

Summary of Major Elements:

To support the decision-making process for the Virginia Department of Education (VDOE) with regards to establishing a passing score, or cut score, for the Praxis Braille Proficiency Test (0631), research staff from the Educational Testing Service (ETS) designed and conducted a standard setting study. The study also collected content-related validity evidence to confirm the importance of the content specifications for entry-level teachers of students with visual impairments. The standard setting study involved an expert panel comprised of teachers and college faculty. The VDOE recommended panelists with (a) experience with teaching students with visual impairments, either as teachers or college faculty who prepare teachers, (b) proficiency with reading and producing Braille, and (c) familiarity with the skills required of beginning teachers of students with visual impairments.

The panel was convened on October 28, 2010, in Richmond, Virginia. The attached technical report (Appendix A) describes the content and format of the assessment, the standard setting processes and methods used, and the results of the standard setting study.

The Praxis Braille Proficiency *Test at a Glance* document (ETS, 2010) describes the purpose and structure of the assessment. The assessment measures whether entry-level teachers of students with visual impairments have the level of Braille proficiency believed necessary for competent professional practice. The four-hour assessment contains 25 multiple-choice questions and four constructed-response questions and covers reading and producing contracted and uncontracted literary Braille and Nemeth Code. The maximum total number of raw-score points that may be earned is 36. The reporting scale for the Praxis Braille Proficiency Test (0631) ranges from 100 to 200 scaled-score points.

For the Praxis Braille Proficiency Test (0631), the panel's cut score recommendation is 24.70. The value was rounded to the next highest whole number to determine the functional recommended cut score, 25. The value of 25 represents approximately 69 percent of the total available 36 raw-score points that could be earned on the assessment. The scaled score associated with 25 raw points is 168.

Texas commissioned the development of this assessment. Texas based their passing score on 25 raw points out of a possible 36 points. On the Praxis scale, this would correspond to a scaled score of 168. The only other state using the assessment, Mississippi, has a scaled cut score of 158.

Table 1

Cut Scores within 1 and 2 SEMs of the Recommended Cut Score – Virginia – Braille

Recommended Cut Score (SEM)		Scaled Score Equivalent
	25 (2.49)	168
-2 SEMs	21	155
-1 SEM	23	162
+1 SEM	28	179
+2 SEMs	30	186

Note: Consistent with the recommended cut score, the cut scores at the different SEMs have been rounded to the next highest whole number.

On January 24, 2011, the Advisory Board for Teacher Education and Licensure (ABTEL) recommended that the Board of Education set a passing score of 168 for the Praxis Braille Proficiency Test (0631) for individuals seeking an initial license with an endorsement in Special Education-Visual Impairments. ABTEL also recommended that the implementation date for the assessment be July 1, 2011, except for individuals completing the approved Virginia Visual Impairments Consortium program who must meet the assessment requirement beginning July 1, 2012.

Superintendent's Recommendation:

The Superintendent of Public Instruction recommends that the Board of Education receive for first review the Advisory Board on Teacher Education and Licensure's recommendations to (1) set a passing score of 168 for the Praxis Braille Proficiency Test for individuals seeking an initial Virginia license with an endorsement in Special Education-Visual Impairments and (2) establish the implementation date for the assessment as July 1, 2011, except for individuals completing the approved Virginia Visual Impairments Consortium program who must meet the assessment requirement effective July 1, 2012.

Impact on Resources:

Costs associated with the administration of the Praxis Braille Proficiency Test (0631) will be incurred by the Educational Testing Service. Prospective teachers seeking an initial Virginia license with an endorsement in Special Education-Visual Impairments will be required to pay the registration and test fees.

Timetable for Further Review/Action:

The item will be presented to the Board of Education for final review at the March 24, 2011, meeting.



Listening. Learning. Leading.

Standard Setting Report

PRAXIS BRAILLE PROFICIENCY (0631)

Prepared for the Virginia Department of Education

November 2010

Conducted by
Educational Testing Service
Princeton, New Jersey

Executive Summary

To support the decision-making process for the Virginia Department of Education (VDOE) with regards to establishing a passing score, or cut score, for the Praxis Braille Proficiency (0631) assessment, research staff from Educational Testing Service (ETS) designed and conducted a standard setting study on October 28, 2010. The study also collected content-related validity evidence to confirm the importance of the content specifications for entry-level teachers of students with visual impairments.

Recommended Cut Score

The standard setting study involved an expert panel, comprised of teachers and college faculty. The recommended cut score is provided to help the VDOE determine an appropriate cut (or passing) score. For the Praxis Braille Proficiency (0631) assessment, the recommended cut score (rounded up) is 25 (on the raw score metric), which represents 69% of total available 36 raw score points. The scaled score associated with a raw score of 25 is 168.

Summary of Content Specification Judgments

Panelists judged the extent to which the skills reflected by the content specifications were important for entry-level teachers of students with visual impairments. The favorable judgment of the panelists provided evidence that the content of the assessment is important for beginning practice.

Introduction

To support the decision-making process for the Virginia Department of Education (VDOE) with regards to establishing a passing score, or cut score, for the Praxis Braille Proficiency (0631) assessment, research staff from Educational Testing Service (ETS) designed and conducted a standard setting study on October 28, 2010, in Richmond, Virginia. The study also collected content-related validity evidence to confirm the importance of the content specifications for entry-level teachers of students with visual impairments. The standard setting study involved an expert panel comprised of teachers and college faculty. The VDOE recommended panelists with (a) experience with teaching students with visual impairments, either as teachers or college faculty who prepare teachers, (b) proficiency with reading and producing Braille, and (c) familiarity with the skills required of beginning teachers of students with visual impairments.

The passing score recommendation for the *Praxis Braille Proficiency* (0631) is provided to the VDOE. The VDOE is responsible for establishing the final passing score in accordance with applicable state regulations. The study provides a recommended passing score, which represents the combined judgments of one group of experienced educators. The full range of the VDOE's needs and expectations could not be represented during the standard setting study. The VDOE, therefore, may want to consider both the panel's recommended cut score and other sources to information when setting the final *Praxis Braille Proficiency* (0631) cut score (Geisinger & McCormick, 2010). Other kinds of information may provide reasons for the VDOE to adjust the recommended cut score. The recommended cut score may be accepted, adjusted upward to reflect more stringent expectations, or adjusted downward to reflect more lenient expectations. There is no *correct* decision; the appropriateness of any adjustment may only be evaluated in terms of its meeting the VDOE's needs.

Two critical sources of information to consider when setting the cut score are the standard error of measurement (SEM) and the standard error of judgment (SEJ). The former addresses the reliability of *Praxis Braille Proficiency* (0631) scores and the latter the reliability of panelists' cut score recommendations. The SEM allows VDOE to recognize that a *Praxis Braille Proficiency* (0631) score—any test score on any test—is less than perfectly reliable. A test score only approximates what a candidate *truly* knows or *truly* can do on the test. The SEM, therefore, addresses the question: “How close of an approximation is the test score to the *true* score?” The SEJ allows the VDOE to consider the

likelihood that the recommended cut score from the current panel would be similar to cut scores recommended by other panels of experts similar in composition and experience. The smaller the SEJ, the more likely that another panel would recommend a cut score consistent with the recommended cut score. The larger the SEJ, the less likely the recommended cut score would be reproduced by another panel.

In addition to measurement error metrics (e.g., SEM, SEJ), the VDOE should consider the likelihood of classification error. That is, when adjusting a cut score, policymakers should consider whether it is more important to minimize a false positive decision or to minimize a false negative decision. A false positive decision occurs when a candidate's test score suggests he should receive a license/certificate, but his actual knowledge/skill level is lower (i.e., the candidate does not possess the required knowledge/skills). A false negative occurs when a candidate's test score suggests that she should not receive a license/certificate, but she actually does possess the required knowledge/skills. The VDOE needs to consider which decision error to minimize; it is not possible to eliminate both types of decision errors simultaneously.

Praxis Braille Proficiency Assessment

The Praxis Braille Proficiency *Test at a Glance* document (ETS, 2010) describes the purpose and structure of the assessment. In brief, the assessment measures whether entry-level teachers of students with visual impairments have the level of braille proficiency believed necessary for competent professional practice.

The four hour assessment contains 25 multiple-choice questions¹ and four constructed-response questions and covers reading and producing contracted and uncontracted literary braille and Nemeth Code. The maximum total number of raw-score points that may be earned is 36. The reporting scale for the Praxis Braille Proficiency (0631) assessment ranges from 100 to 200 scaled-score points.

¹ Five multiple-choice questions are pretest questions and do not contribute to a candidate's score.

Expert Panels

The standard setting study for the Praxis Braille Proficiency (0621) assessment included an expert panel recruited by the VDOE. The VDOE recruited panelists to represent a range of professional perspectives. A description of the panel is presented below. (See the Appendix for a listing of panelists.)

The panel included 14 teachers of students with visual impairments. Thirteen panelists were White and one was African American. Thirteen panelists were female. All the panelists reported being certified teachers of students with visual impairments in Virginia. Nearly 80% of the panelists had 16 or more years of experience teaching Braille.

A fuller demographic description for the members of the panel is presented in Table 1.

Table 1
Committee Member Demographics

	N	Percent
Group you are representing		
Teachers	14	100%
Race		
White	13	93%
Black or African American	1	7%
Gender		
Female	13	93%
Male	1	7%
Do you currently have a Special Education – Visual Impairments endorsement in Virginia?		
No	0	0%
Yes	14	100%
Are you currently teaching braille?		
No	0	0%
Yes	14	100%
Are you currently supervising or mentoring teachers of visually impaired students?		
No	9	64%
Yes	5	36%

Table 1 (continued)
Committee Member Demographics

	N	Percent
Including this year, how many years of experience do you have teaching braille?		
3 years or less	0	0%
4 – 7 years	1	7%
8 – 11 years	1	7%
12 – 15 years	1	7%
16 years or more	11	79%
At what K-12 grade level are you currently teaching?		
Elementary (K-5 or K-6)	5	36%
Middle School (6-8 or 7-9)	1	7%
High School (9-12 or 10-12)	4	29%
Middle and High School	2	14%
All Grades	1	7%
I am not currently teaching at the K-12 level	1	7%
School Setting		
Urban	3	21%
Suburban	9	64%
Rural	2	14%

Process and Method

The design of the Praxis Braille Proficiency (0631) assessment standard setting study for the VDOE included an expert panel. The panelists were sent an e-mail explaining the purpose of the standard-setting study and requesting that they review the content specifications for the Praxis Braille Proficiency (0631) assessment (included in the Praxis Braille Proficiency *Test at a Glance*, which was attached to the e-mail). The purpose of the review was to familiarize the panelists with the general structure and content of the assessment.

The standard-setting study began with a welcome and introduction. Dr. James Lanham, Director of Licensure, welcomed the panelists and provided an overview of the certification process in Virginia. Dr. Clyde Reese, the ETS facilitator, then provided an overview of standard setting, and presented the agenda for the study. (The agenda for the meeting is in the Appendix.)

Reviewing the Praxis Braille Proficiency Assessment

The first activity was for the panelists to “take the test.” (Each panelist had signed a nondisclosure form.) The panelists were given approximately an hour and a half to respond to the multiple-choice questions and to take notes on the constructed-response (transcription) questions. The purpose of “taking the test” was for the panelists to become familiar with the test format, content, and difficulty. After “taking the test,” the panelists were given the answer key (correct answers for the multiple-choice questions) to self-score and the rubrics for the constructed-response questions; how well a panelist did on the test was not shared.

The panelists then engaged in a discussion of the major content areas being addressed by the assessment; they were also asked to remark on any content areas that they thought would be particularly challenging for entering teachers of students with visual impairments, and areas that addressed content that would be particularly important for entering teachers.

Describing the Just Qualified Candidate

Following the review of the assessment, panelists described the Just Qualified Candidate (JQC). The JQC is the test taker who has the minimum level of knowledge and/or skills believed necessary to be a qualified teacher of students with visual impairments. The JQC description is the operational definition of the cut score. The goal of the standard-setting process is to identify the test score that aligns with this description of the JQC.

For each of the competency areas measured by the Praxis Braille Proficiency (0631) assessment, the panel was asked to provide performance indicators, or “can do” statements that answered the following two questions:

- What can our JQC do to demonstrate the necessary level of competency that a not-quite qualified candidate could not?
- What would be something that might represent a slightly higher level of competency than we would expect from our JQC?

The six competency areas are listed in the Appendix.

Panelists' Judgments

The standard-setting process for the Praxis Braille Proficiency (0631) assessment is described next, followed by the results from the standard-setting study. The recommended cut score for the panel is provided to help the VDOE determine an appropriate cut (or passing) score.

Standard Setting for Multiple-Choice Questions. For the multiple-choice questions included on the Praxis Braille Proficiency (0631) assessment, a probability-based Angoff method (Brandon, 2004; Hambleton & Pitoniak, 2006) was used. In this approach, for each multiple-choice question, a panelist decides on the likelihood (probability or chance) that a JQC would answer it correctly. Panelists made their judgments using the following rating scale: 0, .05, .10, .20, .30, .40, .50, .60, .70, .80, .90, .95, 1. The lower the value, the less likely it is that a JQC would answer the question correctly, because the question is difficult for the JQC. The higher the value, the more likely it is that a JQC would answer the question correctly.

The panelists were asked to approach the judgment process in two stages. First, they reviewed the definition of the JQC and the question and decided if, overall, the question was difficult for the JQC, easy for the JQC, or moderately difficult/easy. The facilitator encouraged the panelists to consider the following rule of thumb to guide their decision:

- difficult questions for a JQC were in the 0 to .30 range;
- moderately difficult/easy questions for a JQC were in the .40 to .60 range; and
- easy questions for a JQC were in the .70 to 1 range.

The second decision was for panelists to decide how they wanted to refine their judgment within the range. For example, if a panelist thought that a question was easy for a JQC, the initial decision located the question in the .70 to 1 range. The second decision was for the panelist to decide if the likelihood of answering it correctly was .70, .80, .90, .95, or 1. The two-stage decision-process was implemented to reduce the cognitive load placed on the panelists. The panelists practiced making their standard-setting judgments for multiple-choice questions.

Standard Setting for Constructed-Response Questions. For the constructed-response questions included on the Praxis Braille Proficiency assessment, an Extended Angoff method (Cizek & Bunch, 2007; Hambleton & Plake, 1995) was used. In this approach, for each question, a panelist decides on the assigned score value that would most likely be earned by a JQC. The basic process that each panelist

followed was to consider the expected proficiency level of the JQC and then to review the question and the rubric for that question. The rubric for a question is based on the number of transcription errors in a candidate's response; the possible scores for each question are 1, 2, 3 and 4. A test taker's response to a constructed-response question is scored by a trained scorer and verified by the chief reader. Each panelist decided on the score most likely to be earned by a JQC. For each of the four constructed-response questions, panelists recorded the score (0 through 4) that a JQC would most likely earn. The panelists practiced making their standard-setting judgments for constructed-response questions.

Judgment of Praxis Braille Proficiency Content Specifications

In addition to the standard setting process, the panel judged the importance of the skills stated or implied in the assessment content specifications for the job of an entry-level teacher of students with visual impairments. These judgments addressed the perceived content-based validity of the assessment. Judgments were made using a four-point Likert scale — *Very Important*, *Important*, *Slightly Important*, and *Not Important*. Each panelist independently judged the six competency areas.

Results

Initial Evaluation Forms

The panelists completed initial evaluations following training for multiple-choice questions and again following training for constructed-response questions. The primary information collected from these forms was the panelists indicating if they had received adequate training to make their standard-setting judgments and were ready to proceed. All panelists indicated that they were prepared to make their judgments.

Summary of Standard Setting Judgments

A summary of the standard-setting judgments is presented in Table 2. The numbers in the table reflect the recommended cut scores — the number of raw-score points needed to “pass” the assessment — of each panelist. For the Praxis Braille Proficiency (0631) assessment, results for the multiple-choice questions, constructed-response questions and the overall assessment are presented. Note that the Praxis

Braille Proficiency (0631) assessment reports a single overall score and that the panel is recommending a single cut score for the combination of the multiple-choice and constructed response questions. The separate “cut scores” for the two parts are intermediate steps in calculating the overall cut score.

The panel’s average recommended cut score and highest and lowest cut scores are reported, as are the standard deviation (SD) of panelists’ cut scores and the standard error of judgment (SEJ). The SEJ is one way of estimating the reliability of the judgments. It indicates how likely it would be for other panels of educators similar in make-up, experience, and standard-setting training to the current panel to recommend the same cut score on the same form of the assessment. A comparable panel’s cut score would be within 1 SEJ of the current average cut score 68 percent of the time and within 2 SEJs 95 percent of the time.

For the Praxis Braille Proficiency (0631) assessment, the panel’s cut score recommendation is 24.70. The value was rounded to the next highest whole number to determine the functional recommended cut score, 25. The value of 25 represents approximately 69% of the total available 36 raw-score points that could be earned on the assessment. The scaled score associated with 25 raw points is 168.

Table 2**Cut Score Summary of Judgments**

Panelist	Multiple-Choice Judgments	Constructed-Response Judgments	Overall Cutscore
1	10.90	11	21.90
2	11.80	11	22.80
3	12.70	14	26.70
4	12.60	10	22.60
5	16.30	14	30.30
6	15.55	13	28.55
7	10.80	13	23.80
8	13.70	11	24.70
9	11.60	11	22.60
10	13.90	13	26.90
11	12.05	14	26.05
12	12.60	11	23.60
13	13.45	11	24.45
14	10.80	10	20.80
Average	12.77	11.93	24.70
Highest	16.30	14	30.30
Lowest	10.80	10	20.80
SD	1.69	1.49	2.69
SEJ	0.45	0.40	0.72

Table 3 presents the estimated standard errors of measurement (SEM) around the recommended cut score. A standard error represents the uncertainty associated with a test score. The scaled scores associated with 1 and 2 SEMs above and below the recommended cut score are provided².

Table 3

Cut Scores within 1 and 2 SEMs of the Recommended Cut Score

Recommended Cut Score (SEM)		Scaled Score Equivalent
25 (2.49)		168
- 2 SEMs	21	155
-1 SEM	23	162
+1 SEM	28	179
+ 2 SEMs	30	186

Note: Consistent with the recommended cut score, the cut scores at the different SEMs have been rounded to the next highest whole number.

Summary of Content Specification Judgments

Panelists judged the extent to which the skills reflected by the Praxis Braille Proficiency (0631) assessment content specifications were important for entry-level teachers of students with visual impairments. Panelists rated the six competency areas on a four-point scale ranging from *Very Important* to *Not Important*. The panelists’ ratings are summarized in Table 4.

Reading Contracted and Uncontracted Literary Braille and Nemeth Code was judge *Very Important* by 12 of the 14 panelists (or 86%) with the remaining two panelists indicating that it is *Important*. ***Producing Braille Using a Manual Braillewriter and a Traditional Slate and Stylus*** was judge *Very Important* by 9 of the 14 panelists (or 64%) with five panelists indicating that it is *Important*. All six competency areas were judged to be *Very Important* or *Important* by more than 90% of the panelists.

² The *raw* score SEM values included in this report are updated throughout the year as data become available. The SEM values listed in each edition of *Understanding Your Praxis Scores* (http://www.ets.org/Media/Tests/PRAXIS/pdf/uyyps_web.pdf) are *scaled* score SEM values based on candidate scores on one or more test forms.

Table 4

Specification Rating

	Very Important		Important		Slightly Important		Not Important	
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>
I. Reading Contracted and Uncontracted Literary Braille and Nemeth Code	12	86%	2	14%	0	0%	0	0%
• Reading contracted and uncontracted literary braille	14	100%	0	0%	0	0%	0	0%
• Reading basic Nemeth Code (e.g., +, -, ×, ÷, =, <, >, %, \$, decimals, punctuation indicators, horizontal and vertical formats of presentation)	7	50%	7	50%	0	0%	0	0%
• Using resources for reading advanced Nemeth Code	5	36%	8	57%	1	7%	0	0%
II. Producing Braille Using a Manual Braillewriter and a Traditional (non-direct) Slate and Stylus	9	64%	5	36%	0	0%	0	0%
• Producing contracted and uncontracted literary braille	10	71%	3	22%	1	7%	0	0%
• Producing basic Nemeth Code (e.g., +, -, ×, ÷, =, <, >, %, \$, decimals, punctuation indicators, horizontal and vertical formats of presentation)	6	43%	8	57%	0	0%	0	0%
• Referring to Nemeth Code rules to produce advanced Nemeth Code	6	43%	7	50%	1	7%	0	0%

Summary of Final Evaluations

The panelists completed an evaluation form at the conclusion of their standard setting study. The evaluation form asked the panelists to provide feedback about the quality of the standard-setting implementation. Table 5 present the results of the final evaluation.

All panelists *Strongly Agreed* that they understood the purpose of the study and that the facilitator’s instructions and explanations were clear. All of the panelists *Agreed* or *Strongly Agreed* that they were prepared to make their standard setting judgments and that the standard-setting process was easy to follow.

Table 5
Final Evaluations

	Strongly Agree		Agree		Disagree		Strongly Disagree	
	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>	<u>N</u>	<u>%</u>
I understood the purpose of the study	14	100%	0	0%	0	0%	0	0%
The instructions and explanations were clear	14	100%	0	0%	0	0%	0	0%
The opportunity to “take the test” and to discuss the test content was useful	13	93%	1	7%	0	0%	0	0%
The opportunity to practice making standard setting judgments was useful	11	78%	3	22%	0	0%	0	0%
The training was adequate to complete my assignment	10	71%	4	29%	0	0%	0	0%
The process of making the standard setting judgments was easy to follow	8	57%	6	43%	0	0%	0	0%

Summary

To support the decision-making process for the Virginia Department of Education (VDOE) with regards to establishing a passing score, or cut score, for the Praxis Braille Proficiency (0631) assessment, research staff from Educational Testing Service (ETS) designed and conducted a standard setting study on October 28, 2010, in Richmond, Virginia. The study also collected content-related validity evidence to confirm the importance of the content specifications for entry-level teachers of students with visual impairments. The standard setting study involved an expert panel, comprised of teachers and college faculty.

Standard setting was conducted using a probability-based Angoff approach for the multiple-choice questions and an Extended Angoff method for the constructed-response questions. For the Praxis Braille Proficiency (0631) assessment, the recommended cut score (rounded up) is 25 (on the raw score metric), which represents 69% of total available 36 raw score points. The scaled score associated with a raw score of 25 is 168.

The panel confirmed that the knowledge and/or skills stated or implied in the Praxis Braille Proficiency (0631) assessment content specifications were important for entry-level teachers. The results of the evaluation surveys (initial and final) support the quality of the standard-setting implementation.

References

- Brandon, P.R. (2004). Conclusions about frequently studied modified Angoff standard-setting topics. *Applied Measurement in Education, 17*, 59-88.
- Cizek, G. J., & Bunch, M.B. (2007). *Standard setting: A guide to establishing and evaluating performance standards on tests*. Thousand Oaks, CA: Sage.
- Educational Testing Service. (2010). *Braille Proficiency: Test at a glance*. Princeton, NJ: Author.
- Geisinger, K.F., & McCormick, C.A. (2010). Adopting cut scores: Post-standard-setting panel considerations for decision makers. *Educational Measurement: Issues and Practice, 29*, 38–44.
- Hambleton, R. K., & Pitoniak, M.J. (2006). Setting performance standards. In R. L. Brennan (Ed.), *Educational Measurement* (4 ed., pp. 433-470). Westport, CT: American Council on Education/Praeger.
- Hambleton, R. K., & Plake, B.S. (1995). Using an extended Angoff procedure to set standards on complex performance assessments. *Applied Measurement in Education, 8*, 41-55.

APPENDIX

Panelists' Names and Affiliations

<u>Panelist</u>	<u>Affiliation</u>
LeeAnn Armbruster	Virginia Beach City Public Schools
Carolyn R. Carver	Virginia School for the Deaf
Scottie Ferras	Henrico County Public Schools
Roxane Hanson	Spotsylvania County Schools
Gail Henrich	Norfolk Public Schools
Mary Kate Jacob	Washington County Public Schools
Helen T. Mast	Roanoke County Public Schools
Donna Mayberry	Laurel Regional Program
Marian S. McHugh	Salem City Schools
Tracey O'Malley	Fairfax County Public Schools
Julienne B. Parker	Danville City Public Schools
Leslie Parrott	Prince William County Schools
Linda K. Ross	Newport News Public School
André B. Webb	Fairfax County Public Schools
James Lanham, Director	Virginia Department of Education
Buffa Hanse	National Federation of the Blind (Virginia)
Clyde Reese, Facilitator	Educational Testing Service
Rick Cullors, Client Relations Director	Educational Testing Service

AGENDA
Praxis Braille Proficiency Assessment

Standard Setting Study

October 28, 2010

- | | |
|----------------------|---|
| 7:30 – 8:30 | Continental Breakfast & Registration |
| 8:30 – 8:45 | Welcome and Introduction |
| 8:45 – 9:00 | Overview of the Licensure Process in Virginia |
| 9:00 – 9:15 | Overview of Standard Setting & Workshop Events |
| 9:15 – 9:30 | Overview of the Praxis Braille Proficiency Assessment |
| 9:30 – 11:00 | “Take” the Praxis Braille Proficiency Assessment |
| 11:00 – 11:30 | Discuss the Praxis Braille Proficiency Assessment |
| 11:30 – 12:00 | Define the Knowledge/Skills of a JQC |
| 12:00 – 12:45 | Lunch |
| 12:45 – 1:30 | Define the Knowledge/Skills of a JQC (continued) |
| 1:30 – 2:00 | Standard Setting Training for M-C Items |
| 2:00 – 2:45 | Standard Setting Judgments for Multiple-Choice |
| 2:45 – 3:00 | Break |
| 3:00 – 3:30 | Standard Setting Training for CR Items |
| 3:30 – 4:00 | Standard Setting Judgments for Constructed-Response |
| 4:00 – 4:30 | Specification Judgments |
| 4:30 – 5:00 | Complete Final Evaluation, Collect Materials & Adjourn |



Copyright © 2010 by Educational Testing Service. All rights reserved.

Praxis Braille Proficiency (0631)
Knowledge and Competencies: Braille and Nemeth Code

I. Reading Contracted and Uncontracted Literary Braille and Nemeth Code

- Reading contracted and uncontracted literary braille.
- Reading basic Nemeth Code (e.g., +, -, ×, ÷, =, <, >, %, \$, decimals, punctuation indicators, horizontal and vertical formats of presentation).
- Using resources for reading advanced Nemeth Code.

II. Producing Braille using a manual braillewriter and a traditional (non-direct) slate and stylus

- Producing contracted and uncontracted literary braille.
- Producing basic Nemeth Code (e.g., +, -, ×, ÷, =, <, >, %, \$, decimals, punctuation indicators, horizontal and vertical formats of presentation).
- Referring to Nemeth Code rules to produce advanced Nemeth Code.

Summary of Major Elements

To support the decision-making process for the Virginia Department of Education with regards to establishing a passing score, or cut score, for the Praxis Technology Education Assessment (0051), research staff from Educational Testing Service (ETS) designed and conducted a standard setting study on November 16, 2010. The study also collected content-related validity evidence to confirm the importance of the content specifications for entry-level technology education teachers.

The study involved an expert panel comprised of teachers, administrators and college faculty. The VDOE recommended panelists with (a) technology education experience, either as technology education teachers or college faculty who prepare technology education teachers, and (b) familiarity with the knowledge and skills required of beginning technology education teachers.

The panel was convened on November 16, 2010, in Richmond, Virginia. The technical report (Appendix A) is divided into three sections. The first section describes the content and format of the assessment. The second section describes the standard setting processes and methods used. The third section presents the results of the standard setting study.

In addition, research staff from the Educational Testing Service (ETS) designed and conducted two multi-state standard setting studies in October 2010. The studies also collected content-related validity evidence to confirm the importance of the content specifications for entry-level technology education teachers. The attached technical report (Appendix B) details the work of the multi-state committees.

The Praxis Technology Education *Test at a Glance* document (ETS, in press) describes the purpose and structure of the assessment. In brief, the assessment measures whether entry-level technology education teachers have the knowledge believed necessary for competent professional practice. A National Advisory Committee of expert practitioners and preparation faculty defined the content of the assessment, and a national survey of the field confirmed the content.

The two-hour assessment contains 120 multiple-choice questions covering *Technology and Society* (approximately 18 questions); *Technological Design and Problem Solving* (approximately 24 questions); *Energy, Power, and Transportation* (approximately 18 questions); *Information and Communication Technologies* (approximately 18 questions); *Manufacturing and Construction Technologies* (approximately 18 questions); and *Pedagogical and Professional Studies* (approximately 24 questions). Candidate scores are reported as an overall score; six category scores – one for each content area listed above – also are reported. Of the 120 multiple-choice questions, 110 questions contribute to a candidate's score. (Ten of the 120 multiple-choice questions are pretest questions which do not contribute to a candidate's score.) The maximum total number of raw points that may be earned on each assessment is 110. The reporting scale for the Praxis Technology Education Assessment (0051) ranges from 100 to 200 scaled-score points.

The process used in the Virginia standard setting study is detailed in Appendix A. The panel's cut score recommendation for the Praxis Technology Education Assessment (0051) is 74.96 (see Table 1). The value was rounded to 75, the next highest whole number, to determine the functional recommended cut. The value of 75 represents approximately 68 percent of the total available 110 raw-score points that could be earned on the assessment. The scaled score associated with 75 raw points is 162.

A similar process was used in the multi-state standard setting studies as described in Appendix B. The recommended cut scores for each panel, as well as the average cut score across the two panels, are provided to help state departments of education determine an appropriate cut (or passing) score (see

Table 2). For the Praxis Technology Education Assessment (0051), the average recommended cut score (rounded up) is 73 (on the raw score metric), which represents 66 percent of the total available 110 raw score points (the recommended cut scores for Panels 1 and 2 are 72 and 74, respectively). The scaled score associated with a raw score of 73 is 159.

When reviewing the Standard Error of Measurement (SEM) for the cut scores recommended by the Virginia Standard Setting Study as well as the Multi-State Studies, there is an overlap in the scaled scores. The SEM is a statistical phenomenon and is unrelated to the accuracy of scoring. All test results are subject to the standard error of measurement. If a test-taker were to take the same test repeatedly, with no change in his level of knowledge and preparation, it is possible that some of the resulting scores would be slightly higher or slightly lower than the score that precisely reflects the test-taker's actual level of knowledge and ability. The difference between a test-taker's actual score and his highest or lowest hypothetical score is known as the standard error of measurement. The Standard Error of Measurement for the recommended cut scores for the Virginia Standard Setting Study and the Multi-State Studies are shown on the next page. Note that consistent with the recommended cut score, the cut scores at the different SEMs have been rounded to the next highest whole number.

Standard Error of Measure Summaries – Technology Education (0051)

Table 1

Cut Scores within 1 and 2 SEMs of the Recommended Cut Score
Technology Education – Virginia

Recommended Cut Score (SEM)		Scale Score Equivalent
	75 (4.91)	162
-2 SEMs	66	150
-1 SEM	71	156
+1 SEM	80	168
+2 SEMs	85	175

Table 2

Cut Scores within 1 and 2 SEMs of the Recommended Cut Score
Technology Education – Multi-State Studies

Panel 1:

Recommended Cut Score (SEM)		Scale Score Equivalent
	72 (5.01)	158
-2 SEMs	62	145
-1 SEM	67	151
+1 SEM	78	166
+2 SEMs	83	172

Panel 2:

Recommended Cut Score (SEM)		Scale Score Equivalent
	74 (4.94)	160
-2 SEMs	65	149
-1 SEM	70	155
+1 SEM	79	167
+2 SEMs	84	173

Combined Across Panels:

Recommended Cut Score (SEM)		Scale Score Equivalent
	73 (4.98)	159
-2 SEMs	64	147
-1 SEM	69	154
+1 SEM	78	166
+2 SEMs	83	172

Note: Consistent with the recommended cut score, the cut scores at the different SEMs have been rounded to the next highest whole number.

On January 24, 2011, the Advisory Board for Teacher Education and Licensure (ABTEL) recommended that the Board of Education set a cut score of 162 for the Praxis Technology Education Assessment (0051) for individuals seeking an initial license with an endorsement in Technology Education. The revised assessment will be offered after September 1, 2011.

Superintendent's Recommendation:

The Superintendent of Public Instruction recommends that the Board of Education receive for first review the Advisory Board on Teacher Education and Licensure's recommendation to set a cut score of 162 for the Praxis Technology Education Assessment (0051) for individuals seeking an initial Virginia license with an endorsement in Technology Education.

Impact on Resources:

Costs associated with the administration of the Praxis Technology Education Assessment (0051) will be incurred by the Educational Testing Service. Prospective teachers seeking an initial Virginia license with an endorsement in Technology Education will be required to pay the registration and test fees.

Timetable for Further Review/Action:

This item will be presented to the Board of Education for final review on March 24, 2011.



Listening. Learning. Leading.

Standard Setting Technical Report

PRAXIS TECHNOLOGY EDUCATION (0051)

Prepared for the Virginia Department of Education

Educational and Credentialing Research

Educational Testing Service

Princeton, New Jersey

November 2010

Executive Summary

To support the decision-making process for the Virginia Department of Education (VDOE) with regards to establishing a passing score, or cut score, for the Praxis Technology Education (0051) assessment, research staff from Educational Testing Service (ETS) designed and conducted a standard setting study on November 16, 2010. The study also collected content-related validity evidence to confirm the importance of the content specifications for entry-level technology education teachers.

Recommended Cut Scores

The recommended cut score is provided to help the VDOE determine an appropriate cut (or passing) score. For the Praxis Technology Education (0051) assessment, the average recommended cut score is 75 (on the raw score metric), which represents 68% of total available 110 raw score points. The scaled score associated with a raw score of 75 is 162.

Summary of Content Specification Judgments

Panelists judged the extent to which the knowledge and/or skills reflected by the content specifications were important for entry-level technology education teachers. The favorable judgments of the panelists provided evidence that the content of the assessment is important for beginning practice.

To support the decision-making process for the Virginia Department of Education (VDOE) with regards to establishing a passing score, or cut score, for the Praxis Technology Education (0051) assessment, research staff from Educational Testing Service (ETS) designed and conducted a standard setting study. The study also collected content-related validity evidence to confirm the importance of the content specifications for entry-level technology education teachers.

The study involved an expert panel, comprised of teachers, administrators and college faculty. The VDOE recommended panelists with (a) technology education experience, either as technology education teachers or college faculty who prepare technology education teachers and (b) familiarity with the knowledge and skills required of beginning technology education teachers.

The panel was convened on November 16, 2010, in Richmond, Virginia. The following technical report is divided into three sections. The first section describes the content and format of the assessment. The second section describes the standard setting processes and methods used. The third section presents the results of the standard setting study.

The passing score recommendation for the Praxis Technology Education (0051) assessment is provided to the VDOE. The VDOE is responsible for establishing the final passing score in accordance with applicable state regulations. The study provides a recommended passing score, which represents the combined judgments of one group of experienced educators. The full range of the VDOE's needs and expectations could not be represented during the standard setting study. The VDOE, therefore, may want to consider both the panel's recommended cut score and other sources to information when setting the final Praxis Technology Education (0051) cut score (Geisinger & McCormick, 2010). Other kinds of information may provide reasons for the VDOE to adjust the recommended cut score. The recommended cut score may be accepted, adjusted upward to reflect more stringent expectations, or adjusted downward to reflect more lenient expectations. There is no *correct* decision; the appropriateness of any adjustment may only be evaluated in terms of its meeting the VDOE's needs.

Two critical sources of information to consider when setting the cut score are the standard error of measurement (SEM) and the standard error of judgment (SEJ). The former addresses the reliability of Praxis Technology Education (0051) scores and the latter the reliability of panelists' cut score recommendations. The SEM allows the VDOE to recognize that a Praxis Technology Education (0051) score—any test score on any test—is less than perfectly reliable. A test score only approximates what a

candidate *truly* knows or *truly* can do on the test. The SEM, therefore, addresses the question: How close of an approximation is the test score to the *true* score? The SEJ allows the VDOE to consider the likelihood that the recommended cut score from the current panel would be similar to cut scores recommended by other panels of experts similar in composition and experience. The smaller the SEJ, the more likely that another panel would recommend a cut score consistent with the recommended cut score. The larger the SEJ, the less likely the recommended cut score would be reproduced by another panel.

In addition to measurement error metrics (e.g., SEM, SEJ), the VDOE should consider the likelihood of classification error. That is, when adjusting a cut score, policymakers should consider whether it is more important to minimize a false positive decision or to minimize a false negative decision. A false positive decision occurs when a candidate's test score suggests he should receive a license/certificate, but his actual knowledge/skill level is lower (i.e., the candidate does not possess the required knowledge/skills). A false negative occurs when a candidate's test score suggests that she should not receive a license/certificate, but she actually does possess the required knowledge/skills. The VDOE needs to consider which decision error to minimize; it is not possible to eliminate both types of decision errors simultaneously.

Overview of the Praxis Assessment

The *Praxis Technology Education Test at a Glance* document (ETS, in press) describes the purpose and structure of the assessment. In brief, the assessment measures whether entry-level technology education teachers have the knowledge believed necessary for competent professional practice. A National Advisory Committee of expert practitioners and preparation faculty defined the content of the assessment, and a national survey of the field confirmed the content.

The two hour assessment contains 120 multiple-choice questions covering *Technology and Society* (approximately 18 questions); *Technological Design and Problem Solving* (approximately 24 questions); *Energy, Power, and Transportation* (approximately 18 questions); *Information and Communication Technologies* (approximately 18 questions); *Manufacturing and Construction*

Technologies (approximately 18 questions); and *Pedagogical and Professional Studies* (approximately 24 questions)¹.

Candidate scores are reported as an overall score; six category scores – one for each content area listed above – also are reported. Of the 120 multiple-choice questions, 110 questions contribute to a candidate’s score². The maximum total number of raw points that may be earned on each assessment is 110. The reporting scale for the Praxis Technology Education (0051) assessment ranges from 100 to 200 scaled-score points.

Processes and Methods

The following section describes the processes and methods used to train panelists, gather panelists’ judgments and to calculate recommended passing scores, or cut scores. (The agenda for the panel meeting is presented in the Appendix.)

The panelists were sent an e-mail explaining the purpose of the standard-setting study and requesting that they review the test content specifications for the assessment (included in the *Test at a Glance* document, which was attached to the e-mail). The purpose of the review was to familiarize the panelists with the general structure and content of the assessment.

The standard-setting study began with a welcome and introduction by James Lanham, from the VDOE. The ETS facilitator then explained how the assessment was developed, provided an overview of standard setting, and presented the agenda for the study.

Reviewing the Assessment

The first activity was for the panelists to “take the test.” (Each panelist had signed a nondisclosure form.) The panelists were given approximately an hour and a half to respond to the multiple-choice questions. The purpose of “taking the test” was for the panelists to become familiar with the test format, content, and difficulty. After “taking the test,” the panelists were given the answer key for the assessment and checked their responses. How well the panelists did on the assessment was not shared with the panel.

¹ The number of questions for each content area may vary slightly from form to form of the assessment.

² Ten of the 120 multiple-choice questions are pretest questions which do not contribute to a candidate’s score.

The panelists then engaged in a discussion of the major content areas being addressed by the assessment; they were also asked to remark on any content areas that they thought would be particularly challenging for entering technology education teachers, and areas that addressed content that would be particularly important for entering teachers.

Defining the Just Qualified Candidate

Following the review of the assessment, panelists internalized the definition of the Just Qualified Candidate (JQC). The JQC is the test taker who has the minimum level of knowledge and/or skills believed necessary to be a qualified technology education teacher. The JQC definition is the operational definition of the cut score. The goal of the standard-setting process is to identify the test score that aligns with this definition of the JQC.

The panelists were split into smaller groups, and each group was asked to write down their definition of a JQC. Each group referred to *Praxis Technology Education Test at a Glance* to guide their definition. Each group posted its definition on chart paper, and a full-panel discussion occurred to reach consensus on a final definition (see the consensus JQC definition in the Appendix).

Panelists' Judgments

The standard-setting process for the Praxis Technology Education (0051) assessment was conducted for the overall test. A probability-based Angoff method (Brandon, 2004; Hambleton & Pitoniak, 2006) was used. In this approach, for each multiple-choice question, a panelist decides on the likelihood (probability or chance) that a JQC would answer it correctly. Panelists made their judgments using the following rating scale: 0, .05, .10, .20, .30, .40, .50, .60, .70, .80, .90, .95, 1. The lower the value, the less likely it is that a JQC would answer the question correctly, because the question is difficult for the JQC. The higher the value, the more likely it is that a JQC would answer the question correctly.

The panelists were asked to approach the judgment process in two stages. First, they reviewed the definition of the JQC and the question and decided if, overall, the question was difficult for the JQC, easy for the JQC, or moderately difficult/easy. The facilitator encouraged the panelists to consider the following rule of thumb to guide their decision:

- difficult questions for a JQC were in the 0 to .30 range;
- moderately difficult/easy questions for a JQC were in the .40 to .60 range; and
- easy questions for a JQC were in the .70 to 1 range.

The second decision was for panelists to decide how they wanted to refine their judgment within the range. For example, if a panelist thought that a question was easy for a JQC, the initial decision located the question in the .70 to 1 range. The second decision was for the panelist to decide if the likelihood of answering it correctly was .70, .80, .90, .95, or 1.0. The two-stage decision-process was implemented to reduce the cognitive load placed on the panelists. The panelists practiced making their standard-setting judgments on the first five questions.

Judgment of Content Specifications

In addition to the standard setting process, the panel judged the importance of the knowledge and/or skills stated or implied in the assessment content specifications for the job of an entry-level technology education teacher. These judgments addressed the perceived content-based validity of the assessment. Judgments were made using a four-point Likert scale — *Very Important*, *Important*, *Slightly Important*, and *Not Important*. Each panelist independently judged the six knowledge categories and 73 knowledge/skills statements.

Results

Expert Panels

The standard setting study included an expert panel. The VDOE recruited panelists to represent a range of professional perspectives. A description of the panel is presented below. (See Appendix for a listing of panelists.)

The panel included 15 teachers, administrators, and college faculty who prepare technology education teachers. In brief, 12 panelists were teachers, one was an administrator, and two were college faculty. Both of the panelists who were college faculty were currently involved in the training or preparation of technology education teachers. Twelve panelists were White, two were African American, and one was Hispanic. Ten panelists were male. Thirteen panelists reported being certified technology education teachers in Virginia. The majority of panelists (11 of the 15 panelists or 73%) had

11 or fewer years of experience as a technology education teacher, and approximately a fifth had 16 or more years of teaching experience.

A fuller demographic description for the members of the panel is presented in Table 1.

Table 1

Panel Member Demographics

	N	Percent
Current Position		
Teachers	12	80%
Administrator/Department Head	1	7%
College Faculty	2	13%
Race		
White	12	80%
Black or African American	2	13%
Hispanic or Latino	1	7%
Gender		
Female	5	33%
Male	10	67%
Are you currently certified as a technology education teacher in Virginia?		
Yes	13	87%
No	2	13%
Are you currently teaching technology education in Virginia?		
Yes	12	80%
No	3	20%
Are you currently supervising or mentoring other technology education teachers?		
Yes	6	40%
No	9	60%

Table 1 (continued)

Panel Member Demographics

	N	Percent
How many years of experience do you have teaching technology education?		
3 years or less	1	7%
4 - 7 years	3	20%
8 - 11 years	7	47%
12 - 15 years	1	7%
16 years or more	3	20%
At what K-12 grade level are you currently teaching technology education?		
Middle School (6 - 8 or 7 - 9)	4	27%
High School (9 - 12 or 10 - 12)	7	47%
Not currently teaching at the K-12 level	4	27%
Which best describes the location of your K-12 school?		
Urban	2	13%
Suburban	5	33%
Rural	6	40%
Not currently teaching at the K-12 level	2	13%
If you are college faculty, are you currently involved in the training/preparation of technology education teachers?		
Yes	2	13%
No	0	0%
Not college faculty	13	87%

Initial Evaluation Forms.

The panelists completed an initial evaluation after receiving training on how to make question-level judgments. The primary information collected from this form was the panelists indicating if they had received adequate training to make their standard-setting judgments and were ready to proceed. All panelists indicated that they were prepared to make their judgments.

Summary of Standard Setting Judgments

A summary of the standard-setting judgments is presented in Table 2. The numbers in the table reflect the recommended cut scores — the number of raw points needed to “pass” the assessment — of each panelist. The panel’s average recommended cut score and highest and lowest cut scores are

reported, as are the standard deviations (SD) of panelists' cut scores and the standard errors of judgment (SEJ). The SEJ is one way of estimating the reliability of the judgments. It indicates how likely it would be for other panels of educators similar in make-up, experience, and standard-setting training to the current panel to recommend the same cut score on the same form of the assessment. A comparable panel's cut score would be within 1 SEJ of the current average cut score 68 percent of the time and within 2 SEJs 95 percent of the time.

The panel's cut score recommendation for the Praxis Technology Education (0051) assessment is 74.96 (see Table 2). The value was rounded to 75, the next highest whole number, to determine the functional recommended cut. The value of 75 represents approximately 68% of the total available 110 raw-score points that could be earned on the assessment. The scaled score associated with 75 raw points is 162.

Table 2
Summary of Standard Setting Judgments

Panelist	Cut Score
1	79.60
2	55.20
3	67.85
4	75.35
5	66.65
6	72.65
7	83.55
8	73.90
9	69.70
10	98.85
11	77.05
12	68.40
13	80.30
14	73.55
15	81.85
Average	74.96
SD	9.77
SEJ	2.52
Highest	98.85
Lowest	55.20

Table 3 presents the estimated standard errors of measurement (SEM) around the recommended cut score. A standard error represents the uncertainty associated with a test score. The scaled scores associated with 1 and 2 SEMs above and below the recommended cut scores are provided. The standard errors provided are an estimate, given that the Praxis Technology Education (0051) assessment has not yet been administered.

Table 3**Cut Scores within 1 and 2 SEMs of the Recommended Cut Score**

Recommended Cut Score (SEM)		Scale Score Equivalent
	75 (4.91)	162
- 2 SEMs	66	150
-1 SEM	71	156
+1 SEM	80	168
+ 2 SEMs	85	175

Note. Consistent with the recommended cut score, the cut scores at the different SEMs have been rounded to the next highest whole number.

Summary of Content Specification Judgments.

Panelists judged the extent to which the knowledge and/or skills reflected by the Praxis Technology Education (0051) assessment content specifications were important for entry-level technology education teachers. Panelists rated the six knowledge categories and 73 knowledge/skills statements on a four-point scale ranging from *Very Important* to *Not Important*. The panelists' ratings are summarized in Table 4 (in Appendix).

The six knowledge categories were judged to be *Very Important* or *Important* by 87% or more of the panelists. The knowledge categories of *Pedagogical and Professional Studies* (73% of the panelists judged as *Very Important*) and *Technological Design and Problem Solving* (87% of the panelists judged as *Very Important*) were seen as the most important for beginning technology education teachers. The knowledge categories of *Information and Communication Technologies* (27% of the panelists judged as *Very Important* and 13% of the panelists judged as *Slightly Important*) and *Manufacturing and Construction Technologies* (27% of the panelists judged as *Very Important* and 7% of the panelists judged as *Slightly Important*) were seen as less important for beginning technology education teachers. All but 5 of the 73 knowledge statements were judged to be *Very Important* or *Important* by at least two-thirds of the panelists.

Summary of Final Evaluations.

The panelists completed an evaluation form at the conclusion of their standard setting study. The evaluation form asked the panelists to provide feedback about the quality of the standard-setting implementation. Table 5 (in Appendix) present the results of the final evaluations.

All panelists *strongly agreed* that they understood the purpose of the study and that the facilitator's instructions and explanations were clear. All panelists *agreed* or *strongly agreed* that they were prepared to make their standard setting judgments. Approximately 73% of the panelists *strongly agreed* that the standard-setting process was easy to follow.

Summary

To support the decision-making process for the Virginia Department of Education (VDOE) with regards to establishing passing score, or cut score, for Praxis Technology Education (0051) assessment, research staff from Educational Testing Service (ETS) designed and conducted a standard setting study. The study also collected content-related validity evidence to confirm the importance of the content specifications for entry-level technology education teachers.

The recommended cut score is provided to help the VDOE determine an appropriate cut (or passing) score. For Praxis Technology Education (0051), the average recommended cut score is 75 (on the raw score metric), which represents 68% of total available 110 raw score points. The scaled score associated with a raw score of 75 is 162.

Panelists judged the extent to which the knowledge and/or skills reflected by the content specifications were important for entry-level technology education teachers. The favorable judgments of the panelists provided evidence that the content of the assessment is important for beginning practice.

References

- Brandon, P.R. (2004). Conclusions about frequently studied modified Angoff standard-setting topics. *Applied Measurement in Education, 17*, 59-88.
- ETS. (In press). *Technology Education Test at a Glance*. Princeton, NJ.
- Geisinger, K.F., & McCormick, C.A. (2010). Adopting cut scores: Post-standard-setting panel considerations for decision makers. *Educational Measurement: Issues and Practice, 29*, 38–44.
- Hambleton, R. K., & Pitoniak, M.J. (2006). Setting performance standards. In R. L. Brennan (Ed.), *Educational Measurement* (4th ed., pp. 433-470). Westport, CT: American Council on Education/Praeger.

Appendix

Praxis Names and Affiliation

Panelist

Christopher Balthis
Laura Cooper
Nanette M. Dean
James T. DeMarino
Todd D. Fantz
Sarah Gerrol
Jim Hawley
Cecilia B. Hess
Deidrai D. Murray
Kevin L. O'Rear
Michael Piccione
Philip A. Reed
John Ruf
Scott C. Settar
Mathew B. Weatherford

Affiliation

Wise County Public School
Bath County Public Schools
Norfolk City Public Schools
Arlington County Public Schools
Old Dominion University
Roanoke County Public School
Campbell County Public School
Virginia Beach City Public Schools
Norfolk City Public Schools
New Kent County Public Schools
Prince William County Public Schools
Old Dominion University
Spotsylvania County Public Schools
Fairfax County Public Schools
Pittsylvania County Public Schools

Agenda: TECHNOLOGY EDUCATION (6-12) PANEL

Tuesday, November 16, 2010

8:00 am	Registration and Breakfast
8:30 am	Welcome and Introduction
8:50 am	Overview of Study
9:20 am	Take the Test and Self-Score
10:50 am	BREAK
11:00 am	Discuss the Test Content
11:30 am	Discuss the Just Qualified Candidate (JQC)
Noon	LUNCH
12:45 pm	Define the Just Qualified Candidate (JQC) - Continued
1:30 pm	Training for Standard Setting Judgments
2:00 pm	Complete Standard Setting Judgments
	BREAK
3:00 pm	Specification Judgment Training
3:30 pm	Complete Specification Judgments
3:45 pm	Complete Final Evaluation
4:00 pm	Collect Materials and Adjourn

Thank You for Participating



Copyright © 2010 by Educational Testing Service. All rights reserved.

Description of a Just Qualified Candidate
Praxis Technology Education (0051)
(Developed for the Virginia Department of Education)

- Understands the importance of collaboration and interdisciplinary teaching and demonstrates the relationships in context between technology and other curricular areas
- Can identify and model key safety concerns and practices
- Can describe and apply technological design and problem solving processes
- Can identify and implement objectives that address specific state competencies and national standards
- Uses major concepts, terminology and appropriate tools related to the teaching of technological core topics, i.e., power, energy, transportation, manufacturing, communication, information technology, construction
- Understands and applies the systems model
- Understands and utilizes a variety of professional development opportunities, i.e., professional associations and student organizations
- Can evaluate a technology's impact and identify its interrelationships with society
- Utilizes multiple instructional strategies and assessments that facilitate student achievement and technological literacy

Table 4**Specification Judgments**

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
I. Technology and Society	10	67%	5	33%	0	0%	0	0%
• Understands the nature of technology, technology education, and technological literacy.	15	100%	0	0%	0	0%	0	0%
• Understands how invention and innovation occur, how they are influenced by cultural and economic factors, and how they are built on existing technologies.	6	40%	8	53%	1	7%	0	0%
• Understands how technological development is influenced by knowledge from other fields of study, especially mathematics and the sciences.	7	47%	8	53%	0	0%	0	0%
• Understands the influence that significant technological innovations have had on human history and on today's world.	6	40%	6	40%	3	20%	0	0%
• Understands critical changes in technology through the different periods of human history.	3	20%	8	53%	4	27%	0	0%
• Understands how various factors affect technology development.	2	13%	11	73%	2	13%	0	0%
• Understands the impacts of technology on society and on social institutions such as the family and the political system.	7	47%	7	47%	1	7%	0	0%
• Understands ways to decrease the negative environmental impact of technological systems and processes and knows how to evaluate trade-offs with respect to different approaches.	7	47%	8	53%	0	0%	0	0%
• Understands the relationships between engineering, mathematics, science, and technology.	9	60%	6	40%	0	0%	0	0%

Table 4 (continued)

Specification Judgments

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
II. Technological Design and Problem Solving	13	87%	2	13%	0	0%	0	0%
• Understands how to implement and document the steps of a design process.	12	80%	3	20%	0	0%	0	0%
• Knows how to select and use tools—especially software—in a design process, including the creation, testing, evaluation, and communication of solutions.	7	47%	8	53%	0	0%	0	0%
• Understands how to identify a problem and define design requirements (criteria and constraints).	10	67%	5	33%	0	0%	0	0%
• Knows how to generate possible solutions to design problems and how to select, develop, and refine design proposals, using analysis and creativity.	10	67%	5	33%	0	0%	0	0%
• Knows how to evaluate, test, and optimize designs, using specifications, design principles, modeling, experimentation, and prototyping.	8	53%	7	47%	0	0%	0	0%
• Understands how to organize and communicate the solution to a design problem.	6	40%	9	60%	0	0%	0	0%
• Understands systems thinking and knows how to model it for students.	12	80%	3	20%	0	0%	0	0%
• Understands there is no such thing as a perfect design and that making design decisions involves balancing trade-offs.	10	67%	5	33%	0	0%	0	0%
• Knows how to operate, maintain, and troubleshoot technological systems.	6	40%	7	47%	2	13%	0	0%
• Knows how to apply the design process to systems and problems in energy, power, and transportation.	8	53%	6	40%	1	7%	0	0%

Table 4**Specification Judgments**

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
• Knows how to apply the design process to problems in information technology and communications technology.	7	47%	6	40%	2	13%	0	0%
• Knows how to apply the design process to problems in manufacturing and construction.	7	47%	6	40%	2	13%	0	0%
III. Energy, Power, and Transportation	3	20%	12	80%	0	0%	0	0%
• Understands and knows how to utilize various types of control.	1	7%	9	60%	5	33%	0	0%
• Knows how to apply mathematical and scientific principles to solve problems involving the harness, transfer, loss, transmission, and conversion of power and energy.	7	47%	6	40%	2	13%	0	0%
• Understands energy utilization systems.	1	7%	10	67%	4	27%	0	0%
• Knows the inputs used in transportation systems.	2	13%	10	67%	3	20%	0	0%
• Understands the components of vehicles and support systems, including infrastructures and subsystems for propulsion, suspension, control, and guidance.	1	7%	9	60%	5	33%	0	0%
• Understands the different processes involved in transportation operations, along with the part each process plays in the efficiency of the overall system.	2	13%	7	47%	6	40%	0	0%
• Understands the different forms of energy and the differences between them.	8	53%	6	40%	1	7%	0	0%
• Understands and can model the relationship between energy, power, and work.	5	33%	7	47%	3	20%	0	0%

Table 4
Specification Judgments

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
• Knows how energy is measured and controlled.	3	20%	9	60%	3	20%	0	0%
• Knows how to apply concepts of energy and power to solve problems related to them.	4	27%	9	60%	2	13%	0	0%
• Knows the different ways power is generated and used, including their differences in efficiency and impact on the environment.	2	13%	9	60%	4	27%	0	0%
• Knows and applies safety practices related to working with energy and power.	8	53%	5	33%	2	13%	0	0%
IV. Information and Communication Technologies	4	27%	9	60%	2	13%	0	0%
• Understands major concepts and terminology related to information systems.	8	53%	5	33%	2	13%	0	0%
• Given a communications problem or task, can identify and knows how to use appropriate tools and materials, especially software and hardware, to address it.	4	27%	9	60%	2	13%	0	0%
• Knows how to use operating systems, software applications, communication devices, and networking components in the classroom/laboratory.	5	33%	8	53%	2	13%	0	0%
• Recognizes the various types of network structures.	0	0%	5	33%	10	67%	0	0%
• Understands the concepts that make up a communications system.	7	47%	6	40%	2	13%	0	0%
• Understands concepts and terminology related to audio, video, electronic, data, technical, and graphic communications.	4	27%	10	67%	0	0%	1	7%

Table 4
Specification Judgments

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
• Knows how to arrange the elements of a communication message so that the message is effective and aesthetically pleasing.	1	7%	10	67%	4	27%	0	0%
• Knows the impacts of communication technology and media on society and culture.	6	40%	7	47%	2	13%	0	0%
• Understands legal and ethical issues regarding the use of communications and information technologies.	7	47%	6	40%	1	7%	1	7%
• Knows issues and trends in information and communications technologies.	5	33%	4	27%	6	40%	0	0%
V. Manufacturing and Construction Technologies	4	27%	10	67%	1	7%	0	0%
• Knows the management functions used in construction and manufacturing.	4	27%	7	47%	4	27%	0	0%
• Knows how to apply a systems model to manufacturing and construction processes.	10	67%	4	27%	1	7%	0	0%
• Knows the key concepts associated with the efficiency of production.	2	13%	12	80%	1	7%	0	0%
• Understands the differences between manufacturing systems.	3	20%	6	40%	6	40%	0	0%
• Knows the variety and properties of materials used in the manufacture of products and can evaluate the suitability of material to different manufacturing purposes.	3	20%	8	53%	4	27%	0	0%

Table 4**Specification Judgments**

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
<ul style="list-style-type: none"> Knows the primary processing methods of converting raw materials into industrial materials or standard stock and the secondary processing methods of converting industrial materials into finished products. 	1	7%	10	67%	4	27%	0	0%
<ul style="list-style-type: none"> Understands the key concepts and terminology related to construction. 	6	40%	7	47%	2	13%	0	0%
<ul style="list-style-type: none"> Knows the variety and properties of materials used in the construction of structures and can evaluate the suitability of material to different construction purposes. 	4	27%	8	53%	3	20%	0	0%
<ul style="list-style-type: none"> Understands the numerous constraints on structural designs, such as building codes, cost, and function. 	6	40%	8	53%	1	7%	0	0%
<ul style="list-style-type: none"> Knows the systems and subsystems of buildings and structures and the functions they perform. 	6	40%	5	33%	4	27%	0	0%
<ul style="list-style-type: none"> Understands static and dynamic loads and how they produce forces that affect stability and failure in a structure. 	6	40%	7	47%	2	13%	0	0%
<ul style="list-style-type: none"> Understands the variety of processes used in construction, including on-site and prefabricated techniques. 	4	27%	7	47%	4	27%	0	0%
VI. Pedagogical and Professional Studies	11	73%	4	27%	0	0%	0	0%
<ul style="list-style-type: none"> For a technology education program, knows how to create and implement a curriculum based on state and national standards. 	10	67%	4	27%	1	7%	0	0%

Table 4
Specification Judgments

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
• Knows how to select appropriate instructional content and develop learning activities.	12	80%	3	20%	0	0%	0	0%
• Knows how to choose, adapt, and implement instructional strategies appropriate to both the content and the level at which the content is being taught.	11	73%	4	27%	0	0%	0	0%
• Understands the importance of designing and implementing instructional activities that emphasize problem solving.	14	93%	1	7%	0	0%	0	0%
• Knows how to apply appropriate instructional technology equipment, materials, processes, and tools to enhance teaching and to actively engage students in learning.	7	47%	8	53%	0	0%	0	0%
• Knows how to select and use a variety of assessment methods to monitor and evaluate both student learning and instructional effectiveness.	10	67%	5	33%	0	0%	0	0%
• Knows how to create and maintain a safe and healthy learning environment.	13	87%	2	13%	0	0%	0	0%
• Is aware of the relationship between classroom learning and student organizations.	2	13%	10	67%	3	20%	0	0%
• Understands the relationship between technology education programs and advisory committees.	1	7%	8	53%	6	40%	0	0%
• Knows how to modify instructional activities and methods to address students' diverse needs.	11	73%	4	27%	0	0%	0	0%
• Understands the importance of promoting technology education internally and externally.	7	47%	5	33%	3	20%	0	0%

Table 4**Specification Judgments**

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
• Understands the importance of becoming involved in professional associations and organizations related to technology education.	5	33%	6	40%	4	27%	0	0%
• Understands the importance of the professional growth of the technology education teacher via formal instruction, in-service activities, and professional association meetings.	8	53%	5	33%	2	13%	0	0%
• Is familiar with current educational policy, legislation, and funding opportunities.	8	53%	5	33%	2	13%	0	0%
• Is familiar with opportunities for further education and careers.	5	33%	7	47%	3	20%	0	0%
• Is aware of the history, issues, and trends related to technology education.	4	27%	7	47%	4	27%	0	0%
• Is familiar with the management of resources, records, and budgets.	5	33%	7	47%	3	20%	0	0%
• Recognizes the importance of collaborating with other school faculty to design instruction that integrates knowledge and skills from other core academic subject areas into instruction in technology.	12	80%	3	20%	0	0%	0	0%

Table 5**Final Evaluation**

	Strongly Agree		Agree		Disagree		Strongly Disagree	
	N	Percent	N	Percent	N	Percent	N	Percent
• I understood the purpose of this study.	15	100%	0	0%	0	0%	0	0%
• The instructions and explanations provided by the facilitators were clear.	15	100%	0	0%	0	0%	0	0%
• The opportunity to “take the test” and to discuss the test content was useful	13	87%	2	13%	0	0%	0	0%
• The opportunity to practice making standard setting judgments was useful	10	67%	5	33%	0	0%	0	0%
• The training for the standard setting judgments was adequate to give me the information I needed to complete my assignment	11	73%	4	27%	0	0%	0	0%
• The process of making the standard setting judgments was easy to follow.	11	73%	4	27%	0	0%	0	0%



Multi-State Standard Setting Technical Report

PRAXIS TECHNOLOGY EDUCATION (0051)

Educational and Credentialing Research

Educational Testing Service

Princeton, New Jersey

October 2010

Executive Summary

To support the decision-making process for state departments of education with regards to establishing a passing score, or cut score, for a revised assessment in the Praxis Series™ — Technology Education (0051) — research staff from Educational Testing Service (ETS) designed and conducted two multi-state standard setting studies. The studies also collected content-related validity evidence to confirm the importance of the content specifications for entry-level technology education teachers.

Participating States

Panelists from 18 states were recommended by state departments of education to participate on expert panels. The state departments of education recommended panelists with (a) technology education experience, either as technology education teachers or college faculty who prepare technology education teachers and (b) familiarity with the knowledge and skills required of beginning technology education teachers.

Recommended Cut Scores

The recommended cut scores for each panel, as well as the average cut score across the two panels, are provided to help state departments of education determine an appropriate cut (or passing) score. For the Praxis Technology Education (0051) assessment, the average recommended cut score (rounded up) is 73 (on the raw score metric), which represents 66% of total available 110 raw score points (the recommended cut scores for Panels 1 and 2 are 72 and 74, respectively). The scaled score associated with a raw score of 73 is 159.

Summary of Content Specification Judgments

Panelists judged the extent to which the knowledge and/or skills reflected by the content specifications were important for entry-level technology education teachers. The favorable judgments of the panelists provided evidence that the content of the assessment is important for beginning practice.

To support the decision-making process for state departments of education with regards to establishing a passing score, or cut score, for a revised assessment in the Praxis Series™ — Technology Education (0051) — research staff from Educational Testing Service (ETS) designed and conducted two multi-state standard setting studies. The studies also collected content-related validity evidence to confirm the importance of the content specifications for entry-level technology education teachers. Panelists were recommended by state departments of education¹ to participate on the two expert panels. The state departments of education recommended panelists with (a) technology education experience, either as technology education teachers or college faculty who prepare technology education teachers and (b) familiarity with the knowledge and skills required of beginning technology education teachers.

The two, non-overlapping panels (a) allow each participating state to be represented and (b) provide a replication of the judgment process to strengthen the technical quality of the recommended passing score. For the Praxis Technology Education (0051) assessment, 18 states were represented by 34 panelists across the two panels, (See Appendix A for the names and affiliations of the panelists.)

Table 1
Participating States (and number of panelists) for Multi-State Panels

Arkansas (1 panelist)	New Jersey (2 panelist)
Connecticut (1 panelist)	Nevada (1 panelist)
Idaho (2 panelists)	North Carolina (3 panelists)
Indiana (2 panelists)	Ohio (2 panelists)
Kansas (2 panelists)	Pennsylvania (2 panelists)
Kentucky (3 panelists)	South Carolina (1 panelist)
Louisiana (3 panelists)	Utah (2 panelists)
Maryland (3 panelists)	Wisconsin (2 panelists)
Maine (1 panelist)	Wyoming (1 panelist)

Note. Arkansas, Connecticut, Maine, Nevada, Ohio, South Carolina, Utah and Wyoming were represented on only one of the two panels.

¹ State departments of education that currently use one or more Praxis tests were invited to participate in the multi-state standard setting study.

The panels were convened in September 2010 in Princeton, New Jersey. For both panels, the same processes and methods were used to train panelists, gather panelists' judgments and to calculate the recommended passing score, or cut score. The following technical report is divided into three sections. The first section describes the content and format of the assessment. The second section describes the standard setting processes and methods used. The third section presents the results of the standard setting studies.

The passing score recommendation for the assessment is provided to each of the represented state departments of education. In each state, the department of education, the state board of education, or a designated educator licensure board is responsible for establishing the final passing score in accordance with applicable state regulations.

The first national administration of the new Praxis Technology Education (0051) assessment will occur in fall 2011.

Overview of the Praxis Assessment

The Praxis Technology Education *Test at a Glance* document (ETS, in press) describes the purpose and structure of the assessment. In brief, the assessment measures whether entry-level technology education teachers have the knowledge believed necessary for competent professional practice. A National Advisory Committee of expert practitioners and preparation faculty defined the content of the assessment, and a national survey of the field confirmed the content.

The two hour assessment contains 120 multiple-choice questions covering *Technology and Society* (approximately 18 questions); *Technological Design and Problem Solving* (approximately 24 questions); *Energy, Power, and Transportation* (approximately 18 questions); *Information and Communication Technologies* (approximately 18 questions); *Manufacturing and Construction Technologies* (approximately 18 questions); and *Pedagogical and Professional Studies* (approximately 24 questions)².

Candidate scores are reported as an overall score; six category scores – one for each content area listed above – also are reported. Of the 120 multiple-choice questions, 110 questions contribute to a

² The number of questions for each content area may vary slightly from form to form of the assessment.

candidate's score³. The maximum total number of raw points that may be earned on each assessment is 110. The reporting scale for the Praxis Technology Education (0051) assessment ranges from 100 to 200 scaled-score points.

Processes and Methods

For both expert panels, the same processes and methods were used to train panelists, gather panelists' judgments and to calculate the recommended passing score, or cut score. The following section describes the processes and methods used. (The agenda for the panel meetings is presented in Appendix A.)

The design of the standard setting study included two non-overlapping expert panels. The training provided to panelists as well as the study materials were consistent across panels with the exception of defining the Just Qualified Candidate (JQC). To assure that both panels were using the same frame of reference when making question-level standard setting judgments, the JQC definition developed through a consensus process by the first panel was used as the definition for the second panel. The second panel did complete a thorough review of the definition to allow panelists to internalize the definition. The processes for developing the definition (with Panel 1) and reviewing/internalizing the definition (with Panel 2) are described later, and the Just Qualified Candidate definition is presented in Appendix C.

The panelists were sent an e-mail explaining the purpose of the standard-setting study and requesting that they review the test content specifications for the assessment (included in the *Test at a Glance* document, which was attached to the e-mail). The purpose of the review was to familiarize the panelists with the general structure and content of the assessment.

The standard-setting study began with a welcome and introduction by the meeting facilitator, Dr. Wanda Swiggett from the Center for Validity Research. She explained how the assessment was developed, provided an overview of standard setting, and presented the agenda for the study.

³ Ten of the 120 multiple-choice questions are pretest questions which do not contribute to a candidate's score.

Reviewing the Assessment

The first activity was for the panelists to “take the test.” (Each panelist had signed a nondisclosure form.) The panelists were given approximately an hour and a half to respond to the 120 multiple-choice questions. (Panelists were instructed not to refer to the answer key while taking the test.) The purpose of “taking the test” was for the panelists to become familiar with the test format, content, and difficulty. After “taking the test,” the panelists checked their responses against the answer key.

The panelists then engaged in a discussion of the major content areas being addressed by the assessment; they were also asked to remark on any content areas that they thought would be particularly challenging for entering technology education teachers, and areas that addressed content that would be particularly important for entering teachers.

Defining the Just Qualified Candidate

Following the review of the assessment, panelists internalized the definition of the Just Qualified Candidate (JQC). The JQC is the test taker who has the minimum level of knowledge and/or skills believed necessary to be a qualified technology education teacher. The JQC definition is the operational definition of the cut score. The goal of the standard-setting process is to identify the test score that aligns with this definition of the JQC.

In Panel 1, the panelists were split into smaller groups, and each group was asked to write down their definition of a JQC. Each group referred to the Praxis Technology Education *Test at a Glance* to guide their definition. Each group posted its definition on chart paper, and a full-panel discussion occurred to reach consensus on a definition (see Appendix C).

In Panel 2, the panelists began with the definition of the JQC developed by the first panel. Given that the multi-state standard setting study was designed to replicate processes and procedures across the two panels, it was important that both panels use consistent JQC definitions to frame their judgments. For Panel 2, the panelists reviewed the JQC definition, and any ambiguities were discussed and clarified. The panelists then were split into smaller groups, and each group developed performance indicators or “can do” statements based on the definition. The purpose of the indicators was to provide clear examples of what might be observed to indicate that the teacher had the defined knowledge. The performance indicators were shared across the group, and discussed and added to the definition. The panel also had

an opportunity to suggest minor changes to the initial definition, if doing so added clarity. No significant changes to the initial definition were suggested by Panel 2.

Panelists' Judgments

A probability-based Angoff method (Brandon, 2004; Hambleton & Pitoniak, 2006) was used for the multiple-choice questions. In this approach, for each question, a panelist decides on the likelihood (probability or chance) that a JQC would answer it correctly. Panelists made their judgments using the following rating scale: 0, .05, .10, .20, .30, .40, .50, .60, .70, .80, .90, .95, 1. The lower the value, the less likely it is that a JQC would answer the question correctly, because the question is difficult for the JQC. The higher the value, the more likely it is that a JQC would answer the question correctly.

For each panel, the panelists were asked to approach the judgment process in two stages. First, they reviewed the definition of the JQC and the question and decided if, overall, the question was difficult for the JQC, easy for the JQC, or moderately difficult/easy. The facilitator encouraged the panelists to consider the following rule of thumb to guide their decision:

- difficult questions for a JQC were in the 0 to .30 range;
- easy questions for a JQC were in the .70 to 1 range; and
- moderately difficult/easy questions for a JQC were in the .40 to .60 range.

The second decision was for panelists to decide how they wanted to refine their judgment within the range. For example, if a panelist thought that a question was easy for a JQC, the initial decision located the question in the .70 to 1 range. The second decision was for the panelist to decide if the likelihood of answering it correctly was .70, .80, .90, .95, or 1.0. The two-stage decision-process was implemented to reduce the cognitive load placed on the panelists. The panelists practiced making their standard-setting judgments on the first five questions.

The panelists engaged in two rounds of judgments. Following Round 1, feedback was provided to the panel, including each panelist's (listed by ID number) recommended cut scores and the panel's average recommended cut score, highest and lowest cut scores, and standard deviation. Following discussion, the panelists' judgments were displayed for each question. The panelists' judgments were summarized by the three general difficulty levels (0 to .30, .40 to .60, and .70 to 1), and the panel's average question judgment was provided. Questions were highlighted to show when panelists converged

in their judgments (at least two-thirds of the panelists located a question in the same difficulty range) or diverged in their judgments. Panelists were asked to share their rationales for the judgments they made. Following this discussion, panelists were provided an opportunity to change their question-level standard-setting judgments (Round 2).

Other than the definition of the JQC, results from Panel 1 were not shared with the second panel. The question-level judgments and resulting discussions for Panel 2 were independent of judgments and discussions that occurred with Panel 1.

Judgment of Content Specifications

In addition to the two-round standard setting process, each panel judged the importance of the knowledge and/or skills stated or implied in the assessment content specifications for the job of an entry-level technology education teacher. These judgments addressed the perceived content-based validity of the assessment. Judgments were made using a four-point Likert scale — *Very Important*, *Important*, *Slightly Important*, and *Not Important*. Each panelist independently judged the six knowledge categories and 73 knowledge/skills statements.

Results

Results are presented separately for the two panels. The recommended cut scores for each panel, as well as the average cut score across the two panels, are provided to help state departments of education determine an appropriate cut (or passing) score.

Expert Panels

The standard setting study included two expert panels. The various state departments of education recruited panelists to represent a range of professional perspectives. A description of the panels is presented below. (See Appendix A for a listing of panelists for each panel.)

Panel 1 included 18 teachers, administrators, and college faculty who prepare technology education teachers, representing 14 states. In brief, 12 panelists were teachers, two were administrators or department heads, and four were college faculty. All four of the panelists who were college faculty were currently involved in the training or preparation of technology education teachers. Fifteen panelists were White, one was African American, and one was Asian American. Six panelists were female.

Sixteen panelists reported being certified technology education teachers in their states. Two-thirds of panelists (12 of the 18 panelists or 67%) had seven or fewer years of experience as a technology education teacher, and two had 16 or more years of teaching experience.

Panel 2 included 16 teachers, administrators, and college faculty, representing 14 states. In brief, six panelists were teachers, four were administrators or department heads, five were college faculty, and one was a technology integration specialist. Four of the five panelists who were college faculty were currently involved in the training or preparation of technology education teachers. Thirteen panelists were White, two were African American, and one was Asian American. Six panelists were female. Eleven panelists reported being certified technology education teachers in their states. Over half of panelists (9 of the 16 panelists or 56%) had seven or fewer years of experience as a technology education teacher, and three had 16 or more years of teaching experience.

A fuller demographic description for the members of the two panels is presented in Tables D1 and D2 in Appendix D.

Initial Evaluation Forms.

The panelists completed an initial evaluation after receiving training on how to make question-level judgments. The primary information collected from this form was the panelists indicating if they had received adequate training to make their standard-setting judgments and were ready to proceed. Across both panels, all panelists indicated that they were prepared to make their judgments.

Summary of Standard Setting Judgments by Round.

A summary of each round of standard-setting judgments is presented in Appendix D. The numbers in each table reflect the recommended cut scores — the number of raw points needed to “pass” the assessment — of each panelist for the two rounds. The panel’s average recommended cut score and highest and lowest cut scores are reported, as are the standard deviations (SD) of panelists’ cut scores and the standard errors of judgment (SEJ). The SEJ is one way of estimating the reliability of the judgments. It indicates how likely it would be for other panels of educators similar in make-up, experience, and standard-setting training to the current panels to recommend the same cut score on the same form of the assessment. A comparable panel’s cut score would be within 1 SEJ of the current average cut score 68 percent of the time and within 2 SEJs 95 percent of the time.

Round 1 judgments are made without discussion among the panelists. The most variability in judgments, therefore, is typically present in the first round. Round 2 judgments, however, are informed by panel discussion; thus, it is common to see a decrease both in the standard deviation and SEJ. This decrease — indicating convergence among the panelists’ judgments — was observed for both panels. The Round 2 average total score is the panel’s recommended cut score (passing score).

The panels’ cut score recommendations for the Praxis Technology Education (0051) assessment are 71.86 for Panel 1 and 73.92 for Panel 2 (see Tables D3 and D4 in Appendix D). The values were rounded to the next highest whole number to determine the functional recommended cut scores — 72 for Panel 1 and 74 for Panel 2. The values of 72 and 74 represent approximately 65% and 67%, respectively, of the total available 110 raw-score points that could be earned on the assessment. The scaled scores associated with 72 and 74 raw points are 158 and 160, respectively.⁴

Table D5 (in Appendix D) present the estimated standard errors of measurement (SEM) around the recommended cut scores for each panel. A standard error represents the uncertainty associated with a test score. The scaled scores associated with 1 and 2 SEMs above and below the recommended cut scores are provided. The standard errors provided are an estimate, given that the Praxis Technology Education (0051) assessment has not yet been administered.

In addition to the recommended cut scores for each panel, the average cut across the two panels is provided to help state departments of education determine an appropriate cut (or passing) score for the Praxis Technology Education (0051) assessment. The panels’ average cut score recommendation for the Praxis Technology Education (0051) assessment is 72.89. The value was rounded to 73 (next highest raw score) to determine the functional recommended cut score. The value of 73 represents approximately 66% of the total available 110 raw-score points that could be earned on the assessment. The scaled score associated with 73 raw points is 159. Table D5 (in Appendix D) presents the standard error of measurement (SEM) around the recommended cut score combining the information from the two panels.

⁴ For reference purposes, if the recommended raw cut score was 71 or 73 points, the scaled score would be 156 or 159, respectively.

Summary of Content Specification Judgments.

Panelists judged the extent to which the knowledge and/or skills reflected by the Praxis Technology Education (0051) assessment content specifications were important for entry-level technology education teachers. Panelists rated the six knowledge categories and 73 knowledge/skills statements on a four-point scale ranging from *Very Important* to *Not Important*. The panelists' ratings are summarized in Table D6 (in Appendix D).

The six knowledge categories were judged to be *Very Important* or *Important* by 85% or more of the panelists. The knowledge categories of *Pedagogical and Professional Studies* (85% of the panelists judged as *Very Important*) and *Technological Design and Problem Solving* (79% of the panelists judged as *Very Important*) were seen as the most important for beginning technology education teachers. The knowledge categories of *Information and Communication Technologies* (15% of the panelists judged as *Slightly Important*) and *Manufacturing and Construction Technologies* (12% of the panelists judged as *Slightly Important*) were seen as less important for beginning technology education teachers. All but nine of the 73 knowledge statements were judged to be *Very Important* or *Important* by at least two-thirds of the panelists.

Summary of Final Evaluations.

The panelists completed an evaluation form at the conclusion of their standard setting study. The evaluation form asked the panelists to provide feedback about the quality of the standard-setting implementation and the factors that influenced their decisions. Tables D7 and D8 (in Appendix D) present the results of the final evaluations.

All panelists *agreed* or *strongly agreed* that they understood the purpose of the study and that the facilitator's instructions and explanations were clear. All panelists *agreed* or *strongly agreed* that they were prepared to make their standard setting judgments. Across the two panels, all but one of the panelists *strongly agreed* or *agreed* that the standard-setting process was easy to follow. All but one of the panelists reported that the definition of the JQC was at least *somewhat influential* in guiding their standard-setting judgments. All but one of the panelists reported that between-round discussions were at least *somewhat influential* in guiding their judgments. Across the two panels, 10 of the 34 panelist indicated that the cut scores of other panelists did not influence their judgments.

There were similar ratings between the two panels when asked to respond to their level of comfort with their panel's recommended passing score. All but three of the 34 panelists indicated they were *very* or *somewhat comfortable* with their recommendation. Two panelists (one from each panel) reported being *somewhat uncomfortable* with their recommended passing score; one panelist from Panel 1 reported being *very uncomfortable* with the panel's recommended passing score. For both panels, the majority of the panelists indicated that the recommend cut score was *about right* (100% for Panel 1 and 88% for Panel 2) and the remaining panelists from Panel 2 indicated the cut score was *too low*.

Summary

To support the decision-making process for state departments of education with regards to establishing a passing score, or cut score, for a revised assessment in the Praxis Series™ — Technology Education (0051) — research staff from Educational Testing Service (ETS) designed and conducted two multi-state standard setting studies. The studies also collected content-related validity evidence to confirm the importance of the content specifications for entry-level technology education teachers.

The recommended cut scores for each panel, as well as the average cut score across the two panels, are provided to help state departments of education determine an appropriate cut (or passing) score. For the Praxis Technology Education (0051) assessment, the average recommended cut score (rounded up) is 73 (on the raw score metric), which represents 66% of total available 110 raw score points (the recommended cut scores for Panels 1 and 2 are 72 and 74, respectively). The scaled score associated with a raw score of 73 is 159.

Panelists judged the extent to which the knowledge and/or skills reflected by the content specifications were important for entry-level technology education teachers. The favorable judgments of the panelists provided evidence that the content of the assessment is important for beginning practice.

References

- Brandon, P.R. (2004). Conclusions about frequently studied modified Angoff standard-setting topics. *Applied Measurement in Education, 17*, 59-88.
- ETS. (In press). *Technology Education Test at a Glance*. Princeton, NJ.
- Hambleton, R. K., & Pitoniak, M.J. (2006). Setting performance standards. In R. L. Brennan (Ed.), *Educational Measurement* (4th ed., pp. 433-470). Westport, CT: American Council on Education/Praeger.

Appendix A
Panelists' Names & Affiliations

Praxis Technology Education

Panel 1⁵

Panelist

Akers, Ruth
Bishopp, Doug
Christensen, Brad
Doring, Susan A.
Gilliam, Deborah
Huffman, Tanner
Johnson, Jason
Kelley, Todd
Kerr, Janel
Levy, Donna
McCoy, Benjamin Mabe
Neden, Michael
Sansuchat, Dan
Semko, Thomas
Smoot, Michael
Sonnier, Wendy
Wykoff, Matthew V.

Affiliation

Baltimore County Public Schools (MD)
Tripp Middle School (ME)
Berea College (KY)
Paul Laurence Dunbar (KY)
Grambling State University (LA)
Richland School District (PA)
Mukwonago Area School District (WI)
Purdue (IN)
University of Idaho (ID)
Clark County School District (NV)
London High School (OH)
Pittsburg State University (KS)
Granville Middle School (OH)
New Jersey Technology Education Association (NJ)
Jordan Applied Technology Center (UT)
Welsh High School (LA)
Vance High School (NC)

Panel 2

Panelist

Brusic, Sharon
Butler, John M.
Cattanach, Bruce
Day, Gerald
Dischino, Michele
Gensemer, Amy
Hung, Jui-Long
Kalk, Rick
Kaluf, Kevin
Raper, Johnna Shantele
Rigler, Kenny
Roubion, Eric M.
Scott, Kwamina
Shotts, Alan
Ubersox, Ryan J.
Waggoner, Erin

Affiliation

Millersville University (PA)
Dalton L. McMichael High School (NC)
The Lakeview School (NJ)
University of Maryland Eastern Shore (MD)
Central Connecticut State University (CT)
Montgomery County Public Schools (MD)
Boise State University (ID)
Spartanburg School District Five (SC)
Kankakee Valley High School (IN)
Osceola School District and Arkansas Northeastern College (AR)
Fort Hays State University (KS)
Orleans Parish School Board (LA)
Kernersville Middle (NC)
Cody High School (WY)
Waukegan Community High School (WI)
Jessamine County Schools (KY)

⁵ One panelist on Panel 1 declined to have his/her name listed in the technical report.

Appendix B
Workshop Agenda

**Praxis Technology Education Assessment
Standard Setting Study**

Day 1

9:00 – 9:15	Welcome and Introductions
9:15 – 9:45	Overview of Standard Setting & Workshop Events
9:45 – 9:55	Overview of the Praxis Technology Education Assessment
9:55 – 10:00	Break
10:00 – 11:30	“Take” the Praxis Technology Education Assessment
11:30 – 12:00	Discuss the Praxis Technology Education Assessment
12:00 – 12:45	Lunch
12:45 – 3:00	Define the Knowledge/Skills of a JQC
3:00 – 3:05	Break
3:05 – 3:30	Standard Setting Training
3:30 – 5:00	Round 1 Standard Setting Judgments for Questions 1-80
5:00 – 5:15	Collect Materials; End of Day 1

**Praxis Technology Education Assessment
Standard Setting Study**

Day 2

9:00 – 9:15	Overview of Day 2
9:15 – 9:30	Review of the Standard Setting Process
9:30 – 10:30	Round 1 Standard Setting Judgments for Questions 81-120
10:30 – 10:45	Break
10:45 – 12:00	Round 1 Feedback & Round 2 Judgments
12:00 – 1:00	Lunch
1:00 – 2:30	Round 1 Feedback & Round 2 Judgments (continued)
2:30 – 2:45	Break
2:45 – 3:15	Specification Judgments
3:15 – 3:30	Feedback on Round 2 Recommended Cut Score
3:30 – 3:45	Complete Final Evaluation
3:45 – 4:00	Collect Materials; End of Study

Appendix C

Just Qualified Candidate (JQC) Definitions

Description of a Just Qualified Candidate Praxis Technology Education

A JQC ...

- Understands the importance of collaboration and interdisciplinary teaching and demonstrates the relationships in context between technology and other curricular areas
- Understands major concepts, terminology, and uses appropriate tools related to information/communication systems
- Can identify and model key safety concerns and practices
- Can describe and apply the steps of an engineering design process
- Can identify objectives that best address specific national standards
- Understands the basic technology core topics, i.e., power, energy, transportation, manufacturing, communication, information technology, construction
- Understands and applies the systems model
- Understands and utilizes a variety of professional development opportunities and professional and student organization
- Can evaluate a technology and identify its interrelationships with society
- Utilizes multiple instructional strategies and assessments that facilitate student achievement in technology literacy

Appendix D

Results for Praxis Technology Education

Table D1**Panel Member Demographics — Panel 1**

	N	Percent
Current Position		
Teachers	12	67%
Teacher/Administrator	2	11%
College Faculty	4	22%
Race		
White	15	83%
Black or African American	1	6%
Asian or Asian American	1	6%
Other	1	6%
Gender		
Female	6	33%
Male	12	67%
Are you currently certified as a Technology Education teacher in your state?		
Yes	16	89%
No	2	11%
Are you currently teaching Technology Education in your state?		
Yes	14	78%
No	4	22%
Are you currently supervising or mentoring other Technology Education teachers?		
Yes	11	61%
No	7	39%
How many years of experience do you have teaching Technology Education?		
3 years or less	3	17%
4 - 7 years	9	50%
8 - 11 years	2	11%
12 - 15 years	2	11%
16 years or more	2	11%

Table D1 (continued)**Panel Member Demographics — Panel 1**

	N	Percent
At what K-12 grade level are you currently teaching Technology Education?		
Elementary (K - 5 or K - 6)	1	6%
Middle School (6 - 8 or 7 - 9)	3	17%
High School (9 - 12 or 10 - 12)	7	39%
Middle and High School	1	6%
Other	1	6%
Not currently teaching at the K-12 level	5	28%
Which best describes the location of your K-12 school?		
Urban	5	28%
Suburban	3	17%
Rural	6	33%
Not currently working in a K-12 school	4	22%
If you are college faculty, are you currently involved in the training/preparation of Technology Education teachers?		
Yes	4	22%
No	0	0%
Not college faculty	14	78%

Table D2**Panel Member Demographics — Panel 2**

	N	Percent
Current Position		
Teachers	6	38%
Administrator/Department Head	4	25%
College Faculty	5	31%
Technology Integration Specialist	1	6%
Race		
White	13	81%
Black or African American	2	13%
Asian or Asian American	1	6%
Gender		
Female	6	38%
Male	10	63%
Are you currently certified as a Technology Education teacher in your state?		
Yes	11	69%
No	5	31%
Are you currently teaching Technology Education in your state?		
Yes	10	63%
No	6	38%
Are you currently supervising or mentoring other Technology Education teachers?		
Yes	10	63%
No	6	38%
How many years of experience do you have teaching Technology Education?		
3 years or less	2	13%
4 - 7 years	7	44%
8 - 11 years	3	19%
12 - 15 years	1	6%
16 years or more	3	19%

Table D2 (continued)**Panel Member Demographics — Panel 2**

	N	Percent
At what K-12 grade level are you currently teaching Technology Education?		
Elementary (K - 5 or K - 6)		
Middle School (6 - 8 or 7 - 9)	2	13%
High School (9 - 12 or 10 - 12)	3	19%
Middle and High School	1	6%
Other	2	13%
Not currently teaching at the K-12 level	8	50%
Which best describes the location of your K-12 school?		
Urban	1	6%
Suburban	4	25%
Rural	6	38%
Not currently working in a K-12 school	5	31%
If you are college faculty, are you currently involved in the training/preparation of Technology Education teachers?		
Yes	4	25%
No	1	6%
Not college faculty	11	69%

Table D3**Cut score Summary by Round of Judgments — Panel 1**

Panelist	Round 1	Round 2
1	81.85	79.25
2	70.40	69.95
3	73.00	72.60
4	71.55	72.05
5	84.90	84.05
6	76.05	76.55
7	77.85	77.60
8	55.40	56.35
9	70.65	71.80
10	60.30	60.70
11	80.40	74.80
12	69.90	71.00
13	61.85	64.45
14	78.50	75.10
15	77.35	76.85
16	72.20	71.90
17	47.20	58.10
18	82.45	80.40
Average	71.77	71.86
SD	10.01	7.63
SEJ	2.36	1.80
Highest	84.90	84.05
Lowest	47.20	56.35

Table D4**Cut score Summary by Round of Judgments — Panel 2**

Panelist	Round 1	Round 2
1	69.35	70.15
2	75.00	74.50
3	61.50	62.10
4	77.20	77.05
5	78.20	77.80
6	74.05	82.30
7	76.40	78.00
8	57.80	60.30
9	84.60	83.65
10	70.65	73.65
11	77.45	78.40
12	84.85	84.95
13	64.85	69.55
14	58.05	62.55
15	91.00	89.25
16	58.15	58.45
Average	72.44	73.92
SD	10.22	9.35
SEJ	2.56	2.34
Highest	91.00	89.25
Lowest	57.80	58.45

Table D5**Cut Scores within 1 and 2 SEMs of the Recommended Cut Score****(a) Panel 1**

Recommended Cut Score (SEM)		Scale Score Equivalent
	72 (5.01)	158
- 2 SEMs	62	145
-1 SEM	67	151
+1 SEM	78	166
+ 2 SEMs	83	172

(b) Panel 2

Recommended Cut Score (SEM)		Scale Score Equivalent
	74 (4.94)	160
- 2 SEMs	65	149
-1 SEM	70	155
+1 SEM	79	167
+ 2 SEMs	84	173

(c) Combined Across Panels

Recommended Cut Score (SEM)		Scale Score Equivalent
	73 (4.98)	159
- 2 SEMs	64	147
-1 SEM	69	154
+1 SEM	78	166
+ 2 SEMs	83	172

Note. Consistent with the recommended cut score, the cut scores at the different SEMs have been rounded to the next highest whole number.

Table D6

Specification Judgments — Combined Across Panels

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
I. Technology and Society	12	35%	21	62%	1	3%	0	0%
• Understands the nature of technology, technology education, and technological literacy.	23	68%	10	29%	1	3%	0	0%
• Understands how invention and innovation occur, how they are influenced by cultural and economic factors, and how they are built on existing technologies.	13	38%	21	62%	0	0%	0	0%
• Understands how technological development is influenced by knowledge from other fields of study, especially mathematics and the sciences.	20	59%	14	41%	0	0%	0	0%
• Understands the influence that significant technological innovations have had on human history and on today's world.	8	24%	17	50%	9	26%	0	0%
• Understands critical changes in technology through the different periods of human history.	5	15%	23	68%	6	18%	0	0%
• Understands how various factors affect technology development.	7	21%	23	68%	4	12%	0	0%
• Understands the impacts of technology on society and on social institutions such as the family and the political system.	16	47%	14	41%	4	12%	0	0%
• Understands ways to decrease the negative environmental impact of technological systems and processes and knows how to evaluate trade-offs with respect to different approaches.	13	38%	19	56%	2	6%	0	0%
• Understands the relationships between engineering, mathematics, science, and technology.	26	76%	8	24%	0	0%	0	0%

Table D6 (continued)

Specification Judgments — Combined Across Panels

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
II. Technological Design and Problem Solving	27	79%	7	21%	0	0%	0	0%
• Understands how to implement and document the steps of a design process.	29	85%	5	15%	0	0%	0	0%
• Knows how to select and use tools—especially software—in a design process, including the creation, testing, evaluation, and communication of solutions.	17	50%	16	47%	1	3%	0	0%
• Understands how to identify a problem and define design requirements (criteria and constraints).	23	68%	9	26%	2	6%	0	0%
• Knows how to generate possible solutions to design problems and how to select, develop, and refine design proposals, using analysis and creativity.	20	59%	14	41%	0	0%	0	0%
• Knows how to evaluate, test, and optimize designs, using specifications, design principles, modeling, experimentation, and prototyping.	20	59%	12	35%	2	6%	0	0%
• Understands how to organize and communicate the solution to a design problem.	20	59%	13	38%	1	3%	0	0%
• Understands systems thinking and knows how to model it for students.	19	56%	13	38%	2	6%	0	0%
• Understands there is no such thing as a perfect design and that making design decisions involves balancing trade-offs.	13	38%	20	59%	1	3%	0	0%

Table D6 (continued)

Specification Judgments — Combined Across Panels

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
• Knows how to operate, maintain, and troubleshoot technological systems.	12	35%	18	53%	4	12%	0	0%
• Knows how to apply the design process to systems and problems in energy, power, and transportation.	14	41%	20	59%	0	0%	0	0%
• Knows how to apply the design process to problems in information technology and communications technology.	15	44%	16	47%	3	9%	0	0%
• Knows how to apply the design process to problems in manufacturing and construction.	16	47%	15	44%	3	9%	0	0%
III. Energy, Power, and Transportation	8	24%	23	68%	3	9%	0	0%
• Understands and knows how to utilize various types of control.	9	26%	21	62%	4	12%	0	0%
• Knows how to apply mathematical and scientific principles to solve problems involving the harness, transfer, loss, transmission, and conversion of power and energy.	11	32%	22	65%	1	3%	0	0%
• Understands energy utilization systems.	6	18%	20	59%	8	24%	0	0%
• Knows the inputs used in transportation systems.	4	12%	18	53%	12	35%	0	0%
• Understands the components of vehicles and support systems, including infrastructures and subsystems for propulsion, suspension, control, and guidance.	4	12%	18	53%	12	35%	0	0%
• Understands the different processes involved in transportation operations, along with the part each process plays in the efficiency of the overall system.	2	6%	19	56%	13	38%	0	0%

Table D6 (continued)

Specification Judgments — Combined Across Panels

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
• Understands the different forms of energy and the differences between them.	20	59%	14	41%	0	0%	0	0%
• Understands and can model the relationship between energy, power, and work.	11	32%	18	53%	5	15%	0	0%
• Knows how energy is measured and controlled.	9	26%	19	56%	6	18%	0	0%
• Knows how to apply concepts of energy and power to solve problems related to them.	12	35%	21	62%	1	3%	0	0%
• Knows the different ways power is generated and used, including their differences in efficiency and impact on the environment.	11	32%	20	59%	3	9%	0	0%
• Knows and applies safety practices related to working with energy and power.	28	82%	5	15%	1	3%	0	0%
IV. Information and Communication Technologies	12	35%	17	50%	5	15%	0	0%
• Understands major concepts and terminology related to information systems.	19	56%	11	32%	4	12%	0	0%
• Given a communications problem or task, can identify and knows how to use appropriate tools and materials, especially software and hardware, to address it.	14	41%	18	53%	2	6%	0	0%
• Knows how to use operating systems, software applications, communication devices, and networking components in the classroom/laboratory.	12	35%	16	47%	6	18%	0	0%
• Recognizes the various types of network structures.	2	6%	8	24%	21	62%	3	9%
• Understands the concepts that make up a communications system.	8	24%	20	59%	6	18%	0	0%

Table D6 (continued)

Specification Judgments — Combined Across Panels

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
• Understands concepts and terminology related to audio, video, electronic, data, technical, and graphic communications.	2	6%	25	74%	7	21%	0	0%
• Knows how to arrange the elements of a communication message so that the message is effective and aesthetically pleasing.	7	21%	18	53%	9	26%	0	0%
• Knows the impacts of communication technology and media on society and culture.	7	21%	19	56%	7	21%	1	3%
• Understands legal and ethical issues regarding the use of communications and information technologies.	21	62%	10	29%	3	9%	0	0%
• Knows issues and trends in information and communications technologies.	6	18%	23	68%	5	15%	0	0%
V. Manufacturing and Construction Technologies	7	21%	23	68%	4	12%	0	0%
• Knows the management functions used in construction and manufacturing.	7	21%	20	59%	7	21%	0	0%
• Knows how to apply a systems model to manufacturing and construction processes.	18	53%	13	38%	3	9%	0	0%
• Knows the key concepts associated with the efficiency of production.	9	26%	18	53%	7	21%	0	0%
• Understands the differences between manufacturing systems.	4	12%	19	56%	11	32%	0	0%
• Knows the variety and properties of materials used in the manufacture of products and can evaluate the suitability of material to different manufacturing purposes.	7	21%	21	62%	6	18%	0	0%

Table D6 (continued)

Specification Judgments — Combined Across Panels

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
<ul style="list-style-type: none"> Knows the primary processing methods of converting raw materials into industrial materials or standard stock and the secondary processing methods of converting industrial materials into finished products. 	8	24%	18	53%	8	24%	0	0%
<ul style="list-style-type: none"> Understands the key concepts and terminology related to construction. 	16	47%	12	35%	6	18%	0	0%
<ul style="list-style-type: none"> Knows the variety and properties of materials used in the construction of structures and can evaluate the suitability of material to different construction purposes. 	9	26%	19	56%	6	18%	0	0%
<ul style="list-style-type: none"> Understands the numerous constraints on structural designs, such as building codes, cost, and function. 	8	24%	15	44%	10	29%	1	3%
<ul style="list-style-type: none"> Knows the systems and subsystems of buildings and structures and the functions they perform. 	3	9%	20	59%	10	29%	1	3%
<ul style="list-style-type: none"> Understands static and dynamic loads and how they produce forces that affect stability and failure in a structure. 	11	32%	14	41%	9	26%	0	0%
<ul style="list-style-type: none"> Understands the variety of processes used in construction, including on-site and prefabricated techniques. 	4	12%	16	47%	14	41%	0	0%
VI. Pedagogical and Professional Studies	29	85%	5	15%	0	0%	0	0%
<ul style="list-style-type: none"> For a technology education program, knows how to create and implement a curriculum based on state and national standards. 	25	74%	8	24%	1	3%	0	0%

Table D6 (continued)**Specification Judgments — Combined Across Panels**

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
• Knows how to select appropriate instructional content and develop learning activities.	29	85%	5	15%	0	0%	0	0%
• Knows how to choose, adapt, and implement instructional strategies appropriate to both the content and the level at which the content is being taught.	27	79%	7	21%	0	0%	0	0%
• Understands the importance of designing and implementing instructional activities that emphasize problem solving.	25	74%	9	26%	0	0%	0	0%
• Knows how to apply appropriate instructional technology equipment, materials, processes, and tools to enhance teaching and to actively engage students in learning.	19	56%	14	41%	1	3%	0	0%
• Knows how to select and use a variety of assessment methods to monitor and evaluate both student learning and instructional effectiveness.	20	59%	14	41%	0	0%	0	0%
• Knows how to create and maintain a safe and healthy learning environment.	31	91%	3	9%	0	0%	0	0%
• Is aware of the relationship between classroom learning and student organizations.	5	15%	18	53%	11	32%	0	0%
• Understands the relationship between technology education programs and advisory committees.	6	18%	12	35%	12	35%	4	12%
• Knows how to modify instructional activities and methods to address students' diverse needs.	23	68%	10	29%	1	3%	0	0%
• Understands the importance of promoting technology education internally and externally.	11	32%	16	47%	6	18%	1	3%

Table D6 (continued)**Specification Judgments — Combined Across Panels**

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
• Understands the importance of becoming involved in professional associations and organizations related to technology education.	5	15%	21	62%	7	21%	1	3%
• Understands the importance of the professional growth of the technology education teacher via formal instruction, in-service activities, and professional association meetings.	10	29%	20	59%	3	9%	1	3%
• Is familiar with current educational policy, legislation, and funding opportunities.	7	21%	12	35%	13	38%	2	6%
• Is familiar with opportunities for further education and careers.	8	24%	11	32%	13	38%	2	6%
• Is aware of the history, issues, and trends related to technology education.	6	18%	16	47%	12	35%	0	0%
• Is familiar with the management of resources, records, and budgets.	10	29%	15	44%	8	24%	1	3%
• Recognizes the importance of collaborating with other school faculty to design instruction that integrates knowledge and skills from other core academic subject areas into instruction in technology.	20	59%	13	38%	1	3%	0	0%

Table D7**Final Evaluation — Panel 1**

	Strongly Agree		Agree		Disagree		Strongly Disagree	
	N	Percent	N	Percent	N	Percent	N	Percent
• I understood the purpose of this study.	15	83%	3	17%	0	0%	0	0%
• The instructions and explanations provided by the facilitators were clear.	14	78%	4	22%	0	0%	0	0%
• The training in the standard setting method was adequate to give me the information I needed to complete my assignment.	13	72%	5	28%	0	0%	0	0%
• The explanation of how the recommended cut score is computed was clear.	10	56%	8	44%	0	0%	0	0%
• The opportunity for feedback and discussion between rounds was helpful.	15	83%	2	11%	1	6%	0	0%
• The process of making the standard setting judgments was easy to follow.	10	56%	7	39%	1	6%	0	0%

Table D7 (continued)

Final Evaluation — Panel 1

How influential was each of the following factors in guiding your standard setting judgments?	Very Influential		Somewhat Influential		Not Influential			
	N	Percent	N	Percent	N	Percent		
• The definition of the JQC	15	83%	2	11%	1	6%		
• The between-round discussions	8	47%	8	47%	1	6%		
• The knowledge/skills required to answer each test question	10	56%	8	44%	0	0%		
• The cut scores of other panel members	3	18%	10	59%	4	24%		
• My own professional experience	16	89%	2	11%	0	0%		
	Very Comfortable		Somewhat Comfortable		Somewhat Uncomfortable		Very Uncomfortable	
	N	Percent	N	Percent	N	Percent	N	Percent
• Overall, how comfortable are you with the panel's recommended cut scores?	11	61%	5	28%	1	6%	1	6%
	Too Low		About Right		Too High			
	N	Percent	N	Percent	N	Percent		
• Overall, the recommended cut score is:	0	0%	18	100%	0	0%		

Table D8**Final Evaluation — Panel 2**

	Strongly Agree		Agree		Disagree		Strongly Disagree	
	N	Percent	N	Percent	N	Percent	N	Percent
• I understood the purpose of this study.	15	94%	1	6%	0	0%	0	0%
• The instructions and explanations provided by the facilitators were clear.	11	69%	5	31%	0	0%	0	0%
• The training in the standard setting method was adequate to give me the information I needed to complete my assignment.	12	75%	4	25%	0	0%	0	0%
• The explanation of how the recommended cut score is computed was clear.	13	81%	3	19%	0	0%	0	0%
• The opportunity for feedback and discussion between rounds was helpful.	12	75%	4	25%	0	0%	0	0%
• The process of making the standard setting judgments was easy to follow.	10	63%	6	38%	0	0%	0	0%

Table D8 (continued)

Final Evaluation — Panel 2

How influential was each of the following factors in guiding your standard setting judgments?	Very Influential		Somewhat Influential		Not Influential			
	N	Percent	N	Percent	N	Percent		
• The definition of the JQC	13	81%	3	19%	0	0%		
• The between-round discussions	6	38%	10	63%	0	0%		
• The knowledge/skills required to answer each test question	10	63%	6	38%	0	0%		
• The cut scores of other panel members	0	0%	9	60%	6	40%		
• My own professional experience	13	81%	3	19%	0	0%		
	Very Comfortable		Somewhat Comfortable		Somewhat Uncomfortable		Very Uncomfortable	
	N	Percent	N	Percent	N	Percent	N	Percent
• Overall, how comfortable are you with the panel's recommended cut scores?	9	56%	6	38%	1	6%	0	0%
	Too Low		About Right		Too High			
	N	Percent	N	Percent	N	Percent		
• Overall, the recommended cut score is:	2	13%	14	88%	0	0%		

ETS continues to update the Praxis II assessments through the test regeneration process. When this process results in substantial changes to the assessment, another standard setting study is required.

Summary of Major Elements

To support the decision-making process for the Virginia Department of Education with regards to establishing a passing score, or cut score, for the Praxis Art: Content Knowledge assessment (0134), research staff from Educational Testing Service (ETS) designed and conducted a standard setting study. The study also collected content-related validity evidence to confirm the importance of the content specifications for entry-level art teachers.

The study involved an expert panel comprised of teachers, administrators and college faculty. The VDOE recommended panelists with (a) art education experience, either as art teachers or college faculty who prepare art teachers, and (b) familiarity with the knowledge and skills required of beginning art teachers.

The panel was convened on November 17, 2010, in Richmond, Virginia. The attached technical report (Appendix A) is divided into three sections. The first section describes the content and format of the assessment. The second section describes the standard setting processes and methods used. The third section presents the results of the standard setting study.

In addition, research staff from the Educational Testing Service (ETS) designed and conducted two multi-state standard setting studies in November 2010. The studies also collected content-related validity evidence to confirm the importance of the content specifications for entry-level Art teachers. The attached technical report (Appendix B) details the work of the multi-state committees.

The *Praxis Art: Content Knowledge Test at a Glance* document (ETS, in press) describes the purpose and structure of the assessment. In brief, the assessment measures whether entry-level art teachers have the knowledge believed necessary for competent professional practice. A National Advisory Committee of expert practitioners and preparation faculty defined the content of the assessment, and a national survey of the field confirmed the content.

The two hour assessment contains 120 multiple-choice questions covering *Art Making – General* (approximately 15 questions); *Art Making – Media & Processes* (approximately 61 questions); *Materials & Processes in a Historical Context and Responding to Art* (approximately 17 questions); and *Western Tradition and Beyond the Western Tradition* (approximately 27 questions).

Candidate scores are reported as an overall score; four category scores – one for each content area listed above – also are reported. Of the 120 multiple-choice questions, 110 questions contribute to a candidate's score. (Ten of the 120 multiple-choice questions are pretest questions which do not contribute to the candidate's score.) The maximum total number of raw points that may be earned on each assessment is 110. The reporting scale for the Praxis Art: Content Knowledge Assessment (0134) ranges from 100 to 200 scaled-score points. The first national administration of the Praxis Art: Content Knowledge Assessment will occur in fall 2011.

The process used in the Virginia standard setting study is detailed in Appendix A. The panel recommended a cut score of 69. The value of 69 represents approximately 63 percent of the total available 110 raw points that could be earned on the Praxis Art: Content Knowledge Assessment. The scaled score associated with 69 raw points is 154.

A similar process was used in the multi-state standard setting studies as described in Appendix B. The average recommended cut score recommendations for the Praxis Art: Content Knowledge Assessment (rounded up) is 72 (on the raw score metric), which represents 65 percent of the total available 110 raw score points (the recommended cut scores for Panels 1 and 2 are 73 and 71, respectively). The scaled score associated with a raw score of 72 is 158.

When reviewing the Standard Error of Measurement (SEM) for the cut scores recommended by the Virginia Standard Setting Study as well as the Multi-State Studies, there is an overlap in the scaled scores. The SEM is a statistical phenomenon and is unrelated to the accuracy of scoring. All test results are subject to the standard error of measurement. If a test-taker were to take the same test repeatedly, with no change in his level of knowledge and preparation, it is possible that some of the resulting scores would be slightly higher or slightly lower than the score that precisely reflects the test-taker's actual level of knowledge and ability. The difference between a test-taker's actual score and his highest or lowest hypothetical score is known as the standard error of measurement. The Standard Error of Measurement for the recommended cut scores for the Virginia Standard Setting Study and the Multi-State Studies are shown on the next page. Note that consistent with the recommended cut score, the cut scores at the different SEMs have been rounded to the next highest whole number.

Standard Error of Measure Summaries -- Art: Content Knowledge (0134)

Table 1

Cut Scores within 1 and 2 SEMs of the Recommended Cut Score
Art: Content Knowledge -- Virginia

Recommended Cut Score (SEM)	Scale Score Equivalent	
	69 (5.11)	154
-2 SEMs	59	141
-1 SEM	64	147
+1 SEM	75	162
+2 SEMs	80	168

Table 2

Cut Scores within 1 and 2 SEMs of the Recommended Cut Score
Art: Content Knowledge -- Multi-State Studies

Panel 1:

Recommended Cut Score (SEM)	Scale Score Equivalent	
	73 (4.98)	159
-2 SEMs	64	147
-1 SEM	69	154
+1 SEM	78	166
+2 SEMs	83	172

Panel 2:

Recommended Cut Score (SEM)		Scale Score Equivalent
	71 (5.04)	156
-2 SEMs	61	144
-1 SEM	66	150
+1 SEM	77	164
+2 SEMs	82	171

Combined Across Panels:

Recommended Cut Score (SEM)		Scale Score Equivalent
	72 (5.01)	158
-2 SEMs	62	145
-1 SEM	67	151
+1 SEM	78	166
+2 SEMs	83	172

Note. Consistent with the recommended cut score, the cut scores at the different SEMs have been rounded to the next highest whole number.

On January 24, 2011, the Advisory Board for Teacher Education and Licensure (ABTEL) recommended that the Board of Education set a cut score of 158 for the Praxis Art: Content Knowledge Assessment (0134) for individuals seeking an initial license with an endorsement in Visual Arts PreK-12. The revised assessment will be offered after September 1, 2011.

Superintendent's Recommendation:

The Superintendent of Public Instruction recommends that the Board of Education receive for first review the Advisory Board on Teacher Education and Licensure's recommendation to set a cut score of 158 for the Praxis Art: Content Knowledge Assessment (0134) for individuals seeking an initial license with an endorsement in Visual Arts PreK-12.

Impact on Resources:

Costs associated with the administration of the Praxis Art: Content Knowledge Assessment (0134) will be incurred by the Educational Testing Service. Prospective teachers seeking an initial Virginia license with an endorsement in Visual Arts PreK-12 will be required to pay the registration and test fees.

Timetable for Further Review/Action:

This item will be presented to the Board of Education for final review on March 24, 2011.



Listening. Learning. Leading.

Standard Setting Technical Report

PRAXIS ART: CONTENT KNOWLEDGE (0134)

Prepared for the Virginia Department of Education

Educational and Credentialing Research

Educational Testing Service

Princeton, New Jersey

November 2010

Executive Summary

To support the decision-making process for the Virginia Department of Education (VDOE) with regards to establishing a passing score, or cut score, for the Praxis Art: Content Knowledge (0134) assessment, research staff from Educational Testing Service (ETS) designed and conducted a standard setting study on November 17, 2010. The study also collected content-related validity evidence to confirm the importance of the content specifications for entry-level art teachers.

Recommended Cut Scores

The recommended cut score is provided to help the VDOE determine an appropriate cut (or passing) score. For the Praxis Art: Content Knowledge (0134) assessment, the average recommended cut score is 69 (on the raw score metric), which represents 63% of total available 110 raw score points. The scaled score associated with a raw score of 69 is 154.

Summary of Content Specification Judgments

Panelists judged the extent to which the knowledge and/or skills reflected by the content specifications were important for entry-level art teachers. The favorable judgments of the panelists provided evidence that the content of the assessment is important for beginning practice.

To support the decision-making process for the Virginia Department of Education (VDOE) with regards to establishing a passing score, or cut score, for the Praxis Art: Content Knowledge (0134) assessment, research staff from Educational Testing Service (ETS) designed and conducted a standard setting study. The study also collected content-related validity evidence to confirm the importance of the content specifications for entry-level art teachers.

The study involved an expert panel, comprised of teachers, administrators and college faculty. The VDOE recommended panelists with (a) art education experience, either as art teachers or college faculty who prepare art teachers and (b) familiarity with the knowledge and skills required of beginning art teachers.

The panel was convened on November 17, 2010, in Richmond, Virginia. The following technical report is divided into three sections. The first section describes the content and format of the assessment. The second section describes the standard setting processes and methods used. The third section presents the results of the standard setting study.

The passing score recommendation for the Praxis Art: Content Knowledge (0134) assessment is provided to the VDOE. The VDOE is responsible for establishing the final passing score in accordance with applicable state regulations. The study provides a recommended passing score, which represents the combined judgments of one group of experienced educators. The full range of the VDOE's needs and expectations could not be represented during the standard setting study. The VDOE, therefore, may want to consider both the panel's recommended cut score and other sources of information when setting the final Praxis Art: Content Knowledge (0134) cut score (Geisinger & McCormick, 2010). Other kinds of information may provide reasons for the VDOE to adjust the recommended cut score. The recommended cut score may be accepted, adjusted upward to reflect more stringent expectations, or adjusted downward to reflect more lenient expectations. There is no *correct* decision; the appropriateness of any adjustment may only be evaluated in terms of its meeting the VDOE's needs.

Two critical sources of information to consider when setting the cut score are the standard error of measurement (SEM) and the standard error of judgment (SEJ). The former addresses the reliability of Praxis Art: Content Knowledge (0134) scores and the latter the reliability of panelists' cut score recommendations. The SEM allows the VDOE to recognize that a Praxis Art: Content Knowledge (0134) score—any test score on any test—is less than perfectly reliable. A test score only approximates

what a candidate *truly* knows or *truly* can do on the test. The SEM, therefore, addresses the question: How close of an approximation is the test score to the *true* score? The SEJ allows the VDOE to consider the likelihood that the recommended cut score from the current panel would be similar to cut scores recommended by other panels of experts similar in composition and experience. The smaller the SEJ, the more likely that another panel would recommend a cut score consistent with the recommended cut score. The larger the SEJ, the less likely the recommended cut score would be reproduced by another panel.

In addition to measurement error metrics (e.g., SEM, SEJ), the VDOE should consider the likelihood of classification error. That is, when adjusting a cut score, policymakers should consider whether it is more important to minimize a false positive decision or to minimize a false negative decision. A false positive decision occurs when a candidate's test score suggests he should receive a license/certificate, but his actual knowledge/skill level is lower (i.e., the candidate does not possess the required knowledge/skills). A false negative occurs when a candidate's test score suggests that she should not receive a license/certificate, but she actually does possess the required knowledge/skills. The VDOE needs to consider which decision error to minimize; it is not possible to eliminate both types of decision errors simultaneously.

Overview of the Praxis Assessment

The *Praxis Art: Content Knowledge Test at a Glance* document (ETS, in press) describes the purpose and structure of the assessment. In brief, the assessment measures whether entry-level art teachers have the knowledge believed necessary for competent professional practice. A National Advisory Committee of expert practitioners and preparation faculty defined the content of the assessment, and a national survey of the field confirmed the content.

The two hour assessment contains 120 multiple-choice questions covering *Art Making- General* (approximately 15 questions); *Art Making – Media & Processes* (approximately 61 questions); *Materials & Processes in a Historical Context and Responding to Art* (approximately 17 questions); and *Western Tradition and Beyond the Western Tradition* (approximately 27 questions)¹.

¹ The number of questions for each content area may vary slightly from form to form of the assessment.

Candidate scores are reported as an overall score; four category scores – one for each content area listed above – also are reported. Of the 120 multiple-choice questions, 110 questions contribute to a candidate’s score². The maximum total number of raw points that may be earned on each assessment is 110. The reporting scale for the Praxis Art: Content Knowledge (0134) assessment ranges from 100 to 200 scaled-score points.

Processes and Methods

The following section describes the processes and methods used to train panelists, gather panelists’ judgments and to calculate recommended passing scores, or cut scores. (The agenda for the panel meeting is presented in the Appendix.)

The panelists were sent an e-mail explaining the purpose of the standard-setting study and requesting that they review the test content specifications for the assessment (included in the *Test at a Glance* document, which was attached to the e-mail). The purpose of the review was to familiarize the panelists with the general structure and content of the assessment.

The standard-setting study began with a welcome and introduction by James Lanham, from the VDOE. The ETS facilitator then explained how the assessment was developed, provided an overview of standard setting, and presented the agenda for the study.

Reviewing the Assessment

The first activity was for the panelists to “take the test.” (Each panelist had signed a nondisclosure form.) The panelists were given approximately an hour and a half to respond to the multiple-choice questions. The purpose of “taking the test” was for the panelists to become familiar with the test format, content, and difficulty. After “taking the test,” the panelists were given the answer key for the assessment and checked their responses. How well the panelists did on the assessment was not shared with the panel.

The panelists then engaged in a discussion of the major content areas being addressed by the assessment; they were also asked to remark on any content areas that they thought would be particularly challenging for entering art teachers, and areas that addressed content that would be particularly important for entering teachers.

² Ten of the 120 multiple-choice questions are pretest questions which do not contribute to a candidate’s score.

Defining the Just Qualified Candidate

Following the review of the assessment, panelists internalized the definition of the Just Qualified Candidate (JQC). The JQC is the test taker who has the minimum level of knowledge and/or skills believed necessary to be a qualified art teacher. The JQC definition is the operational definition of the cut score. The goal of the standard-setting process is to identify the test score that aligns with this definition of the JQC.

The panelists were split into smaller groups, and each group was asked to write down their definition of a JQC. Each group referred to *Praxis Art: Content Knowledge Test at a Glance* to guide their definition. Each group posted its definition on chart paper, and a full-panel discussion occurred to reach consensus on a final definition (see the consensus JQC definition in the Appendix).

Panelists' Judgments

The standard-setting process for the Praxis Art: Content Knowledge (0134) assessment was conducted for the overall test. A probability-based Angoff method (Brandon, 2004; Hambleton & Pitoniak, 2006) was used. In this approach, for each multiple-choice question, a panelist decides on the likelihood (probability or chance) that a JQC would answer it correctly. Panelists made their judgments using the following rating scale: 0, .05, .10, .20, .30, .40, .50, .60, .70, .80, .90, .95, 1. The lower the value, the less likely it is that a JQC would answer the question correctly, because the question is difficult for the JQC. The higher the value, the more likely it is that a JQC would answer the question correctly.

The panelists were asked to approach the judgment process in two stages. First, they reviewed the definition of the JQC and the question and decided if, overall, the question was difficult for the JQC, easy for the JQC, or moderately difficult/easy. The facilitator encouraged the panelists to consider the following rule of thumb to guide their decision:

- difficult questions for a JQC were in the 0 to .30 range;
- moderately difficult/easy questions for a JQC were in the .40 to .60 range; and
- easy questions for a JQC were in the .70 to 1 range.

The second decision was for panelists to decide how they wanted to refine their judgment within the range. For example, if a panelist thought that a question was easy for a JQC, the initial decision

located the question in the .70 to 1 range. The second decision was for the panelist to decide if the likelihood of answering it correctly was .70, .80, .90, .95, or 1.0. The two-stage decision-process was implemented to reduce the cognitive load placed on the panelists. The panelists practiced making their standard-setting judgments on the first five questions.

Judgment of Content Specifications

In addition to the standard setting process, the panel judged the importance of the knowledge and/or skills stated or implied in the assessment content specifications for the job of an entry-level art teacher. These judgments addressed the perceived content-based validity of the assessment. Judgments were made using a four-point Likert scale — *Very Important*, *Important*, *Slightly Important*, and *Not Important*. Each panelist independently judged the knowledge categories and knowledge/skills statements.

Results

Expert Panels

The standard setting study included an expert panel. The VDOE recruited panelists to represent a range of professional perspectives. A description of the panel is presented below. (See Appendix for a listing of panelists.)

The panel included 13 teachers, administrators, and college faculty who prepare art teachers. In brief, ten panelists were teachers, two were college faculty, and one was both an administrator and college faculty. All the panelists who were college faculty were currently involved in the training or preparation of art teachers. Nine panelists were White, two were African American, and two were Asian American. Seven panelists were female. Eleven panelists reported being certified art teachers in Virginia. The majority of panelists (7 of the 13 panelists or 54%) had 11 or fewer years of experience as an art teacher, and approximately a third (5 of the 13 panelists or 38%) had 16 or more years of teaching experience.

A fuller demographic description for the members of the panel is presented in Table 1.

Table 1***Panel Member Demographics***

	N	Percent
Current Position		
Teachers	10	77%
College Faculty	2	15%
Administrator/College Faculty	1	8%
Race		
White	9	69%
Black or African American	2	15%
Asian American	2	15%
Gender		
Female	7	54%
Male	6	46%
Are you currently certified as an art teacher in Virginia?		
Yes	11	85%
No	2	15%
Are you currently teaching art in Virginia?		
Yes	12	92%
No	1	8%
Are you currently supervising or mentoring other art teachers?		
Yes	6	46%
No	7	54%
How many years of experience do you have teaching art?		
3 years or less	0	0%
4 - 7 years	3	23%
8 - 11 years	4	31%
12 - 15 years	1	8%
16 years or more	5	38%

Table 1 (continued)***Panel Member Demographics***

	N	Percent
At what K-12 grade level are you currently teaching art?		
Elementary (K - 5 or K - 6)	3	23%
Middle School (6 - 8 or 7 - 9)	1	8%
High School (9 - 12 or 10 - 12)	5	38%
Middle and High School	1	8%
Not currently teaching at the K-12 level	3	23%
Which best describes the location of your K-12 school?		
Urban	3	23%
Suburban	2	15%
Rural	5	38%
Not currently teaching at the K-12 level	3	23%
If you are college faculty, are you currently involved in the training/preparation of art teachers?		
Yes	3	23%
No	0	0%
Not college faculty	10	77%

Initial Evaluation Forms.

The panelists completed an initial evaluation after receiving training on how to make question-level judgments. The primary information collected from this form was the panelists indicating if they had received adequate training to make their standard-setting judgments and were ready to proceed. All panelists indicated that they were prepared to make their judgments.

Summary of Standard Setting Judgments

A summary of the standard-setting judgments is presented in Table 2. The numbers in the table reflect the recommended cut scores — the number of raw points needed to “pass” the assessment — of each panelist. The panel’s average recommended cut score and highest and lowest cut scores are reported, as are the standard deviations (SD) of panelists’ cut scores and the standard errors of judgment (SEJ). The SEJ is one way of estimating the reliability of the judgments. It indicates how likely it would be for other panels of educators similar in make-up, experience, and standard-setting training to the

current panel to recommend the same cut score on the same form of the assessment. A comparable panel’s cut score would be within 1 SEJ of the current average cut score 68 percent of the time and within 2 SEJs 95 percent of the time.

The panel’s cut score recommendation for the Praxis Art: Content Knowledge (0134) assessment is 68.43 (see Table 2). The value was rounded to 69, the next highest whole number, to determine the functional recommended cut score. The value of 69 represents approximately 63% of the total available 110 raw-score points that could be earned on the assessment. The scaled score associated with 69 raw points is 154.

Table 2
Summary of Standard Setting Judgments

Panelist	Cut Score
1	69.25
2	72.65
3	59.70
4	76.60
5	74.50
6	88.20
7	52.60
8	68.45
9	82.25
10	70.15
11	46.45
12	68.35
13	60.50
Average	68.43
SD	11.47
SEJ	3.18
Highest	88.20
Lowest	46.45

Table 3 presents the estimated standard errors of measurement (SEM) around the recommended cut score. A standard error represents the uncertainty associated with a test score. The scaled scores associated with 1 and 2 SEMs above and below the recommended cut scores are provided. The standard

errors provided are an estimate, given that the Praxis Art: Content Knowledge (0134) assessment has not yet been administered.

Table 3

Cut Scores within 1 and 2 SEMs of the Recommended Cut Score

Recommended Cut Score (SEM)		Scale Score Equivalent
	69 (5.11)	154
- 2 SEMs	59	141
-1 SEM	64	147
+1 SEM	75	162
+ 2 SEMs	80	168

Note. Consistent with the recommended cut score, the cut scores at the different SEMs have been rounded to the next highest whole number.

Summary of Content Specification Judgments.

Panelists judged the extent to which the knowledge and/or skills reflected by the Praxis Art: Content Knowledge (0134) assessment content specifications were important for entry-level art teachers. Panelists rated the knowledge categories and knowledge/skills statements on a four-point scale ranging from *Very Important* to *Not Important*. The panelists’ ratings are summarized in Table 4 (in Appendix).

Eleven of the 16 knowledge categories were judged to be *Very Important* or *Important* by 76% or more of the panelists. The knowledge categories of “*Understands and applies the elements of art and principles of visual organization*” and “*Knows and understands safety, environmental, and storage issues*” (77% of the panelists judged as *Very Important*) were seen as the most important for beginning art teachers. The knowledge category of “*Understand materials, tools and processes for videography, filmmaking, and installations*” (62% of the panelists judged as *Slightly Important* or *Not Important*) was seen as less important for beginning art teachers. All but 16 of the 70 knowledge statements covered by the Praxis Art: Content Knowledge (0134) assessment were judged to be *Very Important* or *Important* by at least two-thirds of the panelists.

Summary of Final Evaluations.

The panelists completed an evaluation form at the conclusion of their standard setting study. The evaluation form asked the panelists to provide feedback about the quality of the standard-setting implementation. Table 5 (in Appendix) present the results of the final evaluations.

All panelists *agreed* or *strongly agreed* that they understood the purpose of the study and that the facilitator's instructions and explanations were clear. All panelists *agreed* or *strongly agreed* that they were prepared to make their standard setting judgments. Approximately 85% of the panelists *strongly agreed* that the standard-setting process was easy to follow.

Summary

To support the decision-making process for the Virginia Department of Education (VDOE) with regards to establishing passing score, or cut score, for Praxis Art: Content Knowledge (0134) assessment, research staff from Educational Testing Service (ETS) designed and conducted a standard setting study. The study also collected content-related validity evidence to confirm the importance of the content specifications for entry-level art teachers.

The recommended cut score is provided to help the VDOE determine an appropriate cut (or passing) score. For Praxis Art: Content Knowledge (0134), the average recommended cut score is 69 (on the raw score metric), which represents 63% of total available 110 raw score points. The scaled score associated with a raw score of 69 is 154.

Panelists judged the extent to which the knowledge and/or skills reflected by the content specifications were important for entry-level art teachers. The favorable judgments of the panelists provided evidence that the content of the assessment is important for beginning practice.

References

- Brandon, P.R. (2004). Conclusions about frequently studied modified Angoff standard-setting topics. *Applied Measurement in Education, 17*, 59-88.
- ETS. (In press). *Art: Content Knowledge Test at a Glance*. Princeton, NJ.
- Geisinger, K.F., & McCormick, C.A. (2010). Adopting cut scores: Post-standard-setting panel considerations for decision makers. *Educational Measurement: Issues and Practice, 29*, 38–44.
- Hambleton, R. K., & Pitoniak, M.J. (2006). Setting performance standards. In R. L. Brennan (Ed.), *Educational Measurement* (4th ed., pp. 433-470). Westport, CT: American Council on Education/Praeger.

Appendix

Panelists' Names & Affiliations

Panelist

Al Choo Ashe

Richard J. Bay

Margaret C. Bowen

Kimberly Gibson-McDonald

Al Harris

Trish M. Harris

Patricia S. Herring

Robert S. Hunter

Angel D. Jones

Cynthia B. Redman

Geoffrey Rowland

Aaron Stratten

Edward Young

Affiliation

Hampton City Schools

Radford University

Christopher Newport University

Lynchburg City Schools

Norfolk Public Schools

Henrico County Public Schools

Nottoway County Public Schools

Colonial Beach Public Schools

Norfolk Public Schools

Warren County Public Schools

Montgomery County Public Schools

Fairfax County Public Schools

Russell County Public Schools

Agenda: VISUAL ARTS (K-12) PANEL

Wednesday, November 17, 2010

8:00 am	Registration and Breakfast
8:30 am	Welcome and Introduction
8:50 am	Overview of Study
9:20 am	Take the Test and Self-Score
10:50 am	BREAK
11:00 am	Discuss the Test Content
11:30 am	Discuss the Just Qualified Candidate (JQC)
Noon	LUNCH
12:45 pm	Define the Just Qualified Candidate (JQC) - Continued
1:30 pm	Training for Standard Setting Judgments
2:00 pm	Complete Standard Setting Judgments
	BREAK
3:00 pm	Specification Judgment Training
3:30 pm	Complete Specification Judgments
3:45 pm	Complete Final Evaluation
4:00 pm	Collect Materials and Adjourn

Thank You for Participating



Copyright © 2010 by Educational Testing Service. All rights reserved.

Description of a Just Qualified Candidate
Praxis Art: Content Knowledge (0134)
(Developed for the Virginia Department of Education)

- Knows characteristics of common 2-D and 3-D materials and processes
- Can compare characteristics of common 2-D and 3-D materials and processes.
- Knows characteristics of current technologies and equipment such as photography, videography, and computer applications
- Understands safety and health issues related to common materials and processes; applies safety procedures in the classroom
- Knows how to prepare an exhibition using appropriate presentation techniques
- Demonstrates knowledge and application of art vocabulary
- Knows major trends in Western and Nonwestern art and architecture
- Knows and understands the chronological timeline and thematic organization of art history
- Ability to analyze works of art and evaluate them critically across cultures and periods of time
- Understands the functions and purposes of works of art
- Knows the role of visual literacy and popular culture

Table 4
Specification Judgments

	Very Important		Important		Slightly Important		Not Important		
	N	%	N	%	N	%	N	%	
I. A. ART MAKING - GENERAL									
• Understands and applies the elements of art and principles of visual organization as applied to two-dimensional and three-dimensional media.	10	77%	2	15%	1	8%	0	0%	
• Identifies elements and principles of design in visual stimuli	11	85%	1	8%	1	8%	0	0%	
• Explains relationships of elements to principles	7	54%	5	38%	1	8%	0	0%	
• Distinguishes uses of elements and principles in two-dimensional and three-dimensional art	9	69%	3	23%	1	8%	1	8%	
• Knows various historical methods and contemporary approaches to creating art.	2	15%	10	77%	1	8%	0	0%	
• Defines/identifies both historical and contemporary methods	3	23%	8	62%	2	15%	0	0%	

Table 4 (continued)

Specification Judgments

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
I. B. ART MAKING – MEDIA AND PROCESSES								
• Knows and understands safety, environmental, and storage issues related to the use of art materials and art processes.	10	77%	3	23%	0	0%	0	0%
• Identifies dangerous materials and their effects	11	85%	2	15%	0	0%	0	0%
• Categorizes dangerous materials and their effects	5	38%	8	62%	0	0%	0	0%
• Describes proper ventilation, storage, and disposal procedures based on the medium	11	85%	2	15%	0	0%	0	0%
• Demonstrates knowledge of MSDS sheets	4	31%	7	54%	2	15%	0	0%
• Demonstrates understanding of safety procedures and precautions for using artist’s materials and tools	10	77%	3	23%	0	0%	0	0%
• Demonstrates knowledge of health issues related to the use of artists’ materials and tools	8	62%	3	23%	2	15%	0	0%
• Knows and understands how to use a variety of drawing, painting, and printmaking materials and processes.	6	46%	7	54%	0	0%	0	0%
• Identifies characteristics of materials	7	54%	6	46%	0	0%	0	0%
• Identifies similarities and differences among materials	6	46%	7	54%	0	0%	0	0%
• Knows vocabulary related to drawing, painting, and printmaking materials and processes	6	46%	5	38%	2	15%	0	0%
• Describes drawing, painting, and printmaking processes	5	38%	6	46%	2	15%	0	0%
• Solves problems and evaluates possible solutions	7	54%	6	46%	0	0%	0	0%

Table 4 (continued)

Specification Judgments

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
• Compares materials and techniques, and analyzes the compatibility of materials and techniques	2	15%	8	62%	3	23%	0	0%
• Recognizes or identifies processes through reproductions	2	15%	8	62%	3	23%	0	0%
• Knows and understands how to use digital photography and image processes.	3	23%	8	62%	2	15%	0	0%
• Demonstrates basic camera knowledge (camera parts, vocabulary)	3	23%	9	69%	1	8%	0	0%
• Demonstrates knowledge of common editing and imaging software	2	15%	6	46%	5	38%	0	0%
• Demonstrates knowledge of uploading, downloading, storing common file types, transferring and printing images	3	23%	6	46%	4	31%	0	0%
• Knows and understands how to use the process of creating digital images	2	15%	7	54%	4	31%	0	0%
• Understand materials, tools and processes for videography, filmmaking, and installations	0	0%	5	38%	7	54%	1	8%
• Identifies/describes materials, tools, and processes for videography, filmmaking and installations	0	0%	6	46%	6	46%	1	8%
• Knows and understands how to use sculptural materials and processes.	3	23%	9	69%	1	8%	0	0%
• Identifies characteristics of materials	4	31%	8	62%	1	8%	0	0%
• Identifies similarities and differences among materials	2	15%	8	62%	2	15%	1	8%
• Knows vocabulary related to sculptural materials and processes	4	31%	7	54%	2	15%	0	0%
• Describes sculptural processes	5	38%	6	46%	2	15%	0	0%

Table 4 (continued)

Specification Judgments

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
• Solves problems and evaluates possible solutions	6	46%	6	46%	1	8%	0	0%
• Compares materials and techniques, and analyzes the compatibility of materials and techniques	1	8%	8	62%	3	23%	1	8%
• Recognizes or identifies processes through reproductions	2	15%	5	38%	5	38%	1	8%
• Knows and understands how to use a variety of fiber art materials and processes.	1	8%	5	38%	6	46%	1	8%
• Identifies characteristics of materials	1	8%	6	46%	6	46%	0	0%
• Identifies similarities and differences among materials	2	15%	4	31%	6	46%	1	8%
• Knows vocabulary related to fiber materials and processes	2	15%	6	46%	4	31%	1	8%
• Describes fiber processes	1	8%	7	54%	4	31%	1	8%
• Solves problems and evaluates possible solutions	5	38%	3	23%	5	38%	0	0%
• Compares materials and techniques, and analyzes the compatibility of materials and techniques	1	8%	5	38%	6	46%	1	8%
• Recognizes or identifies processes through reproductions	1	8%	4	31%	6	46%	2	15%

Table 4 (continued)

Specification Judgments

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
<ul style="list-style-type: none"> • Understands the physical aspects and effective ways of presenting art work for display purposes. 	7	54%	4	31%	2	15%	0	0%
<ul style="list-style-type: none"> • Identifies and recognizes methods of mounting and matting work in ways appropriate to the medium 	5	38%	5	38%	3	23%	0	0%
<ul style="list-style-type: none"> • Identifies and describes methods of displaying three-dimensional work 	6	46%	5	38%	2	15%	0	0%
<ul style="list-style-type: none"> • Describes appropriate ways of using exhibition spaces 	7	54%	2	15%	4	31%	0	0%
II. A. HISTORICAL & THEORETICAL FOUNDATION OF ART – MATERIALS & PROCESSES								
<ul style="list-style-type: none"> • Understands the following materials within an art historical context: Painting, Drawing, Printmaking, Sculpture, Architecture, Photography, Fiber Arts, Crafts. 	6	46%	4	31%	3	23%	0	0%
<ul style="list-style-type: none"> • Identifies characteristics of materials, processes, and techniques within an art historical context 	5	38%	5	38%	3	23%	0	0%
<ul style="list-style-type: none"> • Identifies similarities and differences among materials, processes, and techniques (e.g., evolution over time) 	4	31%	6	46%	3	23%	0	0%
<ul style="list-style-type: none"> • Knows vocabulary related to two-dimensional and three-dimensional media and processes within an art historical context 	7	54%	3	23%	3	23%	0	0%
<ul style="list-style-type: none"> • Recognizes or identifies processes within an art historical context through reproductions 	3	23%	5	38%	4	31%	1	8%

Table 4 (continued)

Specification Judgments

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
II. B. HISTORICAL & THEORETICAL FOUNDATION OF ART – THE WESTERN TRADITION IN ART HISTORY								
<ul style="list-style-type: none"> • Recognizes stylistic traits of art and architecture from each of the following time periods: Prehistory; Ancient Near East; Ancient Greece and Rome; Early Christian, Byzantine and Medieval periods; the Renaissance; the Baroque; 18th through 20th centuries in Europe and North America; contemporary art. 	3	23%	5	38%	5	38%	0	0%
<ul style="list-style-type: none"> • Identifies the styles of works of art and architecture 	2	15%	7	54%	4	31%	0	0%
<ul style="list-style-type: none"> • Categorizes art and architecture according to style and/or period 	2	15%	7	54%	3	23%	1	8%
<ul style="list-style-type: none"> • Identifies major works of art and architecture by title, style, and/or artist, as appropriate 	2	15%	5	38%	6	46%	0	0%
<ul style="list-style-type: none"> • Analyzes/explains the influence of art periods or schools on later work 	3	23%	8	62%	2	15%	0	0%
<ul style="list-style-type: none"> • Analyzes compositional elements and principles of design in works of art and architecture 	4	31%	6	46%	2	15%	1	8%
<ul style="list-style-type: none"> • Recognizes the impact of major artistic and technological innovations on the stylistic traits of art 	2	15%	9	69%	2	15%	0	0%

Table 4 (continued)

Specification Judgments

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
<ul style="list-style-type: none"> • Understands the content, context, and/or purpose of art and architecture from each of the following time periods: Prehistory; Ancient Near East; Ancient Greece and Rome; Early Christian, Byzantine and Medieval periods; the Renaissance; the Baroque; 18th through 20th centuries in Europe and North America; contemporary art. 	5	38%	5	38%	3	23%	0	0%
<ul style="list-style-type: none"> • Explains the purposes of works of art from various time periods 	4	31%	6	46%	3	23%	0	0%
<ul style="list-style-type: none"> • Decodes/analyzes the narrative or intended content of a work of art 	4	31%	5	38%	3	23%	1	8%
<ul style="list-style-type: none"> • Analyzes/explains the interrelationships between art and social factors, cultural context, and events 	7	54%	4	31%	2	15%	0	0%
<ul style="list-style-type: none"> • Explains the impact of major artistic and technological innovations on the content, context, and purposes of art 	5	38%	7	54%	1	8%	0	0%
<ul style="list-style-type: none"> • Evaluates information about art and artists from various sources 	3	23%	6	46%	4	31%	0	0%

Table 4 (continued)

Specification Judgments

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
II. C. HISTORICAL & THEORETICAL FOUNDATION OF ART – ART BEYOND THE WESTERN TRADITION								
• Knows and understands the general visual characteristics of art and architecture from Asia, Africa, the Americas, the South Pacific region.	3	23%	6	46%	4	31%	0	0%
• Classifies works of art and architecture by regions/cultures	3	23%	7	54%	2	15%	1	8%
• Describes/analyzes works of art and architecture using compositional elements and principles of design	5	38%	5	38%	2	15%	1	8%
• Describes/analyzes the interrelationships between art from beyond the Western traditions and art from the Western tradition	2	15%	9	69%	1	8%	1	8%
• Identifies major works of art and architecture by title, style, and/or artist, as appropriate	4	31%	3	23%	4	31%	2	15%
• Understands the general content, context, and purposes of art from Asia, Africa, the Americas, the South Pacific region.	5	38%	5	38%	3	23%	0	0%
• Explains the content and/or purpose (as appropriate) of frequently referenced works of art from various locations and cultures ¹⁶	5	38%	4	31%	4	31%	0	0%
• Identifies the general role of a work of art in its culture	4	31%	7	54%	2	15%	0	0%
• Explains how the context in which a work of art is created conveys information about various lifestyles and belief systems	5	38%	4	31%	4	31%	0	0%
• Evaluates information about art and artists from various sources	4	31%	4	31%	3	23%	2	15%

Table 4 (continued)

Specification Judgments

	Very Important		Important		Slightly Important		Not Important		
	N	%	N	%	N	%	N	%	
II. D. HISTORICAL & THEORETICAL FOUNDATION OF ART – RESPONDING TO ART									
• Understands the major theories of art and aesthetics.	5	38%	3	23%	5	38%	0	0%	
• Recognizes the major characteristics of various theories of art and aesthetics	4	31%	8	62%	1	8%	0	0%	
• Distinguishes among the major theories of art and aesthetics	4	31%	5	38%	4	31%	0	0%	
• Compares and contrasts the differences/similarities among theories of art and aesthetics	3	23%	5	38%	5	38%	0	0%	
• Interprets and evaluates works of art based on theories of art and aesthetics (as opposed to personal opinion)	6	46%	2	15%	5	38%	0	0%	
• Understands the relationship between art and critical response.	3	23%	9	69%	1	8%	0	0%	
• Demonstrates knowledge of critical reactions to well-known works and/or art movements	2	15%	8	62%	3	23%	0	0%	
• Recognizes/uses multiple viewpoints in examining a work of art	1	8%	9	69%	3	23%	0	0%	
• Recognizes the way personal experience affects interpretation of art	3	23%	9	69%	1	8%	0	0%	
• Recognizes how meaning is created in art (e.g., through symbols, iconography, formal elements and principles)	8	62%	4	31%	1	8%	0	0%	

Table 5**Final Evaluation**

	Strongly Agree		Agree		Disagree		Strongly Disagree	
	N	Percent	N	Percent	N	Percent	N	Percent
• I understood the purpose of this study.	12	92%	1	8%	0	0%	0	0%
• The instructions and explanations provided by the facilitators were clear.	12	92%	1	8%	0	0%	0	0%
• The opportunity to “take the test” and to discuss the test content was useful	12	92%	1	8%	0	0%	0	0%
• The opportunity to practice making standard setting judgments was useful	11	85%	2	15%	0	0%	0	0%
• The training for the standard setting judgments was adequate to give me the information I needed to complete my assignment	11	85%	2	15%	0	0%	0	0%
• The process of making the standard setting judgments was easy to follow.	11	85%	2	15%	0	0%	0	0%



Listening. Learning. Leading.

Multi-State Standard Setting Technical Report

PRAXIS ART: CONTENT KNOWLEDGE (0134)

Educational and Credentialing Research

Educational Testing Service

Princeton, New Jersey

November 2010

Executive Summary

To support the decision-making process for state departments of education with regards to establishing a passing score, or cut score, for a revised assessment in the Praxis Series™ — Art: Content Knowledge (0134) — research staff from Educational Testing Service (ETS) designed and conducted two multi-state standard setting studies¹. The studies also collected content-related validity evidence to confirm the importance of the content specifications for entry-level Art teachers.

Participating States

Panelists from 22 states were recommended by state departments of education to participate on expert panels. The state departments of education recommended panelists with (a) art education experience, either as K-12 Art teachers or college faculty who prepare Art teachers and (b) familiarity with the knowledge and skills required of beginning Art teachers.

Recommended Cut Scores

The recommended cut scores for each panel, as well as the average cut score across the two panels, are provided to help state departments of education determine an appropriate cut (or passing) score. For the Praxis Art: Content Knowledge (0134) assessment, the average recommended cut score (rounded up) is 72 (on the raw score metric), which represents 65% of total available 110 raw score points (the recommended cut scores for Panels 1 and 2 are 73 and 71, respectively). The scaled score associated with a raw score of 72 is 158.

Summary of Content Specification Judgments

Panelists judged the extent to which the knowledge and/or skills reflected by the content specifications were important for entry-level Art teachers. The favorable judgments of the panelists provided evidence that the content of the assessment is important for beginning practice.

¹ The two multi-state standard setting studies collected expert judgments for questions comprising both the Praxis Art: Content Knowledge (0134) and Praxis Art: Content and Analysis (0135) assessments. Standard-setting procedures and results presented in the following report only pertain to the Praxis Art: Content Knowledge (0134) assessment. A separate report contains similar information for Praxis Art: Content and Analysis (0135).

To support the decision-making process for state departments of education with regards to establishing a passing score, or cut score, for a revised assessment in the Praxis Series™ — Art: Content Knowledge (0134) — research staff from Educational Testing Service (ETS) designed and conducted two multi-state standard setting studies². The studies also collected content-related validity evidence to confirm the importance of the content specifications for entry-level Art teachers. Panelists were recommended by state departments of education³ to participate on the two expert panels. The state departments of education recommended panelists with (a) art education experience, either as K-12 Art teachers or college faculty who prepare Art teachers and (b) familiarity with the knowledge and skills required of beginning Art teachers.

The two, non-overlapping panels (a) allow each participating state to be represented and (b) provide a replication of the judgment process to strengthen the technical quality of the recommended passing score. For the Praxis Art: Content Knowledge (0134) assessment, 22 states were represented by 42 panelists across the two panels, (See Appendix A for the names and affiliations of the panelists.)

² The two multi-state standard setting studies collected expert judgments for questions comprising both the Praxis Art: Content Knowledge (0134) and Praxis Art: Content and Analysis (0135) assessments. Standard-setting procedures and results presented in the following report only pertain to the Praxis Art: Content Knowledge (0134) assessment. A separate report contains similar information for Praxis Art: Content and Analysis (0135).

³ State departments of education that currently use one or more Praxis tests were invited to participate in the multi-state standard setting studies.

Table 1

Participating States (and number of panelists) for Multi-State Panels

Alabama (2 panelists)	New Hampshire (2 panelists)
Arkansas (2 panelists)	New Jersey (2 panelists)
Connecticut (2 panelists)	Ohio (2 panelists)
Kentucky (2 panelists)	Pennsylvania (1 panelist)
Louisiana (2 panelists)	South Carolina (2 panelists)
Maryland (2 panelists)	Tennessee (2 panelists)
Maine (2 panelists)	Utah (2 panelists)
Missouri (2 panelists)	Vermont (2 panelists)
Mississippi (2 panelists)	Washington, DC (1 panelist)
North Carolina (2 panelists)	Wisconsin (2 panelists)
North Dakota (2 panelists)	West Virginia (2 panelists)

Note. Pennsylvania and Washington, DC were represented on only one of the two panels.

The panels were convened in November 2010 in Princeton, New Jersey. For both panels, the same processes and methods were used to train panelists, gather panelists' judgments and to calculate the recommended passing score, or cut score.

The following technical report is divided into three sections. The first section describes the content and format of the assessment. The second section describes the standard setting processes and methods used. The third section presents the results of the standard setting studies.

The passing score recommendation for the assessment is provided to each of the represented state departments of education. In each state, the department of education, the state board of education, or a designated educator licensure board is responsible for establishing the final passing score in accordance with applicable state regulations.

The first national administration of the new Praxis Art: Content Knowledge (0134) assessment will occur in fall 2011.

Overview of the Praxis Assessment

The *Praxis Art: Content Knowledge Test at a Glance* document (ETS, in press) describes the purpose and structure of the assessment. In brief, the assessment measures whether entry-level Art teachers have the content knowledge believed necessary for competent professional practice. A National Advisory Committee of expert practitioners and preparation faculty defined the content of the assessment, and a national survey of the field confirmed the content.

The two hour assessment contains 120 multiple-choice questions covering *Art Making- General* (approximately 15 questions); *Art Making – Media & Processes* (approximately 61 questions); *Materials & Processes in a Historical Context and Responding to Art* (approximately 17 questions); and *Western Tradition and Beyond the Western Tradition* (approximately 27 questions)⁴.

Candidate scores are reported as an overall score; four category scores – one for each content area listed above – also are reported. Of the 120 multiple-choice questions, 110 questions contribute to a candidate’s score⁵. The maximum total number of raw points that may be earned on each assessment is 110. The reporting scale for the Praxis Art: Content Knowledge (0134) assessment ranges from 100 to 200 scaled-score points.

Processes and Methods

For both expert panels, the same processes and methods were used to train panelists, gather panelists’ judgments and to calculate the recommended passing score, or cut score. The following section describes the processes and methods used⁶. (The agenda for the panel meetings is presented in Appendix A.)

The design of the standard setting study included two non-overlapping expert panels. The training provided to panelists as well as the study materials were consistent across panels with the exception of defining the Just Qualified Candidate (JQC). To assure that both panels were using the same frame of reference when making question-level standard setting judgments, the JQC definition developed through a consensus process by the first panel was used as the definition for the second panel.

⁴ The number of questions for each content area may vary slightly from form to form of the assessment.

⁵ Ten of the 120 multiple-choice questions are pretest questions which do not contribute to a candidate’s score.

⁶ Panelists also judged the constructed-response questions that appear on the Praxis Art: Content and Analysis assessment. The process for making these judgments are not described in this report but are described in the technical report for the Praxis Art: Content and Analysis (0135) standard setting.

The second panel did complete a thorough review of the definition to allow panelists to internalize the definition. The processes for developing the definition (with Panel 1) and reviewing/internalizing the definition (with Panel 2) are described later, and the Just Qualified Candidate definitions are presented in Appendix C.

The panelists were sent an e-mail explaining the purpose of the standard-setting study and requesting that they review the test content specifications for the assessment (included in the *Test at a Glance* document, which was attached to the e-mail). The purpose of the review was to familiarize the panelists with the general structure and content of the assessment.

The standard-setting study began with a welcome and introduction by the meeting facilitator, Dr. Clyde Reese from the Center for Validity Research. He explained how the assessment was developed, provided an overview of standard setting, and presented the agenda for the study.

Reviewing the Assessment

The first activity was for the panelists to “take the test.” (Each panelist had signed a nondisclosure form.) The panelists were given approximately an hour and a half to respond to the 120 multiple-choice questions (as well as the three constructed-response questions that are included on the Praxis Art: Knowledge and Analysis assessment). Panelists were instructed not to refer to the answer key while taking the test. The purpose of “taking the test” was for the panelists to become familiar with the test format, content, and difficulty. After “taking the test,” the panelists checked their responses against the answer key.

The panelists then engaged in a discussion of the major content areas being addressed by the assessment; they were also asked to remark on any content areas that they thought would be particularly challenging for entering Art teachers, and areas that addressed content that would be particularly important for entering teachers.

Defining the Just Qualified Candidate

Following the review of the assessment, panelists internalized the definition of the Just Qualified Candidate (JQC). The JQC is the test taker who has the minimum level of knowledge and/or skills believed necessary to be a qualified Art teacher. The JQC definition is the operational definition of the

cut score. The goal of the standard-setting process is to identify the test score that aligns with this definition of the JQC.

In Panel 1, the panelists were split into smaller groups, and each group was asked to write down their definition of a JQC. Each group referred to the *Praxis Art: Content and Analysis Test at a Glance*⁷ to guide their definition. Each group posted its definition on chart paper, and a full-panel discussion occurred to reach consensus on a definition (see Appendix C).

In Panel 2, the panelists began with the definition of the JQC developed by the first panel. Given that the multi-state standard setting study was designed to replicate processes and procedures across the two panels, it was important that both panels use consistent JQC definitions to frame their judgments. For Panel 2, the panelists reviewed the JQC definition, and any ambiguities were discussed and clarified. The panelists then were split into smaller groups, and each group developed performance indicators or “can do” statements based on the definition. The purpose of the indicators was to provide clear examples of what might be observed to indicate that the teacher had the defined knowledge. The performance indicators were shared across the group, and discussed and added to the definition. The panel also had an opportunity to suggest minor changes to the initial definition, if doing so added clarity. Panel 2 made two revisions to the JQC definition developed by Panel 1: (a) splitting the first bullet into two separate bullets and (b) replacing one of the examples in the second bullet.

Panelists’ Judgments

A probability-based Angoff method (Brandon, 2004; Hambleton & Pitoniak, 2006) was used for the multiple-choice questions. In this approach, for each question, a panelist decides on the likelihood (probability or chance) that a JQC would answer it correctly. Panelists made their judgments using the following rating scale: 0, .05, .10, .20, .30, .40, .50, .60, .70, .80, .90, .95, 1. The lower the value, the less likely it is that a JQC would answer the question correctly, because the question is difficult for the JQC. The higher the value, the more likely it is that a JQC would answer the question correctly.

For each panel, the panelists were asked to approach the judgment process in two stages. First, they reviewed the definition of the JQC and the question and decided if, overall, the question was

⁷ The test specifications contained in the *Praxis Art: Content and Analysis Test At A Glance* subsumed the specification for the Praxis Art: Content Knowledge (0134) assessment.

difficult for the JQC, easy for the JQC, or moderately difficult/easy. The facilitator encouraged the panelists to consider the following rule of thumb to guide their decision:

- difficult questions for a JQC were in the 0 to .30 range;
- moderately difficult/easy questions for a JQC were in the .40 to .60 range; and
- easy questions for a JQC were in the .70 to 1 range.

The second decision was for panelists to decide how they wanted to refine their judgment within the range. For example, if a panelist thought that a question was easy for a JQC, the initial decision located the question in the .70 to 1 range. The second decision was for the panelist to decide if the likelihood of answering it correctly was .70, .80, .90, .95, or 1.0. The two-stage decision-process was implemented to reduce the cognitive load placed on the panelists. The panelists practiced making their standard-setting judgments on six of the multiple-choice questions.

The panelists engaged in two rounds of judgments. Following Round 1, question-level feedback was provided to the panel. The panelists' judgments were displayed for each question. The panelists' judgments were summarized by the three general difficulty levels (0 to .30, .40 to .60, and .70 to 1), and the panel's average question judgment was provided. Questions were highlighted to show when panelists converged in their judgments (at least two-thirds of the panelists located a question in the same difficulty range) or diverged in their judgments. Panelists were asked to share their rationales for the judgments they made. Following this discussion, panelists were provided an opportunity to change their question-level standard-setting judgments (Round 2).

Other than the definition of the JQC, results from Panel 1 were not shared with the second panel. The question-level judgments and resulting discussions for Panel 2 were independent of judgments and discussions that occurred with Panel 1.

Judgment of Content Specifications

In addition to the two-round standard setting process, each panel judged the importance of the knowledge and/or skills stated or implied in the assessment content specifications for the job of an entry-level Art teacher. These judgments addressed the perceived content-based validity of the assessment. Judgments were made using a four-point Likert scale — *Very Important, Important, Slightly Important,*

and *Not Important*. Each panelist independently judged the knowledge categories and knowledge/skills statements.

Results

Results are presented separately for the two panels. The recommended cut scores for each panel, as well as the average cut score across the two panels, are provided to help state departments of education determine an appropriate cut (or passing) score.

Expert Panels

The standard setting study included two expert panels. The various state departments of education recruited panelists to represent a range of professional perspectives. A description of the panels is presented below. (See Appendix A for a listing of panelists for each panel.)

Panel 1 included 21 teachers, administrators, and college faculty who prepare Art teachers, representing 21 states. In brief, 18 panelists were teachers, one was an administrators or department heads, and two were college faculty. Both of the panelists who were college faculty were currently involved in the training or preparation of Art teachers. Seventeen panelists were White, one was Hispanic or Latino, one was Asian American, one was American Indian or Alaskan Native, and one panelist indicated “other.” Fifteen panelists were female. Nineteen panelists reported being certified Art teachers in their states. Slightly less than half of panelists (9 of the 21 panelists or 43%) had seven or fewer years of experience as an Art teacher, and five had 16 or more years of teaching experience.

Panel 2 included 21 teachers and college faculty who prepare Art teachers, representing 21 states. In brief, 18 panelists were teachers and three were college faculty. All three of the panelists who were college faculty were currently involved in the training or preparation of Art teachers. Seventeen panelists were White, three were African American, and one was Asian American. Fourteen panelists were female. Eighteen panelists reported being certified Art teachers in their states. Nearly 40% of panelists (8 of the 21 panelists) had seven or fewer years of experience as an Art teacher, and three had 16 or more years of teaching experience.

A fuller demographic description for the members of the two panels is presented in Tables D1 and D2 in Appendix D.

Initial Evaluation Forms.

The panelists completed an initial evaluation after receiving training on how to make question-level judgments. The primary information collected from this form was the panelists indicating if they had received adequate training to make their standard-setting judgments and were ready to proceed. Across both panels, all panelists indicated that they were prepared to make their judgments.

Summary of Standard Setting Judgments by Round.

A summary of each round of standard-setting judgments is presented in Appendix D. The numbers in each table reflect the recommended cut scores — the number of raw points needed to “pass” the assessment — of each panelist for the two rounds. The panel’s average recommended cut score and highest and lowest cut scores are reported, as are the standard deviations (SD) of panelists’ cut scores and the standard errors of judgment (SEJ). The SEJ is one way of estimating the reliability of the judgments. It indicates how likely it would be for other panels of educators similar in make-up, experience, and standard-setting training to the current panels to recommend the same cut score on the same form of the assessment. A comparable panel’s cut score would be within 1 SEJ of the current average cut score 68 percent of the time and within 2 SEJs 95 percent of the time.

Round 1 judgments are made without discussion among the panelists. The most variability in judgments, therefore, is typically present in the first round. Round 2 judgments, however, are informed by panel discussion; thus, it is common to see a decrease both in the standard deviation and SEJ. This decrease — indicating convergence among the panelists’ judgments — was observed for both panels. The Round 2 average total score is the panel’s recommended cut score (passing score).

The panels’ cut score recommendations for the Praxis Art: Content Knowledge (0134) assessment are 72.79 for Panel 1 and 70.33 for Panel 2 (see Tables D3 and D4 in Appendix D). The values were rounded to the next highest whole number to determine the functional recommended cut scores — 73 for Panel 1 and 71 for Panel 2. The values of 73 and 71 represent approximately 66% and 65%, respectively, of the total available 110 raw-score points that could be earned on the assessment. The scaled scores associated with 73 and 71 raw points are 159 and 156, respectively.⁸

⁸ For reference purposes, if the recommended raw cut score was 72 or 70 points, the scaled score would be 158 or 155, respectively.

Table D5 (in Appendix D) present the estimated standard errors of measurement (SEM) around the recommended cut scores for each panel. A standard error represents the uncertainty associated with a test score. The scaled scores associated with 1 and 2 SEMs above and below the recommended cut scores are provided. The standard errors provided are an estimate, given that the Praxis Art: Content Knowledge (0134) assessment has not yet been administered.

In addition to the recommended cut score for each panel, the average cut score across the two panels is provided to help state departments of education determine an appropriate cut (or passing) score for the Praxis Art: Content Knowledge (0134) assessment. The panels' average cut score recommendation for the Praxis Art: Content Knowledge (0134) assessment is 71.56. The value was rounded to 72 (next highest raw score) to determine the functional recommended cut score. The value of 72 represents approximately 65% of the total available 110 raw-score points that could be earned on the assessment. The scaled score associated with 72 raw points is 158. Table D5 (in Appendix D) presents the standard error of measurement (SEM) around the recommended cut score combining the information from the two panels.

Summary of Content Specification Judgments.

Panelists judged the extent to which the knowledge and/or skills reflected by the Praxis Art: Content Knowledge (0134) assessment content specifications were important for entry-level Art teachers. Panelists rated the knowledge categories and knowledge/skills statements on a four-point scale ranging from *Very Important* to *Not Important*. The panelists' ratings are summarized in Table D6 (in Appendix D).

Thirteen of the 16 knowledge categories were judged to be *Very Important* or *Important* by 90% or more of the panelists. The knowledge categories of "*Understanding and Applying the Elements of Art and Principles of Visual Organization*," and "*Knows and Understands Safety, Environment, and Storage Issue*" (81% of the panelists judged as *Very Important*) were seen as the most important for beginning Art teachers. The knowledge category of "*Understanding Materials, Tools and Processes for Videography, Filmmaking, and Installations*" (65% of the panelists judged as *Slightly Important* or *Not Important*) was seen as less important for beginning Art teachers. All but four of the 70 knowledge statements covered by the Praxis Art: Content Knowledge assessment were judged to be *Very Important* or *Important* by at least two-thirds of the panelists.

Summary of Final Evaluations

The panelists completed an evaluation form at the conclusion of their standard setting study. The evaluation form asked the panelists to provide feedback about the quality of the standard-setting implementation and the factors that influenced their decisions. Tables D7 and D8 (in Appendix D) present the results of the final evaluations.

All panelists *agreed* or *strongly agreed* that they understood the purpose of the study and that the facilitator's instructions and explanations were clear. All panelists *agreed* or *strongly agreed* that they were prepared to make their standard setting judgments. Across the two panels, all but one of the panelists *strongly agreed* or *agreed* that the standard-setting process was easy to follow.

All panelists reported that the definition of the JQC was at least *somewhat influential* in guiding their standard-setting judgments; 86% of panelists indicated the definition was *very influential*. All but two of the panelists reported that between-round discussions were at least *somewhat influential* in guiding their judgments. Nearly three-quarters of the panelists (32 of the 42 panelists) indicated that the knowledge/skills required to answer each question as *very influential* in guiding their judgments.

There were similar ratings between the two panels when asked to respond to their level of comfort with their panel's recommended passing score⁹. All panelists indicated they were *very* or *somewhat comfortable* with their recommendation. For both panels, the majority of the panelists indicated that the recommend cut score was *about right* (100% for Panel 1 and 90% for Panel 2). Of the remaining panelists from Panel 2, one indicated the cut score was *too low* and one indicated it was *too high*.

⁹ Panelists indicated their level of comfort with the cut score recommendations for both the Praxis Art: Content Knowledge (0134) and Praxis Art: Content and Analysis (0135) assessments.

Summary

To support the decision-making process for state departments of education with regards to establishing a passing score, or cut score, for a revised assessment in the Praxis Series™ — Art: Content Knowledge (0134) — research staff from Educational Testing Service (ETS) designed and conducted two multi-state standard setting studies¹⁰. The studies also collected content-related validity evidence to confirm the importance of the content specifications for entry-level Art teachers.

The recommended cut scores for each panel, as well as the average cut score across the two panels, are provided to help state departments of education determine an appropriate cut (or passing) score. For the Praxis Art: Content Knowledge (0134) assessment, the average recommended cut score (rounded up) is 72 (on the raw score metric), which represents 65% of total available 110 raw score points (the recommended cut scores for Panels 1 and 2 are 73 and 71, respectively). The scaled score associated with a raw score of 72 is 158.

Panelists judged the extent to which the knowledge and/or skills reflected by the content specifications were important for entry-level Art teachers. The favorable judgments of the panelists provided evidence that the content of the assessment is important for beginning practice.

¹⁰ The two multi-state standard setting studies collected expert judgments for questions comprising both the Praxis Art: Content Knowledge (0134) and Praxis Art: Content and Analysis (0135) assessments. Standard-setting procedures and results presented in the following report only pertain to the Praxis Art: Content Knowledge (0134) assessment. A separate report contains similar information for Praxis Art: Content and Analysis (0135).

References

- Brandon, P.R. (2004). Conclusions about frequently studied modified Angoff standard-setting topics. *Applied Measurement in Education, 17*, 59-88.
- ETS. (In press). *Art: Content Knowledge Test at a Glance*. Princeton, NJ.
- Hambleton, R. K., & Pitoniak, M.J. (2006). Setting performance standards. In R. L. Brennan (Ed.), *Educational Measurement* (4th ed., pp. 433-470). Westport, CT: American Council on Education/Praeger.

Appendix A
Panelists' Names & Affiliations

Praxis Art: Content Knowledge & Praxis Art: Content and Analysis

Panel 1

Panelist

Bonner, Bethany
Brasser, Angela
Brouillette, Charles
Coon, John Mark
Cowles, Mariam
Cullinan, Mary Susan
Gall, Marta
Heid, Karen A.
Hernández-Balcázar, Noemí Verónica
LeCours, Elizabeth
Lindsey, Jennifer
Milliken, Chris
Mock, Stephen
Mojzsis, Katherine
Morin, Derek
Northcutt, Adriana E.
O’Gorman Rhodebeck, Kathleen
Purcell Sacco, Kristine
Roemer, Jordyn M.
Schorsch, Jamie
Tarrell, Robert

Affiliation

Oakdale Elementary School (CT)
Campbellsville Middle & High Schools (KY)
A. E. Phillips Lab School\Louisiana Tech University (LA)
Canton High School (MS)
Cedarville School District (AR)
Colliers Primary (WV)
Macon R-1 School (MO)
University of South Carolina (SC)
Kearns High School (UT)
Hardwick Elementary School (VT)
Mooresville Intermediate School (NC)
Wells Junior High School (ME)
Memphis City Schools (TN)
Sayreville War Memorial High School (NJ)
Kindred Public School (ND)
Trace Crossings School (AL)
Pembroke Hill School (NH)
ACLD Tillotson School (PA)
North County High School (MD)
Oak Hills High School (OH)
Edgewood College (WI)

Praxis Art: Content Knowledge & Praxis Art: Content and Analysis (continued)

Panel 2

Panelist

Aman, Ronald
Armstead, Jacqueline
Csejtey, Stephen
Danenhauer, Audrea
Dieck, Jessica M.
Dunn, Holli J.
Edinger, Ted
England, Marla
Foley, Lisa
Gumbulevich, Jeanette
Hill, Bryan
Kerrigan, Danette
Leach, Randall
Parsons, Juliella
Roberts, Kathryn
Skow, Margaret
Summers, Bridget
Swift, Jason
Wilkie, Kenneth
Winker, Melissa
Yang, Crystal

Affiliation

West Virginia University (WV)
Argyle Middle School (MD)
Akron Public Schools (OH)
Farmington Public Schools (AR)
Hinds County School District (MS)
Kickapoo High School (MO)
Tulip Grove Elementary MNPS (TN)
Barren County Middle School (KY)
Chittenden Central SU (VT)
Waterbury Arts Magnet School (CT)
MLKing Elementary School (DC)
Sacopee Valley Middle School (ME)
J.H. Rose High School (NC)
Tuscaloosa City School System (AL)
Spanish Fork High School (UT)
Rollings Middle School of the Arts\Dorchester District Two (SC)
Lakewood Elementary School (LA)
Plymouth State University (NH)
Riverside School, Princeton (NJ)
Memorial High School (WI)
University of North Dakota (ND)

Appendix B
Workshop Agenda

**Praxis Art: Content Knowledge and
Praxis Art: Content and Analysis Assessments
Standard Setting Study**

Day 1

8:00 – 8:15	Welcome and Introduction * Overview of Workshop Events
8:15 – 8:45	Overview of Standard Setting & the Praxis Art Assessments
8:45 – 9:00	Break
9:00 – 10:30	“Take” the Praxis Art Assessments
10:30 – 11:00	Discuss the Praxis Art Assessments
11:00 – 12:00	Define the Knowledge/Skills of a JQC
12:00 – 12:45	Lunch
12:45 – 2:15	Define the Knowledge/Skills of a JQC (continued)
2:15 – 2:30	Break
2:30 – 3:00	Standard Setting Training for CR Questions
3:00 – 3:30	Round 1 Standard Setting Judgments: CR Questions
3:30 – 4:00	Standard Setting Training for MC Questions
4:00 – 5:00	Round 1 Standard Setting Judgments: MC Questions 1- 40
5:00 – 5:15	Collect Materials; End of Day 1

**Praxis Art: Content Knowledge and
Praxis Art: Content and Analysis Assessments
Standard Setting Study**

Day 2

9:00 – 9:05	Overview of Day 2
9:05 – 9:15	Review Standard Setting for MC Questions
9:15 – 10:30	Round 1 Standard Setting Judgments: MC Questions 41- 120
10:30 – 10:45	Break
10:45 – 11:15	Round 1 Feedback & Round 2 Judgments: CR Questions
11:15 – 12:00	Round 1 Feedback & Round 2 Judgments: MC Questions
12:00 – 1:00	Lunch
1:00 – 2:15	Round 1 Feedback & Round 2 Judgments: MC Questions (continued)
2:15 – 3:00	Specification Judgments
3:00 – 3:15	Feedback on Round 2 Recommended Cut Score
3:15 – 3:30	Complete Final Evaluation
3:30 – 3:45	Collect Materials; End of Study

Appendix C

Just Qualified Candidate (JQC) Definitions

**Description of a Just Qualified Candidate
Panel 1**

A JQC ...

1. Knows characteristics of common 2-D and 3-D materials and processes and compare across materials and processes
2. Knows characteristics of common technologies and equipment such as printmaking, photography, film making, and computers
3. Understands safety and health issues related to common materials and processes; applies safety procedures in the classroom
4. Can prepare an exhibition demonstrating an understanding of aesthetic presentation
5. Demonstrates knowledge and application of art vocabulary
6. Knows major trends in Western and Nonwestern art and architecture
7. Knows and understands the chronological timeline and thematic organization of art history
8. Ability to analyze works of art and evaluate them critically across cultures and periods of time
9. Understands the roles of function and purpose of works of art (i.e., reflection)
10. Knows the role of visual literacy and popular culture

**Description of a Just Qualified Candidate
Panel 2**

A JQC ...

1. Knows characteristics of common 2-D and 3-D materials and processes
2. Can compare characteristics of common 2-D and 3-D materials and processes.
3. Knows characteristics of common technologies and equipment such as printmaking, photography, videography, and computer applications
4. Understands safety and health issues related to common materials and processes; applies safety procedures in the classroom
5. Can prepare an exhibition demonstrating an understanding of aesthetic presentation
6. Demonstrates knowledge and application of art vocabulary
7. Knows major trends in Western and Nonwestern art and architecture
8. Knows and understands the chronological timeline and thematic organization of art history
9. Ability to analyze works of art and evaluate them critically across cultures and periods of time
10. Understands the roles of function and purpose of works of art (i.e., reflection)
11. Knows the role of visual literacy and popular culture

Appendix D

Results for Praxis Art: Content Knowledge

Table D1**Panel Member Demographics — Panel 1**

	N	Percent
Current Position		
Teachers	18	86%
Teacher/Administrator	1	5%
College Faculty	2	10%
Race		
White	17	81%
Hispanic or Latino	1	5%
Asian or Asian American	1	5%
American Indian or Alaskan Native	1	5%
Other	1	5%
Gender		
Female	15	71%
Male	6	29%
Are you currently certified as an Art teacher in your state?		
Yes	19	90%
No	2	10%
Are you currently teaching Art in your state?		
Yes	21	100%
No	0	0%
Are you currently supervising or mentoring other Art teachers?		
Yes	9	43%
No	12	57%
How many years of experience do you have teaching Art?		
3 years or less	1	5%
4 - 7 years	8	38%
8 - 11 years	5	24%
12 - 15 years	2	10%
16 years or more	5	24%

Table D1 (continued)**Panel Member Demographics — Panel 1**

	N	Percent
At what K-12 grade level are you currently teaching Art?		
Elementary (K - 5 or K - 6)	8	38%
Middle School (6 - 8 or 7 - 9)	1	5%
Elementary and Middle School	2	10%
High School (9 - 12 or 10 - 12)	5	24%
Middle and High School	2	10%
All Grades	1	5%
Not currently teaching at the K-12 level	2	10%
Which best describes the location of your K-12 school?		
Urban	3	14%
Suburban	10	48%
Rural	6	29%
Not currently working in a K-12 school	2	10%
If you are college faculty, are you currently involved in the training/preparation of Art teachers?		
Yes	2	10%
No	0	0%
Not college faculty	19	90%

Table D2**Panel Member Demographics — Panel 2**

	N	Percent
Current Position		
Teachers	18	86%
College Faculty	3	14%
Race		
White	17	81%
Black or African American	3	14%
Asian or Asian American	1	5%
Gender		
Female	14	67%
Male	7	33%
Are you currently certified as an Art teacher in your state?		
Yes	18	86%
No	3	14%
Are you currently teaching Art in your state?		
Yes	21	100%
No	0	0%
Are you currently supervising or mentoring other Art teachers?		
Yes	10	48%
No	11	52%
How many years of experience do you have teaching Art?		
3 years or less	2	10%
4 - 7 years	6	29%
8 - 11 years	6	29%
12 - 15 years	4	19%
16 years or more	3	14%

Table D2 (continued)**Panel Member Demographics — Panel 2**

	N	Percent
At what K-12 grade level are you currently teaching Art?		
Elementary (K - 5 or K - 6)	8	38%
Middle School (6 - 8 or 7 - 9)	3	14%
Elementary and Middle School	1	5%
High School (9 - 12 or 10 - 12)	5	24%
Middle and High School	1	5%
Not currently teaching at the K-12 level	3	14%
Which best describes the location of your K-12 school?		
Urban	8	38%
Suburban	7	33%
Rural	3	14%
Not currently working in a K-12 school	3	14%
If you are college faculty, are you currently involved in the training/preparation of Art teachers?		
Yes	3	14%
No	0	0%
Not college faculty	18	86%

Table D3**Cut score Summary by Round of Judgments — Panel 1**

Panelist	Round 1	Round 2
1	68.75	72.30
2	74.30	74.45
3	69.55	71.55
4	54.05	54.05
5	61.35	62.55
6	58.55	59.05
7	72.50	73.70
8	75.15	75.15
9	73.85	74.75
10	72.65	70.00
11	72.15	72.15
12	72.95	73.05
13	82.65	82.75
14	75.65	74.10
15	81.10	80.40
16	75.70	75.40
17	72.25	73.25
18	93.00	93.20
19	69.35	70.65
20	68.40	68.00
21	78.65	78.10
Average	72.50	72.79
SD	8.30	8.08
SEJ	1.81	1.76
Highest	93.00	93.20
Lowest	54.05	54.05

Table D4**Cut score Summary by Round of Judgments — Panel 2**

Panelist	Round 1	Round 2
1	73.05	72.55
2	68.75	71.40
3	68.30	70.20
4	84.75	84.20
5	61.80	66.70
6	59.60	62.65
7	75.75	75.55
8	78.80	78.00
9	53.70	56.50
10	76.30	74.60
11	67.85	71.45
12	55.10	56.20
13	66.55	66.45
14	68.00	67.80
15	66.60	67.65
16	75.30	79.50
17	61.40	61.30
18	79.10	77.90
19	69.05	69.85
20	63.25	66.75
21	80.95	79.65
Average	69.24	70.33
SD	8.41	7.48
SEJ	1.84	1.63
Highest	84.75	84.20
Lowest	53.70	56.20

Table D5**Cut Scores within 1 and 2 SEMs of the Recommended Cut Score****(a) Panel 1**

Recommended Cut Score (SEM)		Scale Score Equivalent
	73 (4.98)	159
- 2 SEMs	64	147
-1 SEM	69	154
+1 SEM	78	166
+ 2 SEMs	83	172

(b) Panel 2

Recommended Cut Score (SEM)		Scale Score Equivalent
	71 (5.04)	156
- 2 SEMs	61	144
-1 SEM	66	150
+1 SEM	77	164
+ 2 SEMs	82	171

(c) Combined Across Panels

Recommended Cut Score (SEM)		Scale Score Equivalent
	72 (5.01)	158
- 2 SEMs	62	145
-1 SEM	67	151
+1 SEM	78	166
+ 2 SEMs	83	172

Note. Consistent with the recommended cut score, the cut scores at the different SEMs have been rounded to the next highest whole number.

Table D6

Specification Judgments — Combined Across Panels

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
I. A. ART MAKING - GENERAL								
• Understands and applies the elements of art and principles of visual organization as applied to two-dimensional and three-dimensional media¹¹.	34	81%	7	17%	0	0%	0	0%
• Identifies elements and principles of design in visual stimuli	34	81%	8	19%	0	0%	0	0%
• Explains relationships of elements to principles	23	55%	17	40%	2	5%	0	0%
• Distinguishes uses of elements and principles in two-dimensional and three-dimensional art	26	62%	15	36%	1	2%	0	0%
• Knows various historical methods and contemporary approaches to creating art.	12	29%	26	62%	4	10%	0	0%
• Defines/identifies both historical and contemporary methods	10	24%	24	57%	8	19%	0	0%

¹¹ One or more panelists did not rate this knowledge/skill category or statement.

Table D6 (continued)

Specification Judgments — Combined Across Panels

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
I. B. ART MAKING – MEDIA AND PROCESSES								
• Knows and understands safety, environmental, and storage issues related to the use of art materials and art processes.	34	81%	8	19%	0	0%	0	0%
• Identifies dangerous materials and their effects	35	83%	7	17%	0	0%	0	0%
• Categorizes dangerous materials and their effects	23	55%	15	36%	4	10%	0	0%
• Describes proper ventilation, storage, and disposal procedures based on the medium	26	62%	16	38%	0	0%	0	0%
• Demonstrates knowledge of MSDS sheets	14	33%	22	52%	5	12%	1	2%
• Demonstrates understanding of safety procedures and precautions for using artist’s materials and tools	33	79%	9	21%	0	0%	0	0%
• Demonstrates knowledge of health issues related to the use of artists’ materials and tools	28	67%	12	29%	2	5%	0	0%
• Knows and understands how to use a variety of drawing, painting, and printmaking materials and processes¹².	25	60%	15	36%	0	0%	0	0%
• Identifies characteristics of materials	26	62%	16	38%	0	0%	0	0%
• Identifies similarities and differences among materials	18	43%	21	50%	3	7%	0	0%
• Knows vocabulary related to drawing, painting, and printmaking materials and processes	24	57%	17	40%	1	2%	0	0%
• Describes drawing, painting, and printmaking processes	19	45%	22	52%	1	2%	0	0%
• Solves problems and evaluates possible solutions	23	55%	17	40%	2	5%	0	0%

¹² One or more panelists did not rate this knowledge/skill category or statement.

Table D6 (continued)

Specification Judgments — Combined Across Panels

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
• Compares materials and techniques, and analyzes the compatibility of materials and techniques	11	26%	24	57%	7	17%	0	0%
• Recognizes or identifies processes through reproductions	10	24%	23	55%	9	21%	0	0%
• Knows and understands how to use digital photography and image processes.	8	19%	29	69%	5	12%	0	0%
• Demonstrates basic camera knowledge (camera parts, vocabulary)	12	29%	25	60%	5	12%	0	0%
• Demonstrates knowledge of common editing and imaging software	5	12%	27	64%	10	24%	0	0%
• Demonstrates knowledge of uploading, downloading, storing common file types, transferring and printing images	10	24%	28	67%	4	10%	0	0%
• Knows and understands how to use the process of creating digital images	7	17%	23	55%	12	29%	0	0%
• Understand materials, tools and processes for videography, filmmaking, and installations	4	10%	11	26%	23	55%	4	10%
• Identifies/describes materials, tools, and processes for videography, filmmaking and installations	3	7%	11	26%	24	57%	4	10%
• Knows and understands how to use sculptural materials and processes.	21	50%	21	50%	0	0%	0	0%
• Identifies characteristics of materials	20	48%	22	52%	0	0%	0	0%
• Identifies similarities and differences among materials	14	33%	25	60%	3	7%	0	0%
• Knows vocabulary related to sculptural materials and processes	21	50%	21	50%	0	0%	0	0%
• Describes sculptural processes	17	40%	24	57%	1	2%	0	0%

Table D6 (continued)

Specification Judgments — Combined Across Panels

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
• Solves problems and evaluates possible solutions	23	55%	16	38%	3	7%	0	0%
• Compares materials and techniques, and analyzes the compatibility of materials and techniques	11	26%	23	55%	8	19%	0	0%
• Recognizes or identifies processes through reproductions	10	24%	20	48%	12	29%	0	0%
• Knows and understands how to use a variety of fiber art materials and processes¹³.	5	12%	26	62%	8	19%	2	5%
• Identifies characteristics of materials	3	7%	31	74%	7	17%	1	2%
• Identifies similarities and differences among materials	3	7%	26	62%	11	26%	2	5%
• Knows vocabulary related to fiber materials and processes	8	19%	20	48%	13	31%	1	2%
• Describes fiber processes	3	7%	24	57%	13	31%	2	5%
• Solves problems and evaluates possible solutions	9	21%	21	50%	10	24%	2	5%
• Compares materials and techniques, and analyzes the compatibility of materials and techniques	4	10%	23	55%	13	31%	2	5%
• Recognizes or identifies processes through reproductions ¹³	3	7%	23	55%	12	29%	3	7%

¹³ One or more panelists did not rate this knowledge/skill category or statement.

Table D6 (continued)

Specification Judgments — Combined Across Panels

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
<ul style="list-style-type: none"> • Understands the physical aspects and effective ways of presenting art work for display purposes. 	20	48%	18	43%	4	10%	0	0%
<ul style="list-style-type: none"> • Identifies and recognizes methods of mounting and matting work in ways appropriate to the medium 	17	40%	22	52%	3	7%	0	0%
<ul style="list-style-type: none"> • Identifies and describes methods of displaying three-dimensional work 	19	45%	16	38%	7	17%	0	0%
<ul style="list-style-type: none"> • Describes appropriate ways of using exhibition spaces 	15	36%	21	50%	6	14%	0	0%
II. A. HISTORICAL & THEORETICAL FOUNDATION OF ART – MATERIALS & PROCESSES								
<ul style="list-style-type: none"> • Understands the following materials within an art historical context: Painting, Drawing, Printmaking, Sculpture, Architecture, Photography, Fiber Arts, Crafts. 	26	62%	16	38%	0	0%	0	0%
<ul style="list-style-type: none"> • Identifies characteristics of materials, processes, and techniques within an art historical context 	18	43%	24	57%	0	0%	0	0%
<ul style="list-style-type: none"> • Identifies similarities and differences among materials, processes, and techniques (e.g., evolution over time) 	15	36%	25	60%	2	5%	0	0%
<ul style="list-style-type: none"> • Knows vocabulary related to two-dimensional and three-dimensional media and processes within an art historical context 	24	57%	18	43%	0	0%	0	0%
<ul style="list-style-type: none"> • Recognizes or identifies processes within an art historical context through reproductions 	13	31%	27	64%	2	5%	0	0%

Table D6 (continued)

Specification Judgments — Combined Across Panels

	Very Important		Important		Slightly Important		Not Important		
	N	%	N	%	N	%	N	%	
II. B. HISTORICAL & THEORETICAL FOUNDATION OF ART – THE WESTERN TRADITION IN ART HISTORY									
<ul style="list-style-type: none"> • Recognizes stylistic traits of art and architecture from each of the following time periods: Prehistory; Ancient Near East; Ancient Greece and Rome; Early Christian, Byzantine and Medieval periods; the Renaissance; the Baroque; 18th through 20th centuries in Europe and North America; contemporary art. 	24	57%	17	40%	1	2%	0	0%	
<ul style="list-style-type: none"> • Identifies the styles of works of art and architecture 	20	48%	22	52%	0	0%	0	0%	
<ul style="list-style-type: none"> • Categorizes art and architecture according to style and/or period 	17	40%	22	52%	3	7%	0	0%	
<ul style="list-style-type: none"> • Identifies major works of art and architecture by title, style, and/or artist, as appropriate 	17	40%	21	50%	4	10%	0	0%	
<ul style="list-style-type: none"> • Analyzes/explains the influence of art periods or schools on later work 	15	36%	26	62%	1	2%	0	0%	
<ul style="list-style-type: none"> • Analyzes compositional elements and principles of design in works of art and architecture 	21	50%	20	48%	1	2%	0	0%	
<ul style="list-style-type: none"> • Recognizes the impact of major artistic and technological innovations on the stylistic traits of art 	15	36%	25	60%	2	5%	0	0%	

Table D6 (continued)

Specification Judgments — Combined Across Panels

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
<ul style="list-style-type: none"> • Understands the content, context, and/or purpose of art and architecture from each of the following time periods: Prehistory; Ancient Near East; Ancient Greece and Rome; Early Christian, Byzantine and Medieval periods; the Renaissance; the Baroque; 18th through 20th centuries in Europe and North America; contemporary art¹⁴. 	20	48%	21	50%	0	0%	0	0%
<ul style="list-style-type: none"> • Explains the purposes of works of art from various time periods 	15	36%	25	60%	2	5%	0	0%
<ul style="list-style-type: none"> • Decodes/analyzes the narrative or intended content of a work of art 	14	33%	25	60%	3	7%	0	0%
<ul style="list-style-type: none"> • Analyzes/explains the interrelationships between art and social factors, cultural context, and events 	17	40%	23	55%	2	5%	0	0%
<ul style="list-style-type: none"> • Explains the impact of major artistic and technological innovations on the content, context, and purposes of art 	17	40%	20	48%	5	12%	0	0%
<ul style="list-style-type: none"> • Acquires and evaluates information about art and artists from various sources 	18	43%	19	45%	5	12%	0	0%

¹⁴ One or more panelists did not rate this knowledge/skill category or statement.

Table D6 (continued)

Specification Judgments — Combined Across Panels

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
II. C. HISTORICAL & THEORETICAL FOUNDATION OF ART – ART BEYOND THE WESTERN TRADITION								
• Knows and understands the general visual characteristics of art and architecture from Asia, Africa, the Americas, the South Pacific region.	16	38%	26	62%	0	0%	0	0%
• Classifies works of art and architecture by regions/cultures ¹⁵	13	31%	27	64%	1	2%	0	0%
• Describes/analyzes works of art and architecture using compositional elements and principles of design	18	43%	23	55%	1	2%	0	0%
• Describes/analyzes the interrelationships between art from beyond the Western traditions and art from the Western tradition	12	29%	25	60%	5	12%	0	0%
• Identifies major works of art and architecture by title, style, and/or artist, as appropriate	12	29%	20	48%	10	24%	0	0%

¹⁵ One or more panelists did not rate this knowledge/skill category or statement.

Table D6 (continued)

Specification Judgments — Combined Across Panels

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
<ul style="list-style-type: none"> • Understands the general content, context, and purposes of art from Asia, Africa, the Americas, the South Pacific region¹⁶. 	17	40%	23	55%	1	2%	0	0%
<ul style="list-style-type: none"> <ul style="list-style-type: none"> • Explains the content and/or purpose (as appropriate) of frequently referenced works of art from various locations and cultures¹⁶ 	15	36%	24	57%	2	5%	0	0%
<ul style="list-style-type: none"> <ul style="list-style-type: none"> • Identifies the general role of a work of art in its culture 	19	45%	21	50%	2	5%	0	0%
<ul style="list-style-type: none"> <ul style="list-style-type: none"> • Explains how the context in which a work of art is created conveys information about various lifestyles and belief systems 	18	43%	21	50%	2	5%	1	2%
<ul style="list-style-type: none"> <ul style="list-style-type: none"> • Acquires and evaluates information about art and artists from various sources 	19	45%	15	36%	8	19%	0	0%
II. D. HISTORICAL & THEORETICAL FOUNDATION OF ART – RESPONDING TO ART								
<ul style="list-style-type: none"> • Understands the major theories of art and aesthetics. 	17	40%	24	57%	1	2%	0	0%
<ul style="list-style-type: none"> <ul style="list-style-type: none"> • Describes the major characteristics of various theories of art and aesthetics 	14	33%	23	55%	5	12%	0	0%
<ul style="list-style-type: none"> <ul style="list-style-type: none"> • Distinguishes among the major theories of art and aesthetics 	12	29%	25	60%	5	12%	0	0%
<ul style="list-style-type: none"> <ul style="list-style-type: none"> • Compares and contrasts the differences/similarities among theories of art and aesthetics 	10	24%	26	62%	6	14%	0	0%
<ul style="list-style-type: none"> <ul style="list-style-type: none"> • Interprets and evaluates works of art based on theories of art and aesthetics (as opposed to personal opinion) 	17	40%	22	52%	3	7%	0	0%

¹⁶ One or more panelists did not rate this knowledge/skill category or statement.

Table D6 (continued)

Specification Judgments — Combined Across Panels

	Very Important		Important		Slightly Important		Not Important	
	N	%	N	%	N	%	N	%
<ul style="list-style-type: none"> • Understands the relationship between art and critical response¹⁷. 	23	55%	16	38%	1	2%	0	0%
<ul style="list-style-type: none"> • Demonstrates knowledge of critical reactions to well-known works and/or art movements¹⁷ 	14	33%	23	55%	4	10%	0	0%
<ul style="list-style-type: none"> • Recognizes/uses multiple viewpoints in examining a work of art 	24	57%	16	38%	2	5%	0	0%
<ul style="list-style-type: none"> • Recognizes the way personal experience affects interpretation of art 	25	60%	15	36%	2	5%	0	0%
<ul style="list-style-type: none"> • Recognizes and discusses how meaning is created in art (e.g., through symbols, iconography, formal elements and principles) 	28	67%	11	26%	3	7%	0	0%

¹⁷ One or more panelists did not rate this knowledge/skill category or statement.

Table D7**Final Evaluation — Panel 1**

	Strongly Agree		Agree		Disagree		Strongly Disagree	
	N	Percent	N	Percent	N	Percent	N	Percent
• I understood the purpose of this study.	17	81%	4	19%	0	0%	0	0%
• The instructions and explanations provided by the facilitators were clear.	21	100%	0	0%	0	0%	0	0%
• The training in the standard setting method was adequate to give me the information I needed to complete my assignment.	20	95%	1	5%	0	0%	0	0%
• The explanation of how the recommended cut score is computed was clear.	15	71%	6	29%	0	0%	0	0%
• The opportunity for feedback and discussion between rounds was helpful.	16	76%	5	24%	0	0%	0	0%
• The process of making the standard setting judgments was easy to follow.	13	62%	7	33%	0	0%	1	5%

Table D7 (continued)

Final Evaluation — Panel 1

How influential was each of the following factors in guiding your standard setting judgments?	Very Influential		Somewhat Influential		Not Influential			
	N	Percent	N	Percent	N	Percent		
• The definition of the JQC	20	95%	1	5%	0	0%		
• The between-round discussions	9	43%	11	52%	1	5%		
• The knowledge/skills required to answer each test question	17	81%	4	19%	0	0%		
• My own professional experience	10	48%	9	43%	2	10%		
	Very Comfortable		Somewhat Comfortable		Somewhat Uncomfortable		Very Uncomfortable	
	N	Percent	N	Percent	N	Percent	N	Percent
• Overall, how comfortable are you with the panel's recommended cut scores?	18	86%	3	14%	0	0%	0	0%
	Too Low		About Right		Too High			
	N	Percent	N	Percent	N	Percent		
• Overall, the recommended cut score is:	0	0%	21	100%	0	0%		

Table D8**Final Evaluation — Panel 2**

	Strongly Agree		Agree		Disagree		Strongly Disagree	
	N	Percent	N	Percent	N	Percent	N	Percent
• I understood the purpose of this study.	21	100%	0	0%	0	0%	0	0%
• The instructions and explanations provided by the facilitators were clear.	20	95%	1	5%	0	0%	0	0%
• The training in the standard setting method was adequate to give me the information I needed to complete my assignment.	19	90%	2	10%	0	0%	0	0%
• The explanation of how the recommended cut score is computed was clear.	15	71%	6	29%	0	0%	0	0%
• The opportunity for feedback and discussion between rounds was helpful.	18	86%	3	14%	0	0%	0	0%
• The process of making the standard setting judgments was easy to follow.	18	86%	3	14%	0	0%	0	0%

Table D8 (continued)

Final Evaluation — Panel 2

How influential was each of the following factors in guiding your standard setting judgments?	Very Influential		Somewhat Influential		Not Influential			
	N	Percent	N	Percent	N	Percent		
• The definition of the JQC	16	76%	5	24%	0	0%		
• The between-round discussions	13	62%	7	33%	1	5%		
• The knowledge/skills required to answer each test question	15	71%	6	29%	0	0%		
• My own professional experience	13	62%	8	38%	0	0%		
	Very Comfortable		Somewhat Comfortable		Somewhat Uncomfortable		Very Uncomfortable	
	N	Percent	N	Percent	N	Percent	N	Percent
• Overall, how comfortable are you with the panel's recommended cut scores?	14	67%	7	33%	0	0%	0	0%
	Too Low		About Right		Too High			
	N	Percent	N	Percent	N	Percent		
• Overall, the recommended cut score is:	1	5%	19	90%	1	5%		

Board of Education Agenda Item

Item: _____ I. _____

Date: February 17, 2011

Topic: First Review of Guidelines to Implement the Provisions of Section 22.1-302(A) of the Code of Virginia Pertaining to the Employment of Substitute Teachers

Presenter: Mrs. Patty S. Pitts, Assistant Superintendent for Teacher Education and Licensure

Telephone Number: (804) 371-2522

E-Mail Address: Patty.Pitts@doe.virginia.gov

Origin:

_____ Topic presented for information only (no board action required)

X Board review required by
X State or federal law or regulation
_____ Board of Education regulation
_____ Other: _____

_____ Action requested at this meeting X Action requested at future meeting: March 24, 2011 (date)

Previous Review/Action:

X No previous board review/action

_____ Previous review/action
date _____
action _____

Background Information:

Section 22.1-302 of the *Code of Virginia* was amended in the 2010 Virginia General Assembly to allow the Superintendent of Public Instruction on a case-by-case basis, during one school year to approve an extension of the 90-teaching-day restriction for substitute teachers in a teacher vacancy. The *Code* section, in part, states the following:

§ 22.1-302. Written contracts required; execution of contracts; qualifications of temporarily employed teachers; rules and regulations.

- A. A written contract, in a form prescribed by the Board of Education, shall be made by the school board with each teacher employed by it, except those who are temporarily employed, before such teacher enters upon his duties. Such contract shall be signed in duplicate, with a copy thereof furnished to both parties. A temporarily employed teacher, as used in this section, shall mean (i) one who is employed to substitute for a contracted teacher for a temporary period of time during the contracted teacher's absence, or (ii) one who is employed to fill a teacher vacancy for a period of time, but for no longer than 90 teaching days in such vacancy, *unless otherwise approved by the Superintendent of Public Instruction on a case-by-case basis, during one school year.*

- B. The Board of Education shall promulgate regulations regarding temporarily employed teachers, as defined in this section, which shall provide that such teachers be at least eighteen years of age and that they hold a high school diploma or a general educational development (GED) certificate.

However, local school boards shall establish employment qualifications for temporarily employed teachers which may exceed the Board's regulations for the employment of such teachers. School boards shall also seek to ensure that temporarily employed teachers who are engaged as long-term substitutes shall exceed baseline employment qualifications.

The General Assembly further requested that the Board of Education develop guidelines to implement provisions of subsection A of Section 22.1-302 pertaining to the employment of substitutes for longer than 90 teaching days during one school year, no later than July 1, 2011.

Summary of Major Elements

A committee was established to recommend guidelines to the Board of Education to implement the provisions of Section 22.1-302 (A) of the *Code of Virginia* pertaining to the employment of substitute teachers. The committee was composed of Dr. Kitty Boitnott, president of the Virginia Education Association; Ms. Charla Cordle, assistant superintendent of human resources, Hanover County Schools; Mrs. Tracey Dingus, chair of the Advisory Board on Teacher Education and Licensure; Dr. Howard Ben Kiser, superintendent of Gloucester County Schools and member of the Board of Directors of the Virginia Association of School Superintendents; Dr. Judi N. Swingen, personnel administrator for licensure, Chesterfield County Schools; Ms. Barbara Warren-Jones, assistant director of human resources, Hampton City Schools, and immediate past-president of the Virginia Association of School Personnel Administrators; and Department of Education staff.

The committee met in December 2010 and recommended the attached *Guidelines to Implement the Provisions of Section 22.1-302(A) of the Code of Virginia Pertaining to the Employment of Substitute Teachers*.

Superintendent's Recommendation:

The Superintendent of Public Instruction recommends that the Board of Education receive for first review the proposed *Guidelines to Implement the Provisions of Section 22.1-302(A) of the Code of Virginia Pertaining to the Employment of Substitute Teachers*.

Impact on Resources:

There is a minimal impact on resources.

Timetable for Further Review/Action:

This item will be presented to the Board of Education for approval at the March 24, 2011, meeting.

GUIDELINES TO IMPLEMENT THE
PROVISIONS OF SECTION 22.1-302(A) OF
THE *CODE OF VIRGINIA* PERTAINING
TO THE EMPLOYMENT OF SUBSTITUTE
TEACHERS

*Presented to the
Virginia Board of Education
February 17, 2011*

Guidelines to Implement the Provisions of Section 22.1-302(A) of the Code of Virginia Pertaining to the Employment of Substitute Teachers

Introduction

Section 22.1-302 of the *Code of Virginia* was amended in the 2010 Virginia General Assembly to allow the Superintendent of Public Instruction on a case-by-case basis, during one school year to approve an extension of the 90-teaching-day restriction for substitute teachers in a teacher vacancy. The *Code* section, in part, states the following:

§ 22.1-302. Written contracts required; execution of contracts; qualifications of temporarily employed teachers; rules and regulations.

- A. A written contract, in a form prescribed by the Board of Education, shall be made by the school board with each teacher employed by it, except those who are temporarily employed, before such teacher enters upon his duties. Such contract shall be signed in duplicate, with a copy thereof furnished to both parties. A temporarily employed teacher, as used in this section, shall mean (i) one who is employed to substitute for a contracted teacher for a temporary period of time during the contracted teacher's absence, or (ii) one who is employed to fill a teacher vacancy for a period of time, but for no longer than 90 teaching days in such vacancy, *unless otherwise approved by the Superintendent of Public Instruction on a case-by-case basis, during one school year.*
- B. The Board of Education shall promulgate regulations regarding temporarily employed teachers, as defined in this section, which shall provide that such teachers be at least eighteen years of age and that they hold a high school diploma or a general educational development (GED) certificate.

However, local school boards shall establish employment qualifications for temporarily employed teachers which may exceed the Board's regulations for the employment of such teachers. School boards shall also seek to ensure that temporarily employed teachers who are engaged as long-term substitutes shall exceed baseline employment qualifications.

The General Assembly further requested that the Board of Education develop guidelines to implement provisions of subsection A of Section 22.1-302 pertaining to the employment of substitutes for longer than 90 teaching days during one school year, no later than July 1, 2011.

Guidelines

An individual (temporarily employed teacher) may be employed to fill a teacher vacancy for a period of time, but for no longer than 90 teaching days in such vacancy, *unless otherwise approved by the Superintendent of Public Instruction on a case-by-case basis, during one school year.* In **a rare exceptional and justifiable case due to extenuating circumstances**, a school division superintendent may submit a request to the Superintendent of Public Instruction to consider an extension of the teaching days a substitute teacher may serve in a vacant teaching position.

The letter of request to the Superintendent of Public Instruction must be submitted and **signed by the division superintendent**. The letter for the exception must include the following information:

1. Date of the teacher vacancy;
2. Justification of efforts made to fill the position, including timelines (such as, when and where the position was advertised);
3. Candidate pool (such as, the number of qualified/acceptable candidates, whether a qualified candidate declined offer of employment, etc.);
4. Full name of the substitute teacher, license number (if applicable), name of school assigned, title of class(es)/grade level(s)/assignment(s); and
5. Qualifications of the temporarily employed teacher (substitute teacher):
 - A. Documentation that the substitute teacher holds or is eligible to hold a Virginia teaching license in the assigned teaching area/content, **or**
 - B. Documentation of the following:
 - (1) Educational level [For a request to be considered, the substitute teacher must have an earned baccalaureate degree from a regionally accredited college or university except in cases where an individual is assigned to a technical professional (occupational) area that does not require a bachelor's degree (i.e., Technical Professional License). If the individual is assigned as a substitute teacher in a technical professional area, the documentation needs to include verification of the occupational experience and, if applicable, a copy of the Virginia license (such as a nursing license or a cosmetology license) to practice in that field.];
 - (2) Content knowledge and expertise in teaching area assigned; and
 - (3) Teaching experience (prior substitute and/or teaching experience).

The Superintendent of Public Instruction will respond within 10 business days of receipt of the request. If the division has not received the response within this time frame, it is the responsibility of the requesting school division to contact the Department of Education to inquire about the status of the request.

Board of Education Agenda Item

Item: _____ J. _____

Date: February 17, 2011

Topic: First Review of Virginia's Proposed Revised Textbook Review Process

Presenter: Dr. Linda Wallinger, Assistant Superintendent for Instruction

Telephone Number: (804) 225-2034

E-Mail Address: linda.wallinger@doe.virginia.gov

Origin:

_____ Topic presented for information only (no board action required)

_____ Board review required by

_____ State or federal law or regulation

_____ Board of Education regulation

X Other: Board of Education request

_____ Action requested at this meeting X Action requested at future meeting: March 24, 2011

Previous Review/Action:

_____ No previous board review/action

X Previous review/action

date January 13, 2011

action Report on the Review of Virginia's Textbook Adoption Process, the Virginia Studies Textbook *Our Virginia: Past and Present*, and Other Selected United States History Textbooks

Background Information:

The Board of Education's authority for approving textbooks and other instructional materials is prescribed in the Virginia Constitution and in the *Code of Virginia*.

Virginia Constitution, Article VIII, § 5 (d)

It [the Board of Education] shall have authority to approve textbooks and instructional aids and materials for use in courses in the public schools of the Commonwealth.

Code of Virginia, § 22.1-238

- A. The Board of Education shall have the authority to approve textbooks suitable for use in the public schools and shall have authority to approve instructional aids and materials for use in the public schools. The Board shall publish a list of all approved textbooks on its website and shall list the publisher and the current lowest wholesale price of such textbooks.
- B. Any school board may use textbooks not approved by the Board provided the school board selects such books in accordance with regulations promulgated by the Board.
- C. For the purposes of this chapter, the term "textbooks" means print or electronic media for student use that serve as the primary curriculum basis for a grade-level subject or course.

The Board of Education's current textbook regulations specify the types of materials that may be adopted.

Regulations Governing Textbook Adoption, 8 VAC 20-220-30

Only those materials which are designed to provide basic support for the instructional program of a particular content area at an appropriate level will be adopted.

On September 23, 2010, the Board took final action to adopt revised regulations regarding textbooks that will supersede those currently in effect. The revised regulations are currently undergoing the provisions of the Administrative Process Act (APA) and will become effective at the conclusion of that process. The proposed regulations were approved by the Attorney General's office on November 23, 2010, and by the Department of Planning and Budget on December 6, 2010. They are currently under review by the Secretary of Education's office, and will also need to be reviewed by the Governor's Office. When the new regulations go into effect, they will state:

Regulations Governing Local School Boards and School Divisions, 8 VAC 20-720 et seq.

8 VAC 20-720-179. Textbooks

A. Textbook approval

1. The Board of Education shall have the authority to approve textbooks for use in the public schools of Virginia.
2. In approving basal textbooks for reading in kindergarten and first grade, the Board shall report to local school boards those textbooks with a minimum decodability standard based on words that students can correctly read by properly attaching speech sounds to each letter to formulate the word at 70 percent or above for such textbooks, in accordance with § 22.1-239 of the *Code of Virginia*.
3. Any local school board may use textbooks not approved by the Board provided the school board selects such books in accordance with this chapter.
4. Contracts and purchase orders with publishers of textbooks approved by the Board for use in grades 6-12 shall allow for the purchase of printed textbooks, printed textbooks with electronic files, or electronic textbooks separate and apart from printed versions of the same textbook. Each school board shall have the authority to purchase an assortment of textbooks in any of the three forms listed above.

The complete text of the proposed regulations is available in Attachment A.

As a result of significant factual inaccuracies found in two history textbooks on the list of history textbooks the Board of Education approved on January 15, 2010, the Board unanimously approved the following motion at its meeting on January 13, 2011:

MOVED that the Board of Education direct the Superintendent of Public Instruction:

1. To initiate on the Board's behalf a process to consider withdrawal of its approval of the textbooks "Our Virginia: Past and Present" (first edition) and "Our America to 1865" (first edition), published in each case by Five Ponds Press; and
2. To seek remedies from Five Ponds Press to help school divisions which have purchased those textbooks in replacing and/or correcting such textbooks as soon as possible, including pursuing any available assistance from and/or remedies involving the publisher; and
3. To obtain a review by qualified experts of any other textbooks published by Five Ponds Press that have been approved by the Board of Education; and
4. To present to the Board of Education for first review at its February 2011 meeting a detailed proposal to revise the Board's process for approving textbooks for purchase by school divisions to ensure that all textbooks approved are factually accurate, incorporating in such proposal a process for prior certification by publishers that each textbook submitted for approval has been reviewed for factual accuracy by qualified experts in the subject matter, and that the publisher will promptly remedy at its expense any substantial factual errors discovered thereafter.

Summary of Major Elements

Attachment B contains a proposed process for textbook approval by the Board of Education to ensure factual accuracy of textbooks approved by the Board. It is the primary responsibility of publishers to ensure the accuracy of their textbooks. Publishers must certify that textbooks submitted for approval have been thoroughly examined and reviewed by qualified content experts for factual accuracy and must list all authors and their credentials. Publishers must list the professional credentials for at least three content review experts who have thoroughly examined each textbook for content accuracy. Also, the publisher must certify that each textbook has been thoroughly examined and reviewed by qualified editors for typographical errors and errors in grammar, written expression, spelling, formatting, and other substantive elements that may affect student learning. The publishers must agree to correct all factual and editing errors found in a textbook, at their expense.

The publisher must agree to the following:

- Prior to shipment to any of Virginia's public schools or school divisions, the PUBLISHER shall correct all factual and editing errors found in the textbooks and accompanying instructional materials at its expense.
- If factual or editing errors are found after textbooks or accompanying instructional materials have been adopted by the Board of Education, the PUBLISHER shall correct them at its expense within 30 calendar days of notification by sending errata sheets to the Department of Education and to all school divisions that have purchased the textbook. The Department of Education will post errata sheets on the Department's *Textbook and Instructional Materials* Web site. These factual and editing errors may have been identified by the Virginia Department of Education, by any Virginia public school division representative, or by the general public. If numerous and/or significant errors are identified in a textbook on the Board of Education's approved list, it may result in the Board of Education withdrawing the textbook

from the approved list. A "significant error" is a factual or editing error that the Board of Education or Department of Education determines within the context of the intended use of the textbook will substantially interfere with student learning. A change in knowledge that occurs subsequent to publication shall not constitute a significant error.

- The PUBLISHER must certify that any duplicate version (i.e., print or digital) of the primary material that is available to Virginia school divisions contains at least the same content included in the primary material selected by the publisher for review. Any additional content, above that contained in the primary material reviewed is accurate and free of errors. If the content of the print and digital versions of the same primary material varies, those variations are outlined in an attachment to the affidavit.
- If the PUBLISHER makes updates/revisions to a primary material in digital media after it has been adopted by the Board of Education, the PUBLISHER ensures that the updated/revised material has been vetted through the same quality assurance process for accuracy and editing outlined in this signed affidavit. The PUBLISHER will notify the Department and any school division that have purchased this primary material of the updates/revisions that have been made.

Publishers must provide a detailed description of the internal process used to ensure accuracy and lack of bias including:

- The quality assurance and workflow steps used to ensure accuracy of content;
- The quality assurance and workflow steps used to eliminate editing and typographical errors, including errors in grammar, written expression, spelling, formatting, and other substantive elements that may affect student learning;
- The fact-back-up guidelines (i.e., what is an acceptable source for a fact and what is not) used by the authors, editors, and outside content experts;
- The review by outside content experts, other than the authors, to verify accuracy and ensure freedom from bias; and
- The process used to reach consensus on information with divergent interpretations.

Department of Education staff will review all textbook publishers' affidavit agreements to determine if forms have been completed correctly, sufficient information has been provided, and the form is signed by an appropriate representative of the publishing company. Any concerns regarding the affidavits will be addressed by Department staff with the appropriate publisher. An agreement that is not completed correctly, is lacking in sufficient information, or is not signed by the appropriate representative, may result in the textbook(s) being removed from consideration for review.

Following final Board action to adopt the list of textbooks, the Department will post the list of adopted textbooks and instructional materials with prices on its Web site along with information from the Textbook Publisher's Affidavit Agreements.

After the textbook adoption takes place, the public can provide ongoing feedback to the Department regarding any inaccuracies found in an adopted textbook. An electronic mailbox will be established for this purpose. Department staff will forward legitimate factual or editing errors to the appropriate publisher. If numerous and/or significant errors are identified in a textbook, further action may be taken to consider removal of the textbook from the Board of Education's approved list.

Superintendent's Recommendation:

The Superintendent of Public Instruction recommends that the Board of Education accept for first review Virginia's proposed revised textbook review process.

Impact on Resources:

This responsibility can be absorbed by the agency's existing resources at this time. If the agency is required to absorb additional responsibilities related to this process, other services will be impacted.

Timetable for Further Review/Action:

This item will be presented to the Board of Education for final review at the March 24, 2011, meeting.

PROPOSED

REGULATIONS GOVERNING
LOCAL SCHOOL BOARDS AND SCHOOL DIVISIONS**8 VAC 20-720-10. Definitions**

"Instructional materials" means all materials, other than textbooks, used to support instruction in the classroom, including, but not limited to, books, workbooks, and electronic media.

"Textbooks" means print or electronic media for student use that serve as the primary curriculum basis for a grade-level subject or course.

8 VAC 20-720-160. Instructional materials.

- A. Local school boards shall be responsible for the selection and utilization of instructional materials.
- B. Local school boards shall adopt policies and criteria for the selection of instructional materials that shall include, at a minimum:
 - 1. The rights of parents to inspect, upon request, any instructional materials used as part of the educational curriculum for students, and the procedure for granting a request by a parent for such access, in accordance with the *Protection of Pupil Rights Amendment*, 20 U. S. C. § 1232H, and its implementing regulation, 34 CFR 98;
 - 2. The basis upon which a person may seek reconsideration of the local school board's selection of instructional materials, including, but not limited to, materials that might be considered sensitive or controversial, and the procedures for doing so.
 - 3. Pursuant to § 22.1-253.13:7 of the *Code of Virginia*, the policies shall include clear procedures for handling challenged controversial materials.

8 VAC 20-720-170. Textbooks

- A. Textbook approval
 - 1. The Board of Education shall have the authority to approve textbooks for use in the public schools of Virginia.
 - 2. In approving basal textbooks for reading in kindergarten and first grade, the Board shall report to local school boards those textbooks with a minimum decodability standard based on words that students can correctly read by properly attaching speech sounds to each letter to formulate the word at 70 percent or above for such textbooks, in accordance with § 22.1-239 of the *Code of Virginia*.

3. Any local school board may use textbooks not approved by the Board provided the school board selects such books in accordance with this chapter.
4. Contracts and purchase orders with publishers of textbooks approved by the Board for use in grades 6-12 shall allow for the purchase of printed textbooks, printed textbooks with electronic files, or electronic textbooks separate and apart from printed versions of the same textbook. Each school board shall have the authority to purchase an assortment of textbooks in any of the three forms listed above.

B. Selection of textbooks by local school boards

Local school boards shall adopt procedures for the selection of textbooks. These procedures shall include, at a minimum, the following:

1. Appointment of evaluation committees by the local school board to review and evaluate textbooks in each of the subject areas.
2. Notice to parents that textbooks under consideration for approval will be listed on the school division's Web site and made available at designated locations for review by any interested citizens.
3. Opportunities for those reviewing such textbooks to present their comments and observations, if any, to the school board through locally approved procedures.
4. Procedures to ensure appropriate consideration of citizen comments and observations.
5. Selection criteria.

C. Purchasing Board of Education approved textbooks

1. Local school divisions shall purchase textbooks approved by the Board of Education directly from the publishers of the textbooks by either entering into written term contracts or issuing purchase orders on an as-needed basis in accordance with § 22.1-241 of the *Code of Virginia*.
2. Such written contracts or purchase orders shall be exempt from the *Virginia Public Procurement Act* (§§ 2.2-4300 et seq. of the *Code of Virginia*).

D. Purchasing non-Board of Education approved textbooks

The purchase of textbooks other than those approved by the State Board is not exempt from the *Virginia Public Procurement Act*.

E. Distribution of textbooks

Each school board shall provide, free of charge, such textbooks required for courses of instruction for each child attending public schools.

F. Certifications

The division superintendent and chairperson of the local school board shall annually certify to the Virginia Department of Education that:

1. All textbooks were selected and purchased in accordance with this chapter; and
2. The price paid for each textbook did not exceed the lowest wholesale price at which the textbook involved in the contract was currently bid under contract in the United States, in accordance with § 22.1-241 of the *Code of Virginia*.

The certification shall include a list of all textbooks adopted by the local school board.

Virginia's Proposed Revised Textbook Review Process

**First Review
February 17, 2011**

Table of Contents

Section I: Introduction	1
Section II: Initiating the Textbook Review Process	2
Section III: Evaluation Criteria and Publishers’ Submission Forms	3
Section IV: Review Committees.....	5
Section V: State Board Action.....	6
Section VI: Ongoing Public Comment.....	6
Appendices.....	7
Appendix A - Virginia’s Proposed Revised Textbook Adoption Process	8
Appendix B - Proposed Publishers’ Submission Forms for Virginia’s Textbook and Instructional Materials Adoption Process	9
Appendix C - Evaluation Criteria.....	17

Section I: Introduction

The Board of Education's authority for approving textbooks and other instructional materials is prescribed in the Virginia Constitution and in the *Code of Virginia*.

Virginia Constitution, Article VIII, § 5 (d)

It [the Board of Education] shall have authority to approve textbooks and instructional aids and materials for use in courses in the public schools of the Commonwealth.

Code of Virginia, § 22.1-238

The Board of Education shall have the authority to approve textbooks suitable for use in the public schools and shall have authority to approve instructional aids and materials for use in the public schools. The Board shall publish a list of all approved textbooks on its website and shall list the publisher and the current lowest wholesale price of such textbooks.

Any school board may use textbooks not approved by the Board provided the school board selects such books in accordance with regulations promulgated by the Board.

For the purposes of this chapter, the term "textbooks" means print or electronic media for student use that serve as the primary curriculum basis for a grade-level subject or course.

The Board of Education's current textbook regulations specify the types of materials that may be adopted.

Regulations Governing Textbook Adoption, 8 VAC 20-220-30

Only those materials which are designed to provide basic support for the instructional program of a particular content area at an appropriate level will be adopted.

On September 23, 2010, the Board took final action to adopt revised regulations regarding textbooks that will supersede those currently in effect. The revised regulations are currently undergoing the provisions of the Administrative Process Act (APA) and will become effective at the conclusion of that process. When the proposed new regulations become effective, they will state:

Regulations Governing Local School Boards and School Divisions, 8 VAC 20-720 et seq.

8 VAC 20-720-179. Textbooks

A. Textbook approval

- 1. The Board of Education shall have the authority to approve textbooks for use in the public schools of Virginia.*
- 2. In approving basal textbooks for reading in kindergarten and first grade, the Board shall report to local school boards those textbooks with a minimum decodability standard based on words that students can correctly read by properly attaching speech sounds to each letter to formulate the word at 70 percent or above for such textbooks, in accordance with § 22.1-239 of the Code of Virginia.*
- 3. Any local school board may use textbooks not approved by the Board provided the school board selects such books in accordance with this chapter.*
- 4. Contracts and purchase orders with publishers of textbooks approved by the Board for use in grades 6-12 shall allow for the purchase of printed textbooks, printed textbooks with electronic files, or electronic textbooks separate and apart from printed versions of the same textbook. Each school board shall have the authority to purchase an assortment of textbooks in any of the three forms listed above.*

Textbooks and instructional materials play an important role in helping teachers provide instruction based on the Standards of Learning (SOL) and in helping students achieve the standards. This document provides a comprehensive overview of Virginia’s textbook review process including 1) how the review process is initiated; 2) the evaluation procedures used before textbooks are submitted to the Board of Education for first review; 3) the forms publishers must complete, including an affidavit agreement; 4) the selection of review committee members; 5) a description of state board action; and 6) an ongoing process for public comment on textbooks adopted by the Board of Education.

Section II: Initiating the Textbook Review Process

The Board of Education approves the textbook and instructional materials review process and determines the schedule for adoption of specific content area textbooks. The Board shall adopt textbooks for, but not limited to, the four core subjects of English, mathematics, science, and history and social science.

The Virginia Department of Education administers the adoption process on behalf of the Board of Education. A flow chart showing the order of events in Virginia’s textbook review process is provided in Appendix A. The Board of Education gives administrative authority to the Department to make necessary technical edits and changes to the process based on state or federal statutes or regulations and on the specific needs of each of the subject areas (e.g., kindergarten through grade three English/reading books may necessitate review criteria somewhat different than secondary English textbooks).

Section III: Evaluation Criteria and Publishers' Submission Forms

Following the Board's approval of the textbook and instructional materials adoption process for each subject area, the Department invites publishers to submit textbooks for review. It is the primary responsibility of publishers to ensure the accuracy of textbooks they submit for review. The Department will work to ensure that publishers have accomplished this by establishing the following evaluations for each textbook submitted: 1) an accuracy review based on the publishers' submission forms (Textbook Publisher's Affidavit Agreement and Quality Assurance for Accuracy and Editing Form); 2) a review for correlation to the Virginia Standards of Learning, content, bias, and suitable instructional planning and support based on the evaluation criteria used by review committees; and 3) a public examination of materials during a public review and comment period.

1. **Publisher's Submission Forms** (Appendix B): Publishers indicate their intent to submit textbooks and instructional materials for the adoption process by returning the completed Textbook Publisher's Affidavit Agreement and the Quality Assurance for Accuracy and Editing Form. The forms require each publisher to certify that textbooks have been thoroughly examined and reviewed by qualified content experts for factual accuracy and to list all authors and their credentials. Publishers must also list the professional credentials for at least three content review experts who have thoroughly examined each textbook for content accuracy. In addition, the publisher must certify that each textbook has been thoroughly examined and reviewed by qualified editors for typographical errors and errors in grammar, written expression, spelling, formatting, and other substantive elements that may affect student learning. The publisher must agree to correct all factual and editing errors found in a textbook, at its expense. The publisher must agree to the following:

- Prior to shipment to any of Virginia's public schools or school divisions, the PUBLISHER shall correct all factual and editing errors found in the textbooks and accompanying instructional materials at its expense.
- If factual or editing errors are found after textbooks or accompanying instructional materials have been adopted by the Board of Education, the PUBLISHER shall correct them at its expense within 30 calendar days of notification by sending errata sheets to the Department of Education and to all school divisions that have purchased the textbook. The Department of Education will post errata sheets on the Department's *Textbook and Instructional Materials* Web site. These factual and editing errors may have been identified by the Virginia Department of Education, by any Virginia public school division representative, or by the general public. If numerous and/or significant errors are identified in a textbook on the Board of Education's approved list, it may result in the Board of Education withdrawing the textbook from the approved list. A "significant error" is a factual or editing error that the Board of Education or Department of Education determines within the context of the intended use of the textbook will substantially interfere with student learning. A change in knowledge that occurs subsequent to publication shall not constitute a significant error.

- The PUBLISHER must certify that any duplicate version (i.e., print or digital) of the primary material that is available to Virginia school divisions contains at least the same content included in the primary material selected by the publisher for review. Any additional content, above that contained in the primary material reviewed is accurate and free of errors. If the content of the print and digital versions of the same primary material varies, those variations are outlined in an attachment to the affidavit.
- If the PUBLISHER makes updates/revisions to a primary material in digital media after it has been adopted by the Board of Education, the PUBLISHER ensures that the updated/revised material has been vetted through the same quality assurance process for accuracy and editing outlined in this signed affidavit. The PUBLISHER will notify the Department and any school division that have purchased this primary material of the updates/revisions that have been made.

Publishers must provide a detailed description of the internal process used to ensure accuracy and lack of bias including:

- The quality assurance and workflow steps used to ensure accuracy of content;
- The quality assurance and workflow steps used to eliminate editing and typographical errors, including errors in grammar, written expression, spelling, formatting, and other substantive elements that may affect student learning;
- The fact-back-up guidelines (i.e., what is an acceptable source for a fact and what is not) used by the authors, editors, and outside content experts;
- The review by outside content experts, other than the authors, to verify accuracy and ensure freedom from bias; and
- The process used to reach consensus on information with divergent interpretations.

Department of Education staff will review all Textbook Publisher's Affidavit Agreements to determine if forms have been completed correctly, sufficient information has been provided, and the form is signed by an appropriate representative of the publishing company. Any concerns regarding the affidavits will be addressed by Department staff with the appropriate publisher. An agreement that is not completed correctly, is lacking in sufficient information, or is not signed by the appropriate representative, may result in the textbook(s) being removed from consideration for review.

2. **Evaluation Criteria** (Appendix C): The textbook evaluation criteria used by review committees are composed of two sections: 1) correlation with the Standards of Learning (SOL); and 2) instructional planning and support.

In Section I, publishers are provided with correlation forms that list all of the SOL for the subject area being reviewed and are asked to provide specific evidence of how and where the SOL are addressed in the textbook. Review committees use the correlation forms to determine the degree to which content found in the textbook is correlated in thoroughness and accuracy to the SOL. They are also given the opportunity to comment on content accuracy, bias, or other concerns resulting from their reviews.

In Section II, a rubric is provided for review committees to offer insight on how well the textbook is designed for instructional planning and support. The rubric may vary based on the subject area being reviewed but typically includes criteria relating to the organization of materials, format design, writing style and vocabulary, graphics and illustrations, and instructional strategies.

3. **Public Examination of Materials:** After the Board of Education accepts for first review the lists of recommended textbooks, it directs the Department to seek public comment on all textbooks on the recommended list for adoption. Review copies of all textbooks are available for public examination at various sites around the Commonwealth. Individuals are invited to examine the proposed textbooks at the examination sites and to submit written comments via mail to the Department or via e-mail to an established electronic mailbox. Department staff review public comments and provide a summary of them to Board members as a part of the final review of the recommended textbooks for adoption.

Section IV: Review Committees

As a part of the review process, the Department seeks nominations for qualified educators and content experts to serve on the textbook review committees. Nominations are solicited from division superintendents for teachers, principals, administrators, content specialists, and others who have expertise with the content areas and the standards. Department staff members will also collaborate with community colleges, institutions of higher education, and other sources of subject-matter experts with graduate degrees in the field, to assist with content review. Every attempt will be made to include the following members on each review committee: 1) teachers; 2) a division-level content specialist; and 3) a subject-matter expert who may work across committees. In selecting committee members, Department staff members will attempt to have representation from all regions of the state. Committee members must certify any potential conflict of interests they may have with serving as a member of the review committee before they will be confirmed as a member of the committee.

The Department notifies the publishers of evaluation committee members for the purpose of sending all textbooks under consideration for adoption to these reviewers. Committee members use the evaluation criteria, including the publisher's SOL correlation forms, to review the textbooks independently for SOL correlations and design for instructional planning and support.

Members of the review committee submit their individual analyses of each textbook to Department staff. The full committee is then convened to reach consensus on their reviews of the submitted textbooks. Following the meeting, consensus evaluations are shared with publishers, and publishers are given an opportunity to respond to committees' reviews and recommendations. Requests by publishers for reconsideration of SOL correlations are examined carefully prior to the list of recommended textbooks being submitted to the Board of Education for first review.

Section V: State Board Action

The Superintendent of Public Instruction reviews the list of textbooks proposed by the reviewers and makes a recommendation to the Board of Education that it accept for first review the proposed list of textbooks for state adoption. Copies of the Textbook Publisher's Affidavit Agreements and Quality Assurance for Accuracy and Editing Forms are also included as part of the presentation to the Board. Upon acceptance for first review by the Board, a 30-day public examination period is announced. The public is invited to review copies of the books that have been placed at review sites around the state and to provide public comment to the Board either by mail or to an established electronic mailbox.

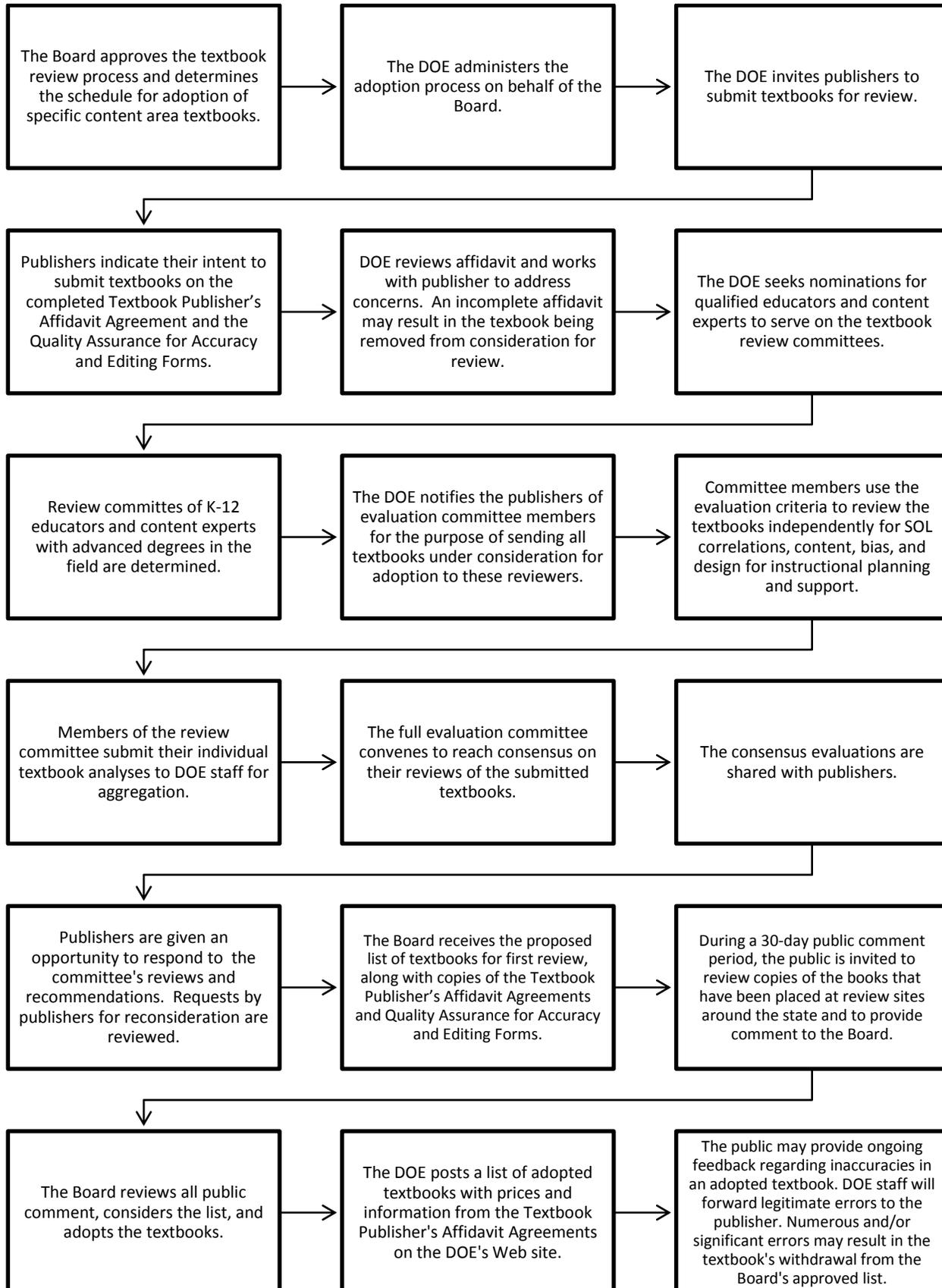
The Board reviews all public comment, considers the list, and adopts the textbooks. Following Board action, the Department posts a list of adopted textbooks and instructional materials with prices on the Department's Web site under *Textbooks and Instructional Materials*. Information from the Textbook Publisher's Affidavit Agreements will also be posted on the Web site.

Section VI: Ongoing Public Comment

After the textbook adoption takes place, the public can provide ongoing feedback to the Department regarding any inaccuracies found in an adopted textbook. An electronic mailbox will be established for this purpose. Department staff will forward legitimate factual or editing errors to the appropriate publisher. If numerous and/or significant errors are identified in a textbook, further action may be taken to consider removal of the textbook from the Board of Education's approved list.

Appendices

Virginia's Proposed Revised Textbook Adoption Process



**Proposed Publishers' Submission Forms for
Virginia's Textbook and Instructional
Materials Adoption Process**

First Review

February 17, 2011

Introduction

The Virginia Board of Education's authority for approving textbooks and other instructional materials is prescribed in the Virginia Constitution and in the *Code of Virginia*.

- *Virginia Constitution, Article VIII, § 5 (d)*
It [the Board of Education] shall have authority to approve textbooks and instructional aids and materials for use in courses in the public schools of the Commonwealth.
- *Code of Virginia, § 22.1-238*
 - A. The Board of Education shall have the authority to approve textbooks suitable for use in the public schools and shall have authority to approve instructional aids and materials for use in the public schools. The Board shall publish a list of all approved textbooks on its website and shall list the publisher and the current lowest wholesale price of such textbooks.
 - B. Any school board may use textbooks not approved by the Board provided the school board selects such books in accordance with regulations promulgated by the Board.
 - C. For the purposes of this chapter, the term "textbooks" means print or electronic media for student use that serve as the primary curriculum basis for a grade-level subject or course.

This document, including all attachments, provides textbook publishers with the required information and forms for submitting textbooks for review by the Virginia Department of Education (VDOE). By submitting textbooks for evaluation, publishers agree to follow the procedures set forth in this document. Failure to comply with all procedures may result in disqualification of the textbook as a part of the review and adoption process.

Primary Material Submitted for Review

As noted in section 22.1-238.C of the *Code of Virginia* above, the term textbook refers to print or electronic media for student use that serves as the primary curriculum basis for a grade-level subject or course.

For the remainder of this document, such instructional media will be referred to as "primary material." Primary material contains the core curriculum that is the basis for the grade-level subject or course. VDOE review committees will review the material selected by the publisher as the "primary material." This is typically the student edition of the textbook or the primary material that students will use to gain access to the content, although there may be exceptions according to the content area and grade level of the textbooks (e.g., teacher's editions may need to be included in the review at elementary grades for English/reading). Ancillary and supplemental materials will not be considered for review.

Submitting primary material in digital format is encouraged. However, publishers may submit primary material in either digital or print format, or in a format combining both media. VDOE review committees will review only the material selected as the primary material by the publisher. If a print program is submitted as the primary material to be reviewed, a digital version of this material must also be available to students. Any duplicate or similar version of the primary material submitted will not be reviewed by the VDOE review committees as a part of the textbook adoption process. If a publisher submits digital primary material and this material is also available in print, the review committee will review only the digital version of the primary material. In submitting their materials for review, publishers must provide an explanation of if and how the content in the primary material medium (digital or print) is different from or comparable to that offered in the other medium. Digital primary material may contain items such as embedded video clips or content that is delivered through an interactive format.

Submission Forms

Two submission forms follow:

- Textbook Publisher’s Affidavit Agreement
- Textbook Publisher’s Quality Assurance for Accuracy and Editing

Publishers must complete the *Publishers’ Affidavit Agreement* listing all primary materials submitted for review consideration at the time it signals intent to submit textbooks for review as part of Virginia’s textbook adoption process.

A completed *Quality Assurance for Accuracy and Editing* form must be completed for each primary material submitted.

VIRGINIA DEPARTMENT OF EDUCATION
TEXTBOOK PUBLISHER'S AFFIDAVIT AGREEMENT

3. Prior to shipment to any of Virginia's public schools or school divisions, the PUBLISHER shall correct all factual and editing errors found in the textbook and accompanying instructional materials at their expense.
4. If factual or editing errors are found after textbooks or accompanying instructional materials have been adopted by the Board of Education, the PUBLISHER shall correct them at its expense within 30 calendar days of notification by sending errata sheets to the Department of Education and to all school divisions that have purchased the textbook. The Department of Education will post errata sheets on the Department's *Textbook and Instructional Materials* Web site. These factual and editing errors may have been identified by the Virginia Department of Education, by any Virginia public school division representative, or by the general public.
5. If numerous and/or significant errors are identified in a textbook on the Board of Education's approved list, it may result in the Board of Education withdrawing the textbook from the approved list. A "significant error" is a factual or editing error that the Board of Education or Department of Education determines within the context of the intended use of the textbook will substantially interfere with student learning. A change in knowledge that occurs subsequent to publication shall not constitute a significant error.
6. The PUBLISHER certifies that any duplicate version (i.e., print or digital) of the primary material that is available to Virginia school divisions contains at least the same content included in the primary material selected by the publisher for review. Any additional content, above that contained in the primary material reviewed is accurate and free of errors. If the content of the print and digital versions of the same primary material varies, those variations are outlined in an attachment to the affidavit.
7. If the PUBLISHER makes updates/revisions to a primary material in digital media after it has been adopted by the Board of Education, the PUBLISHER ensures that the updated/revised material has been vetted through the same quality assurance process for accuracy and editing outlined in this signed affidavit. The PUBLISHER will notify the Department and any school division that have purchased this primary material of the updates/revisions that have been made.

(Signature of President of the Company or Designee)

(Date)

(Name and Title of Person Signing)

**VIRGINIA DEPARTMENT OF EDUCATION
TEXTBOOK PUBLISHER'S AFFIDAVIT AGREEMENT**

I. Primary Material (printed book or digital submission)

Please list name and edition of the textbook, series, or instructional resource.

Publisher: _____
Product Name: _____
Author(s): _____
Edition: _____ **ISBN:** _____

II. Quality Assurance for Accuracy and Editing Process

Please describe, in three pages or less, the internal process used to ensure accuracy and lack of bias including:

- the quality assurance and workflow steps used to ensure accuracy of content;
- the quality assurance and workflow steps used to eliminate editing and typographical errors, including errors in grammar, written expression, spelling, formatting, and other substantive elements that may affect student learning;
- the fact-back-up guidelines (i.e., what is an acceptable source for a fact and what is not) used by the authors, editors, and outside content experts;
- the review by outside content experts, other than the authors, to verify accuracy and ensure freedom from bias; and
- the process used to reach consensus on information with divergent interpretations.

Enter the description here. (Additional information will not be considered or reviewed.)

**VIRGINIA DEPARTMENT OF EDUCATION
TEXTBOOK PUBLISHER’S AFFIDAVIT AGREEMENT**

III. Author Information

Please complete the table below. Include each author associated with the development of the primary material. Please insert copies of the table for additional authors.

Author:	Role of the author in writing the textbook (include references to specific sections, chapters, pages, etc.)
Education and professional background:	
Related published works:	
Professional qualifications and specific areas of expertise:	
Did the author review the final copy of his/her work before publication? <input type="checkbox"/> Yes <input type="checkbox"/> No	

Author:	Role of the author in writing the textbook (include references to specific sections, chapters, pages, etc.)
Education and professional background:	
Related published works:	
Professional qualifications and specific areas of expertise:	
Did the author review the final copy of his/her work before publication? <input type="checkbox"/> Yes <input type="checkbox"/> No	

Author:	Role of the author in writing the textbook (include references to specific sections, chapters, pages, etc.)
Education and professional background:	
Related published works:	
Professional qualifications and specific areas of expertise:	
Did the author review the final copy of his/her work before publication? <input type="checkbox"/> Yes <input type="checkbox"/> No	

**VIRGINIA DEPARTMENT OF EDUCATION
TEXTBOOK PUBLISHER’S AFFIDAVIT AGREEMENT**

IV. Content Review Expert Information

Please include each content review expert associated with the quality assurance process for accuracy and editing for the primary material listed in Section I. At least three content review experts must be included with at least 1) two experts with a graduate degree in the content area being reviewed; and 2) at least one teacher with recent experience teaching the content in the appropriate grade level or course. Please insert copies of the table for additional content review experts.

Reviewer:	Role the reviewer had in the review process (entire book or include references to specific sections, chapters, pages, etc.)
Education and professional background:	
Related published works:	
Professional qualifications and specific areas of expertise:	

Reviewer:	Role the reviewer had in the review process (entire book or include references to specific sections, chapters, pages, etc.)
Education and professional background:	
Related published works:	
Professional qualifications and specific areas of expertise:	

Reviewer:	Role the reviewer had in the review process (entire book or include references to specific sections, chapters, pages, etc.)
Education and professional background:	
Related published works:	
Professional qualifications and specific areas of expertise:	

Evaluation Criteria
Section I: Correlation with the Standards of Learning

Using the information in the Standards of Learning and the Curriculum Framework for this subject, determine the degree to which content found in these instructional materials is correlated in thoroughness and accuracy.		
Adequate A	Limited L (Note: Provide examples to support this rating.)	No Evidence N (Note: Provide examples to support this rating.)
<p>Objectives and lessons are aligned with the standards.</p> <p>Content is accurate, clear, and in sequential order.</p> <p>Most of the essential understandings, knowledge, and skills are supported.</p> <p>Many opportunities are provided for students to practice essential skills.</p>	<p>Limited connections between the standards and the lessons are noted.</p> <p>Content contains some inaccuracies or is not always clear.</p> <p>Essential understandings, knowledge, or skills are not sufficiently addressed.</p> <p>There is limited opportunity for students to practice essential skills.</p>	<p>No correlation between the objectives and lessons and the standards.</p> <p>A logical sequence of content cannot be identified and/or significant content inaccuracies are noted.</p> <p>Essential understandings, knowledge, or skills are not addressed.</p> <p>Opportunities to practice essential skills are not included.</p>
<p>Comments or concerns related to content accuracy, bias, or editing:</p>		

Evaluation Criteria
Section II: Rubric for Instructional Design and Support
(Reported and may be used in correlation and adoption considerations.)

Adequate A	Limited L (Note: Provide examples to support this rating.)	No Evidence N (Note: Provide examples to support this rating.)
Criterion 1 - Materials are presented in an organized, logical manner and are appropriate for the age, grade, and maturity of the students.		
Objectives and materials are sequentially developed and aligned with the standards and framework.	Objectives and materials are inconsistent and aligned with the standards and framework.	Objectives and materials are sequentially developed and aligned with the standards and framework.
Criterion 2 - Materials are organized appropriately within and among units of study.		
Scope and sequence is easy to read and understand.	Scope and sequence is confusing and not easy to understand.	Scope and sequence is difficult to read and understand.
Criterion 3 - Format design includes titles, subheadings, and appropriate cross-referencing for ease of use.		
Organizational properties of the materials assist in understanding and processing content.	Organizational properties of the materials assist with limited emphasis in understanding and processing content.	Organizational properties of the materials do not assist in understanding and processing content.
Criterion 4 - Writing style, length of sentences, and vocabulary are appropriate.		
Readability is appropriate for the grade level.	Readability is appropriate but varies throughout the text.	Readability is not appropriate for the grade level.
Criterion 5 - Graphics and illustrations are appropriate.		
Visuals are accurate, support the student text, and enhance student understanding.	Visuals are somewhat unclear, have limited support for the student text, and enhance student understanding.	Visuals are inaccurate, do not support the student text, and do not enhance student understanding.
Criterion 6 - Sufficient instructional strategies are provided to promote depth of understanding.		
Materials provide students with opportunities to integrate skills and concepts.	Materials provide students with limited opportunities to integrate skills and concepts.	Materials provide students with no opportunities to integrate skills and concepts.

Communication in English State-to-State for English Language Learners (ACCESS for ELLs®), adopted by the Virginia Board of Education as the state-approved English Language Proficiency (ELP) assessment. The 2009-2010 test administration provided the second data point.

In November 2010, Virginia submitted a revision to the accountability plan to establish AMAO 1 (progress) at 64 percent for 2009-2010, and establish targets based on ELP assessments administered in 2010-2011 through 2013-2014 based upon review of the ACCESS for ELLs data in subsequent years. USED accepted AMAO 1 (progress) at 64 percent for 2009-2010, but requested that Virginia comply with the statutory requirement to annually increase AMAOs by establishing AMAO 1 and AMAO 2 targets for ELP assessments administered in 2010-2011 despite the fact that the state does not have impact data to review at this time.

Summary of Major Elements:

The Department has researched the process used by several other states using the ACCESS for ELLs® assessment to establish AMAOs in the absence of sufficient impact data. The general practice among these other states is to establish minimal annual target increases. The Department also reviewed Virginia’s AMAO 1 (progress) and AMAO 2 (proficiency) results for the 2010-2011 school year based on 2009-2010 assessment results, which indicate that the state exceeded the AMAO 1 and AMAO 2 targets as indicated in the table below.

**2010-2011 State Annual Measurable Achievement Objective Results
Based on 2009-2010 ACCESS for ELLs Results**

	AMAO 1 (Progress)	AMAO 2 (Proficiency)
AMAO Target	64	15
State Result	75	19

If similar state-level ACCESS for ELLs results are reported for upcoming years, Virginia will be in position to meet or exceed future targets that increase by one point annually. Based on this information and with the absence of other indicators to use as a predictor, the proposed targets for the percent of LEP students making AMAO 1 (progress) and 2 (proficiency) through 2013-2014 are provided in the chart below.

**English Language Proficiency Performance Targets for
AMAO 1 (Progress) and AMAO 2 (Proficiency) for
2009-2010 through 2013-2014**

School Year	Percent of LEP Students Making Progress in Learning English (AMAO 1)	Percent of LEP Students Attaining English Proficiency (AMAO 2)
2009-2010	64*	15*
2010-2011	65	16
2011-2012	66	17
2012-2013	67	18
2013-2014	68	19

*accepted by USED

Superintendent's Recommendation:

The Superintendent of Public Instruction recommends that the Board of Education accept for first review the proposed English language proficiency performance targets for AMAO 1 (progress) and AMAO 2 (proficiency) through 2013-2014 for inclusion in Virginia's Consolidated State Application Accountability Plan.

Impact on Resources:

The provisions of the *Elementary and Secondary Education Act of 1965* (ESEA) require the Department of Education to collect and analyze data related to determining Title III AMAOs for all school divisions in the state. These requirements will continue to have an impact on the agency's resources.

Timetable for Further Review/Action:

The English language proficiency performance targets for AMAO 1 (progress) and AMAO 2 (proficiency) through 2013-2014 will be presented to the Board of Education for final review on March 24, 2011.

Board of Education Agenda Item

Item: _____ L. _____

Date: February 17, 2011

Topic: Annual Report of the Virginia Advisory Committee for Career and Technical Education

Presenter: Ms. Lolita Hall, Director, Office of Career and Technical Education; Mr. Jerry Stewart, Chair; Mr. Byron Hinton, Vice-Chair; Ms. Sandy Hespe, Secretary of the Virginia Advisory Committee for Career and Technical Education

Telephone Number: 804-225-2051

E-Mail Address: LB.Hall@doe.virginia.gov

Origin:

Topic presented for information only (no board action required)

Board review required by
 State or federal law or regulation
 Board of Education regulation
 Other: _____

Action requested at this meeting Action requested at future meeting: _____ (date)

Previous Review/Action:

No previous board review/action

Previous review/action
date _____
action _____

Background Information: The Virginia Advisory Committee for Career and Technical Education is comprised of business and industry leaders, professional organization leaders, and representatives from secondary and postsecondary education who are appointed by the Board of Education. The committee submits an annual report to the Board of Education.

Summary of Major Elements: The report includes a summary of the committee's meetings and recommendations/commendations to the Board.

Superintendent's Recommendation: N/A – non applicable.

Impact on Resources: This activity can be absorbed through existing agency resources at this time. If the agency is required to absorb the additional duties related to this report, other services may be impacted.

Timetable for Further Review/Action: No further action is required.

ANNUAL REPORT

From the

**Virginia Advisory Committee for Career and Technical
Education**

to the

Board of Education

**Jerry Stewart, Chair
Byron Hinton, Vice-Chair
Sandy Hesse, Secretary**

February 17, 2011

The Virginia Advisory Committee for Career and Technical Education (CTE) was organized in 2003. The principal purpose of the Committee is to provide information about the needs of career and technical education students and programs to the Board of Education (BOE) and the Virginia Department of Education (VDOE) and to make recommendations regarding career and technical education.

The advisory committee met five times during the 2009-2010 school year: August 3, 2009; October 8, 2009; January 14, 2010; April 12, 2010; and June 17, 2010.

Membership and Organization

The membership of the Virginia Advisory Committee for Career and Technical Education is composed of persons knowledgeable about and concerned with career and technical education. Initial committee members were appointed by the BOE president, and committee vacancies are filled annually. Once approved by the BOE, new members come onto the committee the following fall. Members reflect all geographic areas of the state whenever possible. Membership for the 2009-2010 school year included nine representatives from business and industry and five representatives from education. The current committee has a total of thirteen members. Members serve three-year staggered terms and may be nominated for a second three-year term up to a maximum of two terms. Officers of the committee are: Jerry Stewart, chair; Byron Hinton, vice chair; and Sandy Hespe, secretary. A list of members for 2009-2010 and 2010-2011 are attached.

Meeting Highlights

The 2009-2010 year was dedicated to refinement and implementation of the program of work for the committee and working with the CTE state staff to monitor program progress. The advisory committee's report is outlined below.

Expected Outcomes

- Meet annual expectation of update to the BOE on the status of CTE in Virginia.
- Provide information on specific areas of focus of our advisory committee.
- Share updates on our program of work.
- Solicit agenda items, topics for consideration, and maintain an "open invitation" for BOE members to attend and participate in our meetings.

Program of Work

- Promotion and marketing in localities and regions of CTE as an essential partner with economic development agencies and businesses.
- Working to establish a "grass roots" transfer of information, concerns, and needs from individual CTE division administrators to the state CTE Advisory Committee.
- Identify opportunities for the integration of academics and career and technical education.

In meeting the annual expectation of update to the Board on the health of CTE in Virginia, we cite the following successes for the 2009-2010 school year:

- Continued increase in the number of industry credentials earned by CTE students;
- Continued increase in the number of Advanced Studies Diplomas earned by CTE students;

- Continual growth in the Science, Technology, Engineering, and Mathematics (STEM) initiatives and programs;
- Completion of career pathway sample plans of study for all 79 nationally identified career pathways;
- Implemented initial assignment of state advisory committee members for communication with regional CTE administrators and committees; and
- Continued work on the development of a marketing strategy and program for CTE curriculum as an enhancement to local regional economic and work force development.
 - This initiative aligns and supports the in-progress work by the Governor’s Workforce Development effort led by Dr. Robert Leber.

The following are currently specific areas of focus of the CTE Advisory Committee:

Support for industry certification programs.

- Industry certification is highly regarded in the business community as an independent verification of skills sets.
- Industry certification is also validated as a third-party assessment that combines with classroom assessment of student competencies to meet the Perkins Technical Skills Assessment Performance Standard.
- Industry certification was supported and endorsed during the Governor’s Forum: Aligning the Agendas for Education, Economic Development, and Business.
- The current support for the industry certifications has enabled Virginia to lead the nation in secondary students obtaining industry credentials. As the number of CTE completers earning industry credentials increases, the need for support increases.
- The value of industry credentials needs to be promoted.

Continue to increase the rigor of CTE programs/courses.

- Promote increased opportunities for collaborative instruction between core academic courses and CTE courses.
- Promote increased utilization of lesson plans that are developed collaboratively by core academics and CTE instructors for CTE competencies/tasks that are correlated to the Standards of Learning.
- Integrate CTE instruction with academics through STEM initiatives and Career Pathways programming.
- Review collaboratively developed lesson plans and begin process of identifying ways to add rigor.

The Virginia Advisory Committee for Career and Technical Education commends the continued support for career and technical education by the Board of Education.

2009 Virginia Advisory Committee for Career and Technical Education

Ms. Theresa Bryant
July 1, 06-June 30, 09

Vice President
Workforce Development
Tidewater Community College

Mr. Johnny Cates
July 1, 06-June 30, 09

Executive Director AYES Program
Virginia Auto Dealers Association

Mr. John E. Cotton
July 17, 08-June 30, 11

Director
Environmental Health, Safety & Security

Mr. Alan R. Hawthorne
July 17, 08-June 30, 11

Executive Director, Joint Industrial
Development Authority of Wythe County

Ms. Sandy Hesse
July 1, 07-June 30, 10
Secretary

Instructional Specialist
York County Public Schools

Mr. Byron K. Hinton
July 17, 08-June 30, 11

Chairman, Stafford County Career and
Technical Education Committee

Ms. Virginia R. Jones
July 17, 08-June 30, 11

Supervisor of Academies
Halifax County Public Schools

Mr. Mike Mills
July 1, 07-June 30, 10
Chair

Corporate Distribution Manager
American Woodmark Corporation

Mr. Toney Rigali
July 1, 07-June 30, 10

Lead Organizer
Virginia Pipe Trades Association

Mrs. Judy Sorrell
July 1, 07-June 30, 10
Vice-Chair

Director
Shenandoah Valley Regional Program

Mr. Jerry W. Stewart
July 17, 08-June 30, 11

Workforce Development Coordinator
City of Virginia Beach Economic
Development Division

Dr. Brenda Long

VACTE Liaison

Virginia Advisory Committee for Career and Technical Education

October, 2010

Ms. Karen DeRoche Black

Sept. 23, 10 – Oct. 23, 13

Technology Academy Coordinator
Chesapeake City

Ms. Anne Carson

Sept. 23, 10 – Oct. 23, 13

President Elect of the Virginia PTA
Glen Allen

Mrs. Jane S. Foy

August, 09 – Sept. 1, 12

Co-host and Producer
WINA Morning News Program, Charlottesville

Dr. Alan G. Hawthorne

July 17, 08 – June 30, 11

Executive Director, Joint Industrial Development
Authority of Wythe County

Ms. Sandy Hespe, Secretary

July 1, 07 – June 30, 13

Instructional Specialist
York County Public Schools

Mr. Byron K. Hinton,

July 17, 08 – June 30, 11

Vice Chair Chairman, Stafford County Career and
Technical Education Committee

Dr. Virginia R. Jones

July 17, 08 – June 30, 11

Director, Instructional Design and Technology
Ferrum College

Mrs. Lynn May

August, 09 – Sept. 1, 12

Registered Nurse
Mathews County

Dr. Robert Mayfield

Sept. 23, 10 – Oct. 23, 13

Plant Manager, Tenaska
Scottsville

Mr. Allan L. Melton

August, 09 – Sept. 1, 12

Manager of Product Training
The Apprentice School, Northrop Grumman, Poquoson

Mr. Frederick Norman

August, 09 – Sept. 1, 12

Owner, Commonwealth of Virginia Consulting
LLC, Chesterfield

Mr. Chad S. Ratliff

August, 09 – Sept. 1, 12

Assistant Director of Instruction & Innovation
Projects, Charlottesville

Mr. Jerry W. Stewart, Chair

July 17, 08 – June 30, 11

Workforce Development Coordinator
City of Virginia Beach Economic Development Division

Dr. Brenda Long

July, 08

VACTE Liaison

October 28, 2010

Board of Education Agenda Item

Item: M.

Date: February 17, 2011

Topic: Report on Virginia's College and Career Readiness Initiative and *College and Career Ready Mathematics Performance Expectations*

Presenter: Dr. Deborah Jonas, Executive Director, Research and Strategic Planning

Telephone Number: 804-225-2067 **E-Mail Address:** Deborah.Jonas@doe.virginia.gov

Origin:

Topic presented for information only (no board action required)

Board review required by

State or federal law or regulation

Board of Education regulation

Other: _____

Action requested at this meeting Action requested at future meeting: _____ (date)

Previous Review/Action:

No previous board review/action

Previous review/action

Date:

Action:

Background Information:

In January 2007, the Board of Education authorized the Virginia Department of Education (VDOE) to conduct studies to determine factors that contribute to success in postsecondary education. This critical component of Virginia's College and Career Readiness Initiative included an external analysis and validation of the *Standards of Learning (SOL)* in English and mathematics. As a result, Achieve, the College Board, and ACT conducted studies comparing their respective standards for postsecondary readiness to the Virginia *SOL* in English/Reading and Mathematics. In 2009 the Board adopted revised *SOL* in mathematics. The revised standards reflect the substantial input and recommended changes provided by college faculty and other experts from the College Board, ACT, Achieve (the American Diploma Project), and the business community.

In June 2010, the National Governors Association (NGA) and the Council of Chief State School Officers (CCSSO) released the *Common Core State Standards for Mathematics*. As Achieve, The College Board, and ACT were partners with NGA and CCSSO, their earlier work with states in the ADP Network provided a foundation upon which the *Common Core State Standards for Mathematics* were developed.

In the fall of 2010, Department staff and external reviewers conducted analyses to ensure Virginia's *Mathematics SOL* and *Curriculum Framework* met or exceeded the *Common Core State Standards for Mathematics*. The review identified some additional concepts that were recommended for incorporation into the *Mathematics SOL Curriculum Framework*. At its January 13, 2011, meeting, the Board of Education adopted a supplement to the revised *Mathematics SOL Curriculum Framework* and accepted the final Report of the Analysis of Virginia's 2009 *Mathematics Standards of Learning* compared to the *Common Core State Standards for Mathematics*.

Summary of Major Elements

The identification of college and career ready mathematics performance expectations has been a critical component of Virginia's ongoing College and Career Readiness Initiative to prepare all students for success in postsecondary education and careers. The expectations are intended to define the level of achievement students must reach to be academically prepared for entry-level, credit-bearing, college courses in mathematics and/or further career and technical training. To develop the performance expectations, VDOE worked in partnership with Virginia's higher education agencies, the Virginia Community College System (VCCS), and the State Council of Higher Education for Virginia (SCHEV).

To facilitate the collaborative work between VDOE, VCCS, and SCHEV partners, the Department identified preliminary college and career ready mathematics performance expectations using the *Mathematics Standards of Learning*, the *Mathematics SOL Curriculum Framework*, and other validated state and national college and career readiness standards, including the *Common Core State Standards for Mathematics*. It was found that certain *Mathematics Standards of Learning* from middle school grades and high school courses correlated highly with the national college and career ready standards.

With assistance from VCCS and SCHEV in recruitment, faculty from Virginia's two- and four-year institutions of higher education provided feedback on the preliminary college and career ready mathematics performance expectations. More than 100 higher education respondents participated in the survey.

A mathematics consensus/review team composed of faculty from two- and four-year higher education institutions and secondary content area experts analyzed the survey data and made recommendations to VDOE on which performance expectations reached the level of "important" or "critical" for college and career readiness. Virginia's *College and Career Ready Mathematics Performance Expectations*, included as Attachment A, represent the consensus/review team's recommendation to the Department. A correlation crosswalk between Virginia's *College and Career Ready Mathematics Performance Expectations* and the *Common Core State Standards for Mathematics* is provided as Attachment B.

The completion of the *Mathematics Performance Expectations* finalizes the work that is one of five components of Virginia's College and Career Readiness Initiative. In support of the initiative, the Department continues to conduct research to further understand associations between secondary outcomes and postsecondary success. The Department, in collaboration with its partners, has also made progress on several other components. Below is a list of each component and a status update of the ongoing work of Virginia's College and Career Readiness Initiative.

- 1) Defining college and career ready performance expectations aligned to national and international college and career ready standards.
 - VDOE, in collaboration with VCCS and SCHEV have collaboratively established Virginia's College and Career Ready Performance Expectations. The *English Performance Expectations* were completed in November 2010, and the *Mathematics Performance Expectations*, presented in this document, finalize this component of the work.
- 2) Developing elective "capstone courses" to support students who need additional instruction to meet college and career ready performance expectations before leaving high school
 - VDOE has drafted course descriptions, program objectives, sample teaching strategies, and delivery options to define the grade-12 capstone courses. Course codes have been identified.
 - In combination with technical assistance and professional development, the course development is intended to enable school divisions to implement the capstone courses in the fall of 2011. At least two school divisions are in the process of finalizing commitments with VDOE to pilot the courses with support from Virginia's institutions of higher education.
- 3) Providing technical assistance and professional development to Virginia's educators to support implementation of the revised English and mathematics standards and the college and career ready performance expectations.
 - The Department has commitments from four state universities to pilot the establishment of professional development centers to support schools in their efforts to improve students' preparation for college and careers. These centers will provide coursework and ongoing teacher support for the content of the college and career ready performance expectations. The work will be accomplished through federal teacher training funds. As part of their work, the centers will develop sample capstone course materials so that teachers can teach secondary courses more effectively and be ready to teach the capstone courses when their divisions implement the programs.
 - The State Council of Higher Education for Virginia has issued a request for proposals that establishes as a priority support for teacher professional development on the performance expectations. These grants require collaboration between the school divisions being served, and four-year universities, to include colleges of education and arts and sciences within the higher education institutions. The program is funded with federal funds from Title IIa, *Elementary and Secondary Education Act*.
- 4) Aligning the state assessments to measure student mastery of the more rigorous mathematics and English standards adopted in 2009 and 2010.
 - As new tests in mathematics and English are developed to align to Virginia's revised *Standards of Learning*, certain high school end-of-course tests are being designed to include quantitative indicators of whether students have met or exceeded the achievement levels needed to be successful in introductory mathematics and English courses in college.
- 5) Identifying accountability measures and incentives for schools to increase the percentage of students who graduate high school having demonstrated the academic and career skills needed to be successful in postsecondary education programs.

- Virginia's Virginia Index of Performance (VIP) is an incentive program that rewards schools and school divisions for exceeding minimum accountability requirements. From its inception, the program has included indicators of college and career readiness. The board took action on proposed revisions to the program at the February 2011 meeting to provide additional incentives for school divisions and schools to strengthen incentives to increase students' college and career readiness, as well as promote student achievement in science, technology, engineering, and mathematics (STEM) areas.
- The Department has started a crucial dialogue with its partners in the higher education community and policy makers to determine whether it is appropriate to provide additional incentives to schools that make gains in increasing students' preparation for college. As well, there might be incentives available directly to students who meet or exceed Virginia's CCR Performance Expectations, with a particular focus on student groups who have been underrepresented in postsecondary education and training programs. For example, the Southern Regional Education Board (SREB) has recommended that Virginia's public postsecondary institutions adopt a policy that would permit direct enrollment in entry-level, credit-bearing college courses for students who meet or exceed the readiness performance standards on the eleventh-grade English reading and writing assessments and the Algebra II end-of-course assessment. The policy would exempt these students from additional placement or readiness testing, thereby reducing the costs and time associated with such testing. Further, this policy would afford more students the opportunity to earn credits towards college graduation.

Superintendent's Recommendation:

The Superintendent of Public Instruction recommends that the Board of Education accept the Report on Virginia's College and Career Readiness Initiative and *College and Career Ready Mathematics Performance Expectations*.

Impact on Resources:

The work to date has been completed with existing Department resources and consulting staff support from the SREB through a grant from the Bill and Melinda Gates Foundation. Funding for the SREB grant will end February 28, 2011. Additional responsibilities related to this activity may affect other Department services.

Timetable for Further Review/Action:

The Department will update the Board of Education as additional components and materials for Virginia's *College and Career Readiness Initiative* are developed.

Virginia's College and Career Ready *Mathematics Performance Expectations*

The Mathematics Performance Expectations (MPE) define the content and level of achievement students must reach to be academically prepared for success in entry-level, credit-bearing mathematics courses in college. They were developed through a process that involved faculty from Virginia's two- and four-year colleges and universities, members of the business community, and high school mathematics educators. The MPE are organized into four interacting and overlapping strands that include content in the areas of algebra and functions, statistics, geometry, mathematical analysis, and trigonometry. This particular strand structure is one of several ways the performance expectations can be organized. The structure is not intended to be a curriculum organizer, as each expectation interacts with many others in a range of problem-solving, modeling, and decision-making situations.

Problem Solving, Decision Making, and Integration

Students will apply algebraic, geometric, and statistical concepts and the relationships among them to solve problems, model relations, and make decisions using data and situations within and outside of mathematics. In accomplishing this goal, students will develop and enhance a repertoire of skills and strategies for solving a variety of problem types.

- 1) Solve practical problems involving rational numbers (including numbers in scientific notation), percents, ratios, and proportions.
- 2) Collect and analyze data, determine the equation of the curve of best fit, make predictions, and solve real-world problems using mathematical models. Mathematical models will include polynomial, exponential, and logarithmic functions.
- 3) Use pictorial representations, including computer software, constructions, and coordinate methods, to solve problems involving symmetry and transformation. This will include
 - a) investigating and using formulas for finding distance, midpoint, and slope;
 - b) applying slope to verify and determine whether lines are parallel or perpendicular;
 - c) investigating symmetry and determining whether a figure is symmetric with respect to a line or a point; and
 - d) determining whether a figure has been translated, reflected, rotated, or dilated, using coordinate methods.
- 4) Verify characteristics of quadrilaterals and use properties of quadrilaterals to solve real-world problems.
- 5) Solve real-world problems involving right triangles by using the Pythagorean Theorem and its converse, properties of special right triangles, and right triangle trigonometry.
- 6) Use formulas for surface area and volume of three-dimensional objects to solve real-world problems.

- 7) Use similar geometric objects in two- or three-dimensions to
 - a) compare ratios between side lengths, perimeters, areas, and volumes;
 - b) determine how changes in one or more dimensions of an object affect area and/or volume of the object;
 - c) determine how changes in area and/or volume of an object affect one or more dimensions of the object; and
 - d) solve real-world problems about similar geometric objects.
- 8) Compare distributions of two or more univariate data sets, analyzing center and spread (within group and between group variations), clusters and gaps, shapes, outliers, or other unusual features.
- 9) Design and conduct an experiment/survey. Key concepts include
 - a) sample size;
 - b) sampling technique;
 - c) controlling sources of bias and experimental error;
 - d) data collection; and
 - e) data analysis and reporting.
- 10) Investigate and apply the properties of arithmetic and geometric sequences and series to solve real-world problems, including writing the first n terms, finding the n th term, and evaluating summation formulas. Notation will include Σ and a_n .
- 11) Use angles, arcs, chords, tangents, and secants to
 - a) investigate, verify, and apply properties of circles;
 - b) solve real-world problems involving properties of circles; and
 - c) find arc lengths and areas of sectors in circles.

Understanding and Applying Functions

Students will be able to recognize, use, and interpret various functions and their representations, including verbal descriptions, tables, equations, and graphs to make predictions and analyze relationships in solving complex, real-world mathematical problems.

- 12) Transfer between and analyze multiple representations of functions, including algebraic formulas, graphs, tables, and words. Select and use appropriate representations for analysis, interpretation, and prediction.
- 13) Investigate and describe the relationships among solutions of an equation, zeros of a function, x -intercepts of a graph, and factors of a polynomial expression.
- 14) Recognize the general shape of function (absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic) families and convert between graphic and symbolic forms of functions. Use a transformational approach to graphing. Use graphing calculators as a tool to investigate the shapes and behaviors of these functions.
- 15) Use knowledge of transformations to write an equation, given the graph of a function (linear, quadratic, exponential, and logarithmic).

- 16) Investigate and analyze functions (linear, quadratic, exponential, and logarithmic families) algebraically and graphically. Key concepts include
- a) continuity;
 - b) local and absolute maxima and minima;
 - c) domain and range, including limited and discontinuous domains and ranges;
 - d) zeros;
 - e) x- and y-intercepts;
 - f) intervals in which a function is increasing or decreasing;
 - g) asymptotes;
 - h) end behavior;
 - i) inverse of a function;
 - j) composition of multiple functions;
 - k) finding the values of a function for elements in its domain; and
 - l) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic, and algebraic.
- 17) Determine optimal values in problem situations by identifying constraints and using linear programming techniques.

Procedure and Calculation

Students will be able to perform and justify steps in mathematical procedures and calculations and graph and solve a range of equations types. Students will reason from a variety of representations such as graphs, tables, and charts and will use displays of univariate data to identify and interpret patterns. Students will be able to calculate probabilities and analyze distributions of data to make decisions.

- 18) Given rational, radical, or polynomial expressions,
- a) add, subtract, multiply, divide, and simplify rational algebraic expressions;
 - b) add, subtract, multiply, divide, and simplify radical expressions containing rational numbers and variables, and expressions containing rational exponents;
 - c) write radical expressions as expressions containing rational exponents and vice versa; and
 - d) factor polynomials completely.
- 19) Graph linear equations and linear inequalities in two variables, including
- a) determining the slope of a line when given an equation of the line, the graph of the line, or two points on the line; describing slope as rate of change and determine if it is positive, negative, zero, or undefined; and
 - b) writing the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line.
- 20) Given a point other than the origin on the terminal side of an angle, use the definitions of the six trigonometric functions to find the sine, cosine, tangent, cotangent, secant, and cosecant of the angle in standard position. Relate trigonometric functions defined on the unit circle to trigonometric functions defined in right triangles.
- 21) Given the coordinates of the center of a circle and a point on the circle, write the equation of the circle.

- 22) Analyze graphical displays of univariate data, including dotplots, stemplots, and histograms, to identify and describe patterns and departures from patterns, using central tendency, spread, clusters, gaps, and outliers. Use appropriate technology to create graphical displays.
- 23) Analyze the normal distribution. Key concepts include
- characteristics of normally distributed data;
 - percentiles;
 - normalizing data, using z-scores; and
 - area under the standard normal curve and probability.
- 24) Describe orally and in writing the relationships between the subsets of the real number system.
- 25) Perform operations on complex numbers, express the results in simplest form using patterns of the powers of i , and identify field properties that are valid for the complex numbers.
- 26) Solve, algebraically and graphically,
- absolute value equations and inequalities;
 - quadratic equations over the set of complex numbers;
 - equations containing rational algebraic expressions; and
 - equations containing radical expressions.

Use graphing calculators for solving and for confirming the algebraic solutions.

- 27) Given one of the six trigonometric functions in standard form,
- state the domain and the range of the function;
 - determine the amplitude, period, phase shift, vertical shift, and asymptotes;
 - sketch the graph of the function by using transformations for at least a two-period interval; and
 - investigate the effect of changing the parameters in a trigonometric function on the graph of the function.
- 28) Find, without the aid of a calculator, the values of the trigonometric functions of the special angles and their related angles as found in the unit circle. This includes converting angle measures from radians to degrees and vice versa.
- 29) Investigate and identify the characteristics of conic section equations in (h, k) and standard forms. Use transformations in the coordinate plane to graph conic sections.
- 30) Using two-way tables, analyze categorical data to describe patterns and departure from patterns and to find marginal frequency and relative frequencies, including conditional frequencies.
- 31) Calculate probabilities. Key concepts include
- conditional probability;
 - dependent and independent events;
 - addition and multiplication rules;
 - counting techniques (permutations and combinations); and
 - Law of Large Numbers.

Verification and Proof

Students will recognize verification and proof as fundamental aspects of mathematical reasoning. Students will integrate and apply inductive and deductive reasoning skills to make, test, and evaluate mathematical statements. This applies equally through simple mathematical calculations, in geometric applications, and more abstract statistical and algebraic processes. Students will use logical reasoning to analyze an argument and to determine whether conclusions are valid.

- 32) Use the relationships between angles formed by two lines cut by a transversal to
 - a) determine whether two lines are parallel;
 - b) verify the parallelism, using algebraic and coordinate methods as well as deductive proofs; and
 - c) solve real-world problems involving angles formed when parallel lines are cut by a transversal.
- 33) Given information in the form of a figure or statement, prove two triangles are congruent, using algebraic and coordinate methods as well as deductive proofs.
- 34) Given information in the form of a figure or statement, prove two triangles are similar, using algebraic and coordinate methods as well as deductive proofs.
- 35) Construct and justify the constructions of
 - a) a line segment congruent to a given line segment;
 - b) the perpendicular bisector of a line segment;
 - c) a perpendicular to a given line from a point not on the line;
 - d) a perpendicular to a given line at a given point on the line;
 - e) the bisector of a given angle,
 - f) an angle congruent to a given angle; and
 - g) a line parallel to a given line through a point not on the given line.
- 36) Verify basic trigonometric identities and make substitutions, using the basic identities.

**Comparison of
Virginia's College and Career Ready
Mathematics Performance Expectations
with the Common Core State Standards for
Mathematics**

February 17, 2010

Common Core State Standards for Mathematics Mathematics Standards for High School ¹ Number and Quantity	Virginia's Mathematics Performance Expectation
The Real Number System	
Extend the properties of exponents to rational exponents	
1. Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. <i>For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.</i>	MPE.18 Given rational, radical, or polynomial expressions, a) add, subtract, multiply, divide, and simplify rational algebraic expressions; b) add, subtract, multiply, divide, and simplify radical expressions containing rational numbers and variables, and expressions containing rational exponents; c) write radical expressions as expressions containing rational exponents and vice versa; and d) factor polynomials completely. (SOL AII.1)
2. Rewrite expressions involving radicals and rational exponents using the properties of exponents.	
Use properties of rational and irrational numbers	
3. Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.	MPE.24 Describe orally and in writing the relationships between the subsets of the real number system. (SOL 8.2)

¹ According to the *Common Core State Standards (CCSS) for Mathematics*, the CCSS high school standards specify the mathematics that all students should study in order to be college and career ready. The *CCSS for Mathematics* also includes additional mathematics that students should learn in order to take advanced courses such as calculus, advanced statistics, or discrete mathematics, as indicated by “(+).” This document includes all CCSS high school standards and the CCSS additional mathematics standards that align with Virginia’s *College and Career Ready Mathematics Performance Expectations*.

Common Core State Standards for Mathematics Mathematics Standards for High School ¹ Number and Quantity	Virginia's Mathematics Performance Expectation
Quantities	
Reason quantitatively and use units to solve problems	
1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.	MPE.1 Solve practical problems involving rational numbers (including numbers in scientific notation), percents, ratios, and proportions. (SOL 8.3, 8.1b)
2. Define appropriate quantities for the purpose of descriptive modeling.	
3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	
The Complex Number System	
Perform arithmetic operations with complex numbers	
1. Know there is a complex number i such that $i^2 = -1$, and every complex number has the form $a + bi$ with a and b real.	MPE.25 Perform operations on complex numbers, express the results in simplest form using patterns of the powers of i, and identify field properties that are valid for the complex numbers. (SOL AII.3)
2. Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.	
3. (+) Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.	
Use complex numbers in polynomial identities and equations	
7. Solve quadratic equations with real coefficients that have complex solutions.	MPE.26 Solve, algebraically and graphically, a) absolute value equations and inequalities; b) quadratic equations over the set of complex numbers; c) equations containing rational algebraic expressions; and d) equations containing radical expressions. Use graphing calculators for solving and for confirming the algebraic solutions. (SOL AII.4)
8. (+) Extend polynomial identities to the complex numbers. <i>For example, rewrite $x^2 + 4$ as $(x + 2i)(x - 2i)$.</i>	

Common Core State Standards for Mathematics Mathematics Standards for High School¹ Number and Quantity	Virginia's Mathematics Performance Expectation
9. (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.	MPE.13 Investigate and describe the relationships among solutions of an equation, zeros of a function, x-intercepts of a graph, and factors of a polynomial expression. (SOL AII.8)

Common Core State Standards for Mathematics Mathematics Standards for High School Algebra	Virginia's Mathematics Performance Expectation
Seeing Structure in Expressions	
Interpret the structure of expressions	
1. Interpret expressions that represent a quantity in terms of its context.	
a. Interpret parts of an expression, such as terms, factors, and coefficients.	MPE.26 Solve, algebraically and graphically, a) absolute value equations and inequalities; b) quadratic equations over the set of complex numbers; c) equations containing rational algebraic expressions; and d) equations containing radical expressions. Use graphing calculators for solving and for confirming the algebraic solutions. (SOL AII.4)
b. Interpret complicated expressions by viewing one or more of their parts as a single entity. <i>For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P.</i>	
2. Use the structure of an expression to identify ways to rewrite it. <i>For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.</i>	MPE.18 Given rational, radical, or polynomial expressions, a) add, subtract, multiply, divide, and simplify rational algebraic expressions; b) add, subtract, multiply, divide, and simplify radical expressions containing rational numbers and variables, and expressions containing rational exponents; c) write radical expressions as expressions containing rational exponents and vice versa; and d) factor polynomials completely. (SOL AII.1)
Write expressions in equivalent forms to solve problems	
3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.	
a. Factor a quadratic expression to reveal the zeros of the function it defines.	MPE.16 Investigate and analyze functions (linear, quadratic, exponential, and logarithmic families) algebraically and

<p align="center">Common Core State Standards for Mathematics Mathematics Standards for High School Algebra</p>	<p align="center">Virginia's Mathematics Performance Expectation</p>
	<p>graphically. Key concepts include</p> <ul style="list-style-type: none"> a) continuity; (SOL AFDA.1) b) local and absolute maxima and minima; (SOL AFDA.1) c) domain and range, including limited and discontinuous domains and ranges; d) zeros; e) x- and y-intercepts; f) intervals in which a function is increasing or decreasing; g) asymptotes; h) end behavior; i) inverse of a function; j) composition of multiple functions; k) finding the values of a function for elements in its domain; (SOL A.7) and l) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic, and algebraic. (SOL A.7) <p>(SOL AII.7)</p> <p>MPE.18 Given rational, radical, or polynomial expressions,</p> <ul style="list-style-type: none"> a) add, subtract, multiply, divide, and simplify rational algebraic expressions; b) add, subtract, multiply, divide, and simplify radical expressions containing rational numbers and variables, and expressions containing rational exponents; c) write radical expressions as expressions containing rational exponents and vice versa; and d) factor polynomials completely. <p>(SOL AII.1)</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Algebra	Virginia's Mathematics Performance Expectation
	<p>MPE.26 Solve, algebraically and graphically,</p> <ul style="list-style-type: none"> a) absolute value equations and inequalities; b) quadratic equations over the set of complex numbers; c) equations containing rational algebraic expressions; and d) equations containing radical expressions. <p>Use graphing calculators for solving and for confirming the algebraic solutions.</p> <p>(SOL AII.4)</p>
<p>b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.</p>	<p>MPE.16 Investigate and analyze functions (linear, quadratic, exponential, and logarithmic families) algebraically and graphically. Key concepts include</p> <ul style="list-style-type: none"> a) continuity; (SOL AFDA.1) b) local and absolute maxima and minima; (SOL AFDA.1) c) domain and range, including limited and discontinuous domains and ranges; d) zeros; e) x- and y-intercepts; f) intervals in which a function is increasing or decreasing; g) asymptotes; h) end behavior; i) inverse of a function; j) composition of multiple functions; k) finding the values of a function for elements in its domain; (SOL A.7) and l) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic, and algebraic. (SOL A.7) <p>(SOL AII.7)</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Algebra	Virginia's Mathematics Performance Expectation
	<p>MPE.18 Given rational, radical, or polynomial expressions, a) add, subtract, multiply, divide, and simplify rational algebraic expressions; b) add, subtract, multiply, divide, and simplify radical expressions containing rational numbers and variables, and expressions containing rational exponents; c) write radical expressions as expressions containing rational exponents and vice versa; and d) factor polynomials completely. (SOL AII.1)</p>
<p>c. Use the properties of exponents to transform expressions for exponential functions. <i>For example the expression 1.15^t can be rewritten as $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.</i></p>	<p>MPE.2 Collect and analyze data, determine the equation of the curve of best fit, make predictions, and solve real-world problems using mathematical models. Mathematical models will include polynomial, exponential, and logarithmic functions. (SOL AII.9)</p> <p>MPE.18 Given rational, radical, or polynomial expressions, a) add, subtract, multiply, divide, and simplify rational algebraic expressions; b) add, subtract, multiply, divide, and simplify radical expressions containing rational numbers and variables, and expressions containing rational exponents; c) write radical expressions as expressions containing rational exponents and vice versa; and d) factor polynomials completely. (SOL AII.1)</p>
<p>4. Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. <i>For example, calculate mortgage payments.</i></p>	<p>MPE.10 Investigate and apply the properties of arithmetic and geometric sequences and series to solve real-world problems, including writing the first n terms, finding the nth term, and</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Algebra	Virginia's Mathematics Performance Expectation
	evaluating summation formulas. Notation will include Σ and a_n . (SOL AII.2)
Arithmetic with Polynomials and Rational Expressions	
Perform arithmetic operations on polynomials	
1. Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.	<p>MPE.18 Given rational, radical, or polynomial expressions,</p> <p>a) add, subtract, multiply, divide, and simplify rational algebraic expressions;</p> <p>b) add, subtract, multiply, divide, and simplify radical expressions containing rational numbers and variables, and expressions containing rational exponents;</p> <p>c) write radical expressions as expressions containing rational exponents and vice versa; and</p> <p>d) factor polynomials completely.</p> <p>(SOL AII.1)</p> <p>MPE.26 Solve, algebraically and graphically,</p> <p>a) absolute value equations and inequalities;</p> <p>b) quadratic equations over the set of complex numbers;</p> <p>c) equations containing rational algebraic expressions; and</p> <p>d) equations containing radical expressions.</p> <p>Use graphing calculators for solving and for confirming the algebraic solutions.</p> <p>(SOL AII.4)</p>
Understand the relationship between zeros and factors of polynomials	
2. Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a , the remainder on division by $x - a$ is $p(a)$, so $p(a) = 0$ if and only if $(x - a)$ is a factor of $p(x)$.	<p>MPE.18 Given rational, radical, or polynomial expressions,</p> <p>a) add, subtract, multiply, divide, and simplify rational algebraic expressions;</p> <p>b) add, subtract, multiply, divide, and simplify radical expressions</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Algebra	Virginia's Mathematics Performance Expectation
	<p>containing rational numbers and variables, and expressions containing rational exponents;</p> <p>c) write radical expressions as expressions containing rational exponents and vice versa; and</p> <p>d) factor polynomials completely. (SOL AII.1)</p>
<p>3. Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.</p>	<p>MPE.13 Investigate and describe the relationships among solutions of an equation, zeros of a function, x-intercepts of a graph, and factors of a polynomial expression. (SOL AII.8)</p> <p>MPE.16 Investigate and analyze functions (linear, quadratic, exponential, and logarithmic families) algebraically and graphically. Key concepts include</p> <p>a) continuity; (SOL AFDA.1)</p> <p>b) local and absolute maxima and minima; (SOL AFDA.1)</p> <p>c) domain and range, including limited and discontinuous domains and ranges;</p> <p>d) zeros;</p> <p>e) x- and y-intercepts;</p> <p>f) intervals in which a function is increasing or decreasing;</p> <p>g) asymptotes;</p> <p>h) end behavior;</p> <p>i) inverse of a function;</p> <p>j) composition of multiple functions;</p> <p>k) finding the values of a function for elements in its domain; (SOL A.7) and</p> <p>l) making connections between and among multiple representations of functions including concrete, verbal, numeric,</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Algebra	Virginia's Mathematics Performance Expectation
	graphic, and algebraic. (SOL A.7) (SOL AII.7)
Use polynomial identities to solve problems	
4. Prove polynomial identities and use them to describe numerical relationships. <i>For example, the polynomial identity $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples.</i>	MPE.18 Given rational, radical, or polynomial expressions, a) add, subtract, multiply, divide, and simplify rational algebraic expressions; b) add, subtract, multiply, divide, and simplify radical expressions containing rational numbers and variables, and expressions containing rational exponents; c) write radical expressions as expressions containing rational exponents and vice versa; and d) factor polynomials completely. (SOL AII.1)
Rewrite rational expressions	
6. Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system.	MPE.18 Given rational, radical, or polynomial expressions, a) add, subtract, multiply, divide, and simplify rational algebraic expressions; b) add, subtract, multiply, divide, and simplify radical expressions containing rational numbers and variables, and expressions containing rational exponents; c) write radical expressions as expressions containing rational exponents and vice versa; and d) factor polynomials completely. (SOL AII.1)
7. (+) Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.	MPE.18 Given rational, radical, or polynomial expressions, a) add, subtract, multiply, divide, and simplify rational algebraic expressions; b) add, subtract, multiply, divide, and simplify radical expressions containing rational numbers and variables, and expressions containing rational exponents; c) write radical expressions as expressions containing rational exponents and vice versa; and d) factor polynomials completely. (SOL AII.1)
Creating Equations	
Create equations that describe numbers or relationships	
1. Create equations and inequalities in one variable and use them to solve problems. <i>Include equations arising from linear</i>	MPE.16 Investigate and analyze functions (linear, quadratic, exponential, and logarithmic families) algebraically and

Common Core State Standards for Mathematics Mathematics Standards for High School Algebra	Virginia's Mathematics Performance Expectation
<p><i>and quadratic functions, and simple rational and exponential functions.</i></p>	<p>graphically. Key concepts include</p> <ul style="list-style-type: none"> a) continuity; (SOL AFDA.1) b) local and absolute maxima and minima; (SOL AFDA.1) c) domain and range, including limited and discontinuous domains and ranges; d) zeros; e) x- and y-intercepts; f) intervals in which a function is increasing or decreasing; g) asymptotes; h) end behavior; i) inverse of a function; j) composition of multiple functions; k) finding the values of a function for elements in its domain; (SOL A.7) and l) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic, and algebraic. (SOL A.7) <p>(SOL AII.7)</p> <p>MPE.26 Solve, algebraically and graphically,</p> <ul style="list-style-type: none"> a) absolute value equations and inequalities; b) quadratic equations over the set of complex numbers; c) equations containing rational algebraic expressions; and d) equations containing radical expressions. <p>Use graphing calculators for solving and for confirming the algebraic solutions.</p> <p>(SOL AII.4)</p>
<p>2. Create equations in two or more variables to represent relationships between quantities; graph equations on</p>	<p>MPE.19 Graph linear equations and linear inequalities in two variables, including</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Algebra	Virginia's Mathematics Performance Expectation
coordinate axes with labels and scales.	<p>a) determining the slope of a line when given an equation of the line, the graph of the line, or two points on the line; describing slope as rate of change and determine if it is positive, negative, zero, or undefined; and</p> <p>b) writing the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line. (SOL A.6)</p> <p>MPE.26 Solve, algebraically and graphically,</p> <p>a) absolute value equations and inequalities;</p> <p>b) quadratic equations over the set of complex numbers;</p> <p>c) equations containing rational algebraic expressions; and</p> <p>d) equations containing radical expressions.</p> <p>Use graphing calculators for solving and for confirming the algebraic solutions. (SOL AII.4)</p>
3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. <i>For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.</i>	<p>MPE.17 Determine optimal values in problem situations by identifying constraints and using linear programming techniques. (SOL AFDA.5)</p> <p>MPE.26 Solve, algebraically and graphically,</p> <p>a) absolute value equations and inequalities;</p> <p>b) quadratic equations over the set of complex numbers;</p> <p>c) equations containing rational algebraic expressions; and</p> <p>d) equations containing radical expressions.</p> <p>Use graphing calculators for solving and for confirming the algebraic solutions. (SOL AII.4)</p>
4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. <i>For example,</i>	<p>MPE.26 Solve, algebraically and graphically,</p> <p>a) absolute value equations and inequalities;</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Algebra	Virginia's Mathematics Performance Expectation
<i>rearrange Ohm's law $V = IR$ to highlight resistance R.</i>	b) quadratic equations over the set of complex numbers; c) equations containing rational algebraic expressions; and d) equations containing radical expressions. Use graphing calculators for solving and for confirming the algebraic solutions. (SOL AII.4)
Reasoning with Equations and Inequalities	
Understand solving equations as a process of reasoning and explain the reasoning	
1. Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.	MPE.26 Solve, algebraically and graphically, a) absolute value equations and inequalities; b) quadratic equations over the set of complex numbers; c) equations containing rational algebraic expressions; and d) equations containing radical expressions. Use graphing calculators for solving and for confirming the algebraic solutions. (SOL AII.4)
2. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.	MPE.26 Solve, algebraically and graphically, a) absolute value equations and inequalities; b) quadratic equations over the set of complex numbers; c) equations containing rational algebraic expressions; and d) equations containing radical expressions. Use graphing calculators for solving and for confirming the algebraic solutions. (SOL AII.4)
Solve equations and inequalities in one variable	
3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.	MPE.17 Determine optimal values in problem situations by identifying constraints and using linear programming techniques. (SOL AFDA.5) MPE.26 Solve, algebraically and graphically, a) absolute value equations and inequalities; b) quadratic equations over the set of complex numbers; c) equations containing rational algebraic expressions; and d) equations containing radical expressions. Use graphing calculators for solving and for confirming the algebraic solutions.

Common Core State Standards for Mathematics Mathematics Standards for High School Algebra	Virginia's Mathematics Performance Expectation
	(SOL AII.4)
4. Solve quadratic equations in one variable.	
<p>a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.</p>	<p>MPE.14 Recognize the general shape of function (absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic) families and convert between graphic and symbolic forms of functions. Use a transformational approach to graphing. Use graphing calculators as a tool to investigate the shapes and behaviors of these functions. (SOL AII.6)</p> <p>MPE.26 Solve, algebraically and graphically, a) absolute value equations and inequalities; b) quadratic equations over the set of complex numbers; c) equations containing rational algebraic expressions; and d) equations containing radical expressions. Use graphing calculators for solving and for confirming the algebraic solutions. (SOL AII.4)</p>
<p>b. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b.</p>	<p>MPE.26 Solve, algebraically and graphically, a) absolute value equations and inequalities; b) quadratic equations over the set of complex numbers; c) equations containing rational algebraic expressions; and d) equations containing radical expressions. Use graphing calculators for solving and for confirming the algebraic solutions. (SOL AII.4)</p>
Solve systems of equations	
5. Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a	<p>MPE.26 Solve, algebraically and graphically, a) absolute value equations and inequalities;</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Algebra	Virginia's Mathematics Performance Expectation
multiple of the other produces a system with the same solutions.	b) quadratic equations over the set of complex numbers;
6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.	c) equations containing rational algebraic expressions; and d) equations containing radical expressions. Use graphing calculators for solving and for confirming the algebraic solutions. (SOL AII.4)
7. Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. <i>For example, find the points of intersection between the line $y = -3x$ and the circle $x^2 + y^2 = 3$.</i>	MPE.17 Determine optimal values in problem situations by identifying constraints and using linear programming techniques. (SOL AFDA.5) MPE.26 Solve, algebraically and graphically, a) absolute value equations and inequalities; b) quadratic equations over the set of complex numbers; c) equations containing rational algebraic expressions; and d) equations containing radical expressions. Use graphing calculators for solving and for confirming the algebraic solutions. (SOL AII.4)
Represent and solve equations and inequalities graphically	
10. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).	MPE.12 Transfer between and analyze multiple representations of functions, including algebraic formulas, graphs, tables, and words. Select and use appropriate representations for analysis, interpretation, and prediction. (AFDA.4) MPE.14 Recognize the general shape of function (absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic) families and convert between graphic and symbolic forms of functions. Use a transformational approach to graphing. Use graphing calculators as a tool to investigate the shapes and

Common Core State Standards for Mathematics Mathematics Standards for High School Algebra	Virginia's Mathematics Performance Expectation
	<p>behaviors of these functions. (SOL AII.6) MPE.19 Graph linear equations and linear inequalities in two variables, including</p> <ul style="list-style-type: none"> a) determining the slope of a line when given an equation of the line, the graph of the line, or two points on the line; describing slope as rate of change and determine if it is positive, negative, zero, or undefined; and b) writing the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line. <p>(SOL A.6)</p>
<p>11. Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.</p>	<p>MPE.17 Determine optimal values in problem situations by identifying constraints and using linear programming techniques. (SOL AFDA.5) MPE.26 Solve, algebraically and graphically,</p> <ul style="list-style-type: none"> a) absolute value equations and inequalities; b) quadratic equations over the set of complex numbers; c) equations containing rational algebraic expressions; and d) equations containing radical expressions. <p>Use graphing calculators for solving and for confirming the algebraic solutions. (SOL AII.4)</p>
<p>12. Graph the solutions to a linear inequality in two variables as a half plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.</p>	<p>MPE.19 Graph linear equations and linear inequalities in two variables, including</p> <ul style="list-style-type: none"> a) determining the slope of a line when given an equation of the line, the graph of the line, or two points on the line; describing slope as rate of change and determine if it is positive, negative, zero, or undefined; and

Common Core State Standards for Mathematics Mathematics Standards for High School Algebra	Virginia's Mathematics Performance Expectation
	<p>b) writing the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line. (SOL A.6)</p> <p>MPE.26 Solve, algebraically and graphically,</p> <ul style="list-style-type: none"> a) absolute value equations and inequalities; b) quadratic equations over the set of complex numbers; c) equations containing rational algebraic expressions; and d) equations containing radical expressions. <p>Use graphing calculators for solving and for confirming the algebraic solutions. (SOL AII.4)</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Functions	Virginia's Mathematics Performance Expectation
Interpreting Functions	
Understand the concept of a function and use function notation	
1. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x . The graph of f is the graph of the equation $y = f(x)$.	MPE.16 Investigate and analyze functions (linear, quadratic, exponential, and logarithmic families) algebraically and graphically. Key concepts include a) continuity; (SOL AFDA.1) b) local and absolute maxima and minima; (SOL AFDA.1) c) domain and range, including limited and discontinuous domains and ranges; d) zeros; e) x- and y-intercepts; f) intervals in which a function is increasing or decreasing; g) asymptotes; h) end behavior; i) inverse of a function; j) composition of multiple functions; k) finding the values of a function for elements in its domain; (SOL A.7) and l) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic, and algebraic. (SOL A.7) (SOL AII.7)
2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.	
3. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. <i>For example, the Fibonacci sequence is defined recursively by $f(0) = f(1) = 1$, $f(n+1) = f(n) + f(n-1)$ for $n \geq 1$.</i>	MPE.10 Investigate and apply the properties of arithmetic and geometric sequences and series to solve real-world problems, including writing the first n terms, finding the nth term, and evaluating summation formulas. Notation will include Σ and a_n. (SOL AII.2)

Common Core State Standards for Mathematics Mathematics Standards for High School Functions	Virginia's Mathematics Performance Expectation
Interpret functions that arise in applications in terms of the context	
<p>4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. <i>Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.</i></p>	<p>MPE.14 Recognize the general shape of function (absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic) families and convert between graphic and symbolic forms of functions. Use a transformational approach to graphing. Use graphing calculators as a tool to investigate the shapes and behaviors of these functions. (SOL AII.6)</p> <p>MPE.15 Use knowledge of transformations to write an equation, given the graph of a function (linear, quadratic, exponential, and logarithmic). (SOL AFDA.2)</p> <p>MPE.16 Investigate and analyze functions (linear, quadratic, exponential, and logarithmic families) algebraically and graphically. Key concepts include</p> <ul style="list-style-type: none"> a) continuity; (SOL AFDA.1) b) local and absolute maxima and minima; (SOL AFDA.1) c) domain and range, including limited and discontinuous domains and ranges; d) zeros; e) x- and y-intercepts; f) intervals in which a function is increasing or decreasing; g) asymptotes; h) end behavior; i) inverse of a function; j) composition of multiple functions; k) finding the values of a function for elements in its domain;

Common Core State Standards for Mathematics Mathematics Standards for High School Functions	Virginia's Mathematics Performance Expectation
	(SOL A.7) and l) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic, and algebraic. (SOL A.7) (SOL AII.7)
5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. <i>For example, if the function $h(n)$ gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.</i>	MPE.16 Investigate and analyze functions (linear, quadratic, exponential, and logarithmic families) algebraically and graphically. Key concepts include a) continuity; (SOL AFDA.1) b) local and absolute maxima and minima; (SOL AFDA.1) c) domain and range, including limited and discontinuous domains and ranges; d) zeros; e) x- and y-intercepts; f) intervals in which a function is increasing or decreasing; g) asymptotes; h) end behavior; i) inverse of a function; j) composition of multiple functions; k) finding the values of a function for elements in its domain; (SOL A.7) and l) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic, and algebraic. (SOL A.7) (SOL AII.7)
6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.	MPE.19 Graph linear equations and linear inequalities in two variables, including a) determining the slope of a line when given an equation of the

Common Core State Standards for Mathematics Mathematics Standards for High School Functions	Virginia's Mathematics Performance Expectation
	<p>line, the graph of the line, or two points on the line; describing slope as rate of change and determine if it is positive, negative, zero, or undefined; and</p> <p>b) writing the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line.</p> <p>(SOL A.6)</p>
Analyze functions using different representations	
7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.	
a. Graph linear and quadratic functions and show intercepts, maxima, and minima.	<p>MPE.16 Investigate and analyze functions (linear, quadratic, exponential, and logarithmic families) algebraically and graphically. Key concepts include</p> <p>a) continuity; (SOL AFDA.1)</p> <p>b) local and absolute maxima and minima; (SOL AFDA.1)</p> <p>c) domain and range, including limited and discontinuous domains and ranges;</p> <p>d) zeros;</p> <p>e) x- and y-intercepts;</p> <p>f) intervals in which a function is increasing or decreasing;</p> <p>g) asymptotes;</p> <p>h) end behavior;</p> <p>i) inverse of a function;</p> <p>j) composition of multiple functions;</p> <p>k) finding the values of a function for elements in its domain; (SOL A.7) and</p> <p>l) making connections between and among multiple representations of functions including concrete, verbal, numeric,</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Functions	Virginia's Mathematics Performance Expectation
	graphic, and algebraic. (SOL A.7) (SOL AII.7)
b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.	<p>MPE.14 Recognize the general shape of function (absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic) families and convert between graphic and symbolic forms of functions. Use a transformational approach to graphing. Use graphing calculators as a tool to investigate the shapes and behaviors of these functions. (SOL AII.6)</p> <p>MPE.26 Solve, algebraically and graphically, a) absolute value equations and inequalities; b) quadratic equations over the set of complex numbers; c) equations containing rational algebraic expressions; and d) equations containing radical expressions. Use graphing calculators for solving and for confirming the algebraic solutions. (SOL AII.4)</p>
c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.	<p>MPE.16 Investigate and analyze functions (linear, quadratic, exponential, and logarithmic families) algebraically and graphically. Key concepts include a) continuity; (SOL AFDA.1) b) local and absolute maxima and minima; (SOL AFDA.1) c) domain and range, including limited and discontinuous domains and ranges; d) zeros; e) x- and y-intercepts; f) intervals in which a function is increasing or decreasing; g) asymptotes;</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Functions	Virginia's Mathematics Performance Expectation
	<p>h) end behavior; i) inverse of a function; j) composition of multiple functions; k) finding the values of a function for elements in its domain; (SOL A.7) and l) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic, and algebraic. (SOL A.7) (SOL AII.7)</p>
<p>d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.</p>	<p>MPE.14 Recognize the general shape of function (absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic) families and convert between graphic and symbolic forms of functions. Use a transformational approach to graphing. Use graphing calculators as a tool to investigate the shapes and behaviors of these functions. (SOL AII.6)</p> <p>MPE.16 Investigate and analyze functions (linear, quadratic, exponential, and logarithmic families) algebraically and graphically. Key concepts include</p> <p>a) continuity; (SOL AFDA.1) b) local and absolute maxima and minima; (SOL AFDA.1) c) domain and range, including limited and discontinuous domains and ranges; d) zeros; e) x- and y-intercepts; f) intervals in which a function is increasing or decreasing; g) asymptotes; h) end behavior;</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Functions	Virginia's Mathematics Performance Expectation
	<p>i) inverse of a function; j) composition of multiple functions; k) finding the values of a function for elements in its domain; (SOL A.7) and l) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic, and algebraic. (SOL A.7) (SOL AII.7)</p>
<p>e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.</p>	<p>MPE.14 Recognize the general shape of function (absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic) families and convert between graphic and symbolic forms of functions. Use a transformational approach to graphing. Use graphing calculators as a tool to investigate the shapes and behaviors of these functions. (SOL AII.6)</p> <p>MPE.15 Use knowledge of transformations to write an equation, given the graph of a function (linear, quadratic, exponential, and logarithmic). (SOL AFDA.2)</p> <p>MPE.16 Investigate and analyze functions (linear, quadratic, exponential, and logarithmic families) algebraically and graphically. Key concepts include</p> <p>a) continuity; (SOL AFDA.1) b) local and absolute maxima and minima; (SOL AFDA.1) c) domain and range, including limited and discontinuous domains and ranges; d) zeros; e) x- and y-intercepts;</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Functions	Virginia's Mathematics Performance Expectation
	<p>f) intervals in which a function is increasing or decreasing; g) asymptotes; h) end behavior; i) inverse of a function; j) composition of multiple functions; k) finding the values of a function for elements in its domain; (SOL A.7) and l) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic, and algebraic. (SOL A.7) (SOL AII.7) MPE.27 Given one of the six trigonometric functions in standard form, a) state the domain and the range of the function; b) determine the amplitude, period, phase shift, vertical shift, and asymptotes; c) sketch the graph of the function by using transformations for at least a two-period interval; and d) investigate the effect of changing the parameters in a trigonometric function on the graph of the function. (SOL T.6)</p>
8. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.	
a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.	<p>MPE.18 Given rational, radical, or polynomial expressions, a) add, subtract, multiply, divide, and simplify rational algebraic expressions; b) add, subtract, multiply, divide, and simplify radical expressions</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Functions	Virginia's Mathematics Performance Expectation
	<p>containing rational numbers and variables, and expressions containing rational exponents;</p> <p>c) write radical expressions as expressions containing rational exponents and vice versa; and</p> <p>d) factor polynomials completely.</p> <p>(SOL AII.1)</p> <p>MPE.26 Solve, algebraically and graphically,</p> <p>a) absolute value equations and inequalities;</p> <p>b) quadratic equations over the set of complex numbers;</p> <p>c) equations containing rational algebraic expressions; and</p> <p>d) equations containing radical expressions.</p> <p>Use graphing calculators for solving and for confirming the algebraic solutions.</p> <p>(SOL AII.4)</p>
<p>b. Use the properties of exponents to interpret expressions for exponential functions. <i>For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{t/10}$, and classify them as representing exponential growth or decay.</i></p>	<p>MPE.2 Collect and analyze data, determine the equation of the curve of best fit, make predictions, and solve real-world problems using mathematical models. Mathematical models will include polynomial, exponential, and logarithmic functions.</p> <p>(SOL AII.9)</p> <p>MPE.14 Recognize the general shape of function (absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic) families and convert between graphic and symbolic forms of functions. Use a transformational approach to graphing. Use graphing calculators as a tool to investigate the shapes and behaviors of these functions.</p> <p>(SOL AII.6)</p> <p>MPE.16 Investigate and analyze functions (linear, quadratic, exponential, and logarithmic families) algebraically and</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Functions	Virginia's Mathematics Performance Expectation
	<p>graphically. Key concepts include</p> <ul style="list-style-type: none"> a) continuity; (SOL AFDA.1) b) local and absolute maxima and minima; (SOL AFDA.1) c) domain and range, including limited and discontinuous domains and ranges; d) zeros; e) x- and y-intercepts; f) intervals in which a function is increasing or decreasing; g) asymptotes; h) end behavior; i) inverse of a function; j) composition of multiple functions; k) finding the values of a function for elements in its domain; (SOL A.7) and l) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic, and algebraic. (SOL A.7) (SOL AII.7)
<p>9. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). <i>For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.</i></p>	<p>MPE.14 Recognize the general shape of function (absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic) families and convert between graphic and symbolic forms of functions. Use a transformational approach to graphing. Use graphing calculators as a tool to investigate the shapes and behaviors of these functions. (SOL AII.6)</p> <p>MPE.16 Investigate and analyze functions (linear, quadratic, exponential, and logarithmic families) algebraically and graphically. Key concepts include</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Functions	Virginia’s Mathematics Performance Expectation
	<ul style="list-style-type: none"> a) continuity; (SOL AFDA.1) b) local and absolute maxima and minima; (SOL AFDA.1) c) domain and range, including limited and discontinuous domains and ranges; d) zeros; e) x- and y-intercepts; f) intervals in which a function is increasing or decreasing; g) asymptotes; h) end behavior; i) inverse of a function; j) composition of multiple functions; k) finding the values of a function for elements in its domain; (SOL A.7) and l) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic, and algebraic. (SOL A.7) (SOL AII.7)
Building Functions	
Build a function that models a relationship between two quantities	
1. Write a function that describes a relationship between two quantities.	
a. Determine an explicit expression, a recursive process, or steps for calculation from a context.	MPE.16 Investigate and analyze functions (linear, quadratic, exponential, and logarithmic families) algebraically and graphically. Key concepts include <ul style="list-style-type: none"> a) continuity; (SOL AFDA.1) b) local and absolute maxima and minima; (SOL AFDA.1) c) domain and range, including limited and discontinuous
b. Combine standard function types using arithmetic operations. <i>For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the</i>	

Common Core State Standards for Mathematics Mathematics Standards for High School Functions	Virginia's Mathematics Performance Expectation
<p><i>model.</i></p> <p>c. (+) Compose functions. <i>For example, if $T(y)$ is the temperature in the atmosphere as a function of height, and $h(t)$ is the height of a weather balloon as a function of time, then $T(h(t))$ is the temperature at the location of the weather balloon as a function of time.</i></p>	<p>domains and ranges;</p> <p>d) zeros;</p> <p>e) x- and y-intercepts;</p> <p>f) intervals in which a function is increasing or decreasing;</p> <p>g) asymptotes;</p> <p>h) end behavior;</p> <p>i) inverse of a function;</p> <p>j) composition of multiple functions;</p> <p>k) finding the values of a function for elements in its domain; (SOL A.7) and</p> <p>l) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic, and algebraic. (SOL A.7) (SOL AII.7)</p>
<p>2. Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.</p>	<p>MPE.10 Investigate and apply the properties of arithmetic and geometric sequences and series to solve real-world problems, including writing the first n terms, finding the nth term, and evaluating summation formulas. Notation will include Σ and a_n. (SOL AII.2)</p>
<p>Build new functions from existing functions</p>	
<p>3. Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. <i>Include recognizing even and odd functions from their graphs and algebraic expressions for them.</i></p>	<p>MPE.14 Recognize the general shape of function (absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic) families and convert between graphic and symbolic forms of functions. Use a transformational approach to graphing. Use graphing calculators as a tool to investigate the shapes and behaviors of these functions. (SOL AII.6)</p> <p>MPE.15 Use knowledge of transformations to write an equation,</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Functions	Virginia's Mathematics Performance Expectation
	<p>given the graph of a function (linear, quadratic, exponential, and logarithmic). (SOL AFDA.2)</p> <p>MPE.16 Investigate and analyze functions (linear, quadratic, exponential, and logarithmic families) algebraically and graphically. Key concepts include</p> <ul style="list-style-type: none"> a) continuity; (SOL AFDA.1) b) local and absolute maxima and minima; (SOL AFDA.1) c) domain and range, including limited and discontinuous domains and ranges; d) zeros; e) x- and y-intercepts; f) intervals in which a function is increasing or decreasing; g) asymptotes; h) end behavior; i) inverse of a function; j) composition of multiple functions; k) finding the values of a function for elements in its domain; (SOL A.7) and l) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic, and algebraic. (SOL A.7) (SOL AII.7)
4. Find inverse functions.	
a. Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse. <i>For example, $f(x) = 2x^3$ for $x > 0$ or $f(x) = (x+1)/(x-1)$ for $x \neq 1$.</i>	<p>MPE.16 Investigate and analyze functions (linear, quadratic, exponential, and logarithmic families) algebraically and graphically. Key concepts include</p> <ul style="list-style-type: none"> a) continuity; (SOL AFDA.1)
b. (+) Verify by composition that one function is the inverse of	

Common Core State Standards for Mathematics Mathematics Standards for High School Functions	Virginia's Mathematics Performance Expectation
<p>another.</p> <p>c. (+) Read values of an inverse function from a graph or a table, given that the function has an inverse.</p> <p>d. (+) Produce an invertible function from a non-invertible function by restricting the domain.</p> <p>5. (+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.</p>	<p>b) local and absolute maxima and minima; (SOL AFDA.1)</p> <p>c) domain and range, including limited and discontinuous domains and ranges;</p> <p>d) zeros;</p> <p>e) x- and y-intercepts;</p> <p>f) intervals in which a function is increasing or decreasing;</p> <p>g) asymptotes;</p> <p>h) end behavior;</p> <p>i) inverse of a function;</p> <p>j) composition of multiple functions;</p> <p>k) finding the values of a function for elements in its domain; (SOL A.7) and</p> <p>l) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic, and algebraic. (SOL A.7)</p> <p>(SOL AII.7)</p>
Linear, Quadratic, and Exponential Models	
Construct and compare linear and exponential models and solve problems	
1. Distinguish between situations that can be modeled with linear functions and with exponential functions.	
a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.	
b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.	<p>MPE.2 Collect and analyze data, determine the equation of the curve of best fit, make predictions, and solve real-world problems using mathematical models. Mathematical models will include polynomial, exponential, and logarithmic functions. (SOL AII.9)</p>
c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.	<p>MPE.12 Transfer between and analyze multiple representations of functions, including algebraic formulas, graphs, tables, and</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Functions	Virginia's Mathematics Performance Expectation
	<p>words. Select and use appropriate representations for analysis, interpretation, and prediction. (AFDA.4)</p> <p>MPE.14 Recognize the general shape of function (absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic) families and convert between graphic and symbolic forms of functions. Use a transformational approach to graphing. Use graphing calculators as a tool to investigate the shapes and behaviors of these functions. (SOL AII.6)</p>
<p>2. Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).</p>	<p>MPE.2 Collect and analyze data, determine the equation of the curve of best fit, make predictions, and solve real-world problems using mathematical models. Mathematical models will include polynomial, exponential, and logarithmic functions. (SOL AII.9)</p> <p>MPE.10 Investigate and apply the properties of arithmetic and geometric sequences and series to solve real-world problems, including writing the first n terms, finding the nth term, and evaluating summation formulas. Notation will include Σ and a_n. (SOL AII.2)</p> <p>MPE.12 Transfer between and analyze multiple representations of functions, including algebraic formulas, graphs, tables, and words. Select and use appropriate representations for analysis, interpretation, and prediction. (AFDA.4)</p> <p>MPE.14 Recognize the general shape of function (absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic) families and convert between graphic and symbolic</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Functions	Virginia's Mathematics Performance Expectation
	<p>forms of functions. Use a transformational approach to graphing. Use graphing calculators as a tool to investigate the shapes and behaviors of these functions.</p> <p>(SOL AII.6)</p> <p>MPE.16 Investigate and analyze functions (linear, quadratic, exponential, and logarithmic families) algebraically and graphically. Key concepts include</p> <ul style="list-style-type: none"> a) continuity; (SOL AFDA.1) b) local and absolute maxima and minima; (SOL AFDA.1) c) domain and range, including limited and discontinuous domains and ranges; d) zeros; e) x- and y-intercepts; f) intervals in which a function is increasing or decreasing; g) asymptotes; h) end behavior; i) inverse of a function; j) composition of multiple functions; k) finding the values of a function for elements in its domain; (SOL A.7) and l) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic, and algebraic. (SOL A.7) <p>(SOL AII.7)</p> <p>MPE.19 Graph linear equations and linear inequalities in two variables, including</p> <ul style="list-style-type: none"> a) determining the slope of a line when given an equation of the line, the graph of the line, or two points on the line; describing

Common Core State Standards for Mathematics Mathematics Standards for High School Functions	Virginia's Mathematics Performance Expectation
	<p>slope as rate of change and determine if it is positive, negative, zero, or undefined; and</p> <p>b) writing the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line. (SOL A.6)</p>
<p>3. Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.</p>	<p>MPE.2 Collect and analyze data, determine the equation of the curve of best fit, make predictions, and solve real-world problems using mathematical models. Mathematical models will include polynomial, exponential, and logarithmic functions. (SOL AII.9)</p> <p>MPE.14 Recognize the general shape of function (absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic) families and convert between graphic and symbolic forms of functions. Use a transformational approach to graphing. Use graphing calculators as a tool to investigate the shapes and behaviors of these functions. (SOL AII.6)</p> <p>MPE.15 Use knowledge of transformations to write an equation, given the graph of a function (linear, quadratic, exponential, and logarithmic). (SOL AFDA.2)</p> <p>MPE.16 Investigate and analyze functions (linear, quadratic, exponential, and logarithmic families) algebraically and graphically. Key concepts include</p> <p>a) continuity; (SOL AFDA.1)</p> <p>b) local and absolute maxima and minima; (SOL AFDA.1)</p> <p>c) domain and range, including limited and discontinuous domains and ranges;</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Functions	Virginia's Mathematics Performance Expectation
	<p>d) zeros; e) x- and y-intercepts; f) intervals in which a function is increasing or decreasing; g) asymptotes; h) end behavior; i) inverse of a function; j) composition of multiple functions; k) finding the values of a function for elements in its domain; (SOL A.7) and l) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic, and algebraic. (SOL A.7) (SOL AII.7)</p>
<p>4. For exponential models, express as a logarithm the solution to $ab^{ct} = d$ where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.</p>	<p>MPE.14 Recognize the general shape of function (absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic) families and convert between graphic and symbolic forms of functions. Use a transformational approach to graphing. Use graphing calculators as a tool to investigate the shapes and behaviors of these functions. (SOL AII.6)</p> <p>MPE.15 Use knowledge of transformations to write an equation, given the graph of a function (linear, quadratic, exponential, and logarithmic). (SOL AFDA.2)</p> <p>MPE.16 Investigate and analyze functions (linear, quadratic, exponential, and logarithmic families) algebraically and graphically. Key concepts include a) continuity; (SOL AFDA.1)</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Functions	Virginia's Mathematics Performance Expectation
	<p>b) local and absolute maxima and minima; (SOL AFDA.1)</p> <p>c) domain and range, including limited and discontinuous domains and ranges;</p> <p>d) zeros;</p> <p>e) x- and y-intercepts;</p> <p>f) intervals in which a function is increasing or decreasing;</p> <p>g) asymptotes;</p> <p>h) end behavior;</p> <p>i) inverse of a function;</p> <p>j) composition of multiple functions;</p> <p>k) finding the values of a function for elements in its domain; (SOL A.7) and</p> <p>l) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic, and algebraic. (SOL A.7) (SOL AII.7)</p>
Interpret expressions for functions in terms of the situation they model	
5. Interpret the parameters in a linear or exponential function in terms of a context.	<p>MPE.2 Collect and analyze data, determine the equation of the curve of best fit, make predictions, and solve real-world problems using mathematical models. Mathematical models will include polynomial, exponential, and logarithmic functions. (SOL AII.9)</p> <p>MPE.14 Recognize the general shape of function (absolute value, square root, cube root, rational, polynomial, exponential, and logarithmic) families and convert between graphic and symbolic forms of functions. Use a transformational approach to graphing. Use graphing calculators as a tool to investigate the shapes and</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Functions	Virginia's Mathematics Performance Expectation
	<p>behaviors of these functions. (SOL AII.6)</p> <p>MPE.15 Use knowledge of transformations to write an equation, given the graph of a function (linear, quadratic, exponential, and logarithmic). (SOL AFDA.2)</p> <p>MPE.16 Investigate and analyze functions (linear, quadratic, exponential, and logarithmic families) algebraically and graphically. Key concepts include</p> <ul style="list-style-type: none"> a) continuity; (SOL AFDA.1) b) local and absolute maxima and minima; (SOL AFDA.1) c) domain and range, including limited and discontinuous domains and ranges; d) zeros; e) x- and y-intercepts; f) intervals in which a function is increasing or decreasing; g) asymptotes; h) end behavior; i) inverse of a function; j) composition of multiple functions; k) finding the values of a function for elements in its domain; (SOL A.7) and l) making connections between and among multiple representations of functions including concrete, verbal, numeric, graphic, and algebraic. (SOL A.7) <p>(SOL AII.7)</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Functions	Virginia’s Mathematics Performance Expectation
Trigonometric Functions	
Extend the domain of trigonometric functions using the unit circle	
1. Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.	<p>MPE.11 Use angles, arcs, chords, tangents, and secants to a) investigate, verify, and apply properties of circles; b) solve real-world problems involving properties of circles; and c) find arc lengths and areas of sectors in circles. (SOL G.11)</p> <p>MPE.28 Find, without the aid of a calculator, the values of the trigonometric functions of the special angles and their related angles as found in the unit circle. This includes converting angle measures from radians to degrees and vice versa. (SOL T.3)</p>
2. Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.	<p>MPE.20 Given a point other than the origin on the terminal side of an angle, use the definitions of the six trigonometric functions to find the sine, cosine, tangent, cotangent, secant, and cosecant of the angle in standard position. Relate trigonometric functions defined on the unit circle to trigonometric functions defined in right triangles. (SOL T.1)</p>
3. (+) Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ and $\pi/6$, and use the unit circle to express the values of sine, cosines, and tangent for x , $\pi+x$, and $2\pi-x$ in terms of their values for x , where x is any real number.	<p>MPE.5 Solve real-world problems involving right triangles by using the Pythagorean Theorem and its converse, properties of special right triangles, and right triangle trigonometry. (SOL G.8)</p> <p>MPE.20 Given a point other than the origin on the terminal side of an angle, use the definitions of the six trigonometric functions to find the sine, cosine, tangent, cotangent, secant, and cosecant of the angle in standard position. Relate trigonometric functions</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Functions	Virginia's Mathematics Performance Expectation
	defined on the unit circle to trigonometric functions defined in right triangles. (SOL T.1)
4. (+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.	MPE.27 Given one of the six trigonometric functions in standard form, a) state the domain and the range of the function; b) determine the amplitude, period, phase shift, vertical shift, and asymptotes; c) sketch the graph of the function by using transformations for at least a two-period interval; and d) investigate the effect of changing the parameters in a trigonometric function on the graph of the function. (SOL T.6)
Model periodic phenomena with trigonometric functions	
5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.	MPE.27 Given one of the six trigonometric functions in standard form, a) state the domain and the range of the function; b) determine the amplitude, period, phase shift, vertical shift, and asymptotes; c) sketch the graph of the function by using transformations for at least a two-period interval; and d) investigate the effect of changing the parameters in a trigonometric function on the graph of the function. (SOL T.6)
Prove and apply trigonometric identities	
8. Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle.	MPE.36 Verify basic trigonometric identities and make substitutions, using the basic identities. (SOL T.5)

Common Core State Standards for Mathematics Mathematics Standards for High School Geometry	Virginia’s Mathematics Performance Expectation
Congruence	
Experiment with transformations in the plane	
<p>1. Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc.</p>	<p>MPE.3 Use pictorial representations, including computer software, constructions, and coordinate methods, to solve problems involving symmetry and transformation. This will include</p> <ul style="list-style-type: none"> a) investigating and using formulas for finding distance, midpoint, and slope; b) applying slope to verify and determine whether lines are parallel or perpendicular; c) investigating symmetry and determining whether a figure is symmetric with respect to a line or a point; and d) determining whether a figure has been translated, reflected, rotated, or dilated, using coordinate methods. <p>(SOL G.3)</p> <p>MPE.11 Use angles, arcs, chords, tangents, and secants to</p> <ul style="list-style-type: none"> a) investigate, verify, and apply properties of circles; b) solve real-world problems involving properties of circles; and c) find arc lengths and areas of sectors in circles. <p>(SOL G.11)</p> <p>MPE.32 Use the relationships between angles formed by two lines cut by a transversal to</p> <ul style="list-style-type: none"> a) determine whether two lines are parallel; b) verify the parallelism, using algebraic and coordinate methods as well as deductive proofs; and c) solve real-world problems involving angles formed when parallel lines are cut by a transversal. <p>(SOL G.2)</p>
2. Represent transformations in the plane using, e.g.,	MPE.3 Use pictorial representations, including computer

Common Core State Standards for Mathematics Mathematics Standards for High School Geometry	Virginia's Mathematics Performance Expectation
<p>transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).</p> <p>3. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself.</p>	<p>software, constructions, and coordinate methods, to solve problems involving symmetry and transformation. This will include</p> <p>a) investigating and using formulas for finding distance, midpoint, and slope;</p> <p>b) applying slope to verify and determine whether lines are parallel or perpendicular;</p> <p>c) investigating symmetry and determining whether a figure is symmetric with respect to a line or a point; and</p> <p>d) determining whether a figure has been translated, reflected, rotated, or dilated, using coordinate methods.</p> <p>(SOL G.3)</p>
<p>4. Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments.</p>	<p>MPE.3 Use pictorial representations, including computer software, constructions, and coordinate methods, to solve problems involving symmetry and transformation. This will include</p> <p>a) investigating and using formulas for finding distance, midpoint, and slope;</p> <p>b) applying slope to verify and determine whether lines are parallel or perpendicular;</p> <p>c) investigating symmetry and determining whether a figure is symmetric with respect to a line or a point; and</p> <p>d) determining whether a figure has been translated, reflected, rotated, or dilated, using coordinate methods.</p> <p>(SOL G.3)</p> <p>MPE.32 Use the relationships between angles formed by two lines cut by a transversal to</p> <p>a) determine whether two lines are parallel;</p> <p>b) verify the parallelism, using algebraic and coordinate methods</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Geometry	Virginia's Mathematics Performance Expectation
	<p>as well as deductive proofs; and c) solve real-world problems involving angles formed when parallel lines are cut by a transversal. (SOL G.2)</p>
<p>5. Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure using, e.g., graph paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another.</p>	<p>MPE.3 Use pictorial representations, including computer software, constructions, and coordinate methods, to solve problems involving symmetry and transformation. This will include a) investigating and using formulas for finding distance, midpoint, and slope; b) applying slope to verify and determine whether lines are parallel or perpendicular; c) investigating symmetry and determining whether a figure is symmetric with respect to a line or a point; and d) determining whether a figure has been translated, reflected, rotated, or dilated, using coordinate methods. (SOL G.3)</p>
<p>Understand congruence in terms of rigid motions</p>	
<p>6. Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.</p>	<p>MPE.3 Use pictorial representations, including computer software, constructions, and coordinate methods, to solve problems involving symmetry and transformation. This will include a) investigating and using formulas for finding distance, midpoint, and slope; b) applying slope to verify and determine whether lines are parallel or perpendicular; c) investigating symmetry and determining whether a figure is symmetric with respect to a line or a point; and d) determining whether a figure has been translated, reflected,</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Geometry	Virginia's Mathematics Performance Expectation
	rotated, or dilated, using coordinate methods. (SOL G.3) MPE.33 Given information in the form of a figure or statement, prove two triangles are congruent, using algebraic and coordinate methods as well as deductive proofs. (SOL G.6)
7. Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent.	MPE.33 Given information in the form of a figure or statement, prove two triangles are congruent, using algebraic and coordinate methods as well as deductive proofs. (SOL G.6)
8. Explain how the criteria for triangle congruence (ASA, SAS, and SSS) follow from the definition of congruence in terms of rigid motions.	
Prove geometric theorems	
9. Prove theorems about lines and angles. <i>Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints.</i>	MPE.32 Use the relationships between angles formed by two lines cut by a transversal to a) determine whether two lines are parallel; b) verify the parallelism, using algebraic and coordinate methods as well as deductive proofs; and c) solve real-world problems involving angles formed when parallel lines are cut by a transversal. (SOL G.2)
10. Prove theorems about triangles. <i>Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point.</i>	MPE.33 Given information in the form of a figure or statement, prove two triangles are congruent, using algebraic and coordinate methods as well as deductive proofs. (SOL G.6)
11. Prove theorems about parallelograms. <i>Theorems include:</i>	MPE.4 Verify characteristics of quadrilaterals and use properties

Common Core State Standards for Mathematics Mathematics Standards for High School Geometry	Virginia’s Mathematics Performance Expectation
<i>opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals.</i>	of quadrilaterals to solve real-world problems. (SOL G.9)
Make geometric constructions	
12. Make formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). <i>Copying a segment; copying an angle; bisecting a segment; bisecting an angle; constructing perpendicular lines, including the perpendicular bisector of a line segment; and constructing a line parallel to a given line through a point not on the line.</i>	MPE.35 Construct and justify the constructions of a) a line segment congruent to a given line segment; b) the perpendicular bisector of a line segment; c) a perpendicular to a given line from a point not on the line; d) a perpendicular to a given line at a given point on the line; e) the bisector of a given angle; f) an angle congruent to a given angle; and g) a line parallel to a given line through a point not on the given line. (SOL G.4)
13. Construct an equilateral triangle, a square, and a regular hexagon inscribed in a circle.	
Similarity, Right Triangles, and Trigonometry	
Understand similarity in terms of similarity transformations	
1. Verify experimentally the properties of dilations given by a center and a scale factor:	
a. A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged.	MPE.3 Use pictorial representations, including computer software, constructions, and coordinate methods, to solve problems involving symmetry and transformation. This will include a) investigating and using formulas for finding distance, midpoint, and slope; b) applying slope to verify and determine whether lines are parallel or perpendicular; c) investigating symmetry and determining whether a figure is symmetric with respect to a line or a point; and
b. The dilation of a line segment is longer or shorter in the ratio given by the scale factor.	

Common Core State Standards for Mathematics Mathematics Standards for High School Geometry	Virginia's Mathematics Performance Expectation
	d) determining whether a figure has been translated, reflected, rotated, or dilated, using coordinate methods. (SOL G.3)
2. Given two figures, use the definition of similarity in terms of similarity transformations to decide if they are similar; explain using similarity transformations the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides.	MPE.7 Use similar geometric objects in two- or three-dimensions to a) compare ratios between side lengths, perimeters, areas, and volumes; b) determine how changes in one or more dimensions of an object affect area and/or volume of the object; c) determine how changes in area and/or volume of an object affect one or more dimensions of the object; and d) solve real-world problems about similar geometric objects. (SOL G.14) MPE.34 Given information in the form of a figure or statement, prove two triangles are similar, using algebraic and coordinate methods as well as deductive proofs. (SOL G.7)
3. Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar.	MPE.34 Given information in the form of a figure or statement, prove two triangles are similar, using algebraic and coordinate methods as well as deductive proofs. (SOL G.7)
Prove theorems involving similarity	
4. Prove theorems about triangles. <i>Theorems include: a line parallel to one side of a triangle divides the other two proportionally, and conversely; the Pythagorean Theorem proved using triangle similarity.</i>	MPE.34 Given information in the form of a figure or statement, prove two triangles are similar, using algebraic and coordinate methods as well as deductive proofs. (SOL G.7)
5. Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures.	MPE.7 Use similar geometric objects in two- or three-dimensions to a) compare ratios between side lengths, perimeters, areas, and

Common Core State Standards for Mathematics Mathematics Standards for High School Geometry	Virginia's Mathematics Performance Expectation
	<p>volumes;</p> <p>b) determine how changes in one or more dimensions of an object affect area and/or volume of the object;</p> <p>c) determine how changes in area and/or volume of an object affect one or more dimensions of the object; and</p> <p>d) solve real-world problems about similar geometric objects. (SOL G.14)</p> <p>MPE.33 Given information in the form of a figure or statement, prove two triangles are congruent, using algebraic and coordinate methods as well as deductive proofs. (SOL G.6)</p> <p>MPE.34 Given information in the form of a figure or statement, prove two triangles are similar, using algebraic and coordinate methods as well as deductive proofs. (SOL G.7)</p>
Define trigonometric ratios and solve problems involving right triangles	
6. Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.	<p>MPE.5 Solve real-world problems involving right triangles by using the Pythagorean Theorem and its converse, properties of special right triangles, and right triangle trigonometry. (SOL G.8)</p>
7. Explain and use the relationship between the sine and cosine of complementary angles.	
8. Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.	
Apply trigonometry to general triangles	
9. (+) Derive the formula $A = \frac{1}{2} ab \sin(C)$ for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.	<p>MPE.5 Solve real-world problems involving right triangles by using the Pythagorean Theorem and its converse, properties of special right triangles, and right triangle trigonometry. (SOL G.8)</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Geometry	Virginia's Mathematics Performance Expectation
Circles G-C	
Understand and apply theorems about circles	
1. Prove that all circles are similar.	MPE.11 Use angles, arcs, chords, tangents, and secants to a) investigate, verify, and apply properties of circles; b) solve real-world problems involving properties of circles; and c) find arc lengths and areas of sectors in circles. (SOL G.11)
2. Identify and describe relationships among inscribed angles, radii, and chords. <i>Include the relationship between central, inscribed, and circumscribed angles; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle.</i>	
3. Construct the inscribed and circumscribed circles of a triangle, and prove properties of angles for a quadrilateral inscribed in a circle.	MPE.4 Verify characteristics of quadrilaterals and use properties of quadrilaterals to solve real-world problems. (SOL G.9) MPE.35 Construct and justify the constructions of a) a line segment congruent to a given line segment; b) the perpendicular bisector of a line segment; c) a perpendicular to a given line from a point not on the line; d) a perpendicular to a given line at a given point on the line; e) the bisector of a given angle; f) an angle congruent to a given angle; and g) a line parallel to a given line through a point not on the given line. (SOL G.4)
4. (+) Construct a tangent line from a point outside a given circle to the circle.	MPE.35 Construct and justify the constructions of a) a line segment congruent to a given line segment; b) the perpendicular bisector of a line segment; c) a perpendicular to a given line from a point not on the line; d) a perpendicular to a given line at a given point on the line; e) the bisector of a given angle; f) an angle congruent to a given angle; and

Common Core State Standards for Mathematics Mathematics Standards for High School Geometry	Virginia's Mathematics Performance Expectation
	g) a line parallel to a given line through a point not on the given line. (SOL G.4)
Find arc lengths and areas of sectors of circles	
5. Derive using similarity the fact that the length of the arc intercepted by an angle is proportional to the radius, and define the radian measure of the angle as the constant of proportionality; derive the formula for the area of a sector.	MPE.11 Use angles, arcs, chords, tangents, and secants to a) investigate, verify, and apply properties of circles; b) solve real-world problems involving properties of circles; and c) find arc lengths and areas of sectors in circles. (SOL G.11)
Expressing Geometric Properties with Equations	
Translate between the geometric description and the equation for a conic section	
1. Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.	MPE.21 Given the coordinates of the center of a circle and a point on the circle, write the equation of the circle. (SOL G.12)
2. Derive the equation of a parabola given a focus and directrix.	MPE.29 Investigate and identify the characteristics of conic section equations in (h, k) and standard forms. Use transformations in the coordinate plane to graph conic sections. (SOL MA.8)
3. (+) Derive the equations of ellipses and hyperbolas given foci and directrices.	
Use coordinates to prove simple geometric theorems algebraically	
4. Use coordinates to prove simple geometric theorems algebraically. <i>For example, prove or disprove that a figure defined by four given points in the coordinate plane is a rectangle; prove or disprove that the point $(1, \sqrt{3})$ lies on the circle centered at the origin and containing the point $(0, 2)$.</i>	MPE.3 Use pictorial representations, including computer software, constructions, and coordinate methods, to solve problems involving symmetry and transformation. This will include a) investigating and using formulas for finding distance, midpoint, and slope; b) applying slope to verify and determine whether lines are parallel or perpendicular;

Common Core State Standards for Mathematics Mathematics Standards for High School Geometry	Virginia's Mathematics Performance Expectation
	<p>c) investigating symmetry and determining whether a figure is symmetric with respect to a line or a point; and d) determining whether a figure has been translated, reflected, rotated, or dilated, using coordinate methods. (SOL G.3)</p> <p>MPE.21 Given the coordinates of the center of a circle and a point on the circle, write the equation of the circle. (SOL G.12)</p> <p>MPE.32 Use the relationships between angles formed by two lines cut by a transversal to</p> <p>a) determine whether two lines are parallel; b) verify the parallelism, using algebraic and coordinate methods as well as deductive proofs; and c) solve real-world problems involving angles formed when parallel lines are cut by a transversal. (SOL G.2)</p>
<p>5. Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).</p>	<p>MPE.3 Use pictorial representations, including computer software, constructions, and coordinate methods, to solve problems involving symmetry and transformation. This will include</p> <p>a) investigating and using formulas for finding distance, midpoint, and slope; b) applying slope to verify and determine whether lines are parallel or perpendicular; c) investigating symmetry and determining whether a figure is symmetric with respect to a line or a point; and d) determining whether a figure has been translated, reflected, rotated, or dilated, using coordinate methods. (SOL G.3)</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Geometry	Virginia's Mathematics Performance Expectation
	<p>MPE.32 Use the relationships between angles formed by two lines cut by a transversal to</p> <ul style="list-style-type: none"> a) determine whether two lines are parallel; b) verify the parallelism, using algebraic and coordinate methods as well as deductive proofs; and c) solve real-world problems involving angles formed when parallel lines are cut by a transversal. <p>(SOL G.2)</p>
<p>6. Find the point on a directed line segment between two given points that partitions the segment in a given ratio.</p> <p>7. Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.</p>	<p>MPE.3 Use pictorial representations, including computer software, constructions, and coordinate methods, to solve problems involving symmetry and transformation. This will include</p> <ul style="list-style-type: none"> a) investigating and using formulas for finding distance, midpoint, and slope; b) applying slope to verify and determine whether lines are parallel or perpendicular; c) investigating symmetry and determining whether a figure is symmetric with respect to a line or a point; and d) determining whether a figure has been translated, reflected, rotated, or dilated, using coordinate methods. <p>(SOL G.3)</p>
Geometric Measurement and Dimension	
Explain volume formulas and use them to solve problems	
<p>1. Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone. <i>Use dissection arguments, Cavalieri's principle, and informal limit arguments.</i></p>	<p>MPE.6 Use formulas for surface area and volume of three-dimensional objects to solve real-world problems.</p> <p>(SOL G.13)</p> <p>MPE.7 Use similar geometric objects in two- or three-dimensions to</p>

Common Core State Standards for Mathematics Mathematics Standards for High School Geometry	Virginia’s Mathematics Performance Expectation
	<p>a) compare ratios between side lengths, perimeters, areas, and volumes;</p> <p>b) determine how changes in one or more dimensions of an object affect area and/or volume of the object;</p> <p>c) determine how changes in area and/or volume of an object affect one or more dimensions of the object; and</p> <p>d) solve real-world problems about similar geometric objects. (SOL G.14)</p> <p>MPE.11 Use angles, arcs, chords, tangents, and secants to</p> <p>a) investigate, verify, and apply properties of circles;</p> <p>b) solve real-world problems involving properties of circles; and</p> <p>c) find arc lengths and areas of sectors in circles. (SOL G.11)</p>
2. (+) Give an informal argument using Cavalieri’s principle for the formulas for the volume of a sphere and other solid figures.	<p>MPE.7 Use similar geometric objects in two- or three-dimensions to</p> <p>a) compare ratios between side lengths, perimeters, areas, and volumes;</p> <p>b) determine how changes in one or more dimensions of an object affect area and/or volume of the object;</p> <p>c) determine how changes in area and/or volume of an object affect one or more dimensions of the object; and</p> <p>d) solve real-world problems about similar geometric objects. (SOL G.14)</p>
3. Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.	<p>MPE.6 Use formulas for surface area and volume of three-dimensional objects to solve real-world problems. (SOL G.13)</p>
Visualize relationships between two-dimensional and three-dimensional objects	
4. Identify the shapes of two-dimensional cross-sections of	MPE.29 Investigate and identify the characteristics of conic

Common Core State Standards for Mathematics Mathematics Standards for High School Geometry	Virginia's Mathematics Performance Expectation
three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.	section equations in (h, k) and standard forms. Use transformations in the coordinate plane to graph conic sections. (SOL MA.8)
Modeling with Geometry	
Apply geometric concepts in modeling situations	
1. Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).	MPE.6 Use formulas for surface area and volume of three-dimensional objects to solve real-world problems. (SOL G.13)
2. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).	MPE.7 Use similar geometric objects in two- or three-dimensions to
3. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).	a) compare ratios between side lengths, perimeters, areas, and volumes; b) determine how changes in one or more dimensions of an object affect area and/or volume of the object; c) determine how changes in area and/or volume of an object affect one or more dimensions of the object; and d) solve real-world problems about similar geometric objects. (SOL G.14)

Common Core State Standards for Mathematics Mathematics Standards for High School Statistics and Probability	Virginia’s Mathematics Performance Expectation
Interpreting Categorical and Quantitative Data	
Summarize, represent, and interpret data on a single count or measurement variable	
1. Represent data with plots on the real number line (dot plots, histograms, and box plots).	MPE.22 Analyze graphical displays of univariate data, including dotplots, stemplots, and histograms, to identify and describe patterns and departures from patterns, using central tendency, spread, clusters, gaps, and outliers. Use appropriate technology to create graphical displays. (SOL PS.1)
2. Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.	MPE.8 Compare distributions of two or more univariate data sets, analyzing center and spread (within group and between group variations), clusters and gaps, shapes, outliers, or other unusual features. (SOL PS.3)
3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers).	MPE.22 Analyze graphical displays of univariate data, including dotplots, stemplots, and histograms, to identify and describe patterns and departures from patterns, using central tendency, spread, clusters, gaps, and outliers. Use appropriate technology to create graphical displays. (SOL PS.1)
4. Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.	MPE.22 Analyze graphical displays of univariate data, including dotplots, stemplots, and histograms, to identify and describe patterns and departures from patterns, using central tendency, spread, clusters, gaps, and outliers. Use appropriate technology to create graphical displays. (SOL PS.1) MPE.23 Analyze the normal distribution. Key concepts include a) characteristics of normally distributed data; b) percentiles; c) normalizing data, using z-scores; and d) area under the standard normal curve and probability. (SOL AFDA.7)
Summarize, represent, and interpret data on two categorical and quantitative variable	
5. Summarize categorical data for two categories in two-way	MPE.30 Using two-way tables, analyze categorical data to

Common Core State Standards for Mathematics Mathematics Standards for High School Statistics and Probability	Virginia’s Mathematics Performance Expectation
frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data.	describe patterns and departure from patterns and to find marginal frequency and relative frequencies, including conditional frequencies. (SOL PS.7)
6. Represent data on two quantitative variables on a scatter plot, and describe how the variables are related.	
a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. <i>Use given functions or choose a function suggested by the context. Emphasize linear and exponential models.</i>	MPE.2 Collect and analyze data, determine the equation of the curve of best fit, make predictions, and solve real-world problems using mathematical models. Mathematical models will include polynomial, exponential, and logarithmic functions.
b. Informally assess the fit of a function by plotting and analyzing residuals.	(SOL AII.9)
c. Fit a linear function for a scatter plot that suggests a linear association.	
Interpret linear models	
7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.	MPE.2 Collect and analyze data, determine the equation of the curve of best fit, make predictions, and solve real-world problems using mathematical models. Mathematical models will include polynomial, exponential, and logarithmic functions. (SOL AII.9) MPE.19 Graph linear equations and linear inequalities in two variables, including a) determining the slope of a line when given an equation of the line, the graph of the line, or two points on the line; describing slope as rate of change and determine if it is positive, negative, zero, or undefined; and b) writing the equation of a line when given the graph of the line, two points on the line, or the slope and a point on the line. (SOL A.6)

Common Core State Standards for Mathematics Mathematics Standards for High School Statistics and Probability	Virginia's Mathematics Performance Expectation
8. Compute (using technology) and interpret the correlation coefficient of a linear fit.	MPE.2 Collect and analyze data, determine the equation of the curve of best fit, make predictions, and solve real-world problems using mathematical models. Mathematical models will include polynomial, exponential, and logarithmic functions. (SOL AII.9)
9. Distinguish between correlation and causation.	MPE.2 Collect and analyze data, determine the equation of the curve of best fit, make predictions, and solve real-world problems using mathematical models. Mathematical models will include polynomial, exponential, and logarithmic functions. (SOL AII.9)
Making Inferences and Justifying Conclusions	
Understand and evaluate random processes underlying statistical experiments	
1. Understand statistics as a process for making inferences about population parameters based on a random sample from that population.	MPE.9 Design and conduct an experiment/survey. Key concepts include a) sample size; b) sampling technique; c) controlling sources of bias and experimental error; d) data collection; and e) data analysis and reporting. (SOL AFDA.8)
2. Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. <i>For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?</i>	
Make inferences and justify conclusions from sample surveys, experiments, and observational studies	
3. Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.	MPE.9 Design and conduct an experiment/survey. Key concepts include a) sample size; b) sampling technique; c) controlling sources of bias and experimental error; d) data collection; and
4. Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.	

Common Core State Standards for Mathematics Mathematics Standards for High School Statistics and Probability	Virginia’s Mathematics Performance Expectation
5. Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.	e) data analysis and reporting. (SOL AFDA.8)
6. Evaluate reports based on data.	
Conditional Probability and the Rules of Probability	
Understand independence and conditional probability and use them to interpret data	
1. Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events (“or,” “and,” “not”).	MPE.31 Calculate probabilities. Key concepts include a) conditional probability; b) dependent and independent events; c) addition and multiplication rules; d) counting techniques (permutations and combinations); and e) Law of Large Numbers. (SOL AFDA.6)
2. Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent.	
3. Understand the conditional probability of A given B as $P(A \text{ and } B)/P(B)$, and interpret independence of A and B as saying that the conditional probability of A given B is the same as the probability of A , and the conditional probability of B given A is the same as the probability of B .	
4. Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. <i>For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects</i>	MPE.30 Using two-way tables, analyze categorical data to describe patterns and departure from patterns and to find marginal frequency and relative frequencies, including conditional frequencies. (SOL PS.7)

Common Core State Standards for Mathematics Mathematics Standards for High School Statistics and Probability	Virginia’s Mathematics Performance Expectation
<i>and compare the results.</i>	
5. Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. <i>For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.</i>	MPE.31 Calculate probabilities. Key concepts include a) conditional probability; b) dependent and independent events; c) addition and multiplication rules; d) counting techniques (permutations and combinations); and e) Law of Large Numbers. (SOL AFDA.6)
Use the rules of probability to compute probabilities of compound events in a uniform probability model	
6. Find the conditional probability of A given B as the fraction of B 's outcomes that also belong to A , and interpret the answer in terms of the model.	MPE.31 Calculate probabilities. Key concepts include a) conditional probability; b) dependent and independent events; c) addition and multiplication rules; d) counting techniques (permutations and combinations); and e) Law of Large Numbers. (SOL AFDA.6)
7. Apply the Addition Rule, $P(A \text{ or } B) = P(A) + P(B) - P(A \text{ and } B)$, and interpret the answer in terms of the model.	
8. (+) Apply the general Multiplication Rule in a uniform probability model, $P(A \text{ and } B) = P(A)P(B A) = P(B)P(A B)$, and interpret the answer in terms of the model.	
9. (+) Use permutations and combinations to compute probabilities of compound events and solve problems.	
Using Probability to Make Decisions	
Calculate expected values and use them to solve problems	
2. (+) Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.	MPE.31 Calculate probabilities. Key concepts include a) conditional probability; b) dependent and independent events; c) addition and multiplication rules; d) counting techniques (permutations and combinations); and e) Law of Large Numbers. (SOL AFDA.6)
4. (+) Develop a probability distribution for a random variable defined for a sample space in which probabilities are assigned empirically; find the expected value. <i>For example, find a current data distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per</i>	

Common Core State Standards for Mathematics Mathematics Standards for High School Statistics and Probability	Virginia's Mathematics Performance Expectation
<i>household. How many TV sets would you expect to find in 100 randomly selected households?</i>	
Use probability to evaluate outcomes of decisions	
5. (+) Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values.	
a. Find the expected payoff for a game of chance. <i>For example, find the expected winnings from a state lottery ticket or a game at a fast food restaurant.</i>	MPE.31 Calculate probabilities. Key concepts include a) conditional probability; b) dependent and independent events; c) addition and multiplication rules; d) counting techniques (permutations and combinations); and e) Law of Large Numbers. (SOL AFDA.6)
b. Evaluate and compare strategies on the basis of expected values. <i>For example, compare a high-deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident.</i>	
6. (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).	
7. (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).	