Preparing Students for College and STEM Careers Beyond High School

Regional Educational Laboratory (REL) Appalachia
March 20, 2013

http://www.vaschoolboards.org/images/uploads/REL_AP_Task_3_10_Preparing_Students_for_STEM_beyond_HS_final.pdf

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Welcome and Introductions

William S. Kidd, Wythe County School Board,
VSBA Finance/Audit Committee Chairman

REL Appalachia and Goals of Today's Workshop

Laura Holian, Ph. D
REL Appalachia
CNA

What are REL Appalachia's goals?

- Assess regional research needs by monitoring emerging education issues and challenges
- Maintain and refine research alliances through ongoing dialogue between educators in each region and researchers
- Provide analytic technical support to increase use of data and analysis to understand policies and programs, make decisions, and support effective practice
- Conduct research and evaluation studies of rigor and method appropriate to the questions the studies attempt to answer
- Distribute results of REL research across the region
- Coordinate and partner with other RELs; federal, state, and local education research groups; and technical assistance organizations

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REL Appalachia's mission

- Support the applied research and technical support needs of Kentucky, Tennessee, Virginia, and West Virginia
- Conduct empirical research and analysis
- Bring evidence-based information to policy-makers and practitioners
  - Inform policy and practice – for states, districts, schools, and other stakeholders
  - Focus on high-priority, discrete issues and build a body of knowledge over time

www.relappalachia.org

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Goals of today's workshop

- Learn about research on the association between high school course-taking, particularly in Science, Technology, Engineering, and Mathematics (STEM) fields, and college enrollment.
- Understand data indicators in Virginia: STEM proficiency, high school graduation rates, and college enrollment rates.
- Provide an example of how to increase access to high school STEM CTE courses.
- Foster dialogue among participants about strategies to increase STEM enrollment.
- Take examples of best practices and synthesize the strategies into a logic model.

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Profile of College Preparation and College-Going in Virginia

Laura Holian, Ph. D
REL Appalachia
CNA

Overview of research and data in Virginia

- Review research on association between high school course taking and outcomes such as graduation and college enrollment
- Understand rates of advanced proficiency in End of Course (EOC) tests
  - Algebra I
  - Algebra II
  - Geometry
  - Biology
  - Chemistry
- Understand graduation rates by diploma type
- Understand college enrollment rates by diploma type and CTE status

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Math course taking and college enrollment

- Higher scores on summative math tests in high school associated with greater likelihood of enrolling in college (Garland et al. 2011; Holian & Mokher 2011; Jonas et al. 2012; Lichtenberger, et al. 2010)

- Participation and success in Algebra II during high school predicts success in freshman level college math courses (Garland et al. 2011; Jonas et al. 2012)

- Taking calculus in high school, compared to Algebra II, associated with greater likelihood of completing college (Adelman 2006)

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Increasing academic rigor to prepare students

- Many initiatives to increase access to higher level academic courses
  - Increase Algebra I participation in 8th grade (e.g., Algebra for All)
  - Dual enrollment
  - Advanced Placement

- But, district or state mandates do not necessarily result in better student outcomes (standardized test scores, college enrollment rates)
  - If policies are made, there must be support for struggling students

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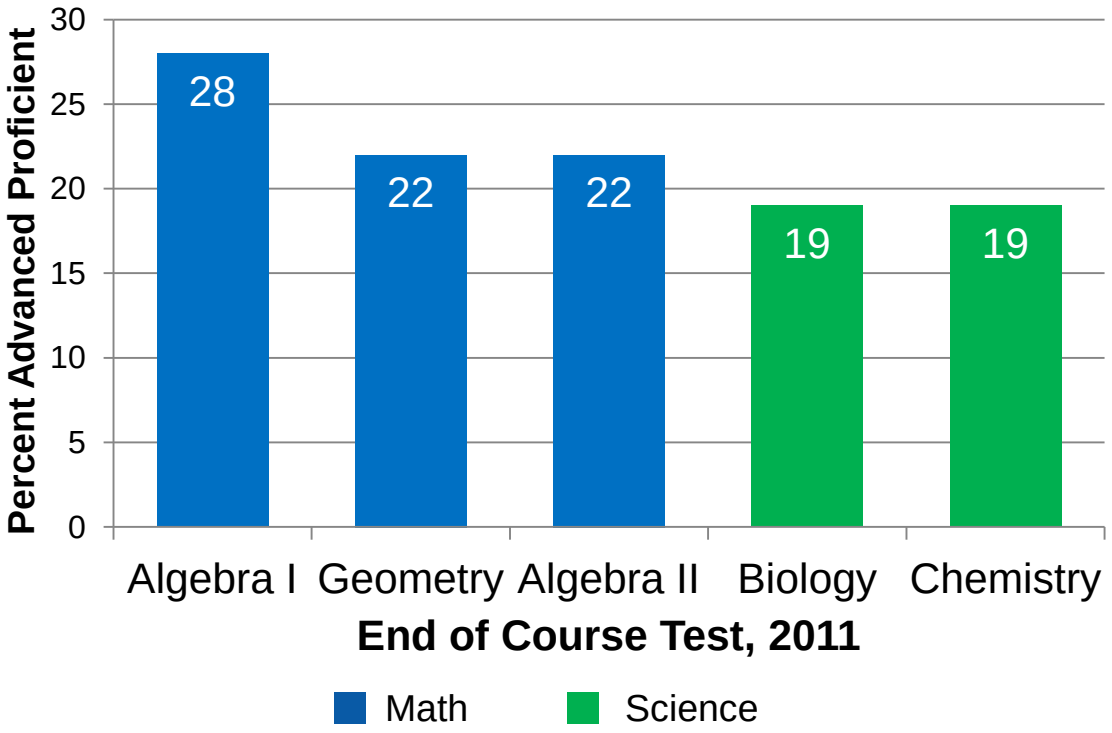
Low rates of Advanced Proficiency in Virginia

- Earning Advanced Proficient on SOL EOCs is associated with a high probability of enrolling in and persisting in college (Garland et al. 2011; Holian & Mokher 2011; Lichtenberger et al. 2010)
- Just over 1 in 5 students scores Advanced Proficient in Geometry or Algebra II
- Fewer than 1 in 5 students scores Advanced Proficient in science courses



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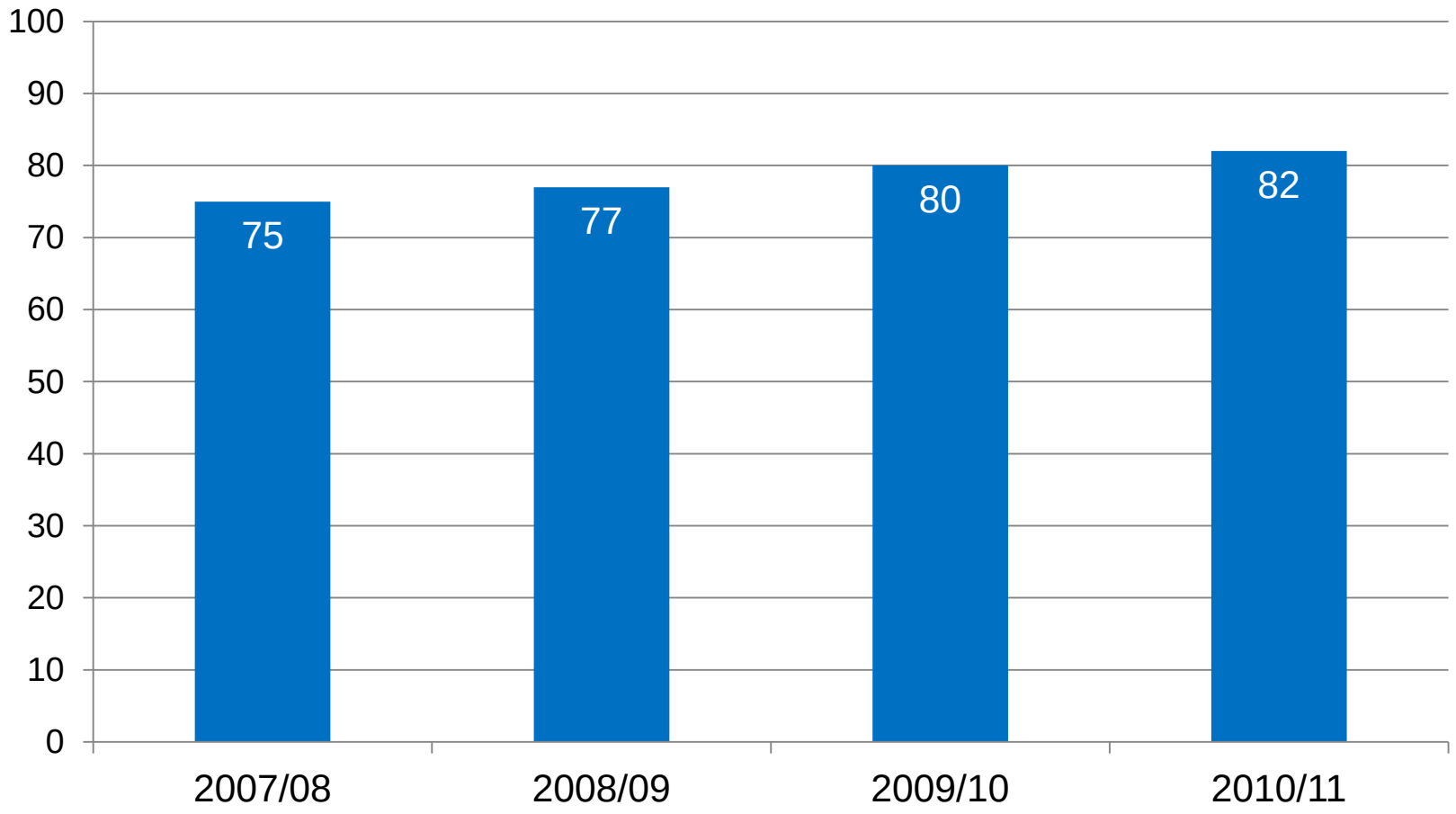
Federal Graduation Indicator: Rising rates in VA



Source: Virginia Department of Education

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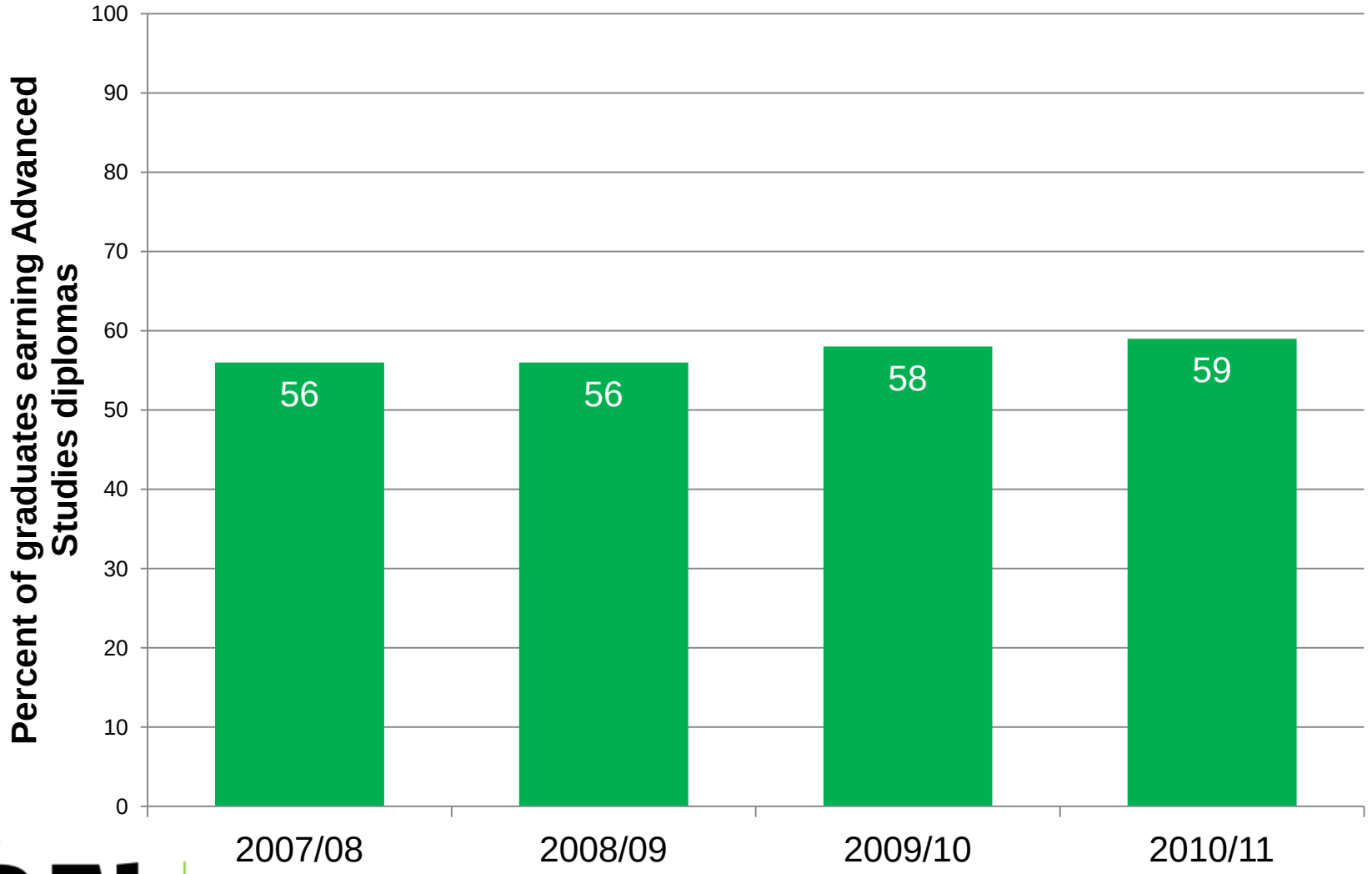
Slight increase in percentage of graduates earning Advanced Studies diplomas



Source: Virginia Department of Education

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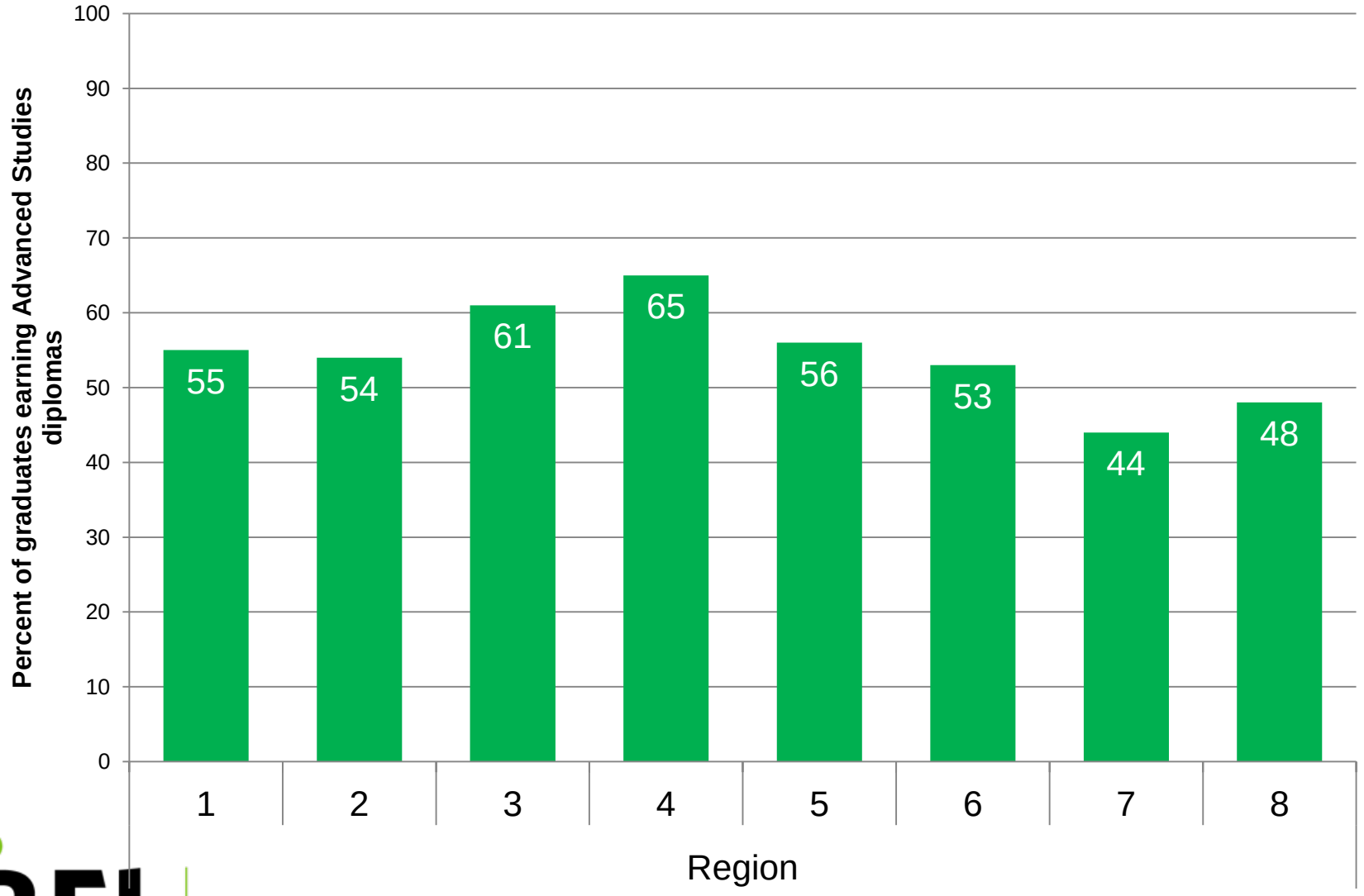
Variation in Advanced Studies diplomas by region, 2010/2011



Source: Virginia Department of Education

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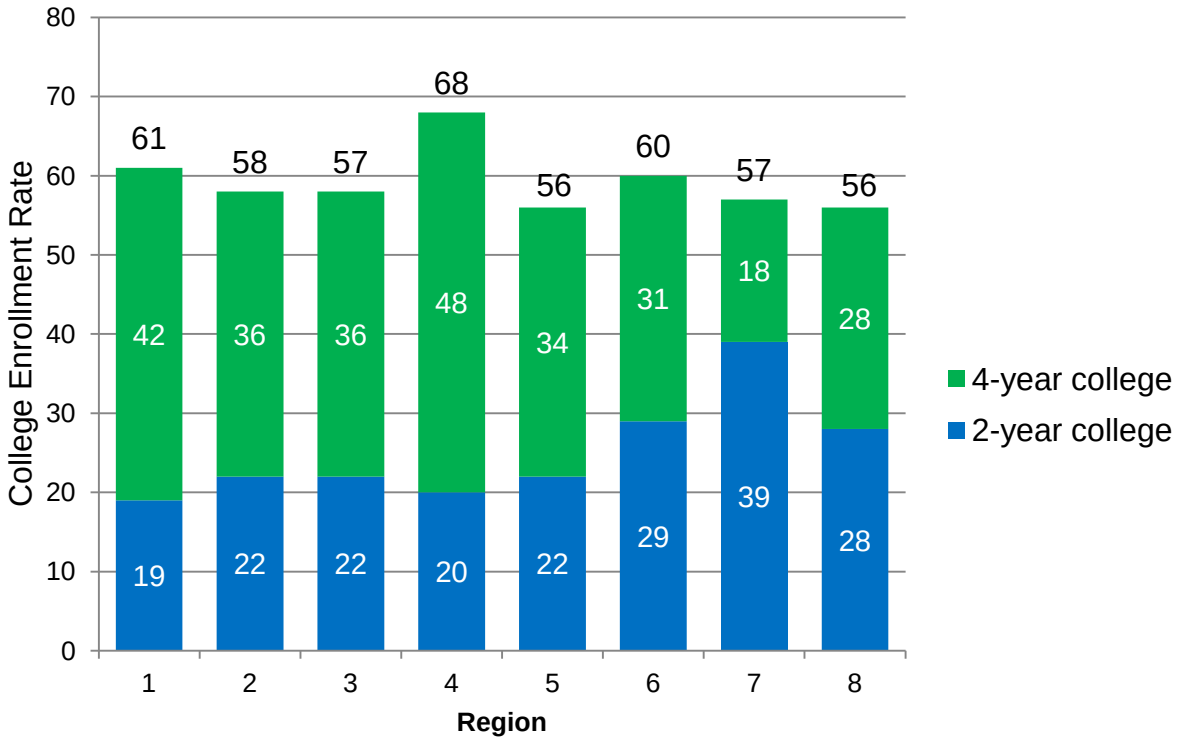
College enrollment rate

- 62 percent of class of 2011 enrolled in college within 16 months of high school graduation
  - 23 percent in 2-year colleges
  - 39 percent in 4-year colleges
- Rates similar across regions



Source: Virginia Department of Education

2011 REL Appalachia report

- Examined first-fall college enrollment rates of the 2008 high school graduates in Virginia
- Disaggregated results by student characteristics including:
  - Demographic characteristics – race/ethnicity, sex, economically disadvantaged status, limited English proficient
  - High school diploma type
  - CTE completer status
  - Proficiency level of end-of-course assessments

http://ies.ed.gov/ncee/edlabs/regions/appalachia/pdf/REL_2011104.pdf

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Using data from the National Student Clearinghouse

- College enrollment rates are calculated after matching VDOE data from high school graduates with college enrollment records collected by the National Student Clearinghouse (NSC).
- Resulting enrollment data are estimates, with biases due to:
  - Participating and non-participating institutions of higher education
  - Number of students whose records were blocked (enrolled, but NSC cannot release information)
  - Number of students enrolled in post-secondary but where matching algorithm did not create the link
- Biases tend to underestimate enrollment*

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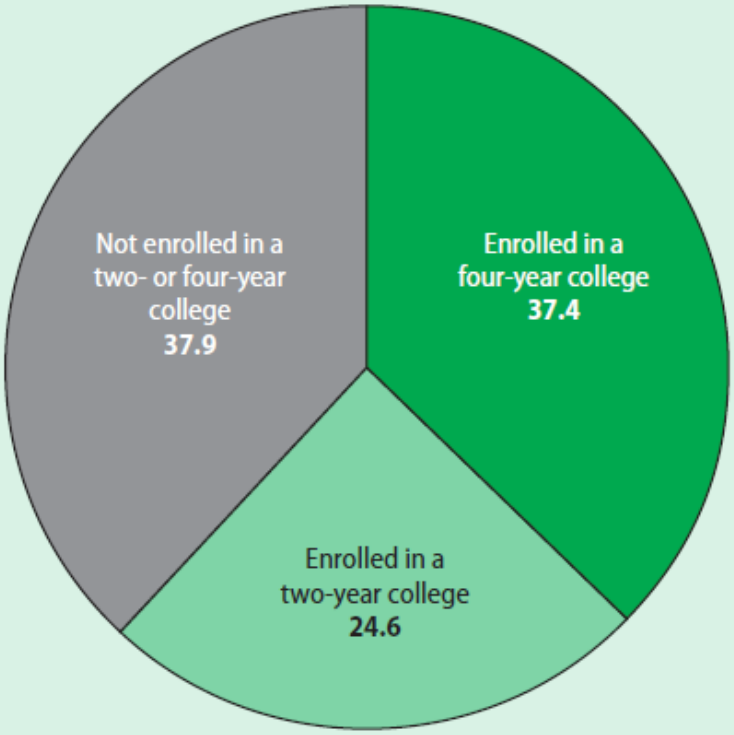
*More information about potential biases is available in the full research report, http://ies.ed.gov/ncee/edlabs/regions/appalachia/pdf/REL_2011104.pdf.

62 percent of 2008 graduates enrolled in college

Class of 2008 Virginia public high school graduates enrolled in a two- or four-year college within one year of graduation



Note: $n = 86{,}194$; percentages do not sum to 100 because of rounding.

Source: Authors' calculations based on data provided by the Virginia Department of Education (2010).

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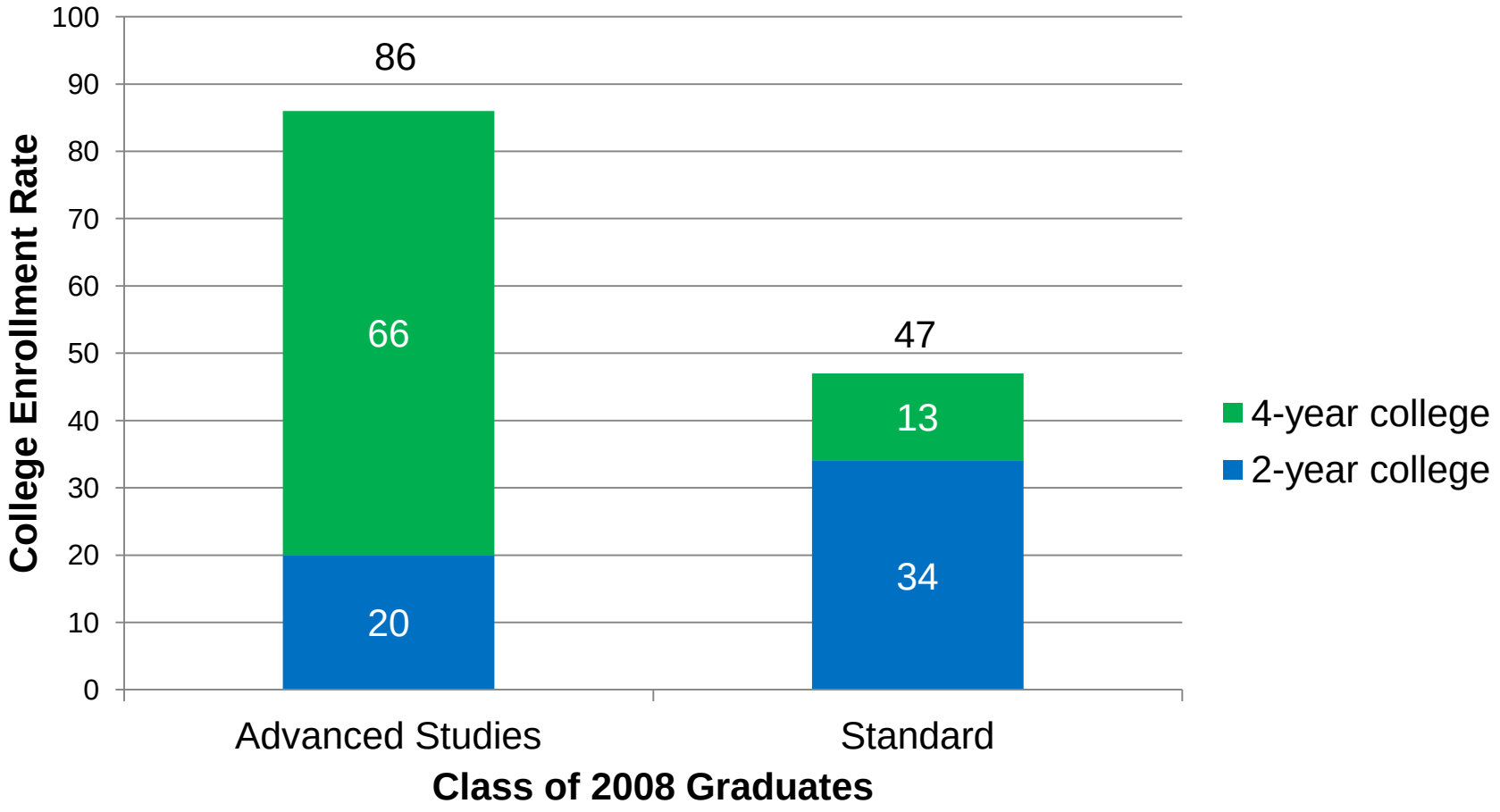
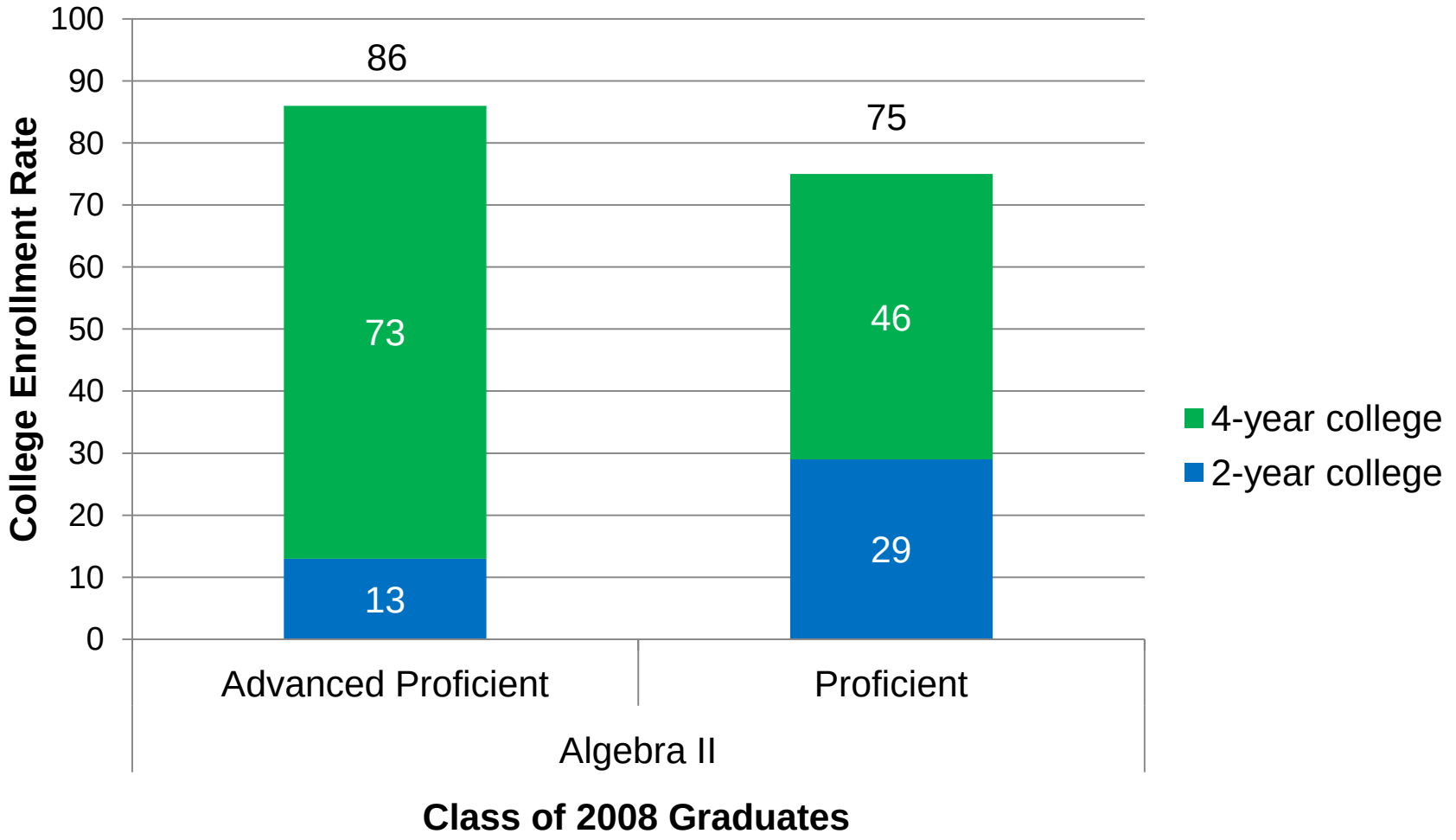
College enrollment higher for Advanced Studies diploma earners



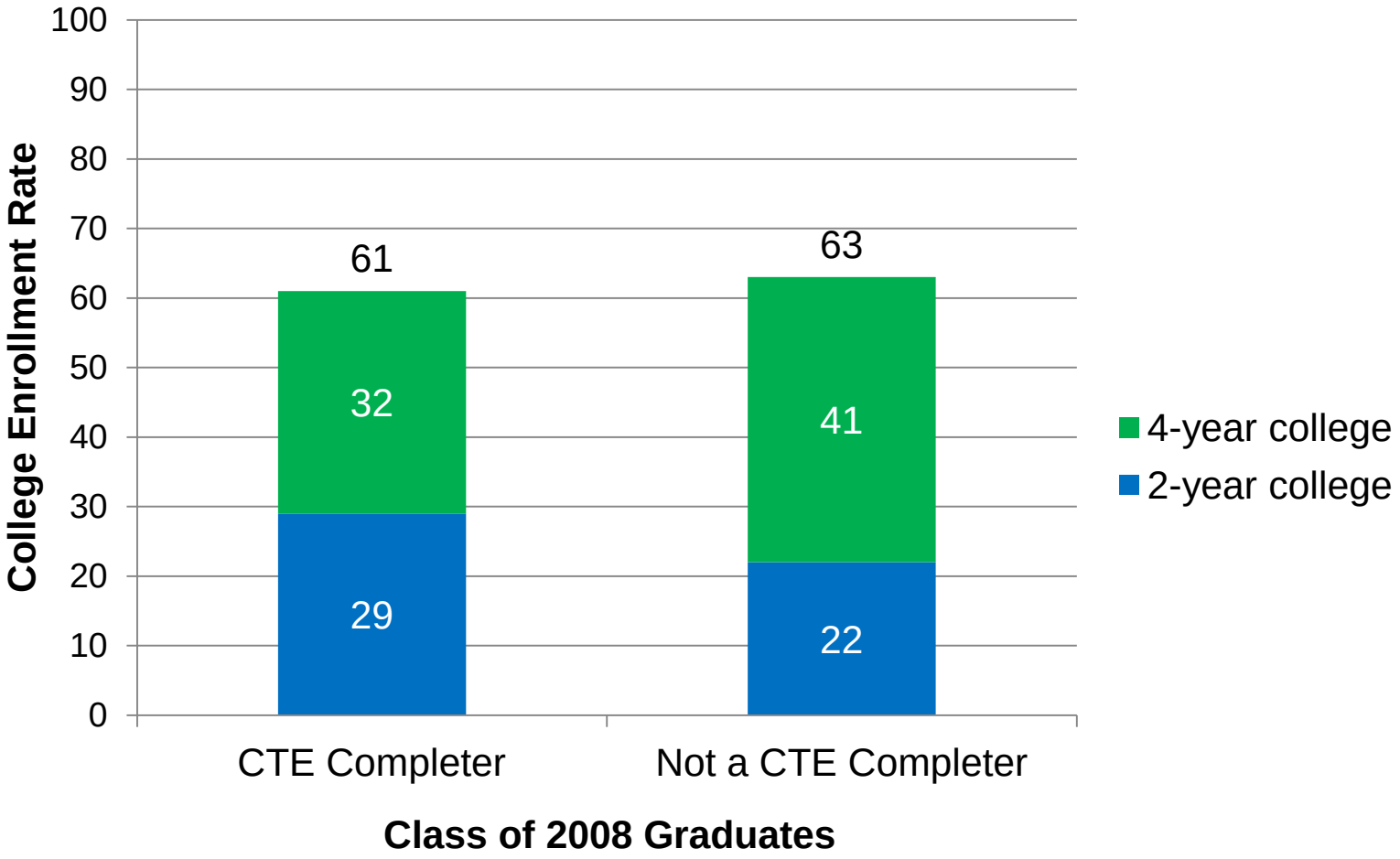
Source: Holian and Mokher 2011

Advanced Proficient in Algebra II associated with greater college enrollment, especially at 4-year institutions



Source: Holian and Mokher 2011

CTE completers enroll in higher education at similar rates, more go to 2-year colleges



Source: Holian and Mokher 2011

Summary

- Advanced Studies diplomas and EOC scores are associated with college enrollment
- Low rates of advanced proficiency in math and science EOCs
  - What are the participation rates in Algebra II? Biology? Chemistry?
- On-time graduation rate has been rising, and more graduates are earning Advanced Studies diplomas
  - Graduation rate is approximately 80 percent, and just over half (~60%) of graduates earn an Advanced Studies diploma
  - Does this mean more students are ready for college or careers?
- Students who earned Advanced Studies diplomas were more likely to enroll in college than students who earned Standard diplomas

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Blue Ridge Crossroads Governor's Academy for Technical Education: The Future of STEM Education in the Twin County Region

Mark A. Burnette, Ed. D.
Director of Middle and Secondary Education,
Carroll County Public Schools

Rationale for BRCGATE

Whether it's improving our health or harnessing clean energy, protecting our security or succeeding in the global economy, our future depends on reaffirming America's role as the world's engine of scientific discovery and technological innovation. And that leadership tomorrow depends on how we educate our students today, especially in math, science, technology, and engineering.

-President Barack Obama, January 8, 2010

Virginia must take an 'all of the above' approach to developing wind, solar, nuclear, oil, natural gas, coal, and biomass energy sources that can create new jobs in the commonwealth while moving Virginia and the nation closer to energy independence.

-Governor Bob McDonnell, June 15, 2011

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BRCGATE Goals and Challenge

- Goals
  - Address the need for a highly skilled workforce that will attract high-tech industry to a rural economically challenged area of southwest Virginia.
  - Allow secondary students to develop advanced level technical and academic skills through real world instruction that integrates critical thinking, problem solving, and inquiry based instruction.
  - Emphasize dual high school and college credit courses, project based learning experiences, and community based internships necessary to meet the expectations of the future global workforce.
- Challenge
  - Provide this service without any additional Local, State or Federal Funding.

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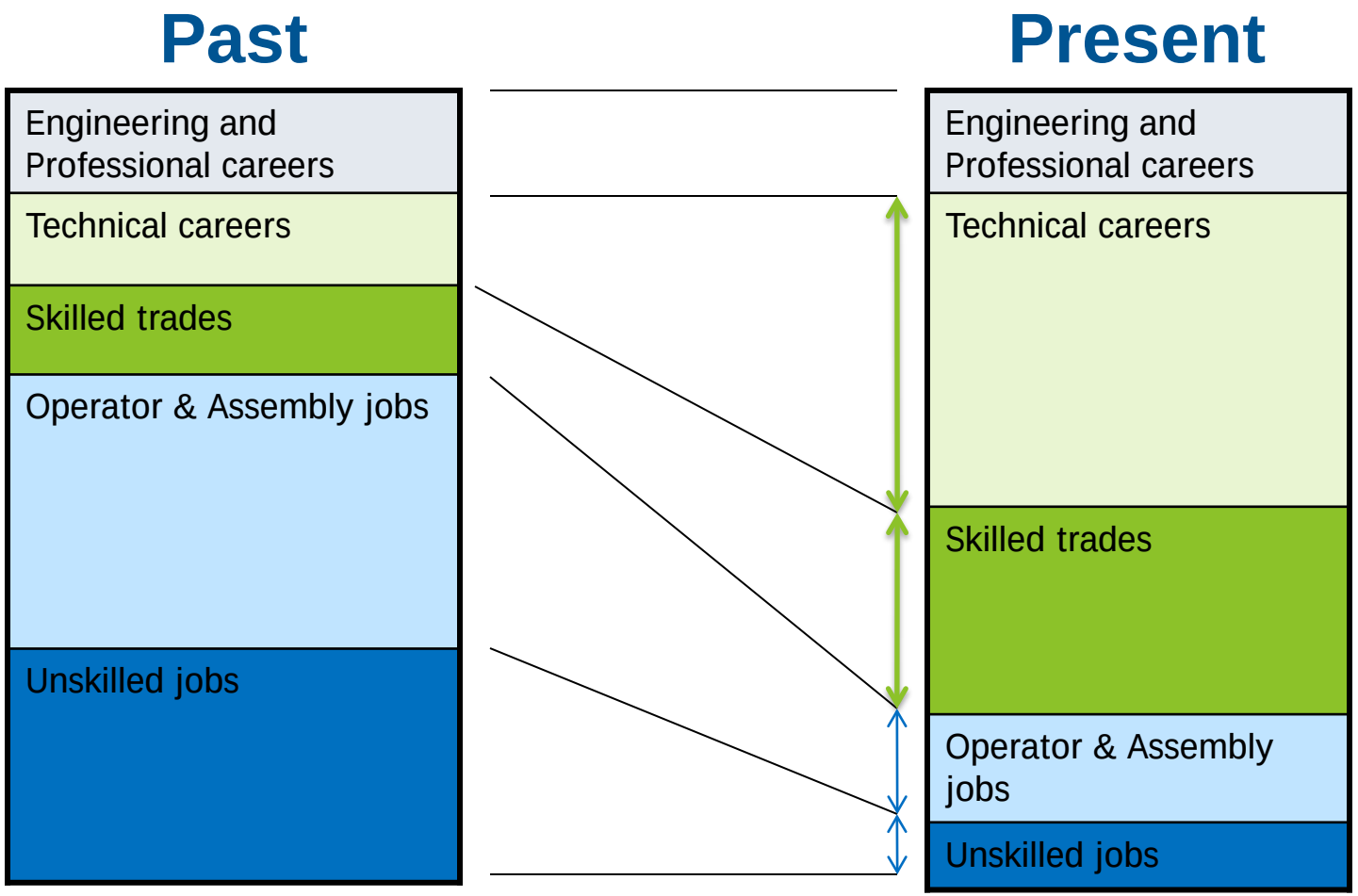
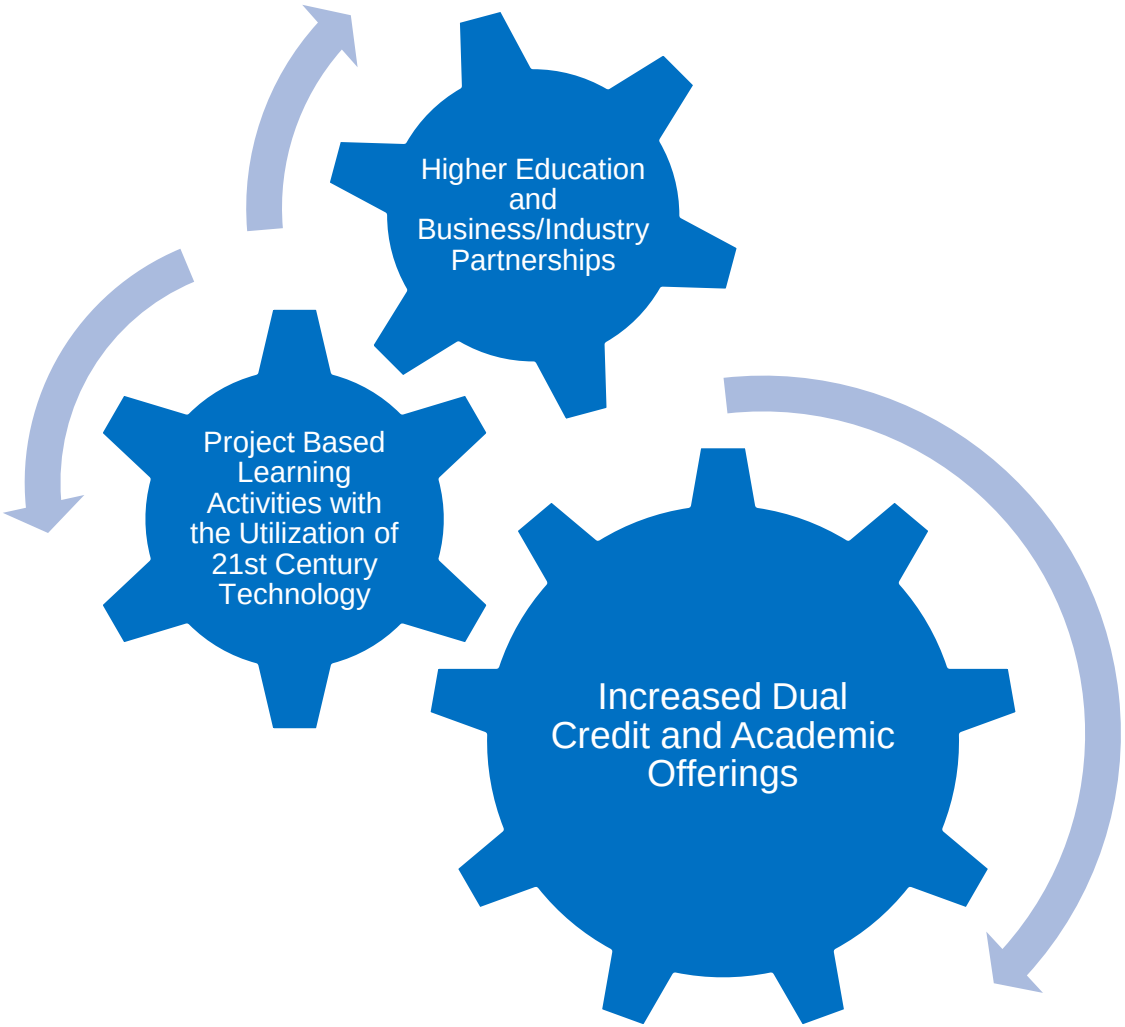
How employment in the U.S. has changed



(Dallas Garrett, 2010)

Program Design Concepts



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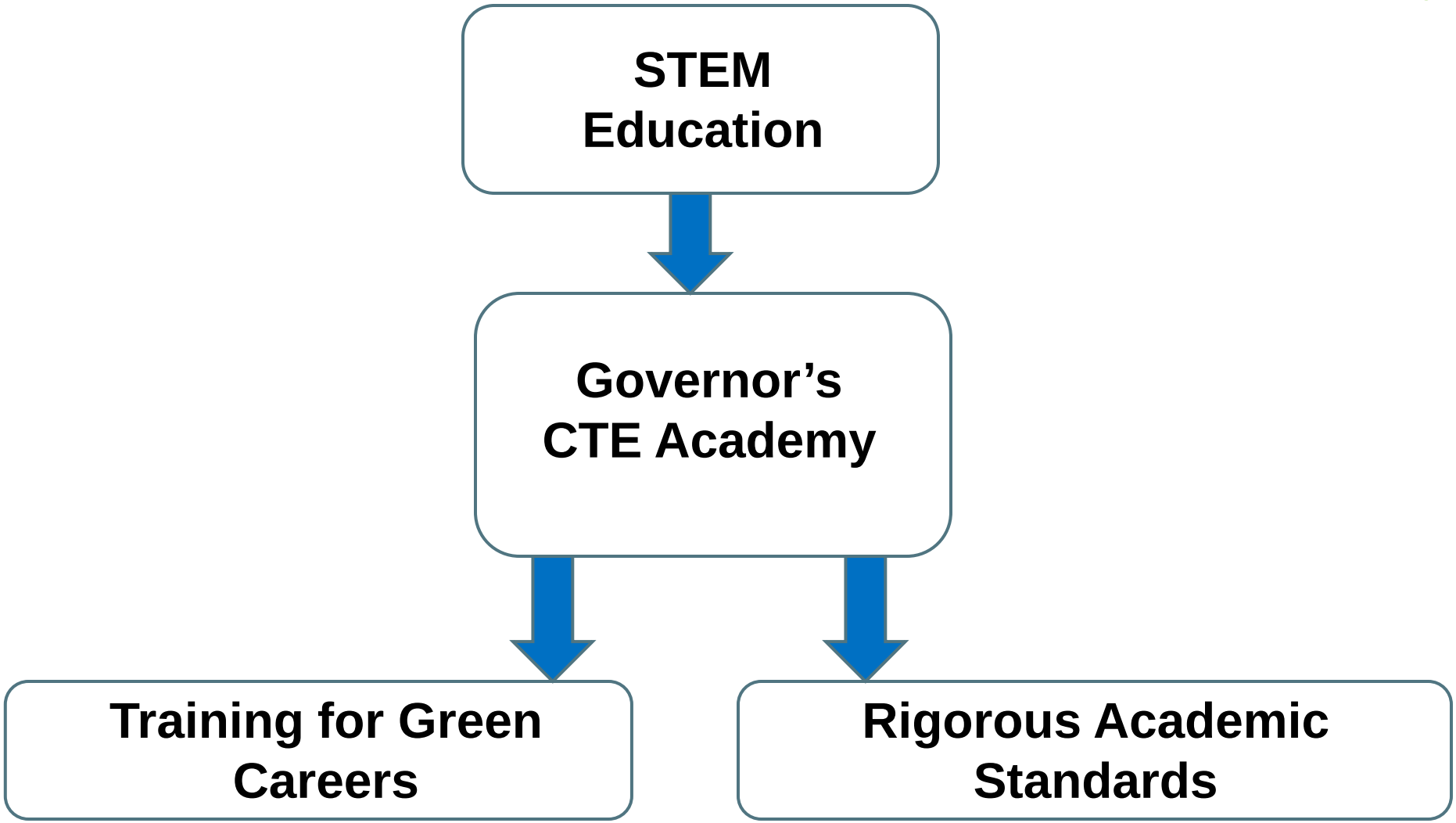

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Three BRCGATE areas of focus

Agriculture, Food and Natural Resources Cluster provides an Agriculture Science program with focus on material fabrication, Computer Aided Manufacturing in wood technologies, agriculture production, natural resource management, greenhouse production, biotechnology and ecological processes to reduce our carbon footprint.

Architecture and Construction Cluster provides a Building Trades program with a focus on "Green" construction and an updated Drafting curriculum focused on Computer Aided Design/Computer Aided Manufacturing and Animation.

Science, Technology, Engineering and Mathematics Cluster with a newly developed Pre-Engineering and Technology college preparatory program and an updated Electronics program with a focus on robotics and nano-technology. The STEM cluster also aligns very closely with programs provided in the Information Technology Cluster that contains the Networking Systems and Database Design and Management programs.

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Number of Students Served By Each CTE Pathway

Pathway	Number of students per year
Pre-Engineering	40
Network Systems (CISCO)	20
Computer Programming and Software Development (ORACLE)	20
Design/Pre-Construction	30
Construction	50
Environmental Service and Natural Resource Systems	40
Food Production and Processing Systems/Power Structural and Technical Systems	40

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STEM Education options at BRCGATE

Science	Technology	Engineering	Mathematics
Biology (101 & 102 Dual Credit) *Chemistry (111 & 112 Dual Credit)* *Physics (101 & 102 Dual Credit)* Applied Physics Biological Application in Agriculture Veterinary Science	Technology Foundations Computer Control and Automation Computer Systems Technology (ITN 107 & 200 Dual Credit) Computer Networking Hardware Operations (CISCO) (ITN 154, 155, 156, & 157 Dual Credit) *Biotechnology Foundations* *Biotechnology Applications in Agriculture*	Drafting/Engineering Graphics (DRF 151 & 152 Dual Credit) Electronics Technology (ETR 113, 114, 156, & 160 Dual Credit) Building Trades (BLD 105, 110, 111, 112, & 195; ELE 110 & 115 Dual Credit) Agriculture Power Systems, Agricultural Fabrication and Emerging Technologies *Introduction to Engineering Design, Principles of Engineering (EGR 120 & 123 Dual Credit)*	*Algebra for all 8th grade students* Algebra, Functions and Data Analysis College Pre-Calculus (MTH 163 Dual Credit) *College Calculus (MTH 271 & 272 Dual Credit)* Computer Mathematics (ITP 112 Dual Credit) *Statistics (MTH 241 & 242 Dual Credit)*

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New classes italicized and in red

Training for “green” careers

Over 340 green career occupations are available in 15 of 16 different career clusters. Examples include:

- Agriculture, Food, and Natural Resources
  - Agricultural Inspectors, Environmental Protection Foresters, Sustainable Landscape Workers and Supervisors, Alternative Fuel Production Technicians, and Cleantech Fabricators
- Architecture and Construction
  - Green Building Carpenters, Masons, Plumbers, Roofers and Electricians, Solar, Thermal and Wind Energy Technicians, and Installers, Cleantech Drafters, CAD Technicians, Engineers, and Construction Managers
- Science, Technology, Engineering, and Mathematics
  - Agricultural Engineers, Biological Technicians and Engineers, Biomass Technicians and Engineers, Nanotechnology Engineers and Technicians, Green Building Materials Designers, Environmental Science Engineers and Technicians, Cleantech CNC Programmers, Cleantech Electrical and Electronic Technicians, Green/Sustainable Energy Organization Computer Programmers, Support Specialists, Managers, Network Systems Administrators, and Software Engineers

ComputerSystems

Networking for the future...

CST & CISCO

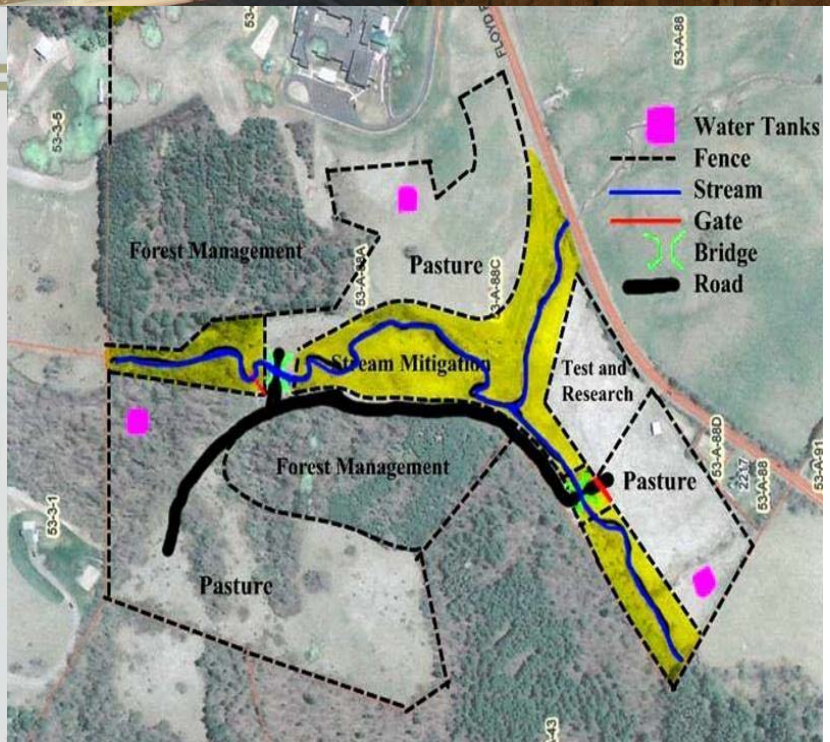
Are you interested in computers? Do you want to know what makes them work properly or do you want to know how to build one from "the ground up?" If so, this where you should be.

CISCO:
Top row (R-L): Cody Webb, Justin Sievec, Christopher Patton, Will Bowen, Jason Nester. Bottom Row: John Nicholson, Matthew Alderman, Eddie Justice, Jacob Rutherford, Justin Linecum.

Mr. Slate: CST Teacher

(Above) Whitney Dalton listens to a lecture in CST. Mr. Slate uses video lectures to help bring the world of computers to life for students. (Right) Ashley Vaughn works on a computer program.

Eddie Justice and Will Bowen working on a motherboard.



STATE SCHOLARS INITIATIVE

BRCGATE–Areas of Focus

Agriculture, Food and Natural Resources Cluster provides an Agriculture Science program with focus on material fabrication, Computer Aided Manufacturing in wood technologies, agriculture production, natural resource management, greenhouse production, biotechnology and ecological processes to reduce our carbon footprint.

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Recruitment and admissions

Recruitment	Admissions Criteria
• Career Fairs • Open House • Career Investigation Presentations • Guest Speakers Network • College Field Trips • Summer Workshops	• Student GPA • Passing Scores on 8th grade EOC SOL tests • Teacher recommendations • Completed application packet

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Needs of new programs

- Highly qualified staff
- Partnership agreements between participating agencies
- Startup and sustainability funding sources
- Grant opportunities
- Advisory Committee to provide guidance and recommendations
- Opportunities for student internships and work-based learning experiences
- Department of Education approval as a designated CTE Governor's Academy

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Objectives and Performance Measures

Objective	Performance Measure (Target dates for each)
Improve academic achievement of Academy students	An increase of 5% of students enrolled in the BRCGATE will achieve advanced level proficiency on VA SOL end of course mathematics and science assessments annually. Baseline data will be established during the 2011-2012 school year
Increase completion of dual enrollment courses	The percentage of students completing dual credit classes will increase by 2% annually and will be at or above 90% by the end of the 2013 -2014 school year
Provide workplace readiness experiences for students through strong partnerships with businesses	The number of business partnerships offering workplace experiences will increase by 10% over the next year
Increase high school graduation rates	Students enrolled in the BRCGATE will achieve a graduation rate at or above 90% annually
Reduce dropout rates	Students enrolled in the BRCGATE will have an annual 7-12 dropout rate of less than the state average of 1.76%

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Objectives and Performance Measures

Objective3	Performance Measure (Target dates for each)
Increase enrollment and retention in postsecondary education	Students enrolled in the BRCGATE will show a 10% increase in enrollment and completion in postsecondary education by the end of the 2013-2014 school year
Increase the proportion of students completing a college and workplace ready curriculum in high school	Students enrolled in the BRCGATE will show a 5% increase in completing a workplace readiness curriculum in high school by meeting the requirements of the Virginia College and Career Readiness Initiative by the end of the 2011-2012 school year
Reduce the proportion of students requiring remediation in college	Students enrolled in the BRCGATE requiring developmental coursework in college will be reduced by 5 % annually
Increase the number of industry certifications awarded to high school CTE completers	Students enrolled in the BRCGATE will achieve industry certifications at a 5% higher rate than the state average within 2 years
Increase the number of graduates employed in high-wage, high-demand and high-skill careers	Students graduating from the BRCGATE program will obtain successful employment in a high-wage, high-demand, and high-skill career at a 10% higher rate than their peers graduating with a Standard Diploma within 5 years of graduation

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A Sample of Who We Are And What We Are Doing

BRCGATE Promotional video

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Blue Ridge Crossroads Governor's Academy for Technical Education

the Crossroads Institute
A Rural Entrepreneurial & Educational Initiative

RED HILL GENERAL STORE
Quality Products for Everyday Living

Carroll County Public Schools

Galax City Public Schools

Grayson County Public Schools

Red Hill General Store

The Turman Group

New River/Mt. Rogers Workforce Investment Board

Wytheville Community College

Virginia Polytechnic Institute

Virginia Cooperative Extension

Crossroads Institute

Chestnut Creek School of the Arts

Virginia Department of Forestry

Lowes Home Improvement

Partners in STEM Education

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Virginia Cooperative Extension

New River/Mount Rogers Workforce Investment Area

LOWE'S Let's Build Something Together

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Strategies to Increase STEM Achievement and College and Career Readiness

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Logic Models as a Tool to Promote STEM Readiness

Ryoko Yamaguchi, Ph.D.
Deputy Director, REL Appalachia
Plus Alpha Research and Consulting, LLC

What is a logic model?

- What is a logic model? How is it different from a theory of change or a conceptual framework?
  - Logic models clarify *what* you are doing; theories of change clarifies *why* you are doing it (Center for Civic Partnerships)
  - A logic model is a systematic and visual way to present and share your understanding of the relationships among the resources you have to operate your program, the activities you plan, and the changes or results you hope to achieve. (Logic Model Development Guide, WKKF)

- Why do you need a logic model?
  - The purpose of a logic model is to provide stakeholders with a road map describing the sequence of related events connecting the need for the planned program with the program's desired results. (Logic Model Development Guide, WKKF)

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Components of a logic model

- Helping you think through what is needed to achieve your goals
  - Step 1. What are your goals? (long-term outcomes)
    - Increase percent advanced proficient in math and science
    - Increase graduation rates or reduce graduation rate gaps
    - Increase student participation in STEM CTE courses
    - Increase college enrollment rates
  - Step 2. What are you doing or could you do to make sure you achieve your goals? (activities and processes)
    - Focus on math and science instruction
    - Provide professional development to staff, especially in math and science
    - Create partnerships with local colleges to offer dual enrollment (DE) Career and Technical Education STEM courses
  - Step 3. For each activity, what will you see that will let you know you are on track to achieve your goals? (outputs)
  - Step 4. What supports do you need? (inputs)

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Example 1: BRCGATE Logic Model

Inputs	Activities	Outputs	Outcomes
• Agency partnerships • Highly qualified staff • Funding sources • VDOE support • Governors STEM Academy designation	• Identify employment needs in area (Particular focus on STEM gaps) • Develop career pathways aligned with needs • Establish & maintain partnerships with local colleges • Establish & maintain partnerships with local businesses	• Students enroll in more STEM courses • Students participate in work based learning • Students complete more DE courses • Students complete more CTE industry certifications	• Increased academic achievement • Increased HS graduation • Decreased HS dropout • Increased college enrollment rates • Increased number of grads employed in high wage, high demand, high skill jobs

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Example 2: WV Student Engagement Logic Model

(1) INPUTS

State Leadership
- Office of School Improvement supports via school liaison
- Monitor waiver requirements

District Leadership
- Monitor state requirements
- Supports to schools
- Site visits with RESAs
- Utilize WESTEST 2 gap data

Regional Education Service Agencies (RESA)
- 8 RESAs
- TA and job embedded PD
- Site Visits

(2) WV Focus School PROCESS

Support for Personalized Learning (SPL)
- Tiered interventions and pedagogy similar to Response-to-Intervention
- SPL specialist for each school to help schools identify interventions

West Virginia Early Warning System (WVEWS)
- Early warning indicator to identify at-risk students (high school only)
- Specialized assistance from LEA and RESA to target supports to most at-risk students

Teacher Professional Development
- Inclusion of state level PD, program enhancement activities around state initiatives (e.g., college readiness)
- RESA PD

School Strategic Plan for Improvement
- School leadership team, with LEA and RESA, will develop action steps, establish targets, and outline interventions

(3) Student OUTCOMES

Student engagement
- Increase in attendance
- Decrease in disciplinary infractions
- Increase in academic engagement

Student achievement
- Increase in student achievement
- Increase in graduation rates
- Decrease in achievement gaps by priority groups

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Logic Model Handout

RESOURCES	ACTIVITIES	OUTPUTS	OUTCOMES	IMPACT
In order to accomplish our set of activities, we need the following:	In order to address our problem or asset, we will accomplish the following activities:	We expect that once we accomplish the activities, they will produce:	We expect that once accomplished, the activities and outputs will lead to the following changes:	Long term outcomes:

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Source: W. K. Kellogg Foundation (2004)

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Logic Model Development in Groups and Report Out

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Wrap up

Please complete feedback survey

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Thank you!

Closing remarks by William Kidd

Lunch provided by VSBA

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