

The background of the slide is a collage of four images. On the left, a young man in a red and blue plaid shirt is smiling and looking down at a notebook. To his right, a teacher in a light blue shirt is smiling and looking at a group of three students. The three students, two girls and one boy, are gathered around a desk, looking at a notebook and smiling. The text 'CAREER & TECHNICAL EDUCATION PLC' is overlaid in yellow on the right side of the collage.

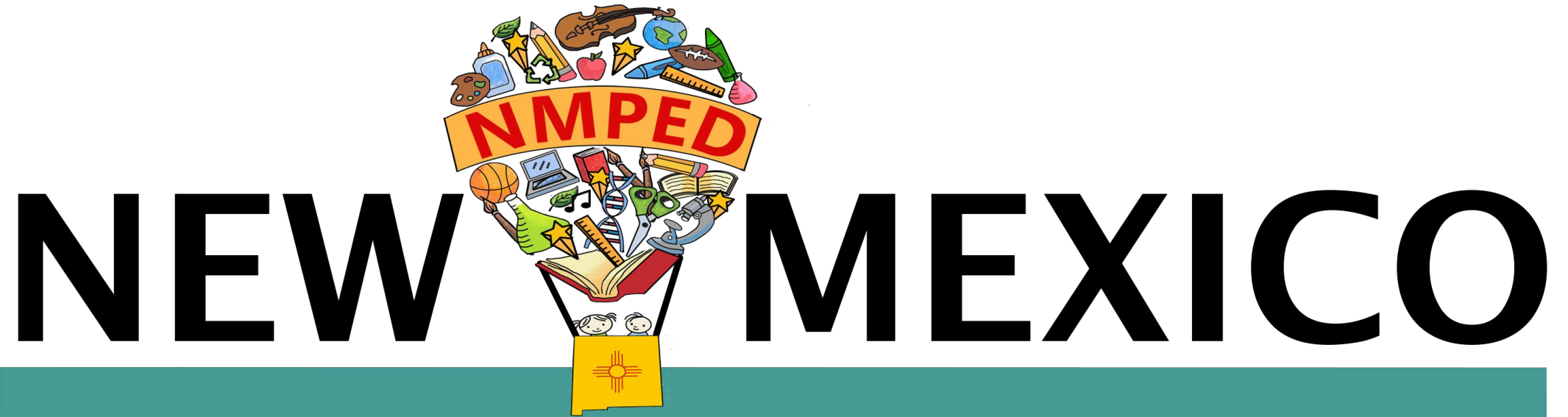
CAREER & TECHNICAL EDUCATION PLC

DECEMBER 8, 2020

AGENDA

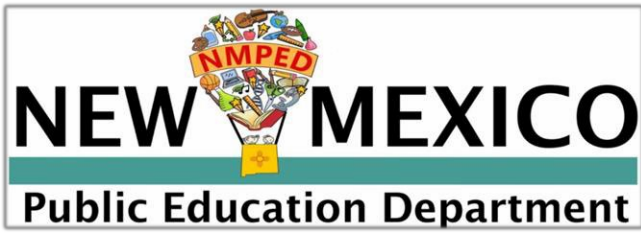
- NM Career Ready and Equitable CTE



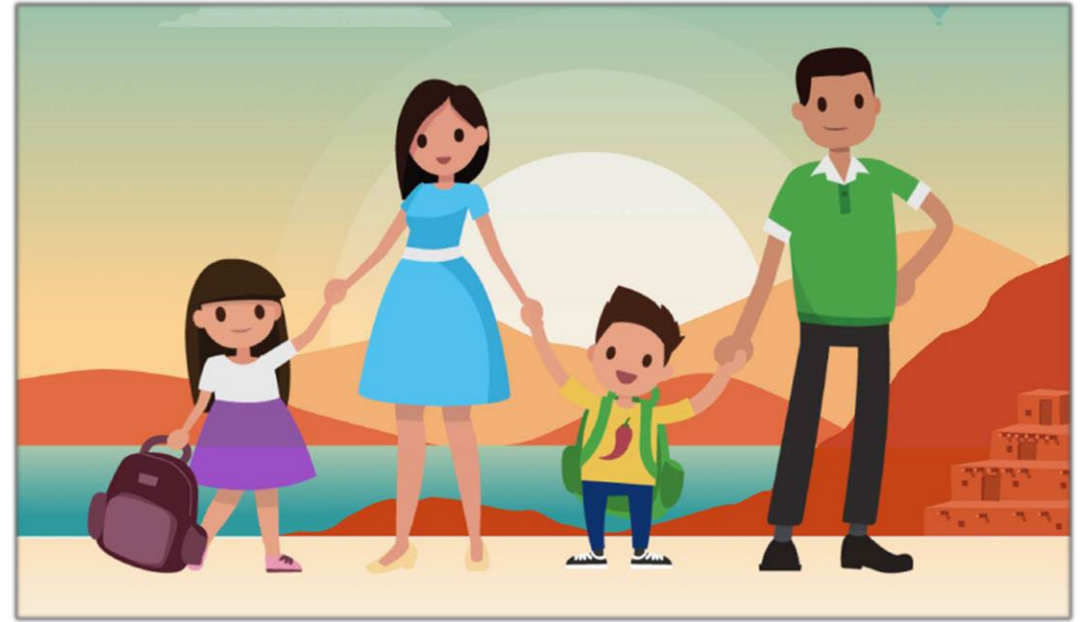


Public Education Department

NM Career Ready and
Equitable CTE



Mission



Equity, Excellence, and Relevance

The New Mexico Public Education Department partners with educators, communities, and families to ensure that all students are healthy, secure in their identity, and holistically prepared for college, career, and life.

Vision

Rooted in our Strengths

Students in New Mexico are engaged in a culturally and linguistically responsive educational system that meets the social, emotional, and academic needs of all students.



Goal 1 – An Educational System that Benefits the Whole Child

Initiatives

- Culturally and Linguistically Responsive Education Framework
- Integrated Social and Emotional Learning
- Support for Special Education
- Academic Content Mastery

Key Strategies

- Bilingual Programming
- Hispanic Education Initiative
- Indigenous Education Initiative
- Bilingual Multicultural Education Act
- Rural Education Initiative
- Deeper Learning Initiative
- Support for Tier 1 Instruction
- Special Education
- Social and emotional learning Initiatives

Outputs

- Funding, technical assistance and monitoring of bilingual programs that are grounded in best practices in multicultural and language pedagogy
- Funding, technical assistance and monitoring to help LEAs with large Native populations to align community goals and academic purpose
- Programs and communities of practice that grow/sustain rigorous and meaningful education for rural space
- Social and emotional framework and curriculum in place for all schools
- Initiatives in early literacy, early numeracy, and high quality, culturally relevant instructional materials
- Professional learning initiatives that support the health and well being of all students
- Literacy/Numeracy Frameworks established and improved educator practice in early literacy and early numeracy
- Indigenous bilingual programs, wellness, and indigenous core values driving purpose within schools systems
- Efficient and compliant special education systems

Outcomes

- Increased English language proficiency for English Learners
- Increased Spanish language proficiency and increased numbers of students graduating with a bilingual seal
- Improved K-3rd grade reading competency
- Improved 8th grade math competency
- 3,5,8, and 11 Science, ELA and Math proficiency, disaggregated by key demographic indicators

Impact

- Robust bilingual programs that reflect community needs, best practices in multicultural and language pedagogy
- Sustained, valued bilingual workforce
- Revitalized school systems that are centered around indigenous ideology and community
- Students academically prepared for rigorous, application-based, learner-centered models of education at the upper elementary and secondary levels
- Healthy, thriving students and educators
- Students with special needs serviced as part of the general education system that honors both their specific needs and individual potential
- Bilingual programs that reflect strong teacher practice in bilingual pedagogy, wide access to dual language programs, and supportive instructional materials and assessment practices
- High quality special education systems and services



Goal 2 – A Vibrant Educator Ecosystem

Initiatives

- Educator Pipeline
- Educator Preparation
- Educator Quality and Professional Learning
- Educational Leadership

Key Strategies

- Professional Educator Salaries
- Early Career Professional Development
- Educational Leadership Development and Support
- Educator and Administrator Recruitment, Retention, and Evaluation
- Teacher Supply Fund
- Teacher Residency and Educator Preparation Program Development

Outputs

- Increased minimum salaries, and equivalent increases for non-certified educators
- Established programming that supports teachers in the first five years of their career
- Established programming that develops administrators as instructional, community-focused leaders
- New educator evaluation system that integrates purposeful feedback, includes opportunities for reflection, incentivizes collaboration, and celebrates the profession
- Grow-your-own initiatives and marketing campaigns to honor and cultivate educators across NM
- Rebuilding the licensure system to incentivize on-going professional learning, promote specialized competencies, and reflect cohesive pathways to educator leadership
- Establishing funds to support supplies for classroom success
- Establishing residency programs and providing stronger technical assistance, monitoring, and partnerships with existing educator prep programs

Outcomes

- Teacher vacancy rate minimized
- Number of candidates in teacher prep programs and residency programs increases
- % of Educators rated Applying or Innovating (level 3 or 4) increases
- % of Educators who are Native increases
- % of Educators who are African American and Hispanic increases
- % of early career teachers who are assigned a mentor increases
- Number of Native educators who are certified to teach Native American languages in the public schools increases
- Micro credentials embedded in licensure system

Impact

- Mitigating educator turnover, increasing retention and recruitment
- Increased successful classroom outcomes including academic metrics and stronger classroom culture
- Mitigating administrator turnover, increasing retention and targeted recruitment to grow our own administrators
- Reflective practitioners that demonstrate life-long learning, collaborate across schools and systems, and center students are the core of their work
- Clearly defined pathways and processes that support and honor educator growth and development
- Thriving classrooms with materials to support project-based, learner-centered practices
- Educator prep programs that are built around outcomes of success for all adults entering the profession and guided by a whole child, bilingual multicultural framework.

Goal 3 – Equitable Access to Educational Opportunities For Students and Families

Initiatives

- Extended Learning Opportunities
- Evidence Based Community Schools
- Targeted and Comprehensive Support for Struggling Schools
- New Mexico Multi-layered System of Supports for Students

Key Strategies

- K-5 Plus Program
- Extended Learning Time Program
- Community Schools & School Based Health Centers
- Increased At-Risk Funding and Accountability
- NM Multi-layered System of Supports
- GRADS Program
- End Childhood Hunger Campaign

Outputs

- Evidence-rich program that reflects an extended school calendar and focuses on building early literacy/numeracy skills through integrated curriculum
- Increased instructional days that are flexible and designed to incentivize innovation. Support for afterschool programming and increased professional development hours
- Programming and services that target students at-risk (i.e. counselors, support staff, wrap-around services, tutoring, afterschool support, and family guidance)
- Multi-layered, flexible intervention design that allows for students' varied needs to be met
- Early warning system and programming that supports dropout prevention
- Funding for teen students who are young parents
- Programs that target child nutrition, ameliorate hunger and provide NM grown produce

Outcomes

- Chronic absenteeism rates reduced for elementary, middle, and high schools
- Participation rates in K-5 Plus and Extended Learning Programs increase
- Average instructional hours increase across the state
- Academic achievement gaps for EL, SPED, Native America, Hispanic and African American students as well as students who are economically disadvantaged reduced

Impact

- Healthy, robust community schools providing integrated services and addressing holistic wellness and security for students and families
- Communities with access to ample opportunities for both academic enrichment and academic supports
- Students who are traditionally underserved find academic and social success that still allows them to be secure in their own identity

Goal 4 – College and Career Pathways Aligned with the Profile of a New Mexico Graduate

Initiatives

- Profile of a New Mexico Graduate
- Universal Prekindergarten
- Family and Community Engagement
- Career and Technical Education Pathways
- Dual Credit, Advanced Placement, and College Pathways

Key Strategies

- College and Career Pathways
- STEAM Initiative
- Innovation in High School Design
- Family and Community Engagement
- Career and Technical Education Initiative
- Advanced Placement and Dual Credit Supports
- Universal Pre-Kindergarten

Outputs

- Developing the Profile of a New Mexican Graduate
- A multi-user friendly dashboard that provides transparency of school metrics and celebrates school identity
- Innovative High School design and programming that provides supports for college applications, career advisement, and mentorships
- Widespread Advanced Placement and Dual Credit programs with increased accessibility
- Curriculum and professional development that targets STEAM education
- Statewide STEM Coalition and partnerships that link STEAM and computer science initiatives with industry
- Strategic outreach, communications and feedback loops with all stakeholder groups including established networks to inform pathways across the system
- Vibrant career technical education programs across the state, informed by industry priority sectors and regional strengths
- Instructional materials that provide for student success in dual credit courses
- Increased slots and educators in high quality Pre-K classrooms

Outcomes

- 4-, 5-, and 6-year graduation cohort rates increase, particularly evidenced by disaggregation of EL, SPED, Native American, Hispanic, African American, and economically disadvantaged students
- % of students participating in Dual Credit, and AP course increases
- % of students as completers in CTE increases
- % of graduates entering a post-secondary pathway increases
- % of students completing Algebra 1 before 10th grade increases
- % and number of children served in state-funded pre-kindergarten increases

Impact

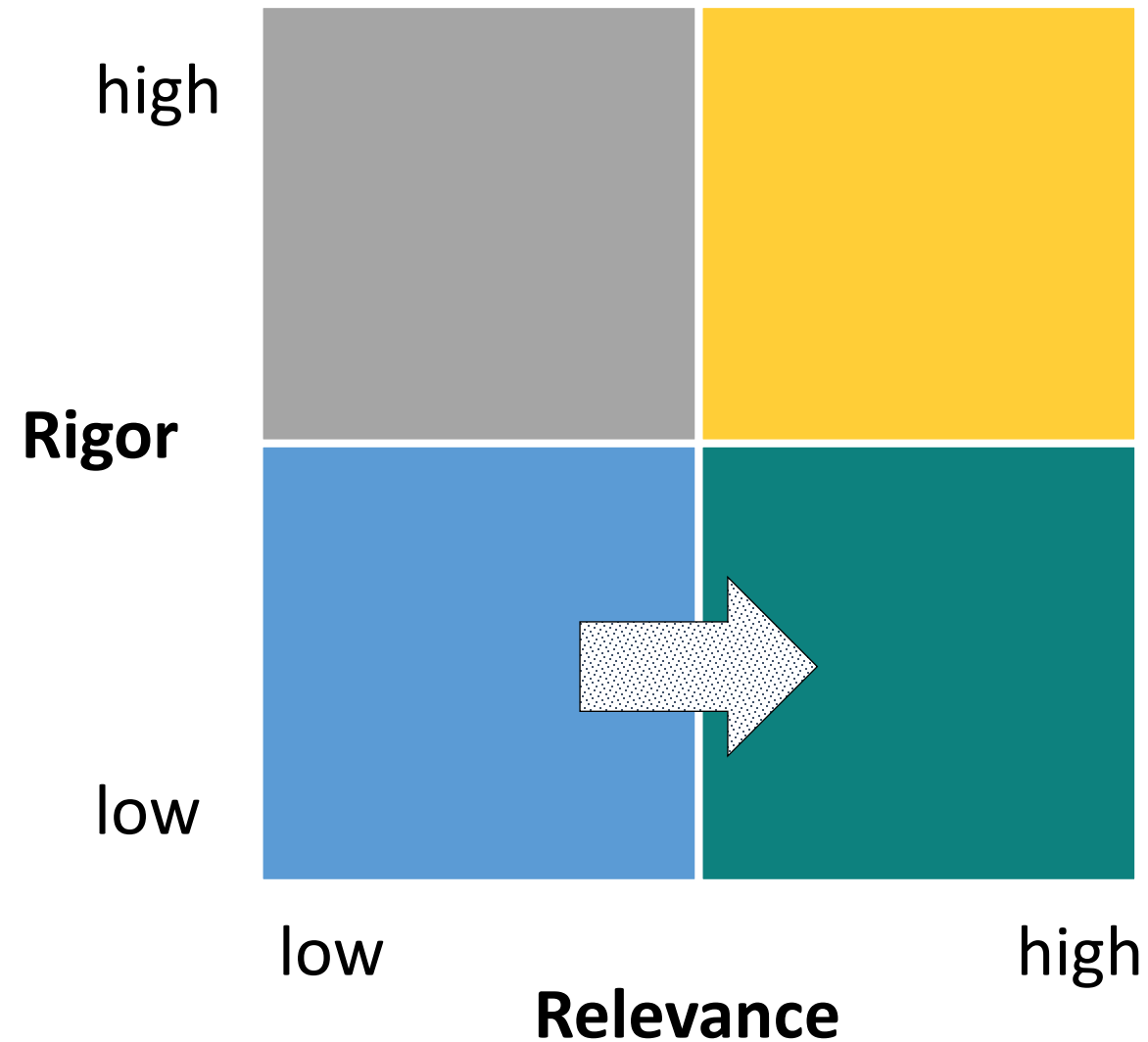
- A Profile of a New Mexican Graduate that becomes a touchstone for all education systems: assessment, curriculum and instruction, school redesign, social and emotional and integrated support systems, and most importantly, connectivity to career, college, and community.
- Cohesive pathways across the Pre-K -12 system that allow students and families to visualize success, understand how the education system functions holistically, and allows them to realize future achievement.

College & Career Readiness Bureau

Vision

- All NM high school students
 - **graduate and are career ready.**
-
- Graduates will have:
 - the academic skills needed to succeed in postsecondary studies,
 - the employability skills that are essential in any career area, and
 - awareness of the next steps in their career path.

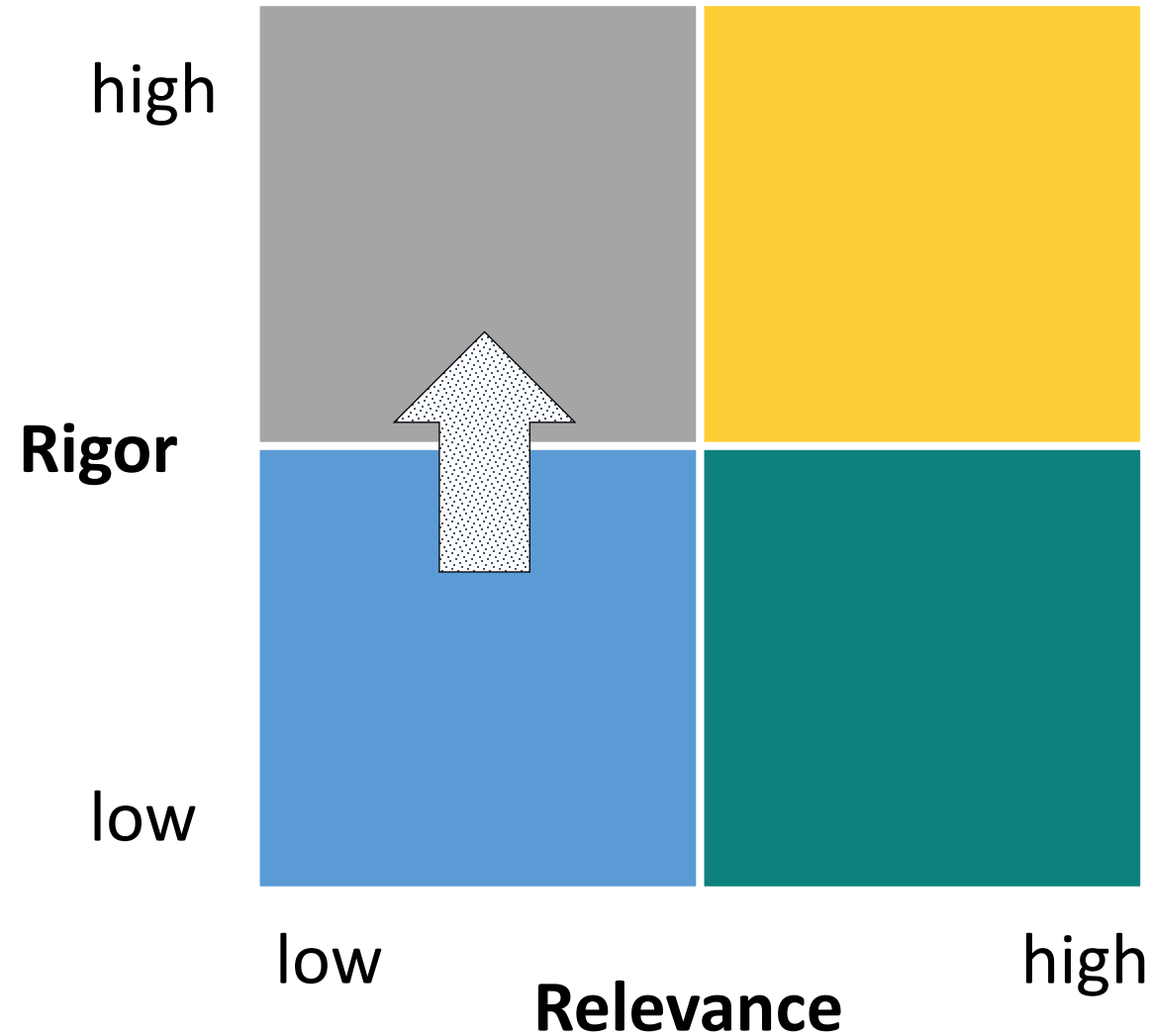
Traditional Vocational Education



Much of our work in CTE for the last several years has focused on moving up the relevance scale.

We've replaced traditional courses with industry-vetted versions that require application of learned skills.

College Ready - College Prep

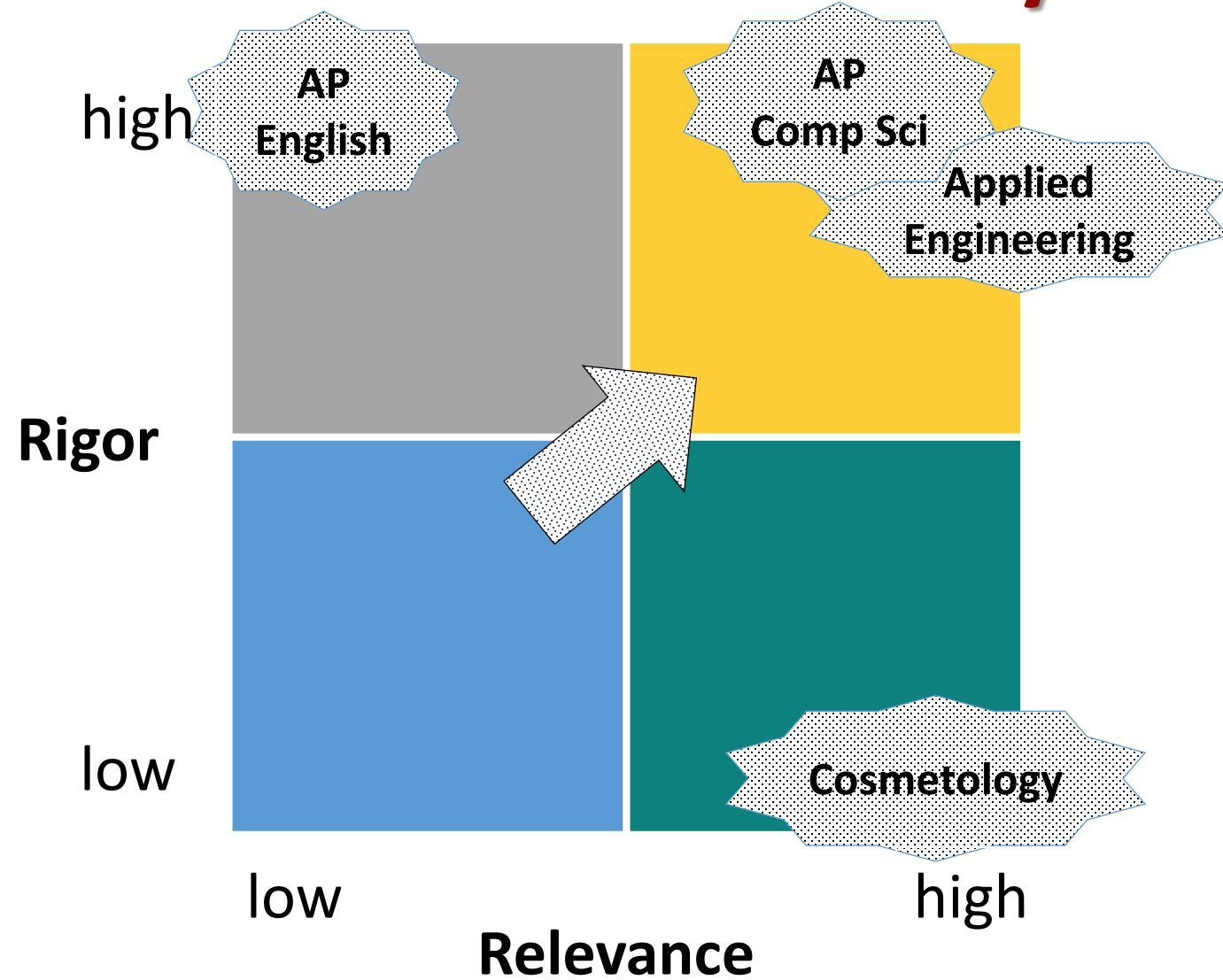


Literacy and numeracy are paramount.

College Prep IS Career Prep!

No matter how much education one gets, eventually the goal is a career, and all careers require core academic skills.

Career Ready



SEA Demonstration Grant

- The Expanding Access to Well-Rounded Courses **Demonstration Grants** program provides competitive **grants** to State educational agencies (SEAs) to demonstrate models for providing well-rounded educational opportunities through course-access programs
- (a) develop or expand, (b) implement, and (c) widely disseminate information on course-access programs (as defined in this notice) to other State or local education leaders and researchers
- in addition to serving all students, its proposed program would meet the needs of rural students, disadvantaged students, or students with disabilities, and contribute to preparing students to be college and career ready.

OVERARCHING GOAL: NM True CTE will make available a series of supports for online Career and Technical Education (CTE) and further students' abilities for a well-rounded education with enhanced career and college readiness upon high-school graduation.

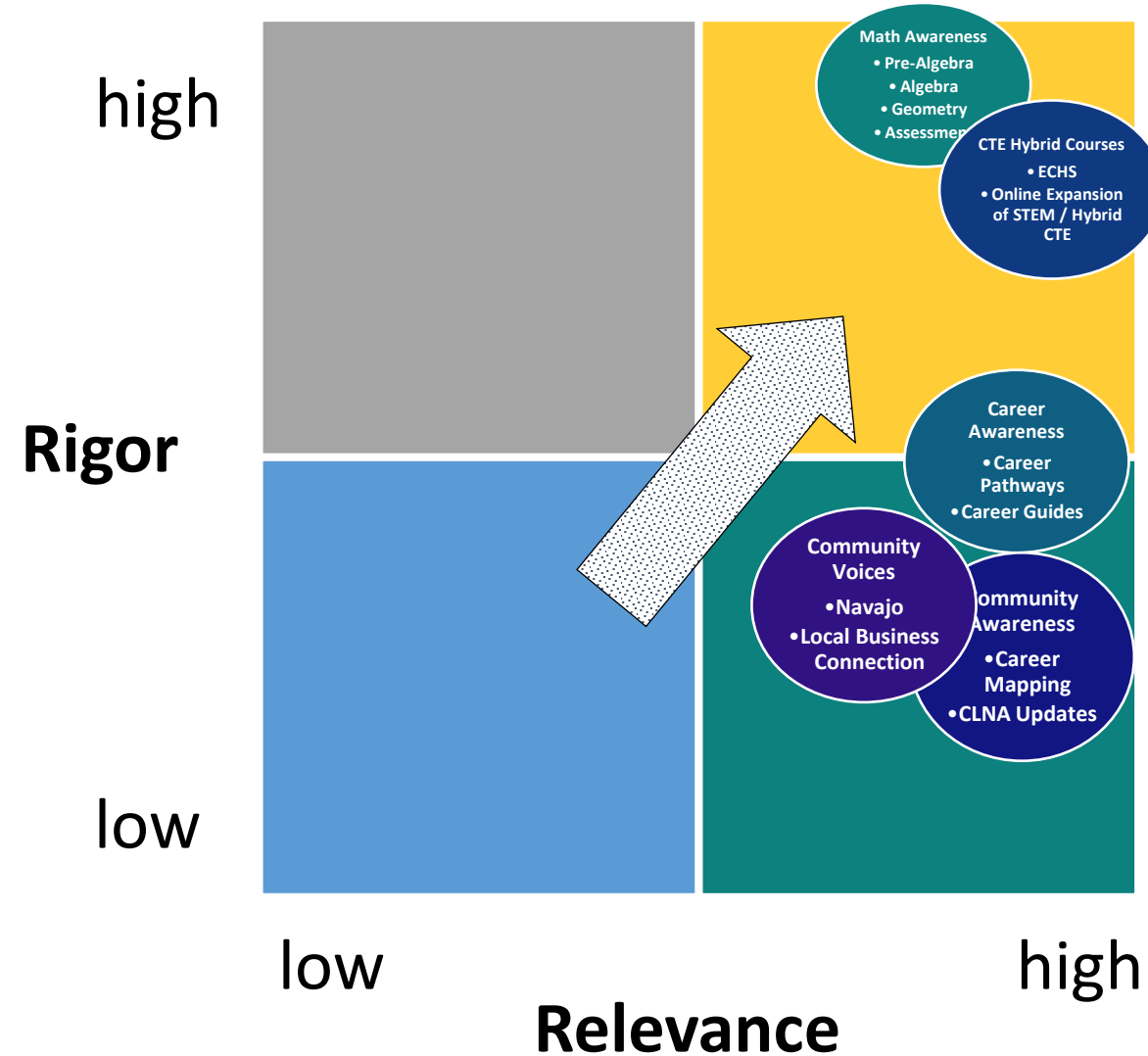
INPUTS	→ OUTPUTS/OBJECTIVES	→ OUTCOMES
Mobilized Resources	Activities and Interventions	Short-term outcomes and measures
<ul style="list-style-type: none"> • New Mexico Public Education Department (NM PED) • NM PED College and Career Ready Bureau Leadership • REC, district and school leaders across 100% of NM's LEAs including: <ul style="list-style-type: none"> --10 Regional Education Cooperatives (RECs) ...representing 68 primarily rural districts. --23 LEAs in urban and suburban districts • Perkins V- Comprehensive Local Needs Assessment (CLNA) Consortia • CTE Industry Council • Higher Ed Council • Early College High Schools • Multiple course providers: <ul style="list-style-type: none"> • Geographic Solutions (career exploration) • The Partnership for Workforce Innovation (soft skills) • NS4ed (STEM workforce contextual Algebra 1 and Geometry) • Front Porch Studios (business and community career podcasts) • Navajo Preparatory School Native American podcasts. • Edmentum (CTE Academies for hybrid ECHSs) • NM TRUE online course delivery platform • MetaMetrics assessment provider • Principal and Teacher Training Academies 	<p><u>NM PED works with Pathways2Careers to build the NM True CTE platform for online CTE course delivery across the state</u></p> <ul style="list-style-type: none"> - All proposed courses will be loaded on the platform for virtual access. - Platform portals allow administrator, teacher, parent, and student access. <p><u>NM PED provides CTE opportunities accessible online to prepare students for college and careers</u></p> <ul style="list-style-type: none"> - Career exploration - Rigorous STEM learning through career-focused pre-Algebra, Algebra, and Geometry courses, which meet requirements for graduation. - Employability Skills (soft skills) - Multi-ethnic including Native American and Hispanic business and community leader podcasts (electives) <p><u>Course curricula represent learning experiences contextual to CTE and college and career readiness</u></p> <ul style="list-style-type: none"> - Align all course curricula with state standards - Articulate courses for college credits and industry certifications. - Work with business and community leaders to align podcasts with course content and high-demand careers. <p><u>NM True CTE builds partnerships in support of CTE opportunities</u></p> <ul style="list-style-type: none"> - Ensure college/career pathways mirror regional high-demand careers. - Engage leaders from businesses, communities, and higher education with parents and schools in all program planning and operations to reflect a true coming together of education, the workforce, and local economies. <p><u>School Districts assures high-need populations served</u></p> <ul style="list-style-type: none"> - Establish equitable recruitment and enrollment guidelines, with priority for under-represented, high-need rural and other students. - Provide hardware and software upgrades for participants needing support. - Make CTE courses accessible both online and onsite to ensure rural students have access to programs not available in their schools. <p><u>NM PED expands its support for ECHSs to include a hybrid online/onsite model</u></p> <ul style="list-style-type: none"> - Provides additional support to rural and other schools with ECHS state designation process. - Promotes effective partnerships between "local" colleges and ECHSs. - Develops policy guidelines for a hybrid ECHS model that combines online and on-site course requirements and electives. - Phases-in online CTE Academies to give rural students opportunities to build their technical skills online for high-demand careers. <p><u>NM RECTE enhances program for principal and teacher quality and leadership in support of on-site and online CTE course and pathways opportunities</u></p> <ul style="list-style-type: none"> - Provide online PD Academy to train educators on how to use Labor Market Information to build their CTE programs. - Provide online Principal and Teacher Training Academies to build skills in online coaching, mentoring, and administration. <p><u>NM True CTE courses include high-level assessments to monitor student growth</u></p> <ul style="list-style-type: none"> - Develop start-of-course, mid-course, and end-of course assessments embedded into each course. - Create a menu of mid-course capstone projects for each course. - Prepare NM True CTE Policy and Procedure Manual to guide continuous improvement, sustainability, and replicability in other states. 	<p>Long-term outcomes reflecting program objectives</p> <ul style="list-style-type: none"> • Increased awareness of career pathways and skill requirements. • Improved employability skills • Improved alignment of courses with local and regional workplace demand. • Improved mathematics skills through career-focused course design. • Quantile assessments of math coursework to measure skill growth. • Increased course options for high-need students to prepare them for college and careers through CTE pathways. • Increased number of ECHSs. • Increased student outcomes including course completion, and growth in workplace and leadership skills as measured by imbedded course assessments. <ul style="list-style-type: none"> • New Mexico's online CTE opportunities increase the preparedness of the State for seamless, uninterrupted teaching and learning. • Online course accessibility increases CTE participation for students across the state, including rural and other under-served and under-represented students in college and high-demand careers. • Completion of industry credentials and college credits increases prior to high-school graduation. • Career and college readiness increases as more students enroll in CTE pathways as a result of greater course accessibility. • Growth in employment outcomes for students transitioning directly into the workforce after high school. • A hybrid ECHS model including onsite and online CTE course opportunities adds to this proven model for engaging underrepresented students in career and college focused learning.

- Scored a 100 on design and approach to SEA Demonstration
- Tentatively funded for five years
- Only Career Based Model approved

NM Career and Equitable CTE



NM Career and Equitable CTE



SEA Demonstration Grant



NM READY AND EQUITABLE CTE PROGRAM



What does our
Data Tell us?

Disconnect between Education to the Realities of Employment



Education

The official four-year graduation rate for students attending public colleges and universities is 33.3%. The six-year rate is 57.6%.



Employment

43% of college graduates are underemployed in their first job. Of those, roughly two-thirds remain in jobs that don't require college degrees five years later.

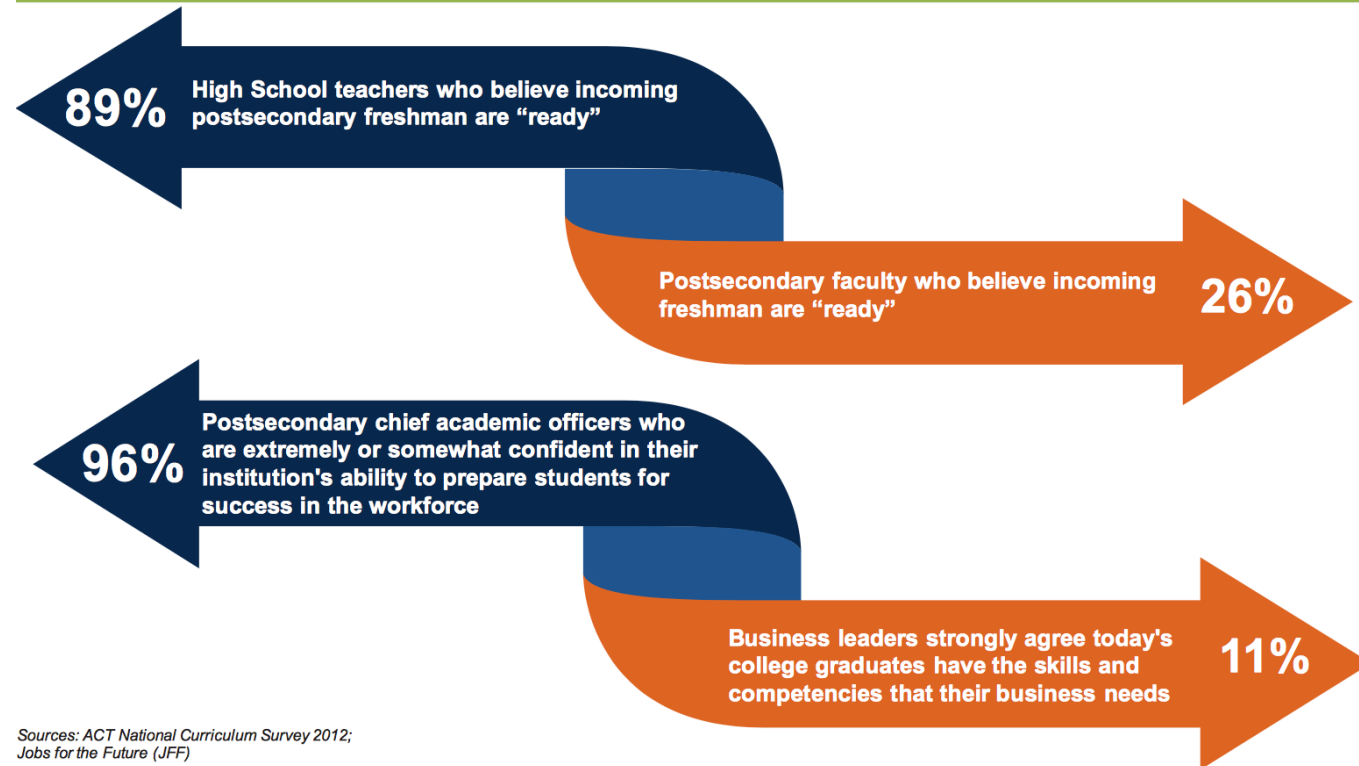


Economic Development

Employers are hiring, but 80% say they can't find skilled candidates

Mismatch in education and business...

MISMATCHES IN “READINESS”



Sources: ACT National Curriculum Survey 2012;
Jobs for the Future (JFF)



Not connecting students
to their
interest and **career paths**
matter

Students Not Feeling Engaged

HIGH SCHOOL DISENGAGEMENT

The 2012 Gallup Student Poll asked students how involved and enthusiastic they feel about school. Nearly eight in 10 elementary students reported high engagement. By high school, only half that many did.

ELEMENTARY SCHOOL
76%

MIDDLE SCHOOL
61%

HIGH SCHOOL
44%



How can **relevance be increased** while supporting the pathway to postsecondary success for all students, particularly those traditionally underserved?



“

In today's world, twenty-first-century skill demands are steadily increasing. **Most high-paying jobs require additional education and training beyond a high school diploma.** We must make sure that our children, particularly those who are traditionally underserved, are prepared for and have access to postsecondary education.

”

—Gov. Bob Wise, Alliance for Excellent Education



Less than **10 percent** of children born in the bottom quartile of household incomes attain a bachelor's degree by age 25, compared to **more than 50 percent** in the top quartile.

Understanding Research

Understanding Research - Motivators

Table 4

Strategy effect sizes from meta-regression model.

Strategy		Effect size	<i>p</i>
Career Development/Job Training	←	0.81	0.56
Family Engagement		0.67	0.00
Mentoring	←	0.63	0.91
Behavioral Intervention		0.46	0.01
Literacy Development	←	0.42	0.00
Work-Based Learning	←	0.26	0.01
School/Classroom Environment		0.25	0.00
Service-Learning	←	0.21	0.00
Health and Wellness		0.18	0.00
Academic Support	←	0.11	0.00



NM READY AND EQUITABLE CTE PROGRAM: CAREER LEARNING

Traditional Approaches to Math Instruction

✓ A dislike for math is commonly reported among students.

✓ Attitudes toward math generally decline when students enter middle school and the material gets more diverse and abstract (Hannula, 2002; Hiebert et al., 2003; Rice et al., 2012).

✓ Negative attitudes toward math can translate into poor engagement and course failure (Akin & Kurkanoglu, 2011; Ma & Xu, 2004; Mayes, Chase, & Walker, 2008).

✓ Students with positive attitudes toward math tend to demonstrate a higher level of achievement (Gottfried, 1985).

Math attitudes decline as material gets more diverse and abstract.



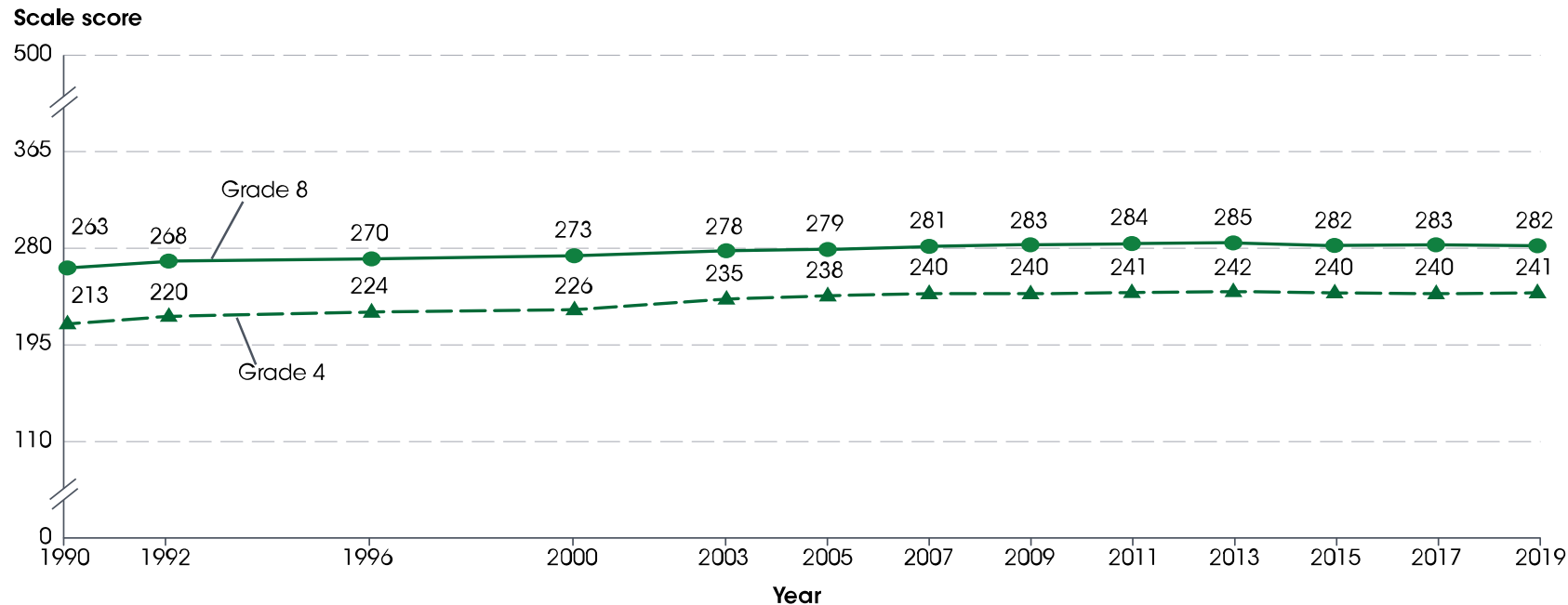
Negative attitudes are associated with poor engagement and course failure.



Students with positive attitudes demonstrate higher levels of achievement.

Traditional Approaches to Math Instruction

Average National Assessment of Educational Progress (NAEP) mathematics scale scores of 4th- and 8th-grade students: Selected years, 1990–2019

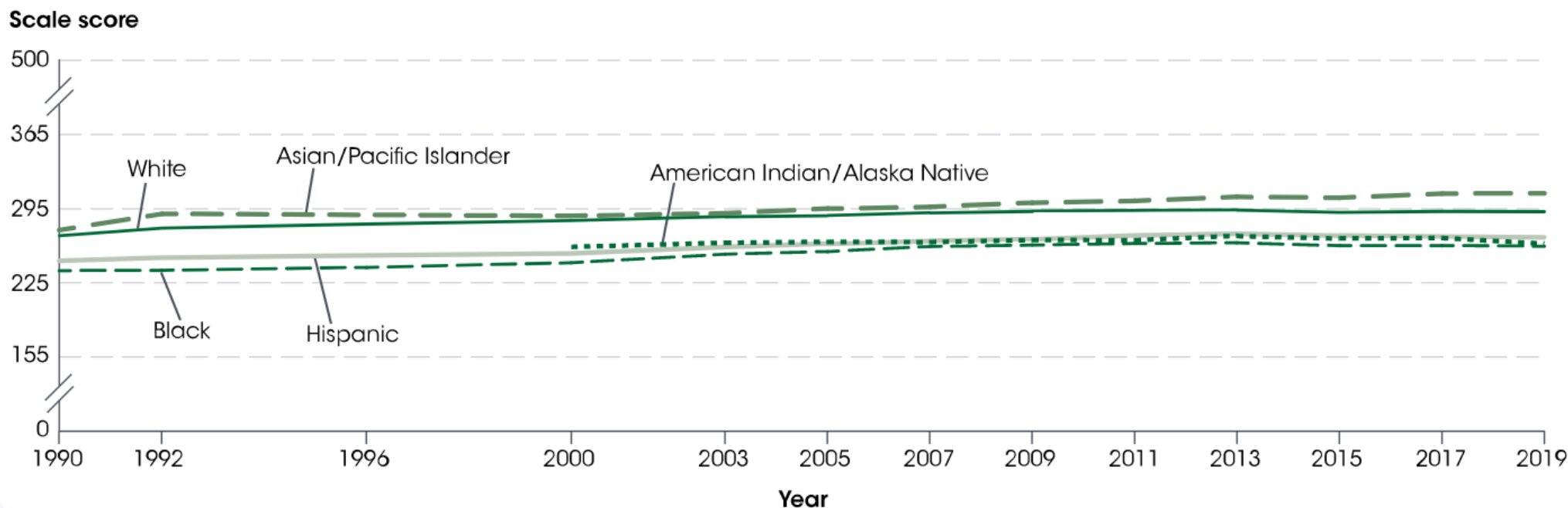


Note: A similar trend is observed for grade 12 results. Grade 12 mathematics scores are not shown because they are reported on a scale of 0 to 300.

[Source: The Condition of Education 2020](#)

Traditional Approaches to Math Instruction

Average National Assessment of Educational Progress (NAEP) mathematics scale scores of 8th-grade students, by selected characteristics: Selected years, 1990–2019



[Source: The Condition of Education 2020](#)

Traditional Approaches to Math Instruction

How can we improve students' attitudes toward math and promote the successful acquisition of critical math skills?

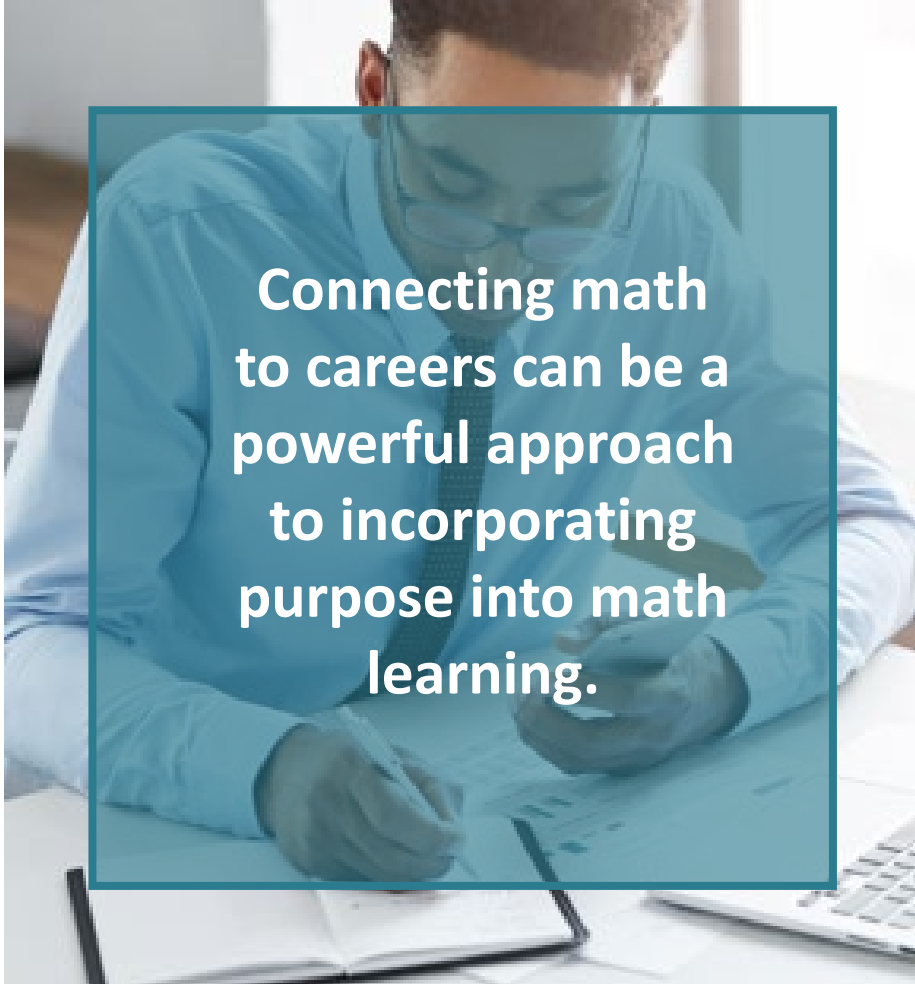
- ✓ Make math less abstract and more concrete.
- ✓ Connect math to authentic, meaningful situations.
- ✓ Demonstrate how math is useful and necessary.
- ✓ **Provide purpose in math learning.**

Traditional Approaches to Math Instruction

When math is taught in the context of a viable career, students can see...

- ✓ how math is applied in meaningful, everyday tasks.
- ✓ the relationship between math proficiency and successful job performance.
- ✓ the value in using math to reach job-related goals.

Bottom Line – Connecting math to careers brings purpose to math learning. This has the potential to improve students' attitudes toward math and enhance motivation to acquire the critical math skills students will need for employment success.



Connecting math to careers can be a powerful approach to incorporating purpose into math learning.

A New Approach to Algebra and Geometry

Authentic Career Application



PATHWAY 2 ALGEBRA
Education with Destination



PATHWAY 2 GEOMETRY
Education with Destination

A New Approach to Algebra and Geometry

- ✓ Pathway2Careers has designed new math curricula for algebra and geometry.
- ✓ The emphasis is on demonstrating authentic application of fundamental math concepts in meaningful on-the-job examples and exercises.
- ✓ **Primary Objective:** Assist students in learning critical math skills and understanding the value of these skills in the workplace.

LESSON 10

Volume of Cylinders, Cones, and Spheres



CAREER SPOTLIGHT: Agricultural Engineer

Occupation Description

Agricultural engineers work on the storage and processing of agricultural products. They use computer programs to solve problems and design various systems, structures, and facilities. Their work can involve pollution and environmental issues. They work in various fields of farming, such as aquaculture, forestry, and food processing.

This career is relevant to New Mexico as agricultural engineers are employed in the industry sector of sustainable agriculture and value-added agriculture.

Agricultural engineers who solve design problems involving structure will need to understand and apply concepts involving volume.

Education

Agricultural engineers need a bachelor's degree, often in agricultural engineering or biological engineering. Students study advanced calculus, physics, biology, and chemistry.

Potential Employers

Agricultural engineers held about 2,600 jobs in 2018. The largest employers of agricultural engineers were as follows:

Crop production	31%
Federal government, excluding postal service	13%
Colleges, universities, and professional schools; state	10%
Management, scientific, and technical consulting services	8%
Engineering services	4%

Watch a Video about Agricultural Engineers:

<https://www.bls.gov/ooh/architecture-and-engineering/agricultural-engineers.htm>

NS4ed™ Pathway2Careers™ 2018 Trademark NS4ed, LLC

Career Cluster

Agriculture, Engineering, Food and Natural Resources

Career Pathway

Power, Structure and Technical Systems

Career Outlook

Salary Projections:

- Low-End Salary, \$46,500
- Median Salary, \$77,110
- High-End Salary, \$116,850
- Jobs in 2018: 2,600
- Job Projections for 2028: 2,800 (increase of 8%)

Geometry Concepts

- Apply volume of solids.
- Apply concepts of density.
- Apply geometric methods to solve design problems.

Is this a good career for me?

Agricultural engineers tend to:

- Use computers to design equipment, systems, or structures
- Modify factors that affect production
- Test equipment
- Oversee construction and production operations

A New Approach to Algebra and Geometry



Over **100 different careers** are featured in the curricula.

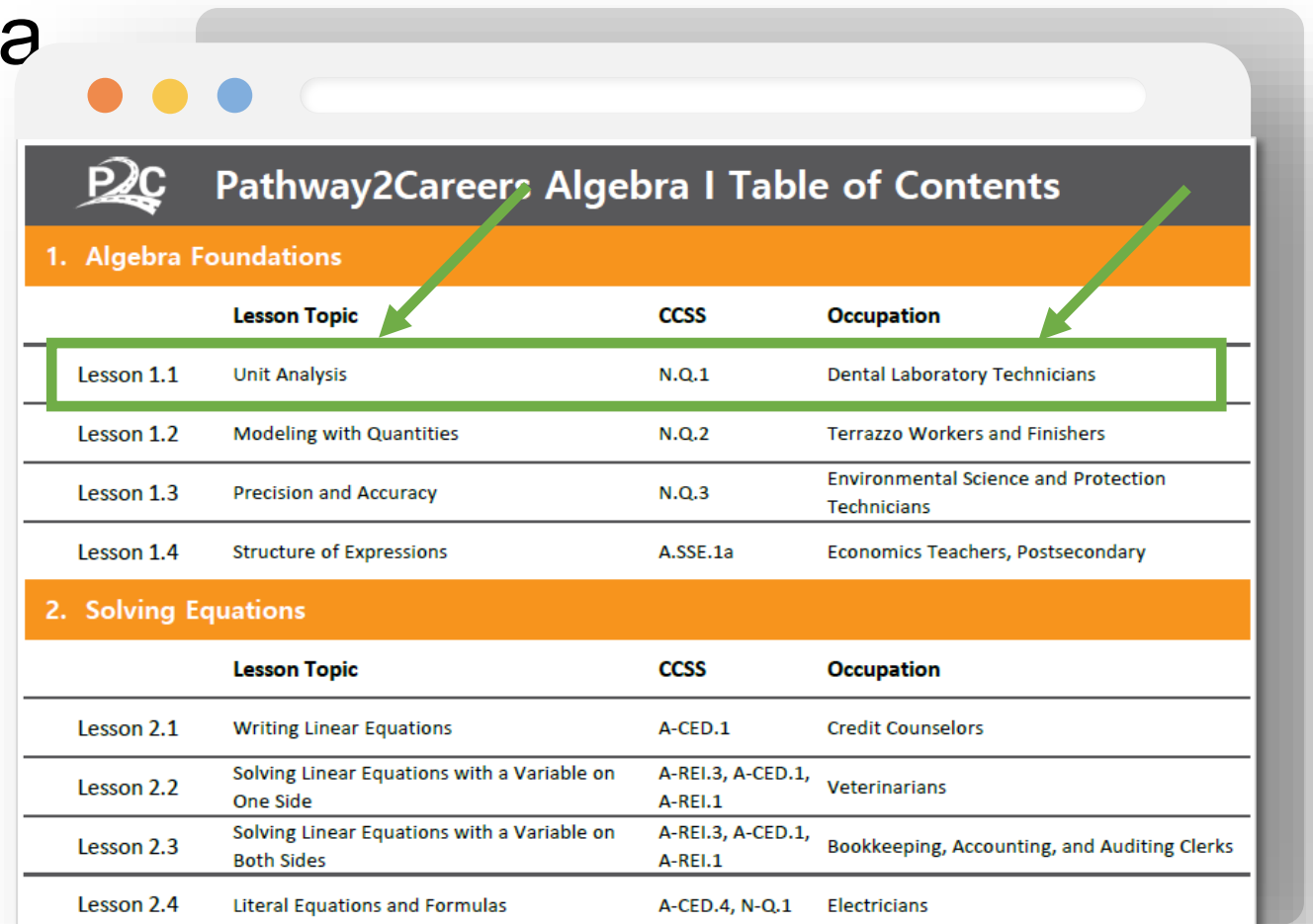


Each lesson offers in-depth exploration of specific math concepts in the context of a spotlighted career.



Occupations represent **high-value careers** in multiple fields.

- High-Demand (O*NET Bright Outlook)
- High-Wage (above \$35,000)
- All 16 Career Clusters



P2C Pathway2Careers Algebra I Table of Contents			
1. Algebra Foundations			
	Lesson Topic	CCSS	Occupation
Lesson 1.1	Unit Analysis	N.Q.1	Dental Laboratory Technicians
Lesson 1.2	Modeling with Quantities	N.Q.2	Terrazzo Workers and Finishers
Lesson 1.3	Precision and Accuracy	N.Q.3	Environmental Science and Protection Technicians
Lesson 1.4	Structure of Expressions	A.SSE.1a	Economics Teachers, Postsecondary
2. Solving Equations			
	Lesson Topic	CCSS	Occupation
Lesson 2.1	Writing Linear Equations	A-CED.1	Credit Counselors
Lesson 2.2	Solving Linear Equations with a Variable on One Side	A-REI.3, A-CED.1, A-REI.1	Veterinarians
Lesson 2.3	Solving Linear Equations with a Variable on Both Sides	A-REI.3, A-CED.1, A-REI.1	Bookkeeping, Accounting, and Auditing Clerks
Lesson 2.4	Literal Equations and Formulas	A-CED.4, N-Q.1	Electricians

A New Approach to Algebra and Geometry

Each student lesson begins with a comprehensive career overview that introduces students to:

- ✓ Job Duties and Responsibilities
- ✓ Education Requirements
- ✓ Types of Employers
- ✓ Career Cluster and Pathway
- ✓ Labor Market Data (wage and demand projections)
- ✓ Occupation-Related Math Concepts
- ✓ Common Work Tasks

LESSON 10

Volume of Cylinders, Cones, and Spheres



CAREER SPOTLIGHT: Agricultural Engineer

Occupation Description

Agricultural engineers work on the storage and processing of agricultural products. They use computer programs to solve problems and design various systems, structures, and facilities. Their work can involve pollution and environmental issues. They work in various fields of farming, such as aquaculture, forestry, and food processing.

This career is relevant to New Mexico as agricultural engineers are employed in the industry sector of sustainable agriculture and value-added agriculture.

Agricultural engineers who solve design problems involving structure will need to understand and apply concepts involving volume.

Education

Agricultural engineers need a bachelor's degree, often in agricultural engineering or biological engineering. Students study advanced calculus, physics, biology, and chemistry.

Potential Employers

Agricultural engineers held about 2,600 jobs in 2018. The largest employers of agricultural engineers were as follows:

Crop production	31%
Federal government, excluding postal service	13%
Colleges, universities, and professional schools; state	10%
Management, scientific, and technical consulting services	8%
Engineering services	4%

Watch a Video about Agricultural Engineers:

<https://www.bls.gov/ooh/architecture-and-engineering/agricultural-engineers.htm>



NS4ed™ Pathway2Careers™ 2018 Trademark NS4ed, LLC

Career Cluster

Agriculture, Engineering, Food and Natural Resources

Career Pathway

Power, Structure and Technical Systems

Career Outlook

Salary Projections:

- Low-End Salary, \$46,500
- Median Salary, \$77,110
- High-End Salary, \$116,850
- Jobs in 2018: 2,600
- Job Projections for 2028: 2,800 (increase of 8%)

Geometry Concepts

- Apply volume of solids.
- Apply concepts of density.
- Apply geometric methods to solve design problems.

Is this a good career for me?

Agricultural engineers tend to:

- Use computers to design equipment, systems, or structures
- Modify factors that affect production
- Test equipment
- Oversee construction and production operations

A New Approach to Algebra and Geometry

- ✓ Career overviews provide students with information that can help them connect with the career examples in the lessons.
- ✓ These overviews also increase students' **exposure** to viable occupations, which can encourage...
 - awareness of a wide range of high-value occupations in various career fields.
 - informed career decisions.
 - interest in additional career exploration.

LESSON 10

Volume of Cylinders, Cones, and Spheres



CAREER SPOTLIGHT: Agricultural Engineer

Occupation Description

Agricultural engineers work on the storage and processing of agricultural products. They use computer programs to solve problems and design various systems, structures, and facilities. Their work can involve pollution and environmental issues. They work in various fields of farming, such as aquaculture, forestry, and food processing.

This career is relevant to New Mexico as agricultural engineers are employed in the industry sector of sustainable agriculture and value-added agriculture.

Agricultural engineers who solve design problems involving structure will need to understand and apply concepts involving volume.

Education

Agricultural engineers need a bachelor's degree, often in agricultural engineering or biological engineering. Students study advanced calculus, physics, biology, and chemistry.

Potential Employers

Agricultural engineers held about 2,600 jobs in 2018. The largest employers of agricultural engineers were as follows:

Crop production	31%
Federal government, excluding postal service	13%
Colleges, universities, and professional schools; state	10%
Management, scientific, and technical consulting services	8%
Engineering services	4%

Watch a Video about Agricultural Engineers:
<https://www.bls.gov/tooh/architecture-and-engineering/agricultural-engineers.htm>



NS4ed™ Pathway2Careers™ 2018 Trademark NS4ed, LLC

Career Cluster

Agriculture, Engineering, Food and Natural Resources

Career Pathway

Power, Structure and Technical Systems

Career Outlook

Salary Projections:

- Low-End Salary, \$46,500
Median Salary, \$77,110
High-End Salary, \$116,850
- Jobs in 2018: 2,600
- Job Projections for 2028: 2,800 (increase of 8%)

Geometry Concepts

- Apply volume of solids.
- Apply concepts of density.
- Apply geometric methods to solve design problems.

Is this a good career for me?

Agricultural engineers tend to:

- Use computers to design equipment, systems, or structures
- Modify factors that affect production
- Test equipment
- Oversee construction and production operations

A New Approach to Algebra and Geometry

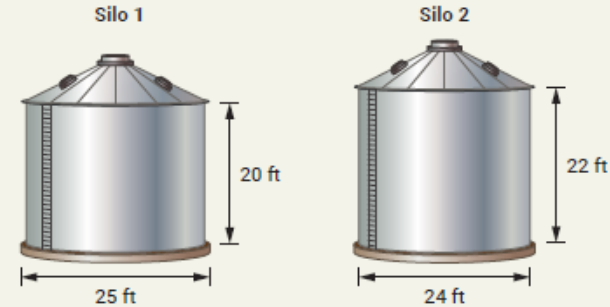
- ✓ As students progress through each lesson they are shown “math at work.”
- ✓ Targeted concepts are applied to several authentic work tasks.
- ✓ Students work through the examples and learn how the specific algebra or geometry concepts are relevant to the work individuals do in that occupation.

Lesson Objective

In this lesson, you will look at how an agricultural engineer uses the volume of solids when designing and evaluating structures and systems used in agricultural settings.

1 Step Into the Career: Volume of Cylinders

An agricultural engineer is designing a farm storage system that will contain a silo for storing dried, shelled corn. The cylindrical part of the silo should store up to 400,000 pounds of corn. If the corn weighs 42 pounds per cubic foot, then which silo should be used?



Devise a Plan

Step 1: Find the storage capacity of each silo. The storage capacity is the volume of the cylindrical part of the silo. The formula for the volume V of a cylinder with radius r and height h is $V = \pi r^2 h$.

Step 2: Find the weight of corn that can be stored in each silo.

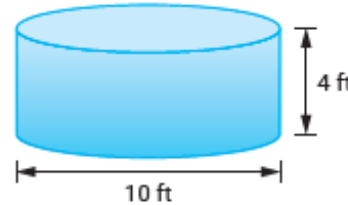
Step 3: Determine which silo can store 400,000 pounds of corn.

A New Approach to Algebra and Geometry

- ✓ Multiple student exercises provide opportunities to practice using algebra and geometry in the context of the career.
- ✓ These exercises build upon career examples presented earlier in the lesson (i.e., similar concepts and ideas are used).
- ✓ Exercises can be completed in class or during independent study.

On the Job: Apply Volume of Cylinders

1. An agricultural engineer is designing a commercial fishery that will raise tilapia. The fishery will have cylindrical aquaculture tanks with the dimensions shown.



Each tilapia requires
3 gallons of water.

- a. What is the volume of a tank? Round to the nearest cubic foot.
- b. If 1 cubic foot of water is about 7.5 gallons, then what is the capacity of the tank in gallons?
- c. If each tilapia requires 3 gallons of water, then how many tilapia can be placed in a tank?

A New Approach to Algebra and Geometry



Practice is available at the end of each lesson that immerses students in the career.



This offers the opportunity for students to practice using the lesson-specific algebra or geometry skills in real, work-related problems and exercises.

Career Spotlight: Practice

4. To help with irrigating farmland, an agricultural engineer is planning the transportation of water using tankers like the one shown.



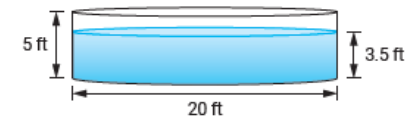
- The cylindrical tank shown has a radius of 3 feet and a height of 38 feet. What is the volume of the tank to the nearest gallon? (Use $1 \text{ ft}^3 \approx 7.5 \text{ gal}$.)
 - Due to weight limits, the truck can carry a maximum of 70,000 pounds of water. If the density of the water being transported is 8.3 pounds per gallon, does the truck with a full tank exceed the weight limit? Explain.
5. Onions that are more than 90% water need special handling since they are more susceptible to bruising. The table shows data collected for two onions. Find the percent of water in each onion. Do either of the onions need special handling? Assume that the onions are spheres, and use $1 \text{ cm}^3 = 1 \text{ mL}$.

QUICK TIP

The percent of an onion that is water can be found as follows: $\frac{\text{Water Content (mL)}}{\text{Volume of Onion (mL)}} \cdot 100\%$.

Onion	Diameter (cm)	Water Content (mL)	Percent of Onion That Is Water
Yellow onion	7	160	?
Sweet onion	6	105	?

6. In an irrigation system for a nursery, water is pumped from a well at a rate of 80 gallons per minute and held in a cylindrical tank. Suppose the height of the water in the tank is 3.5 feet. How long will it take to fill the tank to the top? (Use $1 \text{ ft}^3 \approx 7.5 \text{ gal}$.)



Devise a Plan

Step 1: Find the volume of the cylindrical tank that does not have water.

Step 2: _____?

Step 3: _____?

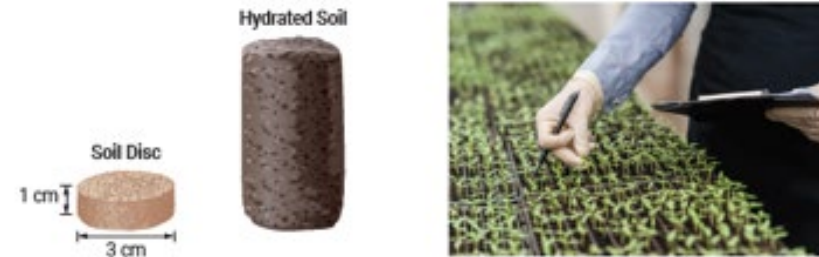
7. A bumper crop of soybeans has been stored in two cone-shaped piles. One pile has a diameter of 36 feet and a height of 8.4 feet. The other pile has a diameter of 24 feet and a height of 5.6 feet. If the soybeans weigh 47 pounds per cubic foot, then how many pounds of soybeans are stored in both piles?

A New Approach to Algebra and Geometry

- ✓ Each lesson concludes with a check for students to complete.
- ✓ A variety of question formats are used to evaluate learning. Multiple choice, matching, equation editing, open response...
- ✓ These checks can be used as a formative assessment to review students' learning and provide feedback.

Career Spotlight: Check

8. A nursery uses dehydrated soil discs to start seeds. Each disc is watered to expand to a cylinder of soil as shown. A hydrated cylinder of soil has 7 times the volume of a disc. Then a seed is planted in the hydrated soil.



An agricultural engineer wants to know how much water is needed to hydrate a soil disc.

First, she finds the volume of the soil disc, which is about

a. 4.7
b. 7.1
c. 28.3

 cubic centimeters.

The volume of the hydrated soil is 7 times the volume of the disc so the volume of the water is

a. 6
b. 7
c. 8

 times the volume of disc. Since $1 \text{ cm}^3 = 1 \text{ mL}$, the amount of water

in the hydrated soil is about

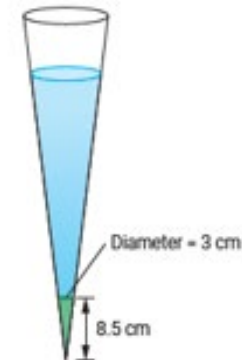
a. 28.2
b. 32.9
c. 42.6

 milliliters.

9. A sample of 1000 milliliters of water is taken from a water source that will be used for an irrigation system. The water is put in a sedimentation cone, and the contents settle for 30 minutes.

The diagram shows the cone-shaped pile of sediment that has settled at the bottom of the cone. What percent of the water is sediment? (Use $1 \text{ cm}^3 = 1 \text{ mL}$)

- A. about 2%
B. about 5%
C. about 20%
D. about 98%



A New Approach to Algebra and Geometry

Common Core State Standards

- ✓ Lessons have been aligned directly with Common Core State Standards.
- ✓ Standards covered within each lesson have been clearly identified.
- ✓ This can assist with tracking skills and concepts explored in the lessons.

Best Practices and Quality Content

- ✓ All lessons were written and evaluated by experts in math curriculum development.
- ✓ Lesson content is presented using well-established methods that align with best practices in math instruction.

P2C Pathway2Careers Geometry Table of Contents			
1. Geometry Fundamentals			
Lesson Topic		CCSS	Occupation
Lesson 1.1	Use Midpoint and Distance Formulas	G-CO.1	Emergency Medical Technicians and Paramedics
Lesson 1.2	Angle Measures and Angle Bisectors	G-CO.1	Occupational Therapists
Lesson 1.3	Use Theorems about Angles	G-CO.9	Carpenters
Lesson 1.4	Estimate Measures using Modeling	G-MG.1, G-MG.2	Meeting, Convention, and Event Planners
2. Parallel and Perpendicular Lines			
Lesson Topic		CCSS	Occupation
Lesson 2.1	Use Theorems about Parallel Lines	G-CO.9	Tree Trimmers and Pruners
Lesson 2.2	Show Lines are Parallel	G-CO.9	Rail-Track Laying and Maintenance Equipment Operators
Lesson 2.3	Use Theorems about Perpendicular Lines	G-CO.9	Brickmasons and Blockmasons
Lesson 2.4	Equations of Parallel and Perpendicular Lines	G-GPE.5	Civil Engineers
3. Transformations			
Lesson Topic		CCSS	Occupation
Lesson 3.1	Apply Translations	G-CO.2, G-CO.4	Biological Technicians
Lesson 3.2	Apply Reflections	G-CO.2, G-CO.4	Marine Engineer and Naval Architect
Lesson 3.3	Apply Rotations	G-CO.2, G-CO.4	Air Traffic Controllers
Lesson 3.4	Investigate Symmetry	G-CO.3	Architecture Teachers, Postsecondary
Lesson 3.5	Apply Compositions of Transformations	G-CO.5	Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic

A New Approach to Algebra and Geometry

Accessing the Lessons

- Lessons are presented in the P2C LMS
- Content can be searched and viewed online
- Print/download PDF copies

Using the Lessons

- Best implemented alongside core curriculum
- Intended for use in a blended learning model where online content is combined with traditional classroom methods

Additional Features

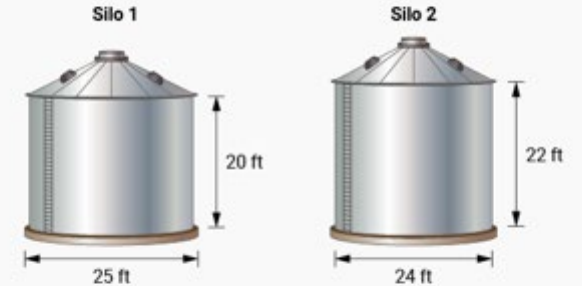
- Teacher's edition with guiding questions, enrichment, extension, and answer keys
- Detailed scope and sequence
- Teacher resources including videos and websites



Career Spotlight: Agriculture Engineer

Step Into the Career: Volume of Cylinders

An agricultural engineer is designing a farm storage system that will contain a silo for storing dried, shelled corn. The cylindrical part of the silo should store up to 400,000 pounds of corn. If the corn weighs 42 pounds per cubic foot, then which silo should be used?



Devise a Plan

Step 1: Find the storage capacity of each silo. The storage capacity is the volume of the cylindrical part of the silo. The formula for the volume V of a cylinder with radius r and height h is $V = \pi r^2 h$.

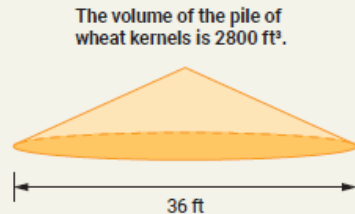
Step 2: Find the weight of corn that can be stored in each silo. **Step 3:** Determine which silo can store 400,000 pounds of corn.

A New Approach to Algebra and Geometry

Sample Teacher's Edition Content

2 Step Into the Career: Volume of Cones

An agricultural engineer designs an area for temporary storage of 2800 cubic feet of harvested wheat kernels. A cone-shaped pile of 2800 cubic feet of wheat kernels will have a diameter of 36 feet. At what minimum height above the ground should the end of the grain auger transporting the wheat be set so that it clears the pile?



Students may not be familiar with a grain auger. A grain auger is a tube with a spiral shaft in the middle that transports grain. This is not to be confused with an auger that is a type of drilling device.

Guiding Questions

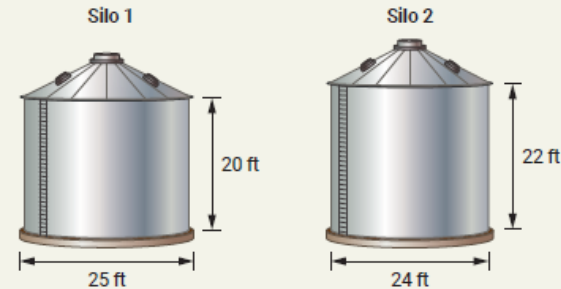
- Could the height be determined if only the volume of the pile was given and not the diameter?
- The height and diameter of a pile of wheat must remain in proportion. Suppose the volume of the wheat increases. Will the height of the pile be greater than or less than 8.25 feet? Explain.

ENRICHMENT The shape of a conical pile depends on the material. For wheat, the angle formed by a line from the vertex of the cone to the ground is about 25° . In this example, students can find this angle by calculating $\tan^{-1}\left(\frac{8.25}{18}\right) \approx 25^\circ$. If the grain for this pile is barley, the angle is about 28° . Ask students to determine the height and volume of a pile of barley with diameter 36 feet.

Teaching Support

1 Step Into the Career: Volume of Cylinders

An agricultural engineer is designing a farm storage system that will contain a silo for storing dried, shelled corn. The cylindrical part of the silo should store up to 400,000 pounds of corn. If the corn weighs 42 pounds per cubic foot, then which silo should be used?



Guiding Questions

- In Step 2, how can the number of pounds be found using a proportion?
- In Step 3, will a silo that has a diameter of 26 feet and a height of 20 feet hold the corn?

ENRICHMENT In this example, both silos can store 400,000 pounds of corn. Ask students to suggest what other criteria an agricultural engineer could consider in designing a silo. Discuss what considerations could be made about the amount of material needed to build the silos. Remind students that the lateral surface area of a cylinder can be determined by the formula $S = 2\pi rh$, where r is the radius and h is the height. Ask students to determine which silo has the greater lateral surface area.

TECHNOLOGY Challenge students to think about the dimensions of a cylinder that can hold 400,000 pounds of corn with the least amount of lateral surface area. Have students find the volume needed for 400,000 pounds of corn and then ask for an expression for the height h of a cylinder that can hold the corn in terms of radius r . Demonstrate using technology (by graphing or using a spreadsheet) how to determine the radius that results in the minimum lateral surface area.

Math Skills and Career Preparedness

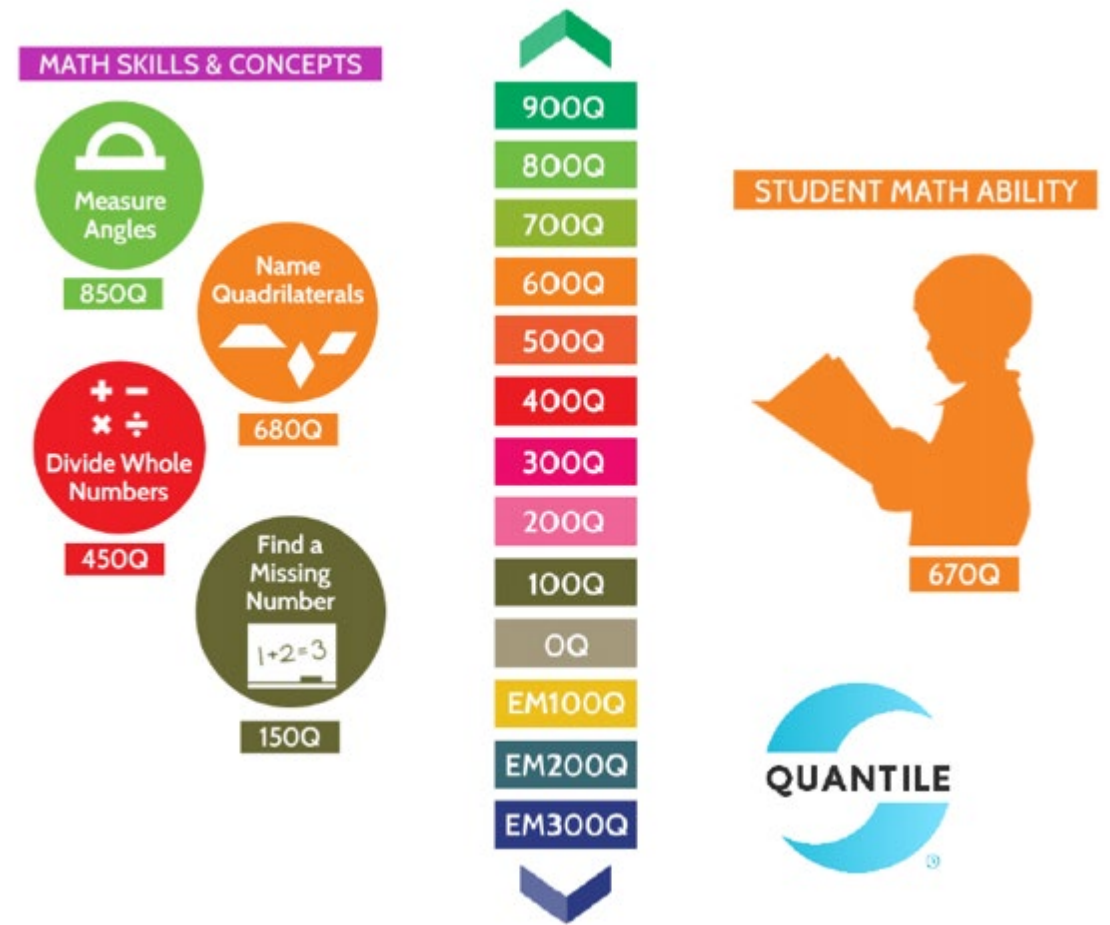
LINKING ASSESSMENT OUTCOMES TO
CAREERS



Math Skills and Career Preparedness

Pathway2Careers Math Assessments

- ✓ Created in partnership with MetaMetrics (developer of the widely adopted Quantile® Framework for Mathematics)
- ✓ Beginning-, middle-, and end-of-year assessments provide students with a Quantile measure that represents students' mathematical achievement level and indicates the skills and concepts they are ready to learn.
- ✓ A student's increasing Quantile measure is an indication of his or her readiness to learn progressively more complex mathematical concepts.



Math Skills and Career Preparedness



QUANTILE
CAREER DATABASE

Sample Database [Search](#) for *Computer Systems Analysts*

Career Information

Bright Outlook ?	Years of Education ?	SOC Code ?	Field(s)
No	16	15-1121.00	Information Technology



Quantile Information ?

Lower Quantile Measure	Typical Quantile Measure	Higher Quantile Measure	Highest Math Course Required
970Q	1120Q	1300Q	Calculus



Student Quantile measures provided by the P2C assessments can be compared to the math demands of different careers in the **Quantile Career Database**.



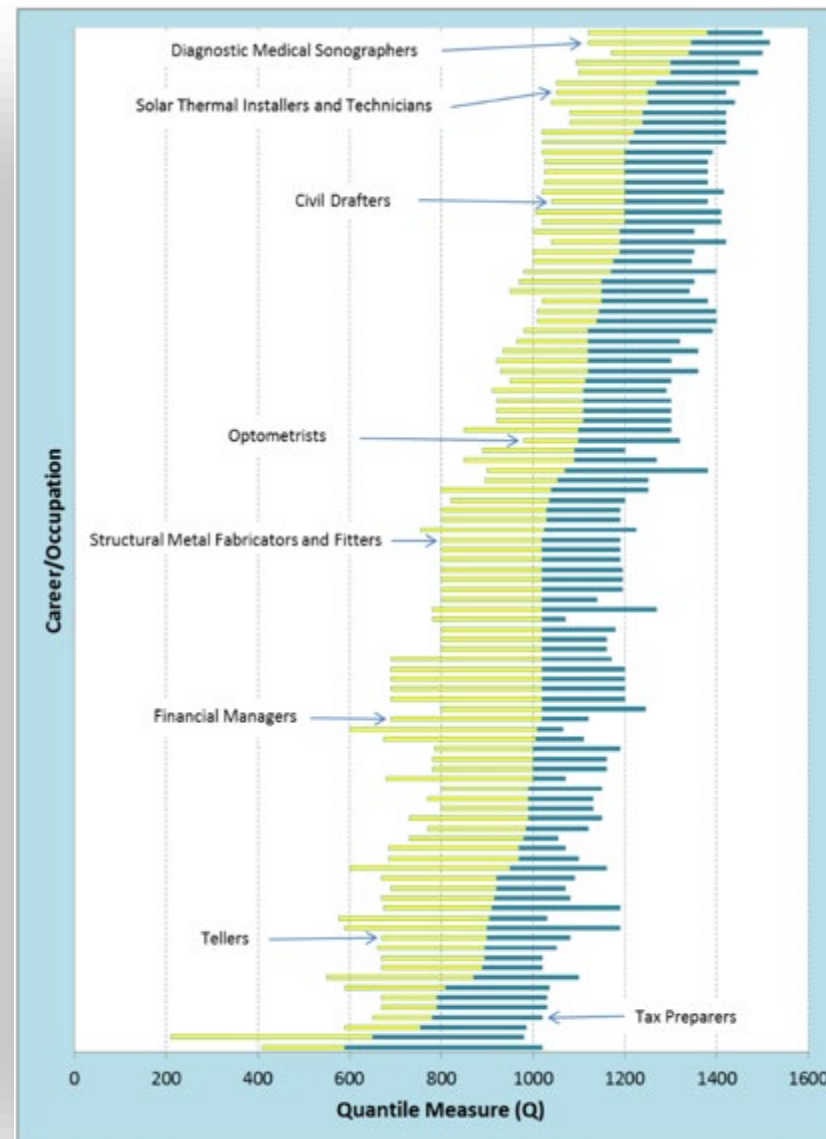
The database lists hundreds of careers and their Quantile measures representing the math demand for entry into the career.



The purpose of the database is to provide a critical point of connection for students, allowing them to **see how their learning applies to their current and future employment potential**.

Math Skills and Career Preparedness

- ✓ The **career range** represents the span of Quantile measures for the mathematical demands of tasks and responsibilities related to **common career training materials and early first-year job requirements**.
- ✓ With this information, students can gain awareness of the **range of mathematics skills and concepts they will need** in order to successfully complete certificate or degree programs and meet initial employment requirements for specific careers.



Follow Up

Career and Technical Education Professional Learning Community

Next CTE
Meeting

January 12, 2021 at 9:00 a.m.

Topics and/or
Questions?

Email Joseph at jgoins@ns4ed.com



<http://www.echs-nm.com/>



jgoins@ns4ed.com



865-414-0033

Thank You Contact Us