



# College and Career Ready for the 21<sup>st</sup> Century: The Critical Role for CTE

James R. Stone III  
University of Louisville  
National Research Center  
for CTE

# Context for the Conversation

- The future of jobs: Raison d'être for CTE
- How we turned HS into middle school
- Evidence of CTE's impact on student engagement, *achievement* and *transition* to careers and college
- Building the CCR system

# Why Research?

“If assumptions you hold about a problem are wrong, then it is very likely your solutions will be as well”



# Starting Point for POS: The Labor Market

*Three  
Perspectives:  
Worse, Worser  
and OMG!*



# The Labor Market

## STEM: Let's clarify . . .

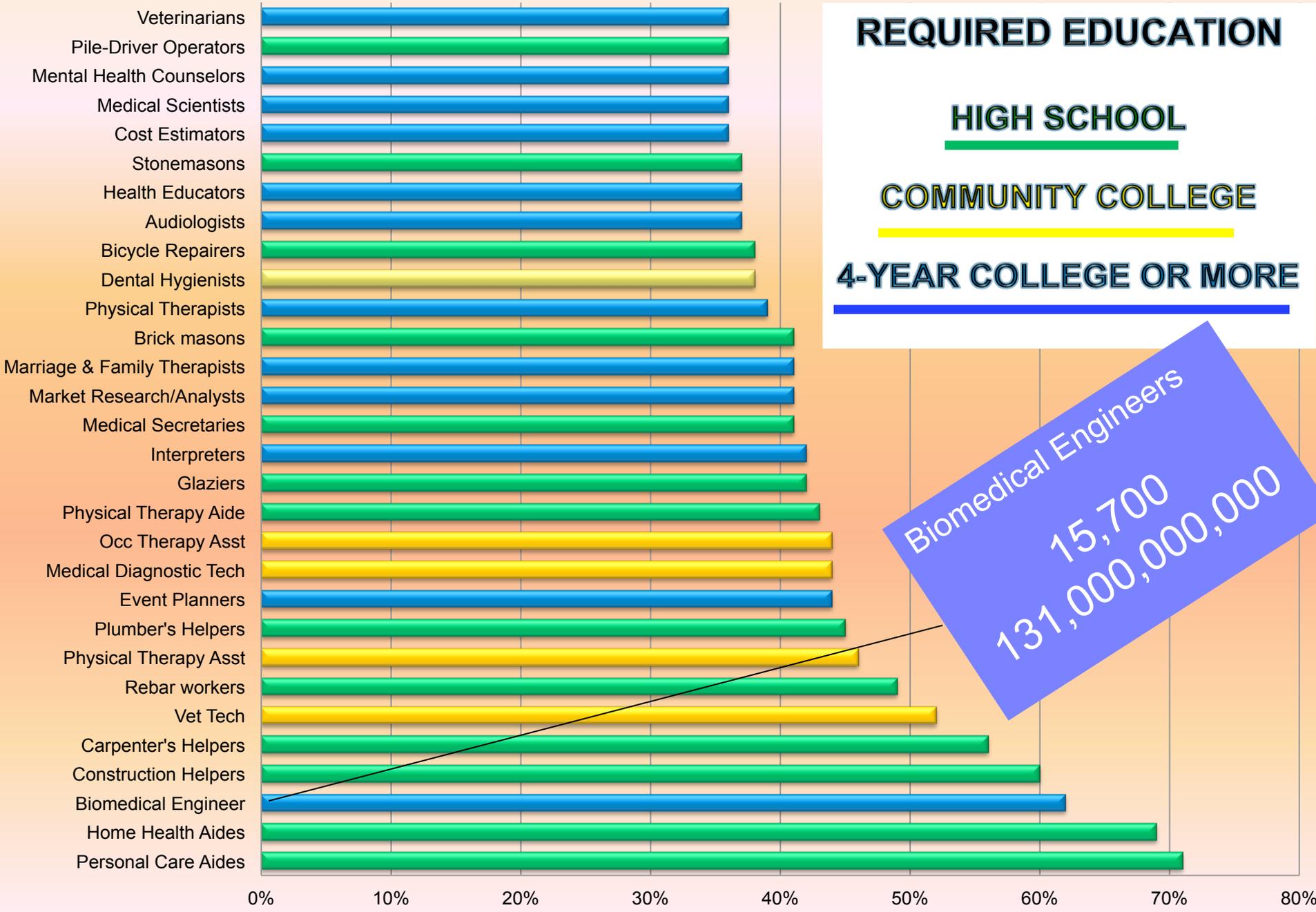
- S&E occupations make up only about one-twentieth (5%) of all workers (5.3% in 2018), Urban Institute, 2007
- 435,000 U.S. citizens and permanent residents *a year* graduated with bachelor's, master's, and doctoral degrees in science and engineering. Over the same period, there were about **150,000** jobs added *annually* to the science and engineering workforce. .

[http://www.businessweek.com/print/smallbiz/content/oct2007/sb20071025\\_827398.htm](http://www.businessweek.com/print/smallbiz/content/oct2007/sb20071025_827398.htm)

# Is there a shortage of scientists?

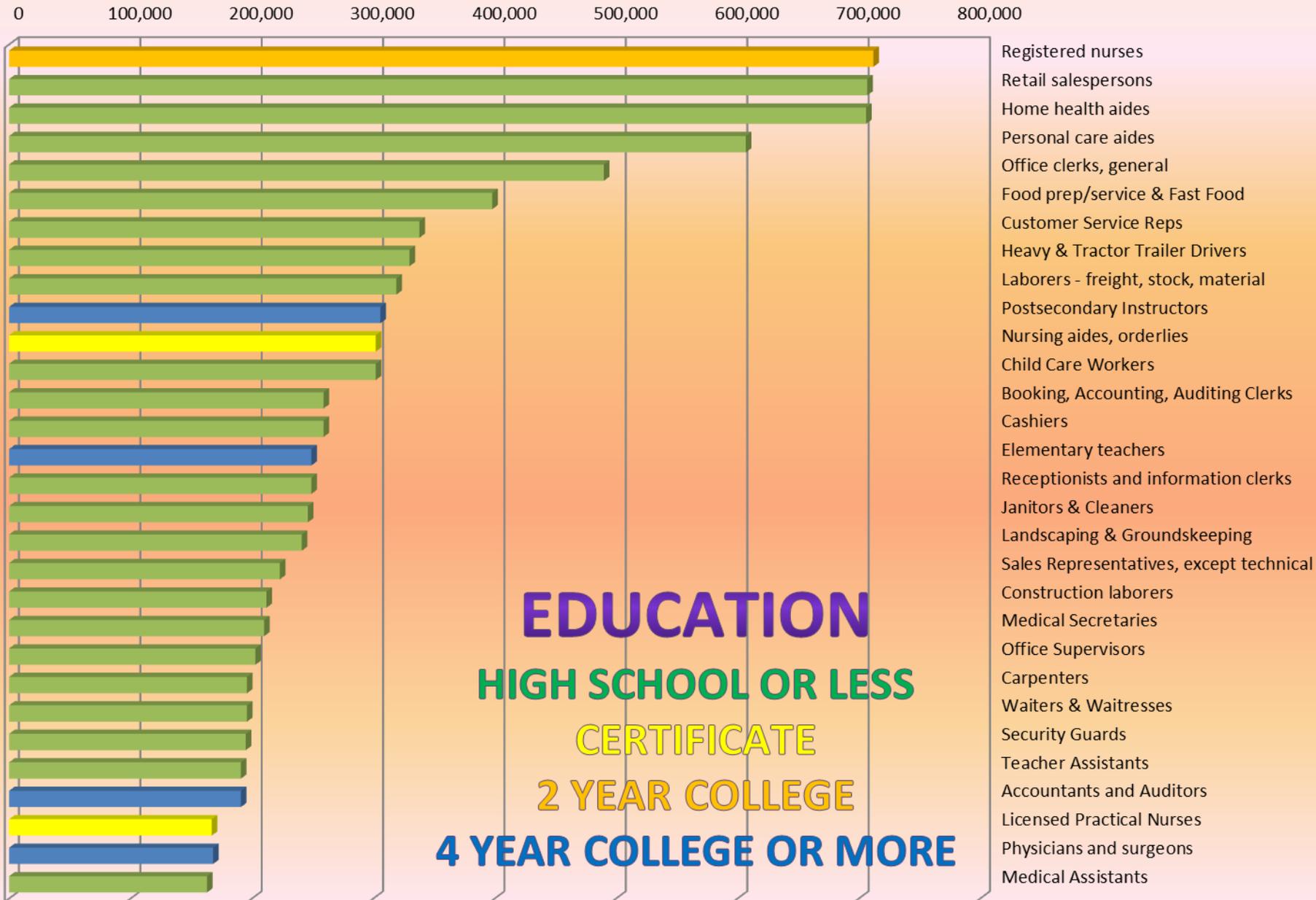
Murray said that none of the companies she has talked with has suggested that there is a shortage of qualified chemists or life scientists. She said that *employers' greatest concern "is not numbers, it is training."* She cited the example of managers who told her they could interview hundreds of candidates for an organic chemistry position but wish they knew how to identify those candidates who *"can behave collaboratively"* and have the other broad competencies discussed at the workshop. She argued that the degree to which scientists have these other capabilities "really seems to be the problem."

# High Growth Occupations 2010-2020

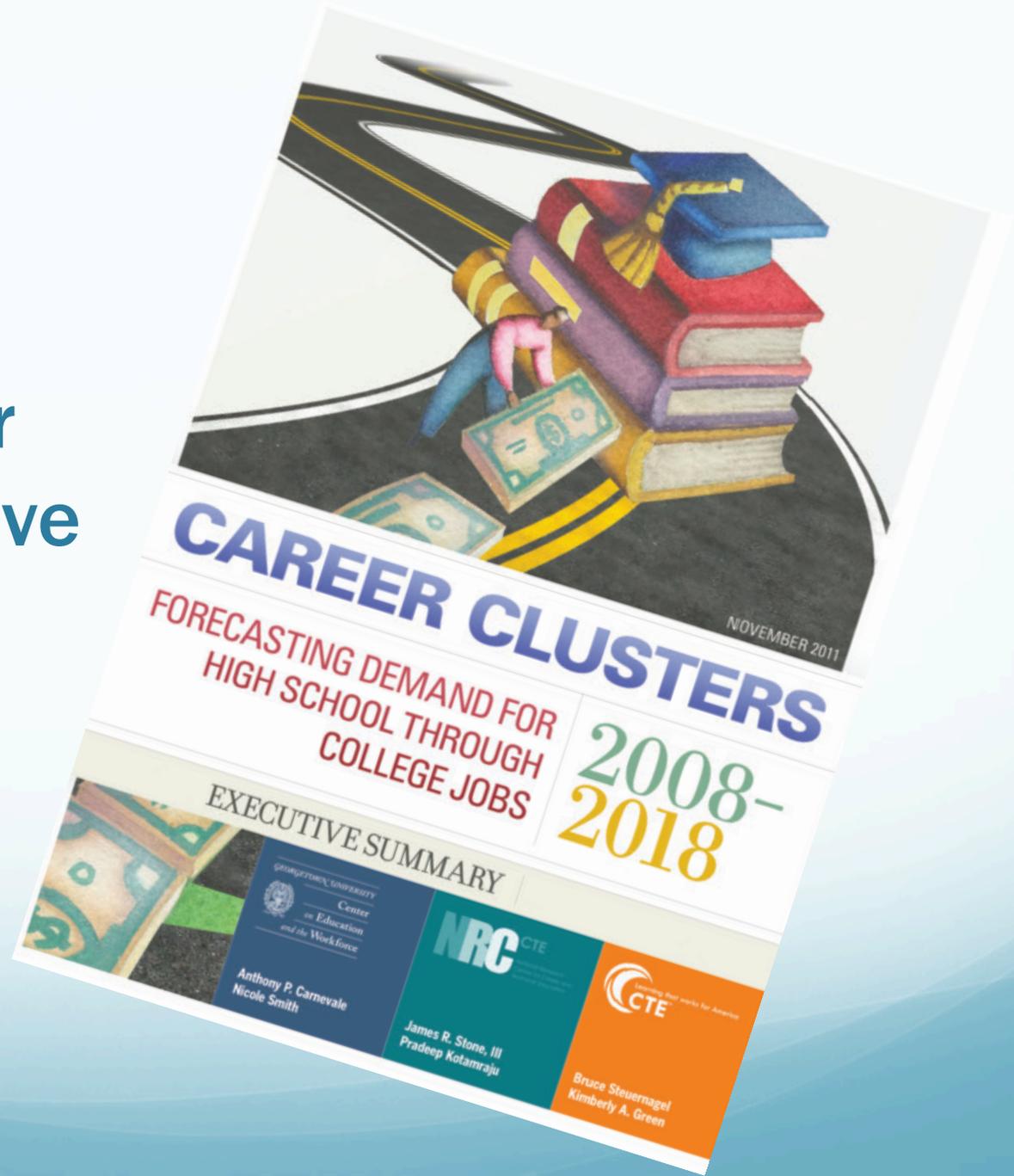


# High Demand Occupations 2010-2020

## The BLS Perspective

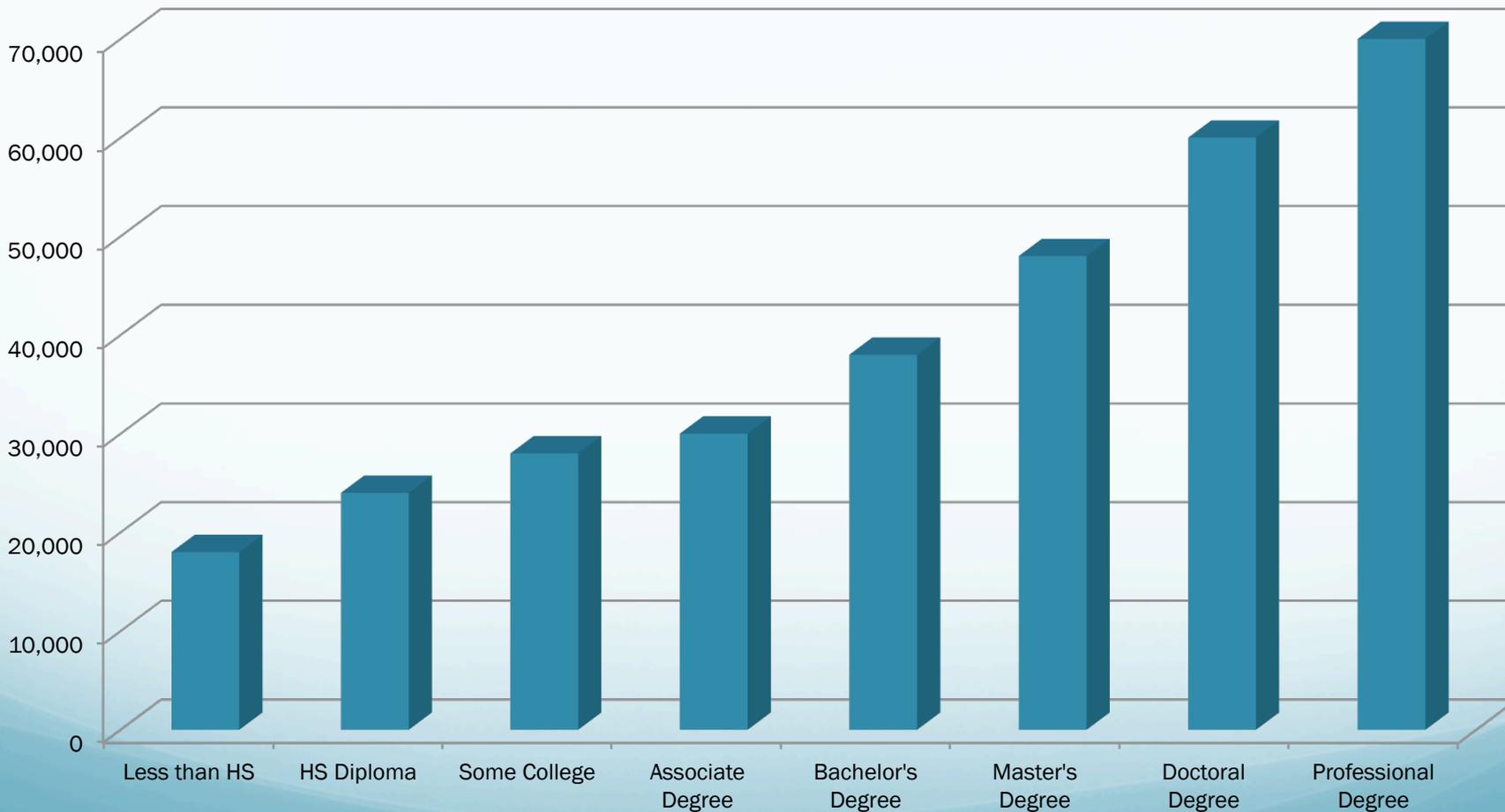


# Another Perspective

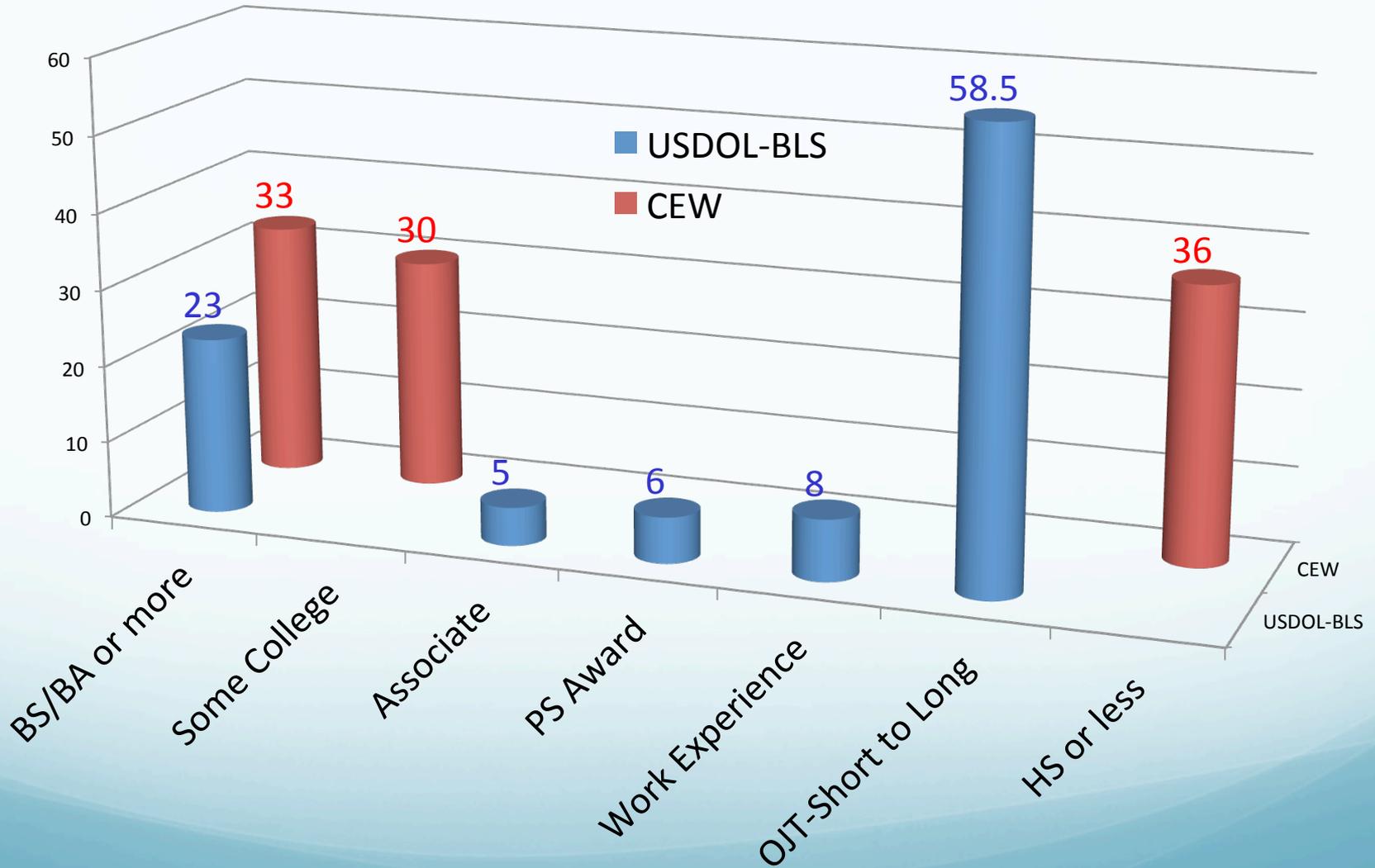


# The USA Today Version of Reality

Annual Salary

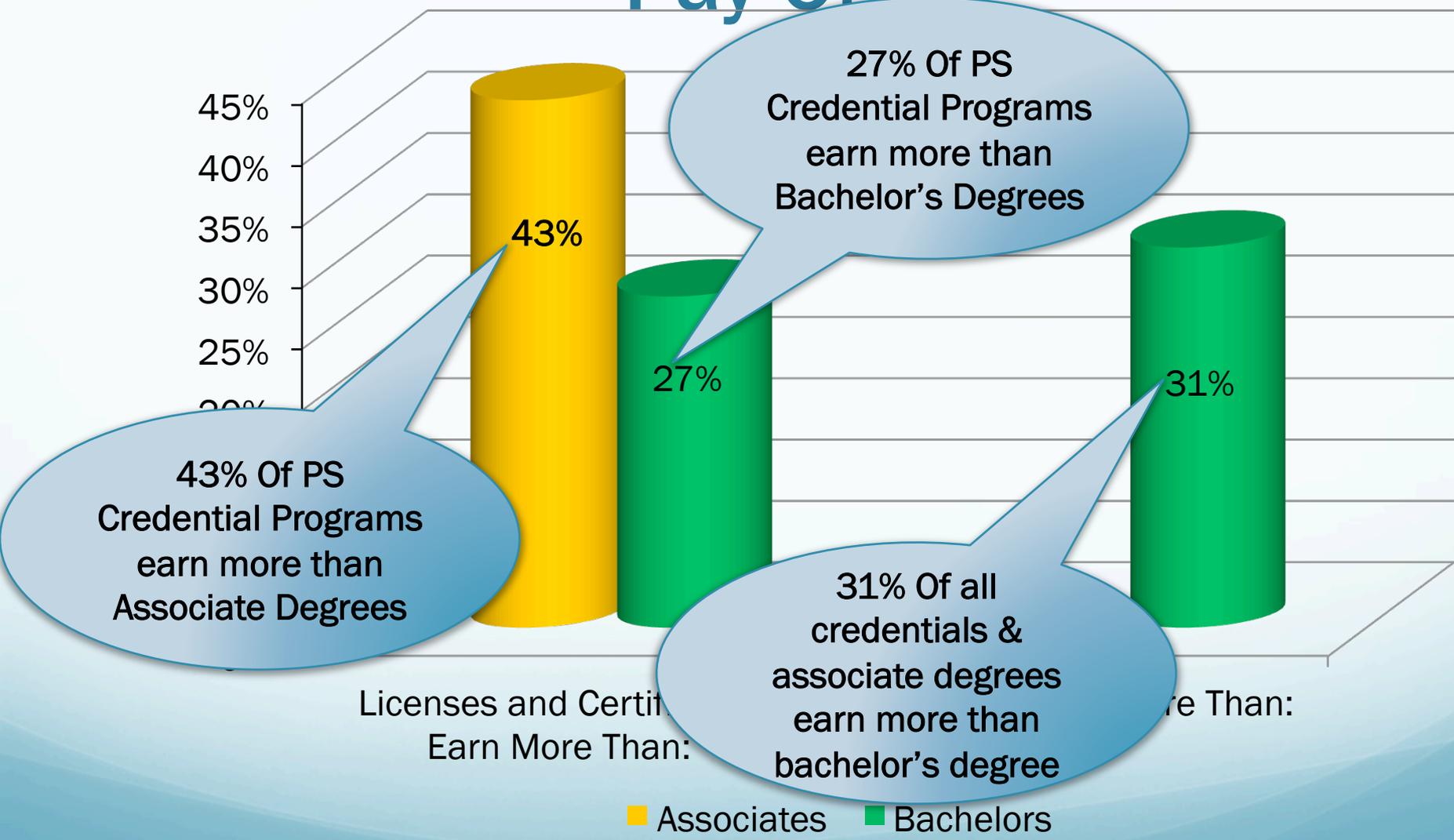


# Education and Future Work: BLS & CEW



# Sub-Baccalaureate Credentials

## Pay Off



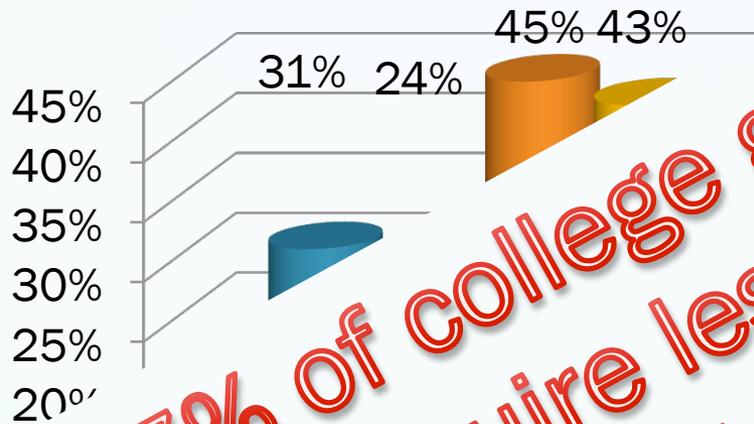
# Middle Skill Occupations (B.A./B.S. NOT Required)

<b>Occupation</b>	<b>Salary</b>
Air Traffic Controller	102,300
Storage and distribution manager	66,600
Transportation manager	66,600
Non-retail sales manager	59,300
Forest fire fighting/prevention supervisor	58,920
Municipal fire fighting/prevention supervisor	58,902
Real estate broker	58,720
Elevator installers and repairer	58,710
Dental hygienist	58,350
Immigration and Customs inspector	53,990
Commercial pilot	53,870

Farr, M. & Shatkin, L. (2006) *The 300 Best Jobs That Don't Require a Four-Year Degree*.  
(US Department of Labor, Bureau of Labor Statistics)

# Why Technical Education Matters

## Credential Growth

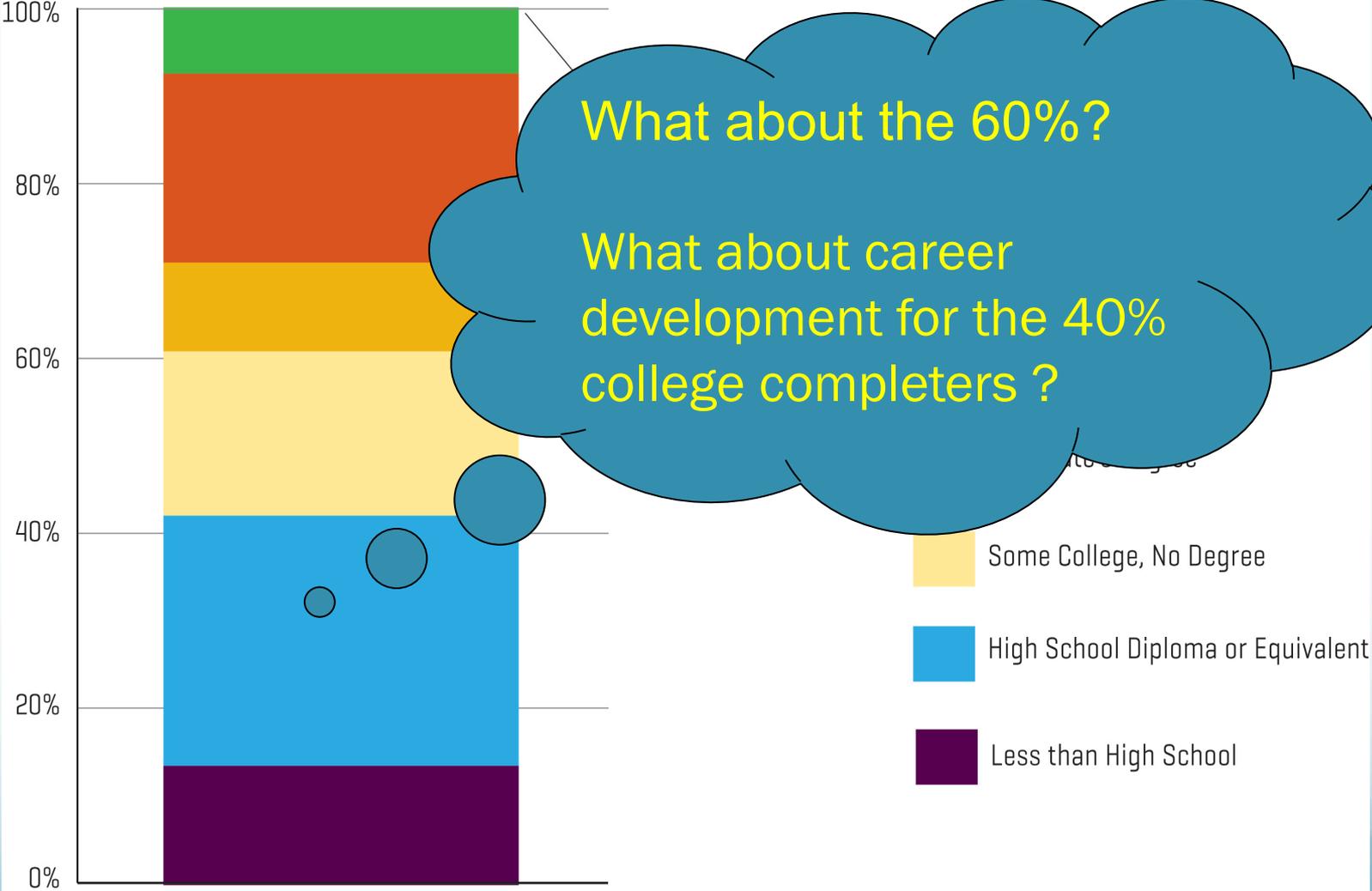


47% of college grads in jobs  
 That require less than BA/BS;  
 37% in Jobs  
 that require HS Only



Doctorate

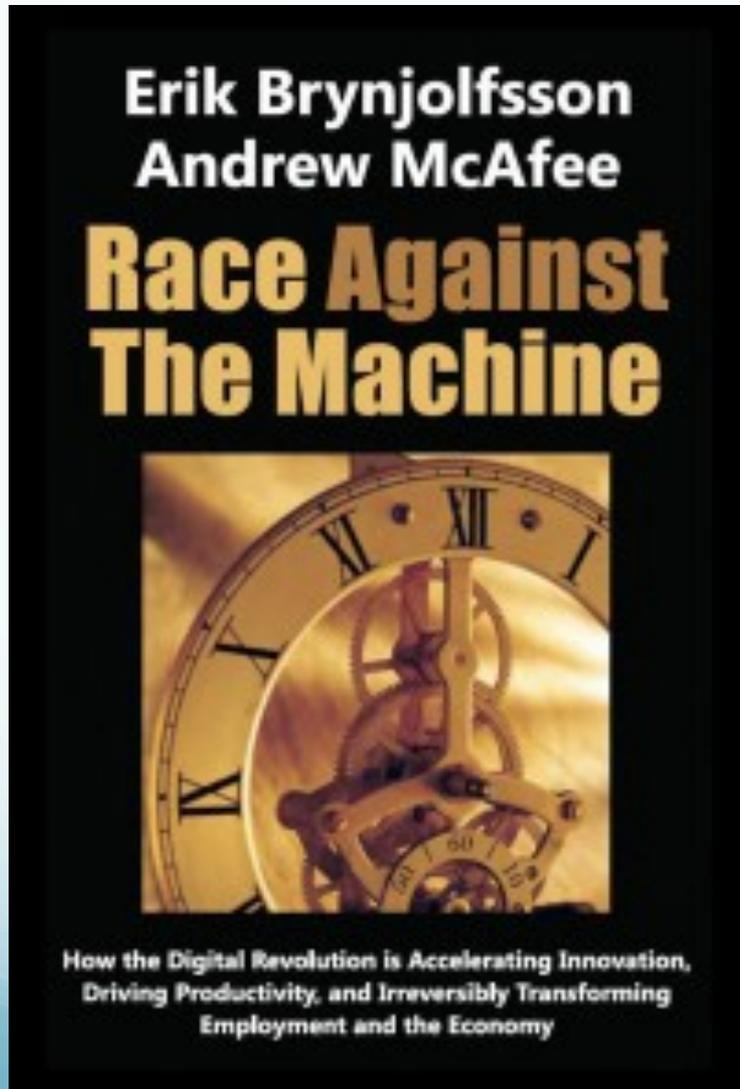
# College for all? Only 40% of 27-year olds have earned an



Educational Attainment, by Age 26-27

Note: Represents data collected in surveys between 2006-2008; GED is approximation based on data from GED Testing Program.  
Source: Current Population Survey Annual Social and Economic Supplement.

## A 3<sup>rd</sup> Disconcerting Perspective



Computers now exhibit human-like capabilities not just in games such as chess, but also in complex communication such as linguistic translation and speech (Think Siri)

# A 3<sup>rd</sup> Perspective: The Race Against the Machine (The Machines are Winning?)

- The Google car(truck?)
- IBM Watson
- Deep Blue
- The “Square”
- Text readers/ Pattern recognition (goodbye legions of lawyers-only 60% accurate)
- Automated ‘call centers’ (goodbye India)
- GeoFluent (goodbye translators)
- Vending machines for ... everything



# Can People Win?

- Instructional methods
- Softer skills
- Instructional focus
- The Human Advantage (for now)
- Khan Academy
- CTSOs/WBL
- Hyperspecialists, entrepreneurship
- Physicality of work
- Advanced pattern recognition
- General problem solving
- Creativity

# That's the Uncertain Reality of the Labor Market

*How has education responded?*

A yellow van is driving on a road that curves upwards. To the left of the road, a green sign on two wooden posts reads "GOAL AHEAD" in white capital letters. To the right, a yellow triangular warning sign is partially visible. The background is a clear blue sky.

GOAL  
AHEAD

# Rigor= More

*A narrow curriculum*

*High school has become the new middle school*

WHERE HAVE WE BEEN:  
30 YEARS OF “REFORM”



GOAL  
AHEAD

Context: Since the mid-1980s we have:

Added the equivalent of *one full year* of core academics (math, science, language arts) to high school graduation requirements.

(NAEP) *Reading scores have not improved or significantly declined\**

(NAEP) *Science scores have not improved or significantly declined\**

(NAEP) *math scores have remained relatively unchanged*

\*Depends on the starting and ending timeframe

# Taking more math is no guarantee

- Only 26% of students who took Alg I, II & Geometry scored a 22 (ACT Benchmark) on the ACT exam scoring an average of 17.7<sup>1</sup>
- **18% in PA (goal is 40%?)**
- Adding Trig increases to the average score to 19.9<sup>1</sup>
- Not until calculus is added, does the average score exceed 22 – 5 years of high school math.
- 43% of ACT-tested Class of 2005<sup>1</sup> who earned A or B grades in Algebra II did not meet ACT College Readiness Benchmarks in math<sup>2</sup>

ACT Score	Level	ACT Standard-Associated Task
13-15	Alg I / CC HS	Simplify ratios
16-19	Alg I / CC 8 <sup>th</sup>	Add, subtract, multiply, and divide rational numbers, including integers, fractions, and decimals, without calculators
	Alg I / CC HS	Use rational numbers to demonstrate knowledge of additive and multiplicative inverses
20-23	Alg I / CC 8 <sup>th</sup>	Set up and solve problems following the correct order of operations (including proportions, percent, and absolute value) with rational numbers (integers, fractions, decimals)
	Alg I / CC 8 <sup>th</sup>	Give the domain and range of relations and functions
	Alg I / CC 8 <sup>th</sup>	Evaluate functions at given values
	Alg I / CC HS	Apply algebraic properties (e.g., commutative, associative, distributive, identity, inverse, substitution) to simplify algebraic expressions
	Alg I / CC HS	Translate real-world problems into expressions using variables to represent values
	Alg I / CC HS	Identify the effect on mean, median, mode, and range when a set of data is changed
	Alg I / CC HS	Find the probability of a simple event
	Geo / CC 8 <sup>th</sup>	Identify corresponding, same-side interior, same-side exterior, alternate interior, and alternate exterior angle pairs formed by a pair of parallel lines and a transversal and use these special angle pairs to solve problems (e.g., solve equations, use in proofs)

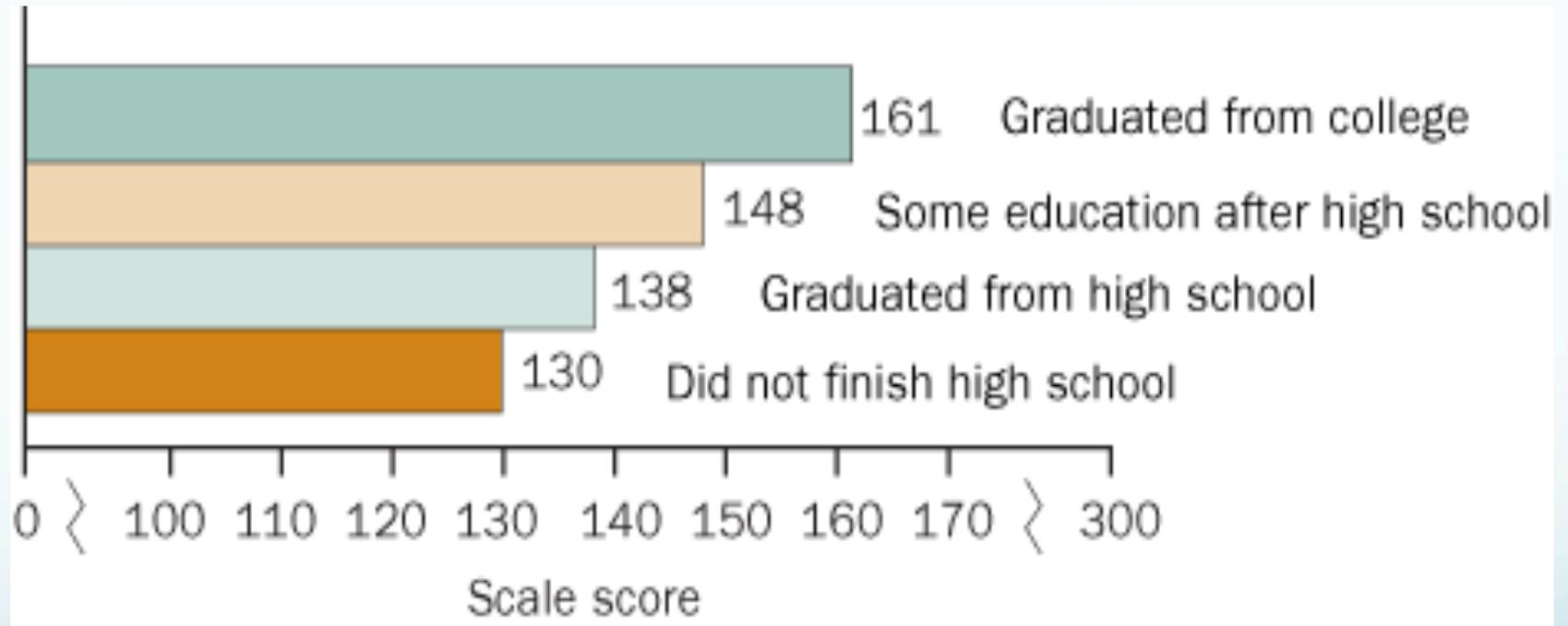
<b>Course/ Common Core</b>	<b>ACT Topic</b>	<b>ACT Score</b>
Alg I CC 8th	Add, subtract, multiply, and divide rational numbers, including integers, fractions, and decimals, without calculators	(16-19)
Alg I CC 8 <sup>th</sup> HS	Use properties of exponents (including zero and negative exponents) to evaluate and simplify expressions	(28-32)
Alg I CC 8th	Find rational number square roots (without calculators) and approximate irrational square roots (with and without calculators)	(24-27)
Alg I CC 8th	Evaluate and simplify radical expressions	(24-27)
Alg I CC 8th	Use scientific notation when working with very large or very small quantities	(24-27)
Alg I CC 8th	Set up and solve problems following the correct order of operations (including proportions, percent, and absolute value) with rational numbers (integers, fractions, decimals)	(20-23)
Alg 8th	Identify, formulate, and obtain solutions to problems involving direct and inverse variation	(24-27)
Alg I CC 8th	Recognize the concept of slope as a rate of change and determine the slope when given the equation of a line in standard form or slope-intercept form, the graph of a line, two points, or a verbal description	(24-27)
Alg I CC 8th I CC	Translate between different representations of relations and functions: graphs, equations, sets of ordered pairs, verbal descriptions, and tables	(24-27)
Alg I CC 8th	Interpret data from line, bar, and circle graphs, histograms, scatterplots, box-and-whisker plots, stem-and-leaf plots, and frequency tables to draw inferences and make predictions	(28-32)
Alg I CC HS	Simplify ratios	(13-15)
Alg I CC HS	Solve formulas for a specified variable	(24-27)
Geo CC HS	Apply relationships between perimeters of similar figures, areas of similar figures, and volumes of similar figures, in terms of scale factor, to solve mathematical and real-world problems	(28-32)
Geo CC HS	Use cross sections of prisms, cylinders, pyramids, and cones to solve volume problems	(28-32)
Geo CC HS	Find the lateral area, surface area, and volume of prisms, cylinders, cones, and pyramids in mathematical and real-world settings	(28-32)
Geo CC HS	Find the surface area and volume of a sphere in mathematical and real-world settings	(28-32)

# Career Ready Math Skills: Getting the job\*

<b>Algebra I</b>	Telecommunication Junior Technician
	Nursing
	HVAC
	Survey Technician
	Plumbing
	Automobile Technician
<b>Geometry</b>	Survey Technician
	Plumbing
	Automobile Technician
	Nursing
	HVAC
<b>Algebra II</b>	Telecommunication Junior Technician

\*Preliminary analysis, NRCCTE 2012

# One solution?



**Be born to smarter parents!**

So, Those are the Challenges . . .



*What does “average” CTE do?*

# To Address College & Career Readiness: *Make High School Matter*

## Increase Engagement

Completing HS  
Completing PS/  
Industry credential



## Improve Achievement

Academic  
Occupational  
Technical



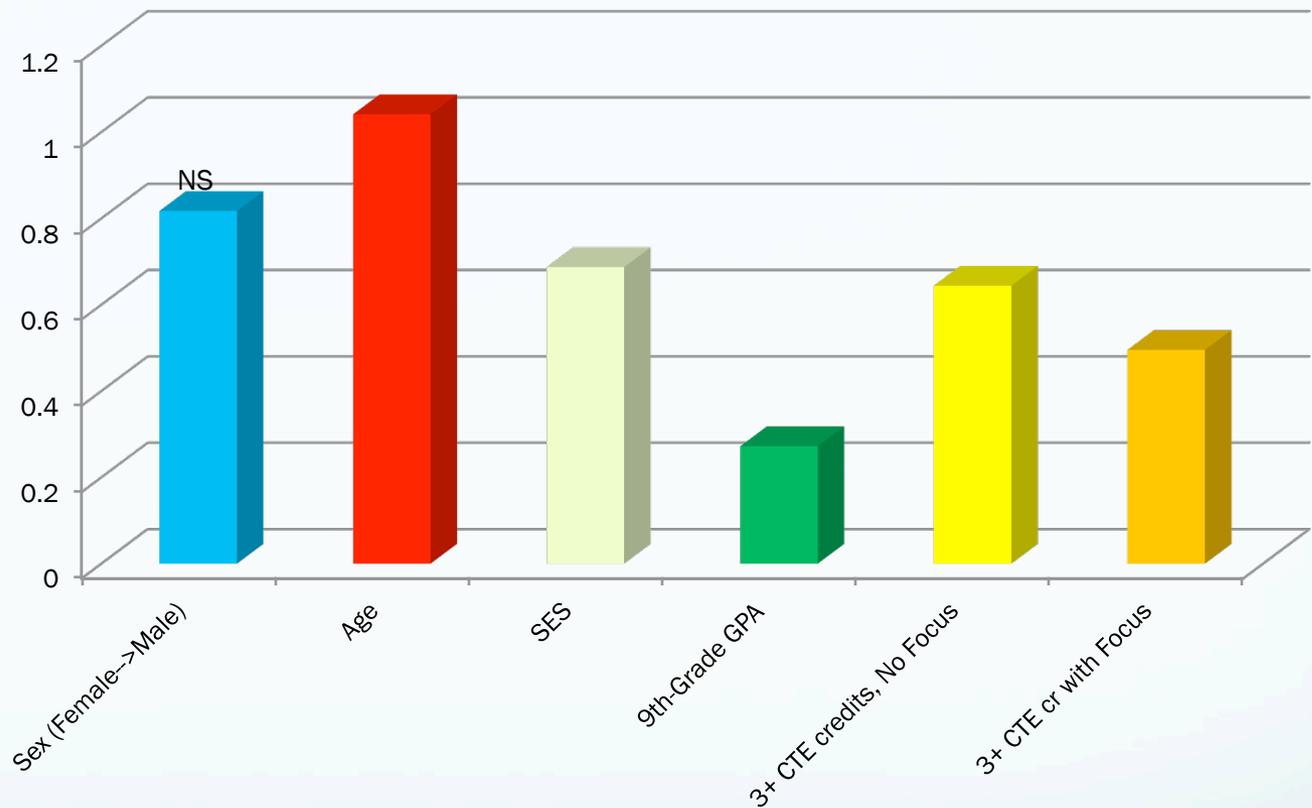
## Enhance Transition

Through School  
To continuing  
education  
To the workplace  
To a successful  
adulthood



# CTE Keeps Kids in School

## A Survival Analysis



NS=Statistically not significant

- CTE Participation helps students “survive” high school
- **Each CTE credit taken (at 3 or more) reduces the hazard of dropping out compared to students taking less than 3 CTE credits**

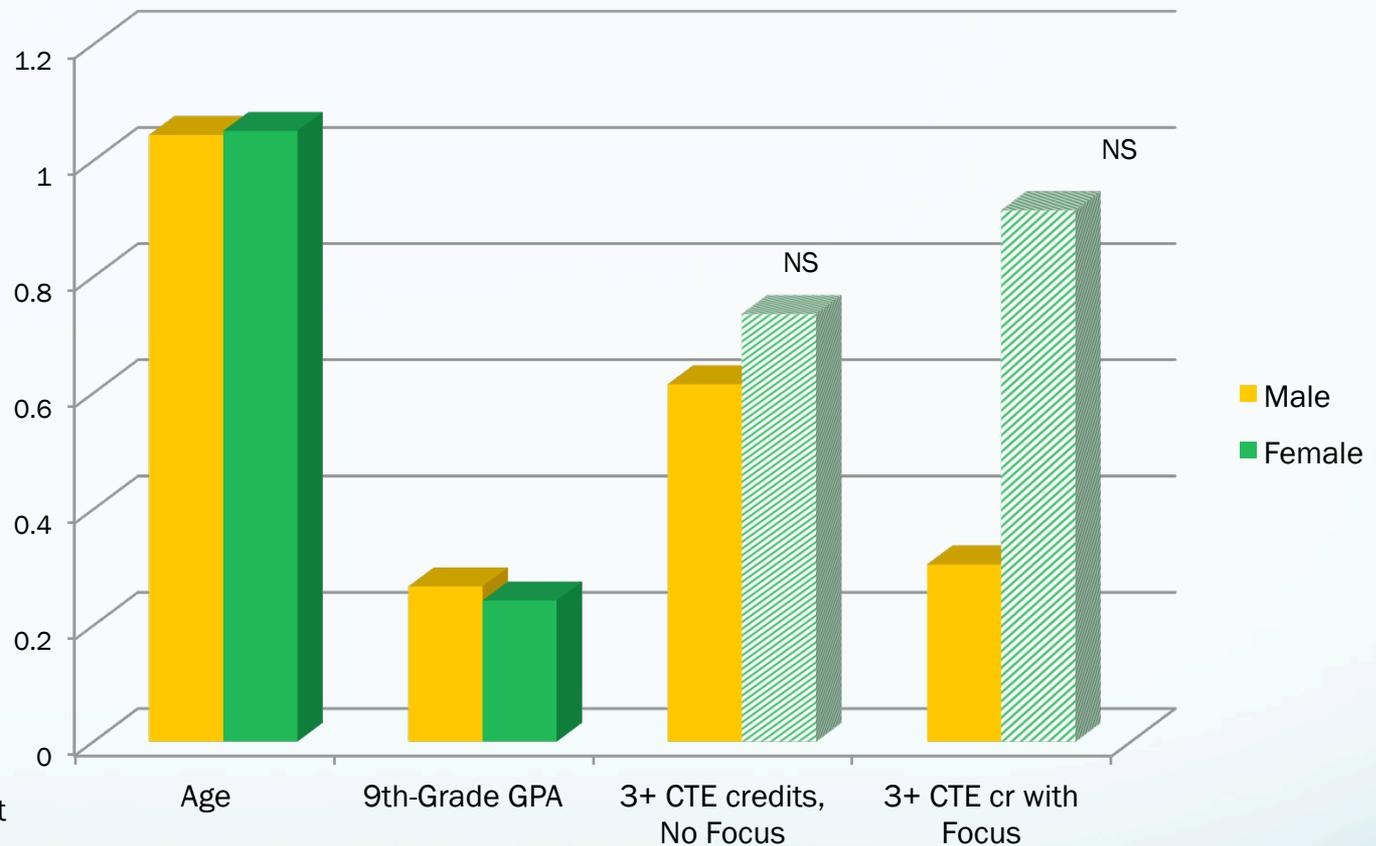
# Engagement: We have a boy problem

*... but many of the people who don't fit in are boys. A decade or so ago, people started writing books and articles on the boy crisis. At the time, the evidence was disputable and some experts pushed back. Since then, the evidence that boys are falling behind has mounted. The case is closed. The numbers for boys get worse and worse.*

- By 12<sup>th</sup> grade, male reading scores are below females'
- 11<sup>th</sup> grade boys write at an 8<sup>th</sup> grade girl level
- Boys used to have an advantage in math and science, but that gap is nearly gone.
- Boys are more likely to have discipline problems
- Boys account for  $\frac{3}{4}$  all D's and F's
- Men are a minority in college (40%)
- 2 million fewer men graduate from college over the past decade than women
- Grad school gap is even higher

# CTE Keeps Boys in School!

## A Survival Analysis

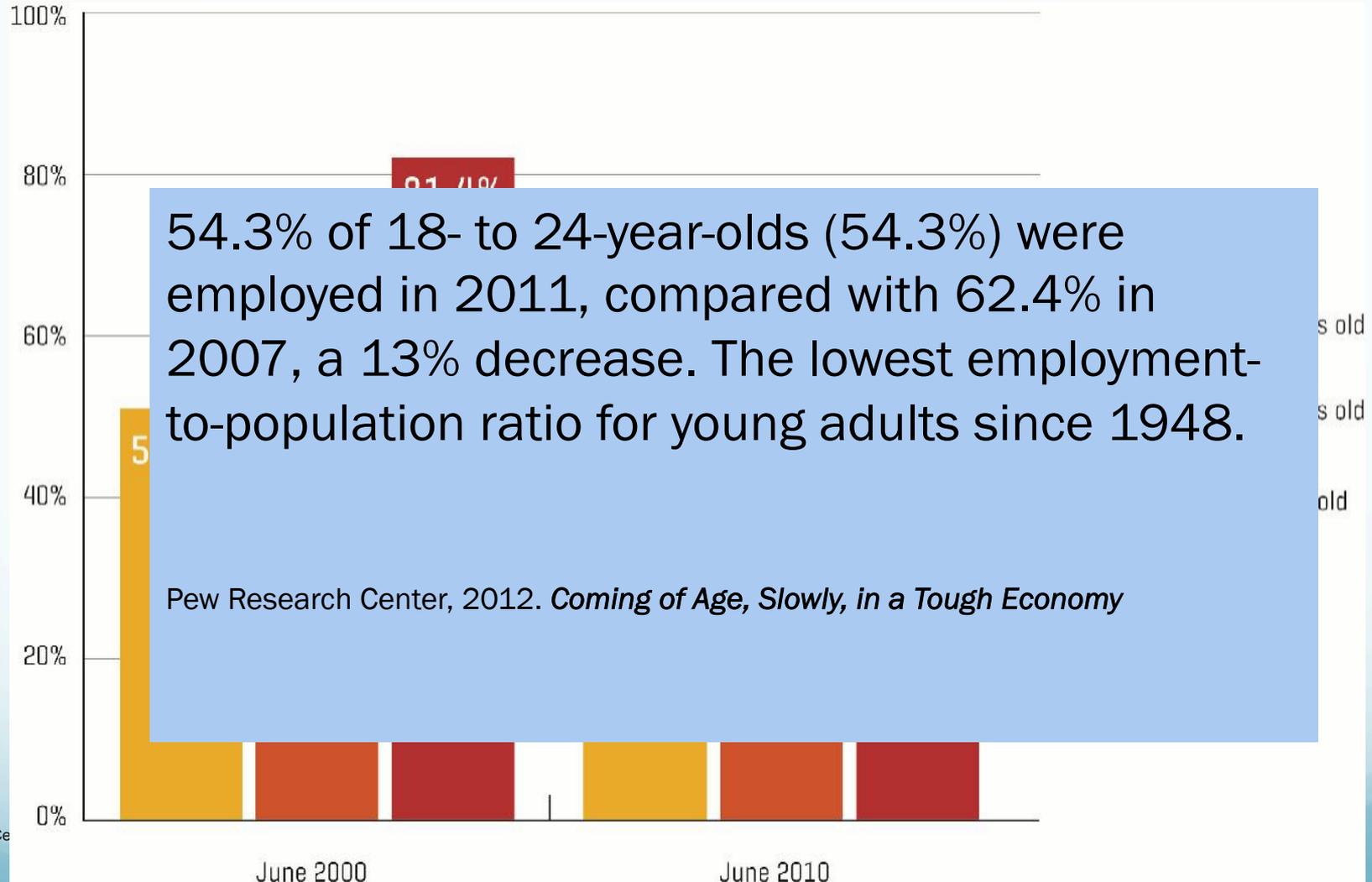


- CTE Participation helps boys “survive” high school
- **There is no CTE “survival” effect for girls; but it “does no harm”**

# Why is this important?

- Lower lifetime earning
- Increased risk they will never engage in sustained full-time employment
- 6.1 million NEETs in the U.S. = \$100 billion annual cost to U.S. taxpayers
- There are the social & emotional costs that are beyond dollars
- Higher risk of social conflict...look to Spain

# Teens and Young Adults have been hit the hardest by the Great Recession



Source: Ce

## Not Just Our Work: Economists' Perspective

“There is one approach that does tend to improve graduation rates and labor market earnings, especially for at-risk youth: high-quality career and technical education (CTE)”

Holzer, H.J., Lane, J.I., Rosenblum, D.B. & Andersson, F. (2011). *Where are all the good jobs going.*



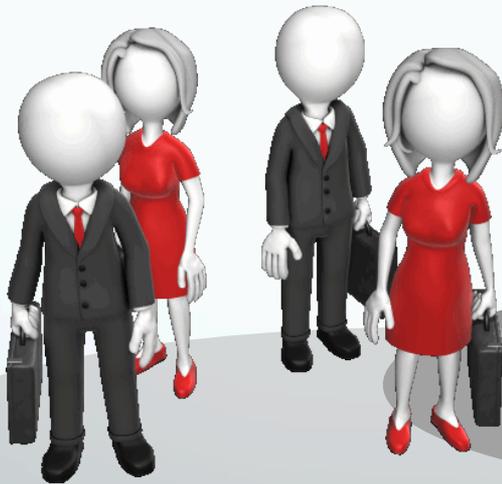
CONSIDER WHAT IS  
REQUIRED FOR THE  
WORKPLACE OF TOMORROW

# Getting students ready for careers and college :

## Their future

Academic  
Mathematics  
Science  
Communications

Technical  
Job specific  
skills valued by  
employers



Occupational  
SCANS

21<sup>st</sup> Century Skills  
“Soft” Skills  
Employability Skills

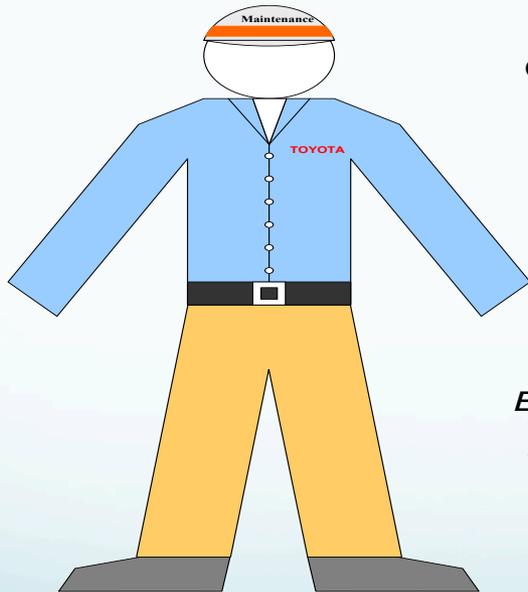
College & Career  
Ready

• **Required skills**

Industry Knows This:

Toyota

# Next Generation Skilled Team Member



**Totally Multiskilled**  
( Electrical/ Fluid Power/ Mechanical/ Fabrication)

**Strong Math Skill**  
( Upper 1/3 nationally)

**Strong Reading Skill**  
( 12<sup>th</sup> Grade level)

**Fast Technical Learner**  
( Can learn, apply, improve, and learn again)

**Uses and Learns With Digital Media**

**Strong Problem Solver**

**Effective Verbal & Written Communicator**

( Comfortable in group and one-on-one situations)  
( Develops high quality processes manuals, guides)

**Effective Interpersonal Skills**

**Natural Teamworker**

**Qualified for the Next Level**



## Target:

### 100% of Maintenance Workforce

# To be college ready: What college, what skills?



## Academic Skills & Knowledge

1. Framework
2. Where skills are learned

- Trade/Technical School?
- Apprenticeship?
- Community College?
  - Certificate? Diploma? Degree-Selective or not?
  - Nursing
  - Allied health
  - Law enforcement
  - Engineering technology
  - Computer technology
  - Cut scores?
- Baccalaureate College?
  - MN College Readiness Benchmarks set by ACT: an 18 in English, 22 in Math, 21 in Reading, and 24 in Science.
  - Only 32% of Minnesota's 2009 ACT-tested graduates met all four

# Too Many College Grads?

- ...turning out vastly more college graduates than there are jobs in the relatively high-paying managerial, technical and professional occupations to which most college graduates traditionally have gravitated.
- Roughly one of three college graduates is in jobs the BLS says require less than a bachelor's degree.
- ... College graduates, on average, are smarter and more disciplined and dependable than high-school graduates—so much of the reported earnings differential has little to do with college learning.
- We have engaged in massive and costly credential inflation to certify competency for jobs.

# Not Enough College Grads?

*By 2020, our research projects that the United States may have 1.5 million too few workers with college or graduate degrees and 6 million more without a high school diploma than employers will demand.* McKinsey Global Institute, 2012

# What Occupational Skills?

## Non-Cognitive

- Deal with setbacks
- Stay on track
- Consistency
- Easily distracted
- Hard worker
- Persistence
- ‘Stick-to-it tiveness’
- Diligence



## Employability

- Teamwork
- Oral & written skills
- Professionalism
- Ethics
- Creativity
- Problem solving
- Ethics
- Systems knowledge
- Responsibility

Duckworth, 2011 “Grit”

SCANS, 21<sup>st</sup> Century

# What technical skills?

- Immediate specific job skills\*
- Industry certifications
- 132 available through HS programs (n=14 states)



\* Learning for jobs (OECD)

# Engaging Students through Career Development



# Pedagogic Tools for World Class CTE

- Classroom instruction



- Work based learning-  
WBL



- CTSOs



- *Project based learning*
- *Contextualized learning*
- *Labs*
- *Shops*
- *Job shadowing*
- *Internships*
- *School-based enterprise*
- *Cooperative education*
- *Apprenticeships*
- *Leadership development*
- *Professional development*
- *Service/social engagement*
- *Competitive events*

# Curriculum Integration Experimental Research *(Instructional)*

- Math-in-CTE: complete
  - Technical Assistance – 7 yrs
- Literacy-in-CTE: complete
  - Technical Assistance – 2 yrs
- Science-in-CTE:
  - Study recently concluded



## ***Pedagogy of Quality CTE: Curriculum Integration***

***Math-in-CTE*** - A study to test the possibility that enhancing the embedded mathematics in Technical Education coursework will build skills in this critical academic area without reducing technical skill development.



# What We Learned:

## Experimental Test of Math Integration

- Students in the experimental classes scored significantly higher on Terra Nova and Accuplacer
- The effect: 71<sup>st</sup> percentile & 67<sup>th</sup> percentile
- No negative effect on technical skills
- 11% of class time devoted to math lessons



# The Occupational Expression of Academics

A career ready person is proficient in the core academic subjects, as well as in technical topics. This foundational knowledge base includes competence in a broad range of academic subjects grounded in rigorous internationally benchmarked state standards... Career Readiness Council 2012

## Math-in-CTE Curriculum Map: Health Science

CTE Course/Unit	CTE Concepts	Math Concepts	Common Core Math Standards Middle School	Common Core Math Standards High School
Patient assessment	Input/output; Vital signs; Height/weight; Conversions; Instrument reading	Reading measurement; Basic operations; Ratio/Proportion; Solving equations; Scales	6.NS.2; 6.NS.3; 7.NS.1; 6.RP.1; 6.RP.2; 6.RP.3; 7.RP.1; 7.RP.2; 7.RP.3; 6.EE.2; 7.EE.3	A.APR.1; A.APR.7; N.RN.3; N.Q.1; G.MG.3; A.CED.4



- Significant improvement from both approaches
- Teachers with two-years experience in method had greater effect



# Experimental Test of Reading Interventions in CTE

# Tools for College & Career Readiness

- Classroom instruction



- Work based learning-  
WBL



- CTSOs



- *Project based learning*
- *Contextualized learning*
- *Labs*
- *Shops*
- *Job shadowing*
- *Internships*
- *School-based enterprise*
- *Cooperative education*
- *Apprenticeships*
- *Leadership development*
- *Professional development*
- *Service/social engagement*
- *Competitive events*

# WBL: Everywhere but in the U.S. . . .

- The % of youth in VET ranges from 5% (Ireland) to 80% (Czech Republic).
- More than 50% youth in VET: Austria, Belgium, Finland, Switzerland, Australia, Germany, Sweden, Denmark and others.
- Japan, United Kingdom, France, Korea and others exceed 20%
- The U.S. doesn't make the list!

*Learning for jobs (OECD, 2010)*

# The Value of WBL

Nations enrolling a *large proportion of upper-secondary students in vocational programs that include heavy doses of WBL* have significantly higher:

- school attendance rates
- higher upper-secondary completion rates
- college attendance

# Pedagogic Tools for World Class CTE

- CTSOs



- *Leadership development*
- *Professional development*
- *Service/social engagement*
- *Competitive events*

# The CTSO: Building Occupational Skills



## Function

- Competitive Events
- Leadership Development
- Professional Development
- Social Engagement

## Effect

- Academic Engagement
- College Aspirations
- Grades
- Career Efficacy
- Employment Aspirations
- No Effect
- (-)Career Aspirations
- Employment Aspirations
- Career Efficacy



(Alfeld, et al, 2007)

# **Beyond Curriculum & Pedgogy**

*Building a CCR System*

# What is a POS?

Perkins

*Incorporate secondary education and postsecondary education elements;*

*Coherent and rigorous content in a coordinated, non-duplicative progression of courses that align secondary education with postsecondary education . . . to adequately prepare students to succeed in postsecondary education;*

*May include dual or concurrent enrollment programs;*

*Lead to an industry-recognized credential or certificate at the postsecondary level, or an associate or baccalaureate degree.*



# An Industry Driven POS-Toyota

## THE SKILL PIPELINE PROBLEM

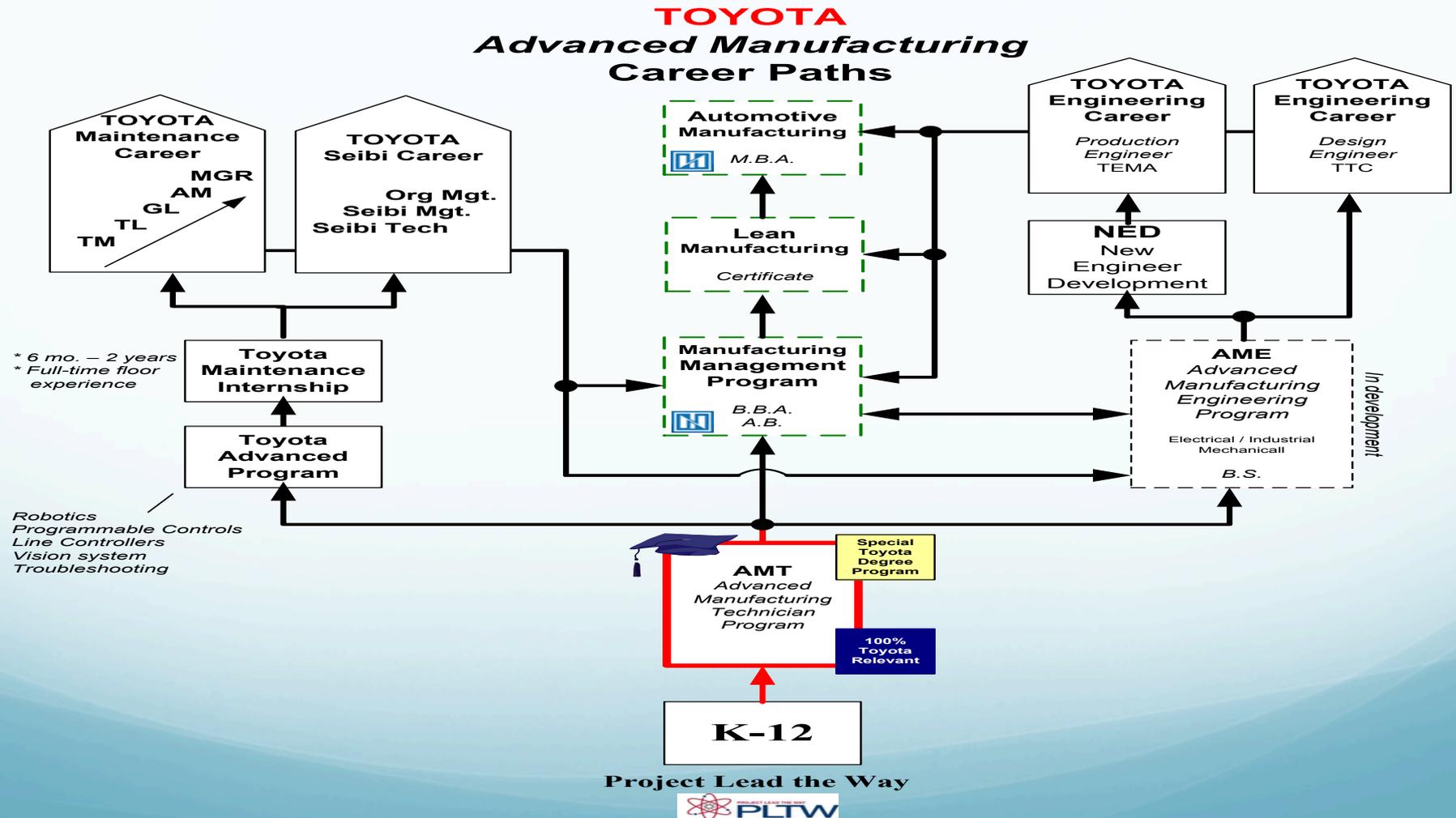
The U.S. community college system produces less capable graduates than parallel systems in competitor nations

Intentional preparation consists mostly of academic education only, i.e. pass technical courses and get a degree.

Schools do not produce graduates with vital preparation for workplace success, such as a highly developed safety culture, skills in workplace organization, lean work skills, and problem solving.

# The Toyota Solution

Seamlessly Connect Paths for Career Long Growth  
and to Strengthen the Whole Company



# The Solution

Totally Redesign the Learning Environment

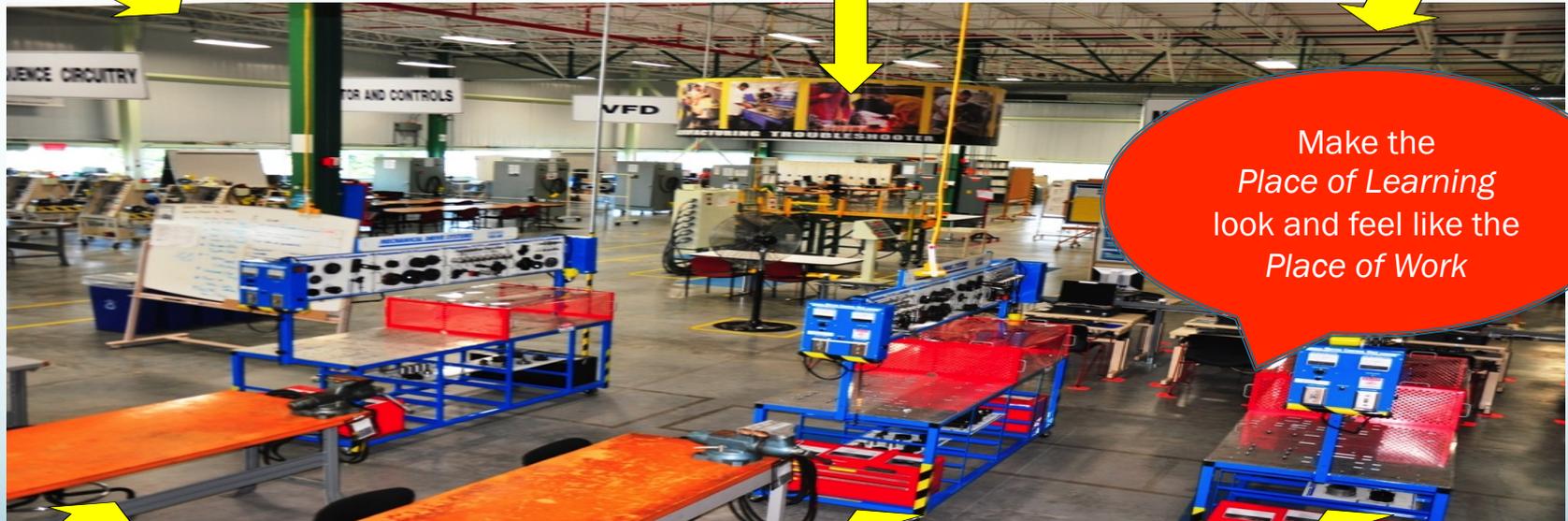
## The New Model School

For Manufacturing

**MORE REALISTIC**  
Looks Like a Factory  
Feels Like a Factory

**MANUFACTURING  
SIMULATOR**  
Central Focus  
Reason for Learning  
Toyota Troubleshooting

**TOYOTA  
LEARNING**  
Safety, TPS, 5S  
Learning Lab



**ORGANIZED BY  
FUNDAMENTAL SKILL**  
Electricity / Fluid Power  
Mechanics & Fabrication

**PROCESS LEARNING**  
Students learn in a  
structure sequence

Students Learn  
the *Right Way*  
the *First Time*

# Key Elements for POS (OVAE, DOL, CLASP)

- Partnerships
- Labor market demand focused balanced with individual focus (career development)
- Alignment – policies, measures, education programs
- Integrated, contextualized curriculum
- Industry Recognized (stackable) credentials
- Professional development
- Data driven: continuous improvement & accountability

# Emergent trends

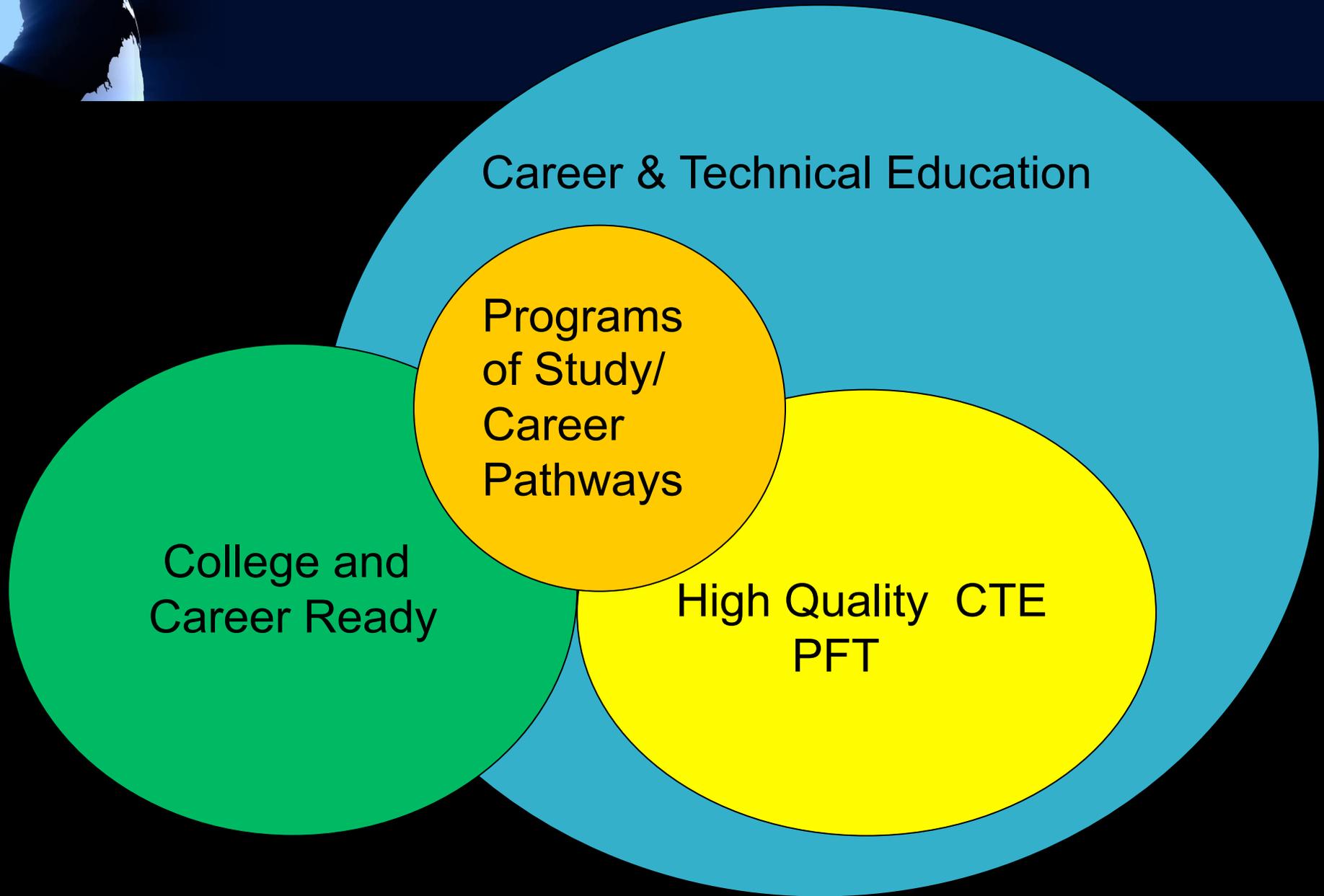
- Some evidence of academic achievement effect, but the evidence is mixed
- Career guidance/career development is a necessary condition for CCR
- Mandate did not appear to have much effect on POS implementation (e.g., % of students engaged in POS, use of dual credit)
- 10 OVAE elements are not equally important or too costly to employ (e.g., TSA)
- Other elements may be more important (e.g., external funding)

# CTE makes HS Matter-It is not just our perspective: Economists' Perspective

“There is one approach that does tend to improve graduation rates and labor market earnings, especially for at-risk youth: high-quality career and technical education (CTE)”

Holzer, H.J., Lane, J.I., Rosenblum, D.B. & Andersson, F. (2011). *Where are all the good jobs going.*

# The good news: This is CTE's Time

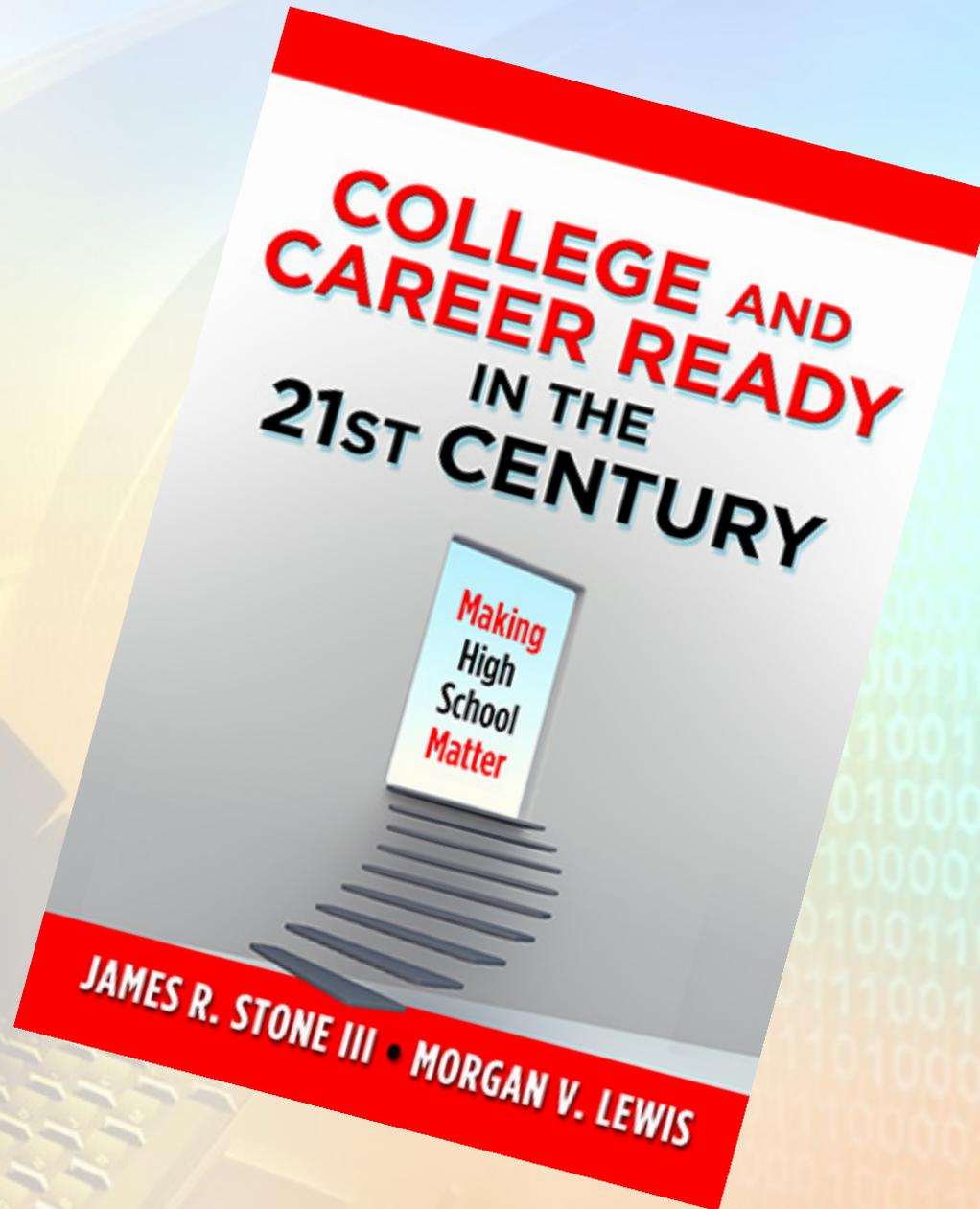




# Key points

- Secondary CTE keeps kids in school, especially boys
- High quality, secondary CTE enhances academic achievement; can support CCSS; improves transition to postsecondary-Necessary for College and Career Readiness
- Effective CTE requires intensive and extensive career development beginning no later than middle school
- Effective CTE requires effective teachers; professional development
- Effective CCR preparation requires a systems approach:
  - Vertical integration: high school & postsecondary & employer
  - Horizontal integration: academic & CTE; CTE & academic
  - Internal integration: authentic, contextualized learning

# Shameless Promotion . . .



# VISIT OUR WEBSITE OR SEND ME A NOTE



[www.nrccte.org](http://www.nrccte.org)



[James.stone@nrccte.org](mailto:James.stone@nrccte.org)

