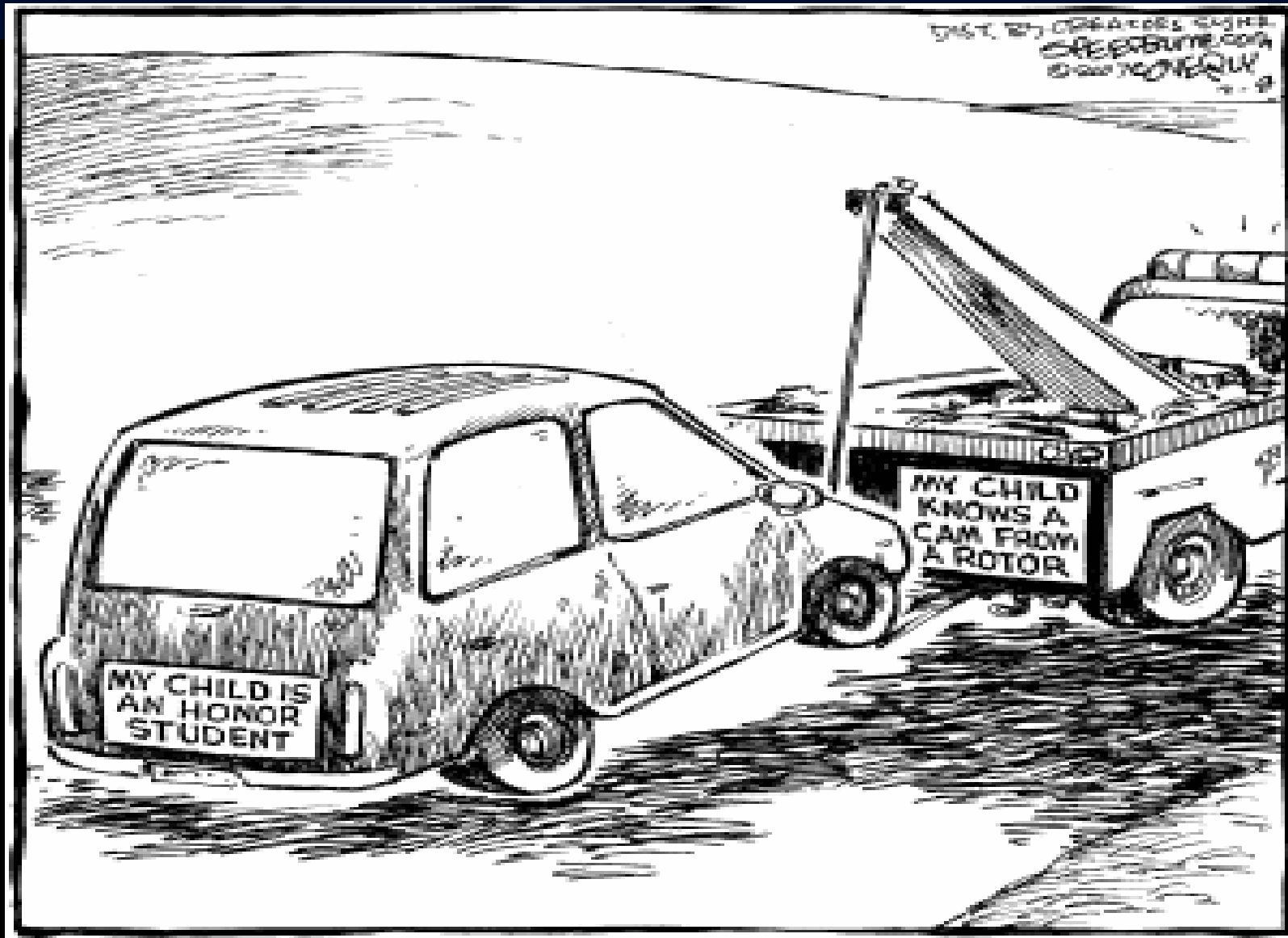# Programs of Study: (How) Do They Work?

Lessons from 4 studies

James R. Stone III

National Research Center for CTE at SREB

The Origins of the Problem

Analyzing the Problem

Labor Market *Dynamics*

Technology *Impact*

30 Years Ed *Reform*

If your assumptions about a problem are wrong, then it is very likely your solution will be as well

Career Pathway Systems

Relevant Programs

Powerful Pedagogies

NRCCTE Research on POS
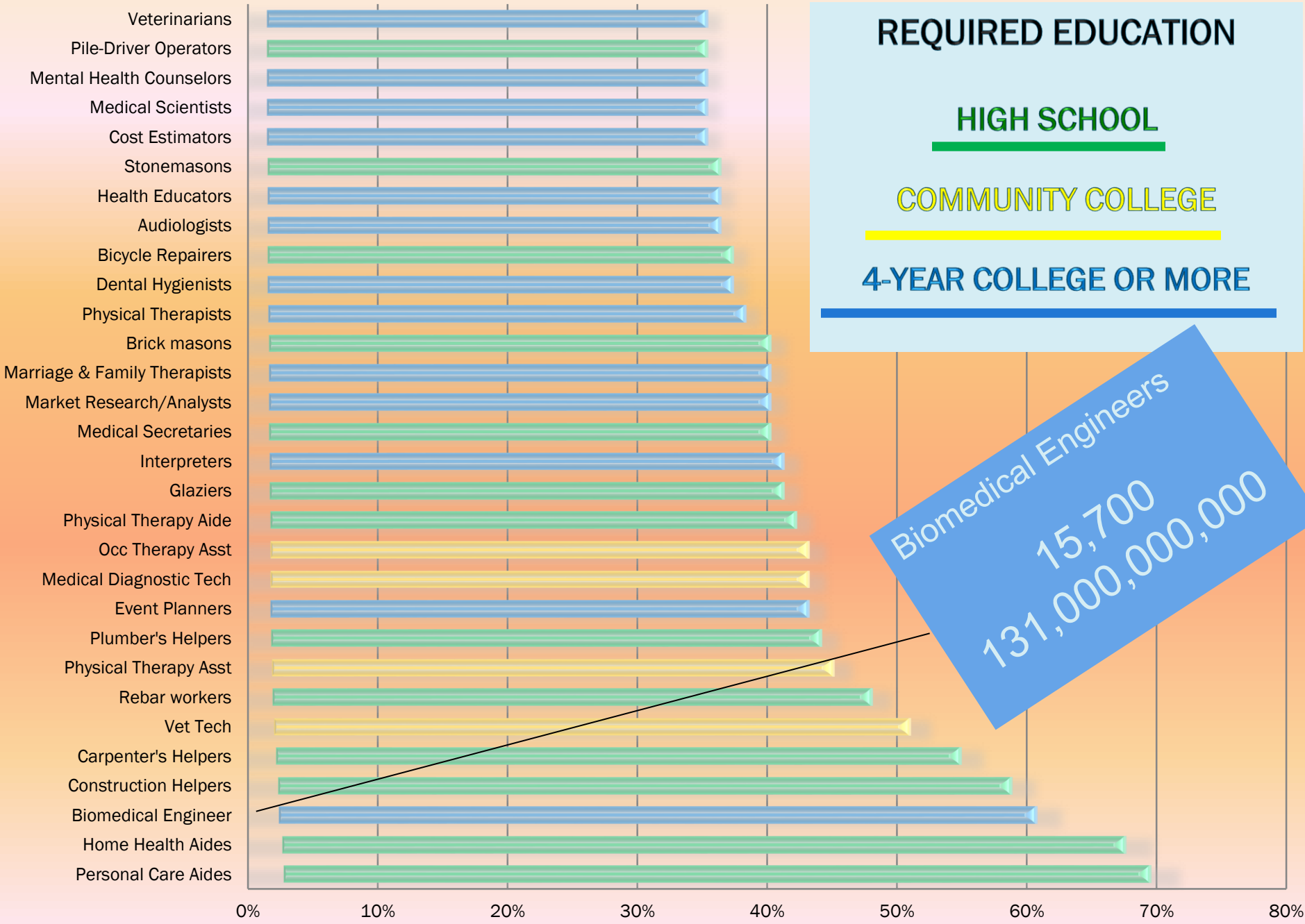
- Mature POS Alfeld & Bhattacharya
  - "Backwards mapping" starting at CC
  - Identifying the factors that led to their success
- SC's Personal Pathways Hammond et al
  - Longitudinal study exploring how a statewide C&CR reform helps implement POS
- Rigorous Tests of POS Castellano & Sundell.
  - Longitudinal study comparing POS student achievement to similar students.

- The Four Elements of the Law
  - Secondary-Postsecondary Elements
  - Non-Duplicative Course Sequences
  - Opportunities for Dual Enrollment
  - Industry-Recognized Credential or Degree
- The Ten Components of the Policy Guidance

A Brief Labor Market National Environmental Scan
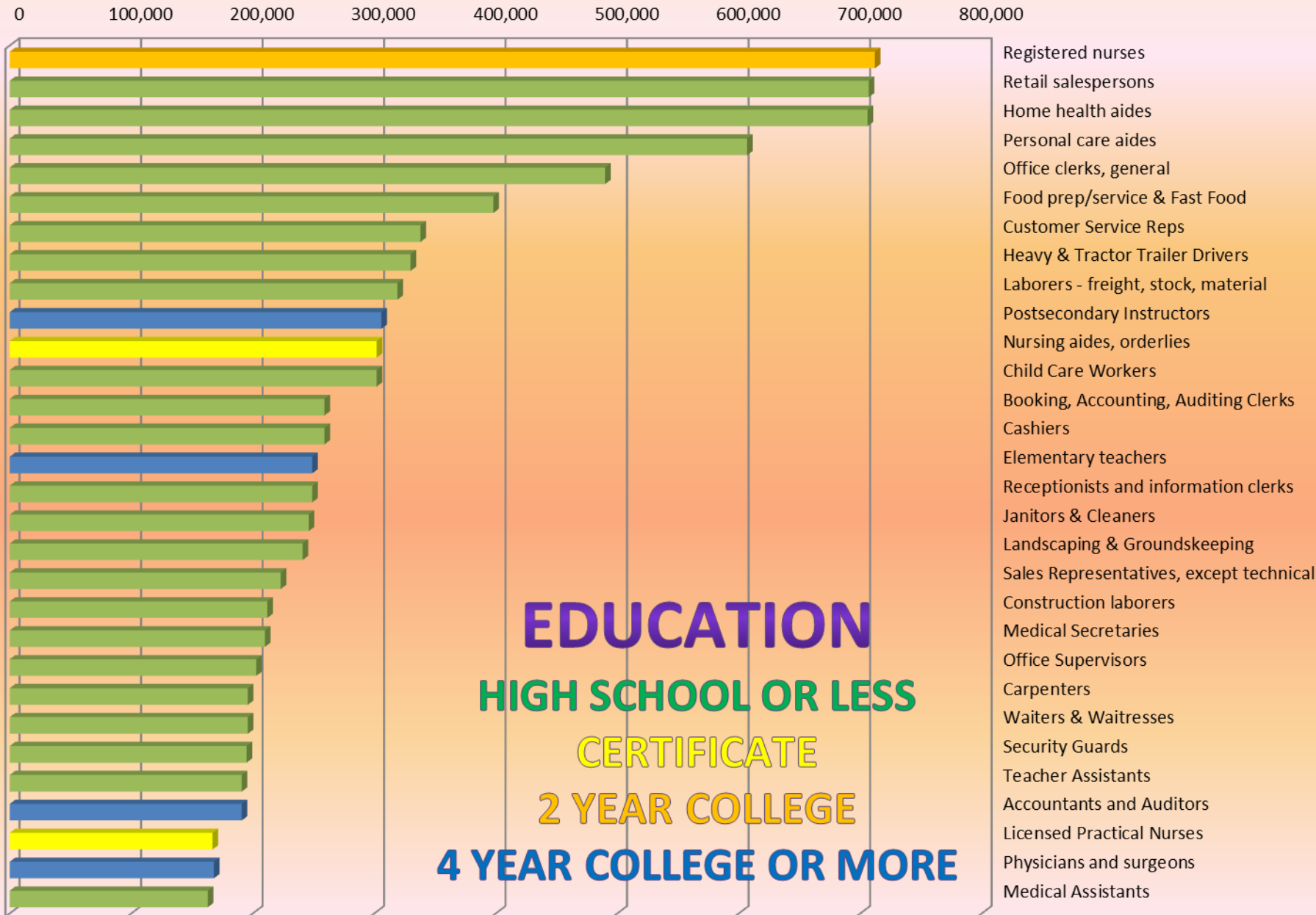
Three Perspectives:

Worse, Worser and OMG!
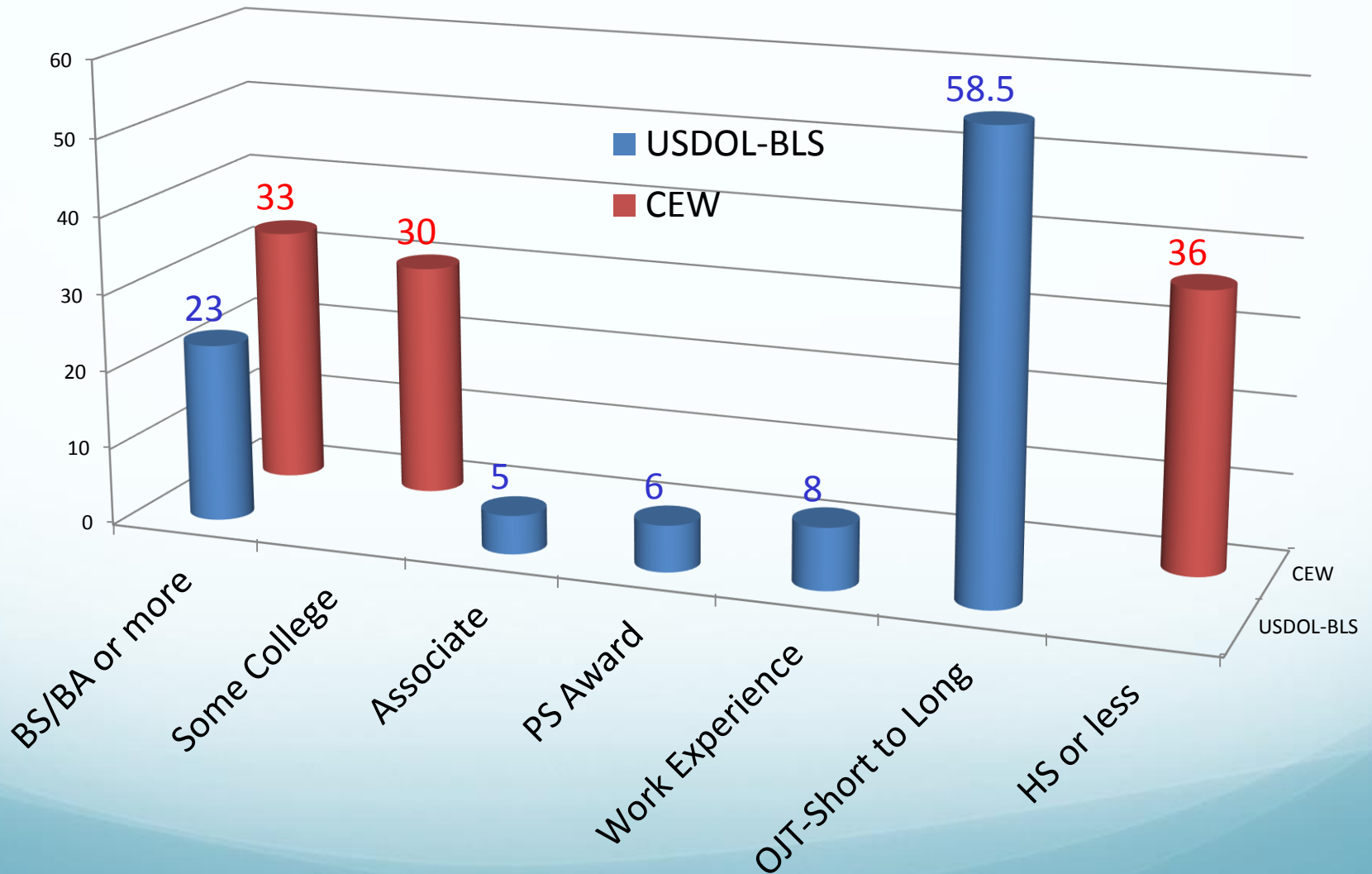
High Growth Occupations 2010-2020

Occupation	Growth
Veterinarians	~35%
Pile-Driver Operators	~35%
Mental Health Counselors	~35%
Medical Scientists	~35%
Cost Estimators	~35%
Stonemasons	~36%
Health Educators	~36%
Audiologists	~36%
Bicycle Repairers	~37%
Dental Hygienists	~37%
Physical Therapists	~38%
Brick masons	~40%
Marriage & Family Therapists	~40%
Market Research/Analysts	~40%
Medical Secretaries	~40%
Interpreters	~41%
Glaziers	~41%
Physical Therapy Aide	~42%
Occ Therapy Asst	~43%
Medical Diagnostic Tech	~43%
Event Planners	~43%
Plumber's Helpers	~44%
Physical Therapy Asst	~45%
Rebar workers	~48%
Vet Tech	~51%
Carpenter's Helpers	~55%
Construction Helpers	~58%
Biomedical Engineer	~60%
Home Health Aides	~67%
Personal Care Aides	~69%

REQUIRED EDUCATION

HIGH SCHOOL

COMMUNITY COLLEGE

4-YEAR COLLEGE OR MORE

Biomedical Engineers
15,700
131,000,000,000

0%   10%   20%   30%   40%   50%   60%   70%   80%

High Demand Occupations 2010-2020
The BLS Perspective

EDUCATION
HIGH SCHOOL OR LESS
CERTIFICATE
2 YEAR COLLEGE
4 YEAR COLLEGE OR MORE

Registered nurses
Retail salespersons
Home health aides
Personal care aides
Office clerks, general
Food prep/service & Fast Food
Customer Service Reps
Heavy & Tractor Trailer Drivers
Laborers - freight, stock, material
Postsecondary Instructors
Nursing aides, orderlies
Child Care Workers
Booking, Accounting, Auditing Clerks
Cashiers
Elementary teachers
Receptionists and information clerks
Janitors & Cleaners
Landscaping & Groundskeeping
Sales Representatives, except technical
Construction laborers
Medical Secretaries
Office Supervisors
Carpenters
Waiters & Waitresses
Security Guards
Teacher Assistants
Accountants and Auditors
Licensed Practical Nurses
Physicians and surgeons
Medical Assistants

Education and Future Work: BLS & CEW

An Evolving Disrupter

- 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)

- Jobs vs. Work

Technology Impact

Erik Brynjolfsson
Andrew McAfee

Race Against The Machine

How the Digital Revolution is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy
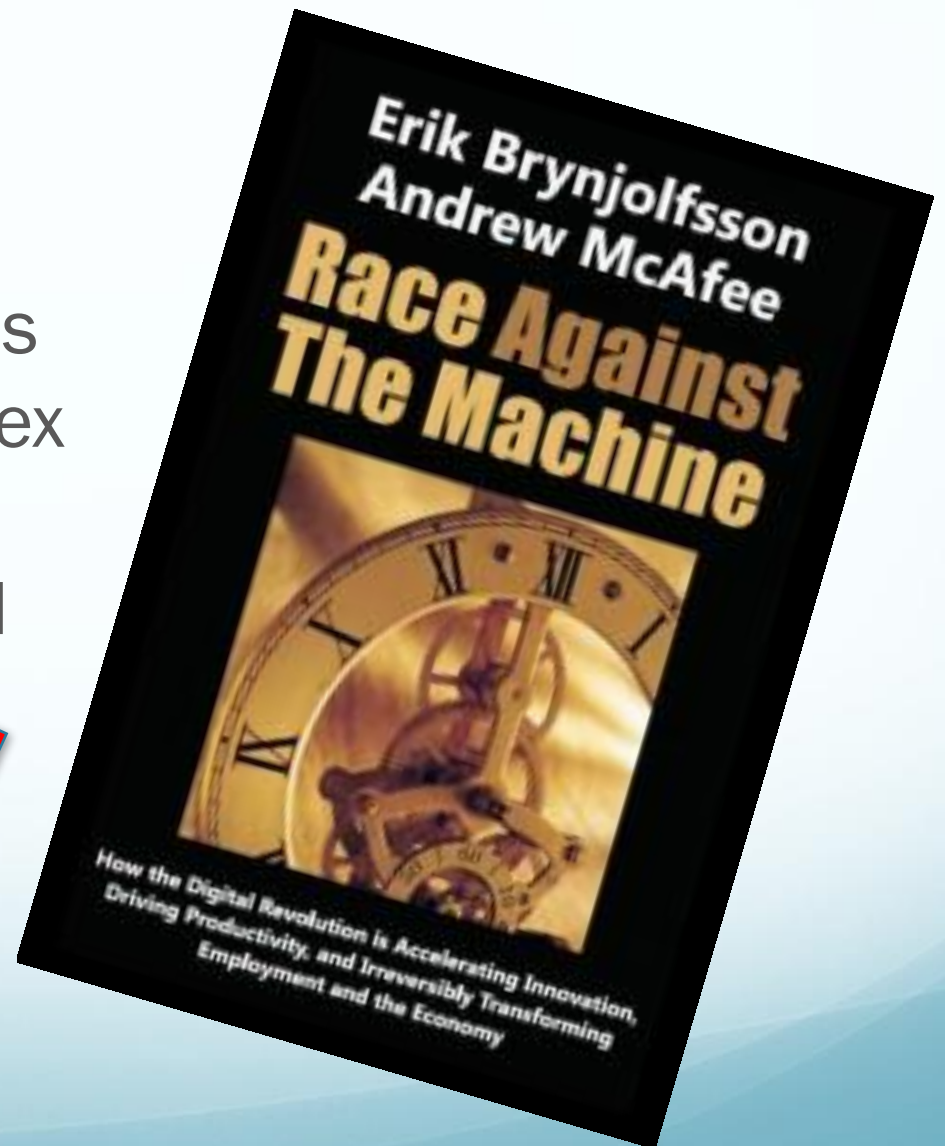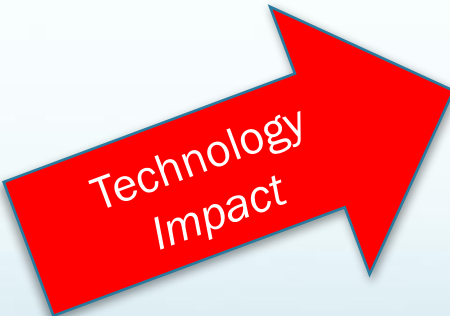
Technology's Impact on Jobs
(The Machines are Winning?)

The Google car(truck?)

IBM Watson (+240%)

Deep Blue

The "Square"

Text readers/ Pattern recognition (goodbye legions of lawyers-only 60% accurate)

Automated 'call centers' (goodbye India)

Firefly removes kidneys

Amazon Drone Delivery
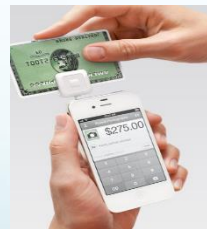
Dark (Lights Out) Manufacturing

- FANUC Robotics operates a lights-out factory employing robots to make other robots.

- Japanese camera giant Canon recently announced that it is phasing out human workers at camera factories

- And in the Netherlands, Philips produces electric razors in a facility with 128 robots and nine human quality assurance workers.

Conversation in Context

- Only 63% of Americans are in the labor market, lowest percentage since the depression[1]

  - Young workers are not getting jobs (13% drop since 2007; lowest rate since 1948) and do not earn a median income until age 30 (26 in 1980)[2]

  - Women have recovered the jobs lost in the "Great Recession." Young male job seekers employment rate has dropped from 84% in 2000 to 65% in 2012[2]

  - 60% of employers currently check credit ratings of new hires[1]

  - 78% of employers conduct pre-employment drug testing in 2013[3,] up from 62% in 1993[4.]

- Overall, 15% will prosper in the coming years, 85% will have lower standard of living than today[1]

1. *Average is Over*, Cowen(2013)
2. *US News* 9/30/2013
3. SHRM, 2013
4. NBER, 2013

The Real Skills Gap
Business Roundtable Survey 2009

•Gap Between Importance of Skill & Workers' Current Skill Level (As Perceived By Employers)

Skill	Gap
Personal accountability for work	-29
Self-motivation	-28
Strong work ethic	-28
Punctuality/showing up to work on time	-24
Time-management skills	-24
Professionalism	-23
Adaptability	-20
Oral communication skills	-17
Creative problem-solving	-17
Teamwork	-16
Critical thinking	-16
Job-specific professional skills	-15
Customer/client relationship management skills	-12
Quantitative reasoning	-11
Reading skills	-9
English skills	-8
Job-specific technical skills	-7
Job-specific knowledge	-4
Writing skills	-4
Basic computer skills	-3
Specialized IT user skills	2
Management skills	3
Administrative skills	3
Mechanical/machine operating skills	9

- •Severe Deficit
- •Moderate Deficit
- •Small Deficit
- •No Deficit

•Q17: You are going to see a list of skills and attributes that employees could have. Please rank how important each skill or attribute is for your employees to have right now using a 7 point scale. Q18: Indicate the level of your current employees' skills overall, for each of the following skills, using a 7 point scale. (Showing difference between 6+7s)

If STEM Jobs are so hard to fill:

Most with bachelor's degrees in science, technology and math don't get STEM jobs.

Amid a U.S. push to get more students interested in science, technology and math, often called STEM, the Census Bureau reported Thursday that 74% of those with a bachelor's degree in these subjects don't work in STEM jobs.
(Census Report: July 14, 2014)

Engineering majors and majors in Computer, Math and Statistics	50%
Physical Science	26%
Psychology	10%
Social Science	7%

We've been here before... Remember Sputnik?

USA TODAY
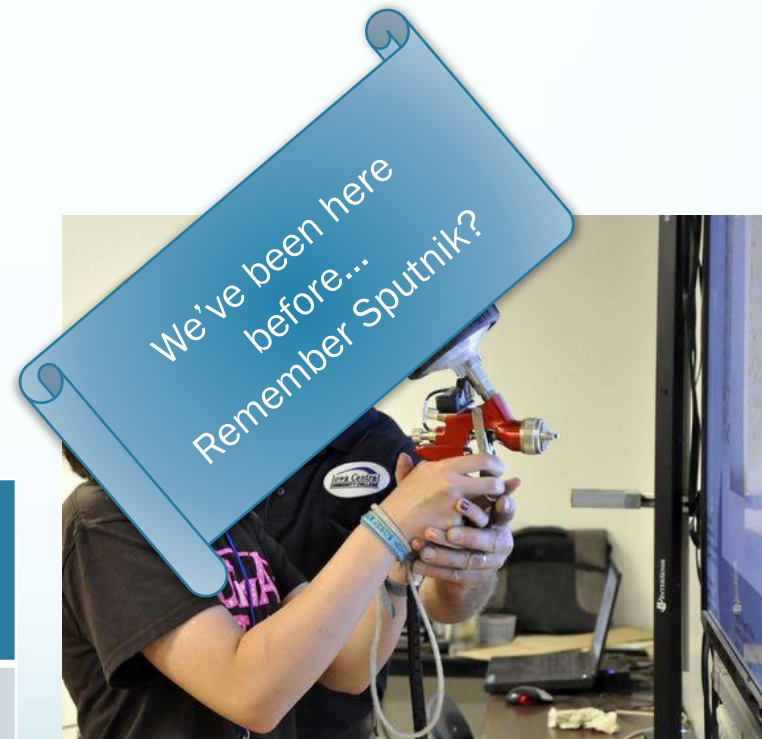
What a shortage of workers on film sets in Georgia says about America

(Aug 2nd 2014)

…Georgia's skills shortage goes beyond the film industry. For every four tradesmen that retire just one takes their place … a similar problem, albeit in less acute form, is in evidence across America. More than half of the country's tradesmen are aged over 45. *According to the Department of Labour, America will need 41,700 more cement masons, 114,700 more electricians and 218,200 more carpenters by 2022.*

But efforts to train young people as plumbers or pipe-fitters run up against concern from parents. Instead of being proud to raise a future welder, "everyone wants to believe that their child will go to Harvard", says Matthew Gambill, the director of the GACTE. *Despite the lower cost of a skills-based education and the solid job prospects, enrolment at technical colleges has dropped 23%* since recession-stricken students clamoured for entry in 2010.

Solution?
Pile on more academics
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*
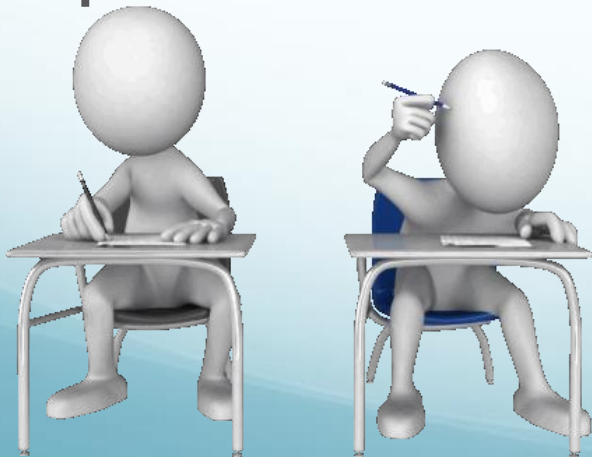
*Depends on the starting and ending timeframe

One solution?

161 Graduated from college
148 Some education after high school
138 Graduated from high school
130 Did not finish high school

Scale score
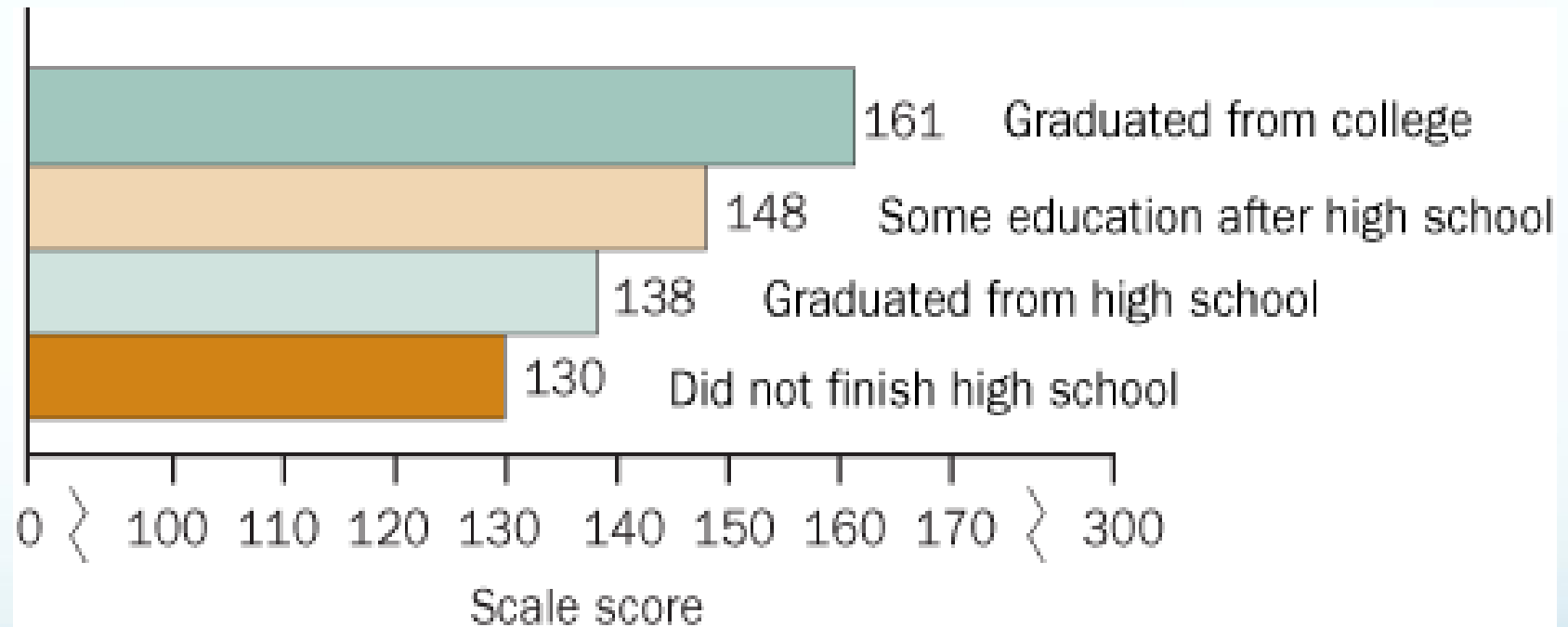
Be born to smarter parents!

Taking more math is no guarantee

(ACT College Ready Math=22)

- Only 26% of students who took Alg I, II & Geometry scored a **22** (ACT Benchmark for CCR) on the ACT exam. (X=17.7)[1]

- Adding Trig increases to the average score to 19.9; *37% are CCR*[1]

- Not until calculus is added, does the average score exceed 22; *55% are CCR* – 5 years of high school math.

- 43% of ACT-tested Class of 2005[1] who earned A or B grades in Algebra II did not meet ACT College Readiness Benchmarks in math[2]

1. ACT, Inc (2004) *Crisis at the Core*

2. ACT, Inc. (2007) *Rigor at Risk*.

While test scores remain flat, Student Engagement plummets
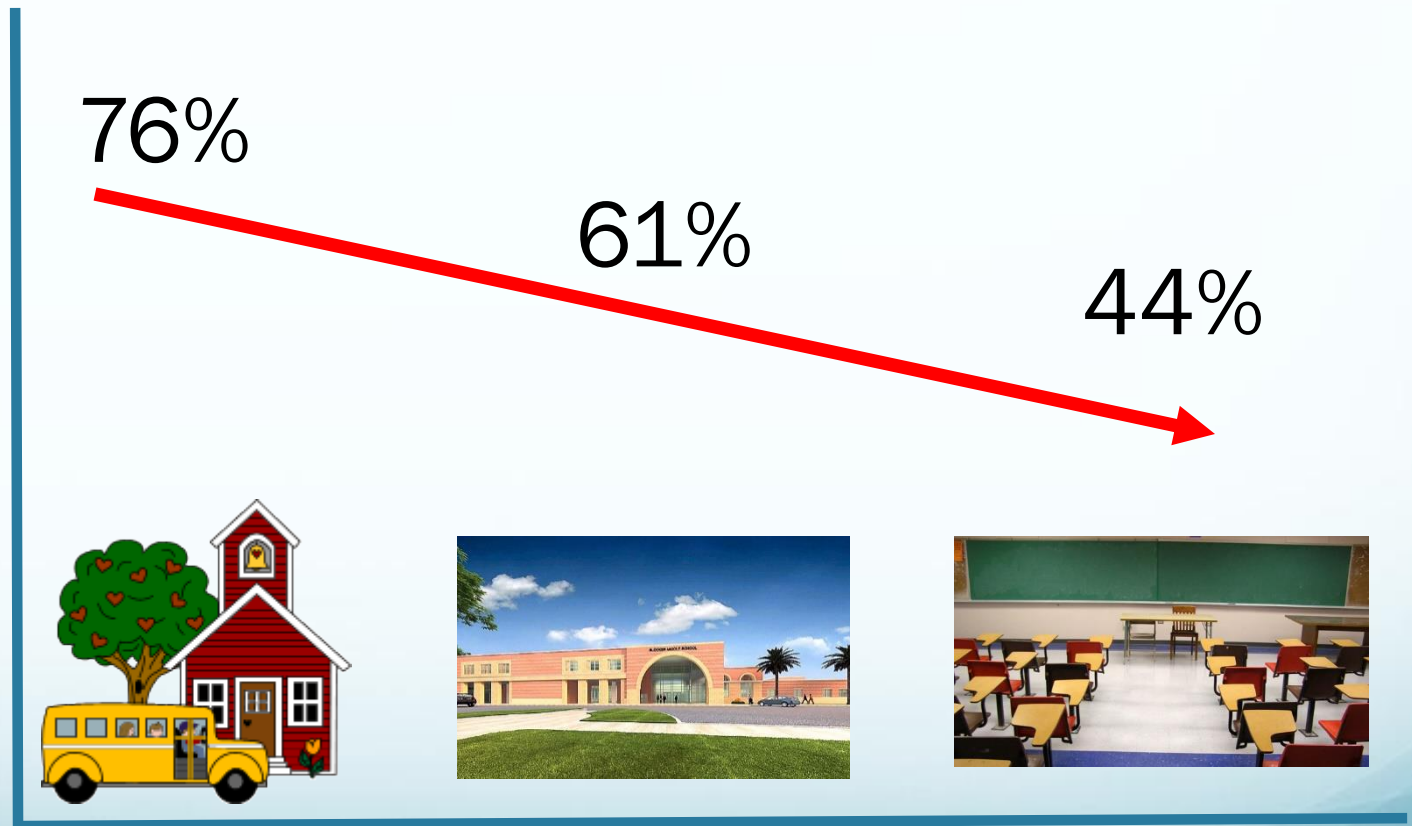
76%

61%

44%

Finishing High School: A Necessary First Condition
for College OR Careers

- ▣ Plank (2001) found CTE a significant factor in reducing the likelihood of dropping out of high school (NELS 88 data): a 1:2 ratio

- ▣ Plank, DeLuca, & Estacion (2005) found CTE a significant factor in reducing the likelihood of dropping out of high school (NLSY97): a 1:2 ratio

- ▣ Castellano, Stone, Stringfield & others (2007) found CTE course taking in 3 high poverty communities significantly increased the likelihood of high school graduation (NRC longitudinal data).

We have a 'boy' problem

- By 12th grade, male reading scores are below females'
- 11th grade boys write at an 8th grade girl level
- Boys advantage in math and science is nearly gone.
- Boys are more likely to have discipline problems
- Boys account for ¾ all D's and F's
- Fewer boys than girls finish high school, start and finish college, start & finish grad school (Brooks, 2012)
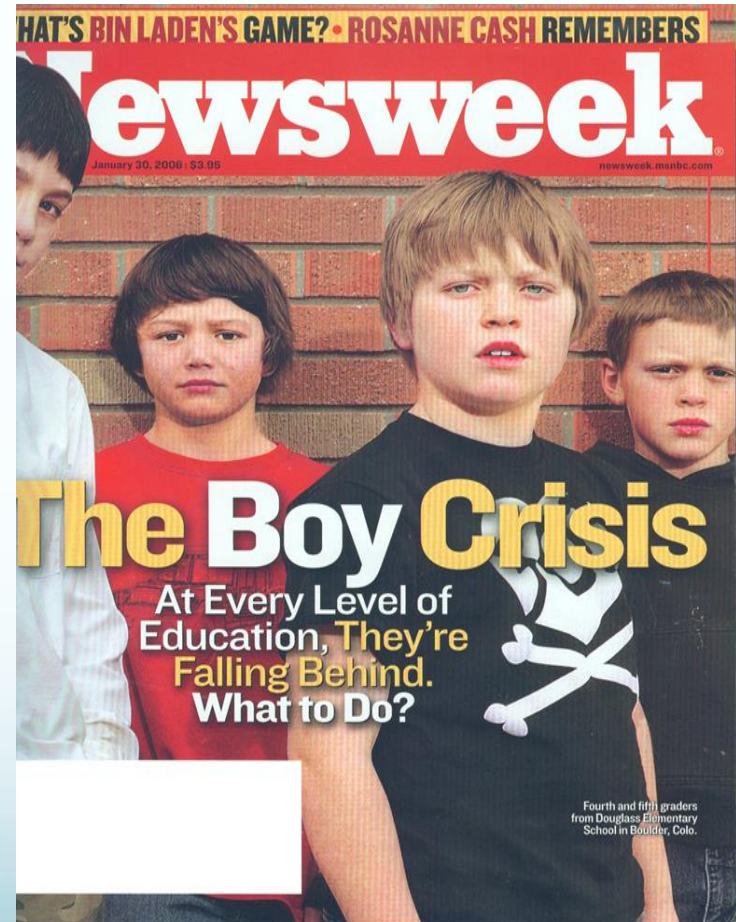
Engagement:
CTE Keeps Boys in School!

A Survival Analysis

NS=Statistically not significant
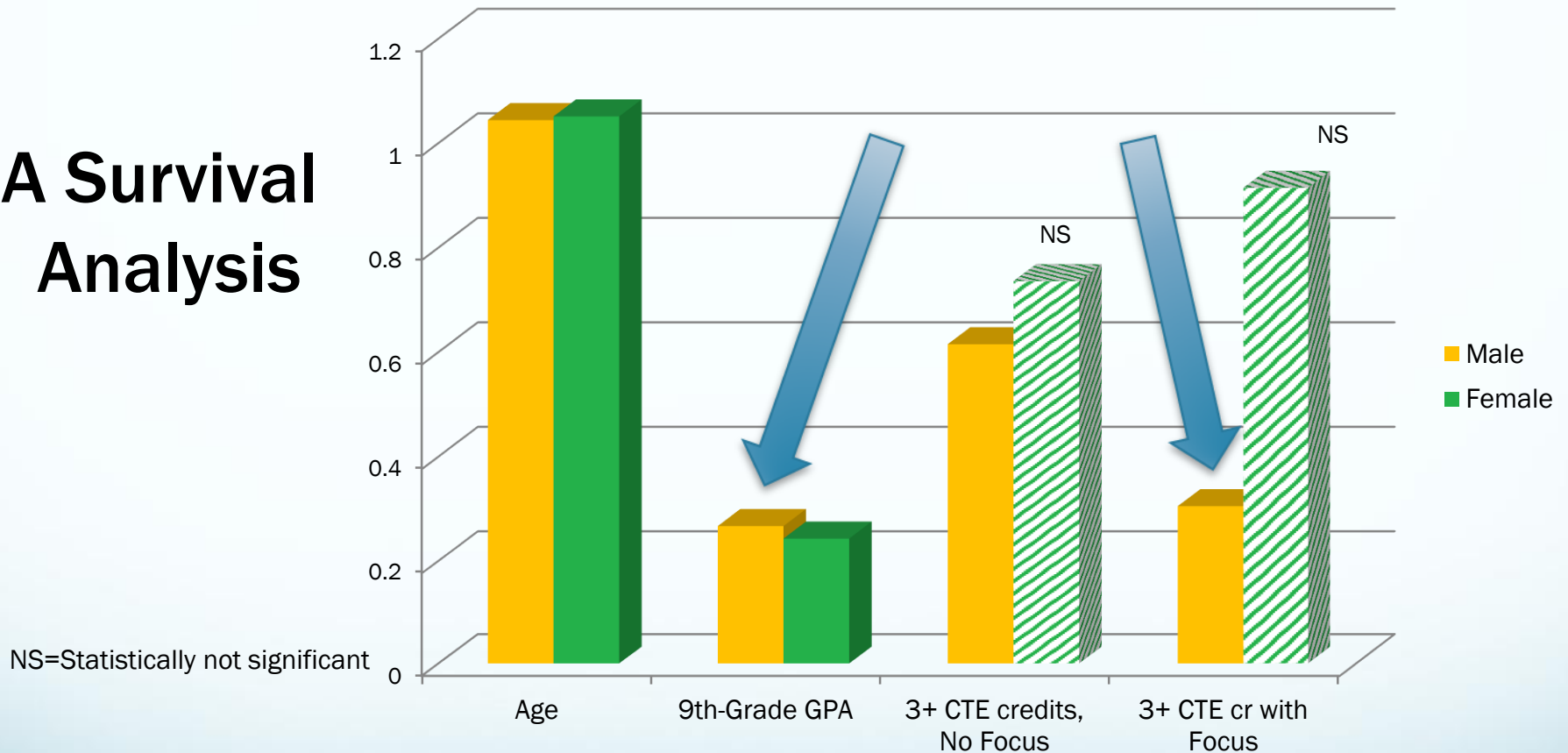
- CTE Participation helps boys "survive" high school
- There is no CTE "survival" effect for girls; but it "does no harm"

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*.

Unintended Consequences:
More high school math, science linked to more dropouts

As math and science requirements for high school graduation have become more rigorous, dropout rates across the United States have risen, The tougher requirements appear to have had a major effect on high school graduation rates of Hispanic and African-American males.

Plunk AD, Tate WF, Bierut LJ, Grucza RA. Intended and unintended effects of state-mandated high school science and mathematics course graduation requirements on educational attainment. *Educational Researcher*, vol. 43(5), June/July 2014
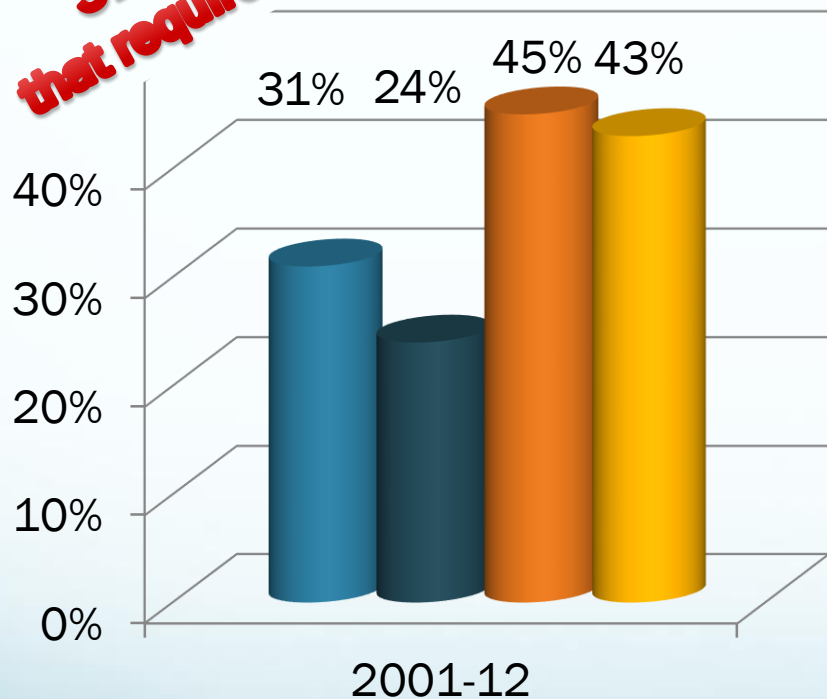
LABOR MARKET CONSEQUENCES

Employment of Young Men
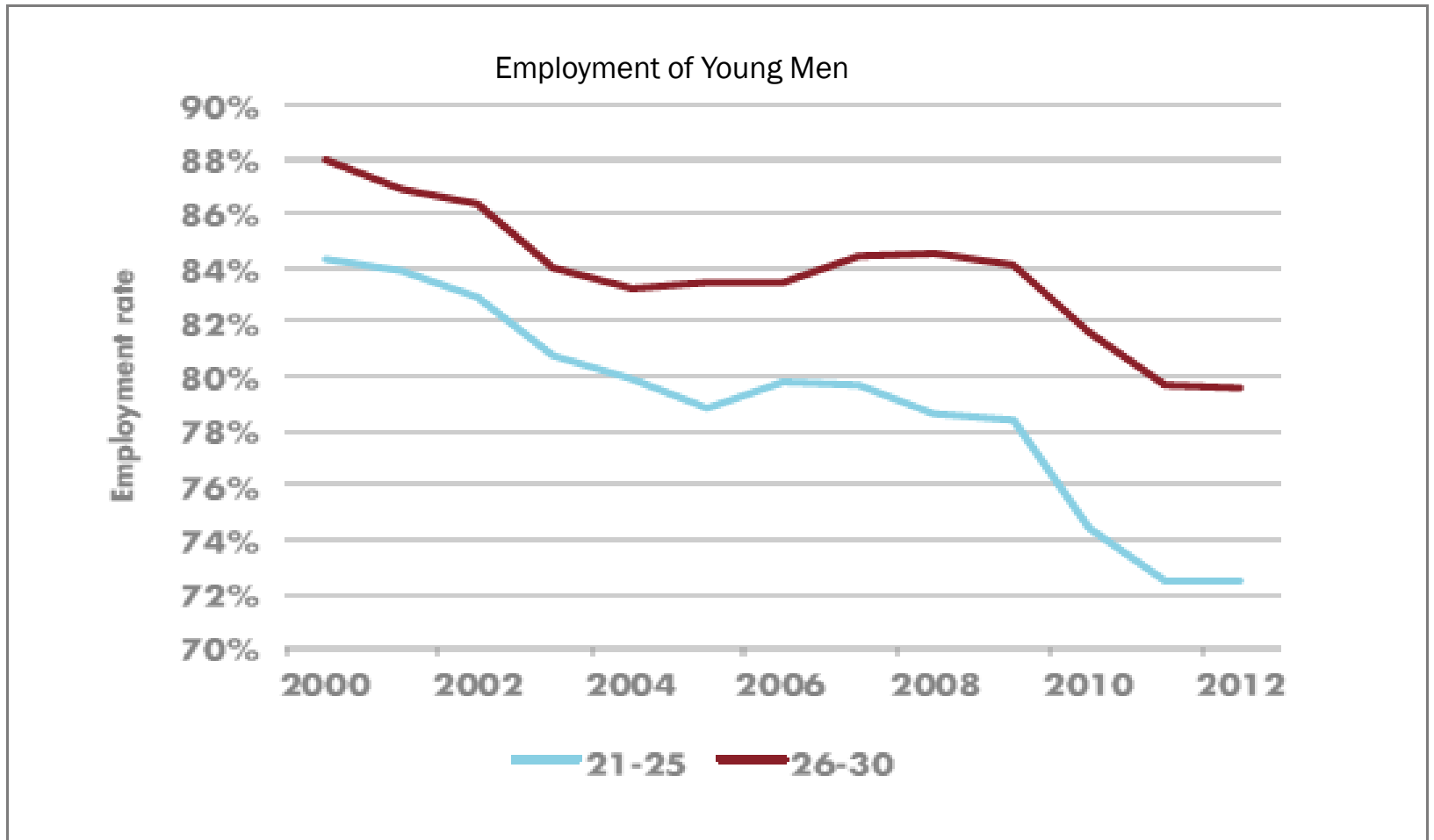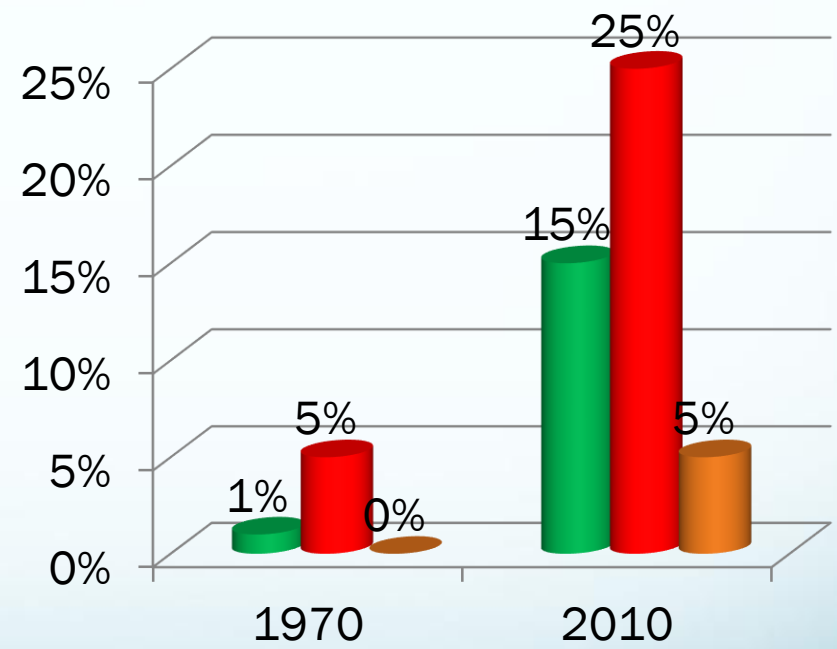
More Consequences

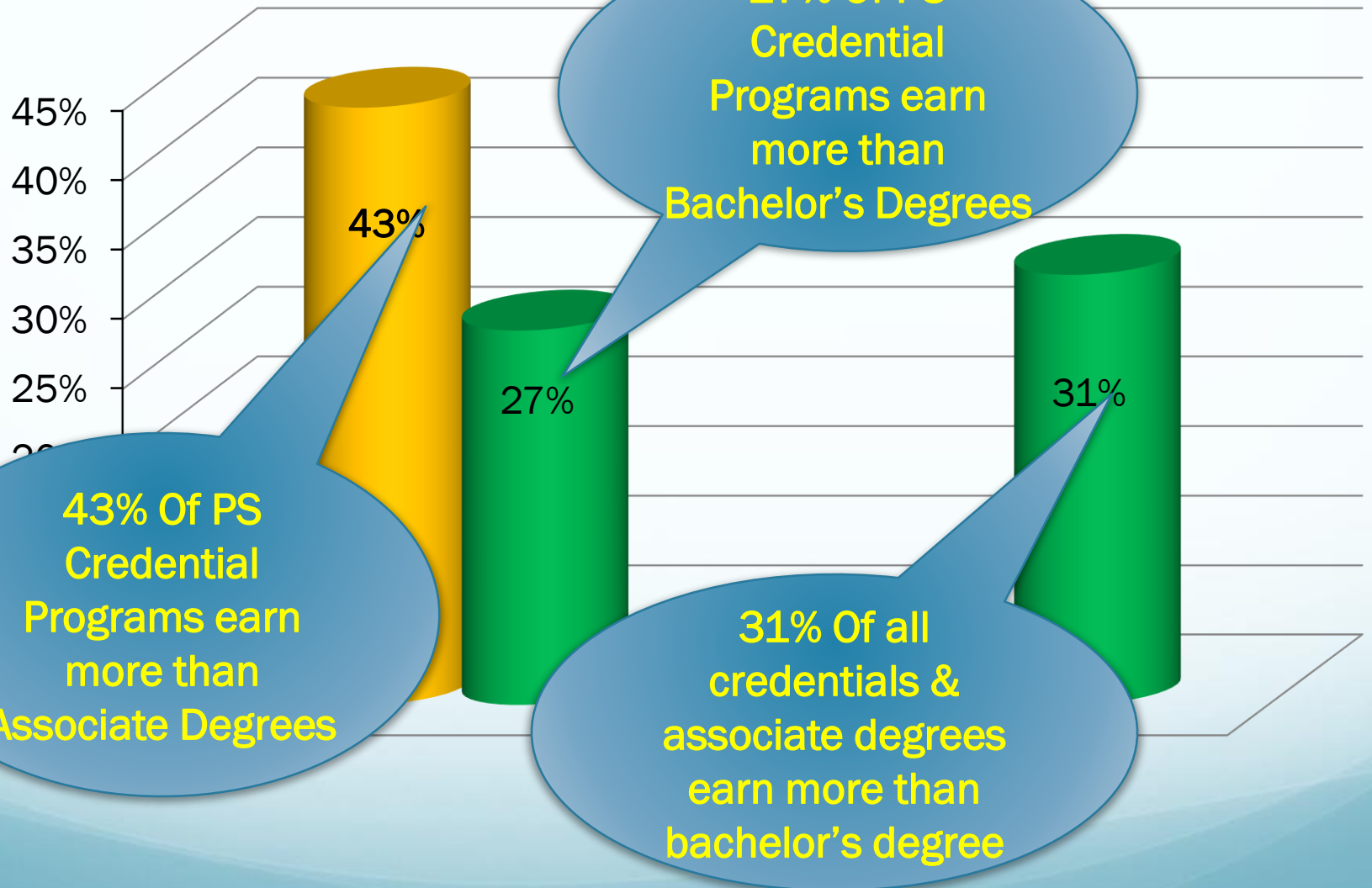47% of college grads in jobs That require less than BA/BS; 37% in jobs that require HS Only

...owth

31% 24% 45% 43%

2001-12

- Associates
- Bachelor's
- Master's
- Doctorate

Labor Market Demand

25%

15% 25%

1% 5% 0% 5%

1970 2010

- Taxi Drivers w/ BA/BS
- Sales Clerks
- Janitors

Vedder, R., Denhart, C., Robe, J. (2010).
Why are recent college graduates unemployed

# Middle Skill - Credentials Pay Off

45%
40%
35%
30%
25%

43%

27%

31%

27% Of PS Credential Programs earn more than Bachelor's Degrees

43% Of PS Credential Programs earn more than Associate Degrees

31% Of all credentials & associate degrees earn more than bachelor's degree

Middle Skill Jobs: Another Way of Winning

47% of all new job openings from 2010 to 2020 will fall into the middle-skill range
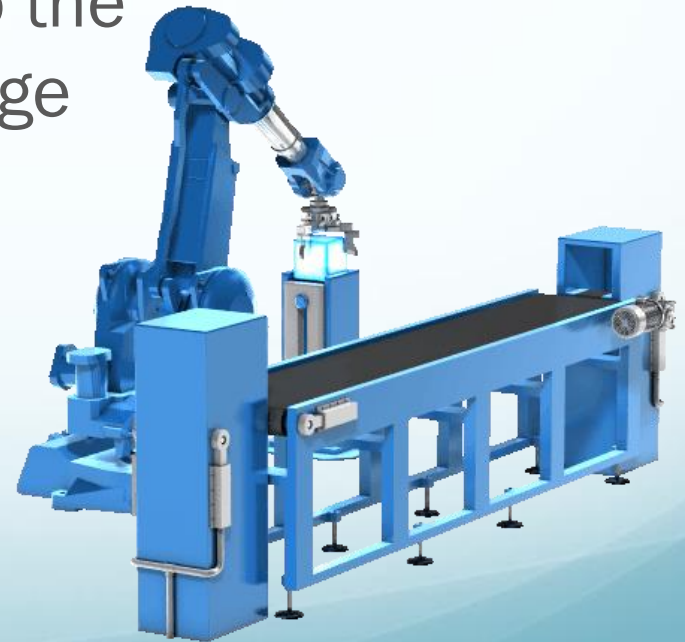
Source: Harvard Business Review, 2012/12,
Who Can Fix the "Middle Skills" Gap?

Research Points Toward . . . Change

Career Pathway Systems

- Systems change
- Program change
- Pedagogy change

Building Quality Career Pathways

Systems Change
- Align the College & Career Ready System Components

Program Improvement
- Bring existing programs to standard & add new programs

Instructional Delivery
- Ensure all CTE faculty are highly skilled in pedagogy and in their professions

Career Pathways
A systems approach to the future
A Ghostbuster Solution?

Multiple Ways of Winning

Building the CCR system

Systems Change

- Vertical Integration: Secondary - Postsecondary – Business & Industry
- K-12 Career Development

First Step: Analyze the System
Program Quality Audit

- Current CTE programs of study alignment with projected job needs in the next decade by economic sectors, by regions or state.

- Secondary CTE programs alignment with current offerings at the community and technical colleges.

- Advisory committee quality and input; role in linking secondary and postsecondary CTE

- CTE facilities alignment with industry standards.

- Faculty perception of access to and value of related professional development.

- Student perceptions of course rigor, faculty and preparation.

- Students success in meeting state benchmarks in career readiness, college readiness or both?

- Student placement in career clusters/pathways that align with their individual learning plan and the regional and state economic sector needs?
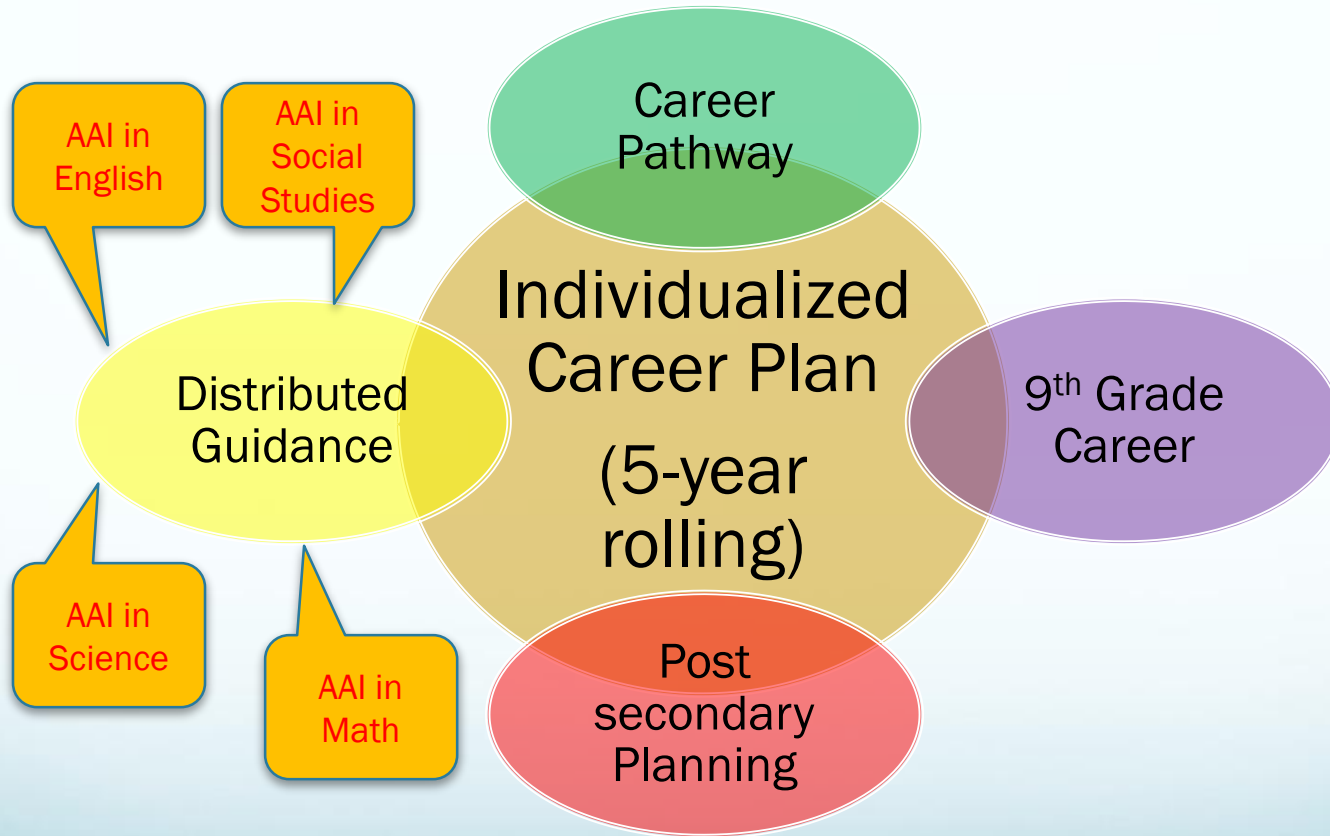
Desk Audit, Surveys & on-site Research

NRC CTE
National Research Center for
Career and Technical Education

Effective CCR Requires a Career Development Framework

Employment: Career ___ ___
Continuing Education and ___ ___ ___

Postsecondary: Career ___
Achieving credentials: ___ ___ ___prenticeship, military

9-12: Career Preparation
Academics and technical co___ ___ance, individual graduation plans

Grade 8: Transition
Choosing a health care___ ___nge easily at any time later)

6-8: Career Exploration
Discovering interest i___ ___ Begin Individualized Graduation Plan

K-5: Career Awareness
Introduction to health careers

A Developmental ILP that Drives Program Choice & Student Course Assignments

Individualized Learning Plan for Career Pathways

Distributed Guidance
Health Career Pathway

ELA: Write a paper explaining infection control practices and procedures documenting examples of when safety protocols were violated.

Science: Conduct a study of local health care facilities to determine how medical waste is disposed.

**Social Studies:** Study the impact of war-time medical care on the advancement of medical techniques.

Math: Compute the number of calories in the school lunch and then calculate how long a person would have to walk to burn off those calories to maintain body weight

- Align the College & Career Ready System Components

A Credentialed Career Pathway (*Programs of Study*)

- From High School to ...

- Work *and (NOT OR)*

- Continuing Education and Training

Goal: Productive Adult in a Global Economy
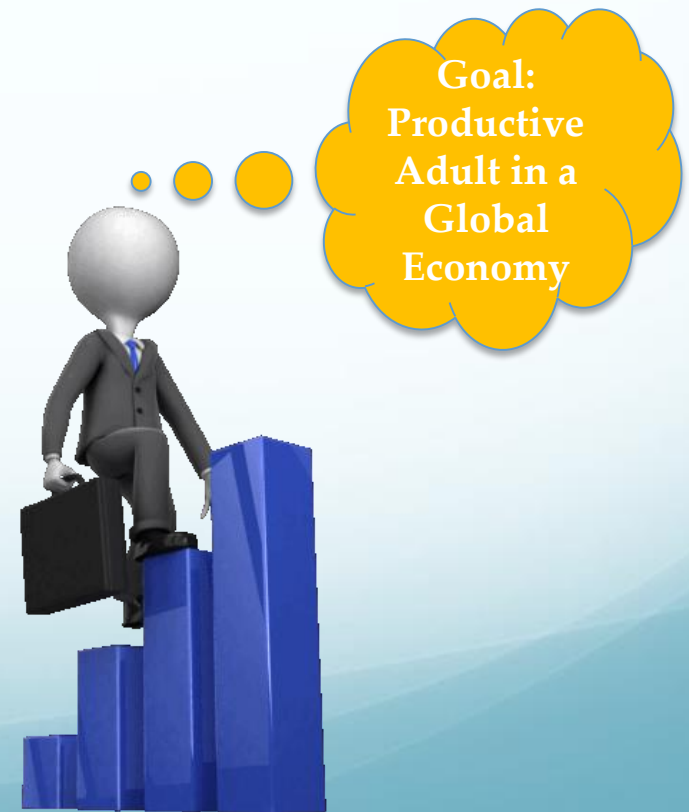
Career Pathway – Stackable Credentials

A recent McKinsey Global Institute study concludes, "policymakers and business leaders across the globe will need to find ways to vastly improve their capacity to provide job-relevant education and training. And, in both developing and advanced economies, new approaches to job creation for low and middle-skill workers will be required (Dobbs, et al, 2012)
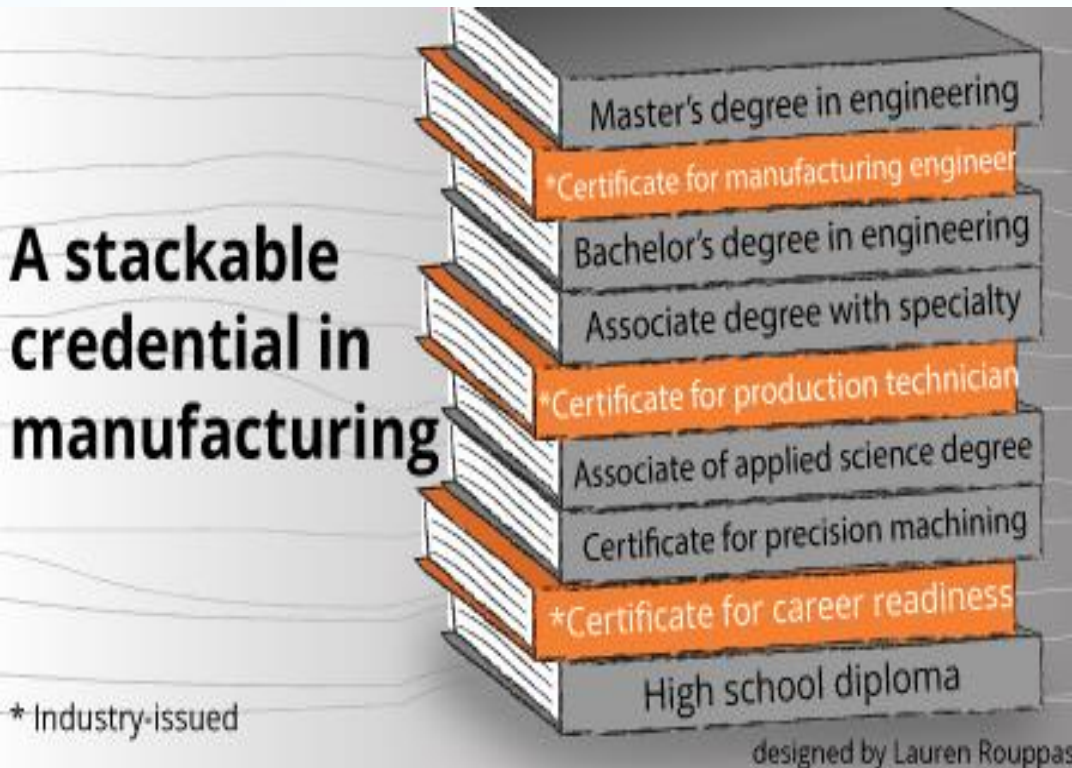
- More than course credit pathways

- *Portable:* trusted by employers and institutions of higher education (external validation)

- *Stackable:* each credential has value (labor market signal) leads to another credential:
  - 51% of CC certificates require less than one year
  - Offer accelerated entry into the labor market
  - Credentialing process can begin in upper secondary education

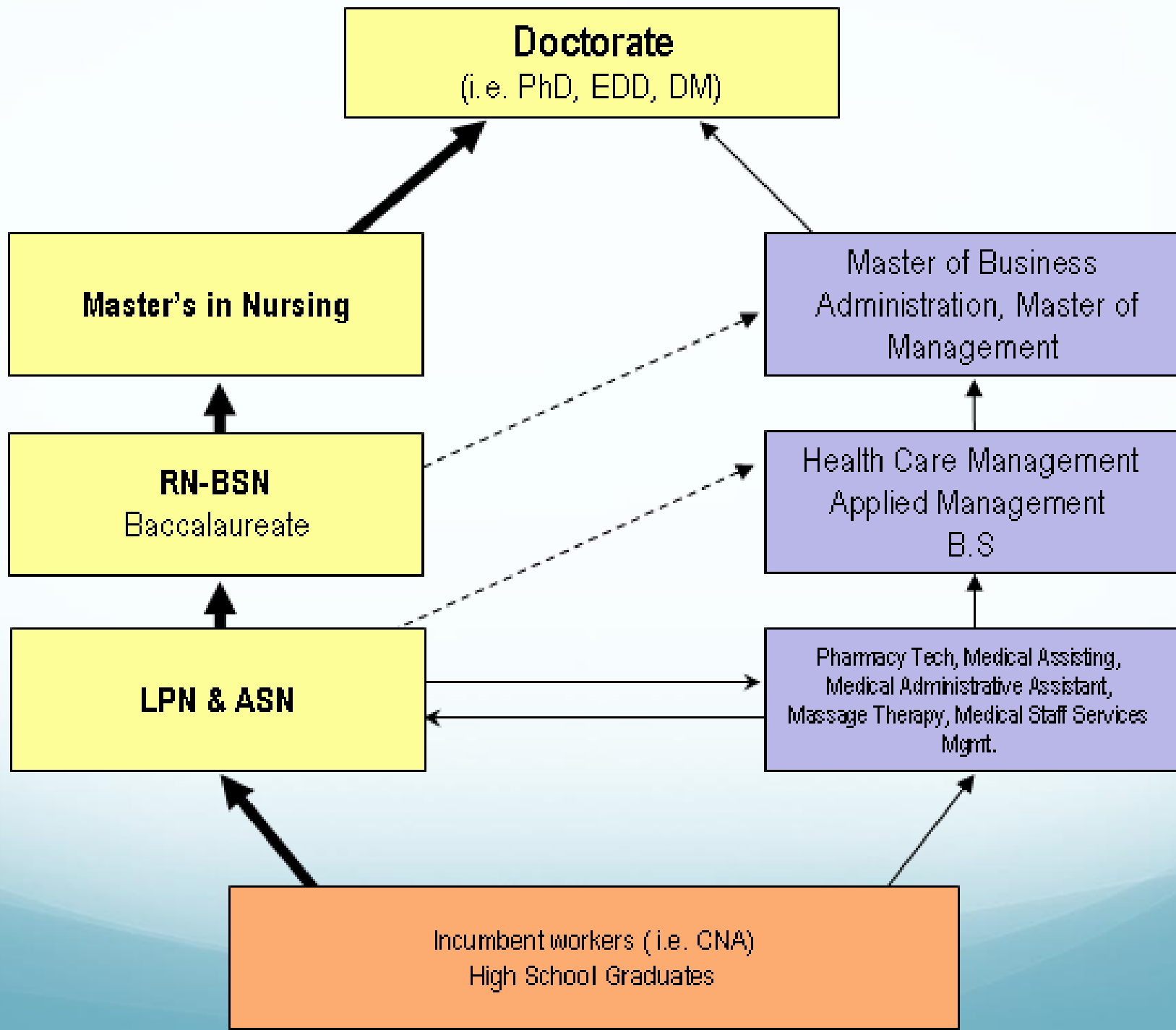- Part of a career pathway *system*

What is a stackable credential?

Part of a sequence of credentials that can be accumulated over time to build up an individual's qualifications and help them to move along a career pathway or up a career ladder to different and potentially higher-paying jobs.

(Source: TEGL 15-10, www.doleta.gov)

A stackable credential in manufacturing

- Master's degree in engineering
- *Certificate for manufacturing engineer
- Bachelor's degree in engineering
- Associate degree with specialty
- *Certificate for production technician
- Associate of applied science degree
- Certificate for precision machining
- *Certificate for career readiness
- High school diploma

* Industry-issued
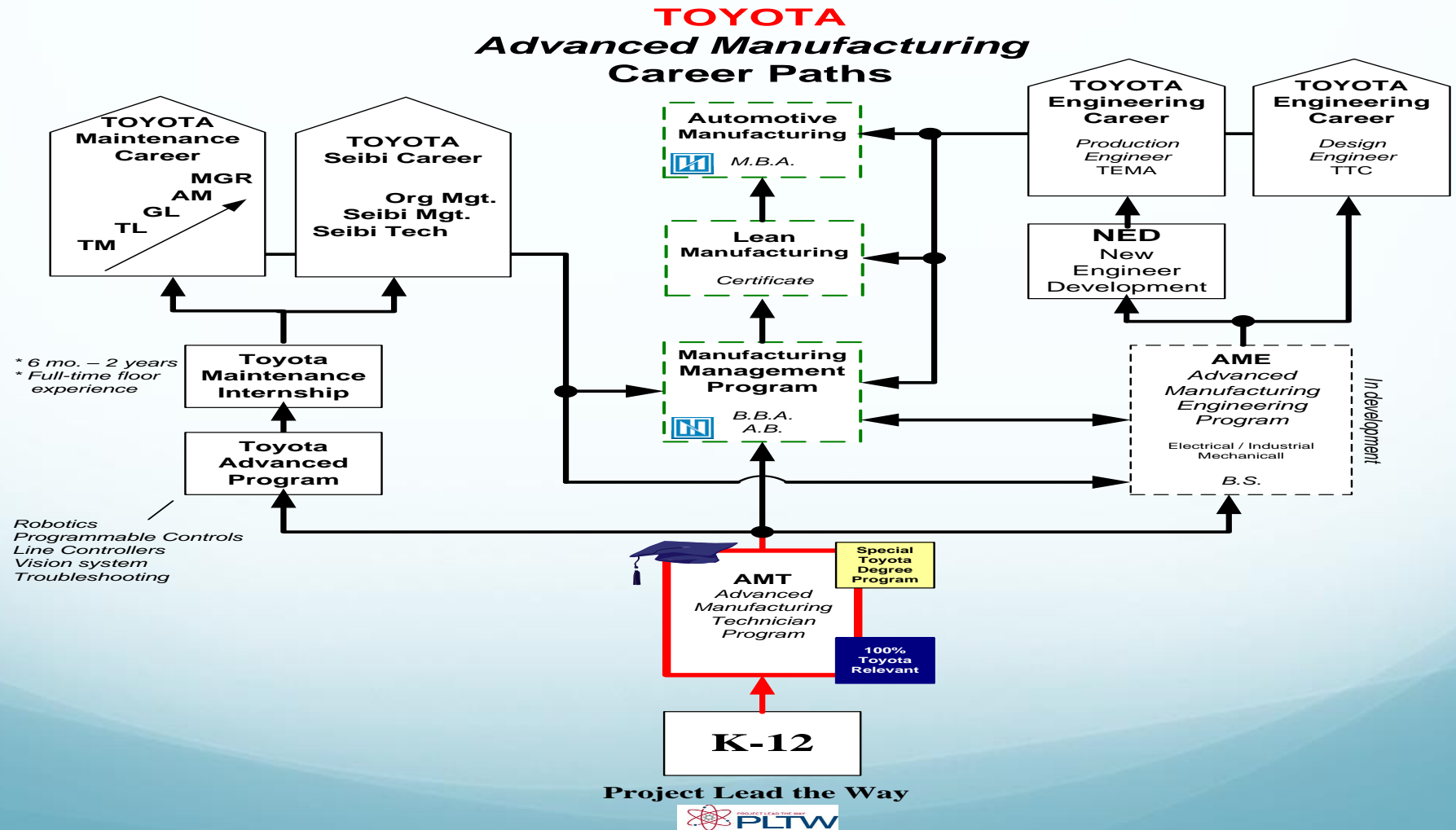
designed by Lauren Rouppas

Industry Built Career Pathway
Seamlessly Connect Paths for Career Long Growth and to Strengthen the Whole Company
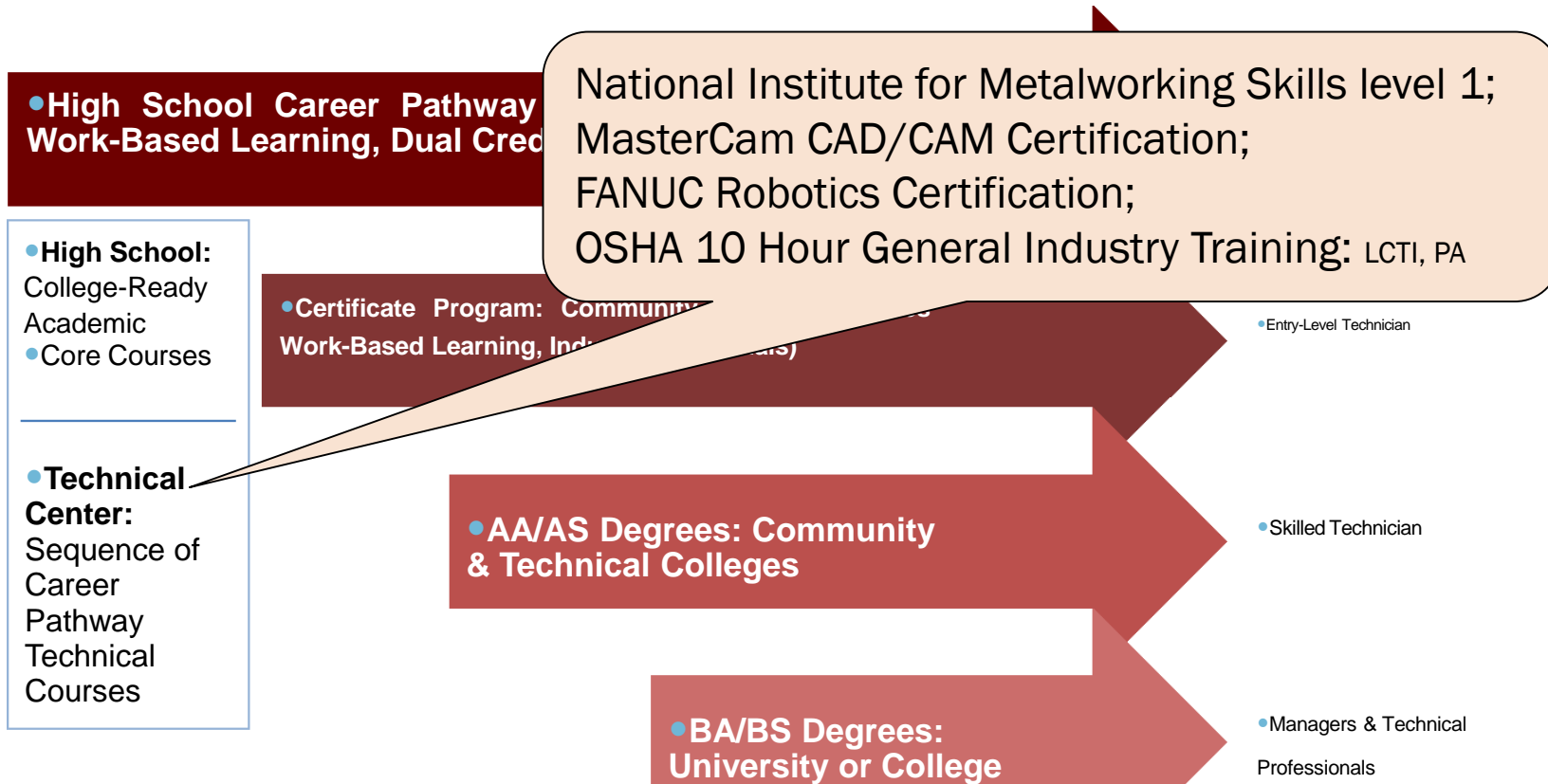
Education Built Career Pathways

Southfield HS Michigan (one of five "theme" academies)

Grade	NASA/Aerospace Pathway	Computer-Aided Design Pathway	Manufacturing Pathway
10th (same courses for all three paths)	Introduction to World Lit. & Composition Geometry or Algebra II Science Social Studies Foreign Language T.E.A.M.Foundation/PC Applications I Health Elective(s)	Introduction to World Lit. & Composition Geometry or Algebra II Science Social Studies Foreign Language T.E.A.M.Foundation/PC Applications I Health Elective(s)	Introduction to World Lit. & Comp Geometry or Algebra II Science Social Studies Foreign Language T.E.A.M.Foundation/PC Applications I Health Elective(s)
11th	American Lit. & Comp. Algebra II or Pre-Calculus Physics Foreign Language Physical Education I-II DC Fundamentals/DC Lab PC Hardware/Computer Network Communication Systems Elective(s)	American Literature Algebra II or Pre-Calculus Physics Foreign Language Physical Education I-II Computer Applications in Manufacturing Mechanical Drafting I Elective(s)	American Literature Algebra II or Pre-Calculus Physics Foreign Language Physical Education I-II Introduction to Manufacturing Mechanical Drafting I Machine Tools Elective(s)
12th	College English Calculus Democratic Citizenship Foreign Language or Elective Speech AC Fundamentals/AC Lab Electronic Devices with Electronic Devices Lab Elective(s)	College English Calculus Democratic Citizenship Foreign Language or Elective Speech CAD I CAD II Basic Mechanisms Elective(s)	College English Calculus Democratic Citizenship Foreign Language or Elective CAD I NC Machining Hydraulics/ Robotics Elective(s)

High quality pathways engage students at all levels of achievement in moving forward to postsecondary education and/or career training.

Pathways should be part of a system of stackable credentials that offer students multiple entry and exit points on the path to educational and career advancement.

High School Career Pathway Work-Based Learning, Dual Cred

National Institute for Metalworking Skills level 1;
MasterCam CAD/CAM Certification;
FANUC Robotics Certification;
OSHA 10 Hour General Industry Training: LCTI, PA

High School:
College-Ready
Academic
Core Courses

Certificate Program: Community
Work-Based Learning, Ind Entry-Level Technician

Technical Center:
Sequence of Career Pathway Technical Courses

AA/AS Degrees: Community & Technical Colleges Skilled Technician

BA/BS Degrees: University or College Managers & Technical Professionals

P-TECH students will be able to take core courses in English, science, mathematics, and the arts. In addition, students will work toward an associate degree in applied science (AAS) in computer systems technology or electromechanical engineering technology.

Designing the CCR Program

Program Improvement

- Integrate Academic, Industry, Non-Cognitive Skills (*Curriculum Mapping*)
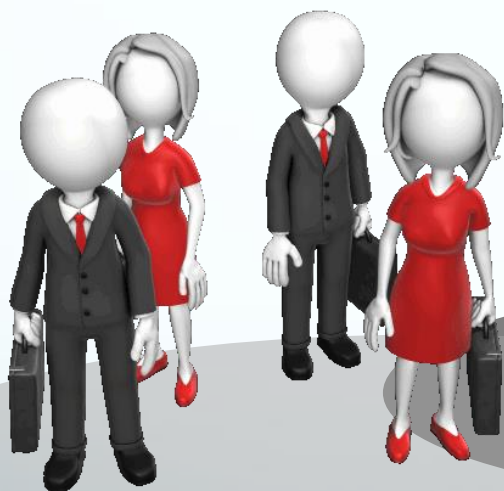- Add new programs focused on emerging occupations (*Advanced Career*)

Three Skill Sets: The Value of CTE

Academic
Mathematics
Science
Communications

Technical
Job specific
skills valued by
employers

Occupational
SCANS
21st Century Skills
"Soft" Skills
Employability Skills

College & Career
Ready

Required skills

High Quality CTE Perspectives

National Academy Foundation

- **Academy Development and Structure:** open to all students; small classes; teacher collaboration across subject areas.

- **Advisory Board:** made up of local business, higher education, and community leaders,

- **Curriculum and Instruction:** NAF curricula are created in partnership with industry professionals and designed around projects that help students make connections across subject areas, acquire valuable workplace skills, and see their education as a step toward long-term career options.

- **Work-based Learning, including Internships:** Academy students participate in a series of work-based learning activities, culminating in compensated internships, designed to provide context and career exposure and build their professional experience and networks.

Linked Learning

- Career Pathways based

- Challenging academics

- Project based learning

- Demanding technical content

- Work based learning

- Support services

Relevant Programs

High Quality CTE: Perspectives

Georgetown Center for Law and Poverty

- Integral part of secondary school

- Built on **strong career guidance**

- Accessible to students of all ability levels

- Strong emphasis on **contextualized learning** linked to rigorous state (academic) standards

- Rigorous technical skill development

- **Develops employability skills**

- More . . .

Southern Region Education Board

- Career pathway design

- Student Assignments

- Curriculum

- Classroom Assessment

- **Counseling & Guidance**

- Staff Qualifications

- Accountability

- **Business Partners**

- *Advanced Careers*

Pathways Require New (and old) Ways of Teaching

Instructional Delivery

- Develop early career teachers (*Teaching to Lead*)
- Contextualize academics in CTE (*Math-in-CTE, Authentic Literacy, Science –in-CTE*)
- Add new pedagogies (*PBL for Career Pathways*)
- Expand Work-Based learning (WBL)
- Integrate CTSOs

Powerful Pedagogies

Achievement in CTE

Pedagogic Opportunity

- **Classroom instruction**

- **Work based learning-WBL**

- **CTSOs**

Pedagogic Tool

- *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*

Business Partners

- Identify authentic projects
- Provide access appropriate technology
- Identify appropriate credentials
- Advise on curriculum
- Sponsor externships for teachers
- Sponsor students to visit your business
- Provide short-term internships to explore your industry
- Provide extended paid 'apprenticeship' experiences linked to school curriculum
- Provide support for student competitive events (judges, locations, material')

IT'S HOW YOU DO IT... Pedagogy

Graduates who had
"experiential and deep learning" have more than

double
the odds of being *ENGAGED* in their work and

more are thriving (13% vs. 10%)

- "Long-term project taking a semester or more to complete"
- "Internship or job where applied learning"
- "Extremely involved in extra-curricular activities & organizations"

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GALLUP

For Teachers

The Iowa Model

- *Externships* are full-time, six-week temporary positions for teachers & counselors.
  - Graduate credit may be earned
  - Mid-June through July
  - A standard 8:00 a.m.- 5:00 p.m., 40-hour work week for six weeks over the summer is expected.

- *Expectations*:
  1) A minimum of **200 hours** at the Externship site with weekly documentation of hours worked;
  2) An **online blog** with weekly reflection of Externship activities and thoughts;
  3) **Identification** of specific content and 21st Century Skills observed and how students will see the real-world application of those skills in the classroom;
  4) **Participation** in pre- and post-externship interviews, observations and surveys to help evaluate the multiple dimensions of the program's effect;
  5) To earn additional graduate credit, **Creation** of a project-based learning unit that will transfer the experience to the classroom;

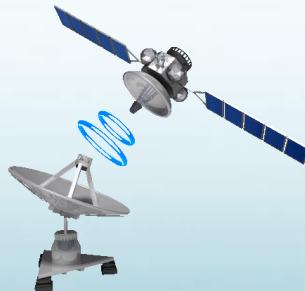# High Quality CTE: A Research Sampler

- Mathematics
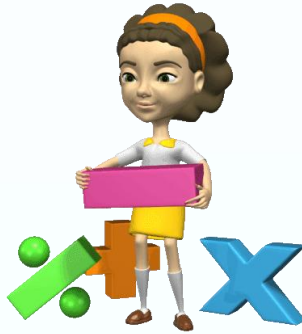
- Literacy

- Science

What We Learned:
Experimental Test of Math Integration

- Students in the experimental classes scored significantly higher on Terra Nova and Accuplacer

- The effect: 71st percentile & 67th percentile

- No negative effect on technical skills

- 11% of class time devoted to math lessons

- Significant improvement from both approaches

- Teachers with two-years experience in method had greater effect

High Quality CTE: Focus on Reading

Science Integration: Experimental Studies

- Overall, no effect

- Significant effect for nonwhite males and females

Two Approaches to High Quality CTE SREB

Enhanced CTE

Professional development for CTE teachers to:

- Design and implement authentic problems, drawn from industry settings

- Projects incorporate literacy, math and science skills tied to national standards

Advanced Career

A rigorous and relevant blend of technical and academic skills in authentic projects in:

- Aerospace Engineering

- Clean Energy Technology

- Energy and Power

- Health Informatics

- Innovations in Science and Technology

- Integrated Production Technologies

For Students:
A Developmental Approach to Work-based Learning

WBL Approach

- *Job shadowing* *(Cross Curricular)*

- *Unpaid Internships* *(short)*

- *School-based enterprise*

- *Cooperative education or*

- *Paid Internships* *(extended)*

- *Apprenticeships* *(intensive)*

- Developmental
- Increasing Intensity
- Linked to Industry Recognized Credentials

Conclude Where I Began

Systems Change
- Align the College & Career Ready System Components

Program Improvement
- Bring existing p[...] standard & add new pro[...]

Instructional Delivery
- Ens[...] CTE faculty are highly skilled in ped[...]gogy and in their professions

A Developmental ILP that Drives Program Choice & Student Course Assignments

Challenges
(A Beginning List)

Education

- Curriculum Space

- Testing Obsession

- Qualified Faculty

- HS-PS Systems Conflict

- Keeping Curriculum and Facilities Current

- Insurance for WBL

Business & Industry

- Meaningful WBL

- Sustaining Partnerships

- Workplace Mentors (Teacher On the Job)

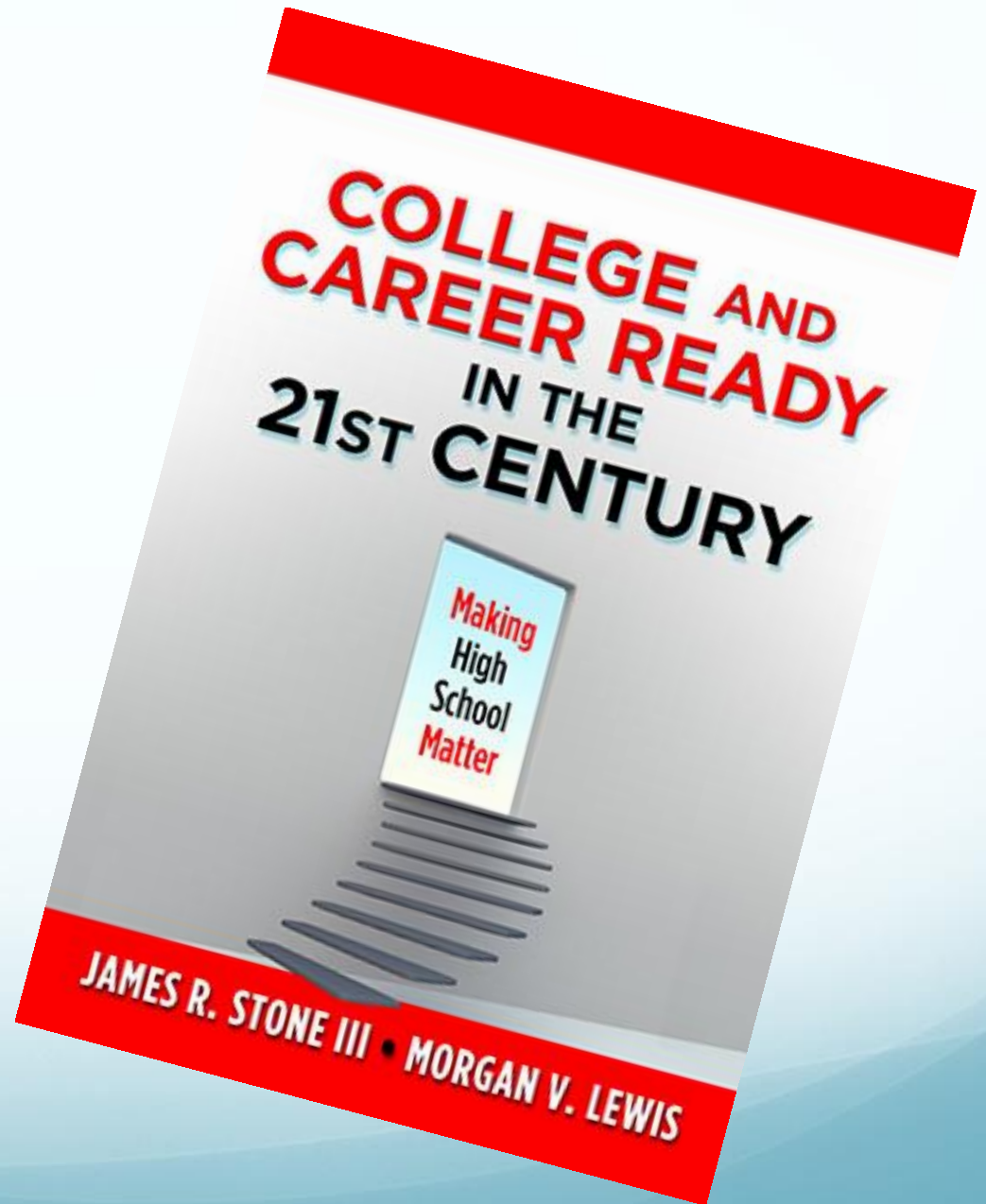- Capacity (Siemens=12)

- Insurance Regulations

Change is Hard

Policy makers use data like a drunk uses a lamp post...

...More for support than illumination

Here is the message:

- Secondary CTE keeps kids in school, especially boys

- High quality, secondary CTE enhances academic achievement & employability skills; improves transition to postsecondary and the labor market

- BUT to move to the next level requires a CTE for the 21st Century: significant and meaningful career development; work-based learning; career pathways.