Slides presented at the
2015 NGSS Network Leadership Conference

NGSS: A Key to Unlocking the American Dream

February 18, 2015

Presenter: S. James Gates, Jr.

NEXT GENERATION SCIENCE STANDARDS
For States, By States

Plenary Session On
Next Generation Science Standards

S. James Gates, Jr.

University System of Maryland Regents Professor, Distinguished
University Professor, John S. Toll Professor of Physics and
Center for String and Particle Theory Director
18 Feb 2015

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301-405-6025 **http://www.umdphysics.umd.edu/people/faculty/135-gates.html**

Q:
Why must we focus on science and STEM more generally in the realm of education?

A:
The population of the U.S. is about 300 million and is expected to continue to grow. So unless the amount of wealth continues to grow commensurately, on average the citizens of this nation will become poorer. Since WWII, economists have come to the conclusion that the major component to the growth of U.S. wealth comes from STEM related activities.

NGSS: A Key To Unlocking The American Dream

Provenance: The National Research Council's "A Framework for K-12 Science Education"

Doctrine: The high quality learning of science, more importantly the skill set developed from this, can no longer be regarded as a realm only for the elite and must serve the goal of permitting the broadest possible access to the American Dream for this Nation's citizens (SJG).

Process: Intensely Collaborative Multi-State & State-Driven

Product: The Next Generation Science Standards

Investment in an Educated Workforce -

The Secret to The American Dream

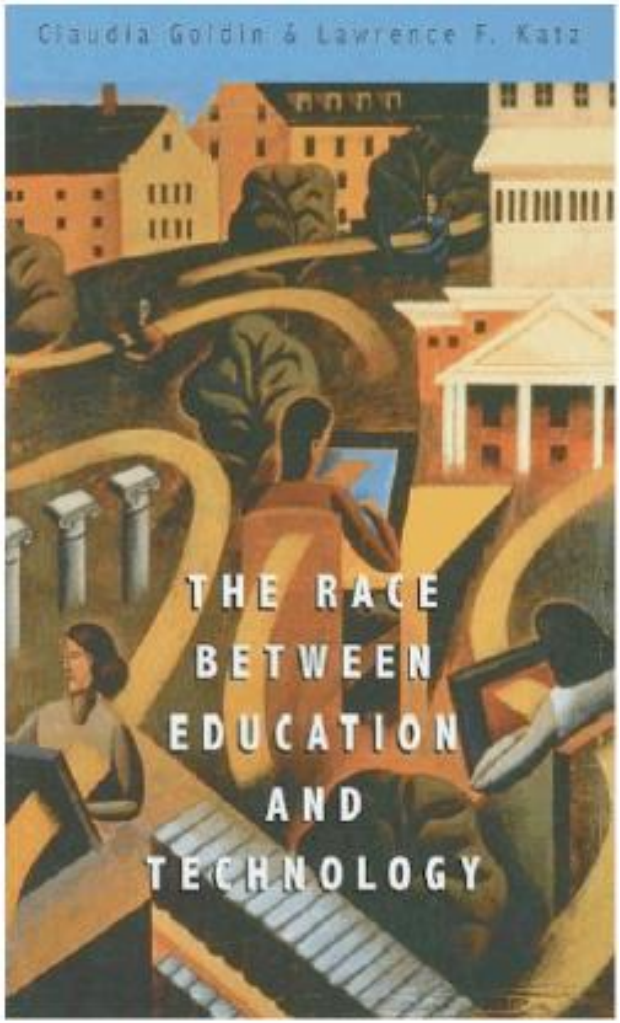
Claudia Goldin & Lawrence Katz

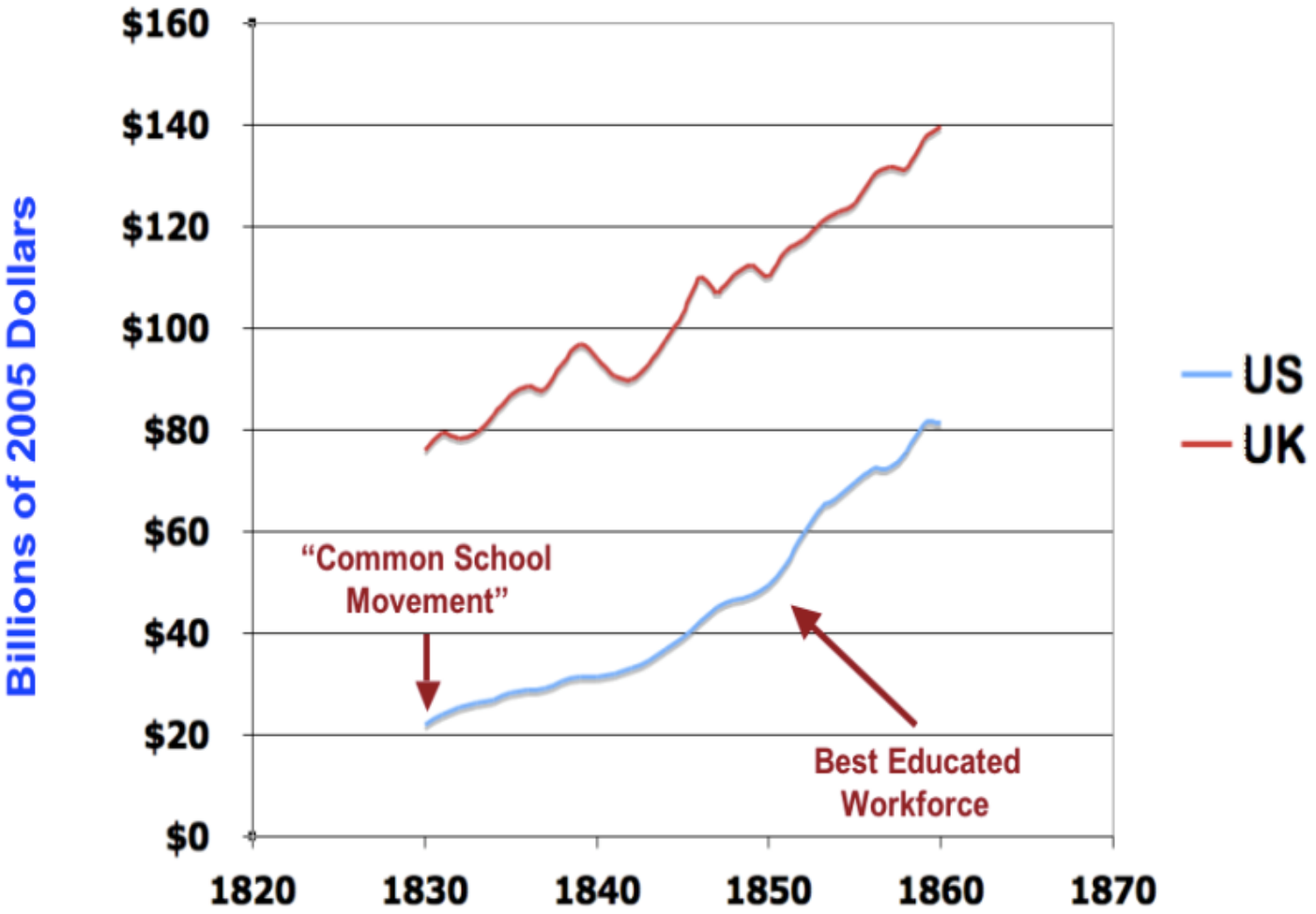
Early U.S. emphasis on education

Best educated workforce (1850)

The high school movement (1910)

Lost momentum (1970s–present)




Billions of 2005 Dollars
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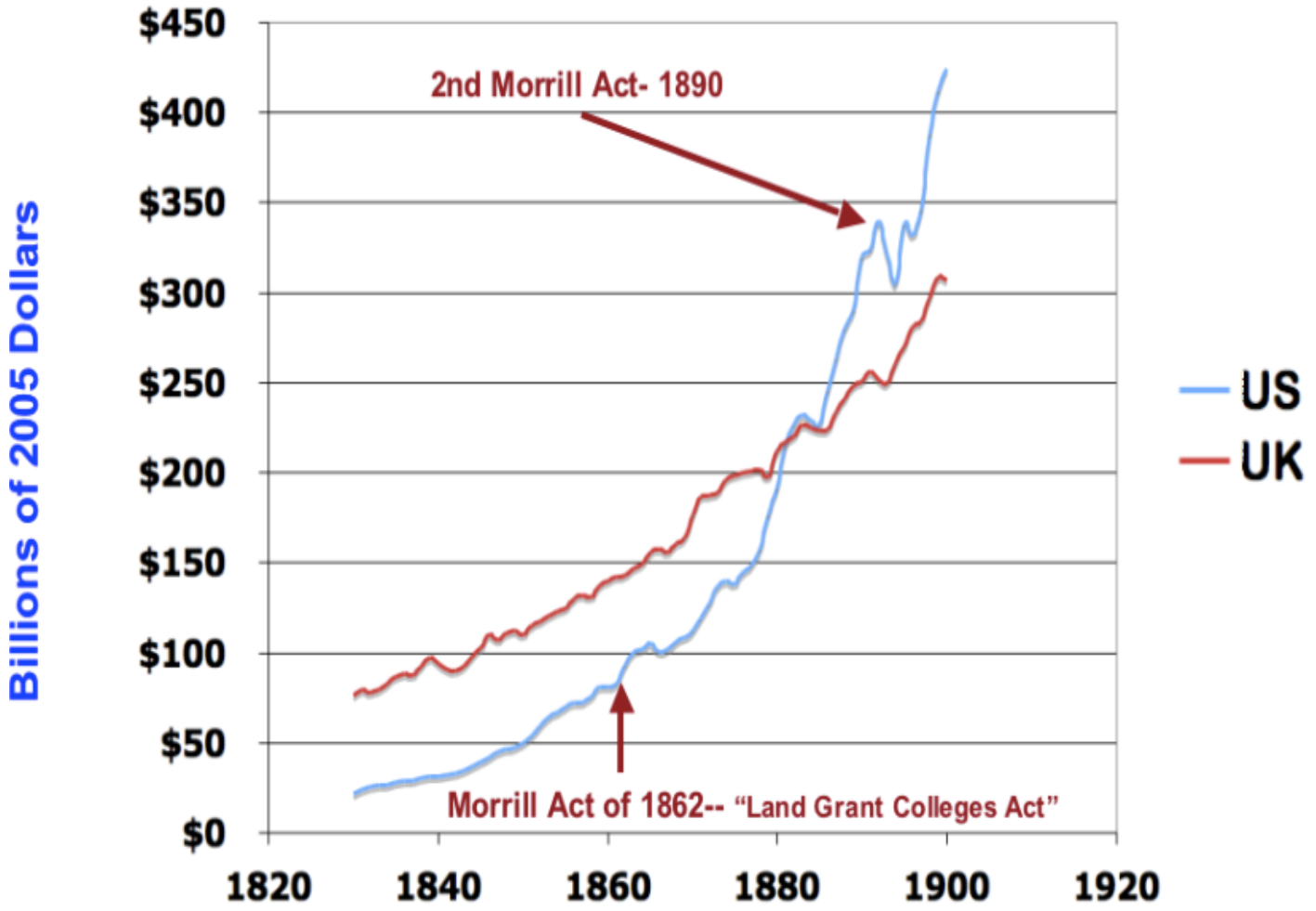
US
UK
"Common School Movement"
Best Educated Workforce


Billions of 2005 Dollars
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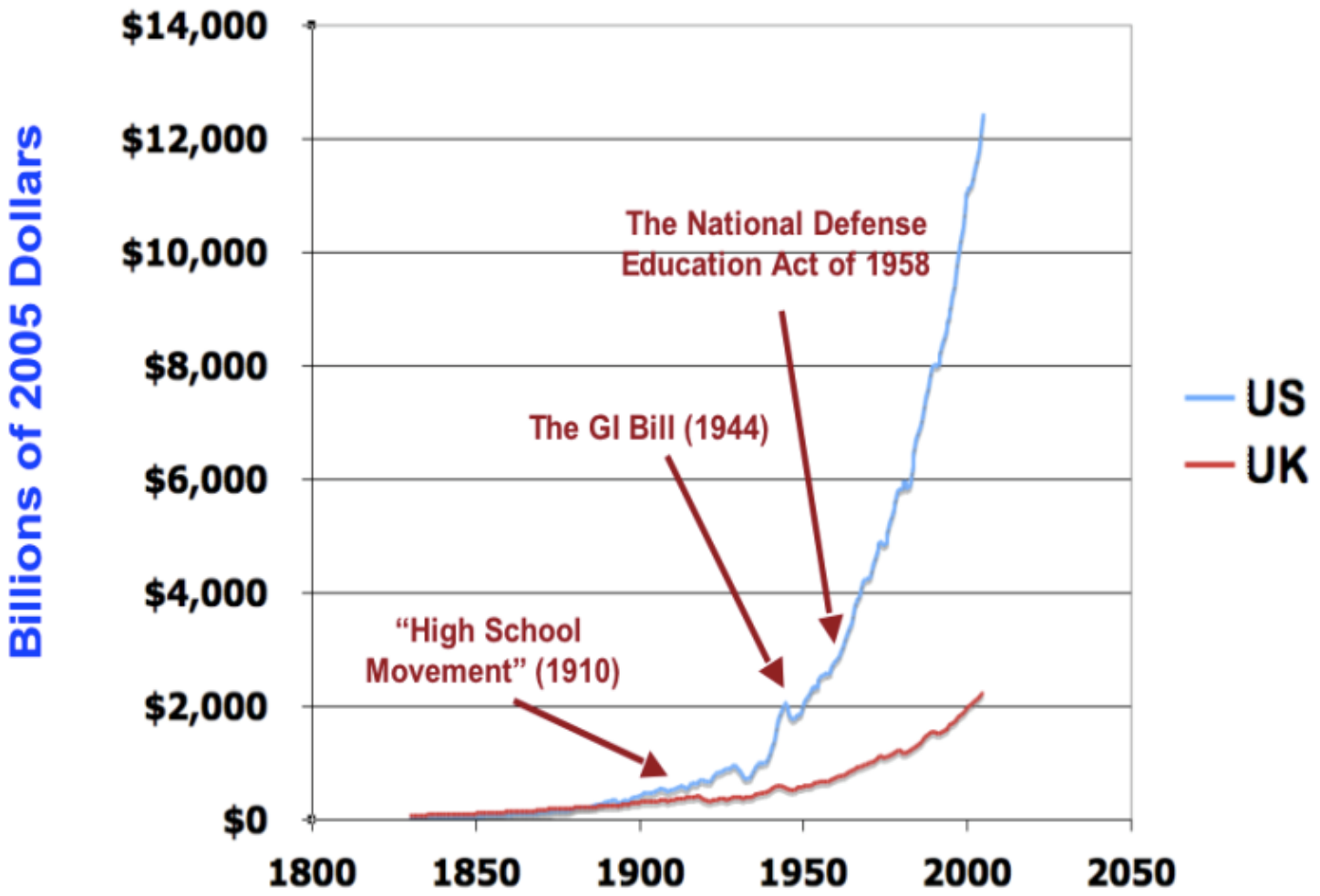
2nd Morrill Act- 1890
Morrill Act of 1862-- "Land Grant Colleges Act"
US
UK


Billions of 2005 Dollars
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$2,000
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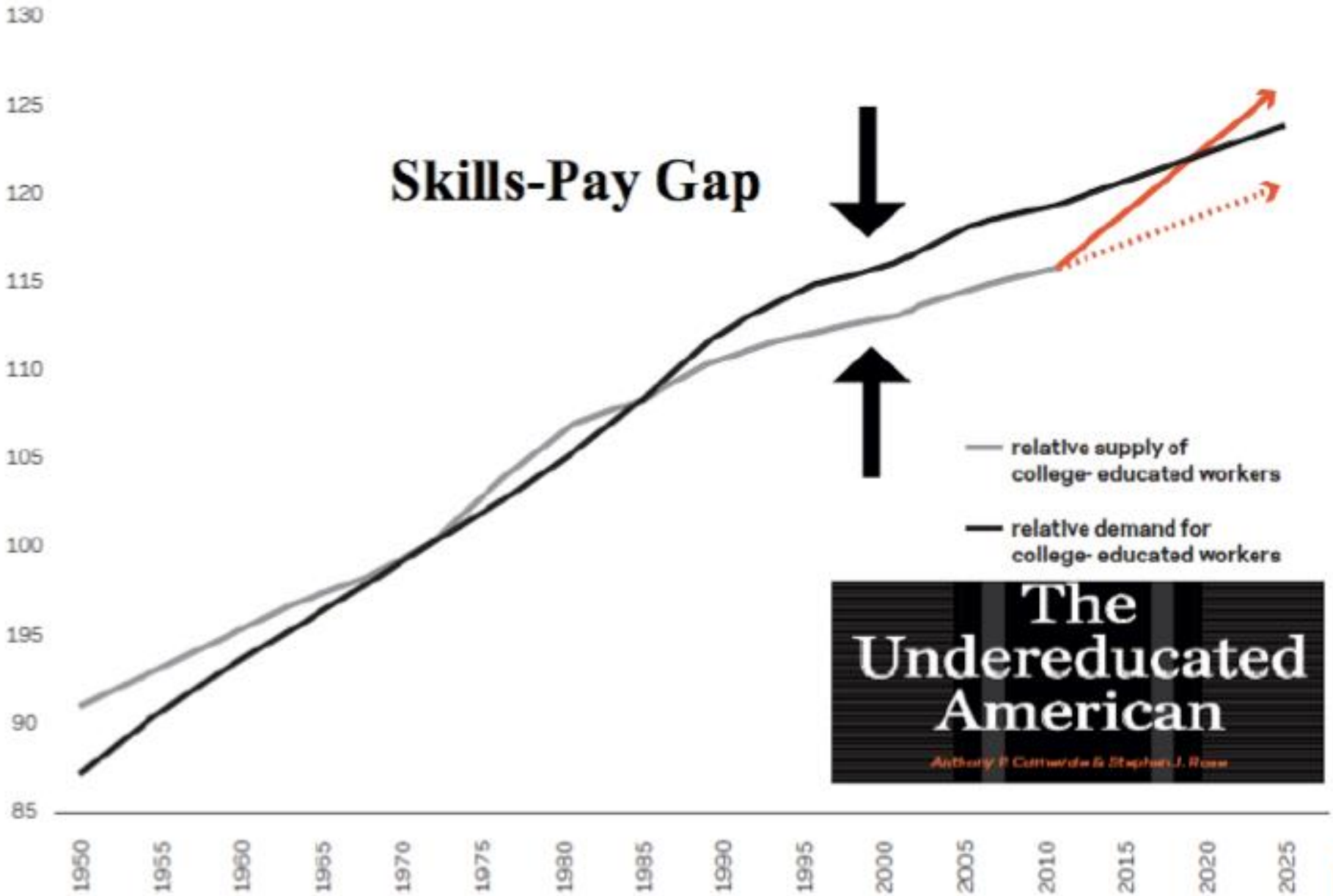
1800
1850
1900
1950
2000
2050
The National Defense Education Act of 1958
The GI Bill (1944)
"High School Movement" (1910)
US
UK

Figure 9. Supply and Demand with Two Paths Forward to 2025



Healthcare, community services and arts, and STEM are the three fastest growing occupational clusters. Healthcare support, however, will have very low wage growth.

TABLE 6: Occupations 2010–2020—fastest growing

Occupation	2010 Total jobs ('000)	Rank	2020 Total jobs ('000)	Rank	Changes in employment 2010–2020: Increase in jobs ('000)	Changes in employment 2010–2020: Rate of growth (% change)	Rank: Largest growth	Rank: Fastest growth
Healthcare professional & technical	6,480	6	8,490	6	2,010	31	5	1
Healthcare support	3,660	9	4,610	9	950	26	9	2
Community services & arts	6,290	7	7,920	7	1,630	26	7	3
STEM	6,050	8	7,600	8	1,550	26	8	4
Education	8,160	5	10,120	5	1,960	24	6	5
Managerial & professional office	19,980	4	24,740	4	4,760	24	1	6
Social science	700	10	830	10	130	19	10	7
Food & personal services	23,220	3	27,380	3	4,160	18	3	8
Sales & office support	37,660	1	42,130	1	4,470	12	2	9
Blue collar	28,400	2	30,750	2	2,350	8	4	10
Total jobs and rate of growth (% change)	**140,600**		**164,590**		**23,990**	**17**		

GEORGETOWN UNIVERSITY
Georgetown Public Policy Institute
Center on Education and the Workforce
ANTHONY P. CARNEVALE
NICOLE SMITH
JEFF STROHL

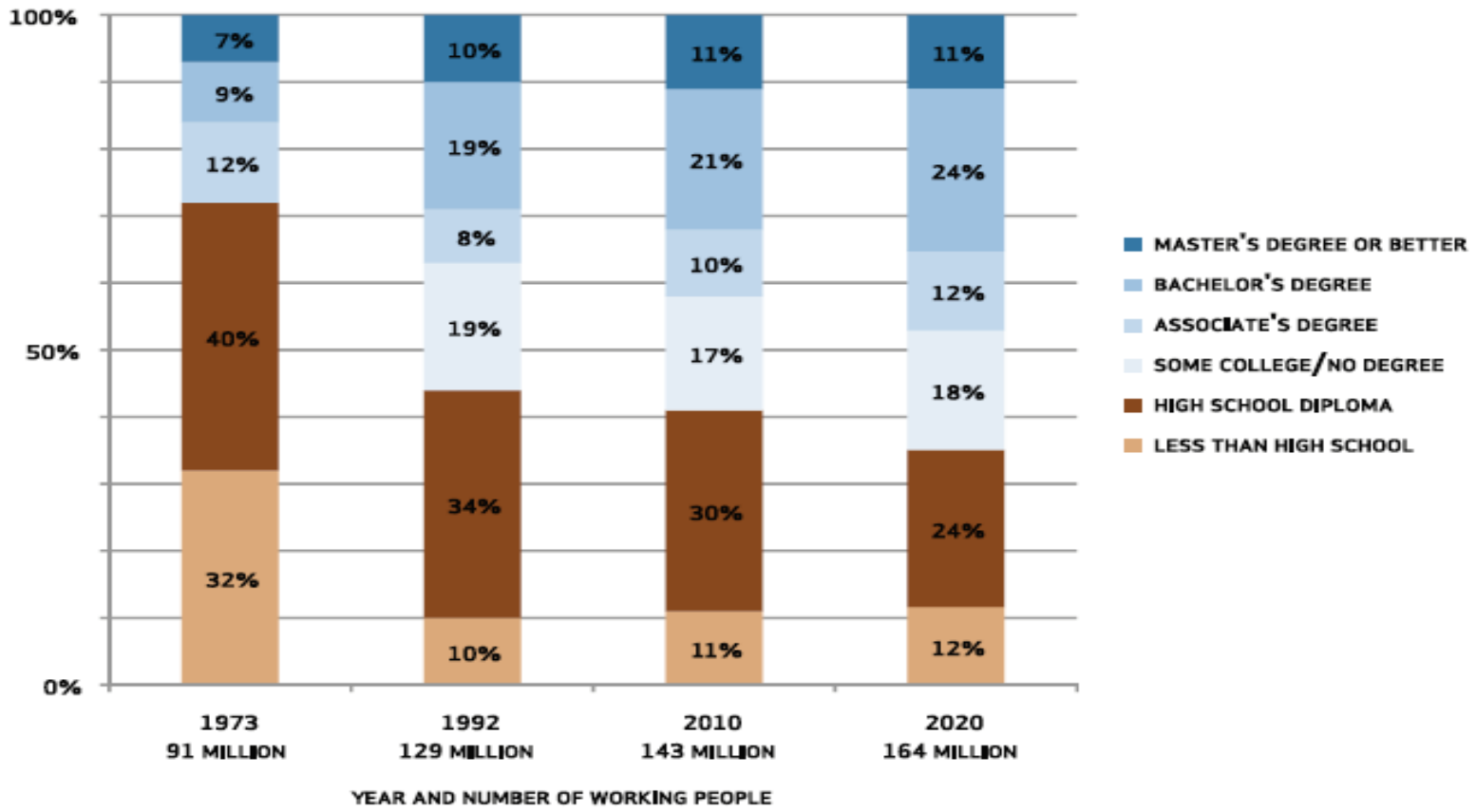
RECOVERY:

Projections of Jobs and Education Requirements Through 2020

June 2013

By 2020, 65 percent of all jobs will require postsecondary education and training, up from 28 percent in 1973.

FIGURE 4: Postsecondary education and training



Note: Numbers may not sum to 100 percent due to rounding.

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RECOVERY:

Projections of Jobs and Education Requirements Through 2020

June 2013

Why is NGSS important?

Why do we need a ‘Tin-Lizzy’version of science standards now?

USA

People QuickFacts	USA
Population, 2012 estimate	313,914,040
Population, 2010 (April 1) estimates base	308,747,508
Population, percent change, April 1, 2010 to July 1, 2012	1.7%
Population, 2010	308,745,538
Persons under 5 years, percent, 2012	6.4%
Persons under 18 years, percent, 2012	23.5%
Persons 65 years and over, percent, 2012	13.7%
Female persons, percent, 2012	50.8%
White alone, percent, 2012 (a)	77.9%
Black or African American alone, percent, 2012 (a)	13.1%
American Indian and Alaska Native alone, percent, 2012 (a)	1.2%
Asian alone, percent, 2012 (a)	5.1%
Native Hawaiian and Other Pacific Islander alone, percent, 2012 (a)	0.2%
Two or More Races, percent, 2012	2.4%
Hispanic or Latino, percent, 2012 (b)	16.9%
White alone, not Hispanic or Latino, percent, 2012	63.0%

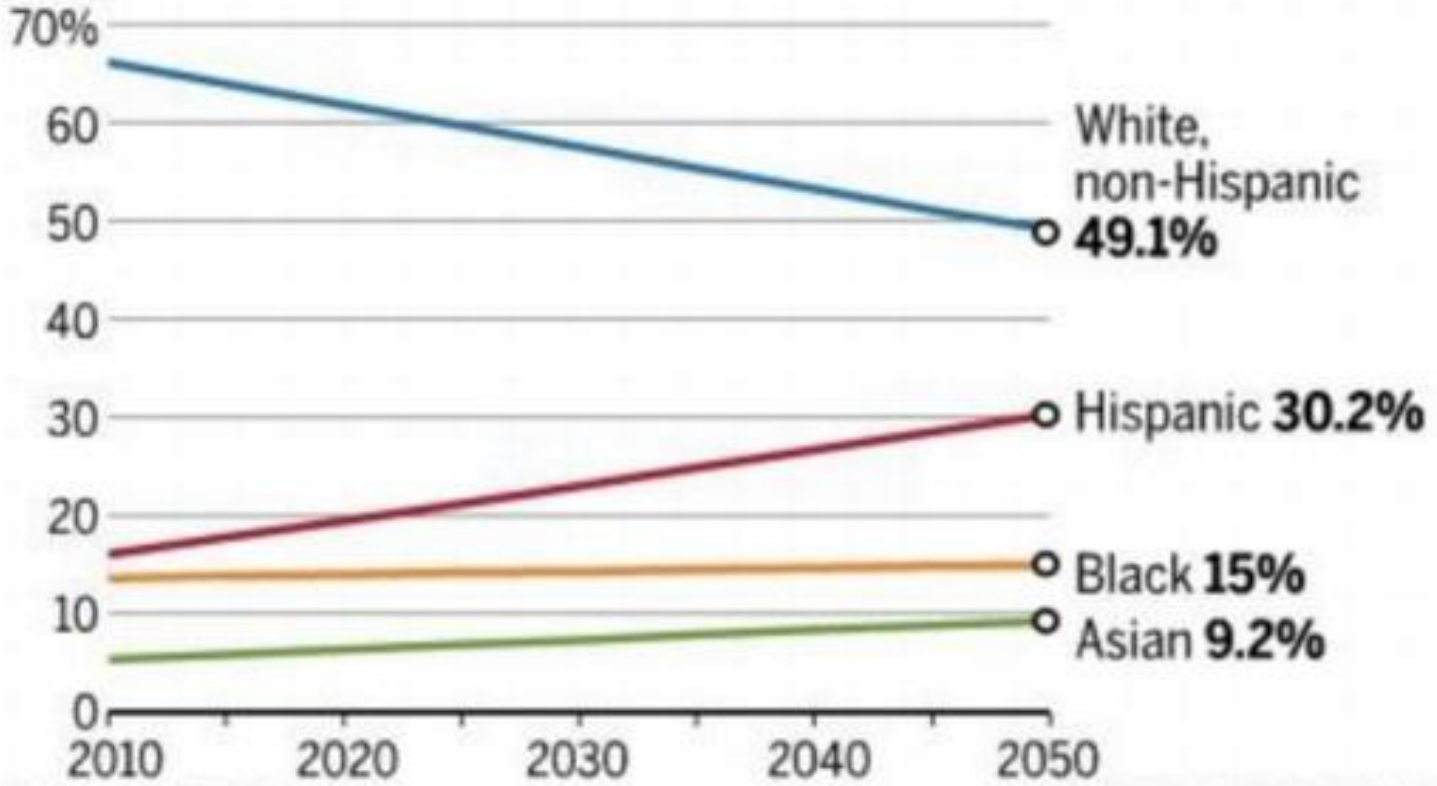
Women have surpassed men in college attendance (2012).

Number of U.S. Colleges and Universities	Number	Enrollment
Public 4-year institutions	629	6,837,605
Private 4-year institutions	1,845	4,161,815
Public 2-year institutions	1,070	6,184,229
Private 2-year institutions	596	303,826
Total	**4,140**	**17,487,475**
Undergraduate		14,473,884
Graduate		2,097,511
Professional		329,076

Degrees Awarded Annually:	Number
Associate	696,660
Bachelor's	1,439,264
Master's	574,618
Doctorate	52,631
Professional	87,289
Enrollment Demographics:	
Women	57.4%
Full-time	61.7%
Minority	30.9%
Foreign	3.3%

Minorities on the rise

Minorities are projected to make up more than half of the U.S. populaton by 2050, with Hispanics leading the growth.



Source: US Census

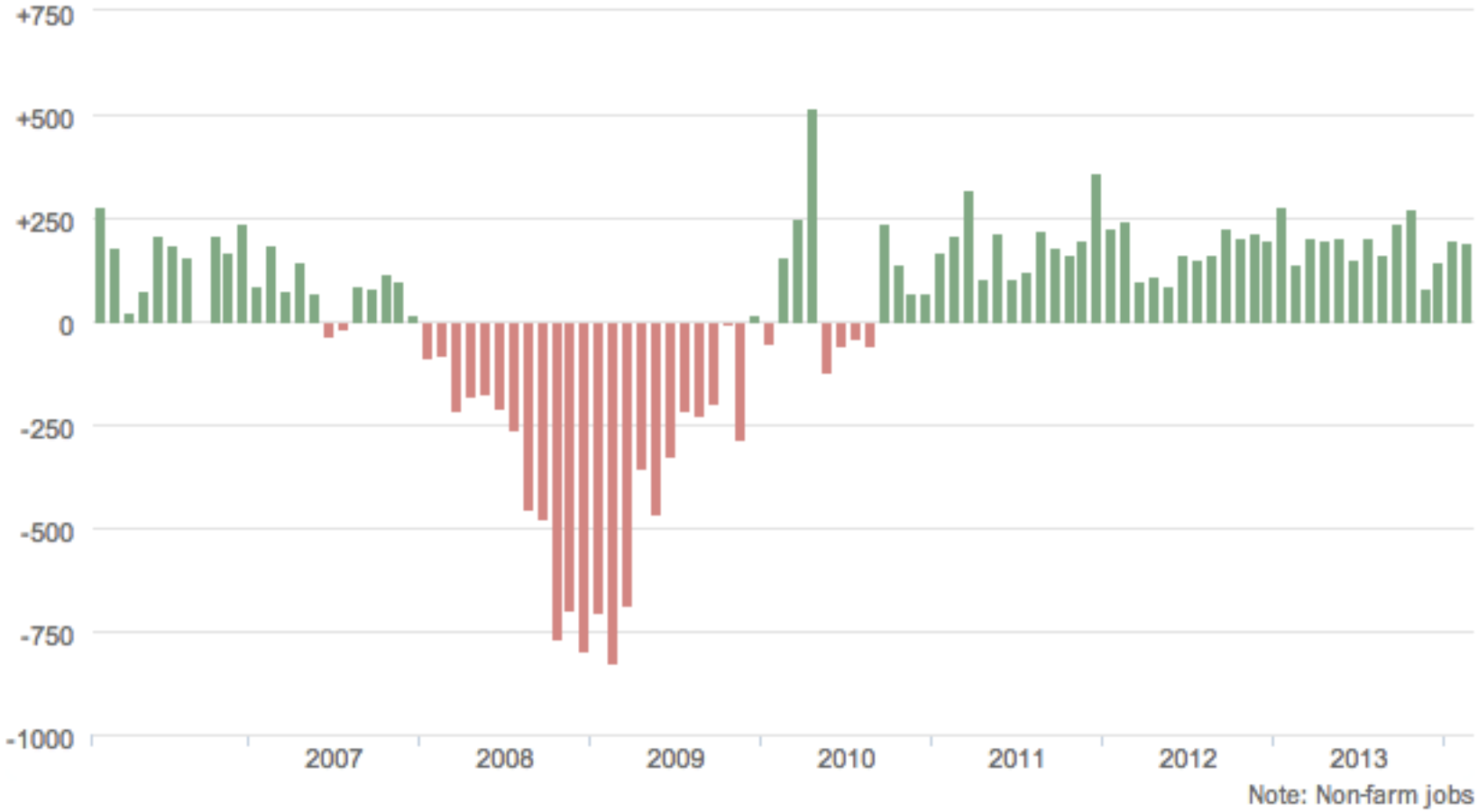
BAY AREA NEWS GROUP

1845: Beginning A Struggle

The first school desegregation case occurred on the island of Nantucket. A young black female student educated in the black elementary school scored highest on admission exam at the local high school but was denied entrance. Absalom Boston, a black whaling captain and her father, supported the effort to integrate the school. After a legal suit the school is integrated.

U.S. jobs gained or lost

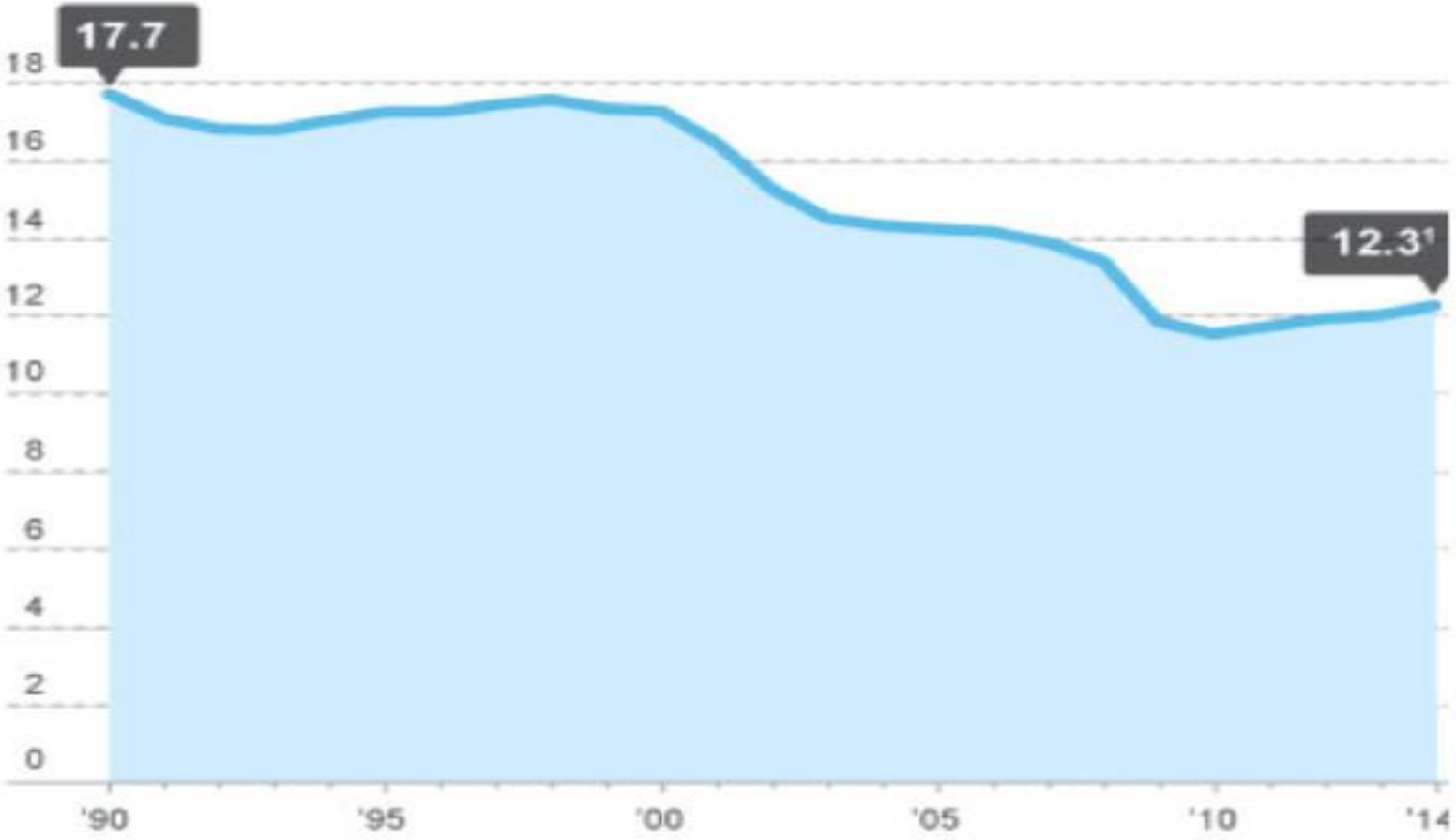
In thousands, seasonally adjusted



SOURCE: The Bureau of Labor Statistics. GRAPHIC: The Washington Post.

Manufacturers are hiring again

U.S. MANUFACTURING COMPANIES HAVE SHED THOUSANDS OF WORKERS SINCE JOBS PEAKED IN THE LATE '70S, BUT TOTAL EMPLOYMENT HAS PICKED UP AGAIN. TOTAL EMPLOYMENT BY YEAR (IN MILLIONS):



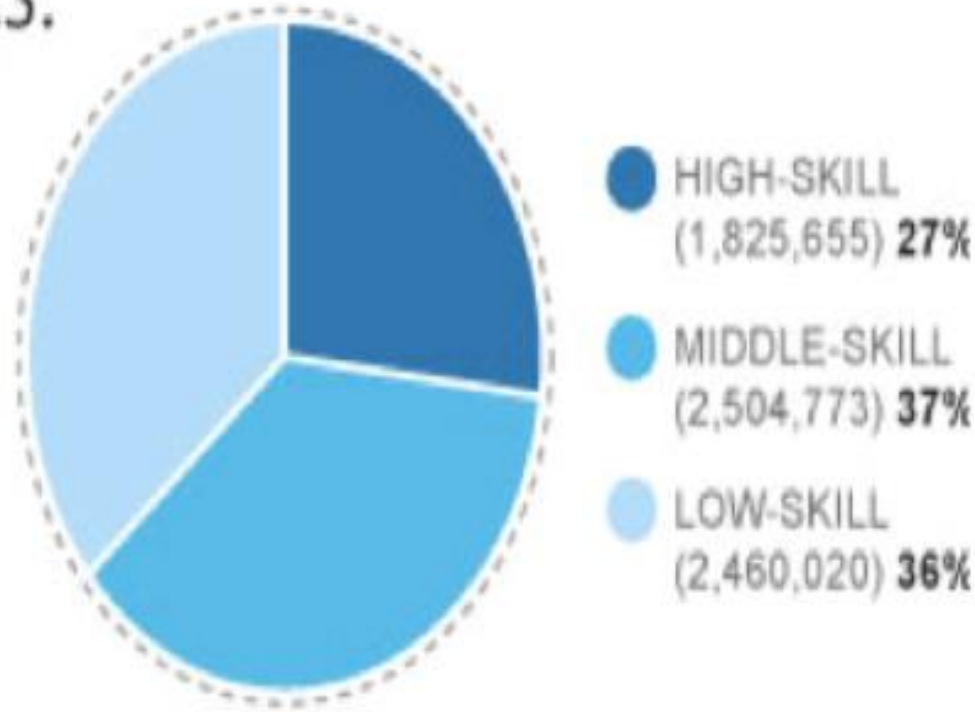
1 – Preliminary figure for August.

Source Bureau of Labor Statistics

New jobs in the U.S.

MIDDLE-SKILL JOBS, REQUIRING SOME POST-SECONDARY EDUCATION BUT LESS THAN A BACHELOR'S DEGREE, ARE EXPECTED TO MAKE UP THE LARGEST SHARE OF NEW JOBS.

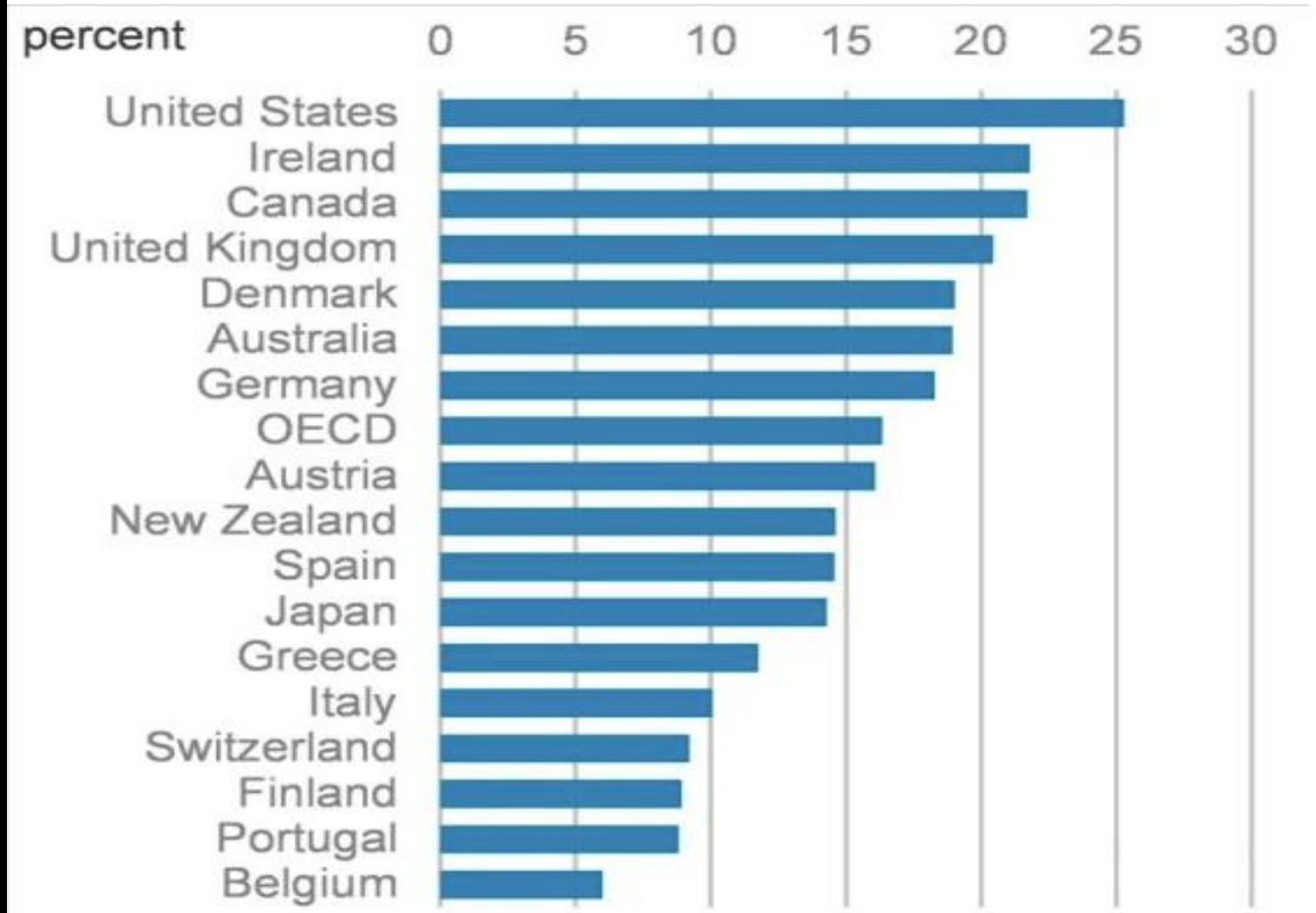
NEW JOBS CREATED 2013 TO 2017:



Sources Economic Modeling Specialists Intl., CareerBuilder

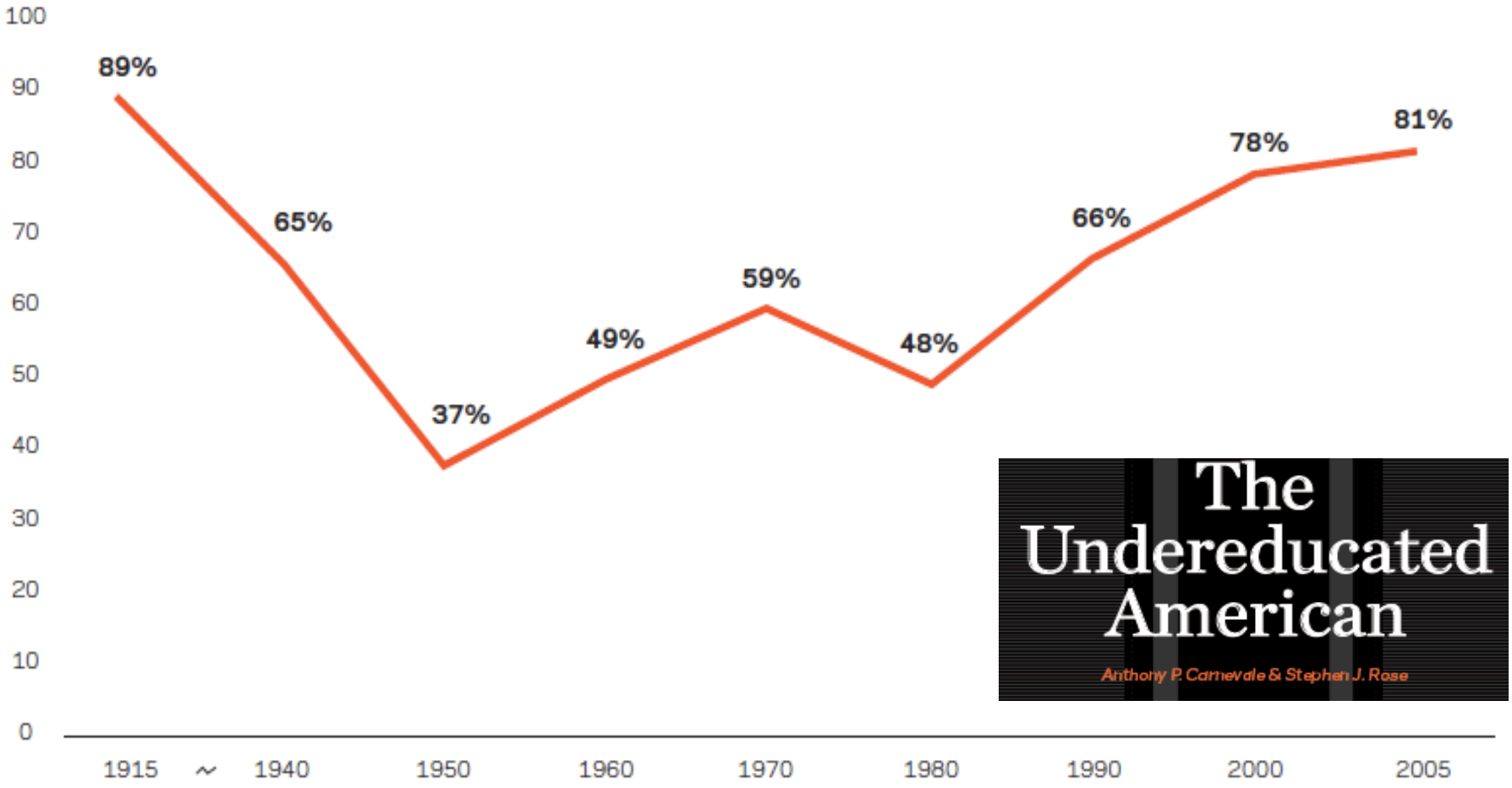
FRANK POMPA, USA TODAY

Exhibit 4: Share of Low Wage Paying Jobs by Country, 2013



Source: OECD Employment Outlook 2013, Morgan Stanley R

Figure 3. Wage Premium of Skilled versus Unskilled Labor, 1915–2005

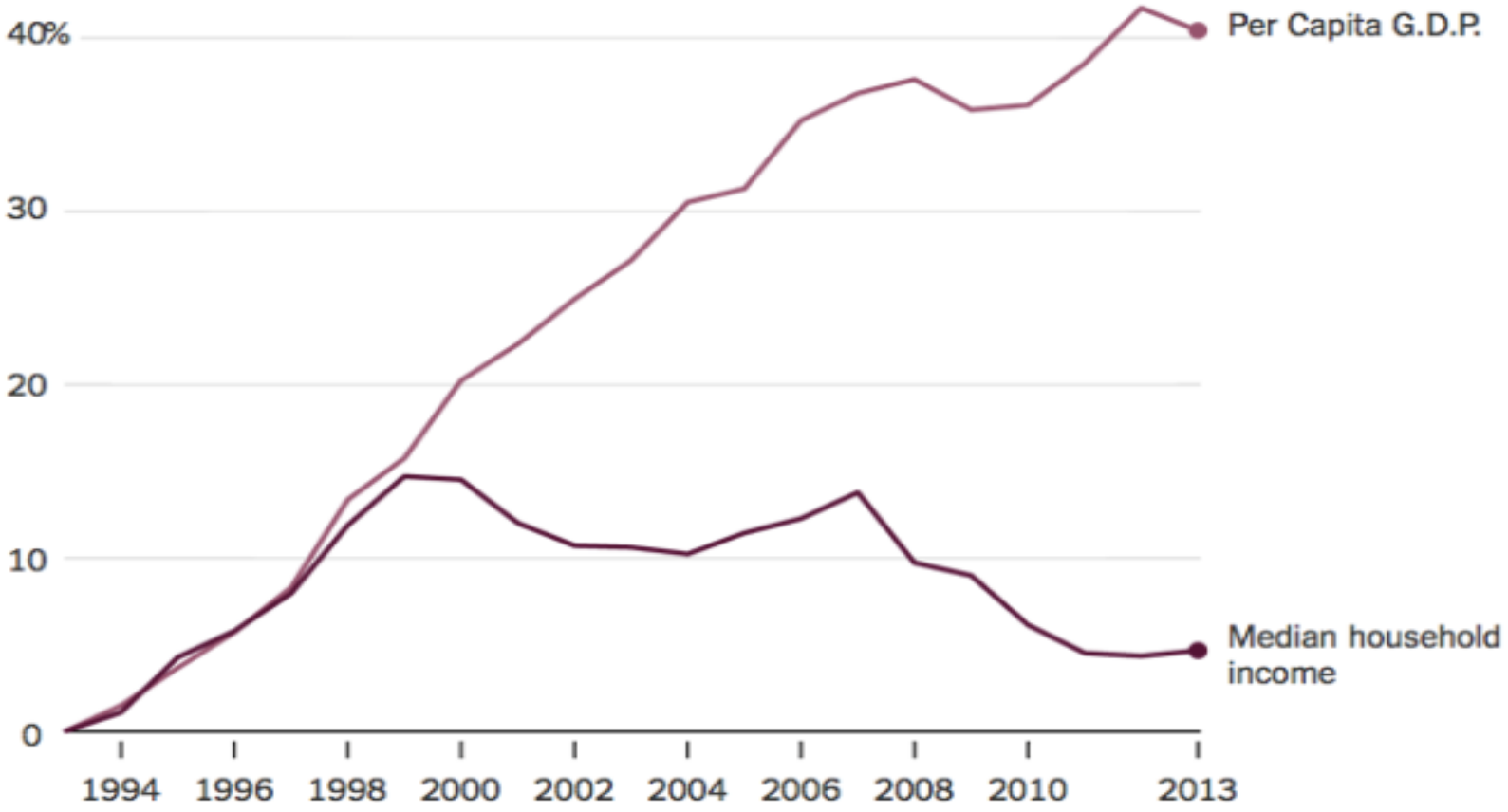


Source: Goldin and Katz (2008)[8]

Growth Hasn't Translated Into Gains in Middle-Class Income

Until around 1999, overall economic growth tended to correspond with growth in earnings for middle-income Americans. Since then, the two have diverged sharply.

Percent change indexed to 1993 level



Source: Census, Bureau of Economic Analysis

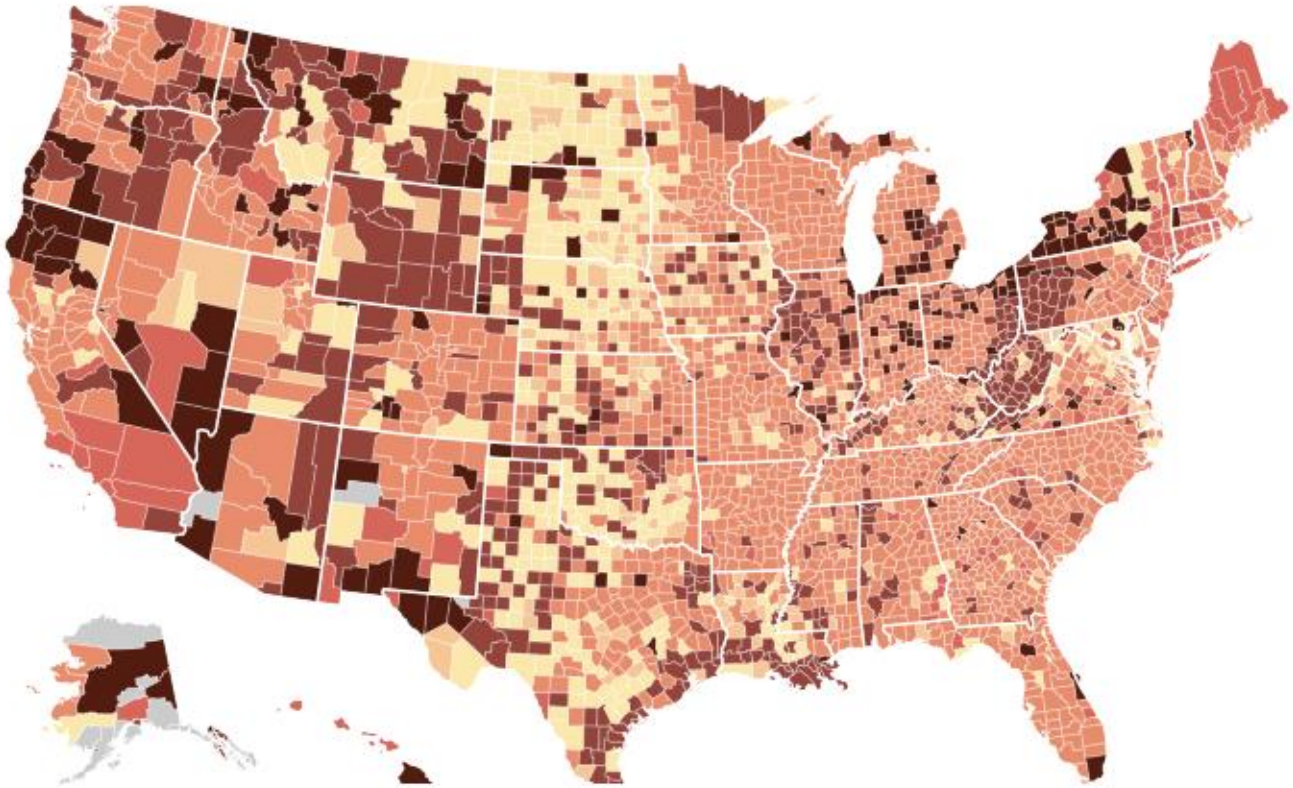
When income peaked

45 years ago	35 years	25 years	15 years	5 years	1 year
210 counties in 1969	572 counties in 1979	141 counties in 1989	1,623 counties in 1999	213 counties in 2009	380 counties in 2013

Search for a county

i.e, Frederick, Md.

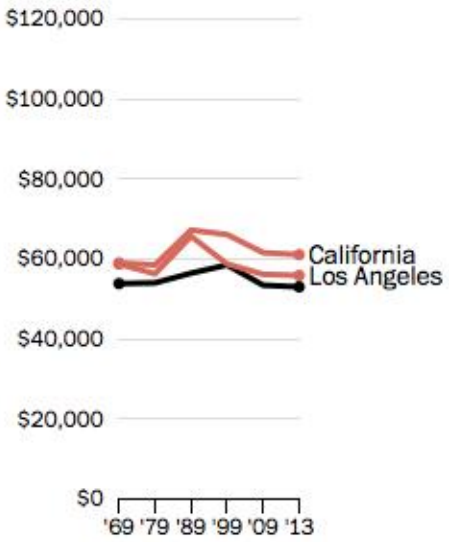
Or click the map to zoom in



Los Angeles County, Calif.

The inflation-adjusted median household income in Los Angeles County, Calif., peaked in 1989 at $65,688.

Here's how it compares to the **U.S.**



SOURCE: U.S. Census Bureau. Published July 5, 2013. Note: Counties in gray do not have enough data to determine the highest median wage.

Business Roundtable℠

More Than Leaders. Leadership.

CHANGE THE EQUATION™

This survey was conducted from Sept. 9 – Nov. 6, 2014. Overall, 126 out of 232 companies responded, including 116 of 203 Business Roundtable member CEOs (57%) and 34 of 63 Change the Equation member CEOs (54%).*

- **CEOs say the skills gap is real and hurts business.** Nearly 98% of CEOs say that the skills gap is a problem for their companies.
- **Most open jobs require STEM knowledge and skills.** Approximately 60% of job openings require basic STEM literacy and 42% require advanced STEM knowledge. Nearly two-thirds of job openings that require STEM skills are in manufacturing and other services.
- **The biggest skills gaps are in advanced computer and quantitative knowledge.** 62% of CEOs report problems finding qualified applicants for jobs requiring advanced computer/IT knowledge, and 41% report problems for jobs requiring advanced quantitative knowledge.
- **Many job candidates lack basic STEM skills.** 38% of respondents say that at least half of their entry-level applicants lack basic STEM literacy. 28% say that at least half of their new entry-level hires lack basic STEM literacy.

The implications are pretty clear.

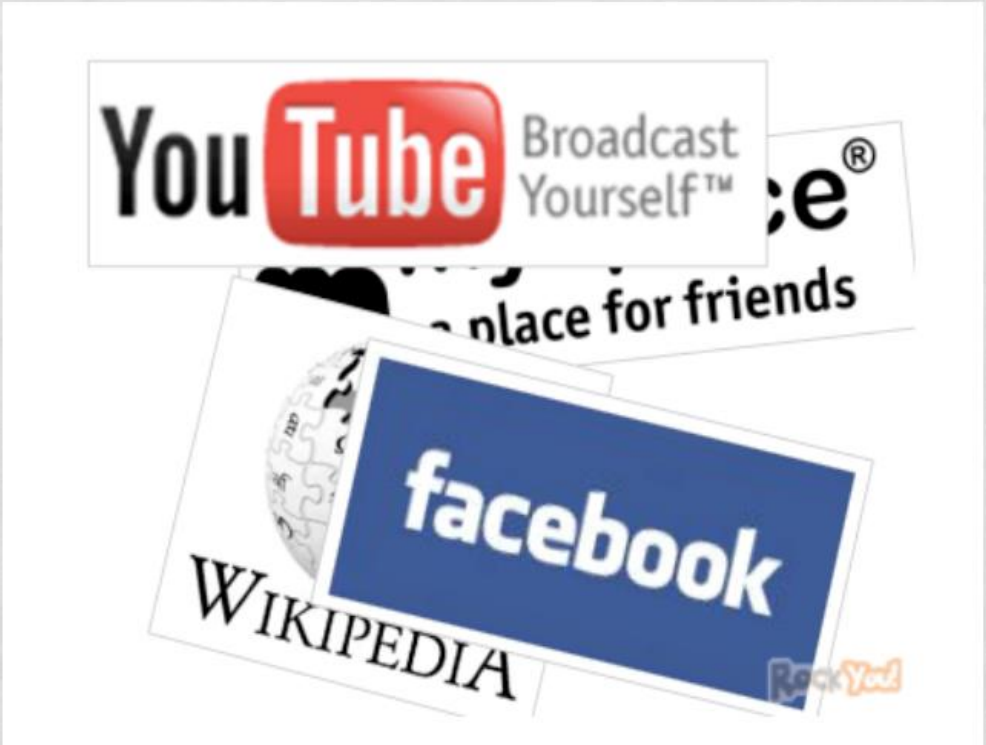
If we want to have an citizen-based workforce that is equipped with the STEM-capable skills to advance the Nation's economic interest, we cannot continue to teach science as if it is for only an elite few.

Doctrine


SOMETHING FOR EVERYONE:
America's Great Vehicular Melting Pot
By Hardy Drackett

Common Characteristics

- Writing
- Sharing
- Producing
- Collaborating
- Communicating
- Reading
- Decision Making
- Redesigning



A new pace… leading to a new way…

Journey to 150 Million Users

Mary Cullinane
Director
Innovation and Business Development Team
Microsoft Education

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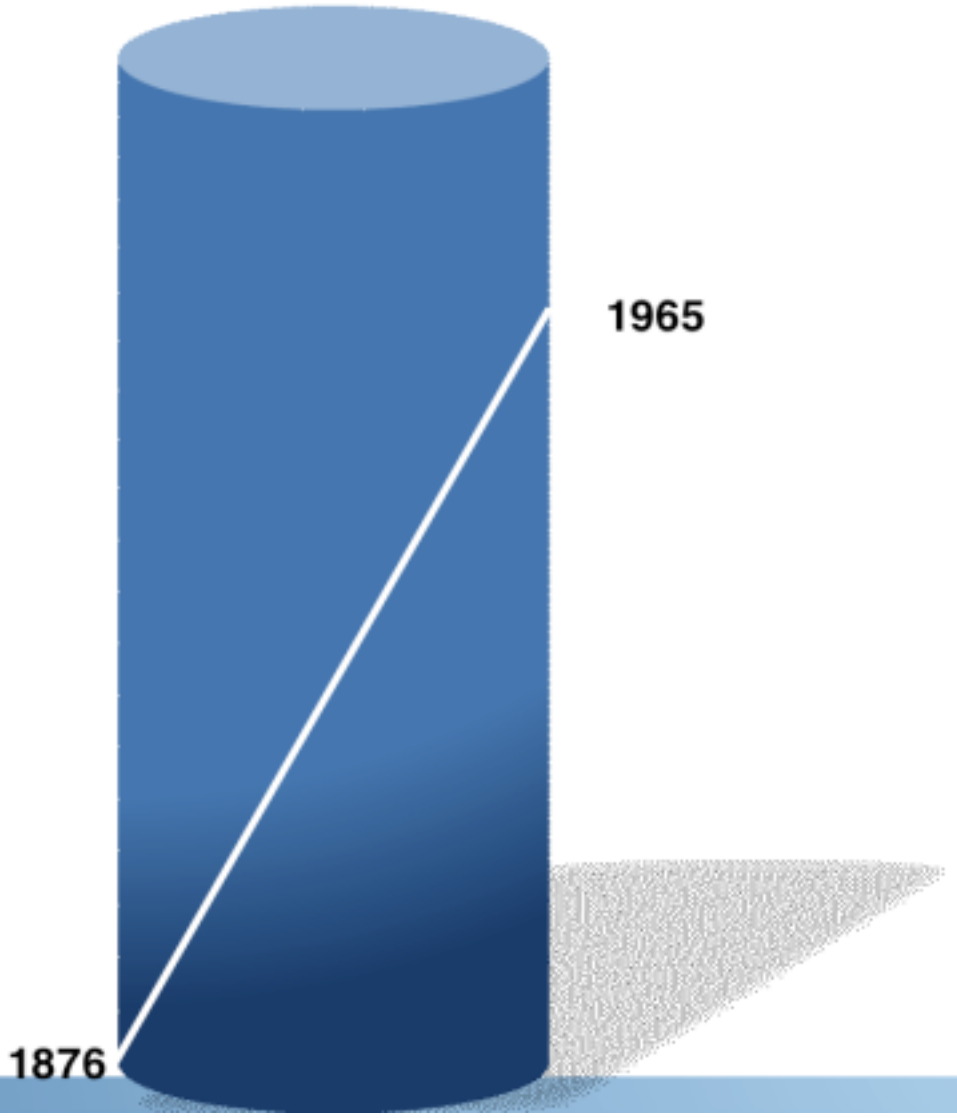
Journey to 150 Million Users



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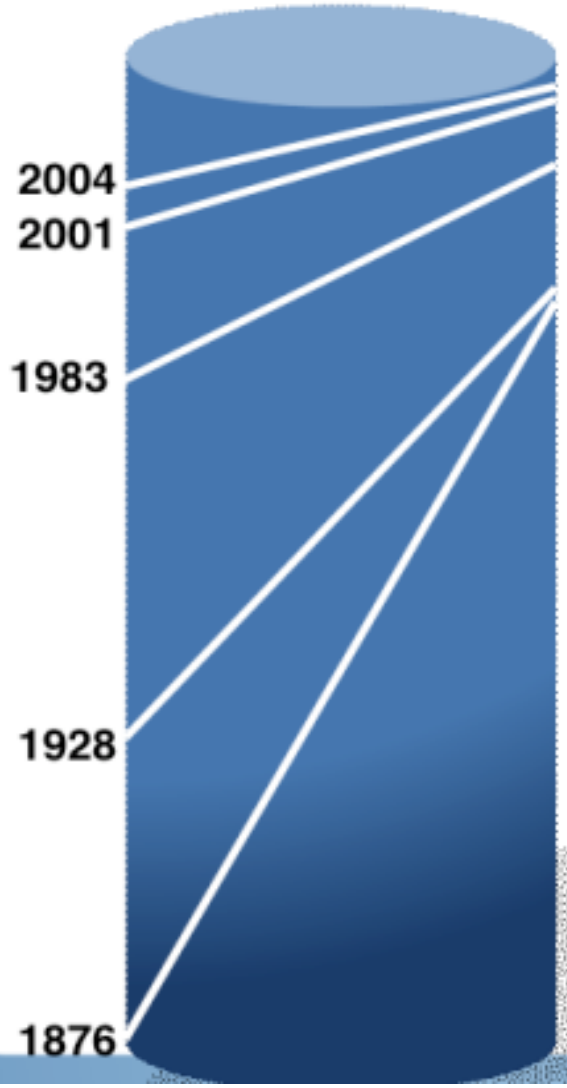

1965 **Telephone** **89 Years**

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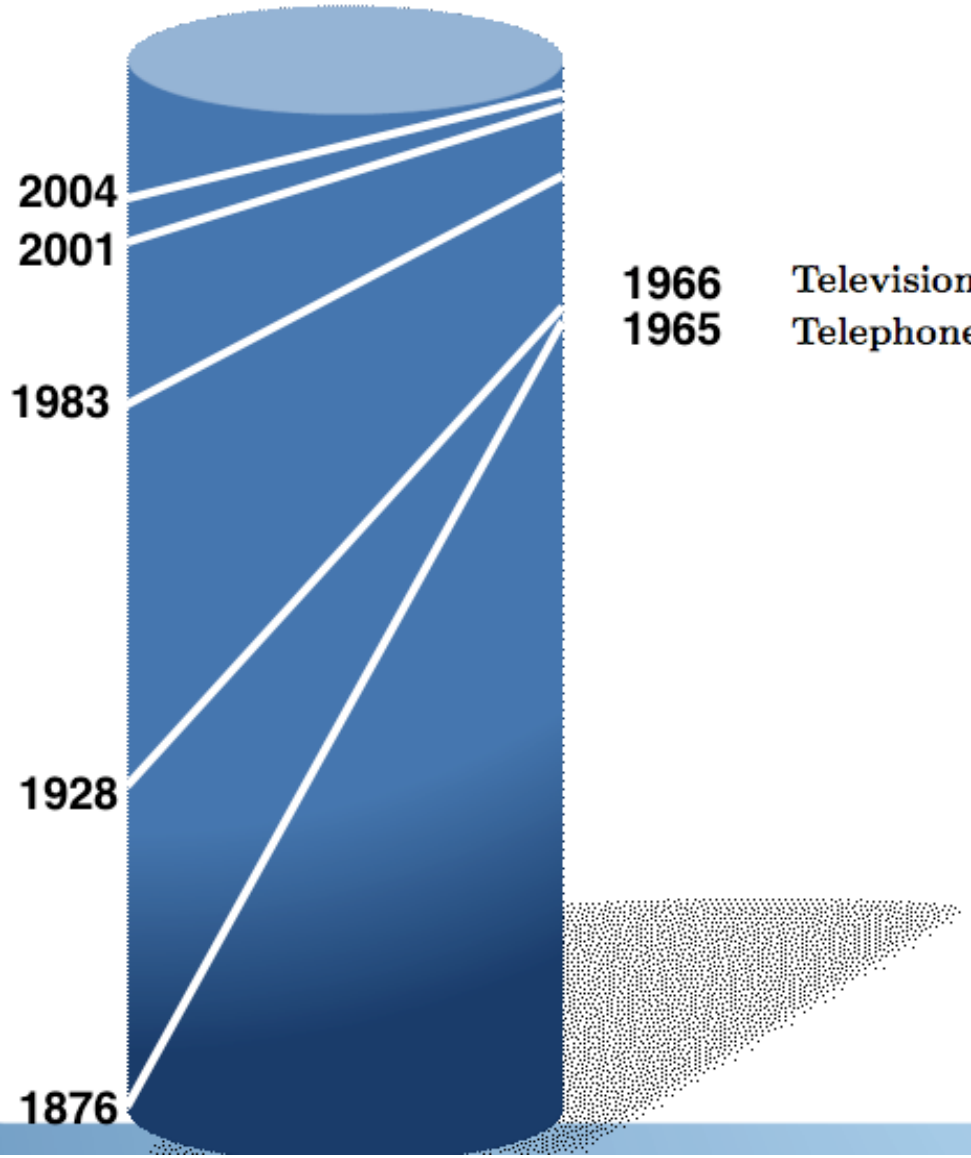

1966	Television	38 Years
1965	Telephone	89 Years

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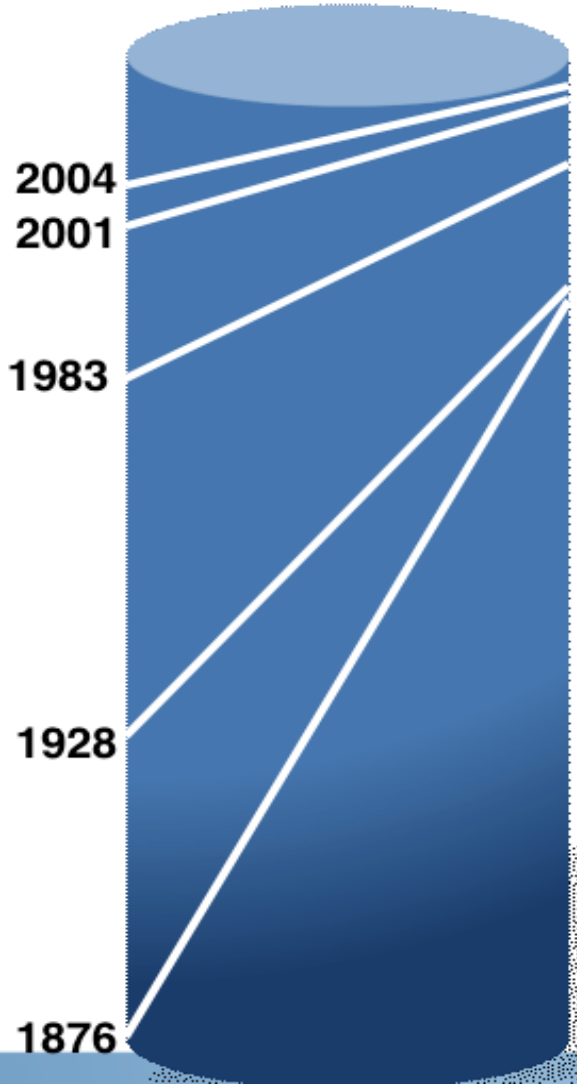

1997	Cell Phone	14 Years
1966	Television	38 Years
1965	Telephone	89 Years

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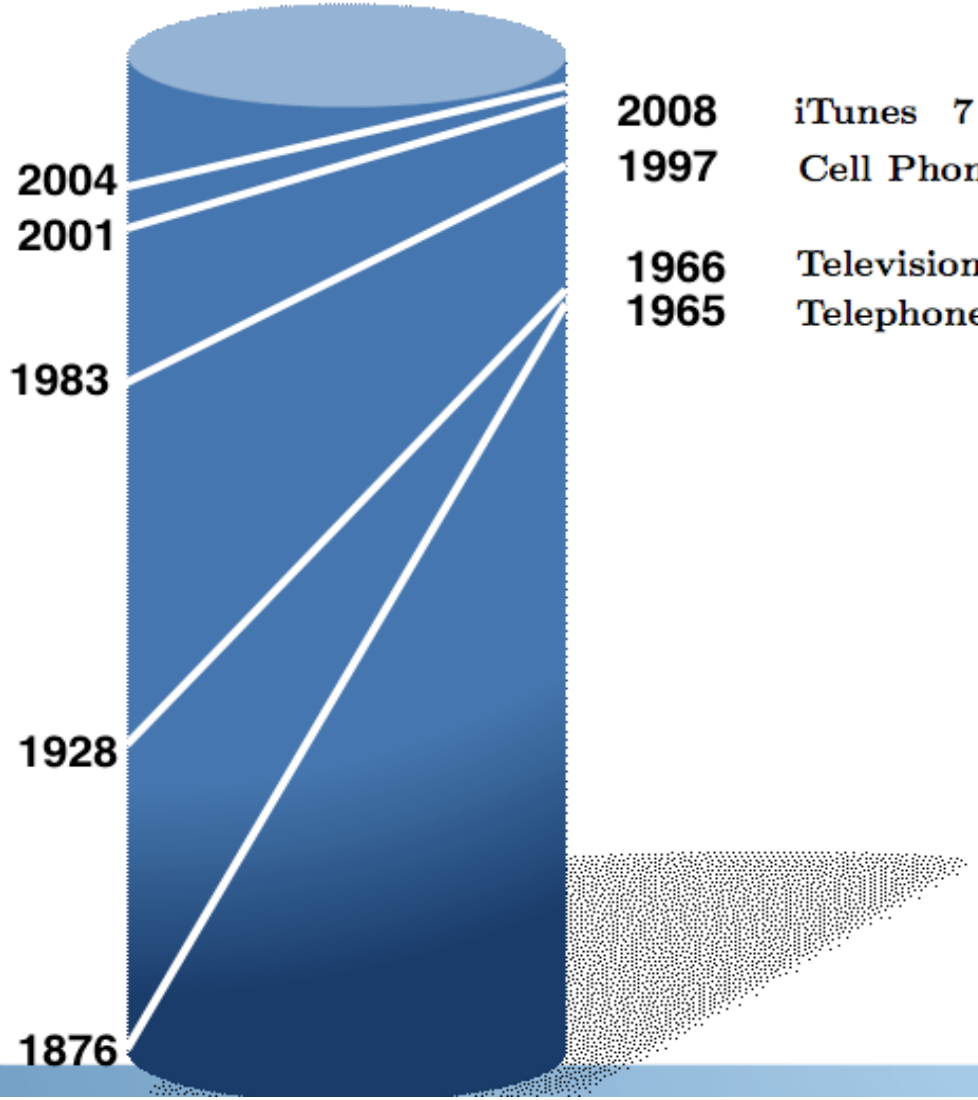

2008	iTunes	7 Years
1997	Cell Phone	14 Years
1966	Television	38 Years
1965	Telephone	89 Years

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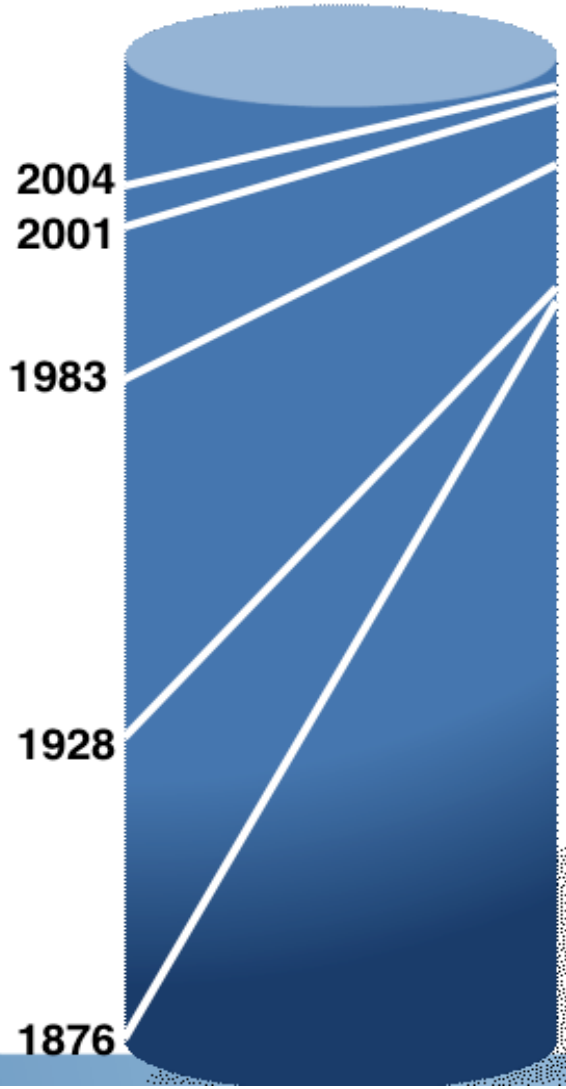

2009	Facebook	5 Years
2008	iTunes	7 Years
1997	Cell Phone	14 Years
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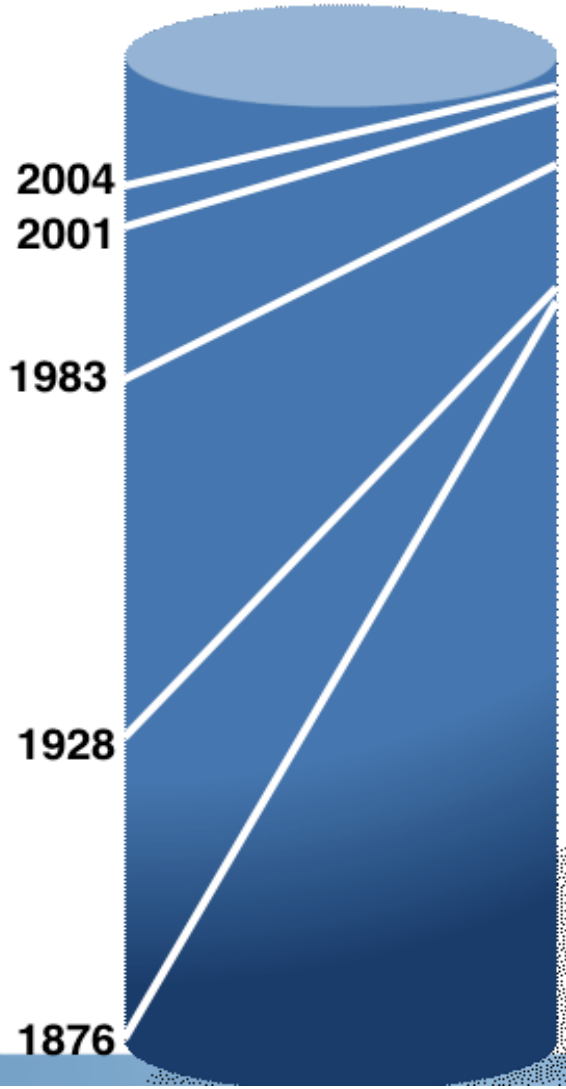

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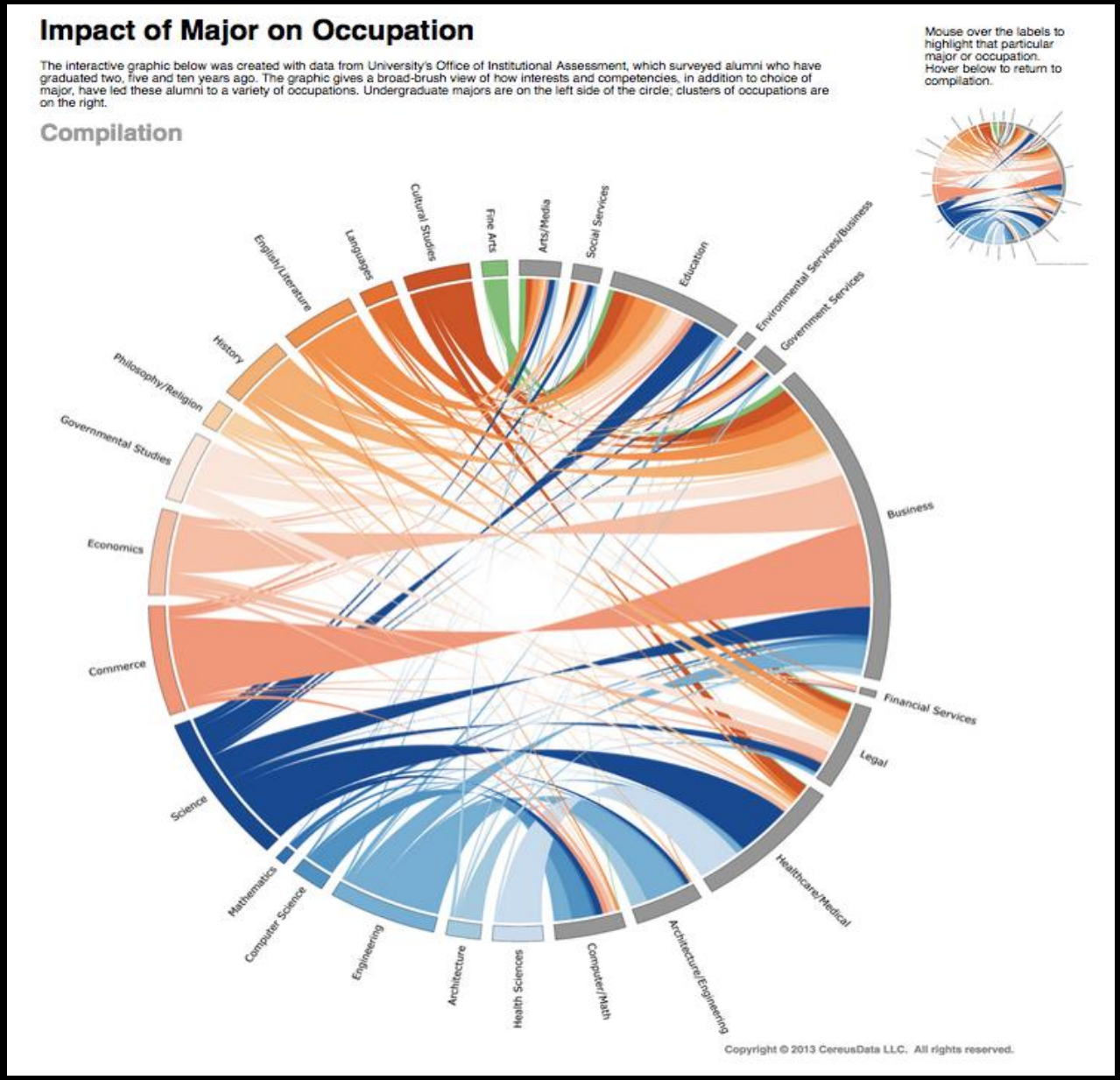
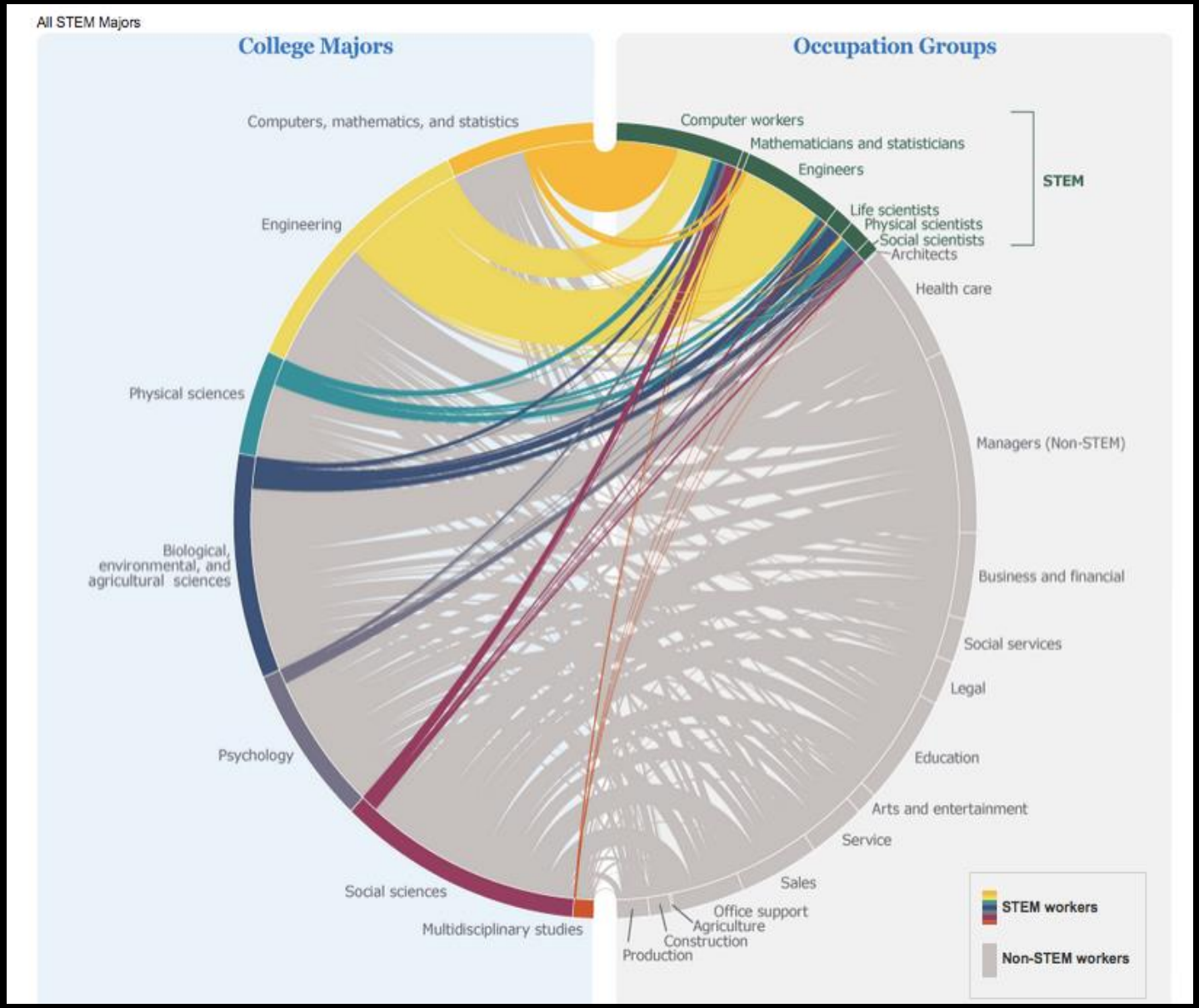


http://uvamagazine.org/only_online/article/two_roads_diverged_in_a_wood#.UqDR4o1lYzr



http://www.census.gov/dataviz/visualizations/stem/stem-html/

The Great Divide August 24, 2013, 2:35 pm 521 Comments

How Technology Wrecks the Middle Class

By DAVID H. AUTOR AND DAVID DORN


6CNY424

transportation - autonomous transit

low-cost, on-demand transit

highly utilized, energy-efficient AVs reduce operating cost

productive, safe commute

massage car, video game car, meeting car, sleep car....
accident-free

land use transformation

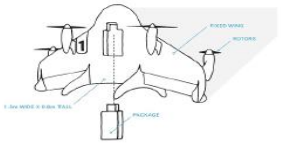
free 20-40% of land devoted to parking / excess lanes

3-D robotics

3DR

Airware

matternet



project wing

airbnb

Breather

zipcar

UBER

BRIDJ

Listening. Learning. Leading.®

AMERICA'S SKILLS CHALLENGE:
Millennials and the Future

THE ETS CENTER FOR
RESEARCH ON HUMAN CAPITAL AND EDUCATION

More specifically, the report on millennials — or those born after 1980 — shows that:

• Even though a greater percentage of young adults in the United States have been attaining higher levels of education since 2003, the numeracy scores of U.S. millennials whose highest level of education is "high school" and "above high school" have declined, from 264 to 247 and from 296 to 285, respectively, on a 500-point scale.

• The percentages of U.S. millennials scoring below Level 3 in numeracy — the minimum standard — has increased at all levels of educational attainment since 2003.

• U.S. millennials with a four-year bachelor's degree were outperformed by all other participating OECD countries except Poland and Spain.

• The scores of U.S millennials whose highest level of educational attainment was high school or less were lower than those of their counterparts in almost every other participating country.

• The "best-educated" millennials — those with a master's or research degree — were outperformed by their peers in all other OECD nations except for Ireland, Poland and Spain.

More specifically, the report on millennials — or those born after 1980 — shows that:

The U.S. performance looks bleak even when disaggregated along demographic lines. For instance:

• Across all levels of parental educational attainment — which was strongly correlated with skills in all countries — there was no country where millennials scored lower than those in the United States.

• The gap in scores between U.S millennials with the highest level of parental educational attainment and those with the lowest was among the highest of the participating countries, at 61 points, compared to other countries such as the Republic of Korea, Ireland and Finland, where the gap is as low as 20, 27 and 30 points, respectively.

• In most countries, native-born millennials scored higher than foreign-born millennials. However, native-born U.S. millennials did not perform higher than their peers in any other country, the report states.

.

Percentage of adults age 16–34 performing below the minimum standard of proficiency level on PIAAC literacy, numeracy, and problem solving in technology-rich environments (PS-TRE) scales, by participating country/region: 2012

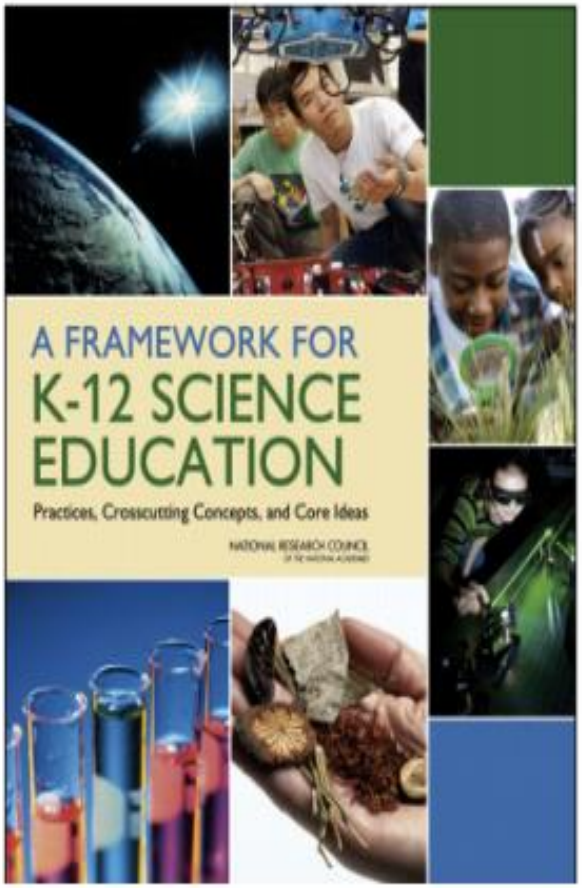
Country/region	Literacy, % below level 3	Numeracy, % below level 3	PS-TRE, % below level 2
OECD average	41	47	44
Australia	38*	51*	43*
Austria	43*	42*	43*
Canada	43*	50*	45*
Czech Republic	39*	40*	42*
Denmark	42*	43*	40*
England and Northern Ireland (UK)	49	58*	50*
Estonia	37*	43*	48*
Finland	23*	32*	32*
Flanders (Belgium)	34*	35*	40*
France	46	54*	—
Germany	42*	44*	43*
Ireland	50	59*	54
Italy	60*	63	—
Japan	19*	33*	33*
Netherlands	28*	36*	38*
Norway	39*	43*	38*
Poland	45*	53*	55
Republic of Korea	30*	42*	40*
Slovak Republic	44*	43*	54
Spain	59*	65	—
Sweden	35*	40*	35*
United States	50	64	56

— Not available.

* Significantly different ($p < .05$) from United States.

SOURCE: Organisation for Economic Co-operation and Development (OECD), Programme for the International Assessment of Adult Competencies (PIAAC), 2012.

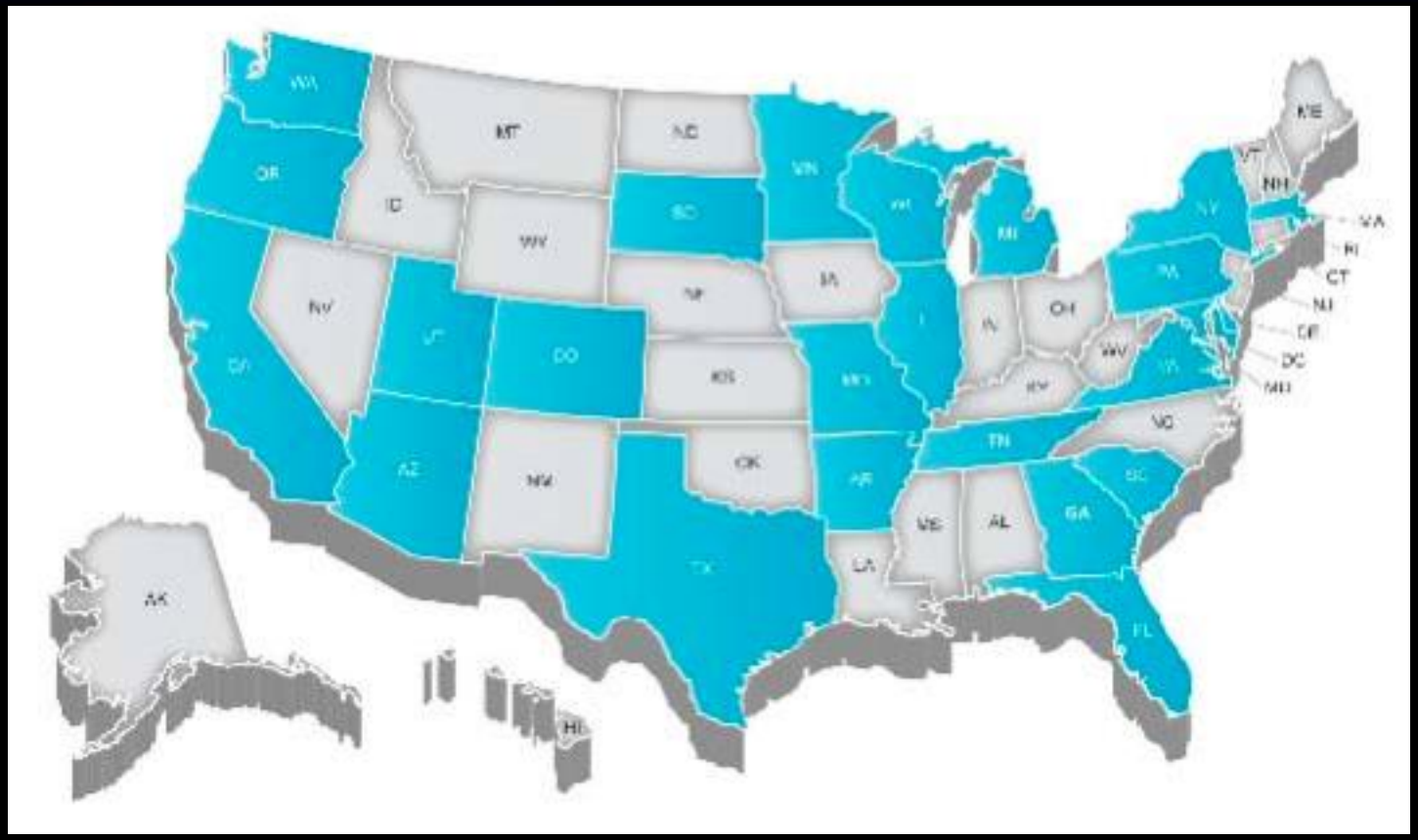
Provenance



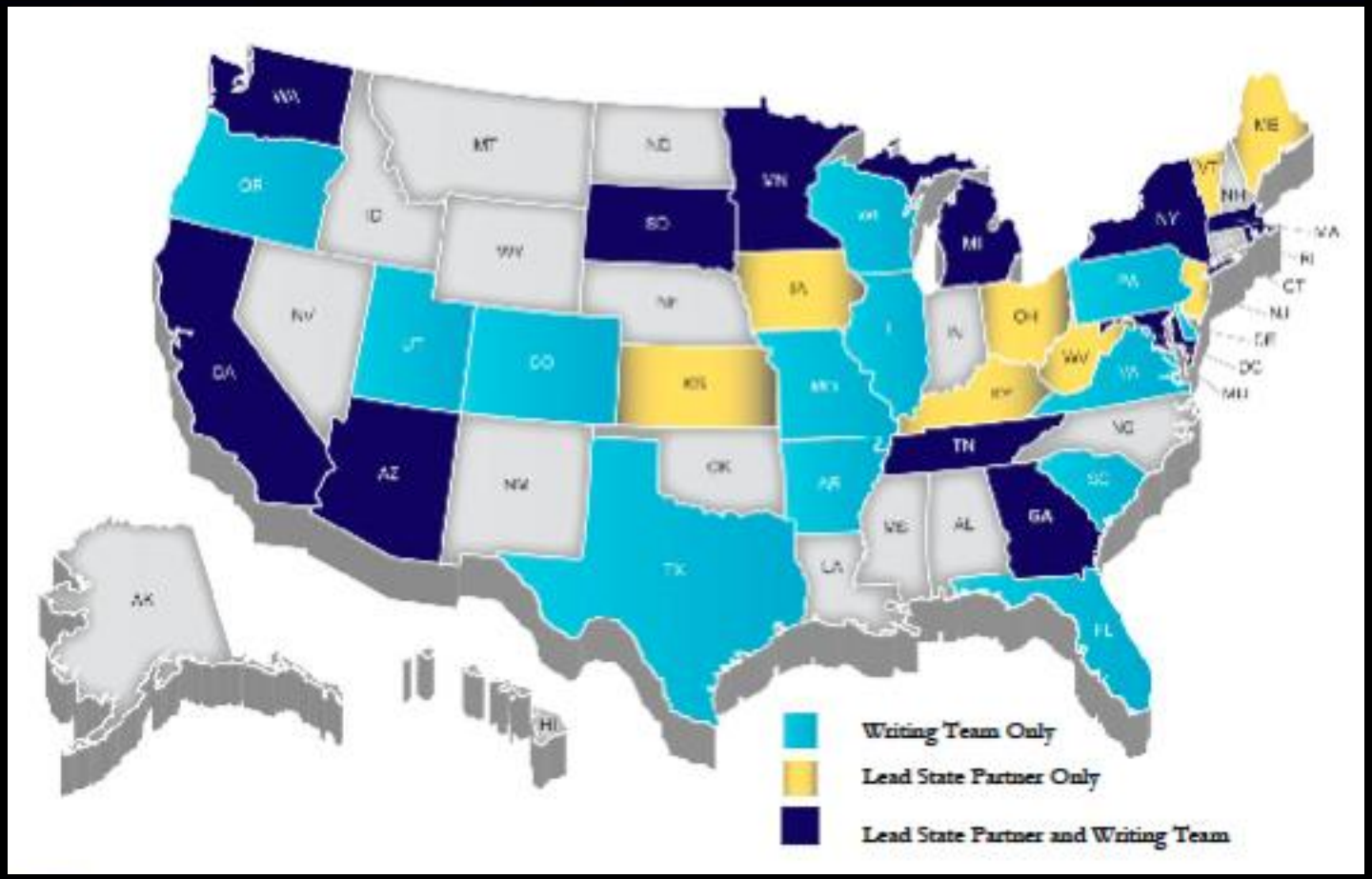
NEXT GENERATION
SCIENCE
STANDARDS

Lead State Partners

NGSS Writing Team Members



Lead State Partners and NGSS Writing Team



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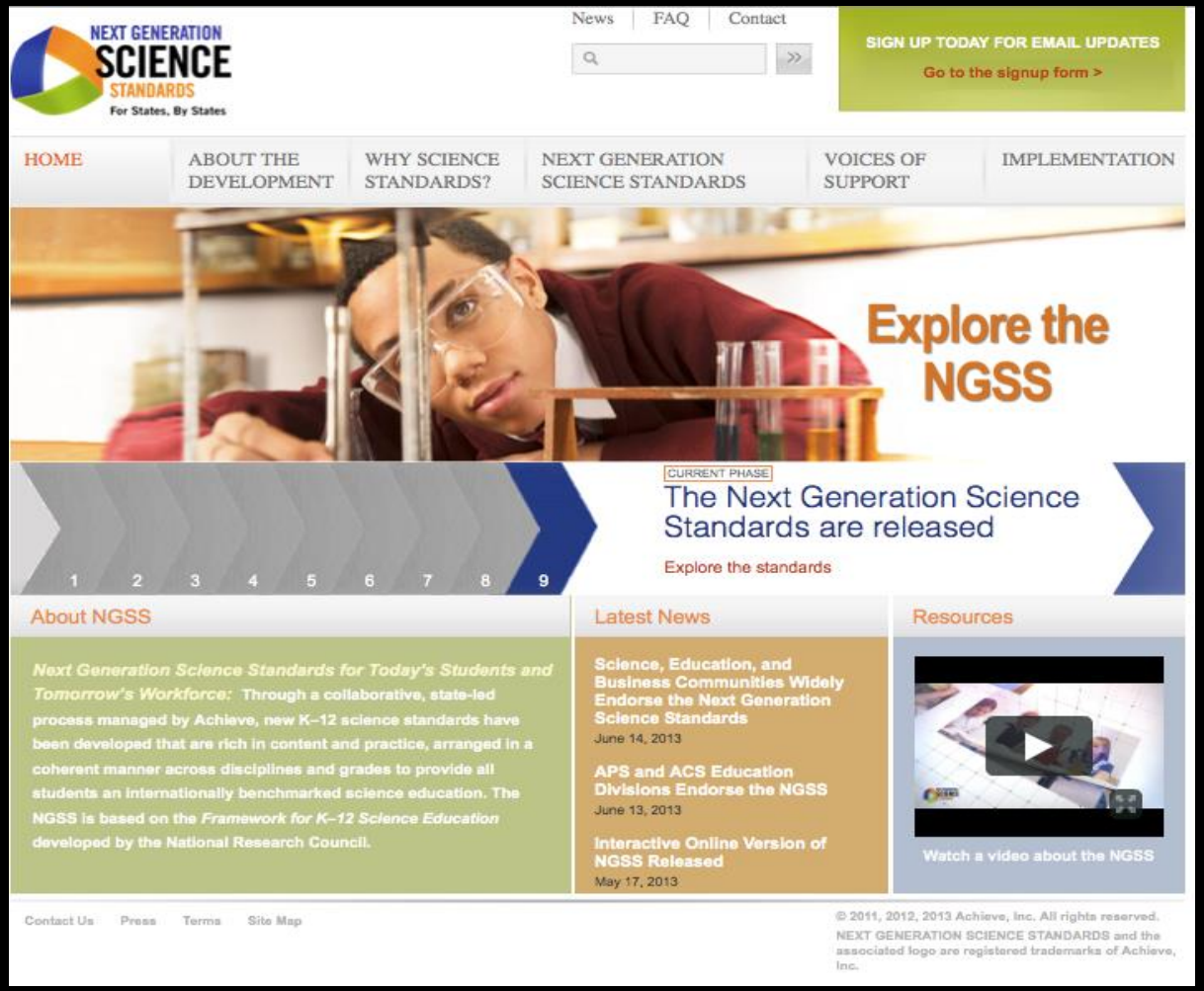
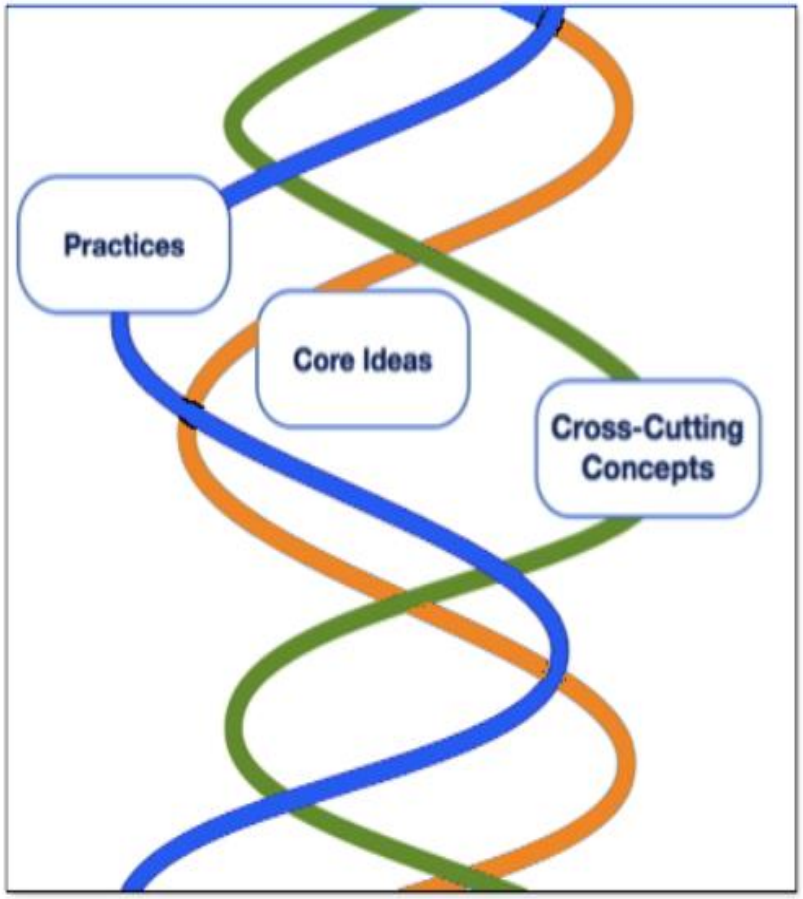


http://www.nextgenscience.org/

Three Dimensions Intertwined



- The NGSS are written as Performance Expectations
- NGSS will require contextual application of the three dimensions by students.
- Focus is on how and why as well as what

SCIENCE EDUCATION

AT THE NATIONAL RESEARCH COUNCIL
www.nationalacademies.org/bose

REPORT BRIEF • JULY 2011 BOARD ON SCIENCE EDUCATION

A Framework for K-12 Science Standards:
Practices, Crosscutting Concepts, and Core Ideas

COMMITTEE ON A CONCEPTUAL FRAMEWORK FOR NEW SCIENCE EDUCATION STANDARDS

HELEN R. QUINN *(Chair)*, SLAC National Accelerator Laboratory, Stanford University; **WYATT W. ANDERSON**, Department of Genetics, University of Georgia, Athens; **TANYA ATWATER**, Department of Earth Science, University of California, Santa Barbara; **PHILIP BELL**, Learning Sciences, University of Washington, Seattle; **THOMAS B. CORCORAN**, Teachers College, Columbia University; **RODOLFO DIRZO**, Department of Biology, Stanford University; **PHILLIP A. GRIFFITHS**, Institute for Advanced Study, Princeton, New Jersey; **DUDLEY R. HERSCHBACH**, Department of Chemistry and Chemical Biology, Harvard University; **LINDA P.B. KATEHI**, Office of the Chancellor, University of California, Davis; **JOHN C. MATHER**, NASA Goddard Space Flight Center, Greenbelt, Maryland; **BRETT D. MOULDING**, Utah Partnership for Effective Science Teaching and Learning, North Ogden; **JONATHAN OSBORNE**, School of Education, Stanford University; **JAMES W. PELLEGRINO**, School of Education and Social Policy, University of Illinois, Chicago; **STEPHEN L. PRUITT**, Office of the State Superintendent of Schools, Georgia Department of Education (until June, 2010); **BRIAN REISER**, School of Education and Social Policy, Northwestern University; **REBECCA R. RICHARDS-KORTUM**, Department of Bioengineering, Rice University; **WALTER G. SECADA**, School of Education, University of Miami; **DEBORAH C. SMITH**, Department of Curriculum and Instruction, Pennsylvania State University

HOW THE FRAMEWORK WAS DEVELOPED

NRC convened a committee of 18 experts in education and scientists from many disciplines to develop the framework drawing on their own expertise, current research , and guidance from small teams of specialists.

A draft of the framework was released in the summer of 2010 to gather comments from scientists, teachers, and the public. The National Science Teachers Association, the American Association for the Advancement of Science, and other groups aided this effort by collecting feedback from their members.

The committee revised the draft in response to all the comments received.

As a final step to ensure high quality, the framework went through the NRC's intensive peer-review process. More than 20 experts in the sciences, engineering, and teaching and learning provided detailed comments.

The committee revised the framework again in response to the experts' comments.

SCIENTIFIC AND ENGINEERING PRACTICES

CORE IDEAS

CROSSCUTTING CONCEPTS

The Two Ways To Teach Arithmetic (and Science)

Content
(1.)
Teach students how memorize 1+ 1 = 2, 1 + 2 = 3, etc., etc., etc. (i.e. the Yul Brunner methodology).

Process
(2.)
Teach students the process that goes behind these memorized results so that they are able to add any two numbers, even ones they have never encountered about before.

GUIDE TO IMPLEMENTING THE NEXT GENERATION SCIENCE STANDARDS

NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

Principle For Implementation

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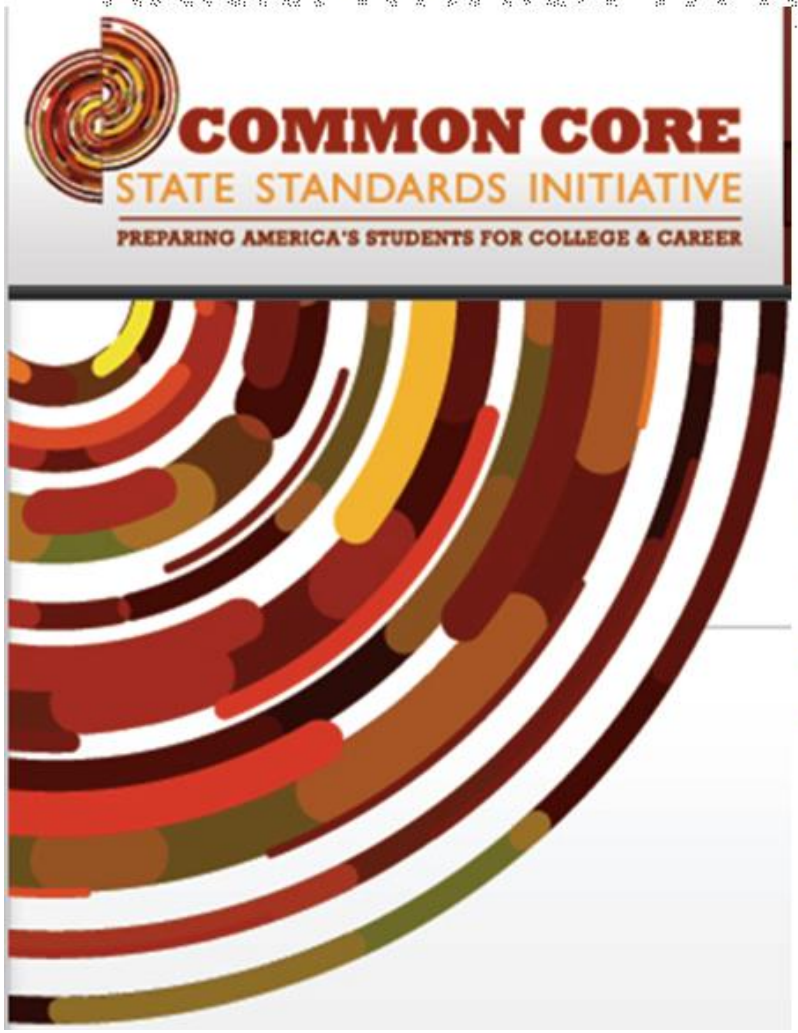
(4.) Build and leverage networks, partnerships, and collaborations.
(5.) Take enough time to implement well.
(6.) Make equity a priority.
(7.) Ensure that communication is ongoing and relevant.

The Common Core State Standards Connection

CONNECTIONS TO CCSS LITERACY



- Determine Central Ideas (RST 2)
- Evidence (RST 1 & WHST9)
- Analysis (RST 5)
- Evaluate Hypotheses (RST 8)
- Synthesize Information (RST 9)
- Writing Arguments (WHST 1)
- Use of Technology (WHST 6)
- Speaking and Listening (SL 1-6)

Q: Aren’t the NGSS less rigorous?

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A: It depends in part on whether you think memorization is equivalent to rigor?

Comparing 'Old Gen'-SS to NGSS

Middle level	National Science Education Standards (1996)	Middle Level	Next Generation Science Standards (2014)
An object that is not being subjected to a force will continue to move at a constant speed and in a straight line. If more than one force acts on an object along a straight line, then the forces will reinforce or cancel one another, depending on their direction and magnitude. Unbalanced forces will cause changes in the speed or direction of an object's motion.		Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.	

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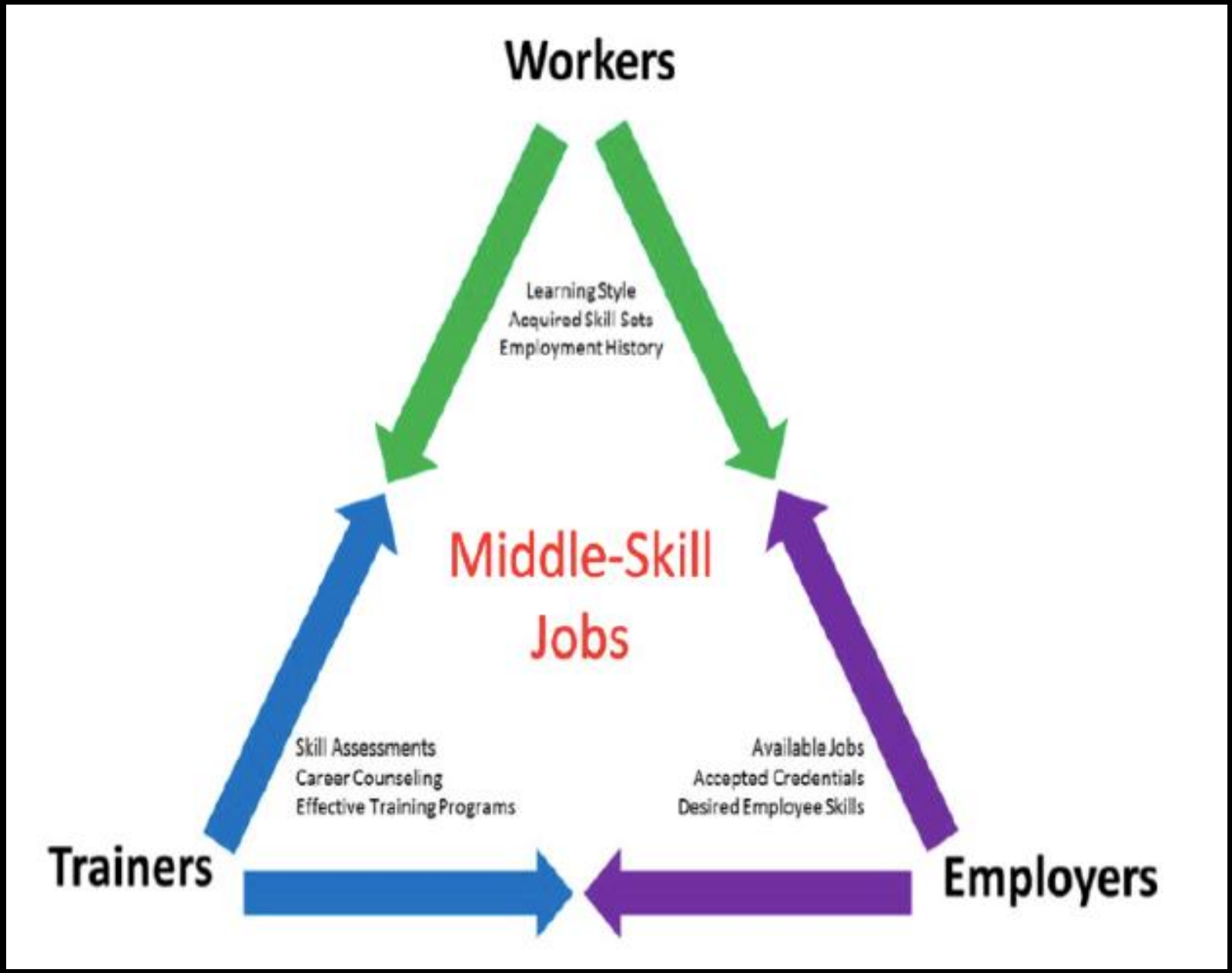
Comparing ‘Old Gen’-SS to NGSS

Middle level	National Science Education Standards (1996)	Middle Level	Next Generation Science Standards (2014)
		Plan an investigation to provide evidence that the change in an object’s motion depends on the sum of the forces on the object and the mass of the object.	
		Crosscutting Concept: Stability and change – Explanation of stability and change in natural or designed systems can be constructed by examining the changes overtime and forces at different scales. **Scientific and Engineering Practices**: Plan an investigation individually or collaboratively, and in the design, identify independent and dependent variables and controls, what tools are needed to do the gathering, how measurements will be recorded, and how many data points are needed to support a claim.	


Workers
Learning Style
Acquired Skill Sets
Employment History
Middle-Skill Jobs
Skill Assessments
Career Counseling
Effective Training Programs
Available Jobs
Accepted Credentials
Desired Employee Skills
Trainers
Employers

Thank You.

I WANT YOU

STEM STAKEHOLDERS