

Introductory Undergraduate Courses in STEM: Is Change Necessary? Inevitable?



**Illinois College
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THE NATIONAL ACADEMIES
National Academy of Sciences
National Academy of Engineering
Institute of Medicine
National Research Council

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Overview

- Introductory Courses as Gateways to STEM and the Liberal Arts
- Learning Research Suggests that Pedagogical Practices in Many Introductory Courses Stifles Learning and Interest
- What's Important to [Un]cover for Introductory Students?



REPORT TO THE PRESIDENT

ENGAGE TO EXCEL: PRODUCING ONE MILLION
ADDITIONAL COLLEGE GRADUATES WITH
DEGREES IN SCIENCE, TECHNOLOGY,
ENGINEERING, AND MATHEMATICS

Executive Office of the President
President's Council of Advisors
on Science and Technology

FEBRUARY 2012



CURRENTLY: ~ 300,000 bachelor and associate degrees in STEM fields annually in the U.S.

FUTURE NEEDS: 1 million more STEM professionals in the next decade than the U.S. will produce at the current rate if the country is to retain its historical preeminence in science and technology.

“To meet this goal, the United States will need to increase the number of students who receive undergraduate STEM degrees by about 34% annually over current rates.”



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Fewer than 40% of students who enter college intending to major in a STEM field complete a STEM degree.

Increasing retention of STEM majors from 40% to 50% would generate three-quarters of the 1 million additional STEM degrees over the next decade.

Many students who abandon STEM majors perform well in their introductory courses and would make valuable additions to the STEM workforce.



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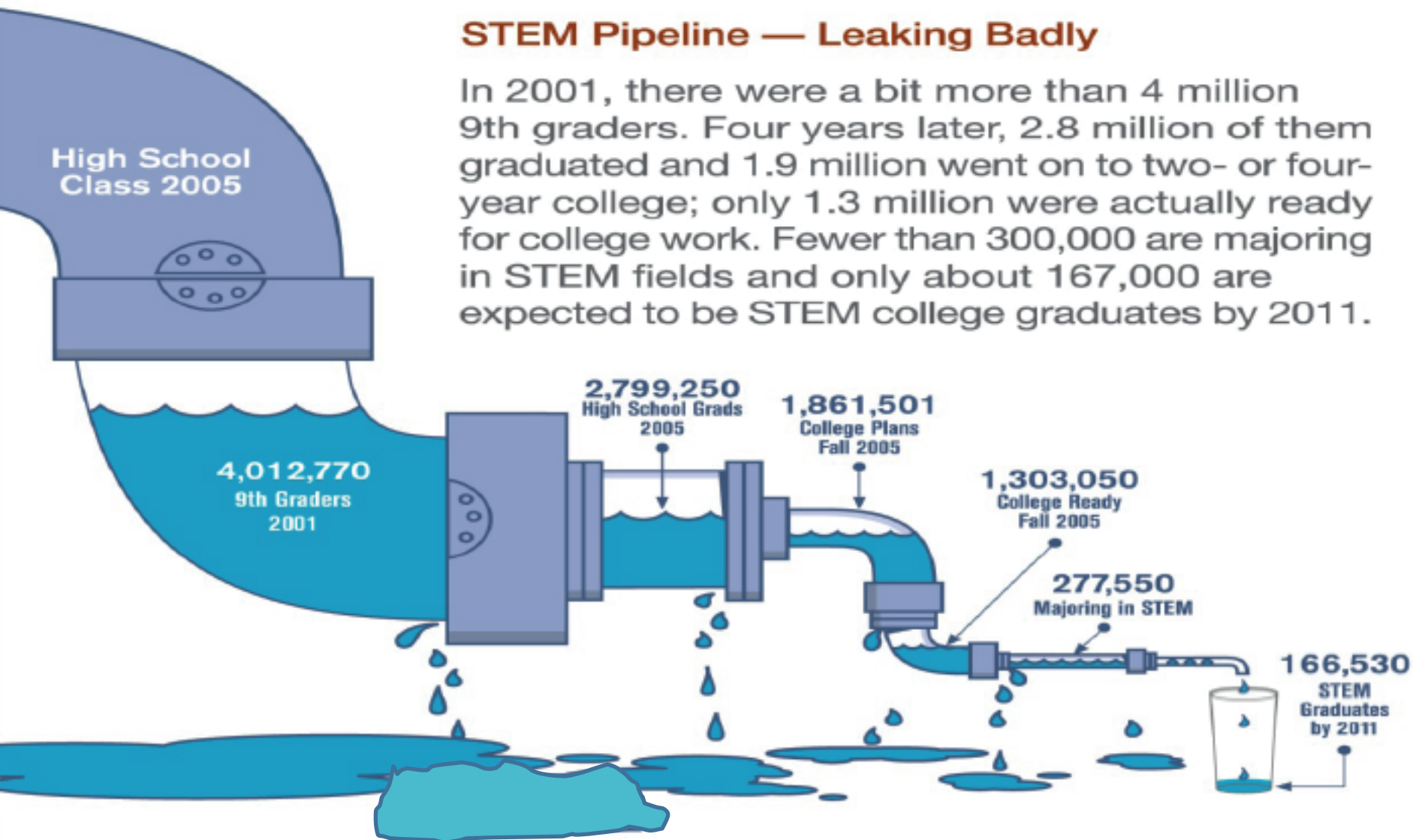


Retaining more students in STEM majors is the lowest-cost, fastest policy option to providing the STEM professionals ... and will not require expanding the number or size of introductory courses, which are constrained by space and resources at many colleges and universities.

The Problem: A Leaky Pipeline

STEM Pipeline — Leaking Badly

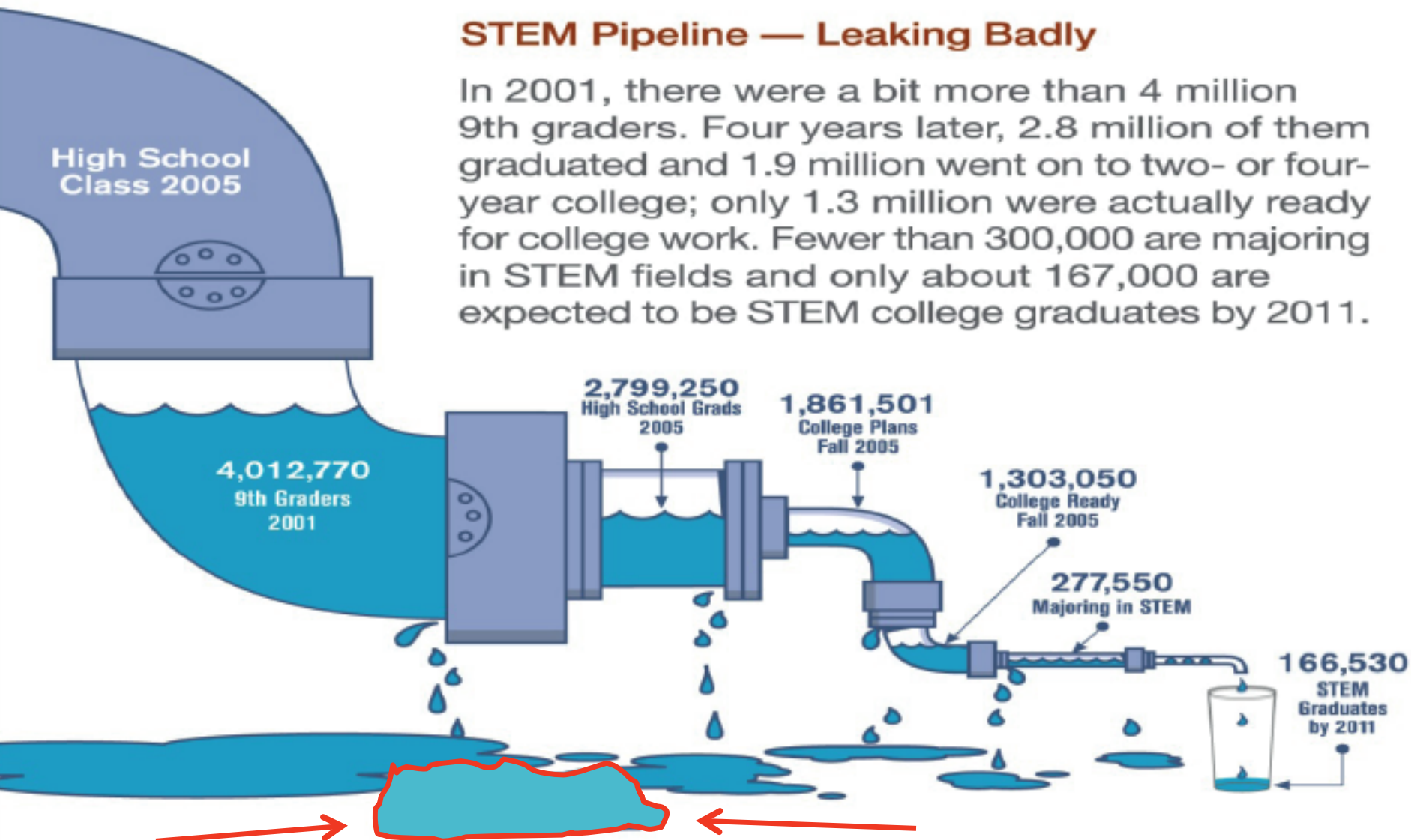
In 2001, there were a bit more than 4 million 9th graders. Four years later, 2.8 million of them graduated and 1.9 million went on to two- or four-year college; only 1.3 million were actually ready for college work. Fewer than 300,000 are majoring in STEM fields and only about 167,000 are expected to be STEM college graduates by 2011.



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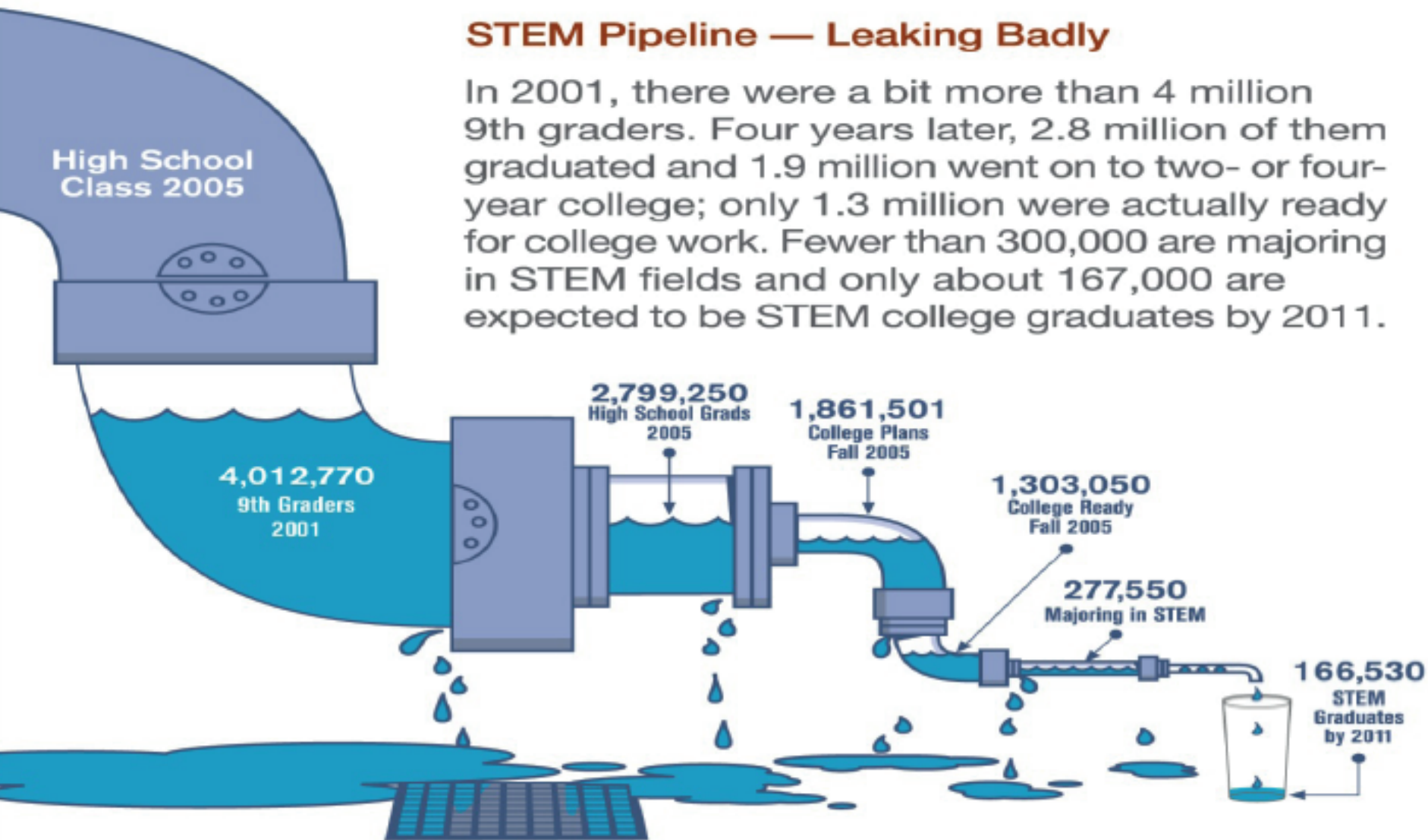
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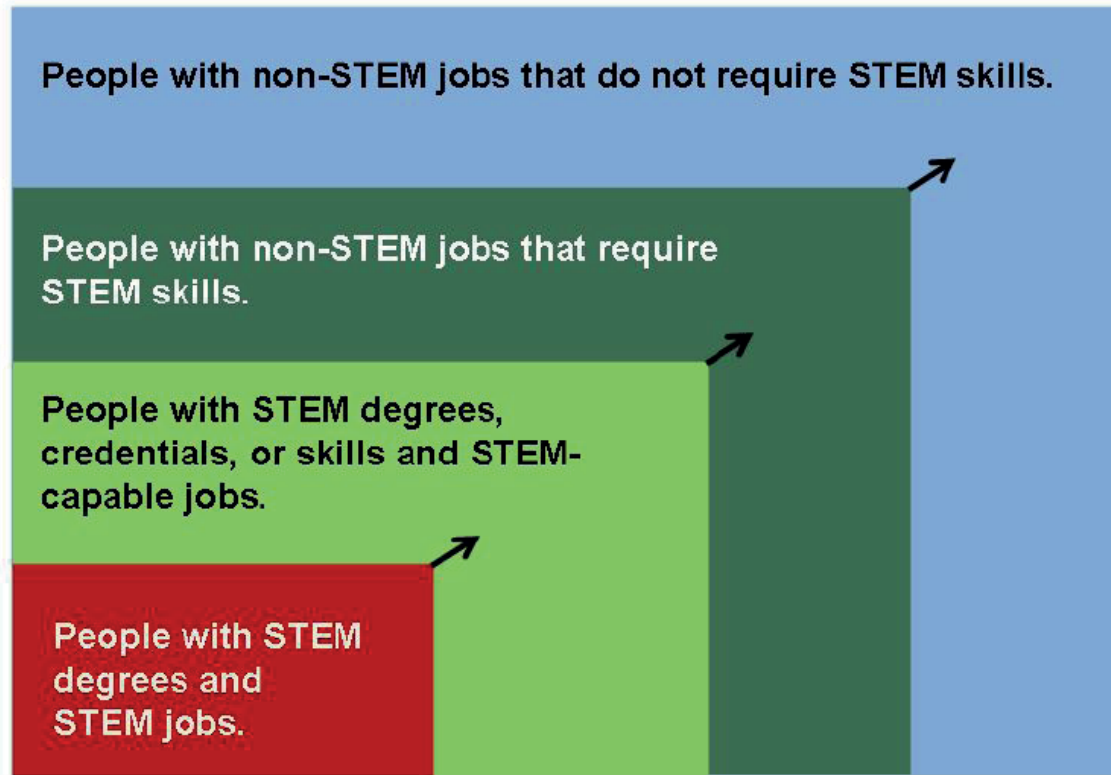
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STEM Workforce Definition

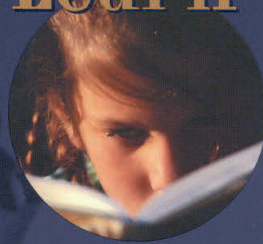
Total U.S. Workforce



Note: The categories of jobs that require STEM skills and understandings are expanding, generating additional demand for workers with STEM degrees.

Expanded Edition

How People Learn



Brain,
Mind,
Experience,
and
School



NATIONAL RESEARCH COUNCIL

National Research Council 2000



PROMISING PRACTICES IN
UNDERGRADUATE SCIENCE,
TECHNOLOGY, ENGINEERING,
AND MATHEMATICS EDUCATION

SUMMARY OF TWO WORKSHOPS



NATIONAL RESEARCH COUNCIL
OF THE NATIONAL ACADEMIES

National Research Council 2011

Outils non fournis
Tools not included
Werkzeuge nicht mitgeliefert
Herramientas no incluidas
Ferramentas nao incluidas
Accessori non forniti
Gereedschap niet bijgeleverd



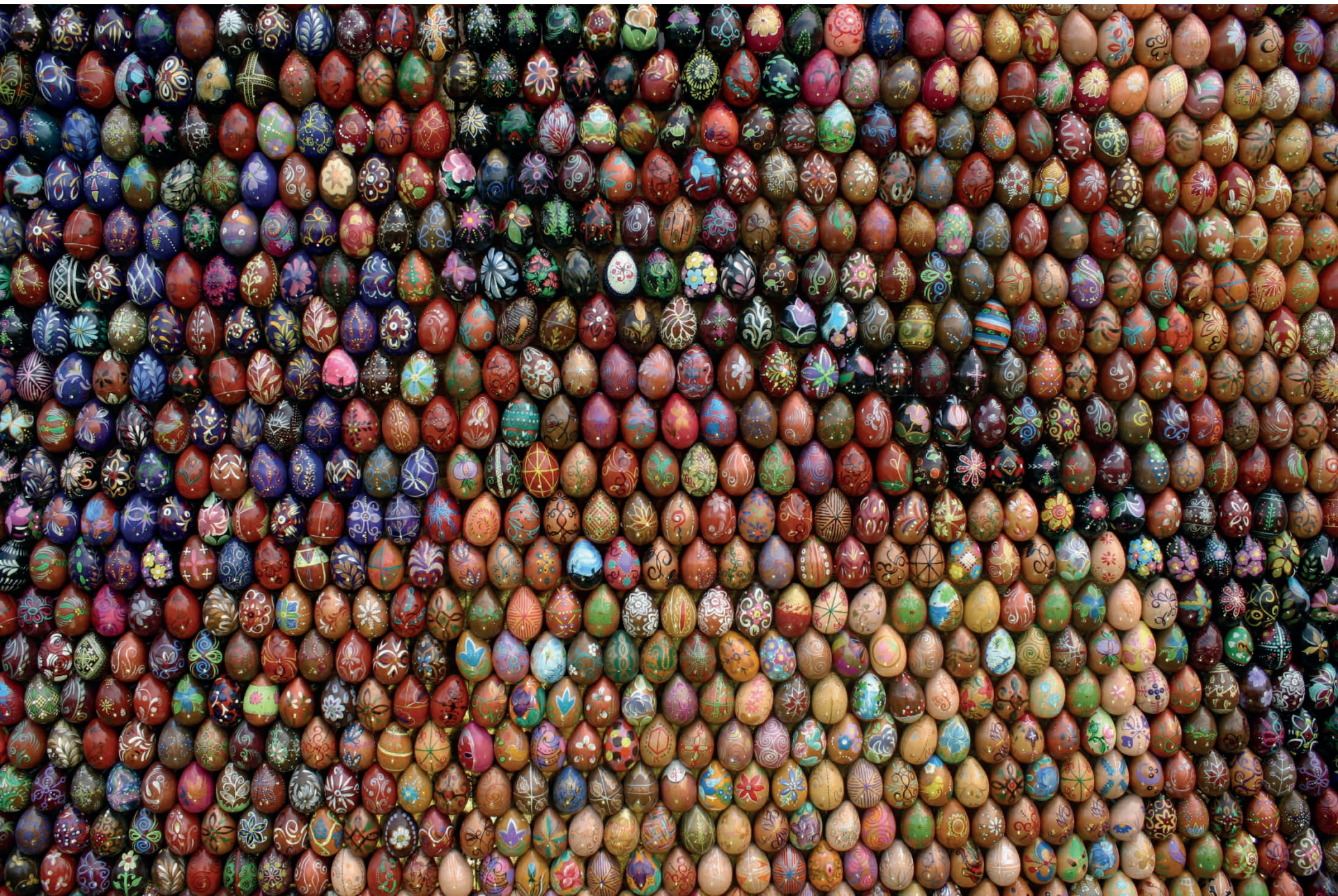
•Le montage et le démontage doivent être effectués par un adulte.
•Must be assembled and disassembled by an adult.
•Der Zusammenbau und das Auseinandernehmen muß von einem erwachsenen durchgeführt werden.
•Het monteren en demonteren moet door een volwassene gedaan worden.
•Il montaggio e lo smontaggio vanno effettuati da un adulto.
•El montaje y el desmontaje debe realizarlo un adulto.
•A montagem e a desmontagem devem ser efectuadas por um adulto.

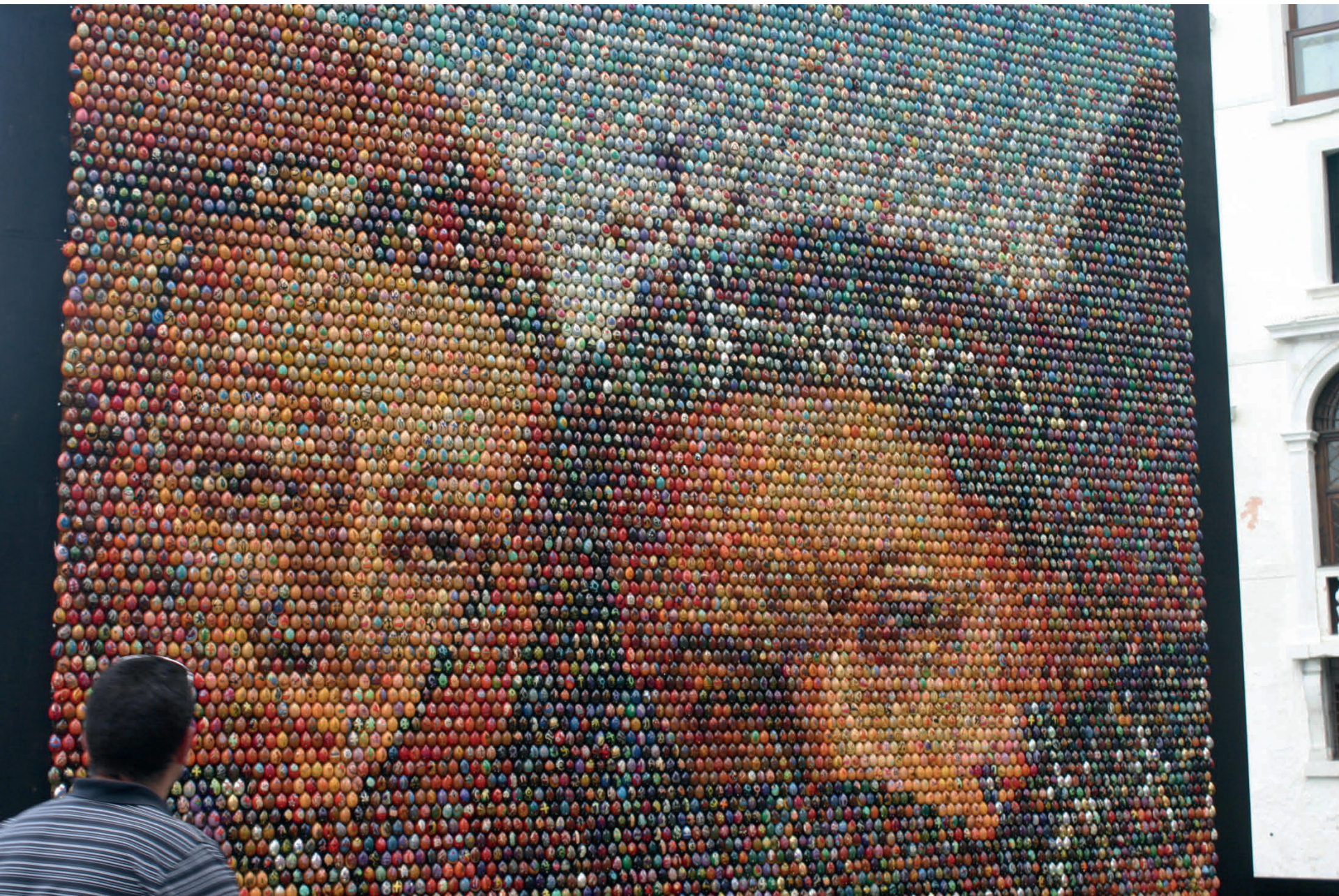
AAP 0780 A

A		1
B		1
C		2
D		2
E		2
F		1
G		1
H		1
J		1
K		1
L		1
M		2
N		1
P		1
Q		2
R		1

S		1
T		1
U		1
V		1
W		1
Y		1
Z	4,5 x 40	2
AA	8 x 60	1
BB	M8	1
CC	4,5 x 16	3
DD	3,5 x 15	1
EE		1
FF		1







Build BOTH

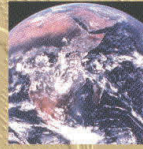
Factual
knowledge



Conceptual
framework



T E A C H I N G A B O U T



E V O L U T I O N



A N D T H E



N A T U R E O F



S C I E N C E



NATIONAL ACADEMY OF SCIENCES