

Online Astronomy Courses for Formal and Informal Learners



Chris Impey, Associate Dean, Univ. of Arizona

Critical Science Education Issues



Literacy

Agency

51%

**don't think
the Big Bang
happened**

40%

**don't
believe in
evolution**

40%

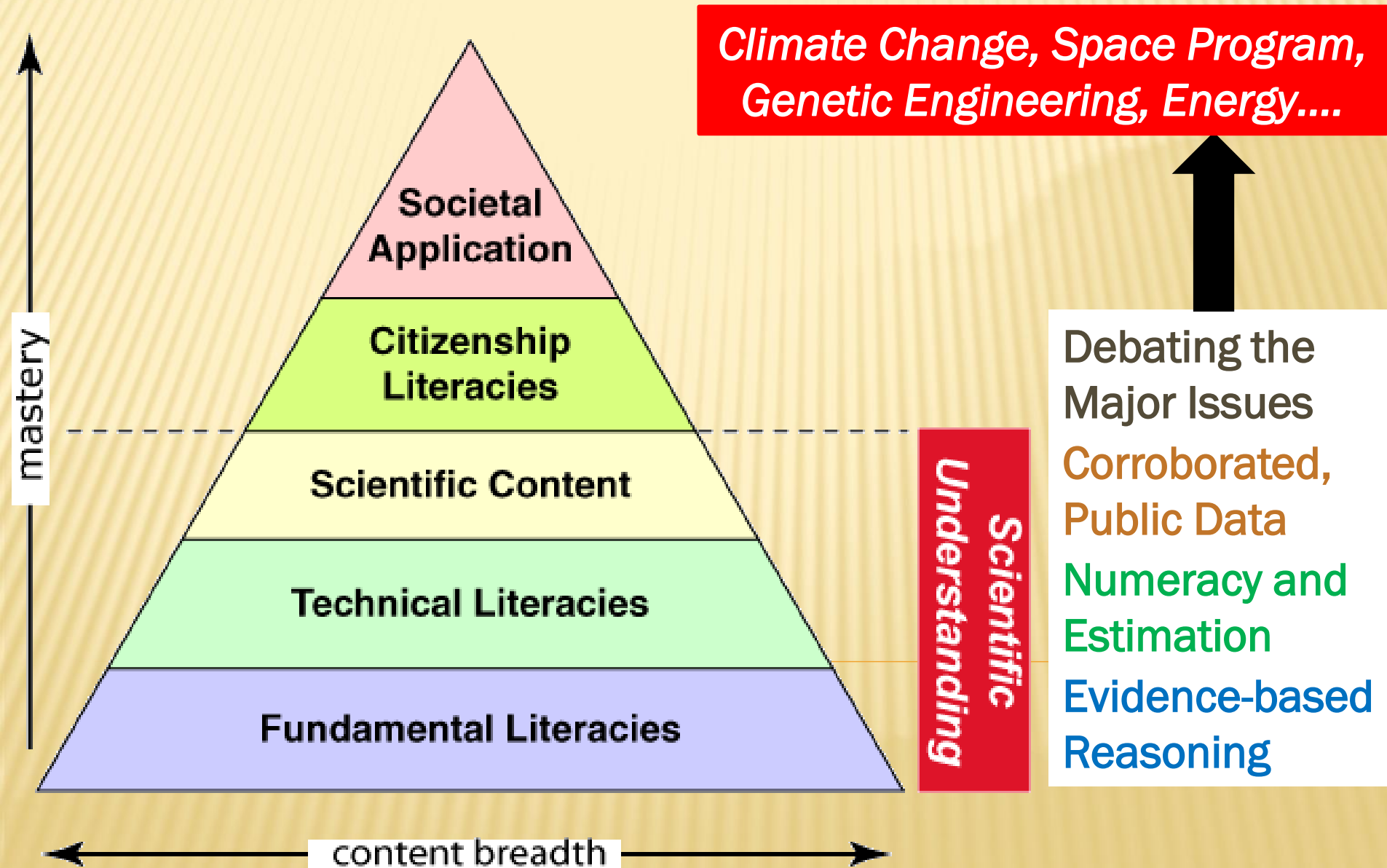
**doubt the Earth
is billions of
years old**

40%

**are unsure or
don't believe in
global warming**

United States/Source: AP-GfK Poll

Science Literacy Schema



Sources of Science Information

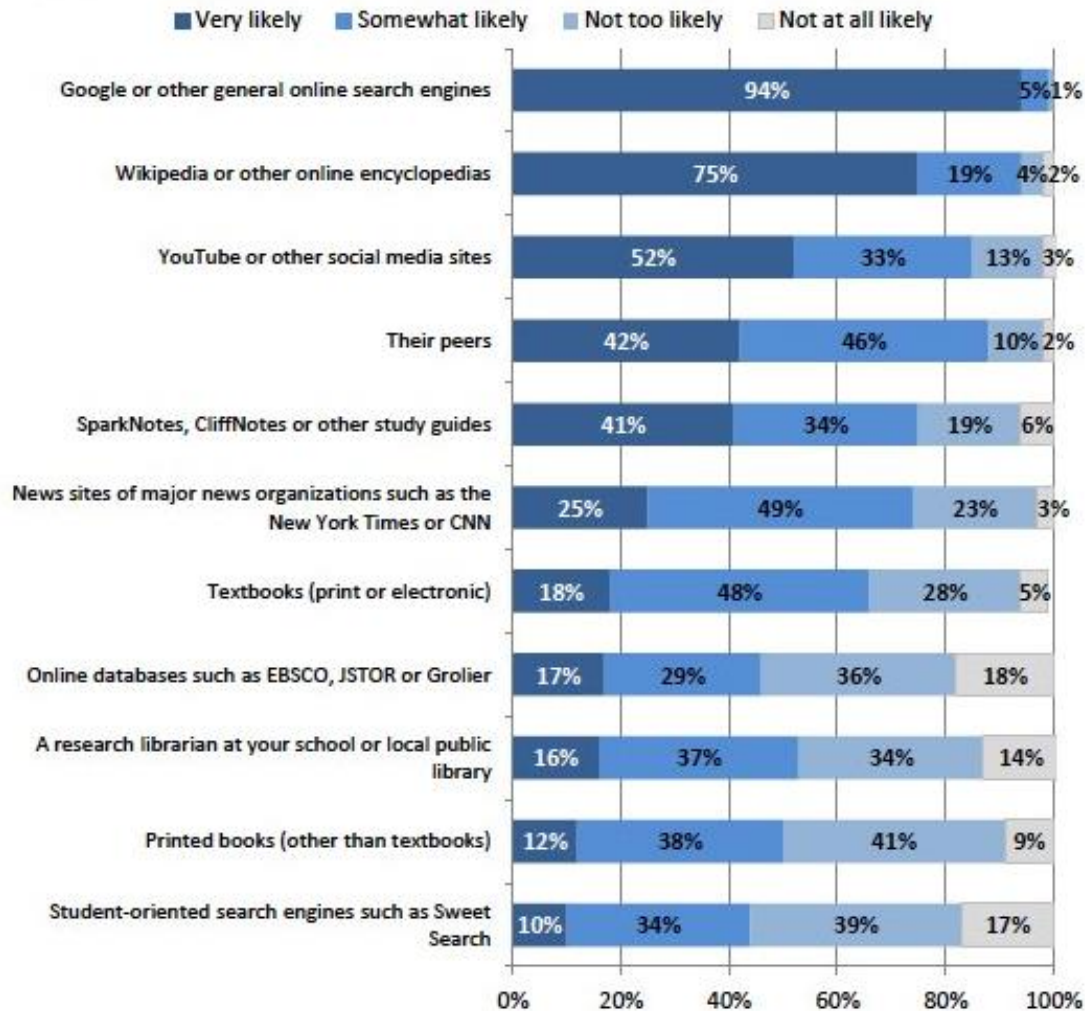
- In open-ended responses, the Internet is given as the first place to look for information by 60%. **Only 2% turn to a book first.**
- In their science classes, students get information online (70%), then their course (40%), textbooks come in last (7%).
- In terms of importance of the information source, the top picks are teachers (90%), Internet (80%), and **Wikipedia in particular (50%).**

College students turn primarily to the Internet for science information, although teachers are seen as more reliable. Books are rarely used, despite being authoritative sources.

Googling Equals Research

Research tools teachers say their students are most likely to use

How likely, if at all, are your students to use each of the following sources in a typical research assignment?



Source: The Pew Research Center's Internet & American Life Project Online Survey of Teachers, March 7 to April 23, 2012, n=2,462 middle and high school teachers.

Survey of Science Literacy

- College graduates have a slightly higher scientific literacy than the general public, with small gains over four years (snapshot, not cohorts).
- **Strong pseudoscience beliefs and superstitions** are resistant to instruction; concept of scientific method is simplistic and shallow.
- **Number of science courses taken** is the strongest predictor of performance, but it **only accounts for 3% of the variance** in literacy scores.

College science courses have at most a marginal impact on the science literacy and beliefs of undergraduates. Also the conception of how science actually works is very primitive.

Traditional STEM Teaching



200 A.D

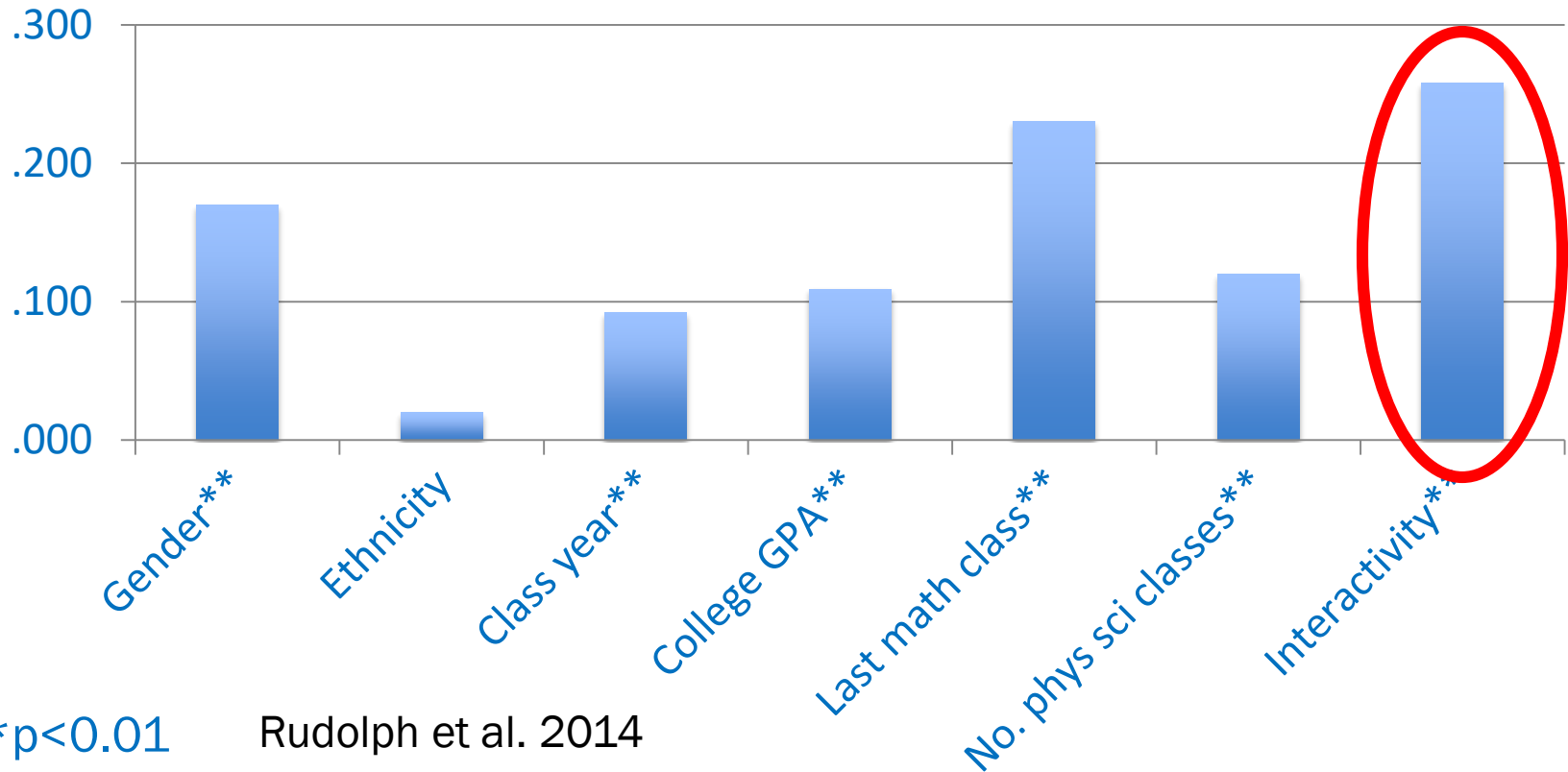


2017 A.D.

Most college STEM classes are still taught in a traditional, transmissive way (large lecture), despite its poor effectiveness in increasing learning.

Concept Inventory Learning Gains

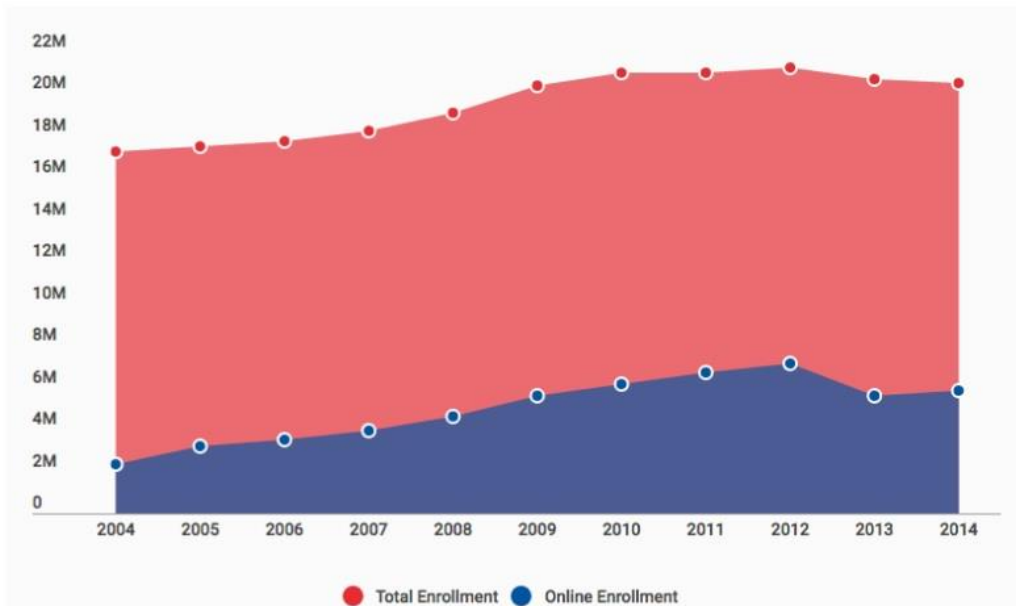
Standardized Coefficients



Active learning methods: lecture tutorials, small group activities, think-pair-share, debates, clickers, role play.

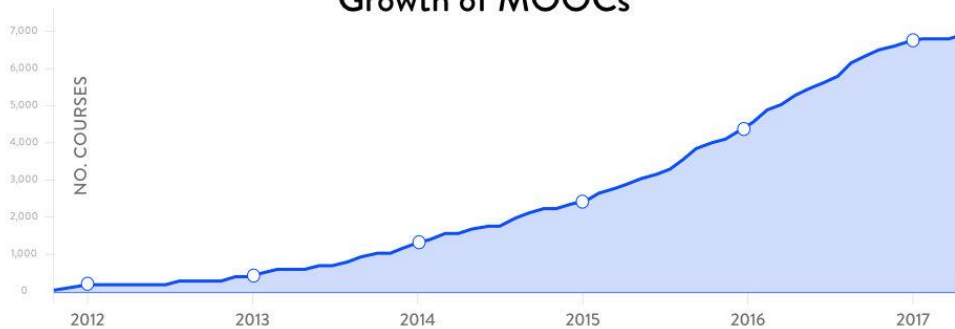
Online Enrollment is Soaring

GROWTH OF ONLINE COLLEGE ENROLLMENT



Online enrollment has doubled in last decade. Less than 20% take all classes in classrooms.

Growth of MOOCs



Enrollment in massive open online classes or MOOCs has grown even more rapidly in 5 years.

Massive Open Online Classes



course

Over 110 thousand
served for 4 years,
and 500,000 hours
of videos watched

udemy

But how well served? Can we increase typically low completion rates, create instructionally rich environments, and learn to effectively use social media?

Astronomy State of the Art MOOC

Completion Rate ~7%

Spanish Translation Complete

Online Book+Google Translate

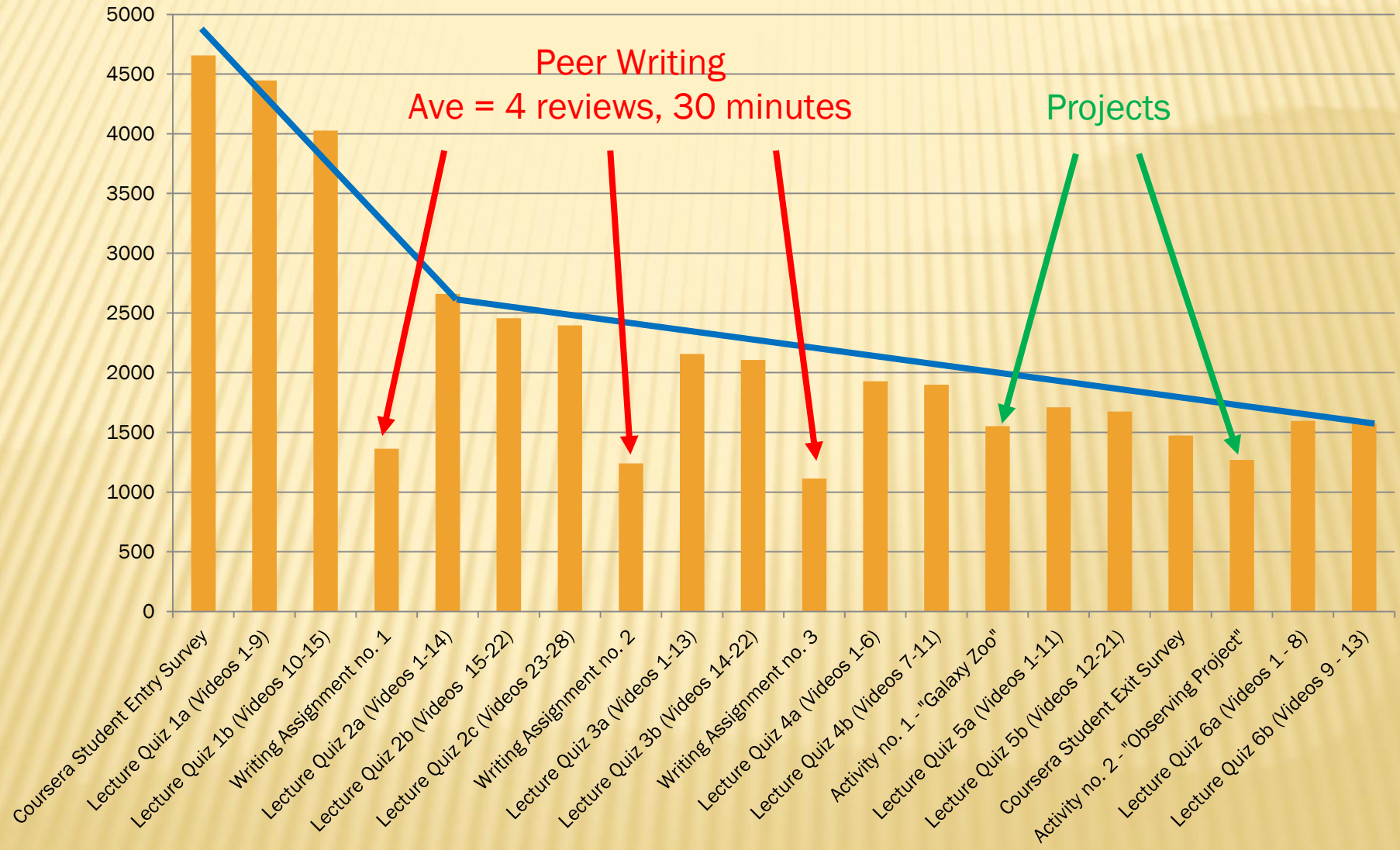
500,000 Hours Engagement

51,500 enrolled in 165 countries

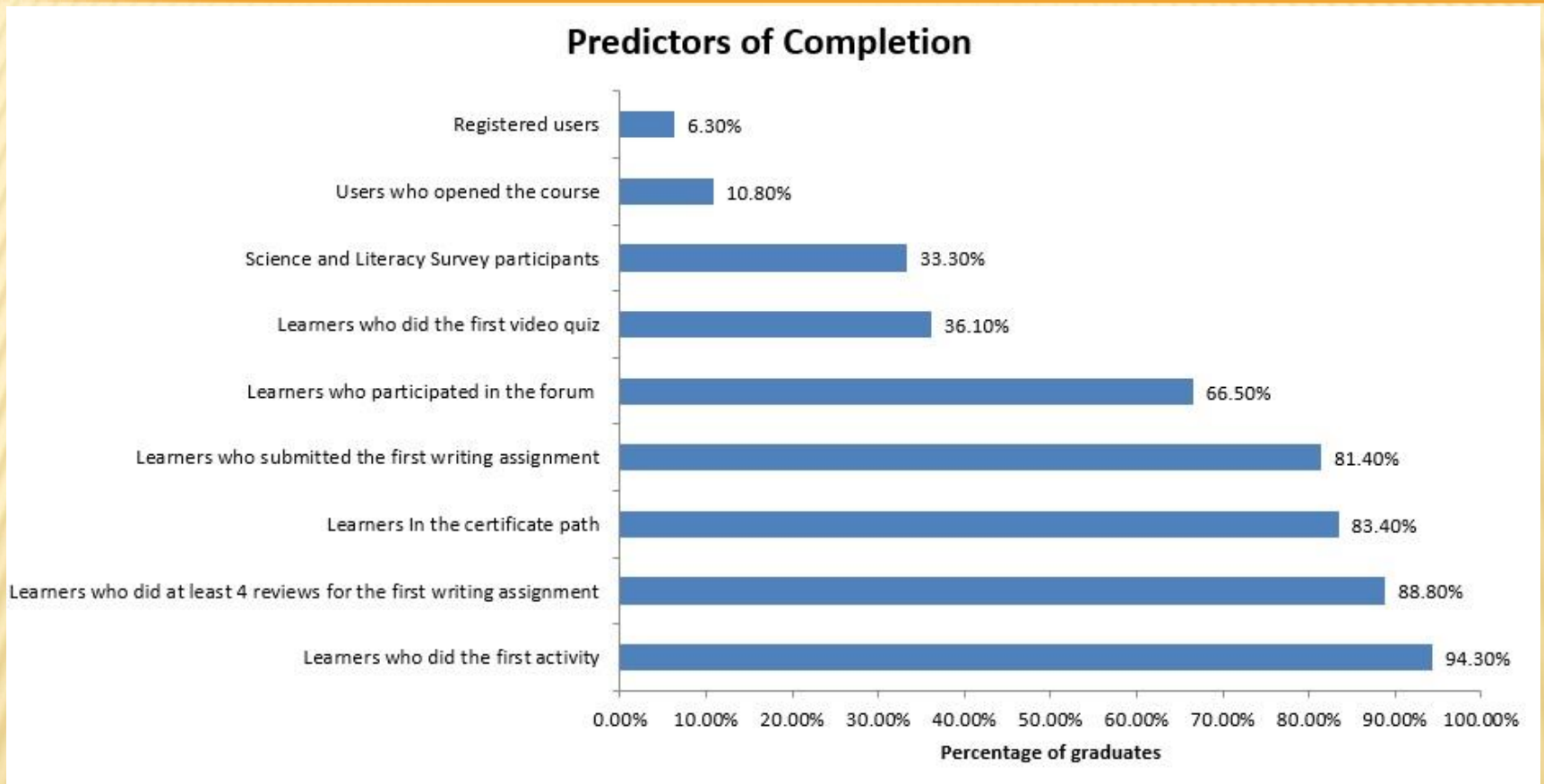


Country / Territory	Sessions	% Sessions
1. United States	30,265	45.66%
2. United Kingdom	4,107	6.20%
3. India	3,320	5.01%
4. Canada	3,118	4.70%
5. Australia	2,892	4.36%
6. South Africa	1,614	2.44%
7. Mexico	1,541	2.32%
8. Brazil	994	1.50%
9. Spain	915	1.38%
10. Colombia	810	1.22%

Participation in Assignments



How to Improve MOOC Outcomes



Our key strategies for increasing engagement and completion: peer writing, citizen science, activities (peer review validated for thousands of participants)

Teach Astronomy Web Site

TEACH ASTRONOMY Educator Forums

Search the Site

TEXTBOOK WIKIPEDIA IMAGES VIDEOS PODCASTS ASTROBITES GLOSSARY NEWS

Astropedia Textbook

Previous Page Next Page

Chapter 1 How Science Works
Chapter 2 Earth Astronomy
Chapter 3 The Copernican Revolution
Chapter 4 Matter and Energy in the Universe
Chapter 5 The Earth-Moon System
Chapter 6 The Terrestrial Planets
Chapter 7 The Giant Planets and Their Moons
Chapter 8 The Gas Giant Planets
Chapter 9 Atmospheres of Gas Giant Planets
Chapter 10 Climate and Weather on Gas Giant Planets
Chapter 11 Interiors of Gas Giant Planets
Chapter 12 Rings of Gas Giant Planets
Chapter 13 Why Gas Giants are Giant
Chapter 14 Gas Giants
Chapter 15 Ring Systems of Gas Giant Planets
Chapter 16 Saturn's Rings
Chapter 17 The Origin of Ring Particles
Chapter 18 The Moons and Resonance and Harmonic Effects of Ring Particles
Chapter 19 Satellite Systems of Gas Giant Planets
Chapter 20 The Voyager Mission
Chapter 21 Jupiter's Galilean Moons

TEACH ASTRONOMY Educator Forums

Search the Site

TEXTBOOK WIKIPEDIA IMAGES VIDEOS PODCASTS ASTROBITES GLOSSARY NEWS

Wikipedia black hole

Black hole READ

- Black hole thermodynamics READ
- Fuzzball (string theory) READ
- Hawking radiation READ
- Supermassive black hole READ
- Kerr metric READ
- Cygnus X-1 READ
- Micro black hole READ
- Stellar black hole READ
- No-hair theorem READ
- General relativity READ

TEACH ASTRONOMY

About Teach Astronomy

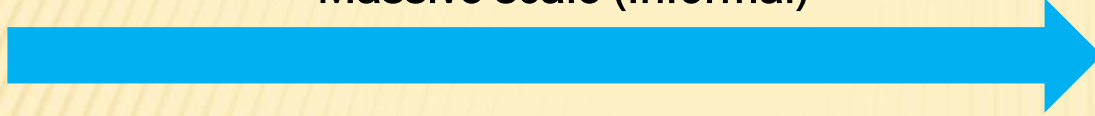
Teach Astronomy is an astronomy learning tool, intended either as a supplement for classroom instruction or for informal learners wanting to know more about the subject. The major types of content can be explored with a keyword search and/or by using the visual display (called a Wikimap) to surf related items.

- Textbook
- Wikipedia
- Images
- Videos
- Podcasts

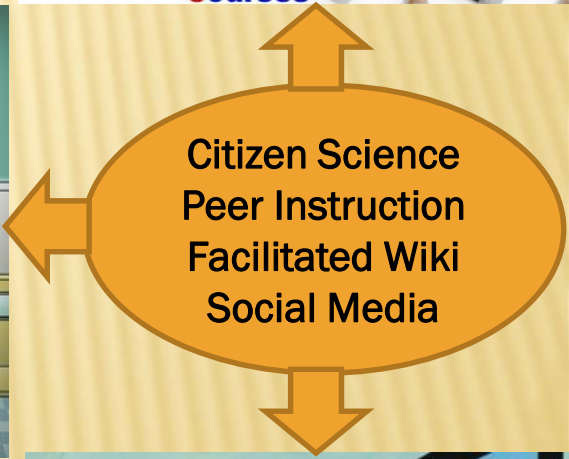
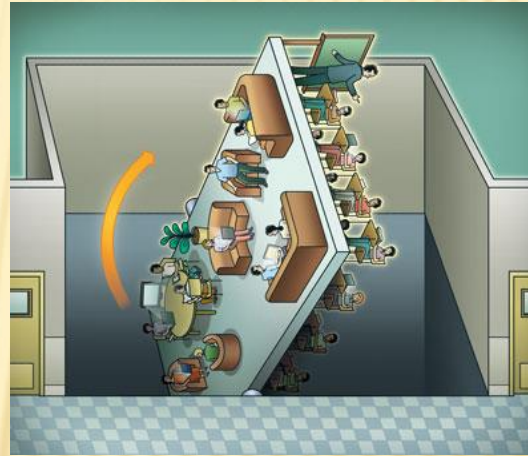
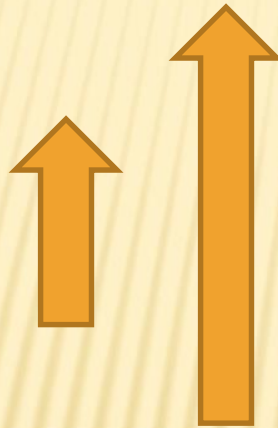
- Free web site supporting astronomy education/outreach
- Over 750,000 unique users, 130,000 page views/month
- Online book: 550 articles, 2000 images, and a quiz tool
- Over 12,000 images and over 75,000 Wikipedia articles
- All content indexed and clustered, with visual navigation
- Video FAQ, timeline tool, Google Home + Amazon Alexa

Next Generation Science Class

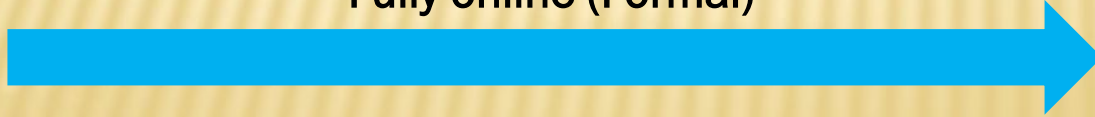
Massive scale (Informal)



Interactivity



Fully online (Formal)



Current Research Questions

- What are the impacts on learning, retention and engagement of flipped vs. face-to-face classes?
- **Can learner-centered tools like lecture tutorials be successfully adapted to an online class?**
- Is there any relation between learning outcomes and use of citizen science and social media?
- **What factors in an online learning environment most influence engagement and completion?**
- Do learner-centered methods improve retention of STEM majors or attract students into STEM?

THE END