Access. Learning. Science.

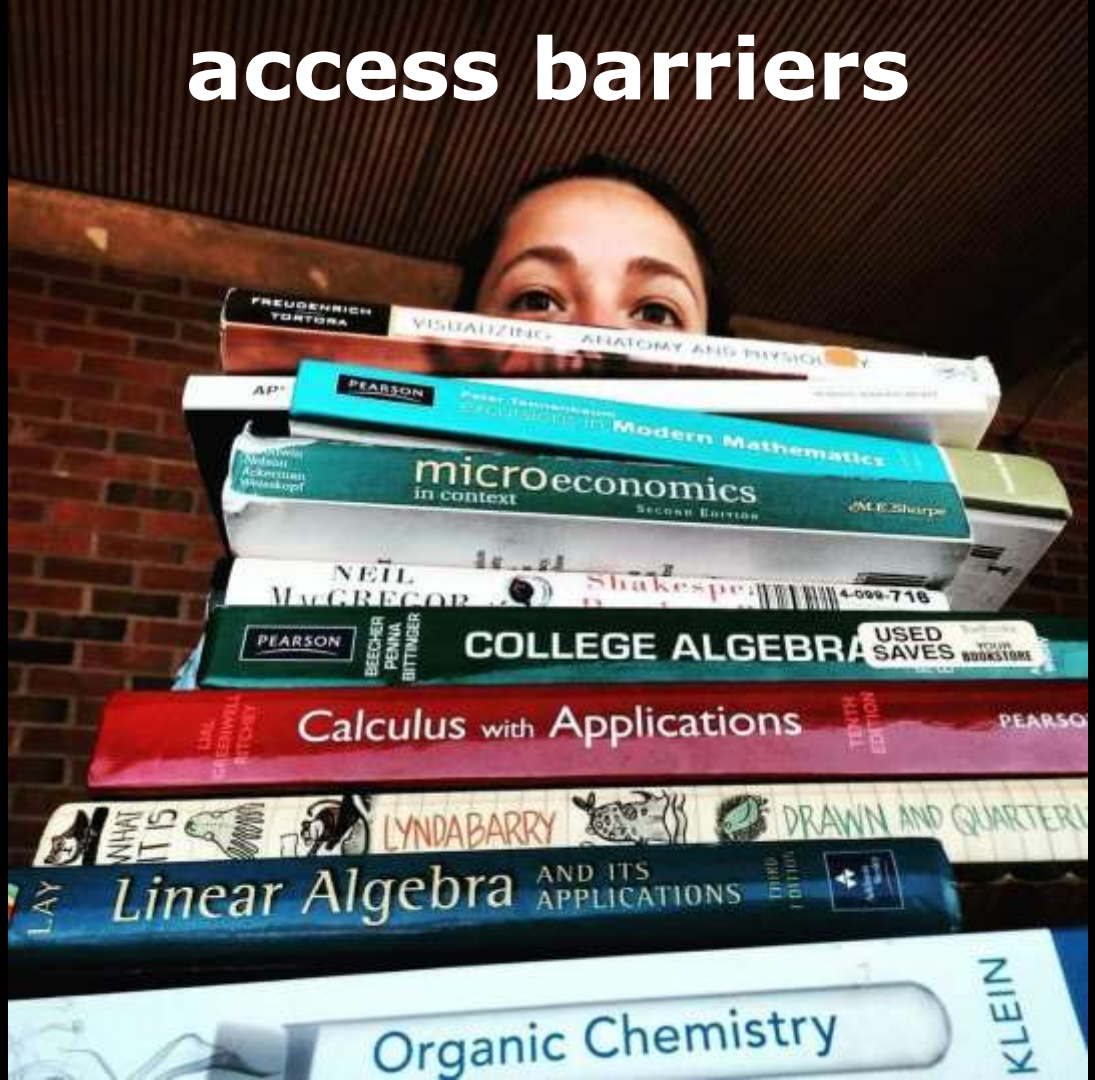
Richard Baraniuk

openstax™

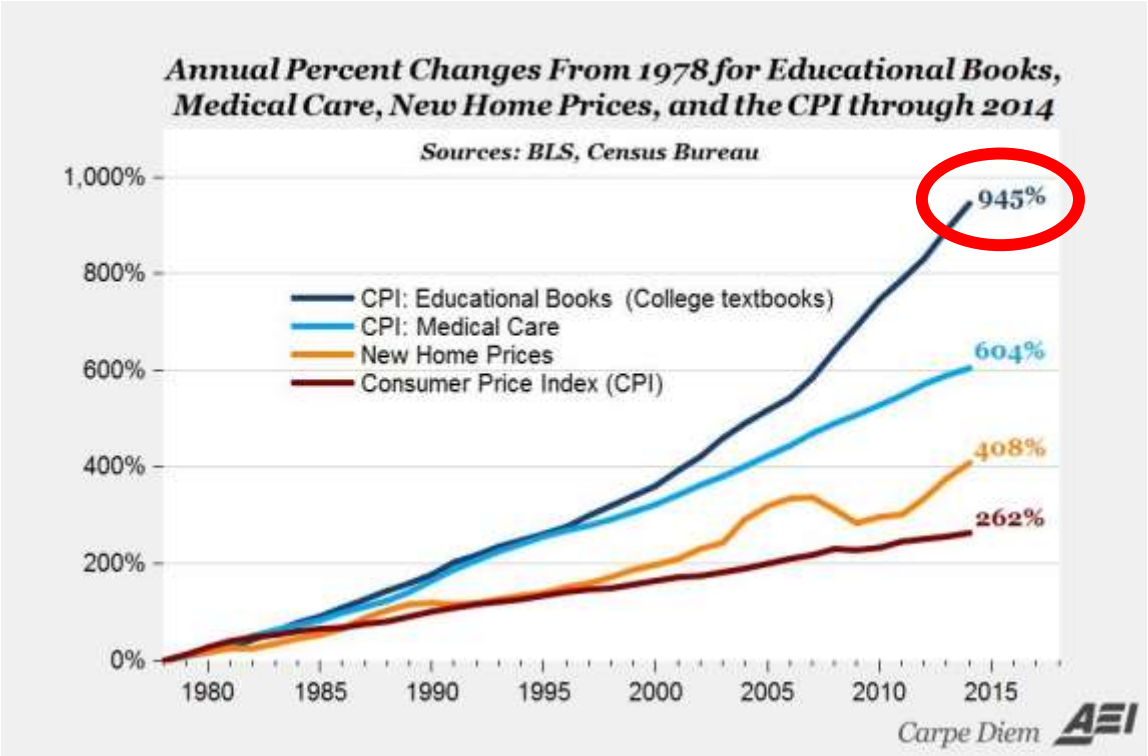
RICE


education today

access barriers



(college) access barriers



- **$400 textbooks**
  - Textbooks represent **>40% of the cost** of attending community college
- **Student loan debt >$1.5T**
  - #2 consumer debt category behind only mortgages

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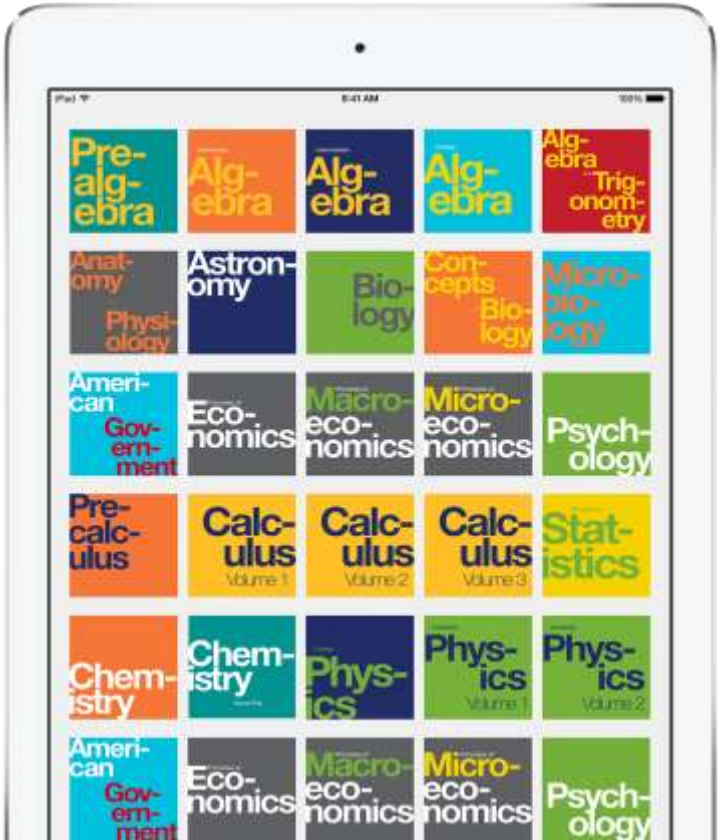
Free online textbooks

pdf, ebook, web
(+low-cost print)



Comprehensive, professionally authored, high quality, **peer-reviewed**

Open-source and easily customized by educators (**modular** structure)

Sustainable and **scalable** business model via 50+ corporate partners

progress (since 2012)

openstax™

40 textbooks

Intro college (100-level), Advanced Placement, high school

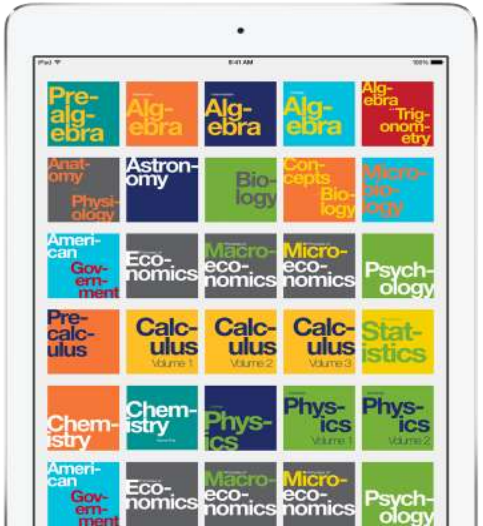
6M students have saved $600M

This past school year, 2.7M students saved $270M
16k instructors
365k high school students

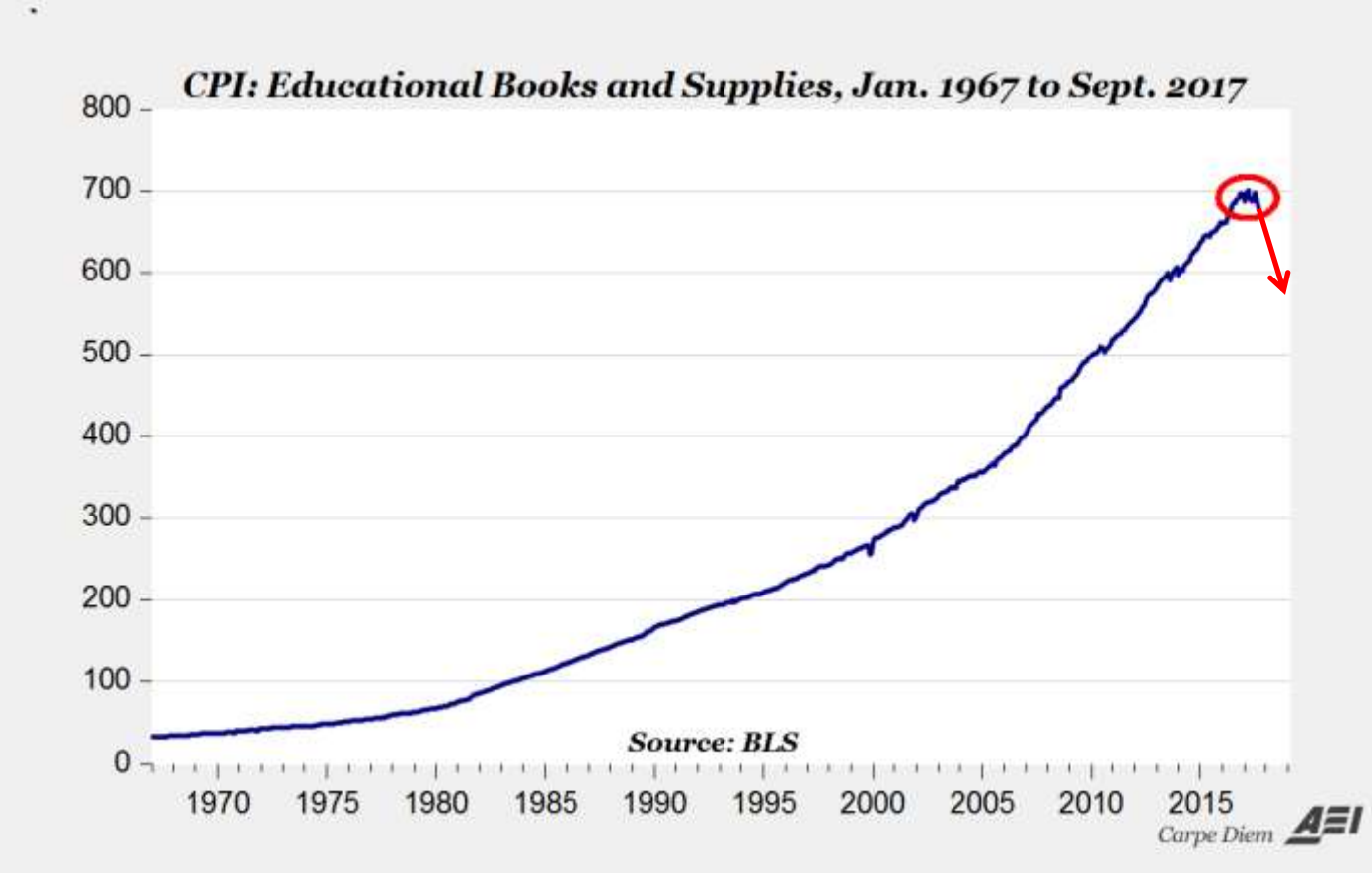
60% of all US degree-granting institutions

OpenStax Physics now #1 text

Other top texts: *Chemistry, Biology, Psychology, Anatomy, Economics*
Averaging 18% market share across library



positive disruption



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what's next?

- **40** more college texts (planning and fund raising)

- **Career pathways collections**
  - **Business** (launched)
  - Computer science / Data science
  - Applied Sciences / Nursing

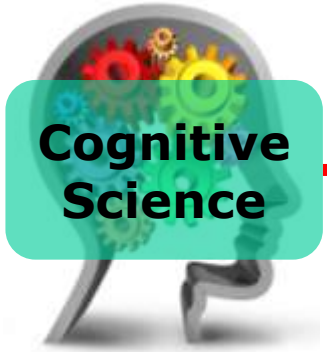
- **High school** texts
  - 7 funded by TEA

TEA
TEXAS EDUCATION AGENCY

learning barriers

openstax TUTOR beta™

data



Cognitive Science

Machine Learning

feedback

openstax TUTOR beta™

The navigation allows the student to review each step of their progress through the reading.

Acceleration

A plane slows down as it comes in for landing in St. Maarten. Its acceleration is in the opposite direction of its velocity. (credit: Steve Conry, Flickr)

You may have heard the term *accelerator*, referring to the gas pedal in a car. When the gas pedal is pushed down, the flow of gasoline to the engine increases, which increases the car's ***velocity***. Pushing on the gas pedal results in ***acceleration*** because the velocity of the car increases, and acceleration is defined as a change in velocity. You need two quantities to define velocity: a speed and a direction. Changing either of these quantities (or both

Continue

Road 3.1 Acceleratio

The reading includes interactive activities to engage students like this simulation on motion in one dimension.

Instructions give the students specific information about what to investigate.

Virtual Physics

The Moving Man

With this animation, you can produce both variations of acceleration and velocity shown in Figure, plus a few more. Vary the velocity and acceleration by sliding the red and green markers along the scales. Keeping the velocity marker near zero will make the effect of acceleration more obvious. Try changing acceleration from positive to negative while the man is moving. We will come back to this animation and look at the "Charts" view when we study graphical representation of motion.

Students vary velocity and acceleration and see the effects on the man's movement and position.

Position

Velocity

Show Vector

Show Vector

Reset All

Follow-up questions make sure that the student can apply what they learned from interacting with the simulation.

(a)

(b)

Which part, (a) or (b), is represented when the velocity vector is on the positive side of the scale and the acceleration vector is set on the negative side of the scale? What does the car's motion look like for the given scenario?

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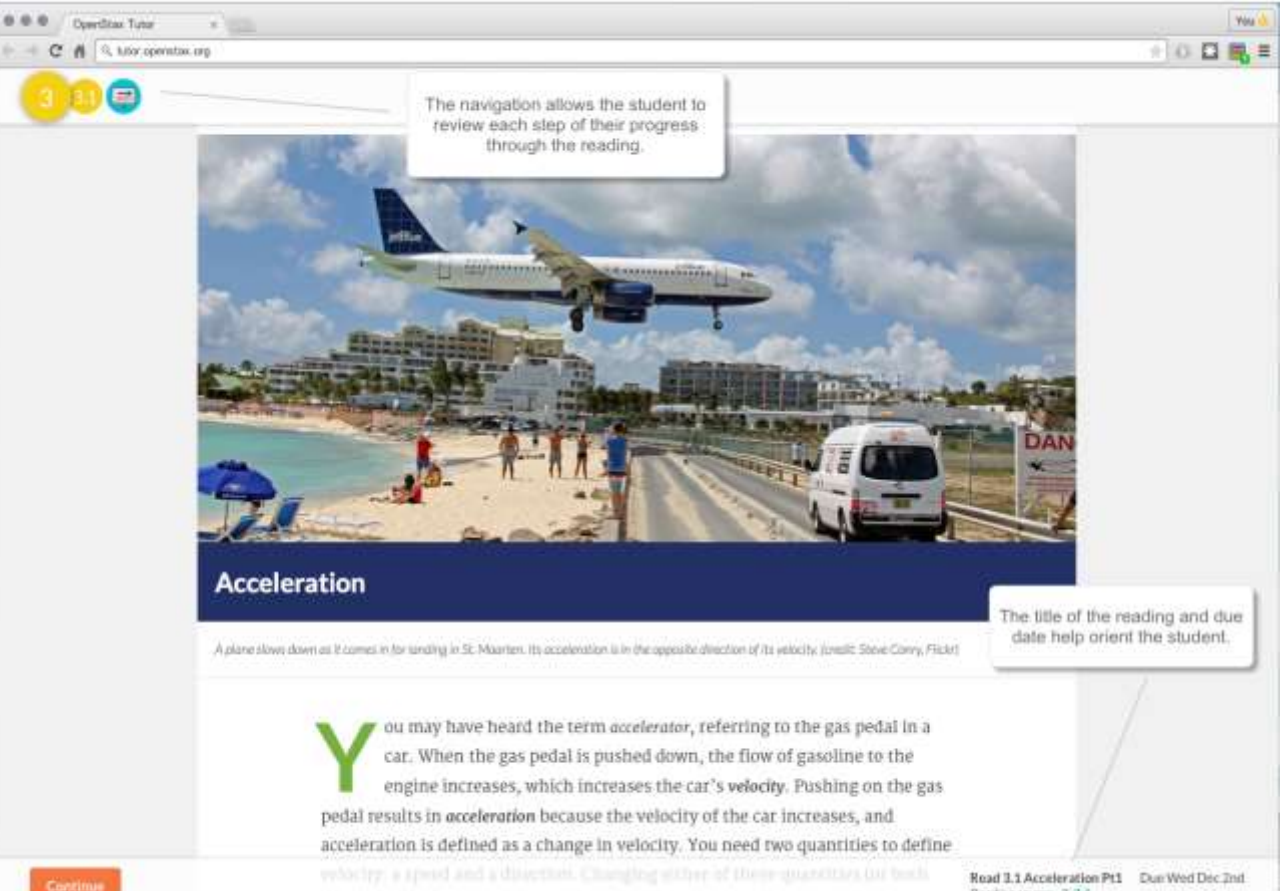


College Physics
Biology
Sociology

Integrating Cognitive Science and Technology Improves Learning in a STEM Classroom

Butler, Andrew C.; Marsh, Elizabeth J.; Slavinsky, J. P.; Baraniuk, Richard G.

Educational Psychology Review, v26 n2 p331-340 Jun 2014

The most effective educational interventions often face significant barriers to widespread implementation because they are highly specific, resource intense, and/or comprehensive. We argue for an alternative approach to improving education: leveraging technology and cognitive science to develop interventions that generalize, scale, and can be easily implemented within any curriculum. In a classroom experiment, we investigated whether three simple, but powerful principles from cognitive science could be combined to improve learning. Although implementation of these principles only required a few small changes to standard practice in a college engineering course, it significantly increased student performance on exams. Our findings highlight the potential for developing inexpensive, yet effective educational interventions that can be implemented worldwide.

- In a real-world engineering classroom, students using OpenStax Tutor improved **½-1 letter grade** over standard practice

scientific barriers

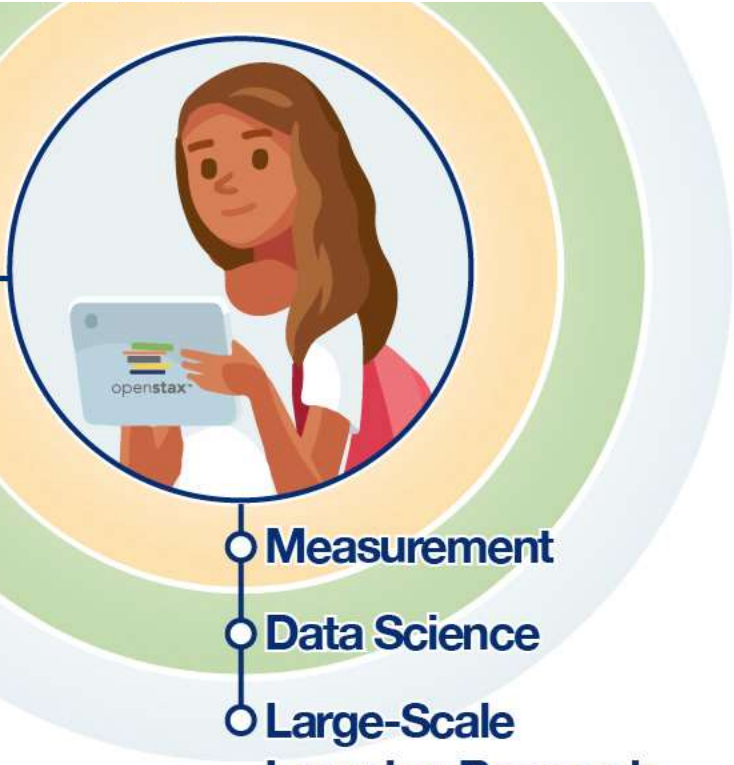
factors affecting learning

Individual Differences

- working memory
- locus of control
- mindset
- gender
- age …

Environmental Factors

- current/prior courses
- grades
- standardized test scores
- institutional factors
- family background factors …



- Measurement
- Data Science
- Large-Scale Learning Research

ongoing study

- Learning/pedagogical/ socio/economic factors most responsible for the **high school to college chasm**

RICE | HERC
Houston Education Research Consortium

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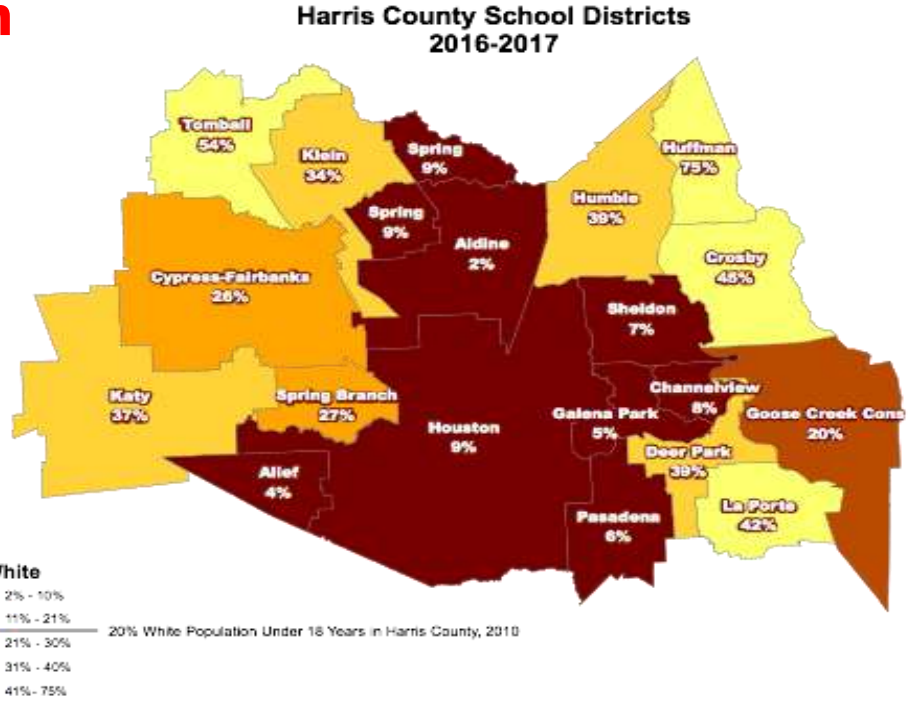
Learner Characteristics

Learning Materials

Learning Strategies

Assessment Characteristics




breaking
barriers
Access
Learning
Science
RICE
openstax™

Access. Support. Science.

Richard Baraniuk

openstax

RICE

1

barriers to education progress

- Today's **education systems are failing** for too many students
  - In the US, nearly half of college students never graduate

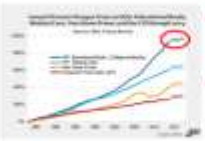
Access barriers
Support barriers
Science barriers

2

access barriers

3

access barriers



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4

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pdf, ebook, web
(+low-cost print)

Comprehensive, professionally authored, high quality, peer-reviewed

Open source and easily customized by educators (modular structure)

Sustainable and scalable business model via 50+ corporate partners, including most of the major publishers

5

progress (since 2012)

openstax

30 textbooks
(also college [100 level], Advanced Placement, high school)

6M students have saved **$600M**
This school year, 2.7M students are using 625M 165b high school books

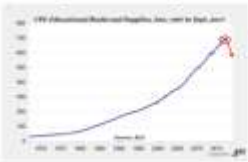
14000% return – and counting – on philanthropic investment

50% of all US degree-granting institutions

OpenStax *Physics* now **#1 text**
Other top texts: Chemistry, Biology, Psychology, AMT, Economics
Averaging 16% market share across library

6

positive disruption



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7

career pathways

Business	Computer/ Data Science	Applied Science/ Nursing	Liberal Arts
5 texts	7 texts	6 texts	4 texts
2.7M students	2.7M students	2.7M students	2.7M students

- Planning (and fund raising for) **40 additional open texts**

8

high school

AP Biology
AP College Physics
AP Principles of Macroeconomics
AP Principles of Microeconomics
TEA AP Biology
TEA AP Macroeconomics
TEA AP Microeconomics
TEA Physics
TEA AP Physics 1: Algebra-Based
TEA AP Physics 2: Algebra-Based
TEA Statistics

AP

TEA

9

support barriers

10

11

12

13

- In a real-world engineering classroom, students using OpenStax Tutor improved **½-1 letter grade** over standard practice

14

science barriers

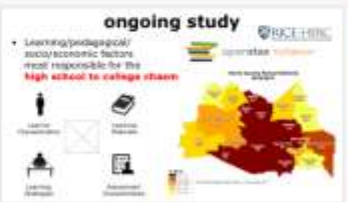
15

factors affecting learning

16

ongoing study

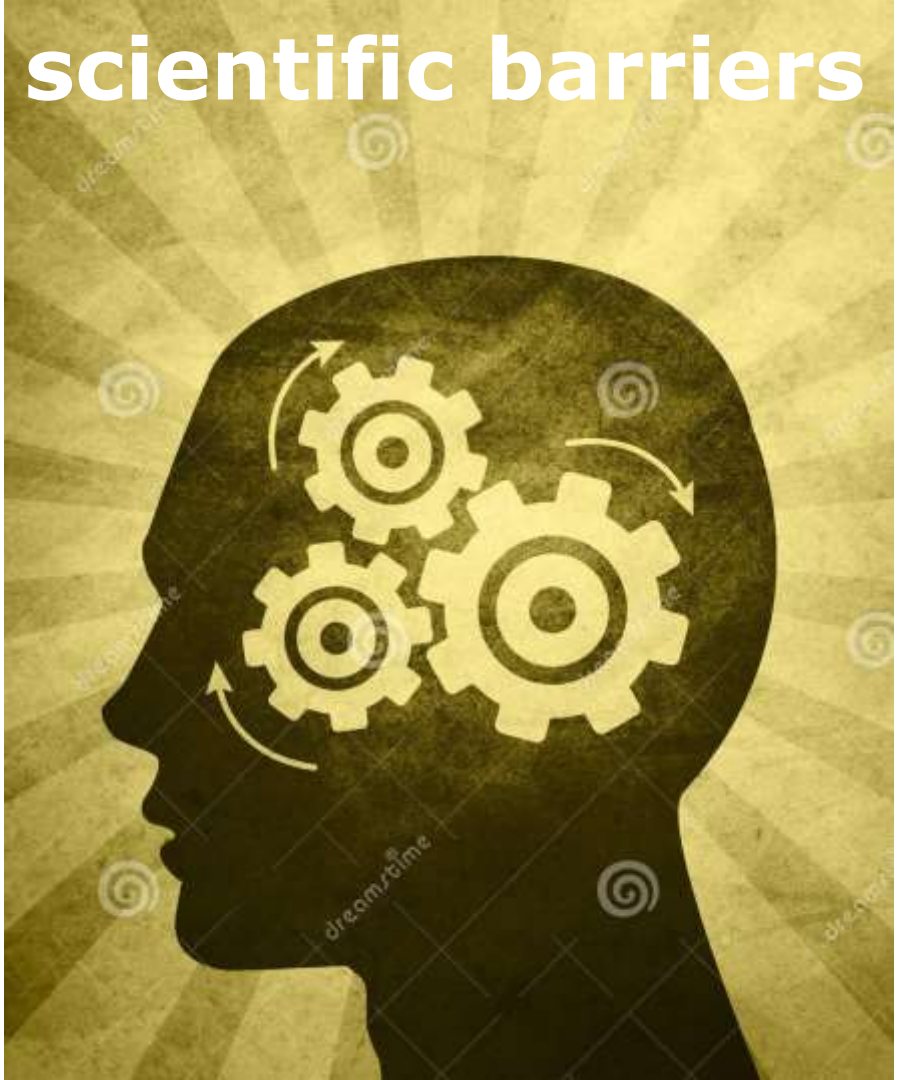
- Learning/pedagogical/ socio/economic factors most responsible for the **high school to college chasm**



17

18

scientific barriers



career pathways

Business	Computer/ Data Science	Applied Science/ Nursing	Liberal Arts
6 texts	7 texts	6 texts	9 texts
2.7M students	**2.7M students**	**1.7M students**	**5.7M students**

- Planning (and fund raising for) **40 additional open texts**

high school

AP Biology
AP College Physics
AP Principles of Macroeconomics
AP Principles of Microeconomics
TEA AP Biology
TEA AP Macroeconomics
TEA AP Microeconomics
TEA Physics
TEA AP Physics 1: Algebra-Based
TEA AP Physics 2: Algebra-Based
TEA Statistics