

Mixed Messages: Climate change in America's classrooms

Josh Rosenau

National Center for
Science Education

@JoshRosenau

rosenau@ncse.com

A sexual misconduct case
rocks anthropology p. 652

Long life in the
valley p. 688

Hybrid autoantigens drive
type 1 diabetes p. 711

Science

\$15
12 FEBRUARY 2016
sciencemag.org

AAAS

**Gordon
Research
Conferences**

Topics include behavior
of thin films p. 742

INSIGHTS | PERSPECTIVES

SCIENCE EDUCATION

Climate confusion among U.S. teachers

Teachers' knowledge and values can hinder climate education

By Eric Plutzer,¹ Mark McCaffrey,²
A. Lee Hannah,³ Joshua Rosenau,²
Minda Berbeco,² Ann H. Reid²

Although more than 95% of active climate scientists attribute recent global warming to human causes (1, 2) and most of the general public accepts that climate change is occurring, only about half of U.S. adults believe that human activity is the predominant cause (3), which is the lowest among 20 nations polled in 2014 (4). We examine how this societal debate affects science classrooms and find that, whereas most U.S. science teachers include climate science in their courses, their insufficient grasp of the science may hinder effective teaching. Mirroring some actors in the societal debate over climate change, many teachers repeat scientifically unsupported claims in class. Greater attention to teachers' knowledge, but also values, is critical.

EDUCATION

Prior surveys [e.g., (5, 6)] suggest that many teachers devote class time to climate change. Although these surveys are suggestive, their use of nonprobability sampling undermines the validity of their results. None quantified the amount of class time or the specific topics covered in class. We undertook the first nationally representative survey of science teachers focused on climate change. Working from a commercial database of 3.9 million teachers, we drew a stratified probability sample of 5000 names and implemented a multiple-contact paper and Web survey protocol during academic year 2014–15. We collected data from 1500 public middle- and high-school science teachers from all 50 U.S. states, representative of the population of science teachers in terms of school size, student socioeconomic status, and community economic and political characteristics. See supplemental materials (SM) for details.

INTRODUCING THE BASICS. Three in four science teachers allocate at least an hour to discussing recent global warming in their formal lesson plans, including 70% of middle-school science teachers and 87% of high-school biology teachers (table S7). Because

virtually all students take middle-school science and 97% enroll in a general biology class (7, 8), the likelihood of any student missing instruction in climate change altogether is low—on the order of 3 to 4%. Most teachers reported covering the greenhouse effect (66%), the carbon cycle (63%), and four or more observable consequences, such as sea-level rise, or changes in seasonal patterns, like the flowering of plants and animal migrations. Teachers also discuss responses to climate change and careers addressing the challenges it poses.

Although most students will hear something about climate change in a science class, the median teacher devotes only 1 to 2 hours to the topic (table S7), inconsistent with guidance from leading science and education bodies [e.g., (9)]. Of course, quality of instruction is more important than quantity, so we turn to how students are introduced to climate change science.

MIXING MESSAGES. Notably, 30% of teachers emphasize that recent global warming “is likely due to natural causes,” and 12% do not emphasize human causes (half of whom do not emphasize any explanation and thereby avoid the topic altogether). Of teachers who teach climate change, 31% report sending

explicitly contradictory messages, emphasizing both the scientific consensus that recent global warming is due to human activity and that many scientists believe recent increases in temperature are due to natural causes (see the first chart). Why might this be the case? Some teachers may wish to teach “both sides” to accommodate values and perspectives that students bring to the classroom (6, 10). Beyond that, the survey data allow us to evaluate three explanations.

First, teachers might experience overt pressure from parents, community leaders, or school administrators not to teach climate change. Only 4.4% of teachers reported such pressure (6.1% reported pressure to teach it, mostly from fellow teachers). This is less than the 15% reporting pressure in Wise's pioneering survey (6), and far less than biology teachers reported in a survey on teaching evolution (10).

Second, teachers also may not be very knowledgeable about a wide range of evidence—e.g., CO₂ measurements from ice cores and from direct measures at Mauna Loa—and how climate models work. Given the relative novelty of the topic in classrooms, instructional materials, and preservice training, this would not be surprising, and nearly 50% said that they would prioritize one or

“When I do teach about climate change, I emphasize ...”

... the scientific consensus that recent global warming is primarily being caused by human release of greenhouse gases from fossil fuels.

... that many scientists believe that recent increases in temperature are likely due to natural causes.

Agree or strongly agree

Disagree or strongly disagree

Agree or strongly agree

Mixed messages
31%

Scientific consensus
54%

Disagree or strongly disagree

Denial
10%

Avoidance
5%

Teachers' emphasis. Teachers reported emphasis on causes of global warming, among those devoting an hour or more to the topic (see SM for details on calculation).

¹Department of Political Science, The Pennsylvania State University, University Park, PA 16802, USA. ²National Center for Science Education, Oakland, CA 94609, USA. ³Department of Political Science, Wright State University, Dayton, OH 45435, USA. *Corresponding author. E-mail: plutzer@psu.edu

Teachers Misinform Students On Climate Change

AMERICAN VOICES

February 15, 2016

VOL 52 ISSUE 06

Opinion

A recent survey found that many teachers are inadvertently instilling climate change denial in students by suggesting global warming is equally the result of human activities and natural causes. What do you think?



“Well, now their colleges will have something useful to teach them.”

Beau Rafferty • PROGRAM NAMER



“It’s so hard for teachers to know what’s right, what with the overwhelming abundance of scientists saying the exact same thing.”

Adrian Baird • UNEMPLOYED



“But surely our students are still being given a proper overview of the Treaty of Tordesillas?”

Gladys Pullman • SYSTEMS ANALYST

1500 Teachers

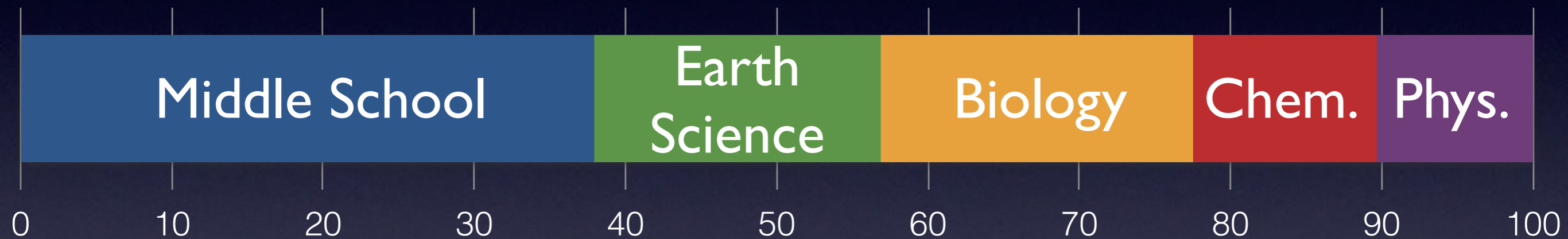
1 500 Teachers

All 50 states

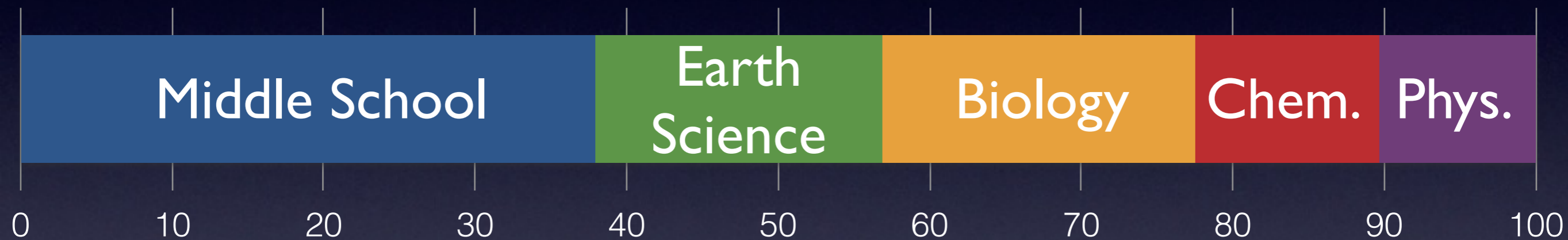
Mail and online response options

37% response rate

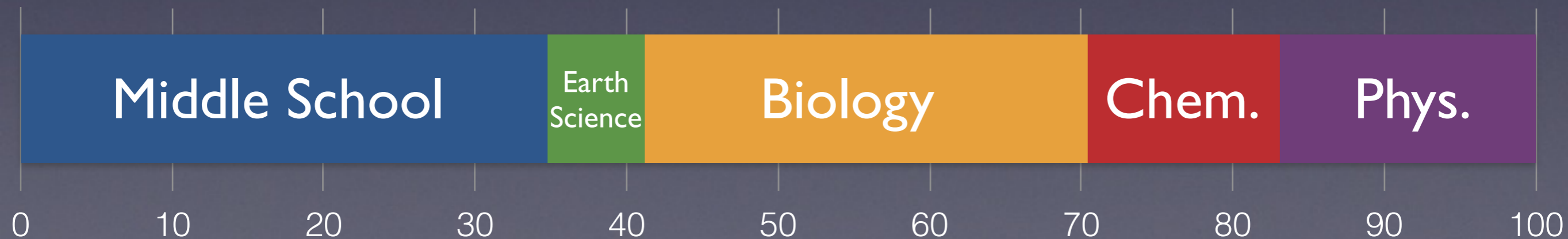
1500 Teachers

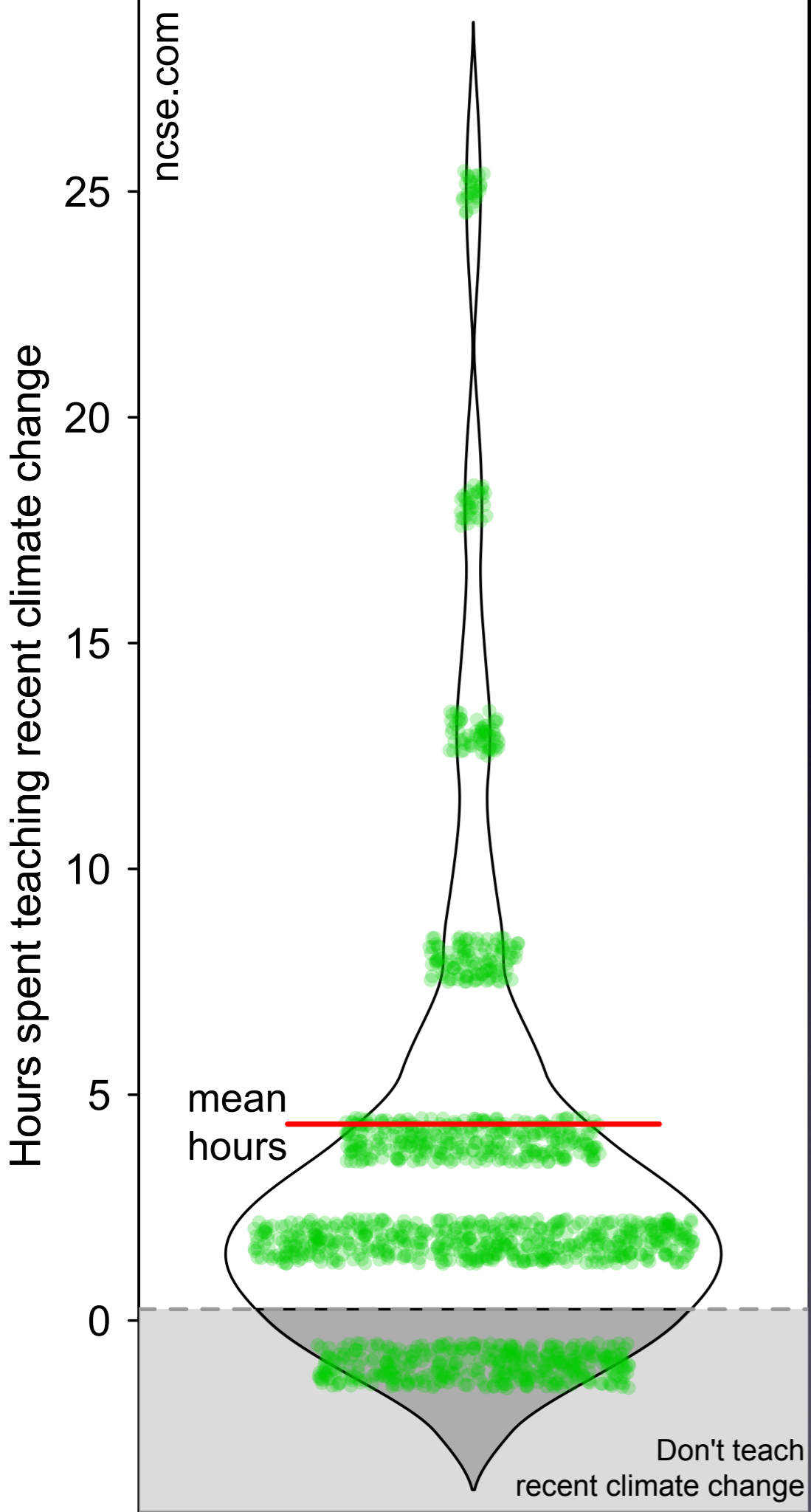


1500 Teachers



Actual distribution of teachers





Hours spent teaching recent climate change

ncse.com

25

20

15

10

5

0

mean
hours

Don't teach
recent climate change

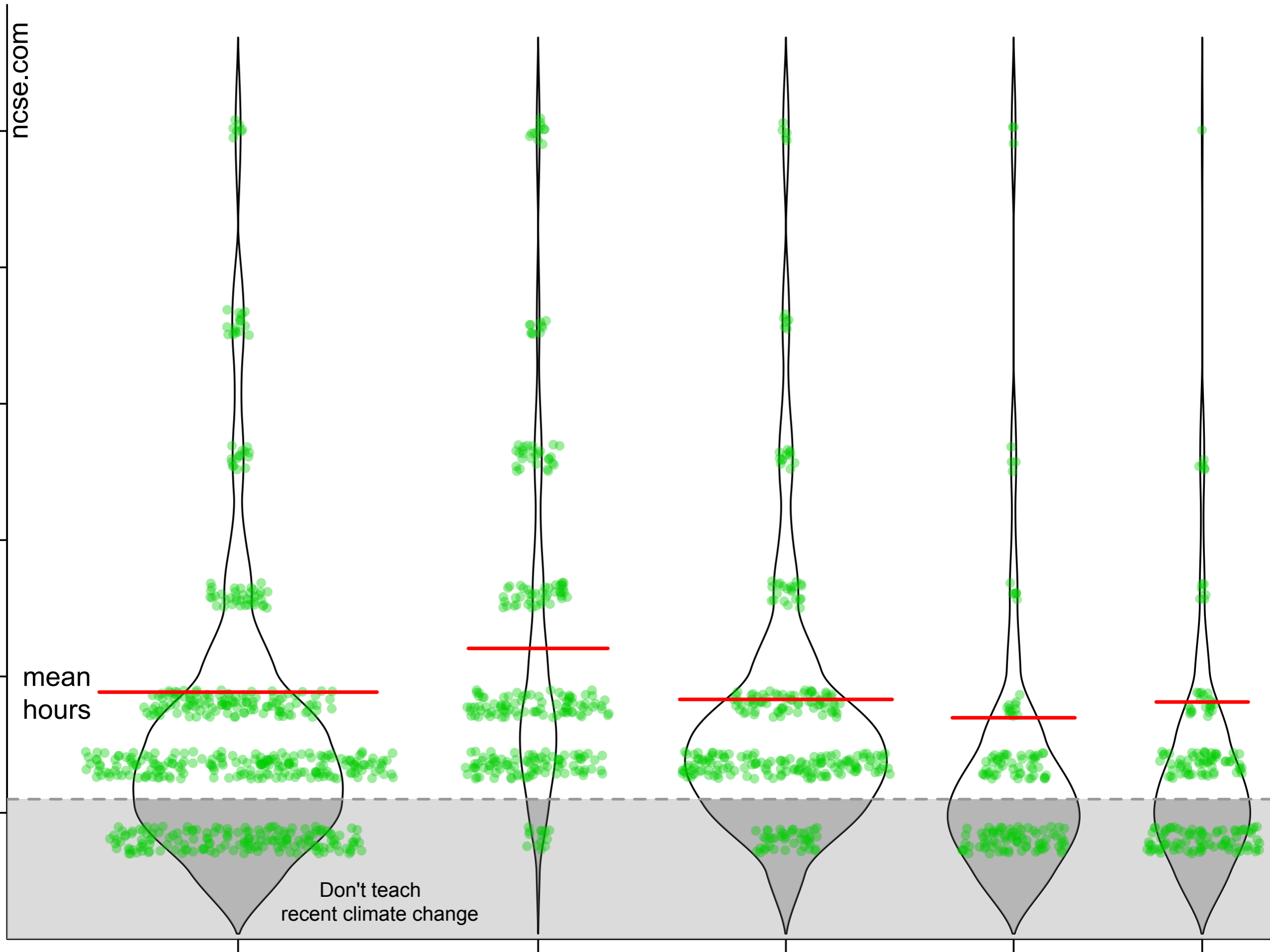
Middle School

Earth Science

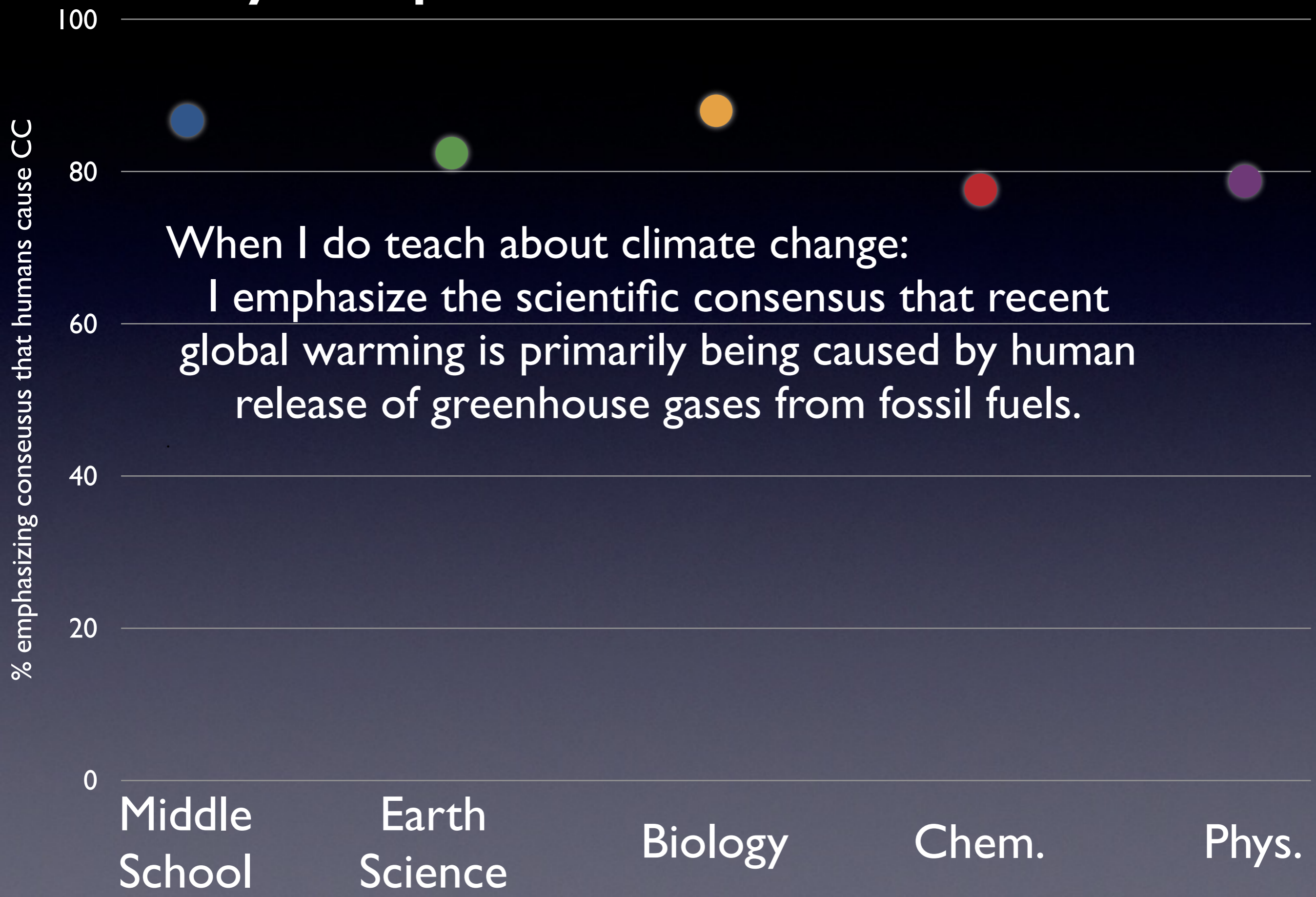
Biology

Chemistry

Physics



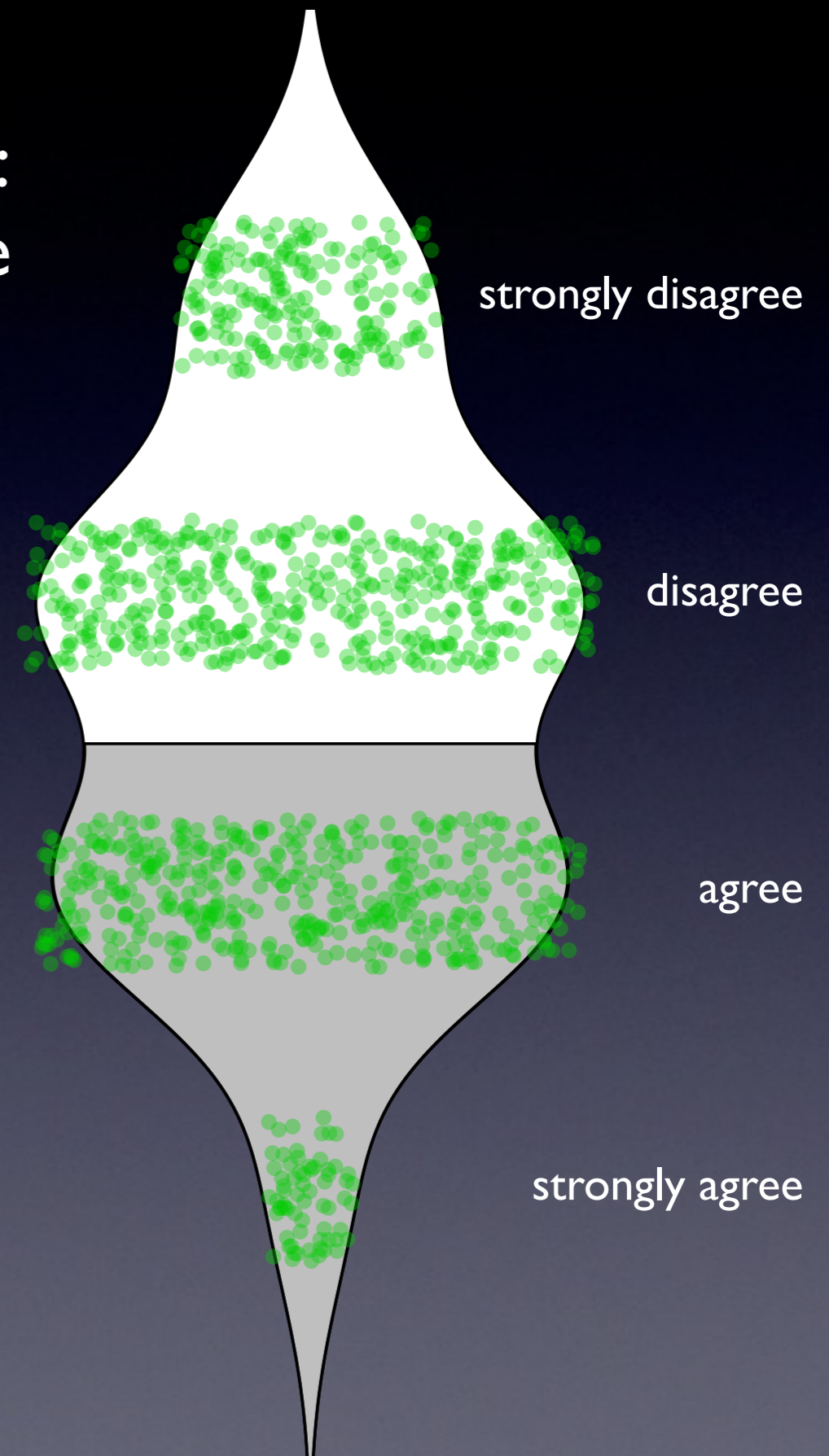
Many emphasize human causes...



Many emphasize natural causes...

When I do teach about climate change:
I emphasize that many scientists believe
that recent increases in temperature is
likely due to natural causes.

43%



“scientific
consensus”

“natural causes”

Agree or
strongly agree

Disagree or
strongly disagree

Agree or
strongly agree

31%
**(mixed
messages)**

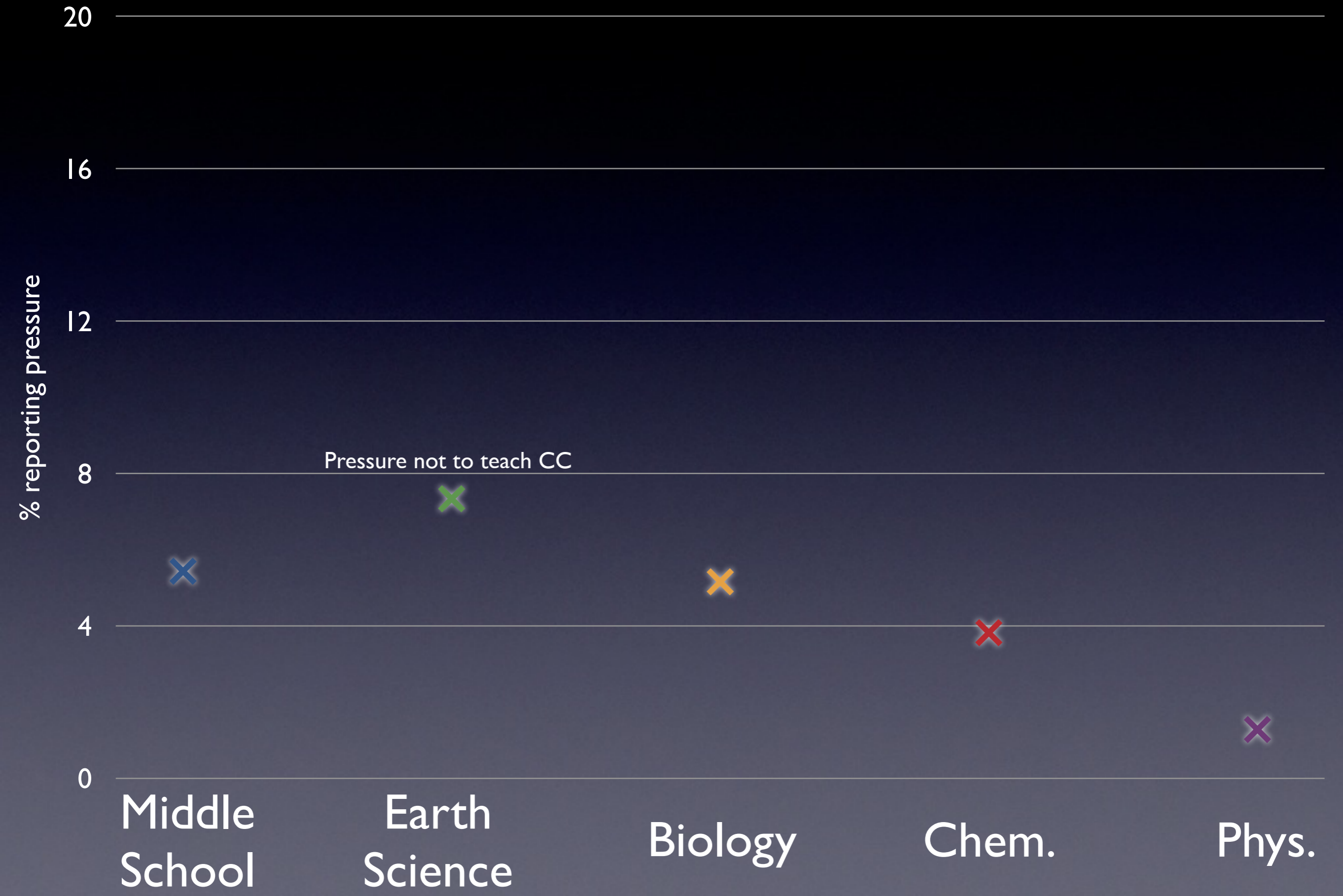
54%
**(scientific
consensus)**

Disagree or
strongly disagree

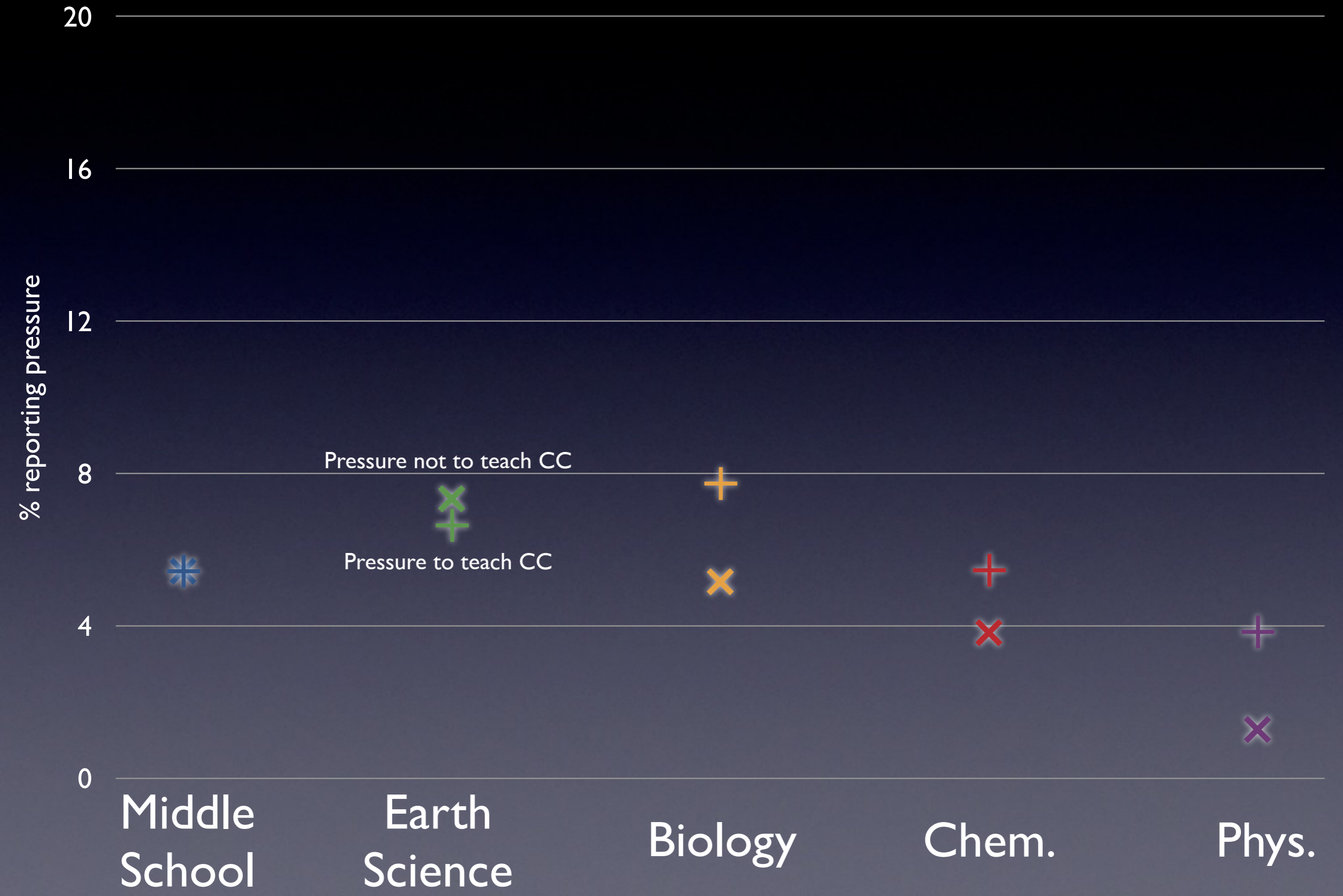
10%
(denial)

5%
(avoidance)

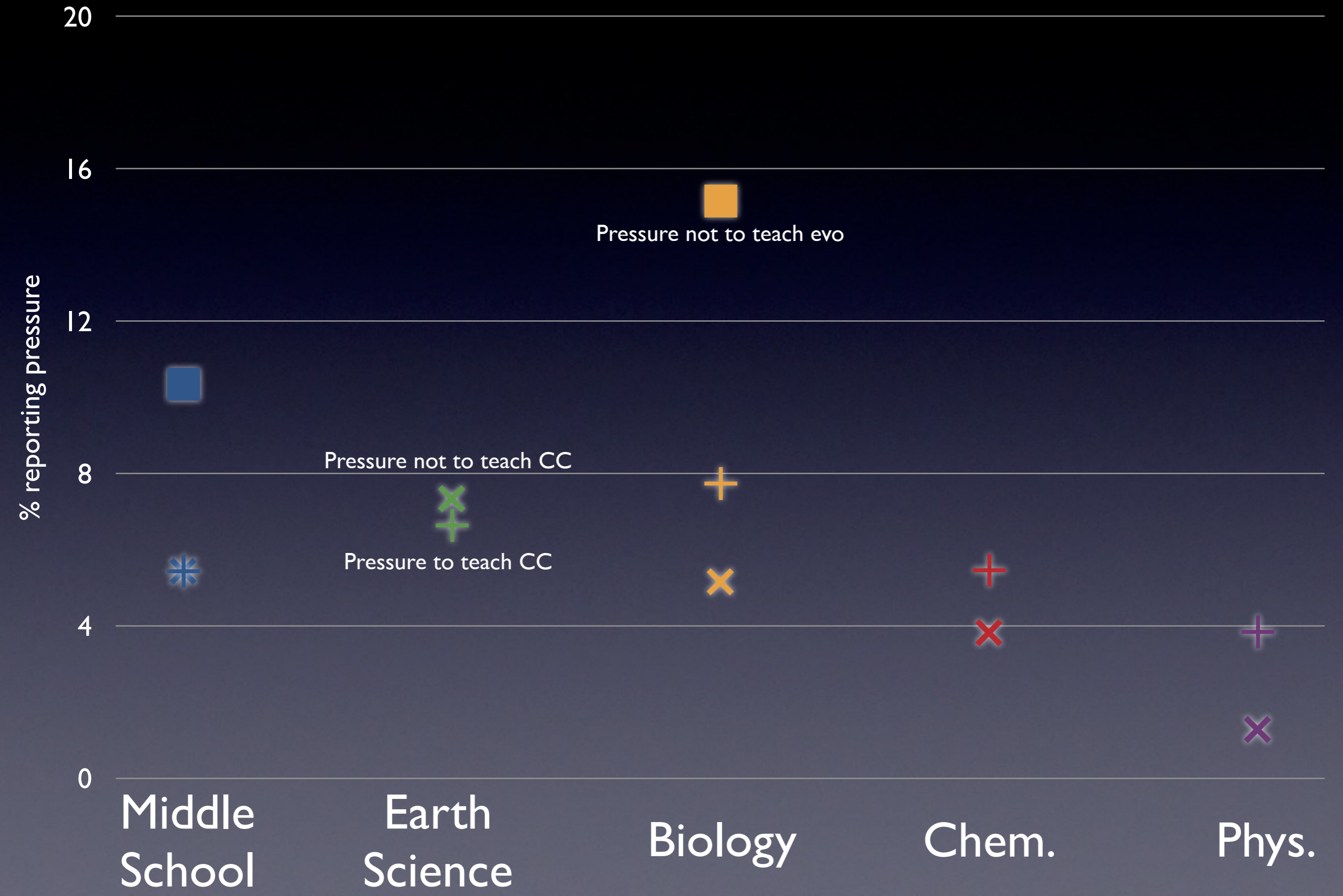
Less Pressure than for Evolution



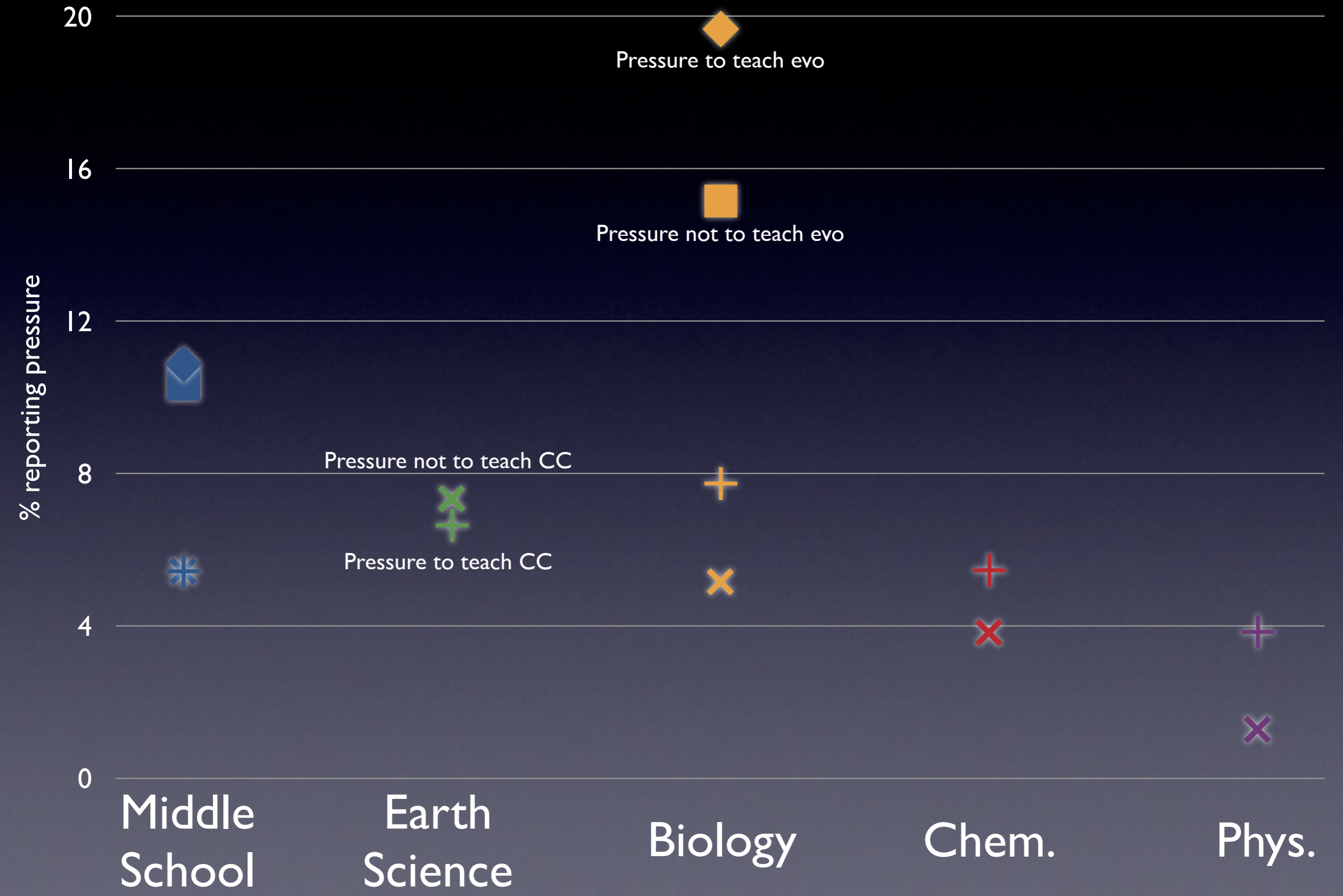
Less Pressure than for Evolution



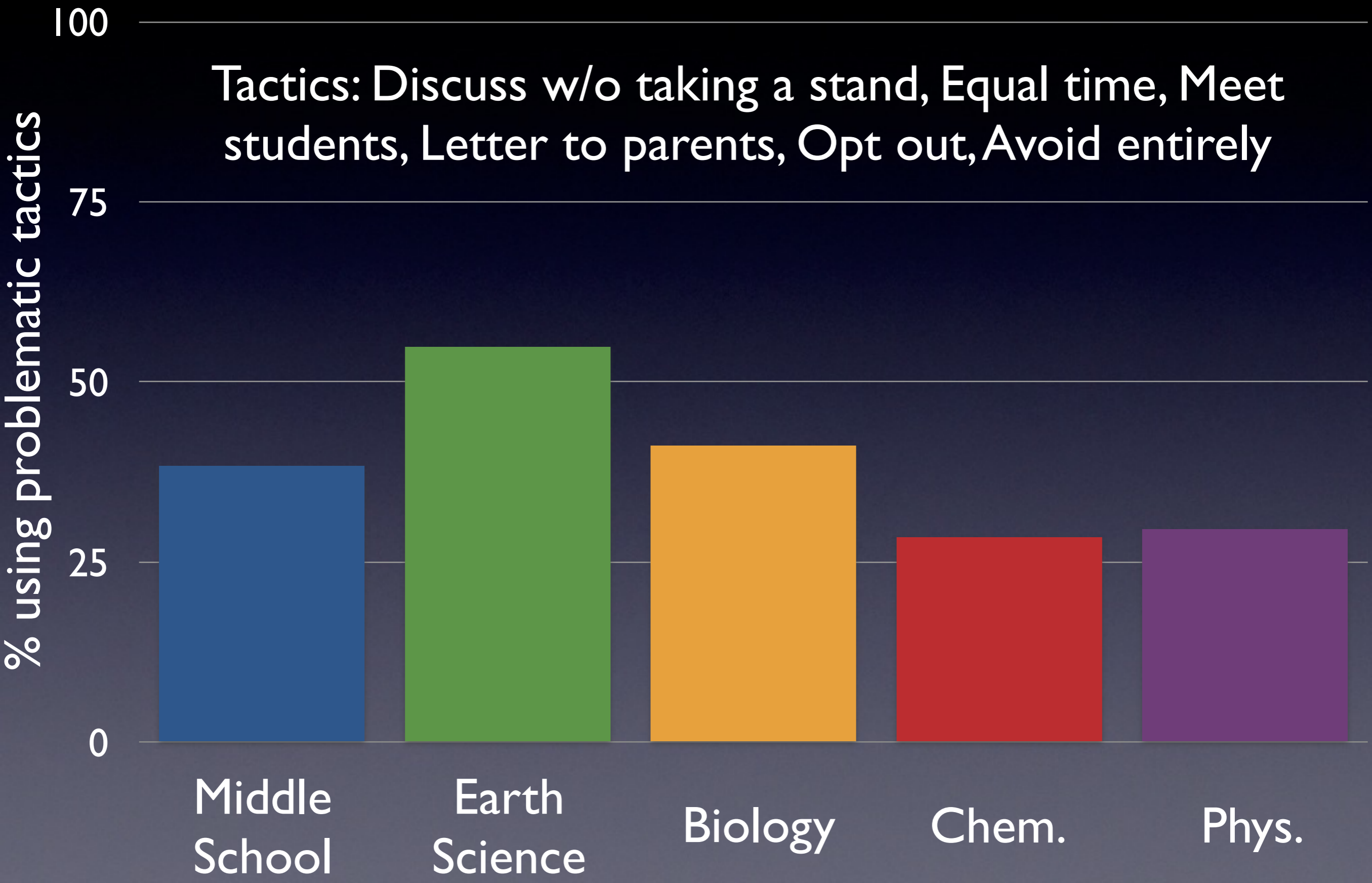
Less Pressure than for Evolution



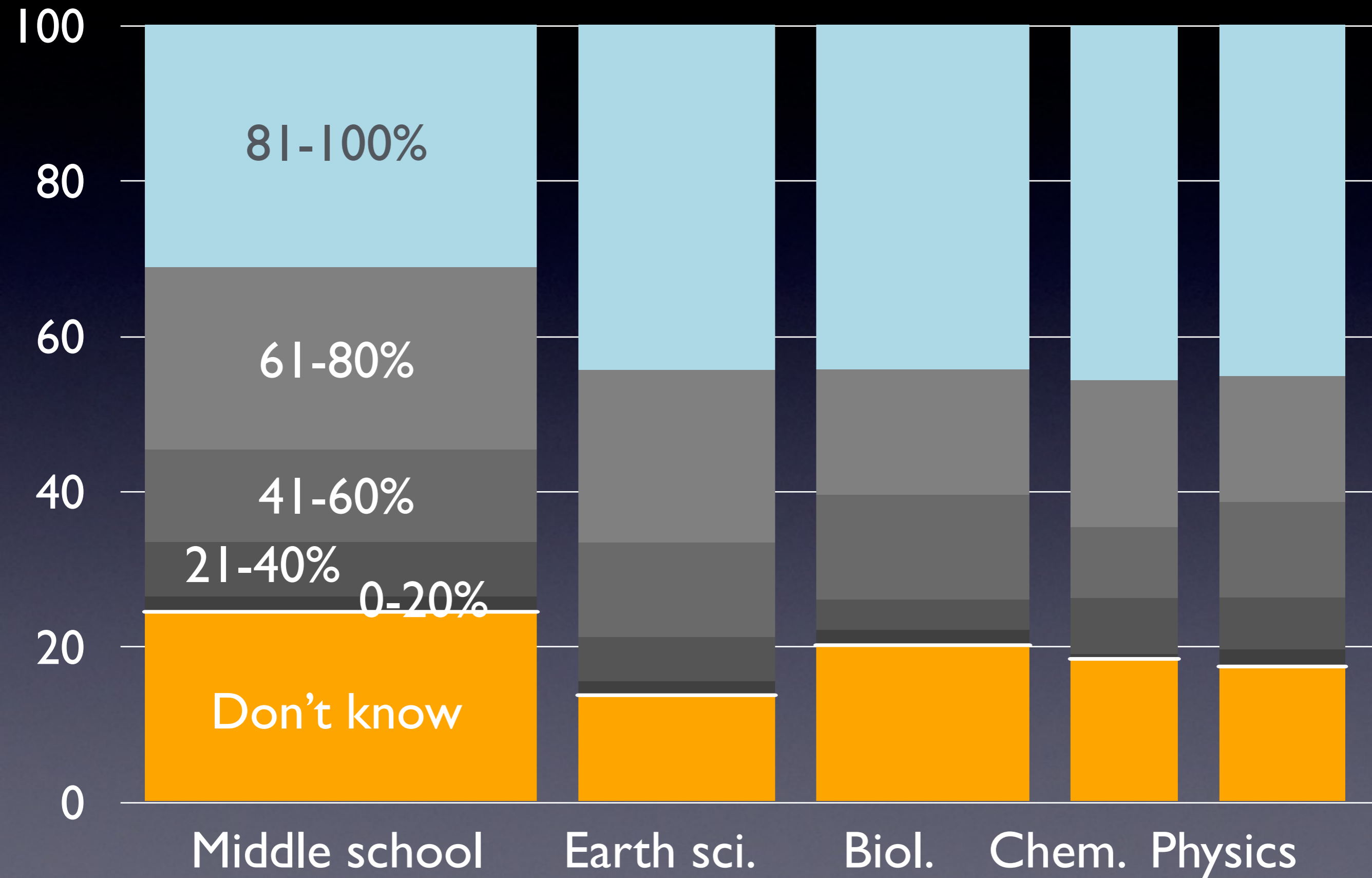
Less Pressure than for Evolution



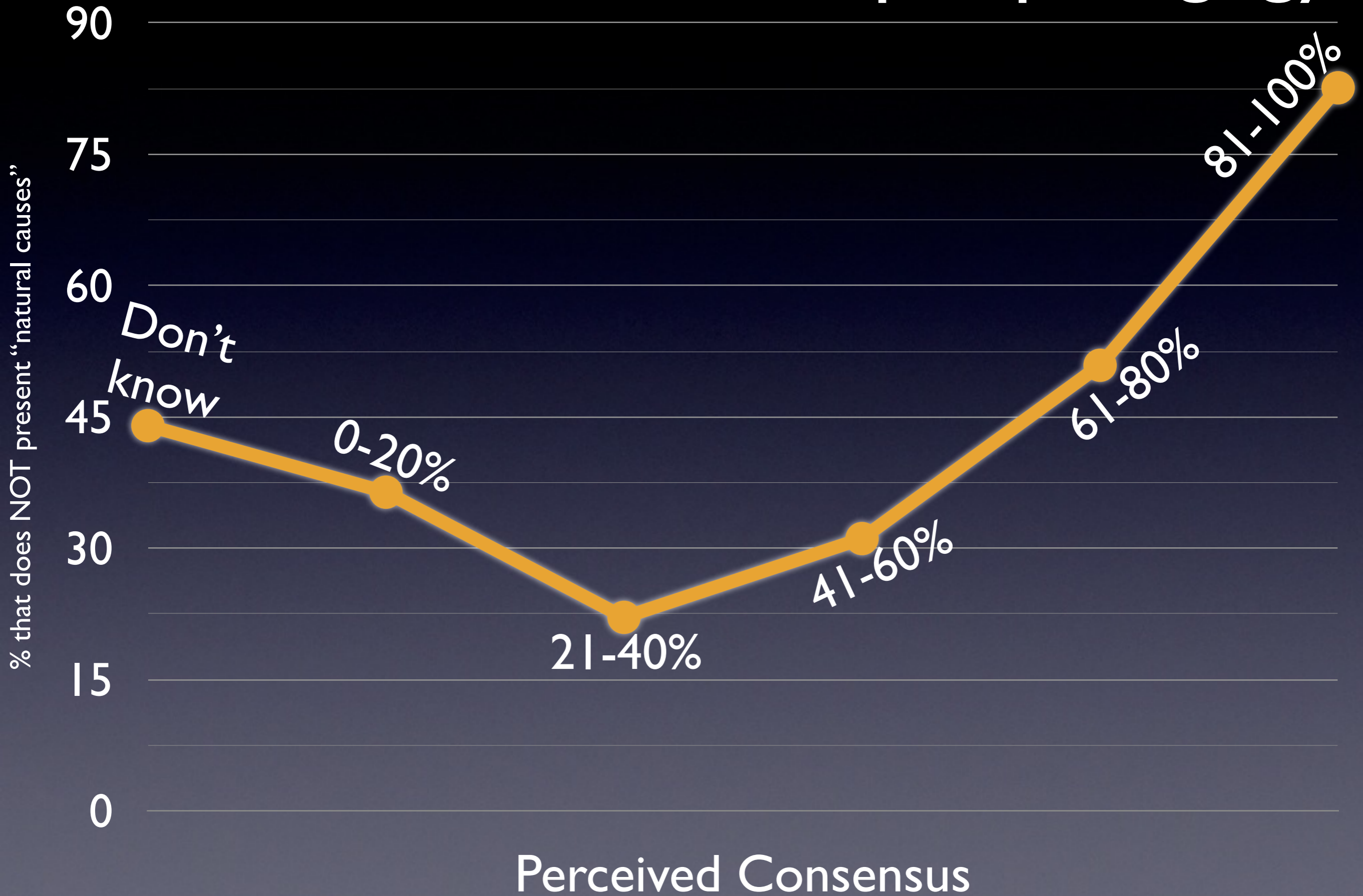
But Teachers Feel Pressure



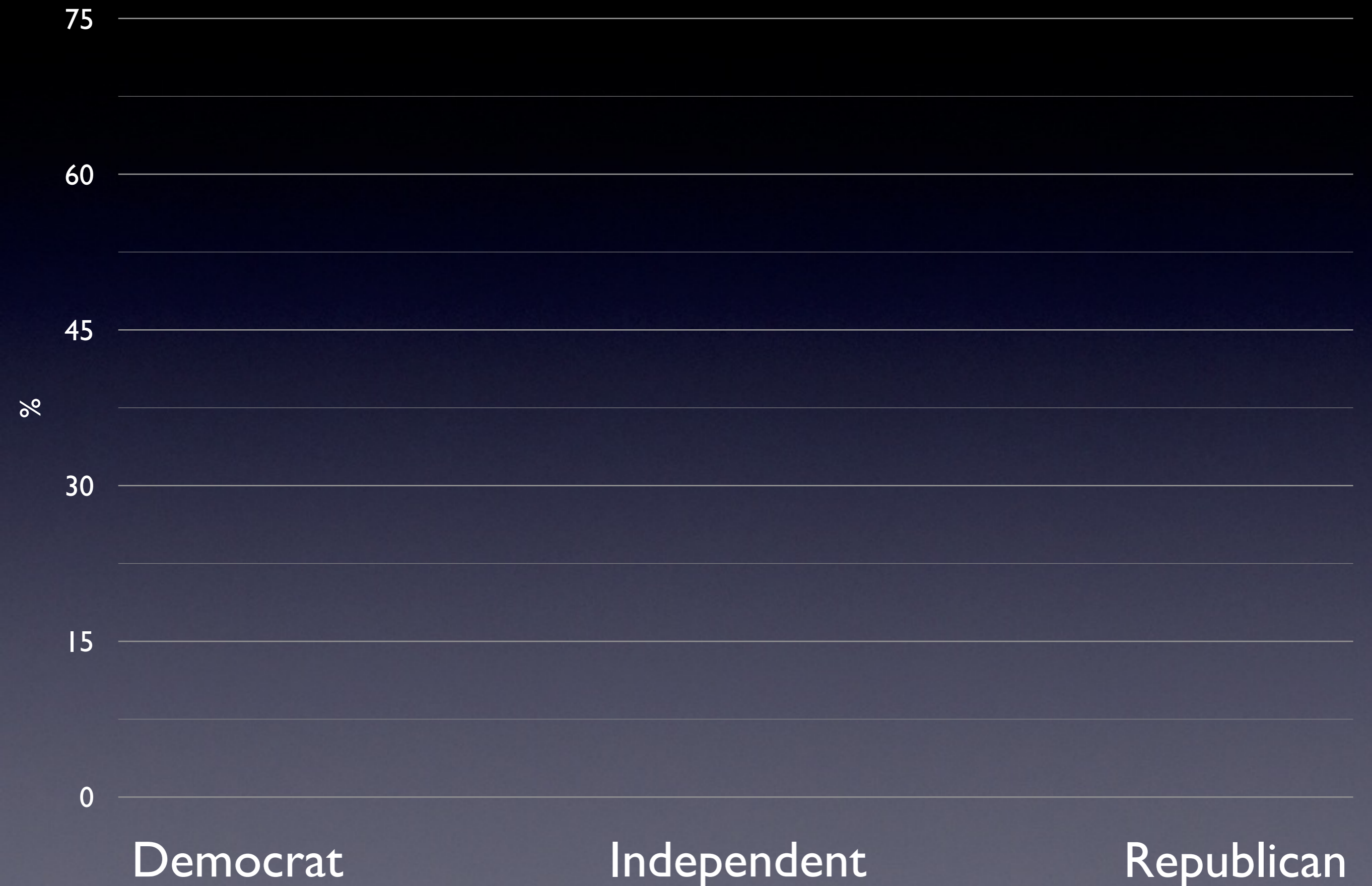
Most teachers don't know the size of the consensus



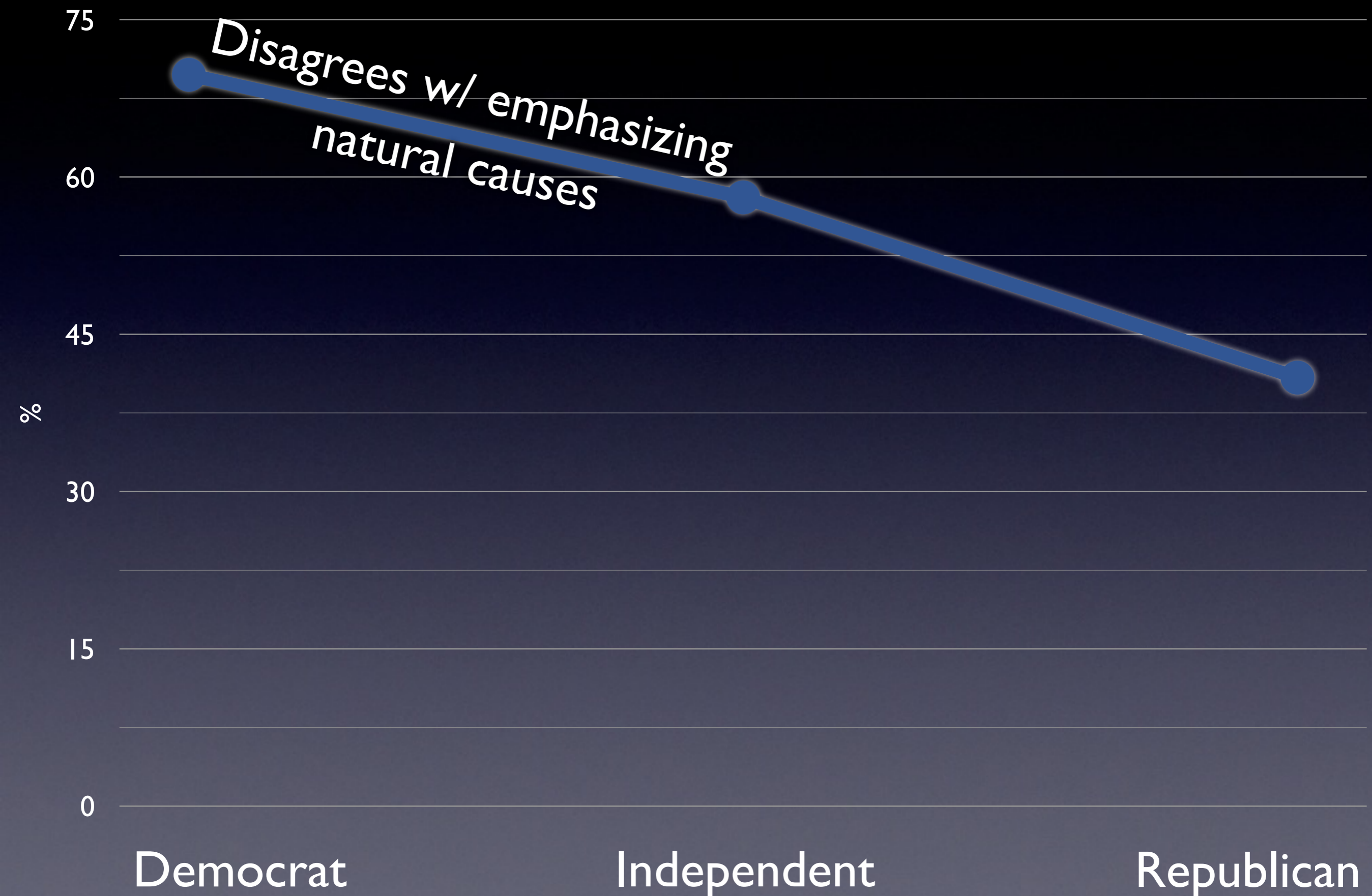
Perceived consensus shapes pedagogy



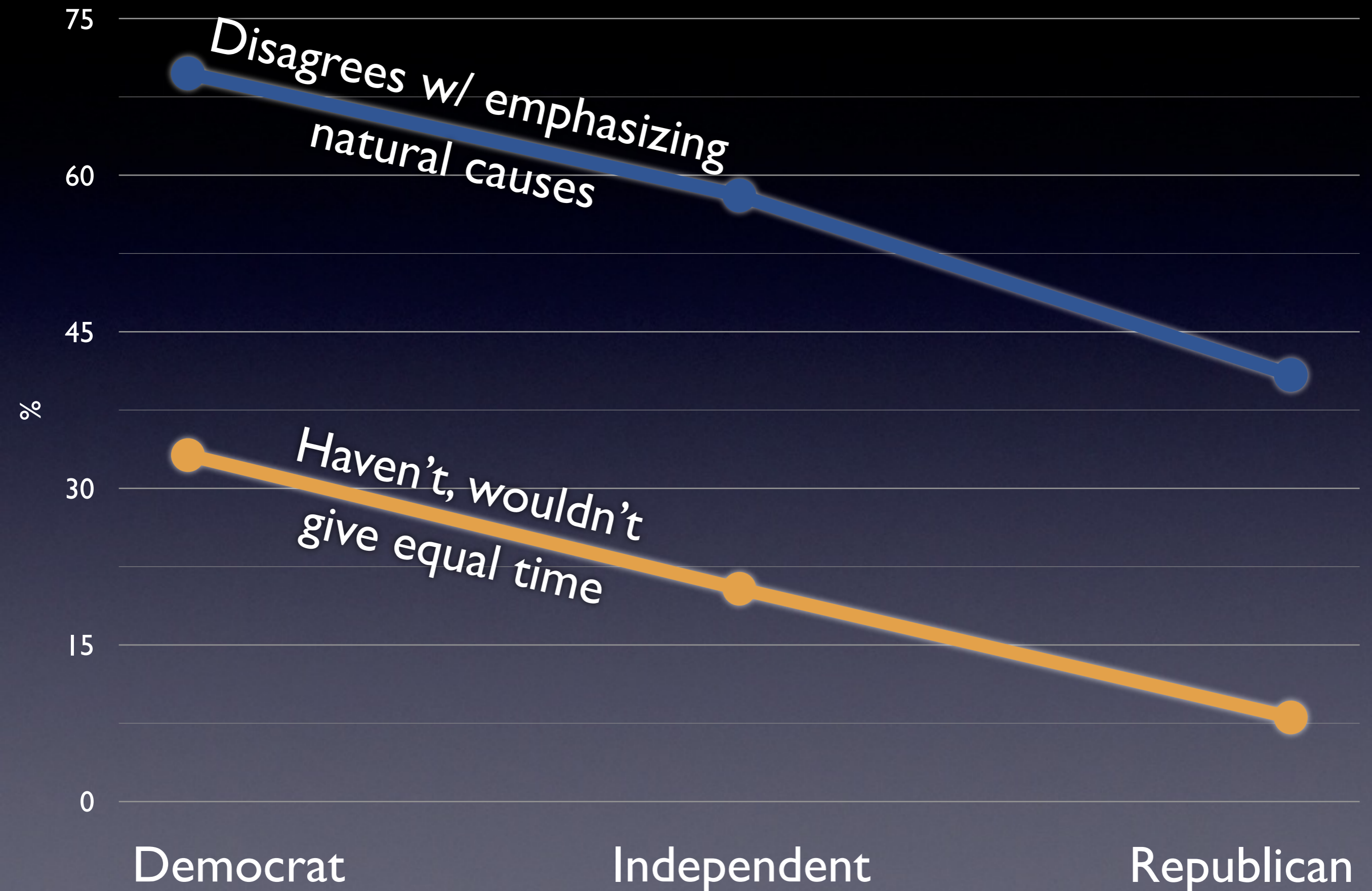
Politics shapes pedagogy



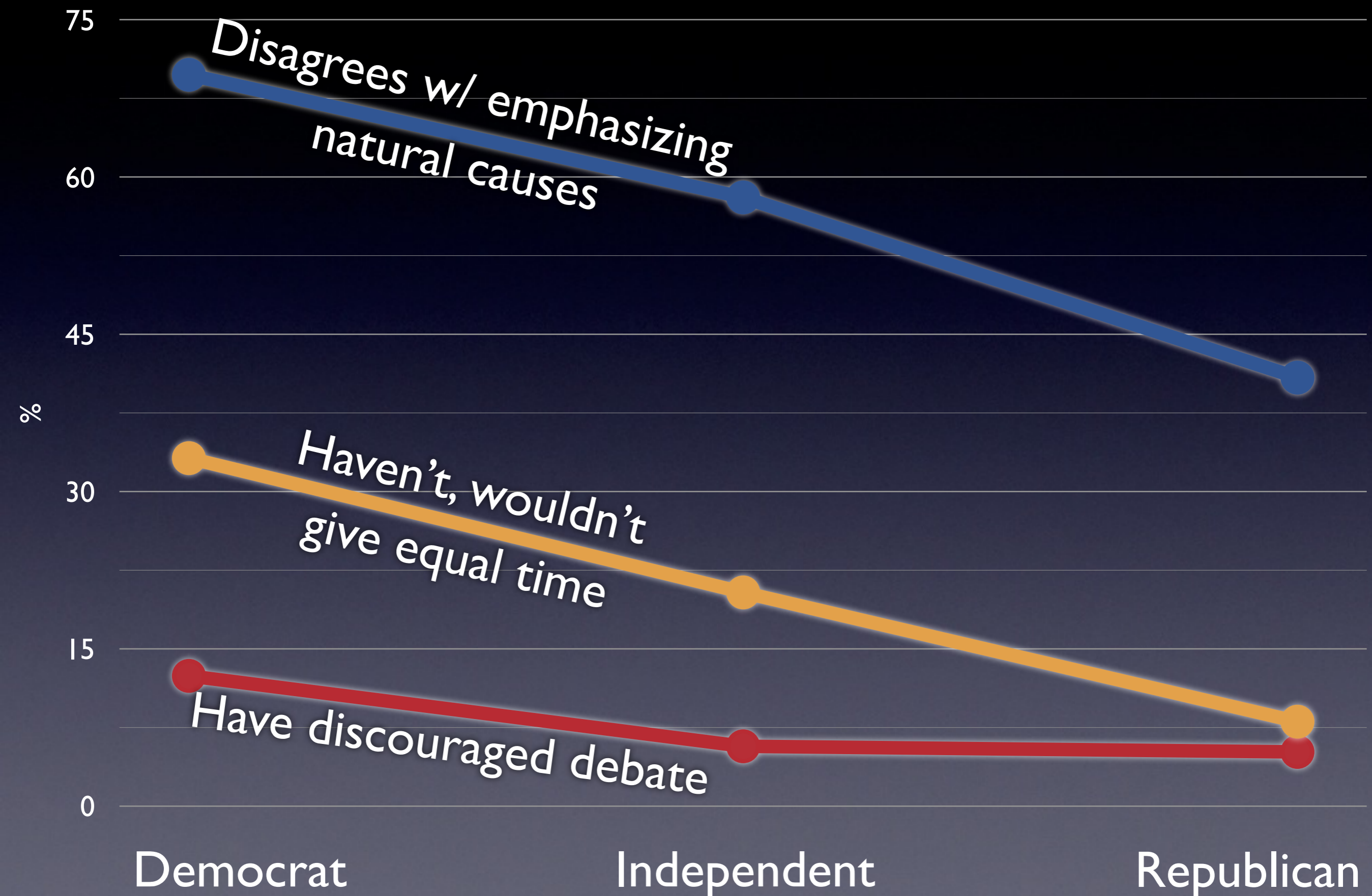
Politics shapes pedagogy



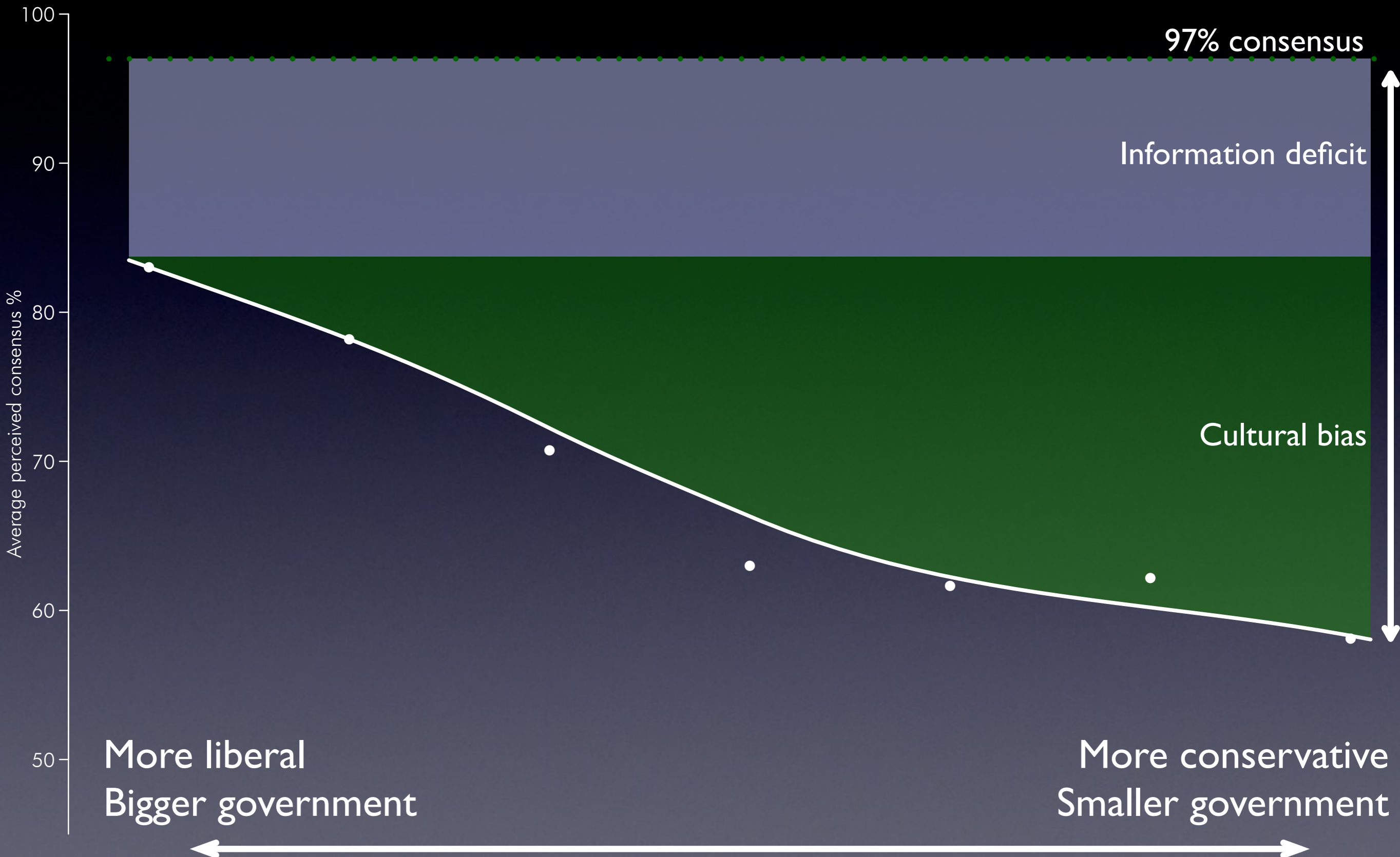
Politics shapes pedagogy



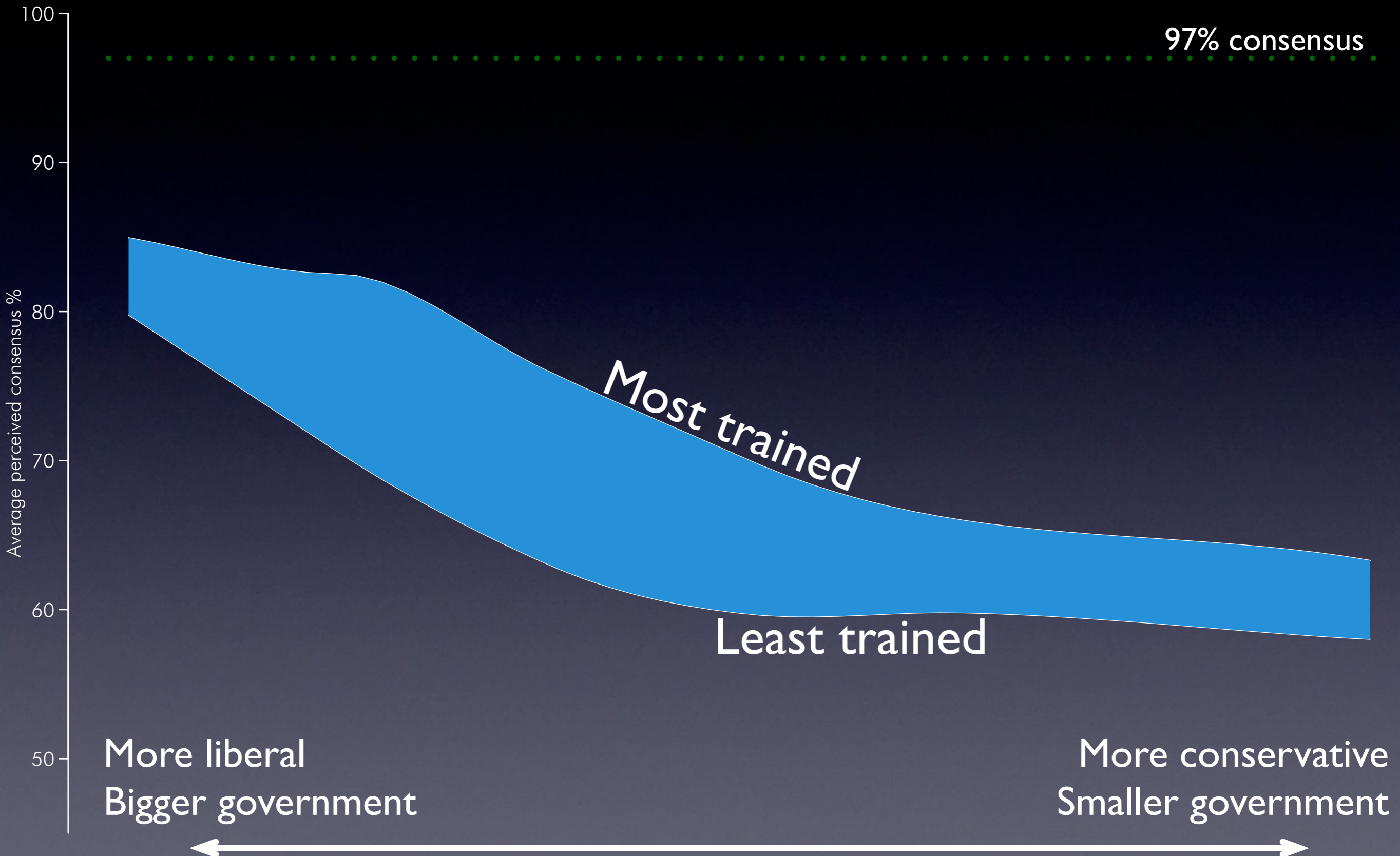
Politics shapes pedagogy



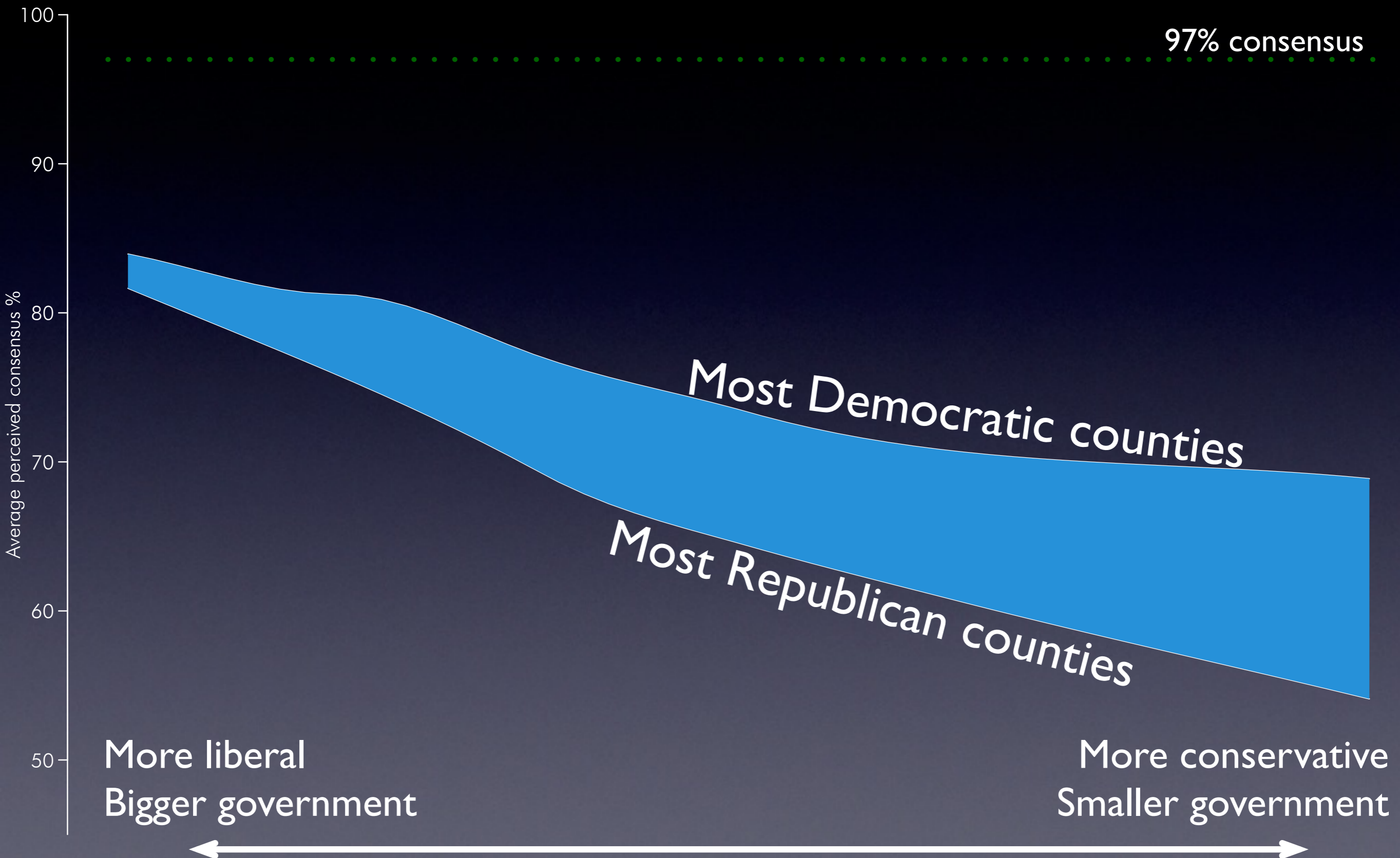
Politics shapes perceived consensus



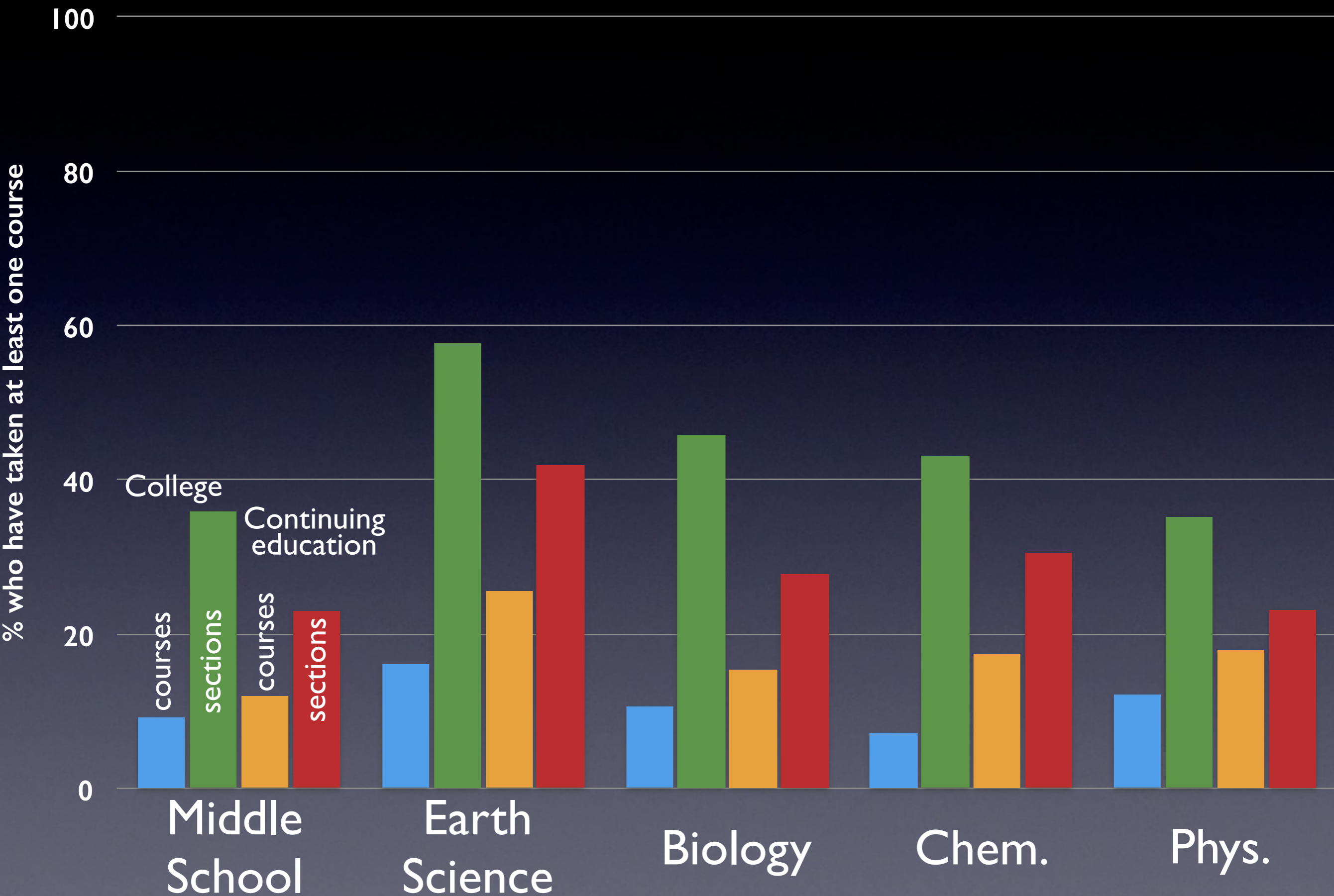
Training shapes perceived consensus



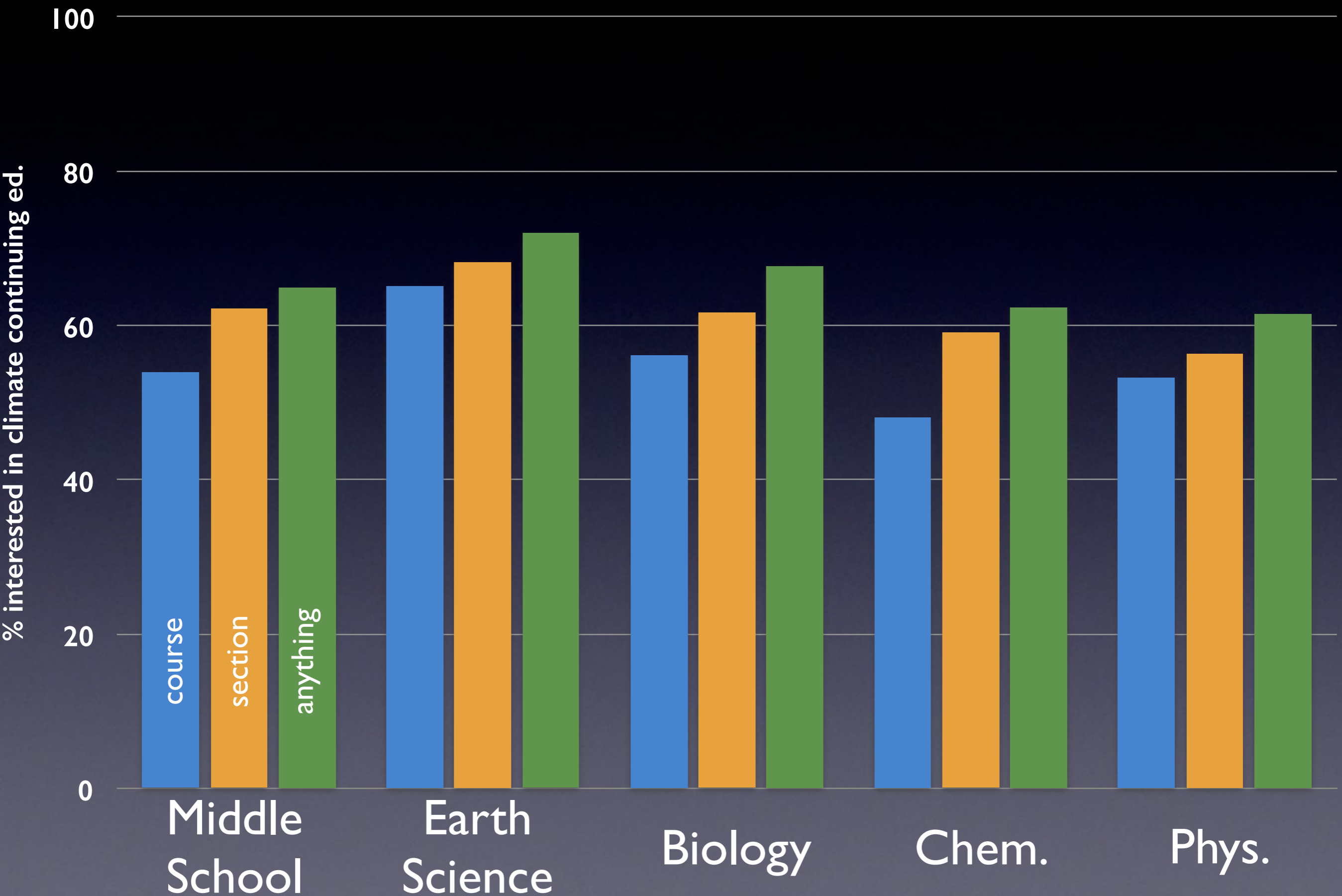
Communities shape perceived consensus



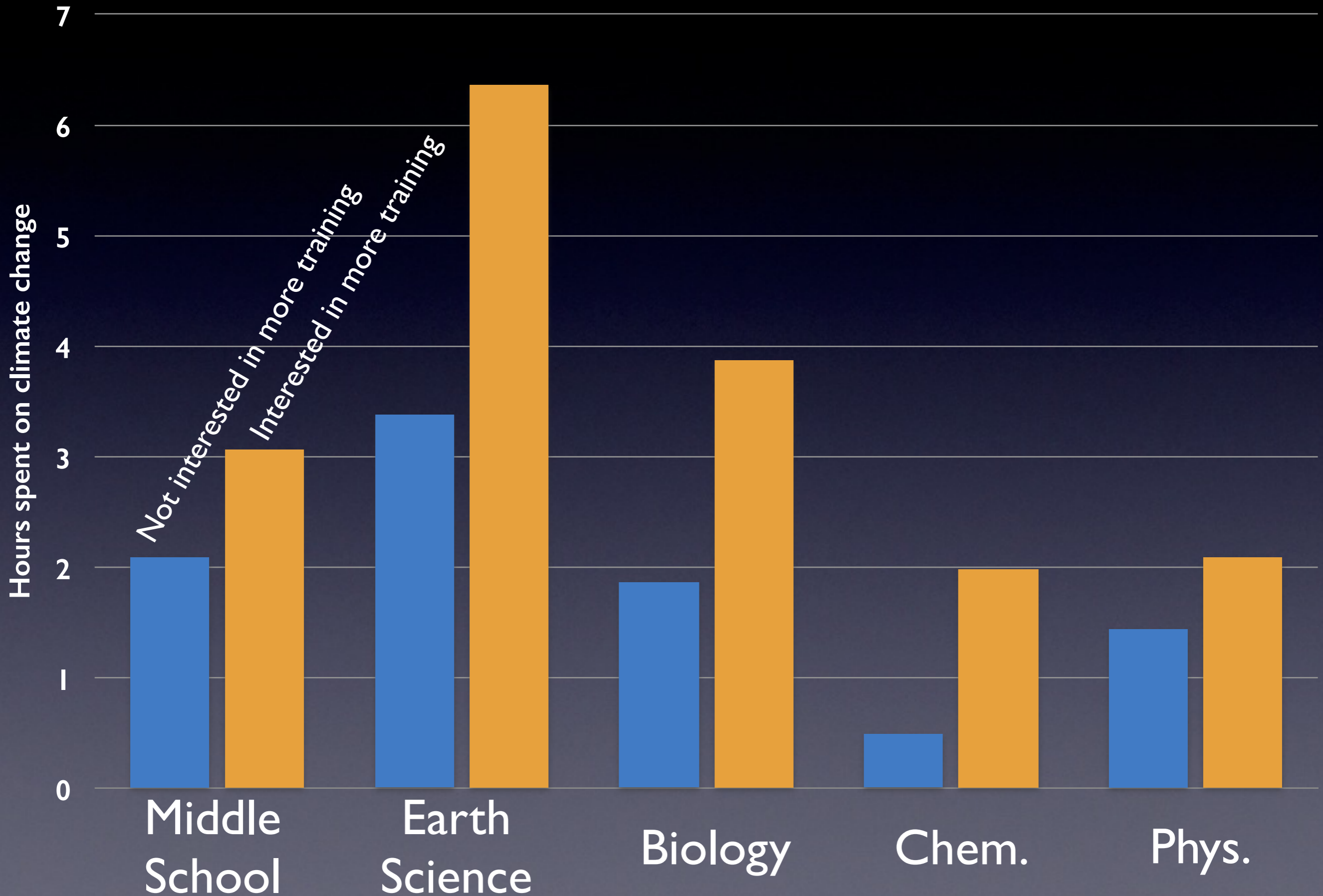
Many took courses



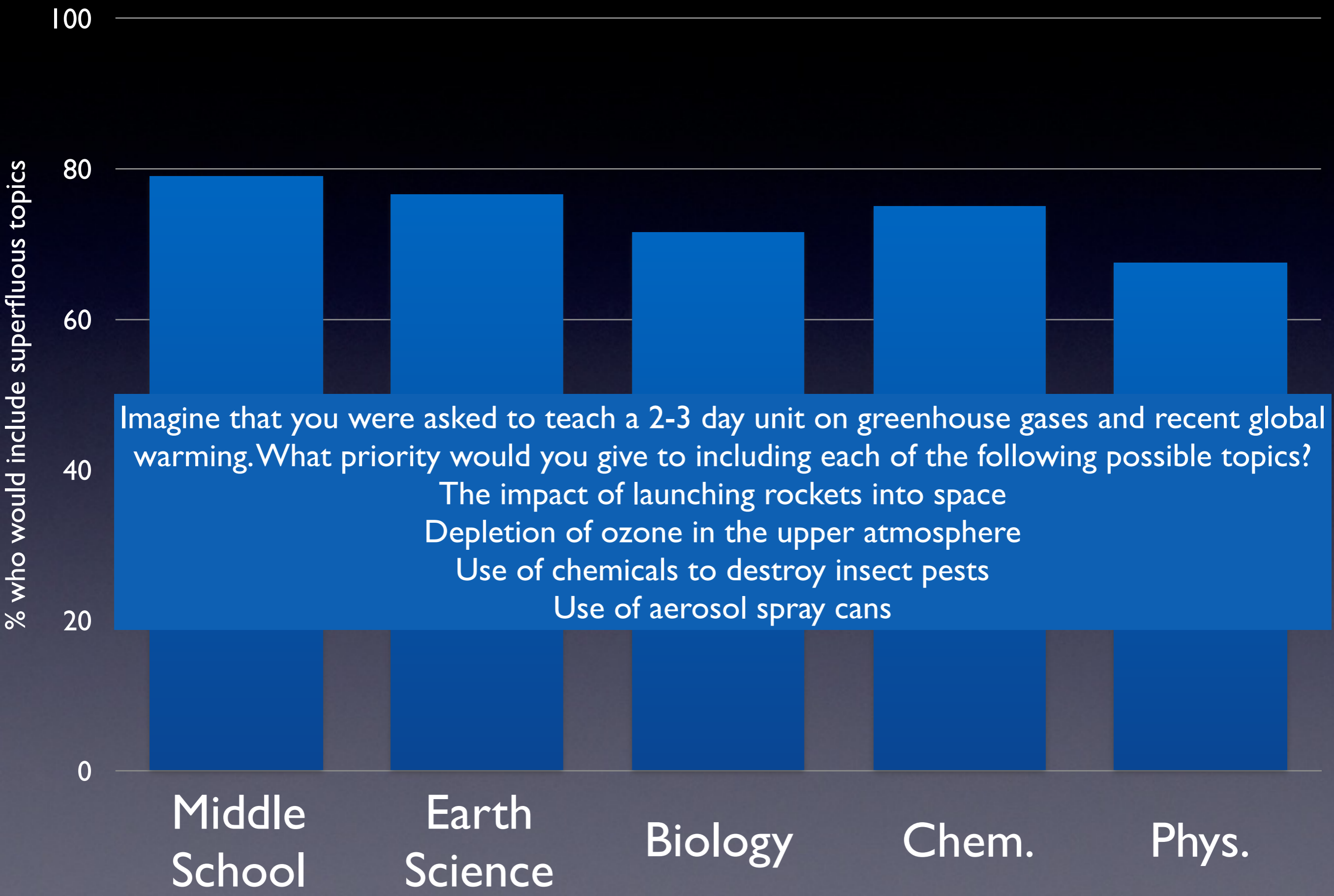
Many willing to take courses



But is it preaching to the converted?



Misconceptions abound





<http://ncse.com>

[facebook.com/evolution.ncse](https://www.facebook.com/evolution.ncse)

@ncse