

Science & Society:

Myths, Mayhem and Strategic Misunderstandings



Science & Society: Myths, Mayhem and Strategic Misunderstandings





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- Founded in 1989
- Founders: NCSU, WFU, UNC, DUKE, ECU, Industry and Others



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NCABR's mission is to...

*provide support for and
promote public understanding of
bioscience research.*



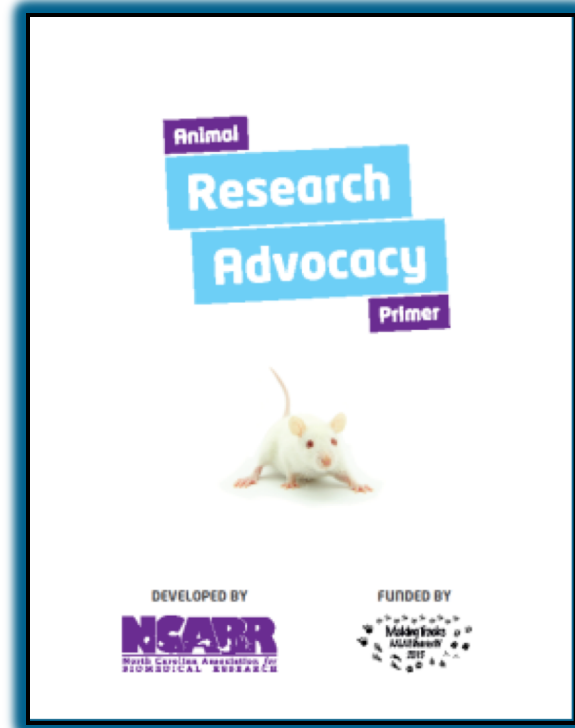
Conferences & Workshops



Media & Communications Assistance

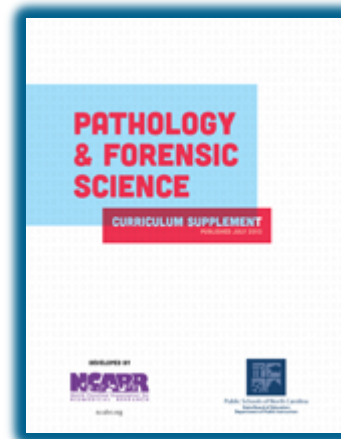
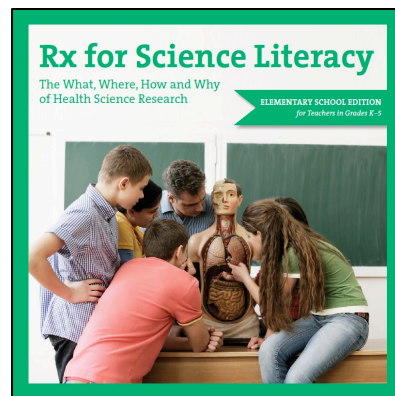


Advocacy Training & Materials

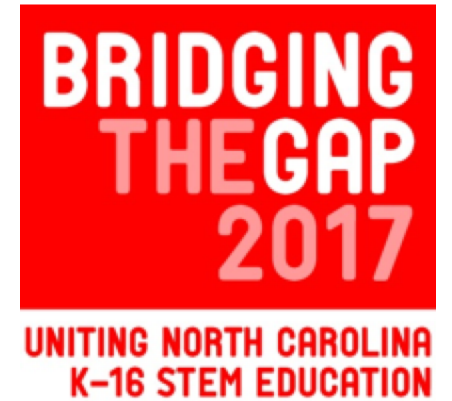


Public Education & Outreach

- Curriculum Materials
- Videos
- Websites



K-12 Teacher and Student Workshops & Conferences



www.ncabr.org

- Member Password: **L3tMeIn!**
- Suzanne Wilkison: **swilkison@ncabr.org**





Providing support for and promoting
public understanding of bioscience research

[For K-12](#)[For Researchers](#)[For the Media](#)[Support Us](#)

PROTECTED: MEMBERS ONLY

Agnotology Tools to Combat Science Myths and Strategic Misinformation

These tools empower educators and the public with resources to counter scientific myths, strategic misinformation/disinformation campaigns, and misunderstandings.

Animal Research Advocacy Primer

Advocating for your work in layman's terms isn't always easy, but it's always important. Whether it involves talking to your family around the Thanksgiving dinner table, giving a presentation at your child's career day or explaining a research breakthrough to a reporter, our talking tips can help make the process a little easier. [Crisis and Communications Manual](#)

Crisis and Communications Manual

The Black Book provides strategic guidance for member organizations facing or planning for animal research-related crisis situations.

Debunking (Inoculation) Handbook

Debunking myths is problematic. This guide provides detailed information about how to debunk myths and misinformation using inoculation. Unless great care is taken, any effort to debunk misinformation can inadvertently reinforce the very myths one seeks to correct. To avoid these "backfire effects," an effective debunking requires three major elements. First, the refutation must focus on core facts rather than the myth to avoid the misinformation becoming more familiar. Second, any mention of a myth should be preceded by explicit warnings to notify the reader that the upcoming information is false. Finally, the refutation should include an alternative explanation that accounts for important qualities in the original misinformation.

Today's Workshop

Science & Society: Myths, Mayhem and Strategic Misunderstandings

A program series for NCABR members & donors



Science & Society:

Myths, Mayhem and Strategic Misunderstandings



Science & Society:

Myths, Mayhem and Strategic Misunderstandings

- **Scope + Tools & Resources Overview**
- **Student Performance in Math & Science**
- **Common Myths About the Public Understanding of Science**
- **Agnotology & Science**
- **What Can We Do? An Integrated Response**
- **Interactive Training Session**





AGNOTOLOGY

<http://www.scienceandsociety.tk/>



America's students have improved in math and science over the past 20 years – but remain behind students in many other industrialized nations.

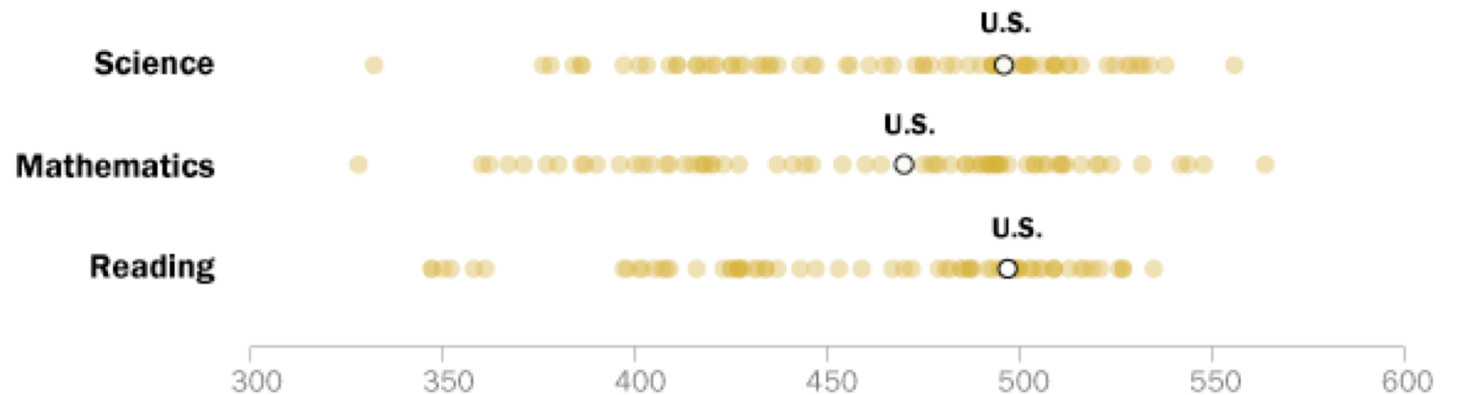
Program for International Student Assessment (PISA)



- The PISA is given every three years to measure reading ability, math and science literacy and other key skills among 15-year-olds.
- The US ranked 38th out of 71 countries in math and 24th in science.
- Rank is *middle of the pack* and behind many other industrial nations.

Internationally, U.S. stands in middle of pack on science, math, reading scores

Average scores of 15-year-olds taking the 2015 Program for International Student Assessment



Note: Scale ranges from 0-1,000. Results from China not included because only four provinces participated in PISA 2015.

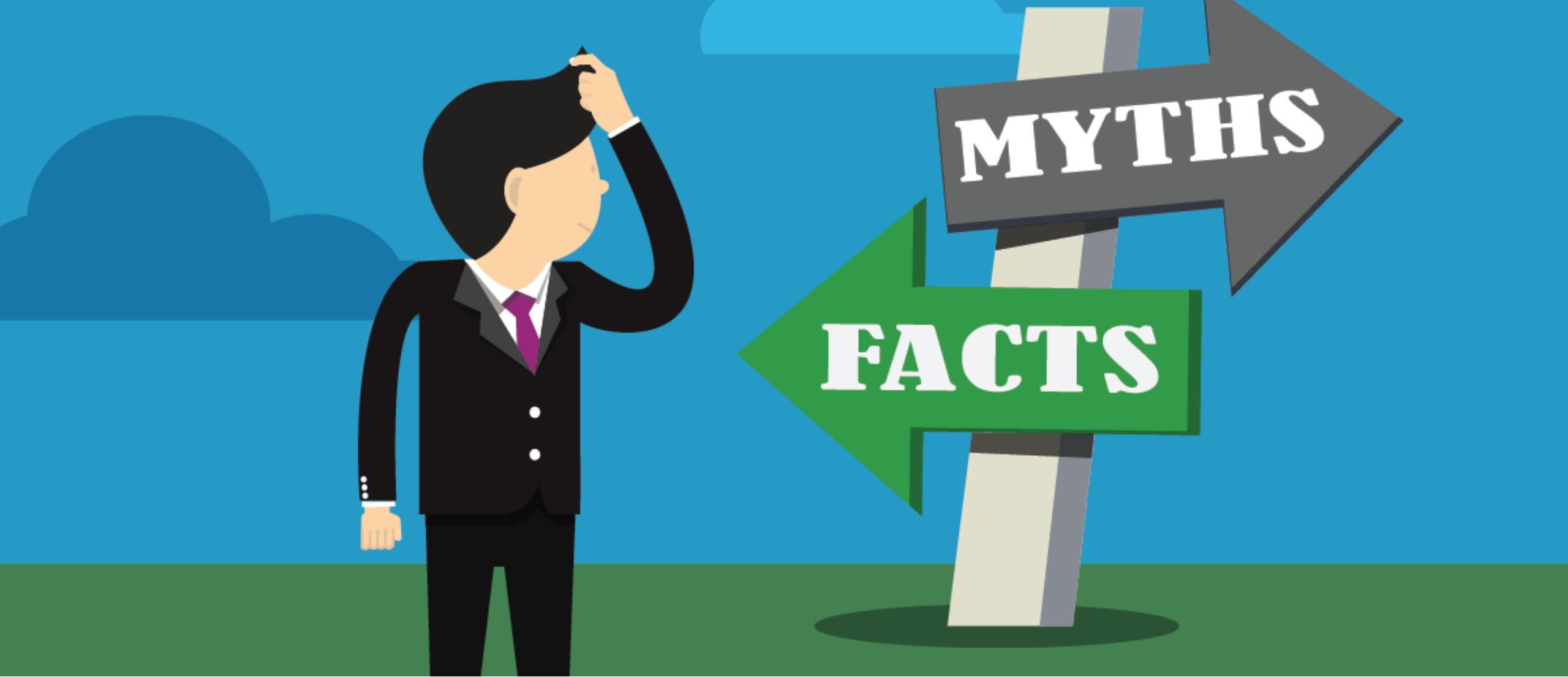
Source: OECD, PISA 2015

PEW RESEARCH CENTER

Trends in International Mathematics and Science Study (TIMSS)



- TIMSS is given every four years for students in grades four and eight.
- In 2015, 10 countries (out of 48 total) had statistically higher average fourth-grade math scores than the U.S. and seven countries had higher average science scores.
- In the eighth-grade tests, seven out of 37 countries had statistically higher average math scores than the U.S., and seven had higher science scores.



Common Myths About the Public Understanding of Science

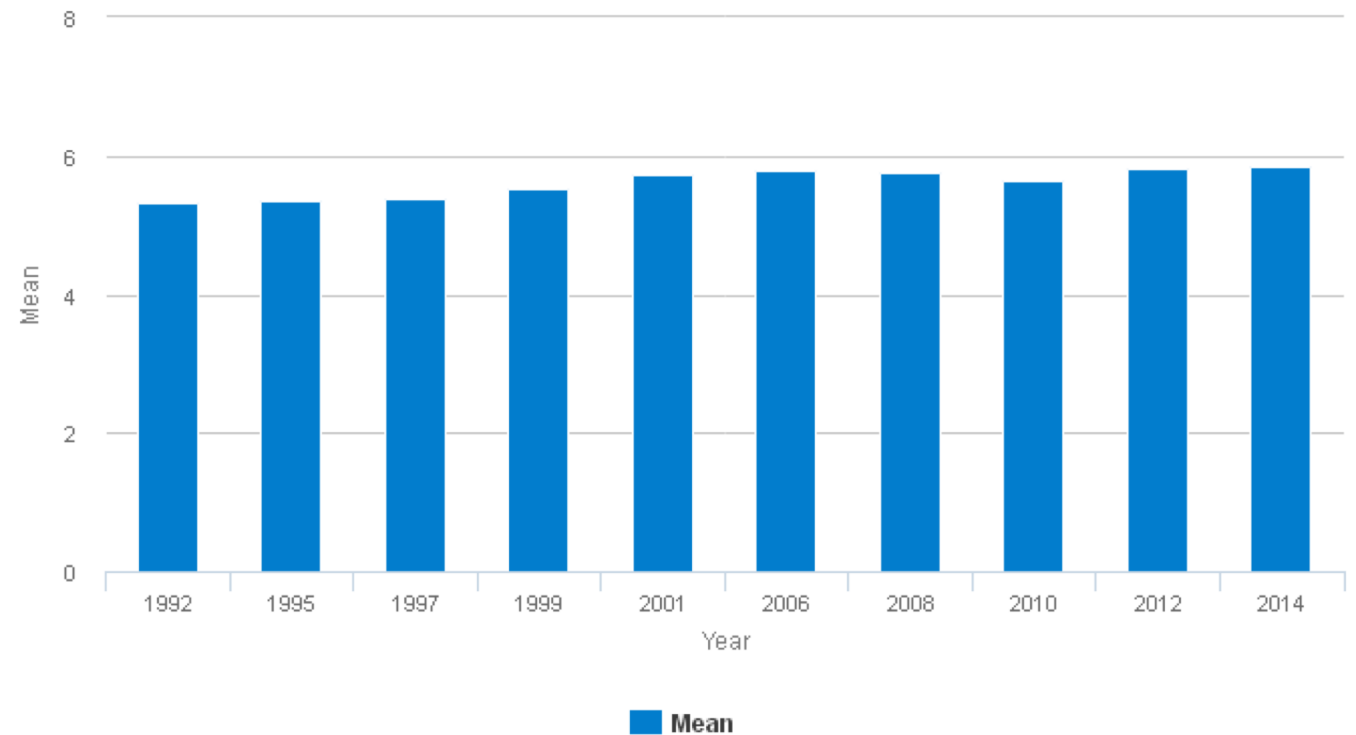
Common Myths About the Public Understanding of Science

Science Literacy in the United States is Declining

Knowledge About Science and Technology is Relatively Stable

Figure 7-8

Mean number of correct answers to trend factual knowledge of science scale: 1992–2014

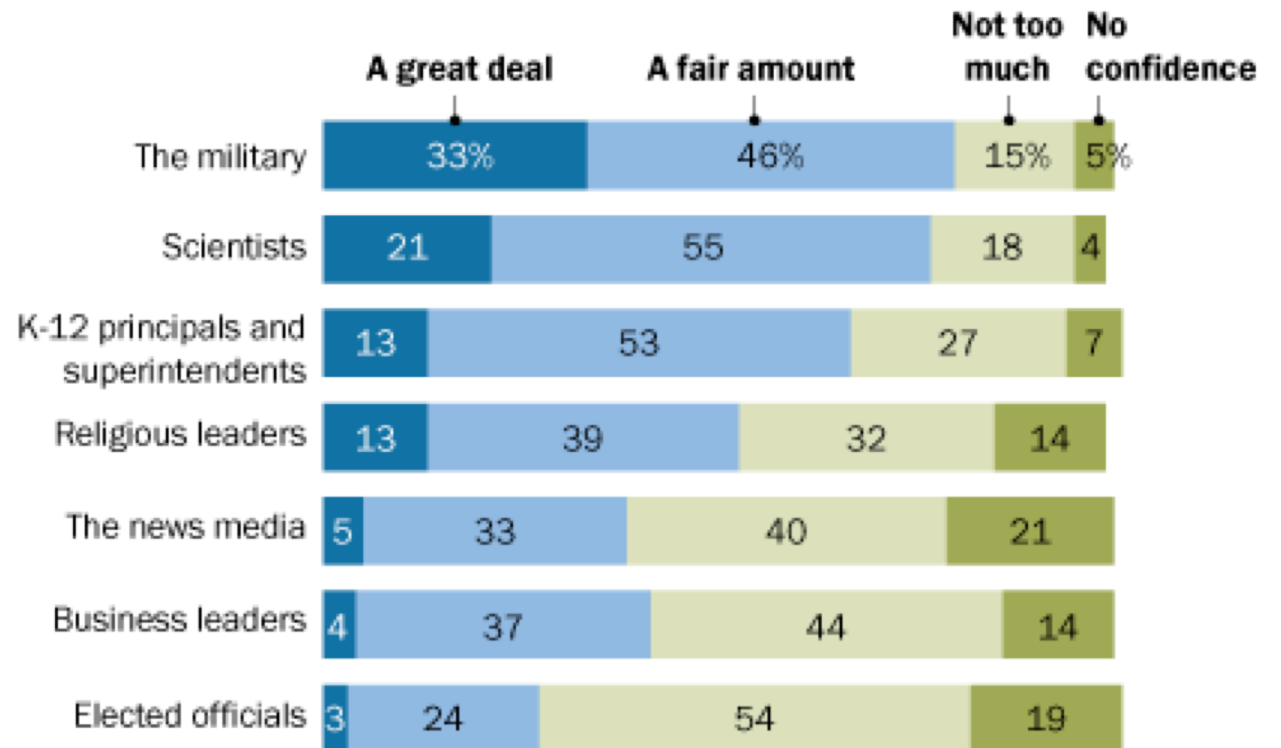


Common Myths About the Public Understanding of Science

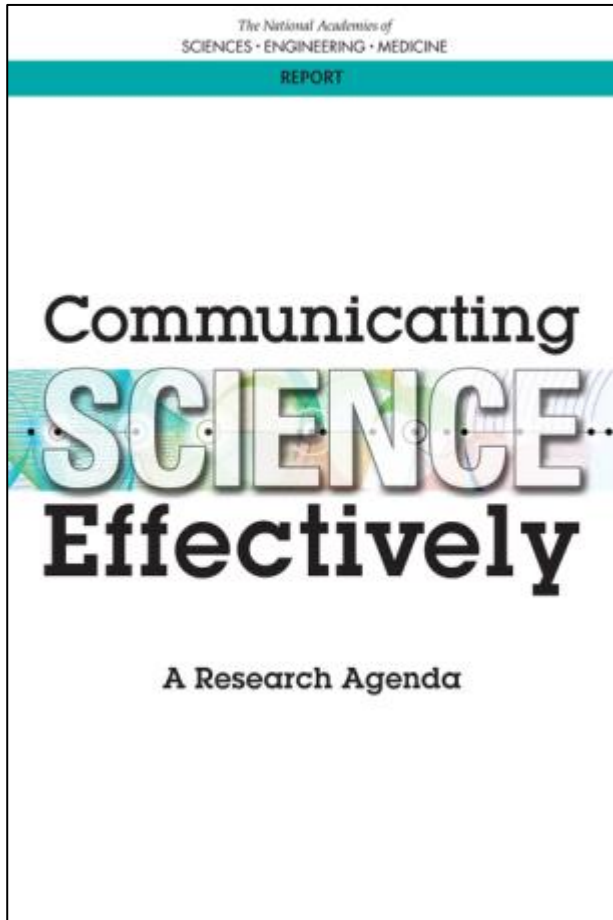
Public Trust in Science Has Decreased

Overall, more people express positive than negative confidence in scientists, but a 55% majority express only a soft confidence in scientists to act in the public interest.

% of U.S. adults who say they have ___ of confidence in each of the following groups to act in the best interests of the public



Common Myths About the Public Understanding of Science



The Deficit Model

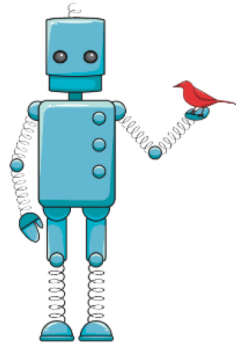
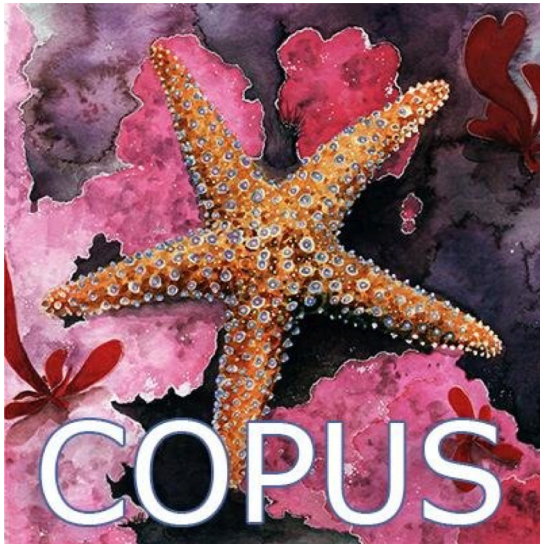
Attributes public skepticism or hostility to science and technology to a lack of understanding, resulting from a lack of information

Genuine Communication

In 2017 the National Academies issued a research agenda focused on the Science of Science Communication to help direct the research base going forward towards identifying the most effective approaches to communicating science

Common Myths About the Public Understanding of Science

People Need More Information to Understand Science



scistarter

ASK FOR
EVIDENCE 



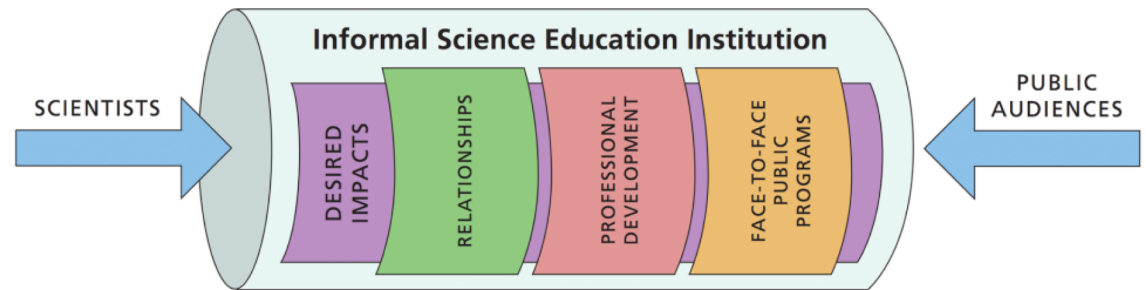
It is not more information that people need – it is better communication and engagement

Common Myths About the Public Understanding of Science

Scientists Know How to Talk in a Manner That the General Public Can Easily Understand



PORTAL
to the Public



Scientists generally require training and professional development in science communication

Common Myths About the Public Understanding of Science

***Arguments Supported by Facts
and Evidence Will Change
People's Beliefs***



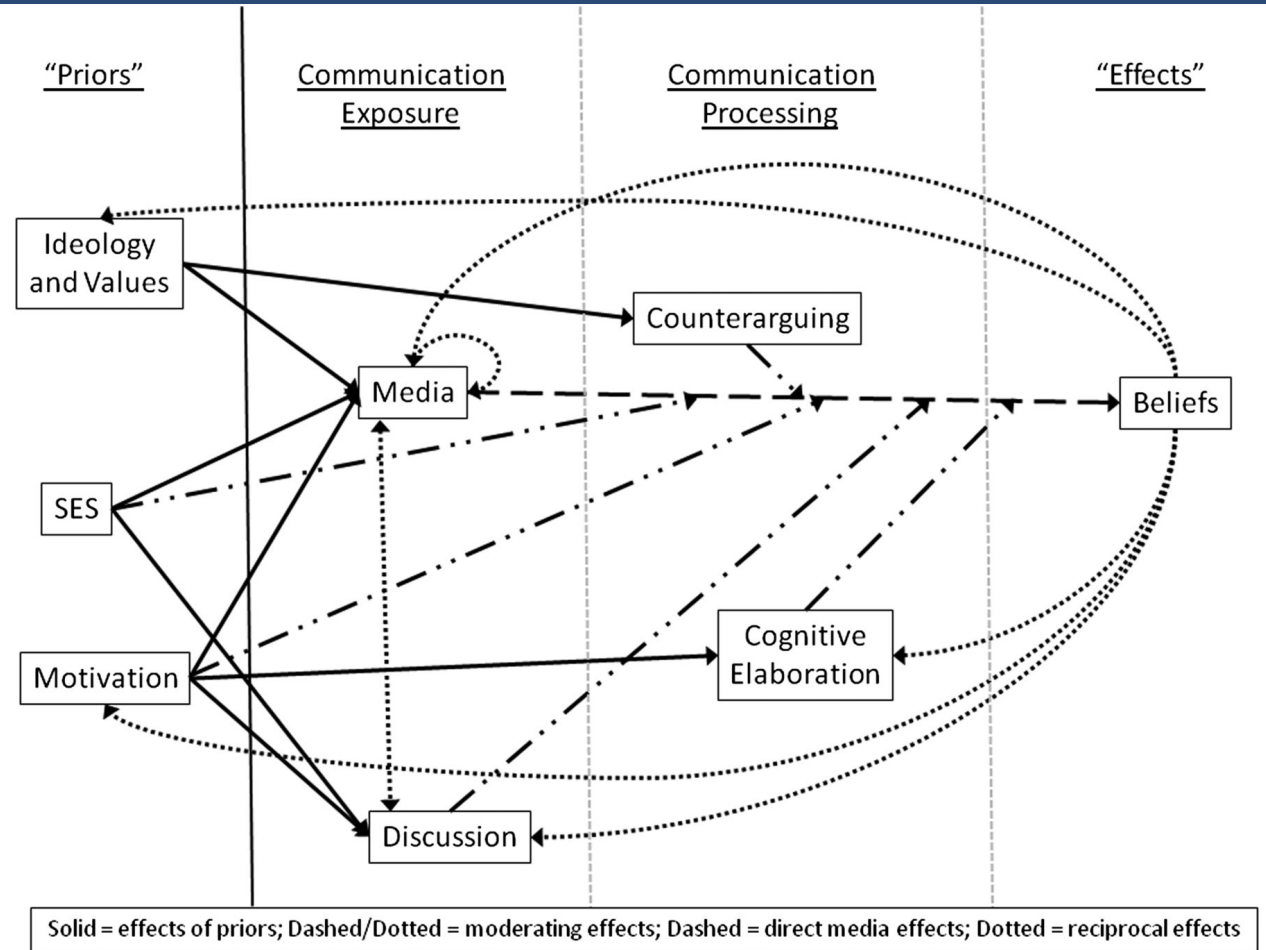
**Factual and evidence-based arguments
do not change most individual's beliefs.**

These type of arguments tend to have what are called “backfire effects” such as making myths more familiar, providing too many arguments, or providing evidence that threatens one's worldview

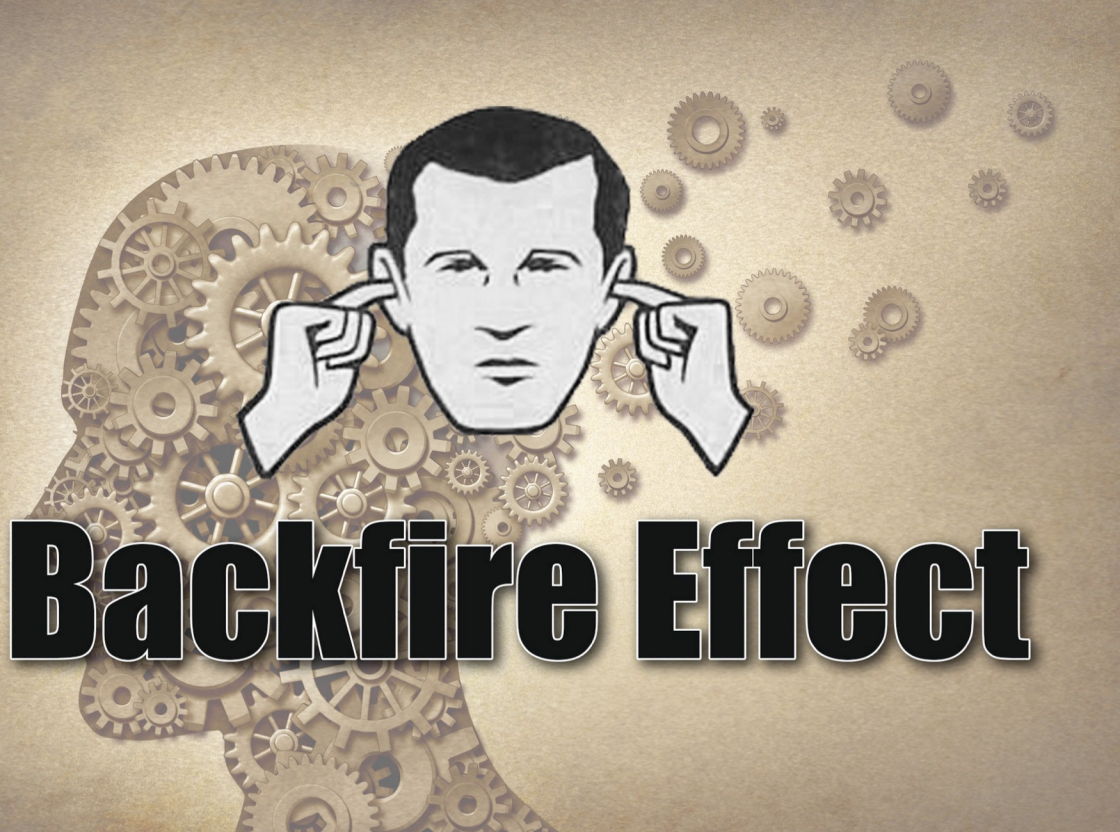
Common Myths About the Public Understanding of Science

Disagreements Are Just About Facts, Which Are Not Understood by the Public

At the core – many disagreements are not really about facts; they are about people's values, ideologies, and beliefs.



The Backfire Effect



Surprising truth is that disproving a misconception can strengthen a persons belief in that very misconception!

When people concerned about the side effects of the flu shot were informed that it was safe they actually became less willing to get it.

Backfire Effect - the more you prove someone wrong - the more they think they are right!

Identity Protective Cognition

Humans are not logical, we are complex, emotional beings

THIS IS YOUR BRAIN—ON FACTS

Quirks in the way we think—and the way we think we think

CONFIRMATION BIAS

We cherry pick “evidence” that backs up what we already “know.”

THE BACKFIRE EFFECT

Faced with conflicting evidence, the brain defends existing beliefs like a fortress.

GROUP-THINK

Opinions are symbols of belonging, so our brains work hard to protect their group’s worldview.

AVAILABILITY HEURISTIC

Conclusions based on one vivid example overpower less memorable narratives.

AFFECT HEURISTIC

Feelings trump facts.

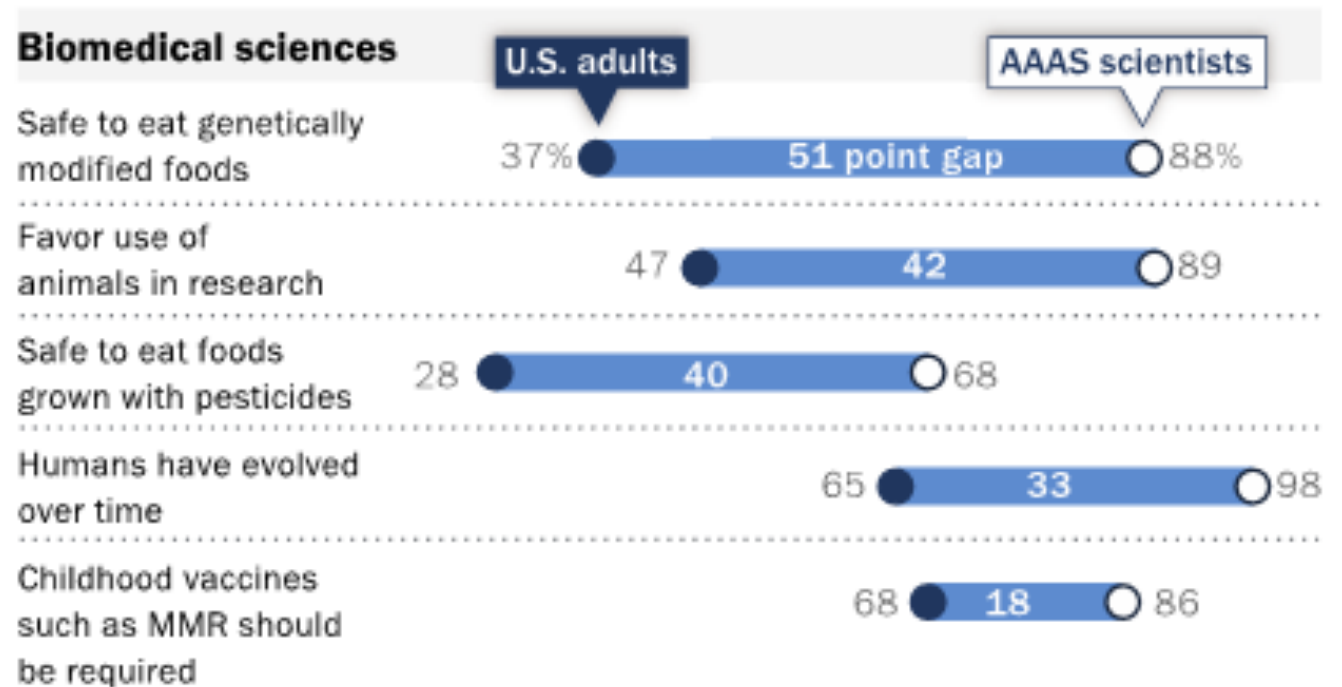


Citizens and Scientists Often See Science Issues Through Different Sets of Eyes

A Sizable Opinion Gap Exists Between the General Public and Scientists on a Range of Science and Technology Topics

Opinion Differences Between Public and Scientists

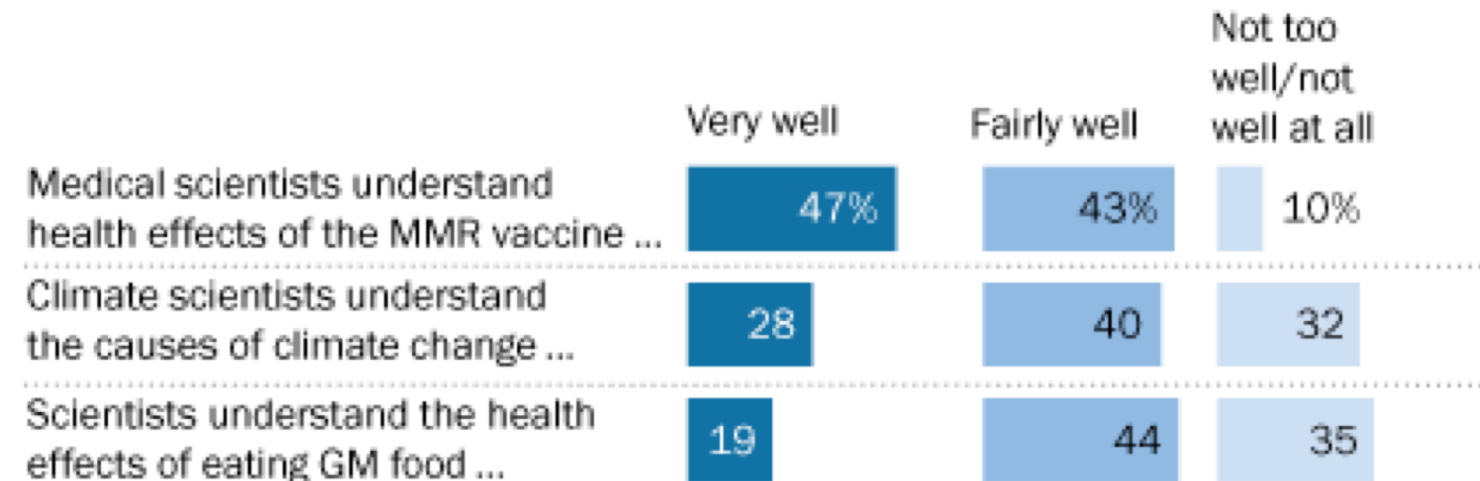
% of U.S. adults and AAAS scientists saying each of the following



Many Americans Are Skeptical of Scientific Understanding

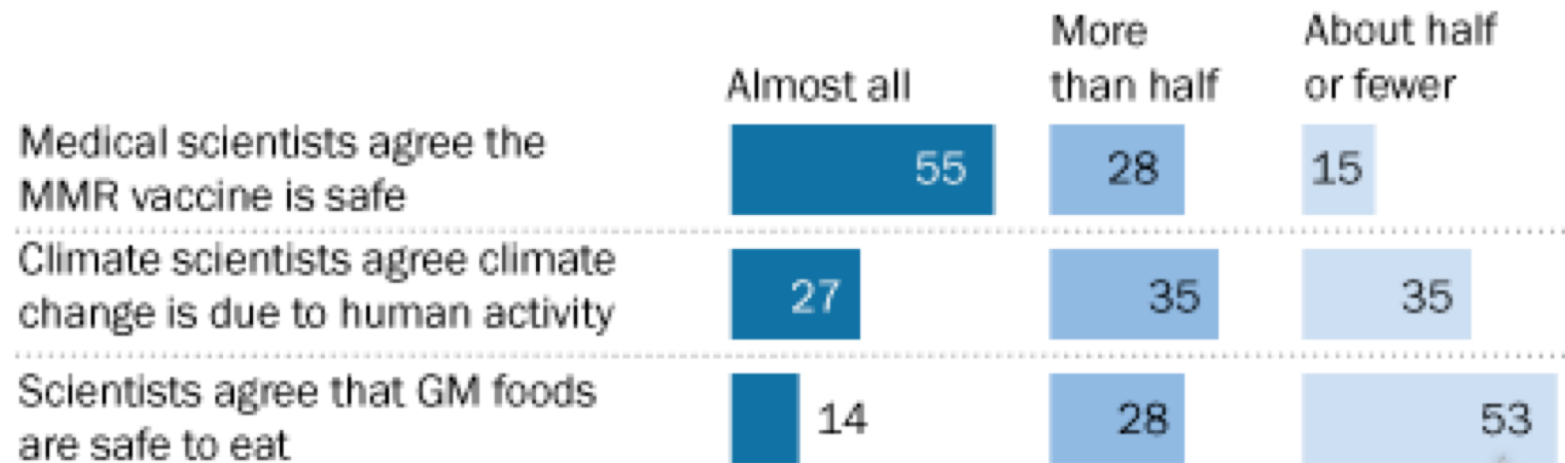
There is limited public trust in the knowledge and understanding of scientists in areas directly relevant to their expertise

% of U.S. adults who say the following



Many Americans Think Scientists Disagree

% of U.S. adults who say the following

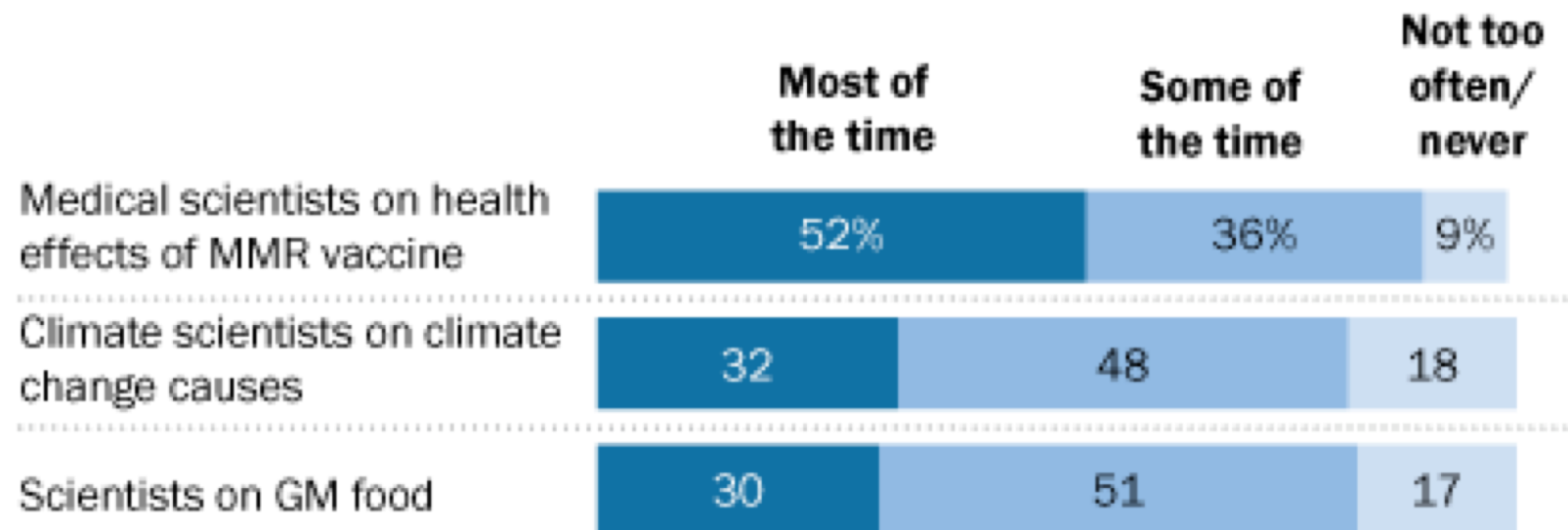


53% of U.S. adults say about **half or fewer** of scientists agree that GM foods are safe to eat

People Hold Mixed Assessments About Science Research

Half or fewer Americans see science research as influenced by the best available evidence most of the time.

% of U.S. adults who say the best available scientific evidence influences research findings of each of these groups ...

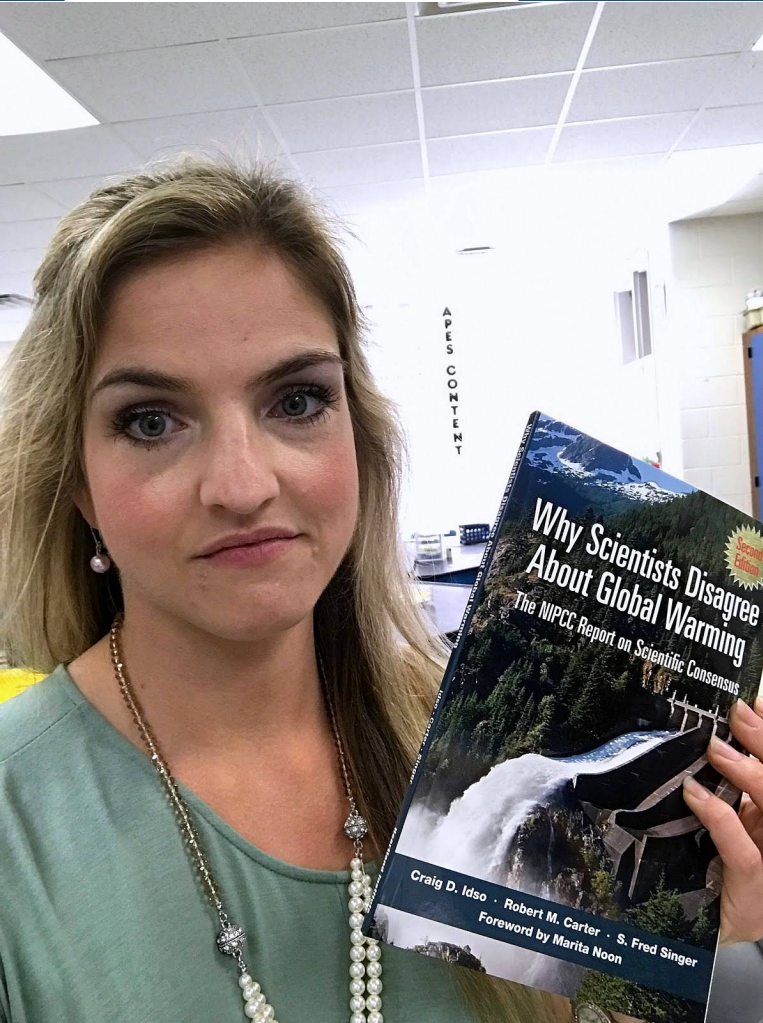




Agnotology

- Agnotology is culturally constructed ignorance, created by special interest groups to create confusion and suppress the truth in a societally important issue. It is especially useful to sow seeds of doubt in complex scientific issues by publicizing inaccurate or misleading data. The Internet has become a powerful tool for propagating misinformation
- Ignorance spreads when firstly, many people do not understand a concept or fact and secondly when special interest groups – like a commercial firm or a political group – then work hard to create confusion about an issue.
- Agnotology also focuses on how and why diverse forms of knowledge do not "come to be," or are ignored or delayed. For example, knowledge about plate tectonics was censored and delayed for at least a decade because some evidence remained classified military information related to undersea warfare.

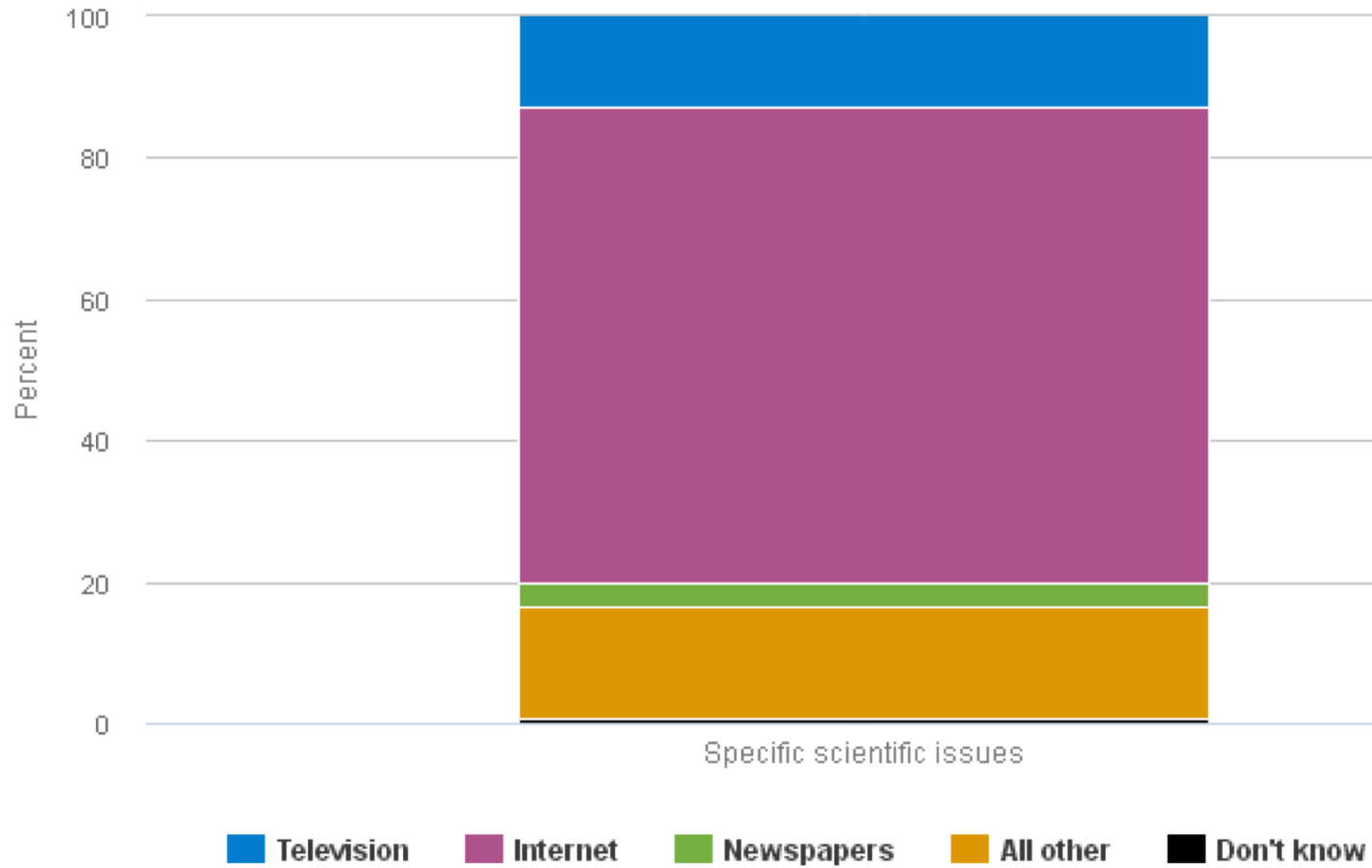
Disinformation Campaigns Are Well Funded and Sophisticated



Why Scientists Disagree about Global Warming by the Heartland Institute

- Mailed to Over 300,000 Educators Across K-16
- Sophisticated Website and Interactives
 - <http://climatechangereconsidered.org/>
- In a landmark study by the National Center for Science Education that involved a comprehensive national survey of public school science teachers for the first time found that:
 - 3 out of 4 teachers are teaching climate change.
 - Only half are correctly explaining that humans are driving climate change.
 - An even smaller number are aware of how overwhelming the scientific consensus on the issue is.

Public Has Shifted Focus Towards Obtaining Scientific Information Online



Disinformation Campaigns Are Well Funded and Sophisticated

Social Bots: These bots are algorithms designed to interact in a human-like way with users. They can re-share and spread harmful misinformation automatically based on a set of parameters.

Psychological Operations (PsyOps): Data analytics companies specializing in "psychological operation" campaigns develop refined and targeted strategies designed to sway public opinion, even using the data for mass propaganda that acts on people's emotions.

- Facebook Users Are Psychologically Profiled
- Users are Matched with National Databases (Axiom, etc.)
- Targeted Online & Offline Campaigns Designed and Delivered

Misinformation is Sticky

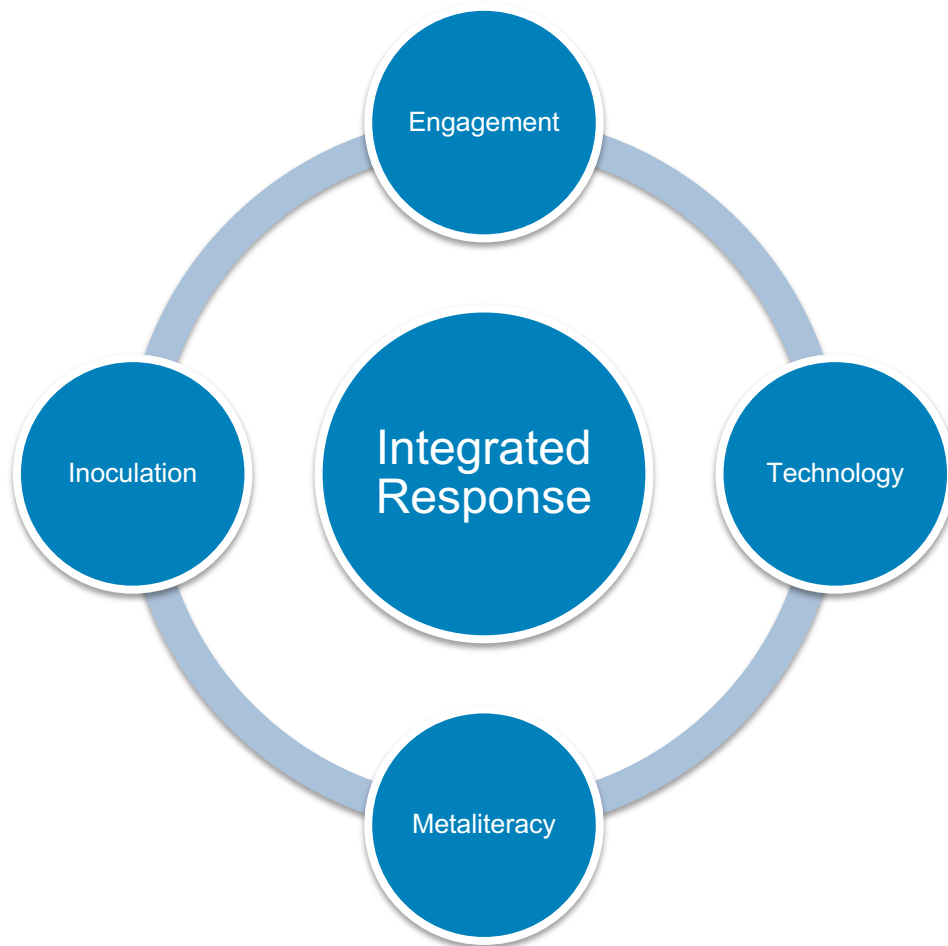
- Rejecting information requires cognitive effort. Weighing the plausibility and the source of a message is cognitively more difficult than simply accepting that the message is true. When we do thoughtfully evaluate the incoming information we tend to ask ourselves:
 - Does the information fit with other things I believe in?
 - Does it make a coherent story with what I already know?
 - Does it come from a credible source?
 - Do others believe it?
- Misinformation is especially sticky when it conforms to our preexisting political, religious, or social point of view. Because of this, ideology and personal worldviews can be especially difficult obstacles to overcome.
- People disbelieve scientifically supported information when they feel they must do so to protect a deeply held value.





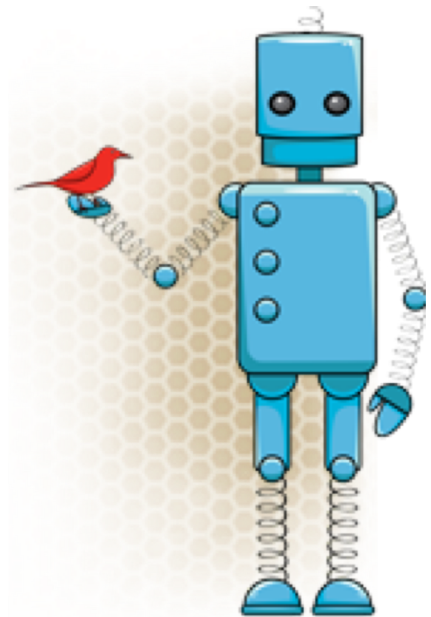
What Can We Do? - *An Integrated Response*

An Integrated Response



Authentic Engagement

The logo for Citizen Science features the words "CITIZEN" and "SCIENCE" in a bold, blue, sans-serif font. Above the word "CITIZEN" is a small graphic of three orange dots connected by lines, resembling a molecular structure or a network.



- Citizen science projects have transformed the practice of science by democratizing access to scientific methods, encouraging scientific literacy, and engaging the next generation of scientists early in their life.
- Participation in citizen science projects can introduce the framework for authentic science research practices.
- Evaluations on a variety of citizen science projects have shown a positive impact on participants' awareness of specific scientific issues and their content-knowledge gains, as well as improved skills related to scientific inquiry and critical thinking.
- By encouraging inclusivity and openness, citizen science can break down the fear about or perceived distance from science, making science more accessible.



Technology Innovations

- **Rumor Intelligence:** Advanced big data system that monitors the entire internet and all news sources for the propagation of misinformation in real time.
- **Artificial Intelligence:** Facebook and Google use a combination of machine learning and crowdsourcing techniques to remove intentional disinformation from the organic feeds. (*Note advertising is exempt!*)
- **Social Bots:** Response bots designed to interact with users posting misinformation. For example, there is a bot specifically for childhood vaccinations.
- **Fact Checking Websites and API Systems:** Websites such as FactCheck.org, Snopes.com, and Hoax-Slayer.com

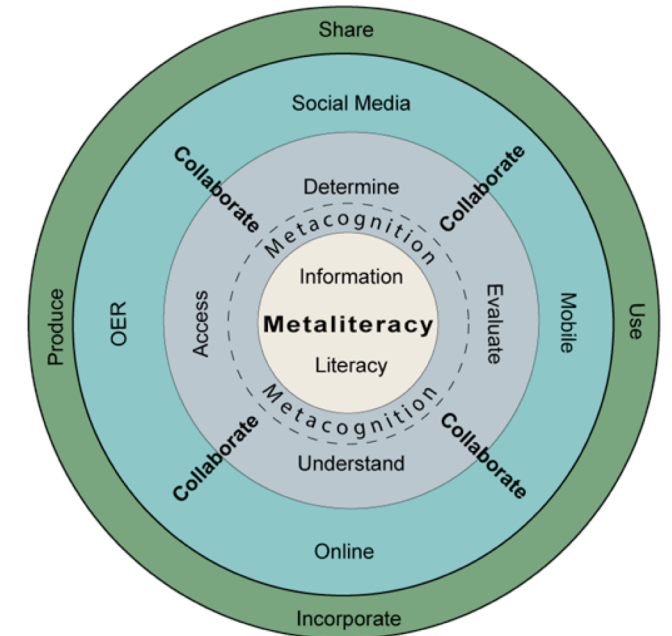
Metaliteracy

When young adults between the ages of 19 and 30 were given a test designed to evaluate their ability to detect fake, misinformation, or disinformation online:

- Only 24 percent were able to correctly answer eight out of nine questions.
- 44 percent could not correctly answer six out of nine questions.

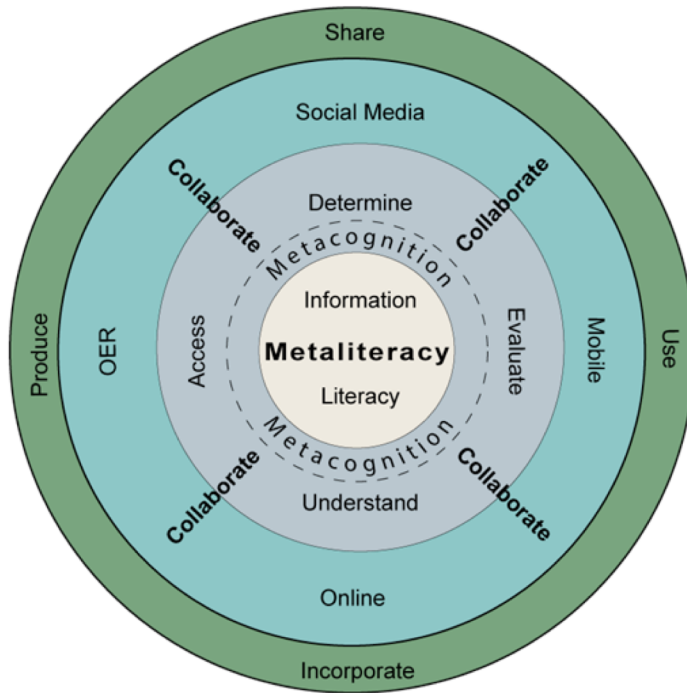
The inability to discern false information is problematic for more than one reason:

- 55 percent of Millennials rely on social media for news and information.
- 51 percent share social media content very or fairly often.
- 36 percent have accidentally shared inaccurate information.



These findings are consistent with a Stanford University survey that found middle school, high school, and college students were unable to distinguish between a news story, an ad, and an opinion piece, and college students actually fared worse than high school students.

Metaliteracy



IMVA/IN Evaluation

Independent sources are better than self-interested sources.

Multiple sources are better than single sources.

Sources who **Verify** with evidence are better than sources who assert.

Authoritative / Informed sources are better than uninformed sources.

Named sources are better than unnamed sources.

Metaliteracy empowers learners to participate in interactive information environments, equipped with the ability to continuously reflect, change, and contribute as critical thinkers. New online curriculum such as Checkology.org has been developed for K-16 to assist in teaching metaliteracy.

Misinformation Inoculation

Fact – Myth – Fallacy

Debunking myths and correcting misinformation is problematic. Unless great care is taken, any effort to debunk misinformation can inadvertently reinforce the very myths one seeks to correct. To avoid these "backfire effects," an effective debunking requires three major elements:

- First, the refutation must focus on core facts rather than the myth to avoid the misinformation becoming more familiar.
- Second, any mention of a myth should be preceded by explicit warnings to notify the reader that the upcoming information is false.
- Finally, the refutation should include an alternative explanation that accounts for important qualities in the original misinformation.



Misinformation Inoculation - Debunking

Example of debunking a climate myth

Sun and climate are going in opposite directions

- Core fact emphasised in headline

Over the last few decades of global warming, the sun has shown a slight cooling trend. Sun and climate are going in opposite directions. This has led a number of scientists to independently conclude that the sun cannot be the cause of recent global warming.

- Core facts reinforced in initial text

One of the most common and persistent climate myths is that the sun is the cause of global warming.

- Myth

This myth cherry picks the data - showing past periods when sun and climate move together but ignoring the last few decades when the two diverge.

- Explaining how the myth misleads (alternative explanation, see Page 5)

The best approach is to focus on the facts you wish to communicate

Misinformation Inoculation - Debunking

A simple myth is more cognitively attractive than an over-complicated correction

MYTH
FACT FACT FACT
FACT FACT FACT
FACT FACT FACT
FACT FACT FACT



MYTH
FACT
FACT
FACT



Misinformation Inoculation - Debunking

Having your cake and eating it too

Writing at a simple level runs the risk of sacrificing the complexities and nuances of the concepts you wish to communicate. At Skeptical Science, we gain the best of both worlds by publishing rebuttals at several levels. Basic versions are written using short,

plain English text and simplified graphics. More technical Intermediate and Advanced versions are also available with more technical language and detailed explanations. The icons used on ski runs are used as visual cues to denote the technical level of each rebuttal.

Select a level...

● Basic

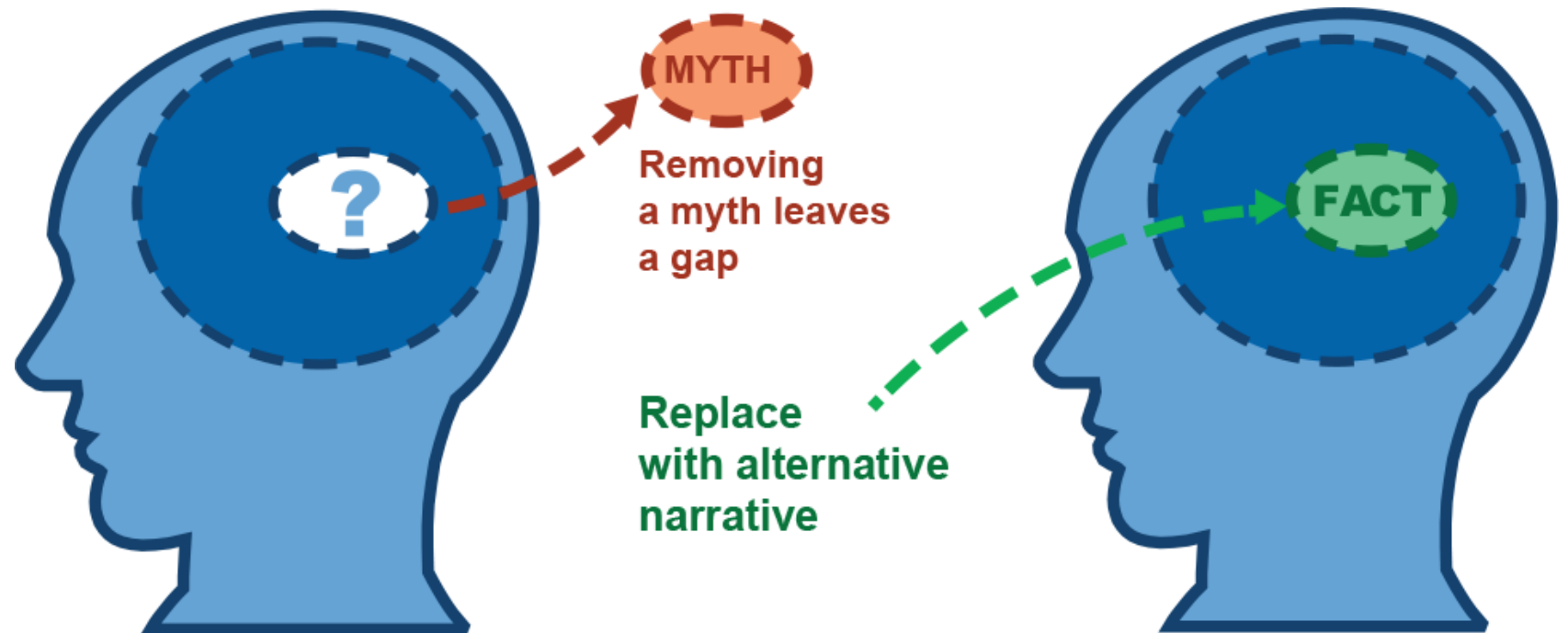
■ Intermediate

◆ Advanced

Over the last few decades of global warming, sun and climate have been going in opposite directions

Misinformation Inoculation - Debunking

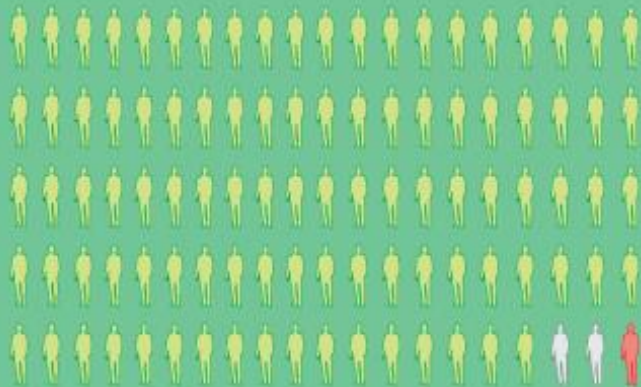
When you debunk a myth, you create a gap in the person's mind. To be effective, your debunking must fill that gap.



Misinformation Inoculation - Example Case

97 out of 100 climate experts agree humans are causing global warming.

Several independent surveys find 97% of climate scientists who are actively publishing peer-reviewed climate research agree that humans are causing global warming.



On top of this overwhelming consensus, National Academies of Science from all over the world also endorse the consensus view of human caused global warming, as expressed by the Intergovernmental Panel on Climate Change (IPCC).

However, movements that deny a scientific consensus have always sought to cast doubt on the fact that a consensus exists. One technique is the use of fake experts, citing scientists who have little to no expertise in the particular field of science.

For example, the OISM Petition Project claims 31,000 scientists disagree with the scientific consensus on global warming.

However, around 99.9% of the scientists listed in the Petition Project are not climate scientists. The petition is open to anyone with a Bachelor of Science or higher and includes medical doctors, mechanical engineers and computer scientists.

Core fact communicated in headline

Core fact reinforced in opening paragraph, fleshed out with additional details.

Core fact reinforced with infographic

Explicit warning cueing reader that misinformation is coming and indicating the nature of the misinformation.

The myth

The gap created by this debunking is how can there be a consensus if 31,000 scientists dissent? This gap is filled by explaining that almost all the 31,000 scientists are not climate scientists.

the DEBUNKING handbook



John Cook
Stephan Lewandowsky

Messaging Related to Animal Research



- Research using animals brings great benefits (try to use examples that people can relate to).
- Research using animals is conducted humanely and with great emphasis on animal welfare.
- The principles of replacement, refinement, and reduction ('the 3Rs') guide research.
- Every effort is made to improve animal welfare, minimize the use of animals and adopt alternative methods.
- The institution recognizes public concerns about animal research and is willing to engage in open dialogue.

Specific Communications Guidance

Strategies to be Open with the Public

- Web Statements
- Carefully Planned Visits
- Publicizing Research
 - Animal Aspects
- The Media – Science & Medical Research Stories
- ***A Researchers' Guide to Communications***

**A Researchers' Guide
to Communications**

Google VR / Expeditions – Imperial Lab Visit



Cardboard





AGNOTOLOGY

<http://www.scienceandsociety.tk/>

www.ncabr.org

- Member Password: **L3tMeIn!**
- Suzanne Wilkison: **swilkison@ncabr.org**



Science & Society

Myths, Mayhem and Strategic Misunderstandings

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Questions and Answers

