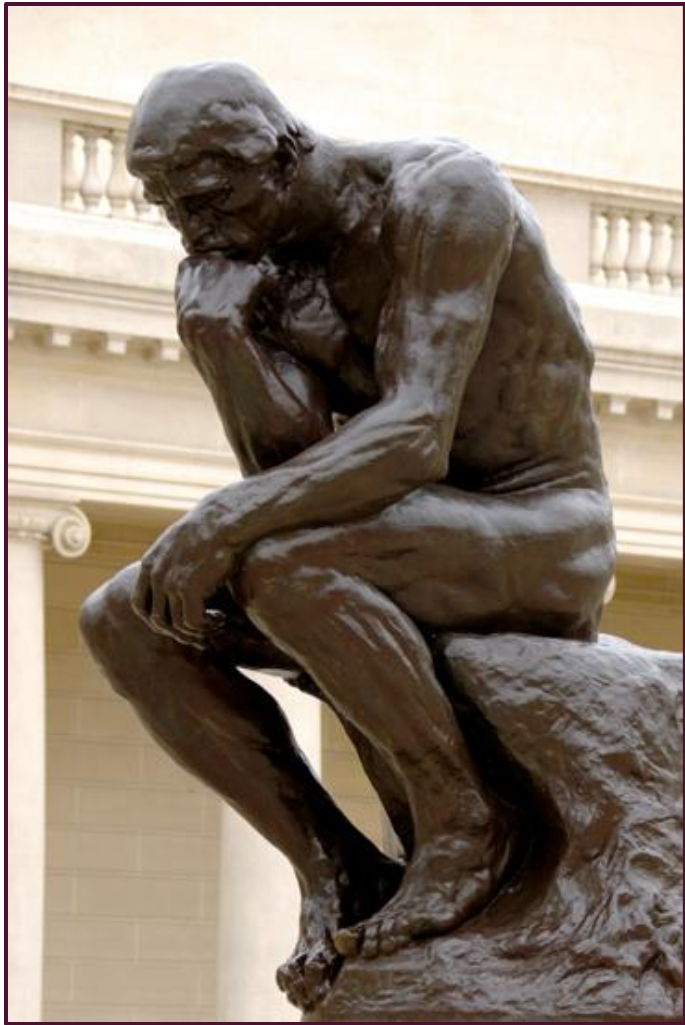


Teaching Science Media Literacy: From Evidence to Sources

An Introductory Reflection for Science Teachers



This presentation is an occasion for teachers to reflect on the nature of science *and* the nature of *science communication*. How do we know what we know, as scientists and as *consumers of science*? And how does it relate to what we need to teach students?

As a science teacher, you no doubt understand anthropogenic climate change.

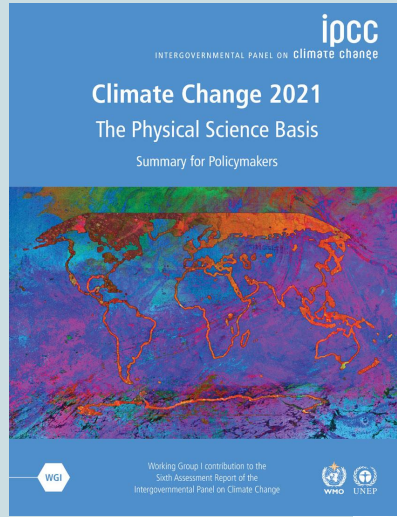


...but why do you (we) believe it, in practical terms?

We teach our students the virtues of scientific reasoning –
Examine the evidence.
Dissect the arguments.
Assess if the conclusions are warranted.
This is how we justify scientific claims (generally).

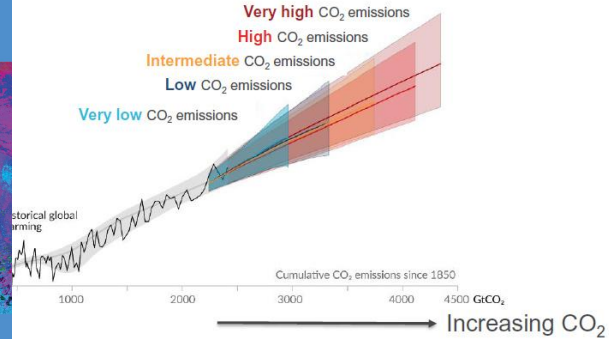
But is this why we believe them ourselves?

What science teacher has read the whole IPCC report, and studied every bit of evidence to reach their own conclusions about climate change?

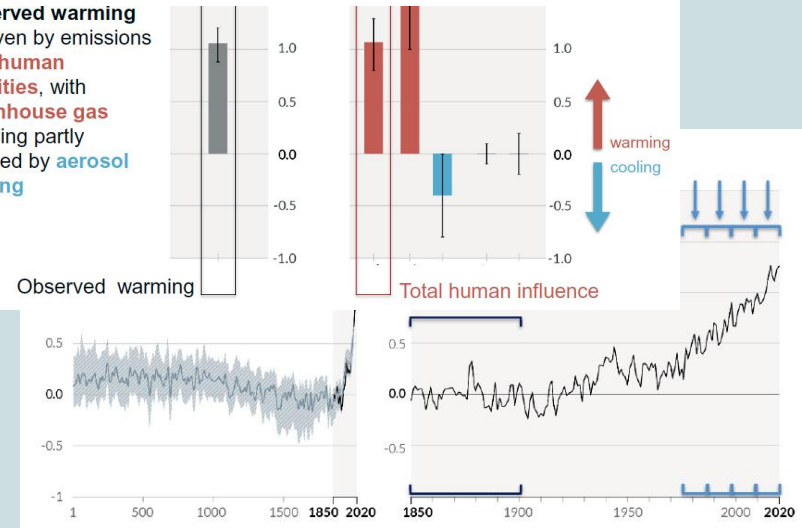


Not even the report's authors have done that!
They all rely on each other's expertise.
The knowledge is distributed across many individuals who *trust* each other.

Temperature increase since 1850-1900 (°C) as a function of cumulative CO₂ emissions (GtCO₂)



Observed warming
driven by emissions
from human
activities, with
greenhouse gas
warming partly
masked by aerosol
cooling

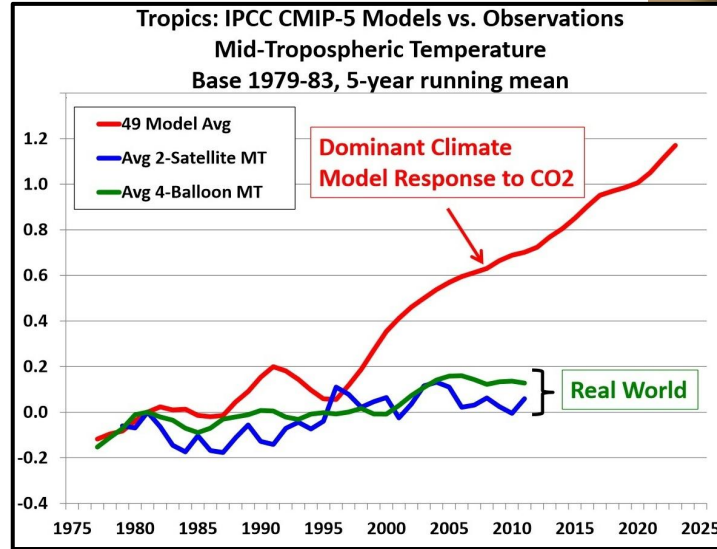


Failed predictions → Reject the hypothesis?

Many teachers tout the scientific method to students: reject the hypothesis when data do not match predictions.

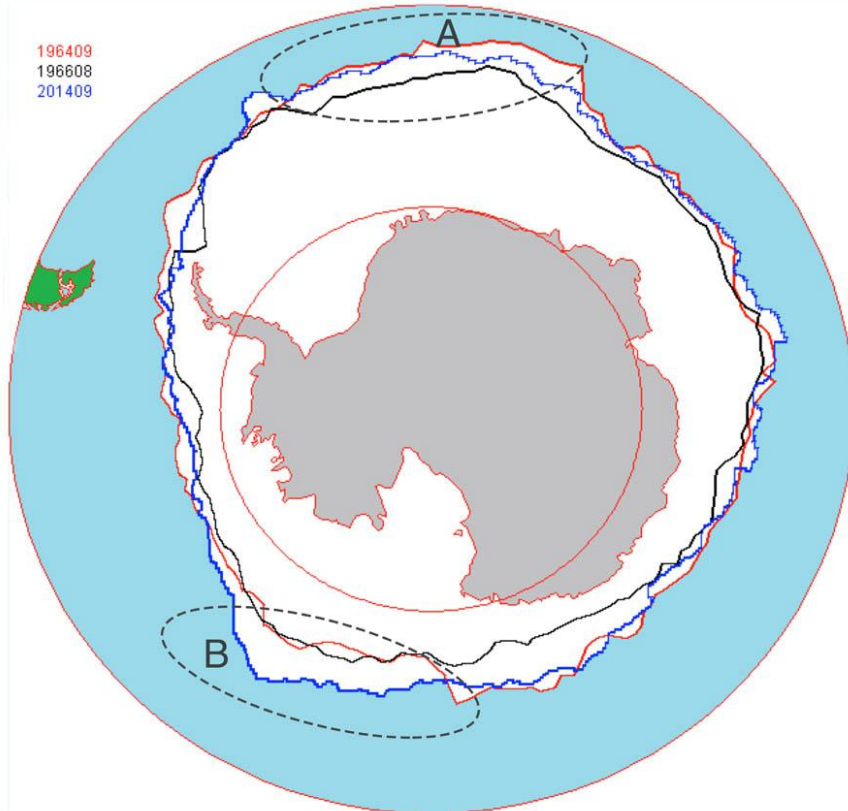
Atmospheric scientist John Christy presented data to Congress that did not match model predictions. Did we thus reject the reality of global warming?

No! And rightly so.



Antarctic Sea Ice Extent

September 2014 vs. September 1964 and August 1966



**global warming—
falsified!**

Many teachers declare the virtues of falsification as part of scientific reasoning.

If they heeded that principle, then when presented with data contradicting global warming – a historic growth in sea ice – they would concede it was false.

But that would be ill advised.

common sense implausibility



Many critics (including many politicians) argue from common sense that increased cold weather contradicts global warming.

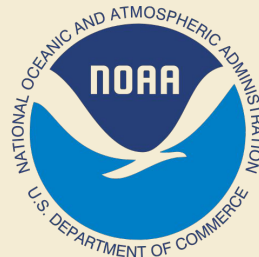
But they are *not scientific experts*.

They do not know all the evidence or alternative explanations. They are not able to make their own expert conclusions.

Nor are we.

trust in experts

We are justified in believing in climate change because we know to trust the many scientific experts — not because we are experts ourselves.



NATIONAL ACADEMY
OF SCIENCES

Which experts? *Who* is an expert?



Michael Crichton
renowned science fiction writer



Steve Milloy
Founder of junkscience.com

We are further justified because we can distinguish authentic experts from would-be know-it-alls who purport expertise.

Climate-naysaying scientists?



Ivar Giaever



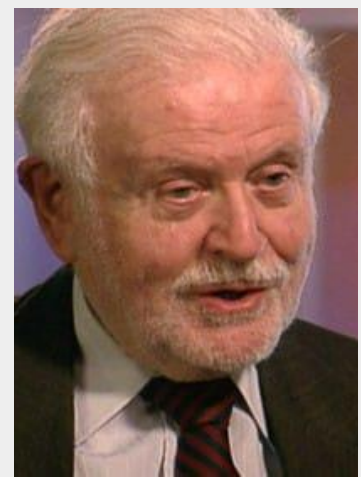
William Nordhaus



John Clauser

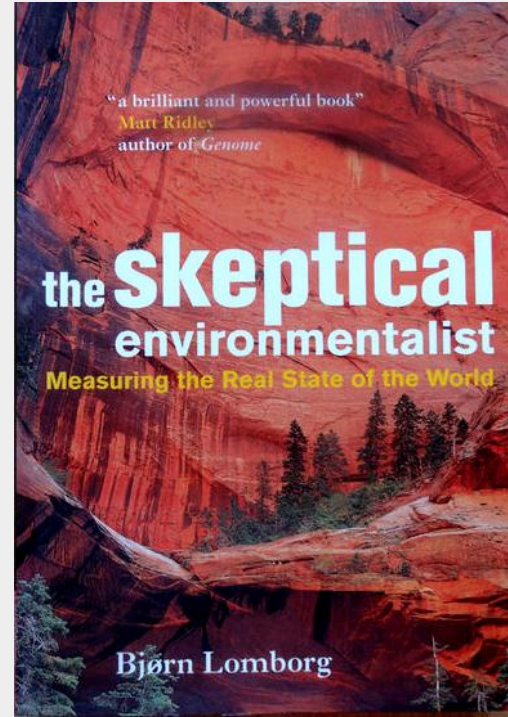
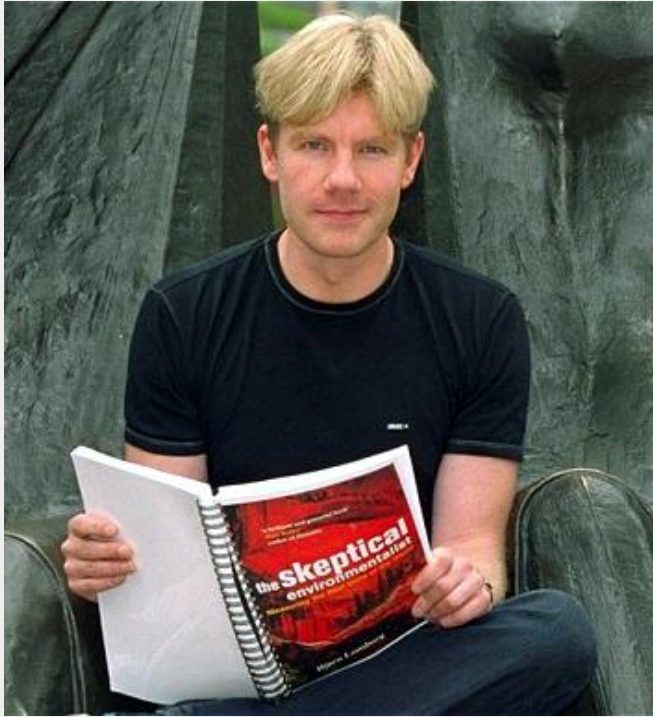


Fred Seitz
former President of the
National Acad. of Sci.



Fred Singer
Director of the
SEPP Institute

We also know that a Nobel Prize or scientific leadership does not confer universal scientific expertise. An expert must have the ***relevant expertise***.



We further know not to trust individual scientists, even if they are an expert.
Rather, we trust the ***consensus*** of the relevant experts.

THE LEIPZIG DECLARATION ON GLOBAL CLIMATE CHANGE

As independent scientists concerned with atmospheric and climate problems, we – along with many of our fellow citizens – are apprehensive about emission targets and timetables adopted at the Climate Conference held in Kyoto, Japan, in December 1997. This gathering of politicians from some 160 signatory nations aims to impose on citizens of the industrialized nation – but not on others – a system of global environmental regulations that include quotas and punitive taxes on energy fuels to force substantial cuts in energy use within 10 years, with further cuts to follow. Stabilizing atmospheric carbon dioxide – the announced goal of the Climate Treaty – would require that fuel use be cut by as much as 60 to 80 percent – worldwide!

Energy is essential for economic growth. In a world in which poverty is the greatest social pollutant, any restriction on energy use that inhibits economic growth should be viewed with caution. We understand the motivation to eliminate what are perceived to be the driving forces behind a potential climate change; but we believe the Kyoto Protocol – to curtail carbon dioxide emissions from only part of the world community – is dangerously simplistic, quite ineffective, and economically destructive to jobs and standards-of-living.

More to the point, we consider the scientific basis of the 1992 Global Climate Treaty to be flawed and its goal to be unrealistic. The policies to implement the Treaty are, as of now, based solely on unproven scientific theories, imperfect computer models – and the unsupported assumption that catastrophic global warming follows from an increase in greenhouse gases, requiring immediate action. We do not agree. We believe that the dire predictions of a future warming have not been validated by the historic climate record, which appears to be dominated by natural fluctuations, showing both warming and cooling. These predictions are based on nothing more than theoretical models and cannot be relied on to construct far-reaching policies.

As the debate unfolds, it has become increasingly clear that – contrary to the conventional wisdom – there does not exist today a general scientific consensus about the importance of greenhouse warming from rising levels of carbon dioxide. In fact, most climate specialists now agree that actual observations from both weather satellites and balloon-borne radiosondes show no current warming whatsoever – in direct contradiction to computer model results.

Historically, climate has always been a factor in human affairs – with warmer periods, such as the medieval “climate optimum,” playing an important role in economic expansion and in the welfare of nations that depend primarily on agriculture. Colder periods have caused crop failures, and led to famines, disease, and other documented human misery. We must, therefore, remain sensitive to any and all human activities that could affect future climate.

However, based on all the evidence available to us, we cannot subscribe to the

Leipzig Declaration (1995)

Petition

We urge the United States government to reject the global warming agreement that was written in Kyoto, Japan in December, 1997, and any other similar proposals. The proposed limits on greenhouse gases would harm the environment, hinder the advance of science and technology, and damage the health and welfare of mankind.

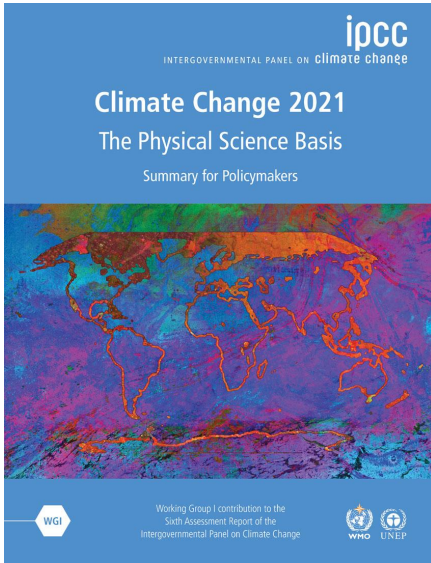
There is no convincing scientific evidence that human release of carbon dioxide, methane, or other greenhouse gases is causing or will, in the foreseeable future, cause catastrophic heating of the Earth's atmosphere and disruption of the Earth's climate. Moreover, there is substantial scientific evidence that increases in atmospheric carbon dioxide produce many beneficial effects upon the natural plant and animal environments of the Earth.

[Handwritten Signature]
Please sign here Please send more petition cards for me to distribute.

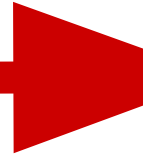
My academic degree is B.S. M.S. Ph.D. in the field of PHYSICS

Oregon Petition (1998, 2007)–
over 30,000 signators

Nor are we misled by statements of
bogus scientific consensus.



ipcc
 INTERGOVERNMENTAL PANEL ON
 climate change



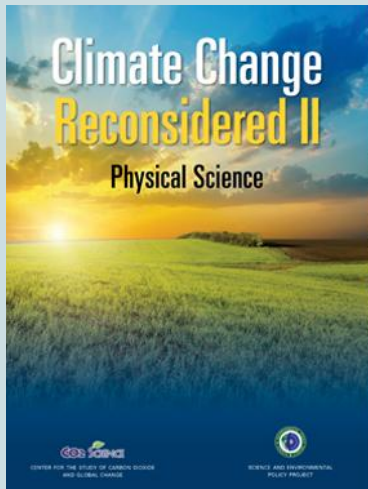
Science information is *mediated*.



We understand how to exercise *trust* in experts.

We know how to recognize *conflict of interest.*





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Consumo total e adicionado de açúcar: avaliação em oito países latino-americanos

MDPI-Nutrientes, 22 de março de 2018

Mauro Fisberg, Irina Kovalsky, Georgina Gómez, Attilio Rigotti, Lilla Yadira Cortés Sanabria, Martha Cecilia Yépez García, Rossina Gabriella Pareja Torres, Mariabella Herrera-Cuenca, Ioná Zalcman Zimberg, Berthold Koletzko, Michael Pratt, Luis A. Moreno Aznar, Viviana Guajardo, Regina Mara Fisberg, Cristiane Hermes Sales, Agatha Nogueira Previdelli e em nome do Grupo de Estudos ELANS

ELANS é um estudo transversal de nutrição e saúde de uma amostra nacionalmente representativa de populações urbanas em oito países da América Latina (Argentina, Brasil, Chile, Colômbia, Costa Rica, Equador, Peru e Venezuela). Um protocolo de estudo padrão foi elaborado para avaliar a ingestão nutricional, os níveis de atividade física e as medidas antropométricas de 9.000 participantes registrados.

O estudo baseou-se em desenho amostral complexo e multiestágio e a amostra foi estratificada por sexo, idade (15 a 65 anos) e nível socioeconômico. Um estudo piloto de

If the source of information is not credible, then not even the evidence they present cannot be trusted.

CO2 Science

www.co2science.org/data/mwpp/mwpp.php

CO2 SCIENCE

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- Oceania
- South America

DO PLANTS LIKE MORE CO2?

OCEAN ACIDIFICATION DATABASE

Medieval Warm Period Project

Project Overview

Study Description and Results

MWP-CWP Quantitative Temperature Differentials

MWP-CWP Qualitative Temperature Differentials

Interactive Map and Time Domain Plot

To view this feature, your computer must be configured to run applets that use Java technology. To download free Java software, we recommend Sun Microsystems' Java Runtime Environment, which is available at www.java.com. Instructions on how to operate the map's features are located under the map. Scroll down clicking on the link above to view them.

[List of Scientists Whose Work We Cite](#)



In summary, we justifiably believe the science of climate change *because*:

- We *trust* the IPCC and the *expertise* of its members
- We *trust* the *process of vetting* in forming a *critical consensus*
- We *trust* the media that *reports* the consensus *faithfully*.

Ironically, we do NOT believe it because we did the research ourselves or weighed all the evidence on our own.

We exercise *informed trust* in scientists' hard-won knowledge.

Our trust is indeed justified — *and it works*.



Educational philosopher Stephen Norris presented us with this dilemma in the 1990s:

In a society of distributed expertise, we inevitably rely on each other's specialized knowledge. We *cannot* be expert in everything. We *cannot* be fully intellectually independent, even if we act as autonomous agents

Thus, as responsible educators, we have to learn how (and teach how) to negotiate our way through mediated knowledge – addressing the problems of expertise, credibility, the sociology of trust, deceit, and so on.

- Norris, S. P. (1995). Learning to live with scientific expertise: Toward a theory of intellectual communalism for guiding science teaching. *Science Education*, 79, 201–217.
- Norris, S. P. (1997). Intellectual independence for nonscientists and other content-transcendent goals of science education. *Science Education*, 81, 239–258.

ELEVENTH EDITION
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BIOLOGY
URRY • GAIN • WASSERMAN
MINORSKY • REECE



Even accepting the word of a textbook is based on layers and layers of trust.

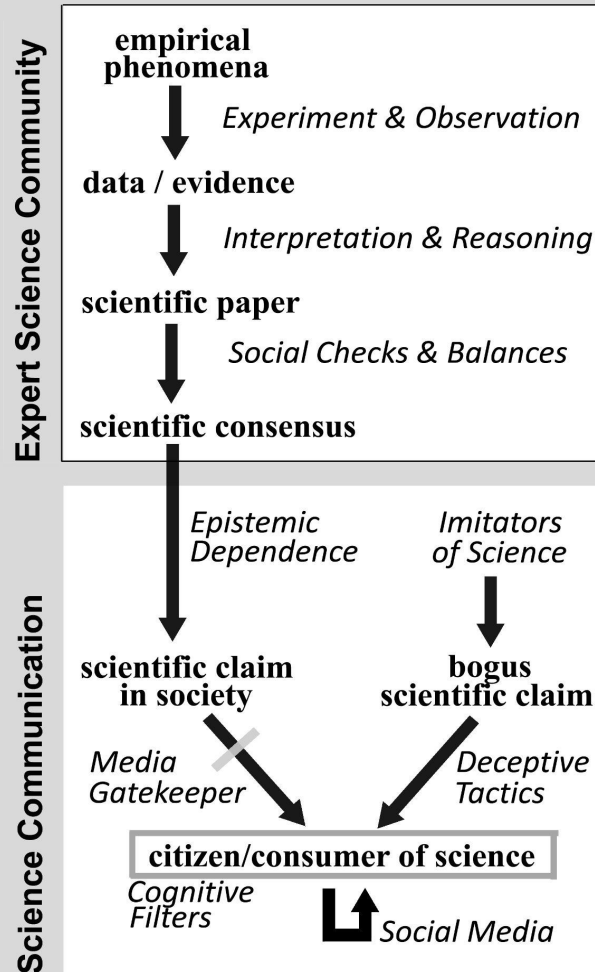
We cannot claim to "know" it all ourselves based on direct observations or personal experience, not without that trust.

Somewhat humbling.
And yet, we manage.

Consider the pathway of scientific knowledge: from test tubes to YouTube, from lab bench to judicial bench.

Conventional science education has focused very narrowly on the internal practices of scientists (top).

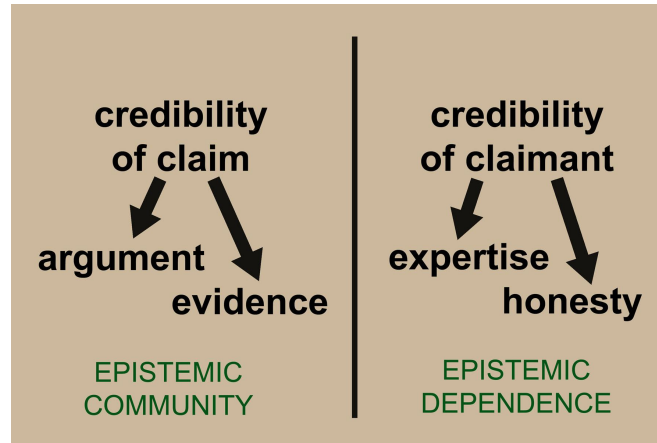
Consumers of science need to know much more to secure that knowledge. They need skills in *science media literacy* (bottom).



**conventional
science teaching**

**"Science-in-the-Wild"
—where Science Media
Literacy education is
needed**

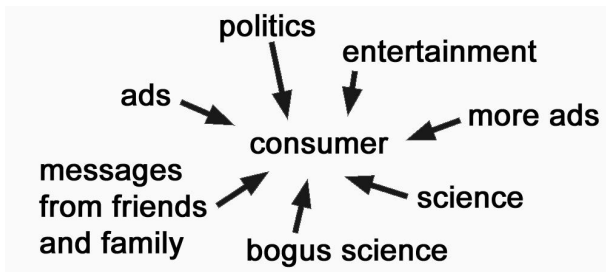
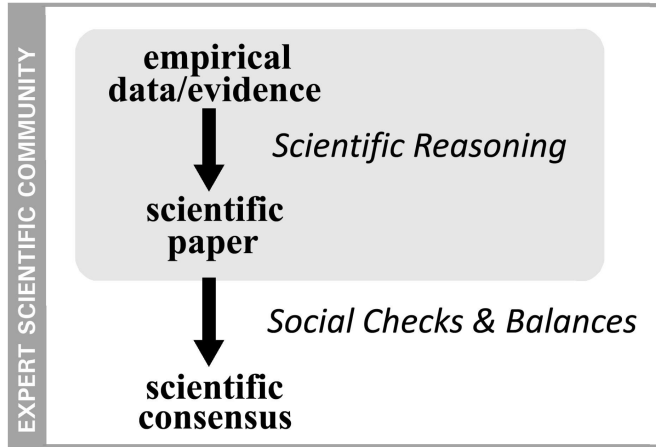
What is the science?



Who speaks for science?*

Even as we continue to teach scientific reasoning (for its role in our personal lives), if we care about the role of science in informing public policy and personal decision-making, we need to help students (as non-experts) learn how to secure *reliable* scientific information in the media.

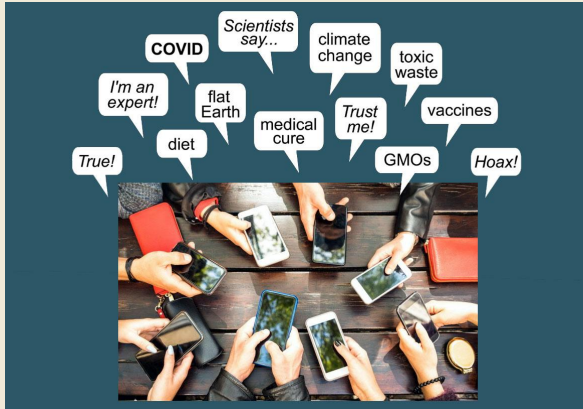
That involves significant reorientation—from assessing the meaning of the **evidence** (*within* science) to assessing the credibility of the **source of information** (that *appeals to* science).



Targeting MISINFORMATION

That is the challenge addressed by the teaching resources in this website:

How do we teach students to be informed consumers of science, not pseudo-experts trying to interpret evidence for themselves?



Ten competencies

Science media literacy involves a set of competencies, many introduced here and discussed further in [the conceptual overview](#).

Motivation

- basic beliefs about knowledge
- when to be analytical
- why trust experts

Media

- identifying expertise
- credibility of "gatekeepers"
- detecting deception
- interpreting technology & social networks

Personal

- role of confirmation bias
- role of other cognitive habits
- why consensus matters

Targeting MISINFORMATION

[ABOUT](#)

Supporting science media literacy in science education

[CONTACT](#)

ORIENTATION



[Fantastic Beasts](#)
(Renaissance Edition)

CREDIBILITY



[The Vaccine
Skeptics of 1721](#)

EXPERTISE



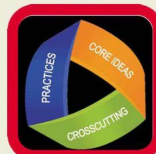
[Inquiry into
Expertise](#)

DECEPTIVE
TACTICS



[The Plausibility Trap](#)

TEACHING
RESOURCES



[Overview & NGSS
Benchmarks](#)



[Fantastic Beasts](#)
(AI Edition)



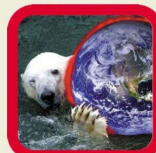
[The New Madrid
Earthquake of 1990](#)



[Who's the Expert?](#)



[Science Liars Game](#)



[From Evidence to
Sources](#)



[Fact-Checking 101](#)



[The Covid
Conundrum](#)



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[Handouts](#)

<http://shipseducation.net/misinfo>