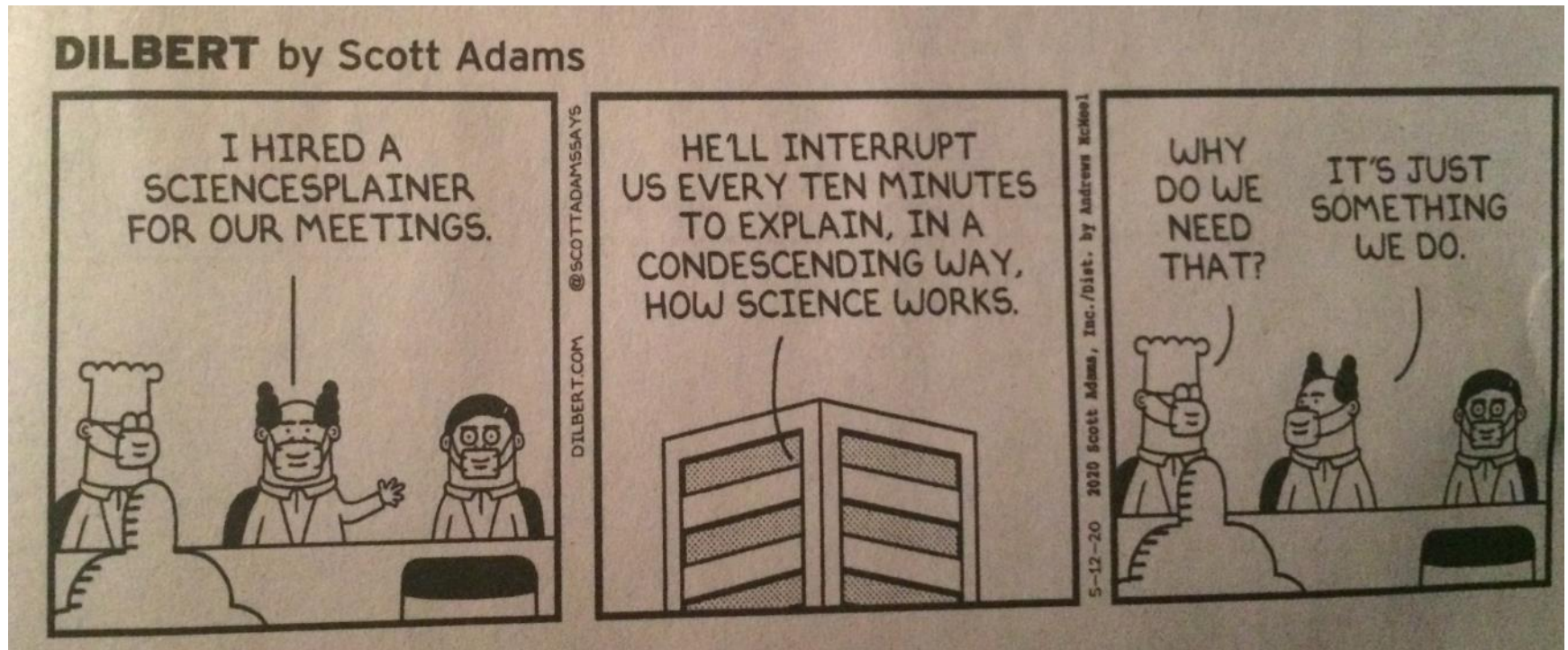


The challenges of science messages

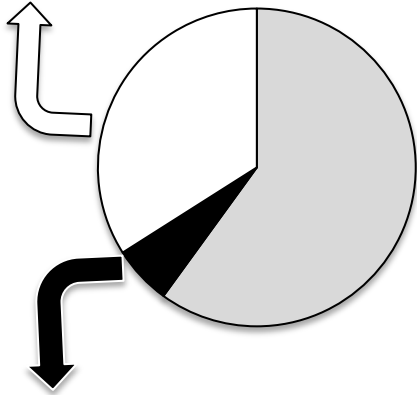


The challenges of science messages

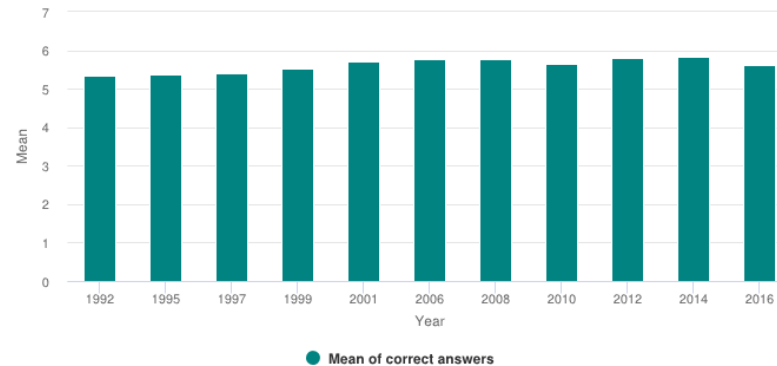
- psychological & physical distance
- negative messaging
- lack of trust
- jargon
- exclusive or discriminatory language

Challenge: distance

33% of high school graduates don't go on to college.



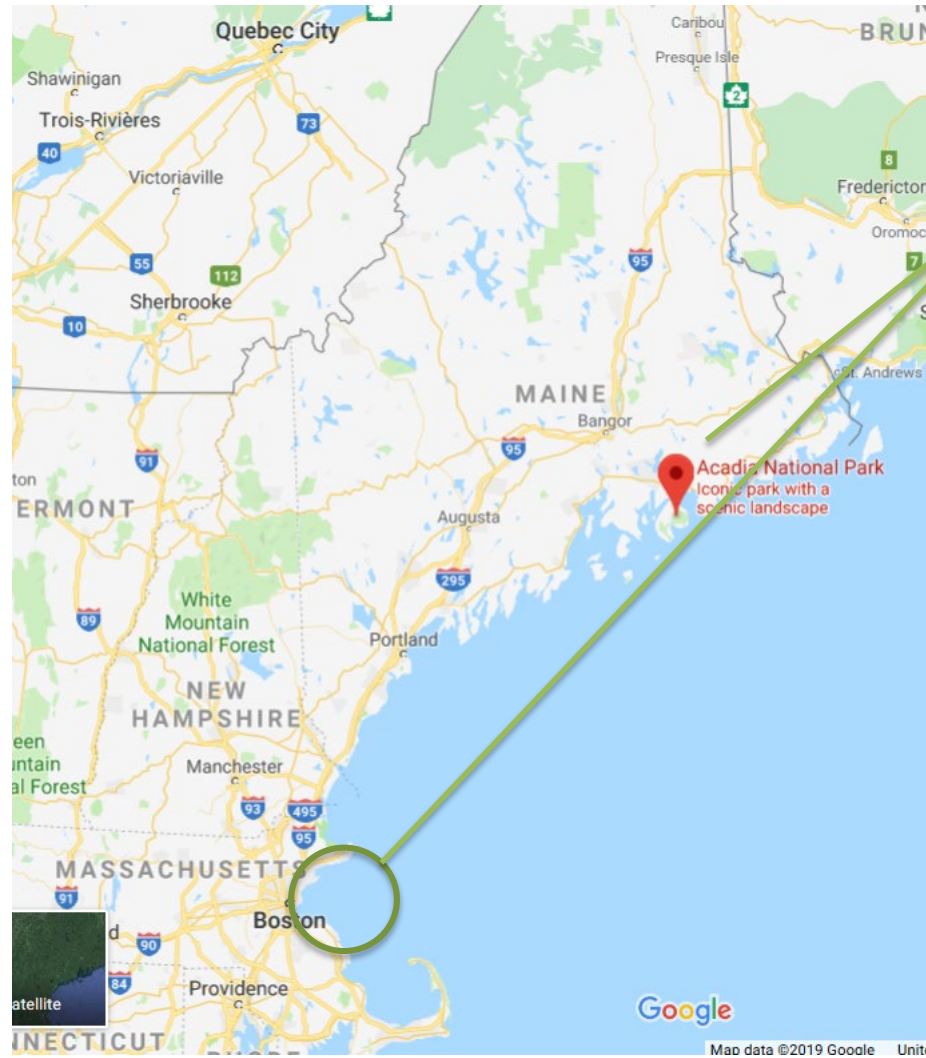
Fewer than 10% of college graduates major in science.



Note(s): Mean number of correct answers to nine questions included in trend factual knowledge of science scale; see Appendix Table 7-2 for explanation and list of questions. See Appendix Table 7-8 for percentage of questions answered correctly. See Appendix Tables 7-9 and 7-10 for responses to individual questions.

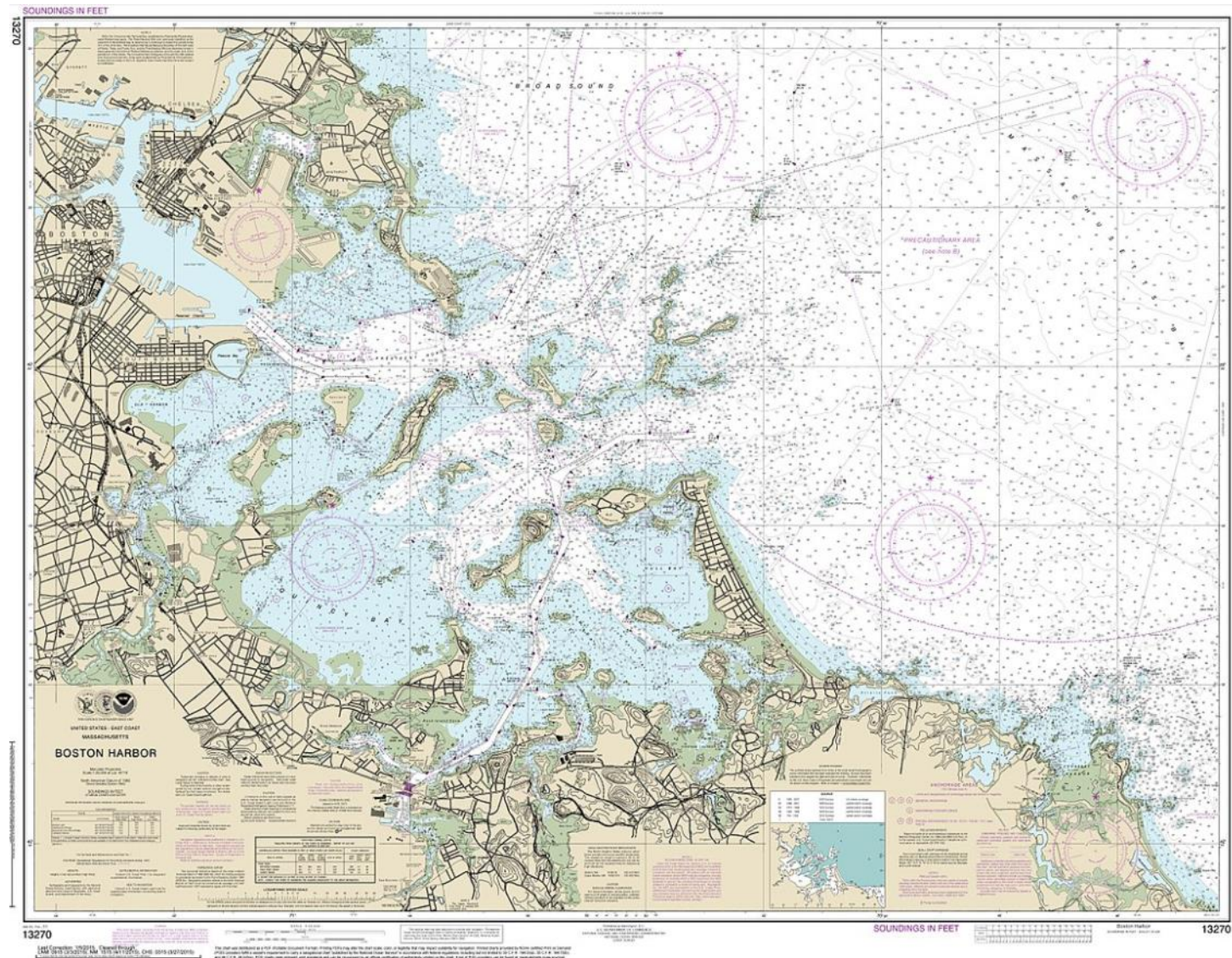
“scientists are apt to be odd and peculiar people.”

Challenge: distance



“nature”

Challenge: distance

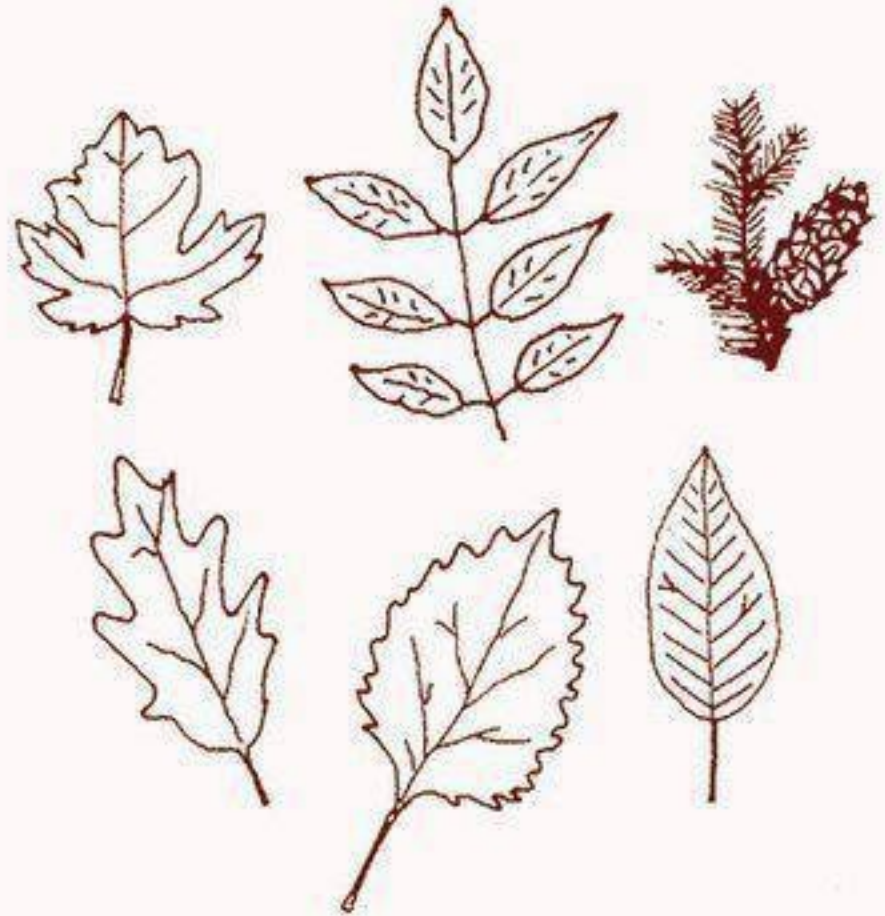


Challenge: distance

Name these brands



Name these plants



Challenge: distance

“nature”

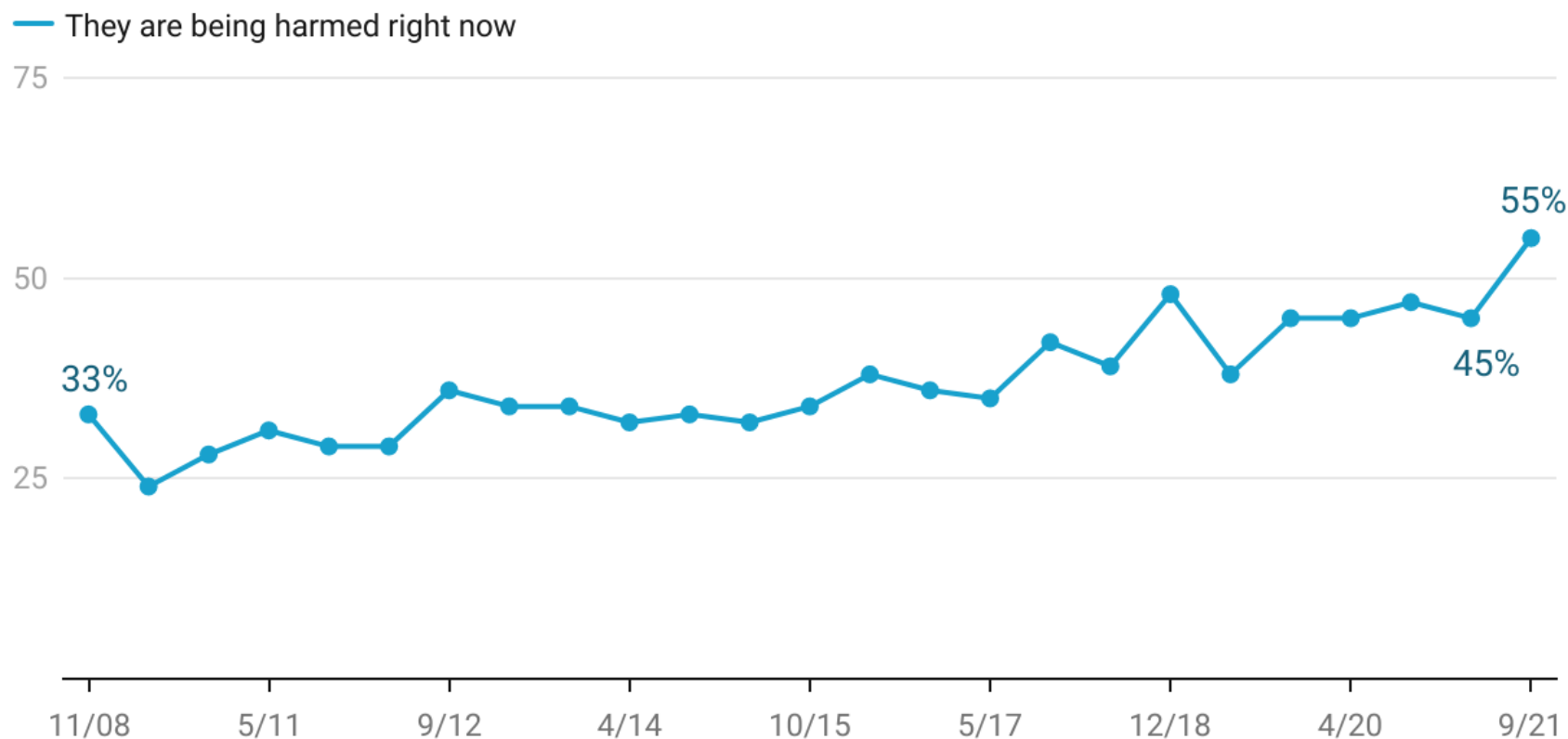


1980s: 3,000 salmon returning/year,
active sport, sustenance fishery
in- and on-the-water activity



2000s: <1,000 salmon
returning/year, Endangered Species
Act listing
next-to-water activity

A majority of Americans say people in the US "are being harmed right now" by global warming



When do you think global warming will start to harm people in the United States?

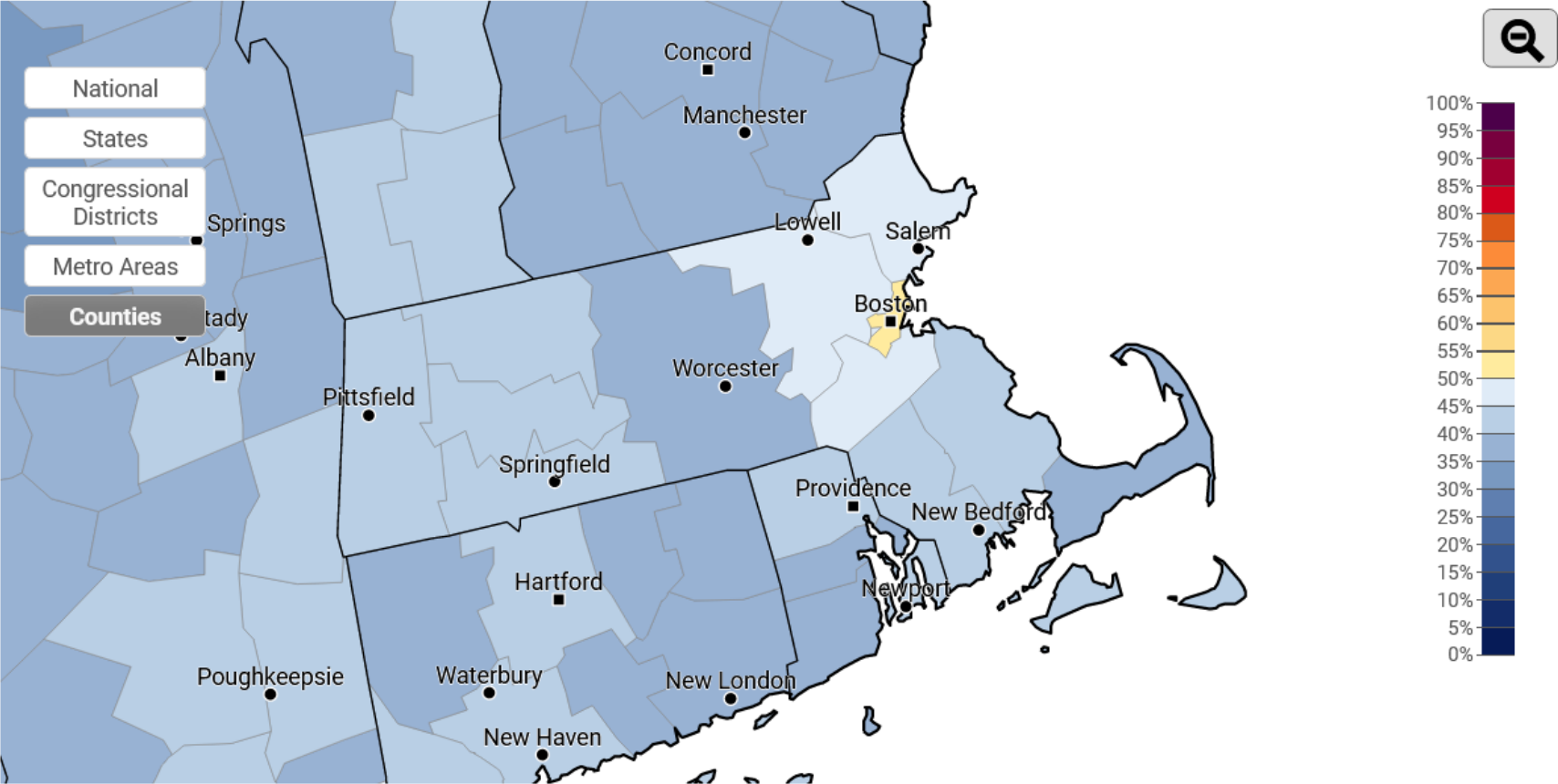
Source: Sept. 2021, Yale/George Mason University • Created with Datawrapper

Challenge: distance

Estimated % of adults who think global warming will harm them personally (43%), 2020

Select Question: Global warming will harm me personally Absolute Value

Click on map to select geography, or: Massachusetts Select a County

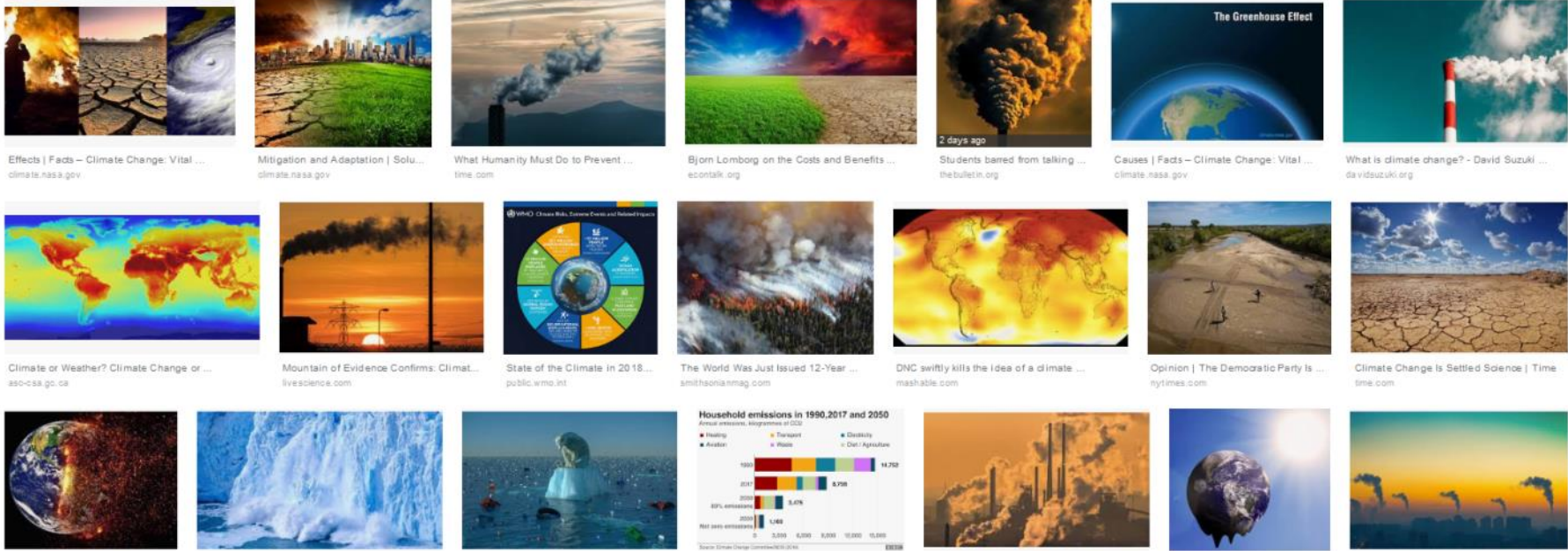


Challenge: Negative messaging

Google climate change

Q All News Images Videos Books More Settings Tools

Collections SafeSearch



Effects | Facts – Climate Change: Vital ...
climate.nasa.gov

Mitigation and Adaptation | Solu...
climate.nasa.gov

What Humanity Must Do to Prevent ...
time.com

Bjorn Lomborg on the Costs and Benefits ...
econTalk.org

Students barred from talking ...
thebulletin.org

2 days ago

Causes | Facts – Climate Change: Vital ...
climate.nasa.gov

What is climate change? - David Suzuki ...
daVIDsuzuki.org

Climate or Weather? Climate Change or ...
aso-csa.gc.ca

Mountain of Evidence Confirms: Climat...
livescience.com

State of the Climate in 2018...
public.wmo.int

The World Was Just Issued 12-Year ...
smithsonianmag.com

DNC swiftly kills the idea of a climate ...
mashable.com

Opinion | The Democratic Party is ...
nytimes.com

Climate Change Is Settled Science | Time
time.com

Household emissions in 1990, 2017 and 2050
Annual emissions, megatonnes of CO₂

Category	1990	2017	2050
Residential	1,148	5,476	8,758
Transport	1,148	5,476	8,758
Industry	1,148	5,476	8,758
Electricity	1,148	5,476	8,758
Heat	1,148	5,476	8,758
Land Use Change and Forestry	1,148	5,476	8,758
Total	1,148	5,476	8,758

Source: Climate Change Commission (CCC) 2014

rogramming ...

Why Do Climate Change Disc...
pbs.org

The Clock's Ticking on Climate Change ...
singularityhub.com

Will **climate change** kill everyone — or just lots and lots of people?

Vox - Jun 13, 2019

In a detailed response, six researchers argued that the report overstates the risks from **climate change**, and that subsequent reporting ...



Challenge: Negative messaging



Will **climate change** kill everyone — or just lots and lots of people?

Vox - Jun 13, 2019

In a detailed response, six researchers argued that the report overstates the risks from



Is Travel
The New
I think a
Your an



The
Live S
If you
acco
'Fright

NationofChange - Jun 12, 2019

Alarmist claims on **extinction** can lead to apathy

Stuff.co.nz - Jun 12, 2019

[View all](#)



the 6th mass ...

e in Earth's history



Challenge: Negative messaging



Do you communicate about
problems facing Boston Harbor & Islands
or
actions people are taking in response?

Challenge: Trust

Are you the right messenger?

Table 4. Average trust ratings by agency and political ideology.

	Very liberal (A)			Moderate (B)			Very conservative (C)			Very conservative trust– Very liberal trust (C–A)	
	Rank	General science trust	Climate science trust	Rank	General science trust	Climate science trust	Rank	General science trust	Climate science trust	General science trust	Climate science trust
NASA	3rd	3.54	3.58	1st	3.38	3.20	1st	3.24	2.88	–0.30	–0.69
NOAA	1st	3.57	3.61	2nd	3.37	3.19	2nd	3.20	2.84	–0.38	–0.77
Smithsonian	2nd	3.57	3.61	3rd	3.24	3.06	8th	2.96	2.60	–0.62	–1.01
CDC	7th	3.41	3.45	4th	3.23	3.05	5th	3.07	2.72	–0.34	–0.73
NSF	6th	3.44	3.47	5th	3.19	3.01	7th	2.98	2.62	–0.46	–0.85
NPS	9th	3.28	3.31	6th	3.18	3.00	3rd	3.10	2.74	–0.18	–0.58
NIH	4th	3.46	3.50	7th	3.13	2.95	9th	2.85	2.49	–0.62	–1.01
USDA	8th	3.28	3.32	8th	3.12	2.94	6th	2.98	2.62	–0.30	–0.69
DOD	11th	2.98	3.01	9th	3.03	2.85	4th	3.08	2.72	0.10	–0.30
EPA	5th	3.45	3.49	10th	3.03	2.85	11th	2.67	2.31	–0.77	–1.17
DOE	10th	3.22	3.25	11th	2.97	2.79	10th	2.76	2.40	–0.46	–0.85
Average		3.38	3.42		3.17	2.99		2.99	2.63	–0.39	–0.79

NASA: National Aeronautics and Space Administration; NOAA: National Oceanic & Atmospheric Administration; CDC: Centers for Disease Control & Prevention; NSF: National Science Foundation; NPS: National Park Service; NIH: National Institutes of Health; USDA: Department of Agriculture; DOD: Department of Defense; EPA: Environmental Protection Agency; DOE: Department of Energy.

Agencies ordered by rank for respondents with moderate political ideologies; table entries are model-based means controlling for age, education, gender, income, race, and church attendance. Furthermore, entries are the average of trust scores between the two different orders of questions.

Challenge: Trust

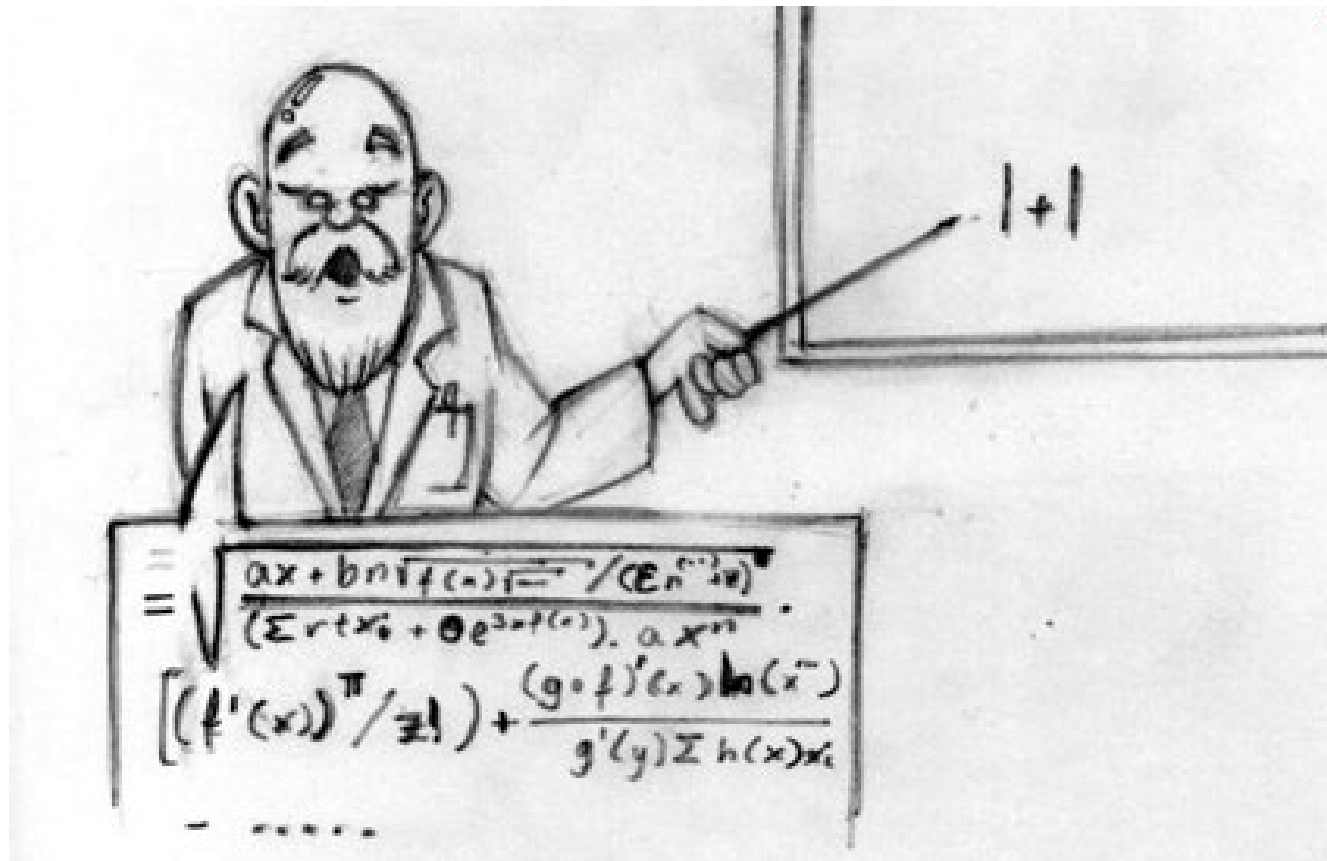


Challenge: Trust



Hi, There are two cedar trees on the west side of Bubble Pond along the carriage path about half way down the pond at the base of Pemetic Mt. ... They are against rocks that line the carriage path. Their roots are entwined in a way that makes them appear to be "holding hands". It is one of the most amazing natural formations in the park and is "hiding in plain sight". We have been checking on their condition twice a year for a least the last dozen years as we have always been worried about potential vandalism of this cherished natural formation as hundreds walk by here every day. This spring we were shocked to discover that three 4"x4" square holes have been bored completely through the more southerly tree at about the 12 foot level. Can you tell us what happened here? We are quite worried for their survival. I'm sure you are too. Thank you for your time. Mary

Challenge: Language



graphic by Doruk Golcu

Challenge: Language

WE NEED SOME NEW TARGON,
THE PUBLIC ARE STARTING TO
UNDERSTAND WHAT WE'RE
TALKING ABOUT!



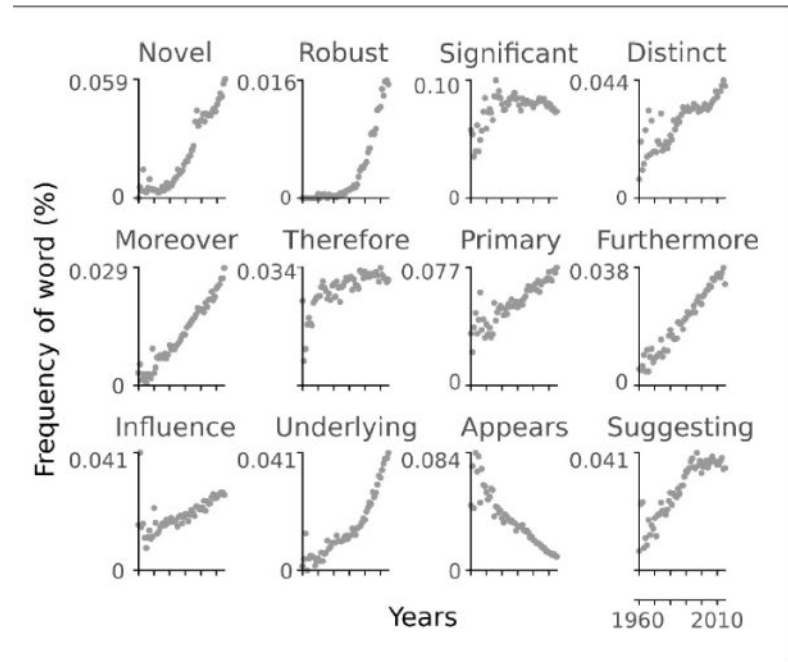
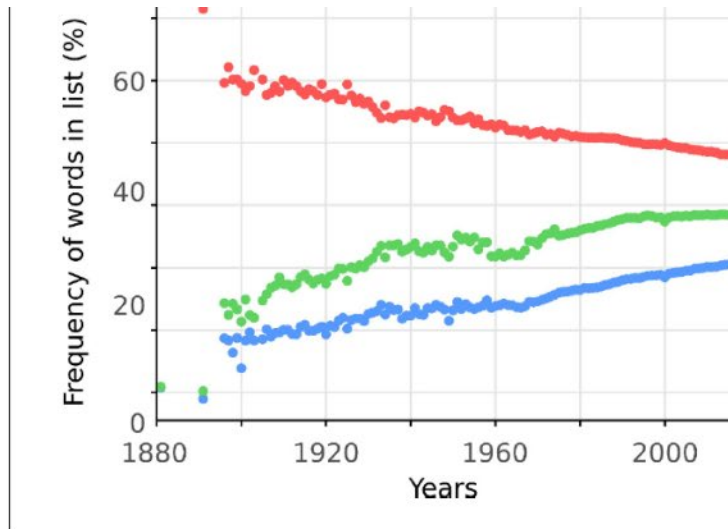
Jargon is a problem in science

RESEARCH

The readability of scientific texts is decreasing over time

Abstract Clarity and accuracy of reporting are fundamental to the scientific process. Readability formulas can estimate how difficult a text is to read. Here, in a corpus consisting of 709,577 abstracts published between 1881 and 2015 from 123 scientific journals, we show that the readability of science is steadily decreasing. Our analyses show that this trend is indicative of a growing use of general scientific jargon. These results are concerning for scientists and for the wider public, as they impact both the reproducibility and accessibility of research findings. DOI: <https://doi.org/10.7554/eLife.27725.001>

PONTUS PLAYÉN-SIGRAY[†], GRANVILLE JAMES MATHESON[†], BJÖRN CHRISTIAN SCHIFFLER[†] AND WILLIAM HEDLEY THOMPSON^{*}



eLife 2017

Jargon is a problem *for* science

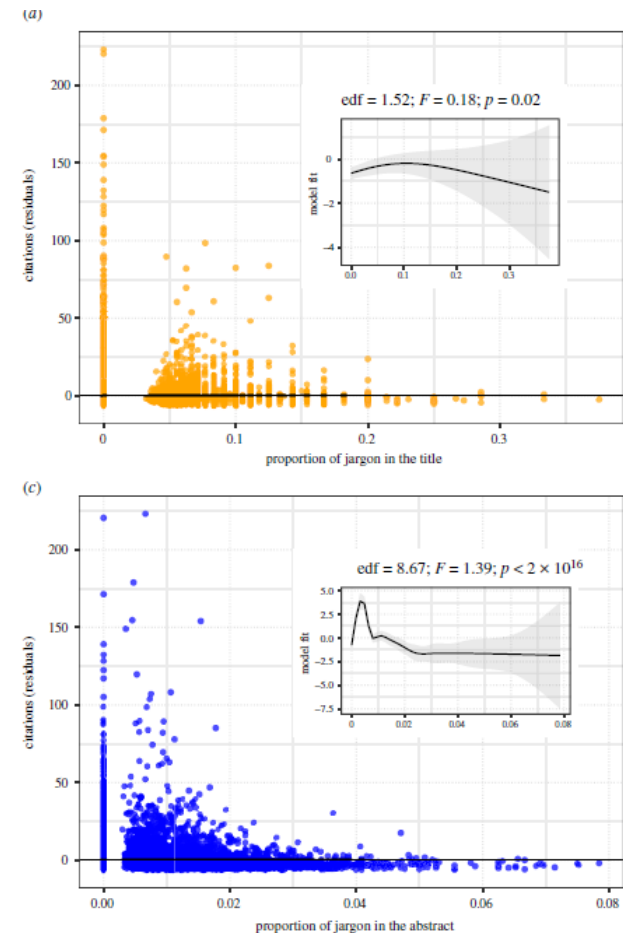
Specialized terminology reduces the number of citations of scientific papers

Alejandro Martínez^{1,†} and Stefano Mammola^{1,2,†}

¹Molecular Ecology Group (Dark-MEG), Water Research Institute (IRSA), National Research Council (CNR), Verbania Pallanza, Italy

²Laboratory for Integrative Biodiversity Research (LIBRe), Finnish Museum of Natural History (LUOMUS), University of Helsinki, Helsinki, Finland

 AM, 0000-0003-0073-3688; SM, 0000-0002-4471-9055



Challenge: Language

The data seem to suggest that there might be a possible effect on some as yet undetermined organism, but we can't really be sure until we continue the experiments for a few years, and even then it will be difficult to say with much confidence whether or not....



Jargon prevents successful communication.

Terms that have different meanings for scientists and the public

Scientific term	Public meaning	Better choice
enhance	improve	intensify, increase
aerosol	spray can	tiny atmospheric particle
positive trend	good trend	upward trend
positive feedback	good response, praise	vicious cycle, self-reinforcing cycle
theory	hunch, speculation	scientific understanding
uncertainty	ignorance	range
error	mistake, wrong, incorrect	difference from exact true number
bias	distortion, political motive	offset from an observation
sign	indication, astrological sign	plus or minus sign
values	ethics, monetary value	numbers, quantity
manipulation	illicit tampering	scientific data processing
scheme	devious plot	systematic plan
anomaly	abnormal occurrence	change from long-term average

Challenge: Language

WORD	SCIENCE MEANING	PUBLIC MEANING
Earth		
Shear	difference in wind speed/direction	cut wool off of
Mantle	planet layer between crust and core	important role passed from person to person
Crust	outermost layer of planet	edge of pizza/pie
Fault	fracture in a rock with movement	responsible for accident/misfortune
Dating	determining age of site/artifact	initial stage of romantic relationship
Grade	gradient/slope	level of proficiency
Plastic	substance that is easily shaped/molded	synthetic material
Matter	physical substance in general	be of importance, have significance
Surf	line of foam on seashore from breaking waves	riding a surfboard
Shelf	a submarine bank	a surface for displaying/storing objects
Submarine	existing/occurring under the sea surface	a ship that stays submerged under water for extended periods
Current	water or air moving in a direction	belonging to the present time
Bank	land alongside a river/lake	a place where people store money
Fetch	distance traveled by wind/waves over water	go far and then bring back something/someone
Swell	sea movement in rolling waves that do not break	to become larger in size (e.g. a body part)
Processes		
Model	computer simulation	promotes fashion/product
Cycling	flow of nutrients or elements	riding a bicycle
Bonding	electrostatic attraction between atoms	making an emotional connection
Driver	influential factor	someone who drives a vehicle
Force	strength/energy of action/movement	make someone do something against their will
Stress	pressure/tension exerted on a material object	mental/emotional strain
Sample	to take a sample for analysis	a small part of something
Productive	creating organic matter through photo/chemosynthesis	busy and efficient
Code	software/computer language	encrypted message

Challenge: Language



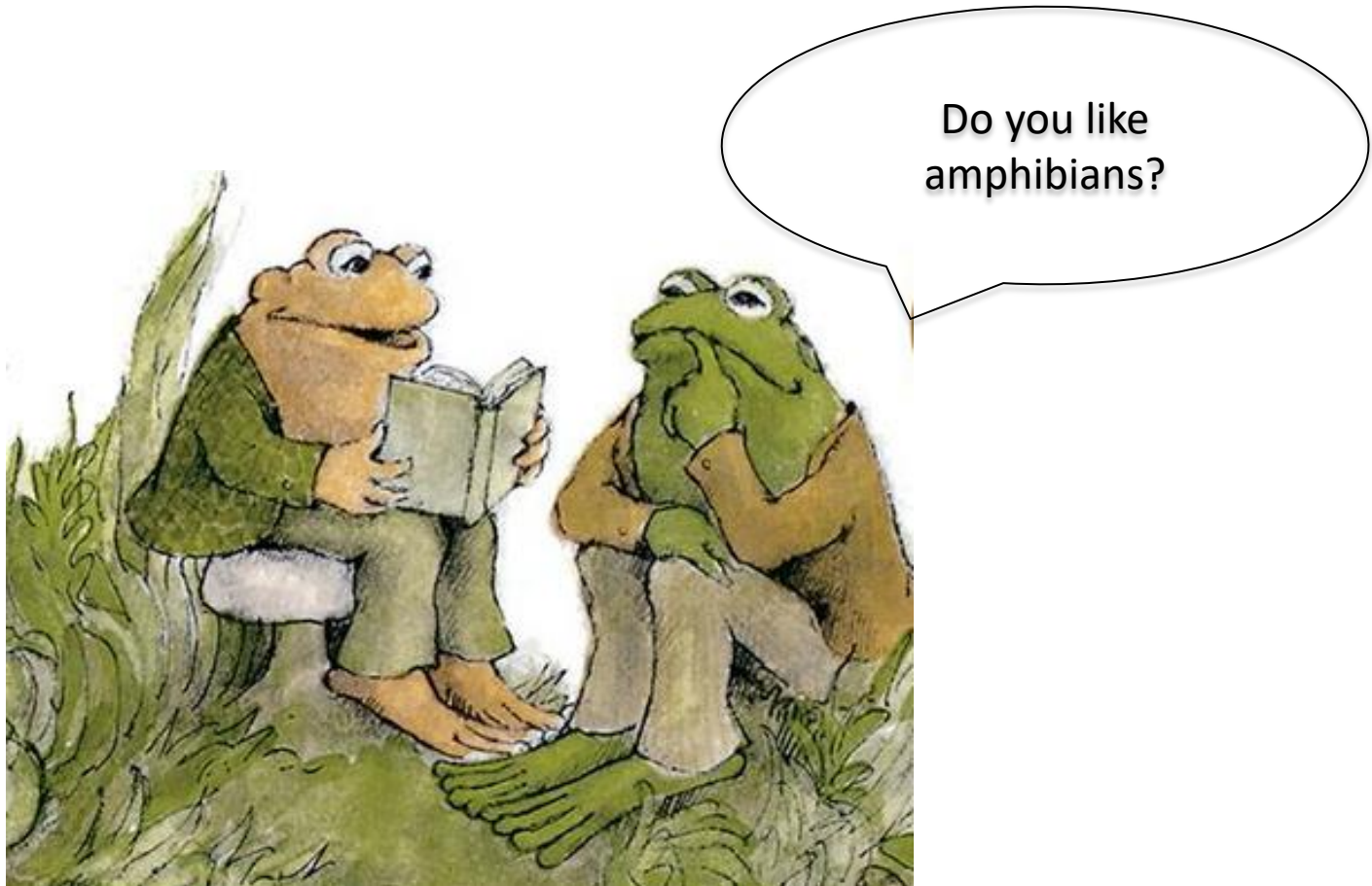
Below are some other examples of insider terminology. While we are not recommending you abandon these terms altogether, each likely requires additional context or explanation in order to prevent more general audiences from becoming confused or drawing conclusions that are counterproductive.

- Carbon neutral
- Environmental sustainability
- Energy transition
- Energy future
- Green infrastructure
- Green economy
- Green businesses
- Ocean acidification
- Food security

Challenge: Language

~~“biodiversity”~~

“wildlife” or “plants and animals”



Arnold Lobel, *Frog and Toad are Friends*

Challenge: Language

~~“ecosystem”~~

“air, land, and water”



Photo by C. Daigle

What would you add to these lists?

Language matters.

PERSPECTIVE ARTICLE

Front. Commun., 30 January 2020 | <https://doi.org/10.3389/fcomm.2020.00002>



Science Communication Demands a Critical Approach That Centers Inclusion, Equity, and Intersectionality

Katherine N. Canfield¹, Sunshine Menezes^{1,2*}, Shayle B. Matsuda³, Amelia Moore⁴, Alycia N. Mosley Austin⁵, Bryan M. Dewsbury⁶, Mónica I. Feliú-Mójer⁷, Katharine W. B. McDuffie^{1,2}, Kendall Moore⁸, Christine A. Reich⁹, Hollie M. Smith¹⁰ and Cynthia Taylor⁶

Words to Watch

Message testing and interviews with external audiences (funders, policymakers, and other leaders representing the health/healthcare, education, children & youth, environment, and corporate sectors) revealed the following “words to watch.” These words were most likely to evoke negative feelings or confusion with external audiences, or were found to not resonate. These words should be used with caution and should be paired with language that provides additional explanation and context.

Nature

Seen as far away, grand, something you “go to.” Sounds elitist. Conjures images of undeveloped, isolated places. Resonates the most with “inside the tent” audiences.

Outside

More expansive term than nature, but less action-oriented. “Right outside the door.” Seen as inclusive of manmade environments. Least popular term tested.

Outdoors

The most accessible of the terms to new audiences. Simpler, more traditional language. Seen as less judgmental, less political than other terms. Connotes elements of activity. Resonates the most with urban audiences.

Stewardship

Often linked with ‘conservation’ and both are problematic and poorly defined by new audiences. Inside the tent jargon. Raises questions of if and how time outdoors correlates to future stewardship.

Resilience

Buzz-wordy. Overused. Can be misunderstood. Best to avoid.

Healthy Communities

Concept tests well, but needs definition for some audiences. Showing common threads of personal health, education, and environmental care are important descriptors.

American(s)

Triggers biases towards non-citizens, raises immigration issues. Seen as exclusionary. Use “all people” or “everyone” as alternatives.

Safe / Safety

Needs context and explanation. Resonates differently for communities of color. Most audiences lack widespread awareness of safety differentials outdoors.

Access

Needs to be paired with examples of why access is an issue, and how lack of access leads to disparities. Most resonant when paired with ‘nature,’ as access to the ‘outside’ has different meaning in an urban setting.



Shared Narrative
Storytelling Resource
rethinkoutside.org

Challenge: Language

problematic metaphors and bias

sports: hit it out of the park

violence (war): combat climate change

machines: economic engine

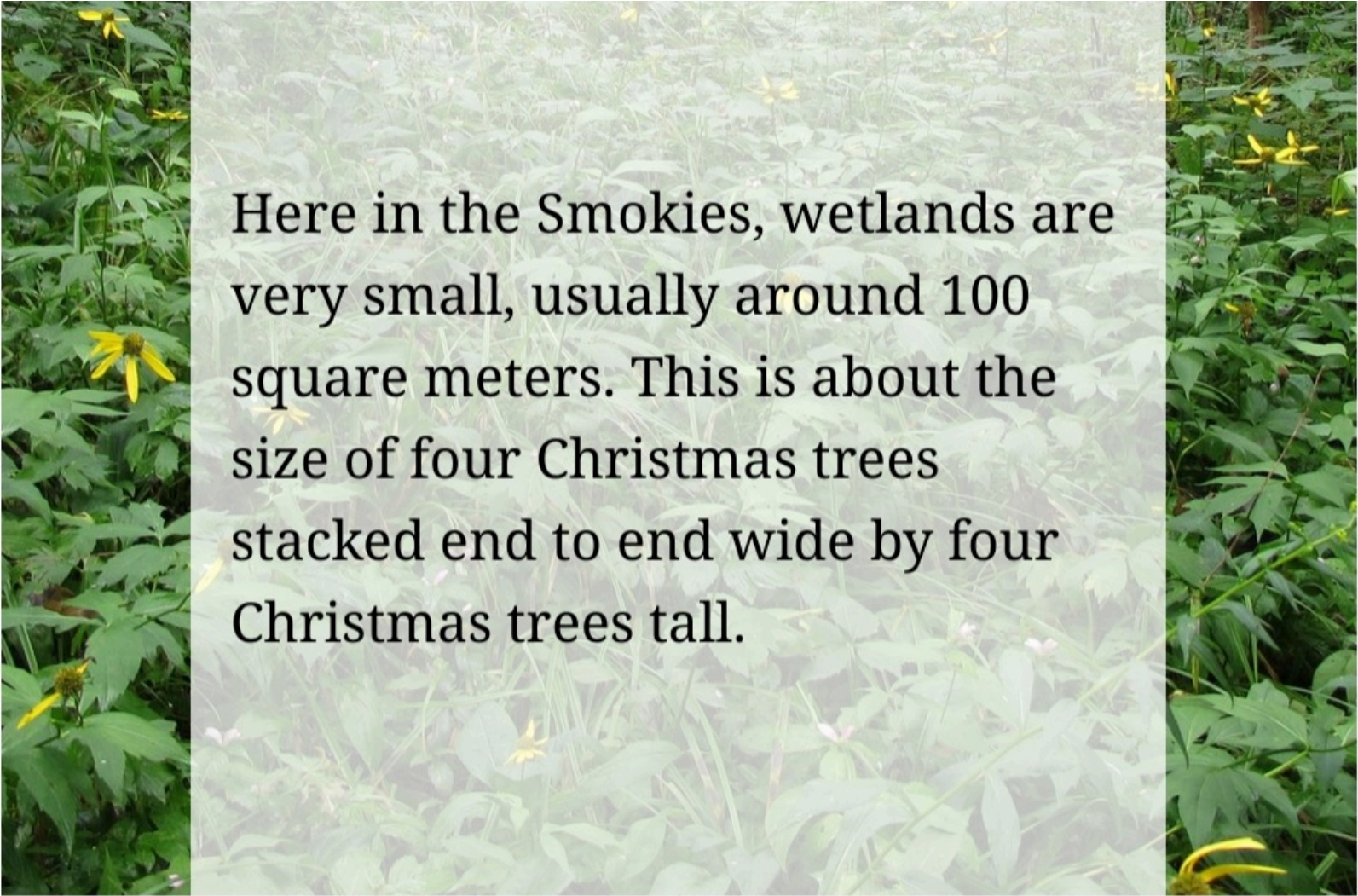
colonialism: wilderness, discover

circle the wagons

plant blindness

citizen science

remote field site



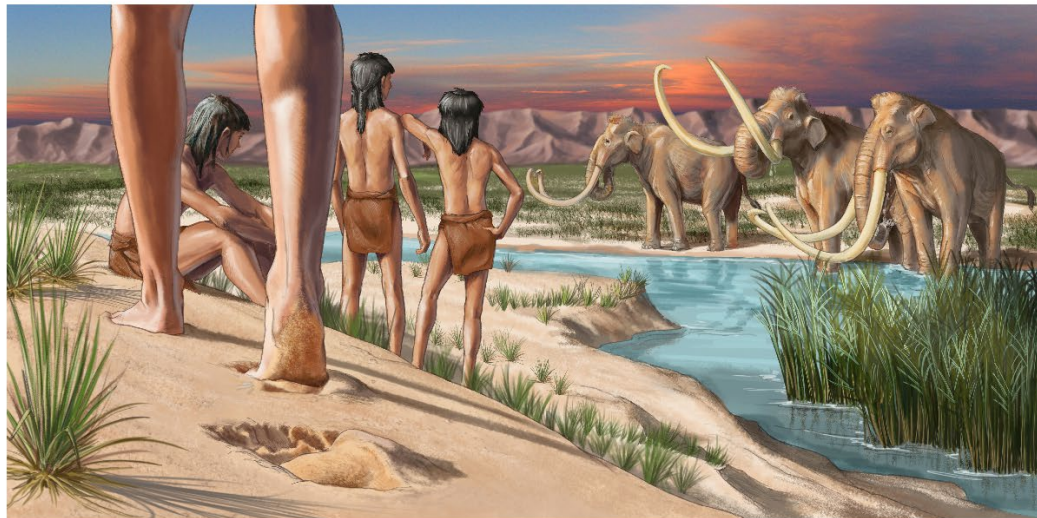
Here in the Smokies, wetlands are very small, usually around 100 square meters. This is about the size of four Christmas trees stacked end to end wide by four Christmas trees tall.

Office of Communications

[Home](#)[What We Do](#)

NEWS RELEASE

Fossilized Footprints Reveal Human Habitation of North America Thousands of Years Earlier than Previously Thought



Long before the sand dunes formed at White Sands National Park, ice age teenagers left their footprints in the mud, only to be discovered thousands of years later.

Courtesy of Karen Carr

News Release Date: September 23, 2021

Contact: newsmedia@nps.gov

ALAMOGORDO – New scientific research conducted at [White Sands National Park](#) in New Mexico has uncovered the oldest known human footprints in North America. The discovery reveals evidence of human occupation in the Tularosa Basin beginning at least 23,000 years ago, thousands of years earlier than previously thought.



NEWS | 23 SEP 2021 | BY LIZZIE WADE

Human footprints near ice age lake suggest surprisingly early arrival in the Americas

If dates hold, tracks would put people in New Mexico thousands of years earlier than thought

So far, the team has found no artifacts that could shine a light on the culture of the people who left the footprints. But Kim Charlie, an enrolled member of the Pueblo of Acoma in New Mexico, feels a deep connection. “Thousands and thousands of years ago, our ancestors walked this place,” says Charlie, who has visited the footprints and even uncovered some herself. Seeing prints of humans together with extinct megafauna such as camels sheds light on why the Acoma language has a word for “camel,” she says.

Challenge: Language

CLIMATE AND DEVELOPMENT
<https://doi.org/10.1080/17565529.2020.1862739>



COMMENT

OPEN ACCESS

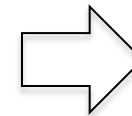
WAMPUM Adaptation framework: eastern coastal Tribal Nations and sea level rise impacts on water security

Kelsey Leonard

Faculty of Environment, University of Waterloo, Waterloo, Canada



research
privilege
attack
armor
colonize
retreat



witness
acknowledge
mend
protect
unite
move



ARTICLE

Indigenizing Archaeology at Acadia National Park

Acadia National Park, [Saint Croix Island International Historic Site](#)

“Community members shouldn’t have to go to second-hand sources about their first-hand experiences.”

- *Issac St. John, Houlton Band of Maliseet Indians, University of New Brunswick, graduate student*

On a small point of land on the shore of the Schoodic Peninsula, rocky shore gives way to softer sediment. Waves lap at the foot of small bluffs, moving sand and broken shell onto a beach strewn with dried seaweed and frayed fishing rope. Roots of spruce and birch trees and grass hold the land in place.

A few apple trees hint at past human presence, but there is deeper history here: along the edge, piles of clam shells mark a space where, between one and two thousand years ago, ancestors of the [Wabanaki](#) people came together to harvest and share food, to interact and relate, to live.

At least 24 Indigenous archaeological sites have been documented within the boundaries of Acadia National Park; only few have been studied.

In 1978, a team of four student archaeologists led by Dr. David Sanger of the University of Maine excavated the Schoodic site. Their purpose was “to identify the nature of the sites including their age and cultural affiliation, the range of activities that occurred, and an assessment of the desirability of further research activity at the sites in order to gain additional useful data.”

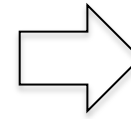
Challenge: Language

CONFIDENTIAL

ARCHAEOLOGICAL INVESTIGATIONS AT
FRAZER POINT AND DUCK HARBOR,
ACADIA NATIONAL PARK, MAINE

PROPERTY OF LIBRARY
DIVISION OF CULTURAL
RESOURCES, NARO
ACAD.045 0.2
CRBIS # 012571

specimen
artifact
biface
midden



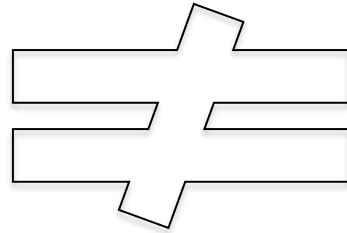
art
creation
gift
mound

sion and by visitor activities. The major purpose of the 1978 field research and analysis was to identify the nature of the sites including their age and cultural affiliation, the range of activities that occurred, and an assessment of the desirability of further research activity at the sites in order to gain additional useful data. Following the field work, in a letter report dated 26 September, 1978, Sanger expressed the view that, while additional artifacts could be recovered, it was unlikely that further excavations could enlarge much on our general understanding of the nature of the sites.

“Historical narratives removed people. We are using a vocabulary that puts people back into the story . These objects reflect the souls of our ancestors, who intentionally created them, who are contained within them.” – Natalie Dana-Lolar

Challenge: Language

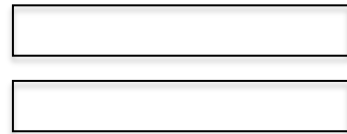
science



knowledge

(what we know)

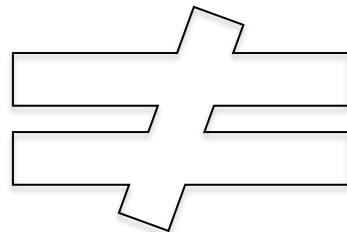
science



process

(how we know it)

science



only or best

way of knowing

The challenges of science messages

- psychological & physical distance
- negative messaging
- lack of trust
- jargon
- exclusive or discriminatory language