Forces Within

A Guide to Communicating Science Outside the Scientific Community

AGU 100
ADVANCING EARTH AND SPACE SCIENCE

Table of Contents

Introduction

You can learn a lot in 100 years—just ask the Earth and space scientists who make up the AGU community, and their peers as they celebrate an upcoming Centennial. The threads of scientific discovery that have led to everything we know about our planet, oceans, and atmosphere today continue unfurling toward a future of grand challenges, ongoing exploration, new discoveries and innovative solutions. It's a process that is at once daunting, exciting, and vitally important – and it's just as important that we communicate our progress and its implications with all of humankind.

Since 1919, AGU has built a thriving community that **connects** scientists, **inspires** collaboration, and **amplifies** your achievements – helping elevate the visibility and value of Earth and space science and its contributions to a better world.

Now, as part of AGU's Centennial celebration, we hope to **inspire** you to share your science, to **connect** you and your work with the wider world and to **amplify** your voice and the contributions of the Earth and space science community in creating a more sustainable future.

How This Guidebook Will Help You

This guidebook distills a vast body of knowledge for communicating your science with the media and the general public into essential practices that you can apply to any situation. It offers more nuanced tips for talking about tough topics, specifically natural hazards, risk, and climate change. You'll also find templates to help you craft key messages, and a compiled a list of additional SciComm resources.

So, go ahead: unleash the forces within your own nature – the ones that inspired you to pursue a life of curiosity, exploration, and discovery in the Earth and space sciences. Use this inner energy to **connect** with others, to **amplify** your passion for the work you do, and to **inspire** respect, appreciation, and awe for the world around us.

There has never been a better time for scientists to step up and speak out. The planet and its people need you!

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Six Steps to Successful SciComm for Every Situation

Science unveils mysteries, breaks new ground, and is just plain cool. Whether it's the natural wonder of a solar eclipse or the discovery of an underground lake on Mars, these basic communication practices will help you share your science in a way that is clear, interesting, and relevant to the audience.

➞ Relax

Yes, you're a scientist, but in this context your role as a communicator comes first. Think of the situation as a conversation, not a lecture – even if you're the one who will do most of the talking. By inviting interaction, you will more effectively engage your audience. Be confident that you know your subject matter well enough to go off script, allowing for questions and the exchange of ideas.

➞ Know your audience

Are you speaking to a reporter, or members of a local Rotary Club? A classroom full of middle schoolers, or a group of policymakers? Each audience brings its own set of interests, concerns, values and priorities. Take these into account as you choose, craft and frame your messages.

➞ Boil your science down to three key messages

As a communication rule of thumb, concepts and ideas presented in threes are inherently more interesting and memorable for the audience. Distill the body of information on your topic into three main messages.

➞ Frame your messages

Think about the context that will resonate best with the audience, then put your messages into that framework. For example, "We all care about [our children's future] [our health] [safe drinking water] [high energy bills] ..."

➞ Ignite interest, then inform

Capture your audience's attention right away by making a bold statement, asking a good question, or sharing a surprising fact. In journalism, this is called the "hook." It's the thing that captures readers' attention and motivates them to keep reading. Your approach here may vary based on what is most likely to spark audience interest and keep them tuned-in, but the principle remains the same: hook their attention early to help keep them engaged.

➞ Tell a story

In the words of scientist, author, and film-maker Randy Olson, tell a good story and the world will listen. Even in academic circles, the most popular professor in a lecture hall or speaker at a scientific meeting is probably the one who tells good stories woven out of completely accurate facts. Scientific narratives increase understanding, interest and engagement – and are also a lot easier for non-scientific audiences to recall, and ideally share.

Sharing Science's Essential Tips & Tools for Communicating your Science

Best practices	What NOT to do	What to do
Avoid jargon or words that have different meanings for the public than for scientists.	✕ "driver…" ✕ "computer models…" ✕ "…this creates a positive feedback effect"	✓ "powerful influence…" ✓ "computer simulations…" ✓ "…this creates a virtuous cycle."
Keep things simple and relevant to the audience at hand.	✕ "Due to the after-effects of ice sheets levering up areas of the east coast 20,000 years ago, portions of the east coast are experiencing land subsidence that will exacerbate other sea-level rise."	✓ "Parts of the east coast are especially vulnerable to flooding because of a combination of global sea-level rise and local land sinking."
Avoid lecturing.	✕ "Today I will discuss my research on tornadoes and how this affects…"	✓ "I want to start by asking you how tornadoes have affected you and this community."
Don't use vague generalizations.	✕ "Global warming is projected to have many negative effects on the whole world—and this region."	✓ "Global warming is projected to change the whole character of our state. For example: ✓ In 50 years our summers are likely to feel more like summer in [the deep South]. ✓ The solid freeze that we expect on Lake Superior is no longer predictable… ✓ The last frost of the season will be 3 weeks earlier, meaning [X] pests will thrive…"

Best practices	What NOT to do	What to do
Give examples that mean something to people's lives.	✕ "Drought in our area means that soil moisture levels will be altered by [X amount]."	✓ "Drought in our area is projected to intensify, putting more pressure on our already stressed water resources and increasing the threats of wildfires; last year alone, wildfires destroyed [X] homes and cost [Y] dollars…"
When using numbers or measurements, use social math to provide scale.	✕ "There are 50,000 gallons of diesel fuel at the abandoned base camp." ✕ Sea-level rise of [X] inches. ✕ [X] money saved [or lost].	✓ "There is enough diesel fuel at the base camp for a car to circle the globe 80 times." ✓ That's a loss of [X area of beachfront.] ✓ This amount could send a child to college
Emphasize the value of science	✕ "I study coronal mass ejections and other space weather."	✓ "The research that I (we) do on conditions on the sun helps predict and prepare for major power-grid outages and disconnects with our weather and GPS satellites."
Provide context	✕ "I study the Pine Island Glacier."	✓ "I study the Pine Island Glacier, the fastest melting glacier in Antarctica, responsible for about a quarter of Antarctica's ice loss so far."
End on a positive note, with how science is part of the solution	✕ "This is a serious issue, and we have to act now to avert catastrophe."	✓ "[My scientific discipline] helps us to overcome these challenges with solutions that can improve our quality of life [e.g., better water or land use, building designs, health and safety measures, emergency planning, etc.]."

Communicating Probability and Risk of Natural Hazards and Disasters

Earth and space scientists continually search for ways to provide more warning time before disasters strike, and to recommend appropriate ways to respond to natural hazards before they become unmanageable. These tips will help you communicate effectively about impending risks and recommended responses, hopefully minimizing related damage.

- ✓ **Know your audience.**
  This is the first rule of effective communication, regardless of your topic. Who are you speaking to? What's important to them/what do they value? Are they likely to be receptive to the information you have to share, or will they be resistant? Considering factors like these will help you tailor your message to your audience in a way that is more palatable to them – increasing the likelihood they will listen to what you have to say and respond in the appropriate, or desired way.

- ✓ **Make your motivation part of the message.**
  Scientists share knowledge about natural hazard and disaster risks to inform and promote community preparedness, safety and resilience. Letting people know you're coming from a place of concern for a community's wellbeing lowers defenses and builds trust with the audience.

- ✓ **Make it local, relevant, and "real" for the audience.**
  Refer to things people can see, or have previously experienced, in their community, such as record-breaking heat waves, increases in street flooding, and so on. Making the event tangible adds meaning and resonance to your message and dissuades potential skepticism and apathy.

- ✓ **Use storytelling to make the message stick.**
  Anecdotes, examples, and relevant metaphors add context, meaning, and memorability to your messages. Use examples that are appropriate to the situation and the scope of the risk you're talking about to avoid coming across as melodramatic.

- ✓ **Choose words wisely.**
  Even in a shared language, words have different meanings — like cycle, modeling, or dating, for example. To communicate science effectively, use words and language geared toward non-scientific audiences and eliminate jargon completely.

- ✓ **Use no "uncertain" terms.**
  Uncertainty is a part of science and of a scientist's vernacular, but if the goal is to send a clear message to non-scientific audiences, present it instead as level of confidence. If you're 90% certain of something, or more, say that. If you DO know something for a certainty, mention that part. Referencing uncertainty – and even using words like "could" or "might" in relation to negative impacts – can introduce doubt and skepticism, undermining your credibility. Instead offer broader, yet still tangible facts that the audience can understand, i.e., "We do know that we're facing dangers that range from inconveniences to loss of homes and lives."
    - Some things, like probability, are inherently uncertain. In these cases, find ways to couch the information in more definite terms. For example, use the number at the top of the range, with qualifiers like "as high as [X] percent," or "as much as [X] times more likely."

- ✓ **End on an empowering note. Plug your science while you're at it.**
  Remind people that they have some control over the situation. "Fortunately, [scientific discipline] helps us understand why and when these things are likely to happen, so we can take precautions and get out of harm's way."

Crafting and Framing Messages about Natural Hazards and Disaster Risks

Key messages are the main points you want an audience to hear, remember and, in some cases, act upon – so presenting a set of facts and figures without context is not enough. Effective messages provide meaning that can influence how your audience perceives and responds to the information you share.

The communication equation – SOLVE FOR "X"

What you want the audience to know

The audience's filter

Goal/desired outcome

1. **What do people need to know?**
   Stick with what's most important for people to know, leaving out unnecessary (and potentially confusing) details or background information.

2. **What do you hope to achieve through your communication?**
   In the case of natural hazard and disaster communication, desired outcomes might be:
   - To inform and spark action (preparation, evacuation, etc.)
   - To influence public policy

3. **Who is your audience? They are variable in your communication equation.**
   - What's important to them/what do they value?
   - Are they likely to be receptive to the information you intend to share, or will they be resistant?
   - How you can best frame your message to achieve your desired outcome?

Framing your hazard/risk message

Framing your message doesn't mean altering the facts. It means presenting the information in a way that makes it more likely to resonate and stick with the audience, based on what you know, or can assume, about their values, biases, and worldview.

For example:

1. **Be prepared.** "Be prepared for the next storm" is an empowering and broadly appealing message. Individual-focused people hear this as a call to take care of themselves; community-focused people hear it as a call to help the community at large.

2. **Personal responsibility.** "Everyone is responsible for their own choices and actions. It's up to you to do what you can to protect yourself, your family, and your home." This kind of message is likely to appeal to people who value individual freedoms and believe in fewer regulations and restrictions.

3. **Stewardship.** "Protecting the planet is important; today's stewardship affects future generations and leaves the world a better place." This approach is often used in reference to future risks, such as sea level rise and climate change – and will appeal to those who value environmental responsibility.

4. **Working together.** "It's important to work together to reduce damage, or potential damage, from extreme weather." Highlight the value of community and shared goals. Community-minded people will respond to this kind of message.

Regardless of how you frame the message, be sure to include recommended precautions and action steps.

Source: *NOAA Risk Communication Basics*

Effective Communication for Controversial Topics

Hearing scientific facts doesn't necessarily translate to adopting science-backed beliefs, and this is especially apparent when it comes to climate change. Since climate change is often linked to the frequency and severity of natural hazards and disasters, it's wise to be ready to take on this still controversial topic.

- **Remember that you're the expert.**
  Speak with confidence and authenticity.

- **Frame it for your audience.**
  What are their values, interests, and sensitivities? How are things they care about impacted by extreme weather and/or climate change? Meet them where they are; if you can find common ground, start the conversation there. Either way, speak of "controversial" science in a language they understand.

- **Lead with, and stick with, what you know – for certain.**
  In the context of informing the public, scientific uncertainty is irrelevant and can diminish the credibility of your message. Focus on what has happened already, and what is happening right now. For example, "We know from data that there is a direct correlation between a warmer planet and more frequent and severe heat waves. This event is part of that trend."

- **Simplify the science – and the way you talk about it.**
  For example, "A warmer atmosphere holds more moisture, leading to heavier rainfall," is a wonderfully clear and simple explanation. Similarly, a term like "heat-trapping gases" is more to the point than the term "greenhouse gases." If you can help people understand what's causing climate change, and why a warming planet is a problem, you've been successful.

- **Humanize impacts.**
  When providing examples, either verbally or with visuals, put a human face on the impacts. In this context, people have more impact than polar bears.

- **End on a hopeful note.**
  There's only so much bad news people can handle. Talk about what is being done to mitigate climate change, and what the audience can do to help the situation. Focusing on solutions implicitly affirms the reality of the problem. Empower your audience with the practical information they need to be part of the solution.

Messaging Templates

You won't find a one-size-fits-all approach to crafting effective messages. These examples provide guidance and structure, but crafting messages that are easily understood, memorable, and relevant is not about the template you use, but about adhering to these key principles:

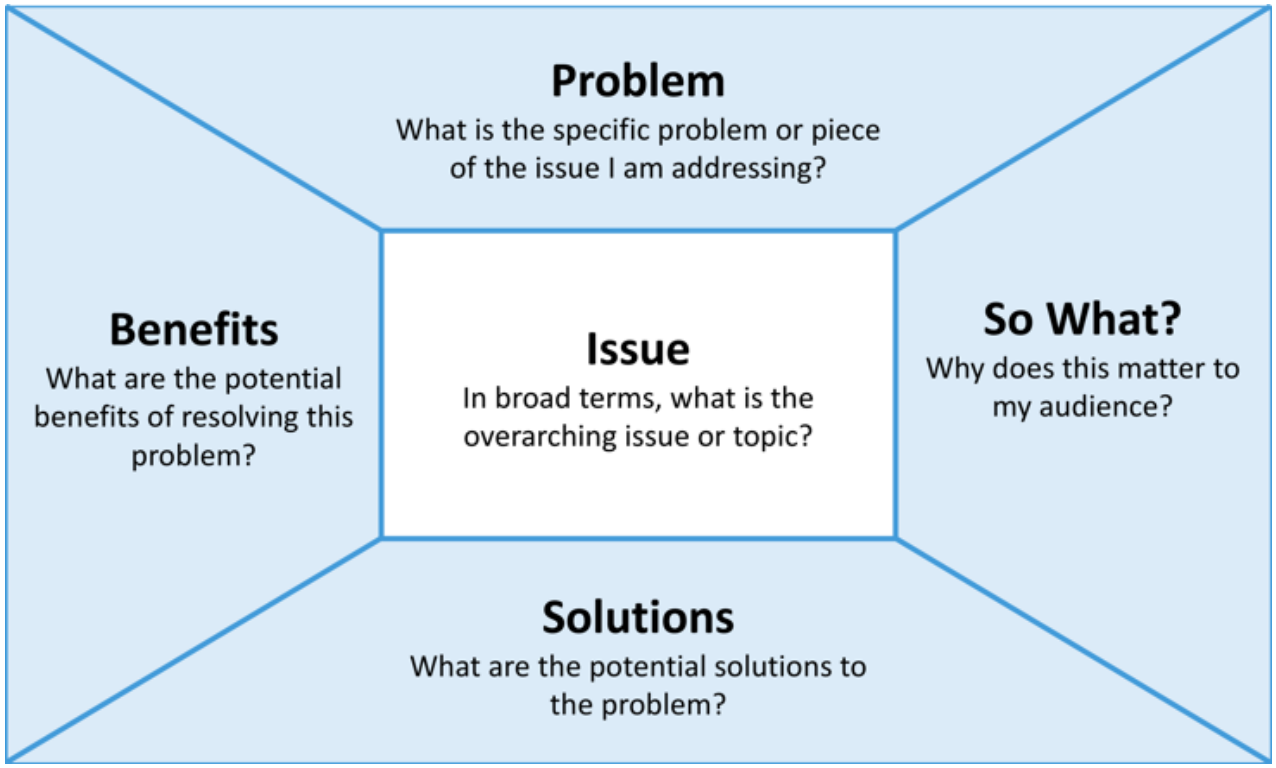
1. Know what you want to say;
2. Know your audience; and
3. Use clear, accessible language to get your points across.

The Message Triangle

This commonly used messaging tool that places your topic in the center, with each side of the triangle dedicated to a broad message. This doesn't mean you can only make three statements! In fact, each of your three broad messages should be supported by facts, examples, metaphors and other proof points. (We've used the upcoming 50th anniversary of the first lunar landing as an example.)

The Message Box

The messages box is recommended by COMPASS, an organization that specializes in SciComm training.



Step One: "So What?"

Why should your audience care about what you have to say?

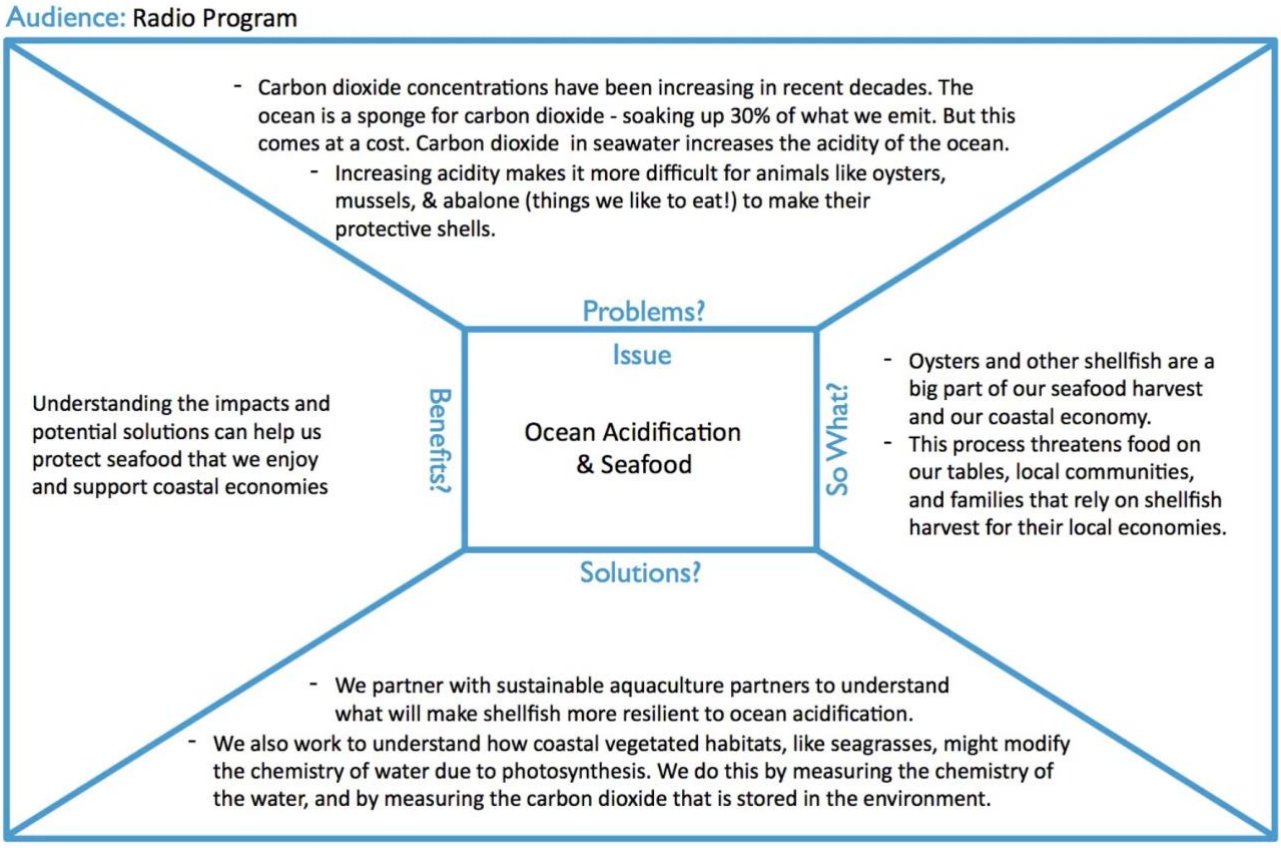
Consider attributes of your audience, like their values, expectations, and interests, and frame the information in a way that is likely to resonate with them. Every audience is different, so be prepared to adjust the way you express, or frame, your main ideas.

Step Two: Fill in the Message Box

It can be hard to distill a vast body of knowledge into something non-scientific audiences can wrap their heads around.

The message box helps zero in on the few key messages that are most salient for your audience, eliminating distracting and irrelevant details.

The example below, from compasssscicomm.org shows a message box completed by Dr. Tessa Hill, an associate professor in the Department of Earth and Planetary Sciences at Bodega Marine Laboratory and associate director of academic programs at the Coastal and Marine Sciences Institute at the University of California at Davis.



Now for a less geometric approach…

In *A Scientists Guide to Talking with the Media*, communications expert Richard Haynes and science journalist Daniel Grossman offer these two templates for structuring your message.

OPTION 1	OPTION 2
The basic science With an increasingly warm ocean, hurricanes are spinning with more energy and carrying more moisture to flood coastal cities.	**Problem** Hotter summers and more frequent droughts are turning forests in the U.S. west into tinderboxes.
Major findings of new research A new study found that climate change might be having an additional effect on hurricanes: they're moving north, increasingly bound for northern New England rather than the mid-Atlantic states.	**Solution** Prescribed burns reduce wildfire hazards by clearing dense swaths of dry forest matter that fuels the spread and intensity of wildfires.
Implications for scientists and society Climate change is changing both the severity and trajectory of hurricanes, and New England needs to prepare for a wet future.	**Recommendation** We must shift to a more proactive approach to wildfire hazard reduction. This means implementing a more comprehensive prescribed burns strategy.
	Benefits By taking a pre-emptive approach we can reduce the number and severity of wildfires and their related catastrophic damage.

Tap into the Forces Within and Share Your Science!

This guidebook is part of a collection of resources developed for members of the AGU community in honor of AGU's Centennial celebration. As we look back at the last 100 years and ahead to the next 100 years of advancements that Earth and space science has made in the wake of historic natural- or man-made disasters, we hope you can use this toolkit to support your efforts to communicate to and engage with the public. We also encourage you to share this resource and your experiences freely with your peers.

For additional and ongoing SciComm support and resources, make sure to check out AGU's Sharing Science program, which includes information on how to share your work with the public, media, K-12 audiences, and/or policymakers.

Read the blog:
The Plainspoken Scientist

Follow Sharing Science on Twitter:
@AGU_SciComm

Become part of AGU's Sharing Science Network

More Resources

Science Communication Essentials

AGU Sharing Science
https://sharingscience.agu.org/

COMPASS
https://www.compasscicomm.org/

Talking about Risks and Hazards

PrepTalks: Modernizing Public Warning Messaging
Dennis Mileti, Professor Emeritus, University of Colorado at Boulder

Why don't people get it? Seven ways communicating risk can fail
TheConversation.com

Climate Change

It's Time to Talk About Climate Change Now
SharingScience.AGU.org

Climate Communication Science & Outreach
https://www.climatecommunication.org/

Principles for effective public engagement on climate change: Handbook for the IPCC
(webinar)
Dr. Adam Corner, Research Director, Climate Outreach

Storytelling for Scientists

How Stories Captivate an Audience by Lauren Lipuma
The Plainspoken Scientist, March 28, 2017

"The And, But, Therefore of Storytelling"
(video)
TEDMed Randy Olson

Storytelling in Science: Communicate Your Research in Style
Enago.com

What's Your Story
by Ben Young Landis

The Future of Science Storytelling by Jim Kozubek
Scientific American, April 30, 2018

Massive Science Consortium
Massivesci.com

From Silent Spring to . . . Jaws? Using Stories to Communicate Science by John Calderazzo
The Plainspoken Scientist, November 25, 2013