

# How to Talk about Climate Change and the Ocean:

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*A FrameWorks MessageMemo*

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# Introduction

This MessageMemo presents the [Strategic Frame Analysis](#)<sup>®</sup> that the FrameWorks Institute conducted on behalf of the National Network for Ocean and Climate Change Interpretation (NNOCCI), supported by the National Science Foundation. To support climate communication and education efforts in informal science education institutions with a marine focus, the FrameWorks Institute conducted a series of studies designed to yield a practical, actionable communications strategy for building public understanding of climate change and its effects on coastal and ocean ecosystems. All in all, more than 9,000 Americans were queried as part of this research. You can find these studies at [FrameWorksInstitute.org](http://FrameWorksInstitute.org).

**Just the Earth Doing Its Own Thing: Mapping the Gaps Between Expert and Public Understandings of Oceans and Climate Change.** Compares data from interviews with both members of the scientific community and lay informants to identify gaps in understanding that can ultimately be addressed through strategic communications. Expert interviews conducted in September – November 2012 with 15 scientific experts on ocean systems and climate change. Cultural models interviews conducted in October 2012 – January 2013 with 40 Americans in 4 states (North Carolina, Massachusetts, California, and Pennsylvania).

**The Value of Explanation: Using Values and Causal Explanations to Reframe Climate and Ocean Change.** Reports on an experiment sampling over 7,000 registered U.S. voters that showed that exploring the values-based messages of Protection and Responsible Management to move attitudes and policy opinions in productive directions.

**Getting to the Heart of the Matter: Using Metaphorical and Causal Explanation to Increase Public Understanding of Climate and Ocean Change.** Details the research process leading to the recommendations of Regular vs. Rampant CO<sub>2</sub>, Climate's Heart, and Osteoporosis of the Sea. Qualitative and quantitative testing of metaphors designed to explain aspects of the science of climate and ocean change were conducted with 2,936 Americans.

This work builds on, and substantially expands, FrameWorks' previous research on climate change, which was conducted in the US and Canada beginning in 2000. This MessageMemo is not intended to take the place of these research reports. FrameWorks strongly recommends that communicators look to these reports for greater detail on each frame element, which is helpful in applying the recommendations with creativity and fidelity.

Climate and ocean scientists are increasingly concerned about the pace and asymmetry of policy responses to the growing negative impacts of climate change. With this dissatisfaction has come growing recognition that climate science must conscientiously build public will by improving its translation of climate science to non-expert audiences. This is no doubt a difficult communications terrain; at the same time that expert consensus on climate change is regularly questioned, the question of what constitutes effective science translation is also contested among social scientists. A recent column in the *Washington Post* proclaimed that “science doubt has become a popular meme.” According to this article, and other research on public perceptions of climate change, popular opposition to expert consensus on climate change is rooted in the conflict between cognition and emotion in human decision-making. And, as the idea that emotions are winning the battle gains prominence among commentators, the advice that climate communicators appeal to emotion is also gaining ground.

FrameWorks' research on the communications aspects of climate change, however, strongly suggests that science communicators do not have to choose between appealing to people's hearts and heads - and that in fact, a strategy that eschews this false dichotomy is more likely to increase public support for meaningful political action. Communicators can and should appeal to the deeply held ways that Americans think about their responsibility to the natural world and to their fellow human beings, *and* make people smarter about the climate system, climate change, and its impacts on our ocean.

The greatest communication challenge for climate scientists and other translators is not a war between cognition and emotion, but rather the lack of consistent and complete storytelling. To invite the public into the

scientific consensus on climate change, it is important to adopt a Core Story Approach, anticipating and answering the questions that attend to every social and scientific issue. Why does this issue matter to us all? What are the mechanisms at play here - and what's going wrong? What should we do to move forward? A truly strategic approach to communications answers these questions systematically, choosing among plausible alternatives by testing for their frame effects - i.e., their ability to move the public toward understandings and attitudes in line with scientific findings. For climate change, the Core Story that FrameWorks recommends begins by activating core environmental *Values*, moves on to translate the science of climate and ocean change with tested *Explanatory Metaphors* and *Explanatory Chains*, and concludes by highlighting *Solutions* frames.

This MessageMemo presents results from Strategic Frame Analysis® research conducted by the FrameWorks Institute on behalf of the National Network for Ocean and Climate Change Interpretation (NNOCCI) and supported by the National Science Foundation. To support climate communication and education efforts in informal science education institutions with a marine focus, the FrameWorks Institute conducted a series of studies designed to yield a practical, actionable communications strategy for building public understanding of climate change and its effects on coastal and ocean ecosystems. These studies documented the conceptual challenges in the public's current understanding of climate and ocean change, and developed and tested framing strategies and tools to support more effective science communication and outreach. This work builds on, and substantially expands, FrameWorks' previous research on climate change and issues affecting the ocean, which was conducted in the US and Canada beginning in 2000.

This MessageMemo charts a course through the dominant patterns of reasoning employed by the public as they address climate and ocean change, identifies the major challenges for communicators, and recommends how communications may be redirected to improve public understanding. It is organized as follows.

- We first **Chart the Landscape** of public thinking by providing a description of the dominant patterns of thinking that are chronically accessible to Americans in reasoning about climate and ocean change, and the communications implications of these dominant models.
- We then identify the **Gaps in Understanding** between experts and ordinary Americans— features that bring into relief the specific locations where translation is needed if expert knowledge is to become accessible to the public in understanding and reasoning about climate and ocean change.
- We then provide an outline of **Redirections**, research-based recommendations that represent promising routes for improving public understanding of climate and ocean change.
- We end with a cautionary tale of the **Traps in Public Thinking** that must be avoided if reframing is to succeed.

# I. Charting the Landscape: Default Patterns of Thinking

Because Americans are both intensely familiar with the climate and ocean and largely unaware of how these aspects of our environment work as systems, there is a complex mental landscape on these topics. In this section, we discuss the most prevalent and highly shared cognitive paths, or “cultural models,”<sup>1</sup> that ordinary Americans rely on when asked to think about climate and ocean topics. These cultural models structure default answers to questions like these: *What is climate change? What causes it, and what effect is it having? How is the ocean involved? What should be done to address these problems?* It is crucial that communicators who seek to build new understandings of climate and ocean change become familiar with these default patterns of understanding in order to accurately anticipate what they are up against and what their communications must overcome.

**Murky Understanding of Climate.** The public understands climate as annual weather patterns in a particular place. This understanding makes it hard to think about long-term changes in climate. Beyond this superficial understanding of climate as yearly weather patterns, the public has no understanding of the climate system. This conceptual hole makes it difficult for people to understand interactions between ocean, land, and atmosphere and, in turn, to understand the relationship between ocean and climate change.

**A Basic Model of Climate Change.** The American public equates climate change with warming. When thinking about what climate change *is* as well as what its *effects* are, the public’s first (and often last) thought is that climate change involves warming of the planet. Effects that are directly related to warming, such as melting ice and rising seas, are thinkable, but people have difficulty seeing beyond these direct effects. Americans recognize, at a superficial level, that natural systems are interconnected and that changes in climate can disrupt the delicate balance of nature, but lacking a clear understanding of *how* climate change is happening, they show little appreciation for what this disruption entails.

**Difficulty Understanding the Causes of Climate Change.** Most Americans can recognize that human activity is responsible for causing climate change, but they lack a clear understanding of *what* humans are doing to change climate and how the *process* of climate change works. People assume that “unnatural pollutants” are to blame. Because carbon dioxide does not fit the profile of an unnatural pollutant—people think of it as a natural part of the life cycle—the public actively resists the idea that carbon dioxide causes climate change. Reasoning from the “unnatural pollutants” model, people frequently assume that the problem must be toxic gaseous pollutants that “eat” holes in the ozone layer, which lets in more heat from the sun and warms the planet. Alongside these dominant understandings of climate change, there is a model of climate change as part of a natural cycle that is not caused by human activity. While this is not a dominant view, it is an available model that the public sometimes draws upon.

**The Ocean’s Spiritual Meaning and Consumer Value:** Americans primarily understand the ocean in spiritual and utilitarian terms, as either a vast and awesome mystery or as a source of consumable resources such as food. While these cultural models elevate the importance of the ocean, they also obscure

its critical place within natural systems, including the climate system.

**Unproductive Assumptions about the Causes of Ocean Change:** When asked how the ocean is changing and what causes these changes, people think first and foremost about solid and liquid pollutants being dumped into the ocean. This “dirty” understanding of pollution makes it difficult for people to appreciate invisible atmospheric emissions of carbon as a cause of ocean change. In addition, the public is almost completely unfamiliar with the problem of ocean acidification. When asked to speculate about what might cause acidification, people consistently suggest that acidification must be caused by acid rain falling into the ocean, a version of the pollutant model.

**Misdirected Thinking on Solutions:** When thinking about what should be done to address climate change, Americans typically adopt an individualist orientation, thinking primarily of the need to take individual steps such as recycling, buying a hybrid vehicle, and making a point to turn off the lights. Alongside this individualist model lies a recessive model of government intervention as the appropriate solution. When thinking with this model, the public sometimes identifies limiting emissions as a solution, although lack of a clear understanding of causes undermines the public’s ability to identify effective solutions.

**Two Minds About Science:** Americans rely on conflicting models of science when considering the science of climate change. At times, the public views science as authoritative. When thinking with this model, people assume that the consensus view among scientists must be right. At other times, the public treats science with skepticism, suggesting that scientists are motivated by financial or political objectives and thus cannot be trusted.

## II. Gaps in Understanding

Gaps in understanding are those places where the cultural models employed by the public to think about an issue differ significantly from experts’ understanding of the same issue. As such, they represent strategic opportunities for framing in order to bridge gaps between expert and lay understandings. As in most issues FrameWorks studies, there are substantial **gaps** in experts’ and the public’s conceptualization of climate and ocean change, which we enumerate below. Drawing from our research on climate and ocean change, we assign specific frame elements— values, metaphors, etc.—to fill these gaps in the next section.

- **Natural and human causes of climate change: Both vs. either.** Experts explain that climate change results from *both* natural and human causes, while the public thinks of climate change as caused by *either* human causes *or* natural causes.
- **Carbon dioxide: The driver of climate change vs. something natural.** Experts view carbon dioxide as the primary driver of climate change, yet the public sees carbon dioxide as a natural part of life and assumes that what is natural cannot also be a problem. This lends credence, in the public’s

estimation, to the rejection of carbon dioxide as a cause of climate change.

- **How climate change works: Heat absorption vs. ????** or **ozone depletion.** While experts explain that climate change results from carbon dioxide trapping heat within the atmosphere, the public lacks awareness of this mechanism. Members of the public are either unable to offer any explanation of climate change or settle on the inaccurate explanation that ozone depletion is warming the planet by letting in more heat from the sun.
- **How people affect oceans: Carbon emissions vs. dumping.** When focusing on human effects on the ocean, experts highlight carbon emissions, while the public overwhelmingly assumes that human harm to oceans results from dumping liquid or solid pollutants. Americans' model of carbon dioxide and their lack of understanding of the connections among parts of the climate system make it difficult for people to understand movement of carbon dioxide from the atmosphere into the ocean.
- **The impacts of climate change: A complex chain vs. a short list.** Experts note a long list of effects of climate change, including downstream effects such as impacts on agriculture and changes in disease patterns. Although experts acknowledge uncertainty about what the precise effects of climate change will be, they insist that effects will be severe. The public, by contrast, is only able to identify effects that are directly linked to warming, such as ice melt and sea rise. Inability to think through downstream effects is linked to the public's limited understanding of natural systems. People assume that uncertainty about effects leaves open the possibility that the effects might not be too bad.
- **What to do: Immediate policy response vs. more recycling.** Experts insist that the need for action is urgent *now*. They focus on reducing carbon emissions as the key to addressing climate change and insist that government intervention is imperative. The public, however, lacks a clear understanding of what solutions would actually help and tends to focus on generic "green" activities such as recycling and other changes in individual behaviors. In general, the public fails to recognize the urgency of the situation and the costs of delayed action.
- **Science: Source of knowledge vs. mixed attitudes.** Experts treat science as a source of knowledge, while the public toggles between treating it as authoritative or worthy of skepticism. While science authority is important to the public, without a clear understanding of the underlying mechanisms, people are vulnerable to erroneous assertions and bogus solutions. Science skepticism turns the topic into a political tug-of-war and redefines science as politics. Both of these outcomes are barriers to effective science translation.

In addition to these gaps, there are several points at which the public simply lacks models or available ways of thinking about an issue. These "**cognitive holes**" must be filled by providing the public with tools that allow people to think about these issues in productive ways.

- **The climate system.** The public lacks understanding of climate as a complex system that includes interconnections between ocean, land, and atmosphere. Providing the public with tools that help them understand these connections can close several of the gaps described above, which stem in part from lack of understanding of the climate system.
- **Ocean acidification.** Americans are simply unfamiliar with the concept and problem of ocean acidification. Tools are needed to familiarize people with the science and to help them understand the importance and effects of acidification.
- **Trouble with trends.** People have trouble reconciling short-term fluctuations in the weather with long-term trends in the climate. Giving them tools to understand climate as a system is an important prerequisite to changing attitudes to and judgments about appropriate and accessible solutions.

These patterns in understanding constitute the key challenges for communicators - and are therefore the challenges that prescriptive reframing research must address.

### III. Redirections

In order to help Americans appreciate what is happening to the ocean as a result of climate change and how this might be addressed by actions we take together, the issue will have to be reframed to: induce more systems thinking, connect humans to the environments and chain of life that affect us all, and foreground causes and solutions, not merely impacts.

Science and science teaching can make valuable contributions to American thinking precisely because: (1) the tone of science teaching gets out of the doom-and-gloom media or contentious political conversations; (2) the explanatory nature of science thinking invites inquiry and evidence; and (3) science routinely explains itself in terms of everyday metaphors and analogies that can help overcome some of the “cognitive holes” in current thinking about climate and ocean change. The following recommendations emerge from FrameWorks research over time as promising strategies.

## What to Do

### 1. Use Values to Establish What’s at Stake

Values are broad ideals about what’s desirable and good. We know from the social science literature that they act as a starting point on a topic, guiding attitudes, reasoning, and decisions that follow. FrameWorks' original research consistently confirms the effects of priming a discussion with effective values. Opening communications with a value can orient people’s thinking on the topic, setting up for success in the interaction that follows. Because values are such strong primes, Strategic Frame Analysis® advises communicators to rely on research to select

Values that reliably orient the communication – rather than simply looking to their own deeply-held values or using data points to establish why an issue matters.

Among several values that FrameWorks tested experimentally, *Responsible Management and Protection* showed the strongest results. Therefore, we advise communicators to open communications with one of these two Values and to rely on them exclusively in brief communications opportunities. However, this is not to suggest that these are the only recommended Values frames. Previous research also found that *Interconnection* and *Innovation* can have productive frame effects. These themes are recommended as reliable Values cues in contexts that allow for longer communications, and work especially well with other frame elements. Specifically, *Interconnection* pairs well with Explanatory Chains that illustrate the disruption of nature's delicate balance, and *Innovation* is a natural fit with Solutions frame elements.

- A. The value of *Protection* focuses on protecting people and places from harm from the threats facing our environment, because those threats are placing us all at risk today. The *Protection* message that FrameWorks tested was worded as follows:

*Protection: It's important that we protect people and places from harm. We can do this by solving the issues facing our environment. This means stepping in to ensure people's safety and well-being to the best of our ability and safeguarding the places we depend on. We also need to take measures to eliminate or reduce risks, making sure that people are able to go about their lives freely. Concern for the welfare of others and vigilance in preserving our habitats are the hallmarks of a protective approach. Simply put, we have a duty to protect our surroundings. Protection is the right thing for us to do.*

*Protection* emphasizes the preservation of habitats and ecosystems not for their own sake, but for an instrumental reason: people depend on these places and resources. Effective uses of this Value impart a sense that an urgent, proactive response is needed now, as the health, safety, and welfare of people are being put in harm's way.

This type of appeal to *Protection* proved especially powerful when combined with Explanatory Chains illustrating how climate change is negatively affecting human health. In fact, this combination of frame elements had the strongest effect on support for strong CO<sub>2</sub> reduction measures of any tested. In addition the *Protection + Human Health Explanatory Chain*- despite not mentioning ocean creatures explicitly - performed very well on measures of public attitude, prioritization, and support for policies protecting marine life.

- B. The *Responsible Management* value is a pragmatic take on the closely-related value of *Stewardship*, tapping into the ideal of our responsibility to tomorrow, but with an equal

measure of emphasis on what it looks like to live up to that duty today. The *Responsible Management* message that FrameWorks tested was worded as follows:

***Responsible Management:*** *It's important that we take responsible steps to manage the issues facing our environment. This means thinking carefully about problems and focusing on the best ways to deal with the problems we face. We also need to keep future generations in mind while we look for the best solutions. Open-mindedness and long-term planning are the hallmarks of responsible management. Simply put, we should take a practical, step-by-step approach that relies on common sense and uses all the evidence we have to take care of our surroundings. Managing challenges responsibly is the right thing for us to do.*

Where *Protection* focuses on our responsibility to minimize human impacts, *Responsible Management* focuses on our duty to preserve and protect nature – but in some very specific, tactically important ways. By defining what it means to be ‘responsible’ as involving a focus on evidence, this frame element responds to climate denial frames – not by directly rebutting them, which only serves to reinforce them, but rather by simply advancing a more productive, affirmative case. Likewise, by including multiple cues for a pragmatic stance – *planning, common sense, taking responsible steps* – this Value offers a way to subtly suppress the stereotype that concern for the environment is a radical or fringe position held only by tree-huggers and hippies.

- C. The *Interconnection* value centers on how ocean, land, and human activity affect one another, such that harm to one harms the other:

***Interconnection:*** *Our fate is intertwined with the fate of the ocean. What happens in the ocean reflects and affects what happens on land: it's one interactive system. By recognizing the connection between human practices and their impacts on marine life and habitats, we can do a better job of leaving the ocean in good shape for the next generation.*

*Interconnection* taps into a cultural model that is felt deeply but understood shallowly: *the web of life is all connected*. Because people readily agree with this assertion but, for the most part, lack the ability to support it with robust examples, this Value is likely to be much more effective when paired with an Explanatory Chain that illustrates the concept in concrete terms. When people understand an issue at a conceptual level, they become better equipped to reason their way to sensible positions on what can be done about it.

Note that this value focuses on mutual dependence – oceans affects land, and land affects ocean; humans are part of nature and nature is part of humanity. This differs subtly – but

substantively – from similar appeals to one-way dependencies (i.e., *nature is counting on us to do the right thing.*)

- D. The *Innovation* value emphasizes using our ability to generate new ideas to solve old problems: .

***Innovation:*** *We have the capacity to solve difficult problems through innovation and ingenuity. We have a history of being resourceful, clever, and thoughtful to solve problems and generate new ideas. It's time to phase out old technologies and practices that contribute to climate change, and start supporting energy innovations that benefit both our ecosystems and our economy.*

In multiple studies on various sociopolitical concerns, FrameWorks research has found that an appeal to ingenuity can be particularly effective on issues that are viewed to be long-standing and intractable (such as addiction or race relations), which suggests that this value probably does important work in building a sense of hope or collective efficacy. It certainly taps into the dominant cultural model that holds that *Americans are problem-solvers*, which is a cherished piece of our collective identity as a nation. In the version of this Value we tested for climate change, we focused American ingenuity on the underlying problem of energy production and use. By asserting that it's possible to move toward energy sources that have both environmental and economic benefits, this frame element avoids reinforcing a sacrifice frame in which the public perceives that they must choose between “jobs or the environment.”

Our recommendation for using *Innovation* follows much the same line of reasoning as the advice regarding *Interconnection*: pair this Value with another frame element that adds a concrete illustration to the abstract ideal. Specifically, use *Innovation* in tandem with *Solutions* frame elements that explain how promising or proven approaches work.

While the *Innovation* has much to recommend it, we offer two cautionary notes to communicators. One is to avoid invigorating a narrative that suggests to the public that “science will save us,” as this understanding could lead people to conclude that there is no role for “ordinary citizens” in addressing these issues. The second is to think strategically about the kinds of innovations that are highlighted in communications. For instance, avoid highlighting innovations that would serve only to remind the public of unproductive default models, such as the assumption that solid and liquid pollutants are the primary means of environmental degradation. Instead, use communications opportunities to share information about effective approaches that respond directly to underlying causes - such as energy sources, energy efficiency, or civic engagement - as innovations in these areas align with the kinds of solutions that experts agree are needed for mitigating climate change.

## 2. Establish the basic mechanism of climate change using tested Explanatory Metaphors.

Americans' cultural models relating to underlying mechanism of climate change - the addition of heat-trapping gases to the atmosphere and ocean - have highly problematic implications. For instance, the assumption that material pollution is the primary environmental problem results in confusion about the types of solutions that can properly address the problem - people suggest, for example, that joining beach clean-up efforts is an appropriate response. In addition, when reasoning from the model that pollution is "the" problem, many effects of climate change are obscured from public view. Likewise, the default line of reasoning that *carbon dioxide is natural, and if it's natural, it can't be harmful* directs attention away from the primary causal agent of global temperature increase.

Because of the critical role that causal understanding plays in the public's overall appraisal of policy options on an issue, in 2000, FrameWorks Institute began to develop and test communications strategies to translate the role of anthropogenic CO<sub>2</sub>. Over multiple phases of empirical investigation, the Explanatory Metaphor of the *Heat Trapping Blanket* proved consistently to a reliable tool for expanding public understanding of how climate change works:

- A. ***Heat-Trapping Blanket:*** *When we burn fossil fuels for energy, such as coal, oil, or natural gas, we release carbon dioxide into the atmosphere. Carbon dioxide is a gas that traps heat. As CO<sub>2</sub> builds up, it acts like a blanket, trapping in heat that would otherwise escape. This "blanket effect" is warming the planet's atmosphere, disrupting the balance that keeps the climate stable.*

This Explanatory Metaphor is highly effective in focusing attention on the underlying cause and mechanism of anthropogenic climate change and has been widely used to good effect since its introduction in 2001. FrameWorks research suggests that it has a greater "stickiness factor" than *Greenhouse Gases*, the dominant metaphor used by the field; in observations in both controlled and natural settings, members of the public were highly likely to repeat and reason with language taken from the blanket domain, and unlikely to do so with language related to greenhouses.

Despite the strong frame effects of *Heat Trapping Blanket*, updated research suggested that additional communications strategies are needed to effectively reframe public understanding around CO<sub>2</sub>. Cultural models research conducted in 2012-2013 suggested that people were unable to easily reconcile carbon dioxide's role in respiration and photosynthesis with its role in climate change. Public thinking might be characterized as running along these lines: "If we breathe it out, how bad can it be?" Another reason for an additional tool emerged from the expanded scientific understanding of the impacts of climate change that has emerged since 2001. For instance, the mechanism explained through *Heat Trapping Blanket* does not lend itself to the problem of ocean acidification, which involves the direct absorption of CO<sub>2</sub> into the ocean.

Thus, FrameWorks pursued the development of an additional frame element to specifically help

the public to overcome the assumption that carbon dioxide is harmless. In both qualitative testing and quantitative experiments, the taxonomy of *Regular vs. Rampant Carbon Dioxide* proved to be a potent means for explaining the harmful role of anthropogenic CO<sub>2</sub>. An example of this comparative Explanatory Metaphor is as follows:

**B. *Regular vs. Rampant Carbon Dioxide Example:*** *Some carbon dioxide, or CO<sub>2</sub>, is needed for life processes. We can call this “regular CO<sub>2</sub>.” But CO<sub>2</sub> is not just something that we breathe out and plants take in. It’s also something that gets put into the air when we use any kind of fossil fuel - when we burn coal to create electricity, or use oil to fuel transportation or manufacturing. These things are putting a lot of CO<sub>2</sub> into the atmosphere and oceans. We can call this Rampant CO<sub>2</sub> because there’s too much of it and it’s getting out of control. Rampant CO<sub>2</sub> accumulates in the wrong places like the ocean, and causes a number of problems in the climate and ecosystems. We’ll always need regular levels of carbon dioxide, but we need to start reducing rampant levels of carbon dioxide.*

This way of framing information about the effects of CO<sub>2</sub> was highly effective in helping people distinguish between beneficial and harmful levels of carbon dioxide, producing an impressive 16 percentage point gain in people’s understanding of this core concept. It also proved effective on scales measuring understanding and attitudes related to the climate system and ocean acidification. The power of the *Regular vs. Rampant Carbon Dioxide* metaphor seems to derive from two sources: first, it offers a taxonomy into which people can organize two pieces of knowledge which, otherwise, seem to conflict; and second, it uses alliteration, which lends to the sense that these two conflicting concepts are a ‘pair.’ The alliterative contrast therefore effectively helps the public distinguish an important nuance between what is common knowledge about carbon dioxide (its role in respiration) and information that is, in the grand scheme of things, much newer (its role in trapping heat in the planet’s atmosphere). Accordingly, communicators are advised to explain the taxonomy fully, and to avoid using only the term ‘rampant carbon dioxide’ on its own. Finally, communicators need not over-worry that the term *rampant* may be unfamiliar to some audiences. Although ‘rampant’ is a relatively low-frequency word in everyday conversation, it proved easily comprehensible with the attached context cues. It also proved to be remarkably “sticky” in on-the-streets testing and persistence trials - people repeated it with great regularity and ease.

These two tools - *Heat Trapping Blanket* and *Regular vs. Rampant Carbon Dioxide* - offer communicators thoroughly tested ways to establish a sound causal understanding and head off dominant misconceptions likely to arise otherwise. As the public’s understanding of underlying causes affects their ability to appreciate visible impacts and evaluate appropriate solutions, this communications task is of primary importance in an overall strategic narrative. And as recent research on public perceptions - from FrameWorks and from others - suggests that large segments of the American public do not understand the role of CO<sub>2</sub>, we advise climate communicators to use one or both of these tools at every opportunity. For both, it is important to keep “fossil fuels” at

the start of the causal chains embedded in the metaphors. Locating the origin of the problem with “human activity” or with “CO<sub>2</sub>” can lead to unproductive chains of reasoning, as these framing choices make it more difficult for the public to imagine appropriate or realistic solutions. The explicit statement that fossil fuels are the source of carbon dioxide is an essential tactical element of these tools, as it foregrounds energy use as an important realm for public deliberation and problem-solving.

### **3. To get the ocean into the story, use explanatory tools to establish its role in the climate system and illustrate how it is affected by climate change.**

While *Heat Trapping Blanket* and *Regular vs. Rampant Carbon Dioxide* effectively translate the essential scientific insight that fossil fuel use is the primary driver of anthropogenic climate change, this single plot point is far from a complete story. The Map the Gaps analysis conducted in 2012-2013 allowed FrameWorks researchers to identify five specific, interrelated tasks in need of more consistent and reliable communications strategies in order to fill in public understanding:

1. Help people understand the role of the ocean within the climate system - increase understanding of how the ocean controls the flow of moisture and heat across the globe and thereby regulates climate.
2. Enable people to understand how the burning of fossil fuels impacts the ability of the ocean to regulate the climate system.
3. Build understanding of a broader range of effects of climate change, especially ocean acidification.
4. Make visible the ways in which ocean acidification affects marine life.
5. Help people reason more productively about how climate and ocean change can be addressed.

Additional frame elements were developed to address these tasks, yielding a set of three explanatory tools.

- A. ***Climate’s Heart***. By comparing the role of the ocean in regulating the climate system to the role of the heart in regulating the body, the Explanatory Metaphor *Climate’s Heart* overcomes the default understanding that ocean and land are ‘worlds apart,’ and generates an alternative, and more scientific understanding that the ocean plays a central role in the climate system. This analogy can be made as follows:

***Climate’s Heart:*** *The oceans regulate the climate system the way your heart regulates the flow of blood throughout your body. The heart sustains the body by controlling the circulation of blood, making sure the right amount gets to all parts of the body — not too much and not too little. The oceans act as the climate’s heart, sustaining the climate by controlling the circulation of things like heat and humidity.*

*The ocean is the heart of a circulatory system that moves heat and moisture through all parts of the climate system, including land, atmosphere, and bodies of water. As the heart*

*of this circulatory system, the ocean regulates the climate by helping to control the earth's temperature. By absorbing heat from the sun and emitting it back into the atmosphere, the ocean maintains a regular flow of heat and stabilizes the earth's temperature. Ocean currents and winds move heat and moisture to different parts of the world which keeps the climate stable.*

*Burning fossil fuels damages the ocean's ability to maintain good circulation of heat and moisture. When we burn fossil fuels, we put a lot of stress on the ocean, which damages its ability to keep the climate stable — so sometimes the oceans pump too much heat and moisture through the system, sometimes too little. Burning fossil fuels weakens the ocean's ability to regulate the climate system.*

This Explanatory Metaphor is particularly effective at providing the cognitive resources necessary for the public to understand how the ocean affects the climate - and thereby offers a powerful way to explain weather-related phenomena that, otherwise, are more difficult for the public to integrate into their existing understanding. By focusing attention on the disruption of flows of heat and moisture around the globe, *Climate's Heart* can be used to explain why climate change is contributing to both droughts and floods, for instance. This can provide a powerful antidote to the thinking that might prevail otherwise - such as the default model that 'my observation is as good as yours,' which in turn, structures opinions such as, 'if global warming is real and happening now, why did we just have the coldest, snowiest winter in memory?' Put another way, thinking of the climate system as a circulatory system provides a mechanistic understanding that explains how climate change is connected to extremes in temperature and precipitation, the frequency and intensity of storms, and other weather-related impacts. For this reason, in using *Climate's Heart*, it is important to stress *circulation* between oceans and atmosphere to help people understand *how* carbon emissions are ultimately affecting global weather patterns.

In addition to translating the idea that the condition of the ocean affects conditions on land, *Climate's Heart* makes it easier to see how activities on land affect the ocean. It thus has several productive effects that are helpful for communicators working on a variety of coastal and marine issues. First, the metaphor promotes recognition that, just as hearts are vulnerable to damage and this damage has wide-ranging effects, the ocean is vulnerable to damage with similarly far-reaching repercussions. This is an important communications accomplishment, as without the help of careful framing, the public is likely to conclude that any harm to the ocean is "a drop in the bucket" and that the vast, invincible ocean is able to heal itself. Along similar lines, this Explanatory Metaphor prompts the public to prioritize efforts to address marine issues by eliciting productive associations with well-known preventive measures for long-term cardiovascular health. In so doing, it expands the range of readily available ideas for marine conservation and preservation.

A final strength of this metaphor is its ability to communicate both a serious problem and its potential resolution. By specifying fossil fuels as the source of stress on the heart of the climate, this frame element focuses public attention on energy consumption patterns as the point of possible intervention. The tactic of pointing the public toward well-matched solutions should also be kept in mind by communicators when extending the metaphor within the domain of heart health. As a general rule, any single frame element should be used in such a way that aligns with, rather than contradicts with, the overall narrative. As such, when using *Climate's Heart*, communicators should take care to avoid extending this analogy in ways that might evoke crisis thinking - eschewing metaphorical entailments such as cardiac arrest, fatalities from heart disease, and the like.

## **B. Explanatory Chains on ocean acidification and other impacts of climate change on marine ecosystems.**

At the time of this writing, Americans are simply unfamiliar with the concept of ocean acidification, and when asked to guess what this environmental problem might be, are likely to speculate that the issue is related to acid rain polluting the ocean and suggest policy responses such as banning chemical dumping in waterways. More effective communication on this topic is essential, and not only because this emerging science deserves attention in its own right, but also because it holds promise as an issue that can be used to build a sense of urgency around climate change. Because the contemporary, observation-based lines of scientific evidence on ocean acidification are arguably less susceptible to denial and rejection than the lines of evidence used on some other climate change issues, such as analysis of changes over deep time and model-based projections, this issue potentially has particular value for climate communicators as an illustration of current impacts.

This promise will not be realized by the currently dominant strategy for explaining ocean acidification - which involves lengthy and abstract chemical equations unlikely to illuminate the issue for the public. To leverage the potential of ocean acidification - and other observable, contemporary impacts of climate change - to build support for swift and meaningful action, science communicators will need to make a shift from *description* to *explanation*. Description provides information by presenting or defining determinants and outcomes; explanation connects determinants to outcomes through a process. FrameWorks refers to these type of explanatory connections between determinants and outcomes, *Explanatory Chains*.<sup>2</sup> These characteristics can be seen in these similar, but far from identical, messages:

## Description vs. Explanation on Ocean Acidification

Description	Explanation
<p>When we burn fossil fuels like coal and gas, we release carbon dioxide into the air. When excess CO<sub>2</sub> from the air gets absorbed into the ocean it causes ocean acidification. Ocean acidification makes it hard for shellfish to build their shells. The loss of these organisms affects the whole ecosystem.</p>	<p>When we burn fossil fuels like coal and gas, we release carbon dioxide into the air. The ocean absorbs a lot of this carbon dioxide, which is changing the ocean's chemistry - a process called ocean acidification. One result of this change in chemistry is that carbonate - something shellfish use to build their shells - becomes scarce. This means there will be fewer shellfish in the food chain for other creatures to eat, which then affects the whole ecosystem.</p>

While the differences between these messages are minimal, the differences in the resulting understandings are significant. In a controlled experiment, the explanation outperformed description on several important measures of frame effectiveness<sup>3</sup>. The strengths of an Explanatory Chain included increased understanding of the role of carbon dioxide in ocean acidification; greater understanding of how ocean acidification was disrupting marine ecosystems; and a clearer understanding that ocean acidification was linked to climate change.

As with the other science translation tools recommended in this MessageMemo, effective Explanatory Chains on the impacts of climate change start with a strategically chosen link: fossil fuels. By explaining the mechanism of acidification as a 'change in chemistry' this Explanatory Chain simplifies a complex process, taking care not to lose the forest for the trees. It is important to give the public a general sense of how ocean acidification works without getting lost in details like chemical terminology or equations. Communicators should also take care when sharing the details of species-specific impacts. While impacts on specific species are part of the story - and indeed, add strength to the story by demonstrating contemporary, observable evidence - it is important to follow through on the repercussions. To make clear why acidification matters, communicators must extend explanations beyond effects on specific organisms and articulate the broader implications of acidification for marine systems and, where appropriate, for human beings.

- C. ***Osteoporosis of the Sea.*** As the effects of ocean acidification emerged, some scientists began to publicly compare ocean acidification's effects on calcifying organisms to the familiar condition of osteoporosis, as both have the effect of creating thinner, more brittle supportive structures. Given this analogy's prevalence in the field, FrameWorks included this metaphor in experimental testing, and found that it was indeed effective in giving people a quick grasp of the effects of acidification

on certain types of shellfish and related disruptions to marine ecosystems. This metaphor can be executed as follows:

***Osteoporosis of the Sea:*** *Ocean acidification is causing “osteoporosis of the sea.” Acidification is changing the chemistry of the ocean and, as a result, many types of shellfish have trouble building and maintaining their shells. This osteoporosis of the sea causes the protective shells of these animals to become thinner and more brittle, which makes it hard for them to grow and survive.*

Because this metaphor is focused primarily on the effects of a process - but not the process itself - it is somewhat more narrow in its application than the Explanatory Metaphors typically developed through Strategic Frame Analysis®. That said, it nonetheless proved very effective in increasing understanding of the effects of ocean acidification on shellfish, and can be used to explain calcification effects beyond shellfish. To enhance the productive effects of *Osteoporosis of the Sea*, it is important to place the metaphor within an Explanatory Chain to help people understand the causes of acidification and its broader repercussions. In addition, given the tendency of the public to think of marine life in instrumental terms, FrameWorks recommends that communicators highlight implications beyond highly familiar food sources such as oysters. To avoid allowing people to draw the conclusion that adapting to other food sources would be a sufficient response to ocean acidification, it is important to explain how harm to calcifying creatures disrupts marine ecosystems more generally.

#### **4. Include Solutions frame elements to establish a sense of agency and build awareness of effective approaches to addressing climate change.**

It is important to recognize that all of these frame elements are designed to open up a more effective public dialogue about addressing climate change. By using this explanatory strategy, the scientific evidence pointing to the need for action becomes easier to understand, and therefore more difficult to dismiss. Yet, for the scientific understanding to lead to effective action (rather than merely despair) it is imperative that science communicators close their communication by offering examples of policies that will address this problem and explain how these actions improve outcomes. To ward off fatalism, the frame element of Solutions is an integral piece of a Core Story of Climate Change.

The communications tools explored thus far are designed for the work that must be done *before* solutions are introduced. Yet this expository prologue requires a resolution. Having established carbon dioxide as the ‘bad guy’ and explored its damaging deeds, storytellers must turn to the possibility of addressing the situation. And having invited the public into the tale not as spectators, but as citizens, the possible solutions proffered should be systems-level initiatives or approaches, with the potential to address the problem at a meaningful scale.

## IV. Traps in Public Thinking

In the following section, we list aspects of thinking about climate and ocean change that trigger models that may be “easy to think” but trap public thinking in unproductive evaluations and judgments. We focus here specifically on traps that are common in science and advocacy communications, as these tend to represent unexamined hypotheses about effective communications.

1. **The “CRISIS!” Trap:** Presenting environmental issues as a crisis may garner temporary attention, but the public quickly develops social issue fatigue, concluding that this is yet another dire social problem about which nothing can be done. Avoid this trap by starting communications with tested Values such as *Innovation* to frame why the issue matters and what is at stake, and maintain a reasonable, explanatory Tone throughout.
2. **The “Cute Critters” Trap:** Relying on peoples’ emotional connection to charismatic animals as a way to get people to care about climate change impacts can limit the conversation, obscuring a focus on the interconnected nature of ecosystems and the process by which human actions affect them. Avoid this trap by appealing to the Value of *Interconnection*: Show and tell how humans rely on ecosystems and ecosystems rely on humans.
3. **The “Incidents and Accidents” Trap:** Using highly publicized weather events or environmental catastrophes to communicate about climate change reinforces little-picture thinking about the environment, as these episodic events are quickly relegated to “yesterday’s news.” Instead of emphasizing the details of a catastrophe, focus on teaching the broad fundamental principles of climate change using the scientific principle illustrated by the event. For example, use *Climate’s Heart* to connect extreme weather events to the underlying mechanism at work.
4. **The “Invisible Process” Trap:** Failure to explain the causes and effects of climate and ocean change makes people even more reliant on their unproductive explanations and further thwarts solutions thinking. Avoid this trap by using the Explanatory Metaphor *Heat Trapping Blanket* to quickly teach the basic mechanism of climate change.
5. **The “Climate vs. Weather” Trap:** Failure to explain *how* the climate system structures global weather patterns leaves the public to figure out their own ways of reconciling personal observations of with what they’ve heard about climate change - and with little opportunity to understand where an intervention point might lie. Instead of using precious communications opportunities to restate definitions that distinguish climate from weather, use *Climate’s Heart* to explain the climate system as a circulatory system that is under stress from *Rampant Carbon Dioxide*.
6. **The “No Solutions” Trap:** When communicators describe the problem but neglect to mention ways it might be addressed, the public is left to wonder what to do about the issue, and more often than not, concludes that the problem is too big to solve. FrameWorks’ research revealed that a sense of fatalism

is especially prevalent on the issue of climate change – making solutions messages all the more critical. A vital part of effectively framing climate and ocean change is highlighting existing, feasible, systems-level approaches that can make things better.

7. **The “Do One Thing” Trap:** Highlighting the environmentally-friendly changes that people can make in their daily lives draws attention away from the community and regional strategies that experts say are critical to addressing the root causes of climate change. Avoid this trap by substituting individual-level actions with their community-level counterparts. For instance, instead of encouraging people to get out of their cars and get on their bikes, talk about how a public bike-sharing initiative is reducing *Rampant Carbon Dioxide*, and tell the story of community involvement that led to its adoption.

## V. Conclusion

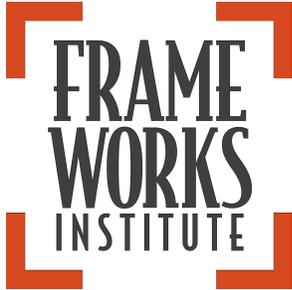
In sum, multiple frame elements can be recruited to reliably and productively expand Americans’ conceptual repertoire for thinking about ocean and climate change. An effective narrative must match tool to task strategically, starting from the knowledge of where people get stuck in understanding core concepts. FrameWorks’ research argues that it is only by assembling a coherent narrative that addresses these specific holes that communicators can make progress in understanding and engagement. Taken together, these tools tell a story that “fills in” the gaps in people’s knowledge and also aligns their thinking with deep beliefs about their responsibility to the environment and their vision of the world they wish to leave to the next generation. This narrative approach is oriented neither to head nor heart, but to both.

The FrameWorks Institute designed and empirically tested the *Heat Trapping Blanket* Explanatory Metaphor over a decade ago. Since that time, it has proven to be a useful tool and is in frequent use in public discourse, by a wide range of science communicators - academic scientists, educators and interpreters in aquariums and zoos, policymakers from the Environmental Protection Agency, and more. In this latest round of research, we have developed new tools that hold the potential to help climate communicators further translate the science of climate and ocean change. The findings suggest that these new tools will be just as “sticky” when communicators use them consistently and intentionally.

Climate scientists and other science translators may have initially started as reluctant advocates, but their work has inspired millions of people across the globe to take action on this issue. Our hope is to contribute in some way to what many believe to be the most critical act of science translation in the century.

## About the FrameWorks Institute

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The FrameWorks Institute is a national nonprofit thinktank devoted to framing public issues to bridge the divide between public and expert understandings. Its work is based on Strategic Frame Analysis™, a multi-method, multidisciplinary approach to empirical research. FrameWorks designs, commissions, publishes, explains, and applies communications research to prepare nonprofit organizations to expand their constituency base, to build public will, and to further public understanding of specific social issues—the environment, government, race, children’s issues, and health care, among others. Its work is unique in its breadth—from qualitative, quantitative, and experimental research to applied communications toolkits, eWorkshops, advertising campaigns, FrameChecks™ and Framing Study Circles. See [www.frameworksinstitute.org](http://www.frameworksinstitute.org)

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## Endnotes

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<sup>1</sup> Quinn, N., & Holland, D. (1987). Culture and cognition. In Holland, D. & Quinn, N. (Eds.), *Cultural models in language and thought* (pp. 3-40). New York: Cambridge University Press, pp. 3-40.

<sup>2</sup> For more information on causal explanations, see [http://www.frameworksinstitute.org/assets/files/eZines/causal\\_sequences\\_ezine.pdf](http://www.frameworksinstitute.org/assets/files/eZines/causal_sequences_ezine.pdf)

<sup>3</sup> Based on a related, but separate, experiment testing alternative ways of framing impacts of climate change on public health, FrameWorks researchers concluded that Explanatory Chains are a highly effective tool for framing a range of contemporary, observable effects of climate change.