Climate Change Confusion

Student Objective
The student:
- will assess climate change data and discuss the research behind it
- will explain the origin of the data cited and the validity of the sources quoted
- can state the psychological and biological reasons why climate change is difficult for us as humans to accept
- will find and use data to develop an argument.

Key Words:
confirmation bias
hyperbole
optimism bias
positive feedback
scientific uncertainty

Time:
1 class period for discussion
1 - 2 class periods for research and presentation preparation
Homework as needed
1 class period for presentations and discussion

Materials:
- Presentation Rubric

Background Information

Climate change is a serious threat to humans, animals and the Earth's ecosystems; however, effective action to stop climate change has been delayed in part because some people despite reams of scientific literature and studies, still deny there is a problem. Psychologists and social scientists have postulated many reasons for this behavior, in fact, one author lists 30 different personality traits and patterns of thinking that contribute to climate change denial. However, a review of the literature shows some common threads:

- **It's in the future** - It can be very difficult for people to be able to understand (or care about) the consequences that their seemingly small actions today could have on future generations. Human beings are wired to deal with immediate threats; we do not easily deal with threats that are 50 to 100 years off, so most people give more weight to short term rather than long term threats, strategies and rewards. Additionally, to date climate change has occurred slowly enough for our brains to normalize it, so it is difficult to see the danger.
- **Finite pool of worry** - There is so much going on in our day-to-day lives, that to keep things running smoothly we need to focus on everyday immediate concerns, blocking out many of the larger issues--like where our food comes from, where our trash goes, how our clothes are made, and what we are doing to the planet. Additionally, some social scientists contend that we block out much of this "unpleasant" information to create a positive sense of self-identity–to create a good, safe world for ourselves.
- **Denial** - Human response to disturbing information is often denial; if we can believe that

the information is false, then it doesn't have to be acted upon or integrated into our belief system.

- **Distrust of science** - Some people distrust what they don't understand. The science of climate change can seem very technical and hard to process. It requires accepting statistical evidence of things that are outside of most peoples day-to-day perceptions. Others distrust any group speaking in authority and tend to see conspiracies when they believe the authority group wants to change the way they live their lives. And still others distrust the language of science which hesitates to speak in absolutes.
- **Social conformity** - Much has been said about the liberal/conservative, left/right divide on the issue of climate change, but it is much more basic than that. People tend to agree with the group that they associate with–it's easier and more comfortable. This group could be political, religious, regional, cultural, familial, or something else.
- **Confirmation bias** - People gravitate toward information that confirms what they believe, and select sources that deliver it. Source selection of information has become more pronounced with the proliferation of information and the ease of selecting sources that provide one-sided commentary. Additionally, studies have shown that people respond to scientific or technical data and evidence in ways that justify their preexisting beliefs.

Procedure (discussion and research)

1. If your class has not completed the previous lesson in Understanding Solar Energy, *Climate Change*, or recently studied climate change, show the video *Climate Science: What You Need to Know* by PBS Digital Studios (see the Internet Sites section for the link), and lead a discussion. Potential talking points could include:
    - Discuss the greenhouse effect and our contribution to greenhouse gases. Are all greenhouse gases bad? What would happen if we had no greenhouse gases?
    - What are the potential causes of the extra CO2 in the atmosphere? How do scientists know that this carbon is caused by human activity?
    - Give some examples of how the climate has changed over the years. How do we account for the fact that we still have cold weather (discuss difference between weather and climate here). How do we know that the changes to our climate are caused by human activity?
    - Discuss what's happening to the oceans. Why is the ocean the most affected by the carbon dioxide that we are putting into the atmosphere?
    - What are some signs that climate change is beginning to affect us? *(rising air temperatures, rising water temperatures, rising sea levels, rising ocean acidity, rising extreme weather events, increased species extinctions, decreased ice mass)* Discuss why these are signs of climate change and which ones of these are positive feedback effects, contributing to the already devastating effects of climate change.
    - Did you learn anything from the video that you didn't know before? Discuss what you learned and any new concerns that you may have.
2. **Engage:** Tell the students, "98% of scientists believe that climate change is real and human-caused, yet in 2016 only about 65% of Americans believe this." Ask them why

they think this is the case. Let students speculate.

3. Show the 7 ½ minute PBS video *Why People Don't Believe in Climate Science* (see Internet Sites for the link)
4. **Explore:** Lead a discussion about climate change denial. Have the students give examples that substantiate the video arguments:
    a) rational vs. emotional brain
    b) optimism bias
    c) confirmation bias
    d) uncertainty of uncertainty (science speak)
    e) hyperbole infused media
    f) personal frame of view
    g) conforming to the group you belong to
    h) having a finite pool of worry
    i) shying away from complex "hard" issues
    - How do we get people to act when we know that many people are influenced by these biases and thus find it difficult to accept the facts?
    - Is there an economic/business effort to combat (or downplay) the climate change information coming from scientists? Where is this counter-information coming from? Who is funding it?
    - Based on the video, what are you worried about? What are you hopeful about?
5. Tell the students that they will be working on group presentations of 5 and 10 minutes long. Each presentation will be on a different argument/piece of evidence for climate change, and be presented in a way to counteract a specific type of climate denial thinking. Students must come up with an argument for climate change based on evidence, such as a graph or a report, and present it to the class in a way that they believe will reach a specific group of "climate change skeptics".
    - Split the students into groups and let them choose a topic. Some possible topics include rising air temperatures, increased water temperatures, rising sea levels, decreasing ice mass, escalating ocean acidity, intensifying extreme weather events, increased species extinctions, etc.
    - Have the groups pick a psychological/behavioral factor that is used by people to dismiss climate change.
    - Tell the students to make sure that they are as convincing as possible. The presentations should be done in a way that will persuade the listener to believe and inspire them to act.
    - The students should present their argument to reach a targeted group of climate change skeptics, and be able to explain who they are targeting, and how they modified their presentation to target this specific group. (For example, if the group wants to target those people who believe that climate change isn't real because they don't see it impacting their own life, the group could focus on effects that can be seen in their geographic area right now. They could compare the amount of storms, wildfires, rainfall, temperature, etc of today with the corresponding data from their great-grandparent's time, thereby adding immediacy to the typical climate change facts.)
    - All presentations should include at least one graph or other piece of evidence from

a scientifically accredited source.

- Give the students a copy of the rubric so that they know the criteria. You can choose for the presentations to be peer- or teacher-evaluated.

Procedure (presentation day)

1. **Explain and Elaborate:** Each group presents their topic. The other students evaluate and score each presentation (except their own) on the Presentation Evaluation Rubric. These sheets can be used to score the presentations (at your discretion), and can also be used to evaluate the knowledge (and attention) of the non-presenters. After each presentation, give the class time to ask questions.
2. End with a discussion of actions that can be taken by individuals, families, businesses, cities and countries so that this lesson is not all "doom and gloom." Action ideas may include:
   - Be an active citizen – vote (when able), write to your representatives, etc. In order to change this far reaching problem, laws must be made or changed so that businesses and people are forced to change their habits and combat climate change. You can help make that happen by voting for representatives who share your concerns.
   - Spread the word. Help increase communication between scientists and the public by sharing what they've learned from these presentations through technology and social media.
   - Incorporate ways of saving energy and resources into your lifestyle:
     a) Consider renewable energy options (solar thermal, solar electric, wind power, biomass, alternative fueled transportation, etc.)
     b) Be energy efficient (use LED lights, turn off/unplug what isn't being used, use Energy Star appliances)
     c) Drive an electric car, walk, bike, take public transportation, carpool, etc.
     d) Eat local and/or organic food (transportation and factory farming are large contributors to the release of CO2 and other greenhouse gases)
     e) Reduce food waste, compost, grow some of your own food
     f) Eat lower on the food chain or consider implementing a "Meatless Monday" (or similar) at school or home.
     g) Plant trees and fight deforestation.

Evaluation and Student Assessment

Post these criteria or discuss them with your students before they begin this project. You may use a checklist or develop a rubric for evaluation.

1. How are students communicating within the group?
   - Are they explaining their ideas and listening to others effectively?
   - Are they modeling collaborative work habits and working effectively?
   - Are they being open and responsive to new ideas?
2. Are the students using critical thinking and problem solving skills?
   - Are they making reasonable choices and decisions within the group?
   - Are they verifying points of view and offering new or different solutions to

improve the quality of the presentation?
    - Are they analyzing the information and resources discovered during the research process?
3. Are the students developing the social skills needed to work as a team?
    - Are they monitoring their own role and being productive?
    - Are they setting high standards and goals for delivering a quality presentation?
    - Are they using their strengths or the strengths of others to accomplish the team's goals?

Collect the Presentation Evaluation Rubrics and use these forms to rank the group's presentation performance. Use these peer review scores to launch your class discussion. These scores may be added to your own assessment score or used alone.

Suggested Overall Assessment:

40% student performance in the group working as a team member (teacher observation)
40% group presentation performance
20% peer review results

Key Words and Definitions

- **confirmation bias** – tendency that most humans have to reinforce their own beliefs by only listening to evidence and opinions which confirm them
- **hyperbole** – exaggerated statements or claim not meant to be taken literally
- **optimism bias** – bias that we have concerning our own fates. Bad things happen to other people, not ourselves.
- **positive feedback** – an effect that amplifies the output of a system. For instance, increased temperatures from carbon dioxide results in decreased ice mass which means decreased heat reflection surface, allowing the earth to absorb more heat and contributing to the warming effect.
- **scientific uncertainty** – the range of expected values in a future prediction done with scientific modeling--how well something is known by scientists. Scientific uncertainty is measured in order to provide transparency and show how well scientists understand the modeling parameters.

Related Research

1. Write a letter to your policymaker about climate change, outlining your concerns, various forms of scientific evidence that you have learned about in this lesson, and why you believe that climate change should be more of a priority.
2. Look up your local environmental issues and laws. What would you change if you were an elected official? Write a report outlining changes you would make, laws you would add, how you would get the community involved, etc.
3. Research a climate change issue directly related to Florida such as: how sea level rise will affect Miami; how citrus and other crops in Florida will be affected by changing temperature and rainfall patterns; how freshwater supplies will be affected by rising temperatures; or increased saltwater intrusion by rising sea levels.
4. Start a school environmental club and work on an initiative (recycling, energy

conservation, reducing food waste, etc) that is important to the group.

5. Schedule a school (or community) screening of the documentary film *Chasing Ice* and invite local decision makers to attend and discuss the film.

Related Reading

- ***A Short Introduction to Climate Change*** by Professor Tony Eggleton (Cambridge University Press, 2013)
  An introduction to climate change and the many issues surrounding it. Includes developments in climate science over the past 250 years, the difference between weather and climate, consequences of our extensive use of fossil fuels, and what actions we can take to halt further global warming.
- ***Don't Even Think About It: Why Our Brains Are Wired to Ignore Climate Change*** by George Marshall (Bloomsbury USA, 2014)
  Why do many of us recognize that climate change is real, yet do nothing about it? Why are some people blatantly ignoring scientific facts? George Marshall explores the psychological parameters around human responses to climate change. Marshall also discusses how we can grow as a species and rise to the challenge of climate change.

Internet Sites - Video resources used in the lesson

https://www.youtube.com/watch?v=ffjIyms1BX4

Climate Science: What You Need to Know. PBS Digital Studios: It's Okay to be Smart series. Basic facts about climate change and how it works.

https://www.youtube.com/watch?v=y2euBvdP28c

Why People Don't Believe in Climate Science. PBS Digital Studios: It's Okay to be Smart series. Video explaining the psychological and biological reasons why climate change is a difficult concept for humans to grasp, despite the overwhelming evidence.

Internet Sites - Research and Further Study

https://www.climate.gov/

NOAA climate information site includes a Global Climate Dashboard that graphs global temperature, carbon dioxide, sea level and other statistics as well as climate change education lessons and links.

http://climate.nasa.gov/evidence/

NASA. Global Climate Change: Vital Signs of the Planet. Lists evidence, causes, effects, consensus, and vital signs all pointing to the fact that climate change is real and will affect us (and has already). Good place to find graphs and other evidence for student presentations.

http://www.climatism.net/facts-about-global-warming/

Website by Steve Gorman, author, engineer and denier of manmade climate change.

http://ghgdata.epa.gov/ghgp/main.do

EPA interactive map of the U.S. shows greenhouse gas emissions (type and amount) from larger facilities such as power plants, manufacturing operations and disposal facilities.

https://nas-sites.org/americasclimatechoices/more-resources-on-climate-change/climate-change-evidence-and-causes/climate-change-evidence-and-causes-figure-gallery/

The National Academies of Sciences, Engineering, Medicine. Climate Change: Evidence and Causes Figure Gallery. Good place to find graphs and other evidence for student presentations.

https://www.ncdc.noaa.gov/indicators/

National Oceanic and Atmospheric Administration, National Centers for Environmental Information. Global Climate Change Indicators. Good place to find graphs and other evidence for student presentations.

http://www.scientificamerican.com/article/seven-answers-to-climate-contrarian-nonsense/

Scientific American. Seven Answers to Climate Contrarian Nonsense. Article refuting various claims by climate deniers.

http://www.ucsusa.org/global_warming/science_and_impacts/science/certainty-vs-uncertainty.html#.VaQIN2dRG70

Union of Concerned Scientists. Certainty vs. Uncertainty: Understanding Scientific Terms about Climate Change. Explanation of certainty and uncertainty regarding climate change and how the definition of "scientific uncertainty" is being twisted.

https://www.youtube.com/watch?v=_YNfA7mDri4

Climate Change: Fact and Fiction. TEDxNASA, Bruce Wielicki.

TED talk covering a range of topics including communication between scientists and the public, climate change modeling, climate versus weather, finding accurate public information about climate science (& resulting policy decisions), etc

https://www.youtube.com/watch?v=z9gHuAwxwAs

The Sixth Extinction. PBS Digital Studios: It's Okay to be Smart.

Video about how we are currently living in and contributing to the sixth major extinction event. Explanation of the Anthropocene and how human activity, including the warming of the planet, is contributing to the rapid extinction rate.

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Florida NGSS Standards & Related Subject Common Core

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Nature of Science																					
Standard 1	**SC.912.N.1.**	**X**		**X**	**X**																
Language Arts Standards		**Grades 9 & 10:** LAFS.910.RI.3.8, LAFS.910.SL.1.1, LAFS.910.SL.1.2, LAFS.910.SL.2.4, LAFS.910.SL.2.5, LAFS.910.L.3.6 , LAFS.910.RST.1.1, LAFS.910.RST.3.7, LAFS.910.RST.3.8, LAFS.910.RST.3.9, LAFS.910.RST.4.10 **Grades 11 & 12:** LAFS.1112.RI.3.7, LAFS.1112.SL.1.1, LAFS.1112.SL.1.2, LAFS.1112.SL.2.4, LAFS.1112.SL.2.5, LAFS.1112.L.3.6, LAFS.1112.RST.1.1, LAFS.1112.RST.3.7, LAFS.1112.RST.3.8, LAFS.1112.RST.3.9, LAFS.1112.RST.4.10																			
Social Studies Standards		SS.912.C.2.2, SS.912.C.2.8, SS.912.C.2.13																			

Science–Standard 1: The Practice of Science

- SC.912.N.1.1 – Define a problem based on a specific body of knowledge, for example: biology, chemistry, physics, and earth/space science and do the following: 3) examine books and other sources of information to see what is already known, 4) review what is known in light of empirical evidence, 8) generate explanations that explicate or describe natural phenomena, 9) use appropriate evidence and reasoning to justify these explanations to others, 10) communicate results of scientific investigations, and 11) evaluate the merits of the explanations produced by others.
- SC.912.N.1.3 – Recognize that the strength or usefulness of a scientific claim is evaluated through scientific argumentation, which depends on critical and logical thinking, and the active consideration of alternative scientific explanations to explain the data presented
- SC.912.N.1.4 – Identify sources of information and assess their reliability according to the strict standards of scientific investigation.

Language Arts –Reading Standards for Informational Text

- LAFS.1112.RI.3.7 - Integrate and evaluate multiple sources of information presented in different media or formats as well as in words in order to address a question or solve a problem.
- LAFS.910.RI.3.8 – Delineate and evaluate the argument and specific claims in a text, assessing whether the reasoning is valid and the evidence is relevant and sufficient; identify false statements and fallacious reasoning.

Language Arts–Standards for Speaking and Listening

- LAFS.910.SL.1.1 & LAFS.1112.SL.1.1 – Initiate and participate effectively in a range of collaborative discussions with diverse partners on grades 9-10 (11-12) topics, texts, and

issues, building on others' ideas and expressing their own clearly and persuasively.

- LAFS.910.SL.1.2 & LAFS.1112.SL.1.2 – Integrate multiple sources of information presented in diverse media or formats evaluating the credibility and accuracy of each source.
- LAFS.910.SL.2.4 & LAFS.1112.2.4 – Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.
- LAFS.910.SL.2.5 & LAFS.1112.SL.2.5 – Make strategic use of digital media in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

Language Arts–Language Standards

- LAFS.910.L.3.6 & LAFS.1112.L.3.6 – Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

Language Arts--Reading Standards for Literacy in Science and Technical Subjects

- LAFS.910.RST.1.1 & LAFS.1112.RST.1.1 – Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.
- LAFS.910.RST.3.7 – Translate quantitative or technical information expressed in words in a text into visual form and translate information expressed visually or mathematically into words.
- LAFS.1112.RST.3.7 – Integrate and evaluate multiple sources of information presented in diverse formats and media in order to address a question or solve a problem.
- LAFS.910.RST.3.8 – Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.
- LAFS.1112.RST.3.8 – Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
- LAFS.910.RST.3.9 – Compare and contrast findings presented in a text to those from other sources, noting when the findings support or contradict previous explanations or accounts.
- LAFS.1112.RST.3.9 - Synthesize information from a range of sources into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
- LAFS.910.RST.4.10 & LAFS.1112.RST.4.10 – By the end of grade 10 (12), read and comprehend science/technical texts in the grades 9-10 (11-12) text complexity band independently and proficiently.

Social Studies–Civics and Government

- SS.912.C.2.2 – Evaluate the importance of political participation and civic participation.
- SS.912.C.2.8 – Analyze the impact of citizen participation as a means of achieving political and social change.

- SS.912.C.2.13 – Analyze various forms of political communication and evaluate for bias, factual accuracy, omission, and emotional appeal.

National Next Generation Science Standards

Earth's Systems

- HS-ESS2-2 - Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth's systems.
- HS-ESS2-4 - Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.

Earth and Human Activity

- HS-ESS3-5 - Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.
- HS-ESS3-6 - Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.

Note: Related Common Core Language Arts Standards are listed in the Florida section above.

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Use the rubric below to evaluate each presentation (except your own). For each criteria, list one example that was covered in the presentation, and rate the presentation on each of the criteria using this scale:

Excellent	**7 - 10 points**	**Above Average**	**4 - 6 points**
Acceptable	**1 - 3 points**	**Not Done**	**0 points**

Group Topic: **Members:**		
Criteria	**Evidence** **Give an example from the presentation**	**Score**
Argument is relevant to topic chosen		
Relevant **vocabulary** is used appropriately		
Scientific evidence is used in the argument		
Argument addresses a **psychological barrier**		
Solutions to the climate change problem are presented		
Presentation is **interesting** and **engaging**		
Scientific evidence is included in the **visuals**		
Presentation is **creative**		
Presentation is **convincing**		
Each member of the group participated		
	Total Group Presentation Score	