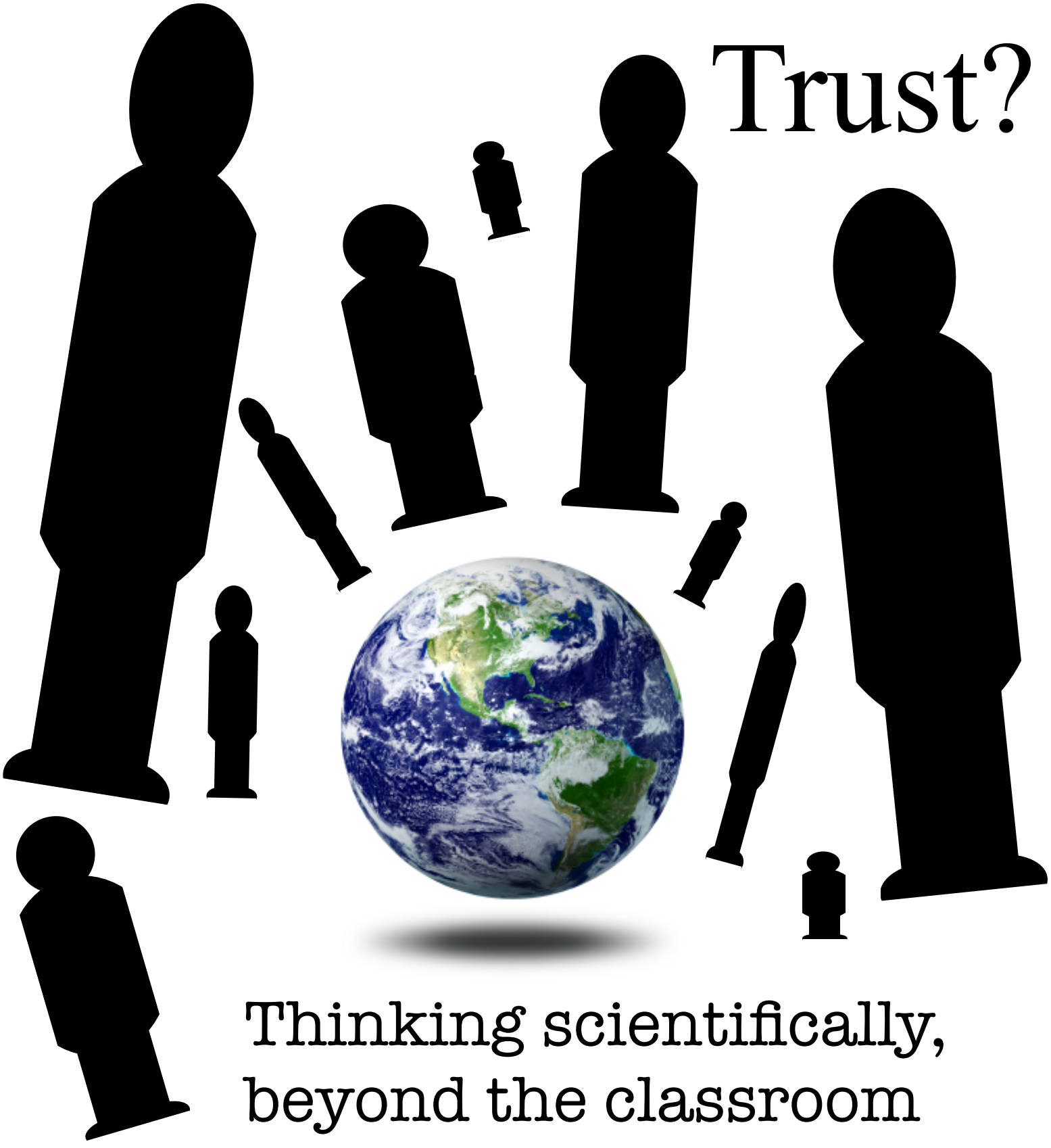
Who Can You Trust?



Thinking scientifically, beyond the classroom

Lesson designed by: Betsy Mills,

Title of Lesson: Who can you Trust?

Grade Level: 8th

Subject(s): Global Warming, Designing an experiment

Summary:

The purpose of this lesson is an end-of-the-year (or anytime) assessment of student's understanding of the scientific method, and ability to plan an experiment and communicate their process. After reading a short excerpt from an article detailing the arguments for and against global warming, students break into groups and design (but do not carry out) their own experiments to test the claims made by both sides. Each then group presents their experiment to the class, with the goal of convincing the class that their approach is the most scientific. The rest of the class then questions each group about their procedure. At the end, the class discusses what made them trust the plans of some groups over others, and how they might use these ideas to evaluate other claims made by friends, the media, and others in the future.

Time Required: 90 minutes

Group Size: Class of 36, broken into 10 groups of 3-4 students each

Cost to implement: ~$20 for large post-it easel pad to serve as posters for student presentations, markers.

Learning Goals:

- Students think critically about how to evaluate claims made by others
- Students practice using the scientific method
- Students are able to distinguish between scientific and unscientific ways to conduct a study or experiment

Level of Inquiry:

This lesson incorporates a high level of inquiry in that students develop their own questions and hypotheses, and determine what would constitute the necessary evidence to test their hypotheses. Students also have control of what they will include on their poster, and how to present it to the class.

Introduction / Motivation:

The lesson is introduced to the class as a way to take what they have learned all year, and to keep thinking like scientists outside of the classroom.

Begin by asking students for their ideas on why it might be valuable to think like a scientist outside of the classroom.

After hearing student ideas, share with them that science is part of our everyday lives in today's society. Science & scientific studies in today's culture are often controversial, from studies of diets to trials of prescription drugs and their side effects, to studies of the effects of oil spills, such as the 2010 oil spill in the gulf of mexico, (or other more current examples), all the way to studies of global warming.

Scientists can get different results, not everyone may agree on how to interpret what they find, and it can be confusing. How do you know who to trust?

Procedure:

- Students read the attached excerpt from a Wall Street Journal article on Global warming. It may be helpful at this point to define terms which students are unfamiliar with, such as El Niño, Greenhouse gas, and Solar output.
- Students share different arguments they read, or that they are otherwise familiar with, both for and against global warming. These arguments are written down in a chart on the board at the front of the room.
- After students have compiled a list of arguments, ask the students, "Which side is right?"
- Tell students that this is a case where thinking like scientists can help us find signs that some arguments or results might not be based on good science, and might not be as trustworthy.
- Ask them: "What are some good questions you could ask that might help you figure out who to trust?" If students are not sure, ask them for some ideas about how they could investigate the claims made by both sides, and write some of these ideas on the board next to the pros and cons.
- Tell students they will be working in groups to design an experiment to test one of these claims (or another related claim of their choice). They should not feel limited by supplies in the classroom, or their surroundings, or even limited by times. The point is not to DO the experiment, the important thing is to think about HOW they would do it,

and how they are going to convince the class that their experiment will be the most scientific, as they will be presenting it to the class.

- Help students get started by having them come up with the steps of the scientific method before breaking into groups, in order to remind themselves how they might proceed.
- Allow students ~20 minutes to design an experiment, and to make a poster that will help them present it to the class. Help groups manage their time, making sure that each group comes up with a question in a timely fashion, and if possible asking groups questions about how they will conduct their investigation, helping to remind them about things such as collecting enough data, collecting data over a sufficient time period, and accounting for such factors as seasonal or tidal variation if students want to measure temperature, ice cap size, or sea levels.
- Have students prsent their results. Remind students before they present their method to the class that the point is tp convince us that they are being the most scientific and that their results will be the most accurate.
- To encourage discussion, give each student who asks a question to the presenting group a piece of candy. Before doing this, it is important to lay some groundwork as to appropriate types of questions (one can restrict them to questions about the methods the group is using) and when and how to ask questions (let the group talk first before you ask your question! Speak up when you are talking, and be quiet and listen when others are talking!).

Lesson Closure:

As a closure, ask the class what they noticed from listening to the presentations from their peers. What made them more likely to trust a group's experiment? What made them less likely to trust a group's experiment?

As part of the closure, the instructor can also share his or her own views on global warming (however, as the point of this lesson is to enable students to think critically about how to trust claims made by others, having students simply accept that there is global warming because you believe so is somewhat counterproductive, so challenge students to ask you why you believe as you do!)

Materials List:

Each student recieves a copy of the article excerpt (attached below) to read, and each group needs a sheet of paper and a marker to make a poster for their final presentation.

Safety Issues: None

Is this lesson based upon or modified from existing materials? If yes, please specify source(s) and explain how related: No

References:
None

CA Science Standards addressed:
9a: Plan and conduct a scientific investigation to test a hypothesis
9b: Evaluate the accuracy and reproducibility of data

Attachments: See below

DECEMBER 6, 2009 excerpt from **THE WALL STREET JOURNAL**

What Global Warming?

A look at the arguments the skeptics make—and how believers respond

CON: " ...warming in the past century has been modest and human activities' contribution to the warming has been minimal; there is no crisis ... There is no consensus that human-caused warming is creating a disastrous rise in global temperatures."

PRO: " ...the planet is warming, and most of the temperature rise is very likely due to an increase in greenhouse gases in the atmosphere caused by human activity. Barring a reduction in greenhouse-gas emissions, the 21st century will see more frequent heat waves, intense storms and, in the tropics, declines in rainfall."

ARGUMENT #1:

CON: "Natural factors are enough to account for the moderate warming we've seen since 1900.

"Changes in solar output in the past have contributed to wide temperature swings across the globe. Other natural phenomena, such as the El Niño Southern Oscillation and its cooling counterpart, La Niña, can cause large but temporary climate shifts.These normal fluctuations are enough to cause the warming of the planet, while the effects of greenhouse-gas emissions remain relatively small."

PRO: "Natural factors aren't enough to account for the sharp increase in temperatures since the late 1970s.

"Studies of solar output over more than 1,000 years show that temperatures rise when solar output increases, and they decline when solar radiance, as measured by sunspot and other activity, decreases. But the studies have also found that solar energy doesn't account for the steep temperature rise since the mid-1970s, a period during which solar output has remained relatively unchanged. The sun's contribution to warming since then has been negligible. Natural climate changes, like El Niño, also have a definite impact on weather patterns for as much as a decade. But such climate changes occur in recurring cycles and don't show longer-term trends"

ARGUMENT #2:

CON: "Polar ice isn't disappearing.

"Warmer temperatures are partly responsible for recent declines in sea ice in the Arctic, but shifting winds are the main factor. What's more, declines in the northern ice cap have been counterbalanced by increases in the Antarctic ice pack, so there's little net loss of polar ice. These opposite trends argue against the existence of man-made global warming."

PRO: "The two ends of the Earth do seem to behave differently, but that reflects the complexity of the world's climate system and isn't evidence against global warming.

"The Arctic is an ocean surrounded by land, which holds in more heat. The Antarctic, by contrast, is a continent surrounded by ocean, and climate models predict that it will respond differently to global warming. In the north, satellite measurements show that Arctic sea ice has decreased steadily since the late 1970s; sea ice has declined about 10% a decade, or about 28,000 square miles through 2007. In the Antarctic, meanwhile, wintertime ice has extended its range by about 1%, or almost 39,000 square miles, a decade"