# Science Consensus and the Climate Change Debate

## # of Days

2

## Prior Knowledge

Students will have attained a basic level of the science behind global warming. Students will also likely have been exposed to elements of the global warming debate through various media sources.

## Lesson Objective

Students will be able to identify elements of scientific consensus making and analyze debates about the validity of global warming claims.

## Language Goals/Demands

Teachers must be prepared to moderate discussions and arguments that may have deep seeded values based on political, religious, or social identities.

## California English-Language Arts Content Standards

Reading 2.8
Listening and Speaking 1.11, 1.12, 1.13

## California State Science Standard

Investigation 1.1, 1.1m

## Materials Needed

Video Projector, Laptop or Computer with Connection to Internet

## Time

**Day 1**

<table>
<thead>
<tr>
<th>Time</th>
<th>Student Learning Task or Activity</th>
<th>Teacher METHOD or Activity</th>
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</thead>
</table>
| 25 min | Preponderance of Evidence Activity  
- Students should be divided into groups. There are 8 different cards. Students will review the cards for their group, discuss the evidence, and then listen/give presentations and take notes on all the other evidence. | GROUPWORK  
5.1.1 Preponderance of Evidence.ppt (to use as resource cards)  
5.1.2 Preponderance of Evidence Activity Card  
5.1.3 Preponderance of Evidence Graphic Organizer  
Pika Video, http://www.youtube.com/watch?v=QVJuRgil0wQ or search for dam cute pika |
| 15 min | A Process of Science  
- Teacher presents and discusses the process of science, scientific consensus, science in policy, and political interference in science. | PRESENTATION  
5.1.4 Process Science SLIDES |
| 5 min  | Video of Commercial on Carbon Dioxide  
- Teacher plays video without much of an introduction. After viewing the video, the teacher asks for initial impressions. | VIDEO  
5.1.5 Video clip for RealPlayer  
http://www.factcheck.org/article395.html has the video as a download  
http://www.youtube.com/watch?v=7sGKvDNdJNA&feature=player_embe dded |
<table>
<thead>
<tr>
<th>Time</th>
<th>Activity Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 min</td>
<td>Students work in groups to analyze the commercial using the transcript and questions on a task card.</td>
<td>GROUP WORK 5.1.6 Transcript of commercial 5.1.7 Task card for student analysis</td>
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<tr>
<td><strong>Day 2</strong></td>
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<tr>
<td>3 min</td>
<td>Bellwork: Perhaps you have heard debates about global warming. Write down different arguments that you have heard in the media about global warming.</td>
<td>INDIVIDUAL SEAT WORK</td>
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<tr>
<td>5 min</td>
<td>What are some of the major debates over global warming that you wrote down for bellwork? - Have students share what they have heard and where they have heard it. Write some of these ideas on the board and note the sources. - Tell students that they will be watching segments from a video called &quot;The Global Warming Swindle&quot;. On their handout, they will be asked to write down some of the major arguments that the video makes. They can also write notes about what they think about the argument to the side as they will be talking about these in groups after the video.</td>
<td>TEACHER-LED DISCUSSION</td>
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<td>20 min</td>
<td>Watch Global Warming Swindle Parts 1 &amp; 2 - Use the note guide to write down the major arguments that the movie makes.</td>
<td>WATCH VIDEO Student Handout 5.2.1: Video Guide Part 1 Link: <a href="http://www.youtube.com/watch?v=6TqqWJugXzs">http://www.youtube.com/watch?v=6TqqWJugXzs</a> Part 2 Link: <a href="http://www.youtube.com/watch?v=L5rGpDMN8lw&amp;NR=1">http://www.youtube.com/watch?v=L5rGpDMN8lw&amp;NR=1</a></td>
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<tr>
<td>8 min</td>
<td>Teacher-led Discussion - Based on your note guide, what are some of the major arguments that the film makes? - What are their sources of evidence? - What is your response to these claims?</td>
<td>TEACHER-LED DISCUSSION</td>
</tr>
<tr>
<td>14 min</td>
<td>Watch the Global Warming Debate Rebuttal</td>
<td>WATCH VIDEO Part 1 Link: <a href="http://www.youtube.com/watch?v=IljGynF4qkE&amp;feature=related">http://www.youtube.com/watch?v=IljGynF4qkE&amp;feature=related</a> Part 2 Link (only need to watch first few minutes): <a href="http://www.youtube.com/watch?v=goDsc9laSQ8&amp;feature=related">http://www.youtube.com/watch?v=goDsc9laSQ8&amp;feature=related</a></td>
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| 6 min | Class Discussion  
How did both of the films use evidence?  
What kind of experts can you trust?  
What must you think about when viewing media critically about climate change? | TEACHER-LED DISCUSSION |
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<tr>
<td>HW</td>
<td>Review Mitigation Strategy Wedges Table</td>
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Temperature (1880-2005)

![Graph showing temperature difference from normal over time from 1880 to 2000, with lines indicating annual average and 5-year running average.]

Shrinking Glaciers

Muir Glacier, Alaska

August 1941 August 2004

Increasing Wildfire Risk

Western US area burned

Source: Westerling et al. 2006

Keeling Curve - CO₂ Concentration

Preponderance of Evidence Resource Card 3

Preponderance of Evidence Resource Card 4
Ice Core Records


Projected Changes in CA Summer Temperature

Preponderance of Evidence Resource Card 5

Preponderance of Evidence Resource Card 6
Species Shifting

Species that are sensitive to temperature conditions can only move up the mountainside as conditions get too warm for them lower down.

In the Sierras, Pika were seen at 7,800 feet and above in 1900. By 2004, they were not seen below 9,500 feet. This trend is expected to continue.

The mountains rise as high as 12,000 feet, but the rocky hillsides where Pika live do not reach that high.

Diminishing Sierra Snowpack
Percentage Remaining, Relative to 1961-1990
5.1.2 Activity Card

Preponderance of Evidence

As a group, examine the resources and discuss the following questions:

• Describe the evidence presented for the observed changes in the physical world or in the biological systems.

• Given what we know, how does the increase of CO$_2$ cause these changes?

• What human activities contribute to the increase of CO$_2$ in the atmosphere?

Individually, complete the summary report. Record your conversation and the reports from the other groups.
<table>
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<tr>
<th>Slide Name</th>
<th>Evidence</th>
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<tbody>
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<td>Temperature 1880-2000</td>
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<td>Keeling Curve - CO₂ Concentration</td>
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<td>Ice Core Records</td>
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<td>Projected Changes in CA Summer Temperatures</td>
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How do we know what is ‘good science’?

- Scientists follow logical paths that refine our knowledge
  - uses quality data and methods to arrive at a defensible position
- The modern scientific process looks somewhat like this:
  - Idea → Research → Conclusions → Publication → Feedback → Research
- All scientific ideas are subject to challenge and modification

Quality Control

- The scientific community polices itself for quality
  - publication of research results
  - independent scientists believe the paper is ‘good science’
  - uses quality data and methods to arrive at a defensible position
- This does not necessarily mean “correct science”
  - all experiments must have repeatable results

Slides are modified from the Union of Concerned Scientists, Scientific Integrity Curriculum Guide, 2nd Edition
For example, the scientific consensus supporting a geocentric model of the solar system and the fixed-plate theory for the earth’s crust were both overturned. The geocentric model was replaced when observation, physics, and mathematics advanced to the point where a more accurate, heliocentric model could be produced. Mounting evidence against the fixed-plate theory overturned this incorrect consensus and gave us our modern theory of continental drift.

More Quality Control

- Research results that do not agree with other results are published as long as it is ‘good science’
- Over time, science is self-correcting
- An open debate of theories pushes out weak ideas until a strong consensus is reached

Scientific Consensus

- When the scientific community comes to a consensus, this means the idea has
  — withstood rigorous testing = ‘good science’
  — represents our best understanding of the subject being studied
- Some uncertainty will always remain
- Scientists strive to minimize uncertainty to reasonable levels
Intergovernmental Panel on Climate Change (IPCC)

- It reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change.
- Thousands of scientists from all over the world contribute to the work of the IPCC on a voluntary basis.
- Differing viewpoints existing within the scientific community are reflected in the IPCC reports.

The IPCC Fourth Assessment (2007) states:

- “Most of the observed warming over the last 50 years is very likely to have been due to the increase in greenhouse gas concentration” ("very likely" is defined as >90% likelihood)
- It is “extremely unlikely” that all observed warming could be due to natural cycles ("extremely unlikely" is defined as <5% likelihood)
Appearances of an ongoing debate

- In the United States, political interference in climate change science contributes to the appearance of an ongoing debate about the causes.
- Journalism and other media provide equal coverage to climate deniers as to the consensus of the IPCC.

Science in the Policy Arena

- Science is an important factor in decisions the government makes about health, security, and sustainability.
- Science is only one aspect of the policy process.
- Manipulation or suppression of science before it enters the public policy arena is not OK.
Consequences of Political Interference in Climate Change

- Interference: Political appointees with no scientific training edited EPA climate reports and barred climate scientists from speaking to the press
- Consequence: The public becomes misinformed about the harmful consequences of climate change, indirectly supporting policy inaction
There’s something in these pictures you can’t see
It’s essential to life.
We breathe it out.
Plants breathe it in.
It comes from animal life, the oceans, the earth,
and the fuels we find in it.
It’s called carbon dioxide---CO$_2$.
The fuels that produce CO$_2$ have
freed us from a world of back-breaking labor,
lighting up our lives,
allowing us to create and move
the things we need, the people we love.
Now some politicians want to label carbon dioxide a pollutant.
Imagine if they succeed.
What would our lives be like then?
Carbon dioxide.
They call it pollution.
We call it life.
5.1.7 Task Card

You will be analyzing this commercial more closely by reading the transcript and thinking about the message and meaning of the commercial.

**WHAT TO DO:**
Read the transcript to yourself.

Some of the statements in this transcript could be tested and other statements are opinions.

- Put a + next to all statements that could be tested and comment on whether you think this statement is true or false.
- Put a ? next to any statement that is an opinion and underline the words that make you think this.

**DISCUSSION:**
As a group, discuss the following questions.

1. What is the message of the commercial?
2. The commercial implies that it will be bad for society if carbon dioxide is legally called a pollutant. Do you agree?
3. What do you “imagine if they succeed”? Is your image of success the same image that the author implied?

**INDIVIDUALLY:**
Do you agree with the message?

How can you know or figure out whether to accept the claims of this commercial?
### Student Handout 5.2.1
The Climate Change Debate

While you are watching the video segments, “The Global Warming Swindle” write down the major arguments that the video makes about global warming. You may not end up using all of the spaces. Next to these arguments, write down the evidence that the video cites as support for these arguments.

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<tr>
<th>Arguments</th>
<th>Evidence</th>
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