



SCIENCE DISSECTED

Climate Change Model-Evidence Link Diagram (MEL)

Earth's climate is a complex system that includes patterns of temperature, precipitation, humidity, atmospheric pressure, atmospheric particle count and other meteorological measurements in a given region over long periods of time. Conversely, weather is the local day-to-day temperature, precipitation activity, and cloudiness.

The term Climate Change refers to the significant and lasting change in the statistical distribution of weather patterns over long periods of time (ranging from decades to millions of years), regardless of the cause. This issue of Science Dissected provides an instructional resource for teachers to present students with the opportunity to examine several pieces of evidence compiled about Earth's climate and critically evaluate two competing models of climate change;

Model A: Current climate is caused by increasing amounts of gases released by human activity.

Model B: Current climate change is caused by increasing amounts of energy released from the Sun.

The following is a suggestion for using this MEL with students:

1. Hand out the Climate Change Model Evidence Link Diagram (page 1). Instruct students to read the directions, descriptions of Model A and Model B, and the four evidence texts presented.
2. Handout the four evidence text pages (pages 3-6).
3. Instruct students to carefully review the Evidence #1 text page (page 3), then construct two lines from Evidence #1; one to Model A and one to Model B. Remind students that the shape of the arrow they draw indicates their plausibility judgment (potential truthfulness) connection to the model.
4. Repeat for Evidence #2-4 (pages 4-6).
5. Handout page 2 for the students to critically evaluate their links and construct understanding.

MEL Key Points

- ◆ Provides a structure for organizing and examining evidence in order to better engage in collaborative argumentation (Claim, Evidence, and Warrant)
- ◆ Encourages students to engage in critical evaluation (analysis of how evidence supports not only hypothesis, model, or theory but also how evidence supports alternative explanation)
- ◆ Supports the ELA Common Core State Standards pertaining to argumentation focused on discipline-specific content
- ◆ Supports the K-12 Science Framework Science and Engineering practices where students understand how knowledge develops through multiple approaches used to investigate, model, and explain the world

Once students have completed page 2, they can then engage in collaborative argumentation as they compare their links and explanations with that of their peers. Students should be given the opportunity to revise the link weighting during the collaborative argumentation exercise. If time permits, have students reflect on their understanding of climate change and create questions that they might explore in the future.

U.S. Environmental Protection Agency website on climate change, <http://www.epa.gov/climatechange/>

Archived Issues of Science Dissected, <http://www.rpdp.net/link.news.php?type=sciencedis>

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MEL p. 2-6 by: Doug Lombardi

Name: _____

Directions: draw two arrows from each evidence box. One to each model. You will draw a total of 8 arrows.

Key:

	The evidence supports the model
	The evidence STRONGLY supports the model
	The evidence contradicts the model (shows its wrong)
	The evidence has nothing to do with the model

Evidence #1
Atmospheric greenhouse gas concentrations have been rising for the past 50 years. Human activities have led to greater releases of greenhouse gases. Temperatures have also been rising during these past 50 years.

Model A
Our current climate change is caused by increasing amounts of gases released by human activities.

Evidence #3
Satellites are measuring more of Earth's energy being absorbed by greenhouse gases.

Evidence #2
Solar activity has decreased since 1970. Lower activity means that Earth has received less of the Sun's energy. But, Earth's temperature has continued to rise.

Model B
Our current climate change is caused by increasing amounts of energy released from the Sun.

Evidence #4
Increases and decreases in global temperatures closely matched increases and decreases in solar activity before the industrial revolution.

Provide a reason for three of the arrows you have drawn. **Write your reasons for the three most interesting or important arrows.**

- A. Write the number of the evidence you are writing about.
- B. Circle the appropriate word (**strongly supports** | **supports** | **contradicts** | **has nothing to do with**).
- C. Write which model you are writing about.
- D. Then write your reason.

1. Evidence # ____ **strongly supports** | **supports** | **contradicts** | **has nothing to do with** Model ____ because:

2. Evidence # ____ **strongly supports** | **supports** | **contradicts** | **has nothing to do with** Model ____ because:

3. Evidence # ____ **strongly supports** | **supports** | **contradicts** | **has nothing to do with** Model ____ because:

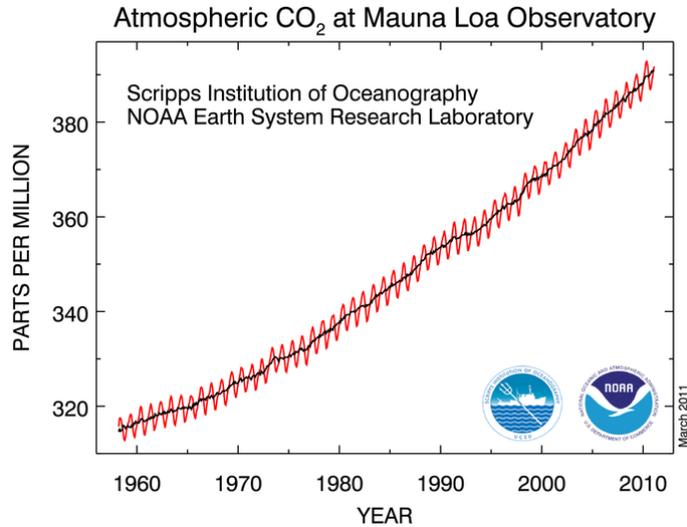
4. Circle the plausibility of each model. [Make two circles. One for each model.]

	Greatly implausible or even impossible										Highly Plausible
Model A	1	2	3	4	5	6	7	8	9	10	
Model B	1	2	3	4	5	6	7	8	9	10	

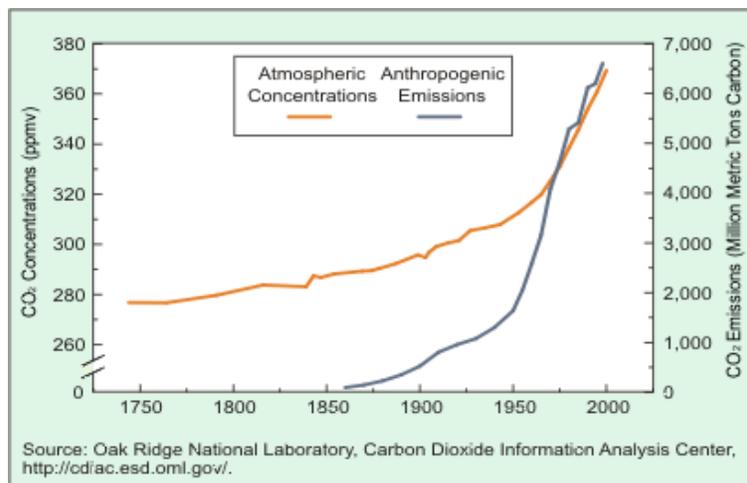
5. Circle the model which you think is correct. [Only circle one choice below.]

Very certain that Model A is correct	Somewhat certain that Model A is correct	Uncertain if Model A or B is correct	Somewhat certain that Model B is correct	Very certain that Model B is correct
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Evidence #1: Atmospheric greenhouse gas concentrations have been rising for the past 50 years. Human activities have led to greater releases of greenhouse gases. Temperatures have also been rising during these past 50 years.

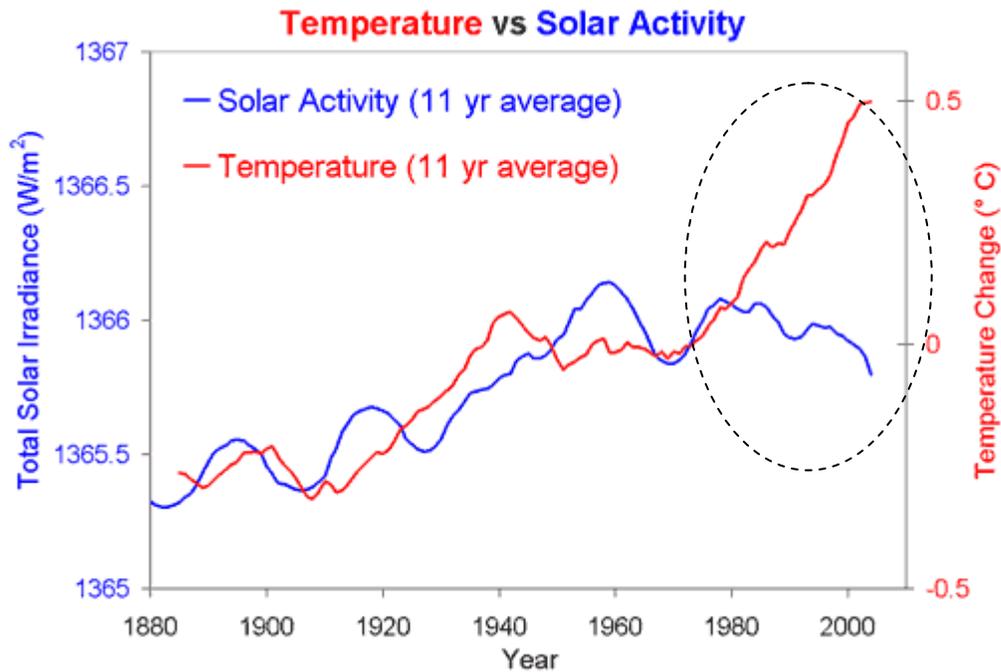


This graph shows carbon dioxide levels in the atmosphere. The symbol for carbon dioxide is CO₂. These levels have been increasing. CO₂ in the atmosphere absorbs energy emitted by the Earth. The atmosphere reradiates some of this absorbed energy back to Earth. People call CO₂ a greenhouse gas because it keeps some of Earth's energy from escaping to space.



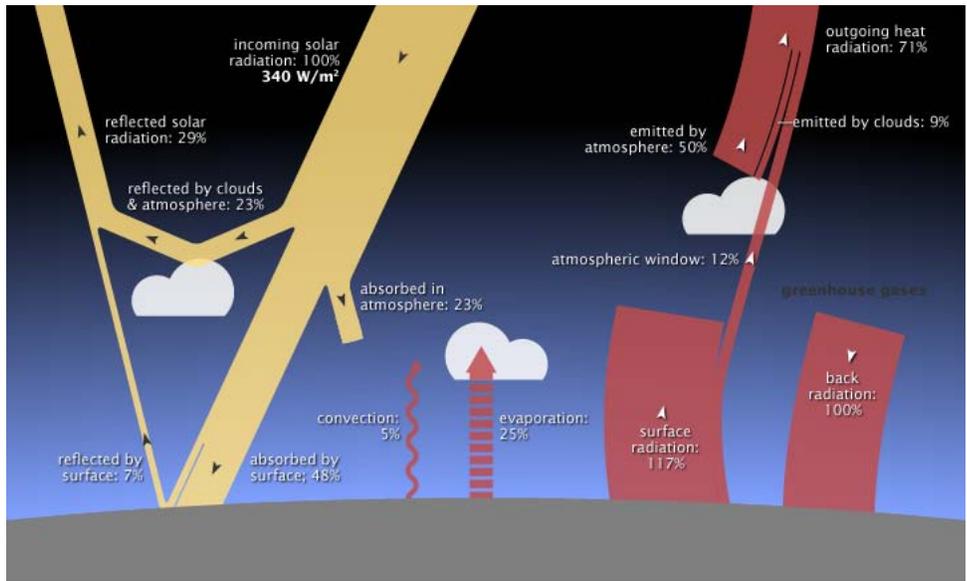
This blue line shows increasing releases of CO₂ by human activities. Burning coal, gasoline, natural gas, and wood releases CO₂ into the atmosphere. The yellow line shows increasing carbon dioxide in the atmosphere. Both the yellow and blue lines have been increasing with time.

Evidence #2: Solar activity has decreased since 1970. Lower activity means that Earth has received less of the Sun's energy. But, Earth's temperature has continued to rise.

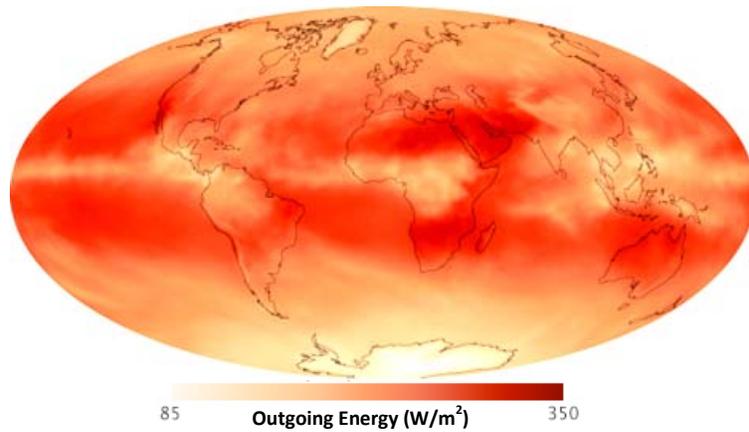


This graph shows solar activity levels. The Sun's brightness is one way to measure solar activity. The blue line shows the Sun's brightness. Since 1970, the Sun's brightness has been decreasing. The red line on the graph shows Earth's temperature. The graph shows that temperatures are increasing while solar activity is decreasing. The region outlined by the dashed circle show where solar activity is increasing and temperature is decreasing.

Evidence #3: Satellites are measuring more of Earth's energy being absorbed by greenhouse gases.

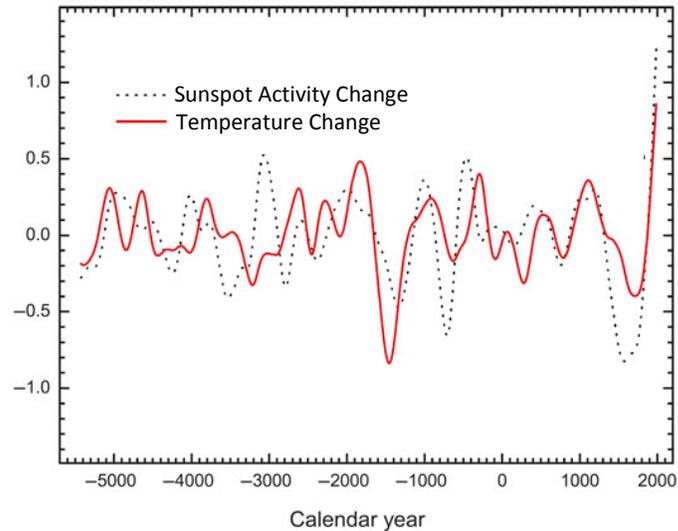


This figure above shows Earth's energy budget. Earth absorbs about half of the Sun's energy. Most of the Sun's energy comes to Earth as visible light. Earth reradiates this absorbed energy as invisible light called infrared. Some of this infrared energy is absorbed by the atmosphere and sent back to Earth. Some escapes into space.



NASA made the map above using satellite data. The map shows how much energy is escaping Earth's atmosphere. Over time, NASA has recorded less infrared energy leaving Earth's atmosphere.

Evidence #4: Increases and decreases in global temperatures closely matched increases and decreases in solar activity before the industrial revolution.



This graph shows sunspot activity and temperature. Sunspot activity is the dashed line. Solar activity increases when the Sun has more sunspots. The red line shows temperature. The shapes of the sunspot and temperature curves match closely. Peaks in the temperature are near peaks in sunspot activity. Dips in temperature are near dips in sunspot activity.

These data show sunspot activity and temperature for the past 9000 years. These data are based on evidence collected from tree rings. Some of the tree rings are from trees that are still living. Some of the trees rings are from ancient trees that have died.