



What Makes You Hot?

NS 696 V: Weather and Climate for Educators

Grade Level: Highschool (9-12)

Standards:

4.9-12.7 The atmosphere has a current structure and composition and has evolved over geologic time

4.9-12.8 Energy transferred within the atmosphere influences weather **4.9-12.15** there is electromagnetic radiation produced by the Sun **5.9-12.3** Graphs, equations or other models are used to analyze systems involving change and constancy **5.9-12.4** There are cause-effect relationships within systems

Learning Objective/s: Students will be able to:

- Manipulate different variables in the model and use this to make inferences about the temperature of Earth

Common student misconceptions and prior understandings:

misconception: Light can only be reflected from shiny surfaces (such as a mirror). Students may also believe that an object cannot absorb and reflect light - it must do one or the other.

All objects absorb and reflect light to different degrees. Our ability to see objects depends on the reflection of light

misconception: The earth gets heat from the sun.

The sun is actually too far from the earth to heat it directly. Instead, the light from the sun is reflected or absorbed by objects on earth. Absorbed light usually increases the energy in an object, causing the object to heat up.

misconception: The greenhouse effect is bad and will eventually cause all living things to die.

Without the greenhouse effect, the earth would not be warm enough to support life. The increase in temperature due to increased greenhouse gases in the atmosphere will have negative effects.

Materials:

Excel Spreadsheet with model (below)

Lesson Sequence:

Explain

- Direct instruction on blackbody radiation

Engage

- Calculate the blackbody radiation of an object at a certain temperature with the class

Explore

- Have the students manipulate the model (see attachment) to determine which factors have an effect on the temperature of the earth

Extend

- Allow students to expand the model by using Excel to add the atmosphere to the model.

Evaluate

- What is a reasonable temperature range for the planet?
- Which variables affect that range?
- This climate model assumes that the earth is black and has no atmosphere. What possible influence would an atmosphere have on Earth's temperature?

Assessment:

- Students will create a set of graphs that depict 3 different variables.
- Write a narrative of how this activity influenced their understanding of scientific modeling

MY FIRST CLIMATE MODEL!!!		
Remember, in this model the earth is completely black and has no atmosphere		
Things you need to run your model		
Temp of the sun (K):	5700	
Earth - Sun distance (m):	149597870600	
Radius of Earth (m):	6378100	
Heat Capacity of Earth ((W yr)/(sq m K)):	17	
Radius of Sun (m):	695500000	
Boltzmann's Constant	0.00000005670400	
Things that are calculated before your model is run		Formula
power output by the sun (W)	3638453964669150000000000000	<-- (B10*B5^4)*(4*3.14159*B9^2)
power per square meter hitting the Earth (W/sq m)	1294	<-- (B13/(4*3.14159*B6^2)
total power received by earth (W)	165344105811326000	<-- (B14*3.14159*B7^2)
Pick a Starting Temp for Earth		
Starting Temp of Earth (K):	230	
Temp of Earth after 30 years		
Earth's temperature after 30 years (K):	275	
Earth's temperature after 30 years (C):	2	
Earth's temperature after 30 years (F):	35	