Heating Earth's Surfaces: Clouds

Lab Instructions

> Think about this: When you are out on a sunny day and a cloud passes overhead, what changes in how the temperature feels? Explain. Do cloudy days tend to be warmer or cooler than sunny ones? What about cloudy nights? Why might this be the case?

Objective

Students will develop and test a hypothesis about how clouds affect the way a surface heats up and cools down.

Materials

thermometers (2)
2-liter soda bottle tops (2)
stopwatch
construction paper circles (2, black, cut to fit in the bottles)
clouds cut from foil
lamp with heat bulb and stand

Procedure

1. Place the bottles side by side on a flat surface, 15-20 centimeters in front of the bulb of the lamp, but don't turn on the lamp yet. (Make sure the distance to each bottle is equal.) Place them so that the light shines on the front of the bottles, not down, and that each bottle will receive the same amount of light. The cut-out clouds covering the front of one of the bottles should face the lamp, blocking some of the lamp's light.

2. Under each bottle, place a black construction paper circle, with a thermometer on top of the circle. Make sure you can read the temperature through the back of the bottle.

3. Record the starting temperature of each bottle in your data table at "0 minutes."

4. Start the stopwatch and turn on the light simultaneously. Record the temperature of each bottle every minute until 10 minutes have passed.

   ➔ **CAUTION: The bulb and shade may get very hot. Be careful, and avoid touching either during the experiment.**

5. At the 10 minutes mark, turn off the light and move it away from the bottles (it will continue to generate heat even when turned off.) Continue to record temperatures every minute for another 10 minutes.

6. Plot your data on the graph. Connect the points for the two sets of data, and label one "clear" and the other "cloudy." (Or use two different colors and complete the key.)

Adapted from NASA Lesson Plan – "Investigating the Climate System: Clouds"
http://pmm.nasa.gov/sites/default/files/document_files/educational/Clouds_04.pdf

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Objective
Students will develop and test a hypothesis about how clouds affect the way a surface heats up and cools down.

Problem (written as a question that will be answered by completing the investigation)
How will temperature change in containers with different amounts of cloud cover?

Independent Variable (the factor that is intentionally changed in an investigation)
This investigation is designed to see if cloudiness, the independent variable, will have any impact on the heat absorbed from radiation.

Dependent Variable (the factor that changes as a result of the independent variable; it is what is measured to determine if the independent variable has the expected effect)
The dependent variable, temperature, is measured in degrees Celsius (˚C) and may change as a result of the different cloud conditions.

Hypothesis (should be written in If [independent variable], then [dependent variable] format and should answer the question posed as the problem)
If bottles with ________________________________ are heated by radiation from a light bulb,
independent variable
*then the _________________________ of the air in the clear bottle will **increase***
dependent variable
______________________ the temperature of the air in the cloudy bottle. After the radiation is
faster than/ slower than /at the same rate as
*turned off, the temperature of the air in the clear bottle will **decrease** ____________________*
faster than/ slower than /at the same rate as
the temperature of the air in the cloudy bottle.

Data

Light Bulb On (radiation simulating daylight hours)

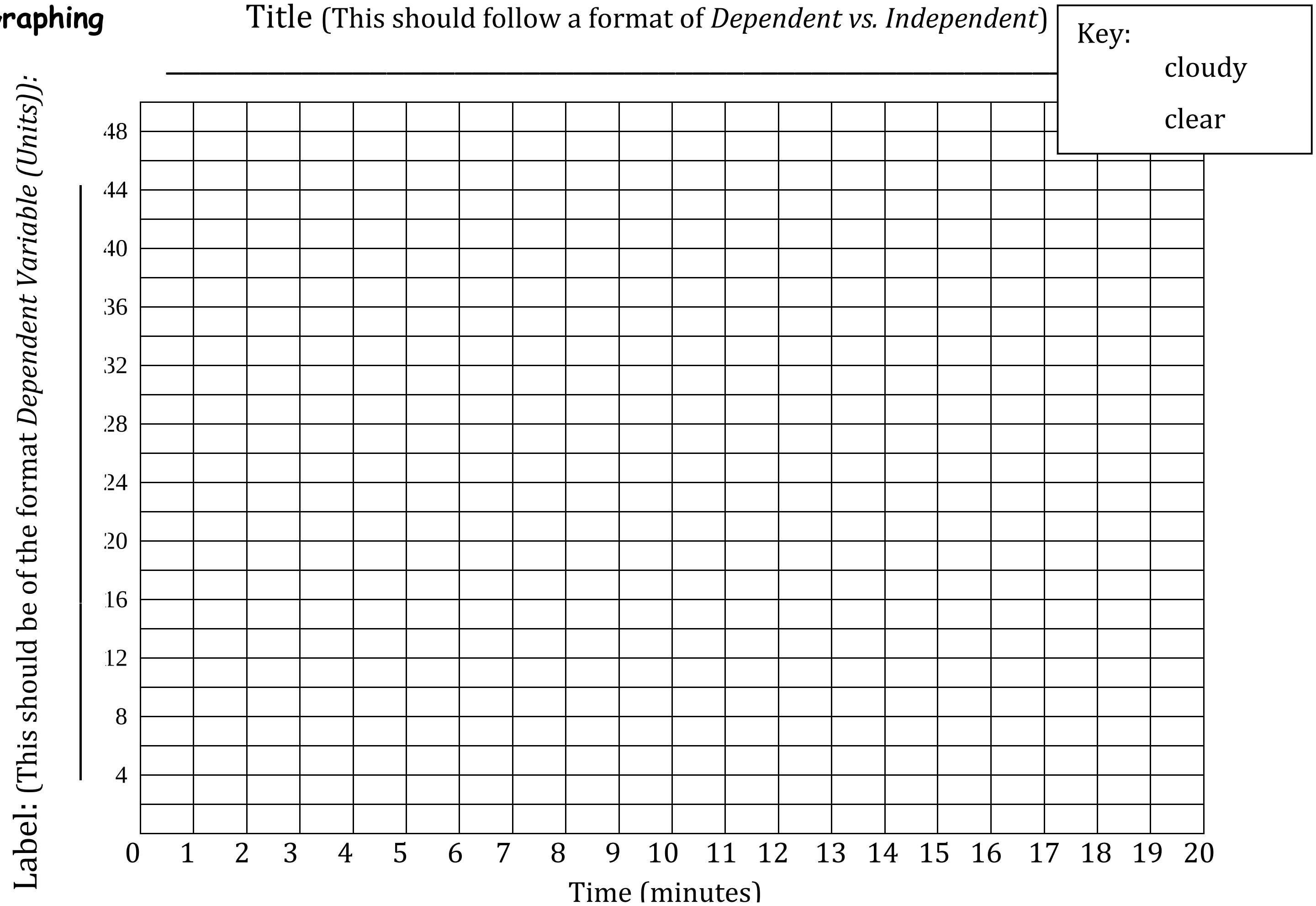
Time (Minute)	0	1	2	3	4	5	6	7	8	9	10
Clear (˚C)											
Cloudy (˚C)											

Light Bulb Off (radiation simulating nighttime hours)

Time (Minute)	11	12	13	14	15	16	17	18	19	20
Clear (˚C)										
Cloudy (˚C)										

Graphing

Title (This should follow a format of *Dependent vs. Independent*) ______________________________



Analyze and Conclude

1. Calculate the total change in temperature for each bottle.

Clear: heated by ____________ degrees in 10 minutes; cooled by ___________ degrees in 10 minutes

Cloudy: heated by ____________ degrees in 10 minutes; cooled by ___________ degrees in 10 minutes

2. Based on your data, which bottle heated up faster? _________________________

Which bottle cooled faster when the light was shut off? __________________________________

3. How do these results compare to your hypothesis?____

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4. Translate these results to the real world. How will a location's temperature be different if it is cloudy during the day? What about if it is cloudy at night? ____

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5. About half of Earth is covered with clouds at any one time. What would happen to worldwide temperatures if that percentage increased? What if it decreased?____

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