Name _____ Date _____

Examining the Enhanced

INSULATING YOU, INSULATING EARTH

Greenhouse Effect

SETTING UP THE EXPERIMENT

1. Please work with your instructor to assemble into teams of 4.
2. Each team member will choose a role from the list of team member roles below.

TEAM MEMBER ROLES
Test subject
Materials manager
Timer
Data recorder

3. **As quickly as possible**, the team member who is the test subject will use a binder clip to attach the thermometer to the clothing on their lap. Attach the binder clip approximately halfway down the length of the thigh, and ensure that as much of the thermometer as possible is contacting the leg (Fig. 1).
4. Complete the prediction and follow the procedures.

Figure 1. Example thermometer set up

PREDICTION

I predict that the temperature of the _____ trial will be **warmer**.

a. Towel
b. Towel + space blanket
c. Neither (they will be the same)

MATERIALS

- Thermometer
- Small binder clip
- Stopwatch
- Hand towel
- Rectangle of space blanket
- Calculator

PROCEDURES FOR TOWEL TRIAL

1. **Data recorder,** once the temperature reading of the test subject's lap has stabilized, record the temperature in the "Your Group" table. It can take several minutes for the temperature to stabilize. Enter the temperature under the "Towel Temp" column in the "Lap" row.
2. **Materials manager**, give the towel to the **test subject**. Test subject, lay the towel over the thermometer and across your lap so that its long side is perpendicular to your thighs, and tuck the ends of the towel under your legs if possible. **Timer**, press the start button on the stopwatch.
3. **Timer**, every time a minute passes on the stopwatch, call out the time to the data recorder. **Data recorder**, when the timer calls out the time, read the temperature on the thermometer and record it in the corresponding row of the "Towel Temp" column. Stop recording after 5 minutes. **Timer**, stop and reset the stopwatch.
4. **Test subject**, remove the towel from your lap and give it to the materials manager. **Leave the thermometer clipped to your lap.**
5. Everyone in the group will transfer these measurements onto their own data table. Using these data, calculate the difference in towel temperature.

PROCEDURES FOR TOWEL + SPACE BLANKET TRIAL

1. Wait until the thermometer reads approximately the same as the beginning lap temperature in the towel trial.
2. **Data recorder**, record the beginning lap temperature under the "Towel + Space Blanket Temp" column in the "Lap" row.
3. **Materials manager**, first give the towel and then the space blanket rectangle to the test subject. **Test subject**, lay the towel over the thermometer and across your lap, and then place the space blanket rectangle on top. Both should be oriented so that the long side is perpendicular to your thighs. Tuck both the towel and the space blanket under your legs together if possible. **Timer**, press the start button on the stopwatch.
4. **Timer**, every time a minute passes on the stopwatch call out the time to the data recorder. **Data recorder**, when the timer calls out the time, read the temperature on the thermometer, and record it in the corresponding row of the "Towel + Space Blanket Temp" column. Stop recording after 5 minutes. **Timer**, stop and reset the stopwatch.
5. Everyone in the group will transfer these measurements onto their own data table. Using these data, calculate the difference in towel + space blanket temperature.
6. Report the temperature differences in your towel trial and your towel + space blanket trial to the class. Record every group's differences, including your own, in the "whole class" table. Calculate the average differences. Answer the results and conclusions questions.

DATA & ANALYSIS

YOUR GROUP		
TIME	A. TOWEL TEMP	B. TOWEL + SPACE BLANKET TEMP
LAP	°F	°F
1 MINUTE	°F	°F
2 MINUTES	°F	°F
3 MINUTES	°F	°F
4 MINUTES	°F	°F
5 MINUTES	°F	°F

A. TOWEL DIFFERENCE

_____°F – _____°F = _____°F
5 min. Lap Difference

B. TOWEL + SPACE BLANKET DIFFERENCE

_____°F – _____°F = _____°F
5 min. Lap Difference

WHOLE CLASS		
GROUP	A. TOWEL DIFFERENCE	B. TOWEL + SPACE BLANKET DIFFERENCE
GROUP 1	°F	°F
GROUP 2	°F	°F
GROUP 3	°F	°F
GROUP 4	°F	°F
GROUP 5	°F	°F
GROUP 6	°F	°F
GROUP 7	°F	°F
GROUP 8	°F	°F
GROUP 9	°F	°F
MEAN		

RESULTS

1. In your group, which trial had the greater temperature difference? (Circle one.)
    a. Towel
    b. Towel + space blanket
    c. Same in both trials

2. In the whole class data, which trial had the greater mean difference? (Circle one.)
    a. Towel
    b. Towel + space blanket
    c. Same in both trials

CONCLUSIONS

1. Turn back to the first page and review your prediction. Was your prediction correct? Use the mean temperature differences from the "Whole Class" table to answer.

    Yes / No

2. Review your answer to the results question #2. Looking at the trial that you circled, why do you think that it had a greater difference in temperature, or if it was the same, why do you think that occurred?

EVALUATION

1. This experiment was a model of the greenhouse effect. Fill in the blanks below to indicate which component in this experiment was modeling the following components of the greenhouse effect. Read the excerpt below for help.

    Earth was modeled by the _____.
    Lap / Towel / Space Blanket

    The atmosphere was modeled by the_____.
    Lap / Towel / Space Blanket

    Additional carbon dioxide was modeled by the_____.
    Lap / Towel / Space Blanket

Think of yourself under a blanket in a cold room. You represent the earth, a warm body giving off energy, what we usually call "heat." The blanket represents the atmospheric layer of greenhouse gases.

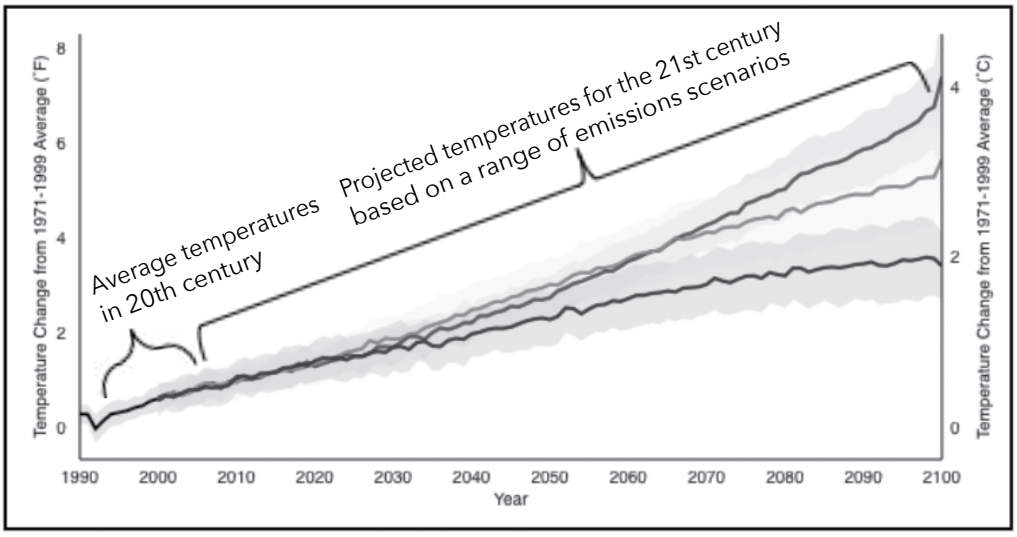
Among the earth's blanket of greenhouse gases, carbon dioxide is the one you probably hear about most often, because it is increasing in the atmosphere as we burn a great deal of coal, oil, and gas for energy.

In our blanket analogy, this is like putting on another blanket, so there are more layers of blanket fibers for the energy to pass through to reach the top.

Excerpted from: American Chemical Society – A Greenhouse Effect Analogy
http://www.acs.org/content/acs/en/climatescience/climatesciencenarratives/a-greenhouse-effect-analogy.html

Figure 2. Global Temperature Projections. The graph shows the average of a set of temperature simulations for the 20th century (single line), followed by projected temperatures for the 21st century based on a range of emissions scenarios (three lines). The shaded areas around each line indicate the statistical spread (one standard deviation) provided by individual model runs.

Source: *www.climate.gov/news-features/understanding-climate/climate-change-global-temperature-projections*



Use the Global Temperatures Projections graph (Fig. 2) to answer the following questions.

2. Examine the scenario with the **warmest** projected temperatures (top line). In the scenario with the **warmest** projected temperatures, by approximately how many degrees Fahrenheit is the average temperature projected to increase over the 21st century, from the year 2000 to the year 2100?

3. Examine the scenario with the **lowest** projected temperatures (bottom line). In the scenario with the **lowest** projected temperatures, by approximately how many degrees Fahrenheit is the average temperature projected to increase over the 21st century, from the year 2000 to the year 2100?

4. How will increasing temperatures affect Earth systems?