COOL SUITS

Student Section Student Name _____

This lesson will help you understand the relationship between energy reflection and absorption, and color.

During this lesson, you will

- collect data by measuring temperature in 2 different colored envelopes (black and white).
- use data to infer which color, black or white, reflects energy better and which color absorbs energy better.

Problem

Which color, black or white, reflects energy better? Which color absorbs energy better?

Observation

Living and working in space is challenging. Outside the spacecraft, astronauts depend upon their space suits to hold in air needed for breathing as well as pressure to keep them alive in the near vacuum of space.

Space suits also help keep astronauts at a comfortable temperature; neither too hot nor too cold. In the harsh environment of space, temperature can vary greatly from the extreme heat of the Sun (solar energy) to the extreme coldness of the darkness of space. For this reason, space suits are made from different colors and materials that reflect large amounts of energy. By avoiding the absorption of energy, the astronauts are kept comfortable for longer periods of time.

In this activity you will test 2 different colors (black and white) to see if color affects energy reflection and absorption.

Brainstorm: Discuss the colors and materials of the clothes you and your classmates are wearing and why those clothes were worn today.

Use the first column of this KWL chart to organize your observations about reflection and absorption. Brainstorm with your group what you want to know about reflection and absorption, then list in the second column of this KWL chart.

KNOW	WANT TO KNOW	LEARNED

Hypothesis

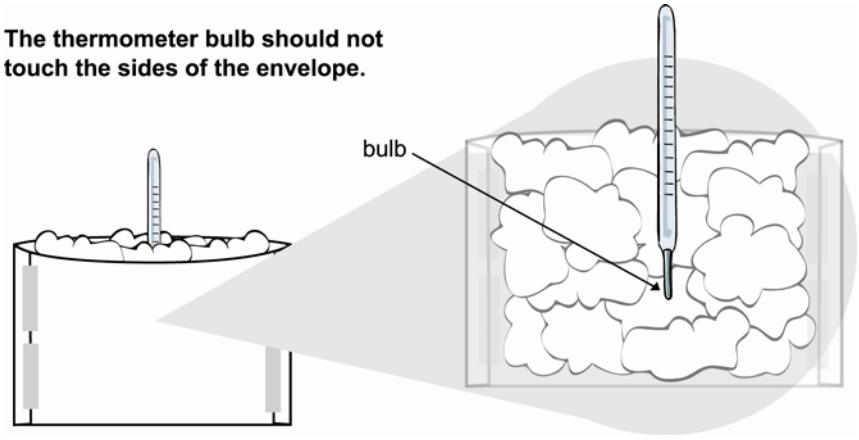
Based on your observations, answer the "problem question" with your best guess about what will happen. (Which color, black or white, reflects energy better? Which color absorbs energy better?) Your hypothesis should be written as a statement.

My hypothesis: _____

MATERIALS	SAFETY
Per group • 2 thermometers (calibrated in units of 1-2 degrees Celsius) • 2 envelopes: one made of black construction paper and one made of white construction paper • cotton balls or tissue paper • 1 small box (shoe box, lid not needed) • stopwatch, watch or clock	Review your classroom and lab safety rules. • Be careful while handling the thermometers

Test

1. Put both envelopes inside a small box to hold them upright while you are working with them.
2. Stuff cotton balls or tissue paper inside the envelopes and then carefully place a thermometer inside each envelope. The thermometers should be upright in the envelope and the bulb of the thermometer should touch the cotton or tissue, not the envelope. See the diagram below.



3. Let the thermometers rest in the envelope for about 1 minute to record the temperature of the new environment. Then check the temperature in degrees Celsius. **Record this data** at 0 minutes in the Cool Suits Data Sheet. Also, record the temperature from the control thermometer, which your teacher will have.
4. Take each envelope from the box and place them in the "test site" (windowsill or outside) where they will receive direct sunlight. Make sure that both envelopes receive the same amount of sunlight.

5. Predict how many degrees the temperature will change in each envelope over the 5-minute period. Record the predicted temperatures on the Cool Suits Data Sheet. Discuss your predictions with your group.
6. After 5 minutes, **collect and record data** by reading and recording the temperature of the thermometers on the Cool Suits Data Sheet. Discuss the data with your group.
7. Every 5 minutes for the next 30 minutes, repeat steps 5 and 6.

Study Data

After taking all measurements on the Cool Suits Data Sheet, study the data by answering the following questions.

1. What changes did you see in the temperature of the different envelopes? Which envelope had more change in temperature?

2. What conclusions can you make about color and how it reflects or absorbs energy?

3. Does this data support your hypothesis? Why or why not?

4. How do your results compare to class results?

5. Based on your findings, what would you suggest to NASA researchers designing new space suits?

6. How might you change this experiment to find out whether different materials affect energy absorption and reflection?

Conclusion

- Update the LEARNED column in your KWL chart.
- Restate your hypothesis and explain how the results do, or do not, support your hypothesis.

Cool Suits Data Sheet

Record Thermometer Readings (Celsius)													
	0min	Predict	**5min**	Predict	**10min**	Predict	**15min**	Predict	**20min**	Predict	**25min**	Predict	**30min**
Black Envelope													
White Envelope													
Control (check with teacher)													

Scientific Investigation Rubric

Activity: COOL SUITS

Student Name _____ Date _____

Performance Indicator	0	1	2	3	4
The student developed a clear and complete hypothesis.					
The student followed all lab safety rules and directions.					
The student followed the scientific method.					
The student recorded all data on the data sheet and drew a conclusion based on the data.					
The student asked engaging questions related to the study.					
The student described at least one recommendation for NASA in the area of space suit design.					
Point Total					

Point total from above: _____ / (24 possible)

Grade for this investigation _____

Grading Scale:

A = 22 - 24 points

B = 19 - 21 points

C = 16 - 18 points

D = 13 - 15 points

F = 0 - 12 points