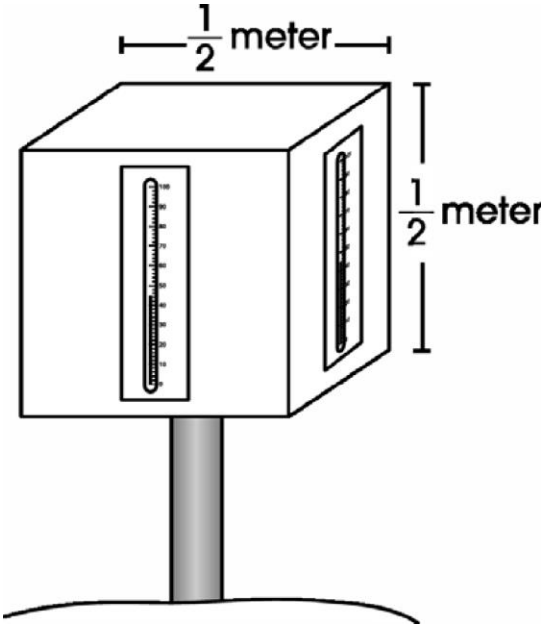
Solar Warming

A group of students in Ohio conducted an investigation during the month of January to study the effects of solar warming. The students used a wooden box painted white. The box was mounted on a post in an open area and a thermometer was fastened on each of the four sides. The box was oriented so that each thermometer faced squarely in a different direction: north, south, east or west. The temperature on each thermometer was recorded in degrees Fahrenheit at 12:00 noon during five consecutive days of clear skies.

The picture shows the apparatus used by the students.



The table shows the data collected by the students.

Effects of Solar Warming (Temperature in °F)

	North	South	East	West
Day 1	29	36	32	32
Day 2	29	36	32	31
Day 3	30	37	34	33
Day 4	27	34	32	30
Day 5	30	37	35	33

Item

24. When designing the investigation, one student suggested painting the wooden box black. Predict how painting the box black would affect the temperature readings from the four thermometers. Explain your reasoning.

Respond in the space provided in your **Answer Document**. (2 points)

Sample Response for Item 24 (Short Answer):

Exemplar Response:

Prediction: (1 pt.)

- Painting the box black would increase the temperature readings on the thermometers.

Explanations include, for example: (1 pt.)

- More light will be absorbed (thus more thermal energy transfer) by the black color, increasing the temperature inside the box.
- Other acceptable responses.

Scoring Guidelines for Item 24

Score Point	Description
2 points	The student response demonstrates a complete understanding of the task by predicting an increase in the temperature readings and explaining in terms of light absorption (thus more thermal energy transfer).
1 point	The student response demonstrates a partial understanding of the task by predicting an increase in the temperature readings. OR The student explains that black color absorbs more light (thus more thermal energy transfer) but fails to indicate how this would affect the temperature readings.
0 points	The student response demonstrates no understanding of the task. The response may provide incorrect information or be irrelevant to the task. The student may only repeat information from the passage or prompt without any supporting information responsive to the task. The student may have written “I don’t know.”

Painting the box black, will bring more heat to it. Causing it to be more noticed and more responsive to the sun.

Score Point: 0

The response does not meet the criteria to score one point. The response does not provide a correct prediction that temperature will increase. The explanation of "will bring more heat" does not adequately explain that black absorbs sunlight, which is converted into heat.

This would affect the readings because darker colors attract sunlight more than lighter colors.

Score Point: 0

The response does not meet the criteria to score one point. The prediction that "This would affect the readings" is too vague to receive credit. It does not indicate that the effect is an increase in temperature. The response does not receive credit for an explanation because it does not explain that sunlight is converted into heat.

The temperature would increase because black attracks heat and will cause the temerature to go up.

Score Point: 1

The response correctly predicts an increase in temperature readings. (Prediction: "The temperature would increase"). The response does not receive credit for an explanation because the black does not attract heat. Sunlight falling on the black is absorbed and then converted into heat.

By painting the box black, that would cause the temperatures to increase. It would cause that because sunlight is attracted to dark colors, expecially black.

Score Point: 1

The response correctly predicts an increase in temperature readings. (Prediction: “that would cause the temperatures to increase”). The response does not receive credit for an explanation because it does not correctly explain that after the sunlight is absorbed, it must then be converted into heat in order for the temperature to increase.

It would send the tempetus sky high Buecuse Black Attracts heat.

Score Point: 1

The response correctly predicts an increase in temperature readings. (Prediction: “It would send the tempeture sky high”). The response does not receive credit for an explanation because it does not correctly explain that sunlight falling on the black is absorbed and then converted into heat. Black does not attract heat.

If the students painted the box black all temperatures would be higher. That would happen because black attracts heat.

Score Point: 1

The response correctly predicts an increase in temperature readings. (Prediction: “all temperatures would be higher”). The response does not receive credit for an explanation because it does not correctly explain that sunlight falling on the black is absorbed and then converted into heat. Black does not attract heat.

If they painted the box black it would absorb more sunlight. This would happen because Black has no color or light in it and the sun beam color and light down so the black would absorb alot more light and sunlight than white.

Score Point: 1

The response explains that black color absorbs more light, (thus more thermal energy transfer), but fails to indicate how this would affect the temperature. (Explanation: “black would absorb alot more light and sunlight than white”).

Painting the box black would have a big effect. All the tempertures would go up in degree. This would happen because the color white reflects sun rays and the color black absorbs sun rays. So the color black would be hotter. So the box would hold more heat In the box and also In the walls, So that would cause the temperatures to rise.

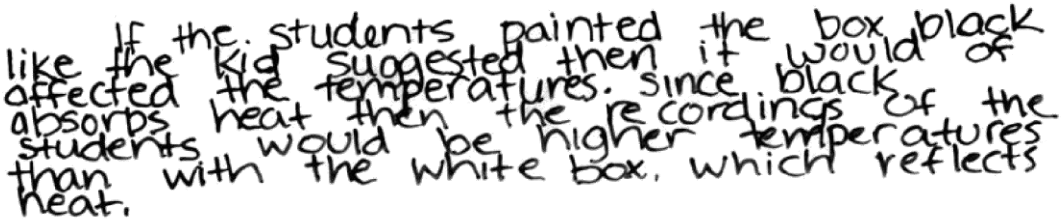
Score Point: 2

The response predicts an increase in temperature readings and explains it in terms of light absorption (thus more thermal energy transfer). (Prediction: “All the tempertures would go up in degree.” Explanation: “because ... the color black absorbs sun rays.”)

Painting the wooden box black would greatly affect the temperature readings. The box would be hotter than normal and give the students false readings. Since black absorbs heat the temperature readings would be higher.

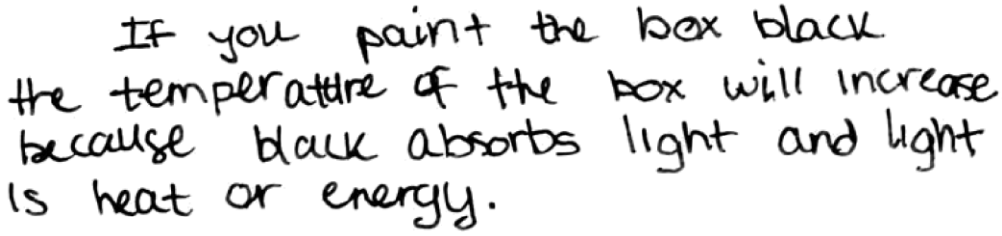
Score Point: 2

The response predicts an increase in temperature readings and explains it in terms of light absorption (thus more thermal energy transfer). (Prediction: “the temperature readings would be higher.” Explanation: “Since black absorbs heat”)



Score Point: 2

The response predicts an increase in temperature readings and explains it in terms of light absorption (thus more thermal energy transfer). (Prediction: “recordings of the students would be higher temperatures than with the white box” Explanation: “since black absorbs heat”)



Score Point: 2

The response predicts an increase in temperature readings and explains it in terms of light absorption (thus more thermal energy transfer). (Prediction: “temperature of the box will increase” Explanation: “because black absorbs light and light is heat or energy.”)