



Solar Houses

Type of Lesson:	<u>Content with Process:</u> Focuses on constructing knowledge through active learning.	
IPC Content TEKS:	6B	Investigate and demonstrate the movement of heat through gases by radiation.
Learning Goal/ Instructional Objective:	<p>Students build a model house to explore the effect of the direction the window face on the temperature inside the house.</p> <p>Given a solar model home, students evaluate the relationship between the directions a window faces to the temperature inside the house.</p>	
Key Question:	What is the relationship between the direction a window faces to the temperature inside the house?	
Related Process TEKS:	<p>(1) Scientific processes. The student, for at least 40% of instructional time, conducts field and laboratory investigations using safe, environmentally appropriate, and ethical practices</p>	<p>The student is expected to:</p> <p>(A) demonstrate safe practices during field and laboratory investigations; and</p> <p>(B) make wise choices in the use and conservation of resources and the disposal or recycling of materials.</p>
	<p>(2) Scientific processes. The student uses scientific methods during field and laboratory investigations.</p>	<p>The student is expected to:</p> <p>(A) plan and implement experimental procedures including asking questions, formulating testable hypotheses, and selecting equipment and technology;</p> <p>(B) collect data and make measurements with precision;</p> <p>(C) organize, analyze, evaluate, make inferences, and predict trends from data; and</p> <p>(D) communicate valid conclusions.</p>
	<p>(3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions.</p>	<p>The student is expected to:</p> <p>(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information;</p>
To the Teacher:	<p>During this activity, students investigate how radiation warms the air causing the temperature to rise inside their model house. The students can alter the investigation if they want to try something different. Some may wish to have colored houses to see if there is a change in the results, some may wish to have a large pool or lake nearby, some may wish to place window tinting to see if it helps reduce the temperature, and so on.</p>	

Multiple Intelligences:	<i>Logical-Mathematical Intelligence—</i>	Consists of the ability to detect patterns, reason deductively and think logically. This intelligence is most often associated with scientific and mathematical thinking.
	<i>Linguistic Intelligence—</i>	Involves having a mastery of language. This intelligence includes the ability to effectively manipulate language to express oneself rhetorically or poetically. It also allows one to use language as a means to remember information.
	<i>Spatial Intelligence—</i>	Gives one the ability to manipulate and create mental images in order to solve problems. This intelligence is not limited to visual domains--Gardner notes that spatial intelligence is also formed in blind children.
	<i>Bodily-Kinesthetic Intelligence—</i>	Is the ability to use one's mental abilities to coordinate one's own bodily movements. This intelligence challenges the popular belief that mental and physical activities are unrelated.

Materials:

- House template copied on white card stock (one per group)
- Tape to "build" the house
- Clear plastic wrap/Saran wrap for the window
- Thermometer
- Stopwatch
- Cardboard/support to hold house and keep off the ground
- Graph paper
- Compass to find the direction (optional)



SAFETY NOTE: Remind students to be careful with the thermometer to ensure they are not broken during the transfer outside. See also Texas Science Safety Manual for lab and investigation guidelines:

http://www.tenet.edu/teks/science/safety/safety_manual.html

Engagement:

Engage the students in a conversation about a new subdivision/house being built in the neighborhood and you notice one house that is sitting crooked in the lot and you are curious as to why it is located there.

Facilitation Questions:

1. Why would a builder make the house crooked in the lot?
2. Why does the direction a house faces effect it's heating and cooling costs?

Explore:

1. Cut out the house and "build" the house using tape. Place a piece of plastic wrap on the inside of the window before closing the house. Place the house on top of the piece of cardboard as support and insulation from the ground.
2. Create a data table in the journal to record the results of the experiment. Place the house in the sun for 15 minutes and record the temperature every minute.
3. When the class goes outside to conduct the experiment, the houses will need to be placed at different directions (North, South, East, West, and any direction in between). Be sure to observe the location of the sun and the time of day as the investigation is conducted. Also note the season/month, weather conditions – sunny, partly cloudy, cloudy, or other notes.
4. As soon as the class is outside and have houses set up, take the initial temperature inside the house. Start the stopwatch and record the temperature inside the house every minute for 15 minutes.



Graph the results and place in the journal.

Time of day: _____

Direction house pointed:

Weather conditions:

Time (minutes)	Temperature (°C)
0 (initial)	
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	

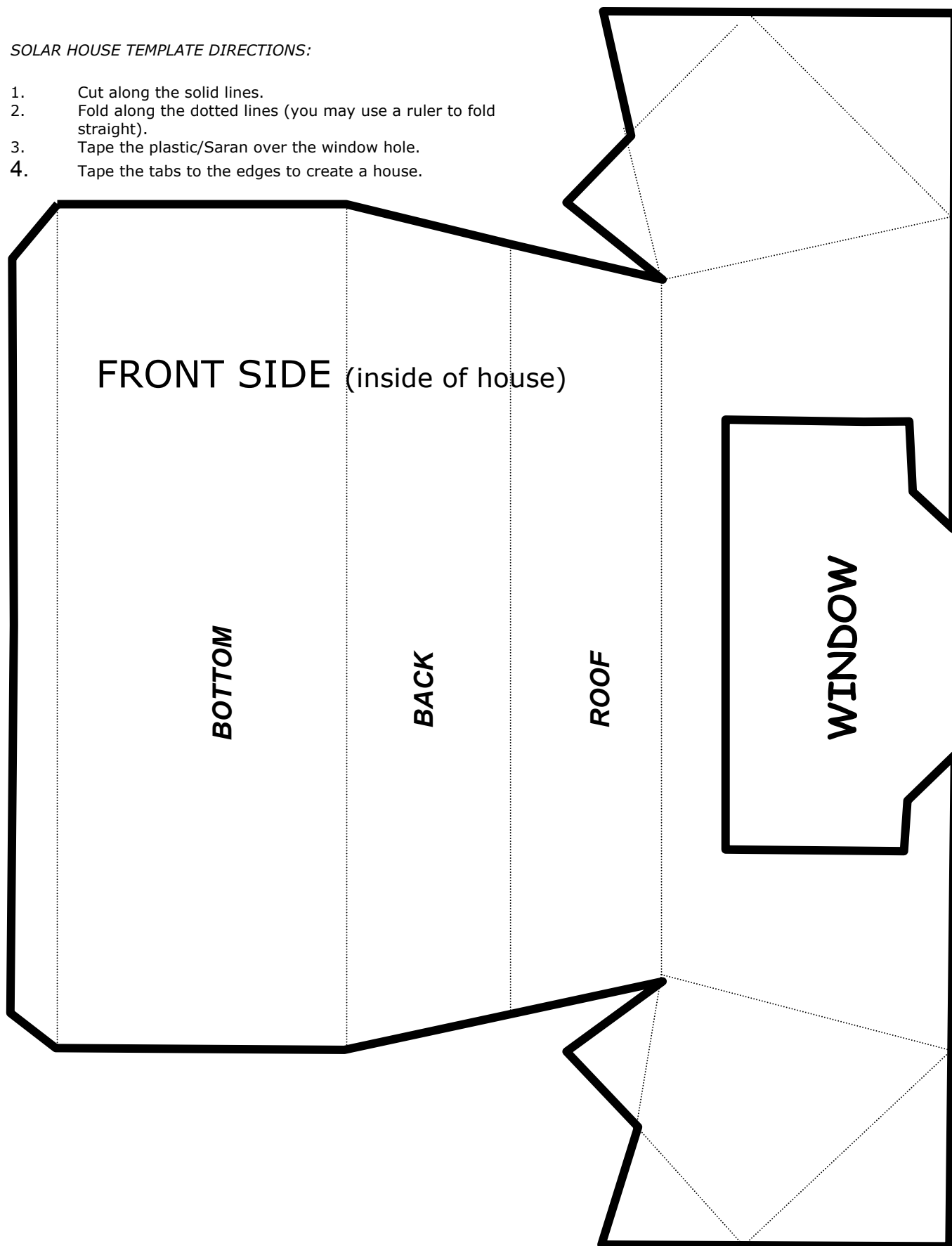
Explain:

1. What observations did you make about the temperature inside the house? *The temperature increased as time increased.*
2. Calculate the temperature change that took place in your house. *Answers will vary with data.*
3. Why did your temperatures increase or decrease? *The air inside the house was trapped and as the sun warmed the air, it could not escape so the temperature increased.*
4. Looking at your graph, are there any trends in the data? If so, describe the trend. *Yes, there was a trend where the temperature increased as the time increased.*
5. If you stayed outside for 30 minutes collecting data, predict what the data might look like. *The temperature would continue to increase, but might start to level off and not increase as quickly.*
6. Compare your results to those of other class periods throughout the day. How did your temperature change compare to your classmates in other groups? *Answers will vary with class times.*
7. How did your results compare to the temperature changes of other class periods throughout the day? *Answers will vary with class times.*
8. If you were designing a house, where would you place the largest windows in the house to maximize the light but minimize the temperature increase? *I would place the window facing the east and a bit north.*



SOLAR HOUSE TEMPLATE DIRECTIONS:

1. Cut along the solid lines.
2. Fold along the dotted lines (you may use a ruler to fold straight).
3. Tape the plastic/Saran over the window hole.
4. Tape the tabs to the edges to create a house.



Elaborate:

The students can alter the investigation if they want to try something different. Some may wish to have colored houses to see if there is a change in the results, some may wish to have a large pool or lake nearby, some may wish to place window tinting to see if it helps reduce the temperature, and so on.

Using the Internet, have students research solar houses and the benefits. With the decreasing amounts of fossil fuels, are solar houses an economical investment for people building a house?

Evaluate:

POINTS	Scientific Accuracy	Reasoning	Communication	Collaboration
4	I can accurately explain the relationship between the direction a window faces to the temperature inside the house. I can accurately explain the movement of heat through radiation.	I analyzed data accurately and answered the all the analysis questions accurately.	I communicated answers to the investigation questions completely and thoroughly using correct grammar. I shared my ideas about the investigation in the whole group discussion and with my team mates.	I worked extremely well with my group. Each person had a lot of input and participated in the investigation.
3	I can explain the relationship between the direction a window faces to the temperature inside the house. I can explain the movement of heat through radiation.	I analyzed data almost accurately and answered the all the analysis questions almost accurately.	I communicated answers to the investigation questions using correct grammar. I shared some of my ideas about the investigation in the whole group discussion and with my team mates.	I worked well with my group. Each person had input and participated in the investigation.
2	I can somewhat explain the relationship between the direction a window faces to the temperature inside the house. I can somewhat explain the movement of heat through radiation.	I analyzed the data with some errors and answered the analysis questions with some errors.	I communicated answers to the investigation questions and with grammatical errors. I shared a few of my ideas about the investigation in the whole group discussion and with my team mates.	I worked somewhat well with my group. Each person had some input and participated in the investigation.
1	I can not explain the relationship between the direction a window faces to the temperature inside the house. I cannot explain the movement of heat through radiation.	I analyzed the data with many errors and answered the analysis questions with many errors.	I communicated answers to the investigation questions and with many grammatical errors. I did not share my ideas about the investigation in the whole group discussion and with my team mates.	I did not work well with my group. A few people had input and participated in the investigation.
	Subtotal: _____	Subtotal: _____	Subtotal: _____	Subtotal: _____

References/Resources/Websites:

- ❖ <http://www.ic-solarhomes.com/>
- ❖ <http://dSPACE.dial.pipex.com/town/terrace/ae198/SolarHouse.html>
- ❖ <http://www.eere.energy.gov/kids/solar.html>

