JSD 3D Learning Activity Template

Grade: 6th	**Title:** Save the Chocolate Bar

Utah Science with Engineering Education Standard (SEEd): 6.2.4 Design an object, tool, or process that minimizes or maximizes heat energy transfer. Identify criteria and constraints, develop a prototype for iterative testing, analyze data from testing, and propose modification for optimizing the design solution. Emphasize demonstrating how the structure of differing materials allows them to function as either conductors or insulators.

Key crosscutting concept(s) (CCC): Energy and Matter; Cause and Effect
Key science and engineering practice(s) (SEP): Designing Solutions; Analyzing and Interpreting Data; Communicating Information

Materials:
Teacher materials: small chocolate candy bars, heat lamps, thermometers,
Student materials: thin cardboard, packaging foam, construction paper, cotton balls, brown wrapping paper, old towels, cloth products, small containers made of different materials

Time: 3 1-hour periods

Teacher background, key content information and hints:
This lesson focuses on how to slow down heat transfer to slow down the heat to melt the chocolate. As radiation heat is transferring through any type of material, it slowly heats up the material it is passing through until it reaches the center. Because the heat source is a heat lamp, the heat will continue to go through the material is it heating.

Prior knowledge that students need: Transfer of heat radiation. Any type of insulation can slow down heat radiation because the particles are far apart and not able to transfer the heat very well, slowing it down.

Learning Activity Plan

These three aspects of a lesson should be identified in your learning activity.

Gathering: Students are to carry out an investigation to see if they can engineer a prototype of slowing down heat that will keep a small chocolate bar from melting. With a thermometer in the center of the prototype, the students will take a reading of the thermometer every 3 minutes for a half hour. At the end of the half hour, the students will take apart their boxes to see at what stage their chocolate bar melted.	***Reasoning:*** Students will evaluate the data to see how long it took for the thermometer to reach 90 degrees F. Each group will graph their data and analyze by looking at the slope of the graph if the heating was fast, slow, or in between. All of the groups will compare their graphs with each other to see which graphs show fast melting or slow melting or in between melting. The groups will group them as such. The students will then compare the contents of their prototypes with the different groups to see the	***Communicating:*** The students will communicate their findings and argue as to which types of materials are the best for chocolate not to melt quickly in heat. They will also use models by drawing and labeling pictures of what the best way to place the materials in their prototypes to slow down the radiation heat transfer.

	differences of materials used that separated the fast, slow and in between melting of the chocolate. The students can also see how the materials were arranged in the prototype to slow down the heat.	

Phenomenon: Of all the candy that is left in the car, on a warm day, chocolate seems to be the one that melts at a lower temperature than other candy. Can a prototype be made of natural materials found around the house to put chocolate in for it not to melt in the car?

Learning Activity: The students will devise a prototype of materials found around the house where a small chocolate bar can be placed in so that it won't melt in quickly in a car in the summer.

1. The students will be put in teams of 3 or 4 and devise a plan of materials that could be used to a certain arrangement to slow down the melting of chocolate in a warm car.
2. The students will draw diagrams of a box with materials in it that they think will slow down the process of heat radiation reaching a chocolate candy bar to keep it from melting. They will then choose one diagram they think that is the best.
3. The constraints are that the box cannot be larger than a 6-inch x 6-inch x 6-inch box; it can't be heavier that 5 pound; the materials would be items that are found around the house for the insulation and not things that can be bought in a store that are specifically made for heat insulation.
4. The criterion is to not have heat radiation reach the chocolate candy bar for a half hour under a heat lamp.
5. The group will be given the box by the teacher. The students will begin to pack the box with the material they have stated in the drawing in the order they have suggested. The candy bar will be placed in the center of the box with the packaging around it. A thermometer with a point on it will be put through the wall of the box so that it will reach the center where the candy bar is.
6. The students will take the temperature of the inside of the box where the candy bar is every two minutes for a half hour and record it on a data sheet.
7. When the half hour is up, the students will take the candy bar out to see if it is melted and how much it is melted. They will put them side by side in the order of melting to compare them with their classmates' candy.
8. Students will graph the results of the melting and put the graphs in front of each of the melted chocolate bar for comparison.
9. Students will compare the results and come up with which materials are the best to use and the order that they feel is best to put the materials in the box. They will argue their decisions with their results.
10. Student will make a second design with the knowledge they have.
11. Students will do the test again for a half hour.
12. Students will compare the results of their first prototype with their second prototype.
13. Students will make a second graph on top their first graph.
14. Students will do a write up of the differences in the results of the two prototypes.

Materials:
Teacher materials: small chocolate candy bars, heat lamps, thermometers
Student materials: thin cardboard, packaging foam, construction paper, cotton balls, brown wrapping paper, old towels, cloth products, plastic bottles, and other readily materials

Assessment of student learning

Short description of the evidence the teacher is willing to accept that a student is proficient with the performance expectations.
This may be a rubric, narrative, or other set of descriptors that are useful for distinguishing proficient from non-proficient performances.

Student Sheet

Title: Save the Chocolate Bar

Introduction: Of all the candy that is left in the car, on a warm day, chocolate seems to be the one that melts at a lower temperature than other candy. Can a prototype be made of natural materials found around the house to put chocolate in for it not to melt in the car?

Materials:
Teacher materials: 6" x 6" x 6" boxes, small chocolate candy bars, heat lamps, thermometers
Student materials: thin cardboard, packaging foam, construction paper, cotton balls, brown wrapping paper, old towels, cloth products, plastic bottles, and other readily materials

Procedures: (what do students do?)

1. The students will draw diagrams of a box with materials it that they think will slow down the process of heat radiation reaching a chocolate candy bar to keep it from melting.
2. They will then choose one diagram they think that is the best.
3. The constraints are that the box cannot be larger than a 6-inch x 6-inch x 6-inch box; it can't be heavier that 5 pound; the materials would be items that are found around the house for the insulation and not things that can be bought in a store that are specifically made for heat insulation.
4. The criterion is not to have heat radiation reach the chocolate candy bar for a half hour under a heat lamp.
5. The students will begin to pack the box give by their teacher with the material they have stated in the drawing in the order they have suggested. The candy bar will be placed in the center of the box with the packaging around it. A thermometer with a point on it will be put through the wall of the box so that it will reach the center where the candy bar is.
6. The students will take the temperature of the inside of the box where the candy bar is every two minutes for a half hour and record it on a data sheet.
7. When the half hour is up, the students will take the candy bar out to see if it is melted and how much it is melted. They will put them side by side in the order of melting to compare them with their classmates candy.
8. Students will graph the results of the melting and put the graphs in front of each of the melted chocolate bar for comparison.
9. Students will compare the results of all the prototypes and come up with which materials are the best to use and the order that is best to put the materials in the box.
10. Student will draw a second diagram and label the insulation parts they will use and the order they will put the insulation in.

11. Students will make their second box with the insulation parts.
12. Students will redo their experiment to see if it works better than the last.
13. Students will graph their results on the graph they made for the first prototype.
14. Students will present as a team the results they had with both prototypes and argue which is best to use.

Reflections—Complete the Questions Below

1. Describe what worked and didn't work in your first prototype.

2. How did your team's temperature variance compare with the rest of the class?

3. How was your graph helpful in making your second prototype?

4. How well did the second prototype work in comparison with the first prototype?

5. Which materials did you see that worked best?

6. Which material did you see that didn't work very well?

7. How did you use other's designs when designing your second prototype?

8. If you were to build another prototype, what changes would you make?