STAYING COOL DESIGN CHALLENGE:

WHAT WILL KEEP MY LUNCHBOX COOL?

LESSON OVERVIEW

LESSON SUMMARY

Students often have creative ideas for solving common problems. Their solutions are often limited to ideas rather than reality and a product. The goal of this activity is to develop the young learner from a creative thinker to a problem solver. In this activity, students will take an everyday problem and design a practical solution. Youngsters will consider how to keep a lunch box cool during a trip to the beach.

GRADE LEVEL
Pre-K - 1

DURATION
Three 30 minute periods

ESSENTIAL QUESTION

How does the amount of sunlight and heat change in areas that are shaded?

OBJECTIVES

Students will be able to:

- Design a solution or product.
- Implement a proposed design.
- Plan and conduct a simple investigation.
- Use data to construct a reasonable explanation.
- Communicate investigations and explanations.

Concepts

- The Sun produces heat.
- Shading an object from the sun can keep it cooler.
- There are many devices that have been invented for shading buildings, people, cars and objects.

Standards & Benchmarks

National Science Education Standards

Standard E2, E3 Understanding About Science and Technology

- People have always had problems and invented tools and techniques (ways of doing something) to solve problems. Scientists and engineers often work in teams with different individuals doing different things that contribute to the results

Standard D5

- The sun provides the light and heat necessary to maintain the temperature of the earth

Benchmarks for Scientific Literacy (AAAS Project 2061)

8B Materials and Manufacturing

Several steps are usually involved in making things.

Tools are used to help make things, and some things cannot be made without tools. Each kind of tool has a specific purpose.

1B Scientific Inquiry

Tools like thermometers often give more information about things than can be obtained by just observing things without their help.

4E Energy Transformation

The sun warms the land, air and water

1C The Scientific Enterprise

Everybody can do science and invent things and ideas

Science Overview

On a hot summer's day the dark outline of a shady area formed by a building, tree or object is more noticed than the object itself. The cool comfort of these shaded areas can teach us something. The sun produces light and heat. When blocked, the bright hot rays of sunlight no longer fall directly on the object. As a result, the object (as well as the air and ground around it) stays cooler in the shade. In a forest, trees form large patches of shaded ground that are home to many different plants and animals that like to stay out of the direct sunlight.

For thousands of years, people have invented ways to shade themselves from the sun. The umbrella was invented thousands of years ago. The earliest umbrellas were made to shade the user from the hot rays of the sun (an umbrella used as a sun shade is called a parasol). Umbrellas were used as much a 4,000 years ago in ancient Assyria, China, Egypt, and Greece. Some spacecraft need umbrella like devices to be protected from the sun's heat in space.

Lesson Plan: Design Challenge: What Will Keep My Lunchbox Cool?

Preparation

The three different activities should be performed in sequence and preferably within the same week or over two weeks. Collect images that depict different ways for shading people, buildings and cars. Some examples might include: awnings, umbrellas, hats, trees, tinted windows, screens, pavilions, car shades, sunglasses images. Magazines and newspapers (advertising sections) should be ready sources. You might set this as a homework assignment for the students.

If you have parent or other volunteers, enlist their help for day three when the students are constructing their designs.

Materials

Day 1:

- 4-5 empty lunch boxes of the same material and color if possible
- 3 lunchboxes of different types/different colors
- Unbreakable thermometers with easy to read scales

Day 2:

- Images that depict different ways for shading people, buildings and cars. Some examples might include: Awnings, umbrellas, hats, trees, tinted windows, screens, pavilions, car shades, sunglasses

Warm-up & Pre-assessment

Begin this lesson by having students focus on the warming effects of sunlight by asking them to cite examples from their own experiences. Students might mention touching a car on a sunny day, sitting on a chair in the sun or walking across hot sand. Reinforce the concepts of earlier experiences. Review or introduce the idea that when sunlight hits a surface, the surface gets warm and so does the air around it. Bring them to the understanding that the light of the sun warms the surface of the Earth.

Procedures

Day 1. Lunch on the Playground

Take the students to the schoolyard or playground on a sunny warm day. Make sure that the area you select has shaded as well as sunny areas. The students are shown a collection of different lunchboxes. Ask the students some questions:

- Why do some students need a lunchbox?
- How does a lunchbox protect the food inside?
- What materials are lunchboxes made of?

After exploring the lunchboxes, set the context for thinking about this activity by asking the students to consider the following: Where would you put your lunchbox in this area if you wanted to keep it from getting hot before lunchtime? Remember to remind the youngsters that they can't take the lunchbox inside the building.

Allow youngsters to answer the question. Some possible thoughts might be:

- Under a tree in the shade.
- Over in the grass.
- On the bus.
- Next to the building in the dark.

Examine the youngster's thinking. Go to each location. Discuss the student's ideas. When appropriate, link common elements of the student's thinking. For instance, each area is shaded in some way or I noticed that no one chose the middle of the playground.

You will now want to test some of the students' ideas. Ask the children:

- How is it possible to measure how hot each lunchbox would get in each location?

The students may come up with the idea to use a thermometer. If not, introduce the instrument to the youngsters. You will need to help the students read the temperature. Measure and record the temperatures in each location. Discuss what type of area would be the best for placing the lunchbox. The group may discover that more than one factor helps keep the lunchbox cool- "Put the lunchbox on grass underneath the tree in the shade."

Once measurements have been made, ask the students-:

- Which location was the best at keeping a lunchbox cool?
- Point out that you would want the location with the lowest temperature (lowest number on the thermometer).

Procedures

Day 2. Ways to Shade

In this activity, different ways of shading will be explored.

Using the collected images ask the following types of questions:

- What is being used to shade?
- How does the object produce shade?
- Why do you think the shade is needed?

> **Teaching Tip**
>
> If the images were collected as part of a homework assignment, you might paste the various pictures to poster board to display in the classroom. Images could be arranged according to function for example: shade for buildings, shade for people, shade for vehicles and machines.

Day 3. Design Challenge

Now the group is ready to be transitioned to the design challenge. Tell the students that they are going to pretend that they are going on a trip to the beach. At this beach, like many, there are no trees, only sand and water and whatever the students might bring (but we forgot to pack the cooler!).

Ask the students to use the materials provided to create solution to the problem:
How would you keep your lunchbox cool at the beach if you forgot to pack the cooler?

Design constraints and requirements

- Use at least two of the materials provided
- The product must keep the lunch box at least 20 degrees cooler than the temperature of the lunchbox when in full sun
- The design should be free-standing (i.e students should be able to walk away from their product without it collapsing)
- The design must not extend over an area of 50cm x 50cm (it would be useful to cut out a few squares of cardboard of these dimensions so that students can use it as a reference as they make their design)

As the students are constructing their solution, ask students to dictate a description of their idea for later discussion. Record the students' ideas.
Photograph the finished products.
Some students will need assistance, especially if they have chosen to work alone.

Discussion & Reflection

Assemble the class. Ask each student to describe their solution to the problem and the reasons for the various features of the design. Ask them questions such as:

What materials did you choose to use and why?

How did you change your design as you went along and why did you make changes?

Can you think of ways to make your design even better?

Teaching Tips

It is useful to follow the recommendations of the National Technology Standards when implementing design challenges. Design challenges should:

- possess a well defined product with explicit constraints on dimensions, weight, etc;
- provide a context for completing the product that is appropriate and familiar to students;
- develop one or two basic scientific concepts;
- involve materials and methods for construction that can be readily accomplished by students without lengthy learning of new skills; and incorporate well tested teaching strategies that promote exploration and experimentation.

This activity is part of a unit that develops ideas and concepts related to solar radiation. Each lesson in the unit thematically develops a new and important aspect of content, and skills. Therefore, this unit is not just a collection of random activities. The sequence of activities is intentional and designed to develop a youngster's conceptual understanding of the Sun's heat.

This design activity begins with a problem selected to get the students wondering by establishing a willingness to become involved in a process. The problem connects their present understanding and experiences with larger scientific ideas.

The scientific ideas that are at the root of the problem are explored in an active manner by establishing a common experience through which the youngsters can offer their solutions to the problem. Allow diverse ideas and solutions to develop. Help students test gather the materials to test their ideas. It is important that you help each group gather and record the information from each test.

Lesson Adaptations

Students at this age need to develop different skills for explaining their thoughts and concepts in words. Some students will be very capable of explaining their thoughts in words. We may want to provide some alternatives for less verbal youngsters. Some of these students may express their ideas best through drawings with dictated captions. Once the drawing is on the paper, the student can talk about the drawing and then may be able to dictate a description. As students share with each other about their drawings, they may discover new words and ideas to explain and refine their ideas.

Some children at this age are not developmentally ready for cooperative group work. Allowing individual, class, or group solutions to this problem will depend on the age and make-up of the particular class of youngsters.

Curriculum Connections

- *Math / Measurement:* Reading thermometers
- *Reading* Read the book, A Tree is Nice as the beginning to a discussion about the shade formed by trees.
- *More Science:* Shading is a common way to cool homes, cars, and people. Begin observing how buildings keep cool with awnings, and tinted windows. Ask the students to think about ways that we shade our homes and cars to keep them cool.
- *Social Studies:* As a class project, investigate the ways that different cultures at different times in history have dealt with the problem of too much heat from sunlight (housing, clothing and apparel, food storage etc) that we shade our homes and cars to keep them cool.

Assessment

The design challenge is an embedded assessment. Consider the following as you evaluate the designs:

Did the student make creative use of the materials?

Does the design solve the design challenge?

What was the care taken for the appearance?

How did the student overcome construction problems?