



Holding The Load

Learning Intention:

Students will learn about the stability of a structure and its ability to support a load.

Success Criteria:

- identify the shape of a structure that makes it most stable
- describe ways to alter a structure in order to improve its strength
- gather and record information using drawings and written descriptions
- make conclusions about the shapes and materials used to make structures
- make connections to people and places in the environment

Materials Needed:

- 2 cardboard squares 8 in. x 8 in. (20 cm x 20 cm), 4 pieces of cardstock paper 8 ½ in x 11 in. (22 cm x 29 cm), tape, 12 paperback books (a set for each student)
- a copy of "Holding the Load" worksheet 1 and 2 for each student
- clipboards (one for each student)
- a copy of "Strengthening Structures" worksheet 3 and 4 for each student
- a copy of "Tying in the Tension" worksheet 5
- a copy of "Strutting Out the Compression" worksheet 6
- pencils, pencil crayons, markers

Procedure:

1. Discuss with students that structures are different shapes. Some shapes are stronger than others and can hold more load. Students will conduct an experiment to investigate which shape is the strongest and most stable. Give them worksheet 1 and 2, and the materials to conduct the experiment. Read through the materials needed and what to do sections with them. Students will make a prediction, conduct the experiment, make observations, and record a conclusion and make a connection.
2. From the experiment, students should have concluded that the triangular shaped structure was the strongest and most stable. Triangle shapes are used to build many structures. On worksheet 3, students will find the triangular shapes in the pictures, and search for triangular shapes in structures throughout their classroom or school.
3. Discuss with students that structures can be strengthened to support a load. This can be done by bundling or adding more layers to a structure, by using triangulation or cross membering, by twisting or braiding, or bracing. On worksheet 4, students will identify ways the structures in the pictures have been strengthened. They will find and draw pictures of structures that have been strengthened throughout their classroom or school.
4. Give students worksheet 5 and 6. Using the diagram of the bicycle rack, explain to them the purpose of a tie and strut. Students will complete the worksheet by locating ties and struts in the illustrations provided.

Differentiation:

Slower learners may benefit by using pre-made tube shaped structures in order to conduct the experiment on worksheet 1 and 2. This will eliminate a time consuming step, and allow them more time to focus on the task of testing the strength of the towers.

For enrichment, faster learners could carry out a walking tour of their home to look for structures that have been built using triangular shapes. They could note the methods of strengthening used on some structures in their home. *An alternative activity for enrichment would be to research design techniques used by engineers on some famous structures around the world.*

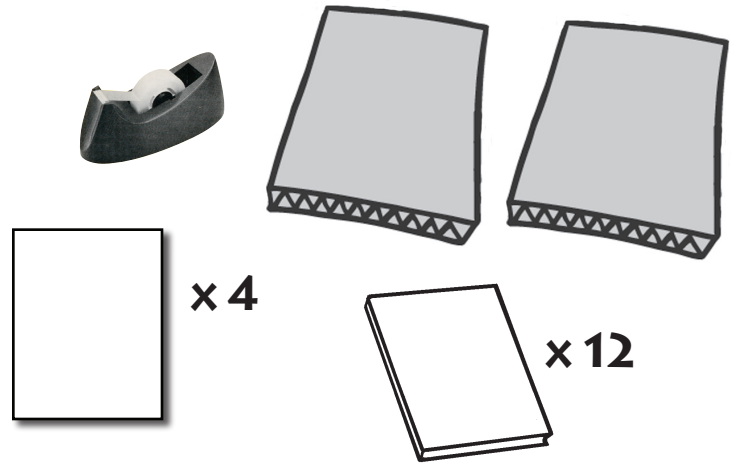


Holding The Load

We know that a structure is built to hold a load. The load is the weight that the structure supports. The shape of a structure can make it both strong and stable. Let's investigate which shape is the strongest and most stable.

MATERIALS NEEDED

- 2 cardboard squares (20 cm x 20 cm)
- 4 pieces of cardstock paper (8 1/2 "x11")
- tape
- 12 paperback books



WHAT TO DO

1. In the chart on worksheet 2, make predictions about the amount of books each paper tube shape will support.
2. Fold the sheets of paper to form a tube shaped tower in each of the following shapes:
 - ☐ square
 - ☐ round
 - ☐ triangular
 - ☐ hexagonal
3. Place the square shaped tower onto a piece of cardboard, then top the tower with the other piece of cardboard.
4. Pile books, one at a time, onto the top of the tower until the tower collapses and can no longer hold the load. Record the result in the chart on worksheet 2.
5. Repeat steps 3 and 4 using the round shaped tower, the triangular shaped tower, and the hexagonal shaped tower.
6. Make a conclusion about what you observed.



Let's Predict ???

Which paper tube shape will support the most amount of books? Record your predictions in the chart below. Then conduct the experiment.

Let's Observe

What happened during the experiment.

PAPER TUBE	PREDICTION	RESULT
square shaped tube		
round shaped tube		
triangular shaped tube		
hexagonal shaped tube		

Let's Conclude

Were your predictions correct? Explain.

Let's Connect It!

How do you think *engineers* design tall structures so that they are strong?





Strengthening Structures

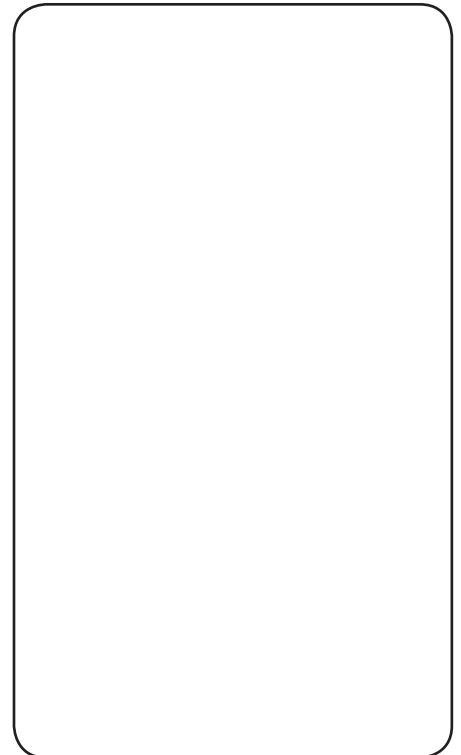
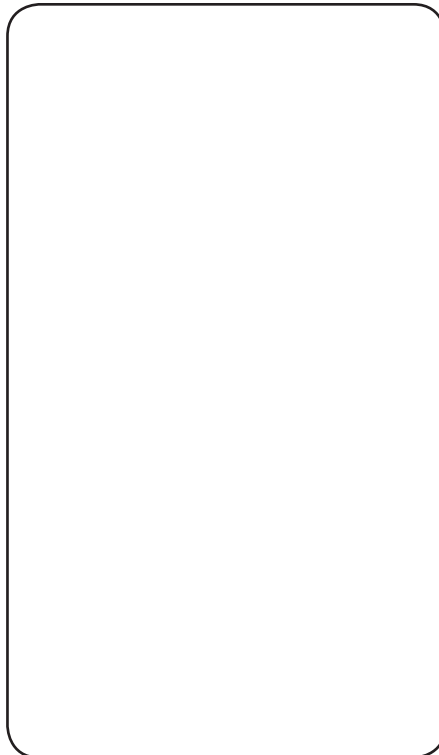
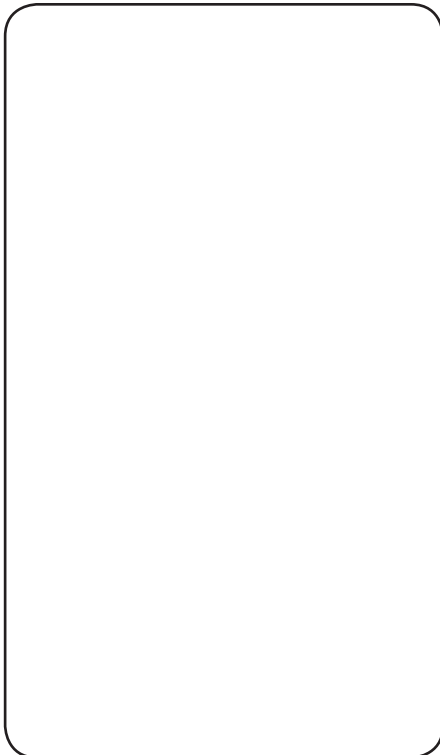
Builders use triangle shapes to build structures because triangle shapes can make structures stronger.

Let's Examine 🔍

Circle all the triangular shapes you see in each structure below.



Take a walk around your school or classroom and look for structures that have been strengthened with triangular shapes. Draw three examples in the boxes below. Be sure to highlight the triangles in your drawings.

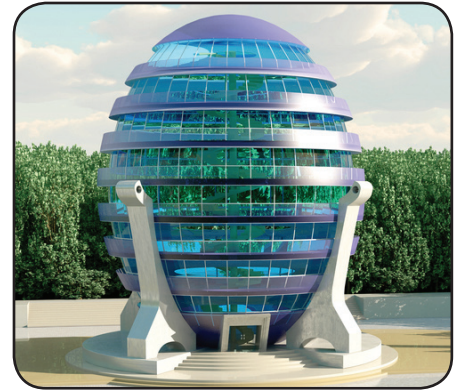




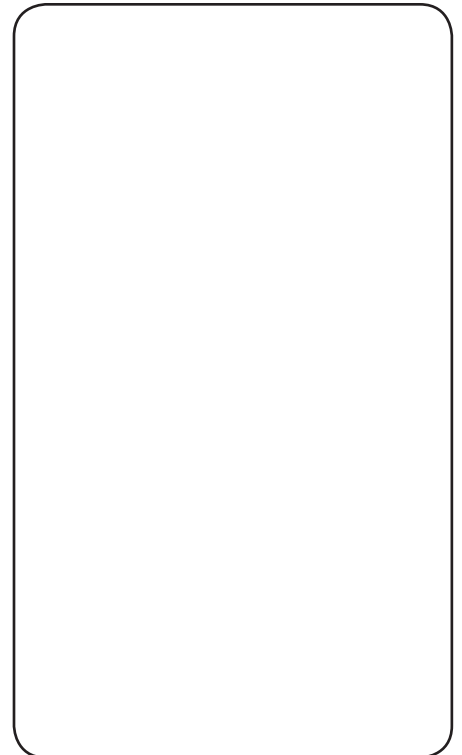
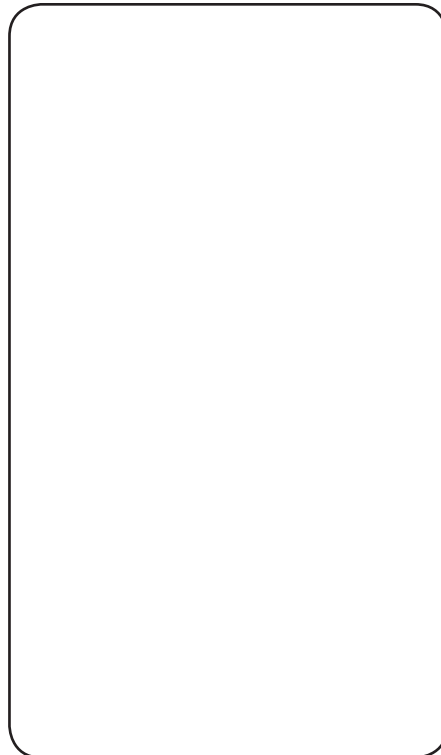
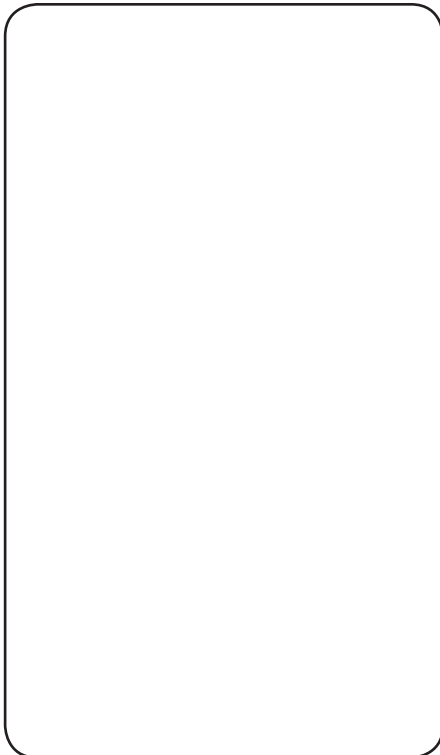
There are other ways to make structures stronger. Layers can be added, weight can be added to the base of a structure, cross members can be used to improve a structure's strength.

Let's Examine

Circle all the ways that each structure below has been strengthened.



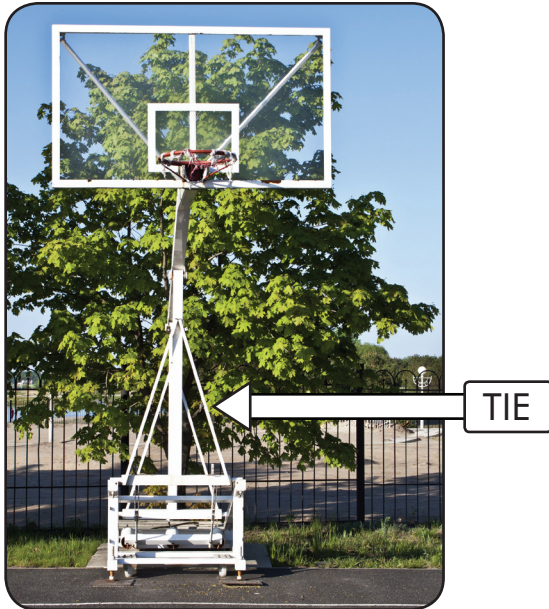
Take a walk around your school or classroom and look for structures that have been strengthened by adding layers, weight, or cross members. Draw three examples in the boxes below.





Tying In The Tension

A tie is a support beam that is used to stop two parts of a structure from separating. It helps a structure to support a load by being in tension.



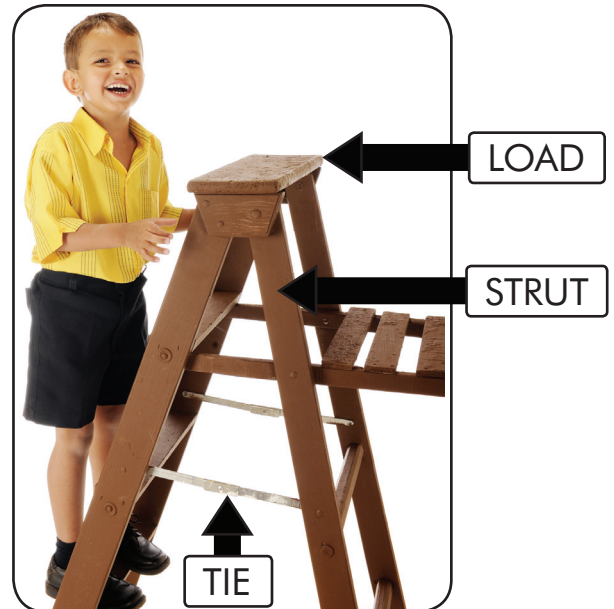
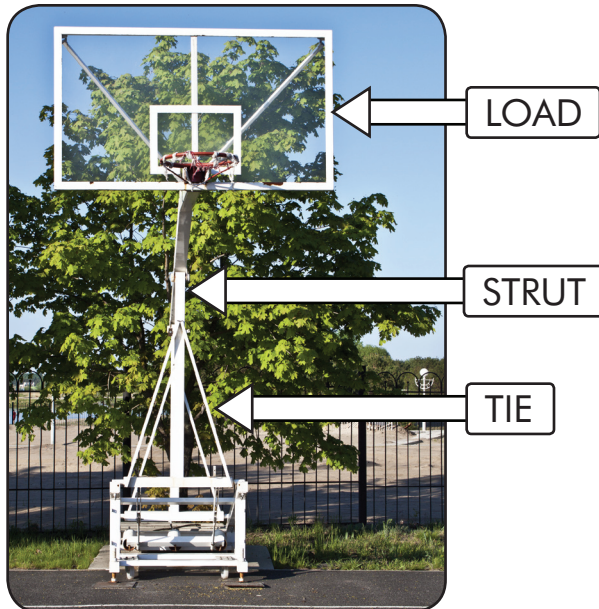
Locate the ties in tension in the objects below. Circle the ones you find.



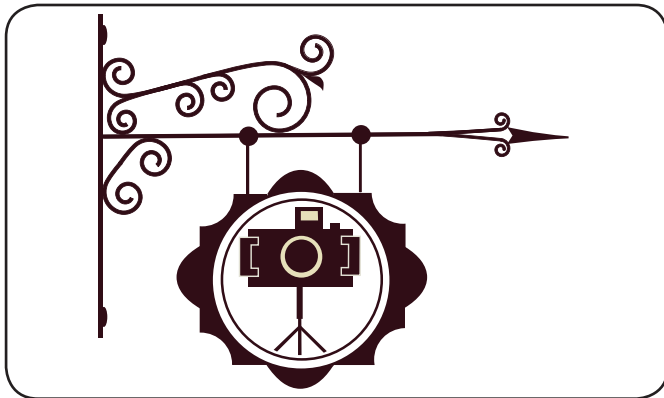


Strutting Out The Compression

A strut is a support beam that is used to stop a structure from collapsing. It helps the structure to hold a load by resisting compression.



Locate the struts in the objects below. Circle the ones you find.



**Here's your
FREE
lesson!**



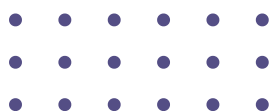
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3rd Grade Physical Science Curriculum Map

The 15 experiments relate to four aspects of physical science:

- **Strong and Stable Structures**
- **Building With a Variety of Materials and Testing Designs**
- **Forces Causing Movement**
- **Hearing and Sound**

In each section, you will find teacher notes designed to provide you guidance with the learning intention, the success criteria, materials needed, a lesson outline, as well as provide some insight on what results to expect when the experiments are conducted.

Suggestions for differentiation are also included so that all students can be successful in the learning environment.

15 experiments:

Experiment One: What is a Structure?

Students will learn about the shapes and features of natural and man-made structures, and assess the environmental impact of those structures.

Experiment Two: Stability of Structures

Students will learn about the stability of a structure and its ability to maintain balance.

Experiment Three: Holding the Load

Students will learn about the stability of a structure and its ability to support a load.

Experiment Four: Under Construction

Students will use problem solving skills and knowledge acquired from previous investigations to design and construct a strong and stable structure.

Experiment Five: Forces Causing Motion

Students will learn about push and pull as forces that cause an object to start moving, stop moving, or change direction.

Experiment Six: Muscular Force

Students will learn how we use our muscles as a force in order to make our bodies move or to make an object start moving, stop moving, or change direction.

Experiment Seven: Gravitational Force

Students will learn how the force of gravity causes objects to be pulled toward the Earth, and how surface area affects the rate at which things fall.

Experiment Eight: Magnetic Force

Students will learn about the magnetic force field and its strength to move objects.

Experiment Nine: Friction

Students will learn how friction acts to slow the movements of objects, and how friction is used to create an electrostatic energy force to move objects.

Experiment Ten: Invention Fair

Students will use problem solving skills and knowledge acquired from previous investigations to design and construct a device that uses force to create movement.

Experiment Eleven: Vibration and Pitch

Students will learn how vibration is created to make high and low pitched sounds that the human ear can hear.

Experiment Twelve: Measuring Sound

Students will learn how to measure the volume of sounds using a decibel meter.

Experiment Thirteen: Making Sound

Students will learn how sound is made, and create instruments to demonstrate sound.

Experiment Fourteen: Sound Travels

Students will learn that sound can travel through certain objects and in different directions.

Experiment Fifteen: Sounding Fun

Students will use problem solving skills and knowledge acquired from previous investigations to design and construct a soundproof device.