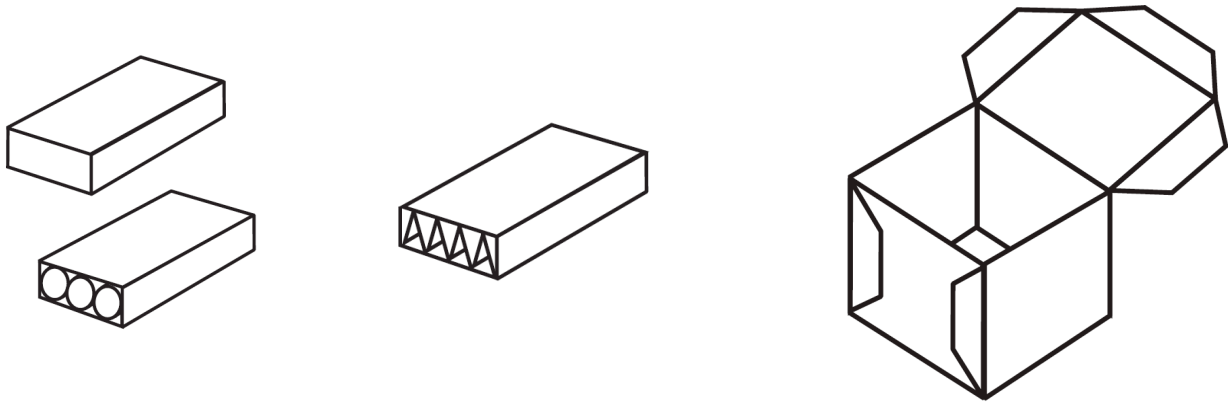


Testing How Structure and Shape Affect Strength

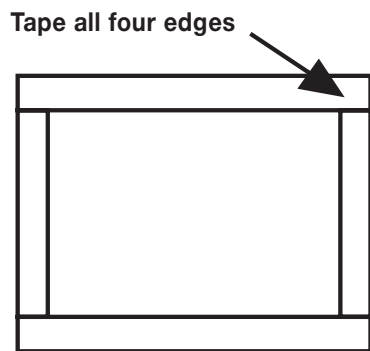


MATERIALS such as concrete, steel, wood and glass are used in everyday construction. They are used in building houses, buildings and bridges. Each material has its own unique properties. These properties determine its strength. Some materials are stronger than others, some are easier to bend or form than others and some can be combined to make the materials stronger than by themselves. A wood beam that holds up a house is very strong. The internal cell structure of wood can withstand heavy loads. The beam does have a maximum allowable stress load. If a beam carries too large a load at its middle, the stress on the internal structure of the beam will cause it to break. It is very difficult to change the internal cell structure of a wood beam to strengthen it, but how a beam is cut, how other materials are used with it and how the beam is formed can all strengthen it.

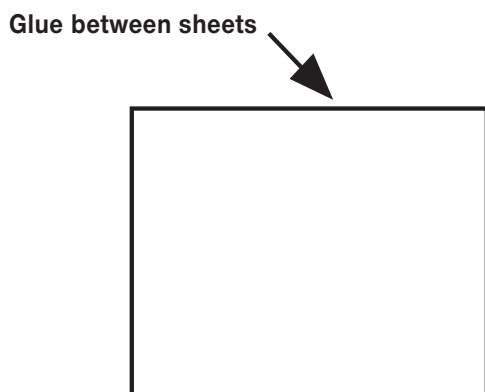
Testing How Structure and Shape Affect Strength

Activity 1

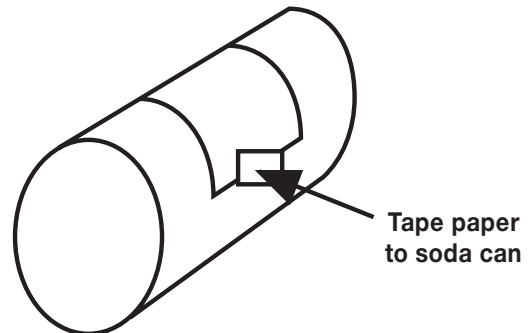
1. Cut out four 4-1/2" × 6" sheets of paper. Stack them together, then tape, folding tape around all four edges.



2. Cut out four 4-1/2" × 6" sheets of paper. Laminate the stack together with glue. Set it aside.



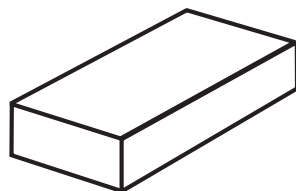
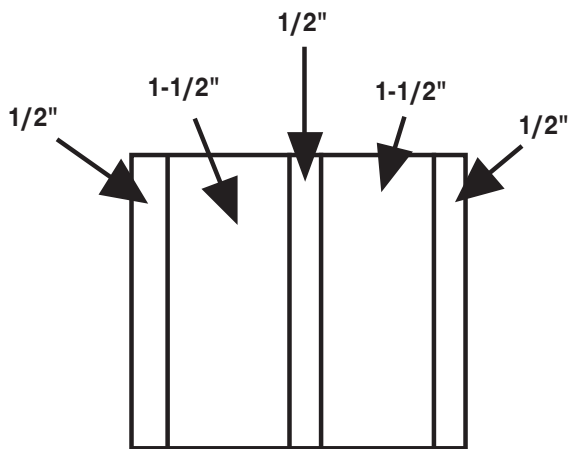
3. Cut out four 4-1/2" × 6" sheets of paper. Laminate the stack together with glue and wrap it around a 16-oz. plastic soda bottle or 12-oz. soda can. Set it aside.



Testing How Structure and Shape Affect Strength

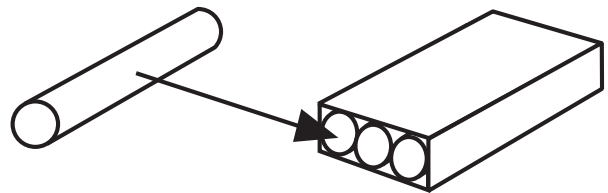
Activity 1, continued

4. Cut out four $4\frac{1}{2}$ " \times 6" sheets of paper. Stack and glue the four sheets together using a glue stick. Draw the pattern shown below on the top sheet of paper. Fold on the lines to make a rectangular beam. Tape or glue it together. Set it aside.

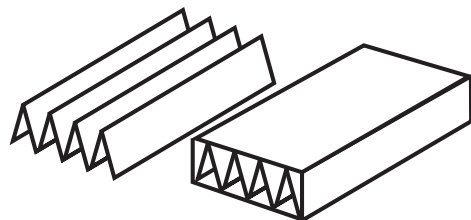


Finished beam

5. Cut out four $4\frac{1}{2}$ " \times 6" sheets of paper. On one sheet, lay out the pattern as shown in step 4. Fold on the lines to make a rectangular beam. Tape or glue it together. Roll and glue the other three sheets into three separate rolled columns. Glue the columns into the rectangular beam. Set it aside.



6. Cut out four $4\frac{1}{2}$ " \times 6" sheets of paper. On one sheet, draw the pattern as shown before. Fold on the lines to make a rectangular beam and tape or glue it together. Corrugate the remaining three sheets of paper and stack them one on top of the other. Put glue on the top and bottom ridges and slide the corrugated sheets into the rectangular beam.



Testing How Structure and Shape Affect Strength

Evaluation Questions

Answer the following questions in complete sentences.

1. Without breaking them, try to twist and compress all six shapes. Which is the strongest, and why?
2. Which is the weakest, and why?
3. What does number 3 look like? What does number 5 look like? What is the similarity?
4. Hold in structure number 3 at its base and push down at its middle. Does the strength of this shape increase? Why or why not?
5. Stand numbers 5 and 6 on their ends and push down. Are they stronger this way than when you bend them in the middle? Why or why not?

Testing How Structure and Shape Affect Strength

Activity 2

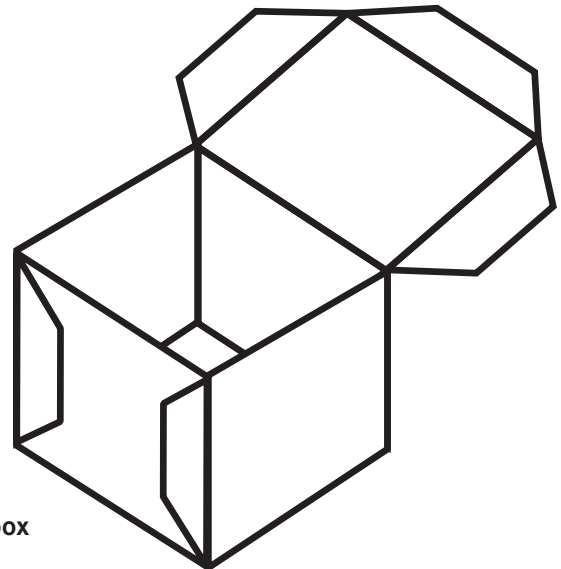
Your technology challenge is to construct a box that will hold as much weight as possible.

1. You will be given three 8-1/2" × 11" sheets of paper and white glue.
2. Following the pattern on page 6, make a 2-1/2" square box out of one sheet of paper. Cut out the pattern and glue tabs on the outside of the box. No wasting glue. Don't glue down the lid until paper reinforcement is added to the box. It is easier to work with the box if it is allowed 24 hours to dry before adding extra strength to it.
3. Using what you have learned about structures and shapes in Activity 1, cut, fold and glue the other two sheets of paper to strengthen the box.

Reinforcement Rules

- Strength must be added by gluing extra sheets to the box.
- You may glue paper to the outside.
- You may glue paper to the inside.
- You may add columns.
- You may add corrugation.
- Crumpling up paper is not allowed, nor is filling the box with glue.
- No tape or other foreign objects, such as wood chips, may be used.

**These boxes may hold as much 400 lbs.
The average box holds under 200 lbs.**



2-1/2" square box

Testing How Structure and Shape Affect Strength

Box Pattern
7-1/2" wide x 10-1/2" long

