

Build a Simple Pulley

Materials Needed

- A wire hanger or wooden skewer, chop stick, toothpick, pencil, pen, etc. for the pulley axle.
- An empty thread spool or plastic bottle cap, empty tape spool, or another thick cylinder for the pulley wheel.
- About 24 inches of string, yarn or other cord material for the rope.
- Ruler
- Glue stick
- Scissors
- Cardboard or cardstock paper
- Optional: pliers, wire cutters

Grade Range

3-5
6-8

Topics/Skills

Math: Measurement
Science: Engineering Design

Learning Standards

Ngss: [3-5 Engineering Design](#);
[6-8 Engineering Design](#)

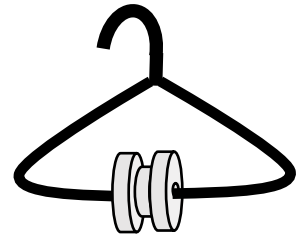
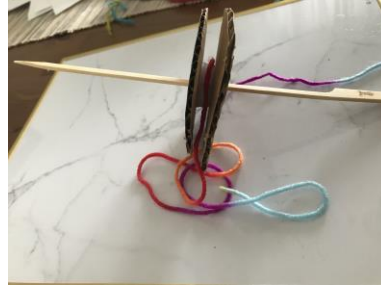
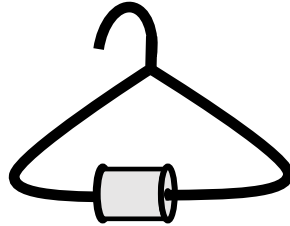
Duration

30 minutes

Prep Time

15-20 minutes

A Simple Machine to Move or Lift Objects



Pulleys are simple machines that have made work easier for people for thousands of years. Explore how this simple device can be built and used to change the direction of motion and force.

Activity Challenge

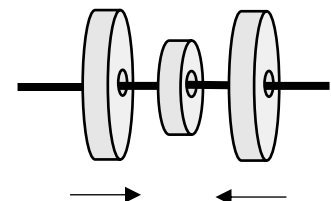
Make a pulley using household items.

Preparation

1. Review the Materials Needed list and gather supplies.
2. Note that pulleys are made up of a wheel, an axle or shaft, and rope, cable or string. Feel free to substitute materials and/or use whatever materials are available to make this simple machine.

To Do

1. Look at the pictures of homemade pulleys on the next page for examples.
2. If using a wire hanger for an axle:
 - a. If the hanger has a cardboard tube across the bottom, remove the tube by bending each wire end out of the tube, then use pliers to straighten out the hook shaped wires on both sides. Bend both sides of the hanger inward so the straightened ends meet in the middle. Slide the spool onto one of the ends.
 - b. If the hanger has a wire bottom, cut the wire in the middle using a wire cutter, or ask an adult to repeatedly bend and straighten the wire about 20 times at the same point. The wire should eventually break. Slip the spool onto one of the ends.
3. If no spool is available, the pulley wheel can be made from cardboard and/or plastic bottle caps. To make the pulley:
 - a. Cut two 2-inch circles from a piece of cardboard. These will make the outsides of the wheel.



- b. Use a bottle cap for the inside of the wheel or three to four 1-inch circles of cardboard glued or taped together.
- c. Find the center of the cardboard circles and bottle cap (if using one) and drill or poke holes. **Adult supervision is required for this step.** Make sure the hole is big enough to slip onto the axle (hanger, wooden skewer/chopstick or whatever is being used).
- d. Glue all the pieces of the wheel together being careful not to get glue in the center holes. Slide the wheel onto the axle as shown on the previous page.
4. The wheel should be able to spin on the axle. Work it back and forth if necessary, so that it spins freely.
5. With an axle (hanger wire or stick) and a wheel, all the pulley needs is rope. Drape string or yarn over the spool and the pulley is complete.
6. Hang the pulley off the back of a chair or on a doorknob or prop it up on books, boxes etc.
7. Find something to lift and give it a go.

Homemade Pulleys



Observations

- Try lifting an object with the pulley. Then lift the same object by the rope without the pulley. Do you notice any difference in the weight? You shouldn't. One pulley will not reduce the amount of force needed to lift or move an object, although it can make it easier and more convenient to do so.
- When would you use a simple machine like this pulley? What tasks would this type of pulley make easier to complete?

Extensions

- Fashion a basket to lift items using the pulley. Load the basket and test the strength of the pulley you made.
- Think about a challenge in everyday life and design a pulley to make the challenge easier.
- See Rapunzel's Tower Learning Activity Sheet to learn how to make compound pulleys. Compound pulleys make it easier to lift objects.

The Science Behind the Activity

For thousands of years, people have been using simple machines to get work done, and we still use the same simple machines today! A pulley is a grooved wheel on an axle with a rope draped across it. Single pulleys, like the one used in this activity, can make lifting more convenient by making it possible to lift a heavy object by pulling down or in another direction rather than by pulling up hand over hand. Multiple interconnected (compound) pulleys can reduce the force needed to lift heavy objects by providing mechanical advantage.