



STEM^{in the}lab

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CREATE A PULLEY SYSTEM



GRADE LEVELS

This activity is appropriate for students in grades 3-5.



MISSION

Build a pulley system and test how much weight it can hold.



VOCABULARY

CIVIL ENGINEERING: a professional engineering discipline that deals with the design, construction, and maintenance of the physical and naturally built environment, including public works such as roads, bridges, canals, dams, airports, sewage systems, pipelines, structural components of buildings, and railways.

PULLEY: A pulley is a wheel that carries a flexible rope, cord, cable, chain, or belt on its rim. Pulleys are used singly or in combination to transmit energy and motion.



MATERIALS

When making a pulley, substitute what you have around the house. There are so many ways to make a pulley. This simple machine can be made with all sorts of different household items.

- » Two band-aids
- » Empty ribbon spool
- » Plastic applesauce cup
- » Chopstick
- » Yarn
- » Hole punch
- » Plastic army men
- » Weights (get creative with rocks, heavier toys, etc.)

ABOUT THIS ACTIVITY

Have you ever seen someone get water out of a well? That is called a pulley. The simplest type of pulley machine is called a fixed pulley. Pulleys are simple machines that have been used for thousands of years and help people move things around easily.

At Idaho National Laboratory, civil engineers design, plan, and analyze construction projects throughout INL sites and facilities. In this activity, you build a pulley system and test how much weight it can hold.



INSTRUCTIONS

- 1 Punch three holes into the applesauce cup.
- 2 Cut three pieces of yarn the same length.
- 3 Tie one end of each of the pieces of yarn through a hole in the cup.
- 4 Tie the loose ends of the yarn together.
- 5 Tie a really long piece of yarn to the three pieces you just tied together.
- 6 Tape the other end of the long piece of yarn to the inside of the ribbon spool.
- 7 Wrap the yarn around the ribbon spool.
- 8 Place a band-aid at each end of the chopstick. The band-aids will keep the chopstick from rubbing against the wood of the banister or wherever you secure the pulley.
- 9 Slide the ribbon spool onto the chopstick.
- 10 Find a location to use your pulley. The length of your chopsticks may determine that.



Image credit: kidsactivitiesblog.com

CHALLENGE:

**ADD WEIGHTS TO YOUR PULLEY AND
SEE HOW MUCH IT CAN HOLD**

WHAT HAPPENED?

Were you able to successfully use your pulley system? How many weights were you able to add before it couldn't hold them anymore? Depending on what materials you used to make your pulley, it may be able to hold heavier items. If your pulley broke, what other materials may you consider using to make it stronger? A sturdier ribbon or stronger cup may help.

THE SCIENCE BEHIND IT

So how does a pulley work? A pulley is one of many simple machines that can make life easier. The pulley you just made is the simplest kind of pulley: a **fixed pulley**.

In this fixed pulley **system**, you pull down on one side of the rope and the other side goes up. You use the same amount of force to pull down as you would to lift the toy yourself. However, you have changed the direction of the force.

A fixed pulley is useful because when you pull down, you can use your body's own weight to add to the push. In contrast, when you exert a force upwards by lifting something, you also have to lift the weight of your own arms. Imagine that you had a small family member sitting on a seat in the air. Would you prefer to lift them overhead with your arms, or hoist them up with a pulley system?



Image credit: education.com

Remember, a fixed pulley changes the direction of the pull, but it doesn't change the amount of force you use to pull. If you have a very heavy object, you could consider building a **movable pulley**. A movable pulley supports an object with two ropes, placing the pulley in the middle. Since the pulley is being supported by two ropes, the amount of force you need to move an object is cut in half.

Simple machines can make life a lot easier. What other simple machines can you create? Are there others that could help you lift a heavy load? Keep exploring to find out!

EXTENSIONS

- » Place your pulley at different heights. Are your results always the same?
- » Experiment with different materials when making your pulley. Do they change the performance of your pulley?
- » Use longer pieces of yarn. How does the pulley work differently?

RESOURCES

- » **Simple Machines for Kids: How to Make a Pulley System**
<https://kidsactivitiesblog.com/27885/simple-machines/>
- » **The Single Fixed Pulley System**
<https://www.education.com/science-fair/article/flag-raiser/#:~:text=A%20fixed%20pulley%20changes%20the,to%20move%20an%20object%20up>

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