

Pulleys		Grade 4 – Structures and Mechanisms
<h1>Lesson Plan</h1>	Safety Notes	Make sure the activity is set up in a strong, stable location. Test out your weights and be careful! Choose a weight that won't break your equipment.
Description Use household items to investigate how pulley systems can influence the relationships between force and distance as they relate to the concept of work.		
Materials For this activity, you will need a long stick. You can use a broom or mop but preferably just the stick part. You'll need a long rope that measures at least 3m. You'll need a lunch box or any other object with a handle to be used as a basket. Other examples could be a water jug or a tool kit. You'll need some objects to act as a weight in your baskets. These could be canned food, water, tools. Lastly, you'll need a marker.		
Science Background Simple machines make work easier for humans. They give us an advantage. We call it a mechanical advantage. There are only 6 kinds of simple machines. One is called a pulley. It is a specialized wheel that can help to lift or lower things. In science, in order to have work, we need to have a force and a displacement. We need to use a force to cause something to move. The work then, is the product of the force times the distance. Pulley systems can reduce the amount of force required to accomplish work. In this activity, you'll be constructing a simulated pulley system. You'll have a rope attached to a weight, that you will then be able to lift. When you lift the weight to a constant height, you will be doing the same amount of work each time.		
Activity Procedure 1 – Choose the object that you will use as a lifting basket. It is best if it has a handle to tie the rope to. You'll want to add some weight because it helps to feel a difference from one set up to the next. Make sure that the basket isn't too heavy. You don't want to bend your stick or break your drawers! 2 - Set up your stick or pole so that it is parallel to the ground but high enough up off of it. You can set it up on kitchen chairs, though that is a little low. You can also use stools which		

are a better height but then you need to secure the pole differently. It works best to go across two cupboard drawers with a space in the middle. You can try in the kitchen or the bathroom. Whichever place you pick, make sure it is a strong, stable base so you don't topple it over. Ask an adult to help you with this set up just to make sure.

3- Once you have your stick or pole set, attach the rope to the handle of your basket and lift it to the height of the broomstick so you can feel how much it weighs. When the basket is on the ground, make a mark on the rope at the height of the broomstick so you can keep track of the distance travelled. If you want to be more precise in your measurement and know how to be safe with a measuring tape, you can use it to measure your rope.

4 – Next, set up your rope so it goes over the broomstick and you can pull down to lift the basket, make a mark at the bottom of the rope. Raise the basket again to the height of the broomstick. How does it feel? How much rope did you use? Explore pulling on the rope at different angles.

5 - Continue to wrap the rope around the broomstick to simulate adding extra pulleys to the system. Mark your rope and do the lift test each time. Explore pulling on the rope at different angles. How does it feel? How much rope did you use?

Debrief

The more loops of rope that you add to your system, the more pulleys you are simulating. Since the distance of your pull force is increasing, the force needed to do so decreases. It feels easier because you use less force over a longer distance.

Pulleys are used in many different applications. They are one of the 6 simple machines that allow more complicated machines to do their work. Their wheels with specialized rims for cords, cables or chains allow them to be used for lifting and lowering.