



Curiosity Guide #402

Pulleys

Accompanies Curious Crew, Season 4, Episode 2 (#402)

Pulley Tug-of-War

Investigation #1

Description

How can you win a tug-of-war against 2 people, even if they are adults?

Materials

- 2 poles, like broom handles or rigid PVC pipes
- Rope of approximately 25 to 30 feet in length
- You and two friends
- A pair of gloves is optional.

Procedure

1. You may want to put on a pair of gloves because you will be pulling on the rope.
2. Tie one end of the rope about a third of the way in from one end of a broom handle or PVC pipe.
3. Have one of your friends hold the handle with both hands in front of him or her.
4. Have your other friend face the first person and hold the second handle so that the handles are parallel and about two feet apart.
5. Loop the loose end of the rope around the second handle, then back to the first handle.

Trial 1

1. Grab the loose end of the rope and stand slightly behind and to the side of your first friend.
2. Challenge your friends to pull the handles apart while you slowly pull the free end of the rope to pull the handles together.
3. Which way did the broom handles move? Why?

Trial 2

1. Hold your end of the rope loosely. Ask the two friends to step away slowly from each other, pulling the ropes without jerking, until the handles are about 5 feet apart.
2. Loop the loose end of the rope around the handles several more times so there are at least five loops on each handle.
3. Holding the end of the rope taut, stand behind and a bit to the side of the first friend.
6. Challenge your two friends to try to pull the handles apart while you slowly pull the free end of the rope to pull the brooms together.
7. Which way did the broom handles move? Why?

My Results

Explanation

This is an example of a pulley which provides a mechanical advantage to the third person. Even a small person can outpull two adults using the pulleys.

Pulleys are simple machines that can change the direction of force. When several pulleys are put together, they can increase the amount of force applied to an object. Pulleys generally have a wheel that rotates around a fixed axle, but the principle in this activity is the same. Adding each loop of rope around the handle in the experiment is like adding extra ropes to the task. This action increases the mechanical advantage to the third person.

You may have noticed that the person pulling the rope can pull more easily with multiple loops of rope, but he or she must move a lot of rope to force the handles together. This is because the total amount of work done to move an object is the same, whether you apply a lot of force over a short distance, or apply less force for a longer period. In Trial 1, you created one loop and pulled a little bit of rope. In Trial 2, you created multiple loops and pulled a lot of rope. Block-and-tackle pulley systems work the same way by using multiple loops to decrease the force to move heavy loads.

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