LEAVE IT TO LEVERS!

GOAL

Students learn when they need to lift a weight too heavy to lift by themselves, they can use a lever and follow a surprising rule: **multiply the length of your lever and you will similarly multiply the weight you can lift.**

GRADE LEVEL

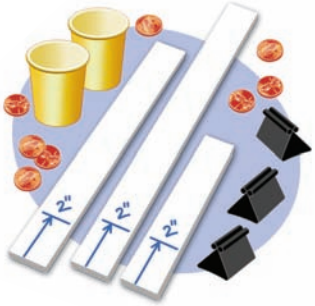
Elementary school

TIE TO CYBERCHASE EPISODE

In *Escape from Merlin's Maze,* as the number of stone slabs multiplies, Matt, Jackie, and Inez multiply the lengths of their levers to clear the way for Shari's escape.

MATERIALS *(for each group of 4 or 5 students)*

- fulcrum: one-inch binder clip, handles removed
- weight containers: 3-ounce paper cups, 6 per group (no-wax cups work best)
- weights: pennies, 200 per group
- tape (for younger students, tape the cups to the lever ends prior to the activity)
- 3 foam board strips, each 1 inch wide and 8 inches, 14 inches, and 20 inches long.



DISCUSSION

Engineers design machines to do difficult jobs. A lever is a simple machine; simple machines are tools that make work easier. They have few or no moving parts. Depending on their grade, elementary school students may be familiar with the six simple machines. Tell the students that they have all seen levers in action: a hammer used to remove nails, and see-saws on the playground.

ACTIVITY

Before the class period, make the foam board strips. Use an 20" x 12" piece of ¼" foam board; measure and cut with scissors or craft knife. Then measure 2" from one end of each of the 3 strips and mark the fulcrum point. Allow one piece of foam board for 3 groups; this will give you some room for error.

Tip: As you talk about the different parts of a lever and how they're used, use the terms fulcrum, load end, effort end and lever arm; then the kids will, too.

Step 1

Point out something in the room that might be lifted by a lever, such as a file cabinet, a sink, or a desk. Demonstrate a simple lever.

Ask: What has to happen at the effort end of the lever arm to make the lever lift the load? (The lever arm needs to be pressed down – either by pushing or with weight.)

Step 2

Divide the class into groups; have them compare the lever arm lengths of 6, 12, and 18 inches.

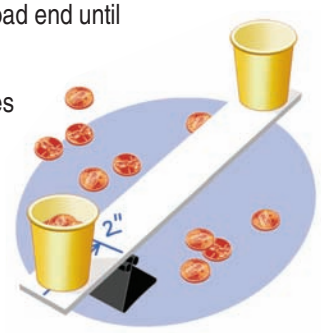
Ask: How do the lengths change? What pattern do you see in the lengths? (The 12" arm is twice the length of the first; the third is 3 times longer). Have each group set up the shortest lever on the fulcrum. Explain that they will reuse the same pennies and fulcrum to experiment with all 3 levers.

Step 3

Have kids put one penny into the cup at the effort end, and explain that this single penny represents how much downward push they will use to lift a load of pennies at the load end.

Step 4

Have the kids drop pennies into the load end until they make the lever tip down.



Explain: To find the number of pennies that the lever can lift, remove one penny from the load end (the load should lift up again), then count how many pennies are in the cup.

Ask: Do you think the other levers will lift less, more, or the same weight?

Repeat steps 3 and 4 for the other two levers; make a chart and record the results on a board or large paper.

Ask: How do the numbers change? Do you see any pattern? (Doubling the lever length should – roughly – double the number of pennies you can lift.)

FURTHER EXPLORATION

Depending on time, encourage the kids to experiment with the levers. They might try moving the fulcrum point or adding pennies to the effort end where only one penny was used before.

Ask: How many pennies do you think you could lift with a 24-inch lever arm? How about a 36-inch lever arm? (Hint: When the 6-inch lever arm was doubled, then tripled, the lever lifted approximately double and triple the number of pennies. A 24-inch arm is 4 times the original length, and 36 is 6 times the length.) The formula may not work precisely, but kids should be able to see a pattern.

CONNECT TO ENGINEERING

Engineers have adapted levers to move heavy objects. Tools like car jacks, bucket loader, cranes, and hydraulic lifts are all levers. Any time you see a small object lift a large weight, you can be sure that a lever is at work.

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