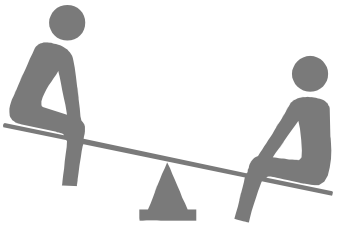
LIFTING WITH LEVERS



BENCHMARK and TASKS

SC.C.2.2.1 The student recognizes that forces of gravity, magnetism, and electricity operate simple machines.

- The student demonstrates that work is done every time a force is used to move something.
- The student identifies the six types of simple machines (screw, inclined plane, wedge, pulley, lever, wheel and axle).
- The student demonstrates how simple machines are used to accomplish work.

KEY QUESTION

How is a lever like a playground seesaw?

BACKGROUND INFORMATION

Machines are mechanical devices that often permit people to do work more easily. Work is done any time a **force** is used to move an object. There are six types of simple machines: **lever, wheel and axle, inclined plane, pulley**, wedge, and screw.

A lever has four parts: a bar or beam, the **fulcrum** (an object on which the bar pivots), the load (the object to be moved), and the effort (the force needed to move the load). Examples of levers are: crowbar, shovel, claw, the hammer when use for prying, hinged door, wheelbarrow, fishing rod, baseball bat, and broom. One of the simplest examples of a lever is the playground seesaw. Levers can be used to decrease the force needed to do a certain amount of work.

MATERIALS

Per pair of students

1 metric ruler
6 pennies
fulcrum (1 thick, round marker)
tape
Lifting with Levers data sheet
1 toothpick or pencil
1 balance

Per class

Early Bird Physics Series, Sally M. Walker and Roseann Feldman, Lerner Publications Co., 2002

ENGAGE

Discuss students' prior experiences with seesaws by asking the following questions:
Have you ever ridden a seesaw?
How do two people of the same size ride a seesaw?
How can two people use the seesaw when the person on one side of the seesaw is much heavier than the other person? (The heavier person must move closer to the middle – the fulcrum.)

EXPLORE

1. Distribute materials to each group.
2. Have students tape the thick marker to the table.
3. Students should place the metric ruler down on the marker and then move the ruler until the ruler is balanced. (Students should note the point of balance, which will be at approximately the 15-cm mark.) The marker is the fulcrum.
4. Students should tape 3 pennies together with a small piece of tape and place the taped stack of pennies on the 11 cm mark of the ruler. Then they should place another stack of 3 pennies (not taped) on the other side of the ruler.
5. Have students use a toothpick or a pencil to move the untaped stack of pennies to the position on the ruler where it just lifts the taped 3-penny load on the other side. (The lever may not be perfectly balanced.) Instruct students to record this position on their chart.
6. Students should keep the taped 3-penny load on the 11-cm mark. Next, they should remove one of the untaped pennies and use only 2 pennies to see where on the ruler the 2-penny stack just lifts the taped 3-penny load. Instruct students to record this position on their chart.
7. Finally, students should use only 1 penny to see if they can find a place on the ruler where it can just lift the taped 3-penny load, still at the 11-cm mark. Instruct students to record the results on their chart.

EXPLAIN

Which part of the lever was the beam? (ruler)
What part of the lever was the fulcrum? (marker)
What part of the lever was the load? (3 pennies taped together)
When you used fewer pennies to lift the 3-penny load, did you move them closer to or farther away from the fulcrum? (As fewer pennies are used, they can still lift the 3-penny load if they are moved farther from the fulcrum.)
How is this like children on a seesaw? (A small child can lift a much larger child if they sit at different distances along the seesaw. The weight of the children and their distance from the fulcrum are the two variables in balancing the seesaw. If one child weighs twice as much as the other, to balance the seesaw, the smaller child must be twice as far from the fulcrum as the heavier child.)
What does the data on your chart tell us about levers? (The greater the load, the closer the effort is to the fulcrum. The lighter the load, the farther away from the fulcrum the effort is.)
Was any work being done? (Yes, because force was used to actually lift the 3-penny load.)

EXTEND/APPLY

1. The balance is an example of a lever. Give students time to explore the balance: Ask: *Where is the fulcrum? What is the load? What part acted as the effort or force?*
2. Encourage students to find other examples of levers in the classroom, at school, and at home. Identify the parts of the levers.
3. Share the *Early Bird Physics Books*. The titles include: *Work, Inclined Planes, Screws, Wedges, Levers, Pulleys, and Wheels and Axles.*

EXTENSION

Have students measure the distances from the pennies to the fulcrum. Then they can multiply the number of pennies times the distance to the fulcrum and see whether the products are the same on

both sides of the fulcrum. For example, the 3 taped pennies were always at 11 cm which was approximately 4 cm from the fulcrum (3 x 4 = 12). Students would need to multiply the number of pennies on the other side of the fulcrum times their distance from the fulcrum. (Note: The exact mathematical relationship between the number of pennies and the distance from the fulcrum is complicated by the fact that not all pennies have the same mass.)

ASSESSMENT

Tell students you need to dig up a large rock, but the rock is too heavy to lift. Have them explain how a lever might help you accomplish this task.

Student investigators _____

LIFTING WITH LEVERS

Number of Pennies in the Taped Stack	Position on the Ruler	Number of Pennies in the Untaped Stack	Position on the Ruler Where the Untaped Pennies Just Lifted the 3-Penny Load
3 pennies	**11 cm**	**3 pennies**	
3 pennies	**11 cm**	**2 pennies**	
3 pennies	**11 cm**	**1 penny**	

Complete the chart and then explain what the numbers in the table tell us about levers.

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