Experiments with Levers

A lever is a machine that allows you to do work with less force. It will not save you any work. As with all simple machines, the lever trades distance for force.

The **mechanical advantage** (MA) of a machine is the number of times the machine multiplies the force you use to do a job. The mechanical advantage of a lever tells you how much the lever is helping beyond the force it would take you to lift the load directly.

$$\text{Mechanical Advantage} = \frac{\text{Load (Output)}}{\text{Force (Input)}}$$

Working in small groups, follow the directions below starting with Test #1

Materials Needed

(for each group)

- 500-gram weight
- a fulcrum (wooden block)
- two rulers

- a lever (meter stick)
- rubber band . spring scale

Investigate – Does a lever system help you lift a load?

Test #1 Without a lever system, lift the **load** (weight) 8 cm from its initial position, using the spring scale. Record the newtons of force used. This number will always be the **output** force.

Test #2 Set up a lever system with the load (weight) rubber-banded or taped to the O-cm mark on the lever. Place the fulcrum at the 50-cm mark. Attach the spring scale to the 100-cm mark, with the scale hanging over the edge of the desk so the lever can be pulled downward. Lift the load 8 cm. Record the number of newtons of force used. This number is the amount of force required to lift the load or the **input force**. You must also measure how far in centimetres you had to push the lever down. This is the distance the **force moved**.

Experiments with Levers (cont'd)

Test #3 Set up a lever system with the fulcrum at 35 cm. Lift the load exactly 8 cm. Record the input force (newtons used to lift the load) and the distance the force pulled the lever down.

Test #4 Set up a lever system with the fulcrum at 20 cm. Lift the load exactly 8 cm. Record the input force (newtons used to lift the load) and the distance the force pulled the lever down.

Test #5 Set up a lever system with the fulcrum at 65 cm. Lift the load exactly 8 cm. Record the input force (newtons used to lift the load) and the distance the force pulled the lever down.

Test #6 Set up a lever system with the fulcrum at 80 cm. Lift the load exactly 8 cm. Record the input force (newtons used to lift the load) and the distance the force pulled the lever down.

Test #7 Set up your own lever system and lift the load exactly 8 cm. Record how far the fulcrum was from the load. Record the input force (newtons used to lift the load) and the distance the force pulled the lever down.

Test #8 Set up another lever system of your own and lift the load exactly 8 cm. Record how far the fulcrum was from the load. Record the input force (newtons used to lift the load) and the distance the force pulled the lever down.

Mechanical Advantage

$$\textbf{Mechanical Advantage} = \frac{\textbf{Output Force}}{\textbf{Input Force}}$$

Look at the data your team has collected, and use a calculator to determine the mechanical advantage of each lever system. Divide the **output force** number by the **input force** number, and record that figure in the mechanical advantage column on the data sheet. A mechanical advantage of 2 means the lever has increased your force by 2, or you are using ½ the force that was needed to lift the load directly.

Extension: Can you set up a lever system that makes it easier (less force) to lift a **load without moving the fulcrum from the 50-cm mark?**

Make a diagram of the system, and record all important data.

Experiments with Levers (cont'd)
Student Data Sheet

Distance of Load to Fulcrum	Output Force	Input Force	Load Moved	Force Moved	Mechanical Advantage
No Fulcrum			8 cm		
50 cm			8 cm		
35 cm			8 cm		
20 cm			8 cm		
65 cm			8 cm		
80 cm			8 cm		
			8 cm		
			8 cm		