

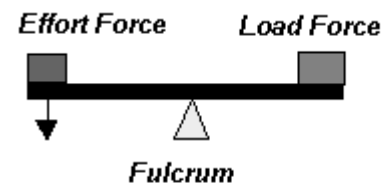
NAME \_\_\_\_\_

## LIFTING A LOAD

**Questions:** Does it always take the same amount of force to lift a load? Where should you press to lift a load with the least amount of force?

**Background Information:** A lever is a simple machine that allows us 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 trade-off a machine requires of us is this: we may not have to apply as much force, but we must apply it for a greater distance.

A lever is a rigid bar that rotates around a fixed point called the fulcrum. The bar may be either straight or curved. In use, a lever has both an applied force [effort force] and a resistance force [load force].



By changing the position of the fulcrum, you can gain extra power with less effort.

The **mechanical advantage** (MA) of a machine is the number of times the machine multiplies the force we 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.

### Materials:

Lever set up

Weights

Spring scale or force sensors

### Procedure:

1. Using the lever set up, put the load 10.0 cm from the fulcrum.
2. Put the spring scale or force sensor 25.0 cm from the fulcrum on the other side.
3. Measure the effort it takes to lift the load so that the lever is balanced. Record this information in the data table.
4. Move the spring scale or force sensor to 20.0 cm from the fulcrum. Leave the load at 10.0 cm from the fulcrum. Measure and record the effort.

5. Move the spring scale or force sensor to 15.0 cm from the fulcrum. Leave the load at 10.0 cm from the fulcrum. Measure and record the effort.
6. Move the spring scale or force sensor to 10.0 cm from the fulcrum. Leave the load at 10.0 cm from the fulcrum. Measure and record the effort.
7. Move the spring scale or force sensor to 5.0 cm from the fulcrum. Leave the load at 10.0 cm from the fulcrum. Measure and record the effort.
8. Move the spring scale or force sensor to 2.5 cm from the fulcrum. Leave the load at 10.0 cm from the fulcrum. Measure and record the effort.

Data:

Position of Effort Force (cm from fulcrum)	Effort Force (Newtons)
25.0	
20.0	
15.0	
10.0	
5.0	
2.5	

**Graph this information using a line**

**graph:**

To do this you must remember: the independent or goes on the X-axis, the dependent goes on the Y-axis. Number each axis in **even** intervals. Intervals are determined by looking at the smallest and largest numbers in the data table.

Label each axis with the variable (position of effort, effort) and the units used to measure the variable (cm, newtons).

Give the graph a title that describes the information in the graph.



## Part 2

### Procedure:

1. Using the lever set up, put the load 25.0 cm from the fulcrum.
2. Put the spring scale or force sensor 10.0 cm from the fulcrum on the other side. Measure and record the effort.
3. Move the load to 20.0 cm from the fulcrum. Leave the spring scale or force sensor at 10.0 cm from the fulcrum. Measure and record the effort.
4. Move the load to 15.0 cm from the fulcrum. Leave the spring scale or force sensor at 10.0 cm from the fulcrum. Measure and record the effort.
5. Move the load to 10.0 cm from the fulcrum. Leave the spring scale or force sensor at 10.0 cm from the fulcrum. Measure and record the effort.
6. Move the load to 5.0 cm from the fulcrum. Leave the spring scale or force sensor at 10.0 cm from the fulcrum. Measure and record the effort.
7. Move the load to 2.5 cm from the fulcrum. Leave the spring scale or force sensor at 10.0 cm from the fulcrum. Measure and record the effort.

### Data

Position of Load Force (cm from fulcrum)	Effort Force (Newtons)
25.0	
20.0	
15.0	
10.0	
5.0	
2.5	

Graph this data using the same guidelines rules you followed previously.



**Conclusions:**

1. What are the four parts of a lever system?

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2. In what ways can a lever provide an advantage?

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3. What is the relationship between the load and effort that gives a lever user the greatest advantage?

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4. When the load is at a constant position on the lever arm, how can you make it easier to lift the load?

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5. What is the difference between the weight of the load and the amount of effort needed to lift it?

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6. How does your graph of Part 2 compare to your graph of Part 1?

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9. Predict: How much effort would it take to lift a load at 10cm if the effort were applied at 22 cm? At 13 cm? At 30cm? **Explain your answers.**

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10. Predict: If a 4.0 N effort were required to lift the load at 10 cm, where was the effort applied? **Explain your answer.**

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