The lever is a simple machine that can change the magnitude and/or direction of the effort force. In this lab, we will investigate how a lever can change the force required to lift an object by changing the position of the fulcrum. The ideal mechanical advantage of a lever is determined by the following equation:

\[ \text{IMA} = \frac{\text{effort arm}}{\text{resistance arm}} \]

The **effort arm** is the distance from the effort force to the fulcrum and the **resistance arm** is the distance from the resistance force to the fulcrum.

There are three classes of levers, all of which can be determined by the location of the fulcrum relative to the effort and resistance forces.

**First class lever:** The location of the fulcrum is between the effort and resistance forces. An example of a first class lever is a seesaw. A first class lever can increase force and distance.

![First class lever diagram](image1)

**Second class lever:** The resistance force is located between the fulcrum and the effort force. An example is a wheelbarrow. A second class lever always increases force.

![Second class lever diagram](image2)

**Third class lever:** The effort force is between the fulcrum and the resistance force. An example is a baseball bat. A third class lever always increases distance (which also increases speed).

![Third class lever diagram](image3)
Procedure:

1. Read all of the front page thoroughly.
2. Set up each lever as described for each experiment below.
3. Record the value of the resistance mass for each trial. Use the force sensor to measure its weight, and record that value.
4. Use the force sensor or spring scale to pull down or lift up on the meter stick at the location of the effort force. Record this value in the data table.
5. Record the values for the effort and resistance arms for each trial.
6. Repeat steps 2-5 for each trial.
7. Be sure to record units for all of the numbers that you record! Round all numbers in your data table to two decimal places.

First class levers:

Experiment 1:
- Place the effort force at the 10 cm mark. Place the resistance force at the 90 cm mark.
- Start with the fulcrum at the 20 cm mark, and then move it in increments of 5 cm until it is at the 80 cm mark.

Experiment 2:
- Place the fulcrum at the 65 cm mark. Place the resistance force at the 90 cm mark.
- Start with the effort force at the 55 cm mark, and then move it in increments of 5 cm until it is at the 5 cm mark.

Second class levers:

Experiment 3:
- Place the fulcrum at the 5 cm mark. Place the resistance force at the 25 cm mark.
- Start with the effort force at the 30 cm mark, and then move it in increments of 5 cm until it is at the 95 cm mark.

Third class levers:

Experiment 4:
- Place the fulcrum at the 5 cm mark. Place the resistance at the 75 cm mark.
- Start with the effort force at the 25 cm mark, and then move it in increments of 5 cm until it is at the 65 cm mark.