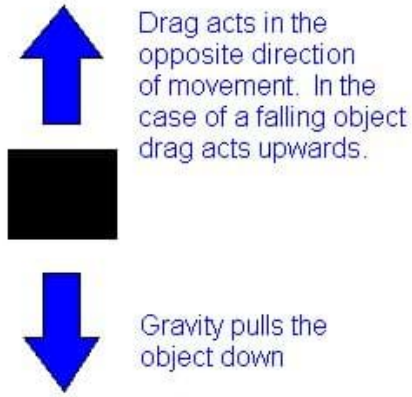
# Function: Shapes, Mass, and Length

**Purpose**: How do different shapes, masses and lengths effect how an object falls?

**Background Information**:
The type of drag that we are most familiar with is *form drag*. This is the resistance (or pushing) sensation you feel when you walk into the wind. It is caused by all of the air molecules running into your body. Form drag is dependent on the shape of an object, the cross-sectional area of an object, and the speed of an object. In the case of drag, the cross-sectional area is the area of an object that is facing the direction of its movement. For example, if you hold your hand out of a car's window with your palm down, you do not feel much push from the wind. If you turn your hand right, so that your palm faces the direction the car is moving, the wind will push your hand back much harder. This increase in resistance (push) is due to the increase of the cross sectional area of your hand, not the overall size of your hand.




Engineers often consider drag in designing things like airplanes and cars. They try to design these things as *streamlined* as possible. Streamlined means that the shape of the object, airplane or car can reduce the drag of the object (reduce the force opposing forward motion). This is why airplanes have rounded nose cones and why they pull up their landing gear after liftoff (to remove the wheels from being in the way and creating unnecessary drag). In this activity, we will demonstrate how shape and size affect the drag on something as simple as a piece of paper.

**Hypothesis**
If I change the shape from a cone to a box then the object will …….

**Set up Procedures**:
1. Read all the procedures before beginning this lab
2. Get the hand out of different shapes from the instructor.
3. Cut each of the 4 designs
4. Construct the cones by taping one side of the pattern to the other to hold the paper in the cone shape.
5. Construct the boxes by folding on the solid lines and taping the tabs in place. Leave the boxes with one open side.
6. Find the mass of your Big Cube using a triple-beam-balance.
7. Don't reset your triple beam balance leave the balance at the same mass as the big cone was.
8. Place on the balance your big cone.
9. By adding small pieces of clay, get your triple beam balance to be equal to the mass of your big cone.
10. Show your teacher all four of your created shapes to receive your data table.

Data Table

| Trials | Big Cone 1 cube | Big Cone 3 cubes | Big Cone 5 cubes | Small Cone 1 Cube | Small Cone 3 Cubes | Small Cone 5 Cubes | Big Box 1 Cube | Big Box 3 Cubes | Big Box5 Cubes | Small Box 1 Cube | Small Box 3 Cubes | Small Box 5 Cubes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | |
| Average | | | | | | | | | | | | |

**Experiment**

1. Select one person to stand on a chair and drop the objects from 2 meters above the floor.
2. When the person with the stopwatch says "go," the timing begins and the object is dropped at the same time. When the object hits the floor, the timer stops the watch.
3. Record your data in the data table in the correct box
4. Conduct 3 trials for this shape.
5. Place a total of 3 plastic cubes into your large cone.
6. Repeat experiment steps 1-4.
7. Switch to your next shape
8. Repeat steps 1-5 for each of your 3 remaining shapes.
9. Find the average for each of the 4 shapes.

**Graph:**

In Google doc create a graph of ONLY your averages and titles.

**Analyzing Data**:

1. What shape fastest?
2. What was your fastest time?
3. What shape fell the slowest?
4. What was your time?
5. What does this tell you about the drag on each of these objects?
6. Is relationship between the Size of the object and Time?
7. What is the relationship between the Mass and Time of an object?