a WOW Lab

BLUEPRINT

Indoor Rockets

Additional Information

There are four forces that act on a rocket during flight: thrust, drag, lift and weight. In an air pump rocket like the one in this demonstration, thrust is provided by the burst of air pumped into the rocket body by the bellows pump. Since this force is only effective while the rocket sits on the launcher tube, thrust is not a factor after launch. Consequently, it can be ignored when studying the flight of the model rocket, as shown in **figure 1**.

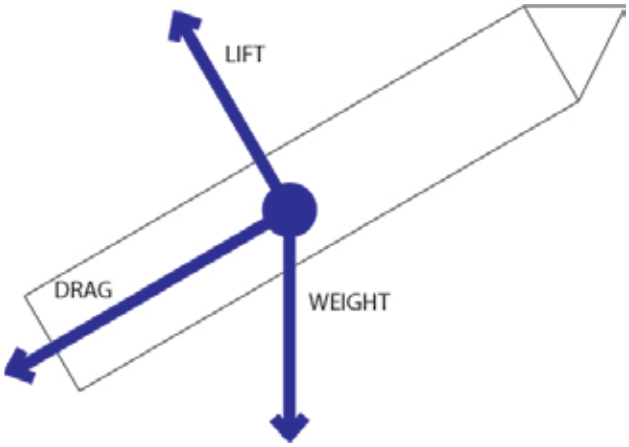

Figure 1

Drag and lift are components of the aerodynamic force, which is a resistive force. The aerodynamic force arises whenever an object submerged in a fluid moves relative to the medium. Drag acts in the direction opposite to the motion of the object, and lift acts in the direction perpendicular to the motion of the object. Drag can be thought of as a frictional force on the rocket. The amount of drag the rocket will experience is partially determined by the material the rocket is made of and its shape. A smooth rocket surface will generate less drag than a rougher one. As well, a more streamlined rocket design will generate less drag.

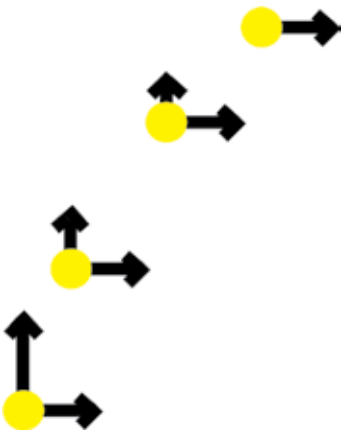
Figure 2

Weight is the force due to gravitation. Unlike the aerodynamic force, which is a mechanical force arising from the interaction of the rocket with the surrounding air, gravity acts independently of physical contact between the rocket and the Earth. A force that acts at a distance is called a field force. For an object whose mass does not change, as is the case with the rocket in this demonstration, gravity is a constant force. In real rockets, the rocket mass decreases as fuel is burnt, so weight becomes an important consideration.

The parabolic path followed by the rocket arises from a combination of the horizontal and vertical components of the motion of the rocket. In a vacuum, the rocket would move along the x-axis at a constant velocity and along the y-axis at a velocity subject to the acceleration downward due to gravity. In **figure 2**, the black arrows represent the velocity component. As the rocket flies higher, gravitational acceleration reverses the upward velocity of the rocket, until, at the height of its flight, the rocket is only moving sideways. Immediately after the peak, the rocket's downward velocity increases until landing.