Pushing and Pulling are Kinds of Forces

Pushing or pulling forces can be used to change the motion of an object. When force is applied, the object can start moving, stop moving, change speed, or change direction.

Effect of Force Strength on Motion

The motion of an object acted on by a force depends partly on the strength of the push or pull. The stronger the push or pull, the faster the object will move. For example, the father in the picture below is pushing his daughter in a swing. When he uses more force to push, the swing moves higher.

Effect of Object Mass on Motion

The motion of an object acted on by a force also depends on the mass of the object. If the same amount of force is used to move two objects with different masses, the object with less mass will move faster.

For example, imagine the father in the picture above were pushing the girl on one swing and her older, larger brother on another. If he pushed both children with the same amount of force, the girl's swing would move farther and faster than her brother's.

Gravity

***Gravity** is a force that acts on an object without having to touch it. Gravity pulls downward on everything that is on or near the Earth's surface.*

The Earth's gravity pulls everything on Earth (or near the Earth) down toward the center of the Earth. Gravity is able to act on things, even if the things aren't touching the Earth's surface.

Gravity pulls everything that falls, such as fruit from a tree or a diver jumping from a diving board, toward the center of the Earth.

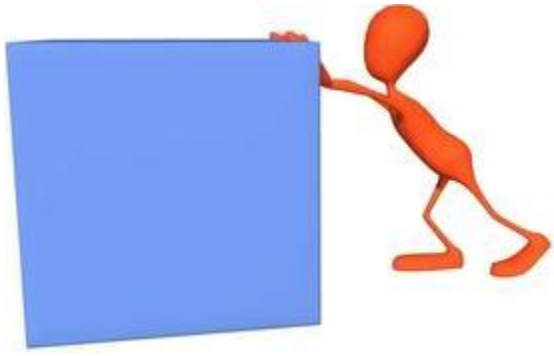
The force of gravity pulls a high diver down toward the Earth. This happens even though the diver is not touching the Earth.

When an object is lifted up, the force of gravity must be overcome. A person hanging from the monkey bars works against gravity to hold himself up. Very heavy things are harder to lift or move because the force of gravity is stronger for objects with more mass.

Friction

***Friction** is a force that opposes motion when two objects are touching one another.*

Friction is a force that opposes motion, which means it causes a moving object to slow down or stop. Friction can also prevent an object at rest from moving.



For instance, friction is the force that keeps a box from sliding across the floor when it is pushed. If a person is pushing on a box to slide it, friction acts on the box in the opposite direction of the pushing force. If the box starts to move, then the force of pushing is stronger than the force of friction.

Friction can be reduced by smoothing the surfaces of the objects in contact with each other. For example, putting wax on skis reduces the force of friction between the skis and the snow. Pouring water onto a slide reduces the friction between a person and the slide, allowing the person to slide down more quickly.

Object Motion

If an object is moving in a way that changes its position, then the object is in motion. Motion is a change in position relative to a frame of reference.

Position & Motion

When we talk about an object's position, we can describe it relative to a reference point. All that means is if we know where one thing is, we can tell someone where something else is *relative* to, or compared to, the first thing.

If an object is moving in a way that changes its position, then the object is in motion. Motion is a change in position relative to a frame of reference.

The position of an object that is in motion is always changing. It does not stay in the same place. The direction that an object is moving might change or it might stay the same.

Direction

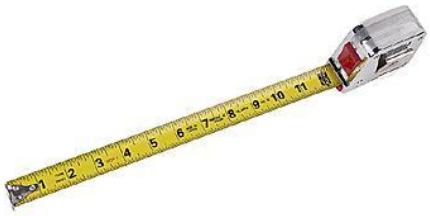
Direction is the path along which something is moving.

Words that can be used to describe the direction of an object's movement include:

- up or down
- left or right
- north, south, east, or west

Distance

Distance is the length between two positions or locations. Distance can be measured in meters, yard, inches, or centimeters with rulers, measuring tapes, or meter sticks. Longer distances can be measured in kilometers or miles.



Speed

Speed is a measurement of how fast an object moves. Faster objects move farther than slower objects if both objects move the same amount of time. The opposite is also true. If one object moved farther than another during a certain amount of time, the first object moved faster.

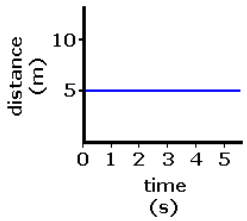
To calculate speed, you find the distance traveled within a given time:

speed = total distance traveled / total travel time

For example, if a car traveled 200 kilometers in 2 hours, the car's speed would be 200 km / 2 hrs = 100 km/hr

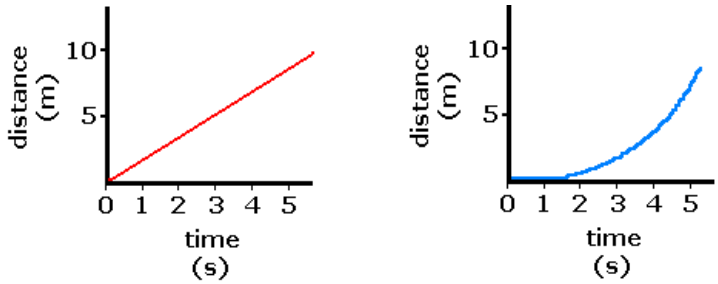
Graphing Motion

Lines on distance-time graphs represent speed. If the line is completely horizontal, the slope of the line and the speed are zero. This means object is standing still.



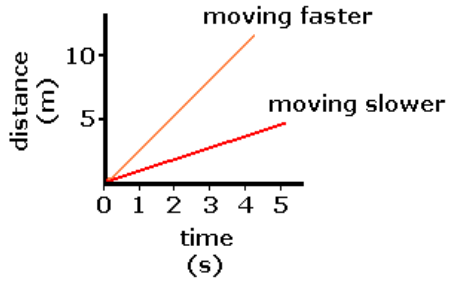
In the example above, the object is standing still at a distance of 5 meters away from the origin.

If the line has a positive slope, the speed is positive. The object is moving away from its origin.



If the line is straight, as in the graph on the left, the object has a constant positive speed. If the line is curved, as in the graph on the right, the object has a non-uniform, or changing, positive speed.

If a graph shows that an object is in motion, then the slope will tell you how fast the object is moving. The steeper the slope, the greater the speed.



The coordinates at any point on a distance-time graph tell the object's position at the corresponding time.