Physics Stations

Station: FRICTION

Background Information: Friction is the resistance that happens when one object moves over or rubs against the surface of another. The force of friction can start things moving, slow them down, or stop them.

Two things that affect the amount of friction are the roughness of the surface and the mass of the object. Lubricants like oil reduce friction by filling in rough spots and smoothing out a surface. But sometimes a surface is too smooth and slippery and you need friction--from treads on your shoes, for example--to help keep you from falling.

The heavier an object is, the more friction there is when you try to move the object.

First Friction

Number of Books	Prediction	Total Mass
1		
2		
3		

More Friction

Surface	Prediction	Total Mass
Bare Desk		
Wax Paper		
Foil		
Plastic Wrap		
Brown Paper		

Overcoming Friction

Number of Books	Total Mass	
	Bare Table	Brown Paper
1		
2		

Station: SPEED & VELOCITY

Background Information. Speed is a way to describe motion. It describes how much time it takes to travel a distance.

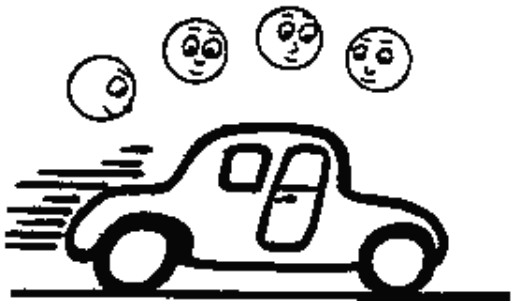
Average Speed is calculated by dividing distance by time.
Speed = distance ÷ time

Distance can be calculated by multiplying speed and time

Velocity is speed AND direction. Velocity changes when speed changes, when direction changes, or both.

Speedwalking

Trial	Distance (m)	Time (sec)	Speed (m/sec)
1			
2			
3			
Average Speed			



Calculating Speed

Show the steps you took in solving these problems:

- If the average speed of a car is 40 km/hour, how far can it travel in 30 minutes?

- A student practicing for a track meet ran 200 m in 25 seconds. What was her average speed?

- A car traveled 1025 km from Dallas to El Paso in 12.5 hours. What was the average velocity?

Speed Graphs

- How much distance has been covered after four hours of motion?

- What is the average speed between hours three and five?

Station: WORK

Background Information: Work in physics means using a force to create movement or cause motion. Work is only done when a force moves an object and the motion of the object is in the same direction as the force.

To measure the amount of work you do, multiply the force times the distance the object moved.
Work= F x D
(work= force x distance the object moved)

Force (or weight) is measured in newtons
Distance is measured in meters.

Unit measure of work = newton x meter or newton meter
A newton meter (N-m) is called a **joule** (J)

Machines make work easier. The work that comes out of a machine can never be greater than the work put into a machine.

Work & Effort

Object	Distance Moved	Force (N)	Total Work (J)

Are You Working?

_____
_____
_____
_____
_____
_____
_____
_____

Station: ACCELERATION

Background Information: Acceleration describes how velocity changes over time.
On the weather channel a hurricane's path is explained in terms of velocity. People want to know how fast a hurricane is traveling but they also need to know in what direction it is traveling so they can evacuate if necessary. For instance, the weatherman will report a hurricane's velocity as five kilometers per hour moving in a northeasterly direction.

Acceleration

- Calculate the acceleration of the roller coaster here. Show your work:

Observing Acceleration:

- Draw your diagrams below:

Station: FORCE

Background Information: A force is a push or a pull. Force gives an object the energy to begin moving, stop moving, or change direction. When you write with a pen you exert a force. When you walk down the hall, blow your nose, turn the lock on your locker, or swim in a pool, you are exerting forces on other objects. No movement would happen without exerting forces on things.

Forces occur in pairs and can be either balanced or unbalanced. **Balanced forces** do not cause a change in motion. They are equal in size and opposite in direction.

Pretend that two forces act at the same time on an object. One is a very strong force to the left, and the other is a weaker force to the right. These two forces add up to one ***net force***. Since the force to the left is stronger, the net force is to the left. This net force to the left will cause the velocity (speed & direction) of the object to change. The object experiences this one net force as if this was the only force pushing it, although, actually, there are two separate forces present. Next let us see what happens when two forces act, but they are equal in strength.

Pretend two forces, one up and one down, push on an object, and imagine that the two forces are the same size. These two forces add up as before, but this time one of them does not overpower the other. They cancel each other out. So, in this example the net force is zero. It is as though no forces were really acting on the object. Under these conditions the velocity (speed & direction) of the object would not change. If it was moving in a straight line at constant speed before the two forces were applied, then it would continue to move in a straight line at constant speed after these two equal and opposite forces were applied. If it was standing still before the application of these forces, it would continue to stand still afterwards.

The net force is the total force. It could be the sum of two forces or more than two forces. If only one force acts upon an object, then this one force would be the net force. If the net force on an object is zero, then the object experiences no velocity change. If the net force on an object is not zero, then the object will show a change in velocity.

Lastly, this net force must be outside the object. The net force can not come from the object itself. You could not, for example, put on ice skates, stand on a frozen pond, push on your back by reaching around with your arms, and expect to get going. Although if someone else came up from behind and gave you a shove, then your velocity would change.

When an object is at rest (not moving), any force acting on it is balanced by an equal force in the opposite direction. If a new, unbalanced force acts on the object, the object will move in the same direction as the new force.

Marble Motion

Diagram the following:

- The marble at rest (not moving)

- The marble moving and a force being applied in the same direction as the marble's movement

- The marble moving and a force being applied in the opposite direction of the marble's movement.

◈ Answer these questions:

1. When you stop applying the force, what does the marble do?

2. Are marbles of different masses affected differently by the same force? Explain your answer.

3. If a force is applied to an object, two things affect its acceleration (speed and direction). What are they, and how do they affect acceleration?

4. Is it possible for an object with a large mass to have the same acceleration as an object with a small mass? Explain your answer.

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Station: NEWTON'S LAWS

Background Information: Newton's First Law of Motion is often stated as: An object at rest tends to stay at rest and an object in motion tends to stay in motion with the same speed and in the same direction unless acted upon by an unbalanced force. Put another way, first law says that if an object is not pushed or pulled upon, its velocity (speed & direction) will naturally remain constant. This means that if an object is moving along, untouched by a force of any kind, it will continue to move along in a perfectly straight line at a constant speed. This also means that if an object is standing still and is not contacted by any forces, it will continue to remain without moving. This is also known as *The Law of Inertia*.

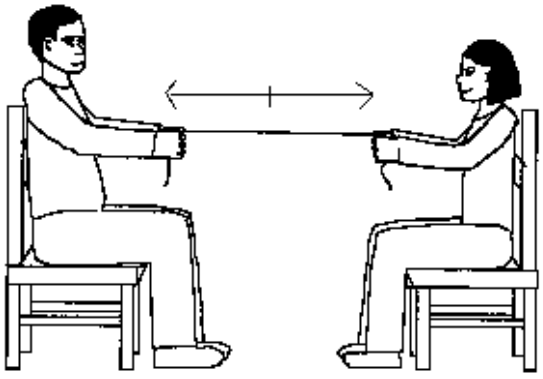
Newton's Second Law of Motion explains how an object will change velocity (speed & direction) if it is pushed or pulled upon.

This law states that if you do apply a force on an object, it will accelerate (change velocity), and it will change its velocity in the direction of the force.

Secondly, this acceleration is directly proportional to the force. For example, if you are pushing on an object, causing it to accelerate, and then you push twice as hard, the acceleration will be two times greater.

Lastly, this acceleration is inversely proportional to the mass of the object. For example, if you are pushing equally on two objects, and one of the objects has five times more mass than the other, it will accelerate at one fifth the acceleration of the other.

Newton's Third Law of Motion states that for every force there is an equal and opposite force. For example, if you push on a wall, it will push back on you as hard as you are pushing on it.



1st Law

- Description:

2nd Law

- Description:

3rd Law

- Description:

Observing the Law

◈ Observations of marble in box:

How is what you observed explained by the 1st Law of Motion?

◈ Force to move the cart:
Empty_____

With weights _____

How is this explained by the 2nd Law of Motion?

◈ Observations of marble collision:

How is what you observed explained by the 3rd Law of Motion?

Station: INCLINED PLANES

Background Information: A plane is a flat surface. For example, a smooth board is a plane. An **inclined plane** is a simple machine with no moving parts. It is simply a straight slanted surface. An inclined plane can help you move objects across distances. And, that's work! A common inclined plane is a ramp. Lifting a heavy box onto a loading dock is much easier if you slide the box up a ramp – an inclined plane.

Inclined Planes

◈ Force needed to lift weight straight up _____

◈ Force needed to lift weight up the incline _____

Longer Inclined Planes

- Observations of weight moving on ruler:

- Observations of weight moving on meter stick:

Station: OTHER SIMPLE MACHINES

PowerPoint Presentation

- Watch the PowerPoint slide show, draw & label each type of simple machine, write a short description of how we use each type of simple machine.

Station: MECHANICAL ADVANTAGE

Background Information: Mechanical Advantage is how much a machine changes force and direction.
There are two types of mechanical advantage:

- Actual Mechanical Advantage.
- Ideal Mechanical Advantage.

Actual Mechanical Advantage (AMA) is how much the machine changes distance.

Ideal Mechanical Advantage (IMA) is how much the machine changes force.

Simple Machines are mechanisms that convert energy to a more useful form of energy.

Since work is composed of two things, force and distance, simple machines change the energy to a more useful form by changing force and distance.
Simple machines can do the following:

- Increase the amount of force by decreasing direction output.
- Decrease the amount of force by increasing direction output.

The work put into the machine is almost the same as the work that comes out.
Machines do not "do" work, they just make it easier.

◈ A lever provides a mechanical advantage by:

◈ A pulley provides a mechanical advantage by:

◈ A wedge provides a mechanical advantage by:

◈ A screw provides a mechanical advantage by:

◈ A wheel & axle provides a mechanical advantage by:

◈ An inclined plane provides a mechanical advantage by:

Station: SKATEBOARD SCIENCE

Background Information: When an object rolls over a surface, the kind of friction that occurs is **rolling friction**. Skate boarders take advantage of this type of friction all the time. Reducing the amount of friction between the surface and the wheels allow skaters to go really fast.

1. What three forces are acting on a skateboard during an Ollie?
   a. _____
   b. _____
   c. _____

2. Describe any change in force that occurs during an Ollie. What does it do?
   _____
   _____
   _____

3. What is a torque?

   _____

4. What is the force that acts on you in midair?

   _____

5. Record your observations of the activity:

   _____
   _____
   _____
   _____
   _____

6. Describe how skateboarders build up speed in a half pipe.

   _____
   _____
   _____
   _____
   _____

Station: POTENTIAL & KINETIC ENERGY

Background Information: Potential Energy is the same thing as stored energy. Energy is stored in the gravitational field. When you lift a heavy object you exert energy which later will become kinetic energy when the object is dropped. The word "kinetic" is comes from the Greek word meaning to move, and the word "energy" is the ability to move. Kinetic Energy is the energy of motion --it's ability to do work. The faster the body moves the more kinetic energy is produced.

Examples of Kinetic & Potential Energy

Kinetic Energy: A gymnast on a balance beam has kinetic energy. The flips that she does demonstrate energy while she is moving. When you are running, walking, or jumping, your body is exhibiting kinetic energy.

Potential Energy: Stretching a rubber band gives it potential energy. A book on a shelf has potential energy. If the book falls from the shelf, the potential energy is converted into kinetic energy. A baseball in a glove has potential energy until it is thrown and it turns into kinetic energy.

Kinetic and Potential Energy: A waterfall has both kinetic and potential energy. The water at the top of the waterfall has stored potential energy. Once the water leaves the top of the waterfall, the potential energy is converted into kinetic energy.

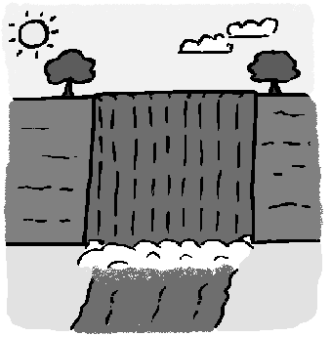
Ramp Race

Number of Blocks	Length of Ramp	Time on Ramp	Average Speed	Distance From ramp
2				
3				
4				

◈ Questions:

1. When did the car move the fastest? _____
2. When did the car move the farthest? _____
3. When the car is at the top of the ramp it has the greatest gravitational potential energy. When it is at the bottom of the ramp it has the least gravitational potential energy. The faster the car is moving, the greater its kinetic energy. Describe what is happening to the potential and kinetic energy of the car as it rolls down the ramp.

   _____
   _____
   _____
   _____



Station: TEXTBOOK

- Staple your "Foldable" to this page.
- Questions, Page 160:

1.	9.
2.	10.
3.	11.
4.	12.
5.	13.
6.	14.
7.	15.
8	