Motion and Energy

Lesson 1 Motion

https://www.youtube.com/watch?v=xKmhS4qLj_s

Position is the location of an object. It tells where an object is.

Motion is a change in position over time. Motion has two parts: distance and direction. Forward, backward, up, down, through, zig zag, circular; north, south, east, west, left or right.

To measure direction you can use a compass or protractor.

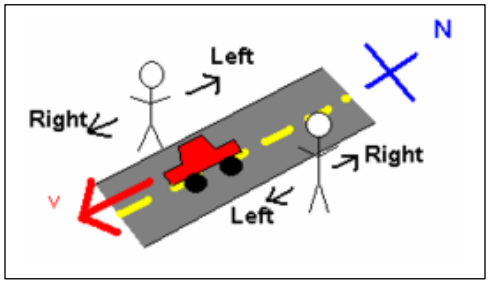
Frame of Reference

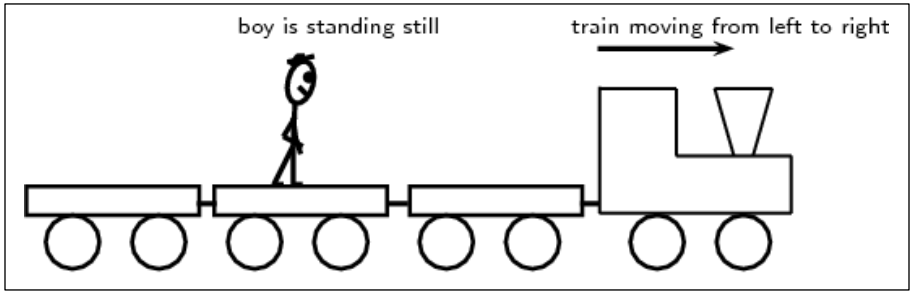
http://www.youtube.com/watch?v=5oSrDrDLylw

A **frame of reference** is a group of objects from which you can measure a position or a motion.

Your frame of reference right now is your classroom and the objects inside. A student walking on the track has a different frame of reference.

A frame of reference can move. Compare what you see from inside a car with what you see as you watch a car pass by you.





From your frame of reference the boy is moving from left to right.

Speed

Speed is how fast an object's position changes over time.

The speed of an object can change over time. When you kick a soccer ball, the ball will eventually come to a stop because it will slow down.

Average speed can be calculated by dividing distance by time.

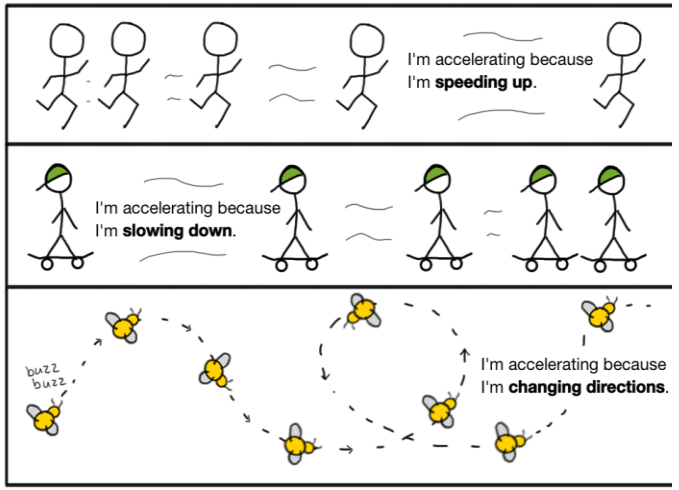
$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

https://www.youtube.com/watch?v=mDcaeO0WxBI

Velocity is the measurement that combines both the speed and the direction of a moving object.

Acceleration

Acceleration is the change in velocity over time for an object. We usually associate acceleration with speeding up. It also includes slowing down or changing direction.



Momentum

Momentum is the product of mass multiplied by velocity. The more mass an object has, the more momentum the object can have.

The more momentum an object has the easier it is for that object to move other objects.

When we want to change an object's velocity, we have to overcome its inertia.

(Inertia is the tendency of any object to keep moving in a straight line.)

Motion and Energy

Lesson 1 Motion

Position is the _____. It tells where an object is.

Motion is a _____.
Motion has two parts: distance and direction. Forward, backward, up, down, through, zig zag, circular; north, south, east, west, left or right.
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Frame of Reference

A **frame of reference** is a _____

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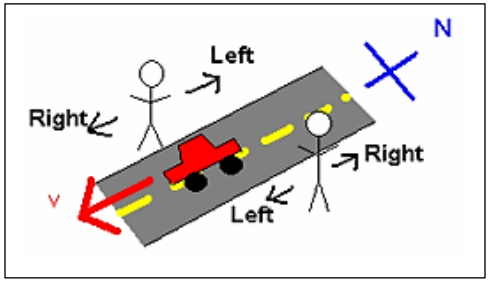
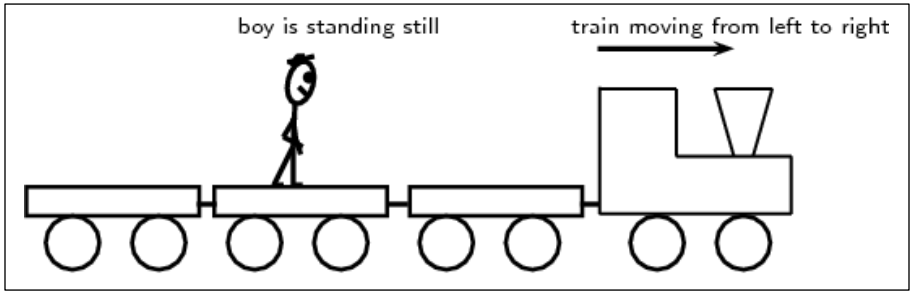


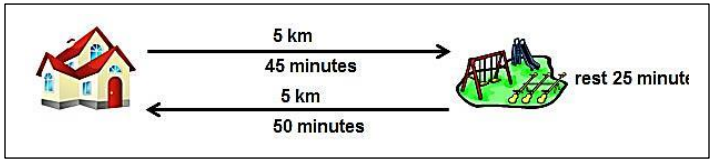


From your frame of reference the boy is moving from left to right.

Speed

Speed is how fast an _____.
The speed of an object_____.
When you kick a soccer ball, the ball will eventually come to a stop because _____.
Average speed can be calculated by _____.

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$



Velocity is the measurement that combines both _____

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Acceleration

Acceleration is the _____

_____

for an object.
We usually associate acceleration with speeding up. It also includes _____

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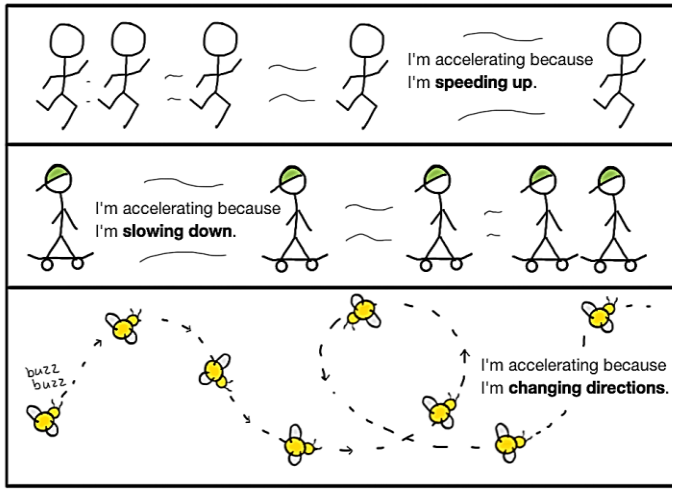


Momentum

Momentum is the product of_____.
The more mass an object has, the _____ the object can have. The _____ an object has the easier it is for that object to _____. When we want to change an object's velocity, we have to overcome its inertia.
(_____ is the tendency of any object to keep moving in a straight line.)

Lesson 2 Forces and Motion

https://www.youtube.com/watch?v=LEs9J2IQIZY

A **force** is any push or pull from one object to another

Force is measured in newtons (N) and pounds (lb).

A **spring scale** is used to measure force.

Forces occur as one object touches another and even when they do not touch.

An airplane has special names for its forces.

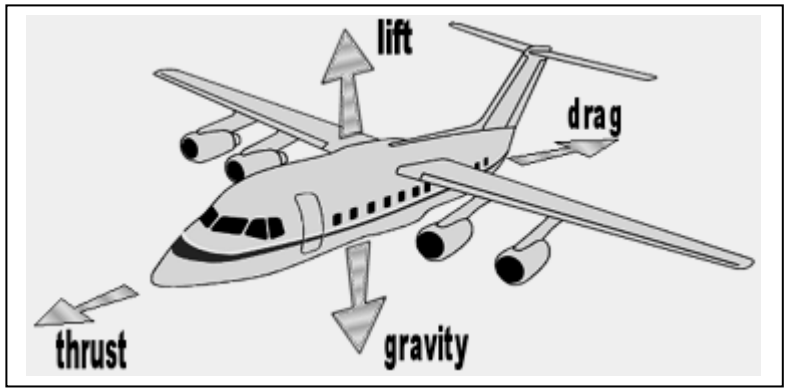
Thrust – the engines push or pull the plane forward

Lift is a force that raises the plane.

As a plane moves forward, air moves around the wings and creates lift.

Weight pulls down on the plane.

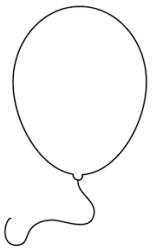
Drag slows a plane down. Drag occurs when air hits the plane and pulls back on it.



A force can cause an object to start moving, speed up, slow down, change directions, or stop.

Forces can act over a long period of time

(a balloon rising slowly)



or short period of time

(bat hitting a ball).

Gravity and Friction - "What goes up, must come down."

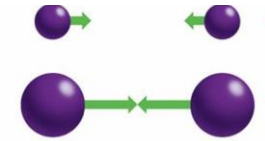
What causes your tears to run down your cheeks or a sky diver to come back to Earth? **Gravity!**

Sir Isaac Newton's law of universal gravitation says that gravity depends on the masses of objects and the distance between them.

The larger the mass, the larger the gravitational force.

The farther apart the objects, the less the gravitational force.

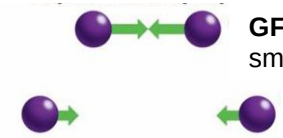
Gravitational Force Depends on Mass



GF is small between objects that have small masses.

GF is large when the mass of one or both objects is large.

Gravitational Force Depends on Distance



GF is strong when the distance between two objects is small.

If the distance between two objects increases, the gravitational force pulling them together decreases rapidly.

What causes a soccer ball to slow down as it rolls across a field?

Friction https://www.youtube.com/watch?v=MAqrWvkBoHk (3:05)

https://www.youtube.com/watch?v=C7NPD9W0kro&safe=active

Friction is a force that opposes the motion of one object moving past another.

Friction depends on the surfaces of two objects and how hard the objects are pushed together.

Friction creates heat. (Rub your hands together)

Less Friction More Friction

Lesson 2 Forces and Motion

A **force** is any _____

Force is measured in newtons (N) and pounds (lb).

A **spring scale** is used to _____

Forces occur as one _____

_____.

An airplane has special names for its forces.

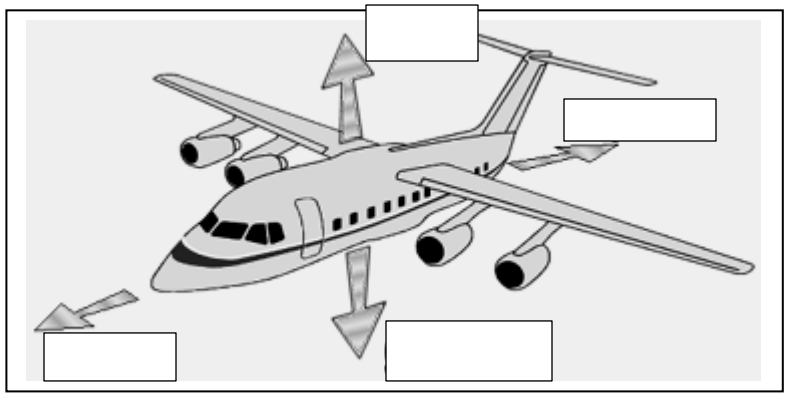
Thrust – the engines _____

Lift is a _____

As a plane moves forward, _____ and creates lift.

Weight _____

Drag _____. Drag occurs when _____



A force can cause an object _____

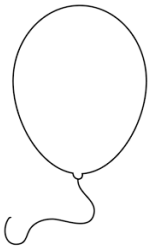
_____

Forces can act _____

(a balloon rising slowly)

_____

(bat hitting a ball).



Gravity and Friction - "What goes up, must come down."

What causes your tears to run down your cheeks or a sky diver to come back to Earth? **Gravity!**

Sir Isaac Newton's law of universal gravitation says that gravity

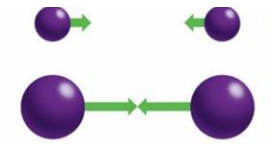
_____

_____

The larger the mass, the _____.

The farther apart the objects, the _____

Gravitational Force Depends on _____



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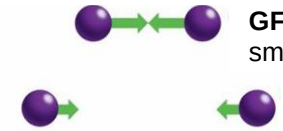

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What causes a soccer ball to slow down as it rolls across a field?

Friction

Friction is _____

_____.

Friction depends on the _____ and how hard the objects are pushed together.

Friction _____. (Rub your hands together)

_____ Friction _____Friction

Newton's 3 Laws of Motion

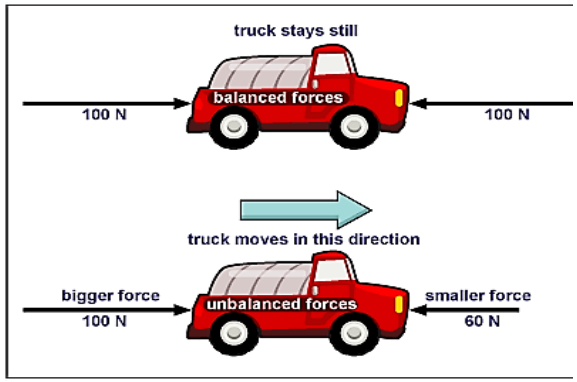
https://mpb.pbslearningmedia.org/resource/idptv11.sci.phys.maf.d4kfom/force-and-motion/#.WlQIK7BG2Uk

Newton's 1st Law of Motion aka "law of inertia": An object at rest tends to stay at rest, and an object in motion tends to stay in motion, unless an unbalanced force acts on it.

https://www.texasgateway.org/resource/newton%E2%80%99s-laws-inertia (Scroll to dominos video)

Balanced forces are forces that act on an object without changing its motion. Balanced forces tend to point in opposite directions and equal 0. Objects that are stationary have balanced forces acting on them. Some moving objects can have balanced forces acting on them.

Unbalanced forces are forces that cause an object to change its motion.

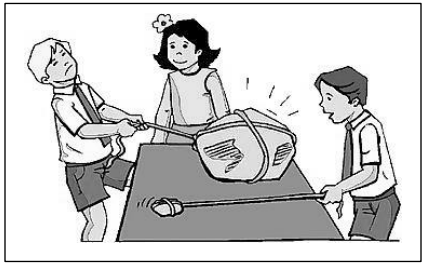


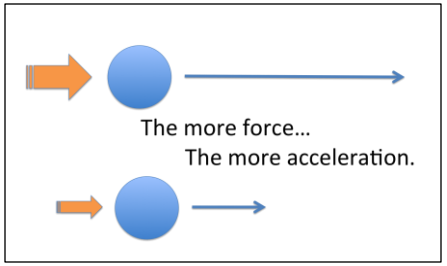
Newton's 2nd Law of Motion: Force equals mass times acceleration.

The more force used, the faster the object will move. The more mass, the slower the object will move.

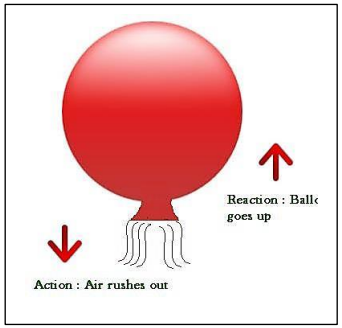
https://www.youtube.com/watch?v=OF8MjW44xDA

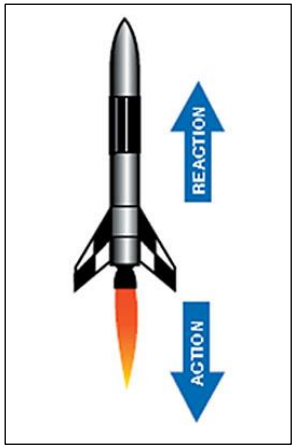
(Demonstration 1:14)

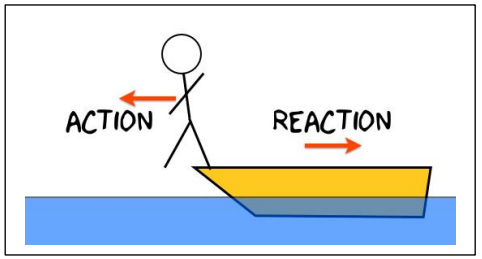




Newton's 3rd Law of Motion: For every action, there is an equal and opposite reaction. All forces occur in pairs, and these two forces are equal in strength and opposite in direction.



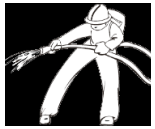




These are examples of which of Newton's Laws?

1. Why we need to wear seat belts?

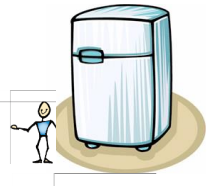
_____



2. A fireman turns on a hose, and the water pushes him back

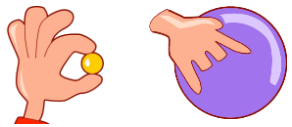
_____

3. A child trying to push a refrigerator



_____

4. You can throw a marble farther than you are able to throw a bowling ball.

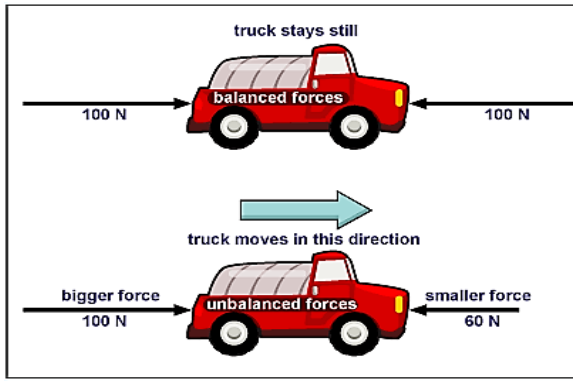


_____

Newton's 3 Laws of Motion

Newton's 1st Law of Motion aka "law of inertia": _____ _____, and _____ _____unless an _____acts on it.)

Balanced forces are forces that act on an object _____ _____ Balanced forces tend to _____ _____ and equal 0. Objects that are _____have balanced forces acting on them. Some _____can have balanced forces acting on them. Unbalanced forces are forces that _____ _____ _____ _____



Newton's 2nd Law of Motion:

_____. F = MA

The _____ used, the _____ the object will move.

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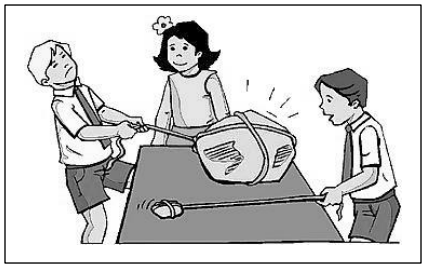
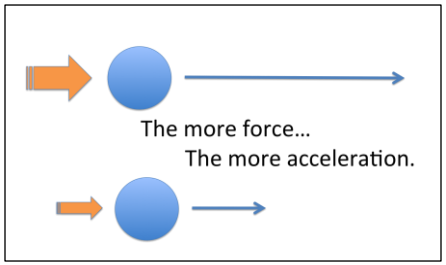
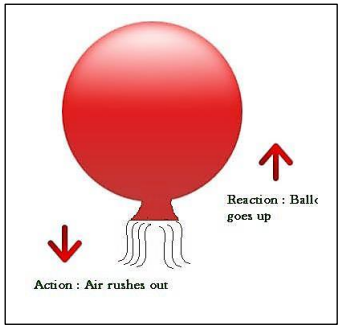
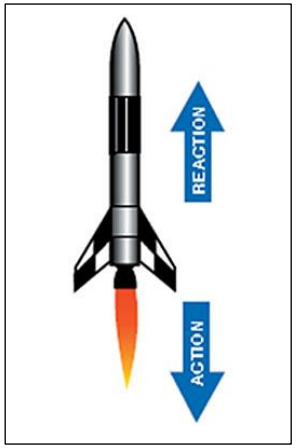
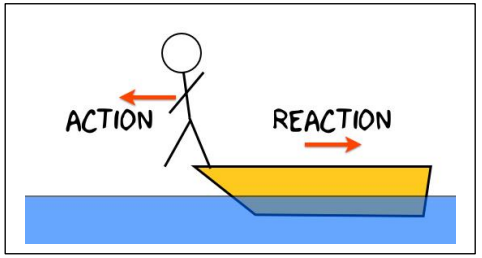




Newton's 3rd Law of Motion: _____ _____ All forces _____, and these two forces are _____ and _____.







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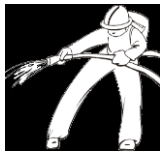

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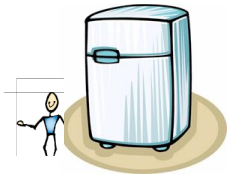

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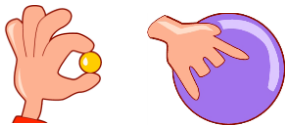


_____

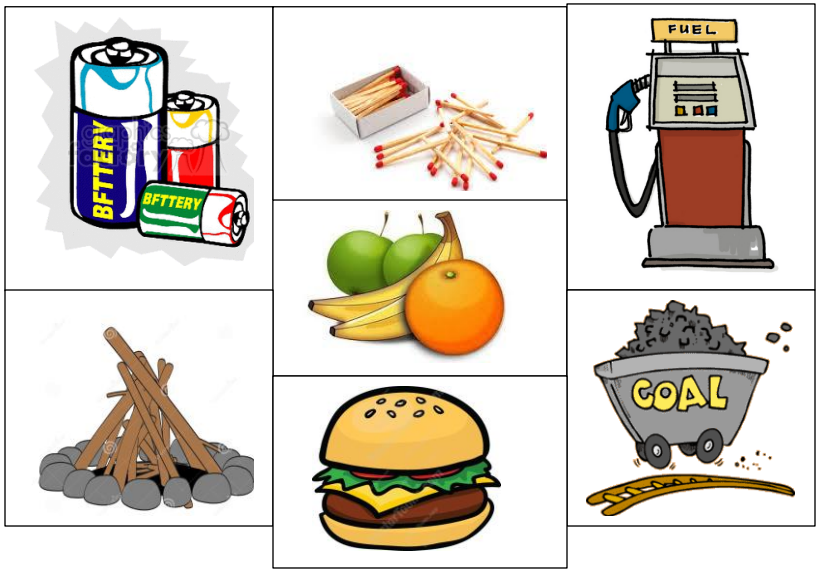
Lesson 3 Energy

Energy is the ability to perform work or to change an object.
https://www.youtube.com/watch?v=ZPIPUDtM1BI (4:04)

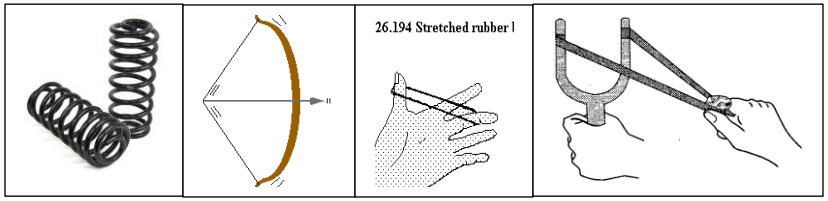
Work is the measurement of the energy used to perform a task.
Work is equal to the force used multiplied by the distance the force was applied.
Energy and work are measured in joules (J).
Objects can have energy.
Energy does not have to involve motion. Think of a stretched spring. It has the potential to do work.

Potential energy is energy that is stored in the position or the structure of an object.
https://www.youtube.com/watch?v=t2vnyfNK870 (song 2:00)

There are 3 types of potential energy:
Chemical potential energy – energy in the links between atoms and molecules.



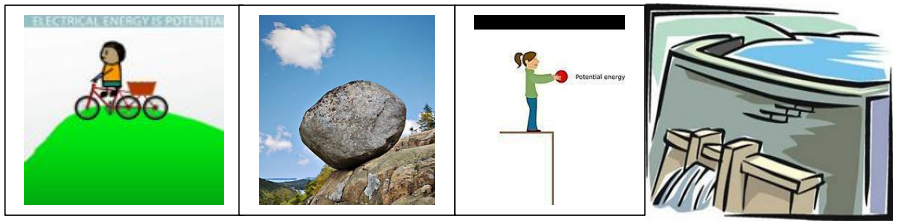
Elastic Potential Energy – energy stored by something that can stretch or compress.



Potential energy can easily change to kinetic energy. When you pull back on a bow and arrow, the arrow has potential energy. When you let go of the bowstring, the arrow has kinetic energy.

Gravitational potential energy – energy an object possesses due to its position above Earth's surface.

The higher above the ground, the greater the gravitational potential energy.



Kinetic energy is the energy of a moving object. The amount of kinetic energy increases the faster the object moves and the more mass the object has.
Kinetic energy can take many forms: heat, electricity, sound, light
In each of these types of kinetic energy, there is movement and the ability to do work.

Law of Conservation of Energy

Energy cannot be created or destroyed, it only changes form.

Kinetic energy is changed into heat energy through the work of friction. (rub your hands together)

Road Runner and Wile E Coyote and Energy
https://www.youtube.com/watch?v=Jnj8mc04r9E&t=2s 1:22
https://www.youtube.com/watch?v=i6e-KrNCe_E&t=132s 3:11
https://www.youtube.com/watch?v=SYpJS3D6vo0 2:53

Lesson 3 Energy

Energy is the _____

_____

Work is the measurement of the _____

Work is equal to the force used multiplied by the distance the force was applied.

Energy and work are measured in_____ (J).

_____can have energy.

Energy does not have to_____. Think of a stretched spring. It has the potential to do work.

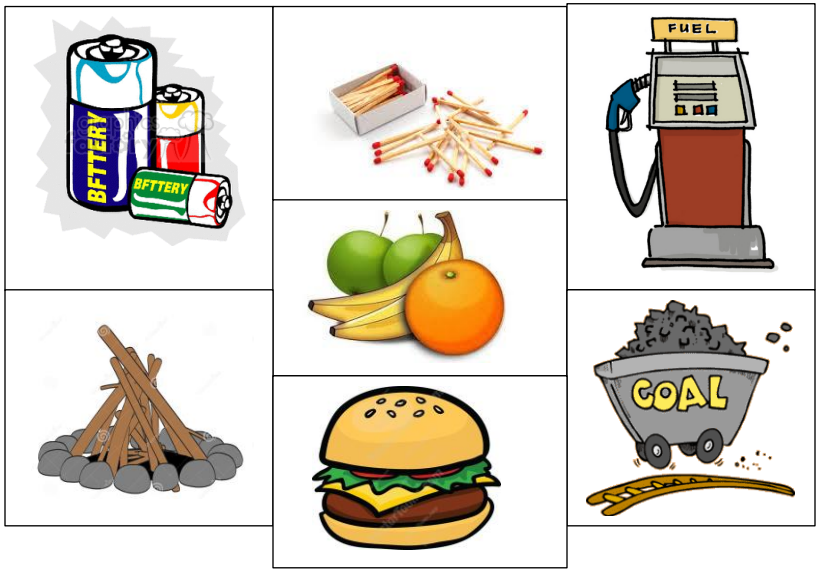
Potential energy is _____

_____

There are 3 types of potential energy:

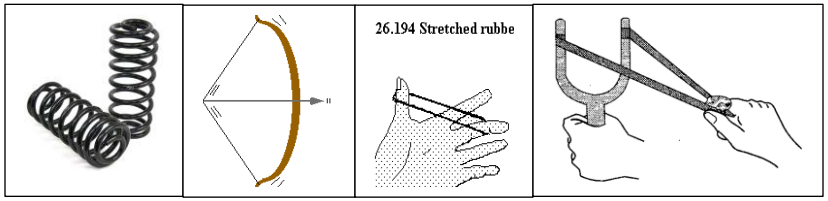
Chemical potential energy – _____

_____



Elastic Potential Energy – _____

_____



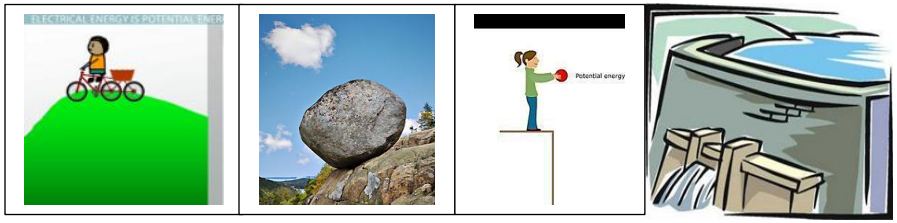
Potential energy can _____ to kinetic energy. When you pull back on a bow and arrow, the arrow has _____. When you let go of the bowstring, the arrow has _____.

Gravitational potential energy – _____

_____

The higher above the ground, the _____

_____



Kinetic energy is the _____.

The amount of kinetic energy increases _____

_____and _____

Kinetic energy can take many forms: _____

_____

In each of these types of kinetic energy, _____

_____

Law of Conservation of Energy

Energy _____

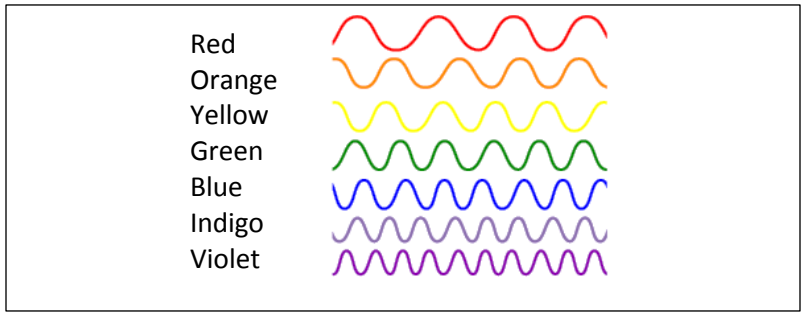
_____

Kinetic energy is _____

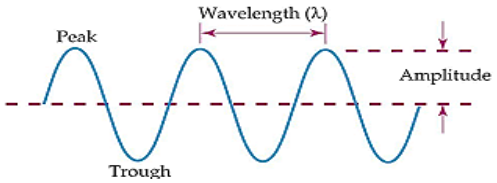
_____(rub your hands together)

Lesson 4 Light

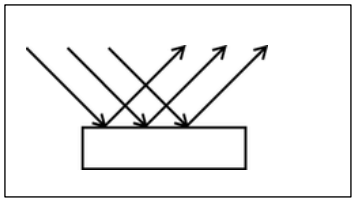
Light is made of vibrating electric and magnetic energy. Light travels in waves.



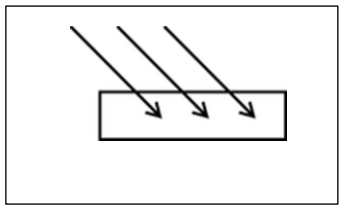
Wavelength is the distance between one peak and the next in a wave. Light is also a particle. Particles of light are called photons. A photon is a tiny bundle of energy by which light travels.



When light hits an object, it can bounce off the surface and change direction. This is called reflection.



Sometimes light hits an object and is absorbed. Absorption is the act of absorbing, or taking in, something. If light rays are absorbed, they go into the object.



Light that is absorbed is usually transferred into heat energy. Dark objects absorb more light than lighter objects. (think of a black car)

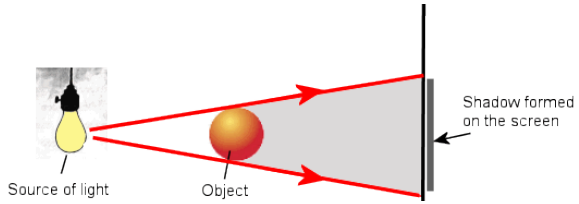
Light can also pass through objects.

Transparent objects allow the most light to pass through. (window)

Translucent objects let a blur of light pass through. (wax paper)

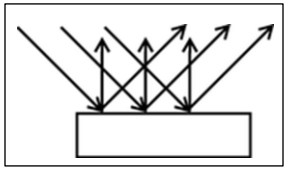
Opaque objects let no light pass through.

When an object is between a light source and another object, it will cast a shadow on the other object.



Light Bends and Bounces

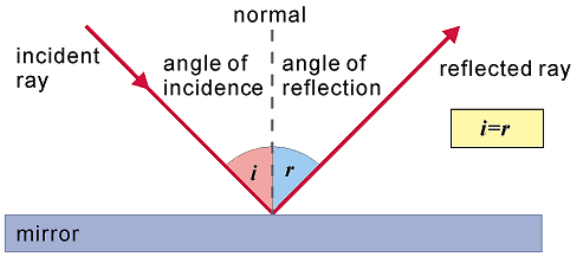
When light strikes an object with a rough surface, photons bounce off at random angles.



This is called scattering.

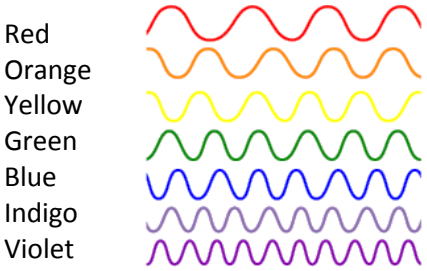
When light rays hit a mirror, the waves reflect the same way off the mirror's smooth surface.

The **Law of Reflection** says the angle of an incoming light ray equals the angle of the reflected light ray.



Lesson 4 Light

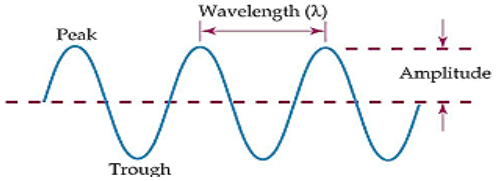
Light is made of _____.
Light travels in waves. .



Wavelength is the _____

_____

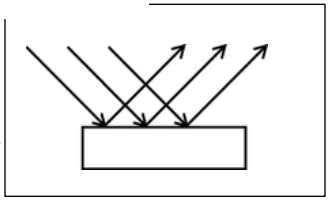
Light is also a particle. Particles of light _____
A photon is _____
by which light travels.



When light hits an object, _____

_____

_____This is called _____

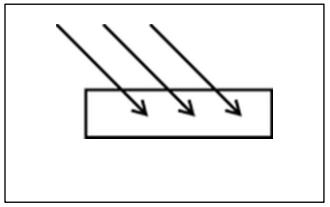


Sometimes light hits an object _____

_____

Absorption is the act of absorbing,
_____, something. If light rays
are absorbed, they go _____

_____.



Light that is absorbed is usually _____.
_____ absorb more light than _____.
(think of a black car)

Light can also pass through objects.

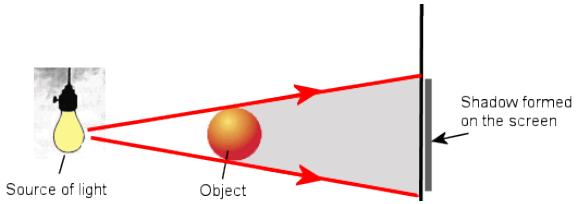
Transparent objects _____

Translucent objects _____

Opaque objects _____.

When an object is between a light source and another object, it will

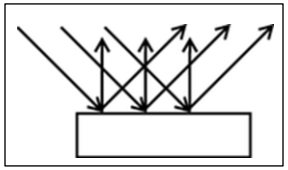
_____



Light Bends and Bounces

When light strikes an object with a rough surface, _____

_____

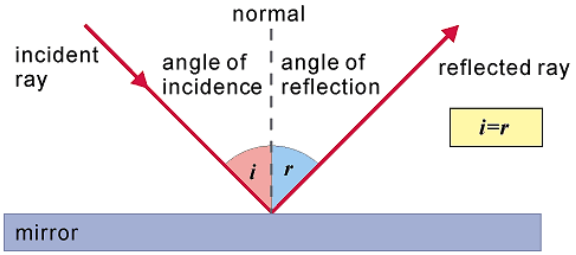


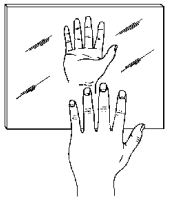
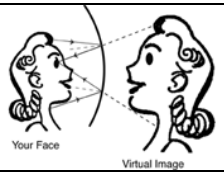
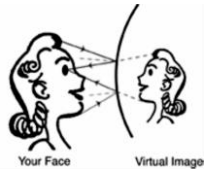
This is called _____.
When light rays hit a mirror, the waves reflect the _____

_____

The **Law of Reflection** says _____

_____



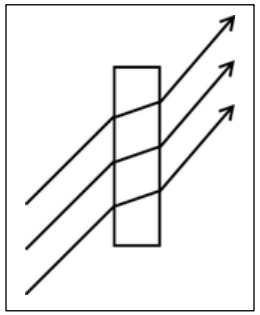
Type of Mirror	Description	Example
Flat Mirror	Surface is flat. Image appears to be behind the mirror.	
Concave Mirror	Surface of the mirror curves in. Images may be upright or upside down. May be enlarged or reduced	
Convex Mirror	Surface of the mirror curves out. Images always produce images that are upright and reduced.	

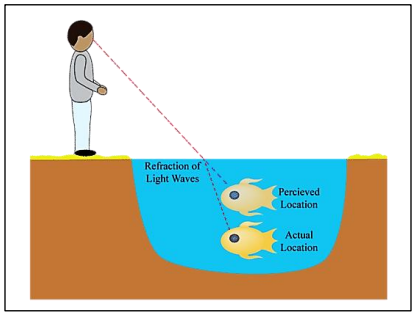
https://www.youtube.com/watch?v=fD1544bM_c4

Bill Nye on Light Bending 2:01

Refraction is the bending of light waves as they pass from one substance into another.

If you put a pencil in a glass of water, it appears to bend. When light hits water, the speed changes causing the light to refract..





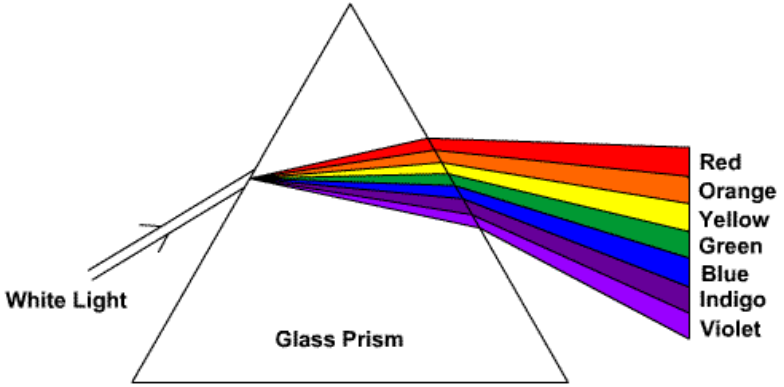
Lenses use refraction to shape images.

Lenses can also be concave and convex. (think of a pair of glasses)

Color

Our eyes see light with different wavelengths as different colors. Different wavelengths of light will reflect and refract at different angles.

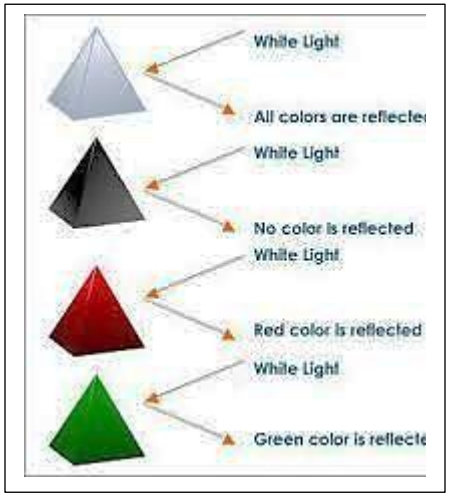
A **prism** is a cut piece of clear glass or plastic in the form of a triangle or other geometric shape. The rainbow of light that passes through it is called a spectrum.

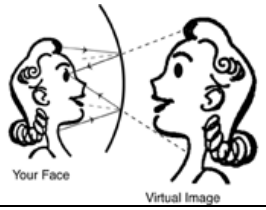
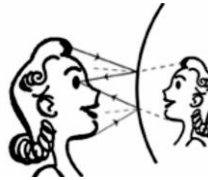


Translucent objects appear the color of the light that passes through them. They absorb all the other colors of light.

Opaque objects are the color of light that they scatter.

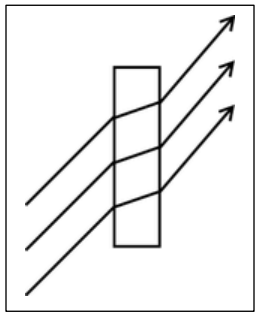
A red apple is red because all colors except red are absorbed and the red color is scattered

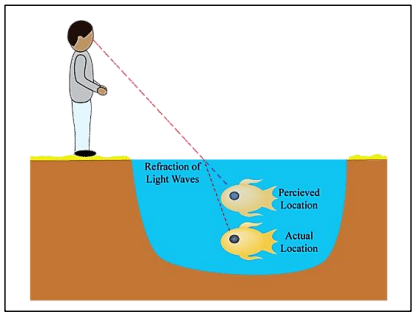


Type of Mirror	Description	Example
Flat Mirror	_____ _____ _____	
Concave Mirror	_____ _____ _____ _____	
Convex Mirror	_____ _____ _____ _____	

Refraction is the _____ as they pass from one substance into another.

If you put a pencil in a glass of water, _____. When light hits water,_____



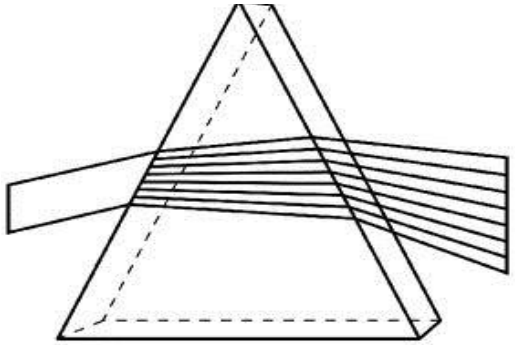


Lenses use refraction _____.

Lenses can also be _____. (think of a pair of glasses)

Color

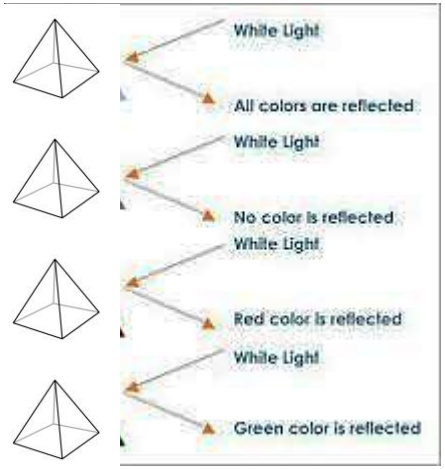
Our eyes see light with different wavelengths _____. Different wavelengths of light will _____ _____. A **prism** is a _____ _____ in the form of a _____ _____. The rainbow of light that passes through it is called a _____.

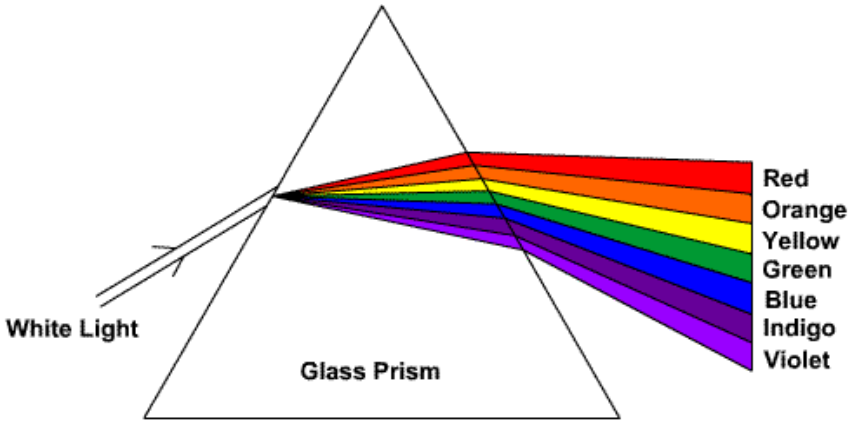


Translucent objects appear the color of the light_____ _____. They absorb _____ of light.

Opaque objects are the color of light _____ _____

A red apple is red because all colors _____ _____ _____ _____

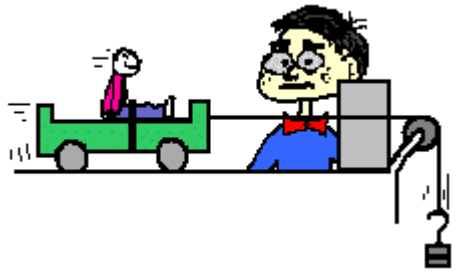



White Light
Glass Prism
Red
Orange
Yellow
Green
Blue
Indigo
Violet

Everyday Applications of Newton's First Law

There are many applications of Newton's first law of motion. Consider some of your experiences in an automobile. Have you ever observed the behavior of coffee in a coffee cup filled to the rim while starting a car from rest or while bringing a car to rest from a state of motion? Coffee "keeps on doing what it is doing." When you accelerate a car from rest, the road provides an unbalanced force on the spinning wheels to push the car forward; yet the coffee (that was at rest) wants to stay at rest. While the car accelerates forward, the coffee remains in the same position; subsequently, the car accelerates out from under the coffee and the coffee spills in your lap. On the other hand, when braking from a state of motion the coffee continues forward *with the same speed and in the same direction*, ultimately hitting the windshield or the dash. Coffee in motion stays in motion.

Have you ever experienced inertia (resisting changes in your state of motion) in an automobile while it is braking to a stop? The force of the road



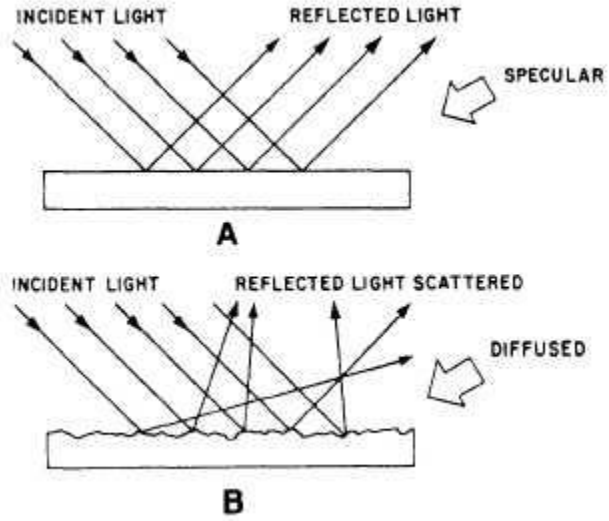
on the locked wheels provides the unbalanced force to change the car's state of motion, yet there is no unbalanced force to change your own state of motion. Thus, you continue in motion, sliding along the seat in forward motion. A person in motion stays in motion with the same speed and in the same direction ... unless acted upon by the unbalanced force of a seat belt. Yes! Seat belts are used to provide safety for passengers whose motion is governed by Newton's laws. The seat belt provides the unbalanced force that brings you from a state of motion to a state of rest. Perhaps you could speculate what would occur when no seat belt is used.

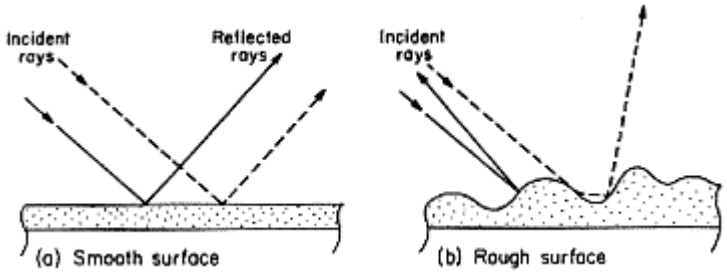
Animation

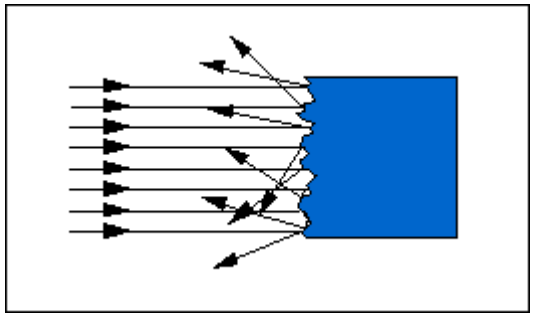
Pretend you went on a walk through your neighborhood. You walk 5 km to the neighborhood park, and it takes you 45 minutes. You stop and rest for 25 minutes at the park, and then you walk 5 km back home. It takes you 50 minutes to walk back home from the park.

There are many more applications of Newton's first law of motion. Several applications are listed below. Perhaps you could think about the law of inertia and provide explanations for each application.

- Blood rushes from your head to your feet while quickly stopping when riding on a descending elevator.
- The head of a hammer can be tightened onto the wooden handle by banging the bottom of the handle against a hard surface.
- A brick is painlessly broken over the hand of a physics teacher by slamming it with a hammer. (CAUTION: do not attempt this at home!)
- To dislodge ketchup from the bottom of a ketchup bottle, it is often turned upside down and thrusted downward at high speeds and then abruptly halted.
- Headrests are placed in cars to prevent whiplash injuries during rear-end collisions.
- While riding a skateboard (or wagon or bicycle), you fly forward off the board when hitting a curb or rock or other object that abruptly halts the motion of the skateboard.







ABSORPTION~

Q. What is absorption?

A. Absorption is the act of absorbing, or taking in, something.

Q. What is an example of absorption?

A. An example of absorption is simple: Think of a leaf. Leaves absorb light, except for green light, which is why they are green. Whatever color is not absorbed and is reflected back is the color of the object.