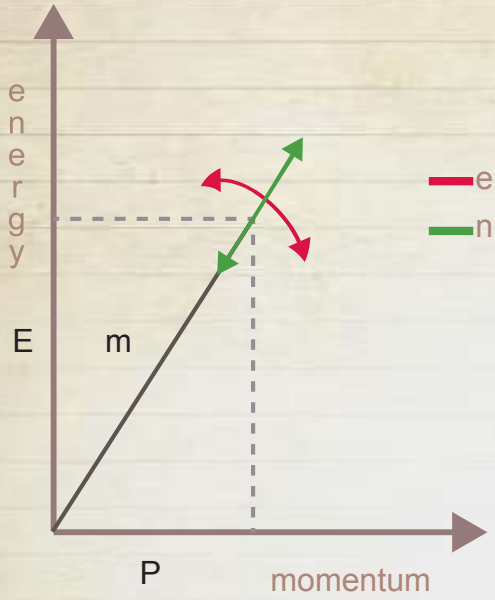
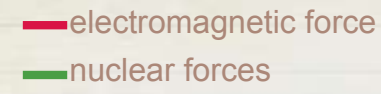
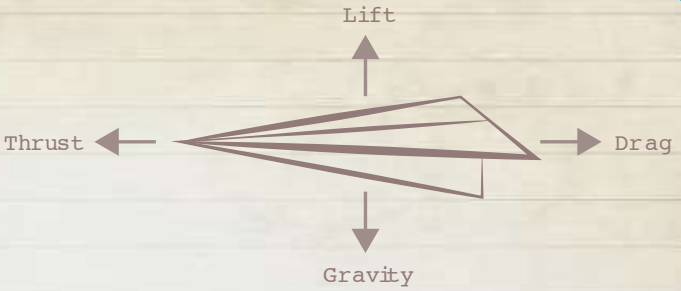
Everyday Physics

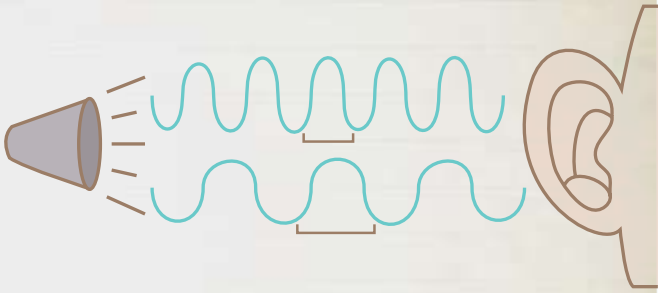
5th Grade

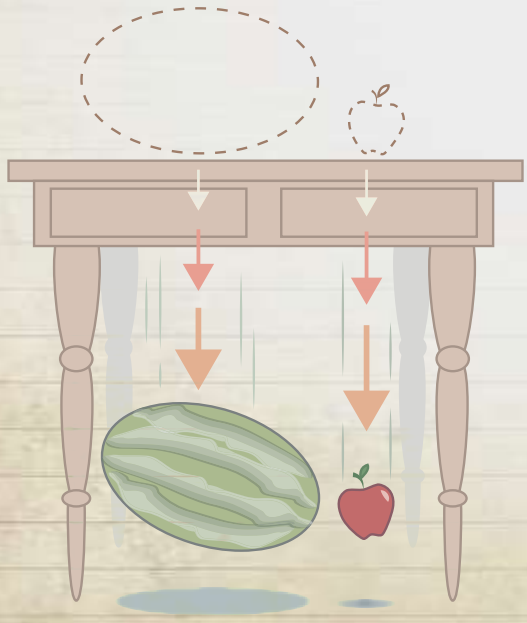


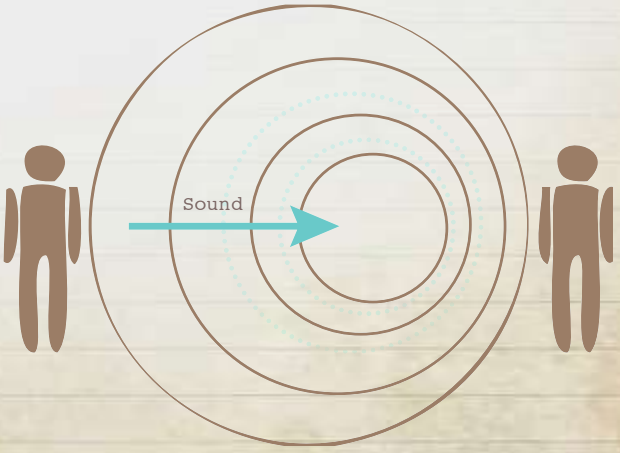




$E=mc^2$







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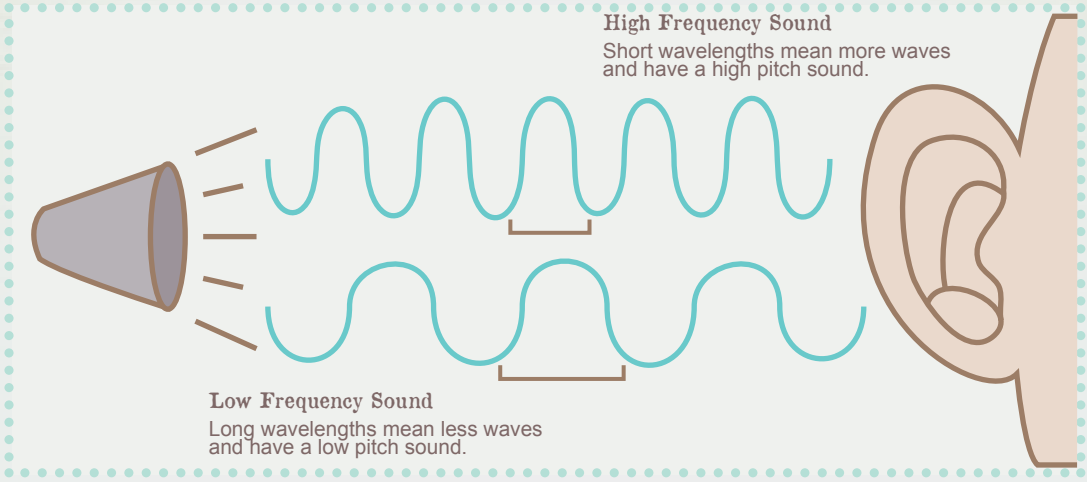
Everyday Physics

** Has an Answer Sheet*

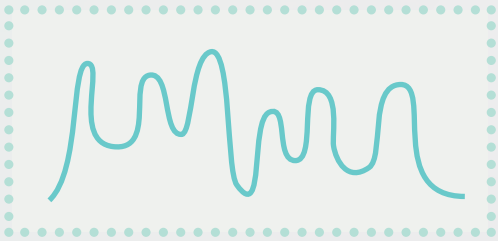
What is Sound?

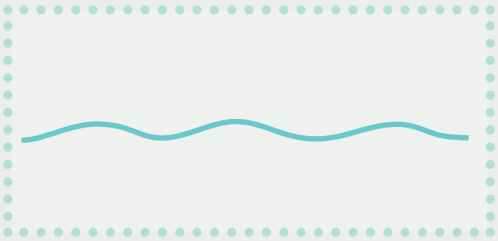
Sound is made with vibrations. Whenever an object vibrates it causes air particles to move and bump into each other in wave-like motions. We call these vibrations *sound waves*. Just like water ripples when you throw a stone into it, sound waves ripple and keep going until they run out of energy. Our ears vibrate in a similar way to the original source of the sound. This is how we hear many different sounds.



NOW YOU TRY:

Describe the frequencies you see below. What kind of sound do you think they are making?





TRY THIS!

Have you ever tried to make a pretty tone by rubbing the rim of a wine glass? When you wet your finger and drag it around the rim, it slips and sticks to the glass—similar to the way a violin bow slips and sticks to the strings that it plays. This “slip-stick” motion causes the glass to start vibrating. Try adding more water to the glass. What happens to the tone?

THINK ABOUT IT

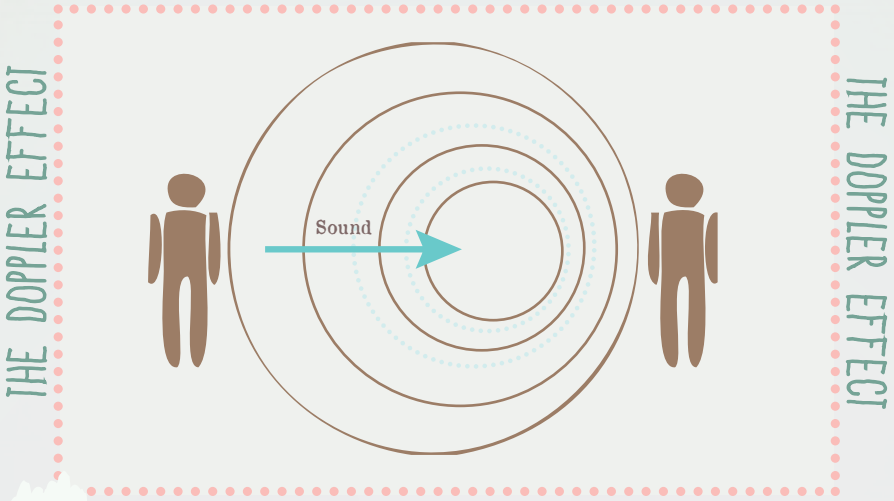
Do you think there is sound in space? Why or why not?
Hint: Space is a vacuum, which means that there are no air particles.

Moving Sound The Doppler Effect

Ever notice how sound changes and warps as it gets nearer or farther away? For instance, as a train comes closer the sound is high pitched, and it increases in pitch until it passes you. Then when it passes the pitch drops very quickly. This is called the Doppler effect.

WHAT'S HAPPENING?

The Doppler effect happens because the air in front of a moving object is compressed. That means the air particles are closer together, so the sound waves are closer together and create a high pitched frequency. The air behind a moving object is not compressed.



THINK ABOUT IT!

We are most familiar with the Doppler effect because of our experiences with sound waves. Perhaps you recall an instance in which a police car or emergency vehicle was traveling towards you on the highway. What do you remember happening as the car passed by? Why do you think that is? Draw an example using the diagram above to show a police car driving by with the sound waves!

DID YOU KNOW?

The Doppler effect is actually very useful for astronomers. They are able to get lots of information about stars and galaxies by studying the frequencies of electromagnetic waves that are produced by moving stars.

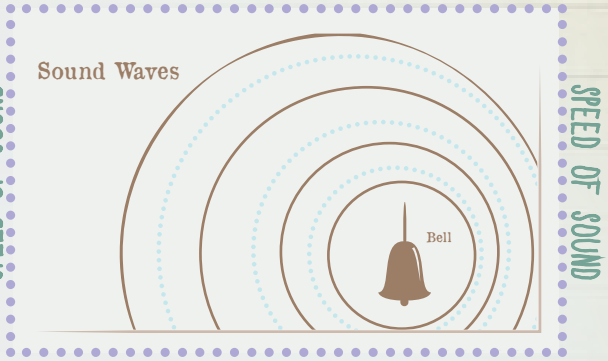
Speed of Sound

Sound travels at different speeds, depending on how fast the vibrations are passed from particle to particle. Because of this, sound travels at different speeds through different materials.

A)

MATERIAL	SPEED OF SOUND
Rubber	60 meters/second
Air	340 meters/second
Lead	1210 meters/second
Glass	4540 meters/second
Aluminum	6320 meters/second

B)



THINK ABOUT IT!

(Use chart A for the following questions)

Why does sound travel at different speeds through different materials?

In chart A, what material does sound move through the fastest? Why do you think this happens?

CHALLENGE QUESTION

If a sound wave travels through the air a approximately 750 miles per hour, how many seconds does it take for that sound wave to travel one mile?

Hint: Speed = Distance ÷ Time

DID YOU KNOW?

Researchers who looked at results from the 2004 Olympics say sprinters who were closest to the gun took off faster, probably because they perceived the shot faster and louder than their competitors did.

Speed of Light

In outer space, where there are no air particles, the speed of light is 299,792,458 meters per second. That is approximately 186,000 miles per second!

DID YOU KNOW

The starlight we see in the night sky is actually tens to hundreds of years old! Although their light travels very fast across the vacuum of space, the stars are so far away that their light takes many years to reach Earth. Light travels much faster than sound.

In fact, the sun's light takes 8 minutes to reach us on Earth. In theory, if the sun were to go out, we wouldn't know until 8 minutes after it happened.

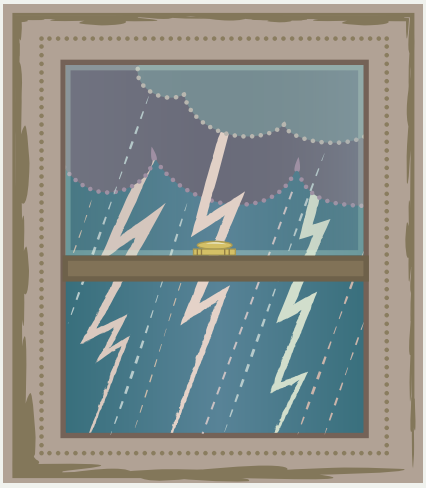
The length of time it takes light to go from:

Moon to Earth:
1.2 seconds

Earth to Sun:
8.5 seconds

THINK ABOUT IT:

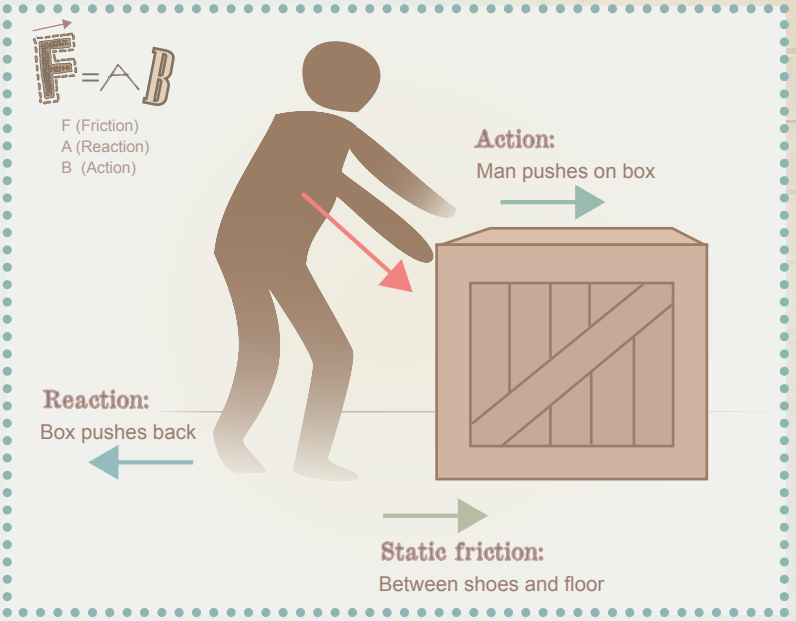
Why do we count the seconds in between the lighting flash and the sound of the thunder?



Friction

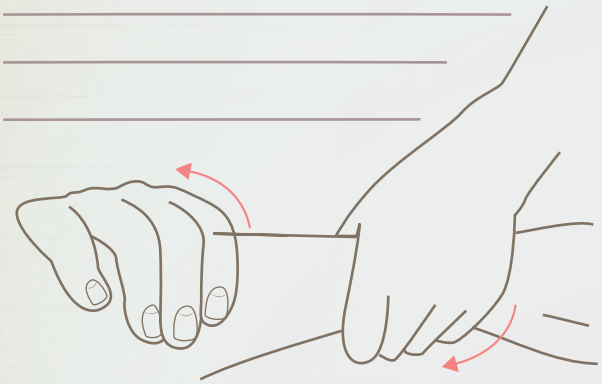
WHAT IS FRICTION?

It is a force that happens when two objects are touching and move across or against each other.



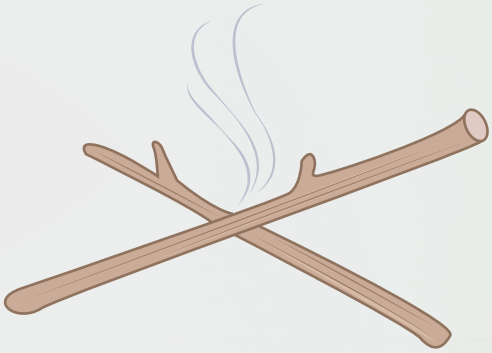
THINK ABOUT IT!

Why does an "Indian burn" hurt so badly?



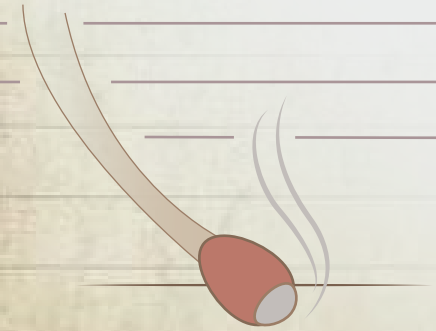
FRICTION CAUSES *heat...!*

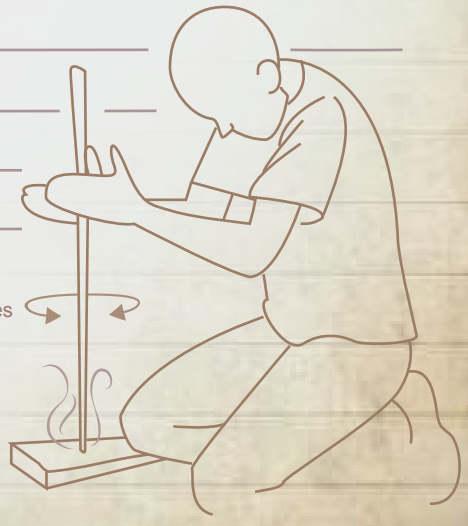
Have you ever tried to rub two sticks together to make a fire? It takes a long time!



CHALLENGE QUESTION!

What modern technology do we have to make fire? Does it involve friction?

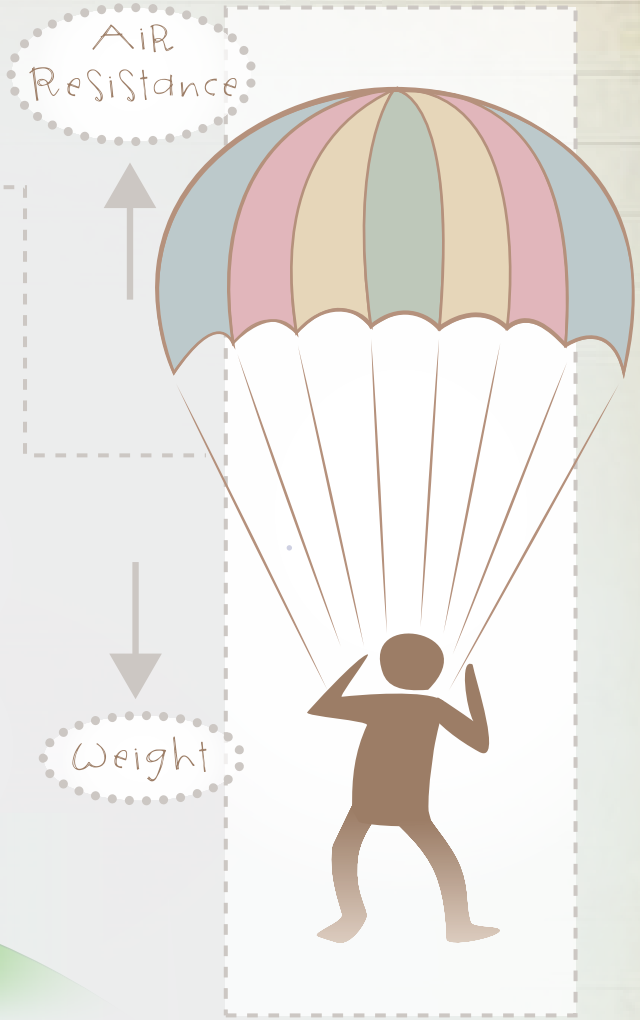




Air Resistance

All matter has substance/mass, even air molecules! Air resistance (or *drag*) happens when air molecules collide with a moving object and slow it down.

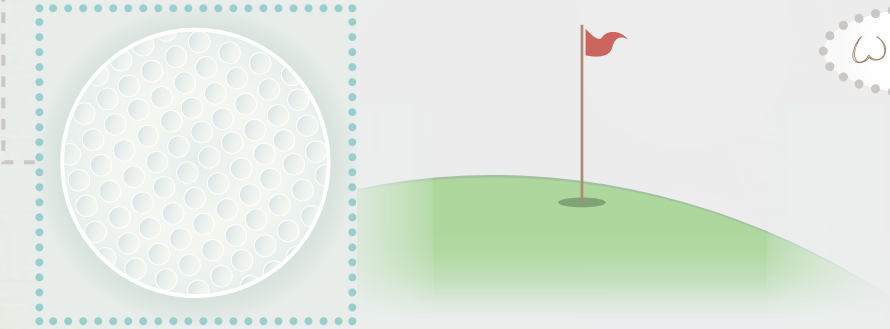
EXAMPLE: A skydiver who jumps out of a plane.



DID YOU KNOW?

When a car travels at 50 miles per hour or more, half of the gas it uses is spent on overcoming air resistance!

Dimples on a golf ball help reduce drag, allowing the ball to fly further than a ball without dimples.



WATER RESISTANCE:

Today's competitive swimwear has has changed so dratiscally that the material goes faster through the water than human skin. Controversy over the new suits has broken out, due to the fact that consistent world record times have been broken since the introduction of new water-resistant material starting around the year 2000.

THINK ABOUT IT!

If you were to drop a 2 dollar bills, one crumpled and one flat, the crumpled one would fall faster because there is less resistance acting on the paper. Air resistance works with an objects surface area. The more of an area the more air resistance!

Air Resistance (continued)

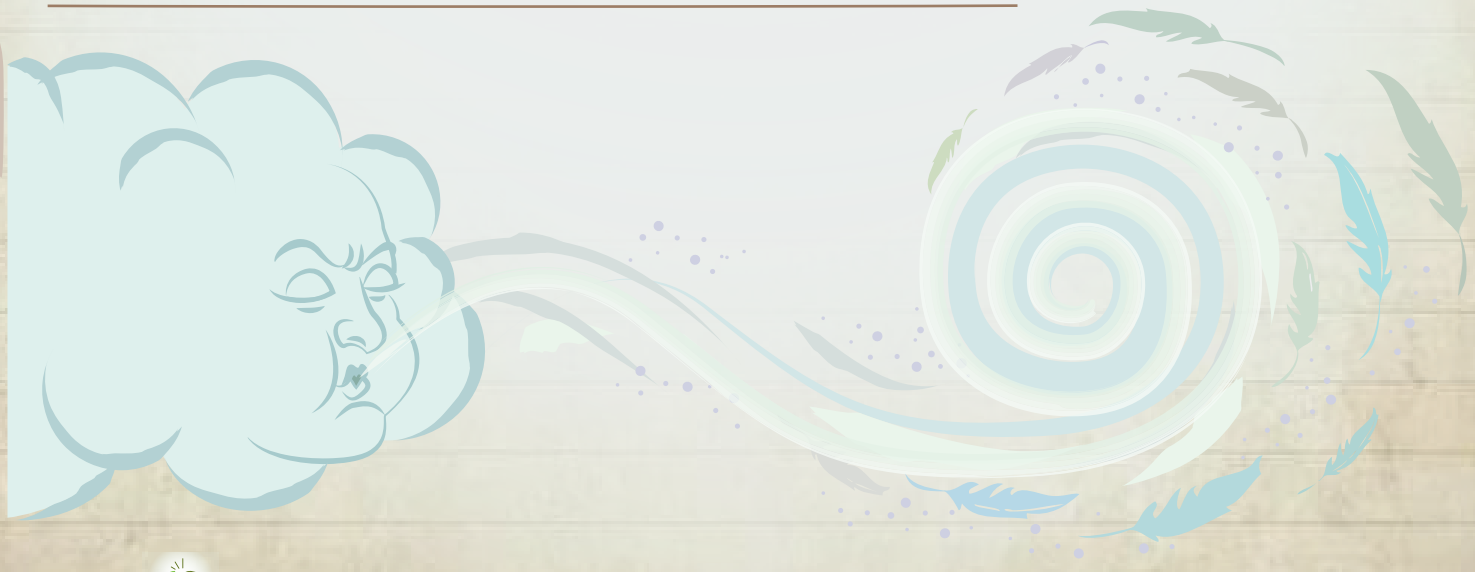
READING COMPREHENSION

1. What factors affect air resistance?

2. What directions do the forces of air resistance and weight act on a falling object?

3. If a skydiver jumps out of a plane, which force is greater - gravity or air resistance?

4. Why does a feather fall slower than a tennis ball?



Paper Airplane Physics

AERODYNAMICS – Have you ever held your hand out of the car window on the freeway? If you hold your palm out with your fingertips toward the sky, the wind fights your hand. This is called *air resistance*. If you hold your hand flat with your finger tips facing the direction that the car is moving, the wind travels smoothly over your hand. That is *aerodynamic*.

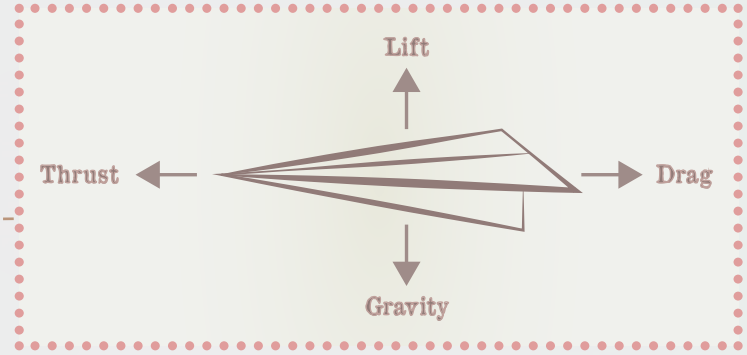
DRAG – For a far and fast flight, less drag is better! Drag is the pull you feel when the air resists your open palm.

GRAVITY – The plane is constantly being pulled down by gravity. The lighter the plane, the better the flight.

THRUST – This is the forward movement of the plane, as you launch it.

LIFT – This is the upward movement of the plane, which comes from the airplane's wings. If the air below the wing is pushing up harder than the air above the wing, the plane will have more lift!

THE FOUR FORCES IN BALANCE

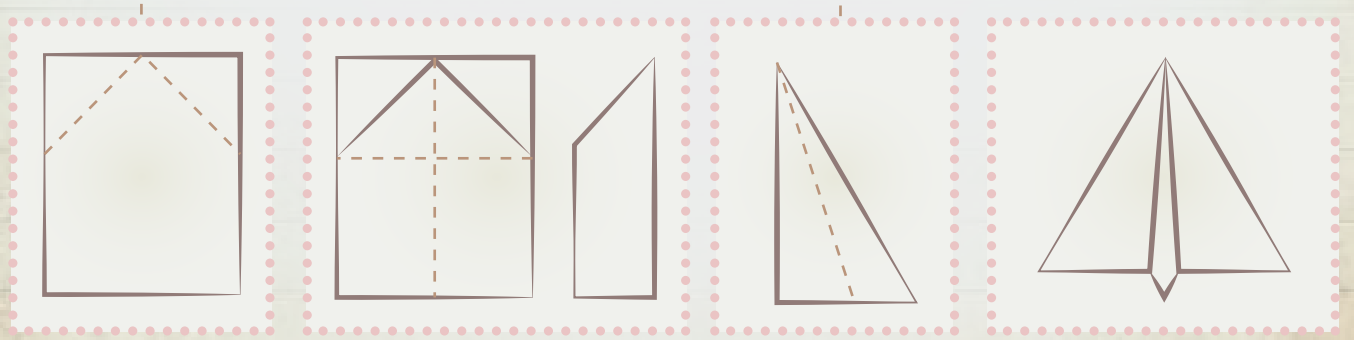


NOW IT'S YOUR TURN

Basic Paper Glider

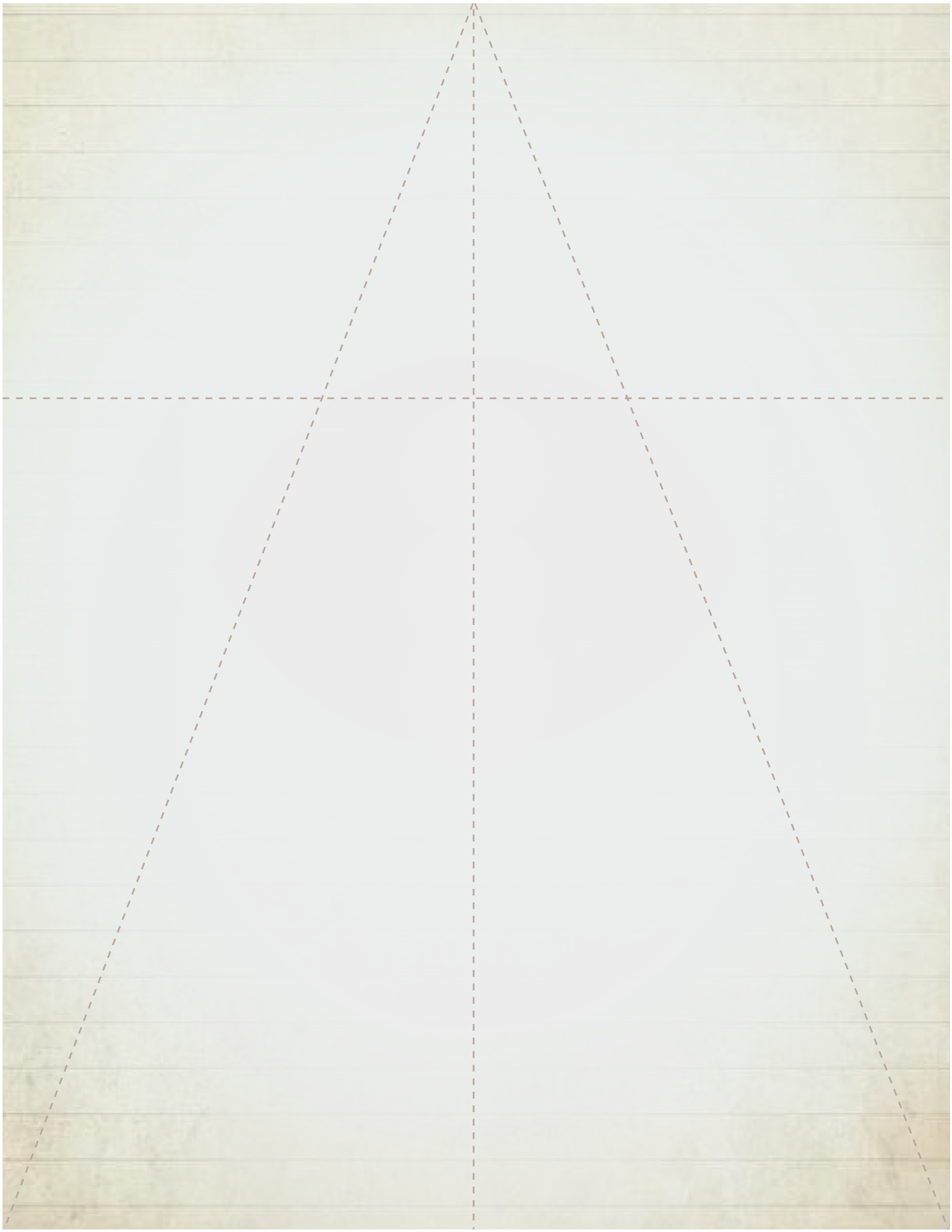
1. Fold the two upper corners down.

3. Take the two outer corners and fold like this:



2. Fold paper in half-length wise.

4. Your glider should look like this!



Gravity Newton's Law of Gravitation

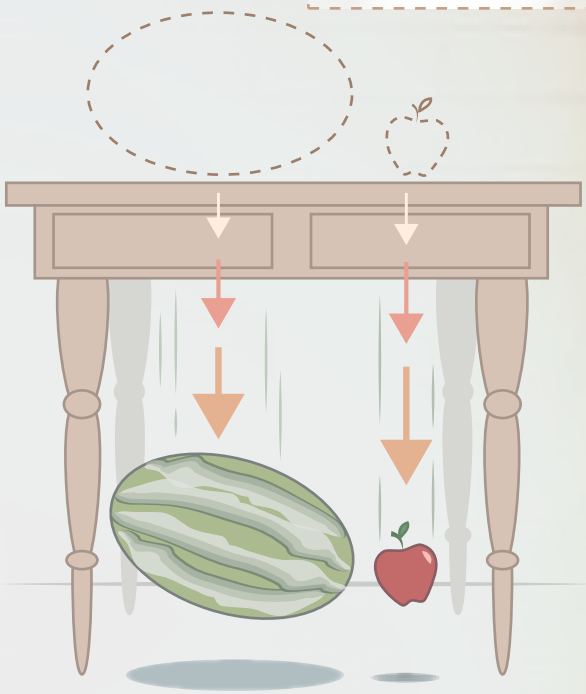
All objects that have mass are attracted to each other.

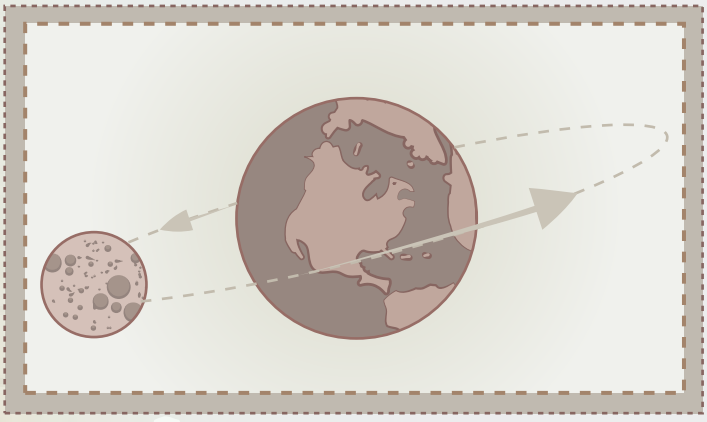
NEWTON'S LAW OF UNIVERSAL GRAVITATION: Every object in the universe attracts every other object with a force directed along the line of centers for the two objects.

Gravity pulls **ALL** objects towards the earth at the same rate of speed!

THINK ABOUT IT!

Using the diagram to the right explain what you see. Will the watermelon hit first or the apple? Why?





WHAT CAUSES THINGS TO ORBIT?

An orbits happens when there is a perfect balance between the forward motion of a body in space, such as a planet or moon, and the pull of gravity from another body in space, such as a large planet or star. An object with a lot of mass moves forward; however, the gravity of another body in space pulls. It's a continuous tug-of-war between the two objects.

DID YOU KNOW?

The moon doesn't circle around the earth? It is actually falling towards the Earth. It does not crash into us because it is held in an orbit by gravity.

FUN FACT:

Weight depends on how strong the gravitational pull is. You'll weigh less or more on different planets. Because of differences in gravity, a 220 pound person would only weigh 84 pounds on Mars.

Newton's First Law The Law of Inertia

THE LAW OF INERTIA

An object at rest will remain at rest unless acted on by an unbalanced force. An object in motion continues in motion with the same speed and in the same direction unless acted upon by an unbalanced force.

THINK ABOUT IT!

The sled only starts moving when someone gives it a push down the hill.

This is why you wear a seatbelt in the car!

When the sled is stopped by a rock, the kid keeps going and flies off of it!

CHALLENGE QUESTIONS!

1. Which objects are in motion in this picture?

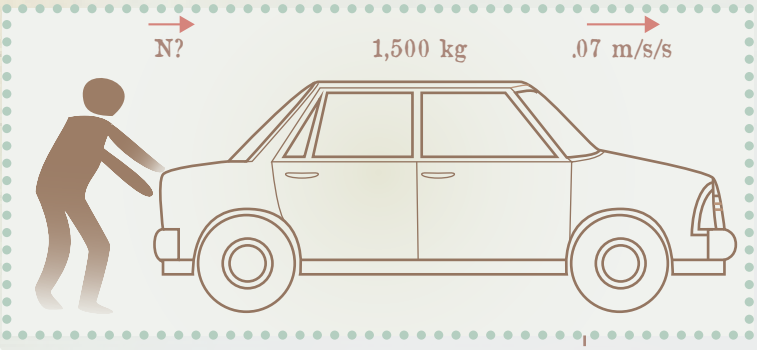
2. What is the unbalanced force in this picture?

3. What happened to the sledder in this picture?

4. Describe an experience you have had relating to Newton's Law of Inertia.

Newton's Second Law The Law of Acceleration

ACCELERATION is produced when a force acts on a mass. The greater the mass of the object being accelerated, the greater amount of force needed to accelerate the object.



Phillip's car, weighs 1,500 kg. He just ran out of gasand needs to push the car to a gas station and he makes the car go 0.07 m/s/s. Using Newton's Second Law, how much force is Phillip applying to the car?

$$F=MA$$
$$F= 1{,}500 \times 0.07$$

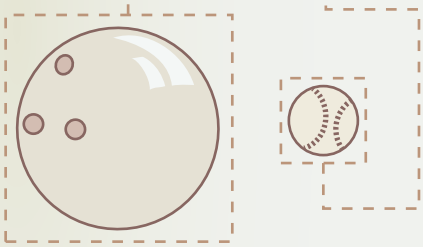
Answer: _____

THINK ABOUT IT!

The heavier the object the more force you will need in order to move it compared to a lighter objects, which requires less force.

(F=MA)

Force = **MASS** × Acceleration



EXAMPLE: Hitting a bowling ball versus a baseball. For every action there is an equal and opposite reaction. When you push an object, it pushes back.

CHALLENGE QUESTION!

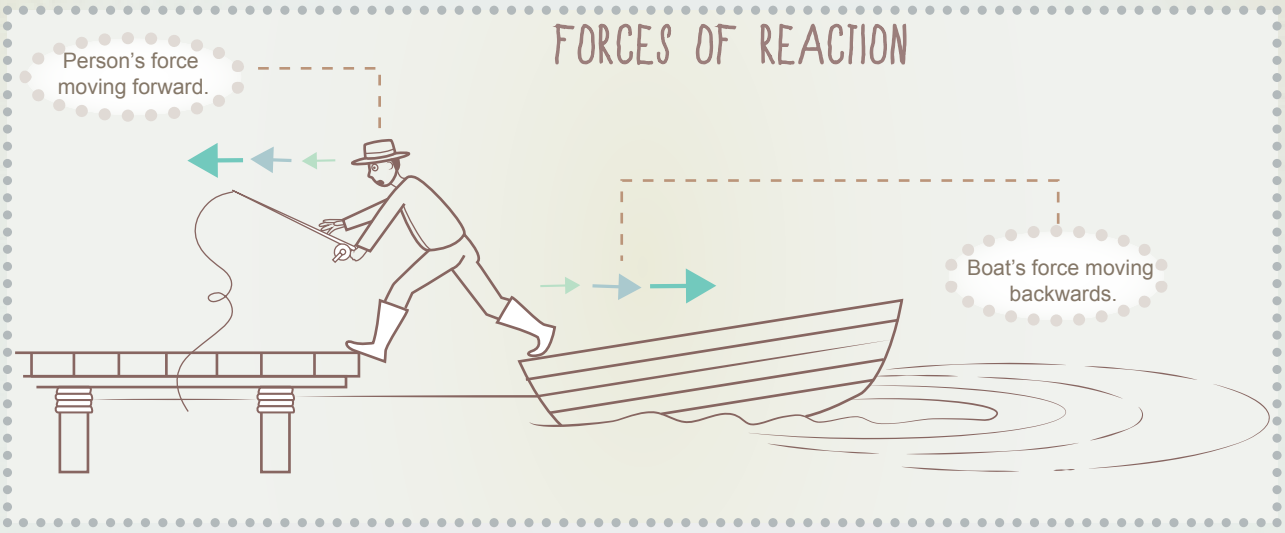
What would happen if you hit a baseball with a bat? A bowling ball? Describe the difference.

Newton's Third Law of Motion The Action-Reaction Law

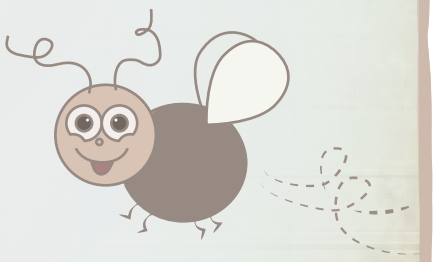
ACTION-REACTION LAW

To every action there is always an equal and opposite reaction.

THINK ABOUT IT!



CHALLENGE QUESTIONS!



1. You're driving down the road, and a bug hits the windshield of the car! The bug hits the car and the car hits the bug. Which of the two forces is greater: The force on the bug or the force on the car?

_____

_____

_____

2. Many people know that a rifle recoils, or jerks back when fired. This is the result of Newton's action-reaction law. A gunpowder blast creates hot gases that expand outward allowing the rifle to push forward on the bullet, and the bullet pushes backwards upon the rifle. The acceleration of the recoiling rifle is _____ than the acceleration of the bullet.:

a) greater
b) smaller
c) the same size

What is Energy?

Energy is the ability for one object to do work on another object. Usually energy is defined as a force that acts over a distance.

Most types of energy fall under two categories: kinetic energy OR potential energy. Kinetic energy is the energy that an object has when it's in motion. Potential energy is the stored energy in an object that is at rest. Forces like gravity and electric charge are what give all objects in this world potential energy.

The law of conservation of energy states that energy cannot be destroyed or created; it can only be transferred or transformed.

Some types of energy are: wind energy, chemical energy, solar energy, nuclear energy, geothermal energy, sound energy, hydro energy, elastic potential energy, gravitational potential energy.

DID YOU KNOW?

Over 1,000 homes can be powered for one year with 1 million tons of garbage. If all garbage in the United States was converted to energy it could power a city for one year.

If 10,000 schools turned off their lights for one minute it could save $81,885.

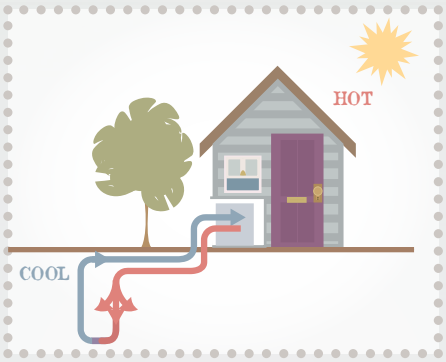
The amount of energy Americans use *doubles* about every 20 years.

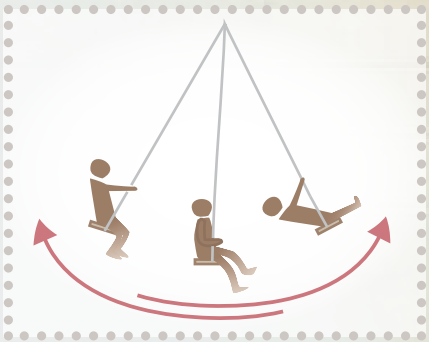
Volcanoes and geysers are examples of geothermal energy.

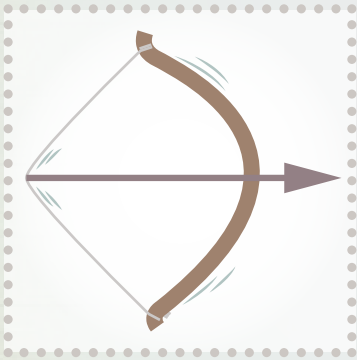
What is Energy? (continued)

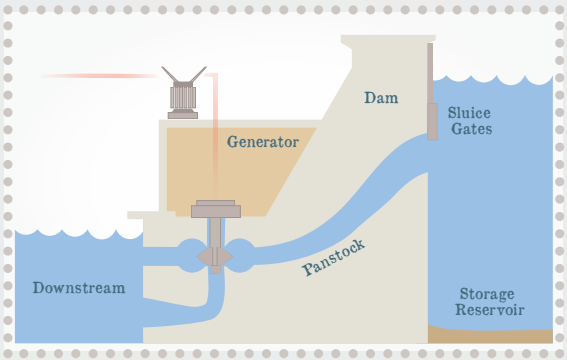
MATCH THE ENERGY!

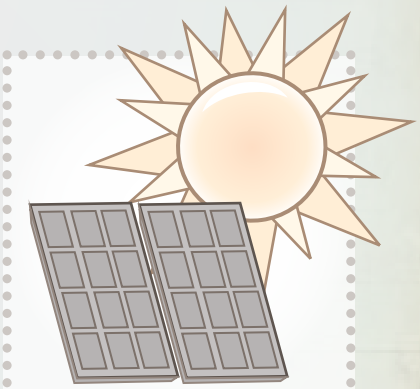
Match the type of energy that goes with the correct picture! Types: wind energy, chemical energy, solar energy, nuclear energy, geothermal energy, sound energy, hydro energy, elastic potential energy, gravitational potential energy.

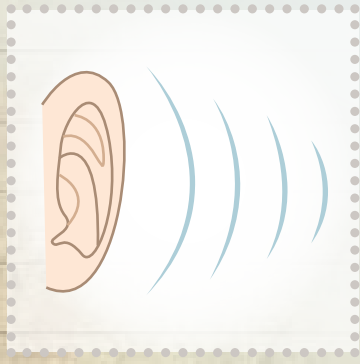


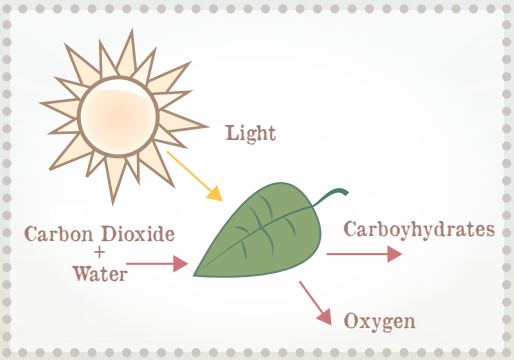


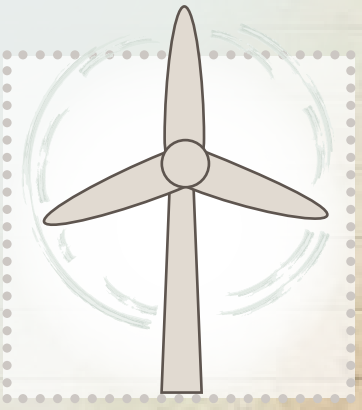












Energy

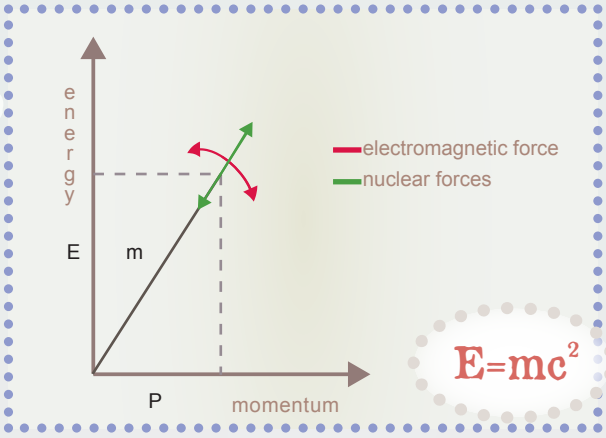
$$E = mc^2$$

WHAT'S HAPPENING?

We all know this famous equation. But what does it all mean?
Two of the most important parts of physical science are matter and energy. Matter is anything that takes up space. Energy is the property of matter that performs work. Matter and energy are two forms of the same thing. Einstein created a mathematical formula that explains how matter can be changed into energy.

E= energy

m= mass



c^2= Speed of light times the Speed of light.

E (energy) equals m (mass) times c2
(c stands for the speed of light).

This equation allows scientists to know how much energy things have, whether it's the energy in a bowling ball or the energy in a supernova.

THINK ABOUT IT!

How do you think the following items use energy?

A growing tree: _____

A person: _____

A toaster: _____

A light bulb: _____

DID YOU KNOW?

Stars shine because the matter inside them is slowly being changed back into energy.

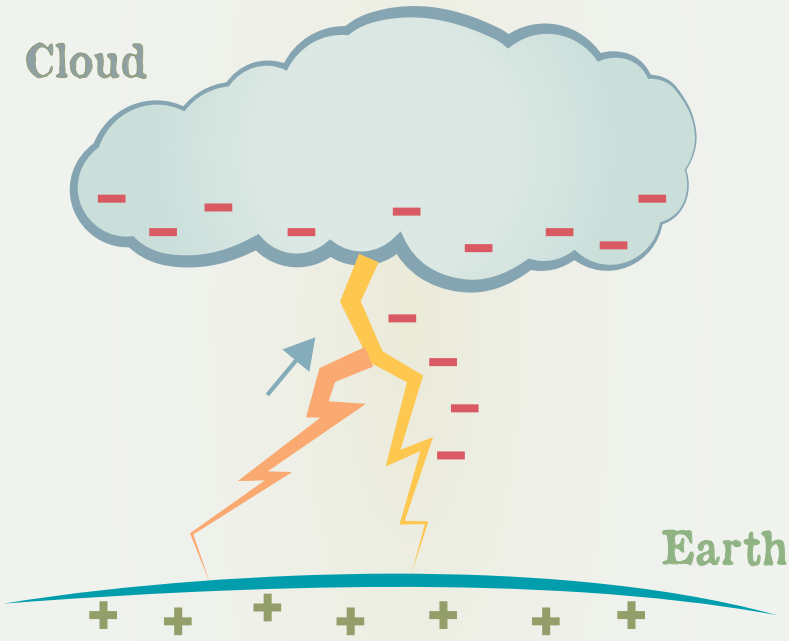
he Physics of Lightning

What is happening when lightning strikes the ground?

As the negative charges approach the ground, a stream of positive charges repelled by the ground attract to the negative stream.

When connected, they have created path which allows a sudden down surge of electrons to jump to the ground.

This is the lightning.

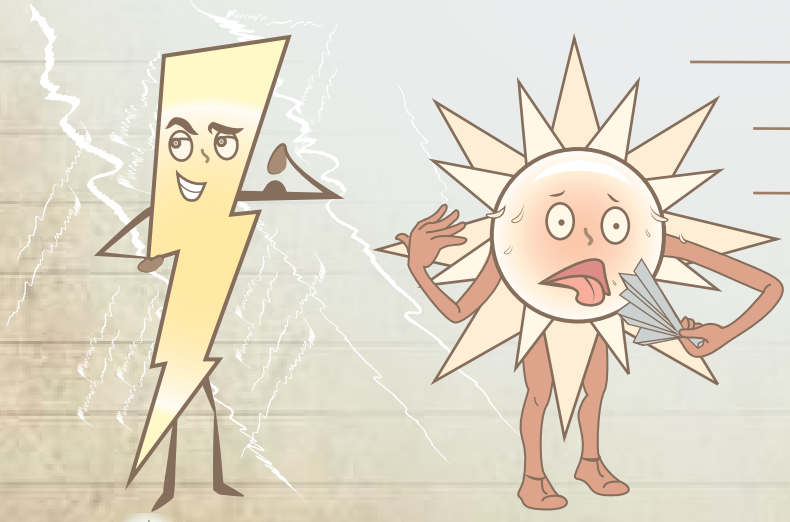


As the NEGATIVE charges collect at the bottom of the cloud it forces the negative charges in the ground to be forced away from the surface. This leaves the ground POSITIVE.

DID YOU KNOW?

Cars are a very safe place to be, and it's not the rubber tires that protect you! This is a very common misconception. It is actually the metal that is surrounding you that acts like a cage of protection. This is due to the Skin Effect which says that electricity, like lightning, will travel only on the surface of enclosed metal objects. So while your car may be hit by lightning, if you stay inside you will be safe.

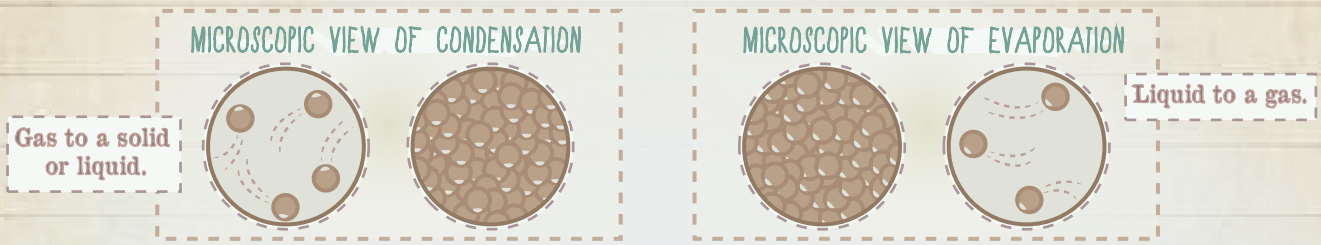
CHALLENGE QUESTION: Why are you safer if you are lower to the ground?



FUN FACTS!

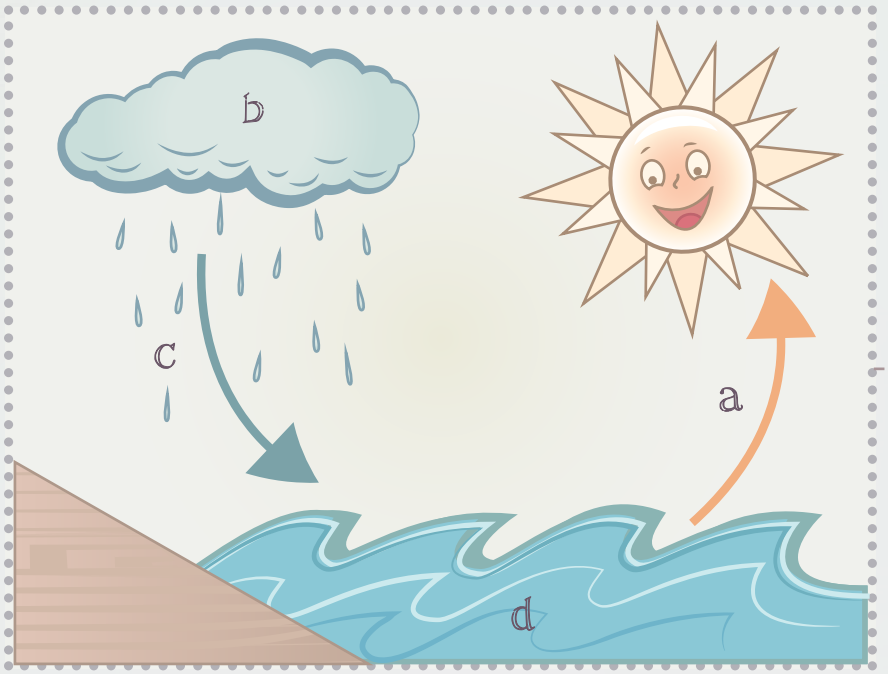
The temperature of a lightning flash is 15,000 to 60,000 degrees Fahrenheit. That's hotter than the surface of the sun (9,000 degrees Fahrenheit).

Condensation and Evaporation



WHAT'S THE DIFFERENCE?

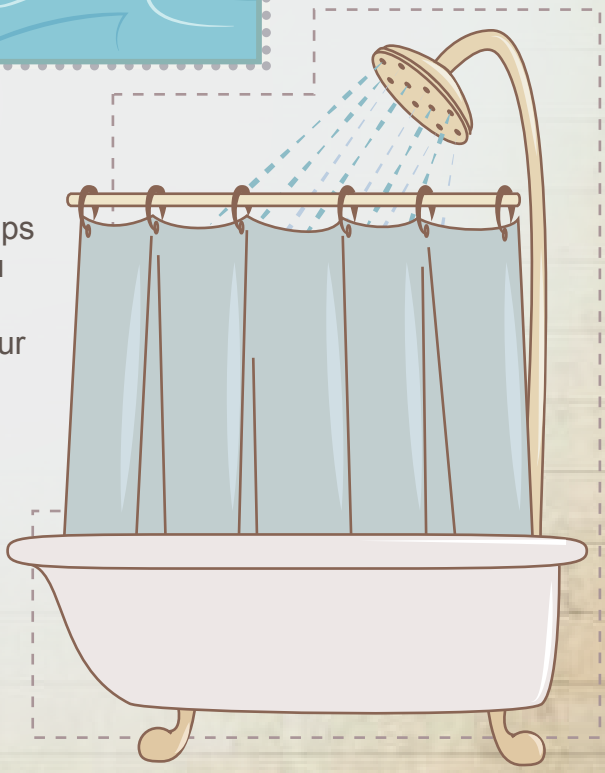
Condensation is a warming effect. It changes from a vapor to a condensed state, either a solid or a liquid. Evaporation is a cooling effect, It's the change of a liquid to a gas.



a: Evaporation
b: Condensation
c: Precipitation
d: Collection

THINK ABOUT IT!

When you're finished in the shower, it's wise to towel off with the curtains/doors still closed – the closed space traps the water vapor in. As the vapor condenses, it keeps you warm. But once you open up the curtains, all the gas will escape and you'll be left with water evaporating off of your body, making you colder.



FUN FACT:

When you sweat, your body knows it's too hot and sweats in order to cool itself. The moisture produced by your body evaporates and helps to cool off your skin.

Condensation and Evaporation

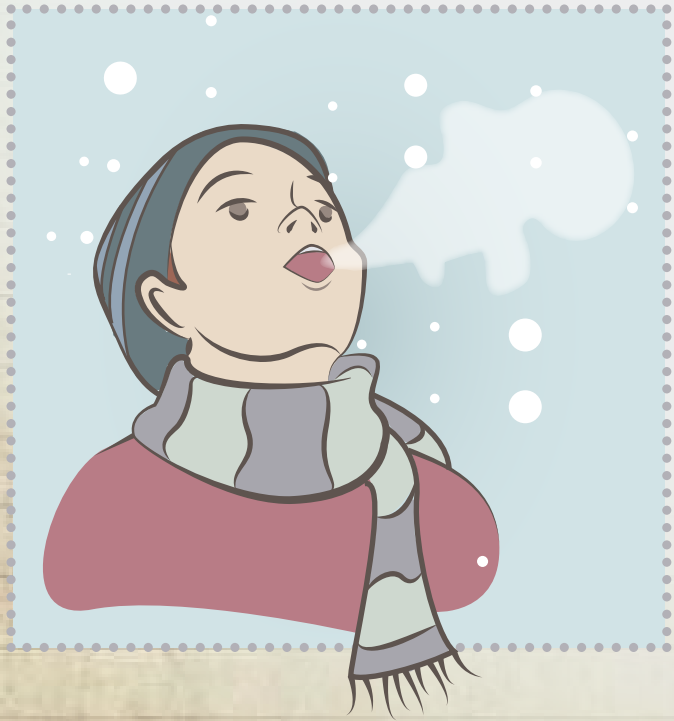
CHALLENGE QUESTION:

1. Hanging Wet Clothes

Where do you think would be the best place to put your clothes/materials so that they will dry as quickly as possible. Draw a picture showing what you think will happen to the water.

2. Condensation of Breath in Air

Describe what you think is happening when you can see your breath in the air. Where do you think it comes from? Do you think you can make it go away?



Magnet Myths

Magnets are objects that create an area of magnetic force called a magnetic field. These fields by themselves are invisible to the human eye. Magnets only attract certain types of metals, such as iron, cobalt, and nickel.

Attracted to:

- Iron
- Cobalt
- Nickel

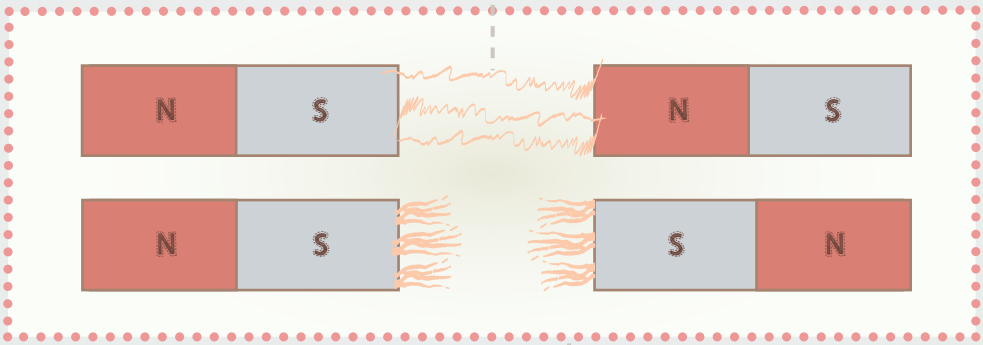
Not attracted to:

- Plastic
- Gold
- Aluminum
- Glass
- Copper
- Silver
- Magnesium

Magnets have a north pole and a south pole. If the same pole of two magnets are put close each other they will repel or push away. If different poles are close to each other they will be attracted to each other and pull together.

Magnetic objects must be inside the magnetic field to respond, which is why you may have to move a magnet closer for it to have an effect.

Unlike poles attract



Like poles Repel

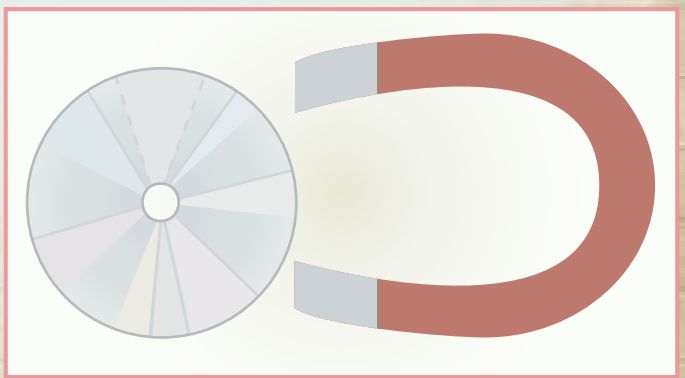
FREQUENT QUESTIONS

Can a magnet damage electronics?

Yes, powerful magnets are actually used to wipe information from computer hard drives. Most types of electronic equipment are made with tiny magnets, and those can be affected by another magnet close by. However, most household magnets, such as fridge magnets, are not strong enough to damage electronics.

Can a magnet wipe information from a CD?

No. The information on a CD is burned onto the CD with a laser. A magnet won't affect the information on a CD.



Magnet Myths (continued)

FREQUENT QUESTIONS...

Can you make a metal magnetic by rubbing a magnet on it?

To make a metal magnetic, you must do something to manipulate the magnetic domains of the metal so that they point in the same direction. This happens when you rub a pin on a magnet – the pin's magnetic domains will align because they've been exposed to the magnet's magnetic field. You can also do this by placing a piece of metal in a strong magnetic field in a north-south direction or passing an electrical current through it.

Do magnets have healing powers?

Doctors and scientists have been studying the healing effects of magnets for a long time. But we're still not quite sure of how powerful a magnet's healing capabilities are. There are many theories to explain why magnets MIGHT be good for your body. For example, some say that the iron found in hemoglobin in your blood can be affected by magnets. That is why many people wear magnetic bracelets or necklaces to help improve blood circulation. Some say that magnets can also change the structure of nearby cells. This could mean that magnets might be able to heal pain or illnesses.

Magnets are used as a part of many different medical devices. For example, an MRI (Magnetic Resonance Imaging) uses magnetic fields to see the organs in our bodies.

COMPREHENSION

1. If you can manipulate metal to be magnetic, do you think you can demagnetize something? How would this work?

2. Magnets do one of two things, repel or attract. Why is this?

erhero Physics!

Now that you have learned all about physics, if you were a *Super Hero* what would your powers be?

Would you rather be able to move at the speed of sound or the speed of light?

Who is Sound Man's arch nemesis?

If you had the gift of super friction, what would you be able to do?

Lightning Boy is about to strike! Where will you hide?

Who does better in the water: Sound Man or Light Man? What about in outer space?

What special features does Air Resistance Man's super suit have?

Great job!

_____

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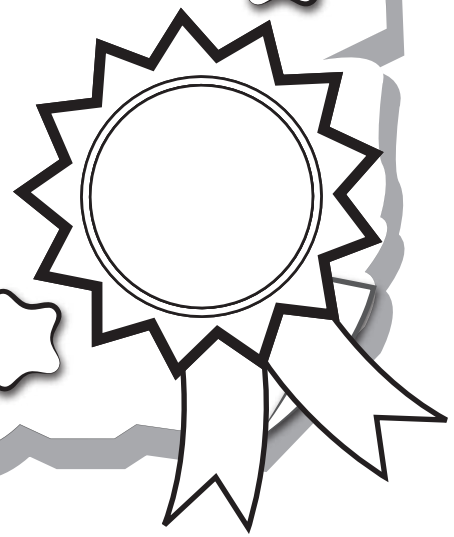


Answer Sheets

Everyday Physics

Speed of Sound
Air Resistance
Newton's Third Law: The Action-Reaction Law
What is Energy?
The Physics of Lightning
Magnet Myths
Superhero Physics!

Answer Sheet

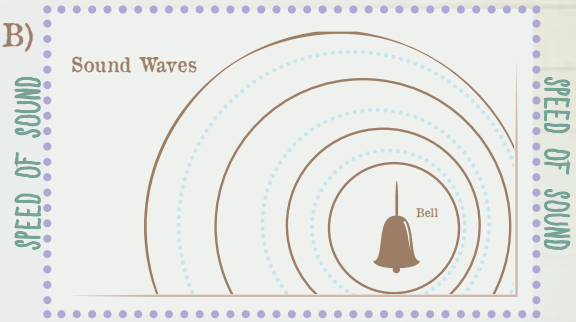
Speed of Sound

Sound travels at different speeds, depending on how fast the vibrations are passed from particle to particle. Because of this, sound travels at different speeds through different materials.

A)

MATERIAL	SPEED OF SOUND
Rubber	60 meters/second
Air	340 meters/second
Lead	1210 meters/second
Glass	4540 meters/second
Aluminum	6320 meters/second

B)



THINK ABOUT IT!

(Use chart A for the following questions)

Why does sound travel at different speeds through different materials?

All materials are made of different particles, and some particles vibrate the sound faster (or slower) than others.

In chart A, what material does sound move through the fastest? Why do you think this happens?

Aluminum moves sound fastest, because it is the least dense of the materials on the list. It vibrates sound very quickly.

CHALLENGE QUESTION

If a sound wave travels through the air a approximately 750 miles per hour, how many seconds does it take for that sound wave to travel one mile?

Hint: Speed = Distance ÷ Time

First find miles per second. To do that, find the number of seconds in 1 hour. 60 x 60 = 3,600 seconds in one hour.

Then, calculate how many miles per second it travels 750 / 3,600 = .21 ≈ .20 miles per second = 1/5 mps

The sound wave travels 1/5 of a mile per second, so it takes 5 seconds to go 1 mile!

DID YOU KNOW?

Researchers who looked at results from the 2004 Olympics say sprinters who were closest to the gun took off faster, probably because they perceived the shot faster and louder than their competitors did.

Answer Sheet

Air Resistance ANSWERS

READING COMPREHENSION

1. What factors affect air resistance?

Size and Shape. Air resistance works with the surface area, the more of a surface the more air resistance.

2. What directions do the forces of air resistance and weight act on a falling object?

Air resistance pushes UP while gravity pulls DOWN. This happens when objects fall straight down. Air resistance works opposite of gravity for an object that is falling down.

3. If a skydiver jumps out of a plane, which force is greater - gravity or air resistance?

Gravity is the greater force. When a falling object is falling, it hits the ground! So gravity wins over air resistance.

4. Why does a feather fall slower than a tennis ball?

A feather has less mass and more surface area. This makes it much more affected by air resistance, and slower to fall.

Answer Sheet

Newton's Law The Action-Reaction Law ANSWERS

1. Trick Question:

The force exerted by the car is the same as the force exerted by the bug, because for every action there is an equal and opposite reaction! The fact that the bug splatters only means that with its smaller mass, it is less able to handle the acceleration of the larger mass (the car) resulting from the impact.

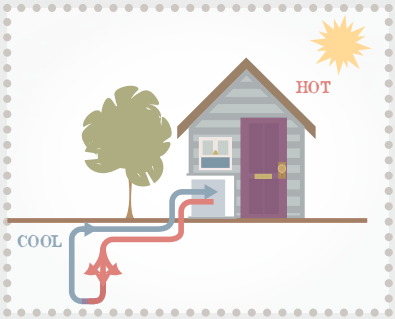
2. C. The force of the rifle equals the force of the bullet.

Answer Sheet

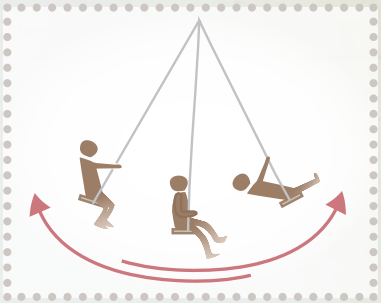
What is Energy? Answers

MATCH THE ENERGY!

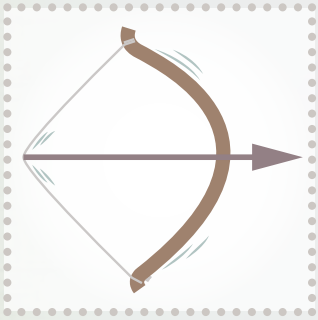
nuclear energy



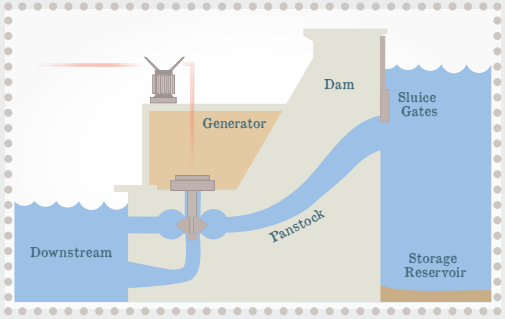
geothermal energy



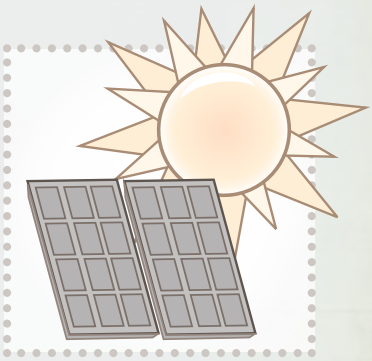
gravitational potential energy



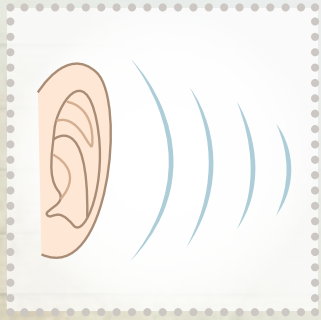
elastic potential energy



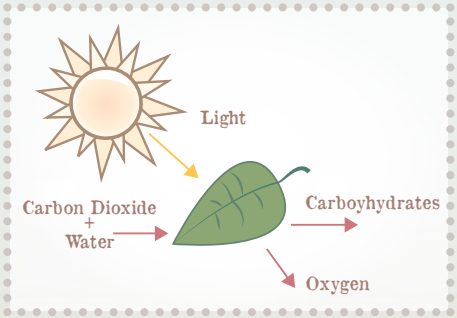
hydro energy



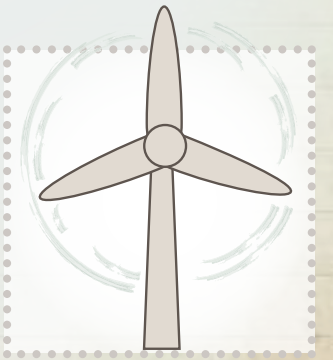
solar energy



sound energy



chemical energy

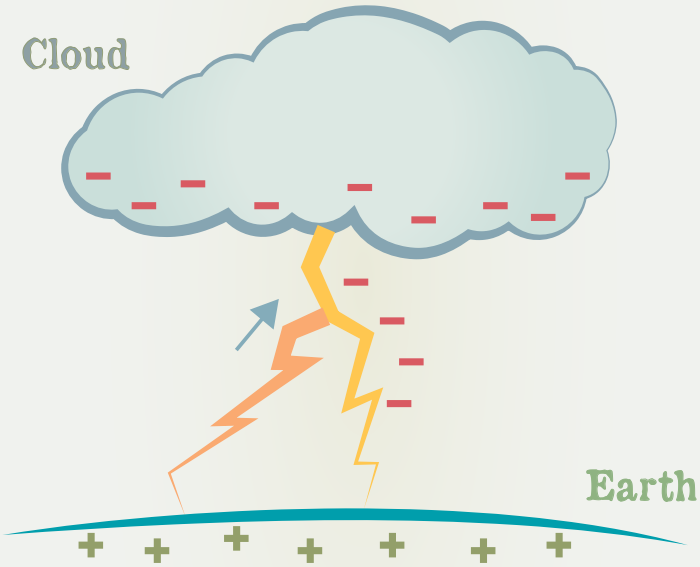


wind energy

Answer Sheet

The Physics of Lightning

What is happening when lightning strikes the ground?



As the negative charges approach the ground, a stream of positive charges repelled by the ground attract to the negative stream.

When connected, they have created path which allows a sudden down surge of electrons to jump to the ground.

This is the lightning.

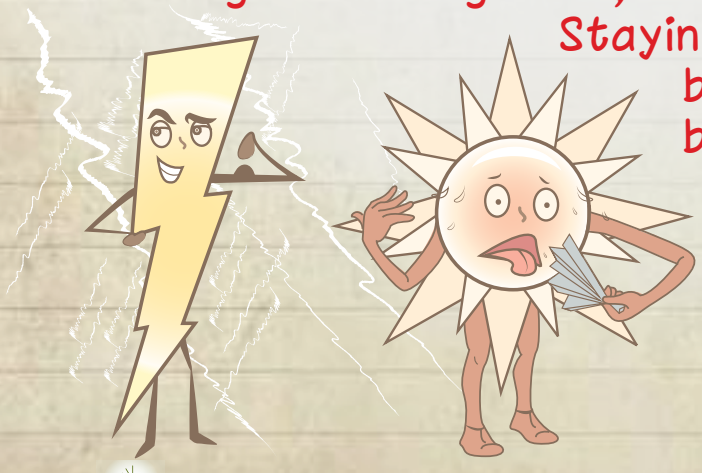
As the NEGATIVE charges collect at the bottom of the cloud it forces the negative charges in the ground to be forced away from the surface. This leaves the ground POSITIVE.

DID YOU KNOW?

Cars are a very safe place to be, and it's not the rubber tires that protect you! This is a very common misconception. It is actually the metal that is surrounding you that acts like a cage of protection. This is due to the Skin Effect which says that electricity, like lightning, will travel only on the surface of enclosed metal objects. So while your car may be hit by lightning, if you stay inside you will be safe.

CHALLENGE QUESTION: Why are you safer if you are lower to the ground?

Lightning is charged ions, trying to cancel their charge by connecting with the ground, taking the shortest path. Staying as low as possible is the best idea. The ground is hit by lightning often enough, but trees get struck more often.



Answer Sheet

Magnet Myths Answers

1. If you can manipulate metal to be magnetic, do you think you can demagnetize something? How would this work?

You can reduce the strength of a magnet (or completely demagnetize it) by exposing it to a magnetic field that is aligned in the opposite direction.

2. Magnets do one of two things, repel or attract. Why is this?

There are two types of electric charges, positive and negative, or north and south pole. If the same pole of two magnets are put close each other they will repel, or push apart. If different poles are close to each other, they will be attracted to each other and pull together.

Answer Sheet

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Now that you have learned all about physics, if you were a **Super Hero** what would your powers be?

Answers may vary.

Would you rather be able to move at the speed of sound or the speed of light?

Speed of light! It is much faster than the speed of sound.

Who is Sound Man's arch nemesis?

Vacuum Man... Outer Space Man... etc.

If you had the gift of super friction, what would you be able to do?

Walk on walls, run really fast, create fire with your fingertips, etc.

Lightning Boy is about to strike! Where will you hide?

In a car, close to the ground ... etc.

Who does better in the water: Sound Man or Light Man? What about in outer space?

Sound Man goes faster in the water, and Light Man goes faster in outer space.

What special features does Air Resistance Man's super suit have?

Air Resistance Man's suit will probably not be affected by Air Resistance; or perhaps it has the power to manipulate air molecules to slow down his opponents.