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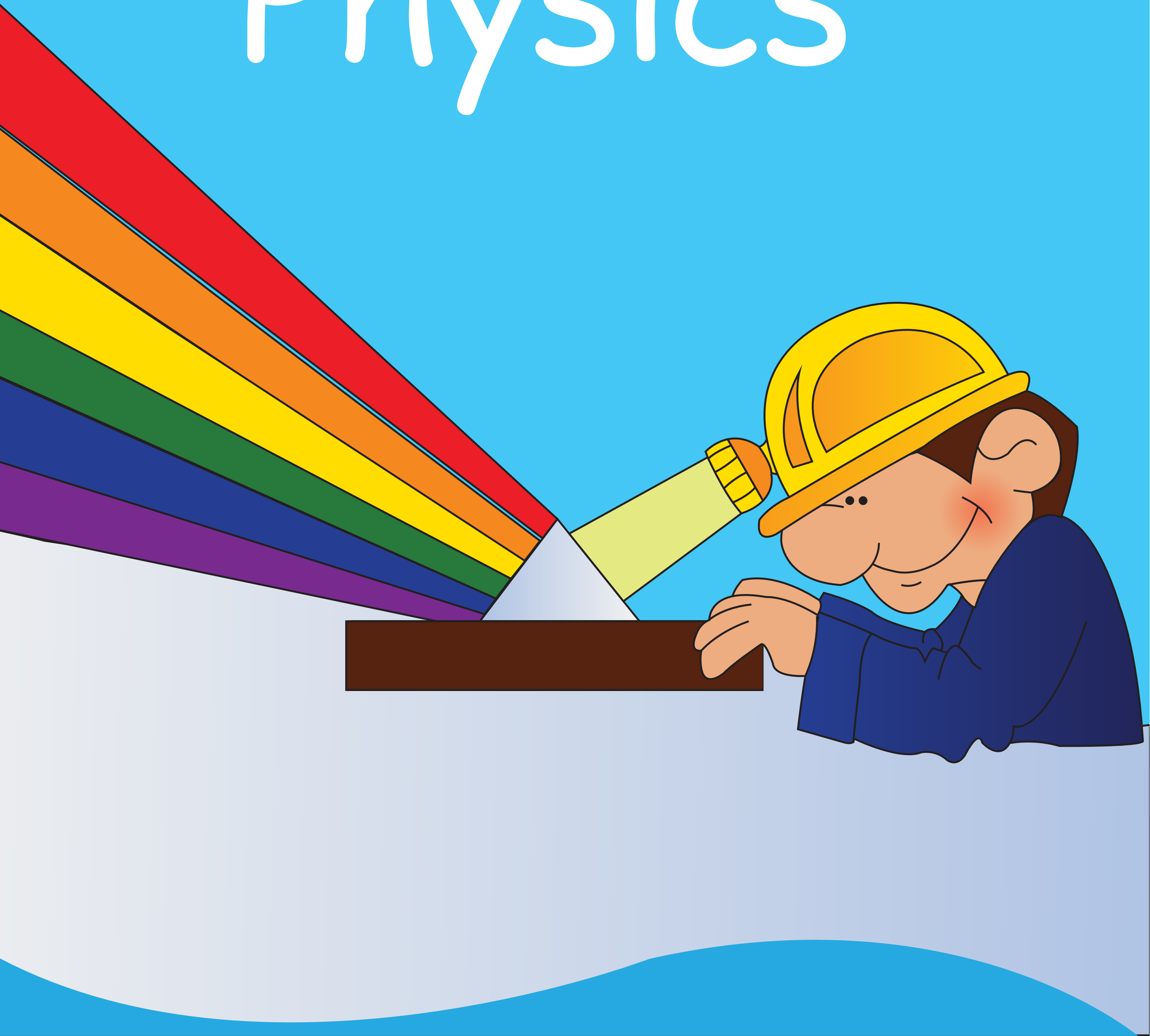
An Introduction to Physics



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CONTENT

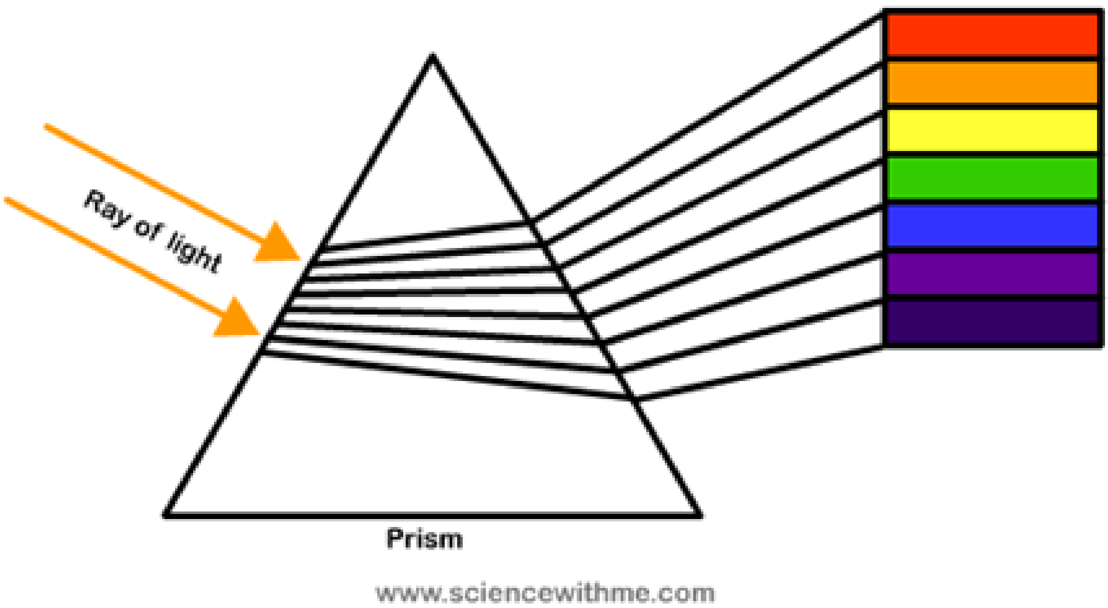
BONUS EXPERIMENTS:

Learn about COLOR

Did you know that color, according to research and studies, is a mere sensation and not an object or property? Color is actually just a visual effect caused by the eye, which can react in various ways to differentiate wavelengths of light. Therefore, an object reflecting light of a certain wavelength will appear to be of a certain color.

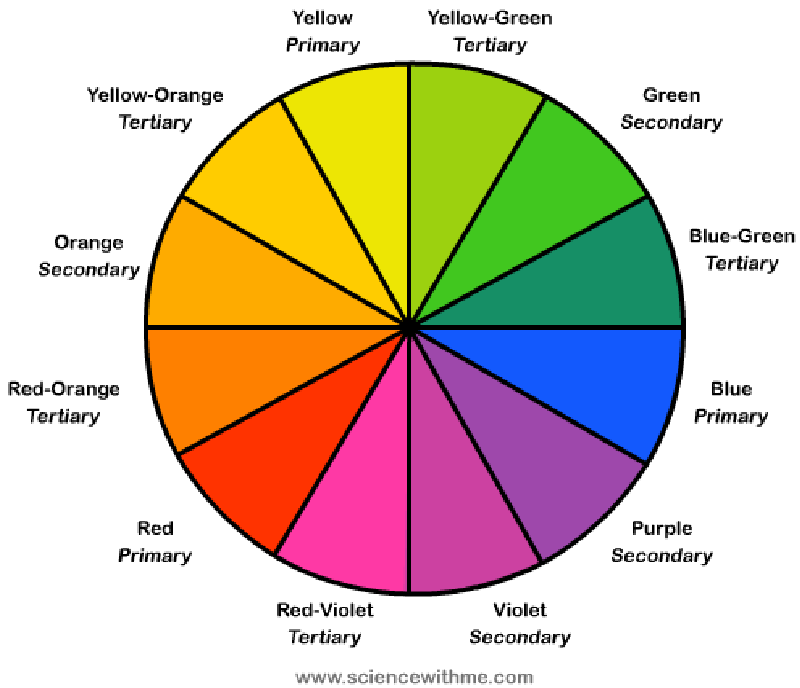
Who was the first person to study about color?

English physicist Sir Isaac Newton (4 January 1643—31 March 1727)—the very person who discovered gravity—was also the first person to make an organized study of color. He did this by passing a thin beam of sunlight through a glass prism of a triangular-shape. With the said experiment, he proved that sunlight is actually composed of a mixture of all the colors that can be seen in the rainbow. When Newton placed a sheet of white paper near his window and the prism cast a shadow of the light that passed through the prism, he called the colorful shadow a spectrum and identified the order of colors to be red, orange, yellow, green, blue, indigo and violet.

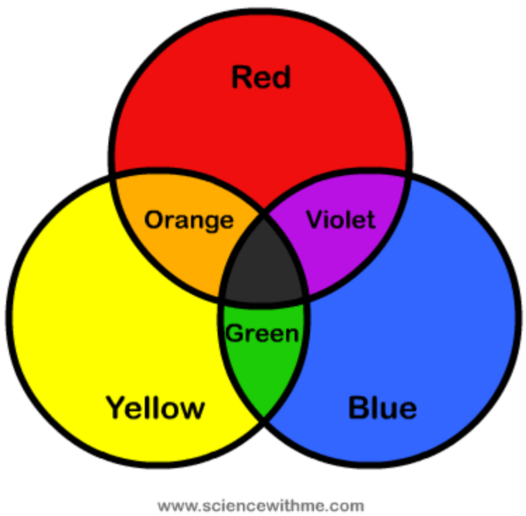


What are the primary colors?

Primary colors (in art) are combined with each other to make other ranges of color. The three primary colors are blue, yellow, and red. Meanwhile, when primary colors are combined with one another they produce another set of colors called secondary colors. These colors are orange, violet, and green.



The complement of each primary color is the combination of the other two primary colors; so red's complementary color is green since blue and yellow makes green. It follows that orange is the complementary color of blue, while violet is the complementary color of yellow. Complementary colors are especially made to produce pleasing colors for artwork and graphic designs. Since complementing colors make each other look brighter, mixing complementary colors with one another gives you a tertiary color that produce the colors brown and gray.



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Are black and white considered colors?

Believe it or not, black and white, although normally included in the color choices, are not considered as colors according to Physics. White is actually the presence of all colors while black is the absence of all colors. In white light, an object that reflects all wavelengths will appear white while one that absorbs all wavelengths will appear black. However, according to human perception, black and white are considered colors since you can see them and use them to describe objects, such as a white hat or a black shoe.

How many colors are there?

In your crayon box, you may have eight, sixteen, twenty-four or even seventy-six colors ranging from the simple reds and yellows, to magentas and turquoise. But in reality there are infinite numbers of colors. To give you a factual estimate, studies show that we can recognize about ten million colors.

Do colorblind people really see colors?

Contrary to some people's assumption that color blindness means that you view the world to be black and white, colorblind people still see colors but are unable to see the difference between them.

Although having such an eye deficiency creates a difficulty in choosing a good color combination of shirts and pants, it's not as serious as you think. In fact, colorblind people can drive like normal people. Although most colorblind people cannot tell the difference between the colors red and green, they can take note that the red light in a traffic light is always on top while the green is the third light from the top.

Colorblindness is caused when one or more of the cones in your eyes does not work as it is supposed to, causing your brain to be confused about what colors you are seeing (the cones are tiny cells in your eyes' retina). The retina is as big as a postage stamp and is located at the rear of the eye. Colorblindness is usually an inherited trait from your parents, who pass on some of their traits to you through the genes.

To determine if you are color blind, eye doctors test for color blindness usually by using a picture that is made up of colored dots. If you can't see the number or letter, or even a picture usually formed by another color of dots, you may be colorblind. Boys are also more prone to colorblindness than girls as studies show that one out of twelve boys is usually colorblind.

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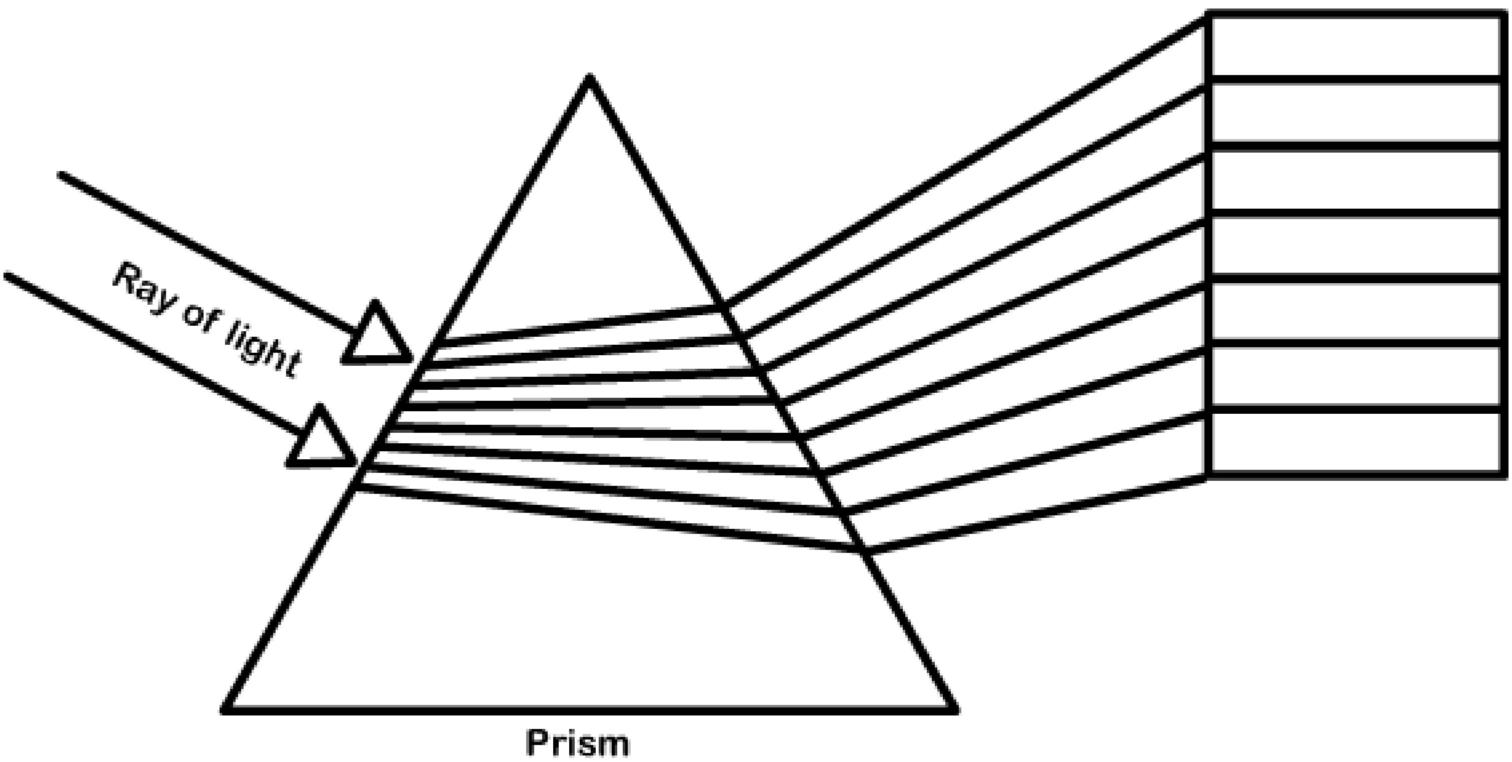
Color the Prism



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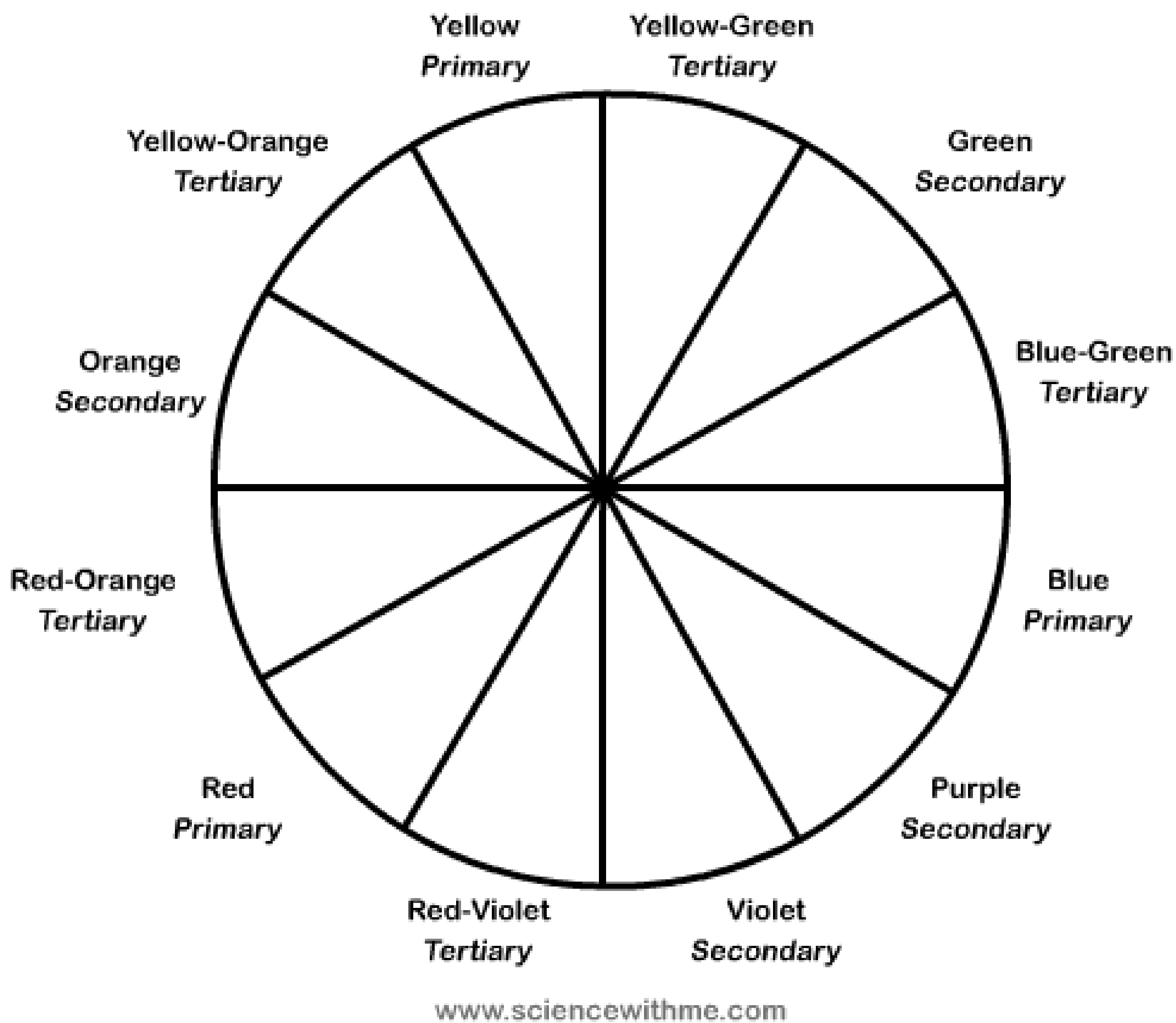
Color the Color Wheel



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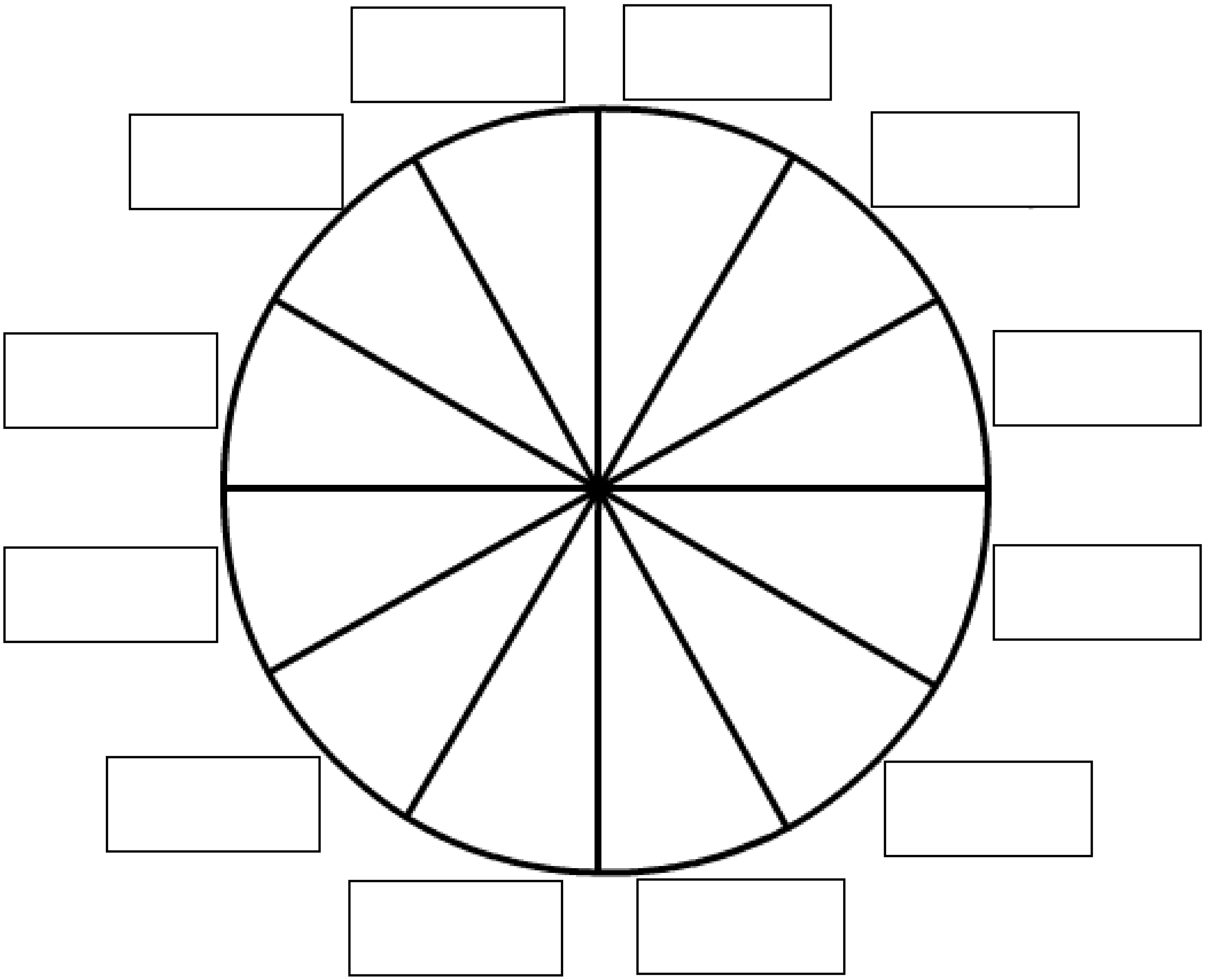
Color and Label the Color Wheel



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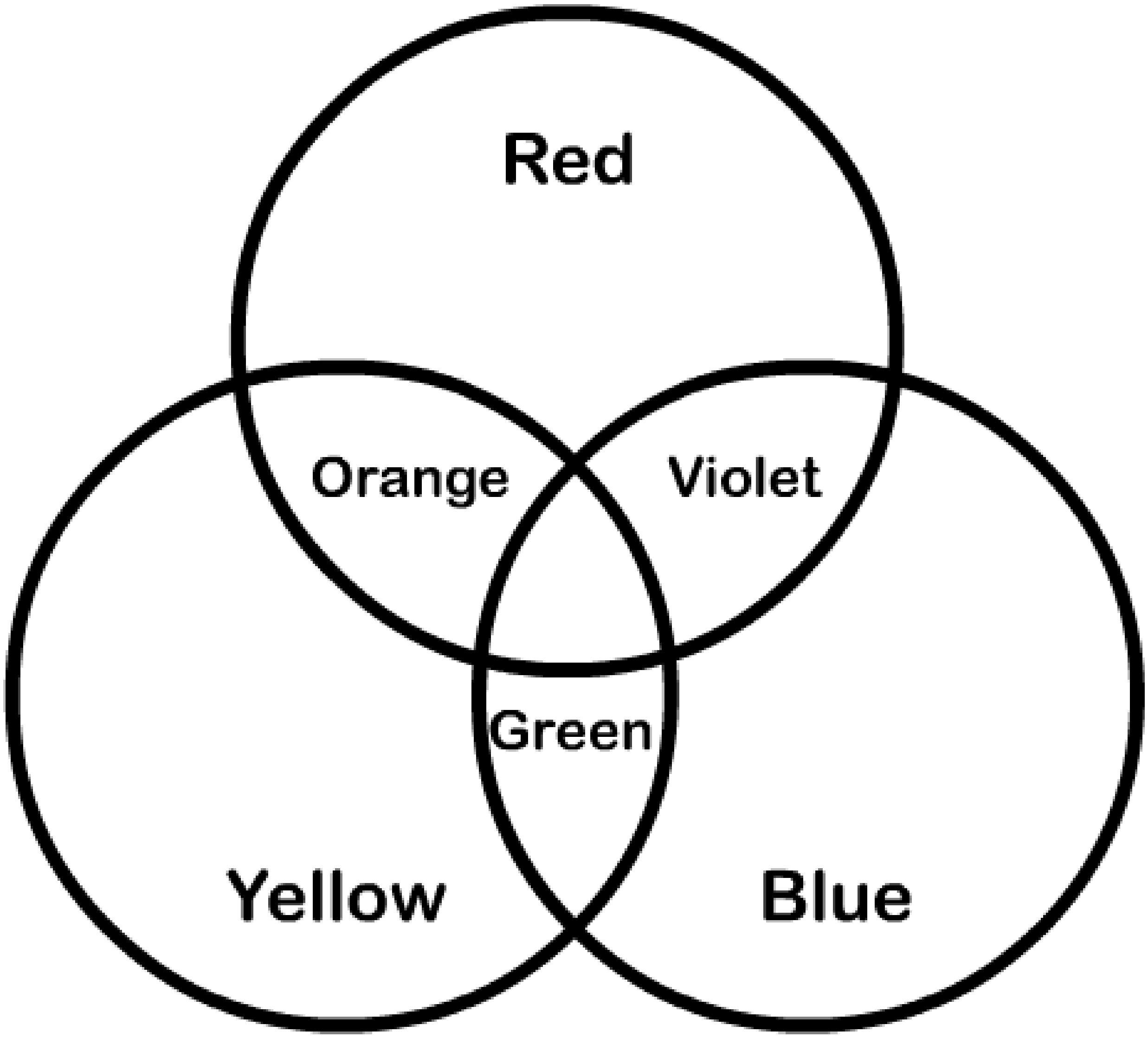
Color the Color Chart



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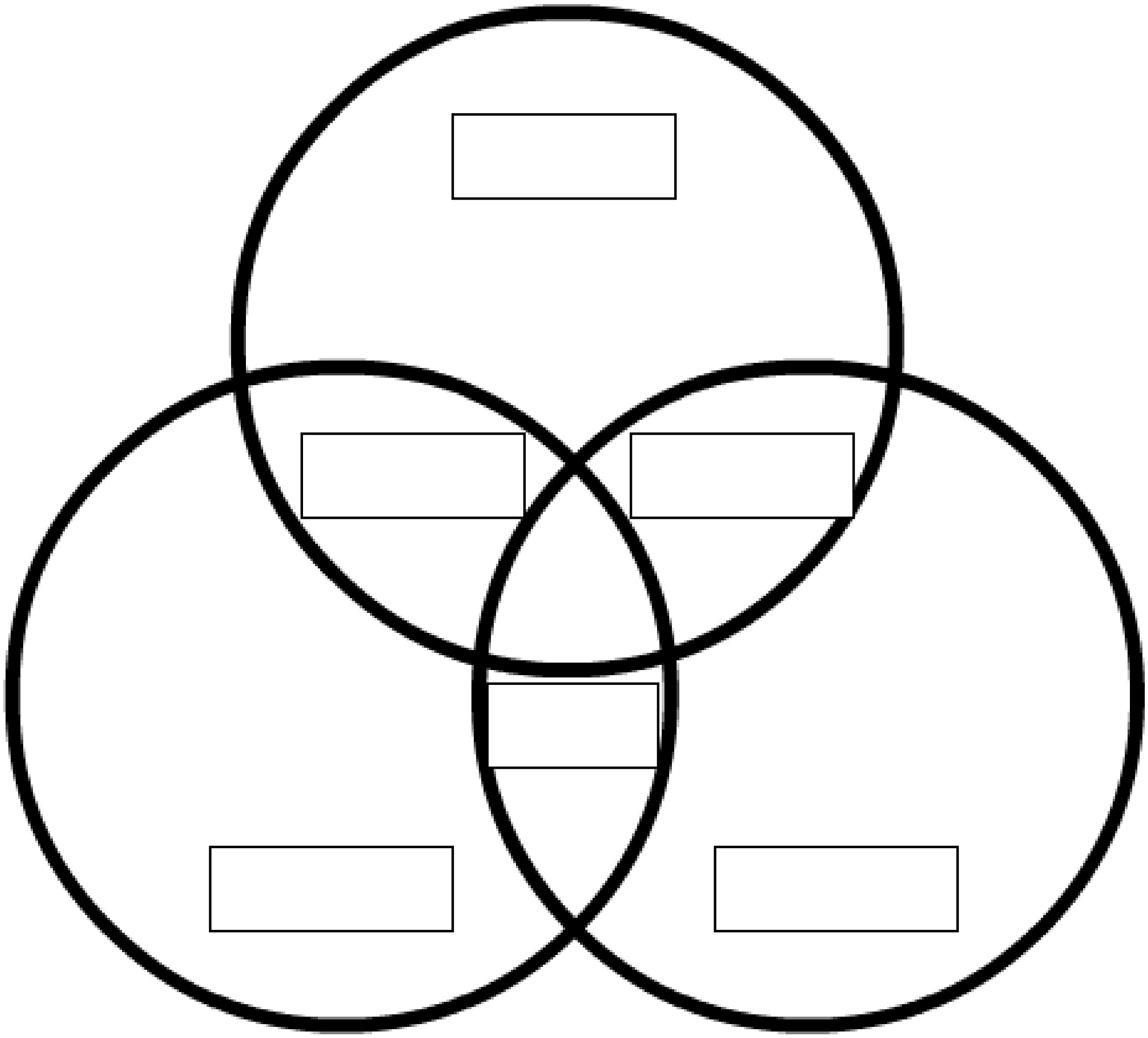
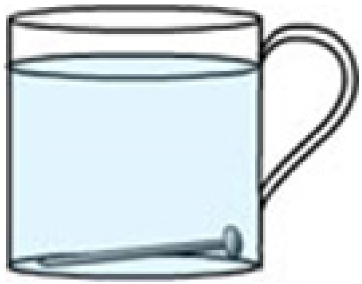
Color and Label the Color Chart

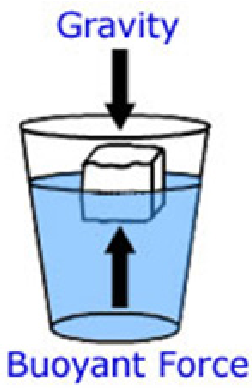


Learn about DENSITY

Believe it or not, black and white, although normally included in the color choices, are not considered as colors according to Physics. White is actually the presence of all colors while black is the absence of all colors. In white light, an object that reflects all wavelengths will appear white while one that absorbs all wavelengths will appear black. However, according to human perception, black and white are considered colors since you can see them and use them to describe objects, such as a white hat or a black shoe.



The nail sinks because the density of the steel is greater than the density of the water. But ocean liners are made of steel so why do they float, and since they do float, why do they sometimes also sink?
Everyone's heard of gravity, that mysterious force that pulls everything downward, but did you know there is also an opposing force? Buoyancy is the push to gravity's pull. Buoyancy is the force that floats your boat. To understand buoyant force, think about what happens when you put an ice cube into your glass of water.



As the ice cube displaces, or pushes away, some of the water it causes the level in the glass to rise and your ice cube to float partially in and partially out of the water like a miniature iceberg. Like a game of tug-of-war; gravity is pulling the ice cube down and buoyant force is pushing it up. How far in or out of the water your ice cube rests depends on its density, or solidness, because that is what the pushing and pulling forces are working against.

A Greek mathematician and inventor named Archimedes noticed that when he stepped into his bathtub the water level rose.

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He reasoned that the weight of the water he displaced was equal to the buoyant force on the water. This is called the Archimedes Principle and it applies to all fluids. Kids find it easy to remember Archimedes and his discovery when you ask them:
"Do you remember the story about the guy who shouted "Eureka!" after leaving his bath naked?
But back to the question of the hour…. Why does a boat float but a nail sink?

Ocean liners are made of steel and they float because their density is less than that of the water they float in. The ability of a boat to float depends on its average density. Average density takes into account not just the weight of the steel hull but also the air trapped in it. A ship with a large volume of trapped air has a lower density than that of the water it sits in – so it floats.

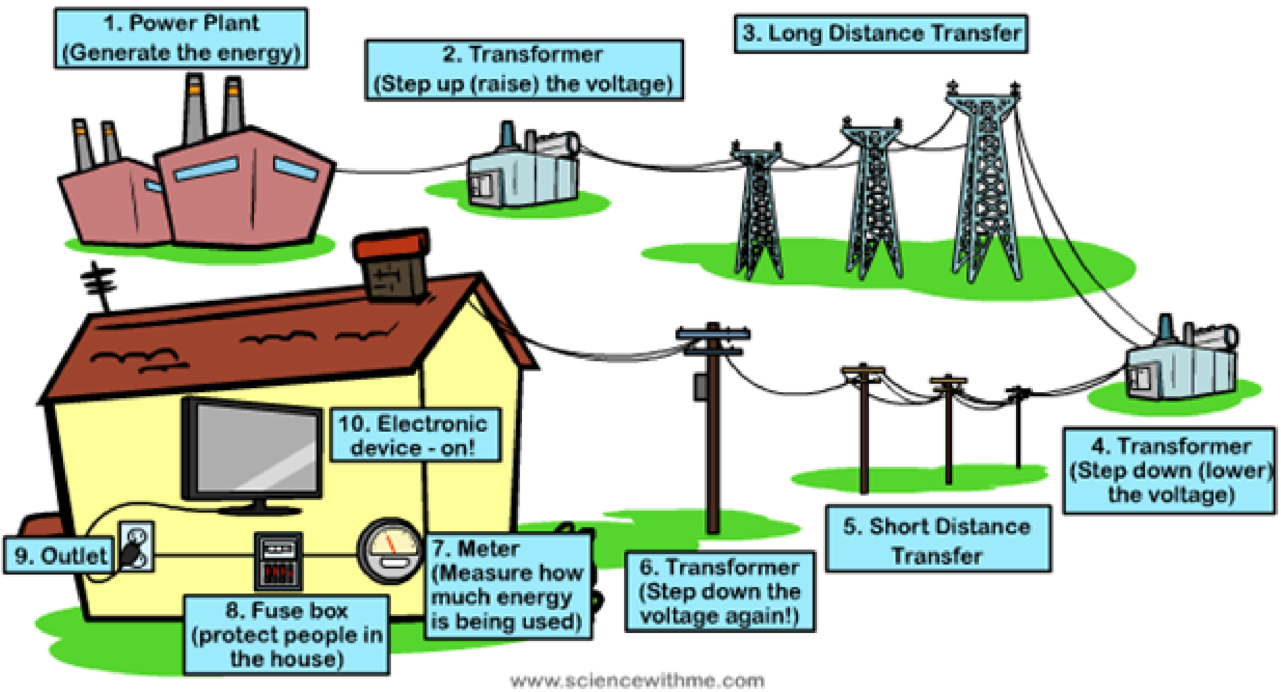
When a ship's hold is full of cargo it floats lower in the water because there is less trapped air making it denser. Likewise a ship empty of cargo has more trapped air so it's less dense and it floats higher out of the surrounding water.
If the ship loses enough of its capacity to hold trapped air, it sinks. Remember the story about the Titanic?
A submarine is designed to have almost the same density of the ocean water that surrounds it. In order for a submarine to sink the crew pumps water into tanks called ballast tanks. To surface the submarine forces the water out of the ballast tanks and fills them with air, lessening the density of the sub and bringing it up to the surface.

Gravity, buoyancy and density work together to determine what floats your boat, or sinks your ship. Here's a science fun activity to try at home with your kids: Fill your kitchen sink with water and have each person make a boat out of aluminum foil and see if it floats high or low in the water.
Have each person add pennies to their boat. Whose boat sinks first and why? Does the boat size influence the number of pennies it can carry?

Learn about ELECTRICITY I

When humankind discovered electricity, it introduced a revolution in the way we go through our daily lives. Just imagine how your ancestors lived when there was no electricity yet. They used lamps. They did not have televisions and computers. They had to preserve their food using salt because they did not have refrigerators. During winter, they had to warm themselves with an open fire, an experience that you might have had during camping. During summer, they did not have the luxury of air-conditioned rooms and probably went to rivers to cool themselves. Therefore, it is really good to live during this age of electricity.

10 Steps To How Electricity Gets To Your Home



What is electricity?

Do you still remember things about charges? An electron carries a negative charge while a proton carries a positive charge. In an atom, the proton is at the center while the electron travels around the proton. The simplest element, hydrogen, has this arrangement. Other atoms have multiple protons and electrons. Everything around us contains atoms. Therefore, by deduction, everything around us has charges.

However, when it comes to electricity, the electrons are the main performers. This is because the protons remain in the nucleus and are unable to escape. Electrons travel in paths in space called orbitals. When they move, they produce an electric current, which is responsible for electricity.

However, when there is a collection of positive and negative charges, these charges are not always equal. This inequality is known as “potential difference” or more commonly, “voltage”. For instance, one may have a charge of -3 while another may have a charge of +2. This difference in charges or “electric potential” allows electrons to move from the more negative object to the more positive object. The movement of the electrons in the given example would therefore be from -3 to +2.

What is current?

When there is a direct and constant flow of electrons between two points that have different electric potentials, it is called direct current (DC). DC is available from a battery. On the other hand, if there is an alternating backward and forward flow between the two points multiple times per second, the current is called alternating current (AC). This is the type of current delivered from your electrical outlet.

So what is a positive current? Do not confuse it with a positive charge. A positive current is one that flows from a location of higher potential to one of lesser one, because of potential difference. Try a little experiment in order to visualize this. Get a plastic box separated into two compartments, with a hole in between. Close that hole first, then put water in one compartment until it is full. When you open the hole, the water goes from the full compartment to the empty compartment, until the water level equalizes. This simulates potential difference and current.

What are insulators and conductors?

You should remember that some materials do not permit electrons to move freely while others do. The first type of material is called an insulator while the second type of material is called a conductor. Examples of conductors are metals like copper and gold. Examples of insulators are rubber and glass. Semiconductors can conduct electricity but not as much as conductors. The most popular semiconductor is silicon.

What are examples and applications of electricity?

Note that although people such as Benjamin Franklin, Thomas Edison and Nikola Tesla are sometimes credited for discovering electricity, they did not really introduce a new concept but rather found out how electricity works. Electricity is a basic energy in nature. If you have seen a lightning streak in the sky, then you have also seen actual electricity. Lightning occurs because there is an unequal distribution of charges between a cloud and another cloud, or a cloud and a surface like the land. However, electricity can also be produced by human technology. For instance, through solar panels, we can convert sunlight to electricity. Coal, nuclear and hydroelectric plants are also sources of electricity. For these reasons, electrically is also called an energy carrier or a secondary energy source.

In the modern world, the science that deals with electricity and the manipulation of conductors and semiconductors is called electronics. The first experiments in electronics were held in the 1900s, which led to the invention of the radio, radar, television and computer.

In 1959, integrated circuits were introduced. These are also called silicon chips and are as thin as wafers. Despite their very small sizes, they contain thousands and thousands of components. In recognition of the importance of silicon, the Silicon Valley got its name. Silicon Valley is a place where many developments in electronics are made. With integrated circuits, we now have personal computers, pocket calculators, digital watches, cell phones and other digital devices.

It is truly wonderful that we are living in a world powered by electricity.

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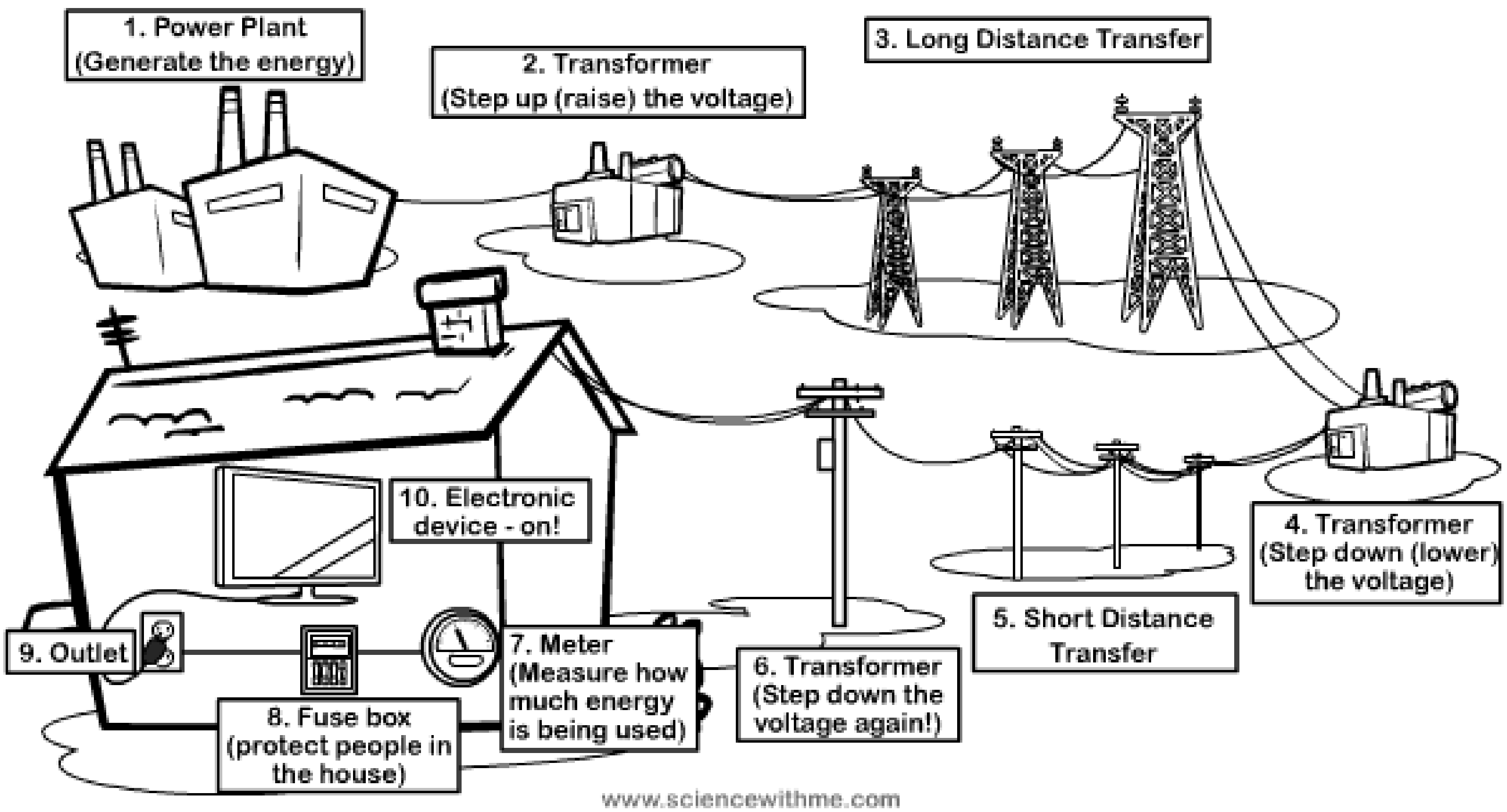
Color the 10 steps on how electricity gets into your home



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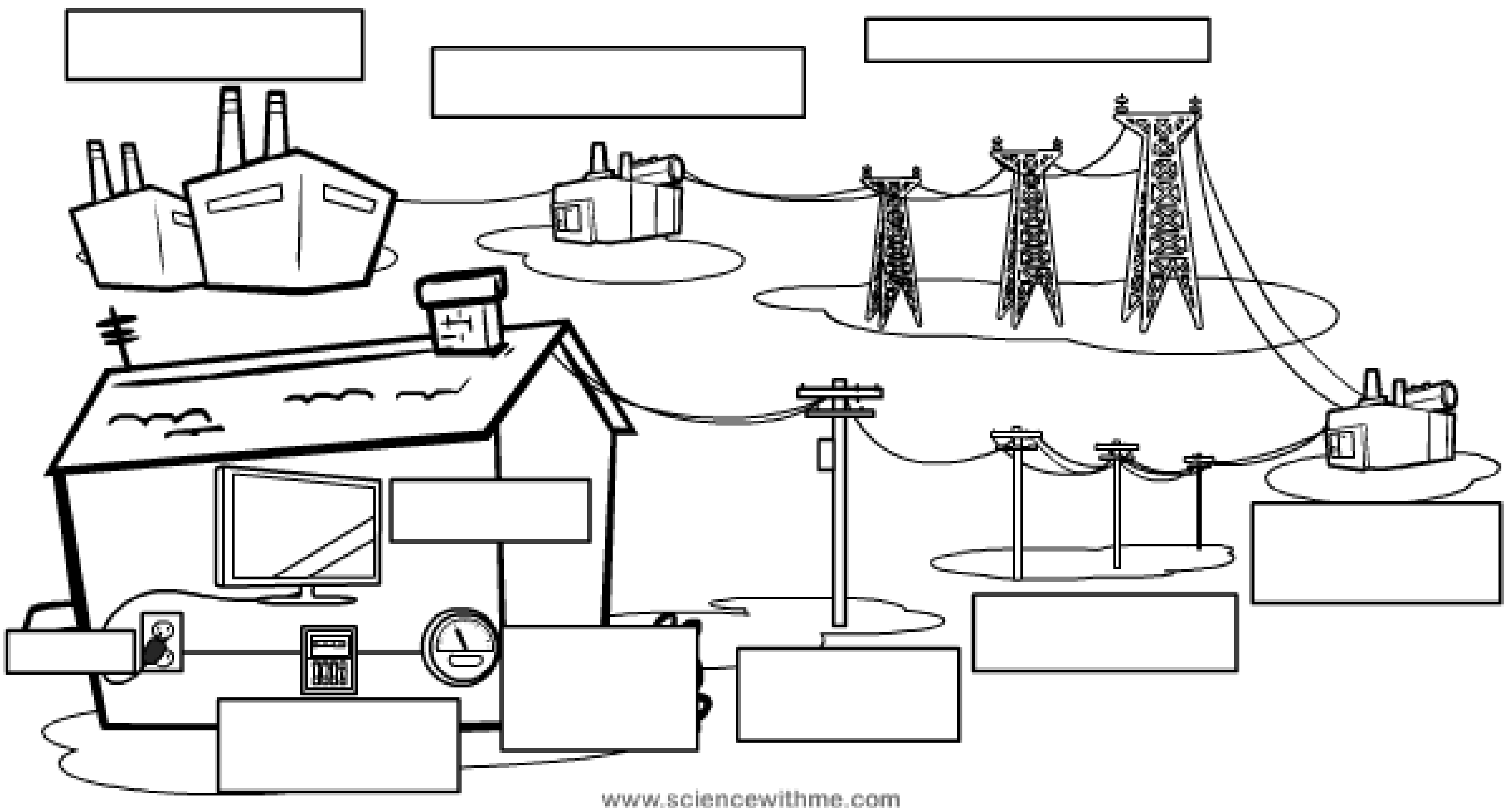
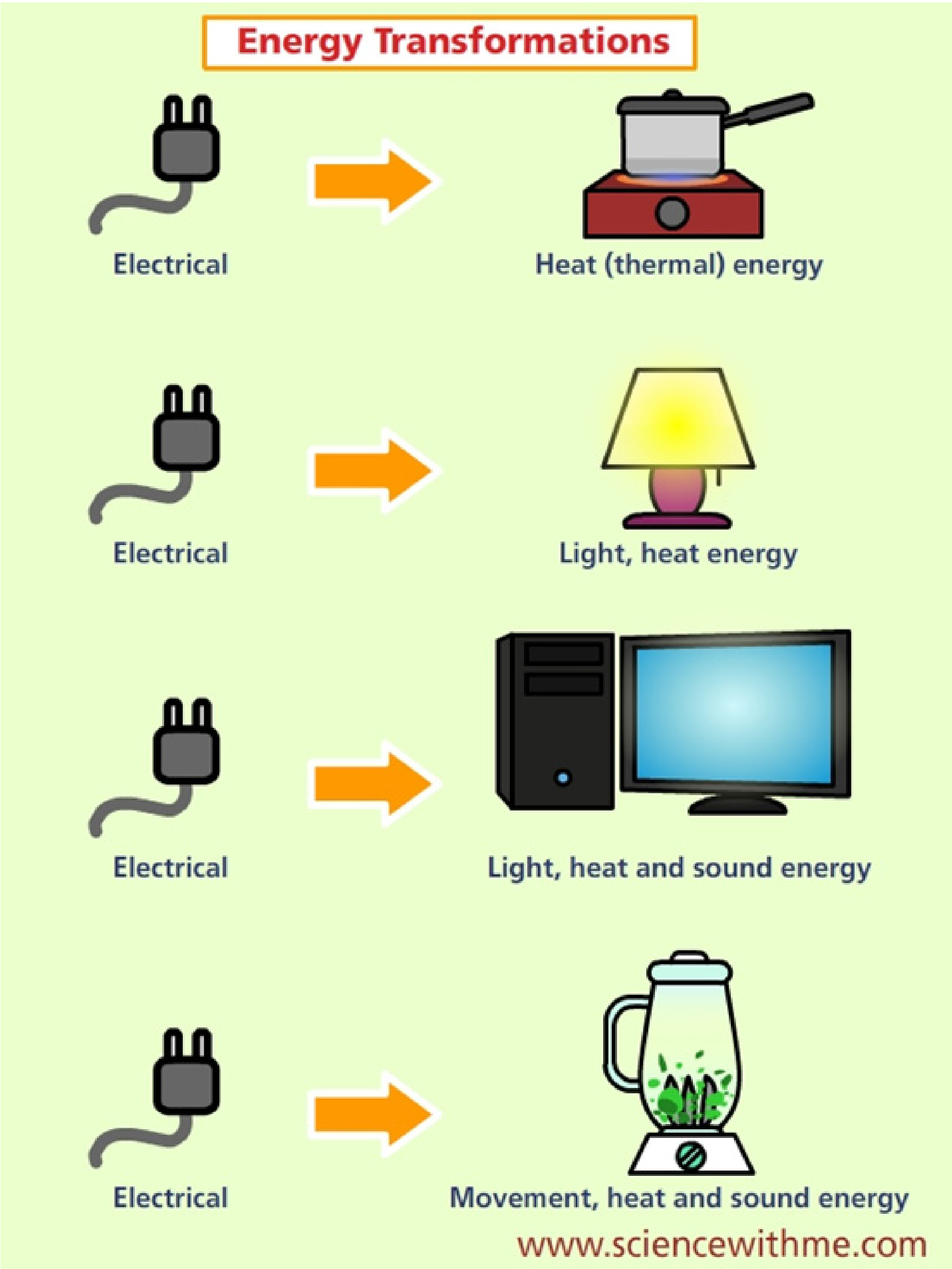
Color and Label the 10 steps on how electricity gets into your home



Learn about ELECTRICITY II

Electricity is a very useful form of energy. Electricity can be used to perform work such as:

- Heating our homes or our food (electrical energy is converted into light and heat energy)
- Lighting our lamps (electrical energy is converted into light and heat energy)
- Powering our computers (electrical energy is converted into light, heat and sound energy) or
- Powering a motor (electrical energy is converted into movement, heat and sound energy).

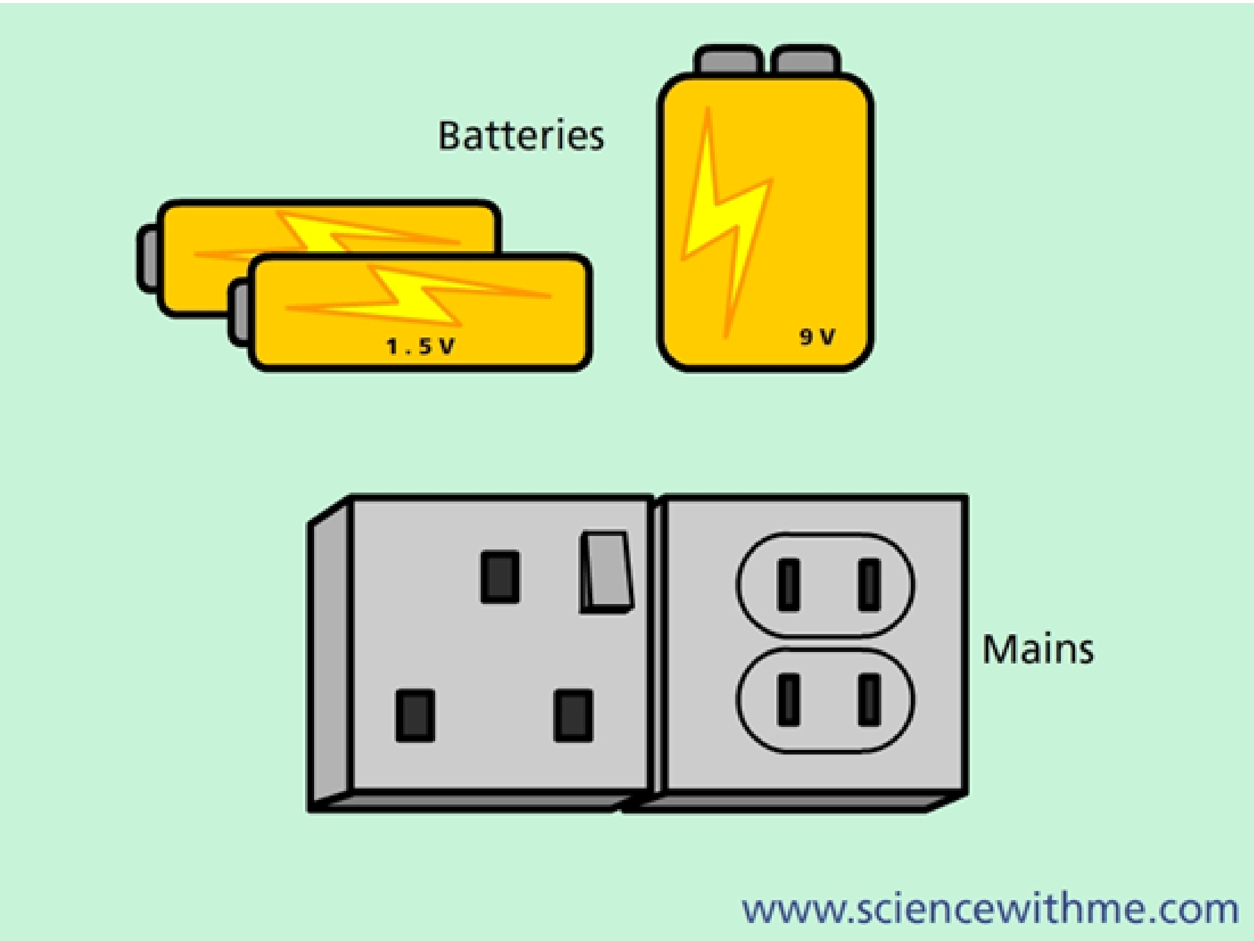


Learn about ELECTRICITY II

All appliances, whether small or large, need a power source.

What is a power source?

A power source provides a steady flow of electrons. Larger appliances like heaters and large computers usually get their power from the mains. But small batteries (cells) can also be a power source. The problem with electrical energy obtained from battery power though, is that battery power eventually runs out and the battery has to be thrown away or recharged. On the other hand, electricity flowing from a mains doesn't run out is much more powerful (and dangerous so be careful!).



Electricity is a "secondary" source of energy. In other words other sources of energy are needed to produce electricity.

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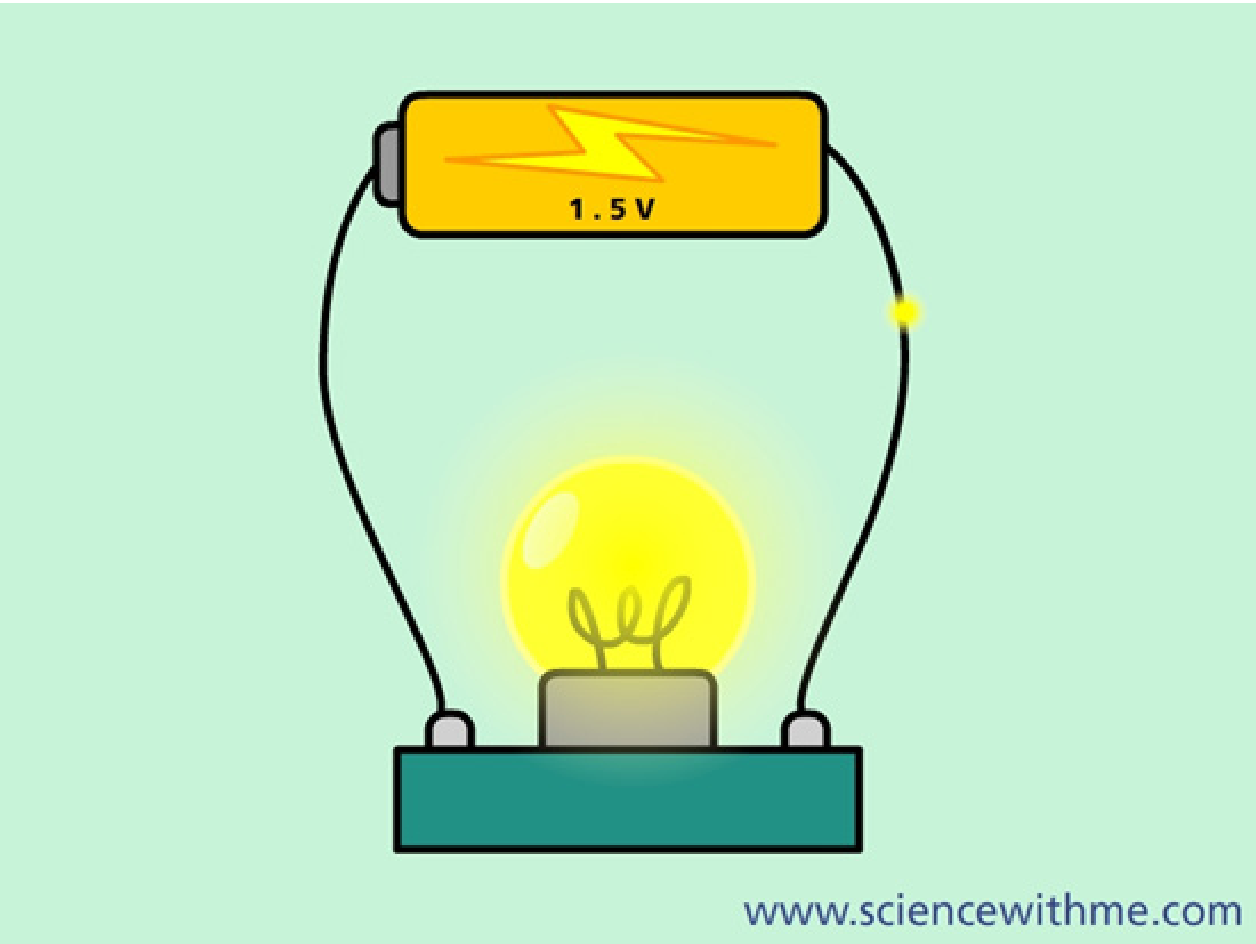
What is an electrical circuit?

Electrical current needs a PATH on which to travel. Another name for this path is a circuit. Electricity flows from the power source, in a loop or a circuit, back to the power source. This means that the electricity must start and finish at the same power source. If the circuit is not complete (i.e. if the loop is not closed) then electricity cannot flow through it properly.

Which one of these loops allows electricity to flow?
LOOP1 or LOOP2? Explain your answer.

LOOP 1:



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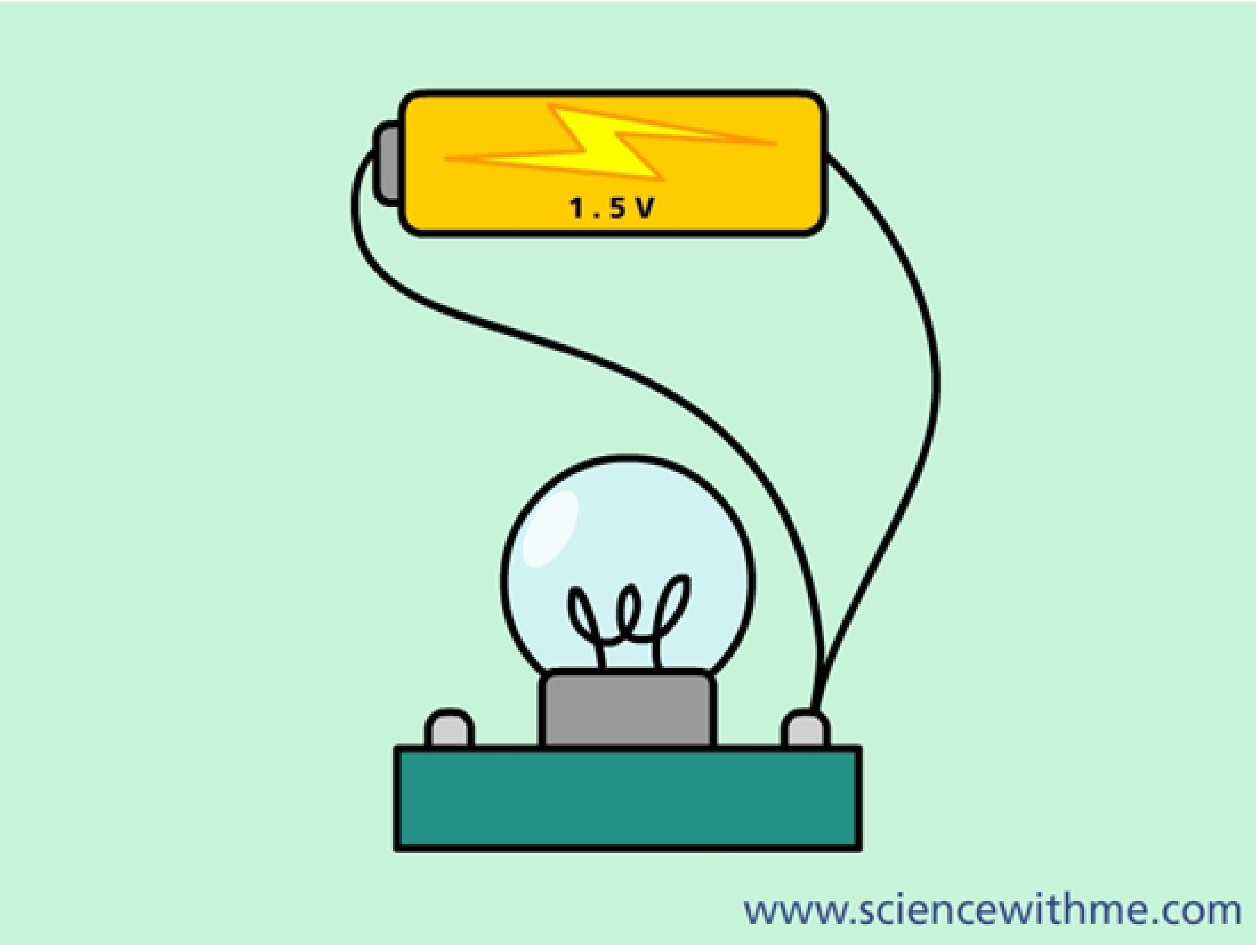
LOOP 1:



Electricity flowing through a circuit is called a current.

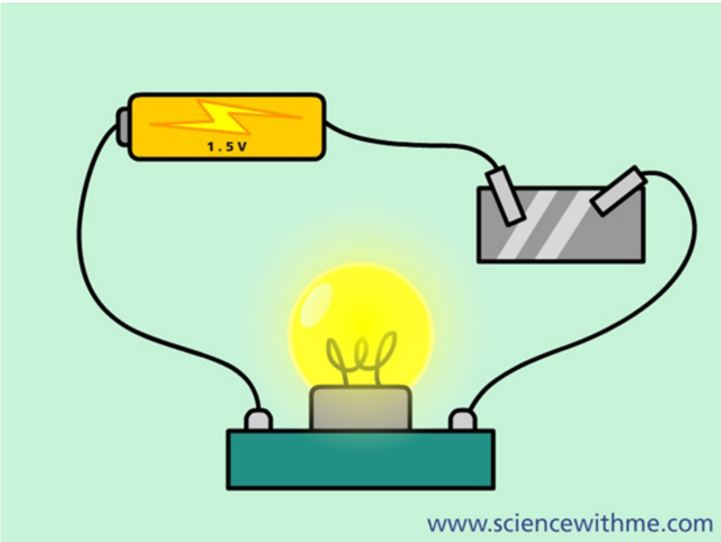
A load is a device that uses electricity (like a buzzer of a light blub). The load needs electrical energy to be able work.

The electric current from the power source flows from one place to another through the wire of a circuit.

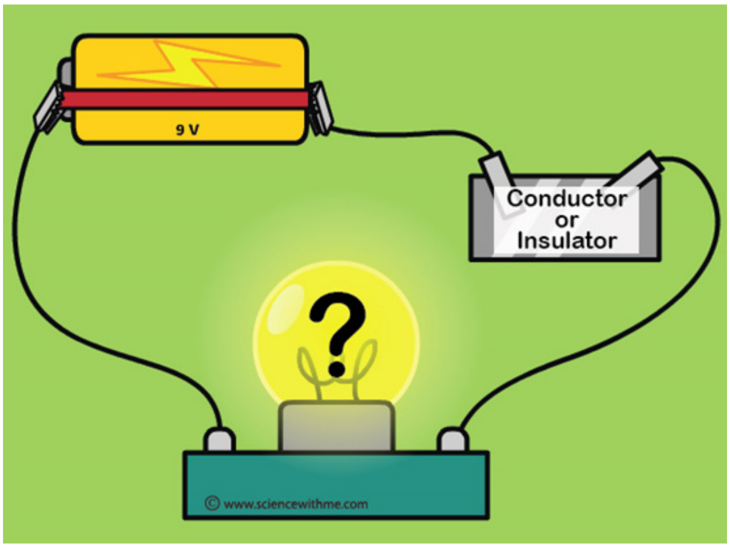
Conductors and Insulators:

These metal wires (conductors) are often wrapped in plastic (insulators) so as to stop the electric current flowing into objects that touch the wire.

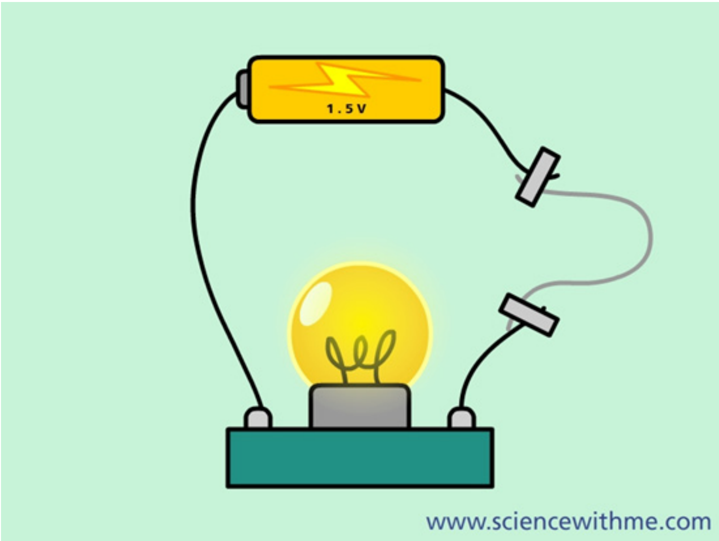
If electricity flows through an object, then scientists say the object conducts electricity, and they call it a conductor. Metals are very good conductors. A small bit of energy is released as heat when electricity flows through the conductor.



If electricity doesn't flow through an object then scientists call it an insulator. Plastic, wood and rubber are all very good insulators.

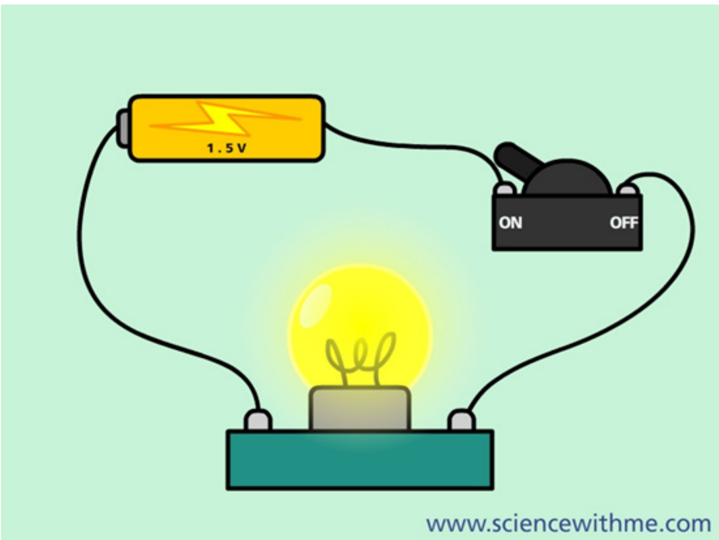


You can increase a circuit by increasing the length of the connecting wire. What do you think will happen to the light bulb as the wire gets longer? How about as the wire gets shorter?



What is a switch?

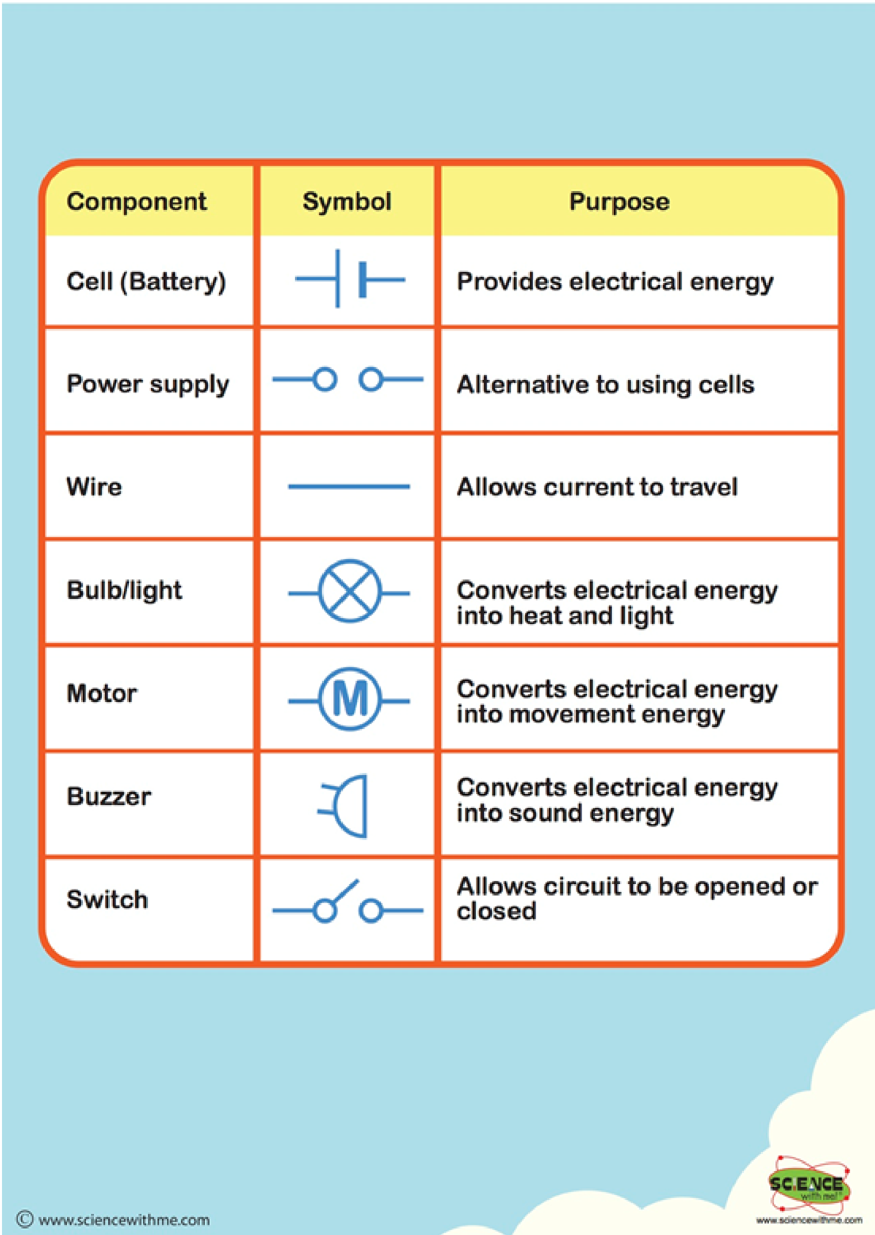
Switches allow you control over the circuit. You can stop the flow of electricity by breaking the circuit. When the switch is in the “on” position the circuit is complete. When the switch is “off” position the circuit is broken.



How do I draw a circuit?

Sometimes circuits are drawn using special symbols. These symbols make it faster and easier to draw circuits and once you understand what the different symbols stand for, these diagrams are very easy to understand. However if you don't understand what the different symbols stand for, then the diagrams look a little strange!

Here is a chart to help you to understand the different circuit symbols that are used in when drawing the different components of the circuit. Each circuit component has it's own symbol. These symbols are universal so we call all understand each other's diagrams.

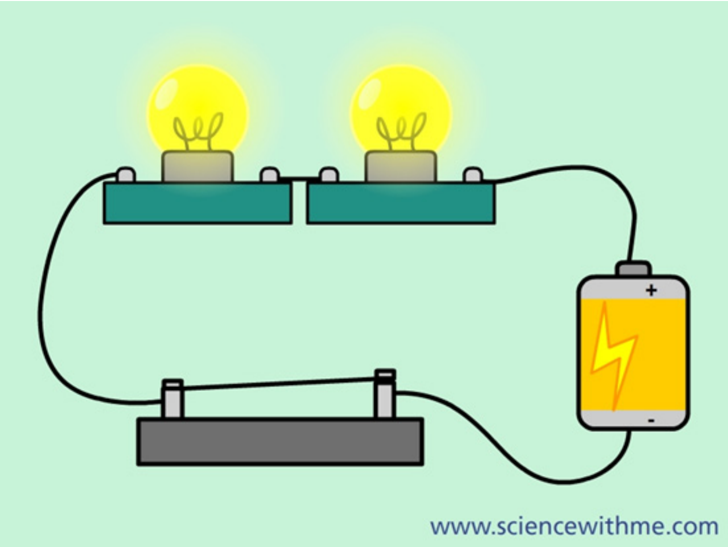


Component	Symbol	Purpose
Cell (Battery)		Provides electrical energy
Power supply		Alternative to using cells
Wire		Allows current to travel
Bulb/light		Converts electrical energy into heat and light
Motor	M	Converts electrical energy into movement energy
Buzzer		Converts electrical energy into sound energy
Switch		Allows circuit to be opened or closed

"In Series" or "In Parallel" Circuits:

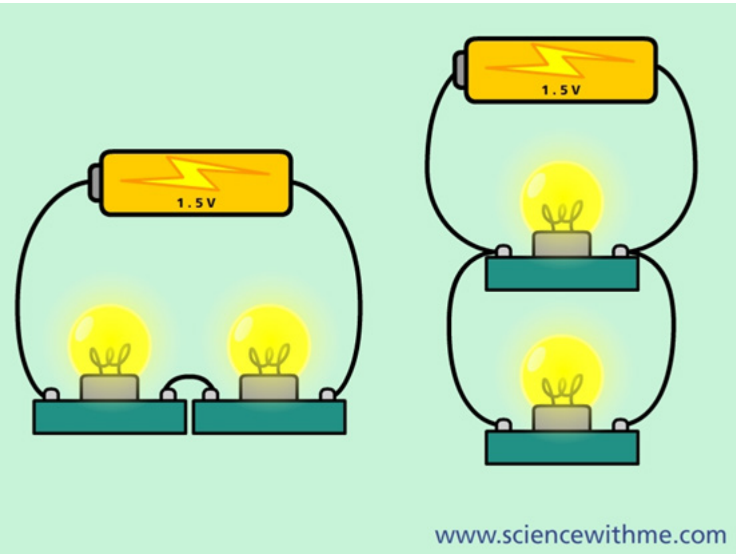
Whenever two components are joined together in the same circuit, there are two different ways they can be wired: in series or in parallel.

In the in series circuit the components are joined together in one bigger circuit i.e. one continuous loop. Electricity passes first through one component first then the next one. A disadvantage of the in series circuit is that when one component malfunctions, the other components will stop working.

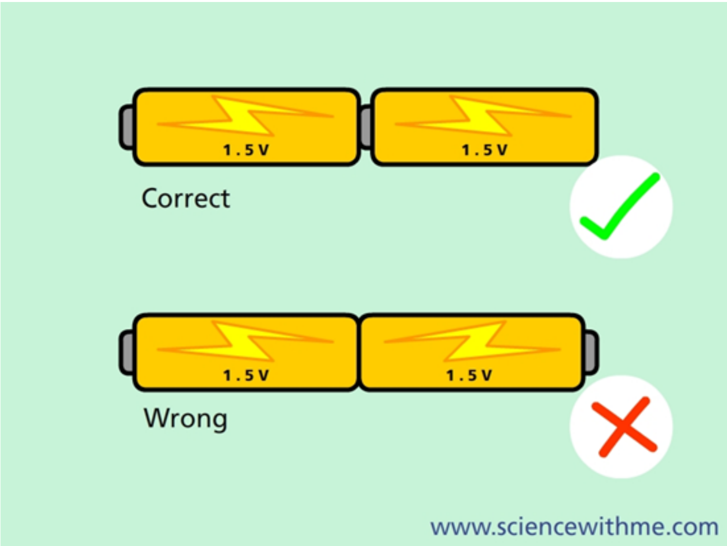


Another option would be to make two SMALLER circuits with each bulb having it's OWN circuit parallel to one other. A major advantage of parallel circuits is that if one component malfunctions, the other continues to function.

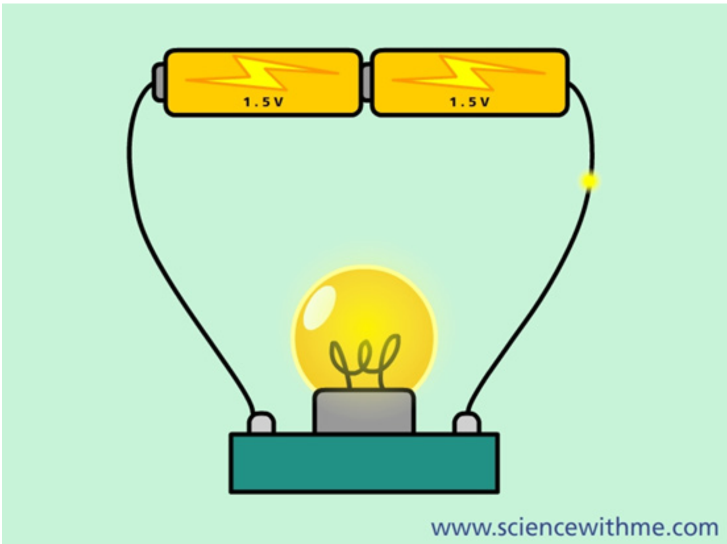
The diagram below shows the difference between these two types of circuits.



Batteries can also be connected in parallel or in series. But, if you are using more than one battery in a circuit they need to all face in the same direction to work. If two batteries are connected in series, then the voltages add together.



Adding more cells in a line (in series) will make the blub burn brighter.



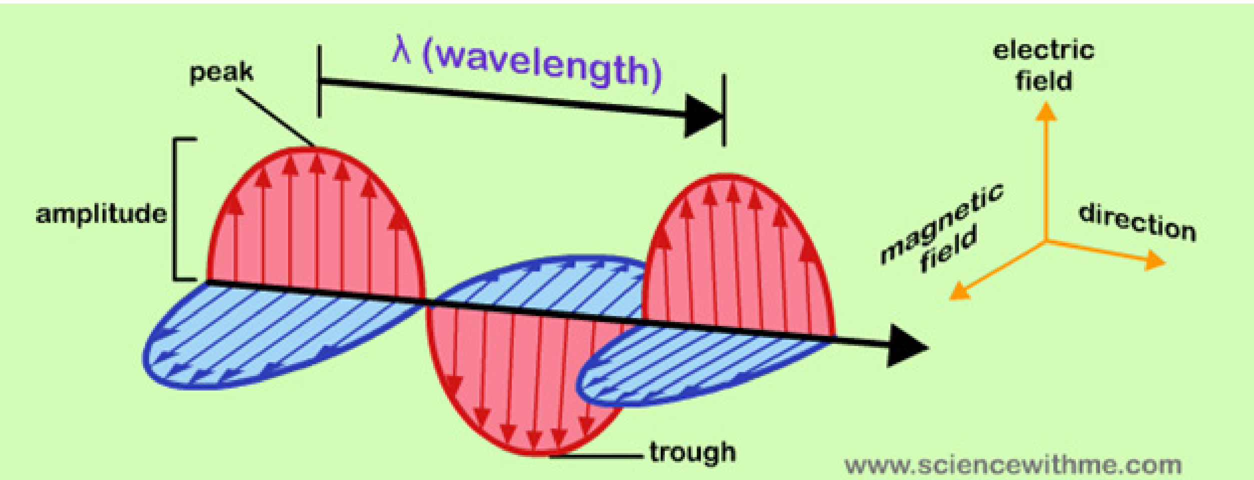
What do you think would happen if you add too many cells in the series?

Learn about LIGHT

Ancient civilizations were fascinated by the existence of light for thousands of years. The Greek philosophers believed that light was made up of countless, tiny particles that enter the human eye and create what we call vision. However, Empedocles and a Dutch scientist named Christian Huygens believed that light was like a wave. According to them, light spread out and travelled like a straight line. This theory was accepted during the 19th century.

How is light perceived today?

In 1905, Albert Einstein published a research paper whereby he explained what is referred to as the photoelectric effect. This theory explains that particles make up light. The particles Einstein was referring to was weightless bundles of electromagnetic energy called photons. Today, scientists agree that light has a dual nature—it is part particle and partial wave. It is a form of energy that allows us to see things around us.



What are sources of light?

Things that give off light are known as sources of light. During the day, the primary source of light is the sun. Other sources of light include stars, flames, flashlights, street lamps, glowing gases in glass tubes, and white-hot filaments in lamps, to name a few.

What are the properties of light?

When we draw the way light travels we always use straight lines. This is because normally light rays travel in a straight line. However, there are some instances that can change the path and even the nature of light. They are the following:

- **Reflection:** Reflection is probably the most common property of light since it enables us to see things around us. It occurs when light waves are not absorbed but are bounced from the surface. We say that the light rays are reflected. Shiny surfaces reflect light back at exactly the same angle as they arrived. Surfaces that reflect a lot of light appear white or even silver, while a smooth and polished silver surface can serve as a mirror. Dull or rough surfaces don't reflect the light back without mixing up the light rays so they are no use as mirrors.

- **Absorption:** Light that hits an object may be absorbed, reflected, and even transmitted depending on the color of the object. For example, a red object reflects red light and absorbs the rest of the colors. Simply put, the color of an item depends on the color it reflects.

- **Interference:** Interference occurs when more than one light wave intersects a path. An example of interference is the rainbow-like light that is seen from oil floating on the sea or on the surface of a bubble.

- **Refraction:** Refraction occurs when light passes from one substance to another. It occurs because of the different speeds at which light passes through different substances. It is the bending of light as it moves from one medium to another of different density. Refraction is seen when a pencil dipped in a glass of water appears to be bent when viewed from the surface. This is because light passes easily through gases (such as air) but passes more slowly through materials such as glass or water.

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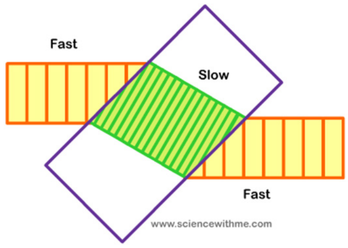
- **Diffraction:** This property of light is seen when light passes through an opening or a corner smaller than the wavelength of the light.

- **Polarization:** As you know, light travels in waves. In fact, it is very much like a rope that when shaken, creates vibrations. If the rope is shaken up and down, you'll be able to produce a vertical wave. A horizontal wave is produced when you shake the rope from left to right. Polarization prevents light from passing through by polarizing the lights from random directions. This is why most of the sunglasses sold in the market are polarized to protect our eyes from being directly hit by strong sunlight.



How fast does a light travel?

Physicists have attempted to measure the speed of light since the early times. In 1849, Hippolyte Fizeau conducted an experiment by directing a beam of light to a mirror located kilometers away and placed a rotating cogwheel between the beam and the mirror. From the rate of rotation of the wheel, number of wheel's teeth and distance of the mirror, he was able to calculate that the speed of light is 313 million meters per second.

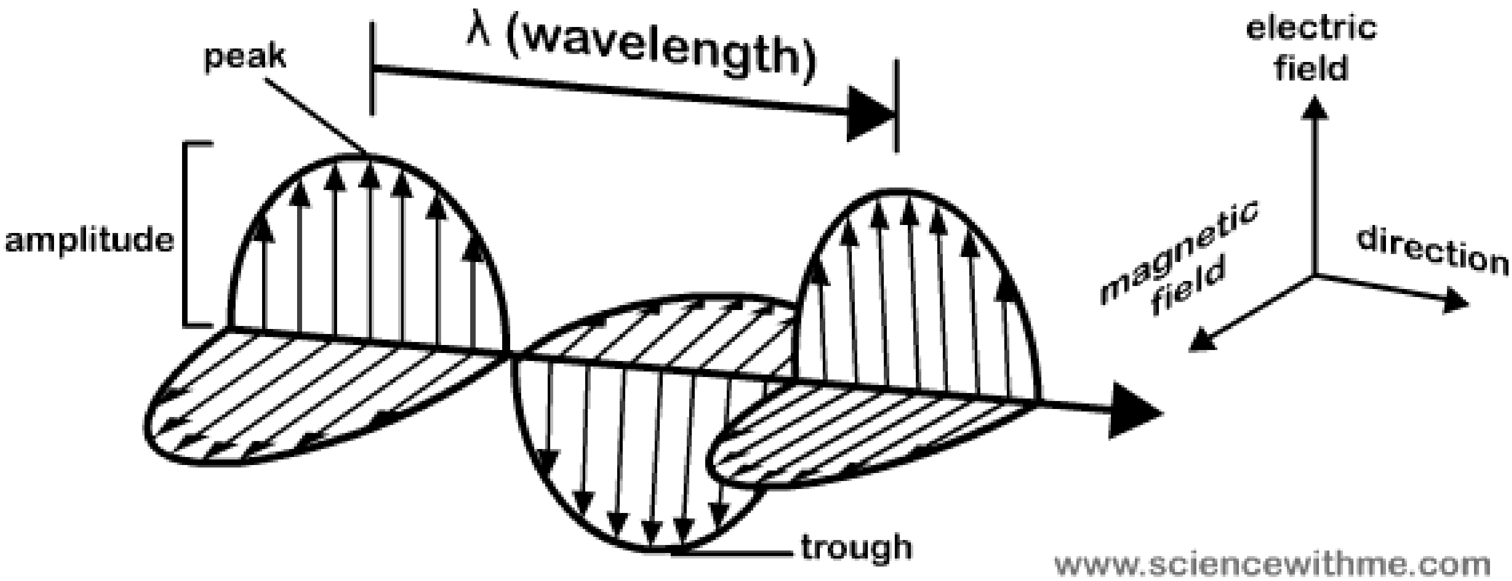
In a vacuum, however, the speed of light is 299,792,458 meters per second.
We can approximate the speed of light to 300,000,000 meters per second or 300,000 km per second). This is about a million times faster than the speed of an airplane.

What causes a shadow?

A ray is referred to as a thin beam of light. A shadow is a dark area formed when an object gets in the way of rays of light. If light did not travel in straight lines it would be able to bend around the object and shadows would not be formed. For a shadow to form three conditions must be met. There must be a light source, there must be an object to block the light and there must be a surface on which the light can fall. Shadows are formed outside when an object blocks the sunlight. Shadows are larger if the object is closer to the light source.

Name : ____________________________________

Color the Lightwave



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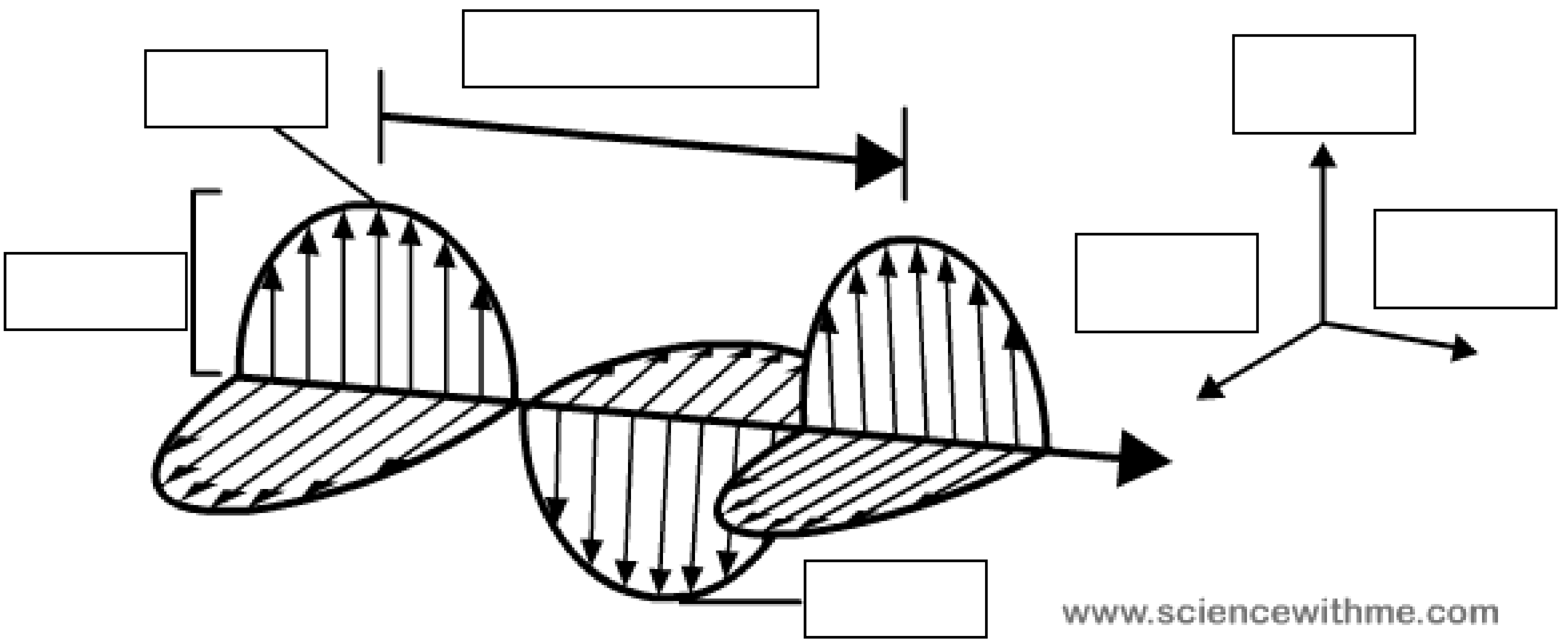
Color and Label the Lightwave



Name : ______________________________

Color the Light source

Learn about MAGNETS & MAGNETISM

What is a magnet?

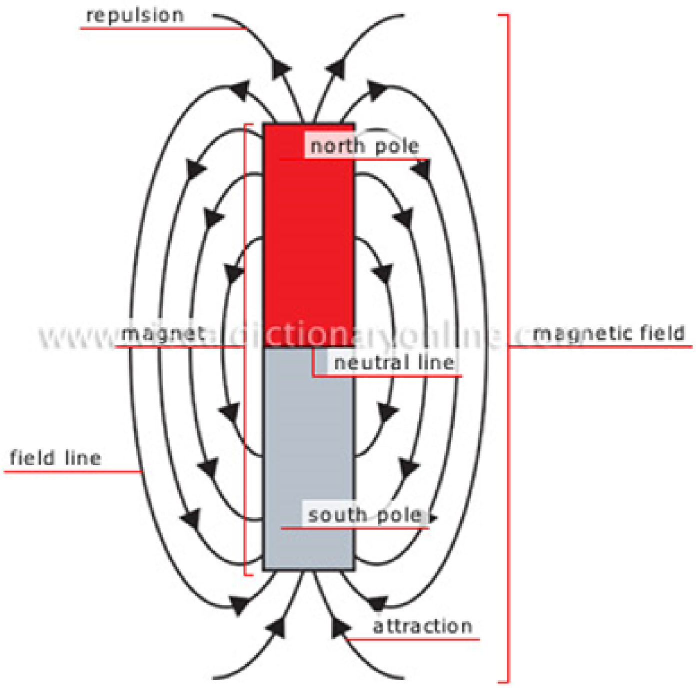
Have you played with magnets before? You might remember trying to make things stick together or move an object just by using a magnet. A magnet is an object that attracts or repels other objects within a magnetic field. Magnets can be permanent or temporary and vary in size, shape or in the strength of its magnetic field. Some magnets are more powerful than others.

During olden times, people thought magnets were magical. Imagine being able to move an object without touching it! Children who discover magnets for the first time also get surprised by how magnets work. Magnets are easy to use and fun to play with, but are also used in nearly every utensil or tool that we have at home. At home, your mom doesn't use glue or tape to stick notes to the refrigerator door; she uses little magnets to attach them. How cool is that?

How do magnets work?

What do magnets have that make objects stick with it? Magnets have an invisible field that forces other objects to react to its properties. This powerful force is called the magnetic field. Magnetic fields have particles called electrons that actively shift and move within the field. These electrons continuously revolve around the core of the magnet (its poles), creating energy that attracts objects. Because of this, magnets have the ability to draw objects towards itself. This ability is called magnetism, caused by the force field that magnets create through its electrons (negative charge) and protons (positive charge).

If two magnets are close together, try figuring out which ends tend to meet. If you look closely, you'll see that unlike poles attract each other, while identical poles repel each other. If you place the south pole of a magnet beside the north pole of another magnet, they will stick together. On the other hand, putting two magnets with both north poles facing each other will force them apart.



Which objects are attracted to magnets?

The magnets can attract all things made of iron. Objects that are made out of other metals like nickel can also stick to magnets, although non-metallic objects like glass, cloth and paper cannot be attracted to magnets.

Do you know that you can also make temporary magnets out of everyday tools? Observe how dangling a permanent magnet on top of a bunch of iron nails automatically pulls the nails towards it. The invisible field exerts a pull on the nails to get attached to the magnet. Objects that are surrounded by a magnetic field can become magnetized for a time and be able to have other objects stick to it. If you attach a nail to a permanent magnet, the nail itself will be caught within the magnetic field and acts as a magnet itself, forcing other nails to attach to it. Sometimes, the magnetic field is too strong for it to disappear right away that an object can retain its magnetism long after it was magnetized. You can test this by running a permanent magnet over an iron bar or nail several times, then leave it be and see if it can attract other nails.

How do we use magnets in everyday life?

Magnets are everywhere! You may not see it or feel it, but nearly everything that works around you uses the magnetic field. When you close the refrigerator door, the way it sticks to the fridge is because of magnets. The microwave oven where you cook your popcorn, the electric fan you use to keep off the heat, even the computer - all use magnets to function!

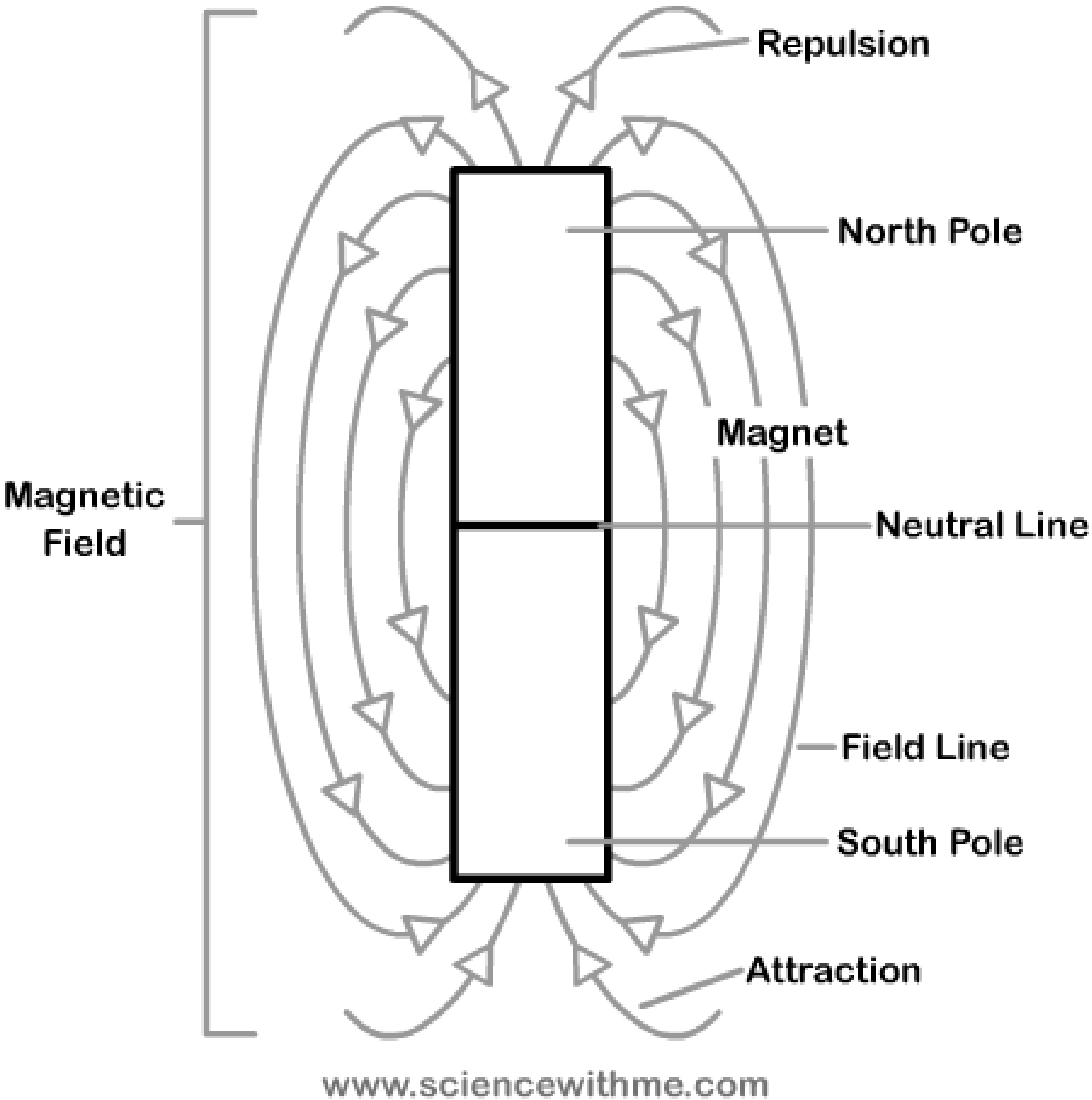
Magnets are even present in the devices we use to enjoy music: without magnets, you wouldn't be able to use your earphones or speakers. Magnets are also useful in medical equipment and electronics. Nearly all appliances that use motor engines use magnets to make them work.

The Earth is actually a huge magnet. Can you believe it? Our planet has both North and South poles, which act within the Earth's magnetic field. Similarly, all magnets have two poles: north and south. The magnetic fields are strongest at the poles, and the ends will point towards its poles. Try hanging a bar magnet in the air, and see how the north end of the magnet follows the direction towards the Earth's North pole, and the south end of the magnet faces the South pole. This is why the compass that we bring and use during hiking uses a magnet to show us the way we need to go.

Now that we have learned about magnets and magnetism, we can be aware of how valuable it is in our daily lives.

Name : ______________________________

Color the Magnet



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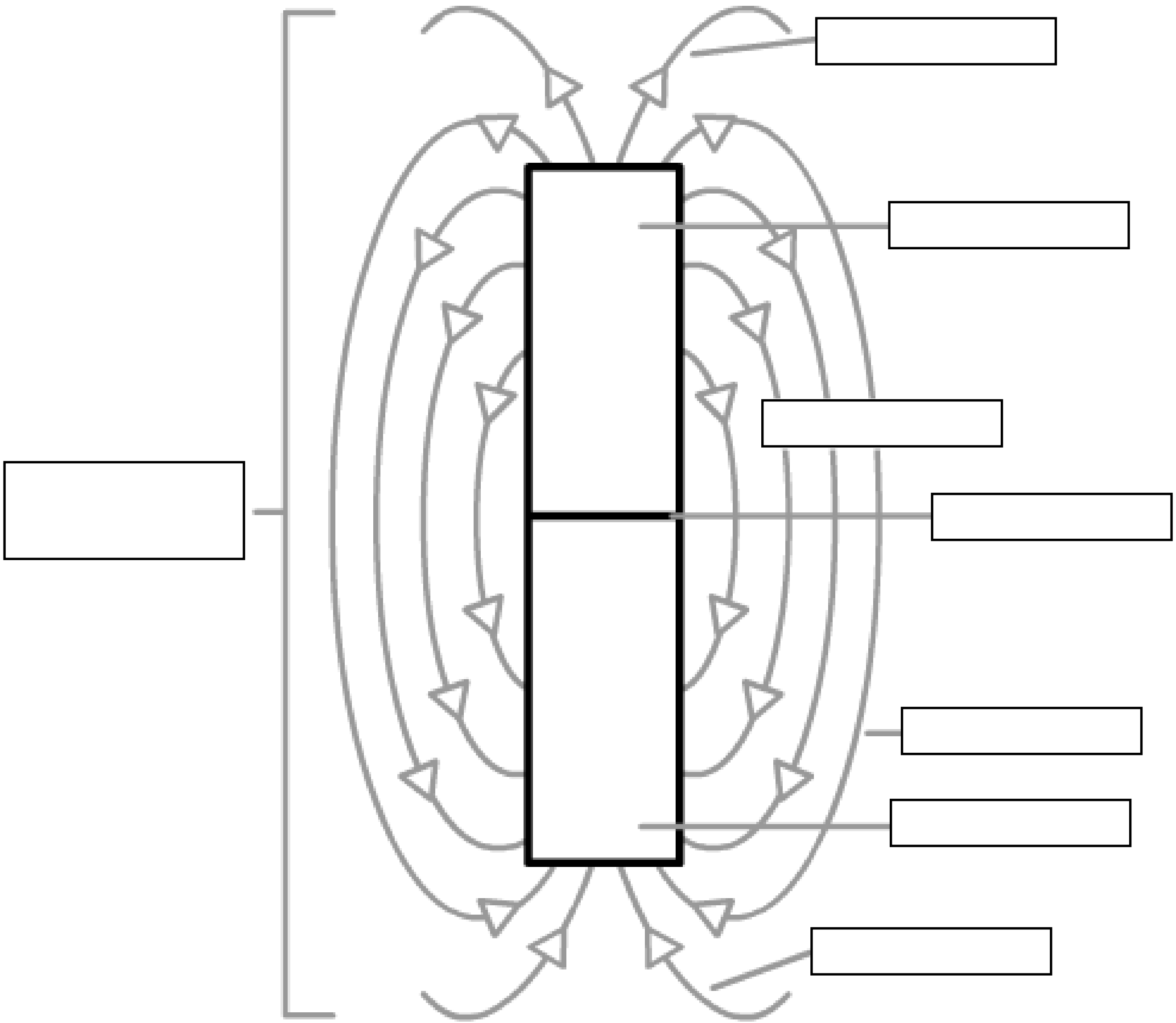
Color and Label the Magnet



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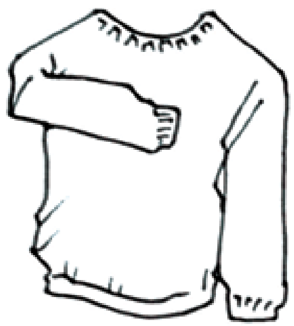
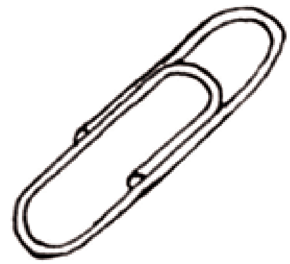
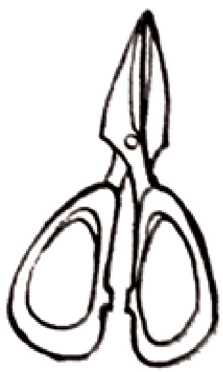
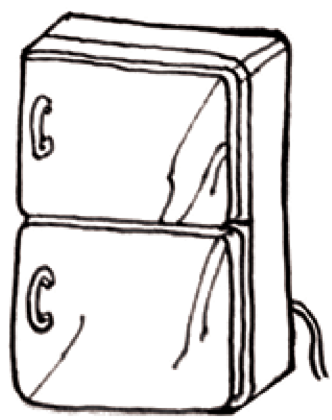
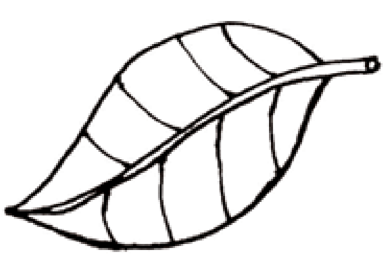
COLOR THE ITEMS THAT ARE ATTRACTED TO A MAGNET

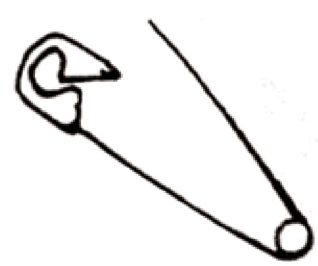












Science with me! Starting reactions that last a lifetime®

Learn about S.I. UNITS

What are S.I. Units?

S.I. stands for Systeme Internationale, which is also known as the International System of Units. You may not notice this but we always use this as a form of measurement. SI units have been accepted around the world as an ideal replacement to other metric systems that may cause confusion and uncertainty among people. Today, people from all countries follow this metric system, and that includes me and you!

How did S.I. Units come about?

A long time ago, people from different countries had different ways of measuring things, which made it harder for them to trade. People need to measure what they buy and exchange for them to prosper, but not having a common and correct way of measuring was a problem. Finally, scientists came up with a unit of measurement that can replace all other existing ways we measure objects. This is how the SI unit of measurement came about.

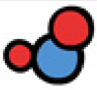
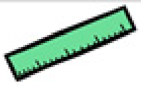
Using the SI unit of measurement helped everyone understand and communicate well doing business. People realized how practical it was to use only one measurement system for every kind of unit. They can now use one unit to measure the weight of a sack of potatoes and a slab of meat, and made it easier to compare their value. It became so useful that everybody started to use SI units because it allowed them to compute in an accurate and simple manner.

What do we measure in S.I. Units?

Scientists decided to set this system of measurement to measure nearly everything that's valuable and important. From the seven basic units of S.I., we can now compute for mass, length, time, temperature, amount or quantity of a substance in matter, brightness of an object or luminous intensity and the flow of electric currents. Even if we use other forms of measurement, we can easily convert these into SI units by following the conversion table.

How do we measure in S.I. Units?

S.I. units are so precise that these are used in all scientific measurements. There are seven basic units, and then we add prefixes for sub-units. Each sub-unit originates from the base unit, so it's easier to identify the type of measurement used (for example, adding the prefix centi to the basic unit meter = centimeter, which is one hundredth of a meter). Listed below are the seven SI basic units of measurement.

Physical quantity measured	Base unit	SI abbreviation
	mole	mol
	meter	m
	kilogram	kg
	second	s
	kelvin	K
	ampere	A
	candela	cd

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- **Meter** (abbreviated as m). The meter is used to calculate distance or length. When scientists first thought of the meter, it was described as one ten-millionth of the distance between the equator and the North Pole. Comparing with other metric systems, 1 yard is exactly 0.9144 of a meter.

- **Kilogram** (abbreviated as kg). The kilogram is used to compute for mass, which is the measurement of the quantity of matter in any given object. In science the kilogram is used to measure mass, but for us we use it to measure both mass and weight. One kilogram is actually a thousand grams, and although gram can be considered the chief unit, the kilogram (prefix kilo + gram) is used to define measurement for objects with considerable size. In real life, we use the kilogram more to shorten descriptions of measurement that may be too long for comfort (example, 22,000 grams = 22 kilograms).

- **Second** (abbreviated as s). The second is the basic unit of measurement for time. Because we now have a way to observe time in its smallest unit or form, this was helpful especially in sports and science. Before, 1 second was first used to describe the time spend in the earth's rotation. Today 1 second is 1/60 of a minute based on the numerical conversion.

- **Kelvin** (abbreviated as K). The kelvin is used to compute the amount of heat in a certain object. We may be not very familiar with using the kelvin to measure temperature, but it is called the absolute scale because the temperature is only stated in positives (no Kelvin measurement uses the negative sign).

- **Mole** (abbreviated as mol). To compute for the quantity of substance within an object, SI uses the mole as its basic unit of measurement. Because there are no other available units used to measure the amount of substance within matter, we may also not be aware of using the mole as a unit of measurement, but this is the general term used by scientists.

- **Candela** (abbreviated as cd). The candela is used to measure the brightness or luminous intensity of an object. You can use this to compute for how much light an object emits, or the amount it glows, or simply how bright it is.

- **Ampere** (abbreviated as A). Amperes or more commonly called amps, is used to measure the electric current. Amps can be used to compute for how much electricity runs in a given object, so all conductors of electricity uses amps to calculate the flow of the current.

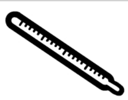
Why is it important to use S.I. Units?

Because using SI units allow us to measure objects or matter in a more simple, straightforward and yet accurate manner, calculating is effortless for everyone. Using an exact way to measure things is way better, and of course easier and more reliable than using your arms or legs to explain the distance between two points.

Isn't it fun to learn about SI units? Now you can easily compare one object with another by using the SI unit for mass (kilogram), or know how far it is to go to a certain place just by using the SI unit for length or distance (meter). Visit www.sciencewithme.com and check the amusing animation called The King to help you remember the SI Units.

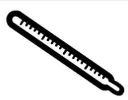
Name : ____________________________________

Color the SI Units

Physical quantity measured	Base unit	SI abbreviation
	mole	mol
	meter	m
	kilogram	kg
	second	s
	kelvin	K
	ampere	A
	candela	cd

Name : ______________________________

Color and Label the SI Units

Physical quantity measured	Base unit	SI abbreviation
		
		
		
		
		
		
		

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Starting reactions that last a lifetime®

Learn how a STEAM ENGINE WORKS

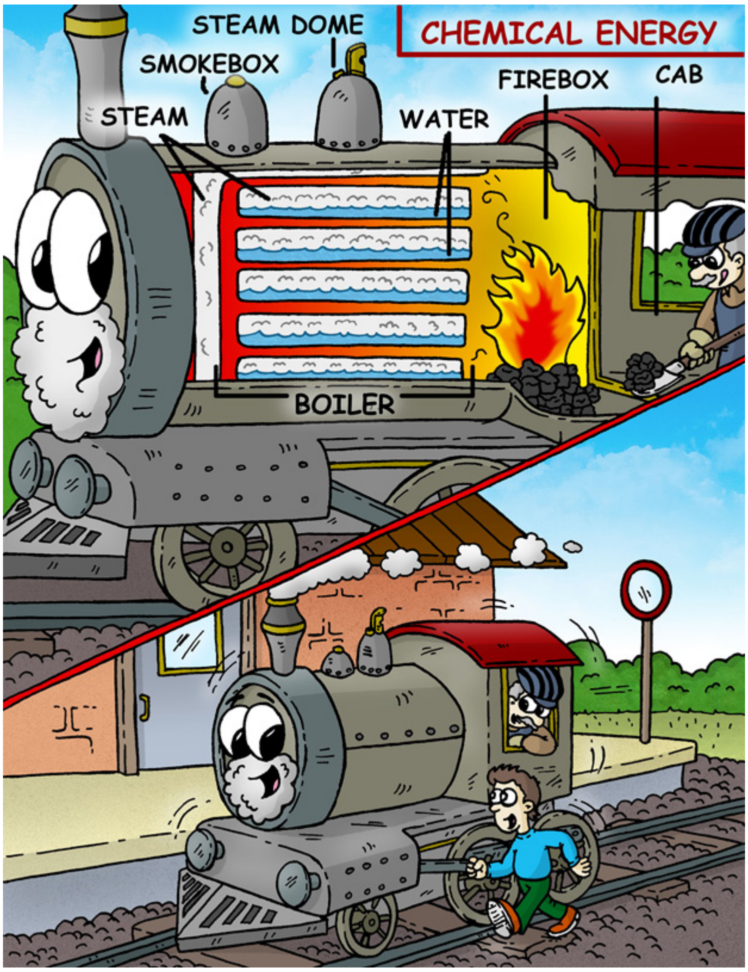
Have you ever ridden a steam locomotive? You can find a classic steam locomotive on old railways because it was traditionally used to transport both people and merchandise to various locations. Merchants use the steam locomotive to carry their goods and sell it in trade fairs or markets. Before the modern railroad system was introduced, all railways used a steam locomotive for their trains. You probably have wondered what makes a steam locomotive so fascinating, and that's because it's powered by a steam engine!

What is a steam engine?

A steam engine is the main reason why steam locomotives can function. With the steam engine people can travel faster which made trade more efficient. Steam engines are among the most brilliant discoveries by mankind. Although most steam locomotives are no longer operating on railways today, you can still find steam engines being used in various factories and industrial plants.

What powers a steam engine?

A steam engine is a type of machine that only relies on steam to facilitate energy. That's right! Energy from a steam engine comes from the heat that emanates from the boiler, which works much like a huge pot filled with water. Burning coal to fire up the boiler is similar to turning on the stove to boil water in a kettle. Men continuously place coal to burn so that the heat can circulate within the boiler, and as the water continues to boil it releases steam which in turn makes the machine work. It looks so simple that it's amazing how this can power an engine!



Understanding energy from steam engines

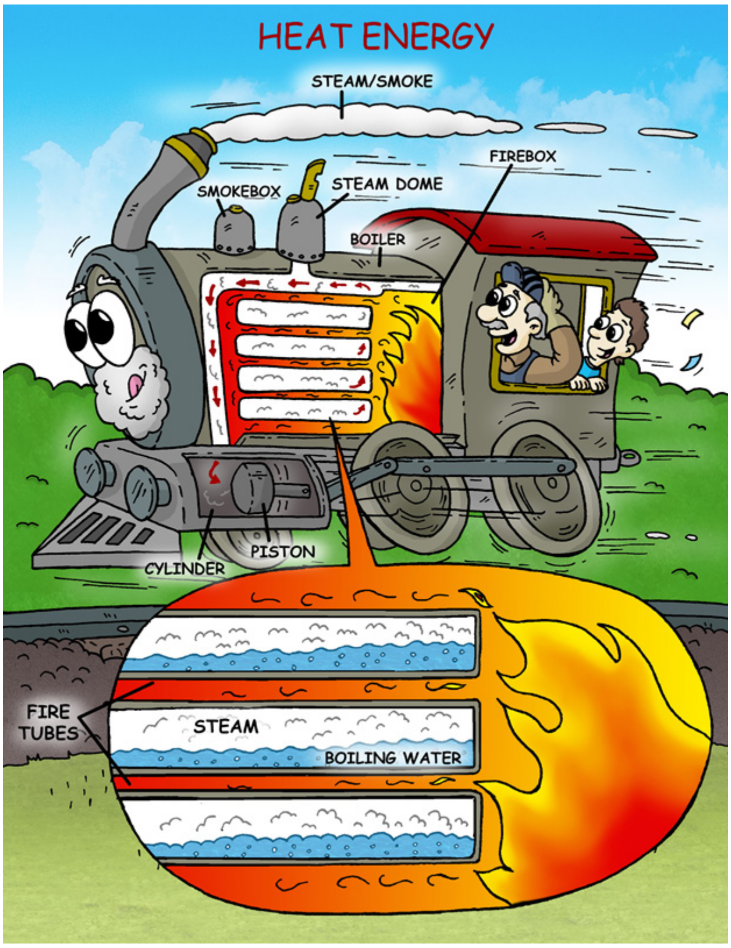
Like steam engines, everything uses energy to function. For example, food that we eat gets digested, and then converted into fuel that our body needs to perform our daily tasks. Energy can be used and converted, but can never disappear. It only passes from one state to another, and steam engines are the perfect example of seeing how it happens. For steam engines to work, energy is derived from four different kinds: chemical energy, heat energy, kinetic energy and then finally, potential energy.

- **Chemical energy.** To produce steam which a steam engine uses to operate, coal is loaded onto the firebox, which is essentially like an oven or wooden stove. Because coal is fuel which can transmit heat efficiently, it is used to increase the temperature for the boiler. The moment coal touches the fire and bursts into flame, it combusts. This kind of chemical reaction is called chemical energy.

- **Heat energy.** The conversion of energy begins in the firebox and ends in the boiler. In a steam engine, chemical energy is transformed to produce heat energy after the coals are set on fire. Heat energy is directed by a change in the temperature. Right after the coals ignites, that chemical energy gets converted to heat energy, which is used to boil the water and produce steam.

- **Kinetic energy.** With steam, the engine can now use this energy to force motion into the gears or in a case of a steam locomotive, the wheels. The steam forces the cylinder and piston within the steam engine to shuffle and move, initiating the turning of the wheels and putting it in motion. This is called kinetic energy. Kinetic energy derived from heat energy (steam) gives power to the cylinder and piston to act forward and backward, triggering mechanical action towards the wheels.

- **Potential energy.** Lastly, steam engines have potential energy when there is a need to function through a gravitational pull. When a steam locomotive goes up a hill, the kinetic energy that generates movement of the wheels suddenly becomes potential energy before the locomotive goes downhill. As the locomotive travels down the hill, this same potential energy converts back to kinetic energy, helping to bring the locomotive down.

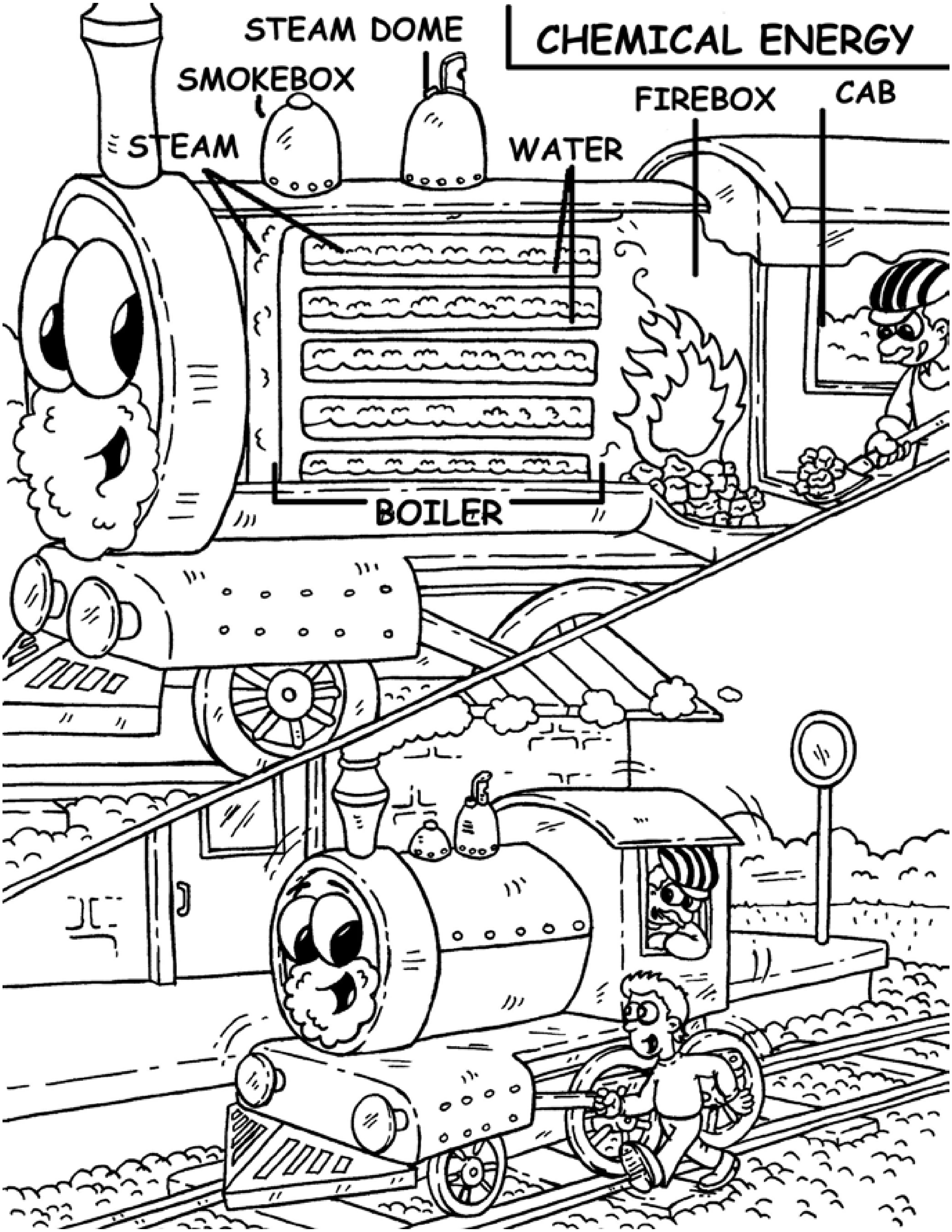


Simply put, steam engines use fire and coal (chemical energy) to boil water and produce steam (heat energy), which in turn pushes the cylinder and piston to drive the movement of the wheels (kinetic). As the wheels turn and move towards a slope or a hill carrying a load (potential energy), it can also go faster when it goes downhill (kinetic energy). This gradual yet steady shift of energy forms makes it possible for a machine like the steam engine to work!

Now that you understand that steam engines use energy in various forms to work, don't you think it's also important to conserve energy? Without energy, nothing can function properly, and everything including steam engines will not operate as it should be. If you're curious about exactly how energy transforms from one kind to another for steam engines to perform, check out our fun steam engine animation available on www.sciencewithme.com.

Name : ____________________________________

Color the Steam Engine



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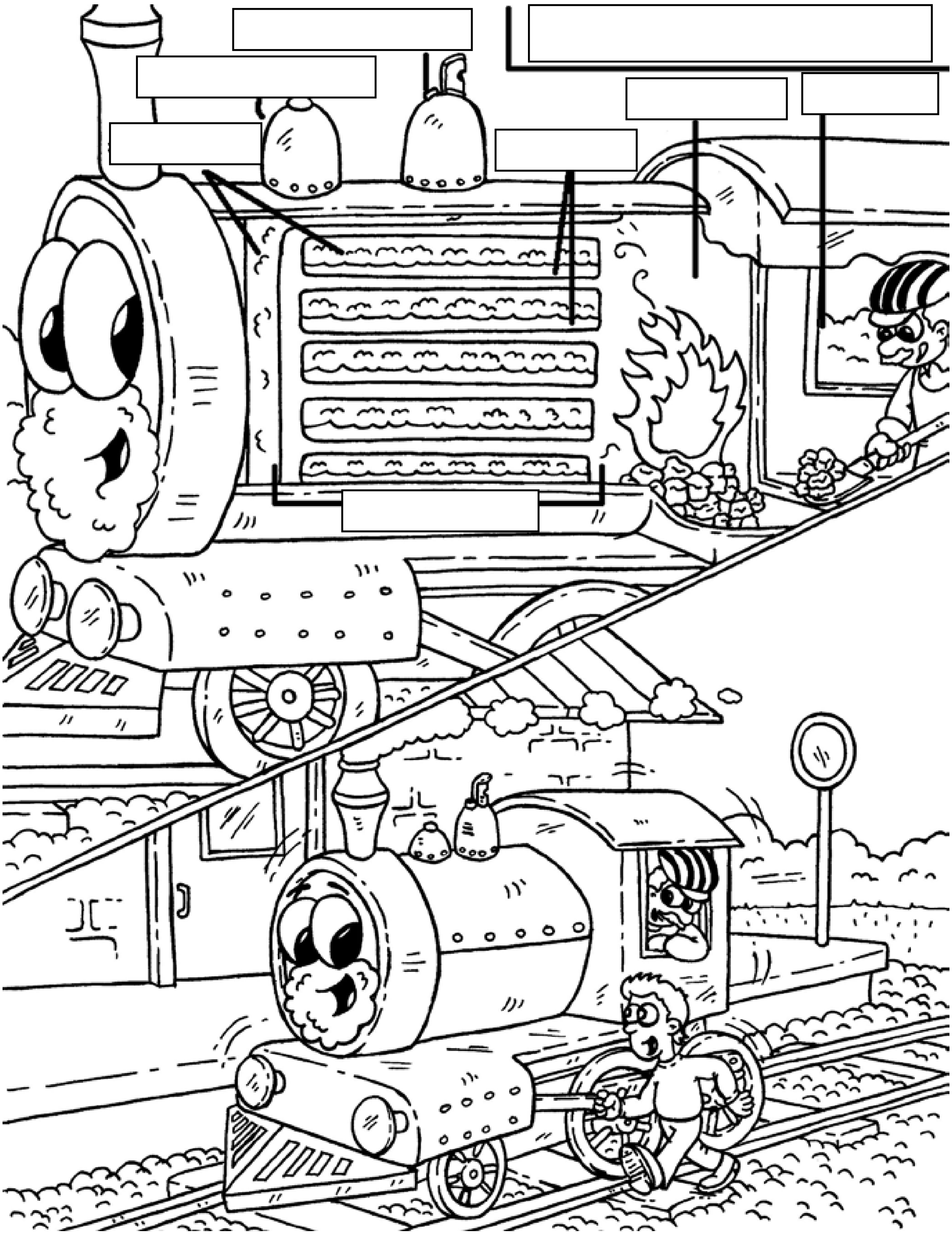
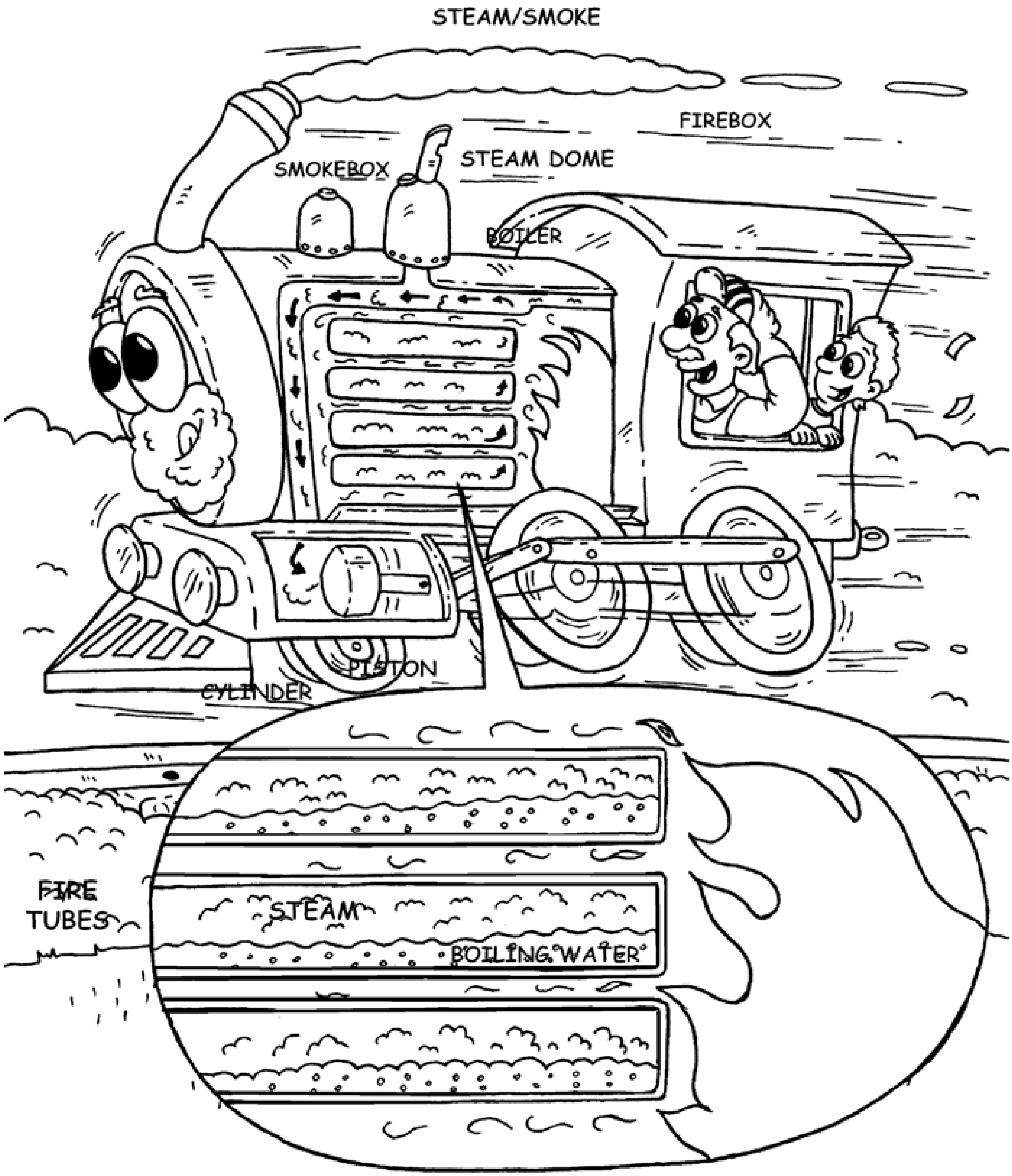
Color and Label the Steam Engine



Name : ______________________________

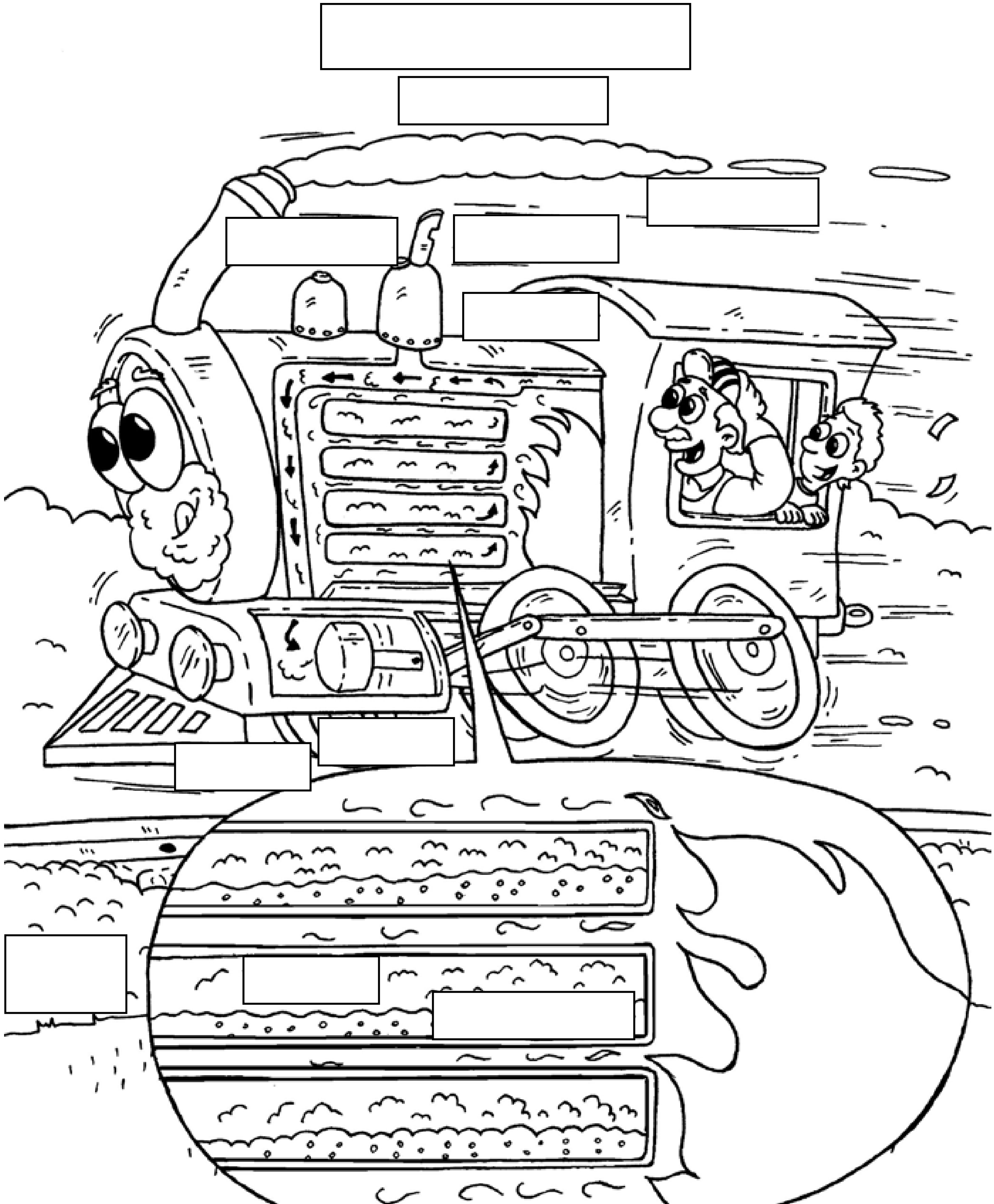
Color the Steam Engine

HEAT ENERGY



Name : ____________________________________

Color and Label the Steam Engine



Name:

Test the following objects to determine if they are CONDUCTORS or INSULATORS.

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Apparatus:

- Light bulb
- Light bulb holder
- Battery
- Alligator clips
- Rubber band

Items to be tested:

- Penny
- Styrofoam
- Cork
- Paper clip
- Rubber
- Aluminum foil
- Toothpick

Method:

Step 1: Place the rubber band around the battery.

Step 2: Attach one alligator clip to each end of the battery.

Step 3: Screw the bulb into the light bulb holder.

Step 4: Connect the other ends of the alligator clips to the metal connections on the bulb holder and turn on the light.

Step 5: Add an extra alligator clip to the circuit.

Step 6: Insert the objects to be tested between the two open ends of the alligator clips. By doing this you are closing the loop again and completing the circuit. If the light lights up that means electrons are flowing and the object conducts electricity. If the object is an insulator and doesn't conduct electricity the light won't turn on.

Make sure however that the two alligator clips don't touch each other otherwise the light will light up and give you an incorrect reading for an object.

Record your results in the table below:

Item tested	Conductors or Insulators
Penny	
Styrofoam	
Cork	
Paper clip	
Rubber	
Aluminum foil	
Toothpick	

How about liquids?
Are they good conductors?

www.sciencewithme.com

Name:

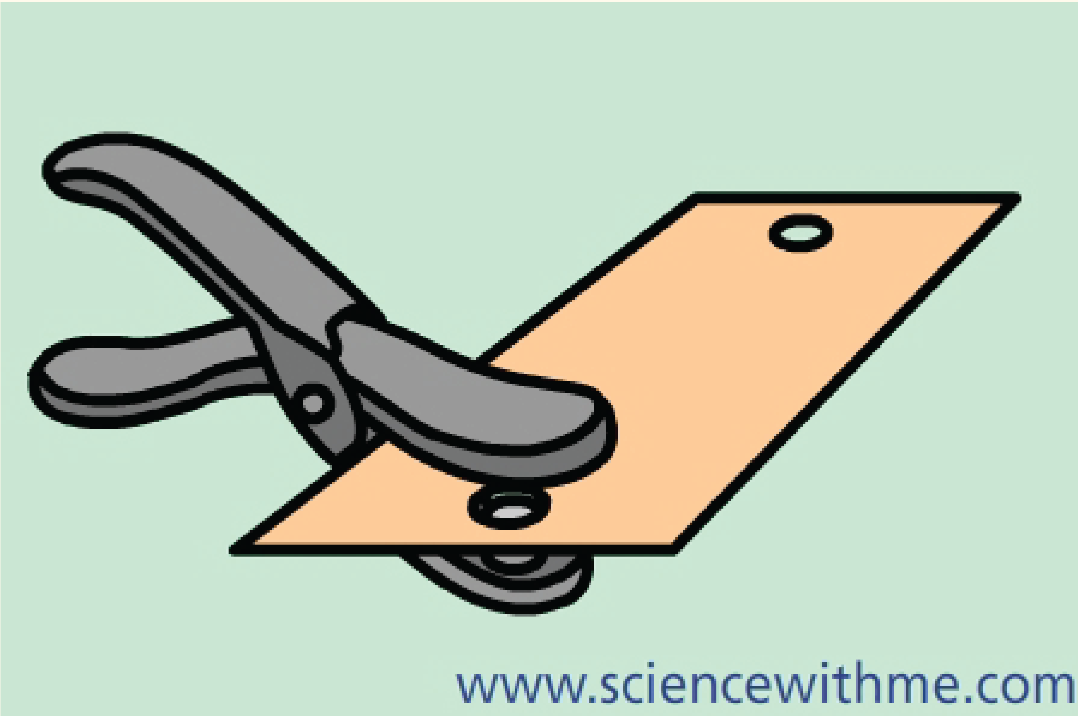
Aim

To make a switch and put it in the circuit so that you can turn the light on and off.

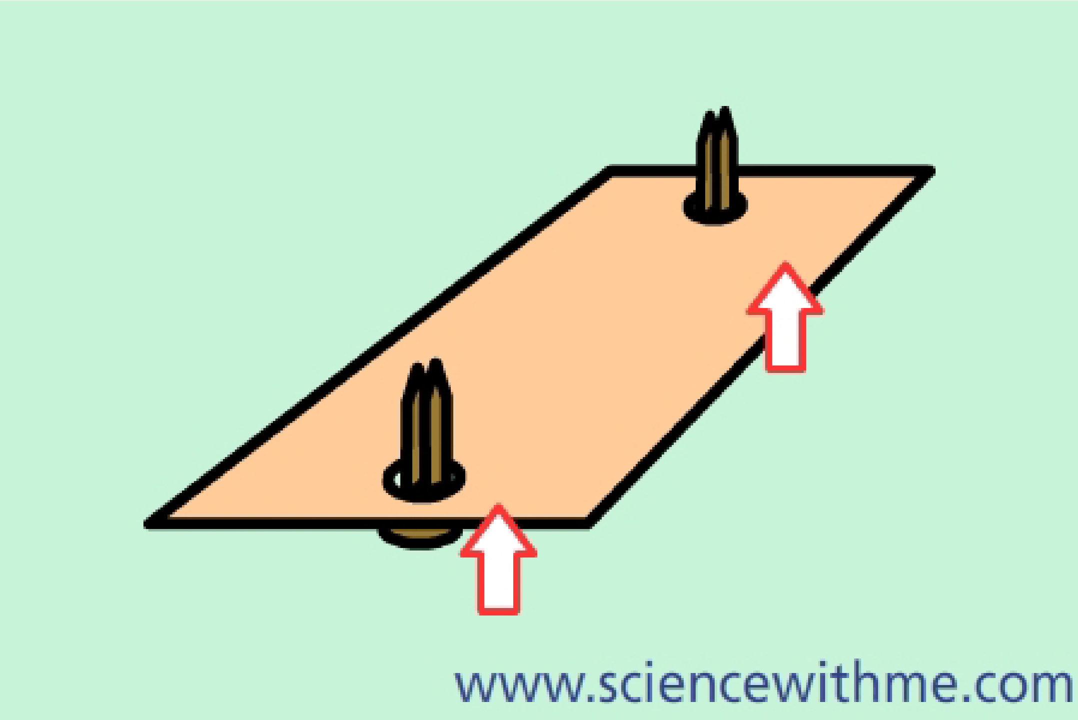
Apparatus:

Strip of cardboard
Brads
Battery
Paper clip
Bulb
Rubber band
Alligator clips

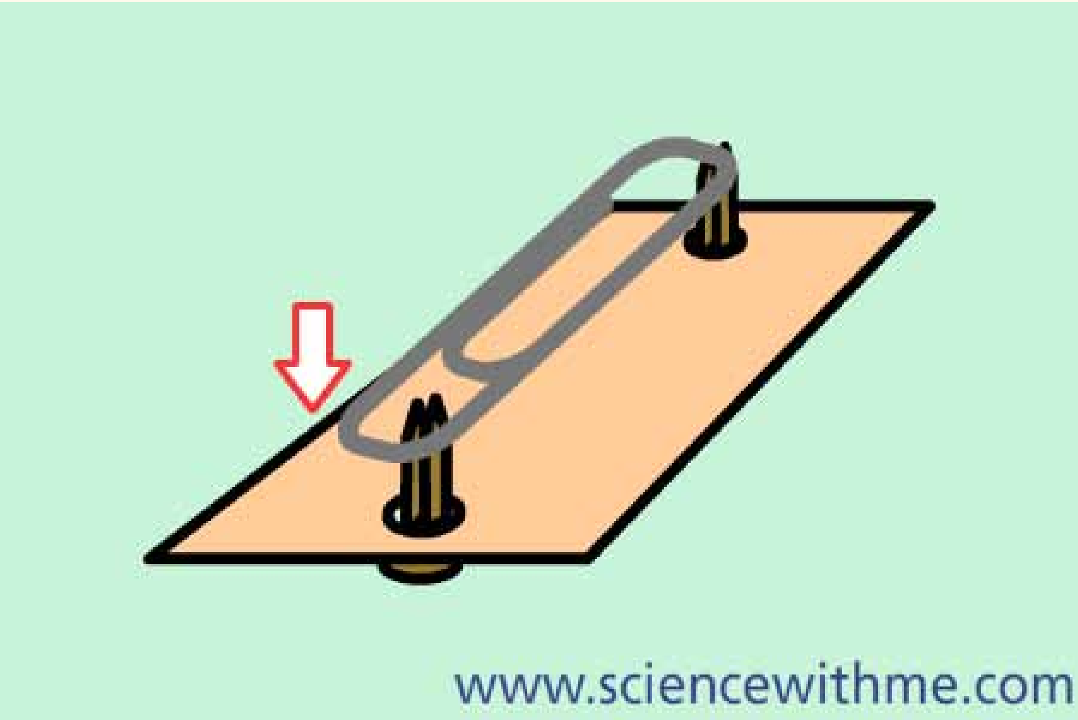
Method:



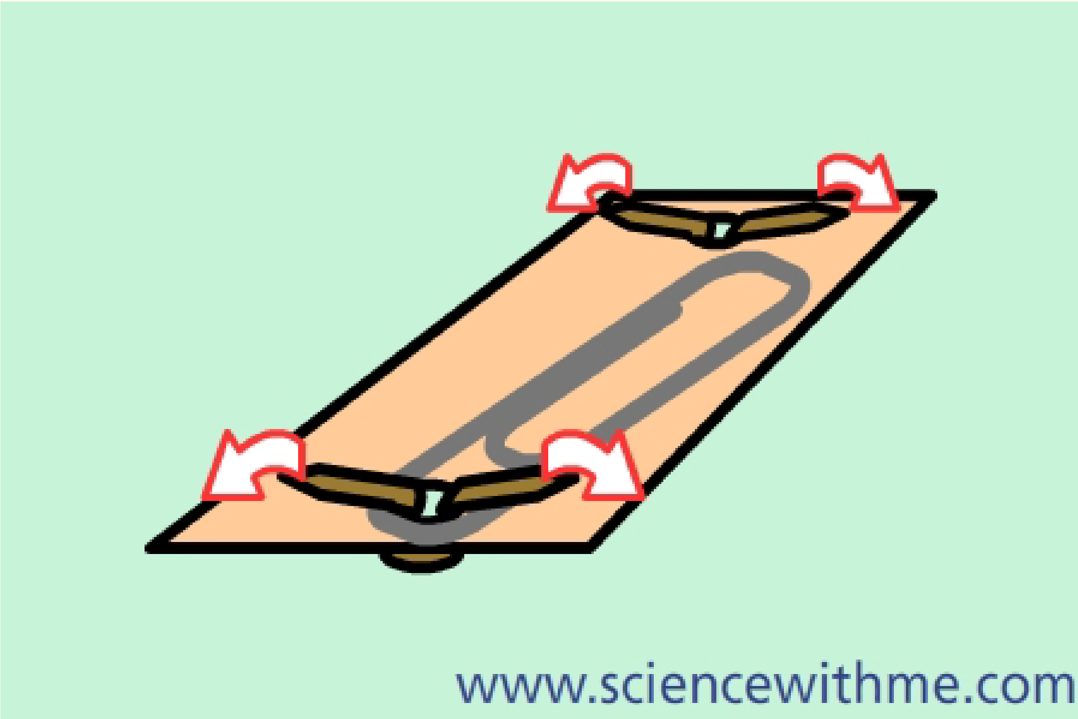
Step 1: Punch two holes in the cardboard.



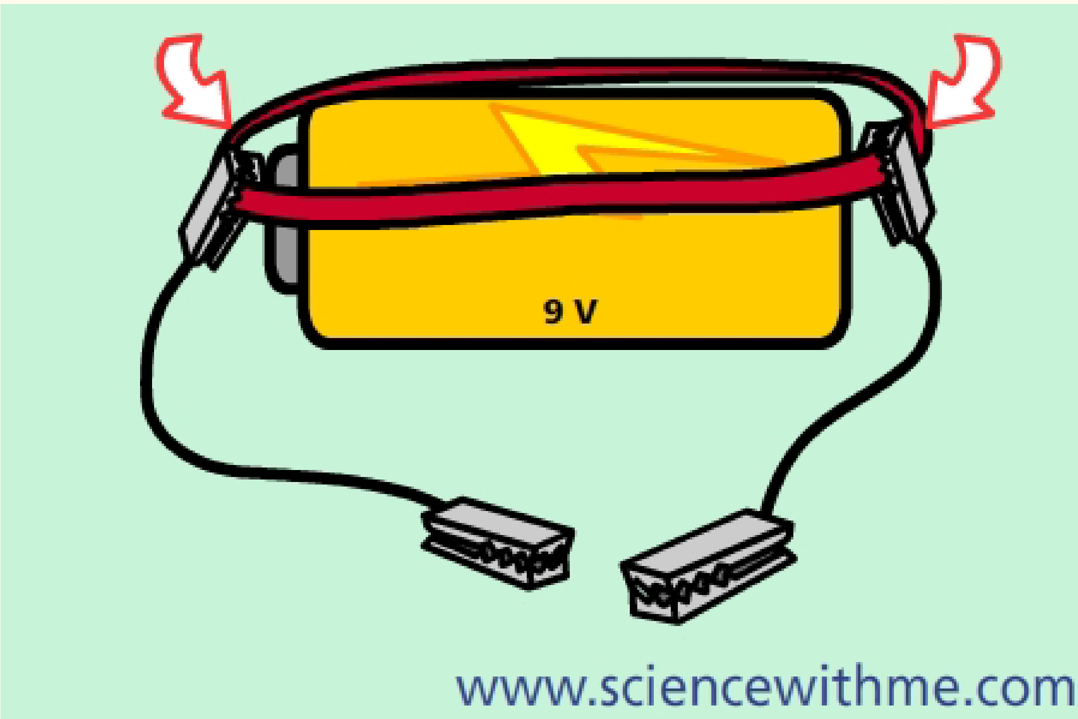
Step 2: Push two metal brads through the pre-punched holes.



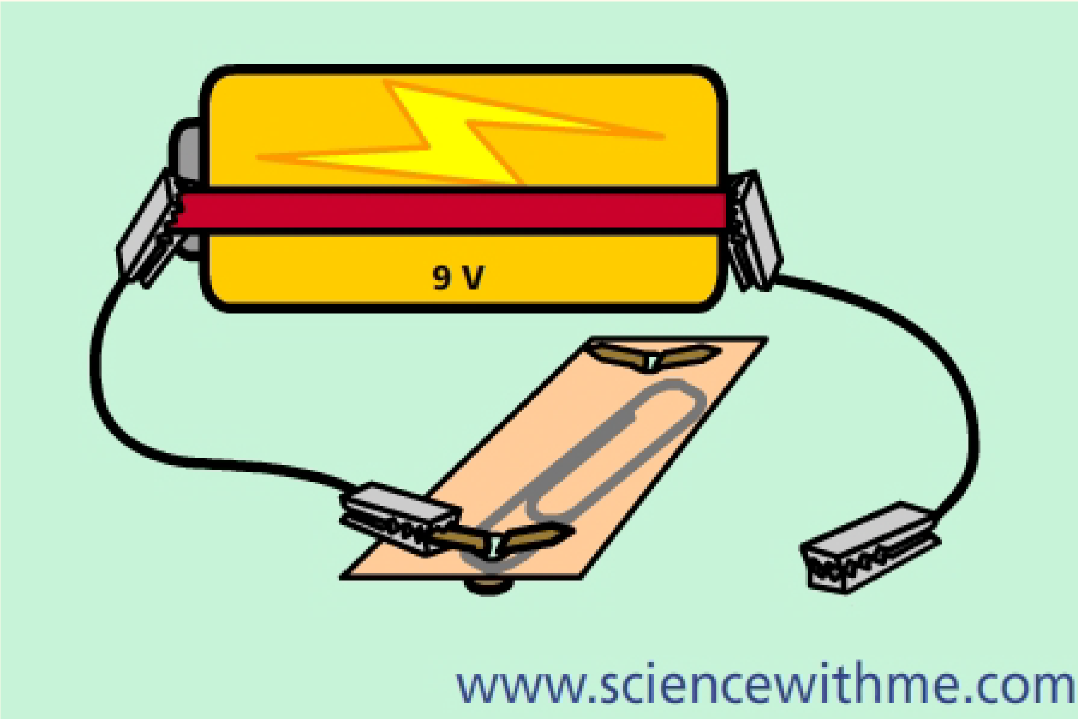
Step 3: Place the paper clip over one of the brads.



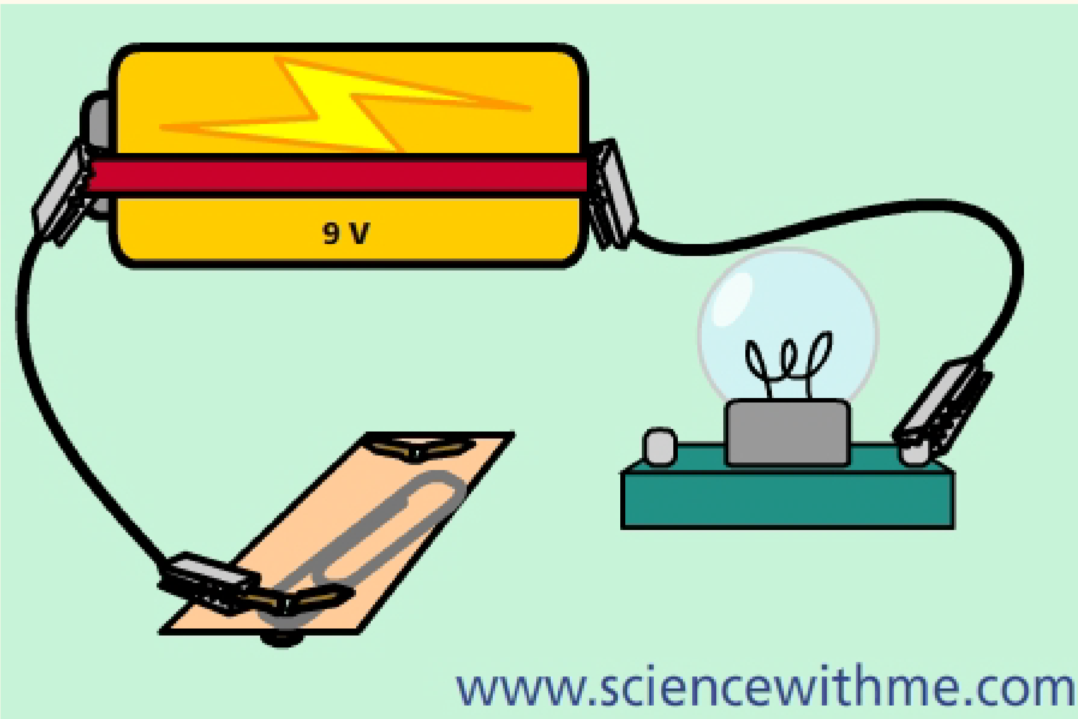
Step 4: Lock the paper clip in place by bending open the brad on the underside. Bend open the other braid too.



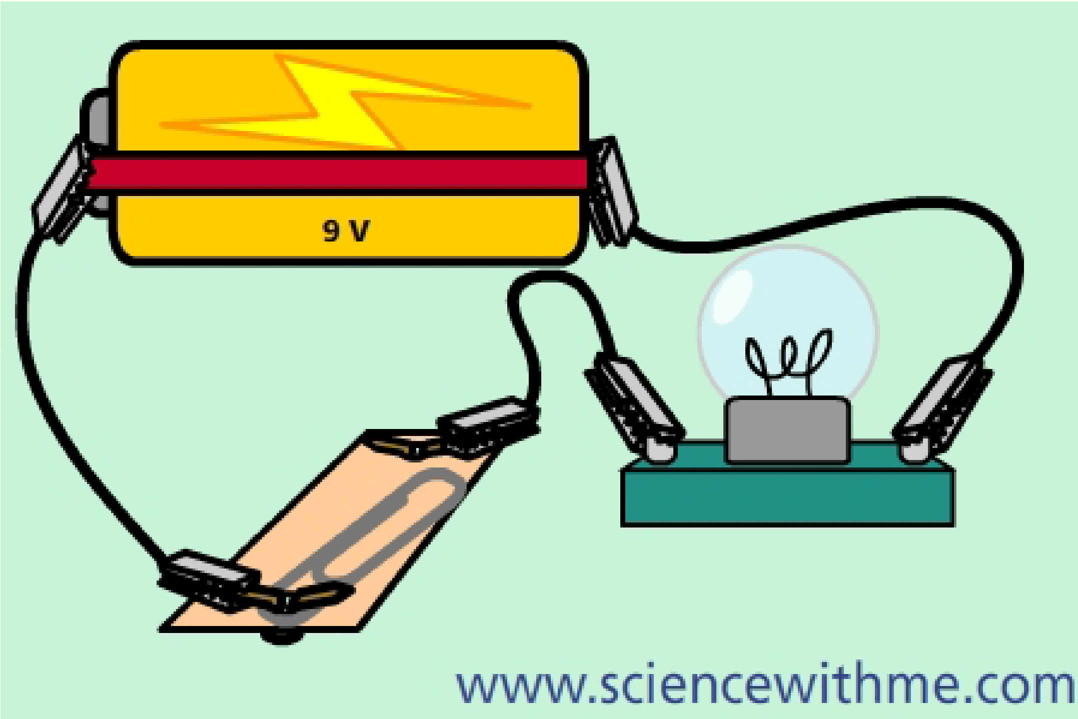
Step 5: Place a rubber band around the battery and connect the alligator clips to the each end of the battery.



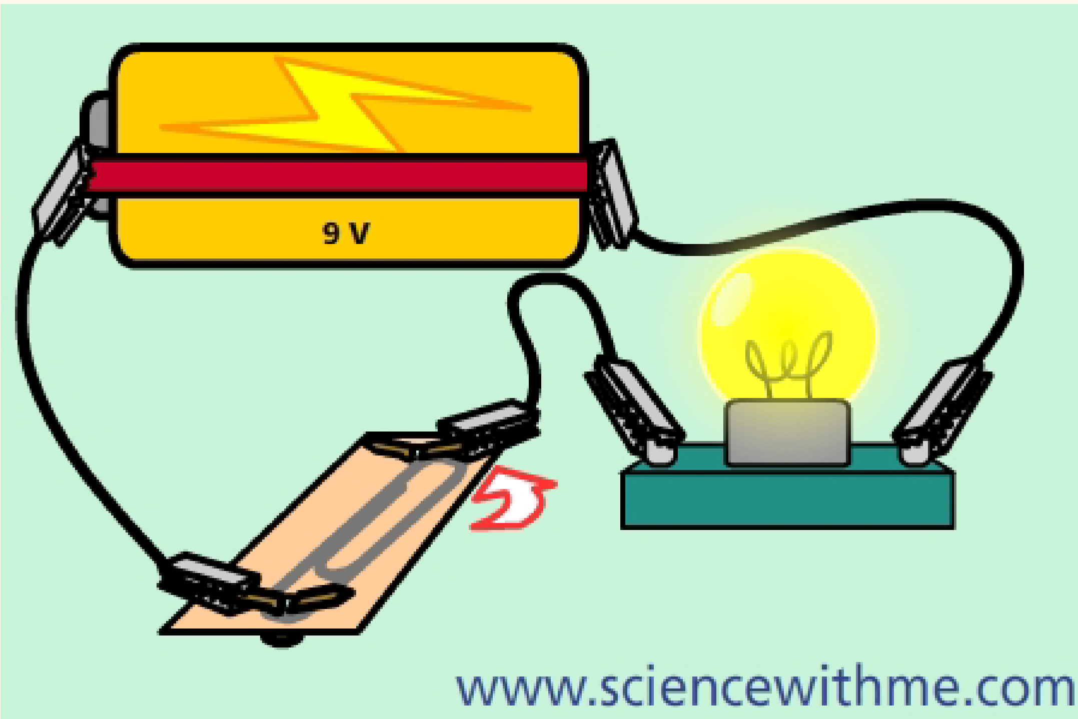
Step 6: Connect one of the alligator clips to the switch.



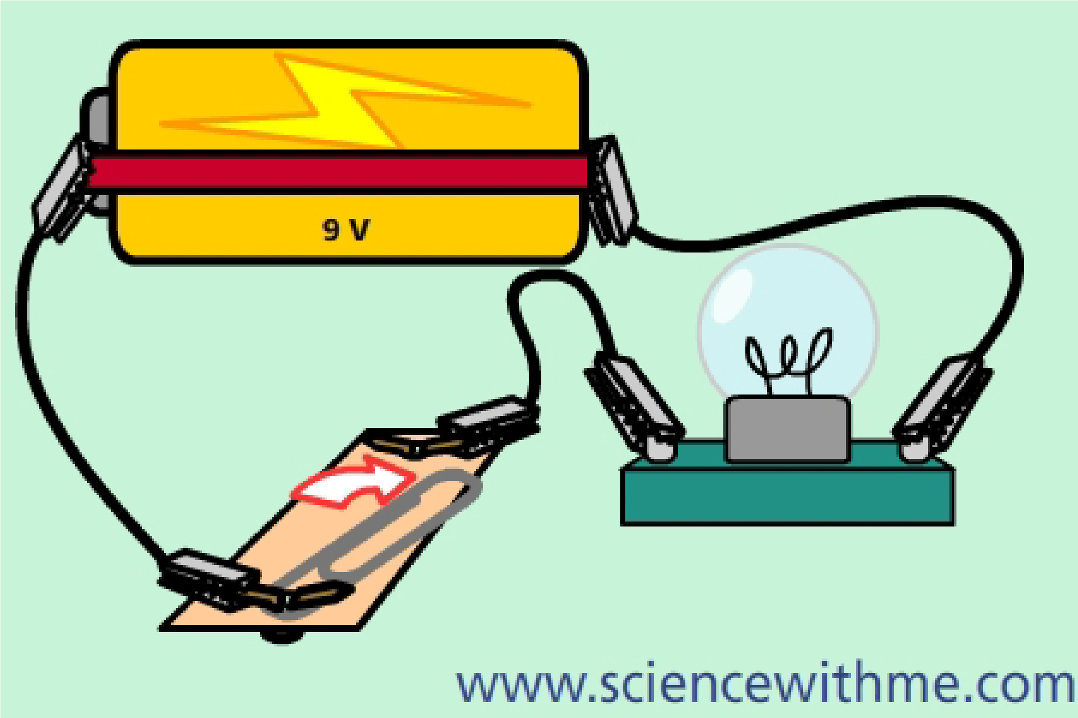
Step 7: Connect the other alligator clip to the bulb.



Step 8: Connect a third alligator clip to the second braid of the switch and the second metal connector on the light bulb.



Step 9: What happens when you push the paper clip against the metal brad and CLOSE the circuit?
Circle your answer below:
The light turns ON OFF



Step 10: What happens when you pull the paper clip away from the metal braid and OPEN the circuit?
Circle your answer below:
The light turns ON OFF

Let's Talk on the Telephone

Apparatus

2 Empty Plastic Cups
Scissors
String
A Science With Me! partner
A Science With Me! lab notebook
Pencil
2 Paper Clips

Questions to ask your child:

What happens if we pinch the string between the two cups? Can we hear each other's voice as well?
What happens if the string between the cups isn't pulled tight? Will the telephone work as well?
Have your child write or draw their observations in their Science With Me! Lab notebook.

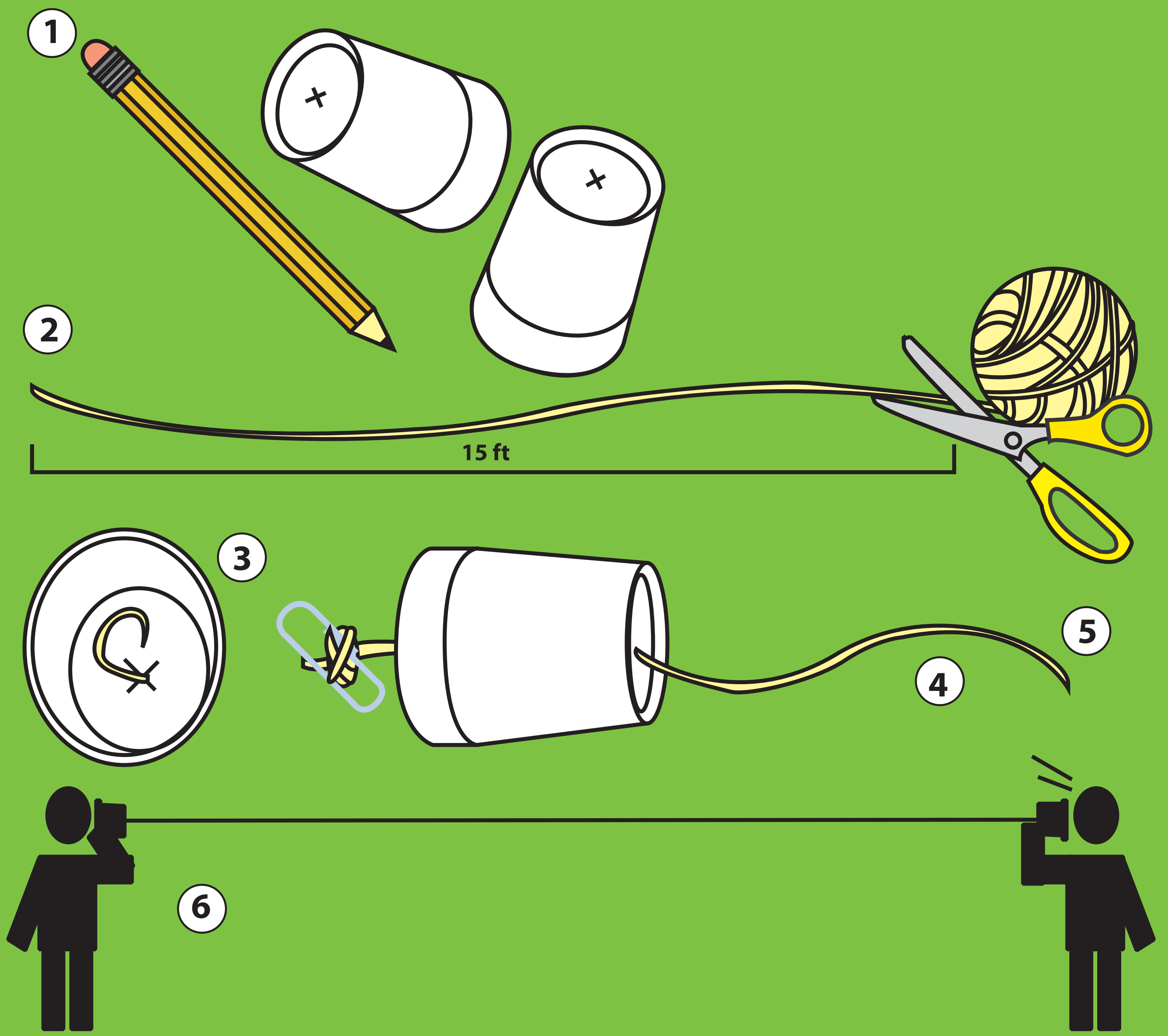
Hypothesis:

All sounds are vibrations. Your voice is no different! When your child talks into their cup this causes the air inside the cup to start vibrating. The vibrations of their voice then travel through the cup, into the string and into the other cup. The 2nd cup channels the vibrating air molecules into your ear so you can hear what they are saying loud and clear

Conclusions:

For the cup telephone to work, the string between the two cups must be able to vibrate freely. That's why if the string is pinched the vibrations are disrupted and your child can't hear your voice as well. This also explains why the string between the cups must be pulled tight for the telephone to work. If the string is loose, the sound vibrations will die out before they reach the other cup. This is similar to the way that sound travels in real telephones with wires.

Let's Talk on the Telephone



Instructions:

1. Using a pencil poke a hole in center of the bottom of each of the plastic cups.
2.Using the scissors cut a piece of string that is about 15 feet long.
3.Thread the end of the string through the hole in the cup.
4. Have your child pull the string a few inches through the cup then help them tie the end of the string in a knot so that the string can't pull back through the cup. You can attach also a paper clip to the knot to stop the string from slipping back through the cup.
5.Repeat steps 3 and 4 to the other end of the string and the other cup.
6. Have your child walk away until the string is tight. Get them to hold the cup up to their ear while you whisper loudly into your cup. Can your child hear what you are saying? Now it's your childs turn to talk. Can you hear what they are saying?

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