

8th Grade Science

From Simple Studies, <https://simplestudies.edublogs.org> & @simplestudiesinc on Instagram

Being a Scientist

Lab Safety:

It is integral that you exercise proper **lab safety** when working in the laboratory. Be sure that you always do the following...

- Read instructions and guidelines beforehand
- Do only experiments that are authorized by the teacher
- Notify the teacher if a mistake has been made or something unsafe has occurred
- Follow the procedures and instructions exactly as they're written
- Wear the appropriate protective gear at all times necessary
- Locate the fire extinguisher, fire blanket, body shower, eyewash station, and first aid kit when first entering a lab

Lab Equipment:

Different types of **lab equipment** are used depending on the circumstances. It is good to know what each tool is and what it does.

- ❖ A **beaker** is a glass container used to mix and heat chemicals. it should never be used to measure exact volumes because its tick marks signifying amounts are not completely accurate.
- ❖ A **graduated cylinder** is a glass container that accurately measures volumes of liquids
- ❖ A **test tube** is a narrow glass container used to mix, heat, and store chemicals
 - A **test tube holder** is an object used to transport and store test tubes
 - A **test tube rack** is a wood, metal, or plastic object used for holding test tubes upright when they have chemicals in them or upside down when they are drying
- ❖ An **Erlenmeyer flask** is a conical glass container used to mix, heat, and store chemicals
- ❖ A **wash bottle** is a plastic container used to store and dispense distilled water
- ❖ A **rubber stopper** is used to prevent chemicals from leaking out of a glass container

- ❖ A **cork** is used to prevent chemicals from leaking out of a glass container
- ❖ A **dropper** is used to transport and dispense small quantities of liquids
- ❖ A **micropipette** is used to transport and dispense minuscule quantities of liquids
- ❖ A **ring stand** is a metal structure that holds glassware in place
- ❖ A **file** is a tool used to file angles, grooves, and corners of an object
- ❖ **Forceps** or tweezers are stainless steel tools used to pick up small pieces of specimen
- ❖ **Tongs** are stainless steel tools used to pick up objects that are too hot to touch with your hands
- ❖ A **scoopula** is a tool used to scoop chemicals up and transfer them to a different spot
- ❖ A **mortar** is a thick, ceramic bowl in which chemicals are grinded using a **pestle**, a heavy, ceramic blunt-ended cylinder

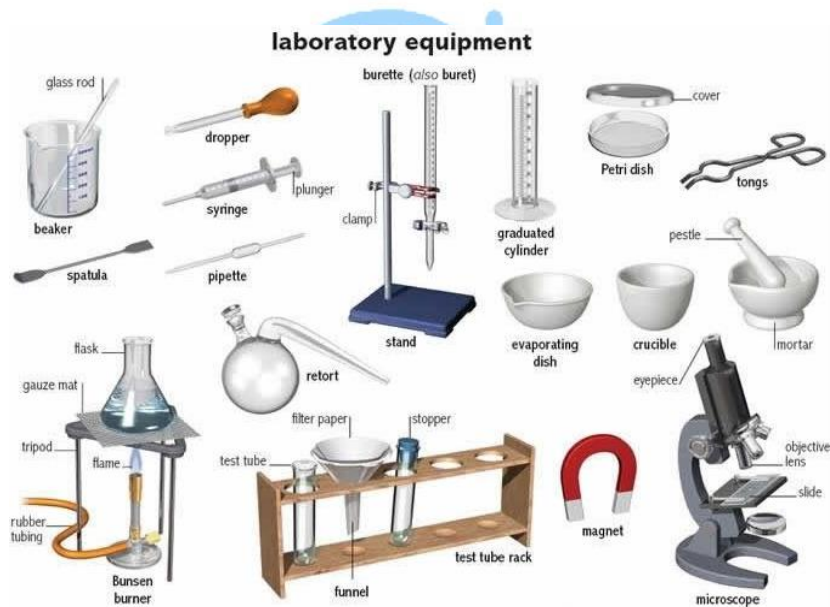
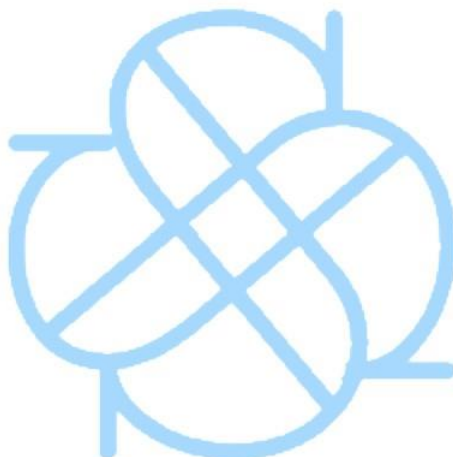


Image: jcilaboratory.com

- ❖ A **funnel** is a conical tool used to control the transfer of liquids to prevent potential spills
- ❖ A **utility clamp** is a tool used to hold materials steady on a ring stand
- ❖ An **iron ring** is an attachment to a ring stand that helps hold glassware or other equipment above a surface, wire gauze is typically placed on the iron ring as support

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- ❖ **Wire gauze** is a metal mesh screen that supports beakers and flasks when they are being heated
- ❖ A **wire brush** is a tool of different sizes with coarse bristles used to clean glassware and other equipment
- ❖ An **evaporating dish** is a dish used to evaporate liquids from a small amount of solution
- ❖ A **watch glass** is a circular dish used to evaporate liquids, hold small solids, or cover beakers to prevent anything from falling into them
- ❖ A **thermometer** is a device used to measure temperature
- ❖ A **bunsen burner** is a device used to heat chemicals in flasks or beakers on open flames
- ❖ A **triple-beam balance** is a device used to measure the mass
- ❖ A **hot plate** is a device used to heat chemicals in flasks or beakers, not on an open flame



Earth Science

Plate Tectonics:

History of Plate Tectonics:

The **theory of plate tectonics** was an idea describing how the Earth's tectonic plates are moving. This theory was proven by scientists **Alfred Wegener**, **Harry Hess**, and **John Tuzo Wilson**. Over one century ago, scientist **Alfred Wegener** came to the conclusion that all seven continents used to be one large continent, therefore creating the idea called **continental drift**. Continental drift was the theory that **Pangea** was what used to once be. Pangea was the name given to the **supercontinent** or massive landmass that was once composed of every continent. Wegener's proof that his theory of Pangea was true included the following...South America and Africa seemed to fit together like puzzle pieces when considering the shapes of their edges



Image: https://commons.wikimedia.org/wiki/File:Pangaea_continents.svg

- ❖ Matching plant and animal fossils were found on the coasts of South America and Africa that were closest to each other
- ❖ Matching landforms-folded mountain belts-were present on the coasts of South America and Africa that were closest to each other

From <https://simplestudies.edublogs.org>

- ❖ Climates were found in places that they wouldn't normally be present in. Coal deposits, which are present in Africa, were found under the ice in Antarctica, and glacial deposits, common in Antarctica, were found in tropical areas of Africa.
- ❖ The data Wegener collected about Greenland's latitude/longitude was different from the data collected in the past

Unfortunately, the rest of the science community did not believe him and often ridiculed Wegener for his theory, saying the evidence he provided was not enough. During World War II, though, oceans were explored more with the help of new technology such as **SONAR** (Sound Navigation and Ranging). Discoveries from SONAR showed that the seafloor was not as flat as it was originally thought to be, reawakening Alfred Wegener's theory of continental drift and allowing modern scientists to prove that Pangea was real.

The observations using SONAR that helped prove continental drift were made by many, one of them being geologist **Harry Hess**. Hess discovered the theory of **seafloor spreading**, the idea that the new ocean floor is constantly being created on one end of the planet, and the old floor is constantly being pushed back into the planet through subduction on another end to ensure that the planet does not grow in size. This showed that the movement of tectonic plates was because of something happening deep inside the earth that was causing the seafloor to spread.

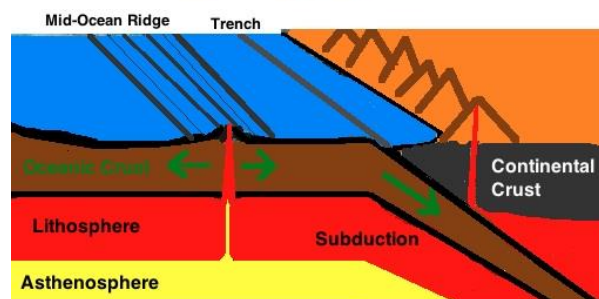


Image: https://commons.wikimedia.org/wiki/File:Seafloor_Spreading_Antarctica.jpg

The final piece to the theory of plate tectonics was discovered by geophysicist **John Tuzo Wilson**. Wilson proposed that the tectonic plates were being moved through convection currents in the mantle. The convection currents push up against the Earth's crust, causing the plates to shift around.

From <https://simplestudies.edublogs.org>

Plate Tectonics and Boundaries:

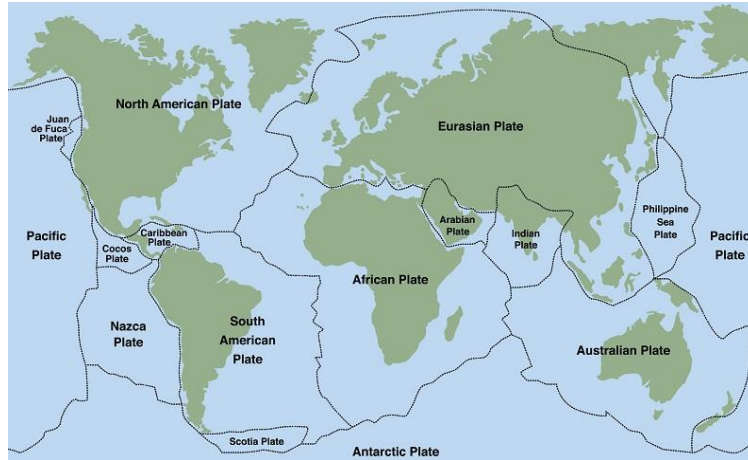


Image: <https://www.worldatlas.com/articles/major-tectonic-plates-on-earth.html>

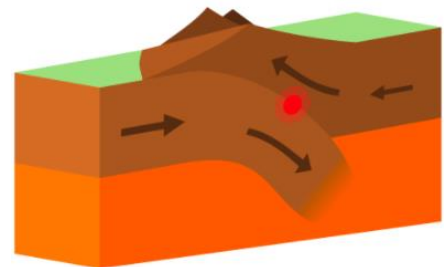
Tectonic plates are portions of the earth that move to create landforms. There are seven large plates and multiple smaller ones. The major plates, shown on the right along with the minor ones, include the African, Antarctic, Eurasian, Indo-Australian (made up of the Indian and Australian plates), North American, Pacific, and South American plates.

There are three types of plate boundaries: **convergent**, **divergent**, and **transform**.

The two types of crusts, **continental** and **oceanic**, are what move when the plates move. The continental crust is less dense than the oceanic crust, meaning whenever they collide, the continental crust will subduct underneath the oceanic one. **Subduction** is the movement of one plate going below another. Landforms are made based on the movement of tectonic plates.

Continental/Continental Convergent:

- ❖ Movement: Plates move towards each other and push up against each other.
- ❖ Landforms/Natural Disasters Formed:

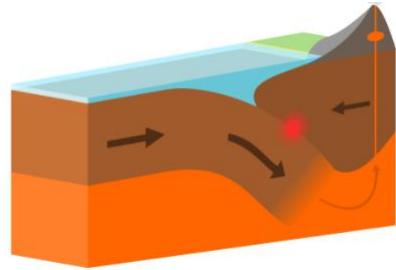


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- Folded mountains
- Mountain ranges
- Earthquakes

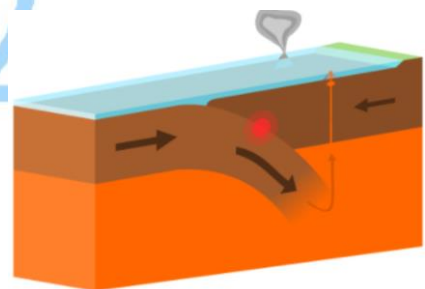
Oceanic/Continental Convergent:

- ❖ Movement: Plates move towards each other and the oceanic plate subducts underneath the continental plate.
- ❖ Landforms/Natural Disasters Formed:
 - Volcanoes
 - Mountains
 - Trenches
 - Earthquakes



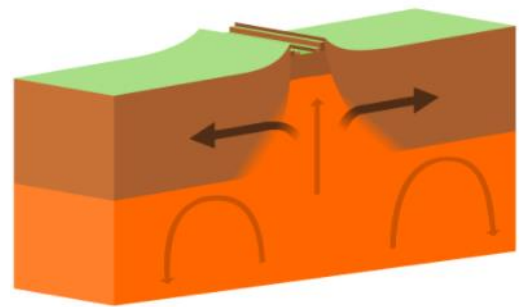
Oceanic/Oceanic Convergent:

- ❖ Movement: Plates move towards each other and one oceanic plate subducts underneath the second oceanic plate.
- ❖ Landforms/Natural Disasters Formed:
 - Volcanic island arcs
 - Underwater volcanoes
 - Trenches
 - Earthquakes



Divergent:

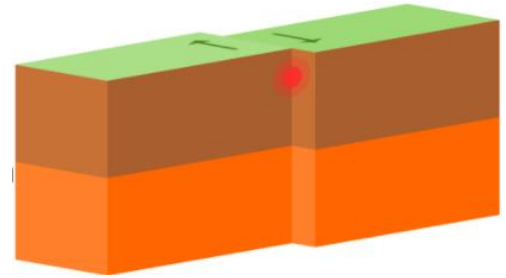
- ❖ Movement: Plates pull or move away from each other.
- ❖ Landforms/Natural Disasters Formed:
 - Rift valleys (on land)
 - Mid-ocean ridges (in water)



- Earthquakes (on land and in water)

Transform:

- ❖ Movement: Plates slide against each other in a sideways motion.
- ❖ Landforms/Natural Disasters Formed:
 - Faults
 - Earthquakes



Images: <https://uhlibraries.pressbooks.pub/historicalgeologylab/chapter/chapter01-plate-tectonics/>

Topographic Maps:

The study of the arrangement of the land is called **topography**. **Topographic maps** are made so scientists can see elevation and latitude/longitude from a bird's-eye view.

A **contour line** is a connected line that shows where points of equal elevation are located on a topographic map.

- ❖ When contour lines are placed closer together, they indicate a steep slope
- ❖ When contour lines are placed farther apart, they indicate a gentle slope

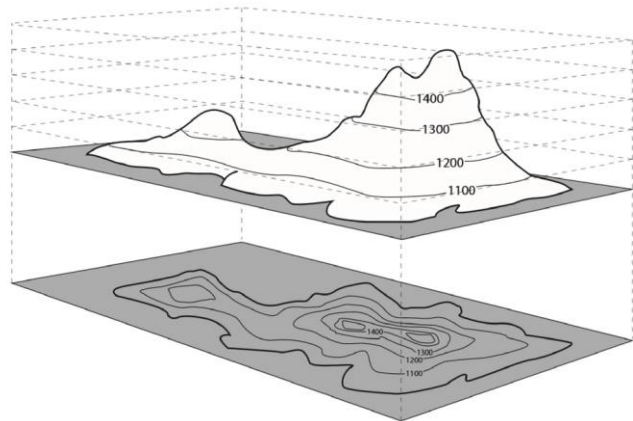


Image: [https://www.greenbelly.co/pages/contour-](https://www.greenbelly.co/pages/contour-lines)

lines

A **contour interval** is a distance between the contour lines on a topographic map.

Ecology

Biotic/Abiotic Factors and Competition:

- ❖ **Biotic Factors** includes all living parts of an ecosystem
 - Material from once-living organisms
 - Waste products from living organisms
 - EX: Bacteria, dogs, flowers, fungi
- ❖ **Abiotic Factors** include all non-living parts of an ecosystem that influence biotic factors
 - Living organisms rely on these factors to survive
 - EX: Rain, rocks, air, temperature
- ❖ **Heterotroph:** an organism that cannot produce its own food
- ❖ **Autotroph:** an organism that can produce its own food
- ❖ **Parasite:** an organism that lives on and gets its food from its host, negatively affecting the host in the process
- ❖ **Host:** an organism that harbours a parasite
- ❖ **Niche:** the role an organism plays in its habitat and how it satisfies its needs
- ❖ **Competition:** interactions between organisms in which they have to challenge each other for resources
- ❖ **Stable Ecosystem:** an ecosystem where each organism has its own niche
- ❖ **Unstable Ecosystem:** an ecosystem where organisms have overlapping niches and must compete for limited resources
- ❖ **Biodiversity:** the variety of life forms that make up an ecosystem
- ❖ **Limited Resources:** resources that there are less of, could be caused by the following:
 - Pollution
 - Flooding
 - Disease
 - Fires
 - Invasive species
 - Drought
 - Global warming

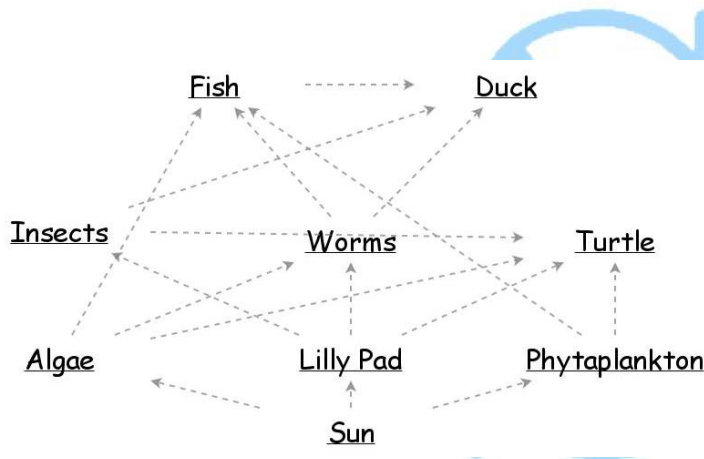
- ❖ **Invasive Species:** a non-native species that intrudes an ecosystem and disturbs the balance and stability

Analyzing Food Webs:

Define **food webs**. Tell how the **competition** is present in an ecosystem.

- ❖ **Terrestrial:** on land
 - EX: deserts, plains, grasslands
- ❖ **Freshwater:** bodies of water with low amounts of salt
 - EX: rivers, lakes
- ❖ **Marine:** salty, large bodies of water
 - EX: oceans, coral reefs, estuaries

The direction the arrows are pointing in indicates the movement of **energy**.



Be sure you can identify the type of ecosystem, **producer/consumer** relationships, **predator/prey** relationships, **parasite/host** relationships, the movement of **energy**, and any other factors that contribute to a food web.

Image: <https://insightmaker.com/tag/Foodweb>

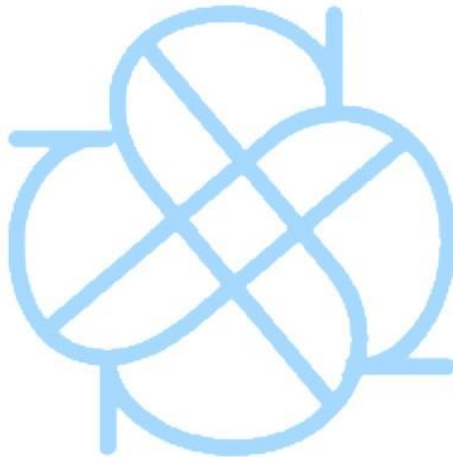
Short-Term and Long-Term Environmental Changes:

- ❖ **Natural Change:** conditions in the environment that are always changing over time

- As natural changes occur, organisms are forced to **adapt** so they can survive the new factors of their environment. If they cannot adapt, they must **migrate** or they will die out and the species could potentially go extinct.
- ❖ **Short-Term Change:** a change in the environment that occurs quickly, not allowing organisms time to adapt
 - EX: volcanic eruptions, flooding, tornadoes



Image: https://commons.wikimedia.org/wiki/File:Mayon_Volcano_Eruption_4.jpg



- ❖ **Long-Term Change:** a change in the environment that occurs slowly over time, affecting organisms over generations
 - EX: global warming, oil spills
- ❖ **Genetic Variation:** an adaptation in genetic traits that allows an organism to better survive in their environment; differences in genes of organisms
- ❖ **Human Effects on Environmental Changes:**
 - **Pollution:** waste disposal, energy production, climate change
 - **Oil Spills:** short-term change
 - **Urbanization:** short-term change, organisms lose their habitat
- ❖ **Biodiversity:** the variety of all life forms on Earth-different plants and animals that make up an ecosystem
 - More diversity = more stability
 - Less diversity = less stability
- ❖ **Biome:** a major ecological community characterized by the predominant vegetation and organisms to that particular environment
- ❖ **Adaptation:** a change that occurs in the body of an animal or in the way it behaves in response to a changing environment
 - **Physical:** a change in the body/appearance of an animal
 - **Behavioral:** a change in the way an animal behaves

Human Interactions with the Oceans

Human Dependence:

The ocean covers around 70% of the Earth's surface. We depend on the oceans for many things, including supporting our basic ways of life.

❖ Oxygen release and carbon dioxide intake

- The ocean exudes over 50% of the world's oxygen
- The ocean takes in large amounts of carbon dioxide

❖ Transportation between continents

- The ocean allows us to travel between all seven continents
- The ocean is where over 90% of global trade occurs

❖ Regulation of the climate

- The ocean is responsible for transporting the diffusion of heat across the globe

❖ Provides food

- The ocean provides an abundance of food sources for over 3.5 billion people

Our Impact:

While the ocean is always giving so much to humans, many people do not treat it with the same kindness. Through many events, our negative impact on the ocean harms it greatly, and in turn, hurts us.

❖ Oil Spills

- Caused by accidents involving pipelines, drilling rigs, large ships, and other factors
- Pollutes the environment and harms marine life
 - Those that consume the plants and animals affected by the oil spills and lived could experience health problems
- Millions of gallons of oil are in the ocean and negatively affecting everything around them

❖ **Algal Blooms**

- Caused by runoff of fertilizer and pesticides and erosion of soil that has been fertilized
- Algae produce toxins that harm marine life as well as humans
 - Drinking and even being near affected water has drastic effects on humans
- We can try to prevent them by using fertilizers and pesticides with less harmful chemicals

❖ **Coral Bleaching**

- Caused by deforestation, the burning of fossil fuels, and climate change overall
- Raised water temperatures cause coral to release the chemical that gives them color, causing them to turn white and “bleach”
- Coral provide an ecosystem for billions of sea animals, are a large food source for millions of people, and are a large contributor to oceanic economies

There are some people out there, though, that are doing whatever they can to give back to the ocean.

❖ **Artificial Reefs**

- Man-made reefs made to give marine life habitats that may have been destroyed
- Provide shelter and food for marine life
- Many are made with lots of recycled parts

Heat and Wind

Sun and Convection:

Heat is a form of **energy**. A fast-moving molecule is a hot molecule and a slow-moving molecule is a cold molecule. To heat something is to speed up its molecules. Heat can be transferred from object to object. **Heat transfer** is the movement of heat from hotter objects to colder objects through **conduction**, **convection**, and **radiation**.

Mechanisms of Heat Transfer

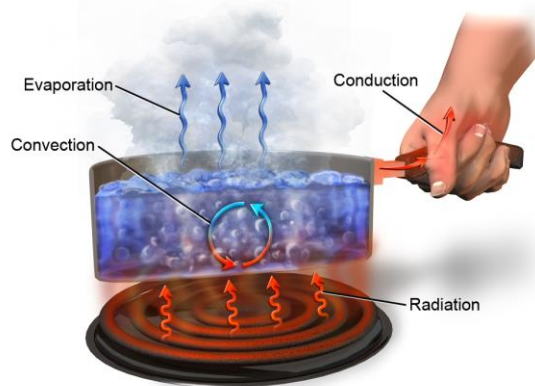


Image: https://commons.wikimedia.org/wiki/File:Heat_Transfer.png

Winds and Air Pressure:

The rays from the sun are a form of **electromagnetic radiation**. Electromagnetic radiation includes both **visible** and **non-visible radiation** (IR and UV radiation). This is the energy that makes the **wind** move. Newton's laws require that something starts moving because a force requiring energy acts upon it. In this case, the energy comes from the sun.

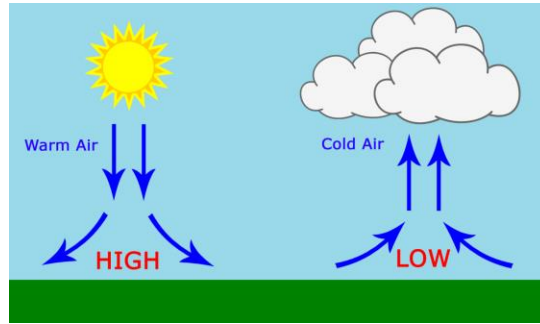


Image: <https://www.circuitbasics.com/set-bmp180-barometric-pressure-sensor-arduino/>

Air is not warmed by the sun's rays directly. It is warmed through conduction as it comes in contact with the ground or with water. Warm air is less **dense** than cold air. Since air is a gas, the warm air is pushed up by the cold air through **convection**. Convection causes warm air to rise and cold air to sink. When warm air rises, it creates a **low-pressure area**. When cool air sinks, it creates a **high-pressure area**. Air will always be pushed away from the high-pressure area towards the low-pressure area. This horizontal movement of air is called **wind**.

Earth, Moon, and Sun

Seasons:

A **season** is a year that is distinguished by its climate conditions and position relative to the Sun. There are four seasons; **spring**, **summer**, **fall**, and **winter**. Each follows one the other as stated. The **Northern Hemisphere** and **Southern Hemisphere** experience the seasons at different times of the year due to the way the Earth tilts on its **axis**. This tilt causes some areas of the Earth to receive more sunlight and heat than other areas, explaining why when it is summer in the United States, it is winter in Australia, which is on the opposite side of the globe.

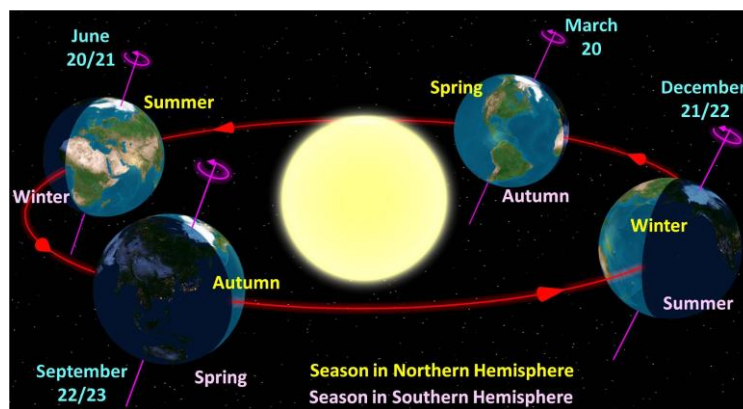


Image: https://commons.wikimedia.org/wiki/File:North_season.jpg

Winter: In the Northern Hemisphere, winter generally begins at the end of December on the **winter solstice**. The day of the winter solstice contains the least number of hours of daylight and the most number of hours of dark compared to any other day of the year. In the winter, the Earth has tilted away from the Sun. It receives less sunlight, contributing to the typical winter, cold weather.

Spring/Autumn: In the spring and autumn seasons, there is no specific part of the earth that is tilted towards or away from the Sun. During these months, the weather is more or less average and changes gradually as it leaves the previous season or approaches the next season. The spring season follows winter and comes before summer. The autumn or fall season comes after summer and before the winter season.

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Summer: In the Northern Hemisphere, summer begins with the **summer solstice** near the end of June. On the day of the summer solstice, the number of daylight hours is significantly larger than the number of dark hours. During summer, the temperature is higher as the portion of the Earth experiencing this season is tilted more towards the Sun and thus receives more of its heat. It can get so hot that droughts could potentially occur and make the ground unsuitable for plant growth.

Moon Phases:

Moon phases describe how the moon looks and where it is in terms of its **revolution** around the Earth. The moon takes about twenty-eight days to revolve around the Earth and within those days, we can break up the way the moon looks into eight phases:

- ❖ 🌑 New Moon
- ❖ 🌒 Waxing Crescent Moon
- ❖ 🌓 First Quarter Moon
- ❖ 🌔 Waxing Gibbous Moon
- ❖ 🌕 Full Moon
- ❖ 🌖 Waning Gibbous Moon
- ❖ 🌗 Third Quarter Moon
- ❖ 🌘 Waning Crescent Moon

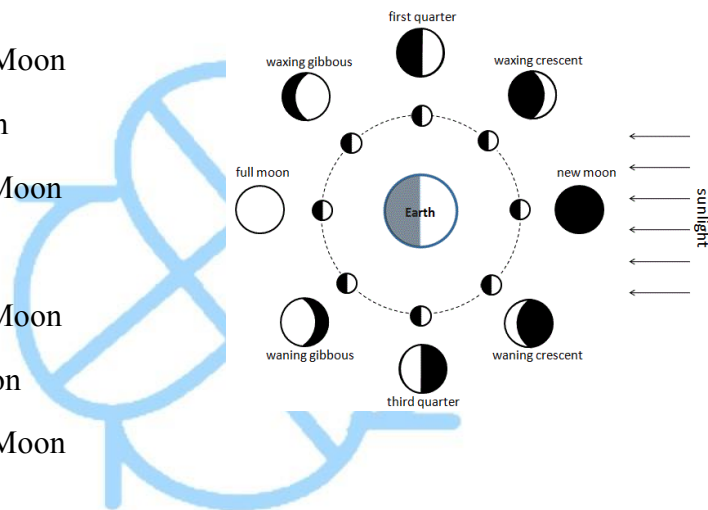


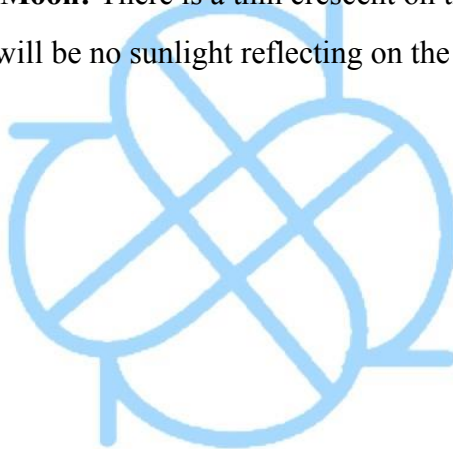
Image: https://commons.wikimedia.org/wiki/File:Moon_Phase_Diagram.GIF

The moon is not physically changing shape throughout its revolution. The amount of sunlight that the moon receives determines what is reflected at us. The Sun always illuminates one side of the moon while the other side is dark.

Phases Explained:

- ❖ 🌑 **New Moon:** The moon can not be seen. There is no sunlight being reflected.
- ❖ 🌒 **Waxing Crescent Moon:** There is a thin crescent shape on the left side of the moon
- ❖ 🌓 **First Quarter Moon:** The whole left half of the moon is lit.
- ❖ 🌔 **Waxing Gibbous Moon:** The midpoint between the full moon being lit and only the half left side. **Waxing** means it is getting bigger.
- ❖ 🌕 **Full Moon:** The whole moon is illuminated and we can completely see it.
- ❖ 🌖 **Waning Gibbous Moon:** This phase is between a half-moon on the right and a full moon. Here the moon is starting to lose sunlight. **Waning** means it is getting smaller.
- ❖ 🌗 **Third Quarter Moon:** Half of the moon is lit on the right side.
- ❖ 🌘 **Waning Crescent Moon:** There is a thin crescent on the right side of the moon.

After this phase, there will be no sunlight reflecting on the moon and the cycle of moon phases will repeat.



The Universe

Components of the Universe:

- ❖ **Galaxy:** a large group of stars, gas, and dust held together by **gravity**
 - **Spiral Galaxy:** a galaxy with a bulge in the center and distinctive arms that radiate outward
 - the **Milky Way**, the galaxy we live in, is a type of spiral galaxy



Image: <https://commons.wikimedia.org/wiki/File:Spiral-galaxy-superstar-u.jpg>

- **Elliptical Galaxy:** an oval-shaped galaxy composed of older, low-mass stars

Image: <https://www.flickr.com/photos/71981454@N00/20168040868/>



- **Irregular Galaxy:** a galaxy that does not have a distinct regular shape



Image: https://commons.wikimedia.org/wiki/File:Hubble_Captures_Elusive,_Irregular_Galaxy.jpg

- ❖ **Nebula:** a cloud of gas and dust in which new stars are formed
- ❖ **Star:** a large sphere of extremely hot and glowing gas

From <https://simplestudies.edublogs.org>

Stars:

A **star** is a ball of **plasma** held together by its gravity. There are tens of billions of stars in our universe. Nuclear reactions occur in stars and energy from the reactions is released as **electromagnetic radiation**.

The Sun is a medium-sized star located in a spiral arm of the **Milky Way**. The Sun is many thousands of times closer to Earth than any other star.

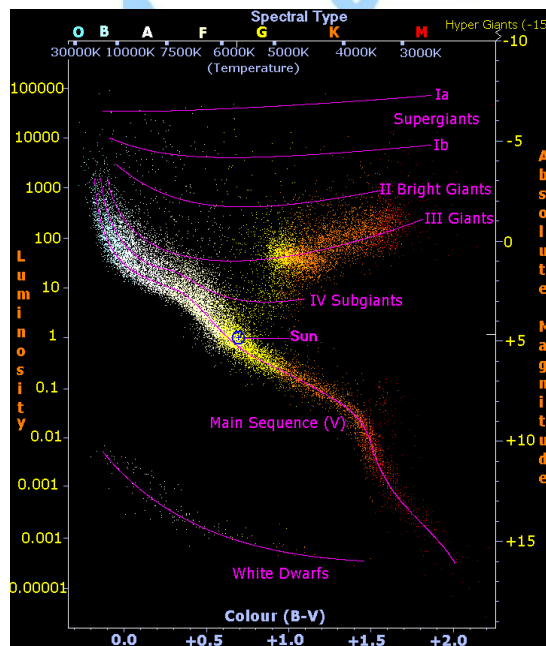
Characteristics:

❖ Magnitude

- A measure of **luminosity** or brightness
- **Apparent Magnitude:** How bright a star appears to be
- **Absolute Magnitude:** How bright a star actually is

❖ Temperature and Color

- The color of a star indicates the temperature of the star
- Stars can be classified by temperature
 - Decreasing temperatures means the star is becoming dimmer. Brighter stars generally mean hotter stars.
 - Classes of stars: O, B, A, F, G, K, M



From <https://simplestudies.edublogs.org>

Image: https://commons.wikimedia.org/wiki/File:H-R_diagram_-edited-3.gif

Life Cycle:

A star's life cycle is determined by its **mass**. Stars begin their lives as clouds of dust and gas called **nebulae**. Gravity causes the nebula to contract. If the star is of an average mass, it will become a **red giant** then a **planetary nebula** before becoming a **white dwarf**. If the star is of a larger mass, it will become a **red supergiant** before a **supernova**, where it can then become either a **neutron star** or a **black hole**.

White Dwarf: a star of high density and temperature and low luminosity

Giant: a star with a large radius and high luminosity

Supergiant: a star of a massive radius and the highest luminosity

Electromagnetic Spectrum:

Wave: a disturbance in space that transfers energy

A wave is of **high frequency** if it has a short **wavelength** and high energy.

A wave is of **low frequency** if it has a high **wavelength** and low energy.

The **electromagnetic spectrum** is a range of **electromagnetic waves** that transfer energy through **electromagnetic radiation**. The spectrum consists of seven types of waves.

- **Radio Waves:** Radio waves are used for communication such as television, mobile phones, and radios. They have the longest wavelength on the spectrum.
- **Microwaves:** Microwaves can be used when transmitting the information. These waves can penetrate rain, snow, clouds, and smoke which make them ideal for transmitting.
- **Infrared Waves:** Infrared waves can be used to reveal an area or object that can not be seen. These waves produce heat and this heat can be picked up to identify objects. These waves can pass through dense regions of dust and gas.

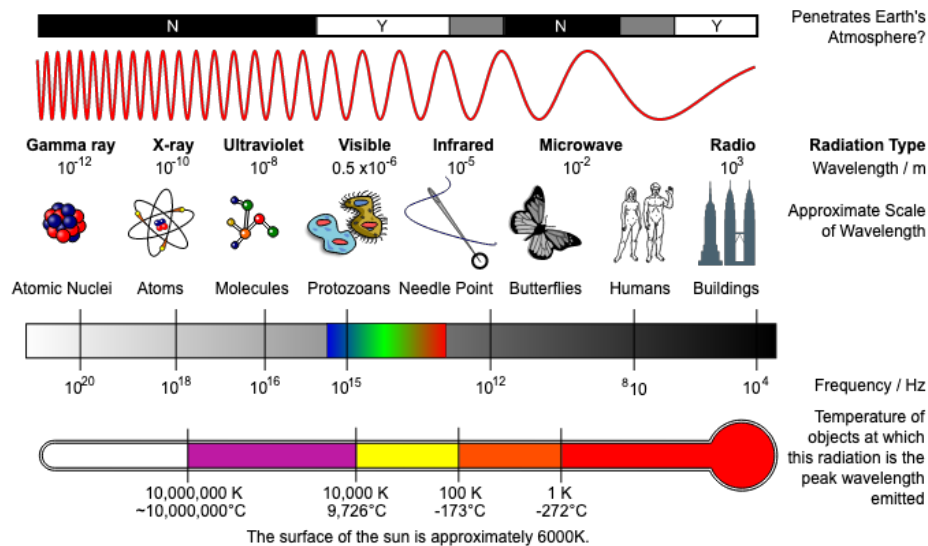


Image: https://commons.wikimedia.org/wiki/File:EM_Spectrum_Properties_reflected.svg

- **Visible Light Waves:** Visible light waves are the waves we can see and they appear as colors. The colors each have a different wavelength. When these waves are out together, we get light.
- **Ultraviolet (UV) Waves:** UV waves are non-visible waves emitted by the Sun. They provide our bodies with warmth and vitamin D, but if we are overexposed to these waves, our skin tans and/or burns.
- **X-ray Waves:** X-ray waves have very small wavelengths. They are used by doctors and dentists to scan images of your teeth and bones.
- **Gamma Waves:** Gamma waves are produced only by the hottest regions in the universe. These include supernova explosions, destruction of atoms, and decaying radioactive material in space. Bursts of these waves can release more energy in ten seconds than the Sun can in its entire lifetime of ten billion years.

Our Expanding Universe:

The Doppler Effect:

The waves a moving object emits can become either stretched or compressed. If the object is moving towards you, the waves will compress and have a shorter wavelength and higher frequency. If the object is moving away from you, the waves will stretch out and have a longer wavelength and lower frequency. This same idea applies to light waves. Red light has longer wavelengths and blue light has shorter wavelengths.

Redshift is when an object is moving away from you, meaning its waves are stretched out and have a longer wavelength. It is called redshift because when an object is moving away, the spectral lines seen on the electromagnetic spectrum are shifted towards the red end. **Blueshift** is when an object is moving towards you, meaning its waves are compressed and have a shorter wavelength. It is called blue shift because when an object is moving towards you, the spectral lines seen on the electromagnetic spectrum are shifted towards the blue end. If a star is moving towards you while emitting light, the light goes bluer. If it is emitting light while moving away from you, the light goes red. If the star is not moving at all but still emitting light, the color of the light looks the same in every direction.

Expansion of the Universe:

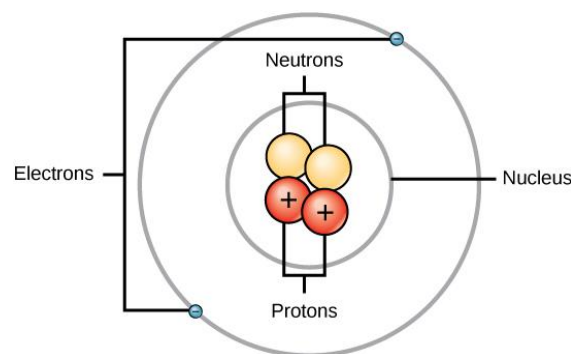
All galaxies in our universe show a redshift of their spectral lines, meaning that these galaxies are all moving away from us and each other. The bigger the redshift, the faster the object is moving and the further away it is, indicating that the universe must be expanding.

Chemistry

Atoms/Atomic Structure:

Atoms are the basic building blocks of all **matter**. Everything in the universe is made out of atoms. They are extremely small and are made of three particles; **electrons**, **protons**, and **neutrons**. Each of these particles makes up an atom, and multiple atoms make up matter.

- ❖ **Protons:** the positively charged part of an atom, located in the atom's nucleus
 - the **atomic number** of an element shows the number of protons within one atom of that element
 - EX: Beryllium, atomic number 4, has four protons in an atom.



https://commons.wikimedia.org/wiki/File:Bohr_Atom_Structure.jpg

- ❖ **Neutrons:** have no charge (neutrally charged), located in the atom's nucleus
- ❖ **Electrons:** the negatively charged part of an atom, located in the **electron cloud**
 - they have no fixed position, they are always moving
 - **Electron Cloud:** The first energy level or ring can hold a maximum of two electrons. The second energy level or ring can hold a maximum of eight electrons. The third ring can hold a maximum of eighteen electrons.
 - **Valence Electrons:** electrons found in the outermost energy level

The nucleus of an atom: The center of an atom where protons and neutrons are found. The mass number of an atom is the atomic mass of an element rounded up.

Atomic Number: equal to the number of protons or the number of electrons (when the atom is neutral)

Atomic Mass or Mass Number: equal to the number of protons plus neutrons

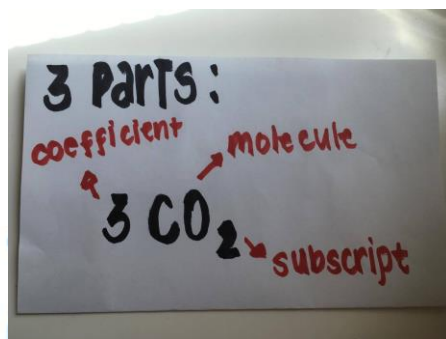
Ion: An electrically charged atom (due to less/more electrons than proton ratio)

Counting Atoms:

A **compound** is two or more different elements that are chemically joined together. Each compound has its formula for the way of identifying it.

In a compound, there are **coefficients** and **subscripts**.

- ❖ **Coefficients** are the big numbers in a **chemical formula** that are before the letter of the element. This number tells us how many **molecules** of the element there are in that compound.
- ❖ **Subscripts** are the numbers that follow an element and are usually lower than the letter. This represents how many atoms of an element are in a compound.



https://commons.wikimedia.org/wiki/File:There_are_3_parts_of_a_Chemical_Formula.jpg

Chemical Reactions:

Indicators of a chemical change:

- ❖ Production of an odor
- ❖ Change in temperature, color, or pH
- ❖ Formation of gas or new substance

The law of conservation of mass states that matter cannot be created nor destroyed. Chemical reactions must be balanced. The number of atoms in the **reactant** and **product** must be the same for the chemical reaction to be balanced.

In every chemical reaction, there is a **reactant** and a **product**.

- ❖ The **reactant** is what the chemical reaction starts with.
- ❖ The **product** of a chemical reaction is what comes out of the chemical reaction.

EX: $\text{CH}_4 + 2\text{O}_2 \gg \text{CO}_2 + 2\text{H}_2\text{O}$

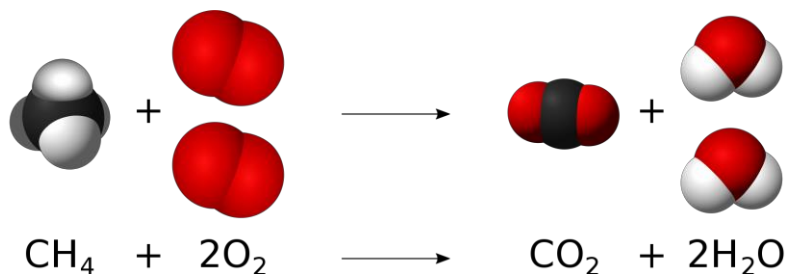


Image: <https://commons.wikimedia.org/wiki/File:Methane-combustion.svg>

Reactants: 1 atom of carbon, 4 atoms of hydrogen, 4 atoms of oxygen. **TOTAL:** 9 atoms

Products: 1 atom of carbon, 4 atoms of hydrogen, 4 atoms of oxygen. **TOTAL:** 9 atoms

This is a **balanced chemical equation** as the numbers of atoms in the reactant and product are equal. Since it is a balanced equation, it follows the law of conservation of mass.

Trends of the Periodic Table:

Chemist Dmitri Mendeleev saw that the elements of the periodic table vary periodically and he noticed that they created a pattern. There are many ways that the periodic table is organized. When you look at a periodic table often you will see numbers at the top of each column. These numbers are used to group the elements within that row. There are eighteen total columns. The columns are also categorized by the number of electrons in their outer rings, which is why columns also have another set of numbers with letters.

For example, the elements in columns (groups) 3-12 are all **transition metals**, and the elements in group 18 are called **noble gases**. The elements in group 1 (minus hydrogen) can be called **alkali metals** and group 2 elements are classified as **alkaline earth metals**. Group 17 elements are called **halogens**.

From <https://simplestudies.edublogs.org>

Periodic Table of the Elements

The periodic table displays elements from Hydrogen (1) to Oganesson (118). It includes the Lanthanide and Actinide series at the bottom. Each element cell contains its atomic number, symbol, name, and atomic weight. The table is organized into groups (columns) and periods (rows).

<https://www.thoughtco.com/how-to-use-a-periodic-table-608807>

Groups 1A (column 1) and Group 7A (column 17) are unstable and both highly reactive. Group 1A has one valence electron, and group 7A has seven valence electrons. To be classified as a stable element, the last ring of an element must be full. Both these groups are close to being full and either need electrons or need to give electrons making them highly reactive with other elements.

Group 8A (column 18) is made up of noble gases which are all stable or inert. The outer shell of electrons is full of eight electrons and doesn't need to gain or lose any electrons. Since the outer shell is full the elements are completely stable.

Physics

Forces and Newton's Laws:

Newton's Laws

First Law: Objects at rest remain at rest and objects that are in motion remain in motion in a straight line unless acted upon by an unbalanced force. This law is called the **law of inertia**.

- ❖ EX: It's harder to start pedaling a bicycle than to keep pedaling when it is already in motion. That is because objects in motion tend to stay in motion. **Inertia** must be overcome for the bike to start moving since things don't spontaneously stop or start moving.

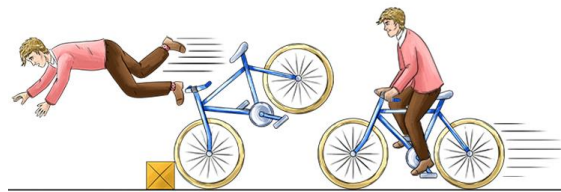


Image: <https://mammothmemory.net/physics/newtons-laws-of-motion/newtons-first-law--examples/newtons-first-law-examples.html>

Second Law: The acceleration of an object depends on the net force acting upon the object and the mass of the object. The more mass an object has, the more force it takes to increase its acceleration.

- ❖ $\text{FORCE} = \text{MASS} \times \text{ACCELERATION}$

<https://www.twowheelgear.com/pages/faq-pannier-backpack-convertible>



From <https://simplestudies.edublogs.org>

- ❖ **EX:** When you are carrying a backpack while riding your bike, it will take more force to keep biking than riding without the backpack.

Third Law: For every action, there is an equal and opposite reaction.

- ❖ **EX:** This is the reason a bike goes forward when you pedal it. As the wheels turn clockwise, they pass along the ground and “grip” it pushing it backward. Since every force has an equal and opposite reaction, the reaction to this force is a “push” from the ground onto the wheels of the bicycle of equal magnitude, which propels the bicycle.

Forces

- ❖ **Force:** a push or pull upon an object
- ❖ **Balanced Force:** when forces on an object are of equal magnitude and in opposite directions; no acceleration
- ❖ **Unbalanced Force:** when forces on an object do not cancel out; causes acceleration
- ❖ **Net Force:** the sum of all the forces acting on an object
- ❖ **Friction:** a force that opposes motion between two surfaces that are in contact
- ❖ **Inertia:** the tendency of an object to resist a change in motion unless an outside force acts on it
- ❖ **Gravitational Force:** the attractive force existing between any two objects that have mass
- ❖ **Mass:** The amount of matter in an object
- ❖ **Weight:** the measure of the force of gravity on an object

Speed, Velocity, and Acceleration:

Speed

- ❖ The rate (i.e., how fast) an object is moving is called **speed**.
- ❖ Speed is how far something travels (distance) in a given amount of time.
- ❖ The formula for finding speed is:
 - $\text{SPEED} = \text{DISTANCE} \div \text{TIME}$

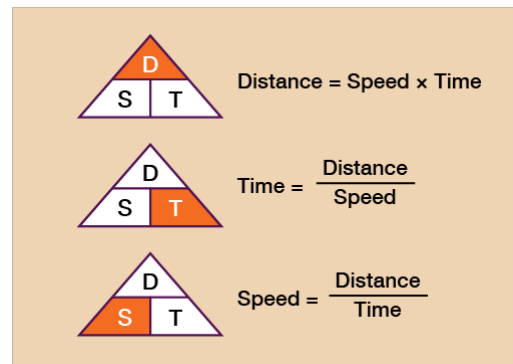


Image: <https://www.open.edu/openlearn/ocw/mod/oucontent/view.php?id=85547§ion=3.3>

- ❖ The unit for speed is meters or kilometers (distance) and seconds or hours (time)
 - m/sec or km/hr

Velocity

- ❖ **Velocity** used when referring to speed and direction.
 - EX: the car is traveling at 50 km/hr north
- ❖ **Velocity** is a vector quantity
 - Vectors can be used to show the direction and magnitude of an object's motion

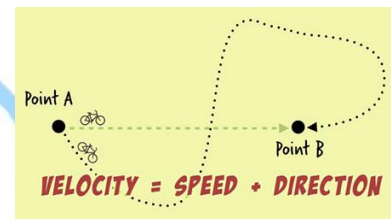


Image: <https://serpmedia.org/scigen/e1.6.html>

Acceleration

- ❖ When an unbalanced force is applied to a moving object, the object can accelerate by speeding up, slowing down, coming to a stop, or changing direction
- ❖ Any change in motion is called an acceleration
- ❖ Measured meters per second per second (m/sec/sec or m/sec²)

Acceleration (a) = **change in**
velocity (V) / time taken (t)

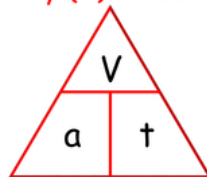
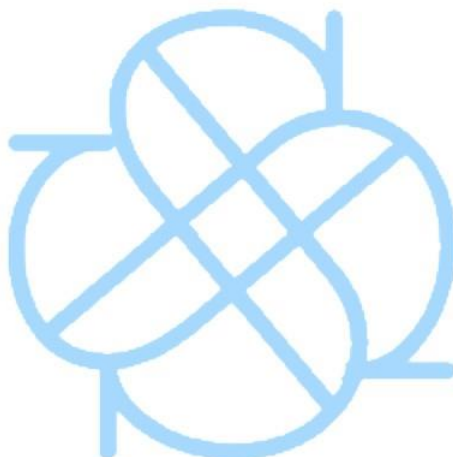


Image: <https://www.tes.com/en-us/teaching-resource/all-equations-for-the-new-science-ocr-21st-century-gcse-9-1-11514059>



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