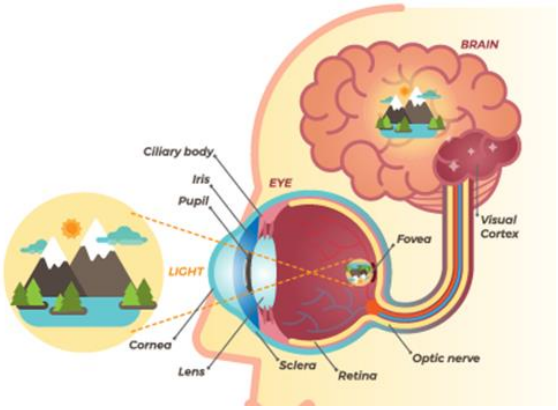
Unit 1 Light Travels / Unit 2 The Bus Driver

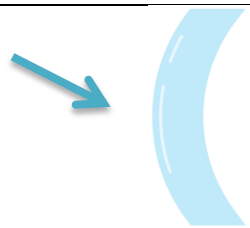
The Role of Light to Sight



The visual ability of humans and other animals is the result of the complex interaction of light, eyes, and brain. We are able to see because light from an object can move through space and reach our eyes. Once light reaches our eyes, signals are sent to our brain, and our brain deciphers the information. The whole process, as complex as it is, would not be possible if it were not for the presence of light.

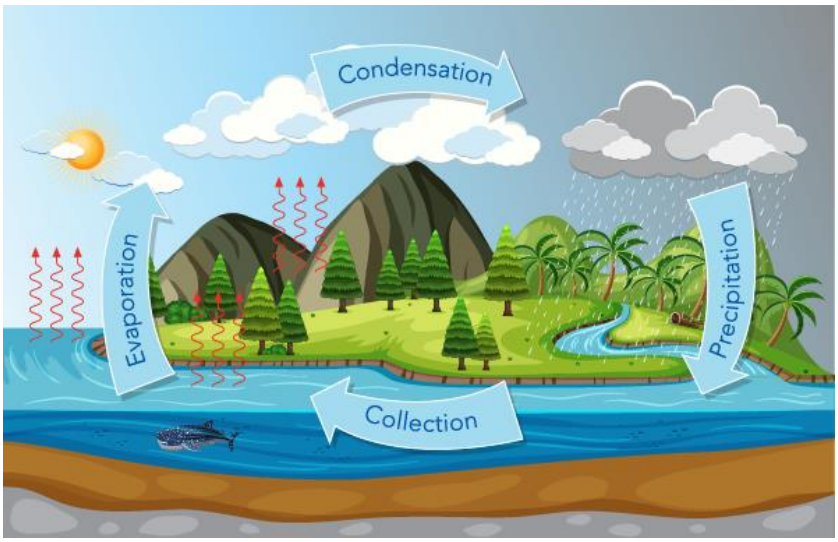
If you prevent any entry of light into the room, then you would notice that nothing in the room would be visible. The appearance of black is merely a sign of the absence of light. When a room full of objects (or a table, a shirt or a sky) looks black, then the objects are not generating nor reflecting light to your eyes.

Difference between Convex and Concave Mirror

Comparison	A **convex mirror** has a shape of the outside of a bowl, curving outward	A **concave mirror** has a shape of the inside of a bowl, curving inward
Shape		
Uses	as rearview mirrors in cars and bikes	as reflectors in projectors, searchlights, shaving mirrors, and more
View	covers a wider area of view 	gives a magnified image of object 

Unit 3 The Water Cycle / Unit 4 Disappeared Water

The amount of water on Earth has remained relatively constant over the past several billion years, according to most experts. Why?



The Water Cycle Process

The reason for this is the water cycle. Water evaporates from the surface of the Earth, rises into the atmosphere, cools and condenses into rain or snow, falls as precipitation, and then collects on land in the oceans, rivers, lakes, and soil, and the cycle begins again.

This is why the amount of water on Earth remains constant. The water might not always exist in the same form, as there could be more or less water, for example, frozen in the icecaps. The water never leaves the Earth's atmosphere, and there is no water coming into the Earth from space, so water always exists in the same amount.

The reason water can't leave the Earth's atmosphere is good old gravity. For a significant amount of water vapor to escape our planet, it would need to be moving with the velocity of a rocket ship.

Unit 5 A Raft of Straws / Unit 6 How Does a Ship Float?

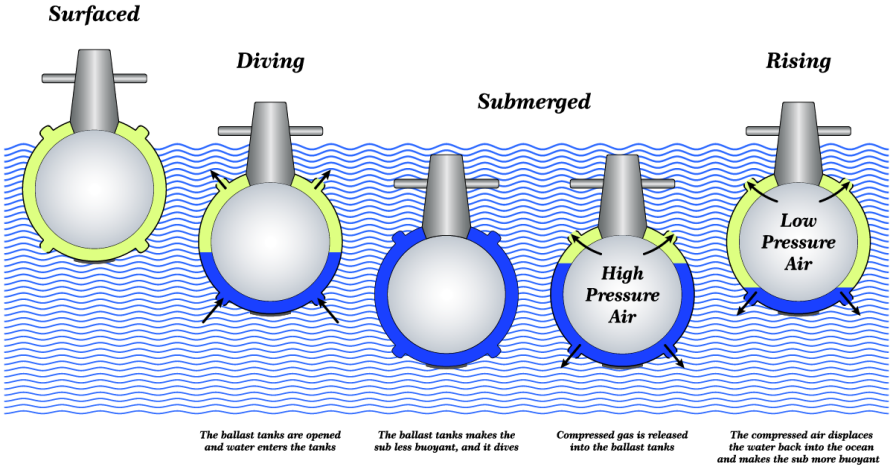
Horizontally Floating on the Water

When we are floating up, a greater pressure is applied by the water (due to the force of buoyancy) than gravity and the result is a net pressure pointing up. When we sink, more pressure from gravity is being applied and the result is a net pressure pointing down.

When you are lying down in water, the area over which you apply the force of gravity on the water is much larger, meaning the pressure you apply is much smaller. If the pressure in the water remains the same, the pressure you apply when standing is greater than the water pressure, but when you are lying down, it is less. As a result, you will float when lying down but not when standing up.

How Submarines Float and Sink

Submarines use ballast and trim tanks, which are filled with air or water to submerge or raise the ship. When the submarine is floating on the surface, the tanks are filled with air causing its density to be less than the surrounding water. When the submarine dives, the tanks are flooded with water causing its density to be greater than the water causing it to sink. Some submarines use two hulls—one inside of another—instead of ballast tanks. In conclusion, as the outer hull fills with water, the submarine dives. And as the water is replaced by air, the submarine resurfaces.



Unit 7 Ice Fishing / Unit 8 Frozen

Does the ocean ever freeze? If you've seen pictures of the North Pole or the South Pole, you know that there are polar ice caps in those places. If the ocean freezes in those areas, why doesn't the rest of the ocean freeze during the winter?

The freezing point of freshwater is 0° Celsius or 32° Fahrenheit. The presence of salt in water, though, reduces the freezing point of water. The more salt in the water, the lower the freezing point will be.

When freshwater freezes, water molecules of hydrogen and oxygen have bonded together into a crystalline structure of ice. The presence of salt makes it harder for water molecules to bond to the ice structure, because ice naturally repels salt molecules. So in a sense, the salt gets in the way of water molecules, blocking them from joining the ice. The salt also bumps into the ice, knocking water molecules off of the structure -- and that's how salt melts ice.

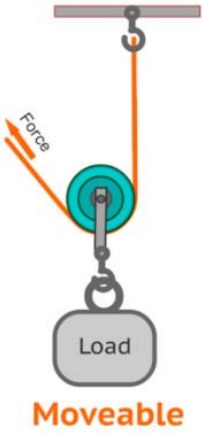
When salt molecules displace water molecules, the freezing rate slows down. This is why salt is often used on icy roads to slow down freezing and make them safer to travel upon. Although the saltiness of ocean water varies, often ocean water has about 35 grams of salt for every 1,000 units of water. This lowers the freezing point of ocean water to about -1.8° C or 28.8° F. So ocean water will freeze if it reaches a lower temperature.

Another factor that affects the freezing of ocean water is its movement. Unlike ponds, ocean waves move around constantly. This helps ocean water retain heat. As a result, only really cold areas, such as the North Pole or South Pole, usually get cold enough for ocean water to freeze.

When ocean water freezes, though, only the water part freezes. The salt molecules are pushed below the surface of the ice. As a result, polar ice ends up being freshwater ice that can be melted for drinking water!

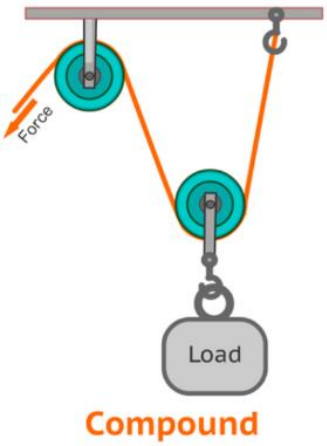
Unit 9 The Power of Pulleys / Unit 10 Inventions of the Past

Fixed pulleys are a very common pulley. These pulleys are secured to a single spot. The name fixed is because the pulley itself remains stationary, attached to something like a wall or ceiling, while the cord or rope passes through it. Because the pulley is fixed, the force that is applied on the side you are pulling, will be the same amount of force that is exerted on the opposite side. So why use a fixed pulley if its capabilities are only to exert the same amount of force? The fixed pulley is very necessary because it changes the direction of the object; which can be very helpful.



Movable Pulleys are yet another type of pulley. It differs from the fixed pulley because the actual pulley machine will move with the load. Because the pulley moves with the load, a moveable pulley multiples force which the user applies to the machine in doing work on an object. These pulleys are often attached to the actual object, in contrast to the fixed pulley which is attached to something stationary. Unlike the fixed pulley, the movable pulley does not change the direction of the object, however it is helpful because of its multiplication of force on the opposite side of the user. This is ideal for heavier loads because you have to exert less force but that force gets multiplied.

Compound Pulley Systems are a combination of both movable and fixed pulleys. This type of pulley system has the greatest success in moving your heaviest loads. It has the greatest multiplication of force. These compound systems can not only change the direction of the load, but also require less force to be exerted by the user.



Examples of Pulleys

- Elevators use multiple pulleys in order to function.

- Wells use the pulley system to hoist the bucket out of the well.

- Many types of exercise equipment use pulleys in order to function.

- Construction pulleys are used in order to lift and place heavy materials.

- Curtains at a theater are moved using pulley systems that pull the curtains apart.

- A crane is a type of pulley that is used in construction.

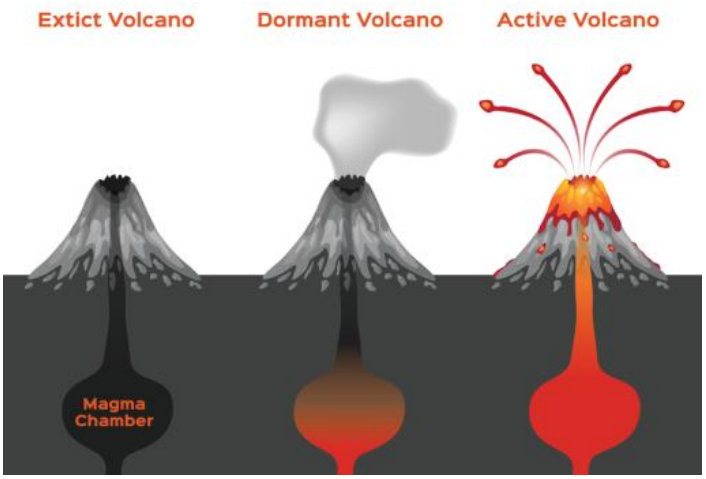
- Pulleys can be used to extend ladders.

- Sails on sailboats are raised and lowered using pulleys.

Unit 11 A Volcanic Eruption / Unit 12 Volcanoes: Good or Bad?

A volcano is an opening in a planet or moon's crust through which molten rock, hot gases, and other materials erupt. Volcanoes often form a hill or mountain as layers of rock and ash build up from repeated eruptions.

Volcanoes are classified as active, dormant, or extinct. **Active volcanoes** have a recent history of eruptions; they are likely to erupt again. **Dormant volcanoes** have not erupted for a very long time but may erupt at a future time**. Extinct volcanoes** are not expected to erupt in the future. Inside an active volcano is a chamber in which molten rock, called magma, collects. Pressure builds up inside the magma chamber, causing the magma to move through channels in the rock and escape onto the planet's surface. Once it flows onto the surface the magma is known as lava.



Can we use magma for good?

Iceland, land of unpredictable volcanoes, has long used hot water and steam produced by volcanic rocks to heat its homes. But now the country may have a new energy resource: magma.

In 2009, a team of researchers drilling a 15,000-foot-deep geothermal well in Iceland's Krafla volcano stumbled upon magma, which was flowing into the well at a depth of 6,900 feet–only the second time magma has slipped into a geothermal well during drilling. The incident forced the scientists to quit drilling. And that's when they figured out that the magma could be used as an energy source.

The researchers' happy accident means that magma can now be used as a geothermal energy source wherever shallow sources of magma are found–both in Iceland and in other places where young volcanic rocks exist.

Unit 13 The Faults in Our Earth / Unit 14 Earthquake Safety

What is the Pacific "Ring of Fire"?

The Ring of Fire is the geographical area around the edges of the Pacific Ocean. It is called so because it is shaped as a horseshoe and it has more exploding, active volcanoes and earthquakes than any place on the earth. It stretches for 40,000 kilometers and has 755 of the world's volcanoes. 80% of the world's earthquakes occur in this area.

Where is the Ring of Fire located on the world?

A stretch of almost 452 volcanoes are found here starting from the southern tip of South America, up along the coast of North America and across the Bering Strait. It goes down through Japan and then straight into New Zealand. The ring closes in Antarctica where there are many active and dormant volcanoes.

What is the cause of the Ring of Fire?

The ring of fire was caused by the movement of the tectonic plates. These plates are nothing but enormous slabs of the Earth's crust which move, break and then fit into each other like pieces of a puzzle. Tectonic plates are constantly moving and most tectonic activity occurs in the Ring of Fire region. These plates crash into each other, causing stress on the surface, break, slip, gets stuck, build pressure causing earthquakes and volcanic activity.

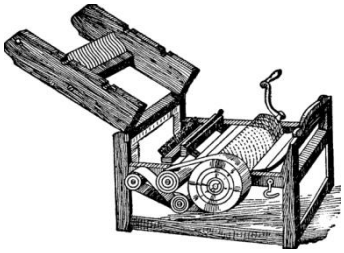
How do Earthquakes occur?

Earthquakes happen when two tectonic plates scrape against each other. The plates are forced underneath each other. The down going plate bends downwards causing the surface to break. The Pacific plate is quite enormous and thus it interacts with a number of small and large plates and causes earthquakes. The South America subduction zone, off the coast of Chile, created the largest known earthquake in 1960.

Unit 15 Machines All Around

History of Mechanical Engineering

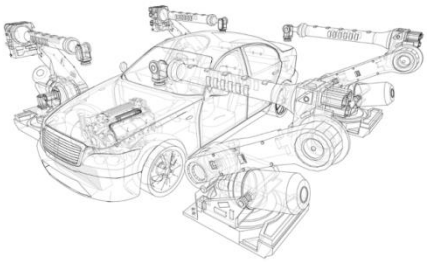
Mechanical engineering has been around for thousands of years, dating back to as early as 300 BC in ancient Greece and China. Back then, many simple machines were created to make daily tasks easier, such as the wheel and axle, screw, inclined plane and pulley system. These simple machines were then used to create tools like wheelbarrows, carts, and even the ancient seismograph that was used to measure earthquakes.



While there was a great amount of mechanical engineering going on during ancient times, it was not recognized as an official field until the Industrial Revolution in the 18th and 19th centuries. During this time, there was a surge of inventions created by mechanical engineers, including the cotton gin, steam boat and the first diesel engine.

Why Are Mechanical Engineers Important?

Can you imagine living in a world without elevators? What about having to get through a day without cars, trains or planes? Basically, any object that is made is somehow connected to mechanical engineers. In the world of transportation, mechanical engineers have been very important in the production of planes, trains, boats, cars, and buses.



Look around your house. There are many things that have been made by mechanical engineers, such as your refrigerator, your couch, and your television. The list of inventions made by mechanical engineers goes on and on.

Unit 16 Underwater Explorers

There are two main branches of archaeology: classical or historical archaeology and anthropological or prehistoric archaeology.

Classical Archaeology

Classical archaeology is the exploration of the records and artifacts of ancient civilizations. Classical archaeologists are particularly interested in the early cultures of the Mediterranean and the Near East—especially Greece, Rome, Persia (now Iran), Egypt, and Mesopotamia (now part of Iraq)—and also in the civilizations of ancient China, of the Indus River valley in modern Pakistan, and of Southeast Asia. The field of classical archaeology has become prominent in many countries interested in preserving their national heritage.

Naturally the curriculum for classical archaeology includes the basic principles and methods of archaeology. However, it also emphasizes historical studies—including art history and the study of classical civilizations—as well as philology (the study of literature and linguistics), ceramics, architecture, mineralogy, and other subjects.

Anthropological Archaeology

Anthropological archaeology focuses on prehistory—the time before written records were kept. The curriculum emphasizes such studies as physical and cultural anthropology and linguistics as well as archaeology itself. The anthropological archaeologist is involved in interdisciplinary studies—with particular emphasis on the way such fields as paleontology, human evolution, geomorphology, geology, and aerial photography relate to archaeology and how their principles and methods can be used by the archaeologist.