

## Unit 1 The Three States of Water / Unit 2 Smoke or Steam?



*Solid*



*Liquid*



*Gas*

Pure water is tasteless, odorless and colorless. Water can occur in three states: solid (ice), liquid or gas (vapor).

Solid water – ice is frozen water. When water freezes, its molecules move farther apart, making ice less dense than water. This means that ice will be lighter than the same volume of water and so ice will float in water. Water freezes at 0° Celsius, 32° Fahrenheit.

Liquid water is wet and fluid. This is the form of water with which we are most familiar. We use liquid water in many ways, including washing and drinking.

Water as a gas – vapor is always present in the air around us. You cannot see it. When you boil water, the water changes from a liquid to a gas or water vapor. As some of the water vapor cools, we see it as a small cloud called steam. This cloud of steam is a mini version of the clouds we see in the sky. At sea level, steam is formed at 100° Celsius, 212° Fahrenheit.

The water vapor attaches to small bits of dust in the air. It forms raindrops in warm temperatures. In cold temperatures, it freezes and forms snow or hail.

## Unit 3 Crushing Cups / Unit 4 Super Skis

### What is pressure?

Pressure is a measure of how much force is acting on an area.

Pressure depends on both the force and the area, and is found using the relationship:

$$\text{Pressure} = \text{Force} \div \text{Area}$$

This means that a smaller area will create a greater pressure with the same force acting on it.

### How to change the pressure

Skiers increase the area in contact with the snow by using skis. Their body weight is no longer concentrated on their feet but is spread out over the area of the skis. The lower pressure of the skis means the skier glides on the snow rather than sinking into it. In comparison, the smaller area of the boot creates a greater pressure, and as a result a person just wearing boots would sink into the snow.

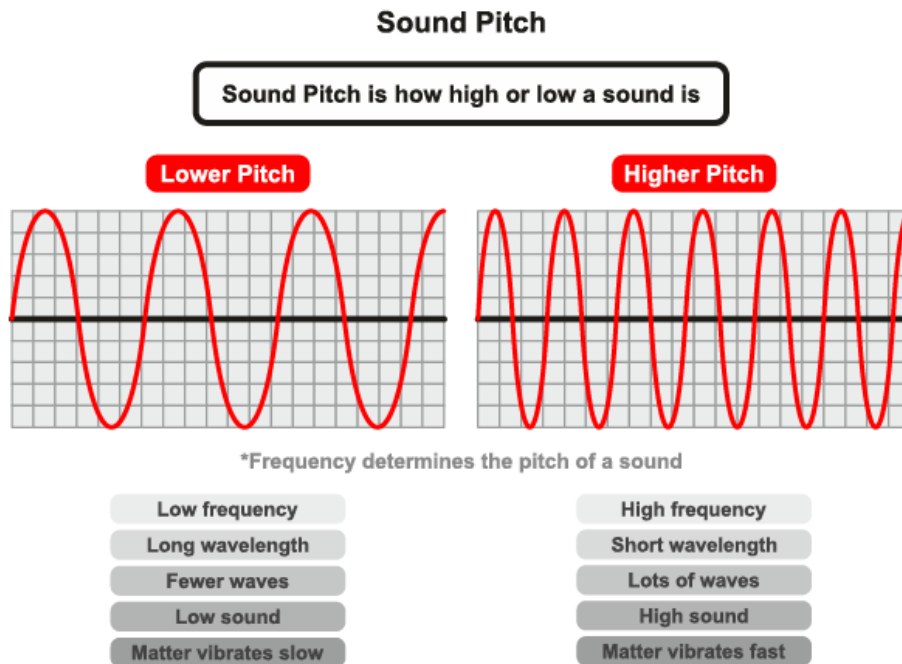


### Pressure in action

Footballers need to get a good grip on the ground. They use boots with studs in them. The studs have a small area to make the pressure large enough to dig into the surface. That way they have better grip and will not slip.



## Unit 5 Straw Flutes / Unit 6 The Wolf and the Whistle



Sound changes depending on how fast or slow an object vibrates to make sound waves. Pitch is the quality of a sound (high or low) and depends on the speed of the vibrations. Different materials produce different pitches; if an object vibrates quickly we hear a high-pitched sound, and if an object vibrates slowly we hear a low-pitched sound. Sounds are usually a mixture of lots of different kinds of sound waves.

To keep it simple, the shorter the instrument the higher the sound. Why? Inside your straw you have a sound wave in a particular arrangement called a 'standing wave.' As you shorten the straw you shorten the standing wave within it, increasing the number of times the wave vibrates per second, changing its pitch.

The sound wave itself is made up of two regions, one region with a higher density of air molecules and another with lower density. These two regions are called the 'nodes' and 'antinodes' respectively.

What do you think will happen if you increase the length of the straw? The pitch will be lowered, as you lengthen the standing wave and reduce the number of times the wave vibrates per second.

## Unit 7 The Pine Cone's Secret / Unit 8 The Story of the Pine Cone

### Fun Facts about Pine Cones

- The main function of a pine cone is to keep a pine tree's seeds safe.
- Pine cones close their scales to protect the seeds from cold temperatures, wind and even animals that might try to eat them. Pine cones open up and release their seeds when it is warm and it is easier for the seed to germinate.
- Pine cones can stay on the tree for more than 10 years before dropping to the ground.
- All conifers produce male and female cones. The pinecones we see are only the female cones. The male cones are much smaller and not showy.



female cone



male cone

### Other Plants that Open and Close

Those that open their petals during the day and then close them at night are reacting to light or temperature changes. Flowers close their petals at night because they are protecting the pollen and other reproductive parts of the plant that are inside from the cold and rain. Also, many flowers are pollinated by insects and birds that are active during the day, so there is no reason to be open at night.



Crocuses, poppies, and morning glories, for example, open as the temperature increases during the day and close as the day gets cooler in the late afternoon.

Some plants also react to touch and close up their leaves and “play dead” if a hand or twig brushes against them. For example, if you touch a mimosa plant, it will fold its leaves and the stalk will droop.



## Unit 9 Roll a Coin / Unit 10 Toy Coins

Common uses of magnets include the compass, vending machines, and electric motors. Some types of trains even levitate above magnetized rails! Without magnets, the world would be a very different place.

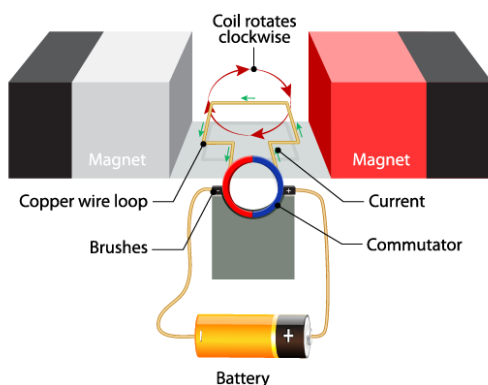
### Vending Machines

The identification mechanism for bills in a vending machine uses optical scanning. Tiny photocells look for patterns in the bill to identify which one it is. The bills are either printed with fluorescent inks or magnetic inks, and the corresponding type of scanner can identify the type and denomination of the bill.

To tell different coins apart, the vending machines look at the physical attributes of the coin, including its diameter, thickness, and the ridges on the sides. It measures all these attributes using light sensors, but that is not all. The machines are equipped with electromagnetic sensors that sense the type of metal the coin is made of.

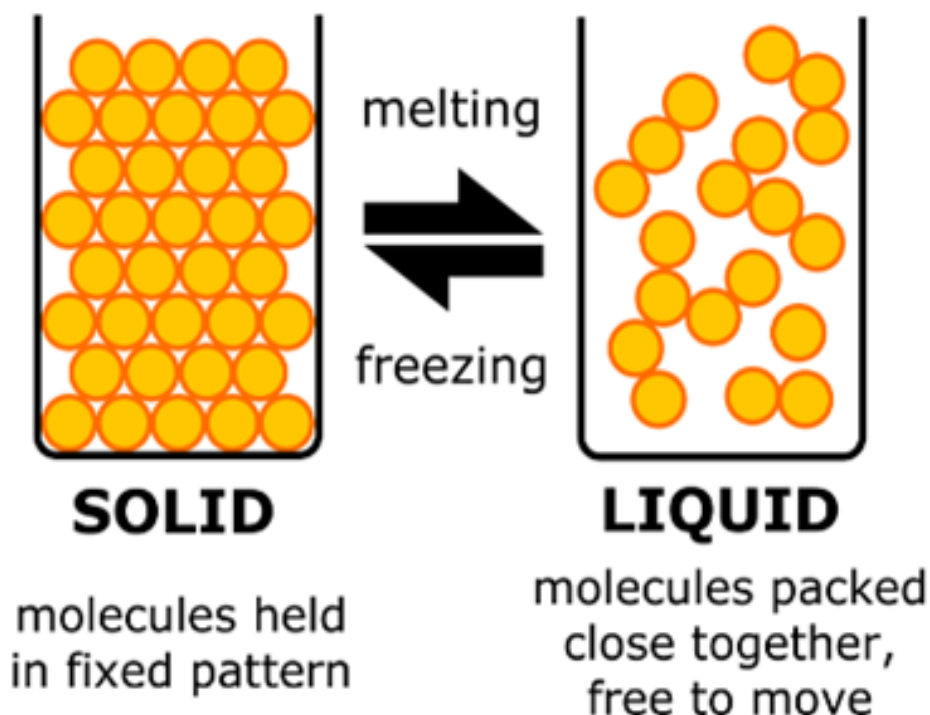


### Electric Motors



Magnets are responsible for making electric motors and generators work. Moving a metal wire near a magnet produces electricity. Electric generators use steam, flowing water or another source of energy to spin wires through a magnetic field and create electricity. Every time you turn on a light or watch television, you can thank magnets for helping produce electricity.

## Unit 11 Liquid to Solid / Unit 12 Ice Breaker



Freezing, or solidification, is a phase transition in which a liquid turns into a solid when its temperature is lowered to or below its freezing point.

All known liquids, except helium, freeze when the temperature is low enough. (Liquid helium remains a liquid at atmospheric pressure even at absolute zero, and can be solidified only under higher pressure.)

For most substances, the melting and freezing points are the same temperature; however, certain substances possess different solid-liquid transition temperatures. For example, agar displays a hysteresis in its melting and freezing temperatures: it melts at 85 °C (185 °F) and solidifies between 31 °C and 40 °C (89.6 °F to 104 °F).

Most liquids freeze by crystallization, the formation of a crystalline solid from the uniform liquid.



## Unit 13 Rock-breaking Rivers / Unit 14 Adventures of Spring Water

### The formation of soil

Soil is formed as part of the Rock Cycle when a process called weathering breaks down rock on the Earth's surface. Weathering may be either a physical or chemical process. When rock is broken down into smaller pieces of rocks and minerals through the physical process of weathering, only the rock is changed, not the minerals that are part of the rock. The physical process of weathering is caused by the following actions.



- Cracks in rocks allow water to settle. When the water goes through a continuous cycle of freezing and thawing, it breaks rocks apart.



- The roots of trees and other plants wedge themselves into cracks, widening the cracks until pieces of rock break off.



- Sand blowing hard against rocks and cliffs in the desert causes abrasion, wearing away or sand-blasting the surface of rocks.



- Fast-moving water, such as pounding waves, scours and breaks down the surface of rocks, mountains, and cliffs.



- Huge glaciers moving downhill scrape and gouge the surfaces of mountains and rocks as they travel past.



- Huge temperature changes in places like deserts heat and expand rock during the day, then cool and contract it at night, causing layers of rock to peel off.

## Unit 15 Building Worlds

### Virtual reality



Virtual reality (VR) refers to the computer-generated simulation in which a person can interact within an artificial three-dimensional environment using special electronic devices, such as special goggles with a screen or gloves fitted with sensors. In the simulated artificial environment, the user is able to explore the various artifacts and proceedings as they might in the real world.

To understand virtual reality, let's draw a parallel with real-world observations. We understand our surroundings through our senses and the perception mechanisms of our body. Senses include taste, touch, smell, sight and hearing, and the inputs gathered by them are processed by our brains to make interpretations. Virtual reality attempts to create an illusory environment that can be presented to our senses with artificial information, making our minds believe it is (almost) a reality.

The simplest example of VR is a three dimensional (3D) movie. Using special 3D glasses, one gets the immersive experience of being a part of the movie with on-spot presence. The leaf falling from a tree appears to float right in front of the viewer, or the shot of a speeding car going over a cliff makes the viewer feel the chasm's depth and gives real-time experience of the fall. Essentially, the light and sound effects of a 3D movie make our vision and hearing senses believe that it's all happening right in front of us, though nothing exists in physical reality.



## Unit 16 Flower Power

### Botanists

A botanist is a highly educated and skilled scientist who studies plant life and organisms. A botanist's research can determine how environmental changes impact certain aspects of plant life and how those changes can improve our medicine, food supplies and building materials.

Botanists are primarily responsible for researching various categories of plant life. They might determine how different plants affect different environments as well as how certain plants can affect the chemical makeup in solutions used for medicines, food or building. Botanists conduct their research in laboratories and outdoors on field expeditions. They also classify and categorize the different types of plants they research based on their cellular makeup. In addition, botanists conduct experiments on plant life to determine growth and oxygenation patterns and how those patterns might affect the environment.

