Trees and Forests

Forests are important to Canada and Alberta because:

- 10% of the world's forests are found in Canada
- 50% of Canada is covered in trees
- 65% of Alberta, especially the north and west, is covered with trees

Trees are important because they:

- provide us with useful products
- produce oxygen
- control erosion
- enrich the soil
- provide food, homes and shelter for wildlife
- protect us from the sun's heat and strong cold winds
- act as a sound barrier
- add beauty and enjoyment to our lives

The Forest Ecosystem

- The ecosystem is made up of living and non-living things.
- Non- living elements to the ecosystem are those that have never been alive. Ex. Water, rocks, sunlight

Living organisms can be broken into three different categories.

- Producers – organisms which use energy from the sun to produce their own food
- Consumers – Organisms which feed on other plants and animals
    - Includes Herbivores (plant eaters), Carnivores (meat eaters) and Omnivores (eats both plants and animals)
    - In a food chain consumers can be labeled Primary (first consumer who eats the producer) secondary (2^{nd}) tertiary (3^{rd})
- Decomposers – Organisms which break down dead material and litter, and release the nutrients back into the soil. Includes Fungi, bacteria, earthworms, mites, molds, ants, maggots etc.

Levels of the Forest

- Upper Canopy –
    - top level of the forest
    - formed by leaves and branches of the tallest trees.
    - Up to 35 % of precipitation falling on a forest is intercepted by the canopy.
    - Birds and insects make their home here.
- Middle level or Understory –
    - smaller tress and larger shrubs.
    - a sheltered space for birds and small mammals to travel.
    - insects, lichen, squirrels, and birds can be found here.
- Herb, Underbrush, or Shrubbery Layer –
    - Ferns, wildflowers and other soft stem plants, tree seedlings,
    - butterflies, dragonflies, mice, weasels, deer etc find their food in this layer.
- Forest Floor –
    - includes the ground cover and the soil.
    - ground cover includes leaf litter, mushrooms, insects, salamanders, toads, moss, and flowers.
    - The soil is the storehouse for growth. There is a thin layer of organic and mineral materials covering bedrock. Worms, bacteria, soil insects, tree roots, spiders, millipedes and centipedes are found here.

Food Chains

- a sequence of organisms in an ecological community,.
- It shows the flow of energy from primary producer to the top predator or carnivore through this series of organisms.
- Decomposers are not included in a food chain.
- Ex. Grass → deer mouse → weasel → Coyote

Fungi, lichens, and Conks

- Fungi – organisms which lack roots, stems, and leaves like that of a plant.
- lack chlorophyll and cannot photosynthesize thus are not considered plants.
- live where they can absorb organic matter and minerals and water

- grow on the remains of plants of animals or as parasites on living organisms.
- Reproduce using spores carried by the wind.
- aide in decomposition of plant and animal matter
- Examples mildew, smuts, mushrooms, puffballs, conks (bracket fungi), yeasts and molds.
- Conks are a type of fungus found attached to tree trunks.
    - grow on tree trunks like shelves and have growth rings like a tree.
    - appear soft but are really hard and firmly attached to the tree.
- Mushrooms –
    - fruiting body of the fungus.
    - Beneath the surface of the ground or bark is the main part of the organism.
    - Thread like mycelium collect water and nutrients from the soil.
- Mycorrhizal Fungi –
    - grow on the roots of trees.
    - mutually beneficial relationship with the tree.
        - fungi uses sugars produced by the tree. In return the fungus breaks down the nitrogen and phosphorous in the soil for the tree. T
    - have eatable blackish fruit called truffles.

Lichens –

- a composite organism made of fungus and algae.
- The Fungus absorbs the water and nutrients, while the algae produces food since is contains chlorophyll. –
- grow on walls, rocks, tree bark and other places.
- grow very slowly and live for a very long time.
- go into a dormant stage is there is not enough water to sustain growth and will grow again once water returns.
- can withstand extremes in heat or cold but not smoke or fumes.
- presence is a good indicator of air quality

There are 6 types of lichen. The three most common types are:

- Crustose (crusty) – grows flat or may be embedded in the bark or rock surface. The entire undersurface is attached.
- Foliose (leaf-like) – attached in spots with margins or ridges that are often lobed and free. They curl up off the surface and look like crumbled leaves. Attached to the surface by root-like threads
- Fruiticose (Tree-like or Shrubby) – looks like a branched plant. They grow upright or hang from the surface from which they grow and are only attached to the surface at the base.

Effects of Trees on Abiotic Factors

Under the canopy it is

- cooler because the trees block the sun.
- wetter because
    - the trees block the drying wind,
    - Trees block the sun which lowers the temperature and decreases evaporation.
- Nutrient rich soil underneath canopy
    - contribute leaves, branches, and stems to the organic material in the soil

Effects of biotic factors on trees

- Many creatures eat tree leaves, such as caterpillars.
    - Large populations of leaf eating organisms can have a harmful effect on trees.
    - Trees can survive one year of tent caterpillars because they can grow secondary leaves, but not two years.
- Yellow-bellied sap suckers can drill enough holes in coniferous trees to kill sections of the tree due to sap loss.
- Trees are also harmed by blights, fungus, and bacteria.

Nutrient Cycle

1. Nutrients in the soil are absorbed by the tree roots.
2. Nutrients travel up the trunk to the leaves.
3. Leaves fall to the ground or are eaten by the consumers.

4.Decomposers break down dead plant or animal mater and return the nutrients to the soil where the cycle begins again.

Photosynthesis and the Leaf's role in the oxygen cycle

- Photosynthesis = photo which means light and synthesis which means putting together.
- is the process by which plants create their own food.
- **Plants take carbon dioxide from the air and water and minerals from the ground. Energy from the sun is trapped by chlorophyll and this energy is used to combine Carbon Dioxide and water to form sugars.**
- Carbon Dioxide (CO_2) + water (H_2O) +Chlorophyll and sunlight = Sugar ($C_6H_{12}0_6$) + Oxygen (O_2)

What makes a tree a tree?

- it must be perennial
- It must have a self supporting trunk
- The trunk must be made of a woody material

Parts of a Tree:

The parts of a tree are:

- ***Roots***: anchor the tree in the ground and absorb water and minerals from the soil.
- ***Trunk:*** strongest part of the tree providing support for the rest fo the tree; contains 4 parts.
- ***Outer Bark (cork):*** outer part of the trunk; is dead tissue; protects the living parts underneath.
- ***Branch***: lateral extensions of the trunk that grow leaves, flowers, fruit and seeds.
- ***Needles or Leaves:*** flat or needle-like structures containing most of the chlorophyll and are the main sites of photosynthesis. Use sunlight, water, and carbon dioxide to produce food for the trees and free oxygen gas.
- ***Cones:*** small woody structures which produce seeds on coniferous trees.
- ***Crown:*** the upper part of a tree made up of branches, twigs, leaves, needles, buds and cones.
- ***Xylem:*** hollow cells that transport water and minerals from the roots throughout the tree make up the wood of the tree.
- ***Phloem:*** tissue that moves sap up and down a tree, makes up the inner bark or layer next to the outer bark; transports nutrients made in the tree leaves down to the roots. The Tree will die if this layer is damaged.
- ***Cambium:*** thin yellowish white layer found between the sapwood and inner bark which produces new xylem cells (wood) every year, allowing the tree to grow.
- ***Heartwood:*** non-living core of tree stem, giving the stem strength. Heartwood makes up most of the stem.
- ***Sapwood:*** a relatively thin layer of active xylem or wood that surrounds heartwood. This is where water and dissolved materials are transported through cells called the xylem, from the roots to the leaves.

Deciduous or Coniferous

- ***Coniferous*** trees are known as conifers or cone bearing trees.
  - have needle-shaped leaves (can be long, narrow, small or scale like).
  - Needles are green year round.
  - produce female cones (contain seeds and are large and thick scaled) and male cones (smaller, pollen grains and thin scaled) on the same tree.
- ***Deciduous*** trees are
  - usually broad-leafed (flat green blades and are attached to a branch by a slender stalk called a petiole)
  - They produce either flowers or catkins (scaly structures, containing seeds which fall off the tree
  - lose their leaves in the autumn.
- The ***larch (tamarack)*** is both a ***coniferous*** (needle leafed and cone bearing) and a ***deciduous*** tree (loses its leaves in the fall).
- Canada has ***31*** different types of ***coniferous*** trees and ***100*** types of ***deciduous*** trees.

Tree Growth

- Springwood – result of rapid growth in the spring and is lighter colored
- Summerwood – result of slower growth in the summer and fall and is darker coloured
- Together, these represent one year of growth or an annual rind.
- There is little or no growth during the winter months.
- Growth patterns are effected by the conditions around the trees.
  - Large even growth rings = result of good weather and good water and nutrient availability.
  - Narrow close together rings may indicate drought
  - Scars may indicate the lost of a branch, fire, or insect attack

Influences on the Forest

Natural Threat	Positive Effects	Negative Effects
Snow and ice	- Supplies water - Distributes seeds	- Breaks branches - Erodes soil
Insects	- help pollinate - eat other insects	- carry diseases - harm trees
Wind	- Helps pollinate - Distributes seeds	- erodes topsoil - exposes roots
Flowing water	- Provides moisture - Distributes seeds	- changes watershed system - washes away top soil
Human Threats		
Chemicals (pesticides, herbicides, insecticides)	- controls or kills disease, fungus, insects, - increases crop yield, encourages growth	- Changes ecosystem - Toxic substances released into air, water, soil.
logging	- Allows new trees to grow	- Destroys adult trees

Air and Aerodynamics

Objective: Provide evidence that air takes up space and exerts pressure, and identify examples of these properties in everyday applications.

Air:

- is invisible
- is a gas,
- takes up space,
- has mass,
- exerts pressure.

Air Takes up Space

- Think about basketballs, hot air balloons, tires, and balloons. Particles that make up air are forcing the sides of the shape out. It is the space the air takes up that gives these objects their shape.
- When you blow into a balloon, the air entering the balloon causes it to inflate. The air you are putting into the balloon requires space and causes the balloon to expand and change shape.

Air Exerts Pressure

- Air pressure is the force exerted on an object by the weight of tiny particles of air.
- Atmospheric pressure is Earth's gravitational field pulling on air. Therefore, the air that surrounds Earth is being pulled down toward us.
- Our bodies are designed to handle a certain amount of air pressure. For each square centimeter of your body, there is one kilogram of air pressing on you. You also have air inside your body. That air pressure balances out the pressure that is pushing on you from the outside. Therefore, air pressure is the same inside and outside you body.
- Because the air pressure on the inside of the balloon is the same as the air pressure on the outside of the balloon, the balloon keeps a constant shape.
- If the air pressure were greater on the inside than the outside, the balloon would burst. If the air pressure on the outside were greater than the air pressure on the inside of the balloon, it would collapse.

Air Has Mass and Density

- Air also has mass and density.
- Mass is defined as the amount of matter in an object.
- Density refers to how tightly or how loosely 'packed' the molecules of an object are.
- Because air has density and mass, it exerts pressure.
- At sea level, air is the densest and exerts the most air pressure.
- Air pressure decreases the higher you go above sea level because the air becomes less dense.
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Objective: Provide evidence that air is a fluid and is capable of being compressed, and identify examples of these properties in everyday life.

Air is a Fluid

- Air is a fluid.
- A fluid can be a liquid or a gas.
- Water has more density than air because molecules of water are closer together than molecules of air.
- Air can be compressed into a smaller space by forcing the molecules closer together (this can be done with pressure).
- Some matter, like water, cannot be compressed.
- When air is heated, it expands because the molecules that make up air start to move faster and take up more space.
- When air gets cold, it contracts. As air cools, its molecules settle closer together and the density increases.
- Warm air rises because it is less dense than the cool air surrounding it.
- When you put air into your car tires, it is forced or squeezed into a confined space. It is compressed. The molecules of the compressed air inside the tire push on the wall, keeping the tire from going flat.
- Compressed air is used for many things such as aerosol spray cans, sports balls, vehicle tires, machines, scuba tanks, and to generate power for pneumatic tools (nail gun, jackhammer)

Objective: Describe and demonstrate instances in which air movement across a surface results in lift – Bernoulli's Principle.

Objective: Recognize that in order for devices or living things to fly, they must have sufficient lift to overcome the downward force of gravity.

Bernoulli's Principle

- Bernoulli's Principle states that as the speed of a moving fluid increases, the pressure within the fluid decreases.
- Aircraft wings are designed so that air flows over the top of the wing faster than it flows under the wing. This causes the air pressure on top of the wing to be lower. The comparatively higher air pressure underneath the wing pushes the air plane up and life is created.
- Lift is an upward force that acts against the force of gravity.

Forces of Flight

- There are four forces of flight at work when an airplane flies: thrust, drag, lift, and gravity.
- Thrust gives an airplane forward motion
- Drag is the force that acts to slow down an object as it moves through a gas or liquid.
- Lift is an upward force that must overcome the force of gravity.
- Gravity is the force that pulls objects down toward Earth.

Objective: Identify adaptations that enable birds and insects to fly

Objective: Describe the means of propulsion for flying animals and for aircraft

Propulsion

- In order for birds and insects to fly, they must create lift. They must also generate enough thrust to create propulsion.
- For a bird thrust and lift are created by flapping wings.
- Propellers
    - powered by an engine
    - Spin to create thrust (air foil shaped blades turn to create a pressure difference)
    - Increasing the number of rotations and/or the number of blades will increase thrust
- Jet engine
    - Generates thrust through a mixture of hot pressurized gases that ignite to create enough force for propulsion.

Adaptations

- An adaptation is a device or mechanism that changes so as to become suitable to a new situation.
- Birds have special adaptations to achieve flight:
    - Feathers - give birds a smooth, streamlined shape that reduces drag and maintains their body temperature
    - powerful flight muscles - designed to be strong to provide sufficient power for flight and not tire quickly

    - air sacs - birds need a large, constant supply of oxygen. Air sacs in a bird's thorax and abdomen fill up with air and provide its body with the needed oxygen needed
    - hollow bones - reduce its weight and allow it to keep a large supply of air in its lungs
    - wings - shape of a bird's wings allows them to achieve lift. Lift and thrust are achieved on the downward stroke
- Insects have many similar adaptations such as wings which are airfoil shaped (curved on the top, flat on the bottom) and specially designed flight muscles.

Objective: Recognize that streamlining reduces drag, and predict the effects of specific design changes on the drag of a model aircraft or aircraft components.

- The larger the surface area of an object, the more drag the object has.
- Today, many manufacturers design objects to have a smooth, streamlined shape to reduce drag.
- Creating a rounded shape which comes to a point reduces drag as does removing edges to create a smooth shape.
- Many sports employ streamlining techniques such as fitted clothing, smooth pointed helmets, tucking in limbs and equipments, removing all but essential parts, and crouching or ducking

Recognize that air is composed of different gases, and indentify evidence for different gases. Example evidence might include effects on flames, the 'using up' of a particular gas by burning or rusting and animal needs for air exchange.

Air Composition

- Air is a mixture of gases;
    - 78% nitrogen and 21% oxygen with traces of water vapour, carbon dioxide, argon, and various other components.
    - Normally, air is a colourless, odourless, tasteless, and mostly non-metal gas.

Oxidation

- Oxidation is the combination of a substance with oxygen.
- If a peeled apple is left exposed to the air, it turns brown. This is a type of oxidation.
- Metal and iron also react with air. This is why vehicles rust.
- Rusting demonstrates the process of oxidation.
- To protect fruit - leave the peel on, refrigerate it, add ascorbic acid like lemon juice, or limit air exposure by covering with plastic wrap.
- For protecting metal - paint acts as a thin wall to reduce contact with oxygen, thick layers of grease or oil also provide excellent protection against rusting. Coating Iron with a thin layer of zinc, called Galvanizing, is also an effective rust reducer.

Combustion

- Combustion is the process of burning.
- If a candle is lit and left to burn in a closed-in space, it will only burn as long as there is air inside the closed-in space.
- Once the oxygen in the air is used up, a flame no longer burns.

Flight

Objective: Conduct tests of a model parachute design, and identify design changes to improve the effectiveness of the design.

- A parachute works by creating drag to slow a person down.
- larger its surface area the more drag it creates.
- You can increase drag using a parachute by
    - Increasing canopy size,
    - Reducing the vent hole size,
    - Increasing string/cable length,
    - And increasing string/cable number

Objective: Describe the design of a hot-air balloon and the principles by which its rising and falling are controlled.

- Hot air balloons are based on very a basic scientific principle: warmer air rises in cool air.
- A hot-air balloon rises because it is filled with hot, less dense air and is surrounded by colder, denser air.

- To make a hot air balloon rise and to keep it rising, the air inside of it must be constantly heated. This is done with a burner positioned under an open balloon "envelope."
- A hot-air balloon has three essential parts:
    - the burner, which heats the air by burning propane
    - the balloon envelope, which holds the air;
    - and the basket, which carries the passengers.
- If you want to go:
    - Up – open the valve on the burner and create more hot air.
    - Down – close the burner valve and open the vent at the top of the envelope to decrease the temperature.
    - Left or right - To move in a particular direction, a pilot ascends or descends to the appropriate level and rides with the wind. Since wind speed generally increases as you go higher in the atmosphere, pilots can control speed by changing altitude.

Objective: Conduct tests of glider designs; and modify a design so that a glider will go farther, stay up longer, or fly in desired way; eg. fly in a loop, turn to the right.
Objective: Recognize the importance of stability and control to aircraft flight; and design, construct, and test control surfaces.
Objectives: Apply appropriate vocabulary in referring to control surfaces and major components of an aircraft. This vocabulary should include: wing, fuselage, vertical and horizontal stabilizers, elevators, ailerons, and rudder.

- If lift is greater than weight, the plane goes up.
- If lift and weight are equal, the aircraft continues level flight.
- If weight is greater than lift, the plane goes down.
- If thrust is greater than drag, the plane moves forward.
- If drag is greater than thrust, the plane slows down.
- The aircraft is made up of several different parts that enable a pilot to have a successful flight:
    - *fuselage* - main body of the plane.
    - *Wings* – used to create life
    - *Ailerons* - Hinged flaps in the trailing edge of the wing
        - Ailerons control roll.
        - If the left aileron is raised and the right one is lowered, the air moving over the upper surface of the wing is slowed, thereby increasing the air pressure. As a result, the plane banks to the left.
        - If the Right aileron is up and the left down the plane banks to the right.
    - *Elevators- t*wo smaller flaps on the plane's horizontal stabilizers can be moved up or down.
        - used to change pitch.
        - *Pitch* is the upward or downward movement of the plane.
        - With the elevators down, lift on the tail is increased and the nose drops.
        - With the elevators up, lift on the nose is increased; the tail goes down and the nose rises.
    - *Rudder* - flap attached to vertical stabilizer
        - allows the pilot to change direction from left to right. This is called "yaw."
        - If the rudder is turned to the left, the nose of the plane turns left.
        - If the rudder is turned to the right, the nose of the plane turns right.

Objective: Construct and test propellers and other devices for propelling model aircraft.

- Helicopters are designed with a giant horizontal propeller, known as a rotor, which spins around very quickly.
    - Each of the blades of the rotor and airfoil shape used to create lift.
    - To move in these different directions, the pilot has to tilt the rotor slightly in the direction he or she wants to go.
    - The four forces of flight still apply to the movement of a helicopter.

Objective: Describe the differences in design between aircraft and spacecraft, and identify reasons for the design differences.

- Since there is no air in space, aircraft and spacecraft have many design differences.

- To achieve lift an airplane must first create thrust. A space shuttle uses two large rocket boosters and three main engines to create lift directly. The engines burn liquid oxygen and hydrogen.
- Shuttles are designed to meet all the environmental needs of the astronauts on board
- When the shuttle is ready to come back to Earth, it must come through Earth's atmosphere. This requires it to be a streamlined shape.
- Spacecraft are designed to be protected from intense heat. They have reinforced carbon on the wing surfaces and underside, high-temperature black surface insulation tiles on the upper forward fuselage and around the windows, and low-temperature white surface tiles on the remaining areas.
- When re-entry to the Earth's atmosphere is complete, the shuttle is able to fly like an airplane.
- Spacecraft are designed with wings that can generate lift when needed.

Sky Science Notes

Emit and Reflect Light

- Stars create light through their nucleus (core), which is at their center. Stars give out or emit their own light.

- Reflected light is light that bounces off another object. Light from another source like the sun shines on them, and we see the reflected light.
- Planets, moons , Asteroids, comets and meteoroids reflect light.

Stars and Constellations

- Stars are burning balls of gas which emit their own light.
- Some stars are visible during certain seasons but not during other seasons. We only see the stars that are in the part of the sky that is away from the sun's light.
- Stars don't actually twinkle. Convection currents in the Earth's atmosphere affect the light we see from stars.
- Light from stars takes time to reach Earth because of the long distance from the stars to Earth. So we are actually looking at light that was emitted in the past.
- Sunlight actually takes 8 minutes and 17 seconds to reach Earth.
- A Greek astronomer named Hipparchus rated stars on their brightness (magnitude). Hipparchus created a scale from 1-6, with 1 representing the brightest star and 6 representing a star that is barely visible.
- Some of the first astronomers were Ancient Greeks.
- The Greeks grouped stars and called them constellations. They named the groups of stars after animals, Greek gods and heroes from their mythology.

Movement of stars

- Earth spins on its axis once every twenty-four hours.
- It moves counterclockwise (if you were looking down at the north pole).
- Earth also orbits the sun once a year.
- Because Earth is titled on its axis, we see different constellations at different times of the year.
    - As Earth moves in its orbit, we see different parts of the night sky.
    - Each year, we can see the same stars in the sky at the same time of the year.
    - Circumpolar constellations all orbit around on star: Polaris (the North Star) and can be seen all year round. Ursa Major (Big Dipper), Ursa Minor (little dipper) and Cassiopeia are circumpolar constellations.
    - The rest of the constellations follow constant and predictable patterns each year.

The Sun and Safe Viewing

- The sun is just one star among millions in our galaxy.
    - It is small for a star and is still 109 times bigger than Earth.
    - the sun has a diameter of 1392000 km.
    - The temperature on the sun ranges from 4000 - 9000 degrees Celsius.

    - It is important to remember that direct viewing of the sun, even for a short time, can cause burns to the retina of the eyes. These burns are not felt, but they can produce a permanent blank spot in the field of vision.
    - Scientists use special lenses or cameras to look at the sun.
    - For home sun viewing you can either use number 14 welder's glass or a device called a pinhole camera that will only reflect small amounts of light to your eye.
    - To view the Sun's image safely we can focus it on a screen using a sun-scope. When using a sun-scope, the Sun's light passes through a pinhole in a 'box', projecting an upside down image of the Sun on a screen.
- The energy produced by the Sun is the result of nuclear reactions occurring in its core.
- Most of the light we see comes from the photosphere (outer surface).

Sunspots

- Sunspots are storm-like occurrences on the Sun's surface.
- They are about 1000˚c cooler than the Sun's surface so they appear darker than other hotter and brighter areas
- Over a period of several days, sunspots would appear to change position because they are moving.
- An average sunspot is about the size of earth.

Shadows

- In Ancient times, sundials were used to tell time using a sundial.
- The length of a shadow depends on where the sun is in the sky.
- In the morning, a shadow from the sun is long and pointing west because the sun is low in the East.
- The length of the shadow gradually gets shorter as the sun rises in the sky.
- When the sun is directly overhead, there is hardly any shadow.
- The point at which the sun is highest in the sky is called solar noon.
- In the northern hemisphere the shadow at solar noon points north.
- As Earth rotates, the sun becomes lower on the horizon. The shadow gradually starts to increase in length and point more to the East until the sun sets in the west.

Seasons

- The seasons are the result of Earth tilting on its axis.
- The Earth's axis is tilted 23.5 degrees.
- Since the axis is tilted, different parts of the Earth are turned toward the sun at different times of the year.
- In Canada, summer is warmer than winter because we get more direct sunlight during summer than during winter. The sun has more warming power when it is directly overhead.
- The days are much longer during the summer than in winter, so the sun warms Earth for much longer time.
- The direct sunlight warms Earth's surface quickly and the heat lasts longer.
- During the winter the days are very short and the sun's rays hit Earth at an extreme angle. We don't feel as much direct heat from the sun.

The Moon

- Has a counterclockwise orbit and always has the same side towards Earth.
- rotates on its axis at the same time as it is revolving around the Earth, once in 27 1/3 days.
- The moon shows different phases as it revolves around Earth.
- The phases of the moon depend on how much of the sunlit half of can be seen at any one time.
- A new moon occurs when we see none of the sunlit half from earth.
- Between the New Moon and the First Quarter we begin to see a lit portion of the moon from Earth. This is called a waxing crescent.
- 7 days after the new moon enters the first quarter and it is a half circle shape.
- Between the First Quarter and the full moon over half the face of the moon illuminated. We call this phase a waxing gibbous.
- A week after the first quarter a full moon appears. The entire face of the moon is illuminated from our perspective.

- Between the full moon and the last quarter we see more than half the face of the moon illuminated with the Earth's shadow beginning to cover the right side. This phase is called waning gibbous.
- A week after the full moon we see the last quarter where the moon appears as half circle once again. This time it is the left side illuminated.
- Between the last quarter and the next new moon the moon will once again appear as a crescent. The crescent will be on the left.
- The entire cycle is repeated each lunar month (the time it takes for one entire cycle of lunar phases to occur is approximately 29 ½ days.)

Solar System

- Our solar system includes objects which revolve around the Sun.
- There are eight planets (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune), along with countless asteroids (rock chunks which float in a belt between Mars and Saturn), meteors, minor planets such as Pluto and other space debris.
- The Sun pulls the planets towards it with a gravitational pull which gets stronger as you approach the Sun.
- The planets do not fall into the Sun because of their tremendous orbital speeds creating a force away from the sun.

Planets

- all basically sphere shaped and spin on an axis.
- All of the planets orbit the sun in an elliptical orbit.
- There are two groups of planets, inner and outer.
    - The inner planets (Mercury, Venus, Earth, Mars) all have solid surfaces and few or no moons (because they are very close to the strong gravitational pull of the Sun). The inner planets are also the smallest four planets. They have shorter revolution periods (years).
    - The outer planets (Jupiter, Saturn, Uranus, Neptune) are the largest four planets. They are all gas giants and have no solid surface. They have many moons orbiting each of them, long orbital periods and extremely long revolutionary periods (years)

Evidence and Investigation

- Observation – Something you can actually see. It can be proven.
- Inference – something you think based on you observations. Drawing conclusions based on your observations.
- Chromatography – a technique used in separating mixtures.
    - We used water to separate the different pigments mixed to create black ink. The steps are
        - Cut out a small strip of paper (coffee filter or chromatography paper) with the ink to be tested drawn in a line across the strip.
        - Place the paper into a cup of water so the bottom is in the water by does not reach the ink.
        - The water is absorbed by the filter and in the ink begins to separate in to various colors.
        - We observed and compared our results.
- Graphology – the study of handwriting. You can compare the shape of letters and style of writing to samples
- Fingerprints; there are four categories of fingerprints:
    - Arch - like a wave or a hill. The ridges enter on one side of the print, rise in the middle and exit on the opposite side of the print. The arch print has no delta
    - Loop - the look is the most common fingerprint type. It looks like a loop. Ridges exit the same side of the print that they entered. It has one delta.
    - Whorl – like a spiral. The pattern circles around like a whirl pool. It has two deltas.
    - Composite – combines two or more of the patterns above.
    - Finger prints are compared by looking at ridge detail, deltas, and overall pattern.
- Fabric Analysis – Many tests can be done to compare fabrics
    - Stretch, colorfastness, absorbency, wrinkling, thread analysis, flammability are some examples.
- Other evidence that might be examined at a crime scene could include; shoe prints, footprints, tire tracks and soil samples.