B1.3 Human reproduction

Adolescence

Adolescence involves both **emotional** and **physical changes**. During adolescence your body goes through physical changes, this is called **puberty**.

Puberty takes place between the ages of about **9 and 14** in most people. Most of the changes take place in your **reproductive system**. The system needs to develop so that you can have children if you choose to when you are older.

Here are some changes that happen to both boys and girls:

- underarm hair grows
- pubic hair grows
- emotional changes
- growth rate increases

<u>Boys</u> **Here are some changes that happen only to boys:**

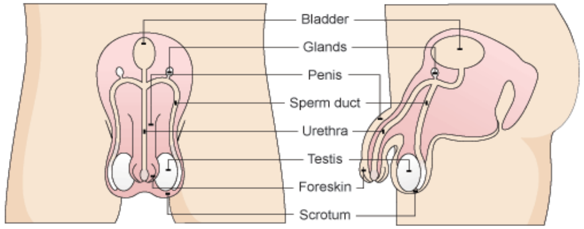
- Voice breaks (gets deeper)
- Testes and penis get bigger
- Testes start to produce sperm cells
- Shoulders get wider
- Hair grows on face and chest.

<u>Girls</u> **Here are some changes that happen only to girls:**

- Breasts develop
- Ovaries start to release egg cells (periods start)
- Hips get wider

All the changes that take place during puberty are caused by sex hormones. Females make these in the ovaries and males in the testes.

Reproductive system



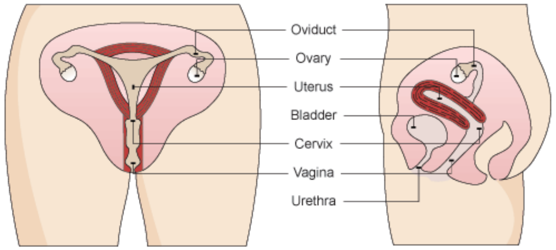
Testes—Produce **sperm cells** and **male sex hormones**, contained in a bag of skin called **scrotum**.

Glands—Produce a fluid that keeps sperm alive. The fluid and sperm together are called **semen**.

Sperm duct—**Carry** the sperm from the testes to the penis.

Urethra—A tube to carry the **urine** from the bladder out of the body or **sperm** out of the body.

Penis—The penis swells with blood and stiffens. This is called an erection and allows the male to **release** sperm into a female during **sexual intercourse**.



Ovaries—They contain the egg cells.

Oviducts—They carry an egg to the uterus.

Uterus (womb) - This is where a baby develops until it is born.

Cervix—A ring of muscle at the entrance to the uterus. It keeps the baby in place while the woman is pregnant.

Vagina—Receives the sperm during sexual intercourse. This is where the man's penis enters the female's body.

Urethra—A tube that carries urine from the bladder out of the body.

Fertilisation and implantation

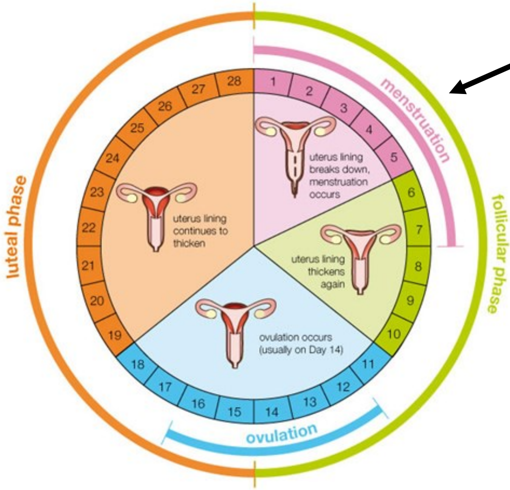
Gametes—Are **reproductive cells**, the **sperm** and the **egg** cells are both called gametes.

Fertilisation—During sexual intercourse the man's penis releases semen into the woman's vagina. Sperm cells travel in semen from the penis and into the top of the vagina. They enter the uterus through the cervix and travel to the egg tubes. If a sperm cell meets with an egg cell there, **fertilisation** can happen. Fertilisation happens when an egg cell meets with a sperm cell and joins with it.

Embryo—The fertilised egg divides to form a ball of cells called an **embryo**.

Implantation—the embryo attaches to the lining of the uterus and begins to develop into a baby.

The menstrual cycle



The menstrual cycle

- The female reproductive system includes a cycle of events called themenstrual cycle. It lasts about 28 days, but it can be slightly less or more than this. The cycle stops while a woman is pregnant. These are the main features of the menstrual cycle.
- If the egg cell does not meet with a sperm cell, the lining of the uterus begins to break down and the cycle repeats.
- If the egg cell meets and joins with a sperm cell, it is fertilised. It attaches to the lining of the uterus and the woman becomes pregnant.

Development of a fetus

Gestation—Is how long it takes from fertilisation until birth. The foetus relies upon its mother as it develops. These are some of the things it needs:

- Protection
- Oxygen
- nutrients (food and water).

It also needs its waste substances removing.

The uterus is where the baby develops, there are three important structures inside the uterus:

- **Placenta**—An organ where substances pass between the mother's blood and the fetus' blood. Oxygen and nutrients diffuse across the placenta from the mother to the foetus. Waste substances, such as carbon dioxide, diffuse across the placenta from the foetus to the mother.
- **Umbilical cord**—This connects the fetus to the placenta.
- **Fluid sac**—This acts as a shock absorber, protecting the fetus from any bumps.

B1.3 Plant reproduction

Seed dispersal

Plants compete with each other for factors such as:

- Light
- Water
- Space
- Minerals in the soil

Seeds must be **dispersed** or **spread away** from each other and from the parent plant. This is to **reduce competition** between the parent plan and the new plants, and between the new plants.

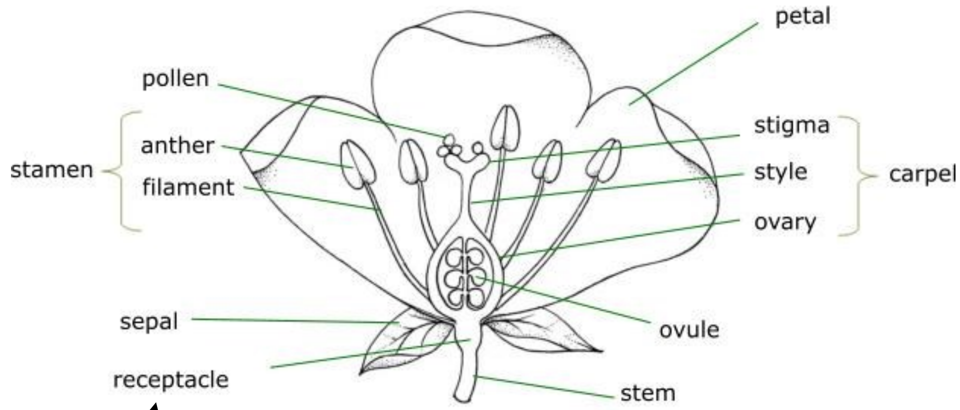
Method	Detail	Examples
Wind	Seeds have lightweight parts, wings or parachutes	Dandelion, sycamore
Animals (inside)	Brightly coloured and tasty fruits contain seeds with indigestible coats, so that the seeds pass through the animal's digestive system undamaged	Tomato, plum, raspberry, grape
Animals (outside)	Fruits have hooks that attach them to the fur of passing animals	Goose grass, burdock
Self-propelled	Have a pod that bursts open when ripe, throwing the seeds away from the plant	Pea pod

Dispersal investigation

Seed dispersed by the wind are easier to investigate than seeds dispersed by other methods. For example, you could release sycamore seeds and measure the distance they travel. Factors that could affect the distance travelled by a sycamore seed include:

- The **height** from which it is released
- The **surface area** of the wings
- The **mass** of the seed
- The **wind speed**

Flowers



The **stamen** is the **male reproductive** part—it contains:

- **Anther**—Produces **pollen**, the **male gamete**.
- **Filament**—Holds up the anther.

The **carpel** is the female reproductive part—it contains:

- **Stigma**—This is sticky to **'catch'** grains of pollen.
- **Style**—Holds up the stigma.
- **Ovary**—Contains **ovules**, the **female gamete**.

Pollination

Pollination is getting **pollen** to the **stigma**.

- To make a seed the male and female sex cells must 'meet up'.
- To do this, the **pollen grains** must get from a **stamen** to a **stigma**. This can happen in two ways:
  1. **Self-pollination**—pollen is transferred from stamen to stigma on the **same plant**.
  2. **Cross-pollination**—pollen is transferred from the stamen of one plant to the stigma of a **different plant**.

Insect pollination - Plant features that help insect pollination:

- Bright coloured petals.
- Scented flowers with nectaries (glands that produce a sugary liquid for insects to feed on).
- Sticky stigma to take the pollen off the insect as it goes from plant to plant to feed in the nectaries.

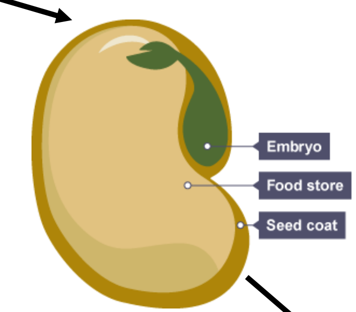
Wind pollination - Features of plants that use wind pollination:

- Usually small dull petals on the flowers.
- No scent or nectaries.
- Long filaments hang the anthers outside the flower so a lot of pollen is blown away.
- Stigma are feathery to catch pollen as it's carried past in the wind.

Fertilisation and germination

For **germination** to happen a seed needs **three things**.

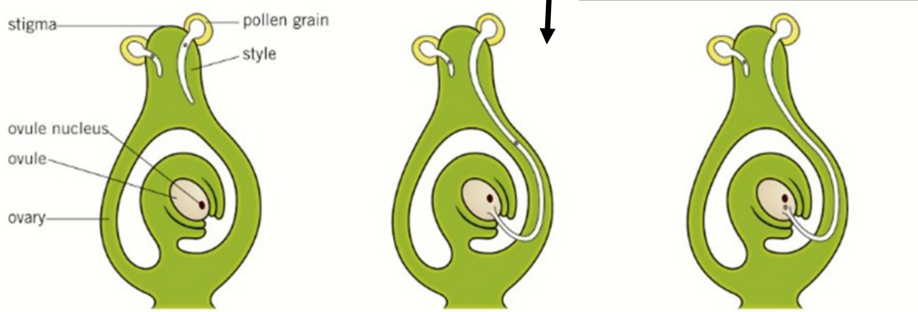
1. **Water**, this allows the seed to **swell up** and the embryo to start growing.
2. **Oxygen**, this is used for **respiration**, transferring energy for germination.
3. **Warmth**, this speeds up **reactions** in the plant, speeding up germination.



Seeds

A seed has three main parts:

- **embryo** - the young root and shoot that will become the adult plant
- **food store** - starch for the young plant to use until it is able to carry out photosynthesis
- **seed coat** - a tough protective outer covering



The tube grows out of the pollen grain and down through the style.

The pollen nucleus moves down the tube.

The pollen nucleus joins with the ovule nucleus. Fertilisation takes place and a seed will form.

C1.2 Elements, atoms and compounds

Naming Compounds

When elements combine to make a compound, their names change slightly.

Rule 1 : when **two** different elements combine the ending is usually **'something –ide'**

NaCl—sodium and chlorine give sodium chlor**ide**

MgO—Magnisum and oxygen give magnesium ox**ide**

Rule 2 : When **three or more** different elements combine—and one of them is **oxygen**—the ending will usually be **'something –ate'**

$CuSO_4$—1 copper, 1 sulphur, 4 oxygens gives copper sulf**ate**

$CaCO_3$—1 calcium, 1 carbon, 3 oxygens gives calcium carbon**ate**

If two identical elements combine, it's not a compound

Identical atoms of the **same element** are often found **combined**. This **doesn't** make them a **compound** through—in fact, their name doesn't even change.

H_2—Hydrogen

N_2—Nitrogen

O_2—Oxygen

F_2—Fluorine

Cl_2—Chlorine

Br_2—Bromine

Atoms

Everything in the world is made from atoms.

1. Atoms are a type of **tiny, tiny particle**.
2. They're so small that you **can't see them directly**. So for a long time, no one knew much about them.
3. **Dalton** was the first modern scientist to try to **explain** things about atoms. According to the **Dalton model**:
   * **All matter** is **made up** of **atoms**.
   * There are **different types of atoms**.
   * Each **element** contains a **different type**.

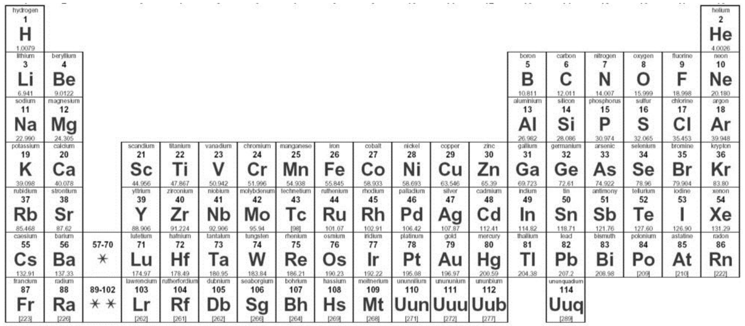
Elements

1. An **element** is a substance that contains **only one type** of **atom**.
2. Quite a lot of **everyday substances** are elements:
Copper, Aluminium, Iron, Oxygen, Nitrogen.
3. All of these elements have **different properties**. For example, **copper** is a **soft, bendy metal**. **Oxygen** is a **colourless gas**.

All elements have a **name** and a **symbol**.

1. There are over **100 different elements** and writing their names out each time you wanted to mention one would take ages
2. So each element has a **symbol**—usually of **one or two letters**
Examples:
Oxygen has the symbol **O**, **Carbon** has the symbol **C**, **Helium** has the symbol **He**, **Iron** has the symbol **Fe**.
3. You can see the **symbol** for each element on the **periodic table**.

The periodic table lists all the **elements** we have **discovered**:



Compounds

Compounds are formed from chemical reactions.

1. A chemical reaction involves chemicals (called reactants) combining together or splitting apart to form one or more new substance (called products).
2. When a new compound is synthesised (made), elements combine.
3. The new compounds produced by any chemical reaction are always totally different from the original elements (or reactants).

Iron's **properties change** when it **forms** a **compound**.

Iron is **magnetic**. It reacts with **sulphur** to make **iron sulphide**, a totally new substance which is **not magnetic**.

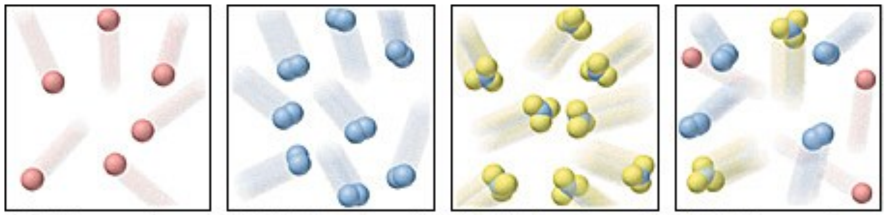
These **equations** show what happens in the reaction:

Word equation: Iron + Sulfur $\xrightarrow{heat}$ Iron Sulfide

In **symbols** : Fe + S $\xrightarrow{Heat}$ FeS

1. When elements undergo a **chemical reaction** like the one above, the products will always have a **chemical formula**—e.g. **H_2O** for **water**
2. Compounds can be **split up** back into their **original** elements but it **won't** just happen by itself—you have to **supply** a lot of **energy** to make the reaction go in **reverse**.

1. When two or more atoms join together, a **molecule** is made. The join is known as a **chemical bond**.
2. **Compounds** are formed when atoms from **different elements** join together. Like CO_2



(a) Atoms of an element — The atoms are all the same and not joined up.

(b) Molecules of an element — The atoms are joined, but there's still only one type.

(c) Molecules of a compound — Here we have different atoms joined together

(d) Mixture of elements and a compound — This is **not** a compound because the elements aren't joined up

P1.1 Forces

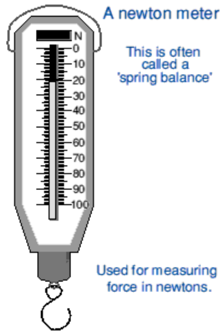
Gravity

Gravity is a **force** that **attracts** all **masses**

1. Anything with **mass** will **attract** anything else with mass. Everything in the universe is attracted by the force of **gravity** to everything else.
2. The **earth** and **moon** are **attracted by gravity**—that's what keeps the moon in its orbit. The **earth** and the **sun** are attracted by an even **bigger force** of **gravity**
3. The **more massive** the object the **stronger** the force of gravity is .
4. The **further the distance** between objects—the **weaker** the gravitational attraction becomes.

Gravity gives you **weight**—but **not mass**

1. **Mass** is just the **amount of 'stuff'** in an object. The mass of an object **never changes**, no matter where it is in the universe.
2. **Weight** is caused by the **pull** of **gravity**.
3. An object has the **same mass** whether it's on **Earth** or on **another planet** (or on a **star**) - but its **weight** will be **different**. For example, a 1kg mass will **weight less** on **Mars** (about 3.7N) than it does on **Earth** (about 10N), simply because the **force** of gravity pulling on it is **less**.



Weight is a **force** measured in **newtons** (N). It's measured using a **spring** balance or **newton meter**. **Mass** is **not** a force. It's measured in **Kilograms** (kg) with a **mass** balance.

Weight (N) = mass (Kg) x gravitational field strength (N/kg)

W = m x g

1. The letter '**g**' represents the **strength** of the gravity and its value is **different** for **different planets**. **On earth** g=**10N/kg**. **On mars**, where the gravity is weaker, g is only about **3.7N/kg**.
2. The formula is **hideously easy** to use:

E.g. what is the weight, in newtons, of a 5kg mass, both on earth and on mars?

***Answer*: W = m x g.**

On earth W = 5 x 10 = **50N** (the weight of the 5kg mass is 50N)

On mars W = 5 x 3.7 = **18.5N** (the weight of the 5kg mass is 18.5N)

Pushes and pulls

1. Forces are **pushes** or **pulls** that occur when two objects **interact**.
2. Forces **can't** be seen, but the **effects** of a force **can** be seen.
3. Forces are measured in **newtons-N**
4. They usually act in **pairs**
5. They **always** act in a **certain direction**
6. A **newton meter** is used to **measure** forces.

Forces can **make objects** do **five** things

1. **Speed** up or **start** moving—like **kicking** a football.
2. **Slow** down or **stop** moving—like **drag** or **air resistance**
3. Change **direction**—like hitting a **ball** with a **bat**
4. **Turn**—like a **turning a spanner**
5. Change **shape**—like **stretching** and **compressing**, **bending** and **twisting**

Friction

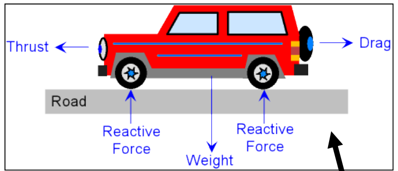
Friction is a **force** that always acts in the **opposite** direction to movement. It's the force you need to **overcome** when **pushing an object** out of the way.

Good points of friction:

1. Friction allows the tyres on a bike to **grip** the road **surface**
2. Friction also acts at the **brakes** where they **rub** n the **rim** of the **wheel** or on the **brake disc**
3. Friction also lets you **grip** the **bike**

Bad points of friction

1. Friction always wastes energy—friction between the moving parts of a bike warms up the gears and bearings—a waste of energy.
2. Friction **limits top speed**. The **air resistance** takes **a lot** of your energy and **limits** your maximum **speed**.



Air and water resistance

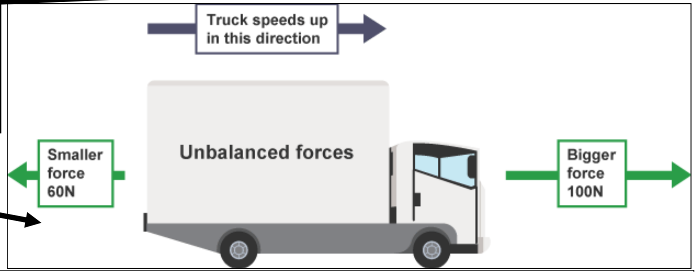
Air and water resistance slow down moving objects

1. Air and water resistance **push against** objects which are moving through the air or water
2. These are kinds of **frictional** force because they try to **slow** objects down.
3. If things need to go fast, then they have to be made very **streamlined**—which means they can **slip** through the **air** or **water** without to much resistance.

Balanced forces produce **no change in movement**

Unbalanced forces change the speed and/or **direction of moving objects**

Force diagrams



We can show the forces **acting on an object** using a **force diagram**. In a force diagram,, an arrow represents each force. The arrow shows:

- The **size** of the force (the **longer** the arrow, the **bigger** the force)
- The **direction** in which the force acts

The arrow should be labelled with the **name** of the **force** and its **size** in **newtons**.

Rules for force diagrams:

1. If the forces are acting in **opposite directions**, you **subtract** the forces to get the **overall force**.
2. If they're acting in the **same direction**, you **add** the forces together to get the **overall force**.

Elasticity

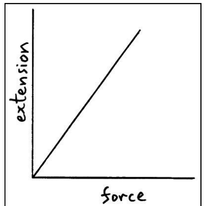
You can **deform** objects by **stretching** o **squashing**.

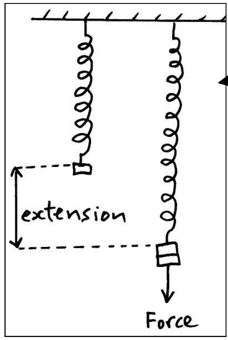
1. You can use forces to **stretch** or **compress** (squash) objects, e.g. when you stomp on an empty fizzy pop can.
2. The force you apply causes the object to **deform** (change its shape)
3. **Springs** are **special** because they usually **spring back** into their **original shape after** the force has been **removed**—they are **elastic**.

Work is **done** when a **force deforms** an object

1. **Work done** is the same and **energy transfer**
2. Energy is transferred and work is done when an object is **deformed**.

- When you **stretch** a **spring**, you're **doing work** by transferring **kinetic energy**.
- The kinetic energy is transferred to **stored elastic energy**.
- When the spring 'springs' back into its **original shape**, the elastic energy is **converted** back into **kinetic energy**.





Hooke's law says **extension of a spring** depends on the **force**

If a spring is supported at the top and then a weight is attached to the bottom, it **stretches**.

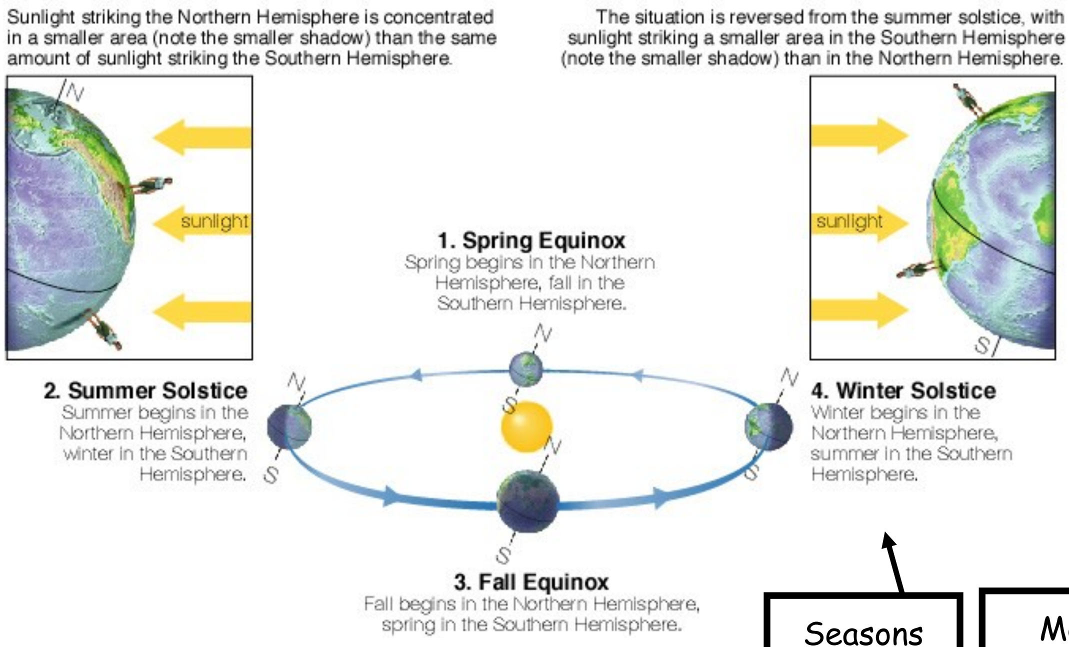
1. **Hooke's law** says the amount it stretches (**extension, e**) is **directly proportional** to the **force applied, F**.
2. Some objects **obey** Hooke's Law, e.g. **springs**. But it **only** applies up to a **certain force**.
3. For springs, the force at which Hooke's Law **stops working** is **much higher** than or most materials. Springs are **unusual**.

When a **stretched** spring holds a **weight**, it's in **equilibrium**

1. **Equilibrium** is just a fancy way of saying **all the forces are balanced**.
2. When a **stretched** or **compressed** spring holds a weight **still**, the force of the weight is **the same** as the force of the spring as it tries to return to its original shape. So the forces are balanced and in **equilibrium**.

P1.4 Space

Seasons



The **seasons** are **caused** by the **earth's tilt**

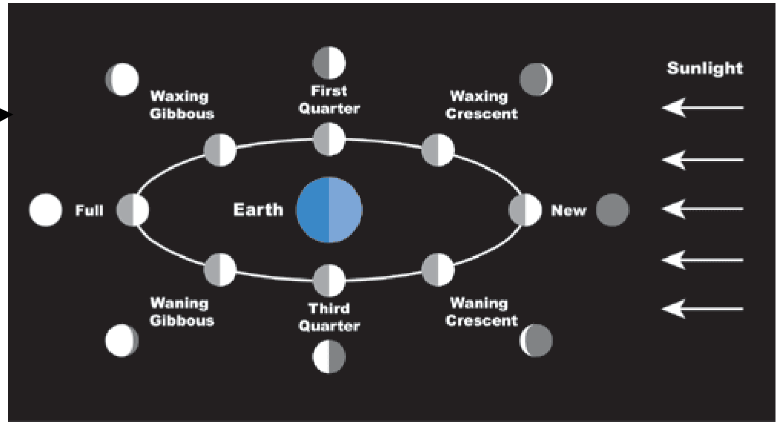
- The earth takes **365 1/4 days** to **orbit once** around the sun. each year has **four seasons**.
- The seasons are caused by the **tilt** of the **earth's axis**.

Day and **night** are due to the **steady rotation** of the **earth**.

- The earth does **one complete rotation** in **24hours**. That's what a **day** actually is—**one complete rotation of the earth** about its axis
- The sun doesn't really move, so as the earth rotates. An place on its surface (like England, say) **will sometimes face the sun (day time)** and other times **face away** into dark space **(night time)**.

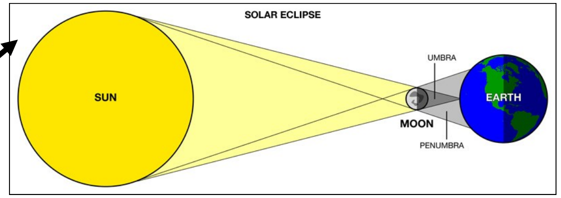
Moon

You see **phases** of the moon because the moon is **orbiting** the earth. **Half** of the moon is always lit by the sun.

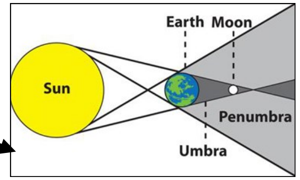


Eclipses

A solar eclipse happens when the moon blocks the light from the sun



A lunar eclipse happens when the earth comes between the sun and the moon



Light year

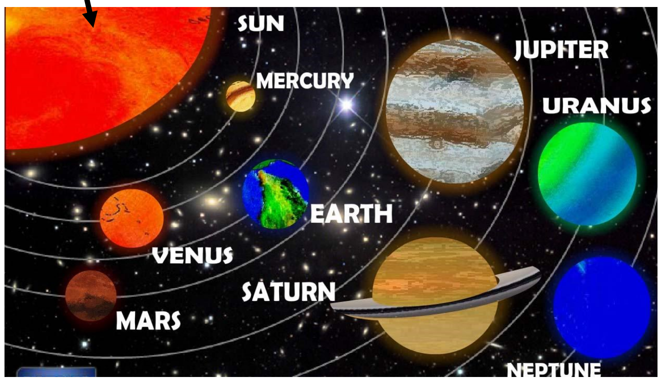
A **light year** is a **unit of distance**

- A light year is **how far light travels** in **one year**
- It's used for measuring **huge distances** between objects—like the distances you find in **space**. E.g. **Proxima Centauri** is about **4 light years** away, which means it takes light from the star 4 years to **reach earth**.

The solar system

The **sun** is at the **centre** of out **solar system**.

1.A **planet** is something which **orbits** around a **star**.
2.The **sun** is a **star**. The **earth** is one of **eight** planets which orbit the sun.
3.The sun is really **huge** and has a big **mass**—so its **gravity** is really **strong**. The pull from the sun's gravity is what keeps all the planets in their **orbits**.
4.The planets all move in **elliptical orbits**.
5.Planets **don't** give out light but the **sun** and other **stars** do.
6.The sun gives out a **massive** amount of **heat** and **light**.



Beyond the **solar system**

- You can see **satellites**, the **international space station**, the **moon**, **comets**, **meteors**, **planets**, **stars** and **galaxies** in the night sky.
- A **galaxy** is a **large collection** of **stars**. The **universe** is made up of **billions** of galaxies.
- Most of the stars you see at night are in our own **galaxy**—the **milky way**. The other galaxies are all **so far away** they just look like **small fuzzy stars**.
- There are **billions** of stars in our galaxy, including the **sun**.
- Other stars in out galaxy include the **north star** or **pole star** and **proxima centauri** (our **nearest star** after the sun).