

AQA Combined Science: **Trilogy**

Year 11

Knowledge organiser booklet

Paper 2

BIOLOGY

B5 Homeostasis and response

B6 Inheritance, Variation and Evolution

B7 Ecology

Name:

B5 – Homeostasis and Response

The nervous system

Job is to **detect** stimuli (changes in environment) and **respond** if needed.
Consists of:

Receptors



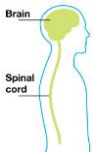
Specialised cells that detect stimuli, found in sense organs and internally

Neurones



3 types – sensory, relay and motor
Carry **impulses** joining all parts of the nervous system

Co-ordination Centres

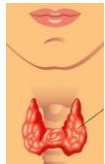


Brain, spinal cord, pancreas.
Coordinates the response

Effectors



muscle or gland



Organs that bring about a response

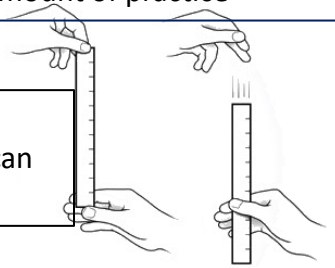
RP 6 - Investigation into the effect of a factor on human reaction time.

1. Person A holds out hand with a gap between thumb and finger.
2. Person B holds ruler with the zero at the top of person A's thumb.
3. Person B drops ruler without telling Person A and Person A must catch it.
4. The distance on the ruler level with the top of person A's thumb is recorded
5. Repeat this ten times.
6. Repeat steps 1-5 after a factor has been changed
7. Use conversion table to convert ruler measurements into reaction time.

The 'factor' could be...

- Caffeine consumption
- Hours of sleep
- Alcohol consumption
- Amount of practice

A computer reaction test can also be used.



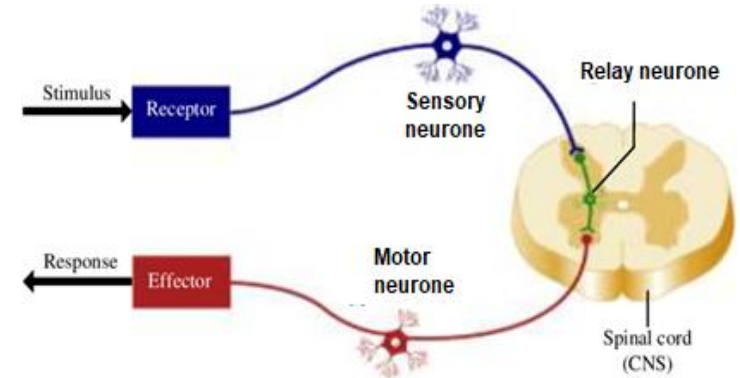
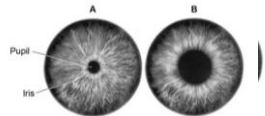
Control variables : distance above the hand, distance between finger and thumb, hand used (dominant or non-dominant, all other factors listed in the box above except the one being changed.

Reflexes

A reflex is an automatic, rapid response
Reflexes do not involve the conscious part of the brain, so cannot be overridden

The response might be brought about by:

- muscle - e.g. pupil being constricted with bright light or knee jerk response
- gland – e.g. mouth watering or tears being released when something gets in your eye



Reflex Arc

stimulus → receptor → **sensory neurone** → **relay neurone** → **motor neurone** → effector → response

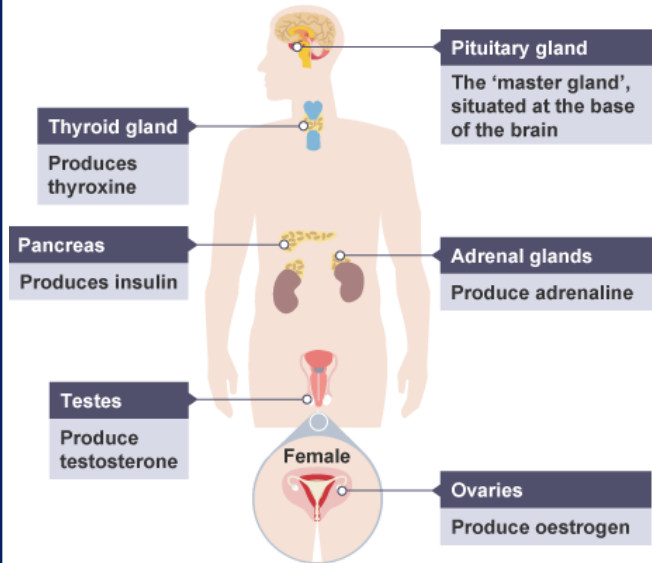
Example

Hot pan → pain receptors → **sensory neurone** → **relay neurone** → **motor neurone** → hand muscles → release pan

B5 – Homeostasis and Response

Hormonal responses

Hormones are chemicals released by glands
They are carried in the bloodstream.
Hormonal responses are slower than nervous responses but they last longer.



Homeostasis

This means keeping internal conditions (of the body or a cell) constant to ensure optimum functioning.
In humans, this includes regulating:

- temperature
- water levels
- blood glucose concentration

Homeostasis can involve nervous or hormonal responses.

Receptors detect changes in the body

Coordination centres (brain, pancreas, spinal cord etc) receive and process information

Effectors carry out responses to return to normal

Blood glucose concentration

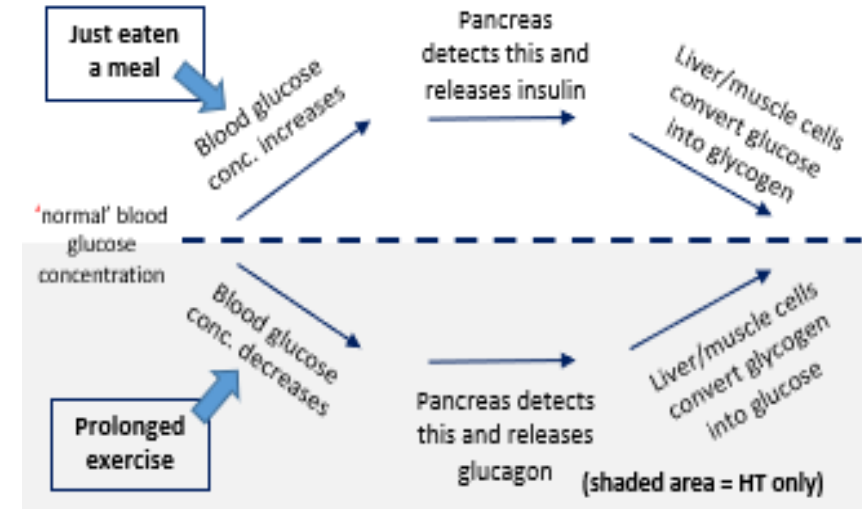
Blood glucose is monitored by the **pancreas**.

If glucose levels rise, the pancreas releases **insulin** into the blood.

This is a message to the liver to remove glucose and store it as **glycogen**.

If blood glucose is too low, **glucagon** is released.

The liver responds by breaking down glycogen into glucose and releasing it into the blood.



Diabetes

There are two types – Type 1 and Type 2

Both result in a lack of control over blood glucose levels

	Type 1	Type 2
Cause	No insulin is made by the pancreas	Insulin is made, but the liver and muscle cells do not respond
Treatment	Injectations of insulin Pancreatic transplant	Controlling carbohydrate intake Losing weight

HT only

Negative feedback is when the release of something brings the levels back towards acceptable levels, it maintains a steady state.

E.g. if blood glucose increases, insulin is released to bring blood glucose back towards the normal range.

B5 – Homeostasis and Response

Adrenaline and thyroxine (HT only)

Adrenaline is produced by the **adrenal glands**.

It is produced in times of fear or stress.

It **increases heart rate** to ensure **more oxygen and glucose** to the cells to prepare for the 'fight or flight' response.

Thyroxine is produced by the **thyroid gland**.

It is involved in regulating **metabolic rate** and growth and development.

Puberty

Females – **Oestrogen** is the main female reproductive hormone produced in the ovary. At puberty, eggs begin to mature, and one is released approximately every 28 days. This is called ovulation.

Males – **Testosterone** is the main male reproductive hormone produced by the testes and it stimulates sperm production.

Name of contraception

Description

+

–

Condoms/diaphragm

Barrier

Very effective, condom protects against STIs

Unreliable if not used properly

Oral Contraception (pill)

Hormonal (oestrogen or progesterone, stops FSH so no eggs mature)

Very effective

Must remember to take everyday, can have side effects

Injection/implant/skin patch

Slow-releasing hormone

Long lasting

Side effects such as heavy periods

Intrauterine Device (IUD or Coil)

Barrier method. Can also contain hormones

Long lasting (up to 5 years)

Side effects such as heavy periods

Surgical Sterilisation

Tying or cutting of sperm ducts/ oviducts.

Almost 100% effective

Difficult or impossible to reverse

Menstrual Cycle

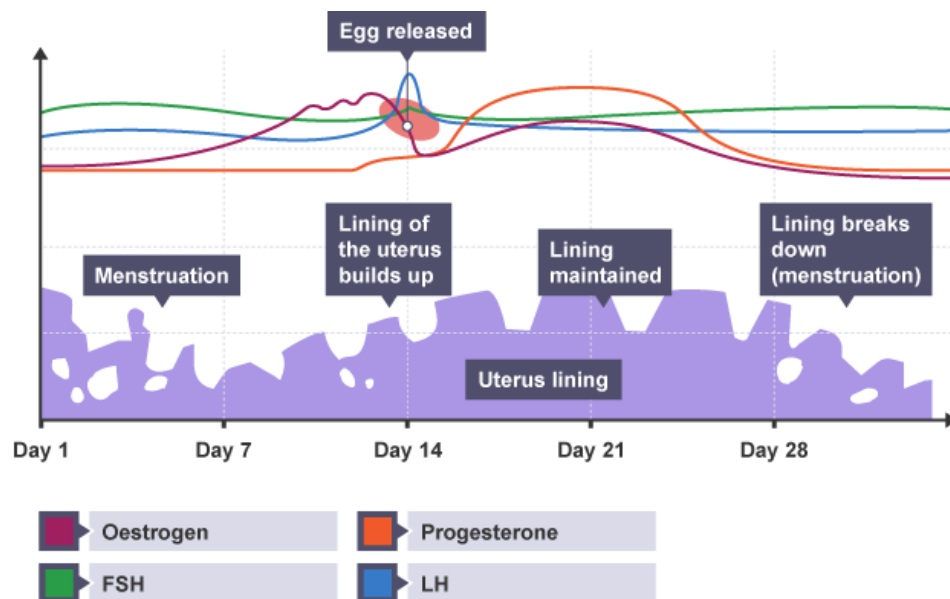
The menstrual cycle is controlled by several hormones:

FSH – from the pituitary. Causes an egg to mature in the ovary

LH – from the pituitary. Causes ovulation

Oestrogen and progesterone are involved in maintaining the lining of the womb.

HT – Oestrogen also feeds back to the pituitary to stop producing FSH.



Infertility (HT only)

Fertility drugs LH and FSH can be given to increase the number of eggs released and increase the chance of fertilisation.

IVF

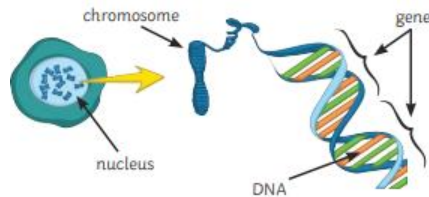
- Woman takes a dose of FSH and LH - stimulates the maturation of several eggs.
- Eggs are collected and fertilised by sperm from the male
- Fertilised eggs develop into embryos.
- One or two embryos inserted into the female's uterus.

Negatives;

- very emotionally/ physically stressful
- success rates are not high
- can lead to multiple births (twins, etc.)
- Many embryos are not used & destroyed

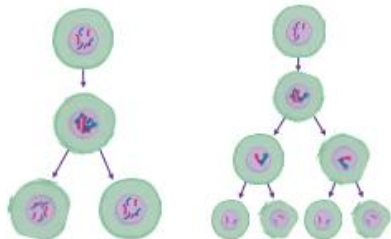
B6 – Inheritance, Variation and Evolution

Cells and cell division



The chromosomes are in the nucleus of cells
Humans have 46 chromosomes.
Chromosomes contain genes, which code for proteins.
In body cells, chromosomes are in pairs – one from each parent.
In sex cells (gametes) they are not in pairs and there is half the number of chromosomes (e.g. 23 in humans)

Cell division – two types:



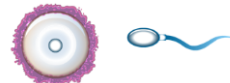
Mitosis (in all body cells)	Meiosis (in testes and ovaries)
2 daughter cells	4 daughter cells
Daughter cells = genetically identical	Daughter cells = not genetically identical
Cell divides once	Two divisions
Daughter cells have same number of chromosomes as original cell	Daughter cells have half the chromosomes as original cell
Used for growth and repair.	Produces gametes for sexual reproduction

Reproduction

Two types of reproduction – sexual and asexual.

	Sexual	Asexual
Number of parents	2	1
gametes used?	Yes	no
Variation in the offspring	lots	None (unless mutations occur) Offspring are clones

Sexual reproduction

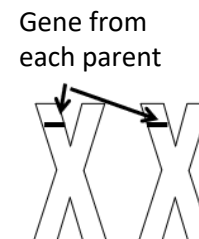


The sperm and egg have half of the genes for the offspring. (in humans 23 chromosomes)
At fertilisation, the sperm and egg nuclei join. (23 + 23 = 46 chromosomes)

There are two genes for any one characteristic – one on the chromosome from mum and one from Dad
Different forms of the same gene are called **alleles**
If the alleles are the same, the person is **homozygous**
If the alleles are different the person is **heterozygous**

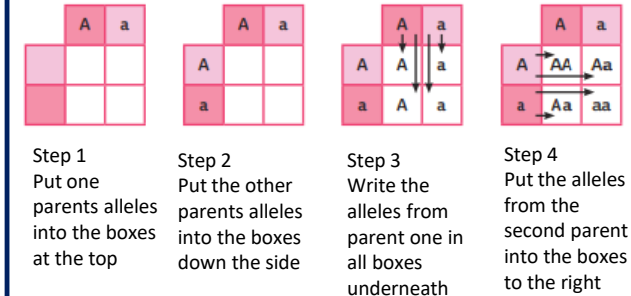
E.g.:
B = brown hair (dominant)
b = red hair

BB = homozygous, brown hair
Bb = heterozygous, brown hair
bb = homozygous, red hair



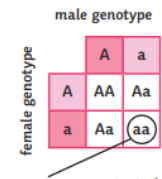
How to complete a punnet square

If A = blue eyes, a = green eyes
Calculate the probability of two heterozygous people having a green eyed child



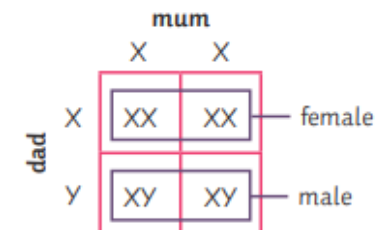
Probability

A green eyed child would have aa genotype.



One of these four has the type aa – that's ¼, 25% or 0.25.

Sex Determination



Females carry two X chromosomes (XX)
Males carry one X and one Y chromosome (XY)
50% chance of male and female.

B6 – Inheritance, Variation and Evolution

Inherited disorders

Cystic fibrosis

Disorder of cell membranes

Caused by a recessive allele

Causes thick mucus to form in membranes

Main organs affected are lungs, digestive & reproductive organs – pancreas and intestines.

Alveoli get blocked with mucus
Increases diffusion path so less
O₂ gets into the blood



		♂ Father	
♀ Mother			
	C	c	
	c	Cc	cc

Polydactyly

Disorder of the hands and feet

Caused by a dominant allele

Causes extra digits, fingers and toes.



Embryo screening

Parents that have inherited disorders may opt for embryo screening

1. Multiple embryos are made in IVF
2. One cell is removed from each embryo
3. The cells are screened for faulty genes
4. Only embryos without the genes for disorders are transferred to the womb of the mother.

- + Babies born free of that inherited disorder
- no guarantee child will be free of other health issues
- Many embryos are destroyed, which are potential human lives

Variation

May be due to differences in:

- Genes that have been inherited (genetic causes)
- Conditions which they have lived in (environmental causes)
- Combination of genes and the environment.

Mutation = a change in the DNA during copying (randomly). Often has no effect on the gene, but sometimes leads to new proteins being made and a new characteristic being seen

Evolution

Evolution = a change in inherited characteristics of a population over time through natural selection – could lead to a new species.

A **species** is a group of organisms that can successfully breed.

Theory of evolution states that all species have evolved from a simple life forms more than 3 billion years ago.



Natural Selection

Described by Darwin

1. **Variation** within a species – different genes. (due to **mutation**)
2. One gene may give characteristics that are better **adapted** for survival in the environment.
3. Those with **advantageous genes** will survive and reproduce – passing genes to **offspring**.
4. Over long periods of time, all members of that species have the characteristic, may even lead to a new **species**.

Extinction

Extinction = no remaining individuals of a species still alive on Earth.

Factors which could cause extinction:

- New disease
- Rapid change in environment (e.g. meteor/volcano eruption)
- New predators
- New competitors (often man)



Evidence for evolution

Fossils

Fossils are the **remains of plants or animals** from **millions of years ago**:

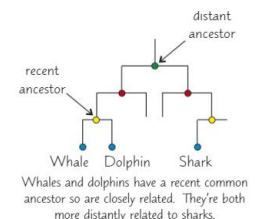
They are formed in different ways:

- Remains of an organism that has not fully decayed as one of the decay conditions was absent (e.g. too cold, not enough O₂)
- Mineralised forms of the harder parts of an organisms (such as bones)
- Traces of organisms such as footprints or burrows.

Many early life forms were **soft bodied** so have left few traces behind, as they decayed so we cannot be sure how life started on Earth. Many have been destroyed by Earth's rock cycle. Fossils help us understand how much or little organisms have changed as life developed on Earth.

Evolutionary trees

Show how species have evolved from and are related to others



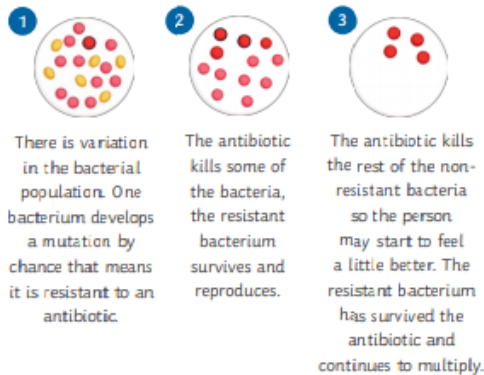
B6 – Inheritance, Variation and Evolution

Resistant Bacteria

- Bacteria **evolve** rapidly as they reproduce at a fast rate. (reproduce approx. every 20 mins)
- Mutations of bacteria can produce new strains.

- Some strains are **resistant** to antibiotics (so are not killed).
- They **survive** and **reproduce** – population of resistant strain rises.
- Resistant strain will spread because people are not **immune** and there is no effective treatment.

- **MRSA** is **resistant** to antibiotics.



How to reduce antibiotic resistant strains:

- Doctors should not prescribe antibiotics for viral infections
- Patients must complete courses of antibiotics
- Agricultural use of antibiotics should be restricted.

Genetic Engineering

- Process which involves modifying the **genome** of an organism by introduction a gene from another organism to give a **desired characteristic**.

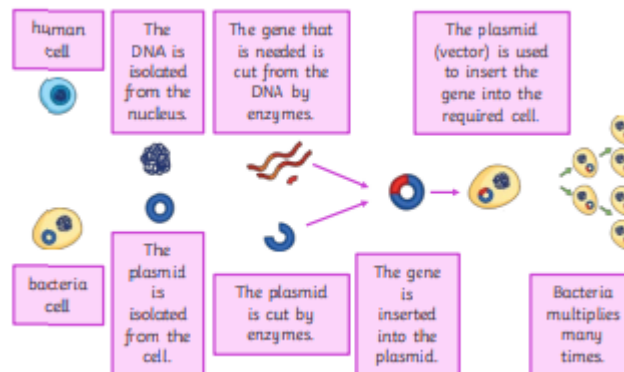
Uses of genetic engineering:

- Plant crops to be **resistant** to diseases or produce bigger, better fruits.
- Bacteria cells to produce useful substances, such as human insulin to treat diabetes.

Genetically modified (GM) crops

Advantages	Disadvantages
Resistant to insect attack	Not sure on long term effects when eating GM crops
Produce increased yields	Could affect populations of wild flowers and insects

Process of Genetic Engineering (HT only)



Selective Breeding

- Process which humans breed plants and animals for particular **genetic characteristics**.

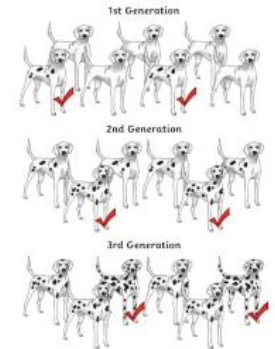
Steps of selective breeding:

1. Choose a male and female with **desired characteristics**.

2. Breed together

3. Pick the offspring which have the desired characteristic and breed together.

4. Continue over many generations, selecting the best offspring each time, until all offspring show desired characteristics.



Classification

Linnaeus classified things into: Kingdom, phylum, class, order, family genus and species.

Organisms are named by the **binomial system** of genus and species. (2 names)

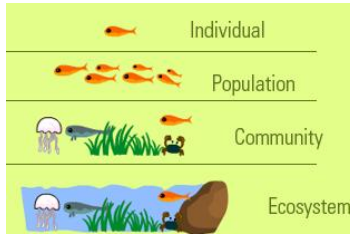
Due to evidence from chemical analysis, there is now a 'three-domain system' by Carl Woese:

Domain	bacteria	archaea	eukaryota			
Kingdom	eubacteria	archaebacteria	protista	fungi	plantae	animalia

B7 – Ecology

Ecosystems

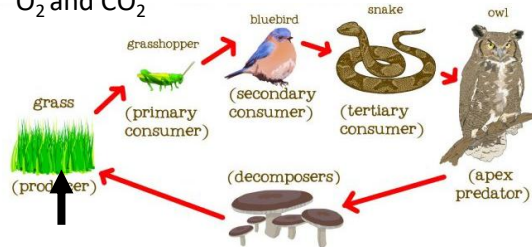
An ecosystem is all the living organisms within an area (community) plus the physical habitat



Interdependence

Organisms rely on each other for...

- Food
- Shelter / nesting sites
- Seed dispersal
- O₂ and CO₂



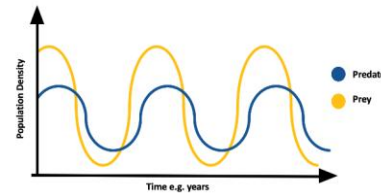
photosynthesises

Biotic and Abiotic Factors

Factors that affect the number of organisms

Biotic – living	Abiotic – non-living
• availability of food • new predators arriving • new pathogens • one species outcompeting another so the numbers are no longer sufficient to breed.	• light intensity • temperature • moisture levels • soil pH and mineral content • wind intensity and direction • carbon dioxide levels for plants • oxygen levels for aquatic animals.

Predator-Prey Relationships



Population increases and decreases follow similar pattern in a cycle because they affect each other – more prey = more food for predator.

However predator and prey not 'in phase', e.g. predator population changes are delayed as it takes time for the predator population to grow.

Competition

Plants	Animals
Light Space Minerals ions Water	Food Mates Territory

Plant adaptations



Plants in desert areas have :

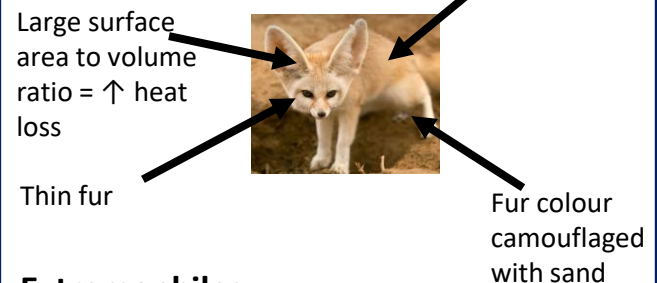
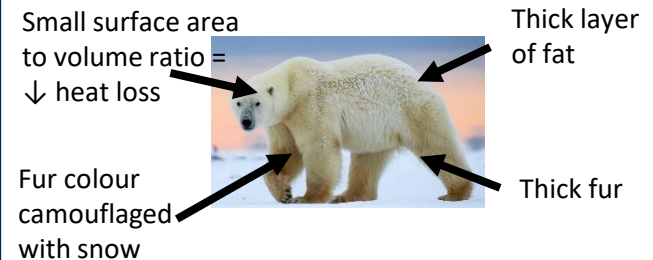
- deep roots to maximise water uptake
- thin/no leaves to minimise water loss
- Spines to stop them being eaten

Animal Adaptations



Can be:

- Structural – a feature of the organism's body (e.g. thick fur, bright colours, camouflage)
- Behavioural – responses from the organism (e.g. hibernation, migration, huddling together)
- Functional – a body process (e.g. camel breaking down hump of fat into water, producing little urine)



Extremophiles

Extremophiles are organisms that live in extreme environments.

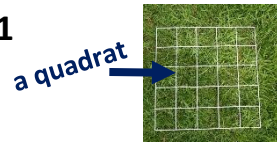
Extreme environments = high temperatures, high pressure or high salt concentration.

E.g. bacteria living in deep sea vents = extremophiles.

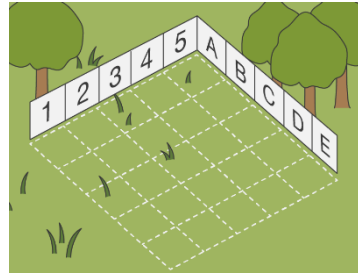
B7 – Ecology

RP7 – Estimating Populations Part 1

1. Calculate area of site.
2. Divide site up into a numbered grid
3. Use a random number generator to pick coordinates.
4. Randomly throw the 0.25m² quadrat at those coordinates.
5. Count the number of particular organism in the quadrat.
6. Repeat steps 3-5 **ten times (minimum)**.
7. Calculate mean number of organism.
8. Calculate estimated number organism in site using the following equation

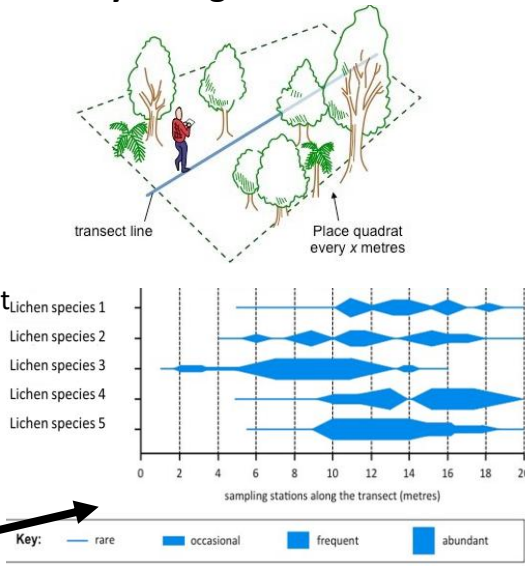


$$\frac{\text{area of site}}{\text{area of quadrat}} \times \text{mean}$$

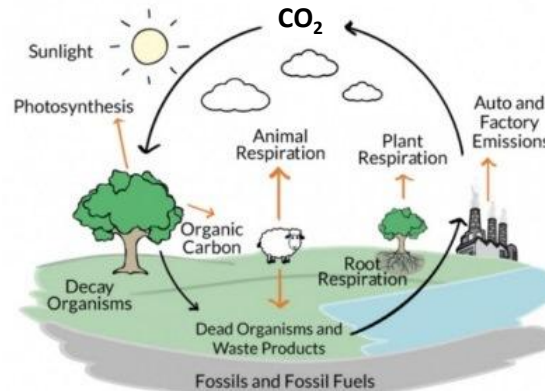


RP7 – how populations may change over a distance

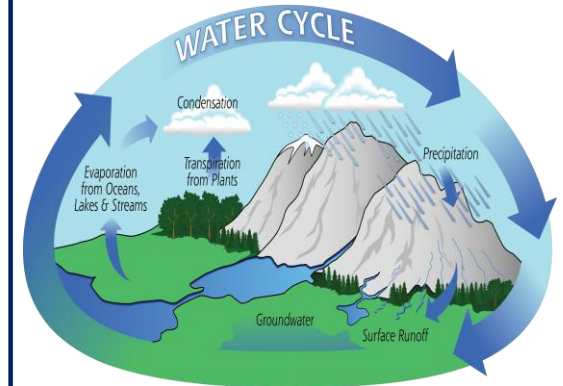
1. Place tape measure (a transect line) through ecosystem being investigated.
2. Place quadrat at regular, random intervals along the transect line and count the number of particular organisms.
3. Draw a distribution graph of your results. (They might look like this.)



The Carbon Cycle



The Water Cycle



Human Impact on Biodiversity

Waste management	Rapid growth in the human population = more resources are used and more waste is produced – this contributes to pollution. Can occur in water, in air and on land.
Land Use	Humans reduce the amount of land available for other animals and plants by building, quarrying, farming, dumping waste and the destruction of peat bogs.
Deforestation	In tropical areas it has occurred to provide land for cattle and rice fields or grow crops for biofuels.
Global Warming	Levels of carbon dioxide, methane and water vapour in the atmosphere are increasing, and contribute to 'global warming'.

Decay

Microbes such as fungi and bacteria break down dead or dying material. This returns carbon to the atmosphere as carbon dioxide and mineral ions to the soil.



Maintaining Biodiversity

- breeding programmes for endangered species
- protection of rare habitats
- reintroduction of hedgerows
- reduction of deforestation and CO₂ emissions
- increased recycling to avoid landfill