Revision Booklet 2022-2023
Edexcel IGCSE(9-1) in Biology

Part 2: Sections 3, 4 & 5 of the specification

3. Reproduction and inheritance
4. Ecology and the environment
5. Use of Biological resources

This revision booklet has been made to follow the specification point by point and it has questions based on each point.

Section 3: Reproduction and Inheritance

3.1 – 3.2 Reproduction in organisms

Compare the differences between sexual and asexual reproduction

	Sexual	Asexual
Number of parents	2	1
Gametes involved	Yes	No
Genetically identical to parents	No	Yes
Genetic variation in the offspring	Yes	No
Anything else?	Is slower than asexual reproduction	Is faster than sexual reproduction
Anything else?	Uses more resources/energy to produce offspring	Uses fewer resources / less energy to produce offspring

What are gametes?

- Gametes are the sex cells of an organism.
- They contain half the number of chromosomes of body cells and so are **haploid**

What does fertilisation mean? Use the words **gamete, zygote, fuse, nucleus** in your answer

- Fertilisation is when the nucleus of a male gamete fuses with the nucleus of a female gamete. This creates a diploid cell (a cell with both set of chromosomes) called a zygote

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What must happen for the zygote to develop into an embryo made of many cells?

- The zygote must undergo cell division to create two cells. Those two cells divide into two, which creates a total of four cells.

3.3 – 3.7 Reproduction in flowering plants

Complete the following table on parts of the flower

Part	Function	Adaptation for pollination (fill in if necessary)
Petal	Is brightly coloured to attract pollinating animals i.e. insects	Attracts pollinating insects
Anther	Produces pollen	The anther is in a position to rub pollen onto the pollinating insect
Filament	Holds the anther up	Controls the height of the anther
Stigma	This receives the pollen	Can be sticky so pollen can stick to it from the pollinating insect
Ovary	This contains the ovules and ova (egg cells). The ovary turns into the fruit after fertilisation occurs	-
Ovule	These contain the egg cells and turn into the seeds after fertilisation occurs	-
Pollen	Is the male sex cell	Can be sticky to attach onto the pollinating insects

Nectary	Contains sugary liquid to attract pollinating animals i.e. insects	Provides an incentive for pollinating insects to visit the flower
Sepal	Tougher outer leaves that protect the flower bud before it opens	-

What is pollination?

- The transfer of pollen from the anther to a stigma by various means (either insect or wind)

What is cross pollination?

- The transfer of pollen from a flower on one plant to a flower on another plant

In the boxes describe, and explain how each type of plant is pollinated (insect or wind pollinated) (*hint – think about the positions of the stamen and carpel and each part is adapted for its function)*

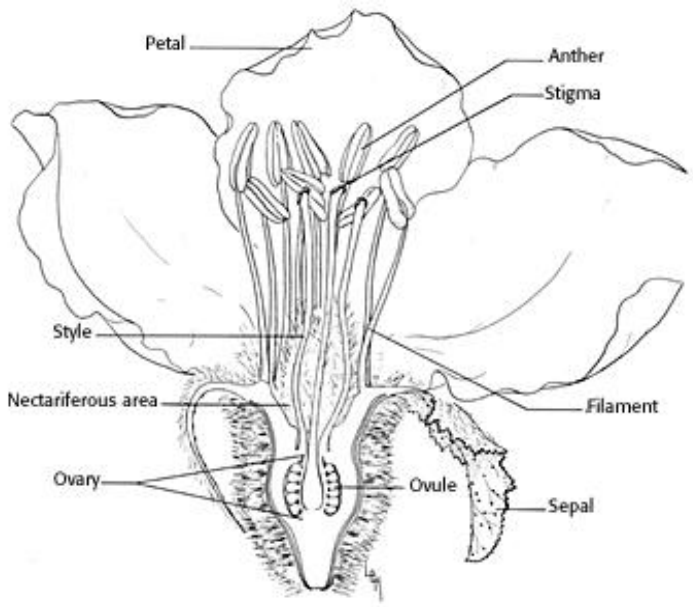
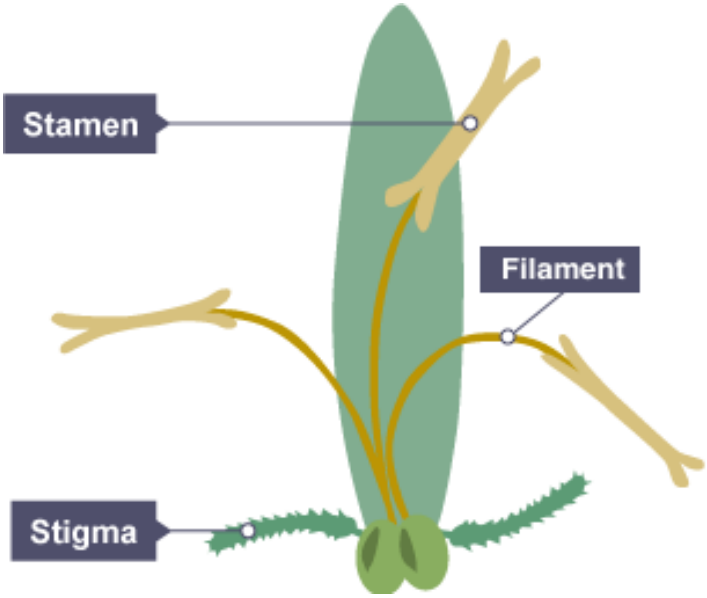


Figure 165. - Longitudinal section of 'Smyrna' quince flower, x4.

- This flower is pollinated by insects as it has:
  - Large, brightly coloured petals
  - Its anthers inside the flower so insects must make contact
  - Its stigma inside the flower so insects must make contact
  - A sticky stigma to attach pollen from insects
  - Pollen grains that are larger, which also are either sticky or have hooks so that they can attach to insects
  - A nectary to attract insects to the flower

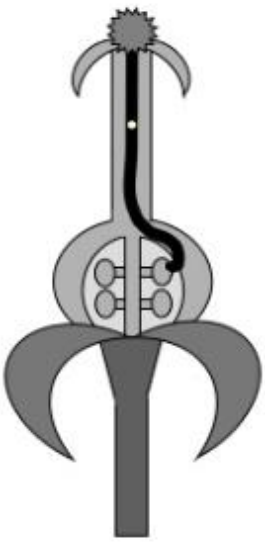


- This flower is pollinated by the wind as it has:
  - Small, dull petals
  - Anthers outside of the flower so they are exposed to the wind so it can easily blow pollen away
  - Stigmas are outside the flower so that they can catch pollen blowing in the wind
  - A feather stigma to increase the surface area to catch pollen grains blowing in the wind
  - Smaller, smooth inflated grains to carry in the wind
  - No nectaries

What are the main differences between insect pollinated and wind pollinated flowers?

- Petal size and colour
- Position of the anthers and stigmas
- Presence of a nectary or not
- Shape of the stigma
- Shape and size of the pollen grains

What is happening in this picture? Use the words **pollen tube, style, ovule, fertilisation, nucleus, fuse**



- When a pollen grain lands onto a stigma a pollen tube starts to grow
- The male nucleus moves down the pollen tube as it grows
- The pollen tube grows down the style until it reaches an ovule
- The male nucleus will fuse with the female nucleus so that fertilisation occurs.

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Describe what happens to the flower after fertilisation occurs:

- Petals: ……

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  - The petals die and fall off

- Fertilised ovule: ..

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  - The ovule wall becomes the seed coat (**testa**)

- Ovary: ……

  ……

  - The ovary wall becomes the fruit coat (which can take on many form depending on the type of fruit)

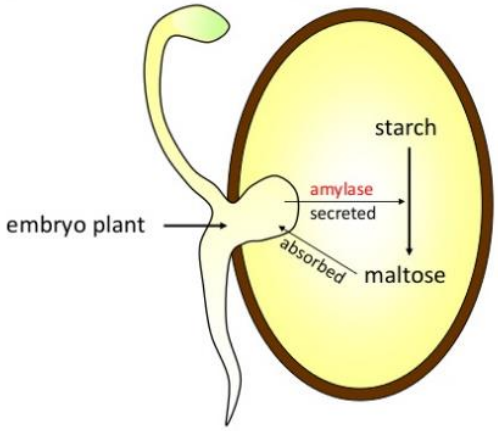
What is Germination?

- Germination is when a seed starts to develop into a new plant

What are the conditions needed for a seed to germinate?

- Warm temperatures, so that enzymes can act efficiently
- Water to help swell up the seed and provide an environment where chemical reactions can take place in solution
- Oxygen is needed for respiration

Enzymes are used in seed germination



In the diagram label the **radicle, plumule, cotyledon**

What is the food store in the cotyledon mainly comprised of?

- Starch and proteins

Why do the radicle and plumule need a food source? (*hint: can photosynthesis happen yet?*)

- They need a source of food so that they can release enough energy during respiration to grow so that the plumule can develop leaves so that the new plant can start to photosynthesise and produce its own food

When is germination considered to be over?

- As soon as the plant is able to photosynthesise and make its own food.

What life process do the cells in the seed undergo as it is germinating?

- Respiration, growth, movement

Why doesn't the seed photosynthesis straight away?

- Because the leaves have not formed yet and the seed may be in the dark – either covered by leaves or soil

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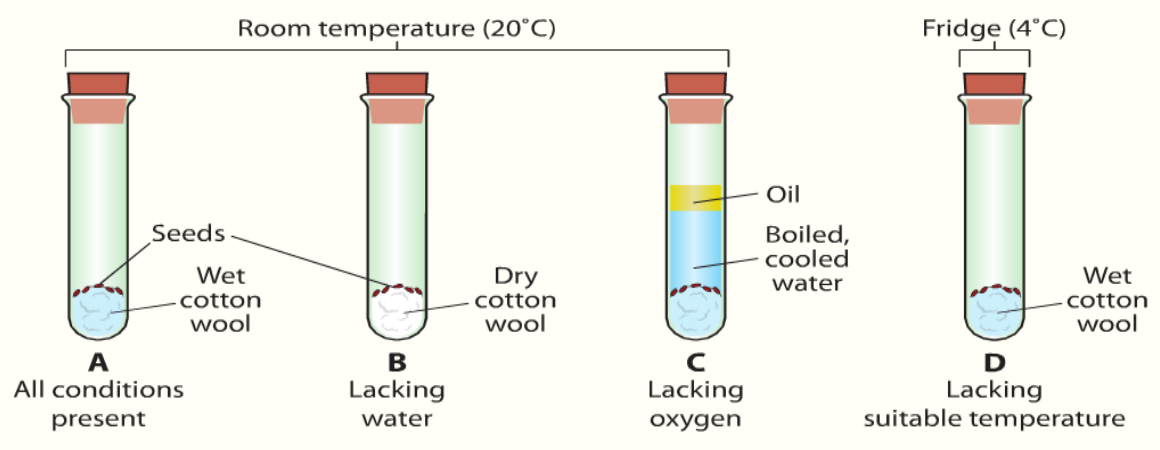
What would happen if the seed was buried too deep?

- The plant would use up the food stores in the cotyledon before photosynthesis can produce food, therefore the new plant would die

3.5 Practical: This diagram shows an experiment to investigate the conditions needed for seeds to germinate.



Describe what would happen to the seeds in test tube A

- The seeds will germinate as the temperature is warm, there is water present and oxygen is present

Describe what would happen to the seeds in test tube B

- The seeds will not germinate as there is no water present

Describe what would happen to the seeds in test tube C

- The seeds will not germinate as there is no oxygen

Describe what would happen to the seeds in test tube D

- The seeds will not germinate or will germinate very slowly as the temperature is low.

Explain why you would expect the results you described for the seeds in the different test tubes

- The conditions for germination in tubes B, C, and D are not all there so the seeds will not germinate (or will germinate slowly in the case of the lower temperature experiment)

Some plants can reproduce asexually via natural methods or artificial methods. Describe these two methods of asexual reproduction in plants:

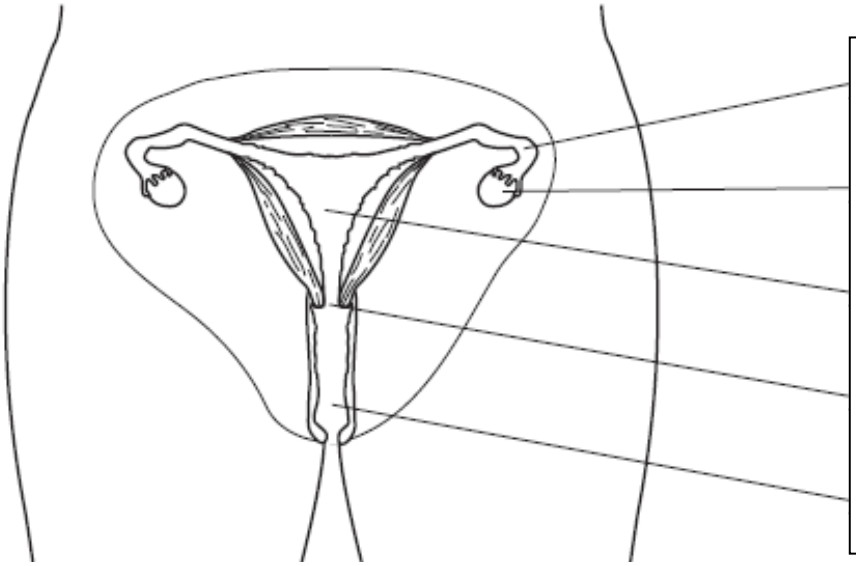
Natural methods	**Artificial** methods
Runners – • Runners in plants like strawberry plants grow from the stem. • From the runners, new plants can grow • The new plants are genetically identical to the parent plant	Cuttings – • A piece of a plant's stem with a few leaves attached is cut off • The cut piece is placed into damp soil or compost • The cutting should develop into a new plant

What are two other ways that some plants can reproduce asexually?

- Potatoes can produce tubers underground. New plants can grow from the ‘eyes’ on the potato
- Some plants form bulbs. These bulbs can develop into new plants

3.8 – 3.13 Reproduction in Humans

Label these parts of the female reproductive system.



- Fallopian tube / oviduct
- Ovary
- Uterus
- Cervix
- Vagina

How is each part of the female reproductive system adapted for its function?

Ovary: ……

- Matures and releases egg cells once a month

Oviduct (*include the ciliated cells in your description*): ……..

- Connects the ovary to the uterus. This is where fertilisation occurs. Sperm wait here until the egg cell is released
- The lining of the fallopian walls has ciliated cells to move / waft the egg cell along from the ovary to the uterus

Uterus:

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- This is where the embryo implants itself
- The lining has many blood vessels so that it can supply lots of oxygen and nutrients to a developing embryo / foetus
- The uterus wall is made of smooth muscle to help push the baby out of the womb
- The placenta form in the wall of the uterus and then produces progesterone

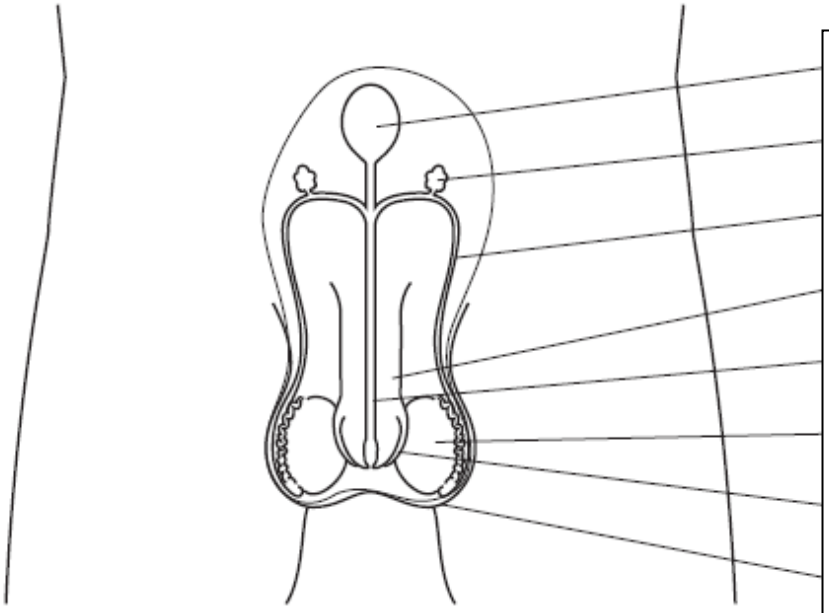
Cervix: ……

- Thick muscular ring that helps keep the baby in the womb

Vagina: ……

- Becomes lubricated to aid sexual intercourse
- This is where semen / sperm is deposited

Label the male reproductive system.



- Bladder
- Seminal vessel
- Sperm duct
- Penis
- Urethra
- Testis
- Foreskin
- Scrotum

What does each part of the male reproductive system do?

Testes: ……

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- Makes sperm
- Makes testosterone
- Needs to be at lower than body temperature to produce healthy sperm

Sperm duct: ……

- This links the testis with the urethra

Seminal glands: .....

- Fluid from these glands is mixed with sperm to make **semen** which is released during sexual intercourse

Scrotum: .....

- Holds the testis. This will let the testis hang from the body if it is too warm or retract the testis into the body if it is too cold

Erectile tissue: .....

- This fills with blood when the male is aroused causing the penis to become erect

Urethra: .....

- This is the tube that semen is ejaculated out of from the end of the penis and into the vagina

Penis: .....

- This becomes erect during male arousal and fits into the vagina during sexual intercourse

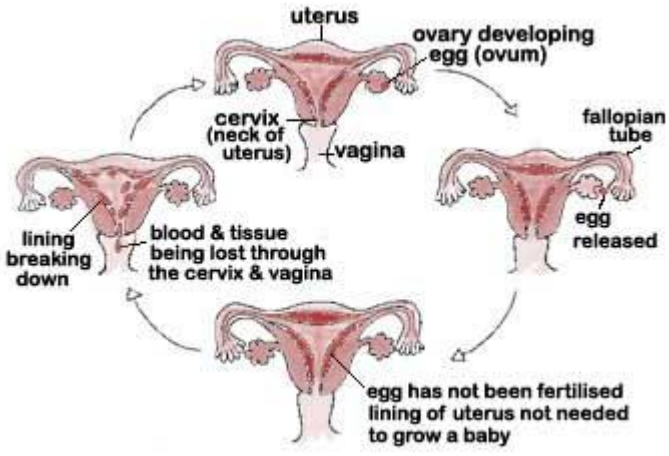
Where is oestrogen produced?

- Ovaries

Where is progesterone produced?

- Corpus luteum (ovaries) and the placenta

Describe what happens to the lining of the uterus during the menstrual cycle



- Days 1-5: menstruation occurs – the lining of the uterus comes out through the vagina. This is called a period.
- Days 6-14: the uterus lining starts to build in preparation for an embryo to implant into
- 15 – 28; the uterus lining continues to develop but if no embryo implants itself into the uterus lining then it starts to breakdown

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What role does oestrogen have in the menstrual cycle?

- Oestrogen helps the body repair the lining of the uterus
- FSH released from the pituitary gland stimulates the ovaries to produce more oestrogen
- As the level of oestrogen increases it inhibits the production of FSH
- High levels of oestrogen also promotes the secretion of LH

What role does progesterone have in the menstrual cycle?

- Progesterone completes the development of the lining of the uterus by thickening and maintaining it.
- Progesterone also inhibits the secretion of FSH and LH so that no eggs mature and ovulation is prevented from occurring again during the menstrual cycle

What does FSH stand for? ……

- Follicle Stimulating Hormone

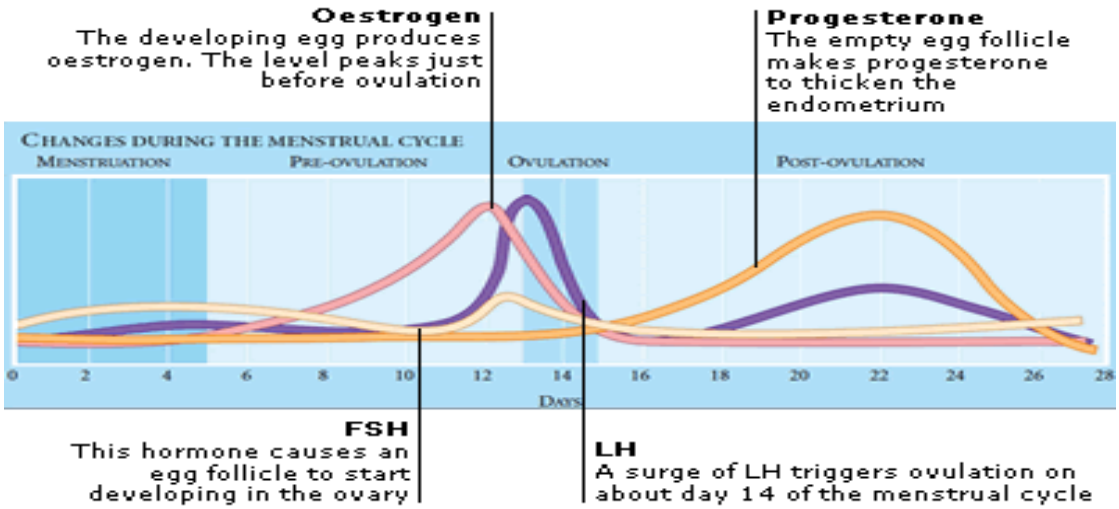
What does LH stand for? ……

- Luteinising Hormones

Where are FSH and LH produced? .

- Pituitary gland

Look at this graph



What is the role of FSH in the menstrual cycle?

- FSH stimulates the maturation of a follicle containing a mature egg cell

What is the role of LH in the menstrual cycle?

- LH causes ovulation to occur

What day in the menstrual cycle does ovulation occur on? .

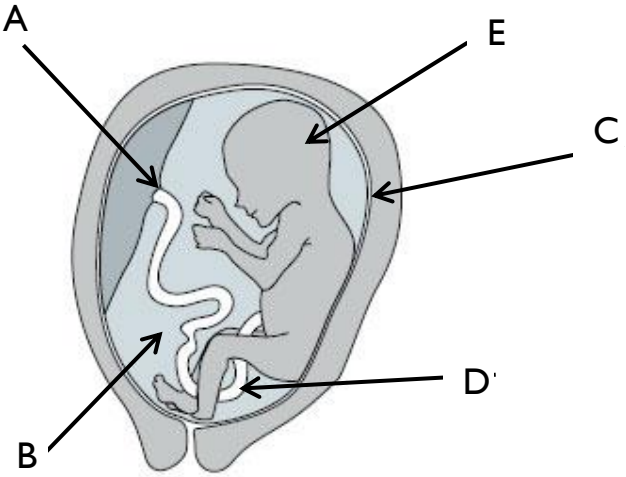
- 14

Which days does menstruation occur on? .

- 1-5

The next few questions will be about the placenta and the role of the amniotic fluid in embryonic development

Label the diagram



A
- Placenta

B
- Amniotic fluid

C
- Amnion

D
- Umbilical cord

E
- Foetus

The placenta develops from foetal tissues and allows the [exchange] of materials between mother and foetus. It has a large number of blood vessels that do not touch. This ensures there is no [mixing] of the maternal and foetal blood.

Give three reasons why it is important that the maternal and foetal blood do not mix.

1. Mother's blood pressure is too high for the foetus
2. So that few/no pathogens are transferred from the mother to the foetus
3. The foetus might have a different blood type to the mother and so could die if they mix

Which substances diffuse from the mother's blood into the foetus? (nutrients as well as 'protective proteins')
Explain why the embryo needs each of the above.

- Oxygen – to allow respiration to occur in the embryo
- Glucose for respiration
- Amino acids – so the foetus can make proteins
- Antibodies – to provide passive immunity to certain diseases so that it can develop those diseases

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Which substances diffuse from the foetus' blood into the mother's blood and why is it important that they are removed?

- Carbon dioxide – high concentrations of this makes the blood acidic which can start to denature proteins
- Urea – this is a toxic substance in high concentrations

What is the role of the amniotic fluid?

- To protect the baby from bumps by providing a 'cushion' softening the baby's movements

What would happen to the baby if there was no amniotic fluid around it?

- The baby would move around the womb too much causing damage to it and the womb.

Complete the table on how the amniotic fluid protects the developing embryo

Protects embryo against:	How it does this:
Damage	Cushions the baby from sudden movements or unexpected bumps

Variable temperatures	Because the amniotic fluid is mainly water it takes a long time to heat it up or cool it down so it doesn't expose the baby to any extremes of heat

Where is testosterone made in males?

- The testis

Where is oestrogen made in females?

- The ovaries

What changes in the human body do these hormones cause during puberty?

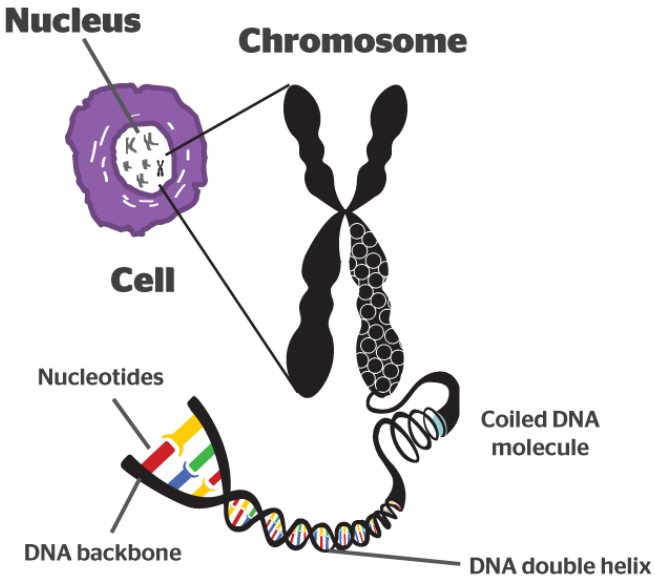
Oestrogen	Testosterone
• The menstrual cycle begins and eggs are released every month • Growth and development of female sexual organs • Growth of armpit and pubic hair • Increase in body mass; development of wider hips • Breasts develop	• Sperm production starts • Growth and development of male sexual organs • Growth of armpit and pubic hair, and chest and facial hair (beard) • Increase of body mass; shoulders widen, growth of muscles • Voice deepens and 'breaks'

• Sexual ‘drive’ increases	• Sexual ‘drive’ develops

What are secondary sexual characteristics?

• Secondary sexual characteristics develop to prepare the body for reproduction. These characteristics allow the person to become sexually mature so that they can make offspring.

3.14 – 3.34 Inheritance



What is the genome of an organism?

- The entire DNA of an organism – the amount of DNA present in a diploid cell

What is a chromosome?

- A thread-like structure found in the nucleus of a eukaryotic cell – it is made of DNA and protein and contains the genetic information or **genes** of an organism

Where are chromosomes found inside the cell?

- Eukaryotic cells – chromosomes are found in the nucleus
- Prokaryotic cells – their 'chromosome' is in the cytoplasm

What is a gene?

- A length of DNA which is part of a chromosome, the basic unit of inheritance. It is a length of DNA that controls a characteristic of an organism.

What do genes do?

- Genes code for the production of a specific protein.

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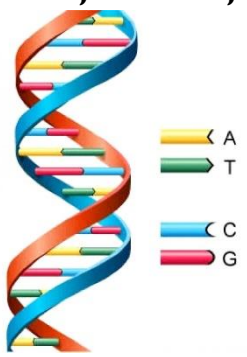
Describe the structure of DNA – use the words: **Bases, double-stranded, double helix, strands, paired bases**



- DNA – deoxyribose nucleic acid
- DNA is a double stranded molecule that is coiled to form a double helix
- The two strands that form the double helix are linked by a sequence of paired bases.
- The base pairs are:
  - Adenine (A) with Thymine (T)
  - Guanine (G) with Cytosine (C)
- Adenine can only pair up with Thymine
- Guanine can only pair up with Cytosine

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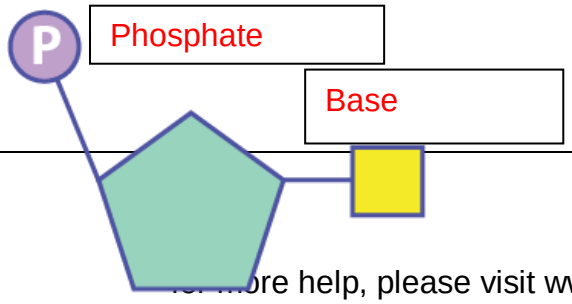
What are the names of the bases?

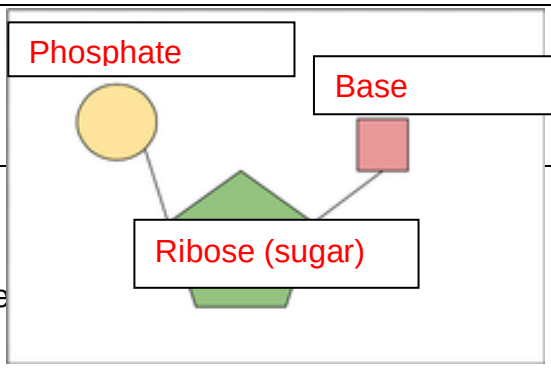
A: Adenine T: Thymine C: Cytosine G: Guanine

How do these bases pair up?

- Adenine can only pair up with Thymine
- Guanine can only pair up with Cytosine

Label the parts of the DNA and RNA nucleotides	
DNA	RNA





Deoxyribose (sugar)	

What are the differences between DNA and RNA?		
Type of sugar	Deoxyribose	Ribose
Bases present	A, T, C, G	A, G, C, and U (**Uracil** instead of thymine)
Double or single stranded?	Double stranded	Single stranded

Reminder: what is the definition of a gene?

- A length of DNA which is part of a chromosome, the basic unit of inheritance. It is a length of DNA that controls a characteristic of an organism.

What is mRNA?

- Messenger RNA – this is created when a gene is transcribed

What are ribosomes?

- Ribosomes are organelles that are the site of protein production

What is tRNA?

- Transfer RNA – these are the molecules that carry amino acids to the ribosome so that the mRNA can be read and the corresponding amino acids can be joined together to make a protein

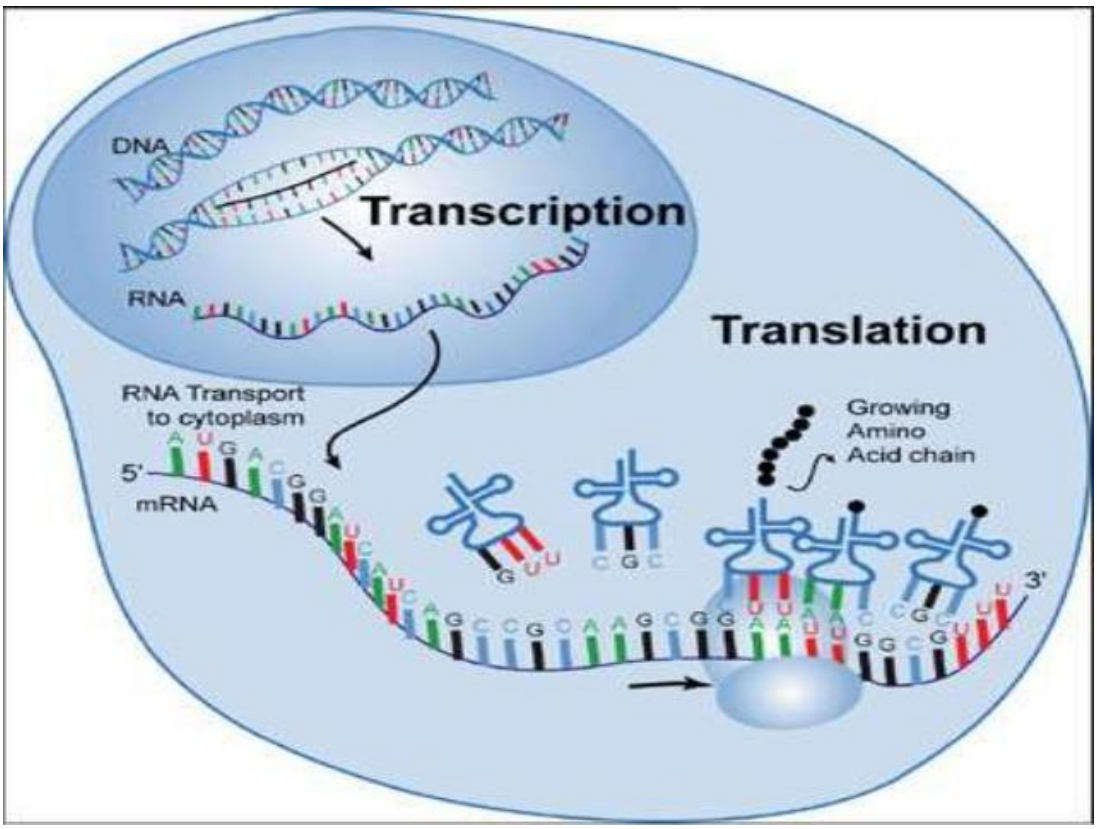
What is a codon and where are they found?

- I codon is a sequence of three bases on a messenger RNA molecule that codes for a specific amino acid

What is an anticodon and where are they found?

- An anticodon is a sequence of three bases found on a transfer RNA molecule which are **complimentary** to the bases on the codon found on the messenger RNA

This is a diagram of transcription and translation. It shows how proteins are synthesised.



Describe the process of transcription and translation: Use the terms mRNA, ribosomes, tRNA, codons, anticodons and complimentary base pairing.

Transcription:

- A gene / length of DNA is 'read' and a mRNA molecule is created. The mRNA molecule is a copy of the sequence of bases found on gene / length of DNA.
- mRNA then moves out of the nucleus into the cytoplasm

Translation:

- A ribosome attaches to the mRNA molecule
- As the ribosome moves along the mRNA molecule tRNA molecules carrying amino acids enter the ribosome.
- The tRNA molecules that have a complementary anticodon to the codon on the mRNA will have a specific amino acid attached
- The amino acids from the tRNA molecules will join together to form a sequence that will be a protein

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What is an allele?

- Alleles are different forms of a gene i.e. eye colour is caused by the differences in the genes that codes for eye colour. These differences between the genes are called alleles.

Why do alleles give rise to differences in inherited characteristics?

- **Alleles are different forms of a gene** i.e. eye colour is caused by the differences in the genes that codes for eye colour. These different forms of genes are called alleles

Define these terms and give examples of them:

Dominant: ……

- This is an allele that will be expressed in the phenotype.
- It is dominant to the recessive allele meaning that if the organism is heterozygous then the dominant allele will be expressed regardless of the recessive allele present
- An example is brown eyed alleles being dominant over blue eyed alleles

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Recessive: ……

- This allele will not be expressed in the phenotype if there is a dominant allele of that gene present i.e. if the organism is heterozygous the dominant allele will be expressed
- An example of this is blond hair alleles will only be expressed if there are no brown haired alleles present.

Homozygous: ……

- This is a genotype with both alleles being the same
  - Homozygous dominant means that both alleles are dominant
  - Homozygous recessive means that both alleles are recessive

Heterozygous: ……

- This is a genotype where each of the two alleles are different; usually a dominant and recessive allele together

Phenotype: ……

- This is how the gene is expressed in the organism.
- The 'appearance' of an organism according to its genotype i.e. eye colour, hair colour

Genotype: ……

- This is the alleles that an organism has for a certain characteristic

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What is meant by codominance?

- This is a pattern of inheritance where neither allele is dominant over the other so both alleles are expressed in the phenotype of the organism

How are blood groups an example of codominance?

- The blood group A and the blood group B are codominant so if they are both in the genotype then the person will have both A and B type blood – AB blood group

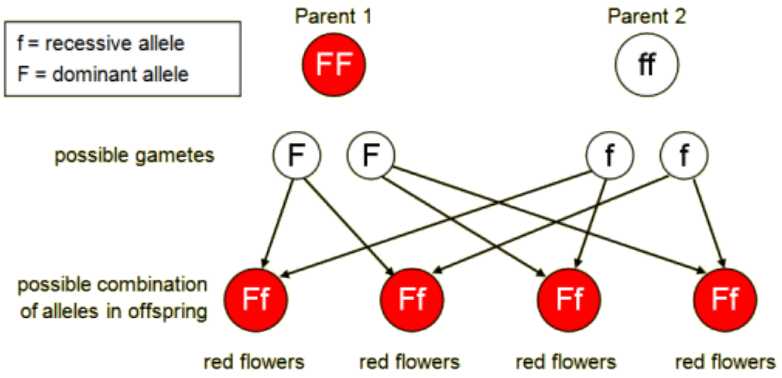
What does **polygenic** mean?

- This is a term that means a characteristic that is caused by more than one gene

Give an example of a polygenic inherited characteristic.

- Height
- Intelligence
- Length of fingers

Look at this genetic diagram and answer the following questions on it:



i. Why do the parents have a double letter to show their genotype?

- They have a pair of alleles – one allele came from the father of the individual, and the other allele came from the mother of the individual

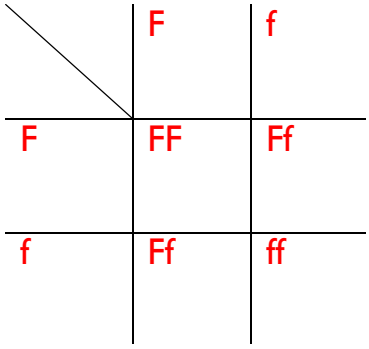
ii. Why do the gametes only have one letter to show their genotype?

- The genetic material has to divide into two so that there is half the number of chromosomes in the gamete

iii. How else can you represent this genetic cross? (please draw a punnett square)

	F	F
f	Ff	Ff
f	Ff	Ff

iv. What would the genetic cross/punnet square look like if the offspring are allowed to self-fertilise



v. What would the ratio of red flowers to non-red flowers (the phenotype) be in the offspring?

- 3:1 – three red flowering plants to 1 white flowering plant

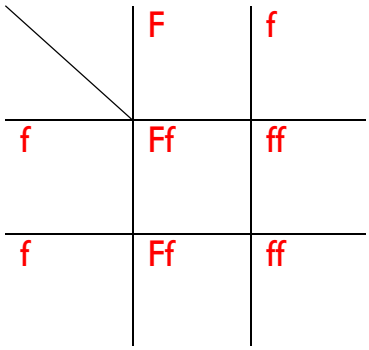
vi. What would the ratio of genotypes of the offspring be?

1:2:1

- One homozygous dominant : two heterozygous : one homozygous recessive

vii. What would the probability of the offsprings' phenotype (red/non-red) if you crossed:

Ff x ff:



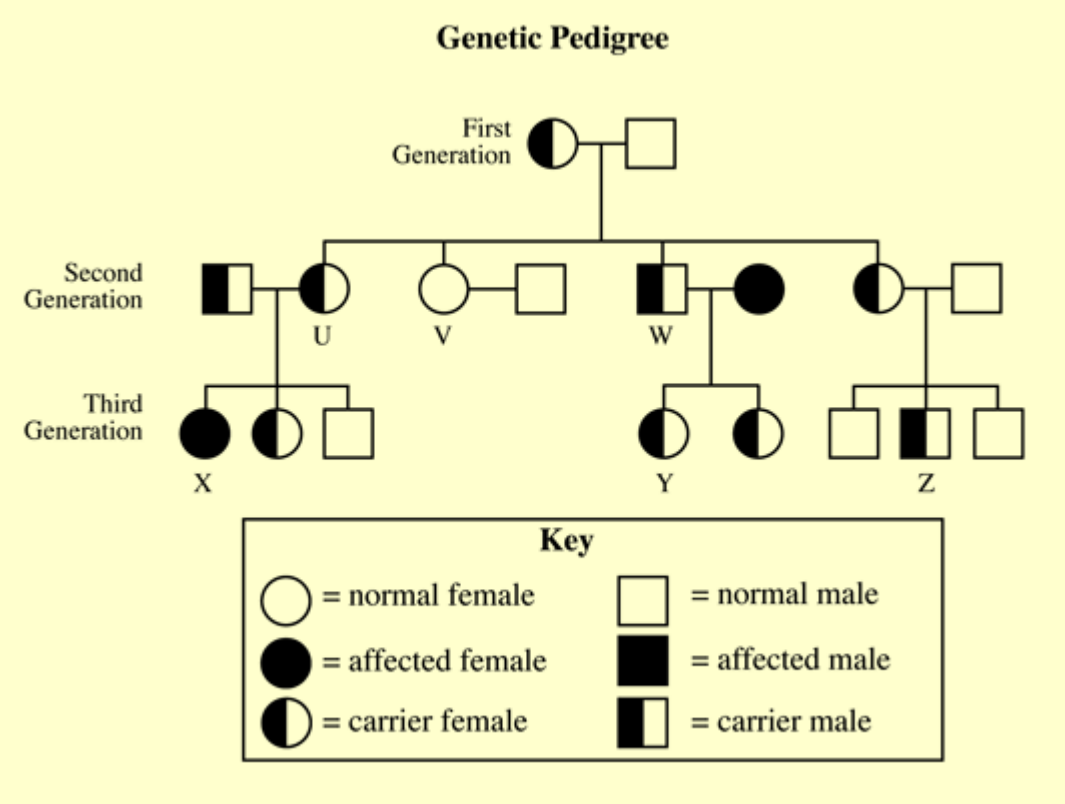
- 1:1 (50:50)
- 50% red
- 50% white

Ff x FF:

	F	f
F	FF	Ff
F	FF	Ff

- 100% red

This is a family pedigree chart of an inheritable disease



a) What is meant by a carrier?

- A person who is heterozygous and the recessive allele will cause a disease if the offspring is homozygous recessive

b) Why would the carrier be phenotypically normal?

- The carrier still has a dominant allele that is being expressed, therefore the phenotype of that person will be normal

c) Is this disease caused by a dominant or recessive allele? Explain your answer

- The disease is caused by a recessive allele as not all the offspring show the disease phenotype.
- If the disease was caused by a dominant allele then there could be no carriers as the dominant allele would be expressed

d) What would the probability be of the offspring getting the disease if a carrier had children with an unaffected person? Show your working out using a Punnett square

- H = dominant normal allele
- H = recessive allele

- 0% chance of having a child with the disease

	H	h
H	HH	Hh
H	HH	Hh

What are the sex chromosomes? How are they commonly displayed?

Female:

Male: ..

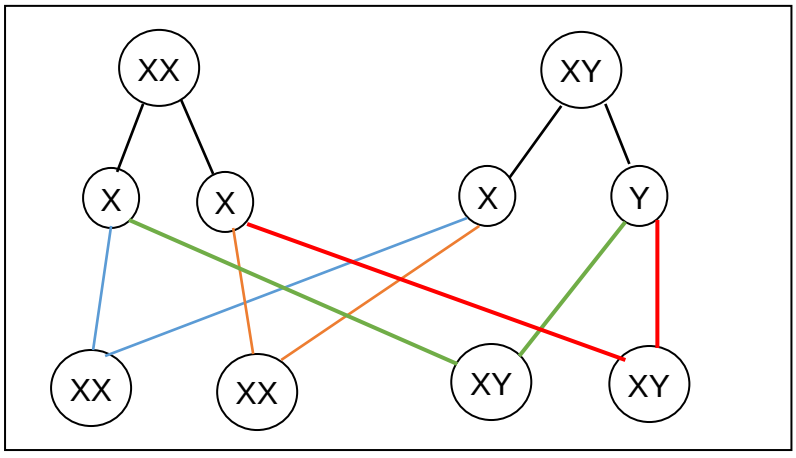
- Two X chromosomes: XX = female
- An X and a Y chromosome: XY = male

Why is this comment true? '*The sex of the offspring is determined by the sperm*'

- The sperm can either be carrying an X chromosome or a Y chromosome.
- An egg cell can only ever have X chromosomes in them
- This means that when an X carrying sperm fuses with an egg cell it would be a female - XX
- If a Y chromosome carrying sperm fuses with an egg cell it would be a male - XY

Draw a genetic diagram (or a Punnett square) to show why the probability of having male or female offspring is 50:50

Genetic Diagram



Punnett Square

	X	Y
X	XX	XY
X	XX	XY

What do these terms mean?

- Diploid .....

- Number of chromosomes found in body cells. Diploid cells contain both chromosomes of each homologous pair – each chromosome in a pair comes from each parent

- Haploid .....

- Number of chromosomes found in gametes. Haploid cells contain one chromosome from each homologous pair

Describe the process of **mitosis**

- Mitosis is a type of cell division
- Before the cell divides, the DNA / chromosomes need to replicate (make a copy of themselves)
- Organelles need to increase in number before division so that there are enough in each daughter cell
- Once all of the DNA /chromosomes have been copied, the cell can split into two genetically identical cells

How many daughter cells are produced in mitosis?

- 2

Why do the daughter cells have genetically identical chromosomes?

- The chromosome replicated before division. This means that each daughter cell will have identical genes / DNA / number of chromosomes

In organisms that have a nucleus (**not bacteria!**) what is mitosis for?

1. .
2. .
3. .
4. .

- Growth – the increase the number of cells (and therefore its size) of an organism
- Repair and replace – dead or damaged cells
- Cloning – to make genetically identical organisms
- Asexual reproduction – to produce genetically identical offspring quickly

Describe the general process of **meiosis** (you do not need to go into much detail about the parts of the process – just explain it generally) include: *number of daughter cells produced, haploid or diploid, genetically identical or not*?

- The DNA / chromosomes are replicated (just like in mitosis)
- The homologous chromosomes pair up and then the pairs are split so that each chromosome goes to either side. The cell splits into two.
- Then the two chromatids of each chromosome separate and those cells split into two
- Four haploid gametes are created

What is the purpose of meiosis?

- To produce gametes which are genetically different to the DNA of the parents so that when sexual reproduction and fertilisation takes place the offspring show variation.
- Genetic variation means that some offspring are better suited to survive any changes in the environment

What is variation?

- Variation is the differences between organisms' DNA. Differences in DNA between organisms are called mutations

What is random fertilisation?

- Random fertilisation means that it is random which sperm cell reaches the egg cell to fertilise it. It is also random which egg will mature and be released every month.

Why does random fertilisation of gametes help produce genetic variation in offspring?

- Since gametes are genetically different to the parents' cells and we do not know which gametes will fertilise each other there will be genetic variation shown in the offspring.

What is the diploid and haploid number of chromosomes in **humans**? (*Remember that different species have different numbers of chromosomes e.g. hedgehog 2n=88, tobacco 2n=48*)

Diploid (2n):
- 46

Haploid (n):
- 23

Explain how variation within a species can be caused by either genetics, the environment, or a combination of both.

- Genetic variation: Differences in the DNA causes different proteins to be made. These differences cause organisms to have different phenotypes i.e. eye colour, blood groups
- Variation caused by the environment: differences in the environment can cause the organism to have a different phenotype e.g. someone's accent, language
- Genetic factors with environmental factors can cause variation as some genetic traits are heavily influence by environmental changes e.g. height of plants – some plants can be either short or tall due to genetics but due to differences in water levels, mineral content of soil, light intensity etc. can cause variation in the height of the short plants or the tall plants. In humans, weight, height, intelligence are examples of both factorsaffecting the phenotype

List a few variations caused by each factor

Genetic	Environmental	Both

Eye colour	Scars	Weight
Attached/detached ear lobes	Language/accent	Height
	Hair length	Intelligence

Define what a mutation is

- A change in the sequence of DNA bases

What are the different types of mutation?

Duplication: …

Deletion: …

Substitution: …

Inversion: …

- A nucleotide is inserted twice instead of once – the entire base sequence is changed, therefore a different protein is created
- A nucleotide is missed out – the entire base sequence is changed, therefore a different protein is created
- A different nucleotide is used – the change may cause a different amino acid to be coded for or it might code for the same amino acid
- The sequence of the bases in a triplet is reversed. The effects are similar to a substitution mutation

How can the phenotype of an organism be affected by a change in DNA?

- The phenotype can be different due to the different proteins being produced by a mutation. The proteins may be advantageous and allow the organism to survive better than other members of its species, or the different proteins may not function well causing the organism to be at a disadvantage or the mutation may even kill the organism.

Why can the shape and function of proteins be affected by a mutation?

- A change in the sequence of DNA bases, which causes a change in the sequence of amino acids in a protein, which causes a change in shape of the protein, which could change the functionality of the protein

Most DNA in an organism is non-coding DNA (what used to be called junk DNA). Why would a mutation in non-coding DNA not necessarily affect the phenotype?

- Since non-coding DNA does not code for proteins then a mutation there may not affect the phenotype of the organism at all.

What is a mutagen?

- A substance or radiation that can increase the rate of mutations in DNA

Give examples of these two different types of mutagen:

Ionising radiation: ……

- Ultra violet light (UV radiation), X-rays, Gamma radiation

Chemical mutagens: ……

- Chemicals in cigarettes and tobacco, tar, mustard gas, nitrous oxide,

Define what survival of the fittest means

- How well an organism is adapted to its environment so that it is successful in reproducing.
- 'survival of the individuals that will leave the most offspring in later generations'

Outline in bullet points how Darwin's theory of evolution by natural selection occurs:

- There is variation within a species
- These variations are caused by mutations
- Changing conditions in the environment (called a selection pressure) favours one particular form of the species (which has a selective advantage)

  More of the individuals with the selective advantage survive under these changed conditions

  Fewer of the individuals without the selective advantage survive under these changed conditions

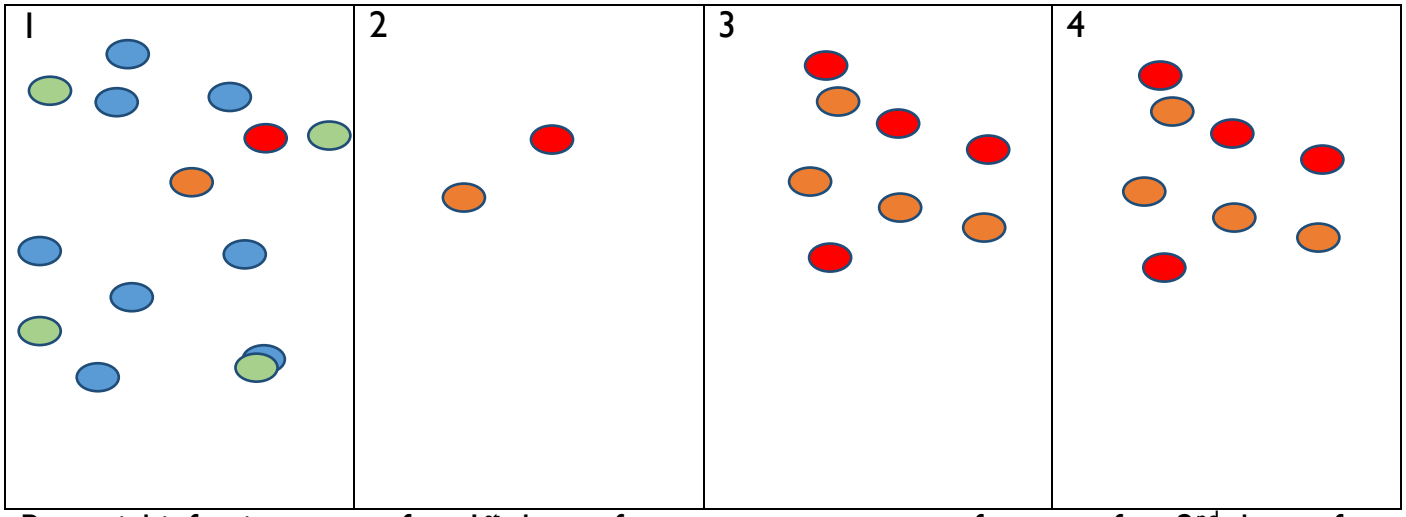
  The mutation that has given the selective advantage to the individuals is more likely to be passed on to offspring as more individuals with the selective advantage survive long enough to reproduce

- .....
- .....
- .....
- .....
- .....

Explain using the principles of natural selection how resistance to antibiotic in bacterial populations occur

Key: + = non-resistant bacteria (will get killed by antibiotics)

+ = Bacteria with mutations that make them resistant to antibiotics



Bacterial infection | after 1st dose of antibiotics | reoccurrence of infection | after 2nd dose of antibiotics

1. There is variation in the population of bacteria.
2. Antibiotics represent a change in the environment. Only the bacteria with advantageous mutations will be more likely to survive this change. The bacteria with the mutations to resist antibiotics have a selective advantage.
3. These mutations are passed on to the offspring.
4. Since the bacteria with the mutation to resist antibiotics are being selected for only they survive if a second dose of antibiotics is used.

Why would infections be difficult to control if bacteria are antibiotic resistant?

- Bacterial infections could spread without any effective treatment leading to more deaths.
- Antibiotics could not be used effectively to stop bacterial growth, therefore people could die from previously treatable diseases / infections

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Section 4: Ecology and the environment

4.1 – 4.5 The organism in the environment

Define these terms:

Population	All the organisms of one species living in a particular habitat at a certain time
Community	All the organisms of all species found in a particular area at a certain time
Habitat	The place where the organism lives
Ecosystem	A community of living organisms together with their non-living environment

What is a quadrat and what is it used for?

- A quadrat is a square used in ecological investigations to sample plants and animals
- It is placed randomly in an area
- The organisms can be counted that are found in the quadrat or the percentage coverage can be calculated
- This process is repeated so that a mean can be calculated

Why must the placing of a quadrat be random?

- So that there is no bias in the results
- So that the results can be more representative of the whole area

How can you set a quadrat randomly?

- Use tape measures along the edges of the area that you are investigating to make a grid
- Use a random number generator on a calculator to make the coordinates on the grid.
- Put the quadrat at the coordinates that the random number generator made

4.2 practical: investigate the population size of an organism in two different areas using quadrats

There are two areas in a field that are used differently. Area A gets trampled more than area B. Design an experiment that will allow you to set random quadrats in both areas to work out the mean number of dandelions per m^2 in each area. What could your hypothesis be?

- Hypothesis: there will be fewer dandelions in the more trampled area than the less trampled area

Method:

- Use 10 metre (or more) tape measures to make a square in each of the areas that are being studied.
- Use a random number generator to make coordinates within the squares.
- Place the quadrats at those coordinates
- Count the number of dandelions in each quadrat.
- Calculate a mean of the number of dandelions at each site.

- A quadrat is usually 50 x 50 cm square so equals $0.25m^2$
- So multiply the mean number by 4 to get number of dandelions per metre squared.

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What does the term biodiversity mean?

- The amount of variation shown by organisms in an ecosystem.
- Biodiversity is a measure of both numbers of species and abundance of each species

What is species richness?

- The number of species in an ecosystem. The higher the number of species the higher the species richness is.

What does the relative abundance of each species mean?

- How many individuals of each species there are in a particular area / ecosystem

Why is high biodiversity considered a good thing for an ecosystem?

- If there is a high number of species living in an area, then that means there are more stable feeding relationships.
- This means that areas with high biodiversity can withstand changes in the environment better and areas with low biodiversity.
- Areas with high biodiversity means that there is a larger variety of habitats in them.

4.4 Practical: investigate the distribution of organisms in their habitats and measure biodiversity using quadrats.

There are two areas that seem to contain different numbers of various plant species. How could you use quadrats to determine the biodiversity of each area.

- Hypothesis: The diversity of plants in area 1 is higher than in area 2

Method:

- Use 10 metre (or more) tape measures to make a square in each of the areas that are being studied.
- Use a random number generator to make coordinates within the squares.
- Place the quadrats at those coordinates
- Count the number of different species and the number of individuals of each species in each quadrat.
- Calculate the total of the number of individuals of each species in the total number of quadrats at each site.

- Plot a bar chart to compare the species number in each area

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What are abiotic factors? .....

- A physical or chemical factor (non-living) that affects an ecosystem e.g. Light intensity, temperature

What are biotic factors? .....

- A biological factor (living) affecting an ecosystem e.g. food supply, predation, disease

How can the population size and distribution of organisms be affected by:

- Abiotic factors like:

Light intensity:	• Less light can mean fewer plants growing in an area
Temperature:	• Higher temperatures can increase the growth rate of plants
Water availability:	• Less water means fewer organisms can survive in an area
Oxygen concentration:	• Only organism adapted for low concentrations of oxygen can survive
Pollution:	• Organisms more resilient to pollution are more likely to survive

- Biotic factors like:

Availability of food:	• More food means more organisms can survive in an area
Competition for food: ..	• Less competition means more food for organisms
Predation:	• More predation means fewer prey organisms survive
Parasitism:	• More parasites mean fewer nutrients going to an organism affecting its chance of survival
Disease:	• Organisms more susceptible to diseases are more likely to die
Availability of nest sites:	• The fewer sites for nesting, the fewer organism can survive into adulthood

4.6 - 4.9 Feeding relationships

What is a food chain?

- A flow diagram showing the feeding relationships in an ecosystem

Where does the energy ultimately come from to start a food chain?

- The energy comes from sunlight / the sun

What do the arrows represent in a food chain?

- That an organism is 'eaten by'
- The flow of biomass / energy from organism to organism

What is a trophic level?

- A feeding level found in a food chain

Define the terms:

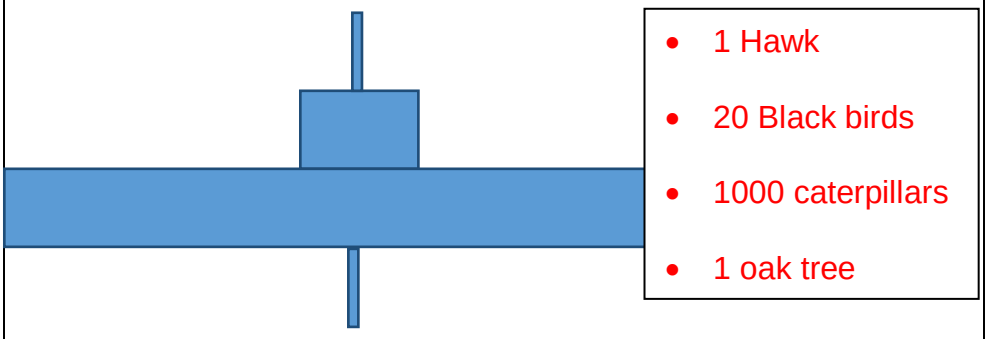
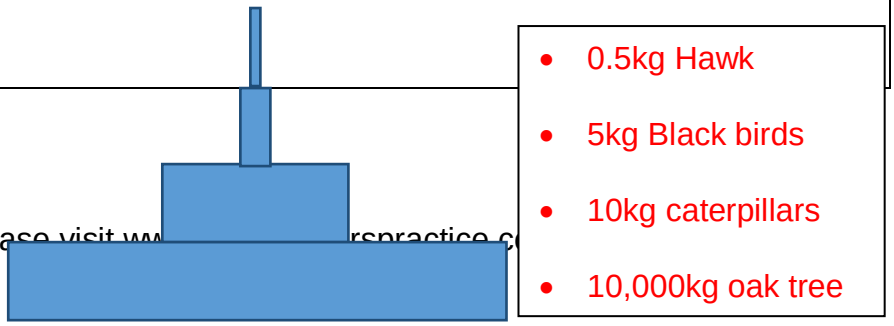
Producer	Organism that makes its own food e.g. green plants or any organism that photosynthesises
Primary Consumer	An organism that feeds on producers (a herbivore) e.g. cows, sheep

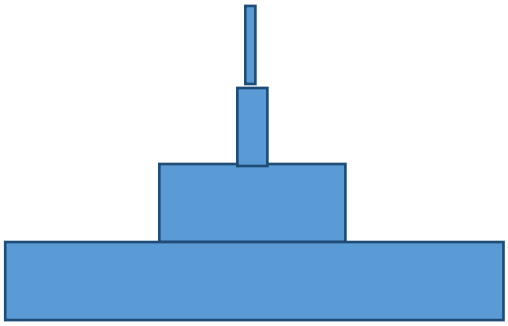
Secondary Consumer	An organism that feeds on a primary consumer (a carnivore / a predator) e.g. wolves, snakes
Tertiary Consumer	An organism that eats secondary consumers (a carnivore / a predator) e.g. wolves, owls
Decomposers (what are the two main types of decomposer?)	An organism that feeds by breaking down the dead remains of other organisms. Usually they release enzymes onto the dead material and absorb the digested products (saprotrophic feeding) e.g. some bacteria and fungi

What is the difference between a food chain and a food web?

- A food web shows the way in which several food chains are linked together in an ecosystem

Sketch a pyramid of numbers, pyramid of biomass, and a pyramid of energy transfer from this food chain: 1 x Oak tree (10,000Kg), 1000 x caterpillars (10Kg), 20 x Blackbirds (5Kg), 1 x hawk (0.5Kg)

Pyramid of numbers	
	

Pyramid of Biomass	
Pyramid of Energy transfer	 • Hawk • Black birds • caterpillars • oak tree

Why are pyramids of numbers not a good representation of the feeding relationships in a food chain?

- Pyramids of numbers do not represent the amount of biomass or energy moving through a food chain.
- This means that the pyramids of numbers can look disproportionally skewed

Why are pyramids of energy a better way to represent the feeding relationships in a food chain?

- Pyramids of energy show the total amount of energy in a trophic level, therefore it is more representative of how energy is transferred through food chains and the ecosystem.

What is energy used for in living organisms?

- Energy is used for:
  - Movement – contraction of muscles
  - Some chemical reactions
  - Changing the structure of molecules i.e. proteins
  - To grow
  - For active transport of substances across membrane against their concentration gradient

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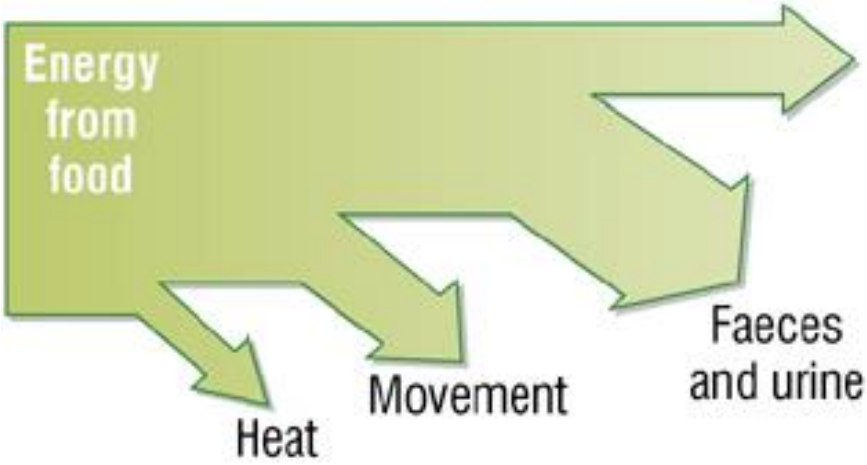
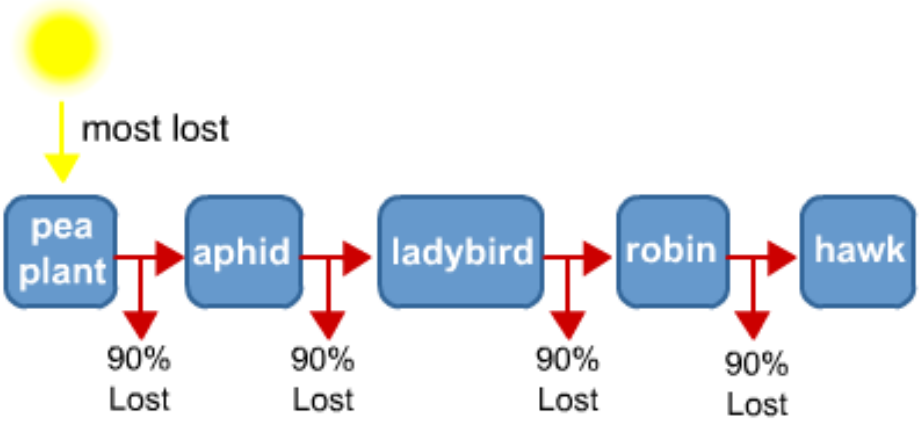
Using the answer that you wrote in the question above,as well as these diagrams explain why only 10% of energy is passed on to the next trophic level and 90% is lost.





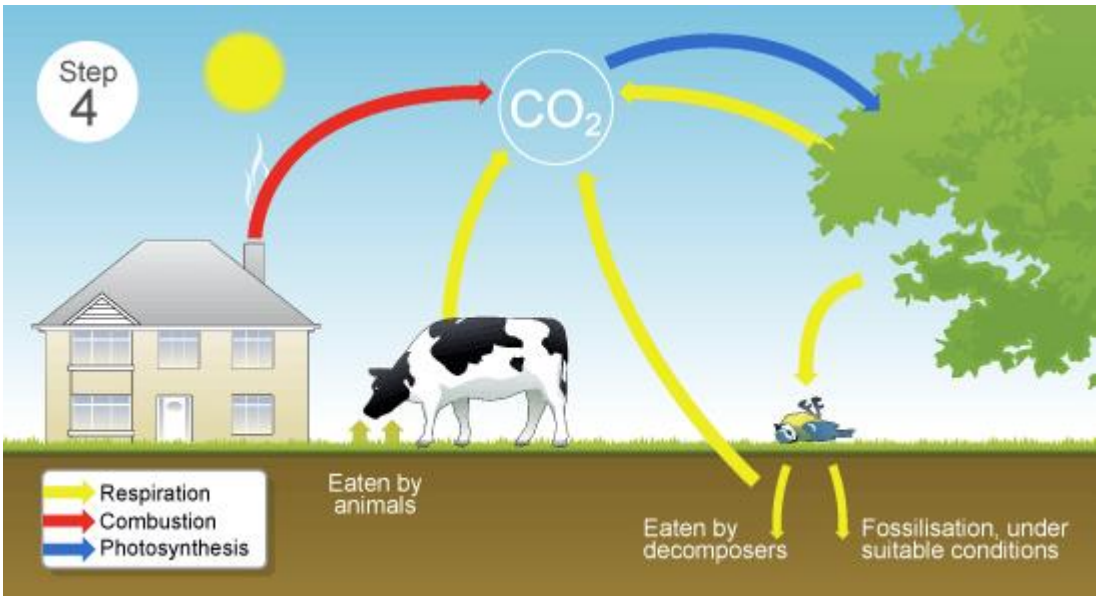
- As energy moves along to the next trophic level, energy is used by the organism in many processes:
  - Energy is mainly lost as heat to the surroundings. The heat is produced as respiration is an exothermic reaction.
  - Energy is used to help the organism move. ATP is created to help the muscles contract
  - Some energy is used to digest food
  - Molecules that contain chemical energy are lost in urine

- Also some energy cannot go along from tropic level to trophic level as some of the energy cannot be digested easily and so exits the body in faeces as egested waste i.e. cellulose in plant cell walls.

- Only some energy is used to help the organism grow and is stored in the tissues of the organism.

4.10 – 4.11 Cycles within ecosystems

Carbon cycle: Describe the stages in the carbon cycle including these words – *respiration, photosynthesis, decomposition, and combustion*.



- Carbon is cycled throughout ecosystems.
- Carbon is put in the atmosphere in the form of carbon dioxide. It is put into the atmosphere by:
  - Respiration from:
    - Animals
    - Plants
    - Decomposers
  - Combustion of fuels like fossil fuels or wood
- Some carbon is stored in the ground which will eventually turn into fossils
- The only way carbon is taken from the atmosphere is by photosynthesis by green plants / algae / cyanobacteria

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Nitrogen cycle: All of the next questions are based on the nitrogen cycle

i) What is the composition of air?

- 78% Nitrogen, 21% Oxygen, 0.9% Argon, 0.04% Carbon dioxide

ii) What do organisms use nitrogen for?

- To make amino acids / proteins / nucleotide bases / DNA

iii) What is the role of nitrogen fixing bacteria?

- To turn nitrogen gas in the atmosphere into ammonium ions

iv) Where can you find nitrogen fixing bacteria?

- In the root nodules of leguminous plants i.e. clover, peas
- In the soil

v) What is the role of decomposers?

- To break down proteins into ammonium ions

……

vi) What is the role of nitrifying bacteria?

- To turn ammonium ions into nitrate ions

vii) What is the role of denitrifying bacteria?

- To turn nitrate ions into nitrogen gas

viii) How do plants get their nitrogen?

- By the assimilation of nitrate ions (they absorb nitrate ions from the soil)

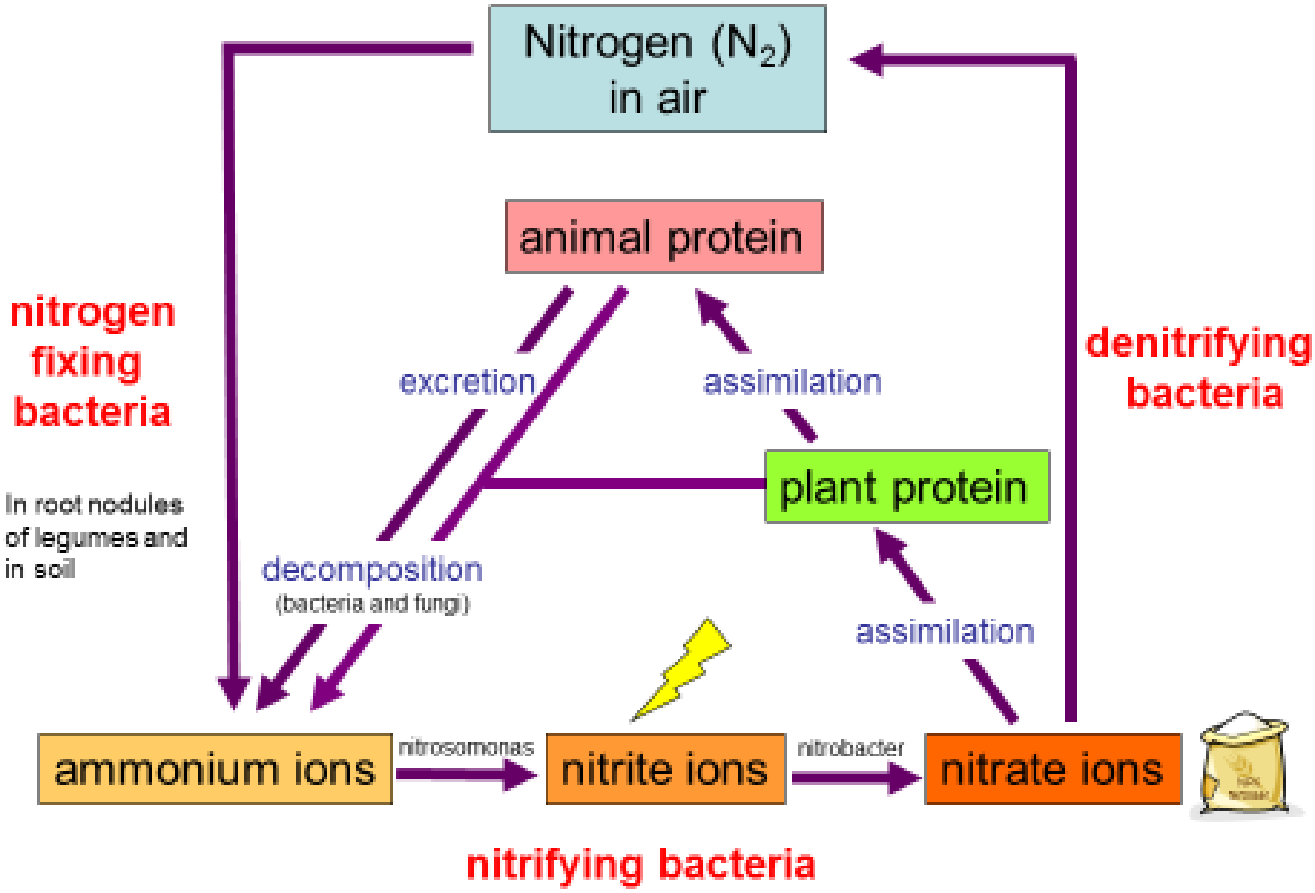
ix) How do animals get their nitrogen?

- By the assimilation of proteins from other organisms (animals consume organisms for their protein)

x) Why can farmers use manure to help fertilise their fields?

- There is a lot of nitrogenous waste in manure that can be turned into nitrate ions which plants can then take up.

Use this diagram to help you remember the nitrogen cycle. ***Remember that you <u>do not</u> need to know the specific names of the types of bacteria in the nitrogen cycle***


Nitrogen (N_2) in air
animal protein
nitrogen fixing bacteria
In root nodules of legumes and in soil
excretion
assimilation
denitrifying bacteria
plant protein
decomposition
(bacteria and fungi)
assimilation
ammonium ions
nitrosomonas
nitrite ions
nitrobacter
nitrate ions
nitrifying bacteria

4.12 – 4.18 Human influences on the environment

How is sulfur dioxide and carbon monoxide produced?

- Sulfur dioxide is produced from burning fossil fuels as well as volcanic eruptions
- Carbon monoxide is produced by combustion in an insufficient supply of oxygen. It is produced in vehicle engines when burning fossil fuels.

Explain what acid rain is and how it is formed.

- Sulfur dioxide (as well as nitrogen oxides) mix with water vapour in the atmosphere (in clouds). This forms sulphuric (and nitric) acids which fall down to earth in the rain. The rain is more acidic than normal rain and is therefore called acid rain.
- Acid rain:
  - Kills conifer trees
  - Acidification of the soil – some is leached into lakes as ions killing fish, root hair cells become less effective at absorbing minerals so causes slower tree growth
  - Acidification od lakes – causes death of algae and bacteria; death of fish and amphibian eggs.

How does sulfur dioxide and carbon monoxide affect the body?

Sulfur Dioxide……

- Can affect the respiratory tract leading to chronic bronchitis

Carbon Monoxide..……

- Can affect the ability of the blood to transport oxygen. Less oxygen is transported which cause tiredness, loss of consciousness and eventually death if left in high concentrations of carbon monoxide for long enough as little oxygen gets to the heart or brain.

Explain what a greenhouse gas is.

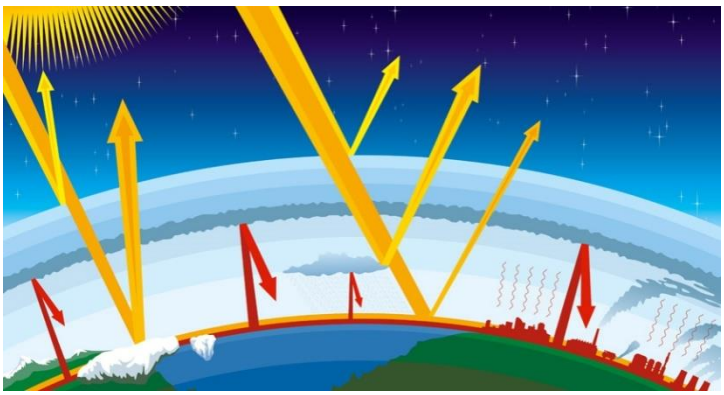
- a gas that contributes to the greenhouse effect by absorbing infrared radiation.

Name the 5 greenhouse gases that you need to know (*from the specification*)

- Water vapour
- Carbon dioxide
- Nitrous oxide
- Methane
- CFCs

- .....
- .....
- .....
- .....

Use this diagram to help explain the greenhouse effect



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- Short wavelength IR radiation from the sun reaches the Earth.
- Some is absorbed by the Earth's surface and emitted again as a longer wavelength IR radiation.
- Greenhouse gases absorb and then re-emit some of the long wavelength IR radiation, which would otherwise escape into space.

How do human activities contribute to greenhouse gases?

- Extra greenhouse gases, like carbon dioxide, are being released into the atmosphere through the combustion of fossil fuels.

If greenhouse gases increase in the atmosphere, explain how this could lead to global warming.

- Extra greenhouse gases cause more IR radiation to be absorbed. This in turn raises the Earth's surface temperature

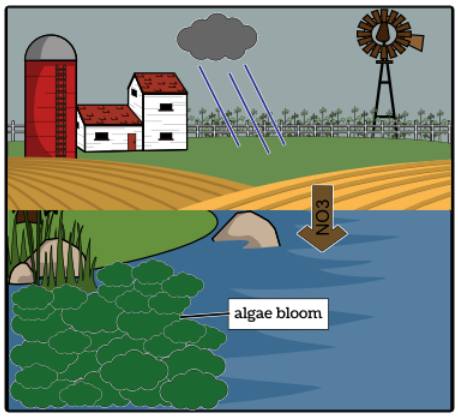
What are the possible consequences of global warming?

- Polar ice caps would melt and raise sea levels.
- Changes in major ocean currents causing warm water to flow to previously cooler areas.
- Changes to global rainfall patterns. More heat means more surface evaporation which means some areas will get more rain whilst others will get less rain.
- Change the nature of many ecosystems – this could cause extinctions as few organisms could adapt fast enough to the changing environment.
- Changes to farming practices as some pests may increase in number and reproduce quicker in warmer climates.

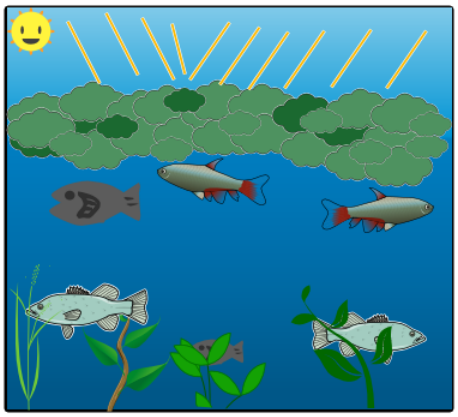
Why does the oxygen content of water decrease if it has been polluted with sewage? Include in your answer *the increase of microorganisms*.

- More microorganisms grow as the sewage provide food for them.
- These microorganisms use oxygen for respiration, therefore the oxygen levels decrease

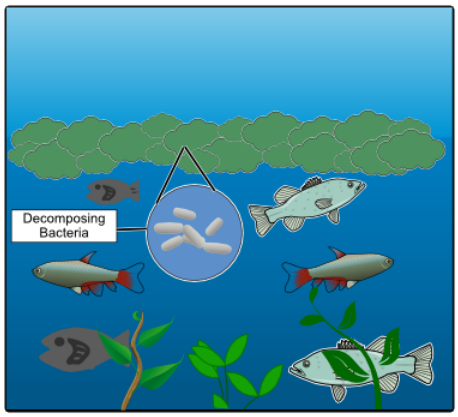
Use this comic strip to outline how eutrophication works



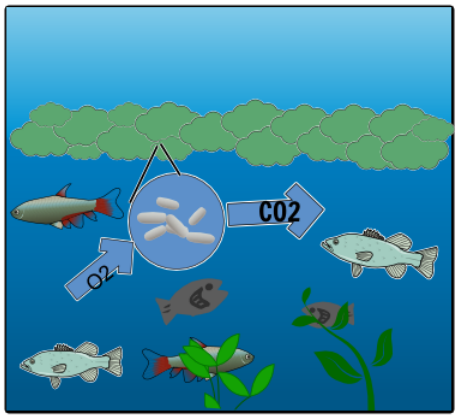
Fertiliser and nitrates leach out of the soil and into rivers, lakes, and ponds.



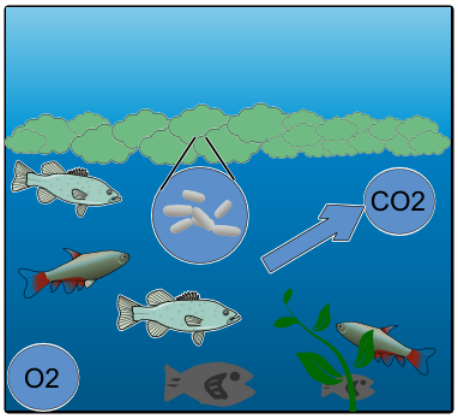
Algae use the excess nitrates to grow and cover the surface of the lake. This blocks the light to the plants underneath.



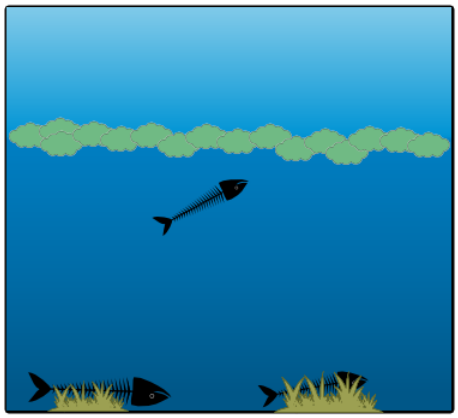
The algae start to die. Microorganisms start to decompose the algae.



The microorganisms use the oxygen for respiration and produce carbon dioxide. The oxygen levels in the water start to decrease. The plants in the water start to die as they cannot photosynthesise as light is blocked.



As the oxygen levels decrease more and more fish die from lack of oxygen.



All the plants under the surface die due to lack of sunlight. All the fish die due to lack of oxygen.

What is deforestation?

- The cutting down of areas of woodland and rainforest for timber or farming.

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How does deforestation effect:

Soil leaching: ……

- Rain washes away the minerals in the soil if there were no roots to hold the soil together.

Soil erosion: ……

- Soil is exposed to the wind as there is no more tree cover and can be blown away.
- Soil can also be washed away by rain into rivers, causing rising water levels and flooding of lowland areas.

Disturbance of evapotranspiration and the carbon cycle: ……

- Water is not transported into the air by transpiration which can cause a disruption in the water cycle.
- If less water is transpired into the atmosphere, fewer clouds can form meaning less rain can fall.
- Deforestation causes more carbon dioxide to be released into the atmosphere because of burning and decomposers respiring; less carbon dioxide is taken back out of the atmosphere.

The balance of atmospheric oxygen and carbon dioxide:

- More carbon dioxide is released due to the slash and burn methods used to clear the rainforests.
- Carbon dioxide is released into the atmosphere by the microorganisms decomposing the felled trees.
- Less oxygen is released into the atmosphere due to less photosynthesis

Section 5: Use of Biological Resources

5.1 – 5.4 Food production with crop plants

Define what is meant by yield when talking about crop plants

- The mass of crops that can be harvested to make food products which can then be sold

Describe how polythene tunnels and glasshouses can be used to increase yield of certain crops

- Polythene tunnels and glasshouses let light through for photosynthesis to occur during the summer months and can be artificially lit during night time as well as the winter months.
- The short wavelength IR radiation is absorbed and re-radiated as longer wavelength IR radiation, which cannot escape through the glass so the glasshouse warms up.
- The tunnels and glasshouses can be heated if the outside temperature is too low. If the heaters burn fossil fuels, such as gas.

Explain in what 2 ways how putting a gas burner inside a glasshouse could help increase crop yield (what does burning gas produce that will help plants grow?)

- Fossil fuel heaters can be installed to heat up the glasshouse to maintain the optimum temperature for photosynthesis to occur the quickest. If the temperature is too high then the enzymes involved in photosynthesis can start to denature, slowing down the rate of photosynthesis, which will reduce the yield of the crop
- Combustion produces higher levels of CO_2 and water vapour which are raw materials for photosynthesis and will therefore increase yield.

What mineral ions do fertilisers contain?

- Nitrates
- Magnesium ions

How do fertilisers increase crop yield?

- Plants can use the nitrates to manufacture amino acids which then get made into proteins which allow the plant to grow.
- Magnesium is needed to make chlorophyll so that the plant can photosynethesise

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Define what a pest is

- Are organisms that reduce the yield of crop plants or stock animals.

In what ways can pests lower crop yields?

- By reducing growth e.g. by damaging leaves and reducing photosynthesis
- By affecting the appearance or quality of a crop, making it unsuitable for sale

What is a pesticide?

- A chemical that can be used to kill organisms that are pests.

Define what biological control is

- The use of another organism to control the numbers of a pest species e.g. introducing a species of wasp to parasitise and kills whitefly larvae, which is a pest of tomatoes.

Write down the advantages and disadvantages between using pesticides and biological control

	Pesticides	Biological control
Advantages	• Quick and easy to spray • Can kill a large range of pest with a single application • Cheap to produce and use	• Is specific to the pest species • Can help maintain biodiversity • Does not kill other insect species •

Disadvantages	• Is not specific and can kill a wide range of insect species including harmless or beneficial ones like bees and butterflies • Can bioaccumulate as it is not broken down and so builds up in concentration as it moves up the food chain • Pest can build resistance to the pesticide making it less effective	• It can never fully get rid of the pest • Lower yields can occur due to some crop being damaged

Give an example of a biological control

- Predators – Ladybirds used to prey on aphids in orange groves
- Parasitism – *Encarsia* wasps used to control whitefly in tomato crops
- Disease – myxomatosis virus used to control rabbit population in Australia
- Sterile males – mate with females and no offspring are produced
- Pheromones – used to attract insects to a specific area, which are then destroyed

Write the word equation of anaerobic respiration in yeast

- Glucose → ethanol + carbon dioxide

What does fermentation mean?

- The use of the respiration of microorganisms to produce useful products

Why is yeast used to make alcoholic beverages?

- Alcohol is produced when yeast undergoes anaerobic respiration

When making beer where do the sugars come from to make the yeast respire?

- Barley contains starch. The barley seeds germinate, which produces amylase – an enzyme that breaks down starch into maltose. Maltose is used by the yeast in fermentation to produce ethanol.

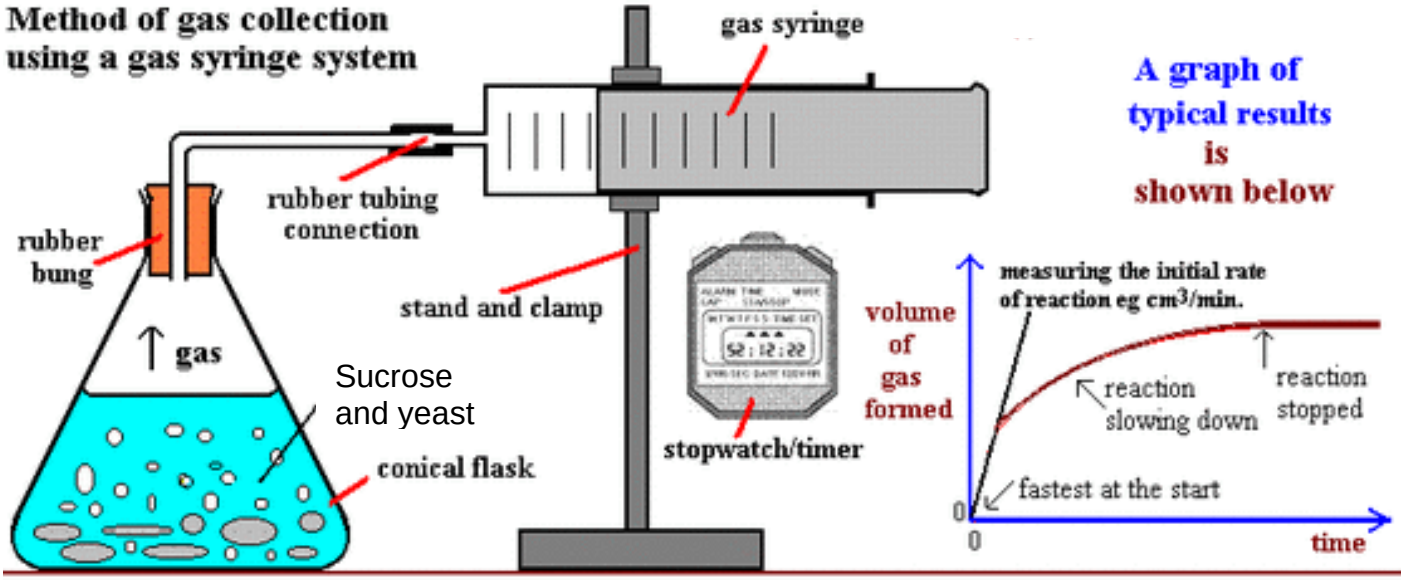
Describe how yeast is used in bread making

- Yeast uses the sugars to respire aerobically and then anaerobically to produce carbon dioxide which makes the dough rise.
- The gas bubbles expand further in the oven. The yeast is killed and any alcohol made by anaerobic respiration is evaporated off.

Explain why unleavened bread does not rise whereas other breads do rise. (*What causes the bread to rise?*)

- Yeast is not used in unleavened bread; therefore, carbon dioxide is not produced to make the bubbles that expand when in the oven.
- This means that the unleavened bread has a denser texture than bread that has risen, as there are no gas bubbles that expand during baking.

5.6 Practical: The next few questions will be based on investigating carbon dioxide production by yeast, in different conditions.



a) Why does the yeast produce carbon dioxide?

- The yeast is respiring, which produces carbon dioxide

b) If you were investigating how the amount of sucrose affected the volume of carbon dioxide formed, what would be the:

i. Control variables?

- Same temperature, same volume of solution, same mass of yeast

ii. Independent variable?

- The mass of the sucrose

iii. Dependent variable?

- The volume of gas produced

iv. What would you expect to see as you increased the amount of sucrose?

- The higher the mass of sucrose used, the more gas will be produced
- However, the amount of gas produced will start to level off as the sucrose is no longer a limiting factor

c) If you were investigating how the temperature of the sucrose and yeast solution affected the volume of carbon dioxide formed, what would be the:

i. Control variables?

- Same mass of sucrose, same volume of solution, same mass of yeast

ii. Independent variable?

- The temperature

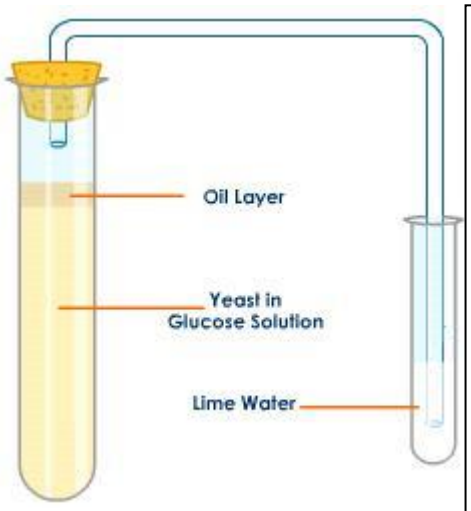
iii. Dependent variable?

- The volume of gas produced

iv. What would you expect to see as you increased the temperature?

- As temperature the increases the volume of gas collected will increase until a certain point – the optimum temperature of the enzymes of the yeast – and then the volume of gas collected will start to decrease as the temperature increases past this point as enzymes would start to denature slowing the reaction rate down.

In the next experiment please describe what the diagram is showing and what would the positive result for carbon dioxide be?



- This experiment is set up to see if carbon dioxide is produced by yeast in anaerobic conditions.
- Lime water will turn cloudy in the presence of carbon dioxide.

Why is there a layer of oil on top of the yeast?

- To prevent oxygen from entering the solution causing aerobic respiration to occur.

What sugar is found in milk?

- Lactose

What is the name of the bacteria that is used to turn milk into yogurt?

- Lactic acid bacteria (*Lactobacillus*)

What does this bacteria produce as it uses the sugar in anaerobic respiration?

- Lactic acid

Explain what happens to the pH as the milk is being turned into yogurt

- The pH will start to decrease
- Lactic acid is an acid therefore the more that is produced the lower the pH will be

How does the change in pH affect the proteins found in milk?

- The mixture coagulates and thickens, this causes the milk proteins to denature and turn into semi-solids.

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What gives the yogurt is characteristic tart/sour taste?

- The lactic acid gives the yogurt the sour taste.
- Acidic foods usually will have a sour taste

Some fermenters are aerobic and not anaerobic. Give some examples of organisms and the products they produce that are grown in these types of fermenter.

- The production of insulin by genetically engineered bacteria
- The production of mycoprotein by fungi for vegetarian meat replacement products

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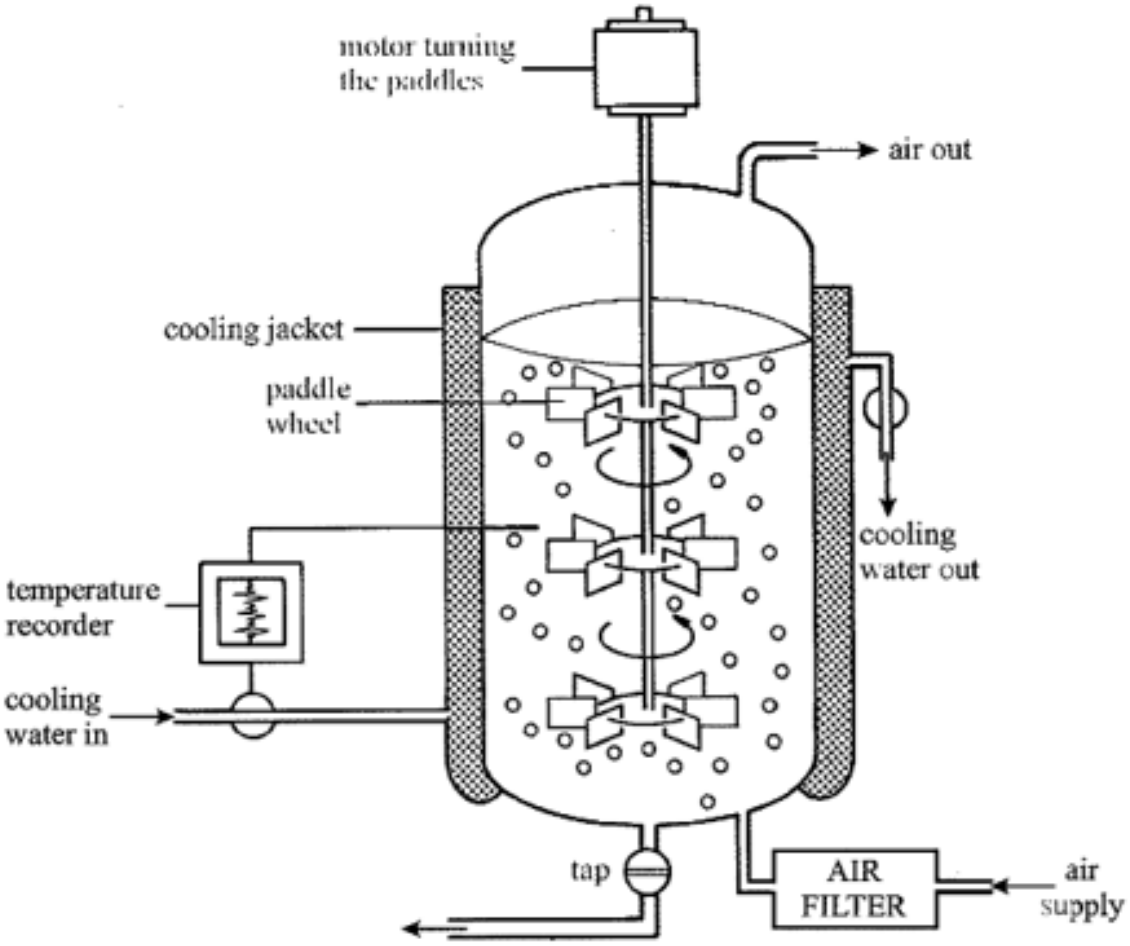
The next few questions will be based on the diagram below. This is an industrial fermenter:



a) Is this an aerobic or anaerobic fermenter? How can you tell?

- Aerobic – Air is supplied to the fermenter so that aerobic respiration can take place.

b) Why do the air and nutrients going into the fermenter need to be sterile?

- The air and nutrients need to be sterile otherwise the fermenter can be contaminated by unwanted microorganisms that would spoil the fermentation process, or make harmful products.
- The unwanted organisms would compete with the organism in culture and therefore reduce the yield

c) What things does the movement of the paddles help distribute evenly?

- Nutrients
- Oxygen
- Heat
- Keeps the microorganism in suspension so that they get more exposure to the nutrients

d) One of the other reasons why there are paddles is so that there isn't a build-up of sedimentation. Suggest how this could affect the growth rate of the organism if the fermenter didn't mix the solution.

- The organisms that would make up the sediment and they would not get enough oxygen and would undergo anaerobic respiration instead which would change the products being made.
- The waste products could build up and kill the microorganisms

e) Respiration is an exothermic reaction. Why does temperature need to be kept constant in this fermenter?

- Otherwise the contents could overheat, which could denature the enzymes involved in respiration which would reduce the yield.

f) How is temperature controlled?

- A water jacket covers the fermenter with cold water running through it. This will take excess heat away from the fermenter keeping it at a constant temperature.

g) Explain what would happen to the enzymes in the organisms inside the fermenter if the pH was not kept at the optimum pH.

- The enzymes would denature.
- This means they would change their 3D shape meaning that the substrates will no longer fit into the active site therefore the rate of reaction would decrease or even stop with would reduce the yield.
- Acid or alkali would be added to keep the pH the same.

5.9 Fish farming

Which food nutrients are fish a good source of?

- Protein
- Lipids

Fish farms keep lots of fish in very small tanks to minimise space requirements. However, this can affect how the fish grow. Explain what is meant by the terms:

- Intraspecific competition: ……

- Competition for resources by individuals within the same species
- Larger individuals will outcompete the smaller fish for resources

How can intraspecific competition be minimised?

- Increase the space the individuals live in
- Ensure there is an excess of food so the individuals do not need to compete with each other for food
- Separate larger and smaller individuals

- Interspecific competition: ……

- Competition between individuals of different species for resources

……

How can interspecific competition be minimised?

- Keep species separated so they cannot compete against each other

As well as competition, **predation** occurs. Explain what is meant by the terms:

- Intraspecific predation: ……...…….

- Smaller individuals can be eaten by the larger individuals

Give ways in which intraspecific predation be controlled

- Sort the individuals by size so the small ones don't mix with the larger ones

- Interspecific predation: ……...……..

- Some carnivorous fish species will prey on other fish species

Give ways in which interspecific predation be controlled

- Keep the different species of fish separated from each other

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Explain why, if not controlled, diseases and parasites have the possibility of spreading quickly through the fish stock.

- If there are too many fish in an enclosure, then it is much easier for disease and parasites to spread from individual to individual.
- This is because they are in close proximity to each other.

Give ways in which diseases and parasites can be controlled

- Antibiotics can be administered to the water to kill bacteria that cause disease
- Predators of the parasites can be introduced to keep the numbers of parasites down.

Why is sterile water pumped in continuously?

- To reduce the number of pathogens entering the enclosure

Explain why waste water is washed out regularly

- To reduce the build-up of waste, which could be toxic to the fish and also cause eutrophication to occur.

Why are fish fed a protein rich diet and sometimes have hormones pumped into the water?

- So that the fish can grow as quickly as possible to

What could happen if excess food that is not eaten is allowed to settle on the floor or falls out of the fish's enclosure?

- The food could upset the food chains outside of the enclosures as well as cause eutrophication

Explain how the use of selective breeding can help breed bigger fish.

- If only the biggest fish are allowed to breed with each other then there is more chance that the offspring will be larger as well.
- If only these large offspring are allowed to breed, then more and more of the offspring will be large.
- This means that the individuals in the captive population become larger and larger, which means they will have more flesh on them to sell.

5.10 –5.11 Selective Breeding

Define what selective breeding is

- Selective breeding is the process by which humans choose desired characteristics shown in a species and only those individuals with those desired characteristics are bred.
- The desired characteristics are inherited by the offspring.
- Again, only the individuals with the desired characteristics are allowed to breed.
- Over time a population of individuals will only have those desired characteristics.

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What can be desirable characteristics in plants that farmers or consumers want or need?E.g. large fruit

- Larger, tastier fruit
- Higher nutrient content
- Resistance to pests
- Faster growing so more harvests per year can happen
- Shorter, stronger stems with larger seeds
- Resistance to drought
- Fruit that do not have harmful chemicals in them

Explain how you might go about producing strawberry plants that used to have small fruit but after selective breeding now have large fruit. (You may want to draw a diagram to help you visualise it)

- Variation is shown in the original population of strawberries – most are small but some are larger.
- Only allow the plants with larger strawberries to cross pollinate.
- Again only allow the offspring with the largest strawberries to cross pollinate.
- Over time more and more generations of the strawberry offspring will have larger strawberries.
- Repeat the process of only allowing the plants with large strawberries to breed.

What desirable characteristics in livestock animals (and pets) do farmers and consumers want or need? E.g. more milk produced per cow

- More milk produced per cow
- More meat produced on animals
- Faster growing animals to reach adulthood more quickly so less energy is used to grow them, therefore more money is saved
- The ability to digest plant food more effectively
- More wool produced by sheep
- **Pets** – more docile, loyalty, 'cuteness', characteristics that help the pet perform a function

Bulls with desired characteristics have their semen collected by artificial means. Why is the sperm then diluted into many different vials?

- This is so as many cows can be impregnated by the sperm of the bull as quickly as possible.
- Also it is easier to transport the semen to many farms instead of the bull travelling farm to farm
- Only one sperm is needed to fertilise an egg cell so this prevents wastage of unused sperm

Explain what artificial insemination is

- Sperm is collected from a male and stored until it is needed.
- Artificial insemination is the introduction of sperm from a male into a female using artificial methods.
- This means the male is not needed to be present to impregnate the female

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5.12 – 5.16 Genetic modification (genetic engineering)

Describe what DNA is

- DNA is a double stranded molecule in the shape of a helix made up of nucleotides with different bases that are complementarily paired up.

Define what the genetic code is.

- The genetic code is the sequence of the bases on a strand of DNA that can be read and translated into a sequence of amino acids to make proteins

Define what a gene is.

- A specific length of DNA that codes for a particular protein

Define what genetic engineering is.

- Techniques used to transfer genes from the cells of a donor organism to those of a recipient organism

Define what **transgenic** means.

- An organism that has been engineered with a gene from another species

Enzymes are used in genetic engineering. What do these enzymes do?

- Restriction enzyme ……

- An enzyme that is used in genetic engineering to cut out a section from a molecule of DNA so that that section can be inserted into the DNA of another organism.

- DNALigase enzyme ……

- An enzyme that is used to join pieces of DNA together in genetic engineering.
- It is used to 'glue' the section of DNA that was cut out from the donor's DNA into the DNA of the recipient.

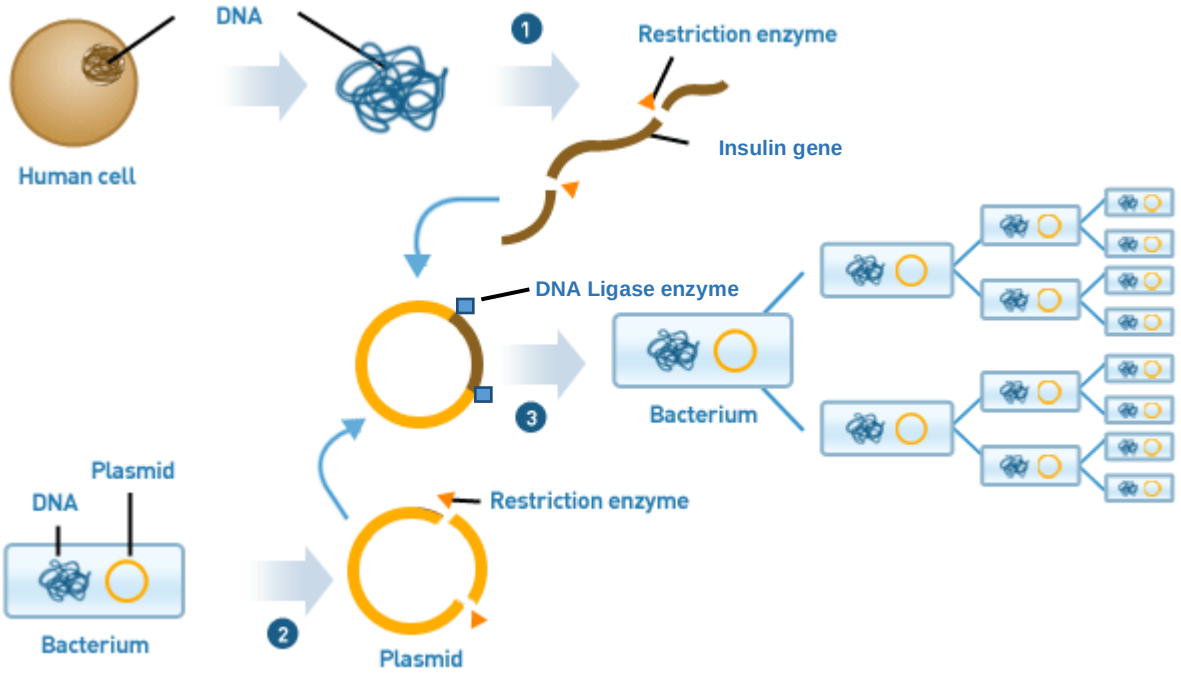
What is a vector?

- A structure which can be used to transfer genes in genetic engineering
- They can be: plasmids, viruses, liposomes

Plasmids are found in bacteria. What are they?

- Small circular piece of DNA found in some bacteria
- It is not part of the bacteria's main 'chromosome'
- Plasmids contain some genes especially involved with antibiotic resistance

This is a diagram of the general process of genetic engineering using the human insulin gene and bacteria.



Describe what is happening in this diagram

- The DNA is isolated from the human cell.
- The insulin gene is cut out of the human DNA using restriction enzymes.
- A plasmid is isolated from a bacterial cell.
- Restriction enzymes are used to cut the plasmid open.
- The insulin gene is inserted into the plasmid and the ligase enzyme is used to stick the insulin gene into the plasmid
- The plasmid with the insulin gene is then inserted into another bacterium.
- The bacterium is allowed to reproduce, all of the offspring will now contain the recombinant plasmid which contains the insulin gene.
- The bacteria can now produce and secrete pure human insulin.

Where will the bacteria be grown to make the insulin?

- In a fermenter

Genetically modified (GM) crops are engineered to have many new characteristics. List a few of them:

- Greater resistance to pests
- Resistance to herbicides so more herbicide can be used to kill weeds
- Increase in nutritional content – golden rice with vitamin A
- Drought resistance
- Ability to tolerate salty soil
- More efficient photosynthesis to increase yield
- Longer shelf life

Many GM crops are engineered to be resistant to pests. Why would this reduce the use of pesticides?

- Only the pests would die if they try to eat the crop
- Less pesticide would be needed to be sprayed onto the plants as the pests would be dying, therefore fewer non-target organisms would be killed because less pesticide is used.

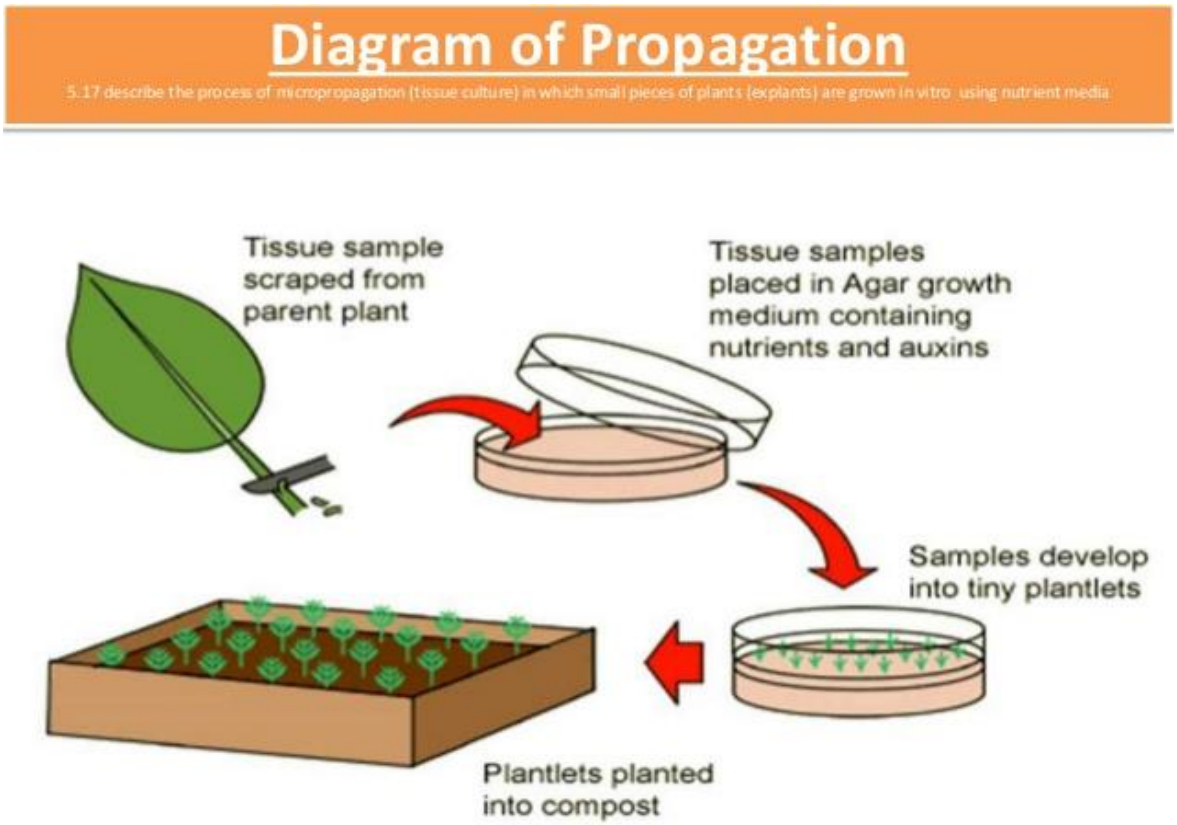
Suggest how the use of GM crops could affect the environment and food chains

- The inserted genes might be able to find their way into the genomes of other non-crop plants which could cause weeds to show resistance to herbicides
- If more herbicides are used, then the weeds will die causing organisms that fed on them to look for food elsewhere.
- Biodiversity could improve if less pesticide is used as fewer organisms would die allowing more food chains to exist

5.17 – 5.20 Cloning

Define what micropropagation is.

- The growing of plants from small pieces of plant tissue in test tubes under controlled conditions



This is a lovely diagram of micropropagation. It shows the general process of how to produce many plants from one sample. It is missing some details so you'll have to fill in the missing information.

a) Why does the agar medium contain nutrients and auxins? (*hint: will the tissue samples be able to photosynthesise?)*

- The samples cannot photosynthesise to make their own food so need the nutrients in the agar.
- The auxins help growth happen quicker.

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b) Why do the tissue samples need to be grown *in vitro* in sterilised conditions?

- Otherwise they could become contaminated with bacteria and fungi.
- These could kill the tissue samples.

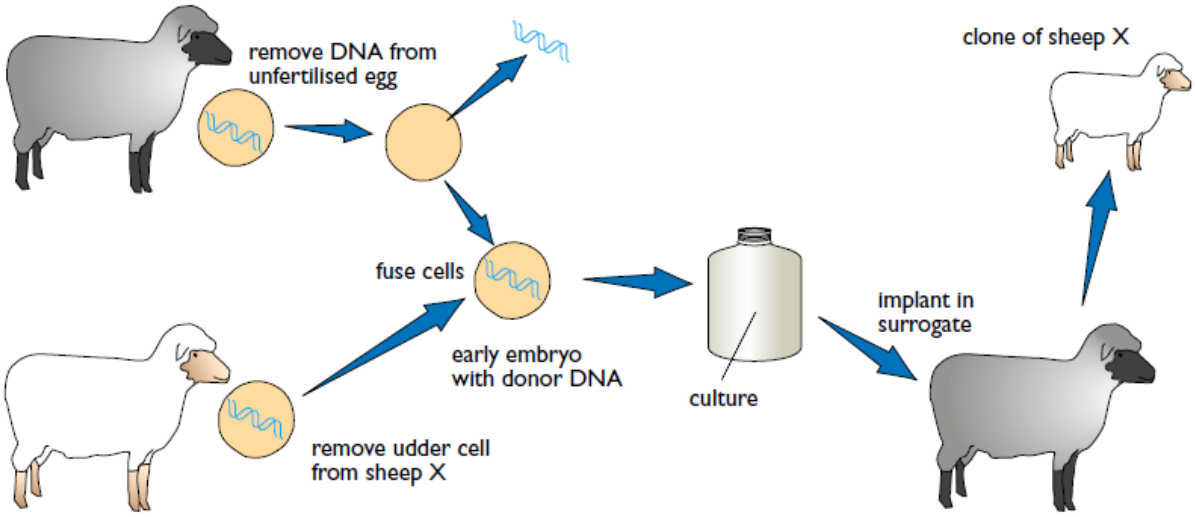
c) Why are the plantlets genetically identical to the plant that the tissue samples came from?

- The cells are from the donor plant and so will contain the same DNA

d) Why do farmers use micropropagation to produce commercial quantities of identical plants with desirable characteristics?

- A large number of plants can be grown by microprogation.
- If a plant with a desirable characteristic is selected then, from that one plant, thousands of plants can be grown which have the same desired characteristics.
- Plants can be produced at any time of the year.
- Genetic modification can be introduced to many plants as quickly as possible, after modifying only a few plants
- Species that are difficult to grow from seeds or cuttings can be propagated this way
- Large numbers of plants can be stored easily

This is how Dolly the sheep was created. The following questions will be based on this.



a) Why is the DNA/nucleus removed from the egg cell?

- So that only the DNA from the donor is present in the cell.
- If the DNA from the egg cell was still present, then it would interfere with the DNA from the donor

b) Why can a clone only be created using the DNA from a cell from the body and not from the DNA from an egg cell?

- There is only half the number of chromosomes in an egg cell, whereas body cells are diploid and have the full number of chromosomes present.

Complete this table on the advantages and disadvantages of cloning animals.

Advantages	Disadvantages
• More individuals with desired characteristics • Increased production of a particular product e.g. higher milk yield or higher muscle mass in bulls • Animals that have been genetically modified can be cloned	• There is a high failure rate to create cloned animals • It is very resource intensive and expensive

Cloning transgenic (genetically engineered) animals can have many potential uses:

- Research – Transgenic mice can be produced with human disease traits. How could this help research?

- As the mice show traits of human diseases then these can be studied more thoroughly
- Drugs can be tested on the mice to see if they have any effect on the disease
- Many mice can be breed with the disease trait quickly

- Drug production – Transgenic animals can be used to produce human antibodies or other human proteins. How could this be helpful?

- The human proteins can be produced in larger quantities.
- Human donors would not be needed
- The supply of the proteins would be uninterupted

- Organ production – Pigs can be genetically modified to produce human organs such as kidneys. What advantages would this have to organ transplantation?

- The pigs can be genetically modified to have human antigens on their cells
- This means that organs can be transplanted from the pigs to humans with less risk of rejection.