3a Reproduction

Edexcel IGCSE Biology (Higher) DOUBLE AWARD - Question and answer notes

How to use these notes

For each question and answer:

- Read it carefully and make sure you **understand** it
- **Memorise** the answer
- **Practice** applying your understanding to past exam questions

You can memorise the answers by using **retrieval practice** - which is when you practise retrieving information from your memory. This can be done using flashcards or a flashcard app, by asking someone to quiz you, or by covering up the answers with a piece of paper and testing yourself. Past paper practice can also be a form of retrieval practice.

3a Reproduction

What is reproduction?
Reproduction is the creation of a new individual organism from one or more parents.

What is sexual reproduction?
Sexual reproduction is when two gametes (sex cells) fuse to form a new organism.

What are gametes?
Gametes are sex cells.

What are female gametes called?
Egg cells

What are male gametes called?
Sperm cells

What process produces gametes?
Meiosis

What is fertilisation?
Fertilisation is when an egg cell and a sperm cell fuse to form a cell called a zygote. A zygote is the first cell of a new individual organism.

What is a haploid nucleus?
A haploid nucleus is a nucleus that contains one set of chromosomes.

What is a diploid nucleus?
A diploid nucleus is a nucleus that contains two sets of chromosomes.

What kind of nucleus does a gamete have?
A gamete has a haploid nucleus.

What kind of nucleus does a zygote have? Why is this?

- A zygote has a diploid nucleus.
- This is because a zygote is formed when an egg cell and a sperm cell fuse.
- The egg cell and sperm cell each have a haploid nucleus containing one set of chromosomes. These two nuclei fuse to form a diploid nucleus.

What happens to a zygote once it has formed?
Once a zygote has formed, it undergoes cell division by mitosis and it develops into an embryo.

What is asexual reproduction?
Asexual reproduction is when a new organism is formed from one parent, without the fusion of gametes. The new organism formed is genetically identical to the parent.

What are the differences between sexual and asexual reproduction?

- Sexual reproduction involves the fusion of gametes produced through meiosis, whereas asexual reproduction does not involve meiosis or the fusion of gametes.
- Sexual reproduction creates genetic variation, whereas in asexual reproduction the offspring are genetically identical to the parent.
- Sexual reproduction often involves two parents, whereas asexual reproduction always involves only one parent.

FLOWERING PLANTS

What are flowering plants?
Flowering plants are plants that produce flowers. They are capable of carrying out sexual reproduction through a process called pollination.

What is the female reproductive structure within a flower called?
Carpel

What is the male reproductive structure within a flower called?
Stamen

What is the typical structure of a flower?

- In most species of flowering plants, each flower contains a carpel (the female reproductive structure) and multiple stamens (the male reproductive structures).
- The carpel is in the centre of the flower and the stamens surround it.
- The carpel and stamens are surrounded by the petals.
- Below the petals there are sepals.

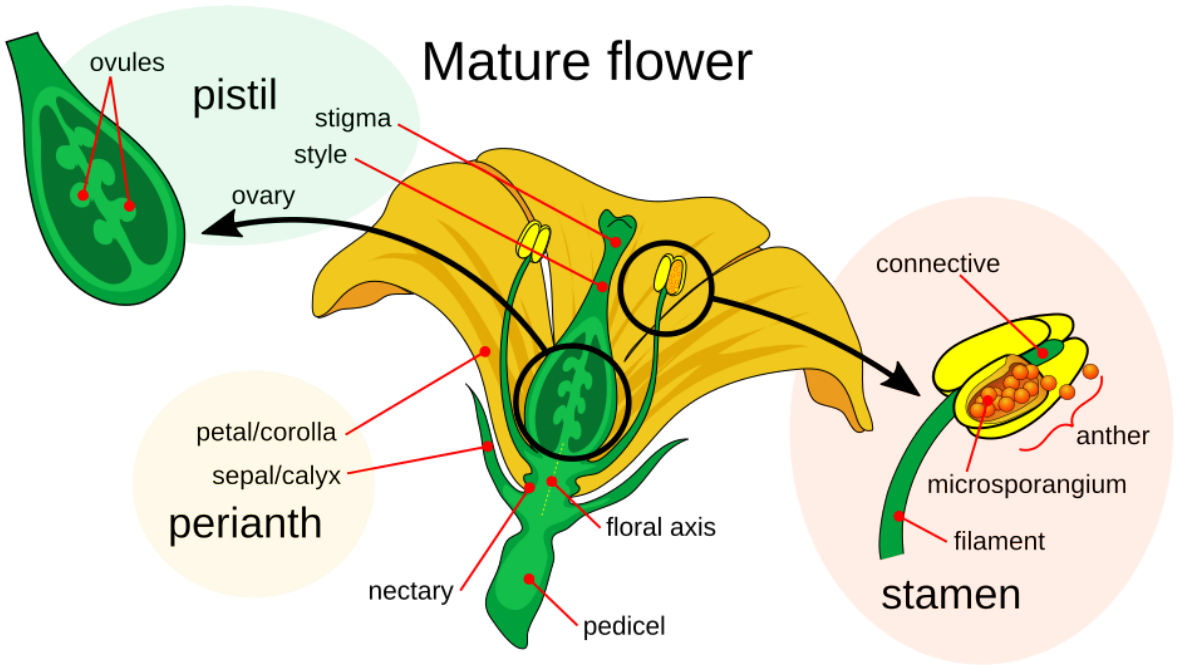
What is the structure of a carpel?
A carpel is made up of:

- The stigma - the top part of the carpel
- The style - below the stigma
- The ovary - at the base of the carpel
- Ovules - structures found within the ovary

What is the structure of a stamen?
A stamen is made up of:

- The anther - at the top of the stamen
- The filament - the stalk that connects the anther to the rest of the flower

NOTE: You **don't** need to learn all the words from the diagram below, it is just included here to show what a flower looks like. See the text above for which terms you need to know.



What does the anther contain?
The anther contains pollen grains.

What is a pollen grain?
A pollen grain is a small, round structure with a hard coat. It produces male gametes (sperm cells).

NOTE: Although the male gametes in plants are called sperm cells, they do not look like human sperm cells - for example, they do not usually have tails.

Where are the egg cells located within a flower?
The egg cells are located within the ovules (which are in the ovary).

What is pollination?
Pollination is when pollen grains are transferred from an anther to a stigma. This leads to the fusion of an egg cell and a sperm cell (fertilisation).

What are the two main types of pollination?

- Insect pollination - where an insect carries the pollen grains from the anther to the stigma.
- Wind pollination - where the wind carries the pollen grains from the anther to the stigma.

In pollination, what happens once a pollen grain arrives on the stigma?

- Once a pollen grain arrives on the stigma, the pollen grain grows a structure called a pollen tube.
- The pollen tube grows down through the style, into the ovary and then into one of the ovules.
- Male gametes (sperm cells) from the pollen grain travel down through the pollen tube and into the ovule.
- Inside the ovule, a sperm cell fuses with an egg cell to form a zygote (this is fertilisation).
- The zygote develops into an embryo.
- The embryo is inside a seed.
- The ovary develops into a fruit, containing the seed.
- The seed is then dispersed into the surrounding environment (e.g. by animals, by wind, or by water).

What is self-pollination?
Self-pollination is when a plant pollinates itself. In other words, pollen grains from the plant arrive on a stigma on the same plant, leading to the formation of seeds with only one parent.

Is self-pollination a form of sexual or asexual reproduction? Why?

- Self-pollination is a form of sexual reproduction.
- Even though it only involves one parent, it still counts as sexual reproduction because it involves the fusion of gametes, and the offspring produced are not genetically identical to the parent.

How are insect-pollinated flowers adapted for pollination?
Insect-pollinated flowers have the following adaptations:

- They have brightly coloured petals to attract insects.
- They are scented flowers to attract insects.
- They have a structure called a nectary which produces a sweet liquid called nectar that attracts insects.
- They have large, sticky pollen grains that stick to insects while they are drinking the flower's nectar.
- They have a sticky stigma so that when an insect with pollen grains stuck to it arrives on the stigma, the pollen grains will stick to the stigma.

How are wind-pollinated flowers adapted for pollination?
Wind-pollinated flowers have the following adaptations:

- They have small, dull petals and no nectaries, as they do not need to attract insects.
- They produce large quantities of pollen grains, to increase the chances that one will reach a stigma.
- They have small, light pollen grains so that they can be carried further by the wind.
- They have long filaments that hang the anthers outside of the flower, enabling the pollen grains to be blown away by the wind.
- They have a large, feathery stigma to catch pollen grains from the wind.
- The stigma hangs outside the flower, which makes it more likely to catch pollen grains from the wind.

What is germination?
Germination is the process in which a plant embryo develops into a seedling which grows out of the seed.

Why do plant seeds contain a food store?

- When a plant germinates, it cannot photosynthesise until it has grown above ground and produced leaves.
- Therefore, it needs a source of food to sustain it until it can produce its own food through photosynthesis.
- The food store provides the seedling with the energy (through respiration) and materials it needs to grow.

What is one natural process by which plants can reproduce asexually?

- Plants can reproduce asexually by the production of runners.
- Runners are structures that grow out of the base of some plants and then grow across the surface of the soil.
- Once a runner has grown away from the original plant it will form roots and develop into a new plant that is genetically identical to the original plant (a clone).

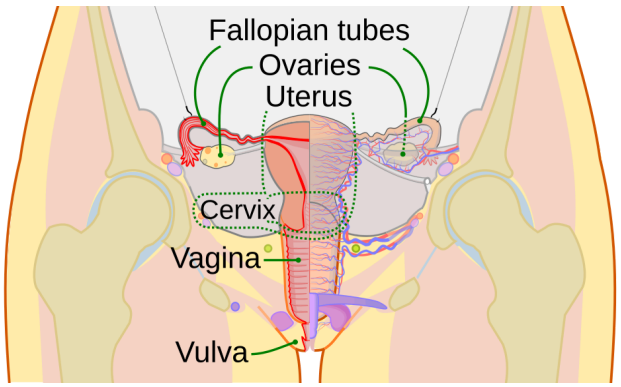
What is one artificial process by which plants can reproduce asexually?

- Plants can be cloned by taking cuttings.
- This is when someone cuts a piece off of an existing plant and grows it into a new plant.
- The new plant is genetically identical to the original plant (it is a clone).

HUMANS

What is the structure of the human female reproductive system?
The human female reproductive system consists of the following parts:

- The vulva - the external part of the female reproductive system
- The vagina - a tube-shaped structure
- The cervix - the structure that connects the vagina to the uterus
- The uterus (also known as the womb)
- The fallopian tubes - which are connected to the uterus at one end and are open at the other end
- The ovaries



What is the role of the ovaries in human reproduction?
The ovaries produce egg cells (female gametes) through the process of meiosis.

What happens to the egg cells that are produced in the ovaries?

- Roughly once every 28 days, one of the ovaries releases an egg cell. This process is called ovulation.
- Once an egg cell is released, it enters the open end of the nearby fallopian tube and starts travelling down the fallopian tube.
- If sperm cells are present in the fallopian tube, fertilisation may take place - this is when the egg cell and sperm cell fuse to form a zygote.
- If fertilisation does not take place, the unfertilised egg cell breaks down.

What is the structure of the human male reproductive system?
The human male reproductive system consists of the following parts:

- The two testes (singular: testis)
- The scrotum - which contains the testes
- The penis
- The urethra - a tube inside the penis
- The sperm ducts - which connect the testes to the urethra
- The erectile tissue - a tissue within the penis containing spaces that can fill with blood

What is the role of the testes in human reproduction?
The testes produce sperm cells (male gametes) through the process of meiosis.

How does sexual reproduction take place in humans?
Sexual reproduction in human takes place by the following process:

- During sexual intercourse, the erectile tissue in the penis fills with blood, causing the penis to become erect.
- The penis enters the vagina.
- Ejaculation takes place - this is when the penis releases a fluid called semen, which contains sperm cells.
- The sperm cells travel through the vagina, then through the cervix, then through the uterus, and then into the fallopian tubes.
- If an egg cell is present in one of the fallopian tubes, it may fuse with one of the sperm cells to form a zygote (in other words, fertilisation may take place).

What happens to a human zygote once it has formed?

- Once a human zygote forms, it travels down the fallopian tube and into the uterus.
- As the zygote travels, it undergoes cell division and develops into an embryo.
- Once the embryo arrives in the uterus, it may implant into the uterus lining.
- If the embryo successfully implants into the uterus lining, pregnancy occurs.
- During pregnancy the embryo develops into a foetus, which is then born, becoming a baby.
- If the embryo does not implant into the uterus lining, then pregnancy does not occur.

What is the menstrual cycle?

- The menstrual cycle is a repeating series of changes that take place within the female reproductive system, beginning at puberty and continuing until around the age of 50.
- Roughly once every 28 days, the menstrual cycle releases an egg cell and prepares the body for fertilisation.

What are the two main parts of the female reproductive system that are involved in the menstrual cycle?
The ovaries and the uterus (womb).

How long does the menstrual cycle last?
The length of the menstrual cycle varies but the average length is around 28 days.

What is menstruation?

- Menstruation (also known as a period) is a process which takes place at the beginning of each menstrual cycle.
- During menstruation, the lining of the uterus breaks down.
- Blood and other tissue from the broken down uterus lining then passes out of the body through the vagina.

How long does menstruation typically last?
Menstruation varies in length, but it typically lasts about 5 days.

What happens in the menstrual cycle after menstruation?

- After menstruation (on around day 6 of the menstrual cycle), the uterus lining starts to thicken again.
- On around day 14, ovulation takes place - this is when an egg cell is released from one of the ovaries.
- The uterus lining then continues to thicken and the egg cell travels through the fallopian tube towards the uterus.
- If the egg cell is not fertilised, the cycle will begin again with menstruation after about day 28.

What is oestrogen?
Oestrogen is a hormone that is produced in ovaries of females and secreted into the bloodstream.

What is progesterone?
Progesterone is a hormone that is produced in ovaries of females and secreted into the bloodstream.

What is testosterone?
Testosterone is a hormone that is produced in testes of males and secreted into the bloodstream.

[Note: In females, oestrogen, progesterone and testosterone are all produced in the ovaries. In males, oestrogen, progesterone and testosterone are all produced in the testes.]

What is the role of oestrogen in the menstrual cycle?
Oestrogen stimulates the uterus lining to build up.

What is the role of progesterone in the menstrual cycle?
Progesterone stimulates the body to maintain the uterus lining.

TRIPLE SCIENCE ONLY

If you are doing double award, you will not be tested on the contents of this box.

What is FSH?
FSH (follicle-stimulating hormone) is a hormone that is produced in the pituitary gland and secreted into the bloodstream.

What is LH?
LH (Luteinising hormone) is a hormone that is produced in the pituitary gland and secreted into the bloodstream.

What is the role of FSH in menstruation?
FSH stimulates an egg cell to mature in one of the ovaries.

What is the role of LH in menstruation?
LH stimulates ovulation (the release of an egg cell from one of the ovaries).

How do oestrogen, progesterone, FSH and LH interact with each other in the regulation of the menstrual cycle?

- FSH stimulates the ovaries to produce oestrogen.
- Oestrogen then inhibits the release of FSH.
- Oestrogen also stimulates the release of LH.
- LH stimulates the ovaries to produce progesterone.
- Progesterone inhibits the release of both FSH and LH.

What is the placenta?

- The placenta is a temporary organ that develops in the uterus during pregnancy.
- The placenta is connected to the mother's blood supply.
- The placenta is connected to the foetus through a structure called the umbilical cord.
- The placenta passes nutrients and oxygen to the foetus through the umbilical cord.
- The placenta also takes the waste products urea and carbon dioxide from the foetus and passes them into the mother's bloodstream.

What is amniotic fluid?

- Amniotic fluid is fluid that is found in the uterus during pregnancy.
- The amniotic fluid surrounds the foetus.
- The amniotic fluid cushions the foetus to protect it from damage.

What is puberty?
Puberty is a process in which the human body undergoes changes that prepare it for reproduction. In most people, puberty begins in childhood and lasts for a few years.

What are secondary sex characteristics?
Secondary sex characteristics are features of the female and male body that develop during puberty.

What are the main female secondary sex characteristics?
The main female secondary sex characteristics are:

- The menstrual cycle begins
- The body has a growth spurt
- Underarm and pubic hair grow
- Breasts develop

What are the main male secondary sex characteristics?
The main male secondary sex characteristics are:

- The testes grow and begin producing sperm
- The body has a growth spurt
- Underarm, pubic and facial hair grow
- The larynx (voice box) gets bigger and the voice breaks (becomes deeper)

What causes secondary sex characteristics to develop?

- During puberty, the body releases reproductive hormones into the bloodstream.
- The main female reproductive hormone is oestrogen and the main male reproductive hormone is testosterone.
- However, both females and males produce both hormones.
- These reproductive hormones stimulate the secondary sex characteristics to develop.