IGCSE BIOLOGY 0610 · CHAPTER 12 NOTES · ~21 MIN READ

Reproduction

Asexual vs sexual reproduction, the parts of a flower, pollination and fertilisation, germination, the human reproductive systems, the placenta, the menstrual cycle and how HIV and other STIs are spread and controlled.

Asexual & sexual | Flowers & pollination | Germination | Human reproductive systems | Menstrual cycle | STIs

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No tag = **Core** (everyone) EXTENDED Extended only highlight = comes up again and again

Test yourself at the end

IN 30 SECONDS

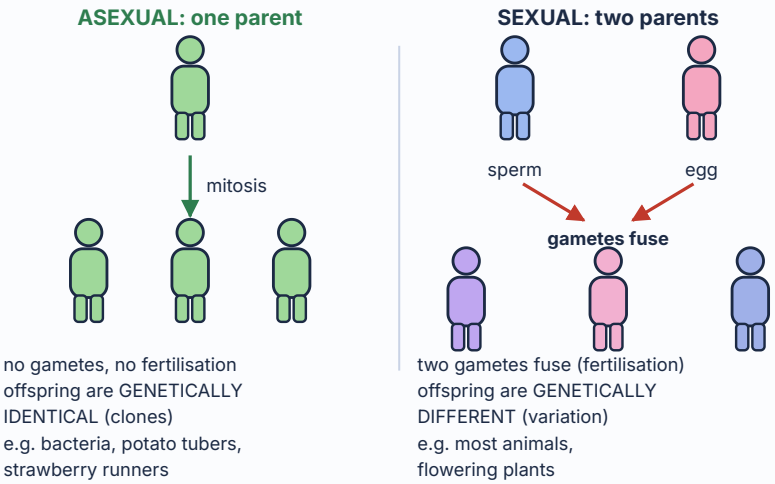
- **Asexual** reproduction needs **one parent** and makes **identical clones**. **Sexual** reproduction **fuses the nuclei of two gametes**, so the offspring are **genetically different**.
- In a flower, **pollination** (pollen reaches the stigma) comes first, then **fertilisation** (two nuclei fuse). The ovule becomes the **seed**. A seed needs **water, oxygen and warmth** to **germinate**.
- In humans, a **sperm fertilises an egg in the oviduct**, the embryo **implants in the uterus lining** and is fed through the **placenta**. **Hormones** control puberty and the **menstrual cycle**.

BY THE END YOU CAN

- Define asexual and sexual reproduction and give examples of each.
- Identify the parts of a flower and state what each part does.
- Compare insect-pollinated and wind-pollinated flowers, including their pollen.
- Define pollination and fertilisation in plants.
- State the conditions needed for seed germination and plan an investigation.
- Identify the male and female reproductive organs and state their functions.
- Compare sperm and egg and explain how each is adapted for its job.
- Describe fertilisation and implantation, and the roles of the umbilical cord, placenta, amniotic sac and amniotic fluid.
- State the roles of testosterone and oestrogen at puberty and describe the menstrual cycle.
- Define an STI, and describe how HIV is spread, how it leads to AIDS and how its spread is controlled.
- Discuss the advantages and disadvantages of asexual and sexual reproduction in wild populations and crops. EXT
- Explain the effects of self-pollination and cross-pollination, and describe pollen tube growth. EXT
- Explain how the placenta works and which harmful substances can cross it. EXT
- Describe the roles of FSH, LH, oestrogen and progesterone in the menstrual cycle. EXT

1 Two ways to reproduce

Asexual reproduction



Asexual: fast, one parent. Sexual: variation helps when conditions change.

Asexual: one parent, no gametes, clones. Sexual: two gametes fuse, offspring vary.

Asexual reproduction — a process resulting in the production of **genetically identical offspring from one parent**.

- **No gametes** and **no fertilisation** are needed. The parent divides by **mitosis** (see mitosis), so the offspring are **clones** with the **same genes** as the parent.
- **Examples: bacteria** split in two, a **potato** plant grows new plants from its **tubers**, a **strawberry** plant sends out **runners** that root and become new plants.

Sexual reproduction

Sexual reproduction — a process involving the **fusion of the nuclei of two gametes** (sex cells) to form a **zygote**, and the production of offspring that are **genetically different from each other**.

- **Gametes: sperm** and **egg** in animals. In flowering plants, the male gamete is in the **pollen grain** and the female gamete is the **egg cell in the ovule**.
- Offspring get **half their genes from each parent** in a **new mix**, so they **vary**.
- EXT Gametes are **haploid** (one set of chromosomes). Fertilisation makes a **diploid zygote** (two sets), which divides by mitosis to grow into the new organism. (chromosomes)

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Which is better?

EXTENDED

	Asexual	Sexual
advantages	only **one parent**, no mate needed; **fast**, many offspring; good features are **kept**; no energy spent on gametes or flowers	**variation**: some offspring may survive a **new disease** or a **changed environment**; the species can **adapt** over time
disadvantages	**no variation**: one disease or one change in conditions can kill **all** of them; offspring **crowd** each other	needs **two parents** or a pollinator; **slower**; uses more energy; **fewer** offspring
in crops	all plants are identical, so **uniform yield**, but all are **equally at risk** from the same disease	farmers can **breed new varieties** (more disease resistance, higher yield), but plants are less uniform
in wild populations	quick way to **fill a stable habitat**	variation is **vital** when conditions change, so the population can **survive and evolve**

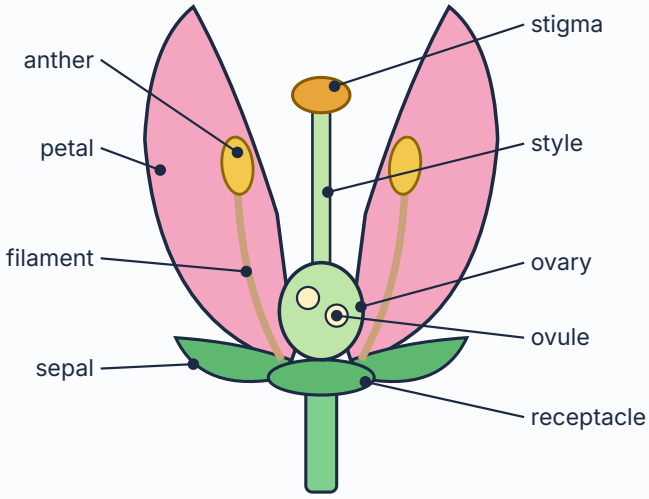
EXAM TIP

Do not just write "asexual is faster". Say **why it matters**: no variation means a **single disease** can wipe out the whole population.

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2 Reproduction in flowering plants

Parts of a flower



Half a flower. Male parts: anther and filament. Female parts: stigma, style, ovary.

Part	Function
sepal	green; **protects the flower bud**
petal	**bright colour** in insect-pollinated flowers, to **attract insects**
stamen (male)	**anther + filament**
anther	makes **pollen grains**, which contain the **male gametes**
filament	**holds the anther up**
carpel (female)	**stigma + style + ovary**
stigma	**sticky top** that **catches pollen**
style	**holds the stigma up**
ovary	contains the **ovules**; it becomes the **fruit**
ovule	contains the **female gamete** (egg cell); it becomes the **seed**

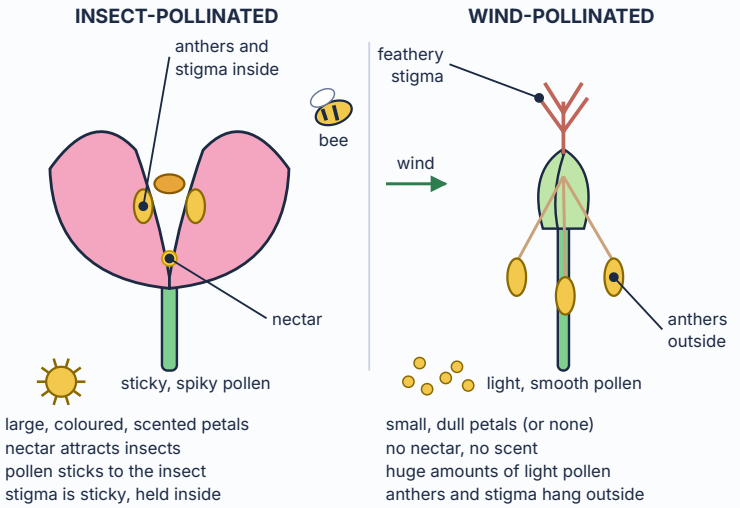
MEMORY TRICK

Anther **A**dds pollen. **S**tigma is **S**ticky and **S**ticks pollen on.

EXAM TIP

Drawing a flower: sharp pencil, **large** drawing (use over half the space), **single clear lines**, **no shading or colour**, **straight label lines** drawn with a ruler that **never cross**. Use a **hand lens** to see the small parts.

Pollination: insect or wind?



The same job, two designs. Insect flowers advertise and have heavy, sticky pollen. Wind flowers are plain and have light pollen.

Pollination — the **transfer of pollen grains from the anther to the stigma**.

Feature	Insect-pollinated	Wind-pollinated
petals	**large, brightly coloured**	**small and dull** (or none)
scent and nectar	**yes**: they attract insects	**none**
anthers	**inside** the flower, where an insect brushes them	**hang outside** on long filaments, so wind shakes pollen out
stigma	small and **sticky**, **inside** the flower	**large and feathery**, **hangs outside** to catch pollen from the air
pollen	**larger**, **sticky or spiky**, so it clings to the insect	**smaller, lighter, smooth**, made in **huge amounts**

- **Examples:** insect-pollinated: hibiscus, sunflower. Wind-pollinated: grasses, maize, wheat.

WORKED EXAMPLE

A drawing of an insect-pollinated pollen grain is 36 mm across. The real grain is 0.04 mm across. Calculate the magnification.

1. magnification = drawing size ÷ real size
2. = 36 ÷ 0.04
3. = **× 900**
4. **both sizes must be in the same unit (here mm), so no conversion is needed**

COMMON MISTAKE

"Pollination and fertilisation are the same thing."
Pollination = pollen **lands on the stigma**.
Fertilisation = nuclei **fuse** (it happens later).

Self- and cross-pollination

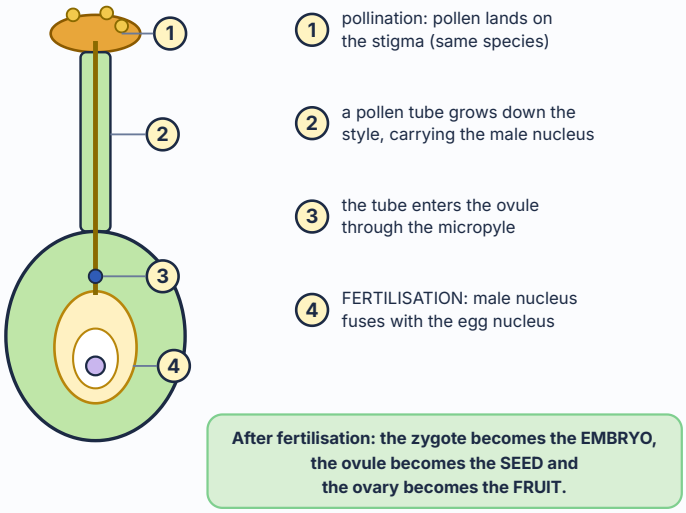
EXTENDED

Self-pollination — EXT transfer of pollen from an anther to a stigma of the **same flower or another flower on the same plant**.

Cross-pollination — EXT transfer of pollen from an anther to the stigma of a flower on a **different plant of the same species**.

Effect on the population	Self-pollination	Cross-pollination
variation	**low**: offspring are similar to the parent	**high**: genes from **two plants** are mixed
response to change	**poor**: a new disease or climate change may harm all	**better**: some offspring are likely to **survive and adapt**
cost	**needs no pollinator** or second plant	needs **wind or insects** and another plant nearby

Fertilisation and seeds

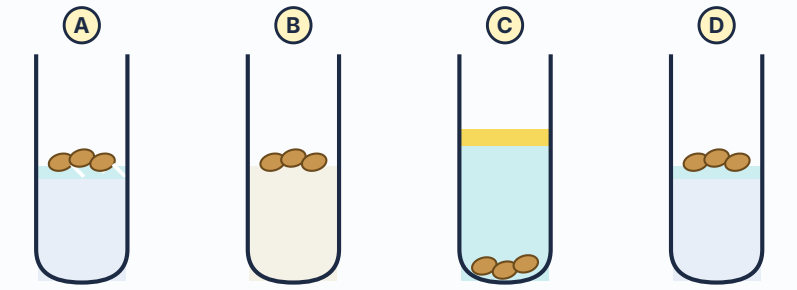


Pollen lands, grows a tube, and a male nucleus fuses with the egg nucleus.

Fertilisation (plants) — the **fusion of a pollen nucleus** (male) with the **nucleus of an ovule** (female).

- EXT **Pollen tube:** a pollen grain that lands on a **sticky stigma** grows a **pollen tube** down through the **style** to the ovary. The tube **enters the ovule** through a tiny opening (the **micropyle**) and the **male nucleus fuses with the egg nucleus** to make the **zygote**.
- **After fertilisation:** the zygote becomes the **embryo**, the **ovule becomes the seed** and the **ovary becomes the fruit**.

Seed germination



A	B	C	D
moist cotton wool air and warmth 20 °C	DRY cotton wool air and warmth 20 °C	boiled water + oil (no oxygen) 20 °C	moist cotton wool air 5 °C (cold)
GERMINATES	**no germination**	**no germination**	**no germination**

Seeds need WATER, OXYGEN and a SUITABLE TEMPERATURE to germinate.
(Most seeds do not need light or soil.)

Tube A has everything and germinates. Each other tube is missing one condition.

Germination — the **start of growth** of a seed into a young plant (a seedling).

- **Three conditions: water**, **oxygen** and a **suitable temperature**.
- **Water** switches on the **enzymes** that start growth. **Oxygen** is needed for **aerobic respiration**, which releases the energy for growth (respiration). A **suitable (warm) temperature** lets **enzymes** work well (enzymes).
- **Light and soil are not needed.** The seed has its **own food store** until the leaves can make food (photosynthesis).
- **How to investigate:** keep one condition missing in each tube: **dry** cotton wool (no water), **boiled water with a layer of oil** (boiling drives out oxygen and the oil keeps air out), a **fridge** (too cold). Tube A is the **control**.

EXAM TIP

Fair test: same **kind and number of seeds**, same **volume of water**, same temperature (except in tube D). Use **about 10 seeds per tube**, because a few may be dead.

WORKED EXAMPLE

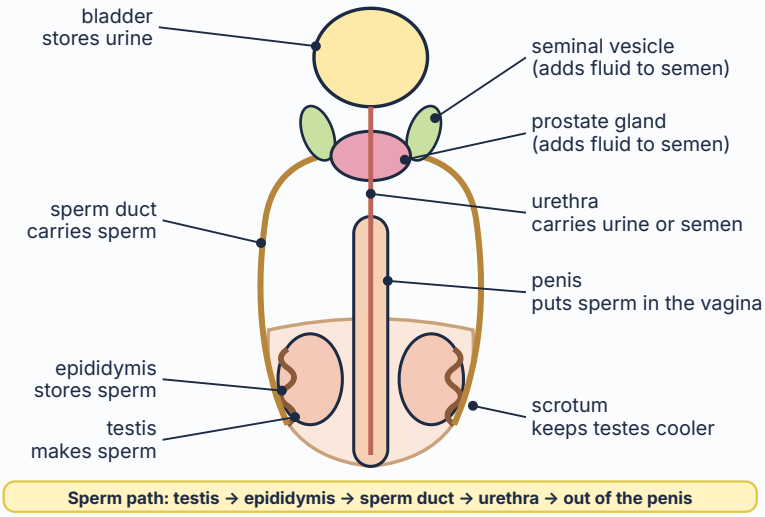
In an experiment, 18 of 20 seeds germinated in tube A and 3 of 20 in tube D. Calculate the percentage germination in each tube.

1. tube A: 18 ÷ 20 × 100 = **90%**
2. tube D: 3 ÷ 20 × 100 = **15%**
3. the difference is 90 − 15 = **75 percentage points**
4. **conclusion: low temperature reduced germination**

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3 Human reproduction

The male reproductive system



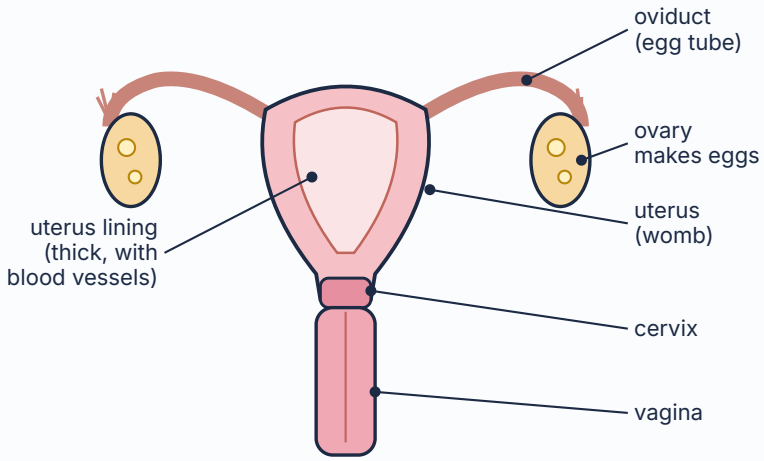
The male system. Sperm path: testis, sperm duct, urethra, out of the penis.

Part	Function
testes	make **sperm** and the hormone **testosterone**
scrotum	sac that holds the testes **outside** the body, where it is a little **cooler** than the body: **better for sperm**
sperm duct	carries sperm from the testes to the urethra
prostate gland	adds **fluid** to the sperm, making **semen**
urethra	tube through the penis that carries **semen** (or **urine**, but never both at once)
penis	puts sperm into the **vagina** during sexual intercourse

- **Extra detail:** the **epididymis** (coiled tube on each testis) **stores sperm**, and the **seminal vesicles** also add fluid to the semen.

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The female reproductive system



Egg path: ovary → oviduct (fertilisation here) → uterus (embryo implants)

The female system. Egg path: ovary, oviduct, uterus.

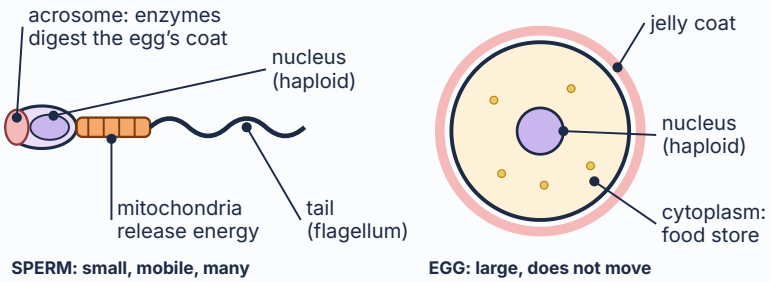
Part	Function
ovary	makes **eggs** and releases **one about every month**; also makes the hormones **oestrogen** and **progesterone**
oviduct (egg tube)	carries the egg to the uterus; **fertilisation happens here**
uterus (womb)	where the **embryo implants** and the **fetus develops**; its **lining** thickens each month
cervix	**ring of muscle** at the bottom of the uterus; it holds the fetus in during pregnancy
vagina	**receives the penis** and sperm; the **birth canal**

COMMON MISTAKE

"Fertilisation happens in the uterus." Fertilisation is in the **oviduct**. The **uterus** is where the embryo **implants** and grows.

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Gametes: sperm and egg



SPERM: small, mobile, many **EGG: large, does not move**

SPERM	EGG
tail to swim	food store for the embryo
many mitochondria	jelly coat changes after fertilisation
enzymes in the acrosome	so only ONE sperm gets in
made in huge numbers	made in small numbers

Sperm are small swimmers. The egg is large and carries food.

Gamete — a **sex cell** (sperm or egg) with **half the normal number of chromosomes** (haploid).

Feature	Sperm	Egg
size	**very small**	**much larger** (about 0.1 mm, just visible)
movement	**swims** using its tail	**does not move**: it is carried along the oviduct
numbers	**millions** made	**usually one** released a month
food store	**very little**	**lots** in the cytoplasm

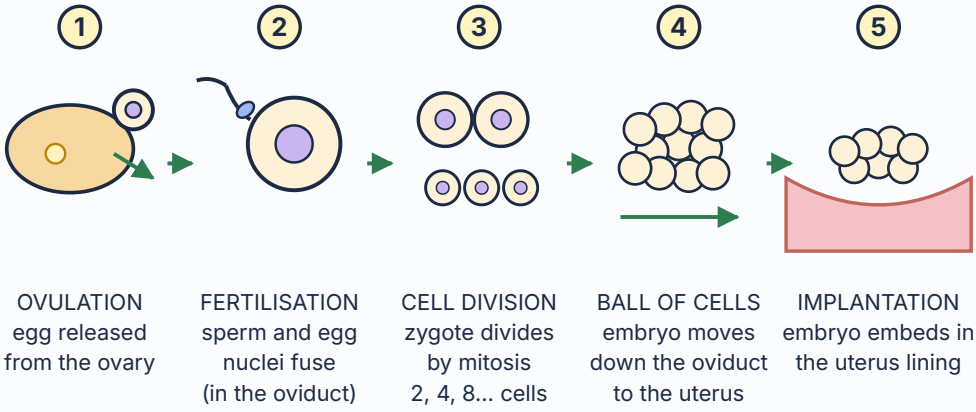
- **Sperm are adapted:** a **tail** to swim, **many mitochondria** to release energy for swimming, and **enzymes in the head (acrosome)** that digest the **outer layer of the egg**.
- **The egg is adapted:** a **large food store** for the early embryo, and an **outer layer that changes after one sperm enters**, so **no other sperm** can get in.

MEMORY TRICK

Sperm **S**wim. The **E**gg is **E**normous and **E**dible (full of food).

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Fertilisation and implantation



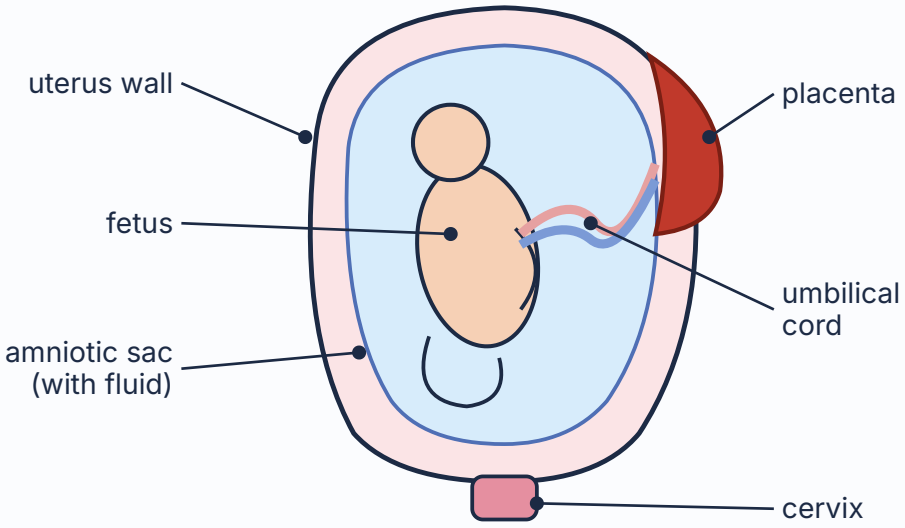
Pregnancy lasts about 9 months: embryo → fetus (from about 8 weeks) → baby

From ovulation to implantation. Fertilisation happens at stage 2, in the oviduct.

Fertilisation (animals) — the **fusion of the nuclei of a sperm and an egg** to form a **zygote**.

- The **zygote divides by mitosis** as it is moved down the oviduct, forming a **ball of cells**: the **embryo**.
- **Implantation:** the embryo **sinks into the thick uterus lining**. This is when **pregnancy begins**.
- After about **8 weeks** the embryo has all its organs and is called a **fetus**. A pregnancy lasts about **9 months**.

The fetus and the placenta



The fetus floats in amniotic fluid and is joined to the placenta by the umbilical cord.

Structure	Function
amniotic sac	a **membrane bag** around the fetus that holds the **amniotic fluid**
amniotic fluid	**cushions** the fetus against **bumps and shocks**, helps keep a **steady temperature** and lets the fetus move
umbilical cord	**joins the fetus to the placenta**; carries blood vessels to and from the fetus
placenta	disc-shaped organ on the uterus wall where **substances are exchanged** between **mother's blood** and **fetus's blood**

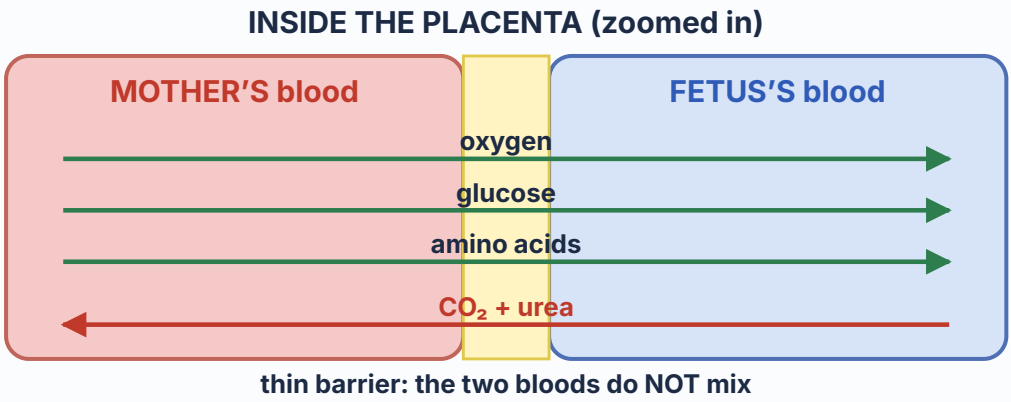
- **From mother to fetus: oxygen**, **glucose**, **amino acids**, **vitamins and minerals**, **water** and **antibodies**. **From fetus to mother: carbon dioxide** and **urea**.

COMMON MISTAKE

"The mother's blood flows into the baby." **No.** Blood stays in **separate vessels**; only **dissolved substances** cross the thin barrier.

How the placenta works

EXTENDED



Mother → baby: oxygen, glucose, amino acids, antibodies (and harmful alcohol, nicotine, viruses such as rubella and HIV). Baby → mother: CO_2 and urea.

EXT Substances cross a very thin barrier by diffusion and active transport. The two bloods never mix.

- EXT **Adapted for exchange:** the placenta has a **large surface area** (many finger-like villi), **thin walls** (short diffusion distance) and a **rich blood supply** that keeps the concentration gradients steep.
- EXT **The two bloods do not mix.** Substances cross by **diffusion and active transport** (diffusion).
- EXT **Harmful things can cross too: toxins** such as **alcohol** and **nicotine**, and **pathogens** such as the **rubella** and **HIV viruses**. That is why pregnant women are advised not to smoke or drink alcohol. (diseases)

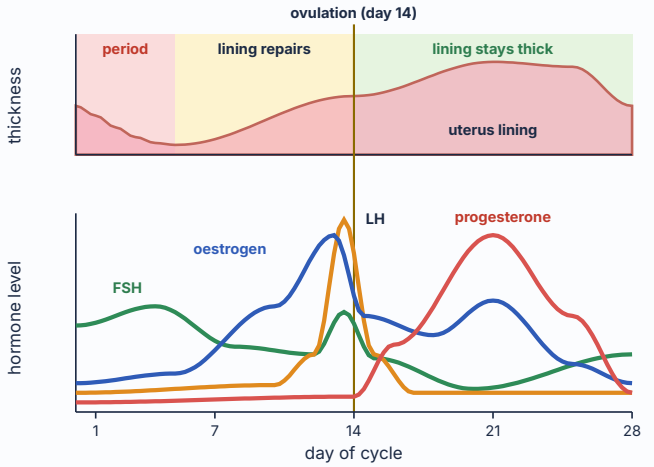
Puberty

- **Puberty** is when the body **becomes able to reproduce**. It usually starts between about **10 and 15 years**.

Hormone	Made in	Changes
testosterone	the **testes**	**facial and body hair**, **deeper voice**, **more muscle**, **sperm production starts**
oestrogen	the **ovaries**	**breasts develop**, **hips widen**, **body hair**, the **menstrual cycle starts**

- Both sexes also have a **growth spurt**, **pubic hair** and **emotional changes**.

The menstrual cycle



A 28-day cycle. The lining repairs, an egg is released near day 14, and the lining breaks down if there is no pregnancy.

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- **Day 1 is the first day of the period.** A typical cycle lasts about **28 days** (it varies between women).
- **Days 1 to 5, menstruation (the period):** the **lining of the uterus breaks down** and leaves through the **vagina** with some blood.
- **Days 5 to 14:** the **lining repairs and thickens** again.
- **About day 14, ovulation:** an **egg is released** from an ovary into the oviduct.
- **Days 14 to 28:** the lining stays **thick and spongy**, ready for an embryo. **If no embryo implants**, the lining breaks down and the next period starts. **If an embryo implants**, the lining is kept and there are **no periods**.

WORKED EXAMPLE

A woman's period starts on 3 March (day 1) and her cycle is 28 days. Find the date of ovulation and the date her next period should start.

1. ovulation is on **day 14**
2. day 1 = 3 March, so day 14 = 3 + 13 = **16 March**
3. next period starts on day 29, which is day 1 of the next cycle
4. **3 March + 28 days = 31 March**

COMMON MISTAKE

"Ovulation and menstruation are the same." **Ovulation** = an **egg is released** (about day 14). **Menstruation** = the **lining breaks down** (the period, days 1 to 5).

Hormones of the cycle

EXTENDED

Hormone	Made in	Main roles
FSH	**pituitary gland**	makes a **follicle (egg) develop** in the ovary; stimulates the ovary to make **oestrogen**
LH	**pituitary gland**	a **surge** about day 14 causes **ovulation**
oestrogen	**ovaries**	**repairs and thickens** the lining; **high levels trigger the LH surge** and **inhibit FSH**
progesterone	**ovaries**	**keeps the lining thick**; if it **falls**, the lining breaks down (period)

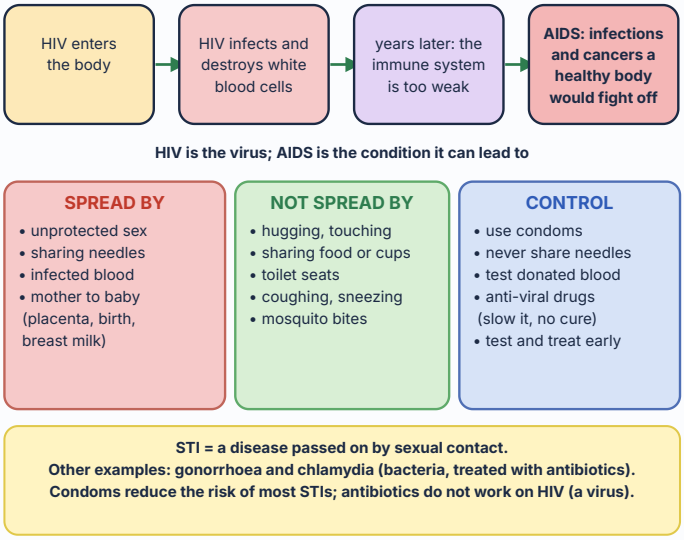
- EXT If the woman becomes **pregnant**, progesterone **stays high**, so the lining is **maintained**. (hormones)

MEMORY TRICK

FSH = **F**ollicle-**S**timulating: it **F**ires up the egg. **LH** = **L**aunches the egg.

4 Sexually transmitted infections

HIV and AIDS



HIV is the virus. AIDS is the condition that can develop years later if HIV is not treated.

Sexually transmitted infection (STI) — an infection that is **passed on by sexual contact**.

- **HIV (human immunodeficiency virus)** is the **pathogen**. It infects and **destroys white blood cells**, so the **immune system weakens** (immunity).
- **AIDS (acquired immune deficiency syndrome)** develops when the immune system is **too weak** to fight off infections and some cancers.
- **How HIV is spread: unprotected sexual intercourse**, **sharing needles** (blood), **infected blood** in transfusions, and **from mother to baby** (across the placenta, at birth or in breast milk).
- **How it is controlled: condoms**, **never sharing needles**, **testing donated blood**, **anti-viral drugs** (these **slow** the virus but do **not cure** it) and **testing and treating** pregnant women.
- Other STIs, such as **gonorrhoea** and **chlamydia**, are caused by **bacteria** and **treated with antibiotics**. **Antibiotics do not work on HIV** because it is a **virus**.

COMMON MISTAKE

"HIV and AIDS are the same." **HIV** is the **virus**. **AIDS** is the **condition** that can develop later.

COMMON MISTAKE

"You can catch HIV from hugging, sharing food or a toilet seat." **No.** HIV passes only through **blood and body fluids**.

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Test yourself — cover the answers first

QUICK CHECK

1. Define asexual reproduction.
2. Define sexual reproduction.
3. Give two examples of asexual reproduction.
4. What does the anther do?
5. Name the female parts of a flower.
6. Define pollination.
7. Give two features of a wind-pollinated flower.
8. State the three conditions needed for germination.
9. Where does fertilisation take place in humans?
10. What is implantation?
11. What is the function of the amniotic fluid?
12. What joins the fetus to the placenta?
13. Which hormone causes the changes in boys at puberty?
14. On about which day of a 28-day cycle does ovulation happen?
15. What virus causes AIDS?
16. EXT Give one advantage of sexual reproduction.
17. EXT What does the pollen tube do?
18. EXT Which hormone causes ovulation?
19. EXT Which hormone keeps the uterus lining thick?
20. EXT Name two harmful things that can cross the placenta.

EXAM-STYLE

21. Describe the differences between insect-pollinated and wind-pollinated flowers. [4]
22. Describe how you would investigate whether oxygen is needed for germination. [4]
23. Describe what happens from fertilisation to implantation. [4]
24. EXT Explain how the placenta is adapted for exchange. [3]
25. EXT Explain why a pregnant woman should not smoke or drink alcohol. [3]
26. EXT Describe the roles of FSH and LH in the menstrual cycle. [4]
27. Describe how HIV is spread and how its spread can be controlled. [4]

Show answers

1. production of genetically identical offspring from one parent
2. fusion of the nuclei of two gametes to form a zygote; the offspring are genetically different
3. bacteria dividing; potato tubers; strawberry runners
4. makes pollen grains
5. stigma, style and ovary (the carpel)
6. the transfer of pollen grains from the anther to the stigma
7. small dull petals; anthers hanging outside; large feathery stigma; light smooth pollen
8. water, oxygen, a suitable temperature
9. in the oviduct
10. the embryo sinks into the lining of the uterus
11. cushions and protects the fetus
12. the umbilical cord
13. testosterone
14. day 14
15. HIV (human immunodeficiency virus)
16. variation, so some offspring may survive a change or a new disease
17. carries the male nucleus down the style to the ovule
18. LH (luteinising hormone)
19. progesterone
20. alcohol, nicotine, viruses such as rubella or HIV
21. insect: large bright petals; wind: small dull petals
    insect: scent and nectar; wind: none
    insect: sticky or spiky pollen; wind: light smooth pollen in large amounts
    insect: anthers and stigma inside; wind: anthers hang out and the stigma is feathery
22. put the same number of seeds in each of two tubes
    one tube has boiled (cooled) water with a layer of oil, so there is no oxygen
    the other (control) tube has moist cotton wool with air
    keep the temperature and water the same and count the seeds that germinate after several days
23. sperm nucleus fuses with egg nucleus in the oviduct
    forming a zygote
    the zygote divides by mitosis into a ball of cells (embryo)
    the embryo moves to the uterus and sinks into the lining
24. large surface area from villi
    thin walls so a short diffusion distance
    rich blood supply keeps concentration gradients steep
25. toxins (nicotine, alcohol) cross the placenta into the fetal blood
    they can harm the development of the fetus
    smoking can lead to a low birth mass

26. both are made by the pituitary gland
    FSH makes a follicle and egg develop in the ovary
    FSH stimulates the ovary to make oestrogen
    LH causes ovulation (release of the egg) about day 14

27. spread by unprotected sex and sharing needles
    spread by infected blood and from mother to baby
    control by using condoms
    control by not sharing needles, testing donated blood or using anti-viral drugs

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