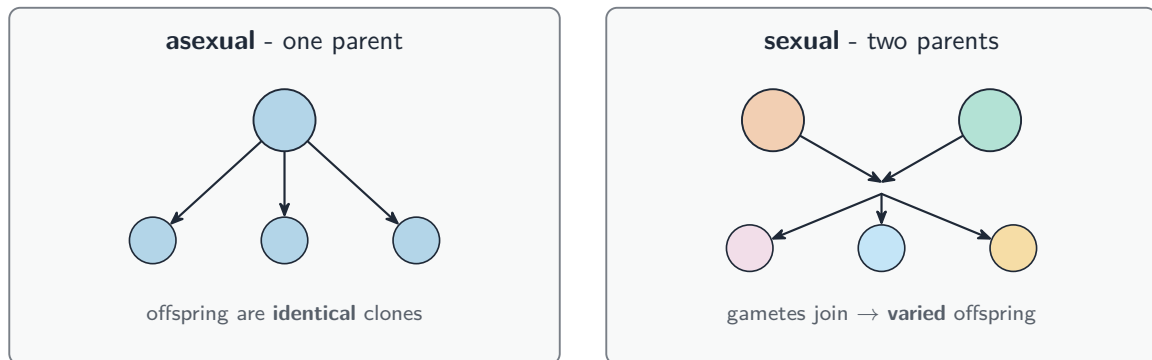


Reproduction

IGCSE Biology

Two kinds of reproduction

Reproduction 生殖 makes new organisms of the same kind. There are two types.



Asexual reproduction needs one parent and gives identical clones; sexual reproduction needs two and gives varied offspring

Asexual reproduction

Asexual reproduction 无性生殖 needs only **one parent** 亲本. The **offspring** 后代 have exactly the same **genes** 基因 as the parent —they are genetically identical (clones).

- **Advantage:** it is fast and needs only one parent —useful when conditions are good and stable.
- **Disadvantage:** all the offspring are identical, so if the **environment** 环境 changes (for example a new disease) they may all die. (In crops, identical plants give an even harvest, but one disease can wipe out the whole crop.)

advantage: fast, needs only one parent

disadvantage: no variation



Asexual reproduction is fast but gives no variation, so one disease can kill every identical offspring

Sexual reproduction

Sexual reproduction 有性生殖 needs **two** parents. It involves the **fusion** 融合 (joining) of the **nuclei** 细胞核 of two **gametes** 配子 (sex cells) to make a **zygote** 合子. This joining is called **fertilisation** 受精. The offspring get a mix of genes from both parents, so they show **variation** 变异 (they are genetically different).

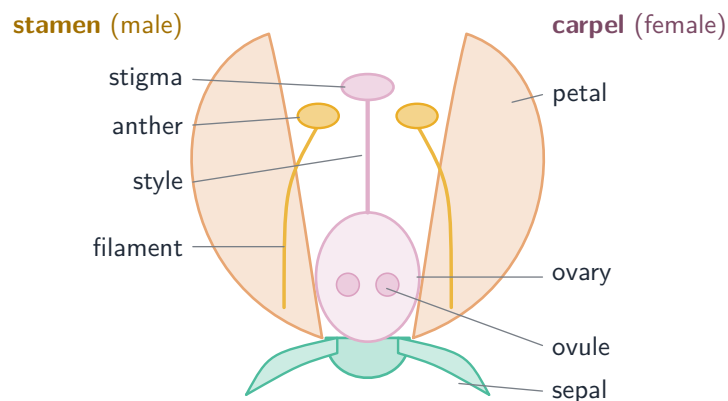
- **Advantage:** variation means some offspring may survive if the environment changes.
- **Disadvantage:** it is slower and needs two parents.

(Supplement) The nuclei of gametes are **haploid** 单倍体 (one set of **chromosomes** 染色体); the nucleus of the zygote is **diploid** 二倍体 (two sets).

Sexual reproduction in plants

Parts of an insect-pollinated flower

Part	Function
sepals 萼片	protect the flower bud before it opens
petals 花瓣	large and colourful, to attract insects 昆虫
stamens 雄蕊	the male parts; each is a filament 花丝 holding up an anther 花药
anther	makes pollen grains 花粉粒
carpel 雌蕊	the female part; made of a stigma 柱头, a style 花柱 and an ovary 子房
stigma	catches pollen grains
ovary	holds the ovules 胚珠, which become seeds



An insect-pollinated flower: the male stamens and the female carpel



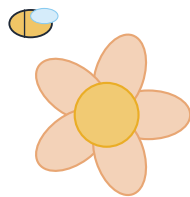
A real lily: the long stamens make pollen and the central stigma receives it

Image: Subhrajyoti07, CC BY-SA 4.0 (commons.wikimedia.org)

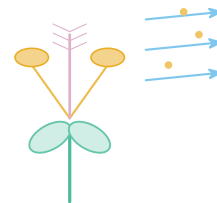
Pollination

Pollination 传粉 is the transfer of pollen grains from an anther to a stigma.

- **insect-pollinated** flowers have bright petals, scent and nectar, and sticky or spiky pollen, to attract insects and stick to them.
- **wind-pollinated** flowers have small dull petals, anthers and stigmas that hang out-side, and light, smooth pollen that blows in the wind.

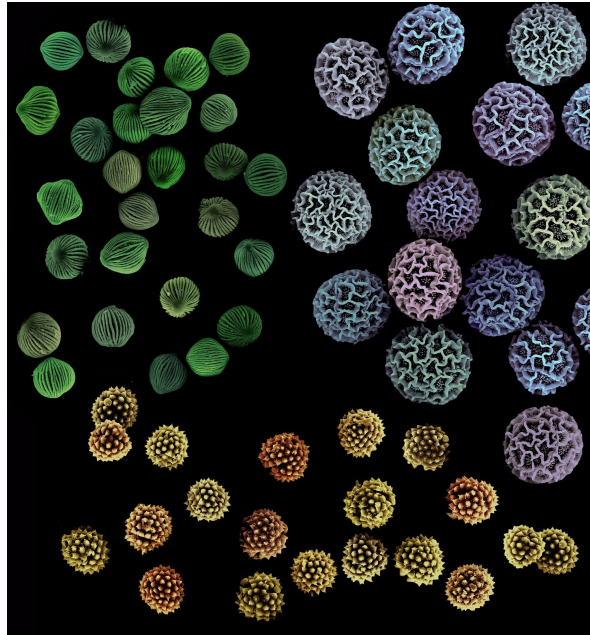


insect-pollinated
bright petals, scent + nectar;
sticky, spiky pollen



wind-pollinated
small dull petals; anthers &
stigma hang out; light pollen

Insect-pollinated flowers are showy; wind-pollinated flowers are small with parts hanging out



Pollen grains seen under an electron microscope (colour added); each plant has its own pattern

Image: Asja Radja, CC BY 4.0 (commons.wikimedia.org)

(Supplement) Self-pollination 自花传粉 is pollen landing on the stigma of the same flower (or another flower on the same plant). **Cross-pollination** 异花传粉 is pollen carried to a flower on a **different** plant of the same species. Cross-pollination gives more **variation**, helping the population cope with change, but it relies on **pollinators** 传粉者 or wind. Self-pollination is more reliable but gives less variation.

Fertilisation and germination

Fertilisation happens when a pollen nucleus fuses with a nucleus in an ovule. **(Supplement)** First a **pollen tube** 花粉管 grows down the style into the ovary, carrying the pollen nucleus to the ovule.

A **seed** 种子 will only **germinate** 萌发 (begin to grow) when it has water, **oxygen** 氧气 and a suitable **temperature** 温度.

Sexual reproduction in humans

The male reproductive system

Part	Function
testes 睾丸	make sperm 精子 and testosterone 睾酮
scrotum 阴囊	holds the testes outside the body, kept slightly cool
sperm ducts 输精管	carry sperm away from the testes
prostate gland 前列腺	adds fluid to make semen
urethra 尿道	carries semen (and urine) out through the penis
penis 阴茎	passes sperm into the female

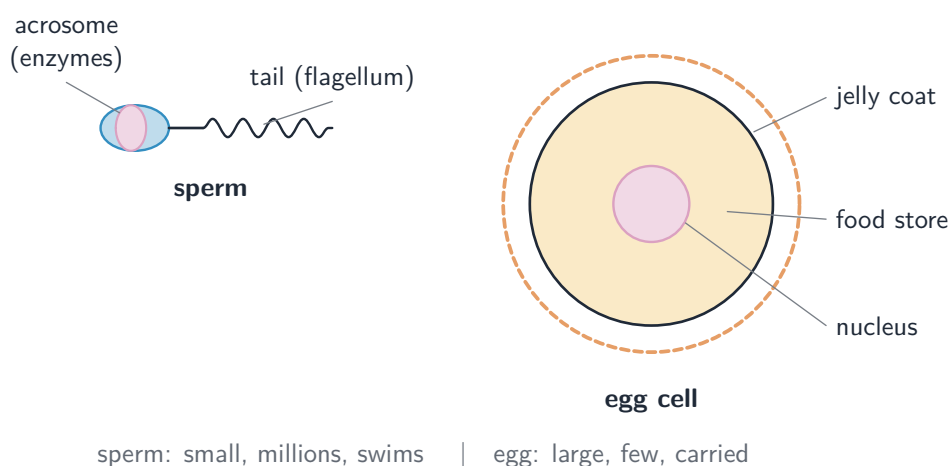
The female reproductive system

Part	Function
ovaries 卵巢	make egg cells 卵细胞 and oestrogen 雌激素
oviducts 输卵管	carry the egg towards the uterus; fertilisation happens here
uterus 子宫	where the baby develops
cervix 子宫颈	the ring of muscle at the base of the uterus
vagina 阴道	receives the penis; also the birth canal

Gametes and fertilisation

Fertilisation is the fusion of the nuclei of a male gamete (sperm) and a female gamete (egg cell). The two gametes are adapted to their jobs:

	Sperm	Egg cell
size	very small	large
number	millions	few (about one a month)
can it move?	yes —swims with a flagellum 鞭毛	no —it is carried along
special features	many mitochondria 线粒体 for energy; enzymes 酶 in the acrosome 顶体 to break into the egg	a store of food; a jelly coat 胶质层 that changes after fertilisation to keep other sperm out

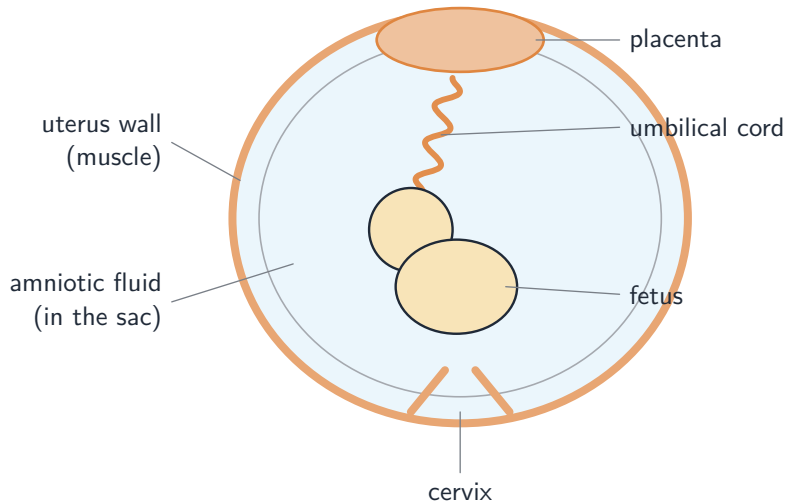


The sperm is small and swims; the egg cell is large and stores food

Pregnancy and the fetus

After fertilisation the zygote divides to form an **embryo** 胚胎—a ball of cells that **implants** 植入 into the lining of the uterus. As it grows it becomes a **fetus** 胎儿. These structures support it:

- the **placenta** 胎盘—where dissolved nutrients, gases and wastes are exchanged between the mother's blood and the fetus's blood (the two never mix).
- the **umbilical cord** 脐带—joins the fetus to the placenta.
- the **amniotic sac** 羊膜囊—a bag around the fetus, filled with **amniotic fluid** 羊水 that cushions it.



The fetus develops in the uterus, supported by the placenta, cord and amniotic sac

(Supplement) Some **pathogens** 病原体 and **toxins** 毒素 can cross the placenta and harm the fetus.

Sex hormones

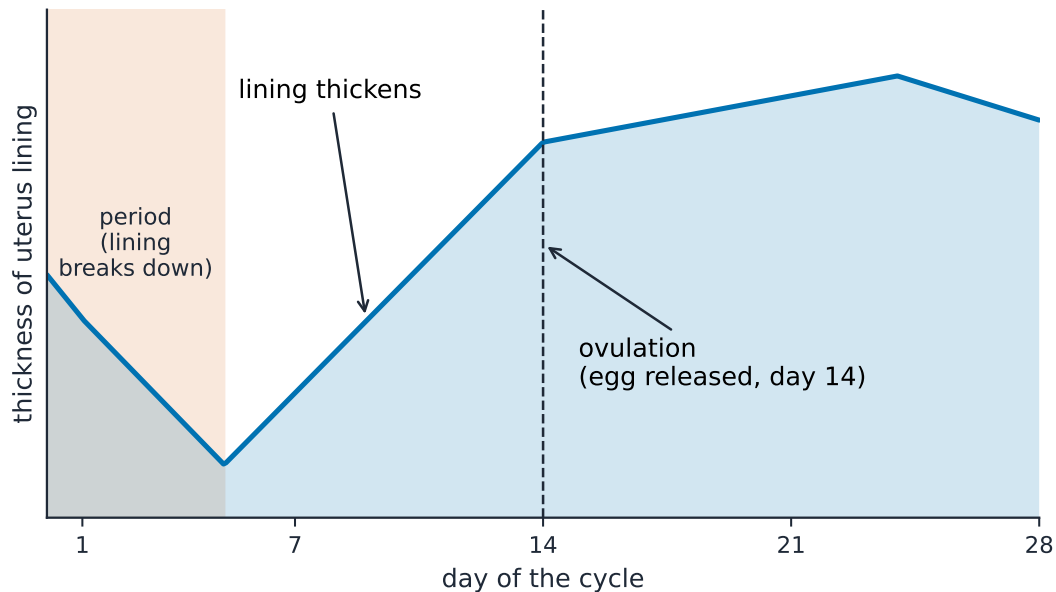
Puberty

At **puberty** 青春期, sex **hormones** 激素 make the body develop **secondary sexual characteristics** 第二性征—such as body hair, a deeper voice in boys, and breasts in girls. **Testosterone** does this in boys; **oestrogen** does it in girls.

The menstrual cycle

The **menstrual cycle** 月经周期 (about 28 days) prepares the uterus for a possible pregnancy:

- the lining of the uterus thickens.
- around day 14 an ovary releases an egg (**ovulation** 排卵).
- if the egg is not fertilised, the lining breaks down and leaves the body (a period), and the cycle starts again.



The lining thickens, an egg is released at day 14, and a period follows if there is no pregnancy

(Supplement) Four hormones control the cycle: **FSH** (makes an egg mature and the ovary release oestrogen), **LH** (triggers ovulation), **oestrogen** (repairs and thickens the lining), and **progesterone** 孕酮 (keeps the lining thick). Oestrogen and progesterone are made in the ovaries; during **pregnancy** 怀孕, progesterone keeps the lining in place.

Worked example. A woman has a regular 28-day cycle, and her period starts on the 1st of the month. On roughly which date is she most likely to conceive? Ovulation happens about **day 14**, so counting 14 days on from the start of the period points to about the **14th**, and the days either side of it are the most fertile. Day 1 is the day the period **starts**, not the day it ends - counting from the wrong day is what makes most cycle questions go wrong.

Sexually transmitted infections

A **sexually transmitted infection** 性传播感染 (STI) is an **infection** 感染 spread through sexual contact.

HIV is a **virus** 病毒 that causes an STI, and it can lead to **AIDS**, in which the immune system stops working properly. HIV is passed on in infected body fluids—for example by sharing needles, during sex, or from mother to baby (across the placenta or in breast milk).

The spread of STIs is controlled by using condoms, having fewer partners, testing and treating infected people, and not sharing needles.

Exam tips

- Asexual: one parent, identical offspring (no variation). Sexual: two parents, gametes fuse, offspring show variation.

- Fertilisation = fusion of two gamete nuclei $\rightarrow$ zygote. (Supplement: gametes haploid, zygote diploid.)
- Learn the flower parts and which are male (stamen) and female (carpel). Compare insect- and wind-pollinated flowers.
- Sperm: small, many, moving (flagellum). Egg: large, few, with a food store.
- Menstrual cycle: lining thickens $\rightarrow$ ovulation (day 14) $\rightarrow$ period if no fertilisation. (Supplement: FSH, LH, oestrogen, progesterone.)
- HIV is a virus that causes an STI and can lead to AIDS; it spreads through body fluids.