sexual reproduction

IN FLOWERING PLANTS

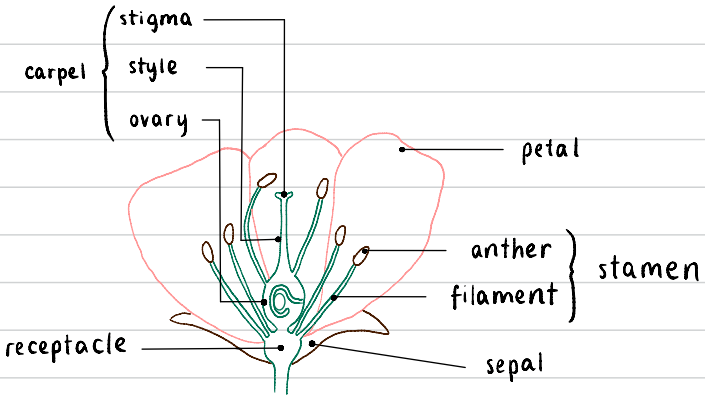
ASEXUAL REPRODUCTION

- offspring are genetically identical (clones)
- all cell divisions are by mitosis
- no variation

SEXUAL REPRODUCTION

- involves two parents
- meiosis is essential to sexual reproduction
- results in variation
- two gametes fuse to form a zygote

FLOWER



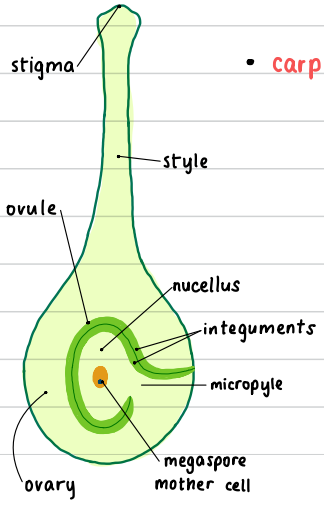
receptacle – supports structures

sepals – protect the flower when it's a bud

petals – attract insects

stamens (male):

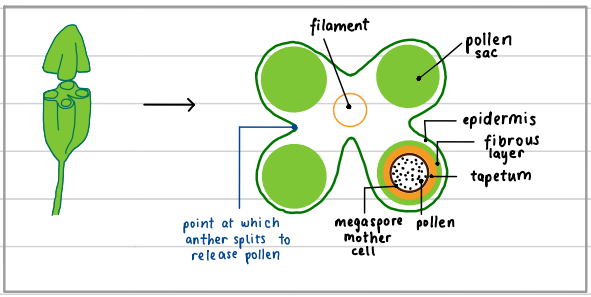
- filament – brings food and water to anther
- anther – produces pollen grains by meiosis

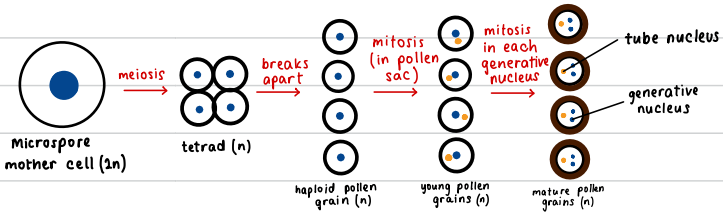


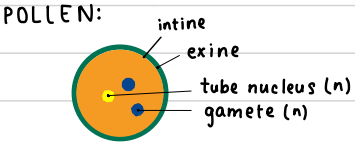
- carpel (female):
  - stigma – where pollen lands
  - style – structure through which pollen tube grows
  - ovary – contains ovule(s)

MALE GAMETE FORMATION

- microspore mother cell (2n) divides by meiosis in the cells lining the anther to produce four haploid pollen grains (tetrad)
- tetrad breaks up forming 4 separate pollen grains (microspores)
- the nucleus in each pollen grain divides by mitosis to produce two haploid nuclei – the generative and tube nuclei

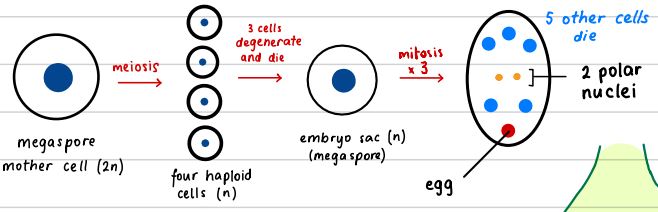


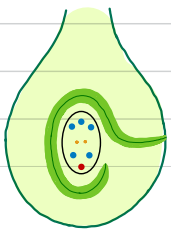




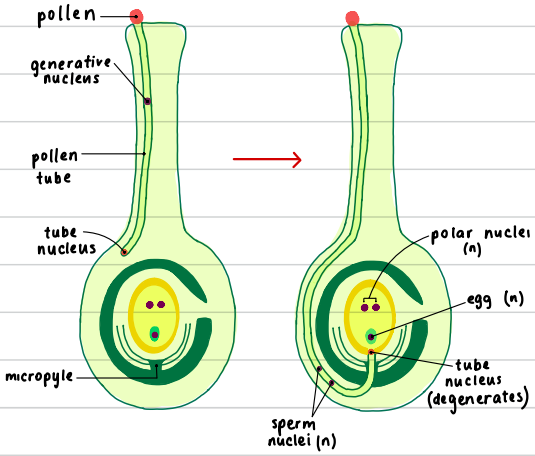
FEMALE GAMETE FORMATION

- megaspore mother cell (2n) divides by meiosis in ovule to form 4 haploid cells (3 degenerate nuclei and 1 embryo sac)
- embryo sac (megaspore) undergoes mitosis a further 3 times forming 8 haploid nuclei
- 5 haploid nuclei die, 2 form polar nuclei and one forms the egg





FERTILISATION



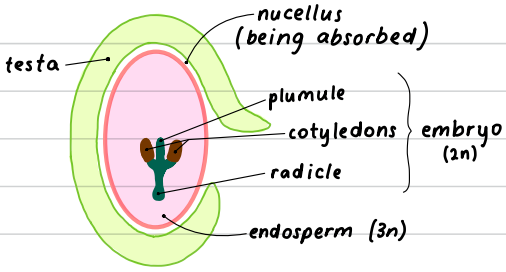
- pollen grain lands on stigma
- tube nucleus controls growth of pollen tube and connects to micropyle in integuments, growing towards chemicals released by ovule (chemotropism)
- generative nucleus divides by mitosis in pollen tube to form two male gametes (sperm nuclei)
- double fertilisation:

1st sperm nucleus (n) + egg nucleus (n) → zygote (2n)

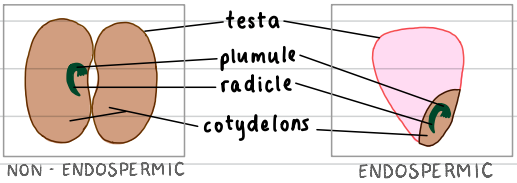
2nd sperm nucleus (n) + 2 polar nuclei (n) → endosperm (3n)

- endosperm acts as a food (lipids and starch) store

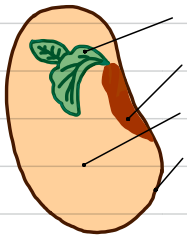
SEED FORMATION



- the fertilised ovule develops into the seed
- as seeds grow, the cotyledons continue to grow and absorb the endosperm
- all the endosperm is absorbed in non-endospermic seeds (e.g. broad bean, peanut, sunflower)
- some endosperm remains in seed in endospermic seeds (e.g. maize, corn)



SEED STRUCTURE (BROAD BEAN - DICOT)



- plumule → shoot
- radicle → root
- cotyledon - food storage + seed leaves
- testa - protects embryo

MONOCOT + DICOT SEEDS

Monocots:

- 1 seed leaf
- don't store food in cotyledon → embryo directly absorbs endosperm
- endospermic seeds are mostly monocots

Dicots:

- 2 seed leaves
- store food in cotyledon → embryo absorbs food from both endosperm and cotyledon
- most dicots have non-endospermic seeds

POLLINATION

- self-pollination advantages:
  - guarantees reproduction even if pollinating agent is not available
- cross-pollination advantages:
  - increases genetic variation

	WIND	ANIMAL
PETALS	· small or absent · green · no scent · no nectaries	· large · brightly coloured · scented · nectaries
POLLEN	· large amounts · light · small · dry + smooth	· small amounts · heavy · large · sticky
ANTHERS	· large · outside petals · loosely attached	· small · inside petals · firmly attached
STIGMA	· large + feathery · outside petals	· small + sticky · inside petals

- wind pollination is wasteful of pollen

FRUIT

BEFORE FERTILISATION	AFTER FERTILISATION
ovule	seed
integuments	testa
nucellus	endosperm + cotyledon
egg	zygote → embryo
polar nuclei	endosperm
ovary	fruit
ovary wall	pericarp

- fruit formation is stimulated by auxin (growth regulator produced by seeds)
- fruits are designed to protect seeds and to help in seed dispersal
- seedless fruits:
  - > genetically altered (e.g. bananas, grapes)
  - > sprayed with growth regulators (e.g. cherries, grapes)
- ethene:
  - > used to ripen fruits commercially
  - > used to 'de-green' fruits by causing the breakdown of chlorophyll
  - > CO_2 inhibits the production of ethene, allowing fruit to be stored for long periods of time

FRUIT + SEED DISPERSAL

- dispersal is necessary to:
  - > prevent competition
  - > increase number of plants
  - > find new areas of growth
- wind dispersal:
  - > small light seeds in orchids
  - > parachute devices in dandelions
  - > wings in sycamore
- animal dispersal:
  - > fruit with hooks → cling to animal's fur (e.g. buttercup)
  - > edible fruits → seeds pass through digestive system unharmed (e.g. apple)
- self dispersal:
  - > explosive mechanisms catapult the seeds away
- water dispersal:
  - > light, air-filled seeds that float

DORMANCY

- as a result of:
  - > growth inhibitors
  - > excessively tough / impermeable testa
  - > lack of suitable growth regulator needed to stimulate growth
- advantages:
  - > allows the plant to avoid harsh conditions of winter
  - > allows time for the seed to be dispersed
  - > allows time for the embryo to develop
  - > aids survival of species → seed bank
- conditions to break dormancy:
  - > cold may cause breakdown of growth inhibitors or the production of growth promoters
  - > seeds soaked in water
  - > physically breaking testa
  - > light / dark

GERMINATION

- conditions:
  - > water → needed to allow enzyme reactions to occur
  - > oxygen → needed for aerobic respiration
  - > suitable temp. → needed to allow enzyme reactions to occur
- seeds store food in the form of oils (sunflower), starch (oats) and proteins (legumes)
- events in germination:
  - »1« seed absorbs water through the micropyle and testa
  - »2« digestion occurs
    - oil → fatty acids and glycerol
    - starch → glucose
    - proteins → amino acid
    - products move into embryo

»3« glucose + amino acids ⟶ cell walls + enzymes
glucose + fats $\xrightarrow{\text{respiration}}$ energy

»4« dry mass falls due to foods used in respiration ⟶ weight of embryo increases

»5« radicle bursts through testa and grows down (geotropism)

»6« plumule emerges above ground and leaves are produced

»7« once the leaves begin to photosynthesise, dry mass increases