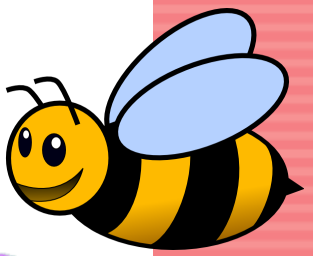
40 - Sexual Reproduction in Plants

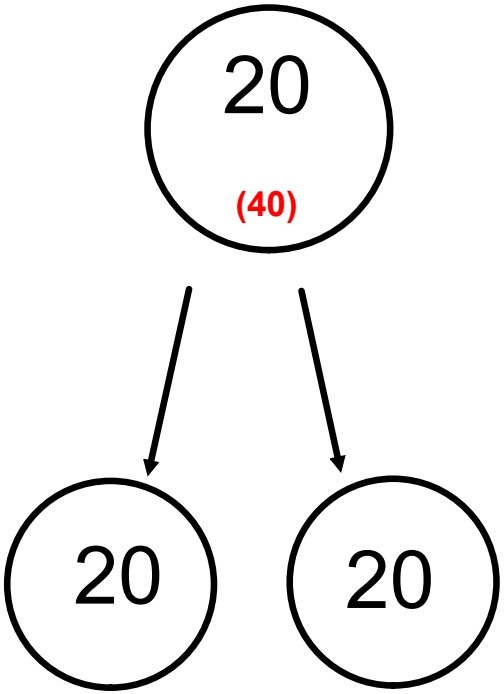


Learning objectives

- To describe the structure and function of the parts of a flower
- To understand that pollen grains produce the male gametes and that the embryo sac produces the egg cell and polar nuclei
- HIGHER To describe in detail the development of pollen grains from microspore mother cells
- HIGHER To describe in detail the development of the embryo sac from megaspore mother cells
- To define and describe 'pollination', 'self-pollination' and 'cross-pollination', to include wind pollination and animal pollination
- To define the term 'fertilisation' and describe the formation of a diploid zygote and endosperm
- To describe the structure and function of seeds and their parts
- To classify and distinguish between monocot and dicot seeds
- To describe the formation of fruit and how genetics and growth regulators can cause seedless fruit production
- To describe fruit and seed dispersal and the need for dispersal
- To define and state the advantages of dormancy and describe how it is used in agriculture and horticulture
- To define the term 'germination' and describe the factors needed for germination
- To describe the stages of seedling growth
- To investigate the effect of water, oxygen and temperature on germination
- To investigate digestive activity during germination, using starch agar or skimmed milk plates.

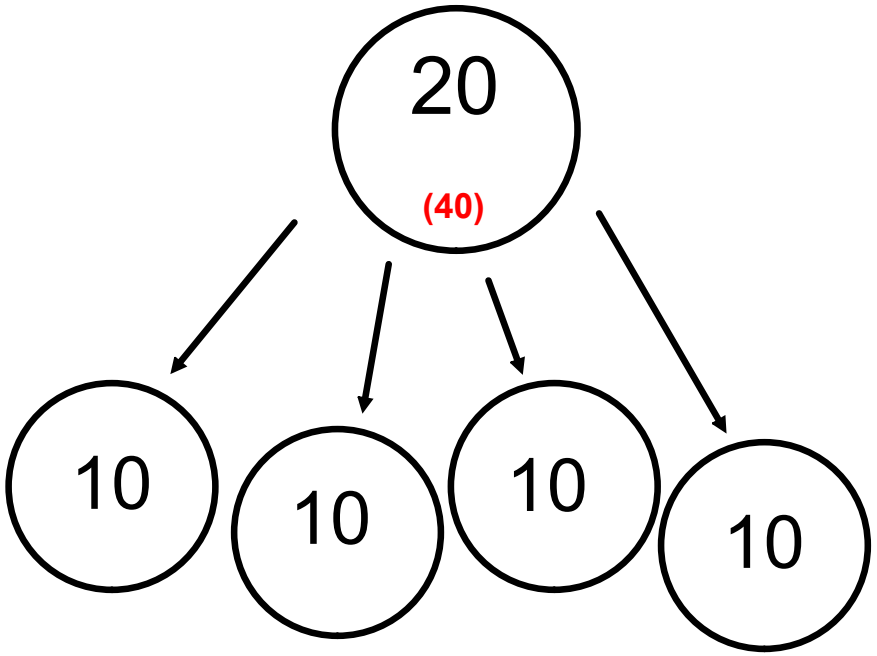
Mitosis

Keeps the number of chromosomes



Meiosis

Halves the number of chromosomes

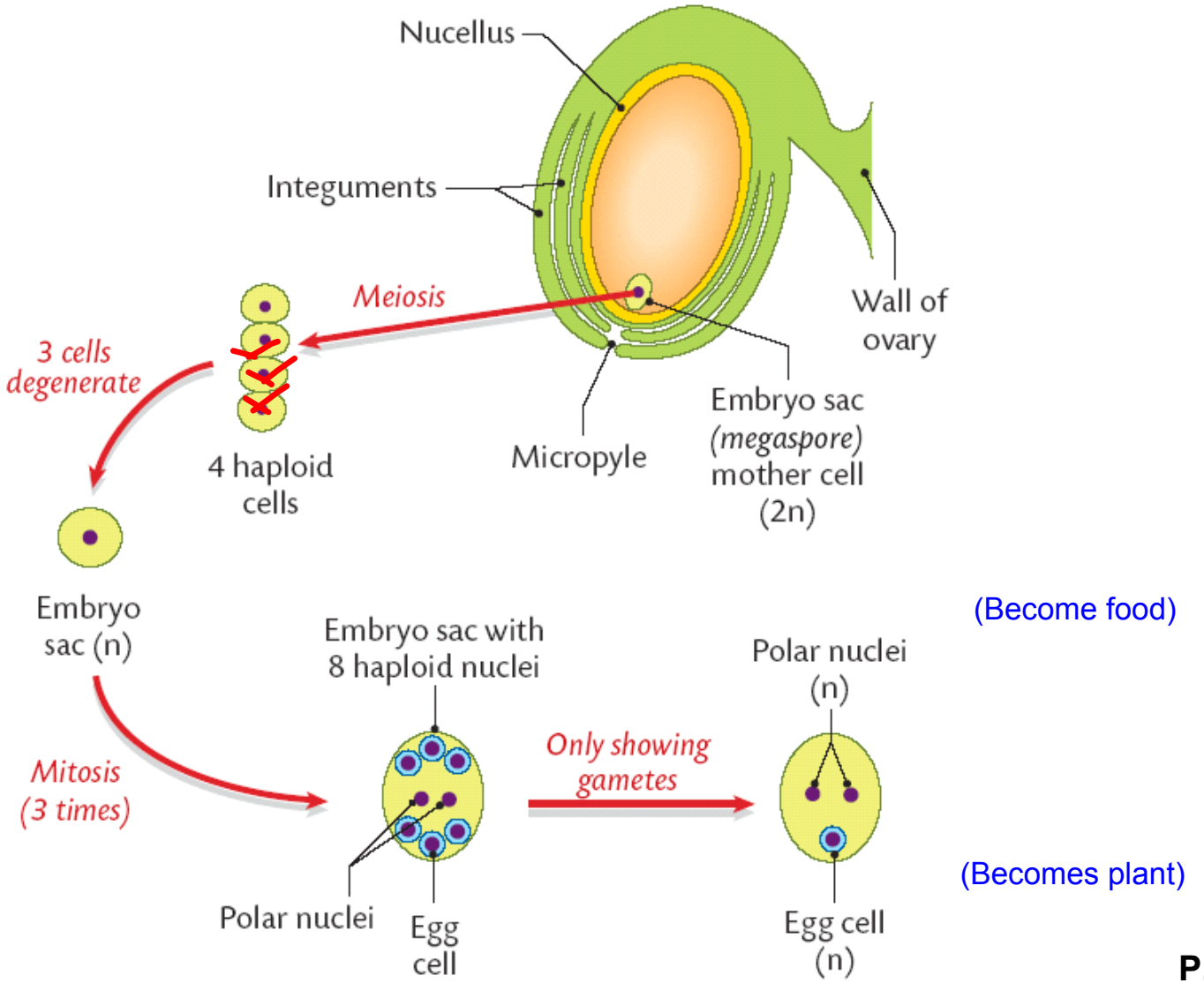


Male Pollen Development

Start

Click the Start button
to show
anther transect

Female Ovule Development



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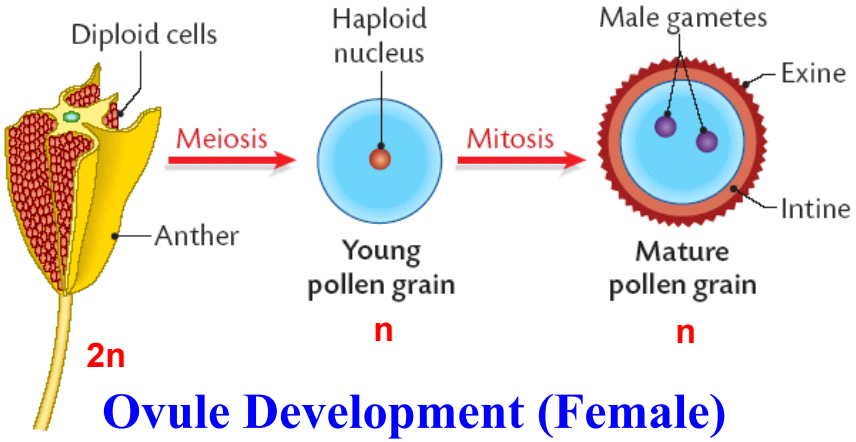
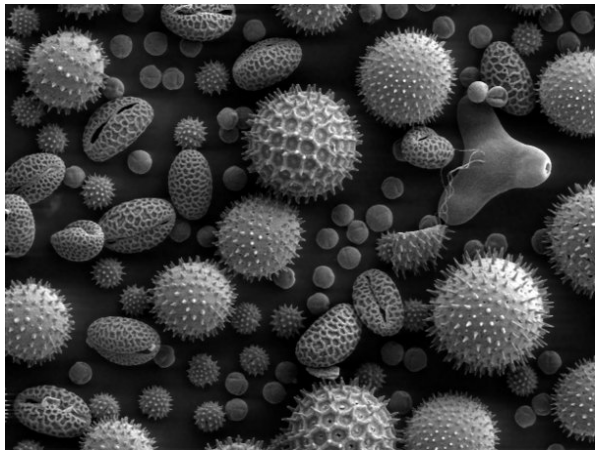
Pollen Development (Male)

- Meiosis occurring in the pollen sac (anther) to produce a haploid embryo sa
- The sac has 4 haploid nuclei. Three of these degenerate and leave just one.
- The nucleus divides by mitosis to form a generative nucleus and a tube nucleus.
- The pollen has a protective coat called the Exine.





Ovule Development (Female)

- The megaspore (2n) produces 4 haploid cells (n) by meiosis
- 3 of these cells degenerate
- Remaining cell divides by mitosis 3 times to make an embryo sac with 8 nucle
- 5 of these nuclei degenerate
- Of these 3 nuclei, 2 nuclei form the polar nuclei
- The remaining nucleus forms the egg cell
- The polar nuclei and the egg cell are the gametes

Pollination

The transfer of pollen from an anther to a stigma of a flower from the same species

Self-pollination occurs where the anther and stigma are on the same pla
Cross-pollination, the anther and stigma are on different plants.

	Wind Pollination	Animal Pollination
Petals	Green or absent	Brightly coloured, scented with nectar
Pollen	Large amounts, light and small	Small amounts, sticky and spiny
Anthers	Large, loosely attached	Small, firmly attached
Stigmas	Large and feathery, outside petals	Small and Sticky, inside petals

Wind Pollinated - Grass

Animal Pollinated - Crocus

Pollination

Specialised Pollination

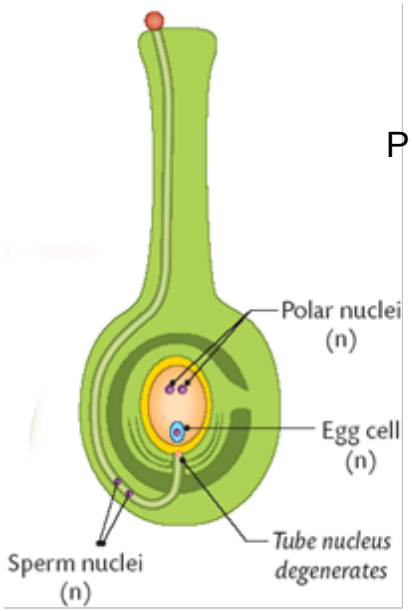
Hay Fever

- Is an allergic reaction to particles of certain harmless substances
- The substance that causes the reaction is called an ***allergen*** .
- Most common are pollen grains, fungal spores, dust, dust mites and animal skin.
- Normal symptoms are inflammation of the mucous membranes in the nose, sneezing, blocked and runny nose along with watery and irritated eyes.
- Hay fever affects around 10% of the population.
- It can be reduced by avoiding the allergen, and treated with decongestant drugs,

Antihistamines to reduce inflammation and other drugs that can partially inhibit the allergic response.

Fertilisation- is the union of male and female gametes

- When a **pollen grain** land on a stigma it grows using sugars from the stigma
- The **tube nucleus** from the pollen forms a tube down the style into the ovule
- The tube grows towards chemicals released from the ovule (Chemotropism)
- The tube nucleus degenerates and the **generative nucleus** moves down the tube
- As it moves down the pollen tube it **divides** into two **sperm** nuclei (n)
- One nuclei joins with the egg cell to form a zygote (n + n = **2n**)
- The other joins with the 2 polar nuclei to form the endosperm (n + 2n = **3n**)
- The **zygote** grows into an **embryo** plant inside of a seed
- The **endosperm** is the **food** store for the plant inside the seed (oils and fats)
- This is known as **double fertilisation**



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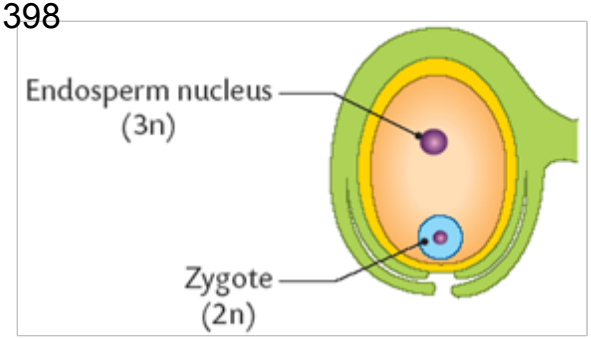
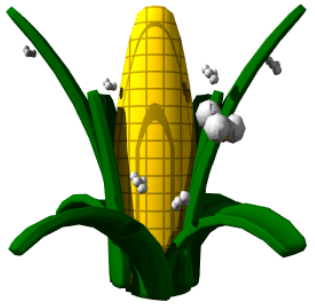
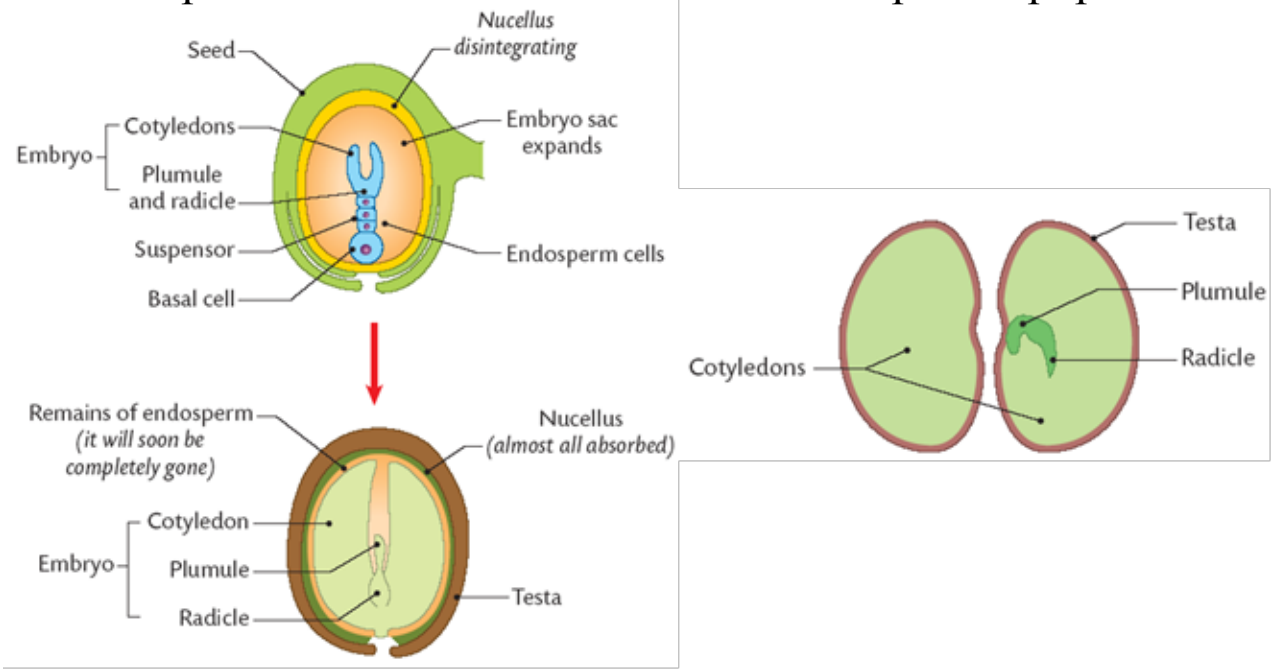


e.g. Popcorn



Seed Formation

- The fertilised **ovule** (embryo and endosperm) forms the **seed**.
- The walls of the ovule **(integuments)** become the wall of the seed **(testa)**.
- The embryo has 3 main parts:
  (i) The **Plumule** (future shoot)
  (ii) The **Radicle** (future roots)
  (iii) The **Cotyledon** (simple seed leaf)
- The cotyledons (leaves) continue to grow in the seed.
- If they **use** all the endosperm as **food**, they are called **non-endospermic**.
- Non-endosperm examples are **broad bean**, peanut and sunflowers.
- Endosperms are maize and corn. The white part of popcorn is the endosperm.



In Monocot Seeds

One cotyledon develops from the embryo
The food is normally stored in the **endosperm**

In Dicot Seeds

Two cotyledons emerge from the embryo
The cotyledons absorb food from the endosperm
If all the endosperm is absorbed, the seed is non-endospermic.

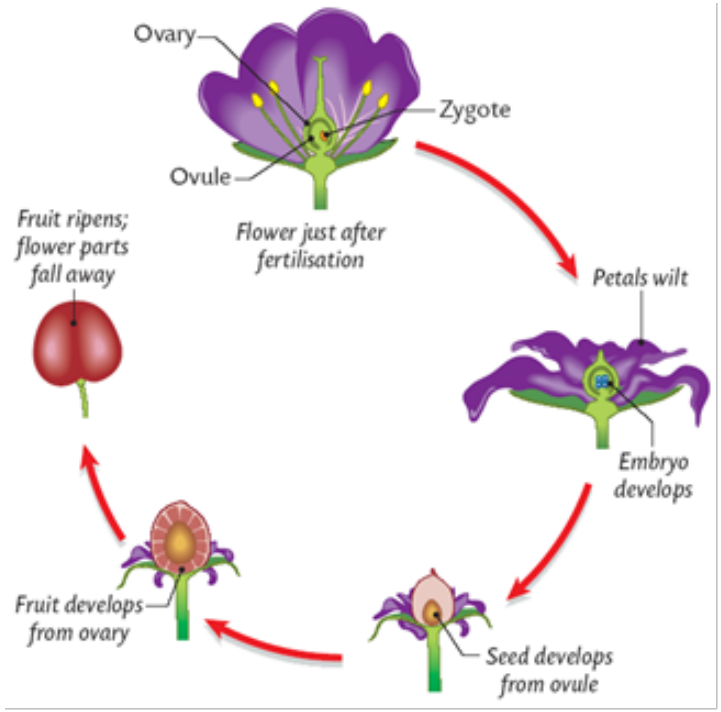
Broad Bean

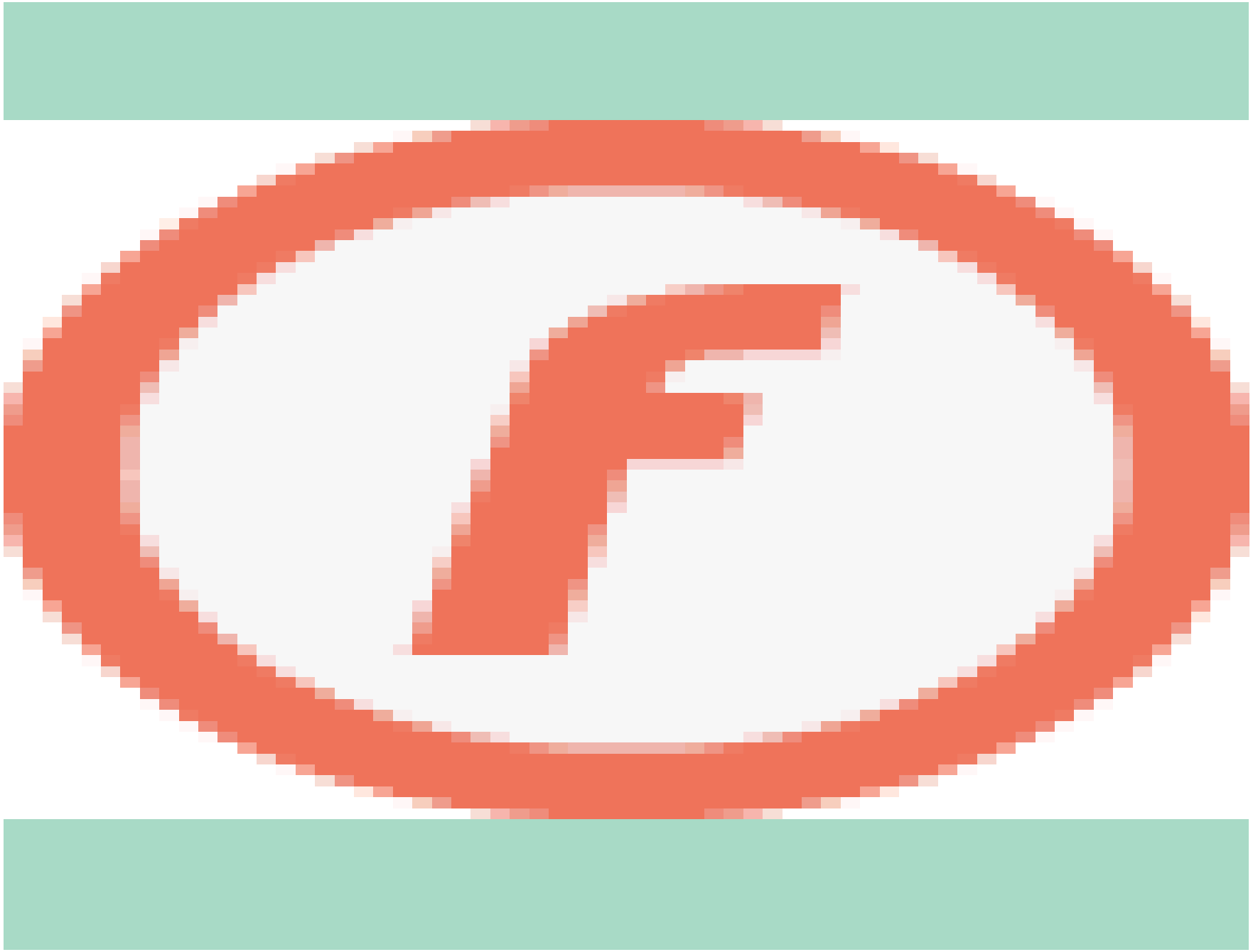
Fruit Formation

- As a seed is developing the surrounding **ovary** becomes the **fruit**
- Fruit formation is controlled by **auxins** (plant hormones)
- Fruits help **protect** and **disperse** seeds
- Some fruits are fleshy (plums) and others are dry (pea pods, monkey nuts, cereals)
- False fruits form from other parts of a flower besides the ovary (e.g. apples)
- **Seedless** fruits can be formed genetically - naturally or by breeding programmes.
- Examples of these are **bananas**, grapefruit, pineapples, seedless oranges & **grapes**
- Another way to make seedless plants is to spray them with growth regulators.
- Examples of these are cherries, peppers, apricots and some tomatoes
- **Ethlyene gas** is used to remove the green colour from fruits and ripen the fruits
- **Carbon dioxide** stops fruits from ripening & means they can be stored over winter

Fruit and Seed Dispersal

- This is the carrying of the seed as far as possible from the parent plant
- The methods of seed dispersal are:
  - **Wind** - Use parachutes or wings to help dispersal (dandelion, sycamore)
  - **Water** - air-filled fruits that float in water (coconut)
  - **Animal** - can be sticky (goose grass), or be edible (blackberries)
  - **Self** - explosive mechanism helps spread seed (peas, beans and gorse)

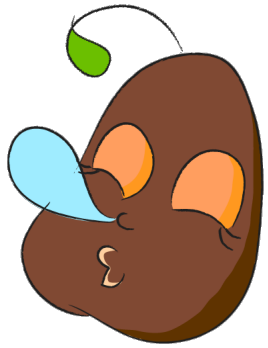




Dormancy

This is a resting period when seeds reduce their metabolism and do not gr

- Dormancy is caused by:
  - (i) Lots of Growth inhibitors - to stop growth.
  - (ii) Testa is impermeable to water or oxygen.
  - (iii) Lack of growth promoter - means no growth.



- The **advantages** of dormancy are:
  - (i) The seedlings avoid growing in winter
  - (ii) The embryo has time to develop
  - (iii) There is time for dispersal
  - (iv) It allows the seedling the maximum growing season
  - (v) It allows some seeds to survive in the soil

Germination

This is the regrowth of the embryo after dormancy, under suitable conditi

The conditions required for germination are: WHO

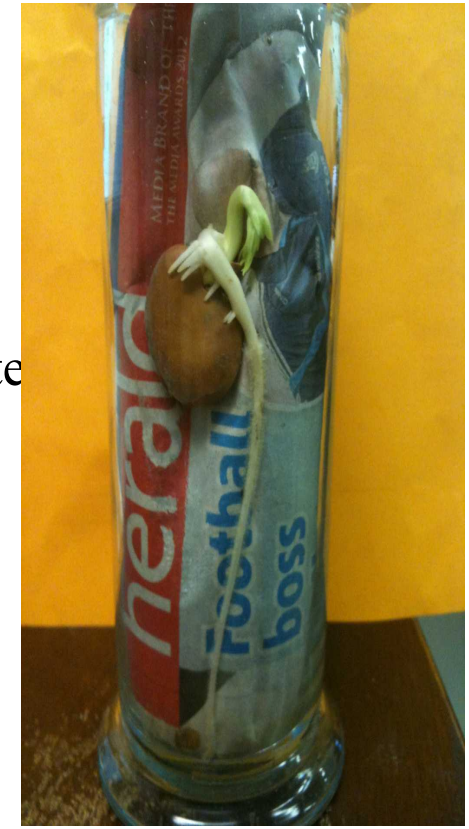
(i) Water - Aids chemical reactions in enzymes

(ii) Suitable temperature, (heat) - temp for enzymes

(iii) Oxygen - needed for plant embryo respiration

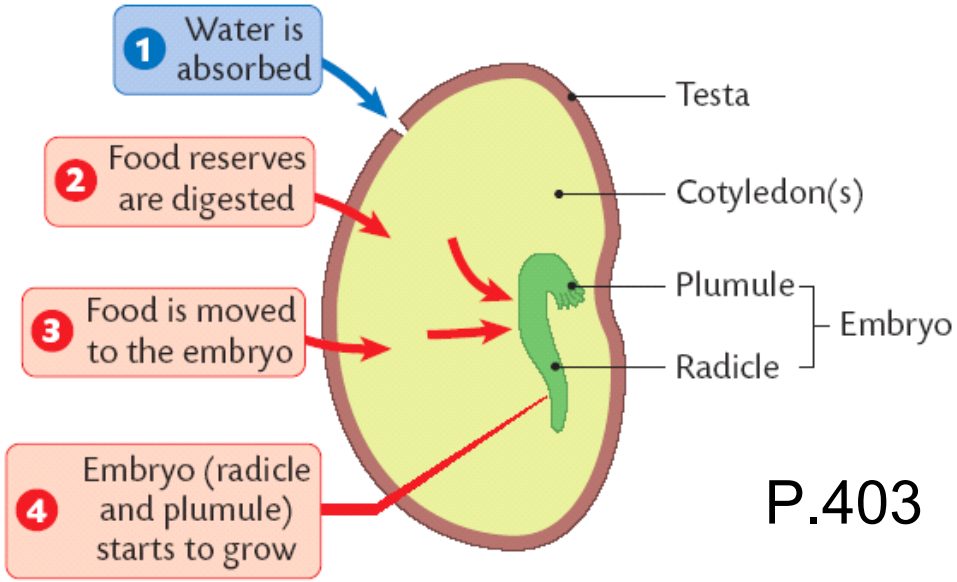
(iv) Dormancy completed, (hormones - growth promote

(v) Sometimes light or dark is required.



The main events in Germination

1. The seeds absorb **water**
2. Stored foods are digested to simpler forms by **enzymes** in the seed
3. Digested foods are transferred from the endosperm or cotyledon to the embryo
4. Some digested foods make new structures and some are used in respiration
5. The **radicle** grows and bursts through the testa
6. The **plumule** emerges above ground and new leaves form



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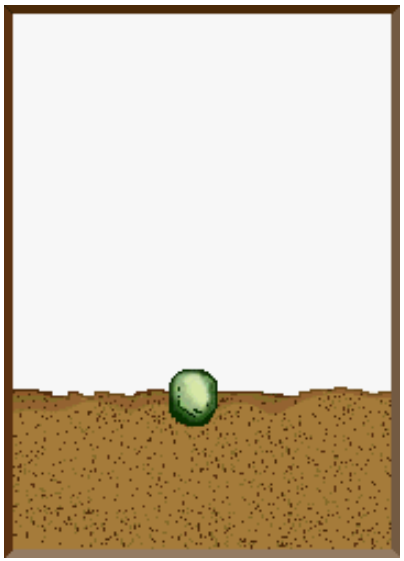


2 Practicals

To investigate the effect of water, oxygen and temperature on germination

Grow a number of radish seeds on damp cotton wool in a warm place (control)
Grow three different sets of radish seeds

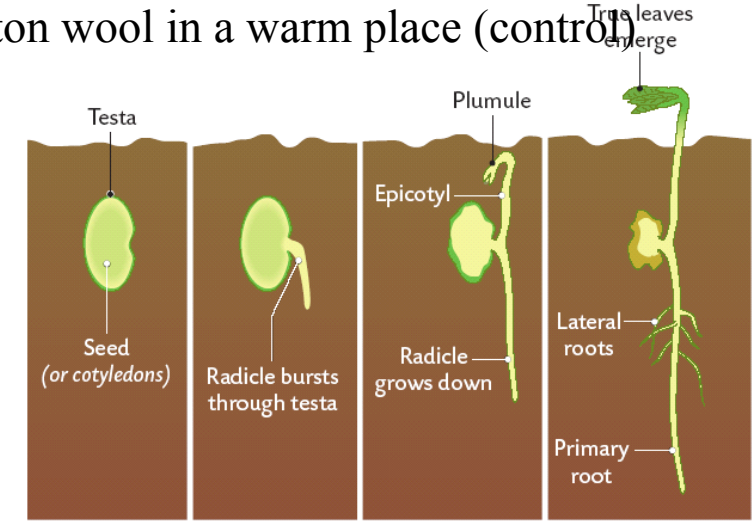
(A) Has Water, Heat and Oxygen.

(B) On dry cotton wool

(C) In anaerobic conditions

(D) In a cold fridge

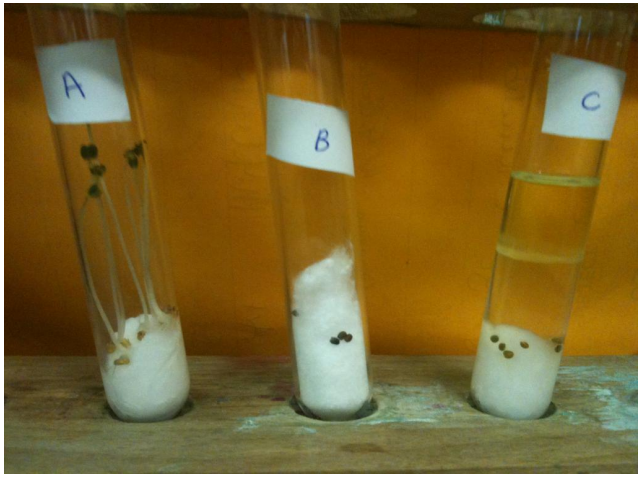
These sets do not germinate due to the lack of water, a heat and Oxygen **WHO**



To show that germinating seeds produce digestive enzymes

Place halved, sterile, soaked seeds on starch agar
Leave in a warm place
Add iodine after a few days
The starch is digested by enzymes in live seeds (clear areas around the seeds)
The starch is not digested by dead (boiled) seeds, as no clear areas appear

Results



When a seed germinates it needs **WHO**
This is Water, Heat, Oxygen.

Test tube A has all the necessary factors.
Test tube B has no water.
Test tube C has no oxygen.
The water was boiled, cooled and oil was added.
Test tube D was placed in a fridge.

The **Starch** agar is coloured Blue/Black by the Iodine.
When the seeds start to germinate they produce **enzymes** that break down the starch agar around the seed.
The color disappears because the starch has been **broken down** by the enzymes.

This proves that seeds produce enzymes to break down the food store to give glucose to the embryo.