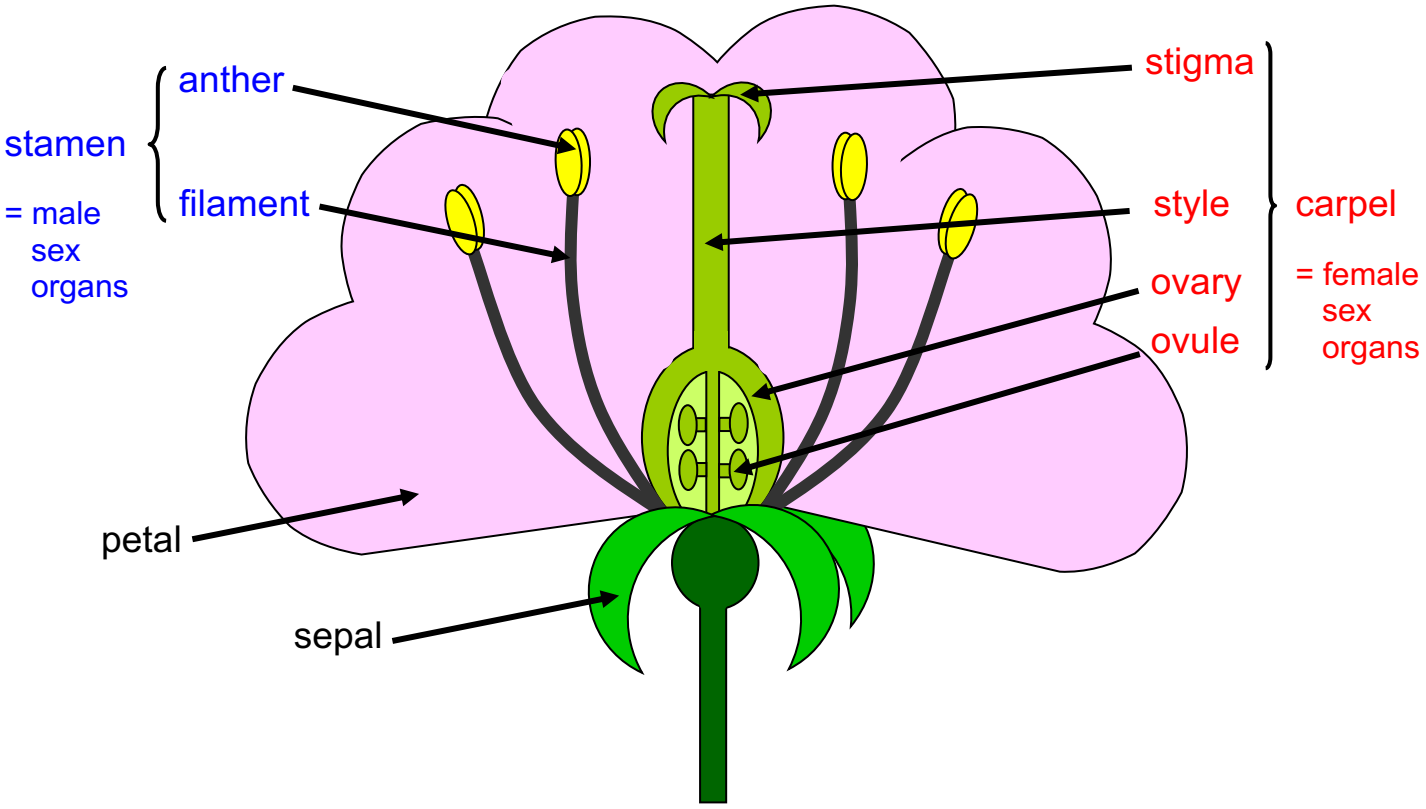
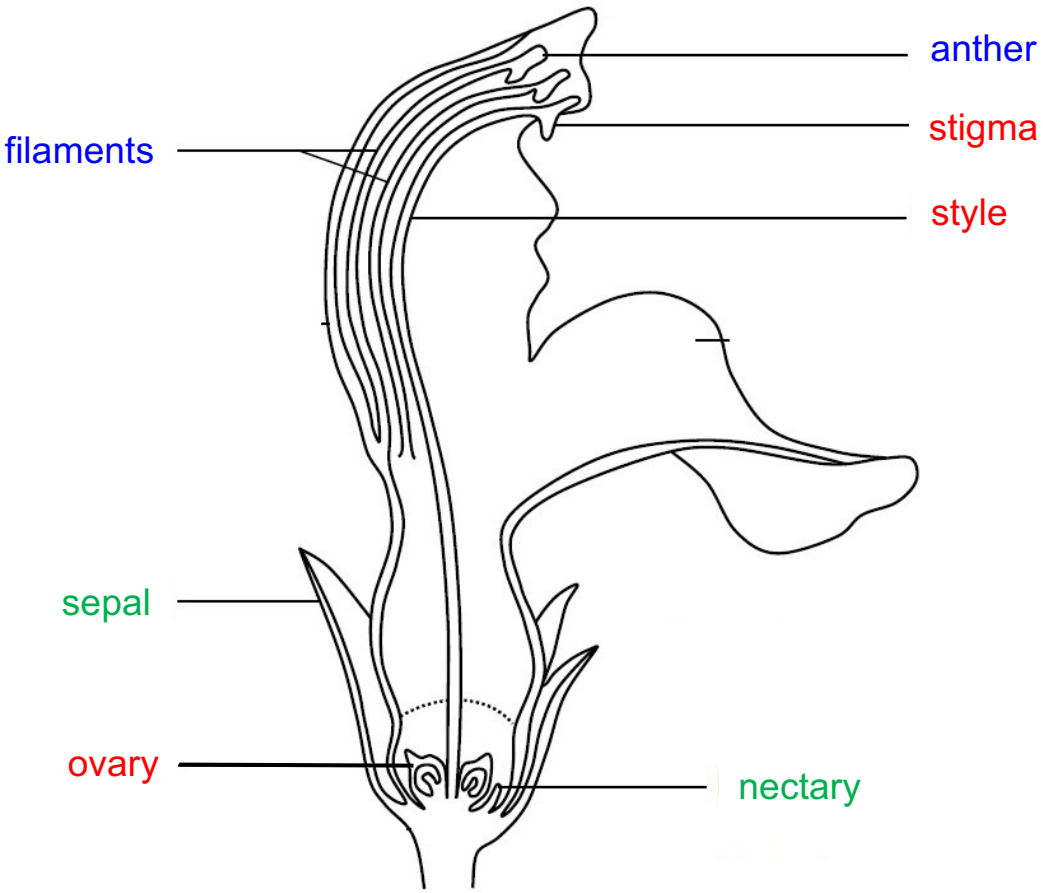
A. FLOWER STRUCTURE



- Anther produces pollen grains, which contain the male sex cell
- Petals attract insects for pollination
- Stigmas are where the pollen grain lands
- Ovaries contain ovules (egg cells) for fertilisation
- Sepals protect the flower bud from wind and the cold

Haploid sex cells are therefore produced in the **anthers** and **ovaries**.

B. DRAWING A HALF-VIEW OF AN ANIMAL-POLLINATED FLOWER



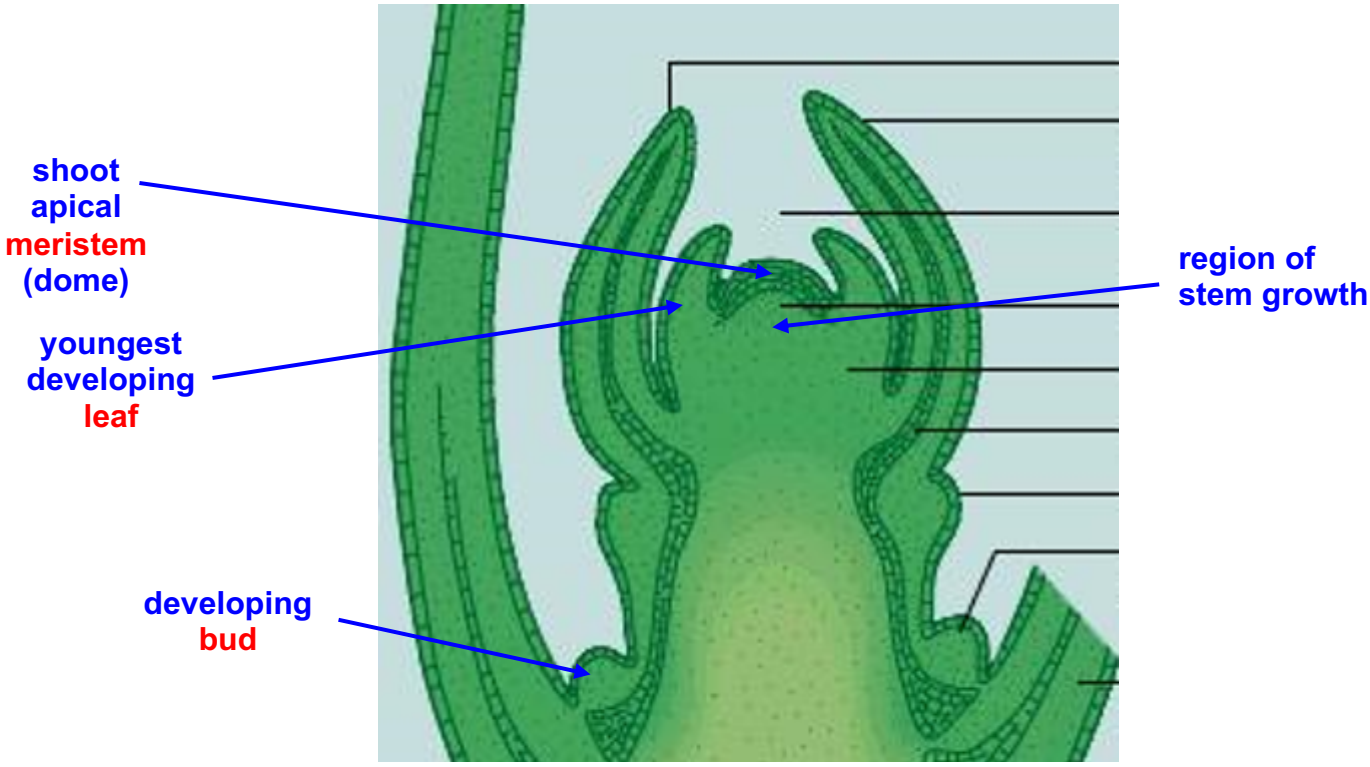
C. DIFFERENCES BETWEEN PLANT GROWTH AND ANIMAL GROWTH

- **Animals** show **determinate** growth – **growth stops** when a **certain size** is **reached**.
- **Plants** show **indeterminate** growth – **cells continue** to **divide indefinitely**.

PLANTS have UNDIFFERENTIATED cells in their MERISTEMS

It is THESE that allow INTEDERMINATE GROWTH

D. THE SHOOT APEX OF A PLANT



Growth in the shoot apex

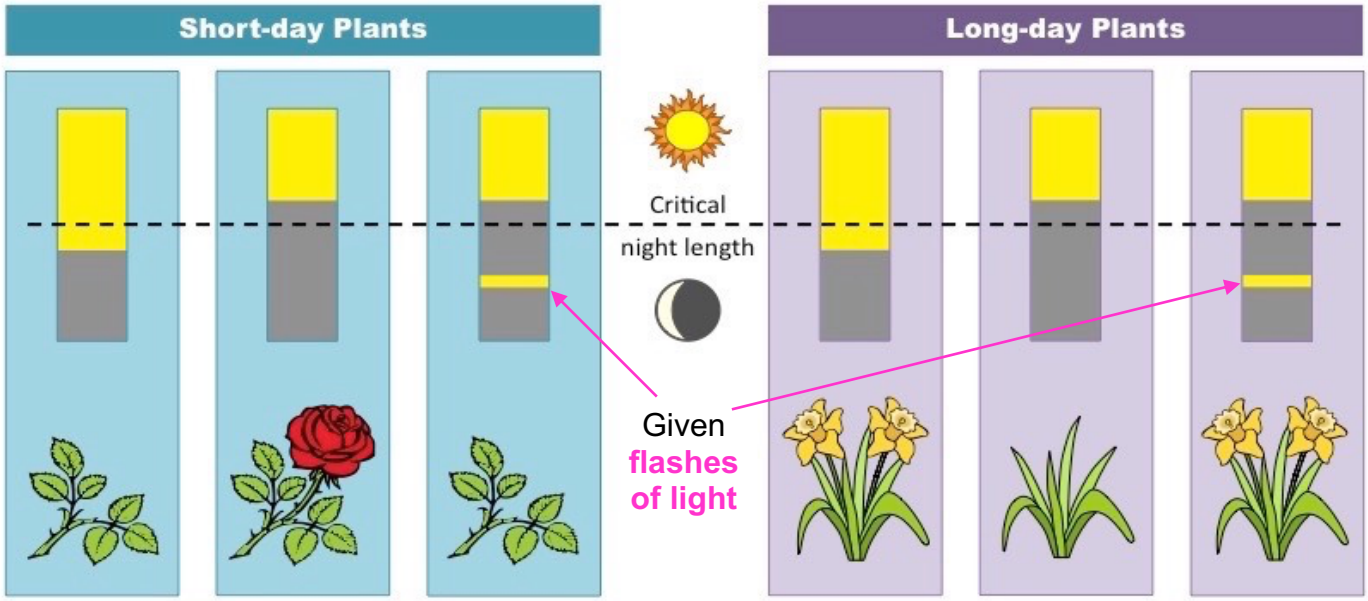
- **growth** is **indeterminate (unlimited)**
- **stem** and **leaves** are produced
- **growth** is affected by **auxin**
- contains **undifferentiated** (stem) **cells**
- **new cells** are produced by **mitosis**
- production of **new cells** causes others to be **displaced** to the **edge** of the **meristem**
- cells at the **edge stop dividing** and **rapid growth** and **differentiation** occurs
- **leaves** start as **small bump**s at the **side** of the **shoot apex**
- shoot apex **grows towards light** (positively phototropic)
- **more auxin diffuses** to the **shaded** side (if incoming light is unidirectional)

E. HOW DO SOME CELLS FORM LEAVES WHILE OTHERS FORM SHOOTS OR FLOWERS?

- Different genes expressed ("switched on");
- By cells in apical meristem;
- Different genes expressed for making leaves/stem/flowers;
- Triggered by a stimulus;
- e.g. long nights in short-day plants / short nights in long-day plants;

F. SHORT-DAY & LONG-DAY PLANTS

- The **shoot apex** produces **more stem** and **leaves** until it receives a **stimulus** that makes it produce **flowers**.
- This '**switch**' to **flowering** involves **expressing different genes** in **cells** of the **shoot apex**.
- The '**switch**' to **flowering** is a **response** to the **length** of **light** and **dark periods** in many plants.



Only **flower** when a **period of darkness EXCEEDS** a critical night length

(NEEDS **LONG NIGHTS**)

Only **flower** when a **period of darkness IS BELOW** a critical night length

(NEEDS **SHORT NIGHTS**)

- For both types of plant, it is the **length of darkness that matters**, rather than **the length of the light period.**
- **Short-day plants**, such as **chrysanthemums**, can be made to **flower out-of-season** by **keeping** them in **greenhouses** with the **blinds closed** to **extend** the **nights** artificially.

G. SOME DEFINITIONS

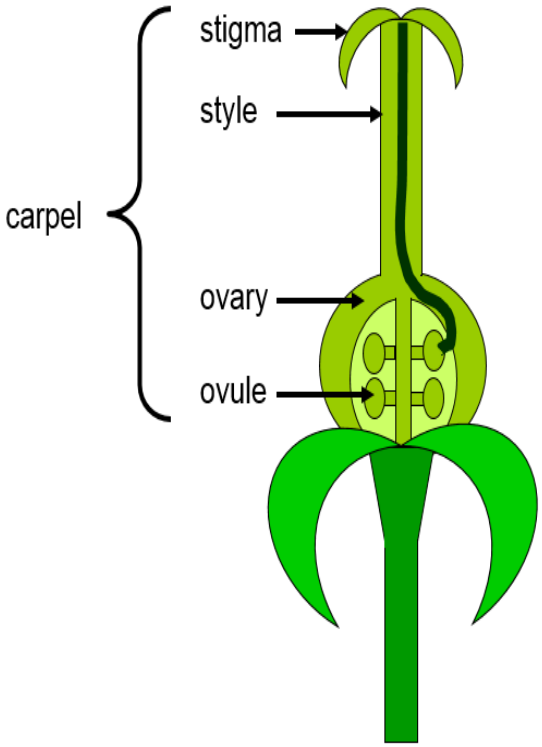
POLLINATION is the TRANSFER of POLLEN GRAINS from the ANTHER to the STIGMA

FERTILISATION occurs when the NUCLEI of a pollen grain and an ovule JOIN

SEED DISPERSAL is the TRANSPORT of SEEDS AWAY from the PARENT PLANT to sites where they can GERMINATE = LESS COMPETITION with the PARENT PLANT

- Most flowering plant have a **mutualistic** relationship with insects.
  - The plant benefits by its **flowers** being **pollinated**;
  - The insect benefits as it **feeds** on the **nectar** (a source of **energy**) and **pollen** (a source of **protein**).

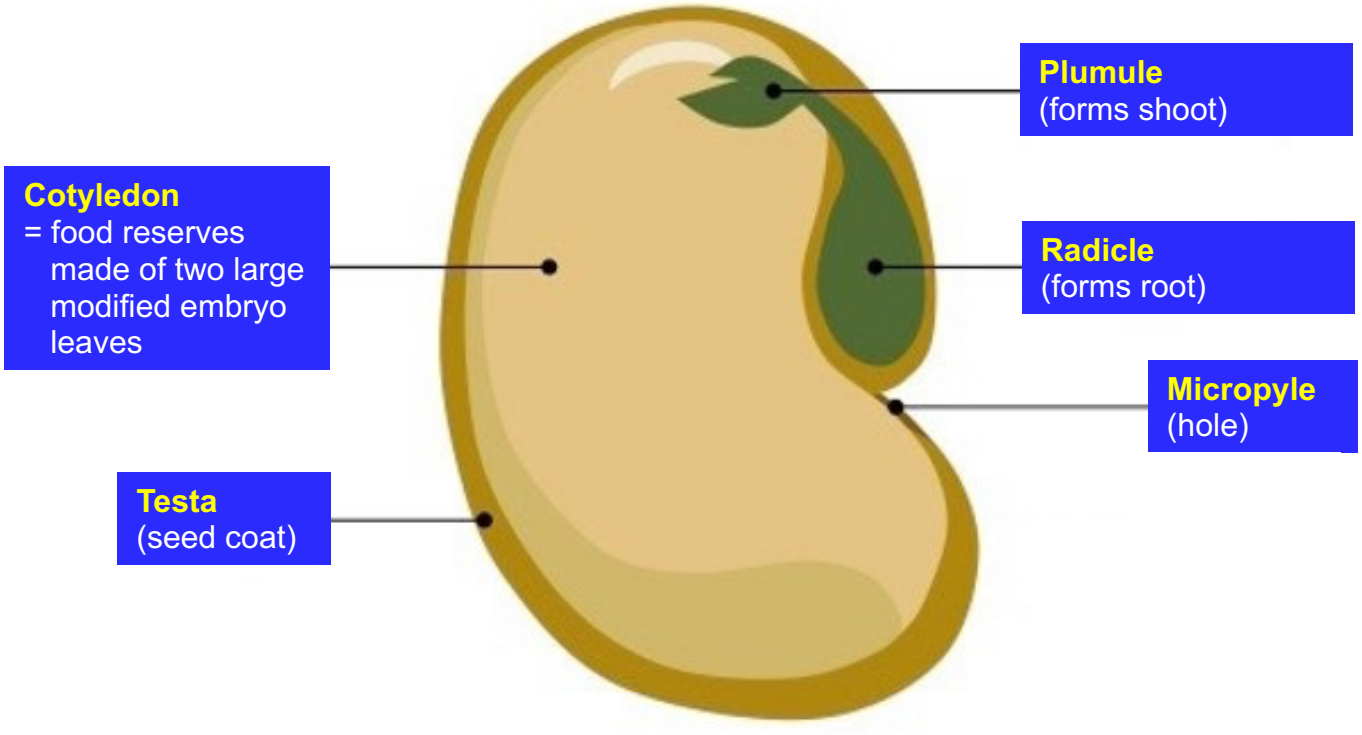
H. POLLINATION / FERTILISATION / SEED & FRUIT FORMATION

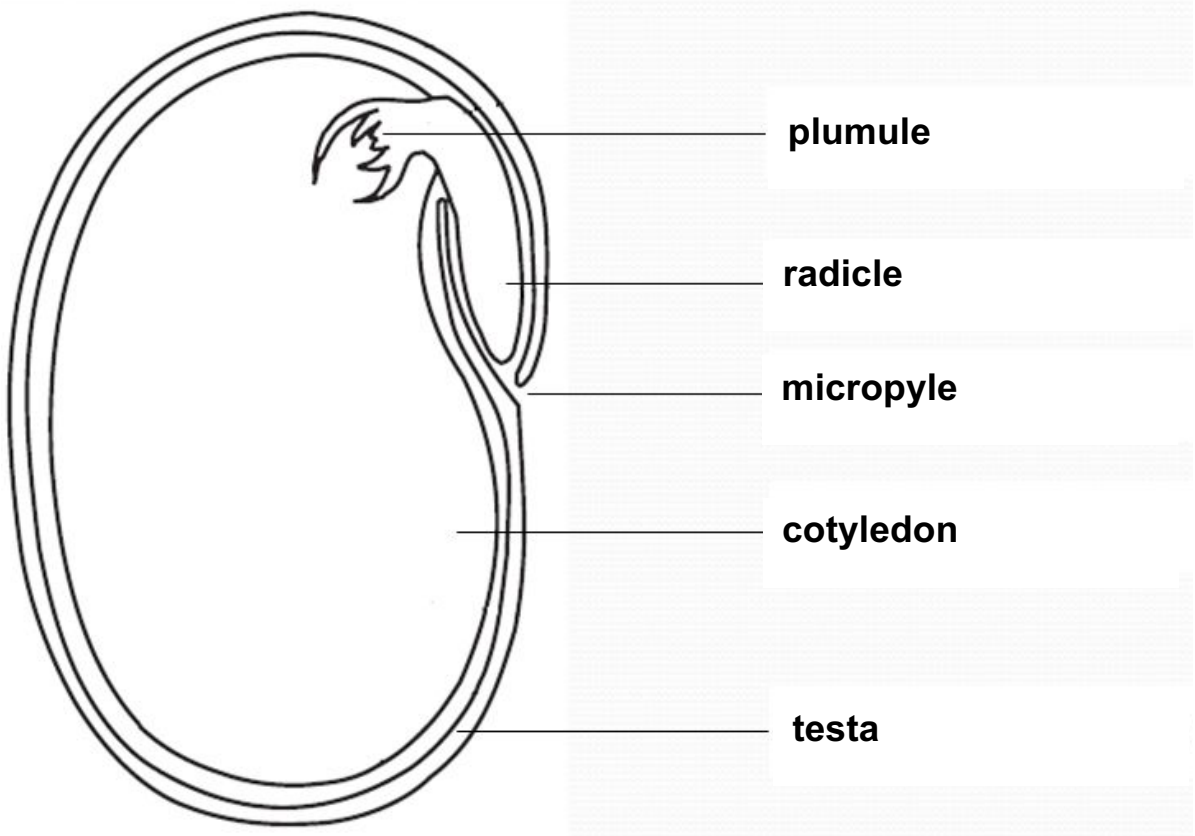


- **Pollen grain lands on stigma**
- **Pollen tube forms and grows down**
- **Through style to the ovary**
- **Pollen grain nucleus joins with an ovule nucleus (= fertilisation)**
- **Fertilised ovule inside develops into an embryo plant**
- **Water leaves = becomes dehydrated**
- **The ovule develops into a seed**
- **The ovary develops into a fruit**

- **Water leaves** the **seed** (it **dehydrates)** and becomes **dormant** so **metabolic reactions stop**.
- This **saves energy** if **environmental conditions** are **not favourable** for **growth**.
- A **seed** contains an **embryo plant** and **food stores** for **germination**.

I. DRAWING AND LABELLING A SEED





J. GERMINATION

- If **environmental conditions** are **favourable**, the **seed coat** will **break open** and the **young plant** starts to **grow**.

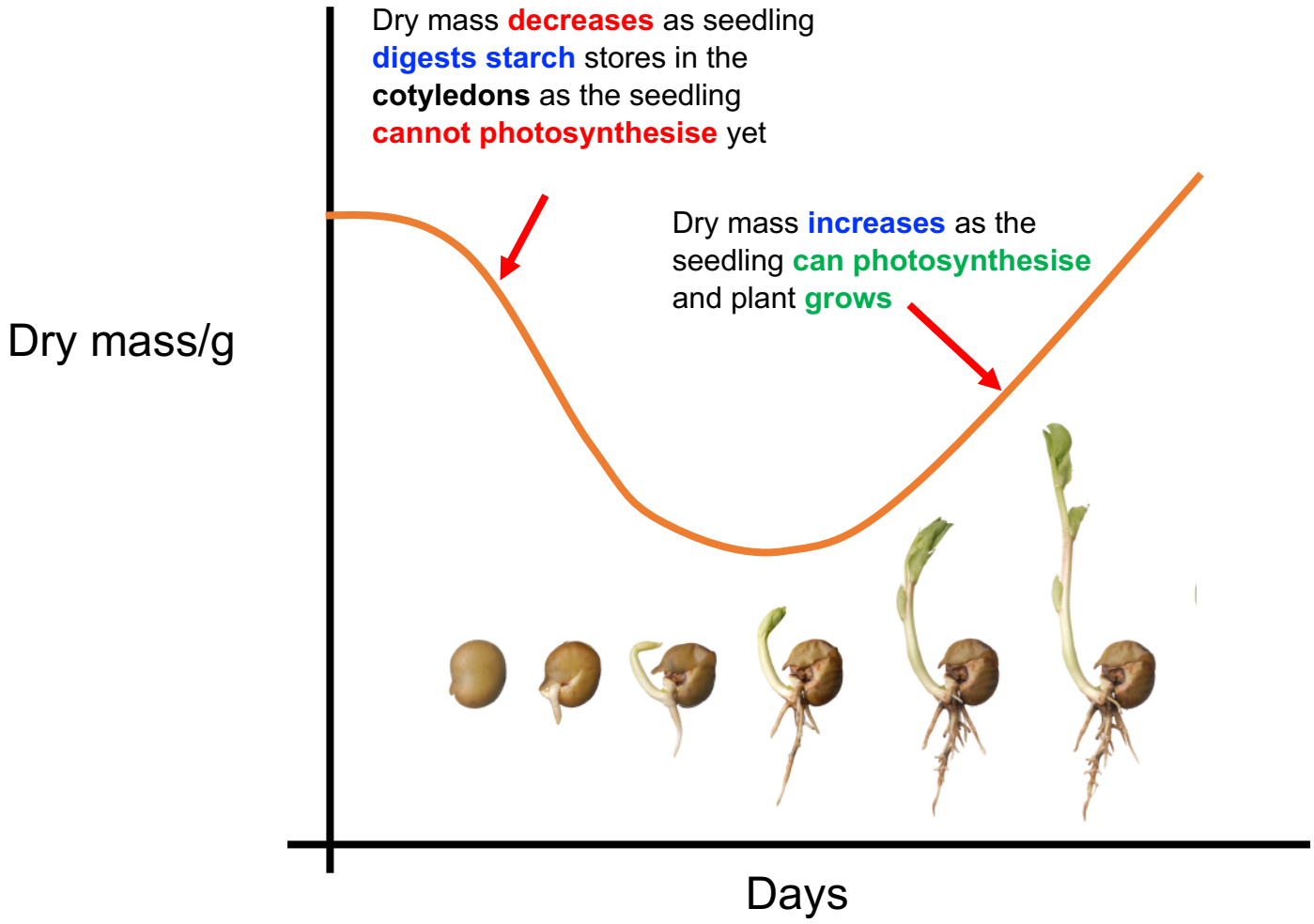
WATER
OXYGEN
WARMTH

} **Needed for germination**

CONDITION	WHY IT IS NEEDED
WATER	To activate enzymes in the seed for metabolism
OXYGEN	For respiration so that energy can be released
WARMTH	To allow enzymes to work close to optimum temperature

- **Water** enters the seed through the **micropyle** and **activates enzymes**.
- The **water** also **softens** the **testa,** causing it to **split**.
- The **activated enzymes break down starch** stores:
- **Starch** $\xrightarrow{\text{amylase}}$ **maltose** $\xrightarrow{\text{maltase}}$ **glucose**
- **Glucose** is used in **aerobic respiration** to **release energy** for **growth**.
- The **radicle** grows into the **root** and the **plumule** grows into the **shoot**.

Changes In Dry Mass During Germination

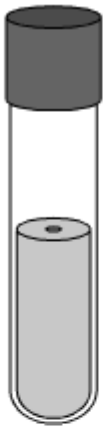


K. MICROPROPAGATION

- This is a fast way of **cloning plants** by **asexual reproduction**, so **only one parent** plant is needed.
- Involves using **three** different plant hormones: **auxin**, **cytokinin** and **gibberellin**.

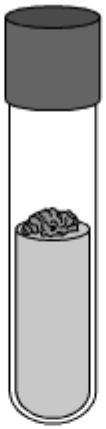
Extract small piece of tissue from the shoot tip.

Sterilise tissue and all growth media to be used to prevent infections.



Place tissue on sterile agar gel containing a high **auxin** concentration.

This stimulates cell growth and division.



A callus grows (ball of cells) that can be split up into separate cells.

Each cell can grow in a different tube containing the same agar containing auxin

Can transfer each callus to agar gel containing less auxin and a high **cytokinin** concentration.

This stimulates roots and shoots to develop.

Gibberellin may also be added to increase shoot growth and prevent dormancy.

Plantlets (baby plants) are then planted in soil.

- **Large numbers** of **rare plants** can be produced, **reducing the cost** and need to **take them** from their **natural habitat**.
- **Virus-free strains** of **existing plants** can be produced because cells in the **shoot apex** do **not contain viruses** that reduce growth, **even if other cells** in the plant **do**.
- **New varieties** with **desirable features** can be produced **quicker** than by previous methods.