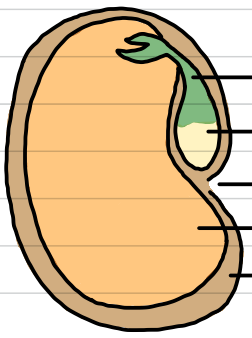
Investigating Germination in Plants

Learning Outcomes

- *16.3.8* – **Investigate** and **describe** the environmental conditions that affect germination of seeds, limited to the requirement for: water, oxygen and a suitable temperature

Germination in Plants

Germination : the process of development of a plant from a <u>seed</u>

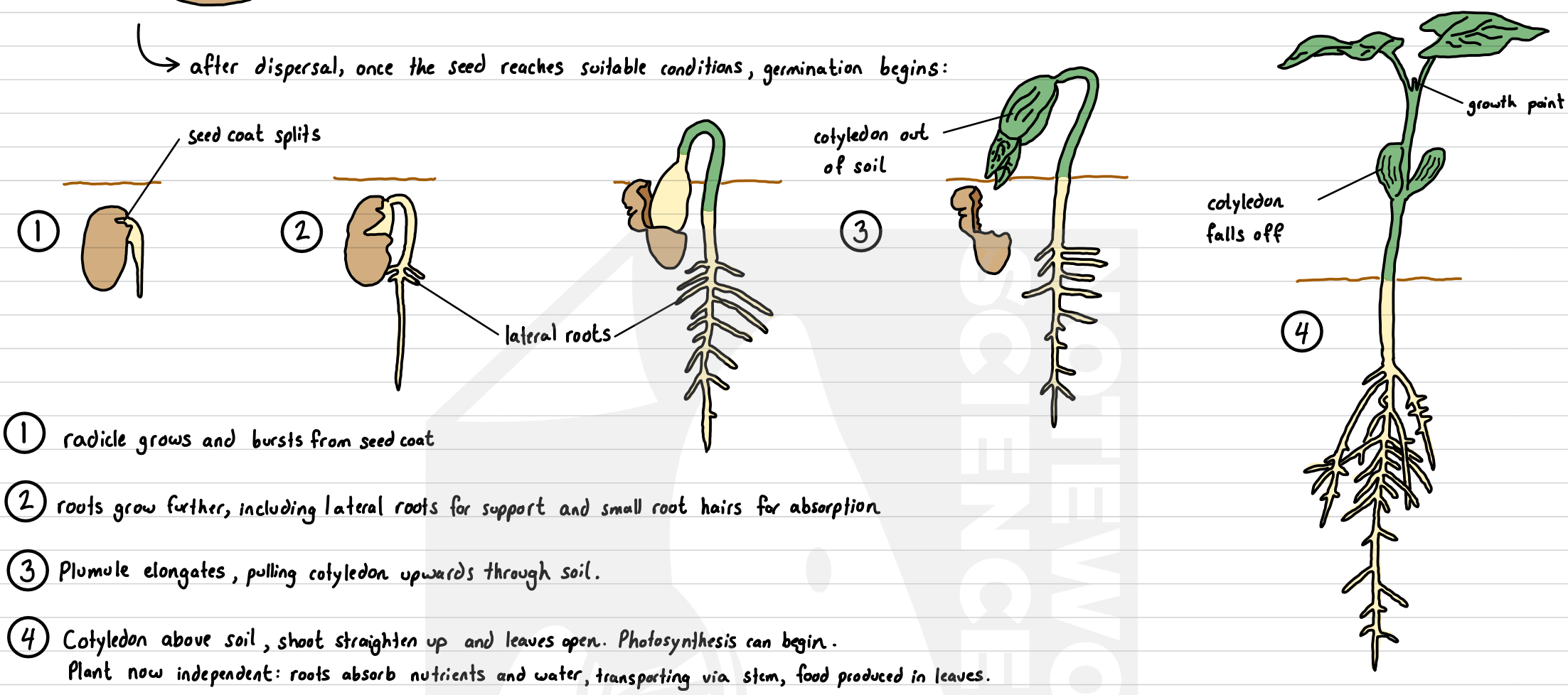


- plumule : embryonic shoot
- radicle : embryonic root
- micropyle : small pore allows passage of water
- cotyledon* : contains food stores (mainly starch) - seed leaves
- seed coat : coat which protects embryonic plant

} embryo

* monocotyledons have 1, dicotyledons have 2

→ after dispersal, once the seed reaches suitable conditions, germination begins:



1. radicle grows and bursts from seed coat
2. roots grow further, including lateral roots for support and small root hairs for absorption
3. Plumule elongates, pulling cotyledon upwards through soil.
4. Cotyledon above soil, shoot straighten up and leaves open. Photosynthesis can begin.
   Plant now independent: roots absorb nutrients and water, transporting via stem, food produced in leaves.

Environmental conditions affecting seed germination

Water

→ initially, seeds contain little water and are in a 'dormant' state where food stores aren't used up.
→ water acts as an activator, as once seeds absorb it, germination begins

water enters the seed via micropyle

→ Why is water important for seed germination?

- activates enzymes and hormones within seed
- used in reactions that breakdown starch to sugars and proteins to amino acids
- transports ions from root to shoot
- transports sugars in solution from cotyledons to growth regions
- expand vacuoles in new cells - causing cells to grow and expand
- used in photosynthesis

Suitable Temperature

→ recall: temperature is the average kinetic energy of particles
→ recall: the higher the temperature, the faster the rate of reaction and particle movement

→ Why is a suitable temperature important for seed germination?

Enzymes within seeds are needed for chemical reactions and these work at optimal temperatures →
- catabolism of biomolecules (cotyledon breakdown)
- anabolism of biomolecules (growth, photosynthesis)
- cellular respiration (ATP production)

* the optimal temperatures varies between species

Oxygen

→ initially, seeds do not have access to O_2 as they are enclosed in a seed coat
→ once seeds are exposed to water, O_2 dissolves in water and enters via micropyle

→ Why is O_2 important for seed germination?

oxygen is required for aerobic cellular respiration → large production of ATP required for metabolism and growth

Investigating Germination

In order for a dormant seed to begin germination, the environment must be suitable.

↳ what does 'suitable' mean? This will depend on the species of plant and how it evolved and adapted to be successful in its environment

In order to test which conditions are optimal and the impact of various factors, an experiment can be conducted.

Recall

When conducting a biological investigation, we seek to answer a Research Question (RQ) which typically is framed as:

How does the Independent Variable (IV) impact / affect the Dependent Variable (DV) in study species ?

↳ variable being manipulated
includes control group and test groups

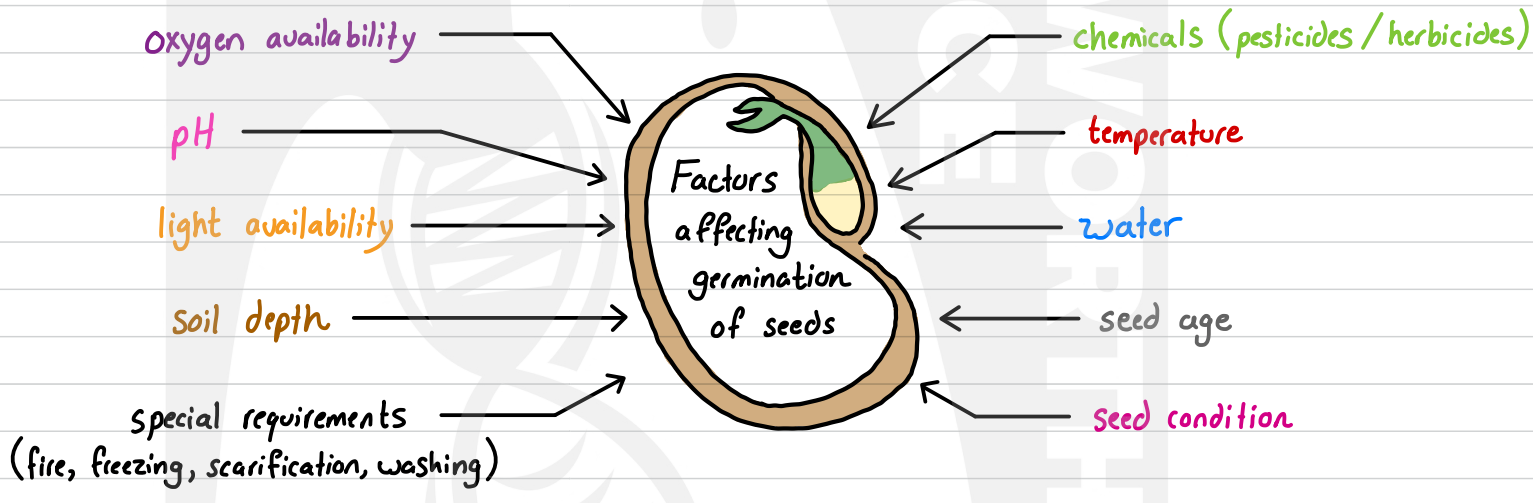
↳ variable being measured
includes unit of measure

↳ the organism being studied
written as species name and (common)

Investigating germination:

↳ Potential IVs:

↓ consider how these factors will be manipulated

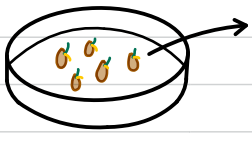


↳ Potential DVs:

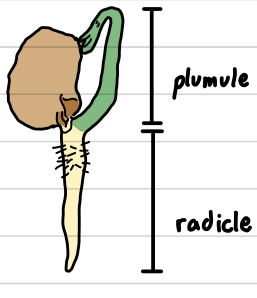
- Germination success (%) = $\frac{\text{number of successfully-germinated seeds}^{*}}{\text{total number of seeds tested}} \times 100$

* need an objective requirement for 'success'. This will depend on study species and experimental setup.

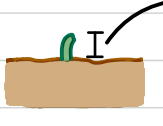
↳ if observing in petri dishes



seedlings with plumule and radicle length that exceed _____ mm



↳ if observing in soil



shoot which has emerged _____ mm above soil

- Germination rate = $\frac{\text{Number of seeds that have germinated}}{\text{* time that has passed}}$ * can be checked at multiple time points and added

↳ Potential controls.

All other factors <u>not</u> being investigated should be kept as constant as possible

Assessment Task

1. Choose a factor (IV), germination measure (DV), study species and create a RQ
   - ↳ including groups
   - ↳ including unit
2. Research and hypothesize what would occur, i.e. answer your RQ. Justify your prediction, i.e. why do you think this will occur?
3. Design your methodology. Explain how you will test this in detail