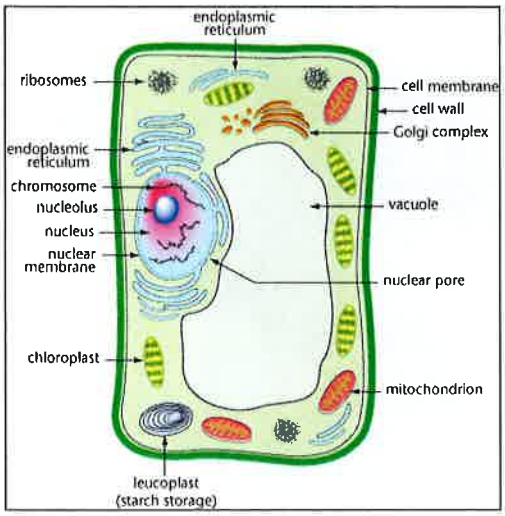
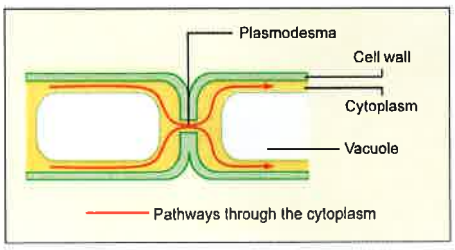
Plant cell structure

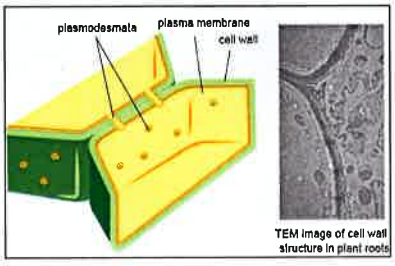


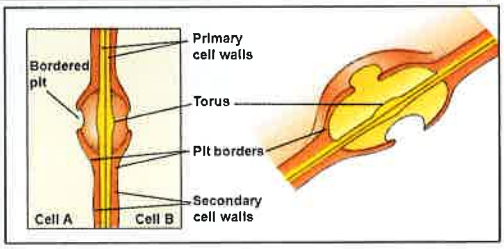
List of plant cell organelles:

- cytoplasm
- Nucleus
- Mitochondria
- Chloroplasts
- Chromoplast
- Starch grains
- Golgi
- ER (rough, smooth)
- vacuoles
- Cell wall
- Cell membrane.

Organelle	*Structure*	*Function*
Cell wall	outer layer, rigid, strong stiff, non-living	Protects and supports cell
Middle lamella	Pectins to form continuous layer between adjacent cells	Stability, allows Plasmodesmata to form
Plasmodesmata	Channels which traverse the cell walls	Transport + communication.
Pits	cavities in lignified cell walls	Allow exchange of fluids.
Chloroplast	Double membrane, stroma granum, lamellae, thylakoids	involved in photosynthesis.
Amyloplast	Non-pigmented organelles	Synthesis + storage of starch granules through polymerisation of glucose
Vacuole/tonoplast	Membrane-bound sac in cytoplasm	support, storage, waste disposal, protection
Rough ER	Double membranes with ribosomes attached	involved in protein synthesis.
Smooth ER	Network of membrane called cisternae	Production and metabolism of fats.
Golgi apparatus	Stacks of flattened membranous sacs	Modify, package and sort proteins for secretion.



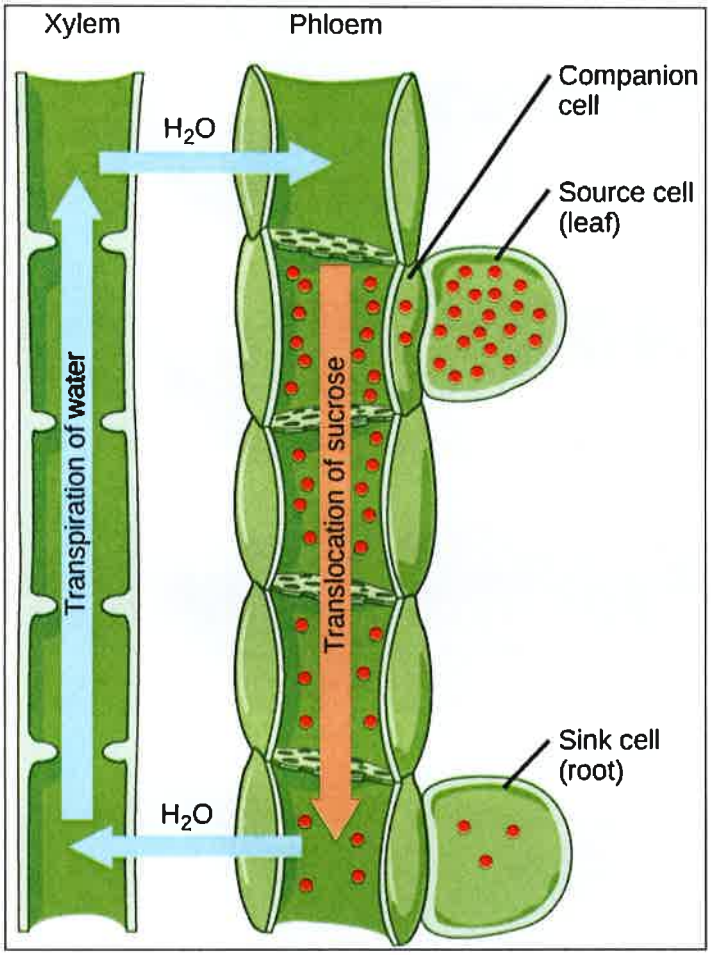




Transport in phloem

What is the mass flow hypothesis?

Explains the passive movement of sucrose from the phloem source to sink.



Stages of transport in phloem

1. Sugars move from source to sinks.
2. Sugars actively taken up by companion cells & passed into sieve tubes.
3. water flows along conc gradient via osmosis
4. This creates hydrostatic pressure, sugars removed at sink
5. water follows solute movement, hydrostatic pressure difference creates mass flow.

Evidence supporting mass flow hypothesis

① Solute conc greater at source than the sink.

① Transport of solutes (movement) is directly proportional to concentration gradient

① water potential / gradient exists between source + sink

Evidence against mass flow hypothesis

① Sugars travel to many different sinks

① sieve plates are a barrier to mass flow

① why would phloem cells waste energy?

How is phloem adapted for transport?

① Bi-directional sucrose flow (food transported all over)

② Perforated end plates

③ companion cells - metabolicly active.

What are 'sources' and 'sinks'?

Source → sugar made (leaves)

sink → sugar stored (roots)

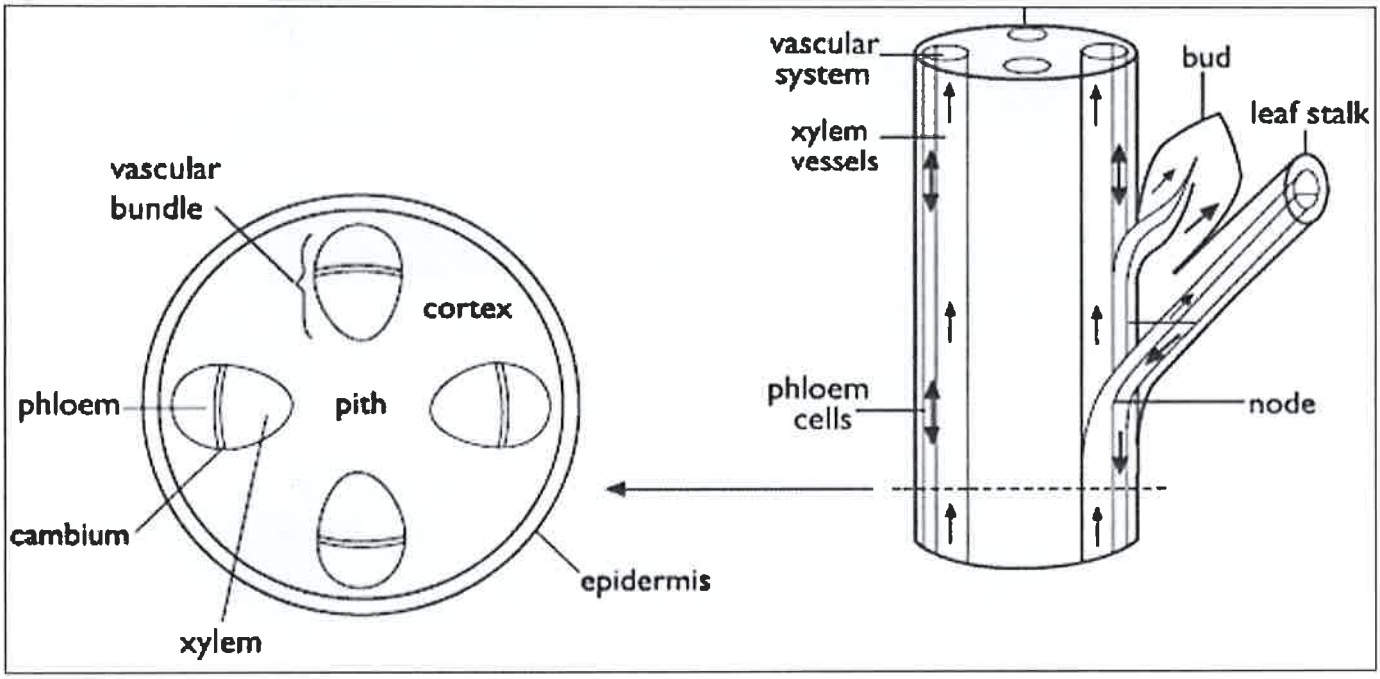
Phloem tissue

What is the phloem?

Living tissue in plants which transports soluble organic compounds made at source to sink where needed.

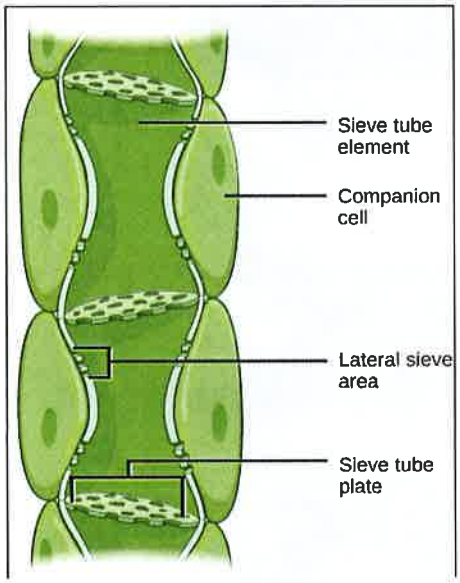
What is translocation?

Movement of ~~tissues~~ materials from leaves to other areas/tissues throughout the plant.



What is the sieve tube element?

Elongated living cells of the Phloem



Composition of S.T element

Cytoplasm:
Limited organelles, No nucleus, No ribosome, tonoplast

Sieve pore:
collectively form Sieve Plates, Provide connection between adjacent elements.

Companion cell:
Specialised parenchyma cell located in phloem. Dense cytoplasm, metabolically active.

Lateral sieve area:
Sides of sievetubes that connect one tube with another.

Why is sucrose transported and **not** glucose?

- More inert
- NO reducing end
- Low viscosity.

What does phloem transport?

Soluble organic compounds made during photosynthesis (sucrose.)

Plant products sustainability

Uses of plant products:

→ Make paper

→ Prepare cotton

→ wood for building

Natural fibres advantages:

Sustainable

High tensile strength

Natural fibres disadvantages:

Expensive

Requires skill

Man-made fibres advantages:

Cheaper

Easier to process

Man-made fibres disadvantages:

Don't breathe, body moisture not absorbed. Made from Products of crude oil.

Future of plastics

What are bioplastics?

Biodegradable materials from renewable resources rather than Petroleum.

Positives of bioplastics:

Renewable
Degrade faster
Lower energy cost
No greenhouse gas emission.

Negatives of bioplastics:

improper disposal = toxicity, landfill
Land wasted to 'grow 'plastic' rather than food.

Sustainability of Plant fibers and starch

- Molecules of cellulose, arranged as microfibrils, does not stretch but flexible + high strength.
- Lignified → resistant to enzymes
  → waterproof
- Renewable so sustainable

Properties of water importance to plants

High specific heat capacity:

Hydrogen bonds - keep temp constant, buffer to temp change

Coherence:

- Stay as continuous columns
- High surface-tension
- Adhesion to other surfaces

Maximum density at 4°c

Ice floats + insulates liquid below, allows living things to keep living

Mineral requirements in plants

Magnesium ions:

Make AA, nucleotides, ATP, protein synthesis.

Nitrate ions:

important part of chlorophyll

Calcium ions:

used in formation of calcium Pectate in middle lamella.

Mineral deficiencies

Lack magnesium: Yellow leaves

Lack Nitrate: stunted growth

Lack Calcium: mis-shapen leaves.

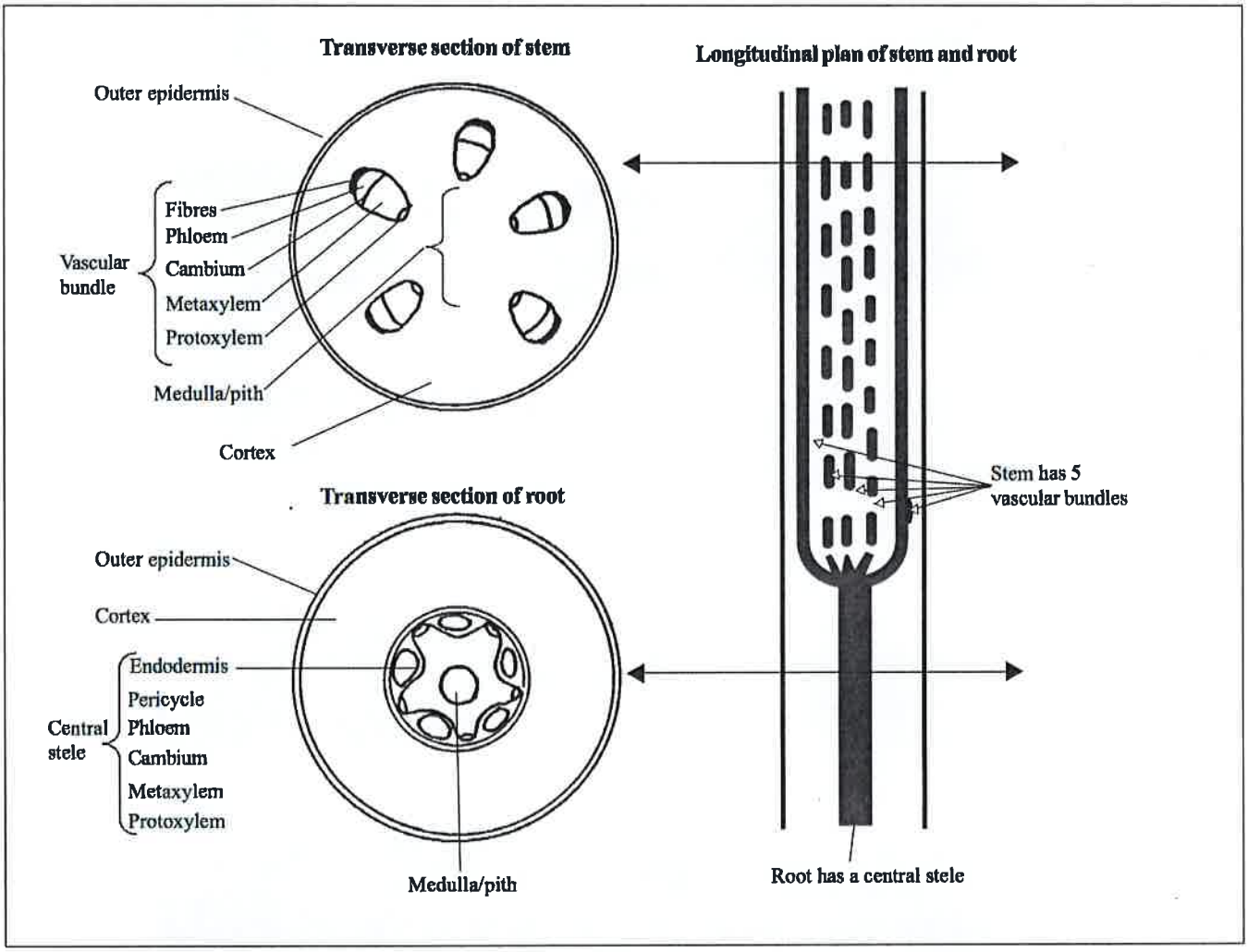
Stems & Roots

What is a vascular bundle?
conducting vessels in the stem/leaves with phloem (outside), xylem (inside)

What is the plasmodesmata?
Narrowed thread of cytoplasm passing through cell walls, allowing communication

How do hollow transport tubes form?
cell contents disintegrate end cell walls have many perforations

What is the cambium?
Tissue layer providing partially undifferentiated cells for plant growth



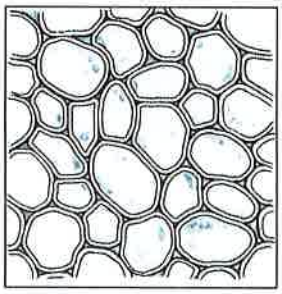
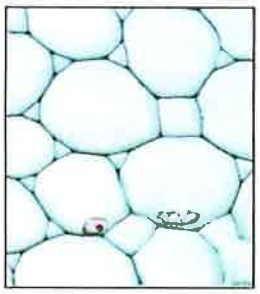
Stems vs Roots

Stems	Roots
xylem + phloem	xylem + phloem
vascular tissues in bundles	vascular tissues as core
sclerenchyma as bundle caps	NO collenchma/sclerenchyma
collenchyma beneath epidermis	
Gas exchange via stomata.	Gas exchange via root hairs

Further plant tissues

Parenchyma

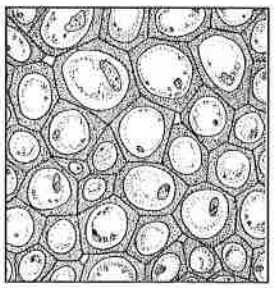
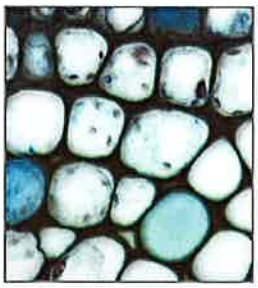
Extensive spaces between cells. Make up mesophyll of leaves and cortex ~~of~~ + pith of stems/roots.

Collenchyma

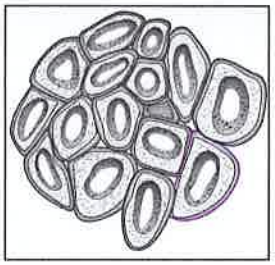
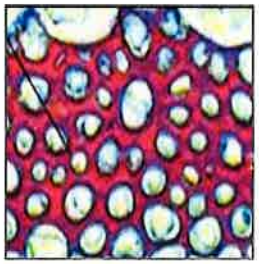
Elongated cells with thick walls to provide support and structure

Found under ~~upper~~ epi dermis

Sclerenchyma

Hard, woody cells that have heavily thickened walls made of lignin. Dead cells, Provide support. (Fibres + sclereids)

Feature	*Parenchyma*	*Collenchyma*	*Sclerenchyma*
Cell shape	Isodimetric spherical Polygonal	circular oval	variable in shape Fibres + sclereids
Cell wall	Thin cellulosic	uneven thickening	Lignified secondary wall
Cytoplasm	Abundent	Present	Absent
Nucleus	Present (Living)	Present (Living)	Absent (dead)
Intracellular spaces	Present	Absent	Absent
Lignin			
Location	Throughout the plant	Beneath epidermis	Fibres in wood, bark, leaves, stems.
Functions	Photosynthesis Respiration Storage Regeneration.	Flexible support system.	Thickened cell walls provide structural support.

Xylem tissue

What is the xylem?

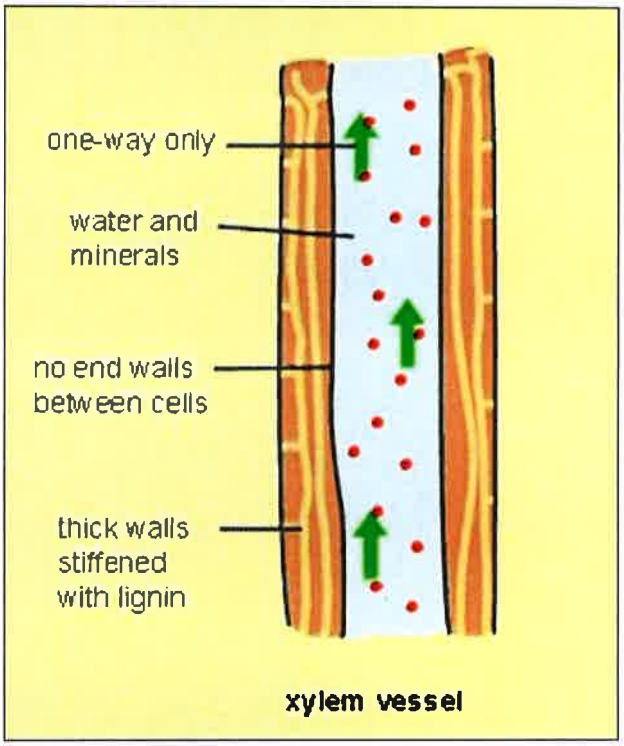
vascular tissue in plants that conducts water + dissolved nutrients upward from the root and help to form woody element in the stem.

What does the xylem transport?

water + solutes from roots to the leaves

Xylem vs phloem

xylem	Phloem
Dead cells	Living cells
Thick walls	Thin walls
Lignin walls	Cellulose walls
No cytoplasm	cytoplasm lining
water + minerals	Food
Movement upwards	Movement UP + down.



Structure of xylem tissue

- Long, hollow
- No end walls
- Cellulose fibres in rings/spiral
- Lignified, thick walls

What is lignin?

Polymer found in cell walls making them rigid + woody.

What are tracheids?

Elongated tubes, lignified walls with large cell cavity. Conduct water + minerals, Provide support to plant

xylem adaptation to function

- Narrow tubes - effective capillary action
- Pits allow water sideways
- Lignin → strength
  → water proof
  → stretching.

What does water potential mean?

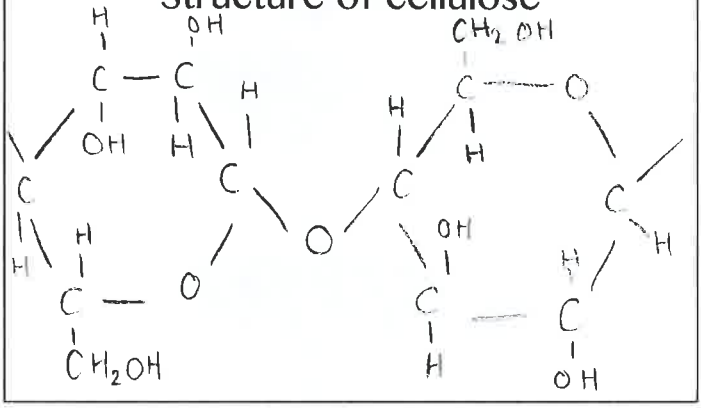
Relative tendancy of water to move from one area to another. Caused by osmosis, gravity, pressure, surface-tension

Cellulose & Cell Wall

What is cellulose?

inorganic compound, polymer of β-glucose, in cell walls.

Structure of cellulose



Function of cellulose

→ Structural support in C. walls

→ Prevent cell from bursting in a hypotonic solution

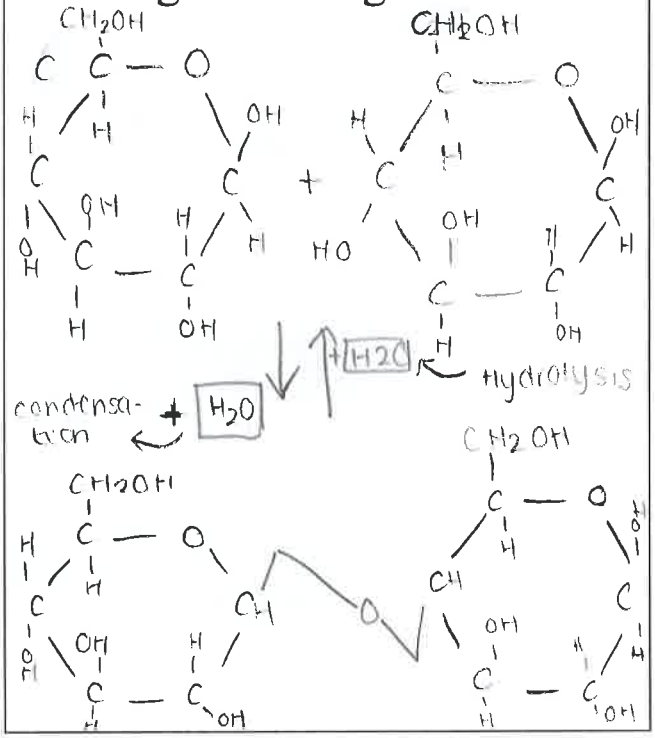
→ Dietary fibre in humans

→ connects cells to form tissues

Starch vs. cellulose

Storage carb- in plants	Provide structural support in walls.
Polymer ∝ glucose	Polymer b-glucose

Joining of 2 beta-glucose units



Primary cell wall

Made of cellulose + pectin

1st to form

What are cellulose microfibrils?

Found in primary cell walls

Many cellulose molecules joined to form cross-links

Hydrogen bonding.

Secondary cell wall

made / impregnated with lignin

2nd to form (some cells) plants

Difference between primary + secondary

(P) All plants, (S) some

(P) inner to middle lamellae, (S) inner to Primary cell wall

(P) elastic, Thin, (S) rigid, thick.

(P) little cellulose, (S) more cellulose

Biodiversity

Define 'biodiversity'

The genetic variation / range of alleles in population

What is species richness?

When there is a high number of different species in a population

What is species evenness?

Relative abundance of the different species making up the richness of an area.

What is diversity index used to measure?

Quantify the biodiversity of a habit.

(Number + size of population)

Simpson's Diversity Index

Biologists use a more complicated formula called Simpson's Diversity Index which calculates biodiversity rather than simply population size:

$$D = \frac{N(N-1)}{\Sigma n(n-1)}$$

Where:

D = diversity index (simply a number with no units)

N = total number of organisms of all species found

n = total number of individuals found of the species you are interested in

Use the calculation to calculate the diversity index for daisies and clover, by throwing 10 quadrats in total

Heterozygosity index

What is it used to measure?

Measures the proportion of genes which are present in heterozygous form.

Equation:

$$\text{Heterozygosity index} = \frac{\text{n.o. heterozygotes}}{\text{Population}}$$

Calculation example:

27 individuals

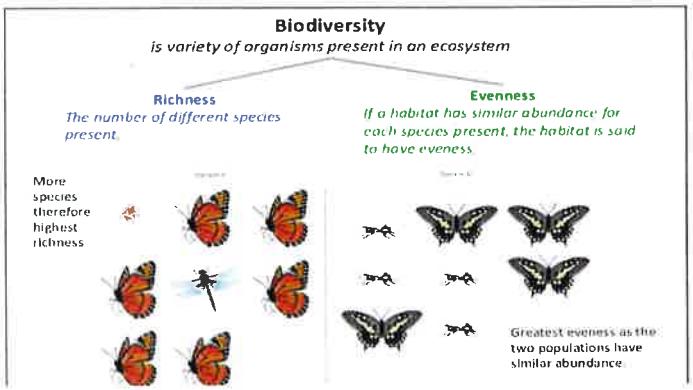
8 heterozygous

$8/27 = 0.30$

0.30 = heterozyosity index

What is the importance of biodiversity?

- Food, keep limits on population
- Sustainability + adaptations



Types of sampling methods:

- Capture - re-capture
- Aerial photographs
- Number of artifacts (nests, burrows etc.)
- Plant cover
- feeding capacity
- Quadrats.

Developing Drugs

What is a double blind trial?

Group with/without drug / placebo. Neither docter nor patient know

What is a placebo?

Same form as the drug, no active ingredient

Historical vs contemporary - similarities

- Both identify useful substance
- Both initially test on small number of people.

Historical vs contemporary - differences

Modern - test on animals/tissues
- test on healthy people
- 3 phases
- Double blind trial
- placebo.

1. Research stage

- Can take 10-12 years
- May cost up to $1Billion

2. Drug discovery

Potentially useful ingredient/ whole substance identified

Active ingredient found and copied to be manufacture synthetically

3. Preclinical trials

- Animal studies
- Tissue testing
- Test for toxicity
- Test for dosage

4. Phase 1 - clinical trial

- Small group of volunteers
- Different dosages / doses.
- Healthy
- Test for distribution / metabolism

5. Phase 2 - clinical trial

- Small group of patients
- (100 - 300 people with disease)
- Drug's effectiveness

6. Phase 3 - clinical trial

- Large group of patients
- (1000 - 3000) patients
- Double blind + placebo
- Adverse reactions monitored

7. FDA approval

› Tested for safety

› Effectiveness tested.

8. Post approval monitoring

- Continued data collected
- Side-effects reported

Niches

What is a 'niche'?

The way in which a species ~~occup~~ exploits environment

Define natural selection

Process whereby organisms better adapted to environment survive + reproduce due to survival of the fittest (S.O.F)

What is species competition?

when two or more species compete for the same resources in limited supply. If resource cannot supply both populations, one will outcompete other.

Types of adaptation:

Behavioural:
change in behaviour of organism to increase its chance of survival

Physiological:
change in the internal biomechanical functioning of organism in response to stimuli

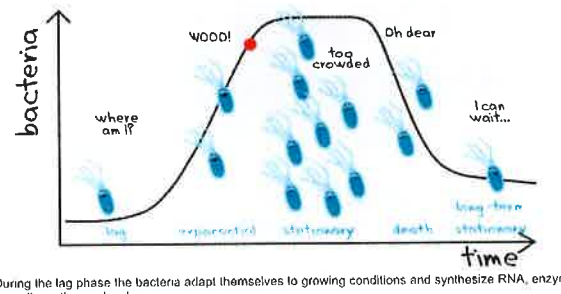
Anatomical:
Physical / structural adaptation can be internal or external

Types of competition:

Interspecific:
competition between diff species

Intraspecific:
competition ~~within~~ same species

Bacterial Growth Phase



During the lag phase the bacteria adapt themselves to growing conditions and synthesize RNA, enzymes as well as other molecules
The log phase is when the bacteria grow very rapidly
The stationary phase occurs when a nutrient is depleted in the environment so death and growth is equal
The death phase is when the bacteria die due to lack of nutrients

Why can't two species occupy same nice?

- Competative exclusion
- As a result of interspecific comp
- Natural selection + S.O.F
- Species with advantageous allele will out compete other
- Number of dominant species will increase

Why do organisms adapt?

withstand environmental change to survive