Topic 4 15/4/09 14:12

The fact that plants can't move means that they must be excellent adaptors, and makes them useful records of climate change

Plant structure

- Strong walls made from sugar polymers
- Specialised tubes run vertically
- Cells stiffened with **lignin**
    - Lignification occurs one year
    - Forming a strong and flexible polymer
- Specialised componentry
    - Chloroplasts
    - Rigid cell walls
    - Vacuole
        - Which controls the flaccidity / turgidity of the cell, and affects the rigidity of the plant
- Types of plant fibre
    - Parenchyma
        - Packing fibre
    - Cellulose
        - Made from B-Glucose molecules
        - Broken by hydrolysis
        - Unbranched
            - Solely 1,4 glycosidic bonds
        - Versus starch
            - Which is alpha-Glucose, branched with 1,6 & 1,4 links
    - Microfibrils
        - Hydrogen bonds between cellulose chains form microfibrils
        - Make up the cell wall
        - Microfibrils are bound helically and held together by amylopectin and hemicellulose glue
        - Multiple angles creates toughness
    - Plasmodesmate
        - Fluid filled channels which link cytoplasms, often found in pits in the cell wall, where there is a lack of cellulose
    - Xylem
        - Stiffened cell walls provide rigidity

        - Often dead
        - Become increasingly lignified, and the **tonoplasts**, which separate the cells, break down to allow flow
    - Phloem
        - The 'nutrient sieve'
    - **Schlerenchyma** is the fibrous outer layer of a plant's stem
        - Columns of which help provide support
- Mass transport
    - Why is water brill?
        - Good solvent; the 'universal solvent'
        - High heat capacity, so useful for stabilising temperatures
- Transport
    - Cohesion between like molecules
    - Adhesion between different ones
        - Water and wall
    - Provides a 'mass flow' system
- Ions
    - Magnesium ions
        - Lack = No chlorophyll, yellow leaves
    - Calcium ions
        - Lack = stunted growth
    - Nitrate ions
        - Lack= stunted growth
        - Needed for nitrogenous bases
- Stems are kept rigid by turgid cells + parenchyma

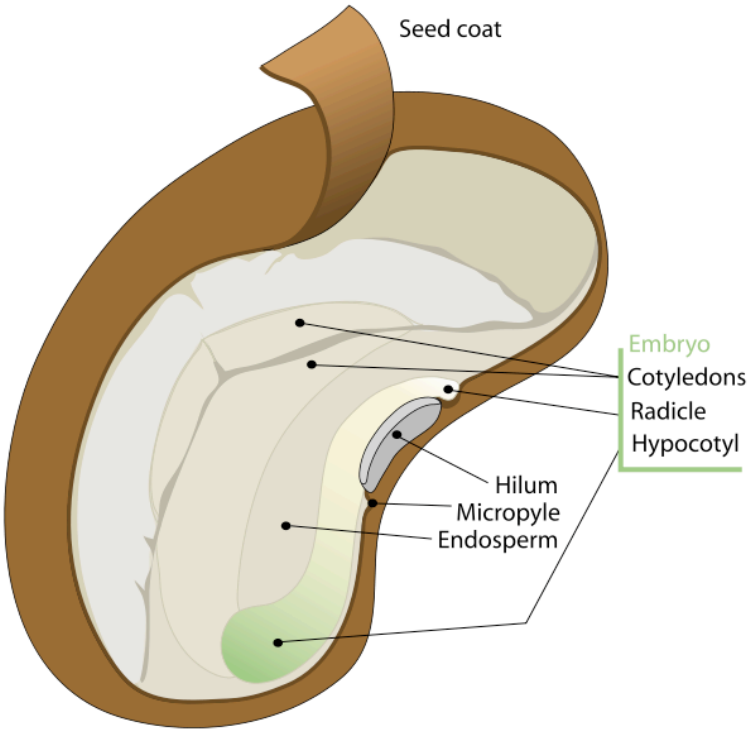
Human use of plants

- Fibres
    - We use **retting** to separate the plant fibres from one another
    - This allows us to remove the lignin
- Natural antibiotics
    - For instance garlic
- Foxgloves & Digitalis
    - To treat dropsy, caused by oedemas
    - Digitalis is a diuretic, causing all the excess fluid to be weed out!
    - Withering kept upping the dose until somebody died

    - Worked out that the efficacy of the digitalis was proportional to urine output
    - Side effects were nausea & vomiting. When these were exhibited he dropped the dose again
- Drug testing today
    - Preclinical tirals
        - Animal and labs
    - Clinical Phase 1
        - Small group of healthy volunteers
        - Mainly to assess how the body absorbs and processes the drug
    - Clinical Phase 2
        - Small group (100-300) of disease sufferes
    - Clinical Phase 3
        - Double blind procedure
        - 1000-3000 sufferers tested

Seeds

- Tough outer coat called **testa**
- Protects seeds
- Dormancy terminated in response to
    - Chilling
    - Gut activity
    - Heat
    - Abrasion
    - Light
- Anatomy of a seed



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Plumule = A young shoot

Cotyledons = Side leaves

Endosperm= External food supply, separate from the embryo)

Seed dispersal

- Wind
  - E.g. sycamore seeds, spinny!
- Water
  - E.g. Coconut seeds, which float
- Animal
  - E.g fruit trees
- Self propagating
  - E.g. peas, which explode!

Germination

- Seeds absorb water through **micropyle**
- Swelling, rupturing the testa
- The enzymes AMYLASE and MALTASE convert starch into sugar
- This sugar is utilised by the plumule for growth

Uses of starch

- Expanded foam
    - E.g. For packaging
- Thickening agent
    - E.g. Wallpaper glue
- Stiffening fabrics
    - Shirt collars
- Super absorbents
    - Tampons
- Soap

Selective breeding of plants

- Mate the best plants with the best plants, or self-pollinate the best plants
- You sometimes get **inbreeding depression**
- But F2 hybrids (breeding two inbred plants)
- Gives hybrid vigour

GM crops

- Insertion by
    - Viral vector
    - Bacterium (DNA in a plasmid)
    - Gold plated bullets from a gene gun
- Development
    - Herbicide resistant marker genes allow the calluses to be nurtured in herbicide rich environments, killing plants which have failed to have the gene incorporated into their genome
    - Then use **micropropagation** to grow your lovely GM plants
- Uses
    - Tougher tomatores (delayed ripening)
    - Herbicide resistant crops
    - Pest resistant crops
        - E.g Corn boring weevils thwarted by toxin producing corn
    - METABOLIC ENGINEERING
        - This is the alteration of the expression of various genes, changing whole metabolic pathways
            - E.g. Ligning removal

- Concerns
    - Antibiotic resistance could spread to weeds
    - The new genes could produce unexpected, harmful products
    - Increased herbicide use is bad for the environment
        - E.g. DDT build up killed loads of kestrels

CLIMATE CHANGE

The effects of temperature change

- Migration patterns chaning
- Alien species alter the community
- Faster photosynthesis leads to faster growth
- Life cycles messed up
    - Spawning, hatching, sex determination in reptiles
- Plants may start flowering at different times, causing pollination problems
- **Photoperiod** means day length
    - Some animals judge by temp, others by photoperiod, which could cause dichotomies, most damagingly between predator and prey

- Monitoring:
    - **PHENOLOGY**
        - The study of natural indicators of season
            - Such as hatching times, migration periods, etc.
    - **Dendrochronology**
        - The study of tree rings
        - Examined on a **skeleton plot**
        - Tall spikes indicate bad seasons
        - Ring width
            - Bigger rings in spring
                - The 'early growth' wood, growth spurt after winter dormancy
            - Smaller rings in summer
                - The 'late growth' wood, more dense and slower grown
    - **Pollen sampling**
        - Made possible by the plentifulness and enduringness of pollen

        - Tested by **carbon-14** dating
            - Comparing ratio of C14: C12; since C14 decays into C12, the more C14, the older it is.
        - Allows us to assess which plants were alive when
        - Giving data on succession
    - Peat beetles
        - Insects react faster to climate change due to their **short life cycles**
        - So the **exoskeletons** of peat beetles can be useful indicators of climate change (bigger beetles usually mean warmer period?)

- Extrapolation
    - This is what we do to predict future climate
    - Weaknesses
        - Relies upon the continuance of current trends
        - There are lots of factors, making it difficult
        - We don't really understand how various factors interact
        - The computing power is often inadequate
- CO_2
    - Comes from:
        - Volcanoes
        - Combustion
        - Emitted by decomposition of limestone (calcium carbonate)
            - Worsened by acid rain
        - CO_2 is bound up in exoskeletons in the sea