Topic 5: On the Wild Side

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Biodiversity

- Species richness (number of different species)
- Diversity within the species (genetic diversity)
- Diversity within specific ecosystems

There are 5-30 million species on Earth

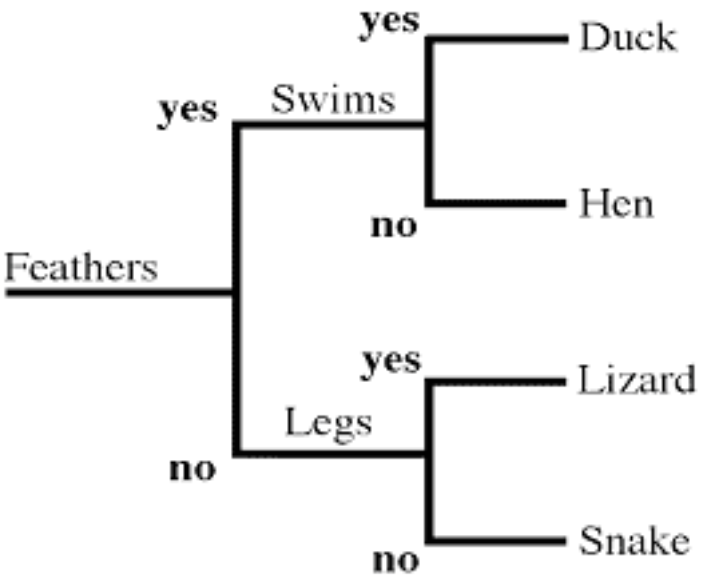
Species:

- ` A group of organisms with similar morphology, physiology and behaviour which can be interbred to produce fertile offspring, and are isolated reproductively in place, time or behaviour from other species'

- Estimates of species numbers come from multiplying up the results of an intensive survey of a small area
- Or using known ratios e.g. 1 Butterfly : 3000 worms, count the butterflies to estimate the number of worms.

Dichotomous key

- The key where there are always just two options:



- Above is a traditional, linear dichotomous key
- A multiple access key allows you to enter from any direction, but is still based on the dichotomous options.

CAT= Computer Aided Taxonomy (or Computerised Axial Tomography, depending on which unit we are talking about!)

Taxonomy: 'Placing animals into groups based upon shared features'

Kingdom	Animalia
Phyla	Chordata
Class	Mammalia
Order	Primates
Family	Homonidae
Genera	Homo
Species	Sapiens

The Kingdoms:

- **Animalia**
  - Heterotrophs
  - Can't photosynthesises
  - Can move
- **Plantae**
  - Autotrophs
  - Can photosynthesize
  - Can't move
- **Fungae**
  - Heterotrophs
  - Can't photosynthesize
  - Can't move
  - Have CHITIN in their cell walls
  - And multinucleate HYPHAE (long thing arms….)
- **Prokaryotae**
  - Small!
  - Store DNA in genophore, not a standard nucleus
  - No cell bound organelles
  - Can move
- **Protoctista**
  - Very simple eukaryotes
  - Have movement

        - There is also the question of **archeabacteria**
        - Which have been proposed as a third group, alongside eukaryotes and prokaryotes

Why bother classifying?

- To keep track of biodiversity
- To understand evolution and relation better
- To aid chemical & medicinal research
    - E.g. The moreton bay chestnut tree produced antiviral fluids that were toxic, so chemists turned to the related Alexa, which was less toxic.

Biodiversity hotspot

- An extremely biodiverse ecosystem
- Reefs are a common example
- Surprisingly, the Mediterranean Basin is the most biodiverse hotspot on earth

Endemic = Only found in a single particular area

Phenotype= The result of the genotype interacting with the environment around; the physio and morphological expression of the genotype in a given environment.

Genetic diversity= The variety of different genotypes in an environment

- Often referenced to number of SNPs; Single Nucleotide Polymorphisms
- Which is the number of single bases that consistently vary within a population
- Another tool to measure genetic diversity is number of different alleles for a loci
- % Of the population with 2+ alleles
- % Loci heterozygous in individuals in a pop (heterozygosity index). 2 bands on gel electrophoresis= hetero, 1 band = homo

Sources of diversity

1. **Mutations** during meiosis
    - Inversion
        - A codon or two are flipped
    - Translation
        - A codon, or base, moves

- Deletion
    - A number of bases are removed

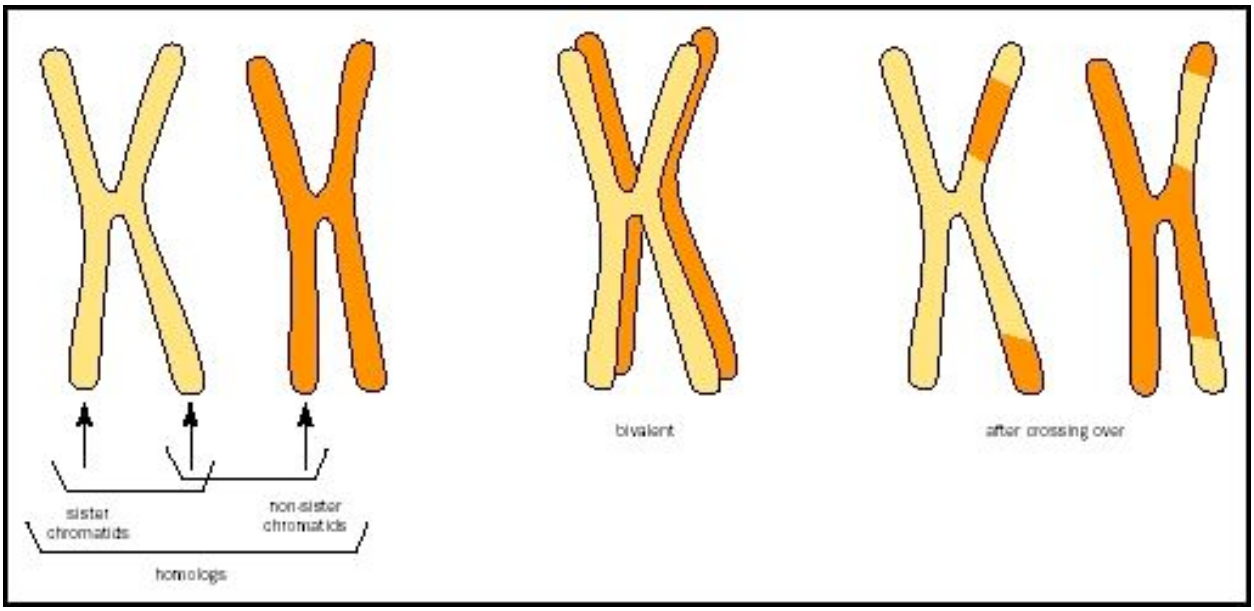
2. **Independent Assortment** of chromosomes during meiosis (the gamete gets a random selection of chromosomes from the producer's own paretnts)

3. **Crossing over** between homologous (equivalent) chromosomes

4. **Mate selection**

5. **Random** (well…. It's not truly random) **fertilisation**

CROSSING OVER



The points at which the chromosomes cross over are known as **chiasma**; points of crossing over.

DIHYBRID INHERITANCE: Where two alleles, inherited independently of one another, both combine to affect a single aspect of the phenpotype.

Common Ratios

Hetero + Homo = 1 : 1 : 1 :1 Genotypes

Hetero + Hetero = 9:3:3:1 Phenotypes

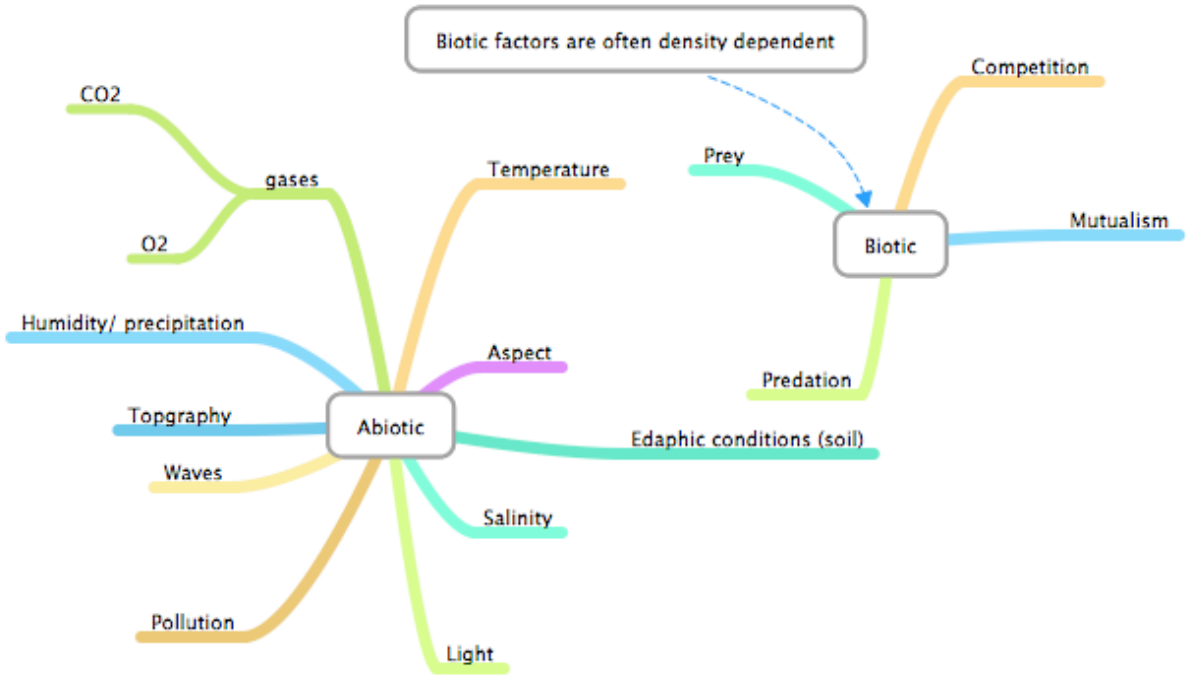
F1= Filial one; the first generation of offspring. F2= the next, and so on.

CODOMINANCE= The phenotype of the heterozygote reflects the presence of both alleles; they are codominant, the dominants doesn't merely override the recessive.

Biosphere= The part of earth and the atmosphere inhabited by organisms

Population= Number of a given species

Community= The number of different species/populations in an ecosystem



There are also anthropological factors; our ecological footprint.

Littoral zones on beaches present similar, but not identical environments, and show how much diversity you can have within a small space.

Adaptations:

- Daisy
    - The basal rosette of leaves allow the daisy to be decapitated by still survive
- Pitcher plant
    - Slippery, waxy coating on leaves causes ants to slip down, particularly in rainfall

Autotrophs are either **photosynthetic** or **chemosynthetic**; some, for instance deep sea extremophile bacteria, can use H_2S without light to chemosynthesise…

Photosynthesis:

- **$6\ H_2O + 6CO_2 \rightarrow C_6H_{12}O_6 + 6O_2$**
- In the presence of UV light

- The energy of the products is significantly higher than that of the reactants, due to the new, strong, energy rich bonds formed.
- That is where the light energy has gone; into chemical energy
- Split into **LDR (**light dependent reaction) and **LIDR (**light independent reaction)

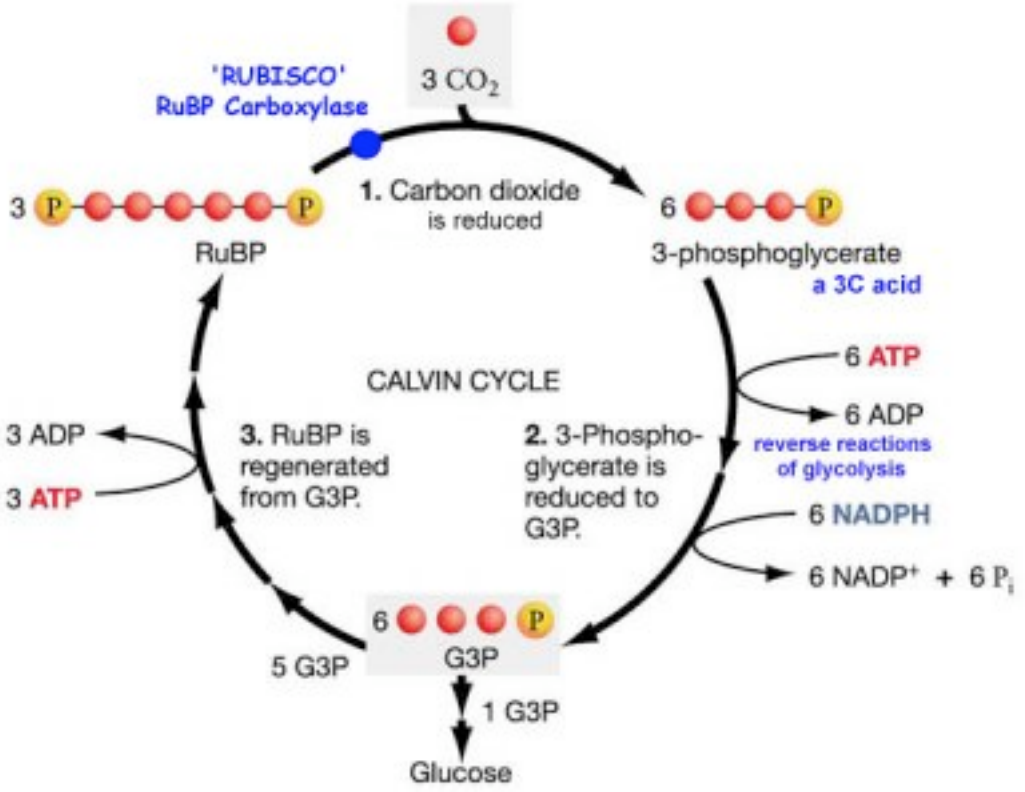
LDR

- Carried out on the **thykaloid membranes**
- Photolysis
    - $H_2O \rightarrow 2H^+ + 2e^- + O$
    - This is used to replenish the electrons used in photosynthesis from the chlorophyll
- The Electron Transfer Chain
    - Sunlight excites electrons from chlorophyll
    - Which are transferred to the electron transfer chain
    - Where, by a series of redox reactions
    - They are passed down energy levels
    - Pumping H^+ out and allowing it to diffuse back through the thykaloid membrane

- Creating ATP & NADH + H^+
- Which are whisked through to the LIDR…

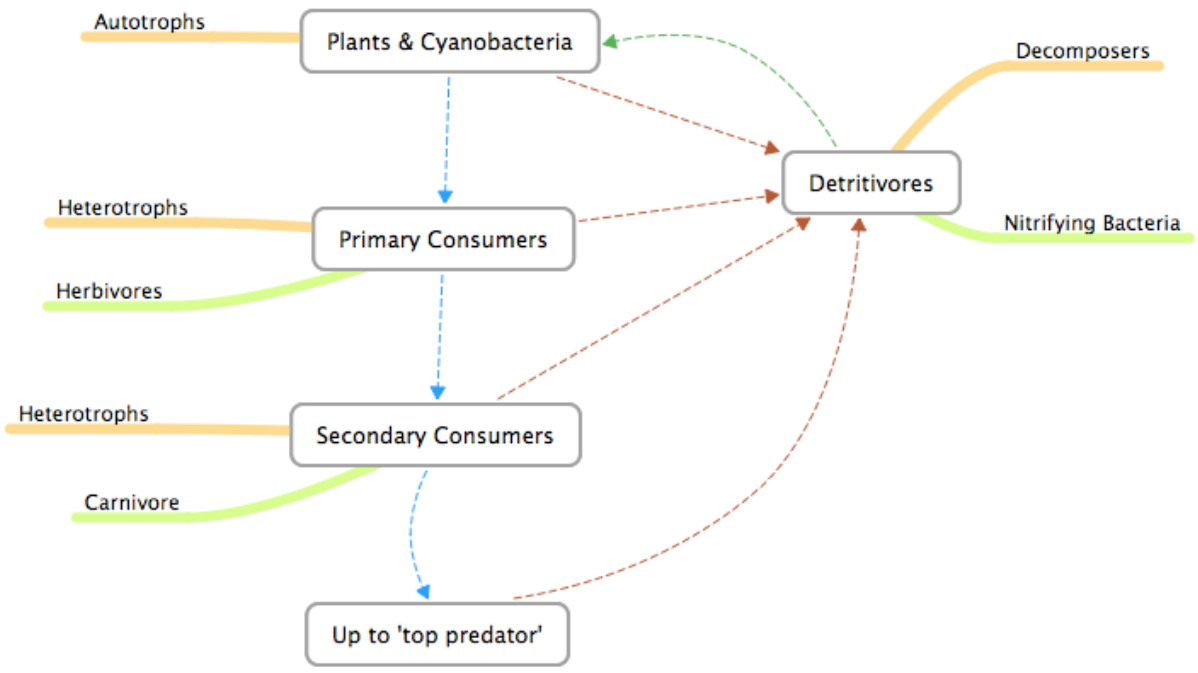
LIDR

- The Calvin cycle (also known as the carbon fixation cycle)



- Basically, RuBISCO is the key enzyme, incorporating CO_2 into the cycle, which then involves ATP to provide energy and NADP + H^+ to provide energy
- The ATP provides energy, allowing **energetically unfavourable (negative entropy)** reactions to take place; the building of carbohydrates- glucose.

Energy transfer within ecosystems

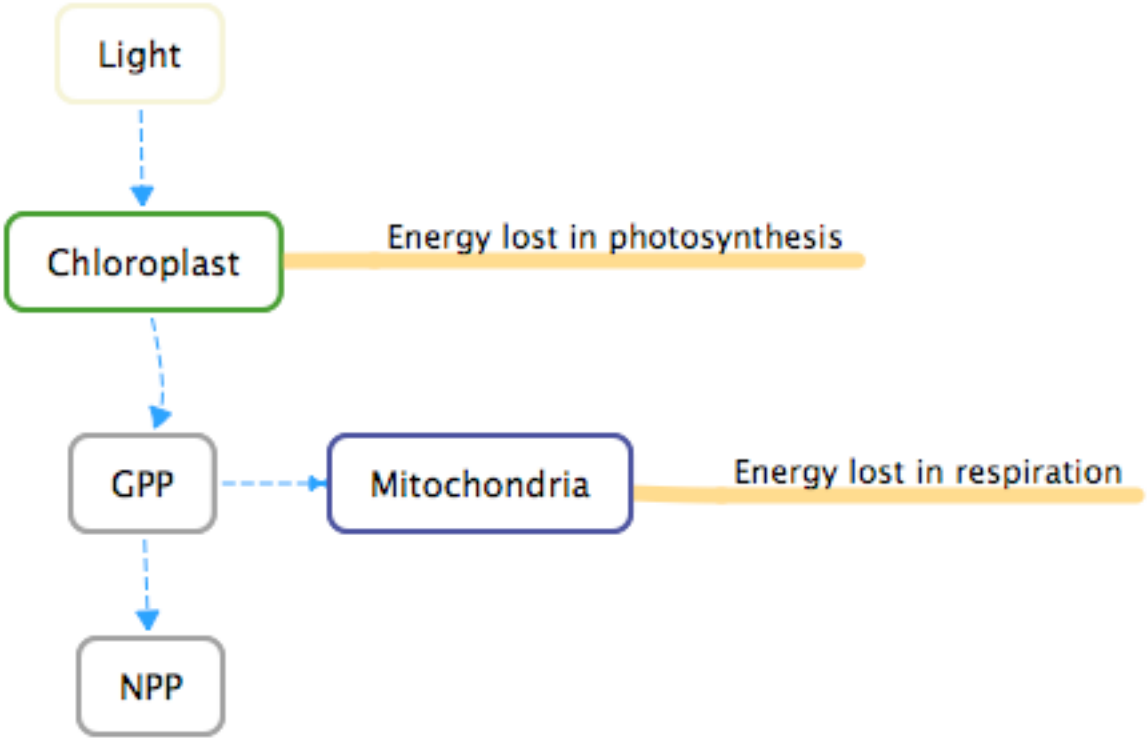


GPP

- The **Gross Primary Product**
- The total amount of energy incorporated into organic molecules by an autotroph

NPP

- **Net Primary Product**
- The amount of energy actually stored as plant biomass
    - So after respiration and transpiration.



Imperfect transfer of energy:

- Not all available biomass is edible
- Energy is lost by the consumed through faces, movement, growth, reproduction

The following trends thus assert themselves

- Decreasing biomass through increasing trophic levels
- Decreasing population through increasing trophic levels
- Increasing size through increasing trophic levels
    - This one is interesting; is it because you need to be bigger than something else to eat it? Probably.

Carnivores are also more efficient at eating than herbivores, because protein is more easily digested than carbohydrate.

Evolution

Darwin & Wallace

- Random mutations are given direction through selective advantages conferred, leading to 'survival of the fittest'
- Which subsequently reproduce, producing fit children

Lamarck

- Changes happen according to the envinroment, and these adaptations can be passed onto offspring.
    - DNA evidence against this; DNA transfer is one way only.

Malthus

- More offspring are born than can possibly survive
- Therefore, there is a struggle for existence

Speciation

- Usually occurs after an initial geographical isolation
- Then, if species come back into contact, the follow isolation prevents interbreeding
    - Ecological Isolation
    - Temporal Isolation
    - Behavioural Isolation
    - Physical Incompatibility
    - Hybrid Non viability
    - Hybrid sterility

ALLOPATRIC= Geographical, isolation based speciation
SYMPATRIC= Genetic divergence of a population purely due to polymorphisms and new niches

CONVERGENT EVOLUTION= Different species ending up looking similar due to similar niches
ADAPTIVE RADIATION= Very closely related species looking wildly different due to different niches

Conservation

4 main reasons to conserve:

- Economic

    - We need biodiversity and sustainability to continue to facilliate economic growth
- Aesthetic
    - The biological world is pretty!
- Ethical
    - We don't have a right to decimate the ecological world
- Ecological
    - Everything is interdependent, and we don't fully understand these links; thus, destroying things could have unpredictable and catastrophic consequences.

Ex situ = Off site, e.g. in a zoo
In Situ= On site, e.g. in the rainforest

Flagship species

- E.g. Pandas
- These raise money for zoos and conservation efforts by being cuddly and attractive, which allows the money to be spent on other, less glamorous species, e.g. beetles.

NNR= National Nature Reserve

SSSI= Site of special scientific Interest

GLTCP= Golden Lion Tamarind Conservation Program

- Captive breeding and reintroduction
    - Must be careful to maintain genetic diversity
    - And necessitates raising them in synthetically wild conditions
- Education of locals
- Translocation of species into reserve
- Research
- Habitat managament

Succession

'The change of a community over time reflected in the dominance of different species and usually accompanied by changes in edaphic conditions'

- Pioneer Stage
    - Poor nutrients in the soil
    - Usually low organic and low moisture content
    - Species such as grasses are good
- Climax Community
    - Won't be displaced unless abiotic conditions change
    - Usually lots of trees

Secondary Succession

- Happens on a brownfield site that has been fertile but is now not e.g. after a forest fire
- There is often an existing seed bank, and the conditions favour plants with
    - A short life cycle
    - Lots of seeds
    - Wide seed dispersal

Deflected Succession

- This is where succession is artificially halted, and a climax community enforced and maintained…. by us
- E.g A Golf Course

Zoos

- The 'mountain chicken' frog was saved by taking 13 frogs to Jersey Zoo and studying it's nocturnal life, along with a captive breeding program
- Captive breeding
    - Increases abundance
    - Maintains genetic diversity
    - Ultimately, the aim is reintroduction
- The loss of genetic variation
    - Zoos must be careful; genetic drift can see useful alleles drift out of the gene pool, with less flexible options being 'fixed'
    - Genetic variation is extremely important if reintroduction is to be successful
        - Stud books are used to prevent in breeding