

## Bio Final Exam KW

**Allele** – one of two or more versions of a gene

- different alleles can result in different observable phenotypic traits
- each trait has 2 alleles
- one allele/chromosome for diploid organisms
- genetic variations in alleles can result in differences, also can be unnoticeable

**Allele frequencies:** the abundance of one allele relative to others at the same gene locus in individuals of a population to describe genetic diversity

- can be calculated by dividing the number of alleles for a certain trait/the total number of individuals in the population
- usually expressed as proportion or a percentage
- denoted as “p” or q”

**Allopatric speciation:** a reproductive isolating mechanism that results from geographical separation between two populations

- a prezygotic mechanism
- Populations evolve independently and diverge into different species
- caused by glaciers, continental shifts, etc

**Allopolyploidy:** having 2 or more complete sets of chromosomes from different parent species

- only plants are capable of this, not animals
- results in a fertile hybrid
- can be created from previously sterile species (ex bread wheat)

**Autopolyploidy:** having 2 or more complete sets of chromosomes from the same parent species

- again only possible in plants through self fertilization
- arise from a failure in the meiotic process
- often resemble parents, except grow more slowly and flower later

**Behavioural Isolation:** -a prezygotic isolation process

- 2 species do not mate because of differences in courtship behaviour
- also known as ethological isolation
- ex: songs of bullfrogs, fireflies example used in class (sequences of bursts of light vary for different species of fireflies within males and females)

**Beneficial mutation:** a mutation that proves to be beneficial for the individual; ex increases fitness

- can help withstand diseases
- ex: those who carry 1 allele of the sickle cell anemia disease are more resistant to malaria in areas of sub-saharan Africa

**Biological Species:** the concept of a species based on the ability of populations to interbreed and produce fertile offspring

- basically a reproductively isolated gene pool
- no universal agreement to what it is
- problems with the concept: how do you define a fossil species?  
how do you define populations that reproduce asexually? (ex archaea and bacteria)

**Bottleneck Effect:** Type of genetic drift that occurs when an event, such as drought, or intensive selection pressure causes a population to significantly dwindle in size  
-the survivors reproduce, but there is limited genetic variability  
-this is a problem!  
ex: elephant seals, tomatoe (taste)

**Chromosomal Inversion:** a chromosome rearrangement in which a segment of a chromosome is reversed end to end  
-occurs when a single chromosome undergoes breakage with itself  
-occurs in the arm of the chromosome, does not involve the centromere  
-do not usually cause abnormalities as long as the re-arrangement is balanced with no extra genetic info  
--however increased production of abnormal chromatids result in heterozygous individuals à lowered fertility due to production of unbalanced gametes

**Chromosomal translocation:** rearrangement of parts between nonhomologous chromosomes  
-ie: a piece of one chromosome breaks off and sticks to another chromosome  
-2 types: reciprocal & Robertsonian  
-Reciprocal: 2 different chromosomes exchange places  
-Robertsonian: a whole chromosome attaches to another  
-Ex: results in Down Syndrome (Trisomy 21; the 21st chromosome has 3 chromosomes instead of 2)

**Crossing over:** recombination in meiosis when chromatids exchange segments  
-IMPORTANCE: genetic variability  
-occurs during prophase I in a process known as synapsis  
-matching regions on matching chromosomes break and then reconnect to the other chromosome

**Deleterious mutation:** a genetic mutation that proves to be harmful for the organism  
-cause errors in protein sequence making a partially functional or completely non-functional protein  
-when the protein plays a critical role in organism functioning, it can be crucial à i.e. a medical condition can result  
-ex: genetic disorders  
-are often repaired by the “double checking system of DNA”

**Diploid:** an organism that contains 2 sets of chromosomes  
-grow through cell division (mitosis) and reproduce by meiosis (production of gametes)  
-ex: animals

**Directional selection:** type of selection in which individuals at one extreme of the phenotypic expression have a higher fitness  
-the frequency of the phenotype becomes higher & is eventually fixed

-occurs most often naturally under environmental changes.  
-ex: breeding for the most desirable trait; i.e. the smallest possible Chihuahua

**Disruptive selection:** type of selection in which extreme phenotypes have higher fitness than intermediate phenotypes  
-results in speciation  
-driving force behind sympatric speciation  
-ex: different species of birds with very long and very small beaks

**Dominant allele:** an allele that expresses its phenotypic effect even when heterozygous with a recessive allele  
-important for masking recessive phenotypes & preserving recessive alleles in a population  
-ex: if the pea plant is dominant for green seeds and recessive for yellow seeds, and the individual is heterozygous then the green seed phenotype will show

**Ecological isolation:** a prezygotic isolation mechanism  
-species that live in the same geographic region occupy different habitats  
-thus making it difficult for them to mate with one another  
-ex: a marsh species vs. a woodland species

**Ecological species:** the species concept where a group of organisms is adapted to a particular set of resources (niche) in the environment  
-the ecological & evolutionary processes that control how resources are divided up produce these clusters  
-good for ecological foodwebs  
-PROBLEM: the observations are just as subjective as the morphospecies concept

**Female choice:** -the females having control over whether reproduction occurs based on their choices of the males  
-due to the fact that females produce the eggs, and want the best possible sperm to fertilize her eggs  
-results in elaborate courtship and extravagant visual appearance on the part of the males in order to attract females

**Fitness:** the ability to survive and reproduce → stronger fitness means that you are more likely to survive and reproduce and vice versa for a weaker fitness  
-alleles with higher fitness become more common; produces natural selection  
-manifested through the phenotype ; affected by developmental environment as well as by genes

**Fixation:** the state in which where only one allele remains of a particular gene  
-the probability of fixation is higher in small populations due to genetic drift  
-in fixation, if one allele is fixed, the other coordinating allele is lost

-otherwise known as the domination of a particular allele  
-IMPORTANCE: it's BAD – we've lost genetic variation

**Founder Effect:** a phenomenon in which a colonizing population has only a fraction of the genetic variety of the parent population  
-a reduced gene pool (loss of genetic variation)  
-often caused by migrating populations, island populations etc.  
-ex: Quebecois in the Saguenay region à increased change of muscular dystrophy in this region because of the founder effect

**Frame Shift Mutation:** a mutation that causes the reading frame of the mRNA to be altered, usually by one codon, which can mess up everything  
-produces a different, non-functional amino acid sequence in the polypeptide  
-caused by insertions or deletions of nucleotides  
-the earlier the frame shift, the more mutated the protein

**Gametic Isolation:** prezygotic reproductive isolating mechanism  
-is the incompatibility of the sperm of one species and the egg of another species to join together  
-ex: giant clams/ sponges/organisms that release their egg and sperm into the water column recognize only each other and don't end up combining with other species

**Gene Duplication:** a segment of one chromosome is broken off and inserted into its homologue (resulting in duplication of the gene on the homologue)  
-the opposite of the deletion

-identical genes can undergo changes and diverge into 2 different genes  
-occurs during unequal recombination (crossing over) that occurs between misaligned homologous chromosomes during meiosis

**Gene flow:** the transfer of genes from one population to another through the migration of individuals, thus introducing new genes  
-can solve the problems of the founder effect, bottleneck effect, genetic drift etc  
-can also result in loss of genetic variety of the gene flow is out of the population instead of into the population  
-mobility affects the rate of gene flow

**Gene pool:** the sum of all alleles at all gene loci in all individuals in a population  
-large gene pool = large genetic diversity, small gene pool = small genetic diversity & lower biological fitness/selection  
-total gene pool is important for calculating the allele frequency (\*remember allele frequency is a percentage)

**Genetic Drift:** random fluctuations in allele frequencies as a result of random change in a finite population  
-usually happens in smaller populations

- basically a sampling error
- if the population is large, the effect of chance = low
- ex: 50/50 heads/tails coin tossing done 25 times vs. 5000 times

**Genetic Equilibrium:** the time at which allele frequencies and genotype frequencies do not change from one generation to another

- defined by the Hardy Weinberg Equilibrium equation
- only happens if all of these conditions are met:
  - 1) Random Mating, 2) No Natural Selection 3) No Genetic Drift (A very large population) 4) No Mutation 5) No Gene Flow

**Genotype frequencies:** percentage of individuals in a populations that contain a particular genotype (ex: AA, Aa, aa)

- Denoted by  $p^2$ ,  $q^2$ , or  $2pq$
- represented as a proportion of the total number of individuals

**Habitat Isolation:** species that live in different habitats

- a prezygotic isolation mechanism
- basically the same thing as an ecological isolation.

**Haploid:** -contain 1 set of chromosomes -may be gametes in diploids (egg and sperm) or an organism that already exists in a haploid state (fungi)

- biologically referred to as "n"

**Hardy-Weinberg Principle:** the "rule of thumb" that states when a population of diploid organisms achieves genetic equilibrium

\*see genetic equilibrium for the conditions under which this is true

IMPORTANCE: It is important to know when things are NOT changing in order to determine if things are changing!

**Heterozygote Advantage:** when heterozygotes have a higher relative fitness than homozygotes

- due to dominating allele masking the possible harmful effects of the recessive allele
- results in heterozygotes surviving more than homozygotes in the case of diseases
- also known as balancing selection
- ex: sickle cell anemia heterozygotes in sub-saharan Africa have higher resistance to malaria

**Heterozygous:** the state of possessing 2 alleles of a gene – can be dominant + recessive ex: Aa

- if dominant + recessive, only the dominant trait will show in the phenotype
- ex: a pea plant containing alleles for both yellow and green seeds, if green is dominant; they will have green seeds, but since they still contain the allele for the yellow seed it is possible for it to pass it onto the next generation

**Homozygous:** the state of possessing 2 alleles of the same gene – ex: both alleles are recessive, or both alleles are dominant

-ie identical alleles for a single trait

-ex: the green seeded pea plant has alleles that both code for green seeds, the yellow seeded pea plant has alleles that both code for yellow seeds

-2 different homozygous individuals can breed to form heterozygotes

**Hybrid breakdown:** -a post zygotic isolation mechanism

-hybrids are capable of reproduction, but the offspring have reduced fertility or reduced viability (fitness)

-the hybrids eventually die out from the population

-this ensures speciation b/c the species in the long run do not mix successfully

**Hybrid sterility:** post zygotic isolation mechanism

-the offspring hybrid is sterile

-meaning that it cannot produce progeny so the line of hybrids also dies out

-ensures speciation

ex: mules are sterile (cross between a horse and a donkey)

**Hybrid viability:** whether or not the hybrid organism will be able to come to term

-the zygote may form, but may end up being destroyed

-if the hybrid is inviable, this ensures speciation because the hybrid will never exist

-or the hybrid will survive, but not to a reproductive age

-this is because the developmental programs of the parent organisms are incompatible

Ex: goats and sheep can fertilize each other but their ova will never come to term

**Hybrid zone:** geographical area where the hybrid offspring of 2 divergent populations are common

-can occur if 2 populations undergo allopatric speciation and then regain contact after isolation

-generally very narrow zones

-some persist for hundreds or thousands of years

**Hybridization:** when 2 species interbreed and produce fertile offspring

-can be the interbreeding between 2 homozygous individuals that creates a heterozygote

-ex: more hardy and disease resistant crops can be formed from hybridization

-leads to speciation

**Inbreeding:** a form of non random mating

-genetically related individuals mate with each other

-reduces heterozygosity

-increases homozygosity

-therefore increases the chances of offspring inheriting deleterious traits

**Male competition:** competition between males for dominance over the females - in order to pass on their genes to the next generation

-can be in 3 forms: 1) sperm competition 2) male-male combat 3) infanticide

1) sperm competition → promiscuous mating, ex: dragonfly males attaching onto females, dumping out male sperm and replacing with their own

2) male-male combat: elephant seals & dominance over a harem of females

3) infanticide – a new alpha male kills old alpha male offspring to ensure only his genes will be passed on

**Mechanical isolation:** pre-zygotic reproductive isolation mechanism

-differences between reproductive organs make it physically impossible for the sperm and egg of different species to join (this also applies to undesired species ex what type of insect will pollinate a certain flower)

ex: the comet orchidà has its reproductive organs behind the petals --12 inch long tube so only a moth with a 12 inch long tongue will be able to fertilize it

**Microevolution:** small-scale genetic changes within populations

-often in response to shifting environmental circumstances or change events

-this type of evolution occurs only in ONE species

-i.e. the frequency of alleles in a population changes

-ONLY genetic changes

-due to: genetic drift, gene flow, mutation, natural selection, non-random mating

**Migration:** The predictable seasonal movement of animals from the area where they are born to a distant and initially unfamiliar destination, returning to their birth site later.

-TRAVELLING to find new habitat

-Trigger: climate, food availability, season of the year

-ANNUAL or SEASONAL

E.g. – Canadian Geese = SOUTH for Winter

**Missense mutation:** A base-pair substitution mutation in protein-coding gene that results in a different amino acid in the encoded polypeptide than the normal one.

- Single nucleotide changed

- May result in the wrong codon being placed

**Morphospecies:**

- Species, distinguishable from others ONLY by morphology

- E.g. – Yellow Throated Warbler vs. Yellow Rumped Warbler

**Mutation:** A spontaneous or heritable change in DNA

-Can be beneficial increasing reproductive fitness (ex. Bacteria and antibiotic resistance)

-Can be neutral (different amino acid sequence but codes for same a.a's, no change)

-Can be deleterious decreasing reproductive fitness (usually removed by natural selection, ex. Hemophilia)

-POINT mutations in a SINGLE nucleotide

Silent: ONE nucleotide changes to corresponding pair

NO CHANGE

E.g. – CG to GC = SAME thing

Missense: ONE nucleotide changes

Codon codes for a DIFFERENT aa

Protein = non-functioning

E.g. – CG to TA

E.g. – Sickle Cell Anemia

Nonsense: PREMATURE stop codon

Codon that DOES NOT specify for any amino acid

E.g. UGC to UGA

Frameshift: INSERTS or DELETES a set of nucleotides

NOT divisible by 3, alters ENTIRE gene expression

Disturbs reading frame = COMPLETELY different translation than before

E.g. – the one big fly had one red eye = the one rbi gfl yha don ere dey

-CHROMOSOMAL: CHANGE genetic structure

Inversion: Repair is BACWARDS, USUALLY do NOT cause abnormalities, AS LONG as NO missing / extra information

Paracentric – DO NOT include centromere, BOTH breaks in ONE arm of chromosome

Pericentric – INCLUDE centromere, breaks in EACH arm

Translocation: Rearrangement between parts of NON-HOMOLOGOUS chromosomes

Change where MAJOR regions are exchanged

E.g. – Leukemia genes

Gene Duplication

ANY duplication of a region of DNA that contains a gene

Primary copy = USED

Secondary copy = FREE from selective pressure

NO deleterious effect

Mutates FASTER than a functional single-copy gene b/c 2x!

Polyploidy

X > 2 sets of paired chromosomes

E.g. – Plants, Goldfish

**Natural selection:** The evolutionary process by which alleles that increase the likelihood of survival and the reproductive output of individuals that carry them become more common in subsequent generations.

-FAVOURABLE traits = MORE likely to reproduce

-ALLOWS organisms to adapt to environment

-IF environment changes, organism MUST adapt to it to survive!

-Violates Hardy-Weinburg

**Neutral mutation:**

-Spontaneous or inheritable mutation

- different amino acid sequence but codes for same a.a's, no change

**Non-Random Mating:**

-Preference of mate

-Inbreeding, sexual dimorphism or sexual selection (female choice, competition)

-results in less allele variation in population

**Nonsense:** A base-pair substitution mutation in a gene in which the base-pair change

results in a change from a sense codon to a nonsense codon in the mRNA. The polypeptide translated from the mRNA is shorter than the normal polypeptide because of the mutation.

-Stop codon is placed.

**Null hypothesis:** A statement of what would be seen if the hypothesis being tested were wrong.

-explains what happens if the manipulated variable doesn't have an effect.

-Made so it can be proven FALSE by observations (proof)

**Parapatric speciation:** Speciation between populations with adjacent geographic distributions.

-Evolution, like allopatric speciation without geographical speciation.

-SUBSTANTIAL reproductive isolation b/w spatially adjacent populations have LIMITED gene exchange

-population on outskirts of zones

**Phenotype:**

- Visible trait

- Organism MAY possess recessive traits that are MASKED by the visible or dominant trait

- Determined by genes

**Phylogenetic species:** A group of organisms bound by unique ancestry

- smallest branch at the end of a cladogram

- can place fossils bacteria and archaea

-branches can be never-ending, subspecies, etc. (Are they species, families, orders?)

**Point mutation:**

- Mutations in a SINGLE nucleotide

->Silent

ONE nucleotide changes to corresponding pair

NO CHANGE

E.g. – CG to GC = SAME thing

->Missence

ONE nucleotide changes

Codon codes for a DIFFERENT aa

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INSERTS or DELETES a set of nucleotides

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Disturbs reading frame = COMPLETELY different translation than before

E.g. – the one big fly had one red eye = the one rbi gfl yha don ere dey

**Polyploidy:** The condition of having one or more extra copies of the entire haploid

complement of chromosomes.

- A second division never occurs, leaving a higher n value
- Fairly common
- Mitotic event without division

**Population:** All individuals of a single species that live together in the same place and time.

- interbreeding is more probable within the area & more probable than cross-breeding with individuals from another area
- any pair of members within the population can breed together; basically means a species
- populations are studied to understand microevolution

**Population genetics:** The branch of science that studies the prevalence and variation in genes among populations of individuals.

- the study of allele frequency distribution and change under the evolutionary processes of: genetic drift, natural selection, mutation, and gene flow
- attempts to explain the effects of speciation/adaptation

**Postzygotic isolation mechanisms:** A reproductive isolating mechanism that acts after zygote formation.

- Hybrid inviability, hybrid sterility and hybrid breakdown-maintains speciation

**Prezygotic isolation mechanisms:** A reproductive isolating mechanism that acts prior to the production of a zygote, or fertilized egg.

- Ecological/habitat, temporal, behavioural, mechanical and gametic-IMPORTANCE: maintains speciation

**Recessive allele:** An allele that is masked by a dominant allele

- can be responsible for carrying states of disease
- represented by lower case letters
- can be present in heterozygotes, but are masked, but can be expressed in future generations

**Reinforcement:** The enhancement of reproductive isolation that had begun to develop while populations were geographically separated.

- Hybrid inviability reinforces variation.-
- also called the "Wallace Effect"
- caused by natural selection
- i.e. reinforces speciation

**Reproductive Isolation:** A biological characteristic that prevents the gene pools of two species from mixing.

**Ring Species:** A species with a geographic distribution that forms a ring around an uninhabitable terrain.

- Gene flow between distant population occurs only through intermediary populations
- Example: Salamanders of California, rattle snake
- Still capable of interbreeding on border between zones (transition zone)
- These become different sub species, each zone is a different sub species, but the all

- under the same species
- offsprings produced by two different sub-species are usually not capable of successfully surviving - hybrid

**Sexual dimorphism:** Differences in the size or appearance of males and females.

- Based on sexual selection
- Female produces large nutrient rich gametes
- Males objective is to create lots of sperm

**Sickle Cell Anemia:** RBC with a sickle shape

- Have defective form of Hb
- In Africa, malaria does not spread as quickly in sickle-celled individuals, often kills parasites.

**Silent mutation:** A base-pair substitution mutation in a protein-coding gene that does not alter the amino acid specified by the gene.

- The same codon is placed, despite the changed nucleotide.
- Same amino acid made
- A type of point mutation

**Speciation:** Species formation

- 3 types:
  - Allopatric (isolation)
  - Parapatric (barrier spanning)
  - Sympatric (contiguous/touching populations)
  - Ex. Rape seed oil—toxic seed removed creating the subspecies, Canola Oil.

**Sperm competition:** physical competition between the sperm of two separate males to fertilize the eggs of a lone female.

- The number of females it inseminates often determines a male's fitness.
- Ex. copulatory wheel of dragonflies

**Stabilizing selection:** A type of natural selection in which individuals expressing intermediate phenotypes have the highest relative fitness level.

- Average/mean stereotype is favoured
- Ex. Not too long or too short tail length are liked by female birds

**Subspecies:** Taxonomic subdivision of species

- Local variants of a species

**Sympatric speciation:** Speciation that occurs without the geographic isolation of populations, based on environment

- Sympatric = Species that occupy the same space at the same time
- Evolves between distinct subgroups that arise within one population
- Ex. Hybrid offspring has a lower fitness and generations eventually die off

**Temporal isolation:**

- A prezygotic reproductive isolating mechanism
- Species live in the same habitat (and sometimes could interbreed)
- Breed at different times of day or different times of year

**Tetraploid:**

- (4n) offspring, each with four complete chromosome sets.
- Autopolyploidy occurs through an error in either mitosis or meiosis, so that gametes spontaneously receive the same number of chromosomes as a somatic cell
- Plant can survive as a tetraploid

**Triploid:**

- Reproduce either by self-pollination or by breeding with other tetraploid individuals.
- Cannot produce fertile offspring by hybridizing with its diploid parents.
- Fusion of a diploid gamete with a normal haploid gamete produces a triploid (3n) offspring, which is usually sterile because the odd number of chromosomes cannot segregate properly during meiosis. Thus, the tetraploid is reproductively isolated from the original diploid population.
- Diploid pollen fertilizes diploid ovules of a self-fertilizing individual or when it fertilizes diploid eggs on another plant with unreduced gametes.

**Vicariance:** The fragmentation of a continuous geographic distribution by non-biological factors. – Allopatric by speciation

- Species become completely separated
- Results in the formation of new species
- Ex. marsupials

**ORGANIZING THE LIVING WORLD**

**Adaptive Radiation** - cluster of closely related species that are each adaptively specialized to a specific habitat or food source.

- groups of organisms filling ecological niches

**Advanced Characters** - a new version of a trait found in the most recent common ancestor of a group.

-more recently evolved

-opposite of primitive characters

- "derived" character

**Analogous** - performing a similar function but has different evolutionary origins

-eg. wings of a bird and a bat

**Apomorphy** - trait that is shared by two or more taxa and their most recent ancestor

- is a derived character within a group

**Artificial Taxonomy** - a prominent or easily observed feature is taken as the mark of resemblance or dissemblance

**Autoapomorphy** - derived trait that is unique to a given group

- found in only one member of a clade --> not in any other groups or taxa

**Binomen** - name of a species

- genus + species

- eg. Homo sapiens

**Camera Eye** - ??

**Character convergence** - similar to convergent evolution

- homoplasy

- similar adaptations in distantly related organisms that occupy similar environments --

> environment puts pressure on the organisms to take a specific shape

**Character Polarity** - hypothesized sequence of evolutionary transition from character state to character state

**Character Reversal** - a character that reverts to a more ancestral state

**Clade** - A monophyletic group of organisms that share homologous features derived from a common ancestor

**Cladistics** - method of grouping organisms that is based on derived traits

- infers phylogenetic relationships and evolutionary history of groups of organisms

**Cladogram** - a dichotomous phylogenetic tree that branches repeatedly

- end points of branches represent different species

**Classical Taxonomy** - ??

**Classification** - an arrangement of organisms into hierarchical groups that reflect their relatedness

**Common Ancestor** - ancestor from which two or more species have evolved

**Convergent Evolution** - see character convergence

**Dendrogram** - tree diagram

- shows taxonomic relationships
- based on phenetic similarity

**Derived characters** - see advanced characters

**Dichotomy** - splitting of a whole into two non-overlapping parts

- repeated branching into two equal parts

**Divergent Evolution** - homology

- accumulation of differences between groups which can lead to the formation of new species
- naturally selected changes in related species that once shared a characteristic in common

**Evolutionary Taxonomy** - classifying organisms using a combination of phylogenetic relationships and overall similarity

**Folk taxonomy** - biological classification

- the way people make sense of and organize their natural surroundings
- 'word of mouth'

**Fungi** - kingdom

- any group of spore-forming organisms feeding on organic matter
- can dissolve rock and create minerals and nutrients that are beneficial to plants
- started the beginnings of soil systems

**Hierarchical** - classification system where entities are arranged based on some hierarchical structure

**Homologous** - having the same evolutionary origin but not necessarily the same function

- eg. bones of a human hand, bat wing and whale flipper --> have the same internal structure

**Homology** - characteristics shared by a set of species because they inherited them from their common ancestor

- similar

**Homoplasy** - see convergent evolution

**KISS principle** - Keep It Simple Stupid

- concept that the simplest way is probably the best way (when building cladograms)

**Linnaeus** - sorted all the names into a hierarchical system that was strictly mechanical (not biological)

- Created by binomen

**Monophyletic** - group of organisms that includes a single ancestral species and all of its

descendants

**Natural Taxonomy** - things classified are arranged according to the totality of their morphological resemblances

**Node** - point on a stem where one or more leaves(species) are attached

**Out Group** - group of organisms not belonging to the group whose evolutionary relationships are being investigated via a cladogram

- Must score "0" on all traits, yet still be related to the organisms being examined

**Paraphyletic** - a group of organisms that includes an ancestral species and some, but not all, of its descendants

**Parsimony** - KISS principle

- in phylogenetic analysis using cladograms, the least number of changes is accepted as a biological principle since this is what likely occurred in evolution

**Phenetic (Numeric) Taxonomy** - grouping by numerical methods

- aims to create a taxonomy using numeric algorithms (cluster analysis)

- may not correlate with evolutionary relationships

**Phylogenetic Taxonomy** - groups of organisms based on shared evolutionary heritage

- eg. DNA and RNA sequencing techniques

**Phylogenetic tree** - branching diagram depicting the evolutionary relationships of groups of organisms

**Phylogeny** - evolutionary history of a group of organisms

**Plesiomorphy** - sharing a character state with an ancestral clade

- primitive

**Polyphyletic** - group of organisms that belong to different evolutionary lineages and do NOT share a recent common ancestor

**Polytomy** - branch point on a tree that has more than two immediate descendants

**Primitive Characters** - traits retained from a common ancestry

- opposite of derived

**Sister group** - two groups resulting from the splitting of a single lineage

- the groups are each other's closest evolutionary relative

**Symplesiomorphy** - primitive trait which is shared between two or more groups

**Synapomorphy** - derived trait which is shared between two or more groups

**Systematics** - branch of biology that studies the diversity of life and its evolutionary relationships

**Taxon** - name designating a group of organisms included within a category in the Linnaean taxonomic hierarchy

**Taxonomy** - the science of the classification of organisms into an ordered system that indicates natural relationships

## SILURIAN/DEVONIAN

**Agnatha** – Superclass of fish that do not have jaws

- moves through water or swims into substrate to get food

- eg. lamprey or hagfish

- has teeth around the edge of the mouth and on the tongue--

>suction cup action

**Alternation of Generations** – Lifecycle found in plants

- Alternates between haploid and diploid states

- Diploid sporophyte undergoes meiosis to produce haploid spores. Spores then create haploid gametophyte, which undergoes mitosis to create haploid gametes. Gametes combine to form a diploid zygote, which undergoes a change into a diploid sporophyte.

Cycle continues.

**Antheridia** – Haploid organ which produces male gametes. Present in gametophyte phase of lower plants such as ferns.

- Male gametangia

**Archegonium** – Organ present in gametophyte phase which contains female gamete.

- Female gametangium

**Arthropoda** – Animal which has an exoskeleton, segmented body, and jointed appendages. Ex – Spiders, insects, crustaceans (lobsters)

**Bony Fish** – predominant today

- has pectoral and pelvic fins attached to the skeleton
- this leads to increased agility and improved mobility --> it can 'hover' and 'stop'
- Have swim bladder to remain at neutral buoyancy

**Cartilaginous Fish** – Called Chondrichthyes. Jawed fish with paired fins, scales, two chambered hearts, and skeletons which are cartilage instead of bone.

- Tissues contain oil to remain at neutral buoyancy
- Cartilagenous body and fin attachment (mostly by muscle) doesn't allow for much agility
- Must keep swimming to be able to breathe by forcing water over gills
- Ex: shark

**Crustacean** – Member of Arthropoda. Includes crabs, lobsters, etc. Have an exoskeleton. Distinguished from other Arthropoda because of biramous (two-parted) limbs.

- Survive the Ordovician extinction and become prominent ocean predators

**Devonian Period** – Starting from end of Silurian 416mya to the beginning of Carboniferous 359mya. Terrestrial life in form of plants. No herbivores to feed on them, so extensive forests are formed. Fish and insects appear.

External Fertilization – Fertilization in which sperm cell and egg cell are united external to the bodies of the reproducing individuals. Many aquatic animals make use of this (sperm can swim through water), and so do plants (Pollination from insects).

**Gametangium** – An organ in which gametes are produced. It is haploid and formation of gametes does not involve meiosis.

**Gametophyte** – Haploid stage of plants. Produces male or female or both gametes through mitosis. Fusion of male and female gametes produces diploid zygote. This zygote goes through mitosis and becomes a multicellular sporophyte. This produces spores through meiosis, which are once again haploid.

**Gastropoda** – Snails and slugs. Part of Mollusc phylum.

**Gemma and Gemma cups** – Cell(s) that detach from the parent and forms a new individual. Asexual reproduction and is referred to as fragmentation. Gemma cups are cup like structures which contain Gemma in them. Rain fall splashes the Gemma out.

**Gill arch** – Supports the gills. Bony or cartilaginous. Extend dorsoventrally on side of pharynx.

**Gill slits** – Individual openings to gills which lack a single outer cover. Characteristic of cartilaginous fish such as sharks. Allow water to exit but angled so it doesn't flow back in.

**Gnathostomes** – Group of vertebrae with jaws.

**Jaw** – Allows the animal to close its mouth. Had hinges on them. Earliest fish didn't even have teeth. The secret was to engulf the food and close the jaw so it could not escape.

**Lignin** – A secondary cell wall. The surface is not water soluble, like Teflon. Ensures that liquids can flow through it with no resistance. Because the molecule of Lignin is crosslinked, it is difficult to digest. It is also toxic, so bacteria will not grow on it. Fungi soon appear and can digest Lignin with acids. Balance is restored.

**Mesozoic Era** – 250mya to 65 mya. Known as the age of reptiles because reptiles, mainly dinosaurs, were the dominant vertebrae at the time. Began after the Permian mass extinction.

**Neutral Buoyancy** – When the body mass of an animal equals the mass it displaces in a surrounding medium. Will neither sink nor rise. Fish do this by filling their float bladder with gas.

**Opercular Gill** – Hard bony flap covering and protecting the gills. Present in bony fish.

**Pectoral Fin** – Aids fish in dynamic lifting force. Also allows fish to walk.

**Pectoral Girdle** – Set of bones that connects the upper limb to the axial skeleton.

**Pelvic Fin** – Assists the fish in going up or down in water, turning sharply, and stopping quickly.

**Pelvic Girdle** – Connects the base of the spine to the legs or rear limbs.

**Placoderm** – Class of prehistoric fish known for their armor. Lived in late Silurian to end of the Devonian. The head and thorax was covered in armored plates while the rest of the body was scaled or naked.

**Placoid Scale** – A small rigid plate that grows out of an animal's skin to provide protection. They are small and numerous. On fish, they allow them to move more quickly since as the scales stick out, they create small levels of turbulence, which decreases laminar flow.

- Made of dentin and pulp, like teeth

**Primary Plant Cell Wall** – Made of Cellulose.

- Covers outer layer of cell

**Rhizoid** – Thread like growths from the base of a plant. Usually found in lower plants such as Algae. Function like roots of plants.

- Not considered roots because they don't have vascular elements: they just serve to anchor the plant in the ground

**Secondary Plant Cell Wall** – Made of Lignin

- Completely covers the inner later of plant cell

**Silurian Period** – From end of Ordovician (443mya) to beginning of Devonian (416mya). Major extinction event. Appearance of jawed and bony fish. Small moss like vascular plants appear on land. However, nothing really happens on land until Devonian.

**Sporangium** – An enclosure in which spores are formed. Usually produce spores by meiosis which are haploid.

**Spore** – Reproductive structure part of the plant and fungi life cycle. Different from seeds since spores have very little food resources stored inside them. Usually haploid and unicellular, produced by meiosis in the sporangium by the sporophyte. Can develop in to a new organism by mitosis, called a gametophyte, which produces gametes. Two gametes from two gametophytes fuse and create a new sporophyte.

**Sporophyte** – Diploid stage in land plants with alternation of generations. Produces haploid spores which develop into haploid gametophytes.

**Stomata** – Pore found in leaf and stem epidermis in plants used for gas exchange. Bordered by guard cells that regulate size of the opening. CO<sub>2</sub> and oxygen enter through these pores for photosynthesis and respiration. Water is also released through these openings, called transpiration.

**Swim Bladder** – Used by fish to regulate buoyancy. Fill and empty it with gas.

**Tetrapod** – Vertebrae with four limbs. Include amphibians, reptiles, birds, and mammals.  
- Evolved from lobe-finned fish in the Devonian period

**Thallus** – Tissue of organisms such as algae and fungi. Thallus usually names the entire body of a non moving organism in which there is no organization of tissues into organs.

- Does not have vascular tissue, therefore not a leaf

- Ex: thallus in liverworts

**Tracheids** – Elongated cells in the xylem of vascular plants that serve in transport of water and mineral salts.

- Have a thickened lignin cell wall