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AS Biology Unit 2

Classification, Adaptation & Biodiversity

Classification and taxonomy

Classification The process of sorting living things into groups.

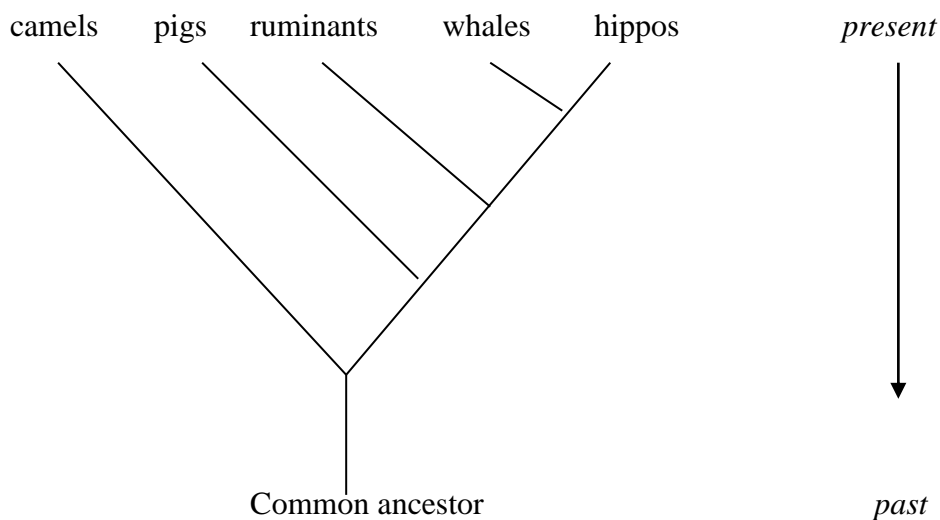
Phylogeny The study of evolutionary relationships between organisms.
(Making ancestral trees)

Taxonomy The study of the principals of classification

Natural classification reflects ancestral relationships.

- it is based on the evolutionary relationships between organisms (phylogeny)
- it classifies species into groups using shared features derived from their ancestors
- it arranges the groups into a **hierarchy**

example:



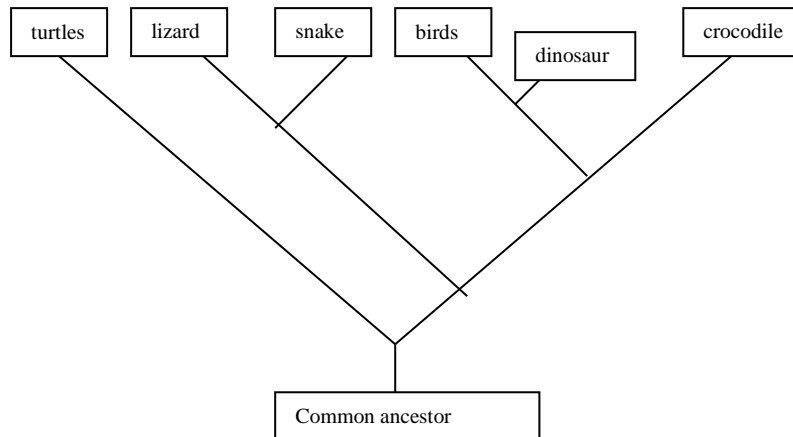
The closer the branches, the closer the evolutionary relationship
Hippos and whales are more closely related than hippos and ruminants (cud chewing animals)

Look at the **phylogenetic tree** below for birds and certain reptiles

Which group is the closest relative of the snake?

Are dinosaurs more closely related to crocodiles or birds?

Suggest a reason why dinosaurs are not shown along the time line like the other groups



Kingdoms

Originally, living organisms were grouped into two kingdoms, namely **animalia** and **plantae**. As techniques of microscopy, DNA analysis etc have advanced, so it has become clear that there are significant differences, for example between green plants, fungi and bacteria. Furthermore, the single celled organisms with mixed plant and animal characteristics require a separate grouping.

- 5 kingdoms:** Prokaryota
 Proctoctista
 Fungi
 Plantae
 Animalia remember PPFPA

Examples of classification

Taxonomic rank			
Domain	eukaryote	eukaryote	eukaryote
Kingdom	animal	animal	animal
Phylum	chordate	chordate	arthropod
Class	mammal	mammal	insect
Order	primate	primate	diptera
Family	hominidae	Hominidae	drosophilidae
Genus	<i>Homo</i>	<i>Gorilla</i>	<i>Drosophila</i>
species	<i>sapiens</i>	<i>gorilla</i>	<i>melanogaster</i>
Common name	human	gorilla	Fruit fly

King Prawn Curry Or Fat Greasy Sausages?

DNA evidence for classification

New alleles arise through random mutations over time. The closer the evolutionary relationship, the fewer the differences in DNA.

DNA hybridisation

- extract DNA from two related species, cut it into fragments and label one set with a radioactive isotope or fluorescent marker
- Heat to break the H bonds and separate the strands
- Mix the strands. The more similarities in base coding, the more hybridisation will occur
- Heat the hybrid DNA gently until DNA strands begin to separate again. The closer the similarities, the more the H bonds and the stronger the hybrid DNA

A study compared the number of base differences in the first 200 bases of a gene found in all five species of primate. The results are shown in the table below.

human	0				
gorilla	12	0			
chimpanzee	15	15	0		
Orang-utan	29	33	26	0	
lemur	48	49	49	50	0
	Human	Gorilla	Chimpanzee	Orang-utan	lemur

What evidence is there to show that humans are more closely related to orang-utan than lemur?

Do these data support the evolutionary relationships of these primates suggested by the other study? Explain your answer.

Amino acid sequences in proteins

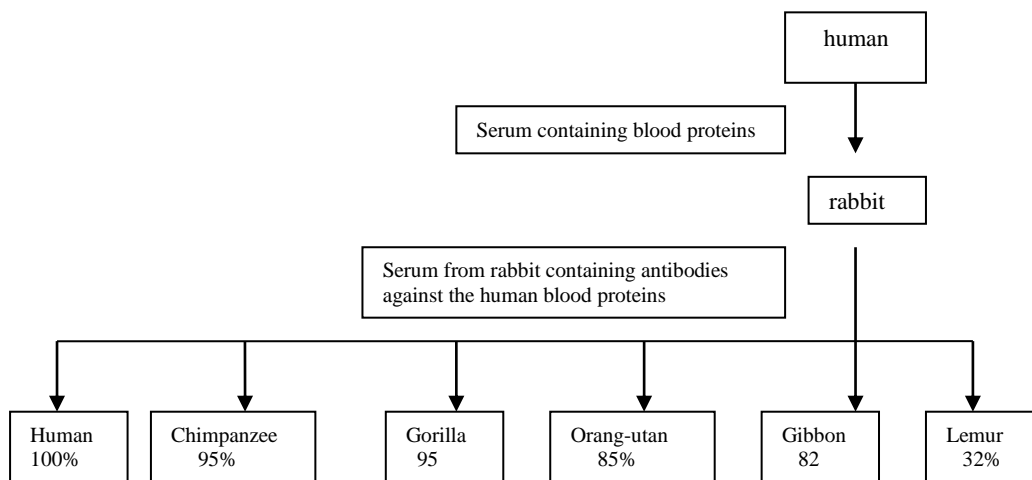
A number of proteins occur in all animals but with time and evolutionary distance, mutations in the alleles coding for them show differences. The closer the similarity in amino acid sequence, the closer the relationship.

Immunological comparisons

A study compared the proteins found in a variety of primates using immunological techniques. The results are shown below. The figures represent the percentage precipitation (clotting) when mixed with serum (plasma extract) from each primate named.

Which two primates does this immunological study suggest are the most closely related? Give reasons for your answer.

Which primate does the study suggest is the nearest relative of the orang-utan? Give reasons for your answer.



Courtship behaviour

Courtship is used to

- Recognise same species
- Identify mate ready for breeding
- Form a pair bond
- Improve chance of fertilisation

Example:

The courtship behaviour of male fruit flies has several components. The diagram shows the courtship sequences of males from two closely related species of fruitfly.

Species A

Faces female - scissor swings - vibrates wings - licks female - mates

Species B

Faces female - scissor swings - licks female - mates

Suggest how the sequences provide evidence that

1. the fruit flies are separate species
2. the species are closely related

Genetic variation in bacteria

Mutation

In good conditions, bacteria can multiply at a rate of three generations per hour. Human generations take 25 years, not 20 minutes! A day in the life of a bacterial species represents years of human existence.

Mutations occur randomly and at a steady rate so it is not surprising that bacteria evolve in a matter of months rather than millions of years.

Conjugation - swapping plasmids

Antibiotic resistance genes are carried by plasmids - horizontal gene transmission can pass them to other bacterial species.

The GM problem

The antibiotic problem

Biodiversity the variety of life as defined on three levels:

- Variety of species
- Genetic variety
- Variety of habitats

Simpson's biodiversity index a measurement of species diversity

Involves estimating two things:

- **species richness**
- **species evenness**

It is calculated using the formula $D \text{ (biodiversity index)} = 1 - (\text{sum of } (n/N)^2)$

Where n = no. of individuals of each species. N= total no. of individuals present

An example for you to calculate taken from two freshwater ponds

Species observed	Population count pond A	Population count pond B
Freshwater shrimps	35	52
Mayfly larvae	11	2
Dragonfly larvae	3	0
snails	12	4
Caddis fly larvae	3	0
Water boatmen	6	2
Tube worms	0	200
total	70	260

Species	Pond A			Pond B		
	n	n/N	(n/N) ²	n	n/N	(n/N) ²
Freshwater shrimps						
Mayfly larvae						
Dragonfly larvae						
snails						
Caddis fly larvae						
Water boatmen						
Tube worms						
sum						
1-sum						

Topic 8: Classification, adaptation and biodiversity

A high value of D indicates a diverse habitat and a stable community of living organisms. What can you conclude from your calculations?

Conservation the management of habitat to maximise biodiversity and prevent extinction

Conservation or Preservation? What's the difference?

Why is biodiversity important?

Suggest some economic, ecological and ethical / aesthetic reasons

Explain and give examples of these human threats to biodiversity?

- Deforestation / desertification

- Removal of hedgerows (monoculture)

Habitat loss in the UK: Hay meadow, chalk grassland, wetlands, heathland, limestone pavement, mixed woodland, hedgerows

