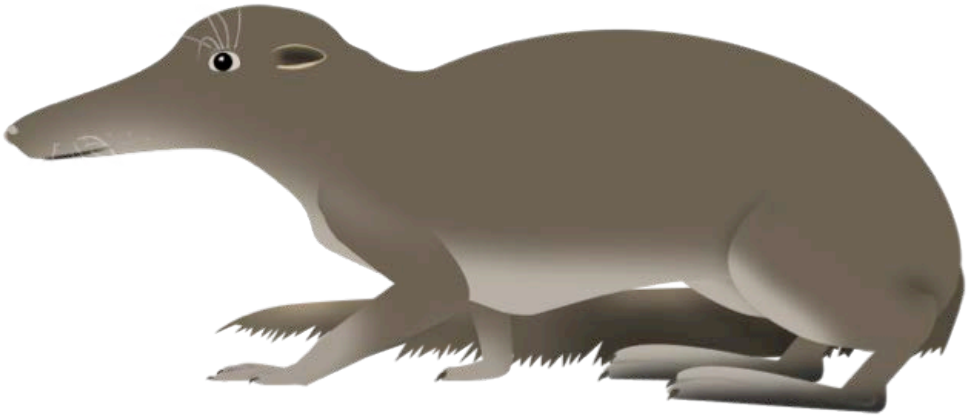
Introducing clades

Is this your ancestor?

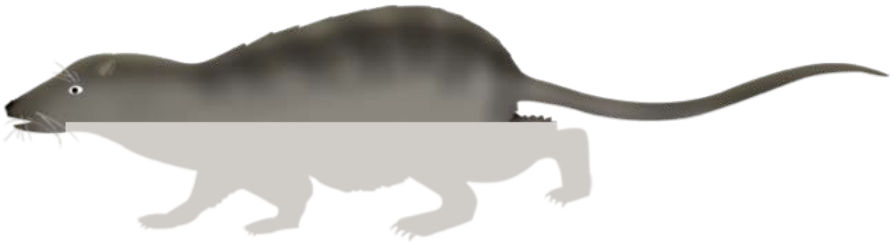
All eutherians (placental mammals) belong to one of four major clades.



A clade is a group of organisms that includes a common ancestor, and all living and extinct descendants of that ancestor.

Members of a clade share characteristics (traits) that can be traced back to their common ancestor.

Which clade do you belong to?

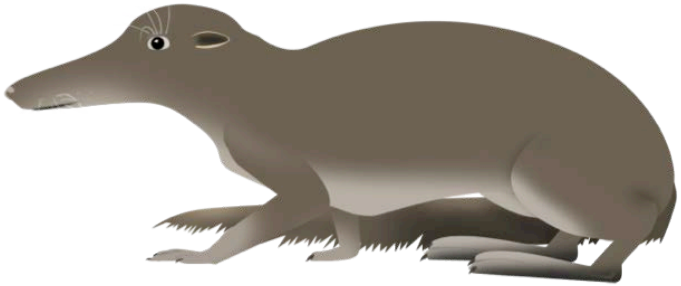


clade Afrotheria

clade Euarchontoglires

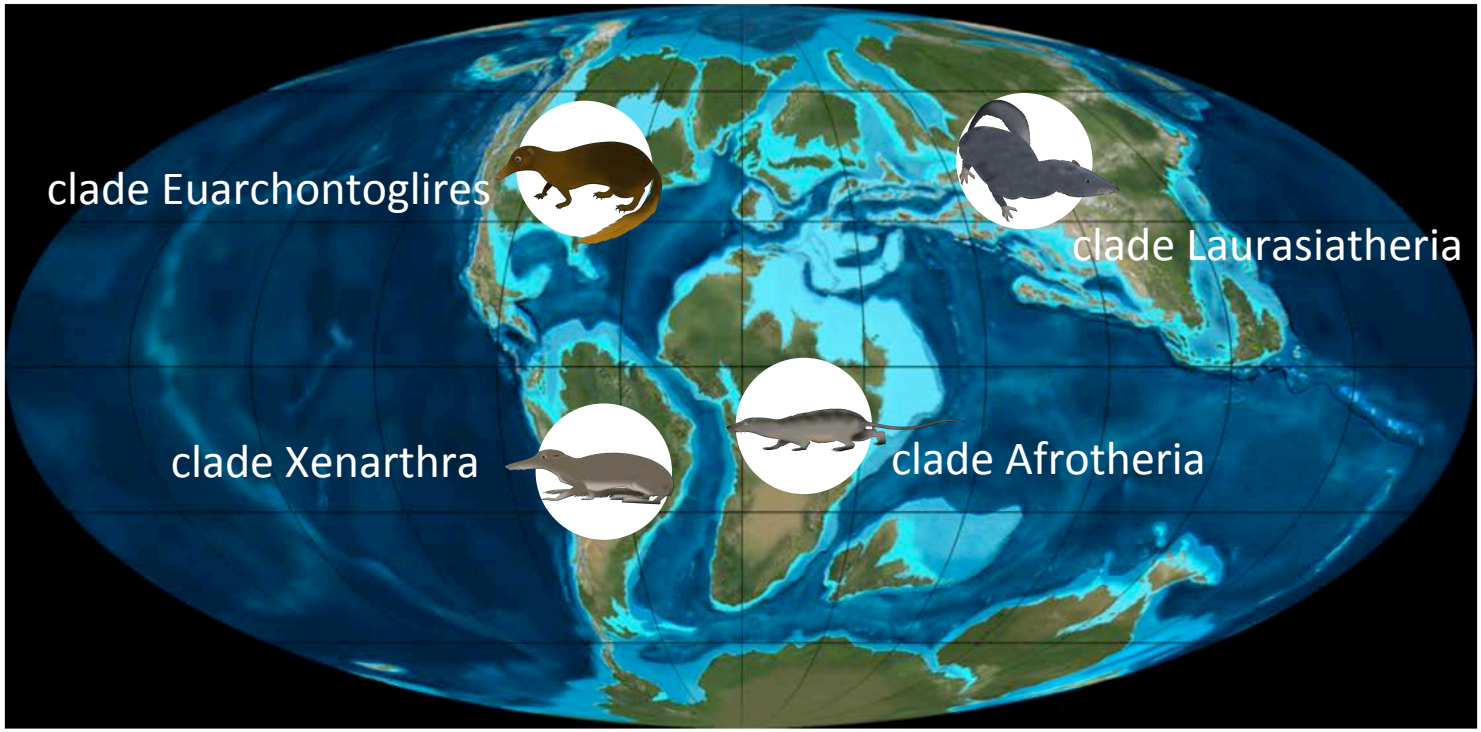
clade Laurasiatheria

clade Xenarthra



Each of these animals is a common ancestor of one of the eutherian clades.

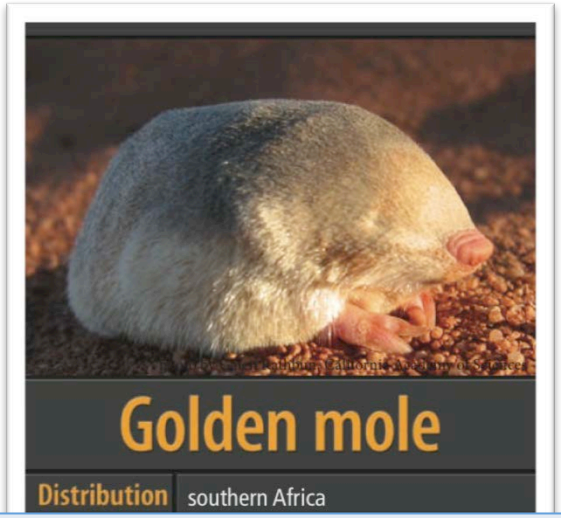
Where did your ancestor come from?

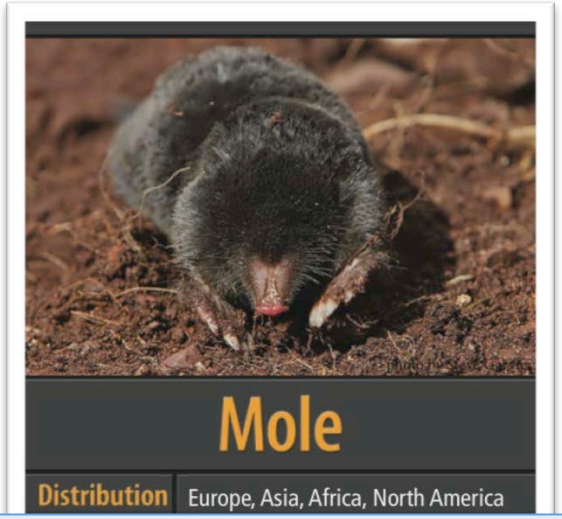


Evolution of the eutherian clades is linked with biogeography.

100 million years ago, separation of the world's supercontinents isolated early mammal species. The common ancestor of each major eutherian clade is believed to have evolved in a specific geographic region.

Who's related?





These three species share many similarities, including: anatomy (body size, body shape); diet (insectivores); distribution (Africa); and behaviour (digging/ burrowing). Based on these similarities they used to be grouped together in order Insectivora.

Molecular evidence resulted in the disbanding of order Insectivora. Golden moles are now placed in clade Afrotheria; and moles and hedgehogs within clade Laurasiatheria.

So, moles and hedgehogs are most closely related.

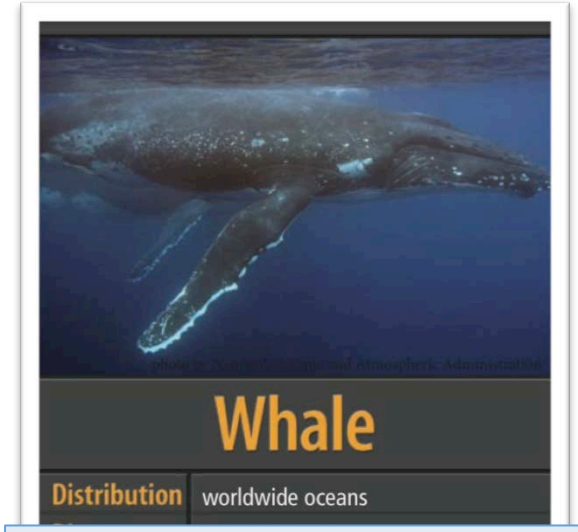
Who's related?

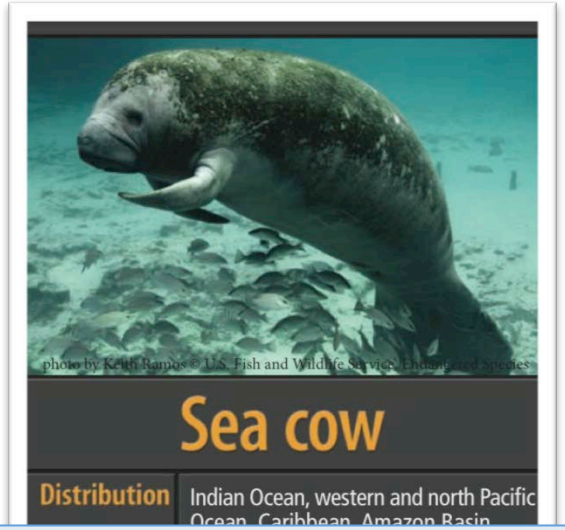
All three species belong to the same clade, Euarchontoglires, based entirely on molecular evidence.

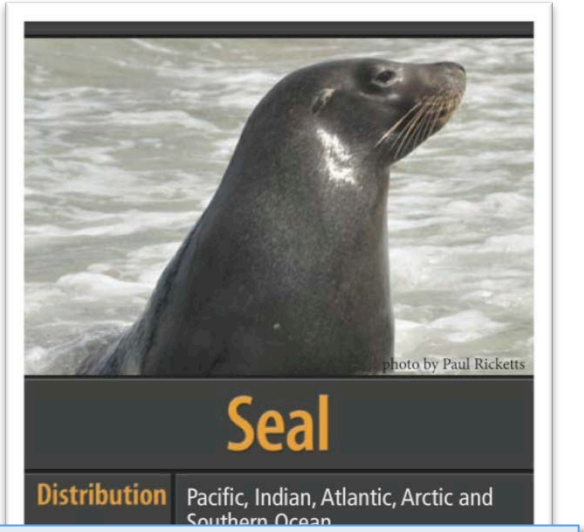
Rats and tree shrews may appear to have more in common with each other than humans, but tree shrews are actually more closely related to humans than they are to rats.

So, humans and tree shrews are most closely related.

Who's related?





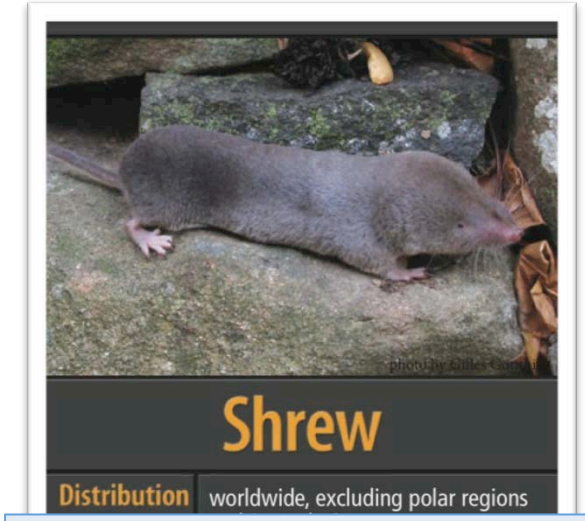


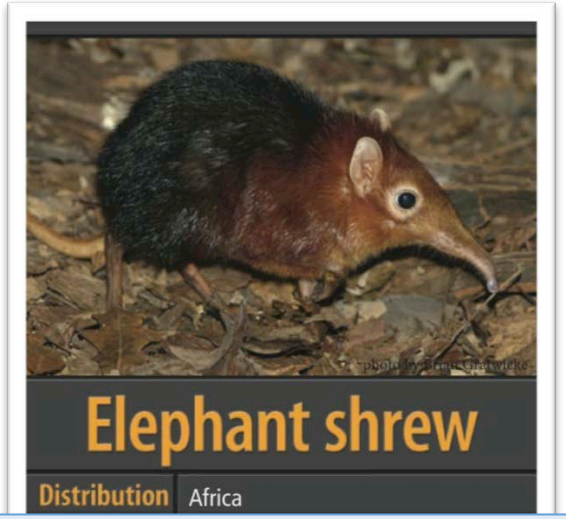
These three species are all marine mammals, but whilst they share similar habitat and similar adaptations for life in water, they're not all closely related.

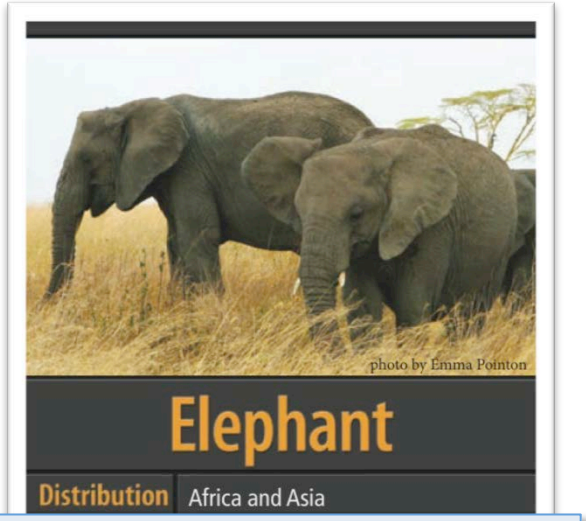
The sea cow belongs to clade Afrotheria together with the elephant and hyrax. Whales and seals both belong to clade Laurasiatheria.

So, whales and seals are most closely related.

Who's related?





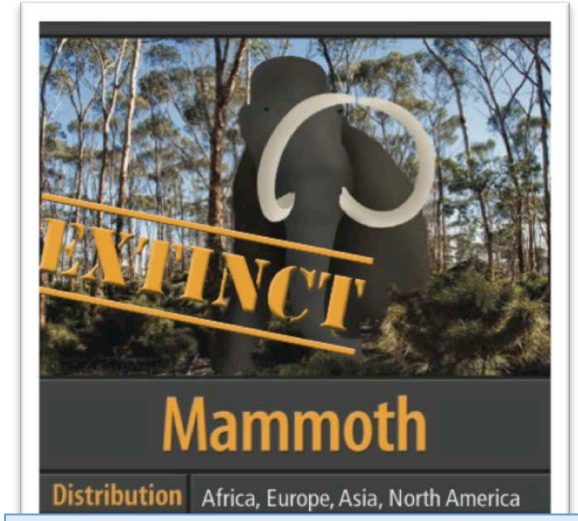


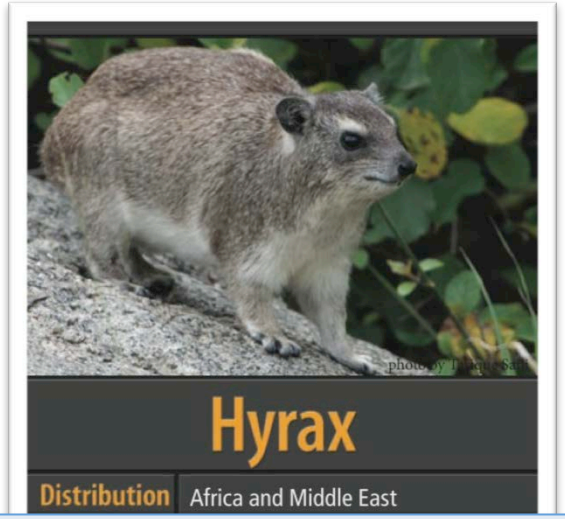
Shrews and elephant shrews share many features, including: distribution (Africa); diet (insectivorous); and anatomy (small body size).

However, molecular evidence reveals they belong to different clades. Elephant shrews and elephants are both in clade Afrotheria, while shrews belong to clade Laurasiatheria.

So, elephants and elephant shrews are most closely related.

Who's related?



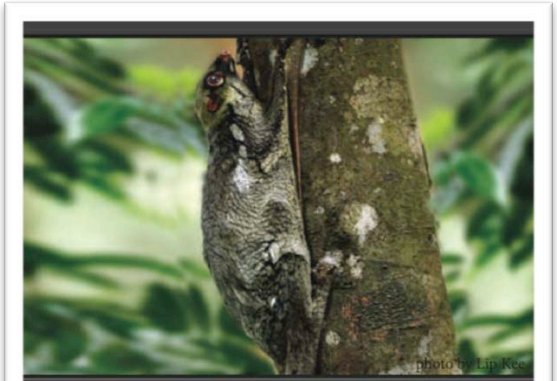


Hyraxes don't look like they share many similarities with mammoths, an extinct relative of elephants, but they belong to the same clade, Afrotheria. This evolutionary relationship is well supported by fossil, anatomical and molecular evidence.

Fossa belongs to a different clade, Laurasiatheria.

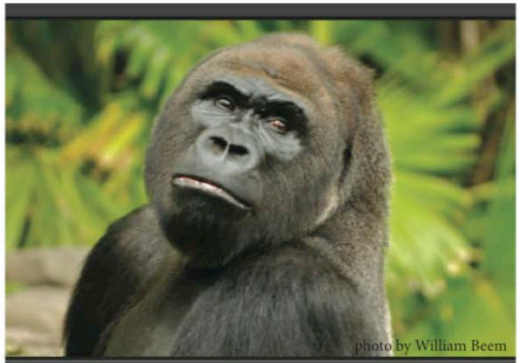
So, hyraxes and mammoths are most closely related.

Who's related?



Colugo

Distribution	South-east Asia



Gorilla

Distribution	Africa

Bat

Distribution	worldwide, excluding Arctic and Antarctic

On the basis of shared anatomical similarities (elongated forelimbs and fused arm bones for flight) bats and colugos (flying lemurs) were once considered to be close evolutionary relatives.

Molecular evidence reveals they belong to different clades: colugos to clade Euarchontoglires (which also includes gorillas), and bats to clade Laurasiatheria.

So, gorillas and colugos are most closely related.

Play the card game, *Who's related?*

Organise forty mammals into four major clades, using evidence outlined on the playing cards.

What evidence did you use?

An animal's geographic distribution can provide some clues about its origin. For example, clade Xenarthra (armadillos, sloths, anteaters) is found only in the Americas, the place of origin of the common ancestor.

However, over geological time, many species have dispersed widely from their place of origin. This dispersion is the result of events such as continental movement and the creation of land bridges. Ungulates (hoofed mammals) evolved in Laurasia, but dispersed worldwide, excluding Antarctica and Australia.

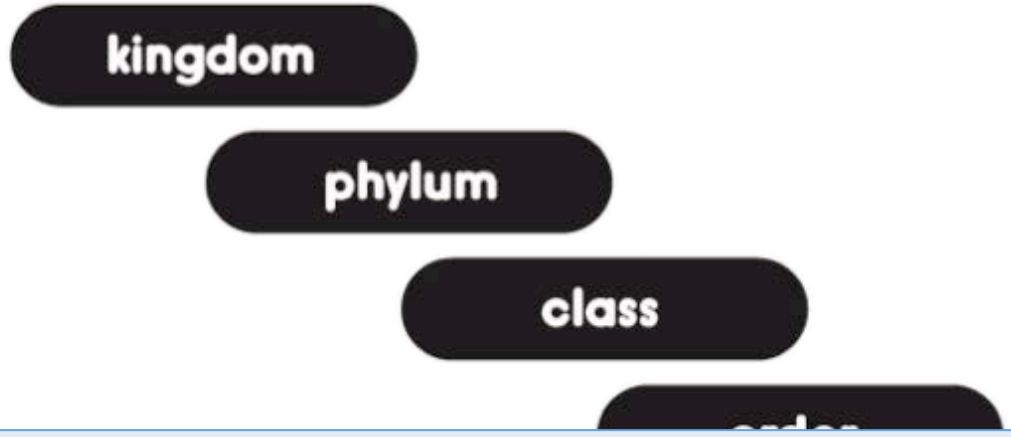
What evidence did you use?

Animals that share a similar diet aren't necessarily related. For example, aardvarks and anteaters both eat termites, but they aren't closely related, belonging to different clades.

What evidence did you use?

Animals that share similar habitats aren't necessarily related. For example, marine mammals such as sea cows and whales inhabit marine environments, but they aren't closely related, belonging to different clades.

What evidence did you use?



Linnaean taxonomy groups animals on the basis of overall similarity, but the Linnaean system doesn't always accurately reflect an animal's evolutionary history, particularly within higher-level groupings.

Animals can share similar anatomical and ecological features without sharing a common ancestor. Similarities may be the result of convergent evolution.

What evidence did you use?

Anatomical evidence is important in understanding evolutionary relationships between organisms. Skeletal, muscular and reproductive evidence are all used in phylogenetics.

Animals that share anatomical characteristics are likely to have evolved from a common ancestor.

Anatomical evidence is limited, as similar traits can be the result of convergent evolution. For example, moles and golden moles share similar anatomical and ecological features, but belong to separate clades. Their similarities are the result of convergent evolution.

What evidence did you use?

Fossil evidence is significant in understanding evolutionary relationships between organisms. Fossils allow us to reconstruct species that are no longer living, and can also reveal times when major evolutionary change occurred.

Fossil evidence is limited: fossils aren't easy to find; soft tissue is rarely preserved; and it is rare to discover an intermediate species.

What other evidence is there?

Molecular evidence provides powerful evidence for evolutionary relationships between organisms.

Evolution is the result of genetic change. Looking directly at genetic material provides information on evolutionary relationships.

Comparing differences and similarities in genetic material between organisms helps determine evolutionary relationships.

The four eutherian clades in the card game are supported by molecular evidence. Except for clade Xenarthra, it's unlikely these clades would have been discovered without molecular evidence.

How did you decide?

In this game, what evidence was most useful for working out evolutionary relationships between eutherian mammals?

Evolutionary biologists collect evidence from multiple sources: anatomy; embryology; fossils; and molecules.

Combining all evidence helps build a clearer understanding about evolutionary relationships between eutherian mammals.

Links between mammals, established by molecular studies, are often followed by anatomical studies that substantiate proposed evolutionary relationships.

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