Self-guided Activities

Stage 6 Year 11 Biology
Module 3: Biological Diversity

AUSTRALIAN MUSEUM

SYLLABUS LINKS

Outcomes	Content	Self-guided
A student: › develops and evaluates questions and hypotheses for scientific investigation BIO11/12-1 › communicates scientific understanding using suitable language and terminology for a specific audience or purpose BIO11/12-7 › describes biological diversity by explaining the relationships between a range of organisms in terms of specialisation for selected habitats and evolution of species BIO11-10	***Adaptations*** **Inquiry question:** How do adaptations increase the organism's ability to survive? Students: • conduct practical investigations, individually or in teams, or use secondary sources to examine the adaptations of organisms that increase their ability to survive in their environment, including: – structural adaptations – physiological adaptations – behavioural adaptations	**Activity 2 (Part I)** **Activity 3**
	Theory of Evolution by Natural Selection **Inquiry question:** What is the relationship between evolution and biodiversity? Students: • explain biological diversity in terms of the Theory of Evolution by Natural Selection by examining the changes in and diversification of life since it first appeared on the Earth (ACSBL088) • analyse how an accumulation of microevolutionary changes can drive evolutionary changes and speciation over time, for example: (ACSBL034, ACSBL093) – evolution of the horse – evolution of the platypus • explain, using examples, how Darwin and Wallace's Theory of Evolution by Natural Selection accounts for: – convergent evolution – divergent evolution	**Activity 4** **Activity 2 (Part II)** **Activity 3**
	Evolution – the Evidence **Inquiry question:** What is the evidence that supports the Theory of Evolution by Natural Selection? Students: • investigate, using secondary sources, evidence in support of Darwin and Wallace's Theory of Evolution by Natural Selection, including but not limited to: – biochemical evidence, comparative anatomy, comparative embryology and biogeography (ACSBL089)	**Activity 1**

Biodiversity and the Theory of Evolution

Life is all around us – in the air and water, on and under the ground, even in our stomachs. Every one of Earth's millions of species is unique in the way it looks, lives and contributes to our planet. While species are unique, they're also connected.

Pre-visit Activity

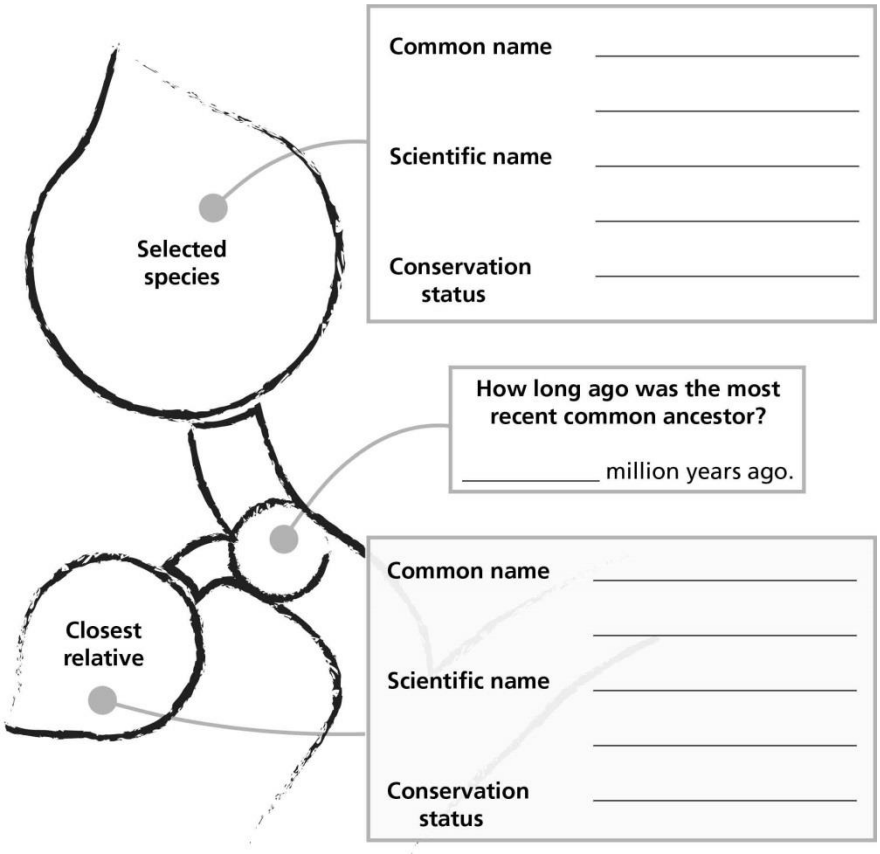
1. Familiarise yourselves with the terms in the glossary (next page).

2. Go to the OneZoom 'Tree of Life Explorer' at http://www.onezoom.org/

3. Click on the big picture of the 'Tree of Life'. Search for one of the these animals: White Rhinoceros, Western Gray Kangaroo or Eastern Gorilla.

4. Complete the following diagram for your animal:

5. Click on the picture of your animal to help you answer the following questions:



Q1. List two of the animal's adaptations: 1. _____

2. _____

Q2. What factors are responsible for the conservation status of your animal?

_____

_____

_____

Glossary

Common ancestor

An ancestral species from which two or more different species evolved.

Comparative anatomy

The study of the similarities and differences in the body structures of different organisms.

Comparative biochemistry

The study of evolutionary relationships between organisms using DNA and protein sequences.

Homologous structure

A physical structure that is present in different species that share a common ancestor. The structure may have evolved alternative functions in different species.

Micro- and macroevolution

Microevolution refers changes that occur over short periods of time within a population. These changes are small and are not captured in the fossil record. Microevolution can be detected by measuring changes in the frequency of genetic alleles. Macroevolution refers to gradual changes that occur over millions of years and describes patterns in the tree of life. Fossils are important for macroevolutionary studies because they record the emergence and extinction of life.

Convergent evolution

The appearance of apparently similar structures in organisms of different lines of descent.

Divergent evolution

The process by which a species evolves into two or more descendant forms.

Evolutionary distinctiveness

A measure of the time since a species diverged from its nearest living relative.

Conservation status

An indicator of how likely a species is to remain alive at present or in the near future.The IUCN Red List of Threatened Species is a worldwide conservation status listing and ranking system. It divides species into nine categories: least concern, threatened, vulnerable, endangered, critically endangered, extinct in the wild or extinct.

Activity 1. Comparative anatomy: evidence of evolution

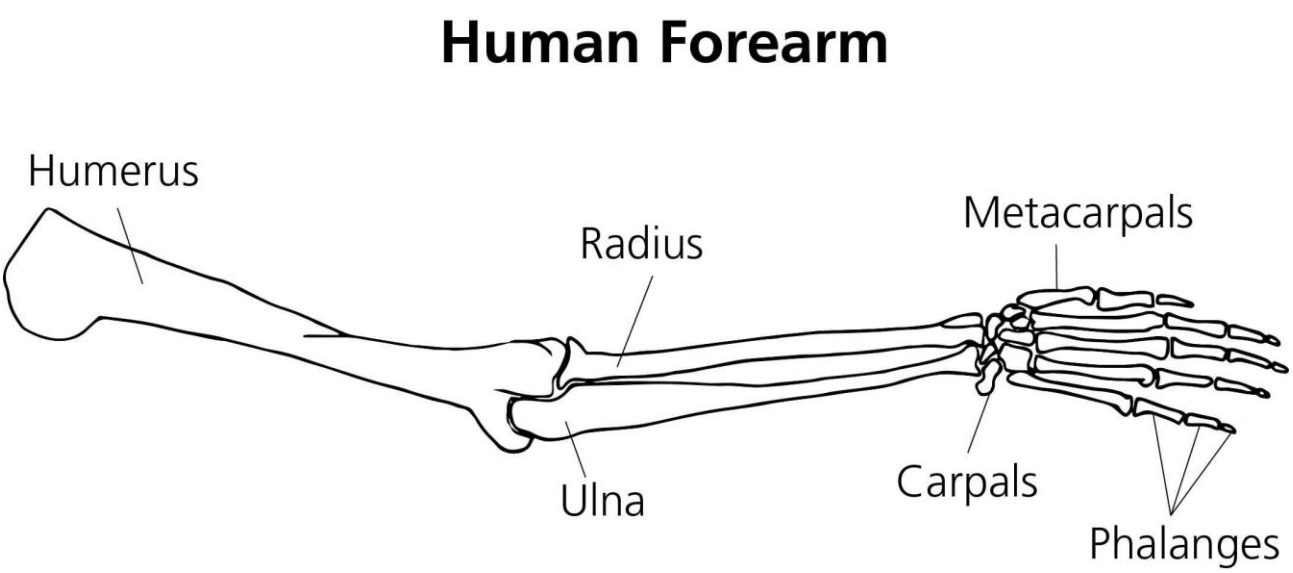
1. Read the introduction

Some connections on the 'Tree of Life' are obvious while others are revealed only through detailed comparisons of physical and genetic features. **Comparative anatomy** is a method that can help detemine if two species are close relatives.

Tetrapods are the vertebrates with four limbs and include the reptiles, amphibians, birds and mammals. At first glance these animals look like they don't have much in common, each having evolved adaptations to survive in different habitats. Below the surface, however, you'll discover that their skeletons have much in common.

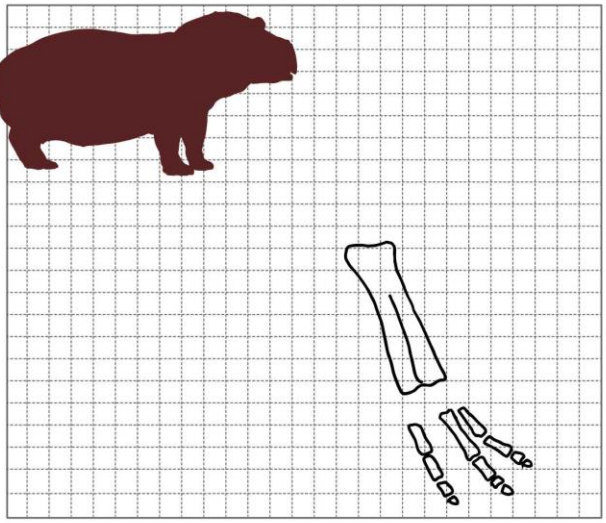
The pentadactyl limb is an example of a **homologous structure** that is present in all tetrapods. It varies in size, shape and function in different species because of evolution by natural selection. If two species have a similar looking limb, this suggests that they are more clocely related to one another, than two species that have a very different looking limb.

2. Look at the diagram of the human arm below and note the position and name of each bone. We are tetrapods and therefore share a common ancestor with all animals in 'Wild Planet'.

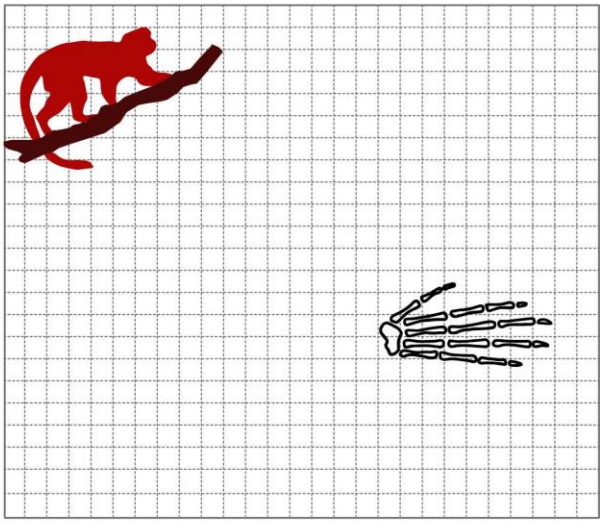


3. Now find the skeletons of the four animals on the next page and finish the drawings of their pentadactyl limb.

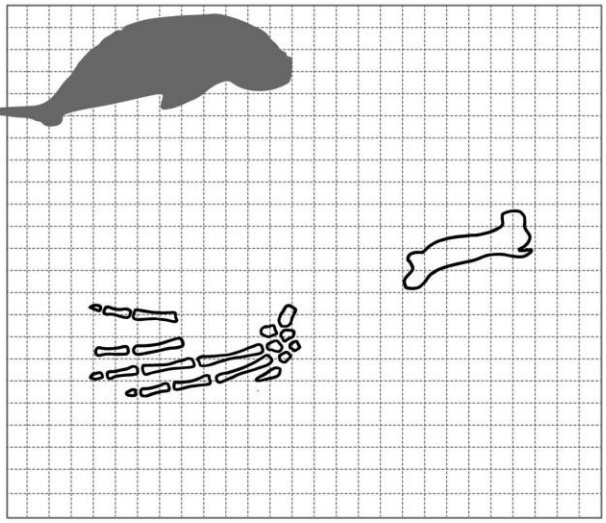
Hippopotamus



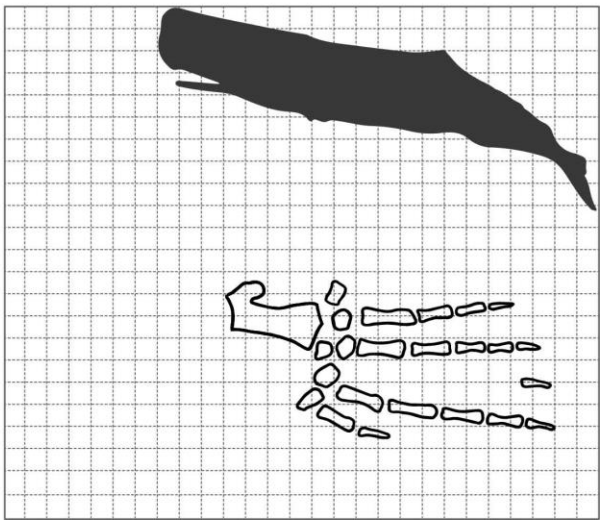
Squirrel Monkey



Dugong



Sperm Whale



Questions

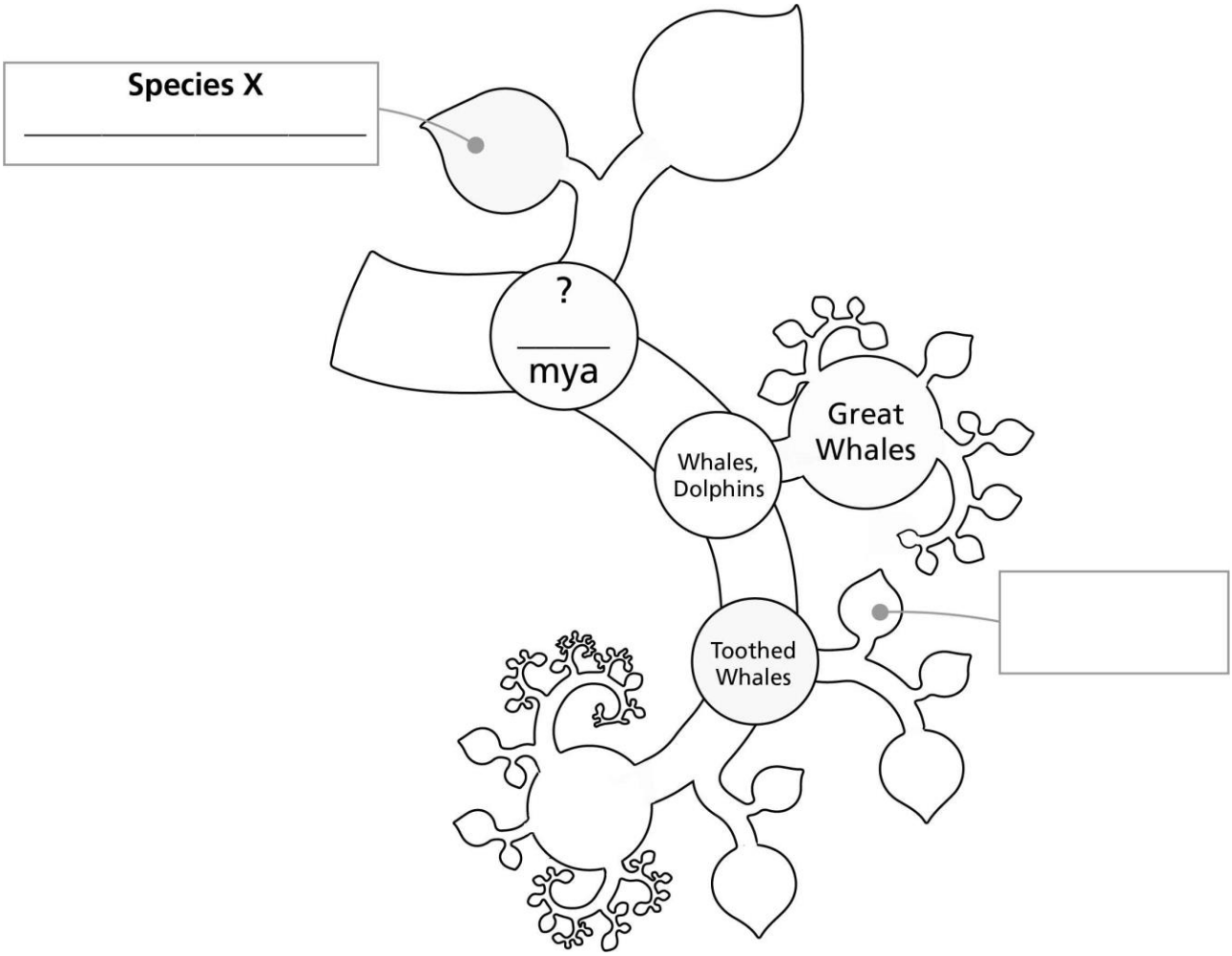
1. What does the forelimb of each animal have in common with our arm?

2. How does the Theory of Evolution explain the differences between our forearm and the Squirrel Monkey?

3. Which animal is most closely related to the sperm whale based on your drawings?

Go to the 'Tree of Life' touch screen to determine which of the four animals is actually the closest relative of the sperm whale.

Search for Sperm Whale to view this part of the 'Tree of Life'



Question

1. List three types of evidence that have been used to place these two species near each other on the tree? (Hint: you can find additional information about species X on the touchscreen next to its skeleton (look at your map to find it).

1. _____

2. _____

3. _____

2. Draw an **arrow** on the diagram to the location of the last common ancestor shared by the Sperm Whale and Species X. How long ago was this? _____ million years ago

Activity 2. Evolution of the platypus

The platypus (*Ornithorhynchus anatinus*) is endemic to Australia and is one of the most ancient and evolutionary distinct animals in the world. It has physical and genetic features in common with mammals, reptiles and birds.

In part I of this activity you will learn about the adaptations of the platypus that enable it to survive and reproduce in an aquatic envronment. In part II on the next page you will explore the evolutionary history of the platypuses.

Part I: Platypus Adaptations

Use the platypus touchscreen to answer the following questions.

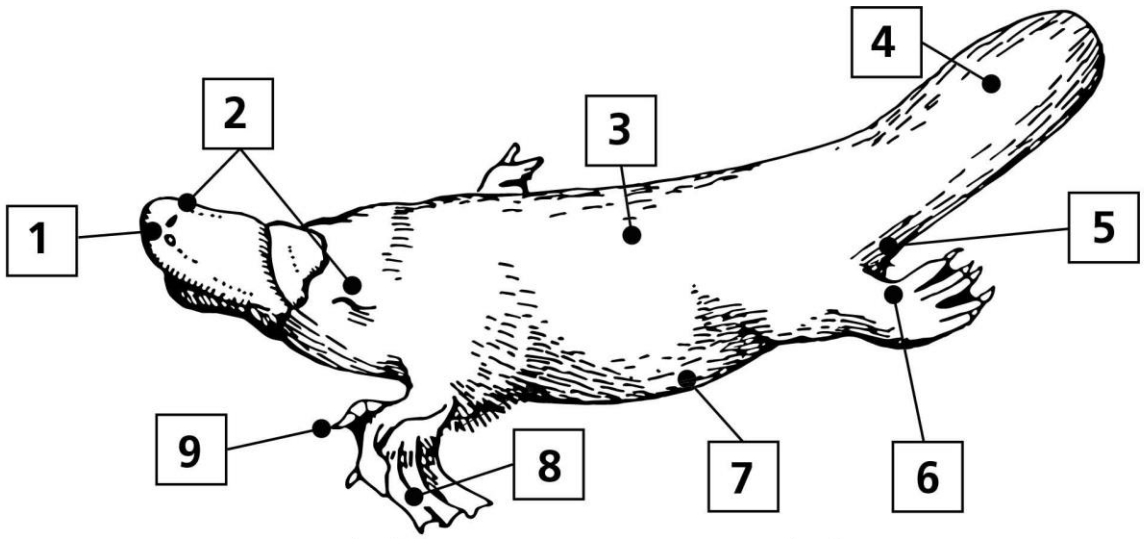
1. Which mammal subclass does the platypus belong to? _____

2. Name one feature of the platypus that is mammalian and one that is reptilian:

Mammalian feature: _____

Reptilian feature: _____

Examine the platypus specimen and use the platypus touchscreen to identify its adaptations for an aquatic environment.



1.	**4.** Storage of fat reserves.	**7.**
2. Closes eyes and nostrils when diving under water.	**5.** Single anal and urino-genital opening	**8.**
3.	**6.** *Hint: only males have this feature.*	**9.**

Part II: Macroevolution of the platypus

There may be millions of species alive today, but that's less than one per cent of those that have existed since life first appeared nearly four billion years ago.

While that's a lot of extinct species, let's put it in perspective. Biodiversity, or the variety of life, changes over time. Through the processes of evolution, new species appear and others become extinct.

Fortunately, it's possible to know how some extinct species looked and lived. We have fossils of some, and images or museum specimens of others. There are also living animals, like the lungfish, that have survived millions of years with few physical changes. Both living as well as long-gone species are placed on the Tree of Life, allowing us to trace relationships back through time.

Fossils have helped us to understand the evoutionary history of the platypus. Use the Riversleigh platypus touchscreen to answer the following questions.

The Riversleigh Platypus

1. Where is Riversleigh? _____

2. During which geological epoch was the Riversleigh platypus alive? _____

3. What is special about the fossil of this platypus? _____

_____

4. Name one feature of the Riversleigh platypus that is different to the living platypus.

_____

5. How can the Theory of Continental drift explain the distribution of platypuses in Australia and South America? _____

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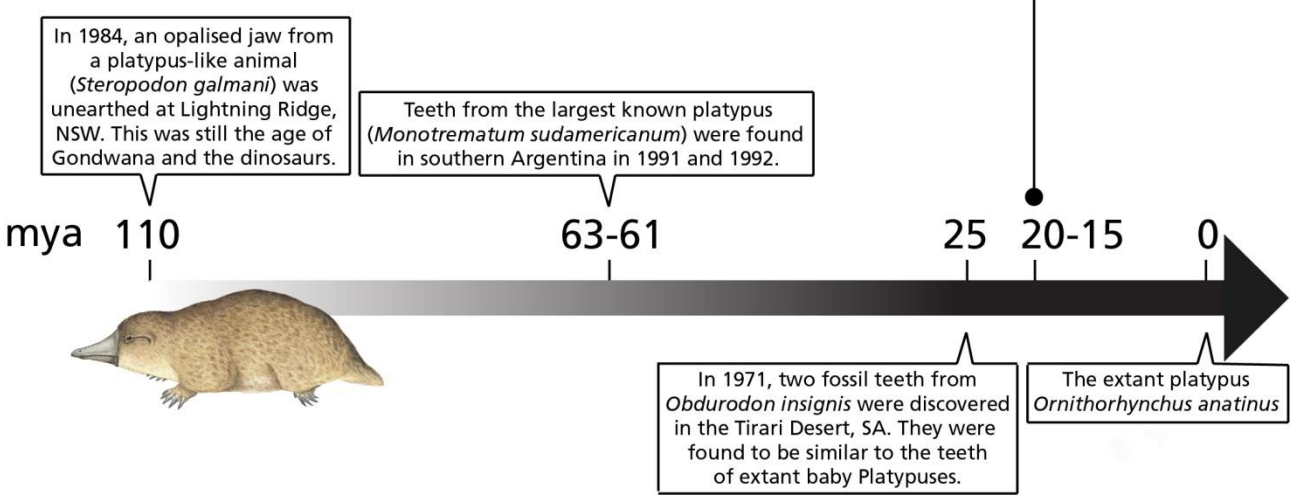


Activity 3. Convergent and divergent evolution

Look through *Wild Planet* and use the information in the cabinets to fill in the boxes below. Identify the adaptation as an example of <u>convergent</u> or <u>divergent</u> evolution for each pair of animals.

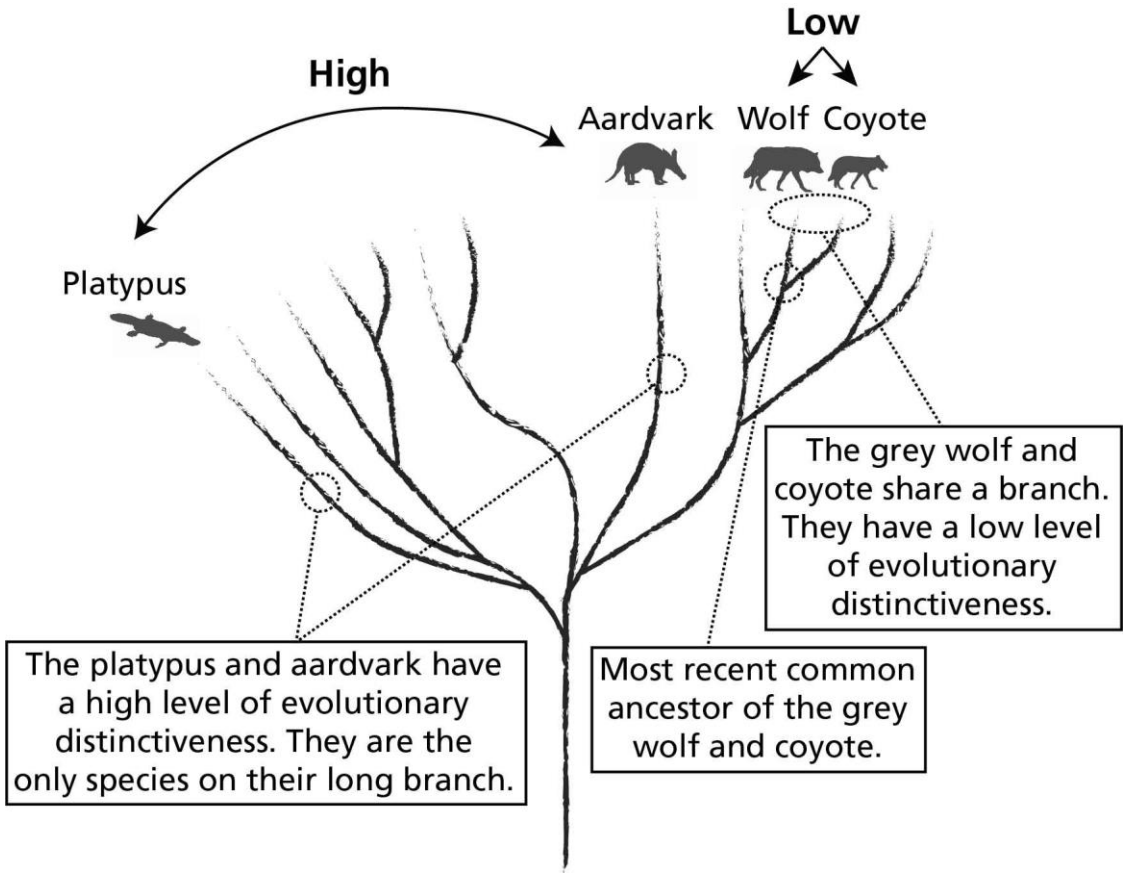
Clue	Animal Pair	Adaptation	Convergent or Divergent?
The numbat is a marsupial and the pangolin is a placental mammal. They are therefore not closely related.	Numbat  Sunda Pangolin 	**Hint**: diet.	*Convergent*
The tiger and leopard belong to the same family called Felidae. They are close relatives because they share a recent common ancestor.	Tiger  Leopard 	**Hint**: camouflage.	
The taipan and platypus belong to different classes of animal; the reptiles and mammals.They both produce something in common.	Coastal Taipan  Platypus 	**Hint**: toxin.	
The echidna is a species of monotreme (egg-laying mammals) and the porcupine is a placental mammal. They are not close relatives.	Short-beaked Echidna  Crested Porcupine 	**Hint**: protection.	
The flying fox and galah belong to different classes of animal; the mammals and birds. Their method of movement evolved independently.	Grey-headed Flying Fox  Galah 	**Hint**: locomotion.	
The tree kangaroo and wallaby both belong to the Macropodidae family. They occupy very different niches in Australia.	Tree Kangaroo  Red-necked Wallaby 	**Hint**: balance.	

Activity 4. Evolutionary distinctiveness

The Tree of Life is the 'ultimate diagram' connecting all species. You are related to all animals in *Wild Planet*. Those with whom you share more features are likely to be your closer relatives and you sit nearer them.

Some animals have many close relatives sitting close together on short branches, while others are the only species sitting on a long branch of three tree. **Evolutionary Distinctiveness** is a measure of how long a species has been isolated on the Tree of Life.

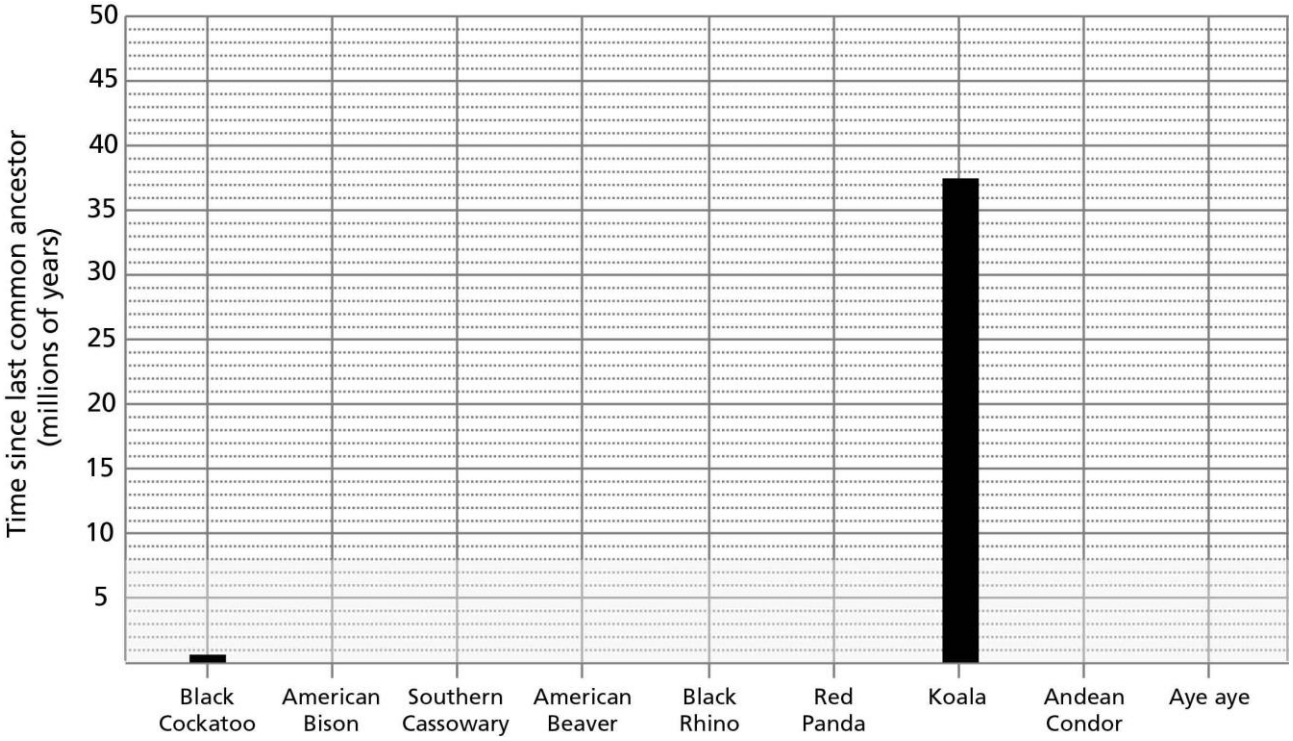
Species like the platypus and aardvark have a high level of evolutionary distinctiveness because it has been a long time since they shared a common ancestor with another species. Species like the wolf has a low level of evolutionary distinctiveness because it evolved relatively recently and has many close relatives. Take a look at the tree shown below!



Find these animals in *Wild Planet* and record their level of evolutionary distinctiveness in the last column of the table.

Species	Millions of years since they shared a common ancestor with another species	Level of Evolutionary Distinctiveness
Koala	37.6	high
American Bison	3.07	
Black Rhino	12.5	
Aye Aye	49.1	
Southern Cassowary	4.47	
Andean Condor	38.8	
Yellow-tailed Black Cockatoo	0.5	low
American Beaver	9.88	
Red Panda	31.4	

Draw a graph of the first column of your table.



Describe the trend between time since last common ancestor and the level of evolutionary distinctiveness. _____

_____

_____

_____

Map of Wild Planet