The Human Story

Educator-led program

Student Activities

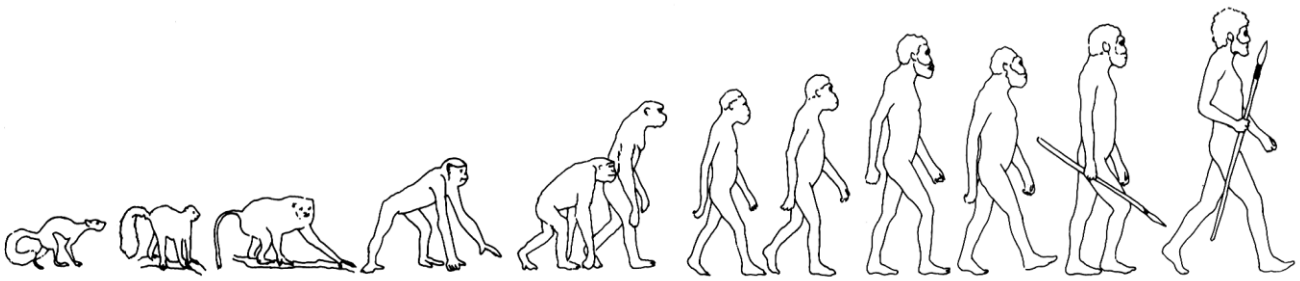

Illustration: Australian Museum.

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6 College Street, Sydney, NSW 2010
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AUSTRALIAN MUSEUM

Activity 1:
Comparing hominid skulls – ancient and modern

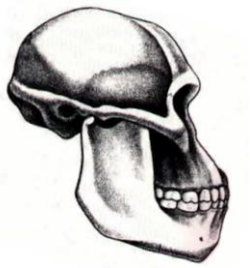
Introduction

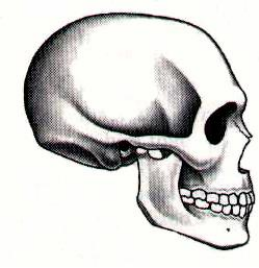
Scientists compare many different physical features when working out evolutionary relationships. For fossil primates, including our ancestors, these features include:

- muzzle angle,
- position of the foramen magnum,
- brain size in relation to body size.

Aim

In this activity you will learn about the features listed above. You will then examine a number of hominid skulls (fossil and modern) to collect data on these features. Using your collected data, you will construct an evolutionary tree in which the hominids you examined are sorted along a timeline that shows evolutionary relationships according to these features.





Instructions

- ☞ Take care of the specimens and handle them **gently**!
- ☞ Please **do not mark** the specimens, photos and other resources with your pens or pencils!
- ☞ Carefully **unpack** all the specimens and other resources from the Activity Box and tidy away the packing materials into the box.
- ☞ **Identify** the specimens and the supplementary resources you'll be using. The **inventory** in the white folder will help.
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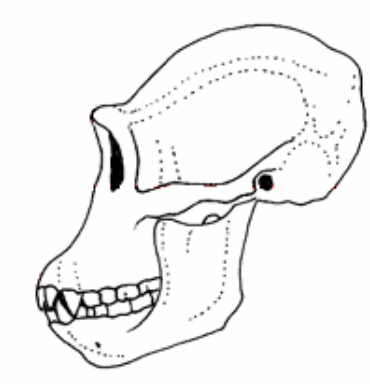
A. Becoming familiar with some terminology and techniques

1. Use the **Information Cards** on skull features to complete the following:

Diagram 1: Muzzle angle



(a) The muzzle angle measures the degree of

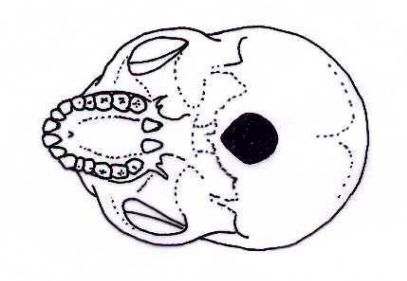
_____.

(b) Draw **lines** on Diagram 1 to show how you would measure the muzzle angle. Include an **arrow** and **label** that indicates which angle you would measure.

(c) The foramen magnum is the _____

_____

Diagram 2: Foramen magnum



(d) Draw an **arrow** and write a **label** on Diagram 2 to indicate the foramen magnum.

(e) Cross out the incorrect word then explain your answer:
The skull in Diagram 2 belongs to a **biped / quadruped** because the foramen magnum is located _____

_____ on the skull's base

rather than being _____.

(f) Brain size is an important characteristic in human evolution investigations. How is it measured?

_____

(g) In human evolution studies, measurements of brain size are of limited use. A more useful measurement is brain size compared with body size. Briefly explain why this is a better measurement.

_____

_____

_____

B. Examining some hominid skulls and collecting data

2. Use the equipment provided to measure the muzzle angle of each skull and record this information in the table below.

3. Look at the skulls and determine the position of the foramen magnum – is its position on the base of the skull reasonably central, at the extreme back, or intermediate?

4. Use the **Information Card** 'Brain versus Brawn' and collect data from the graph so that you can complete the required calculations of percentage **brain to body weight**.

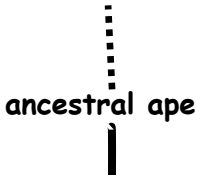
Note: you should **record your data as grams**. Refer to the conversion notes under the 'Brain versus Brawn' graph for help with this conversion.

Species name and age	**Muzzle angle** (degrees)	**Foramen magnum position**	**% brain to body weight**	
			calculations: cranial capacity (grams) / body weight (grams) X 100	= ..... %
ancestral ape (5 - 7 million years ago)	130^0 (estimate)	at the very back of the skull base	% brain to body weight has been estimated to be similar to that of a modern chimpanzee	
Chimpanzee *Pan troglodytes* (modern Common Chimpanzee) (Present)	120^0	at the very back of the skull base	340 / 42,000 X 100	= 0.8 % ie. its brain is 0.8% of its total body weight
Australopithecus afarensis (2.8 - 3.9 million years ago)			X 100	= ..... %
Paranthropus boisei (1.0 - 2.3 million years ago)			X 100	= ..... %
Homo ergaster (1.5 - 1.9 million years ago)			X 100	= ..... %
Homo heidelbergensis (300,000 - 600,000 years ago)	94^0		X 100	= ..... %
Homo sapiens (modern humans) (last 190,000 years) [or last 300,000 years if transitional 'archaic sapiens' fossils are included]			X 100	= ..... %

C. Constructing an evolutionary tree

5. Using just the information in your table, draw an evolutionary tree showing the relationships between these hominids.
The **Information Card**, 'Placing our ancestors into our evolutionary tree' has some hints.

Evolutionary tree based on skull features



6. Identify one species (apart from the chimpanzee) that is unlikely to be a direct ancestor of modern humans. Justify your answer using the data you have collected.

D. Discussion Question

7. In this activity you were asked to work out how a number of different hominids are related by using a single skull of each. Why this might produce **inaccurate** results? Suggest how any problems could be overcome.

Activity 2:
Different interpretations in the search for the missing link

Introduction

Almost 200 years ago, the **first** fossil of a human ancestor was discovered. At first, this fossil and other early discoveries were assumed to be modern human remains because the **concept of evolution** had yet to be developed and there was not yet any other means by which to explain them. Many decades passed before the fossils became recognised in 1864 as coming from a different kind of prehistoric human – Neanderthal Man.

Additional fossils continued to be discovered but in the late 1800s and even for most of the 1900s the fossil record continued to be based on an extremely small number of discoveries. Interpreting the fossil record using such a **small number** of fossils was difficult and there was always the potential for **different interpretations**. There was also the added problem of having only a **limited technology** to use in this new scientific field.

Since these times **new fossil discoveries** have increased our knowledge of human evolution. Our understandings have also continued to expand with the development and use of **new or improved scientific techniques and technologies**.

Aim

In this activity you will investigate an historic example where there were different interpretations of the same fossil evidence. You will examine this fossil evidence and collect your own data. Using this data you will explore the different interpretations that were made before finding out how new fossil evidence and the use of new techniques resolved this controversial issue.

Instructions

- ☞ Take care of the specimens and handle them **gently**!
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A. Early perceptions: Our early ancestors had large brains

Fossil hunters had been searching for the missing link between humans and our ape ancestors ever since the discovery of the first Neanderthal Man fossils in the 1800s. Then in **1912**, an amateur archaeologist named Charles Dawson discovered pieces of a skull and lower jaw at Piltdown Common in England. The fossils showed a **mixture of human and ape features** – it seemed that the 'missing link' had been found! It was nicknamed 'Piltdown Man'.

1. Compare the skulls and jaws of the modern **human** and **adult chimpanzee** from your Activity Box with the reconstructed **'Piltdown Man'** skull and jaw on display.

Note: The chimpanzee is used here to represent a very early ancestor of humans – an ancestral ape.

> *** Why are we using a modern chimpanzee to represent an ancestral ape?**
> Humans and chimps are the most closely related of all the living Great Apes. Using a wide range of evidence –fossil and other biological evidence – scientists **now** believe that our very early ancestors had bodies similar to those of modern chimpanzees. This common ancestor of both humans and chimpanzees lived some time between five and seven million years ago. We did not evolve from chimpanzees but we did evolve from an ape that was very similar.

(a) Refer to the **Information Cards** on skull and jaw features to help you describe 'Piltdown Man' in the following table.

(b) Decide whether each of 'Piltdown Man's' features are most similar to those of modern humans (human-like), most similar to those of the chimpanzee (ancestral ape-like), or whether they are intermediate. Add your observations to complete Table 1.

Table 1: The features of 'Piltdown Man'

'Piltdown Man' features	**Description** (cross-out the options that are least correct – some have been done for you already)	**Human-like, ancestral ape-like or intermediate?**
Brain case	large ~~small~~	human-like
Forehead	high and vertical low and sloping backward	
Eyebrow ridge	~~prominent~~ small ~~absent~~	intermediate
slope of face	strongly protruding intermediate vertical	
Foramen magnum position	central ~~at the back of the skull base~~	
Canine teeth	large and conical intermediate small with a flat or slightly pointed tip	
Dental arcade	~~rectangular~~ intermediate ~~parabolic~~	intermediate
Chin	rounded/sloped pointed	

2. The 'Piltdown Man' discovery supported the social and scientific belief of the time that one of the first human features to evolve was a large brain.

(a) Does the evidence you collected in Table 1 support the idea that 'Piltdown Man' was a human ancestor? Explain. _____

_____

(b) Does your evidence support the idea that our ancestors had a large brain? Describe two features that support your answer. _____

_____

B. A different perspective: Our early ancestors had small brains

In **1924**, **Raymond Dart**, an Australian born Professor of Anatomy working in South Africa came across a fossil of a young primate which became known as the 'Taung Child'. He believed it was a human ancestor, intermediate between apes and humans, and named it A*ustralopithecus africanus*.

3. Compare the **'Taung Child'** with the modern **human** and **adult chimpanzee** and complete Table 2. Note: refer to the additional 'Taung Child' on display for a more complete view of its features.

Table 2: The features of the 'Taung Child'

'Taung Child' features	**Description** (cross-out the options that are least correct)	**Human-like, ancestral ape-like or intermediate?**
Brain case	~~large~~ small	ancestral ape-like
Forehead	high and vertical ~~low and sloping backward~~	human-like
Eyebrow ridge	prominent small absent	
Slope of face	strongly protruding intermediate vertical	
Foramen magnum position	central ~~at the back of the skull base~~	human-like
Canine teeth	large and conical intermediate small with a flat or slightly pointed tip	
Dental arcade	rectangular intermediate parabolic	
Chin	rounded/sloped pointed	

4. **(a)** Does the evidence you have collected in Table 2 support Dart's view that the 'Taung Child' was a human ancestor? Explain.

_____

_____

(b) Does your evidence support the idea that our ancestors had a small brain? Explain. _____

_____

C. A different interpretation of the same fossil evidence

The scientific establishment in Britain rejected Dart's view, maintaining the 'Taung Child' was just a **baby ape** and that the 'Piltdown Man' discovery had confirmed that the early evolution of a large brain was what sent our ancestors on the path to becoming human. Discredited and discouraged, Raymond Dart gave up fossil hunting and his 'Taung Child' fossils gathered dust in a storage cupboard.

5. Refer to the **Information Card**, 'The Taung Child' and outline the reasons for the scientific establishment's disagreement with Dart's view that the 'Taung Child' was a human ancestor.

_____

_____

_____

6. Compare the **'Taung Child'** and the **baby chimpanzee** skulls from your Activity Box. Do you think this was an appropriate interpretation by the other scientists – was the 'Taung Child' just a baby ape? Explain.

_____

D. Updated evidence from new fossil discoveries and new techniques

Robert Broom, a Scottish doctor and palaeontologist, was virtually the only supporter of Raymond Dart. Broom took over Dart's work, determined to find an adult australopithecine in order to prove Dart's theory that our early human ancestors had small brains. From 1936 to 1948, Broom searched for more australopithecine fossils in South Africa. In **1947** he found an almost complete skull of an **adult** *Australopithecus africanus* – the same species as the 'Taung Child'. This skull was nicknamed 'Mrs Ples'.

7. Compare the fossil cast of **'Mrs Ples'** with the **modern human** and **adult chimpanzee** and complete Table 3.

Table 3: The features of 'Mrs Ples'

'Mrs Ples' features	**Description** (cross-out the options that are least correct)	**Human-like, ancestral ape-like or intermediate?**
Brain case	~~large~~ small	ancestral ape-like
Forehead	high and vertical low and sloping backward	
Eyebrow ridge	prominent small absent	
Slope of face	strongly protruding ~~intermediate~~ ~~vertical~~	ancestral ape-like
Foramen magnum position	central at the back of the skull base	
Dental arcade	rectangular intermediate parabolic	

8. Does the evidence you have collected in Table 3 support the view of Dart and Broom? Explain.

_____

9. Read the **Information Card**, 'Skulduggery' and answer the following questions.

(a) What conclusion was finally made about 'Piltdown Man' in 1953? Outline the evidence that led to this conclusion. _____

_____

_____

(b) Could a similar hoax happen today? Justify your answer. _____

_____

E. Reviewing the evidence – were our early ancestors big brained or small brained?

In the **1950s** after the analysis of Broom's new fossil evidence and the final revelations about 'Piltdown Man', scientists finally accepted that the australopithecines were human ancestors and that brain size was **not** one of the first human features to evolve.

10. Today, our understanding of human evolution is much greater. Read the **Information Card**, 'Becoming human' and list in order (from oldest through to most recent) the **three** major **physical trends** that occurred in human evolution. For each physical trend, record how long ago each of these changes began.

_____

_____

_____

Activity 3:
Comparing hominid teeth – ancient and modern

Introduction

Scientists compare many different skeletal features when trying to work out evolutionary relationships. **Teeth** are especially useful. They are the hardest parts of the skeleton and therefore have a better chance of lasting long enough to become fossilised. In fact, some species of fossil hominids are known only from their teeth.
The size, shape and arrangement of the teeth are common features palaeoanthropologists use to investigate the relationships between our ancestors and other primates.

Some of the teeth features examined in human evolution studies are the:

- relative size of the canine teeth,
- presence or absence of a diastema,
- relative size of the molar teeth,
- shape of the dental arcade.

Aim

In this activity you will learn about the teeth features listed above. You will then examine a number of hominid skulls (fossil and modern) to collect data on these features. Using your collected data, you will construct an evolutionary tree in which the hominids you examined are sorted along a timeline that shows evolutionary relationships according to these features.

Instructions

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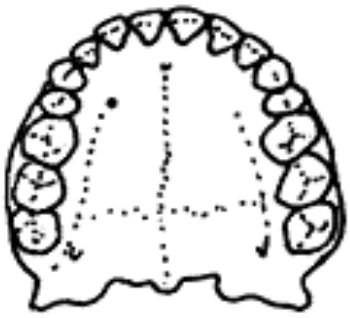
A. Becoming familiar with some terminology

1. Use the **Information Cards** on teeth features to complete the following:

(a) Label Diagram 1 to **name** the four different types of teeth and show where they are **located** in an adult hominid jaw.

Diagram 1: Hominid teeth



(b) A hominid's canines can be considered to be _____ if they are longer than its other teeth and _____ if they are the same height as its other teeth.

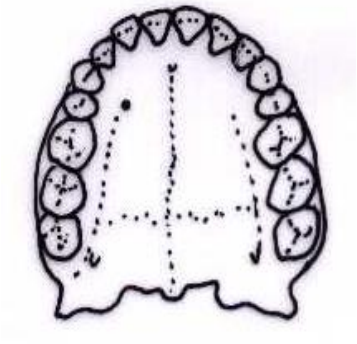
(c) A diastema is _____

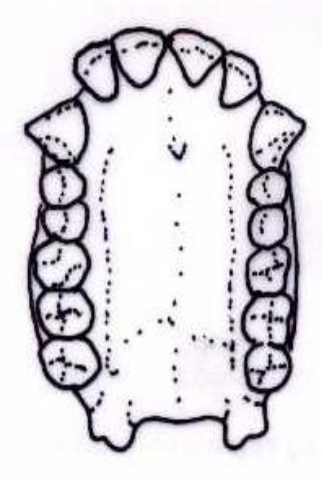
_____

(d) Molars may be described as small if they are _____,
or large if they are _____, or they can be _____

(e) Draw **lines** and write **labels** on Diagram 2 to show the dental arcades of these jaws.

Diagram 2: Dental arcades





B. Examining some hominid jaws and collecting teeth data

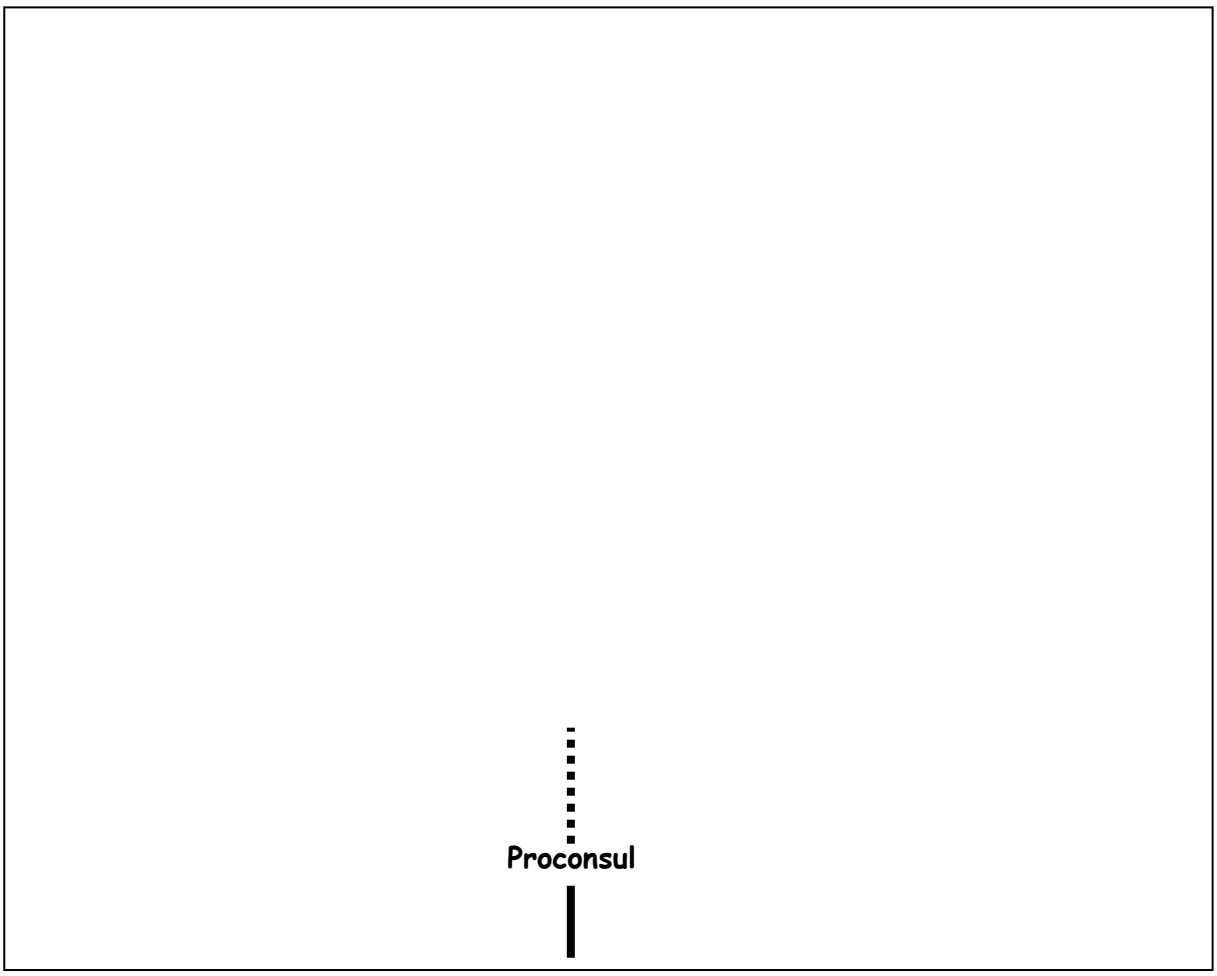
2. Look at the specimens from your Activity Box and compare the teeth of the different hominid species. Examine both the upper and lower jaws where available. Record your observations in the table below.

Species name and age	**Relative canine size** (large or small)	**Diastema** (present or absent)	**Dental arcade** (rectangular, parabolic or intermediate)	**Relative molar size** (large, small or intermediate)
Proconsul (17 – 20 million years ago)		present		intermediate
Gorilla (modern gorillas) (Present)				
Australopithecus afarensis (2.8 - 3.9 million years ago)			intermediate	intermediate
Australopithecus africanus (2.0 - 3.2 million years ago)				
Paranthropus boisei (1.0 - 2.3 million years ago)			intermediate	
Homo ergaster (1.5 - 1.9 million years ago)				
Homo sapiens (modern humans) (last 190,000 years) [or last 300,000 years if transitional 'archaic sapiens' fossils are included]	small			small

C. Constructing an evolutionary tree

3. Using just the information in your table, draw an evolutionary tree on the next page to show the relationships between these hominids.
The **Information Card**, 'Placing our ancestors into our evolutionary tree' has some hints.

Evolutionary tree based on teeth features



4. Identify one hominin species (not *Proconsul* and *Gorilla*) that is unlikely to be a direct ancestor of modern humans. Justify your answer using the teeth data you have collected.

D. Discussion questions

5. Compare your evolutionary tree with the trees shown on the **Information Card**. In what ways is the arrangement of your tree similar or different?

6. Why do you think there are alternate evolutionary trees when they all use the same fossil evidence?

7. In this activity you were asked to work out how a number of different hominids are related by using specimens from a single individual of each species. Why this might produce **inaccurate** results? Suggest how any problems could be overcome.

Activity 4:
Alternative views of *Homo erectus* and *Homo ergaster*

Introduction

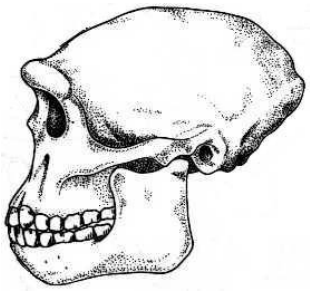
Homo ergaster was first named as a distinct species of early human in 1975 when a fossil jaw was noted to have some unique features. These features were later recognised in a group of fossils from Africa that had initially been thought to be early forms of *H. erectus*. Removing these **'early African'** fossils from *H. erectus* produced a smaller *H. erectus* group based on fossils from **east Asia** – especially China and Java in Indonesia.

The fossils of the new Asian *H. erectus* group had some **specialised** features not found in modern humans. It seemed that they may not be our direct ancestors and were moved to a side branch in our evolutionary tree. The African *H. ergaster* fossils however, were quite **primitive** – perhaps they were our direct ancestors.

The classification of *H. ergaster* is not straightforward and remains controversial. Some scientists deny that it is a separate species. Others do consider it a distinct species but cannot agree on the full range of specimens that should be included in the group.

Aim

In this activity you will investigate the debate about *H. ergaster* and *H. erectus*. You will examine the skulls of these species and collect data to explore their differences. You can then make your own conclusions regarding the debate and decide which viewpoint you support.



Instructions

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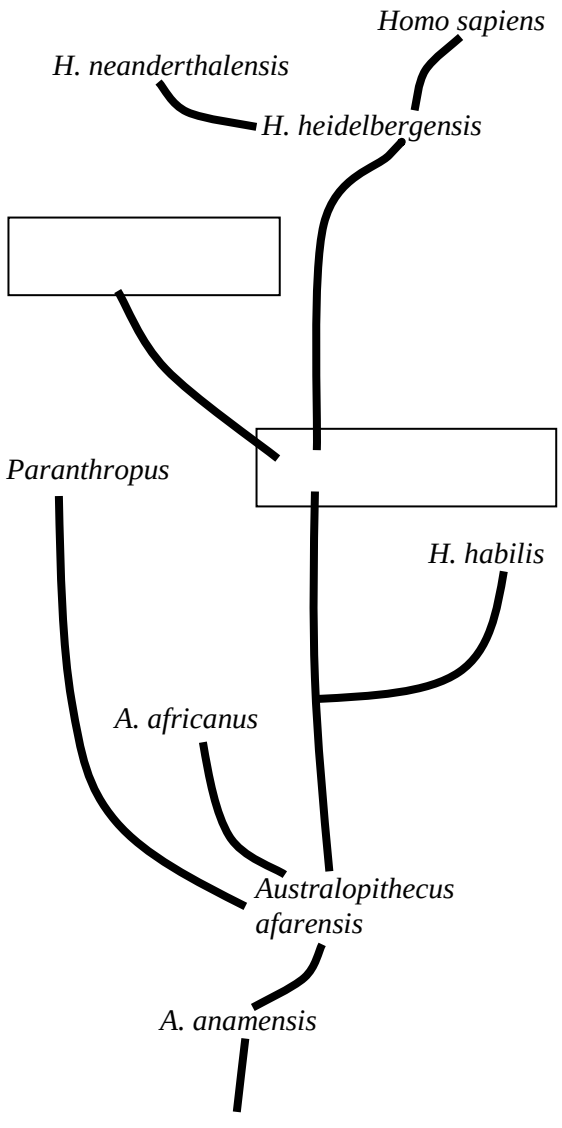
A. Summarising the debate

There are two main views on the classification of *H. ergaster*. They are:

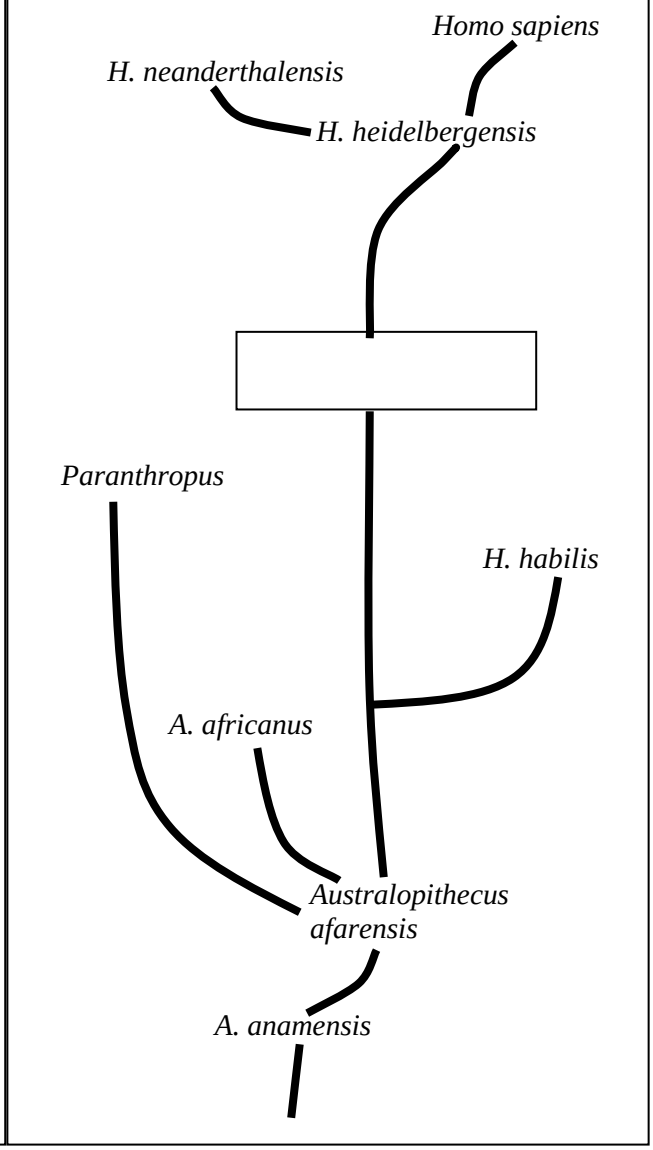
View 1	**View 2**
• *Homo ergaster* **is** a legitimate species. • *H. ergaster* more closely resembles *H. sapiens* than does *H. erectus*. • The features of *H. ergaster* are more primitive whereas *H. erectus* has more specialised features. • *H. ergaster* is therefore the ancestor of *H. sapiens* (modern humans) whereas *H. erectus* is an evolutionary side branch.	• '*H. ergaster*' does **not** exist. • '*H. ergaster*' is not sufficiently different from *H. erectus* and the specimens sometimes called '*H. ergaster*' are actually *H. erectus*. • *H. erectus* therefore remains the direct ancestor of *H. sapiens* (modern humans).

1. Read the two different views for the classification of *H. ergaster* (above). Use this information to complete the following evolutionary trees summarising each view.

View 1



View 2



B. Becoming familiar with some terminology and techniques

2. Refer to the **Information Card** on skull features to complete the following:

(a) Draw **lines** on Diagrams 1 and 2 to show where you would measure the following features:

- nasal bones,
- nasal opening,
- cheek bone,
- post-orbital constriction.

(b) **Label** these four features.

Diagram 1: Skull – front view

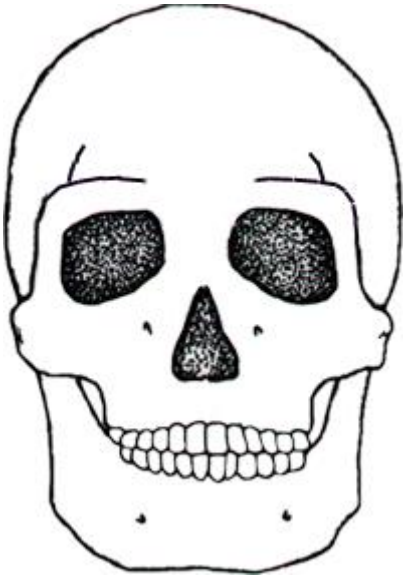
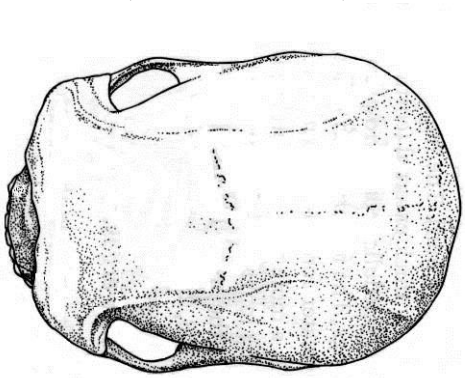


Diagram 2: Skull – top view (face is on the left)



C. Examining some skulls and collecting data

3. Compare the skulls of *Homo ergaster*, *H. erectus* and *H. sapiens* from your Activity Box. Use the metal dividers and then the ruler to accurately measure (in centimetres) its features to complete Table 1. (Please do not mark the skulls.)

Table 1: Physical comparisons

Feature	*Homo ergaster*	*Homo erectus*	*Homo sapiens*
Nasal bones			
Nasal opening			
Cheek bone			
Post-orbital constriction			

4. The information in Table 1 is based on only one skull to represent each species. What errors could arise from this?

D. Gathering more information – additional comparisons

5. Refer to the **Information Cards** on *Homo ergaster* and *Homo erectus* and complete Table 2 to provide some additional comparisons on these species.

Table 2: Other comparisons

Species' characteristics	***Homo ergaster***	***Homo erectus***
Age range (when they lived)		
Geographical range (where they lived)		
Cranial capacity (average brain size)		
Inferred culture		

E. Discussion questions

6. Recall that there are two main views on the classification of *H. ergaster* (see Part A on page 2). Which view do you support – View 1 (*H. ergaster* is a valid species) or View 2 (*H. ergaster* does not exist as a separate species)? Justify your opinion using the evidence you collected during this activity.

7. Scientists all used the same fossil evidence when formulating their views about *H. ergaster* and *H. erectus* yet different scientists hold alternative views about their classification and evolutionary relationships. Why do you think these different views occur?

8. What additional evidence could help resolve this debate?

Activity 5:
Was 'Lucy' a biped?

Introduction

One of the ways modern humans differ from other living apes is our ability to walk upright – called **bipedalism**. Other living apes are **quadrupeds** and move about on all four limbs. Becoming bipedal was the first major physical change that set our ancestors apart from other apes.

The discovery of the fossil skeleton, **'Lucy'** in 1974 created excitement because she may have been a biped. If so, she was the oldest known fossil of a human ancestor, having lived 3.2 million years ago in east Africa. Was 'Lucy' and her species, ***Australopithecus afarensis***, bipedal?

There are a number of features that can reveal whether a fossil hominid was bipedal or quadrupedal. They include the:

- foramen magnum position,
- femur (thighbone) position,
- finger bone and toe bone shape.

Aim

In this activity you will learn about the features listed above and gather information on other features that provide evidence of bipedalism. You will also examine skeletal evidence from a variety of hominids and collect data on these features to investigate whether or not 'Lucy' was bipedal.

Instructions

- ☞ Take care of the specimens and handle them **gently**!
- ☞ Please **do not mark** the specimens and other resources with your pens or pencils!
- ☞ Carefully **unpack** all the specimens and other resources from the Activity Box and tidy away the packing materials into the box.
- ☞ **Identify** the specimens and the supplementary resources you'll be using. The **inventory** in the white folder will help.
- ☞ Work through the activities on the following pages using both the resources in your Activity Box and any additional resources provided.
- ☞ Please **repack** the Activity box when you have finished the activity. Take **care** with the specimens – they will break if they are not packed gently.

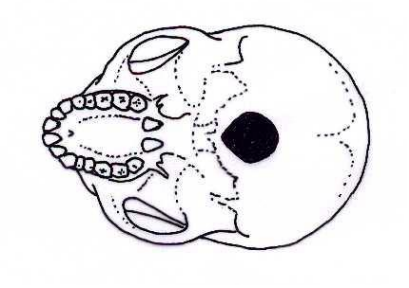
A. Becoming familiar with some terminology

1. Use the **Information Cards** on skeleton features to complete the following:

(a) The foramen magnum is the _____

_____

Diagram 1: Foramen magnum



(b) Draw an **arrow** and write a **label** on Diagram 1 to indicate the foramen magnum.

(c) Cross out the incorrect word then explain your answer:
The skull in Diagram 1 belongs to a **biped / quadruped**
because the foramen magnum is located _____

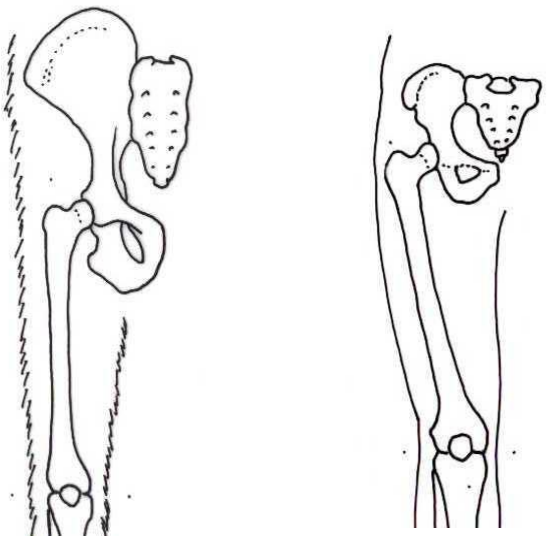
_____ rather than being

_____.

(d) Quadrupedal hominids (four-legged walkers) have _____ femurs (thighbones) whereas bipeds have femurs that _____

(e) Draw **lines** on Diagram 2 to emphasise the differences between the femurs of a biped and quadruped. **Label** the diagram to indicate the differences.

Diagram 2: Femur position



(f) Quadrupedal hominids have _____ finger bones and toe bones whereas bipedal hominids have _____ finger and toe bones.

B. Examining skeletal evidence from a variety of hominids and collecting data

2. Look at each of the specimens from your Activity Box and compare the skulls, femurs and finger bones of the various species. Fill in the appropriate columns of the table below.

3. Examine the specimens from your Activity Box and the other skeletal specimens on display and add another skeletal feature to the table that can be used to separate these bipedal and quadrupedal hominids.

Species	**Foramen magnum position**	**Femur position**	**Finger bone shape**	
Chimpanzee &/or *Gorilla*				
Australopithecus afarensis (includes 'Lucy')				
Homo sapiens (modern humans)				

C. Interpreting your data

4. Describe the evidence you found that suggests 'Lucy' walked upright.

5. Describe the evidence you found that suggests 'Lucy' was quadrupedal.

6. Evaluate the evidence to determine whether 'Lucy' was bipedal or quadrupedal.

D. Gathering more information – additional evidence that can be used to identify bipeds and quadrupeds

7. **(a)** Use the **Information Card**, 'Backbones' to describe the backbone shape.

Chimpanzee: _____

_____

Australopithecus: _____

Homo sapiens: _____

_____

(b) Is *Australopithecus* similar or different to humans? _____

8. Refer to the **Information Card**, 'Walking on two legs – bipedalism' to describe **at least two** other skeletal features that provide evidence on whether a species was bipedal or quadrupedal.

_____

_____

_____

_____

_____

9. Refer to the **Information Card**, 'Tracks through time' and describe the fossil evidence (other than skeletal evidence) that suggests that australopithecines were bipedal.

_____

_____

_____

10. Who discovered this evidence?

_____

E. Discussion question

11. Outline the advantages that upright walking gave to early humans over their quadrupedal relatives.

_____

_____

_____

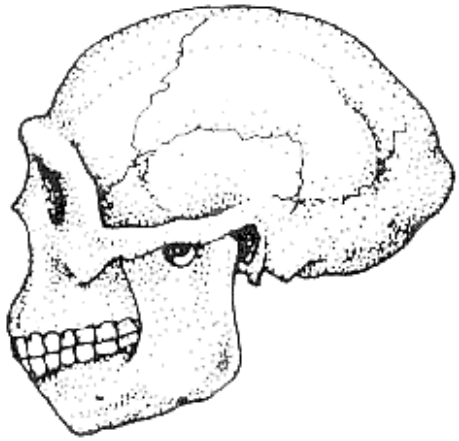
_____

_____

_____

Activity 6:
The search for our most recent direct ancestor – *Homo neanderthalensis* versus *H. heidelbergensis*

Introduction



In August 1856, human-like fossils were discovered in a cave in the Neander valley in Germany. At first, the fossils were first thought to be from a modern human, but their physical differences soon showed that they were from a **different** kind of human.

Neanderthal Man (*Homo neanderthalensis*) was the **very first** discovery of a human ancestor, and was announced to the world only three years before Charles Darwin published his controversial book on evolution, *The Origin of Species*.

At this time, the **concept of evolution**, especially the idea that humans were descended from ape-like creatures, was **not** accepted by **most** of the scientific community or the general public. They considered it both a religious and personal insult.

Darwin's ideas slowly gained support however, and interest in the Neanderthal fossils increased. Soon the hunt was on to find more fossils of human ancestors.

Aim

In this activity you will investigate *Homo neanderthalensis* and *H. heidelbergensis*. You will examine skulls of these species and collect data to explore their similarities and differences when compared with *H. sapiens* (modern humans). Additional evidence regarding our relationships with these two species will then be examined to confirm which species is our direct ancestor.

Instructions

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A. The discovery of another ancestor

Following the initial Neanderthal fossil discoveries, more fossils continued to be found. Some of these had a closer resemblance to modern humans than the Neanderthals and scientists began to question whether the Neanderthals really were ancestral to modern humans or whether they were an evolutionary sideline.

1. Refer to the **Information Card**, '*Homo heidelbergensis*' to answer the following:

(a) Discovery and Classification:
What were the *H. heidelbergensis* fossils called before their name change?

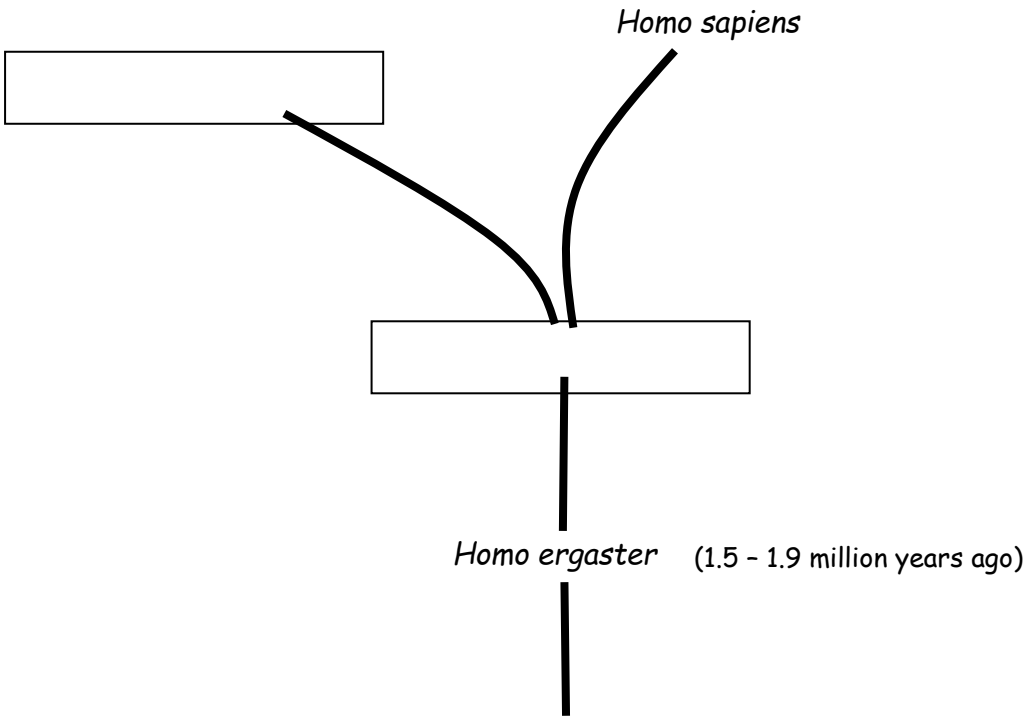
_____

(b) Geographic range:
Where have fossils of this species been found? _____

(c) Relationships with other species:
H. heidelbergensis began to develop regional differences that eventually gave rise to two species of humans.
European populations of *H. heidelbergensis* evolved into _____

while a separate population of *H. heidelbergensis* in **Africa** evolved into _____

(d) Complete the following diagram to show the relationships of the three species named in (c) in an evolutionary tree.



(e) Age:
When did the species, *H. heidelbergensis*, live? Add this information to the diagram above.

(f) Refer to the **Information Cards**, '*Homo sapiens'* and *'Homo neanderthalensis'* to find out when these species lived. Add this information to the diagram above.

B. Examining skulls and collecting data

2. Examine the skulls from your Activity Box and refer to the **Information Cards** on skull features to help you complete the following table.

Feature	*Homo heidelbergensis*	*Homo neanderthalensis*	*Homo sapiens*
Teeth (relative size)		very large	
Nasal opening (relative size)	large	large	
Cheek bones at the front of the skull (orientation)		strongly slanted backwards from the nose	not slanted
Mid-face (relative projection of the central nose and cheek area)	Slight mid-face projection (the central nose and cheek area is slightly 'pulled' outward)		Flat face no mid-face projection
Eye socket (shape of outer rim)			square rather than rounded
Brain case (relative height; length – front to back)			High and short
Occipital bone – at the back of the skull (shape)			smoothly rounded with no bulge
Brow ridge (relative size and shape)	Large; double arched with a large dip above the nose		
Forehead (shape and relative height)			

3. Compare each feature for *H. heidelbergensis*, *H. neanderthalensis* and *H. sapiens* in the table above. Place a **tick** next to each of the *H. heidelbergensis* features that are intermediate compared with the two other species? How many of its features are intermediate? _____

4. How does this data support the theory that *H. heidelbergensis* is the ancestor of both *H. sapiens* and *H. neanderthalensis*?

_____

_____

_____

C. Using other evidence to answer the question: Who is our direct ancestor?

There has been considerable debate about our relationship with the Neanderthals.

5. Read the **Information Card**, 'Neanderthals and us: no relation' and answer the following questions.

(a) What did the scientists discover about our relationship with the Neanderthals?

(b) How did they come to this conclusion?

(c) What are the two opposing views about why the Neanderthals disappeared?

The latest evidence suggests that our species evolved from *H. heidelbergensis* populations that became isolated in Africa. Initially these African *H. heidelbergensis* evolved into **archaic** forms of *H. sapiens* that had features intermediate between *H. heidelbergensis* and modern *H. sapiens*. These archaic *H. sapiens* then evolved into **anatomically modern** *H. sapiens*.

6. Look at the additional specimens on display. Refer to the label information about the **LH 18 skull**, the **Omo II braincase** and **Omo I partial skull**. Complete the table below.

	LH 18 skull	**Omo II braincase**	**Omo I partial skull**
Classification			
Age			
Where it was found (including the continent)			
Transitional features			

7. Read the **Information Card**, 'National Geographic News' and answer the following questions.

(a) The new dates giving the ages of the Omo I and Omo II fossils coincides with the findings from what other biological studies?

(b) These findings place modern *H. sapiens* in Africa many thousands of years before our species appeared on any other continent. To which theory of human origins does this add credibility?