WADHAM
COLLEGE
UNIVERSITY OF OXFORD

SEMINAR SERIES:
WHAT MAKES US HUMAN?

by Dr. Catherine Seed

Overview

Timetable – Tutorials

Tutorial	Date	Time	Location
1			
2			
3			
4			
5			

Tutorial Titles

Tutorial	Title
1	What makes human different?
2	Biological approaches
3	Genetic approaches
4	Behavioural and cultural approaches
5	Group presentations

Assignments

Tutorial	Title
1	Propose an experiment (Due Tutorial 2)
2	Inter-membral index activity (Due Tutorial 3)
2	Prepare presentation (Due Tutorial 5)

Course Rationale

Humans (*Homo sapiens*) share many traits with other species, both in terms of our biology and behaviour. Like other mammals, we have hair, like other primates we have stereoscopic vision which enables us to perceive depth, and like the other apes, we have a longer juvenile stage. But…we build cities, send people to space, and we treat disease. Are we substantially different to other species…or are the behaviours we exhibit just extensions of those we see elsewhere in nature? Do other species have capabilities which set them apart from us?

This course, 'What makes us human?' will explore this question in detail, introducing you to some core concepts, methods and emerging fields in Human Sciences/Anthropology and Biology. The course consists of four tutorials examining different aspects of human biology and culture, placing them in a biological, social and environmental context.

Firstly we will brainstorm human characteristics that we hypothesise may be rare or absent in other animals. Then we will explore the different types of evidence that we have, the weight of that evidence, and the inferences we can make. In the second tutorial we will explore some of the proposed biological explanations for human uniqueness, moving on in the third tutorial to explore genetic approaches comparing us to our primate relatives. We will then consider the behavioural traits of humans, such as the concept of culture. In the final tutorial we will review the course content, and will conclude with a presentation expanding on an area of human evolution introduced in the series.

Throughout the course, students will develop subject knowledge and understanding of:

a. Comparative anatomy and Fossil evidence
b. Experimental design and data analysis
c. Molecular evidence

By the end of this course students will develop skills in:

a. Critical thinking and evaluation
b. Developing and maintaining an argument.
c. Assembling research findings from various sources
d. Identifying research approaches and design experiments
e. Interpreting and summarising data

This workbook is for educational purposes.

Course correspondence to Human Sciences Undergraduate Selection Criteria

Criterion	Tutorial 1	Tutorial 2	Tutorial 3	Tutorial 4	Presentations
Communication and listening skills.					
Evidence of openness of mind and independent thinking.					
Ability to follow an argument.					
Ability to use knowledge in context.					
Shows initiative in deploying their knowledge.					
Ability to cope successfully with essay based tasks.					
Ability to cope successfully with quantitative information.					
Evidence that interest goes beyond current academic training.					

Contents

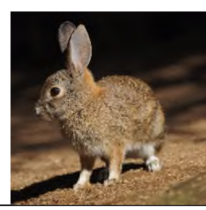
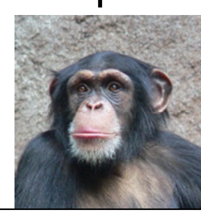
Tutorial 1 – What makes humans different?

Learning Objectives

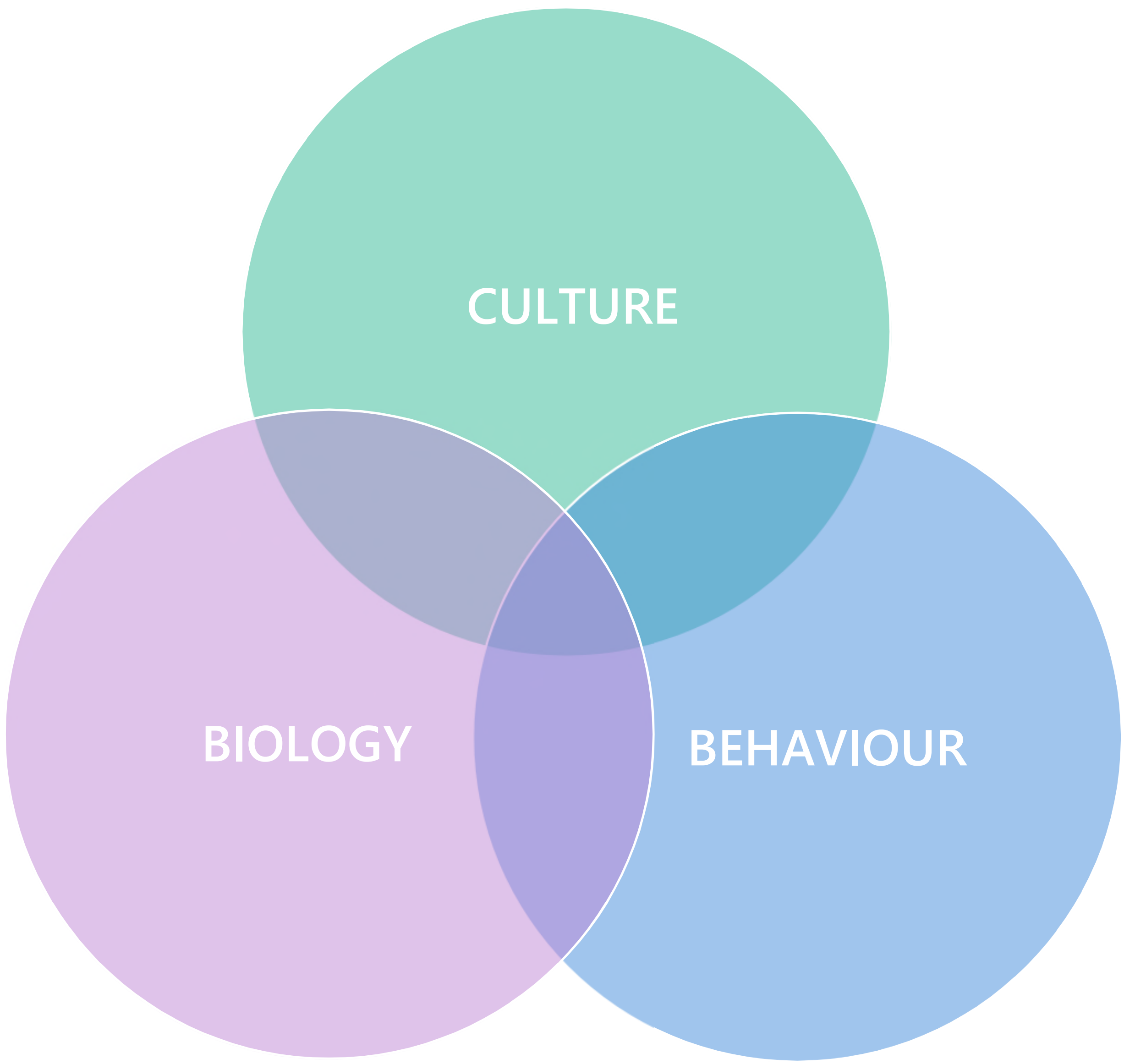
- To identify factors which may make humans unique as a species.
- To categorise groups of species using biological traits.
- To design experiments that would test whether factors are different in humans compared to other living things and why.

Humans can do things, create things and imagine things that a lot of species do not *appear* to be able to do. As scientists and anthropologists, we can use experiments, comparisons and observations to build a picture of what makes humans capable of these behaviours, and how those behaviours may have arisen, often from learning about ourselves and the incredible capabilities of other species in the process.

Firstly, let's consider which behaviour and features we do and do not share with the following:

Shark 	**Rabbit** 	**Chimpanzee** 
Shared features:	Shared features:	Shared features:
Features not shared:	Features not shared:	Features not shared:

What aspects of our lives, behaviour, use of the environment or biology do you think might be unique to humans? (note them below)



Modern science catalogues and compares the behaviours and features of living things. This helps us to both define the characteristics of each species and to try to understand how they are related.

Shared features can help scientists to;

1. understand how all living things are related (the 'tree of life')
2. define the combinations of traits expressed by each species
3. discover *when* different traits and behaviours may have evolved
4. explore *why* different traits and behaviours may have evolved

Let's explore how comparing animals can help us to understand how different groups are related. One way of reconstructing relationships between species is through a process called **cladistic analysis**. This process results in the creation of a **cladogram**, which is similar to a family tree.

Below are two common styles of drawing cladograms.

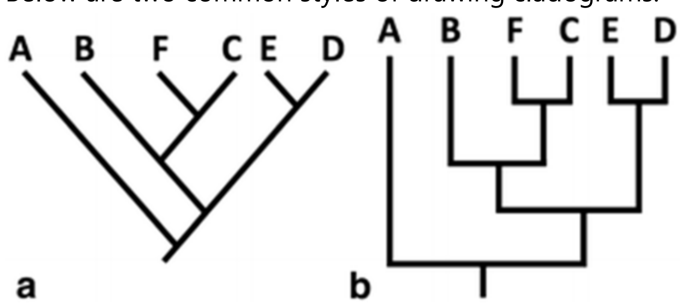


Figure 1. Two ways of showing the same tree of relatedness among species (Dees and Momsen, 2016)

To do this, scientists:

1. Choose the animals whose relationships they want to explore.
2. Determine the features in each species.
3. Determine the presence or absence of each feature in each species.
4. Group animals by the features not present in the ancestral population.
5. Use **parsimony**- the idea that the simplest explanation should be used.
6. Build a cladogram.

Each node represents a common ancestor, with each of its descendent species exhibiting a new specific **trait**.

Let's see this in action.

Fill in the blanks in the table below. Mark which species have which traits.

Traits	Sharks	Ray-finned Fish	Amphibians	Primates	Rodents and Rabbits	Crocodiles	Dinosaurs and Birds
Vertebrae							
Bony skeleton	N	Y	Y	Y	Y	Y	Y
Four limbs							
Amniotic Egg	N	N	N	Y	Y	Y	Y
Two post-Orbital Fenestrae	N	N	N	N	N	Y	Y
Hair							

Which species share similar features?

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Are there common combinations of traits?

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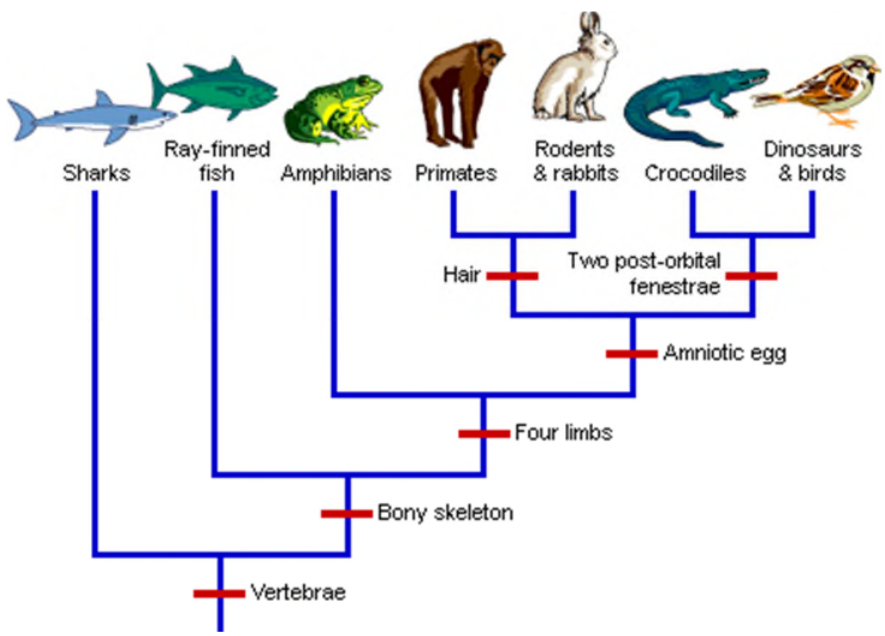
The grouping of species with and without these traits can help us to create a cladogram. This helps us to visualise how species may be related, and in what order traits may have arisen.

Figure 2. Cladistic tree based on presence of shared traits. Source: http://evolution.berkeley.edu



What can we learn from the combinations of features in different living things?

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This tree does not show more advanced or primitive species. All species are constantly adapting to their environments, and are well adapted to their local conditions. Similarly, we have evidence that some traits have been lost and regained over time depending on the environment.

Using the process above, we can also look at the features of humans in comparison with other animals to see whether they are common in nature, or whether they are common among specific groups of living things (termed taxons).

Do we assume that humans are special because we ourselves are human? Are there aspects of our biology that are unique, or do we share more with other animals than we used to assume? Perhaps using cladistics can help us to tell.

Thinking about the biological features that humans have, what features may separate humans from our closest living relative, the chimpanzee?

1 ....

2. ....

3. ....

What are the main biological features of humans, according to anthropologists?

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As scientists it is important we try to avoid the pitfall of **anthropocentrism**.

> Definition of anthropocentism- 'Regarding humankind as the central or most important element of existence, especially as opposed to God or animals.' (Oxford Dictionaries Online)

In the middle ages, our understanding of nature was based on the work of Aristotle who used a lot of observation and dissection to classify living things based on the features species shared with each other. Aristotle's attempt to systematically organise living things based on shared features (Langdon, 2016), was a major step in biology, which influenced the study of science for centuries to come.

Aristotle's system gradually changed into the *Scala naturae* over the next two thousand years, often depicted as a ladder of nature with minerals at the bottom and a creator at the top (see figure 3). This way of understanding living things was shaped by the religious views of the time, and under the *Scale Naturae*, humans were seen placed high up this ladder (Langdon, 2016).

Figure 3. The medieval *scala naturae* depicted as a staircase. By Raimundus Lullus (1512)

Hundreds of years later, Darwin and Wallace's theory of evolution by natural selection gave us an explanation of how species came to be, and how they evolved in response to their environment (Langdon, 2016). Evidence of evolution enabled scientists to view humans as responding to the same forces that were acting on other species, as well as viewing other species as complex and well adapted to their environments, paving the way for scientific comparisons of humans to other living things, which has changed both our understanding of the natural world, and where and why we sit within it.

How might **anthropocentrism** affect how we ask questions and interpret findings?

Over the course of this tutorial, we have explored the history of contextualising humans with other living things. By comparing humans to other species, or designing experiments for humans and/or other species, we can explore which explanations may have more merit.

As scientists we ask questions, collect data and analyse the findings.

There are different types of evidence we can collect, different type of data that falls into, and different strengths and weaknesses to each experiment type.

Most approaches require a well-defined **hypothesis** and research design/experiment.

Hypothesis-a guess about what you might find, which the evidence will either support or refute. A hypothesis should be testable, and is often written to include 'if-then' statements. E.g. if humans are more closely related to chimpanzees than gorillas, then our DNA code will be more similar to chimpanzees than gorillas.

Experiment- Scientists try to change one thing to see what effect it has on the process they are examining. This enables the experiment to be easily repeated, and increases the chance of testing the role of that specific thing they are testing.

To do this scientists also often use a control group, where they are not changing anything to increase the chances that any changes they see in the experiment are due to the thing they are changing.

The thing that is changed is called the independent factor, and the thing that changes is the dependent factor. Scientists may also take into account various factors/variables which may affect the outcome if not controlled for.

Let's look at some theories that have been proposed to explain why

We will practice outlining hypotheses and experiments. Here is an example of some of the components we need in an experiment.
Title of experiment- The effect of A (Independent Variable) on B (Dependent Variable).
Hypothesis- If A changes (how it will change), then B will (prediction)
Groups of A –How A will be separated into different groups to test its effect.
Measurement of B- How will it be measured. What/who will be measured.
Other variables you will control or measure.

Example

What do you want to test- Examining the role of diet type in the evolution of primate brain size.

Hypothesis- Primate species that eat more varied diets will have larger brains.

Groups of Diet- Primates will be grouped into Folivores (Leaf eaters), Frugivores (Fruit eaters) and Omnivores (range of foods) based on what 80% of their diet consists of.

Measurement- Reference data sets of brain volume and diet composition for many species.

Other variables you will control for- evidence of diet. Measurement technique. Sample size and sex variation, body size.

HOMEWORK

Design a question to explore whether one of the traits you proposed earlier is unique to human beings.

Feature to explore...

Question to investigate...

....

Hypothesis...

....

Groups to compare...

....

What would you measure..

Other variable to take into account...

....

Tutorial	Title
1	Propose an experiment (due Tutorial 2)

Tutorial 2 – Biological approaches -Brains and Bipedalism

Learning Objectives

- To interpret data visualisations.
- To hypothesise based on data visualisations.
- To critically evaluate data visualisations.

In our last session we identified a number of traits and behaviours that we hypothesised may make humans 'different' from other living things, and may have facilitated the diversity of technology, culture and civilisation that characterises our species.

As scientists, we don't finish there. Scientists ask lots of questions and conduct experiments to build a detailed picture of why and how. Often a single experiment fails to answer the whole question, so by exploring different approaches we can build a picture of the processes and factors that may explain our behaviour and characteristics.

One feature of the human species is a large brain.

Why might scientists think the brain is important in explaining our uniqueness?

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Why might a big brain be useful?

1. ……………………………………………………………………………………………………

2. ……………………………………………………………………………………………………

3. ……………………………………………………………………………………………………

One question we might ask is -are human brains actually that large. Below are measurements of animal brain sizes.

Table 1. Comparison of brain masses

Animal	Brain Mass (g)
Human	1250
Harbour Porpoise	1735
Proboscis bat	0.11
Short beaked common dolphin	797
Humpback Whale	6100
Walrus	1410
Brown Bear	336

Data from Boddy et al., (2012)

What does Table 1 show about the size of the human brain? What else might explain why other species have larger brains?

Let's have a look at the effect of body size. Below is a graph showing the average body size and brain size for a number of different species. Where there are multiple examples of the same group e.g. mouse, these represent different species.

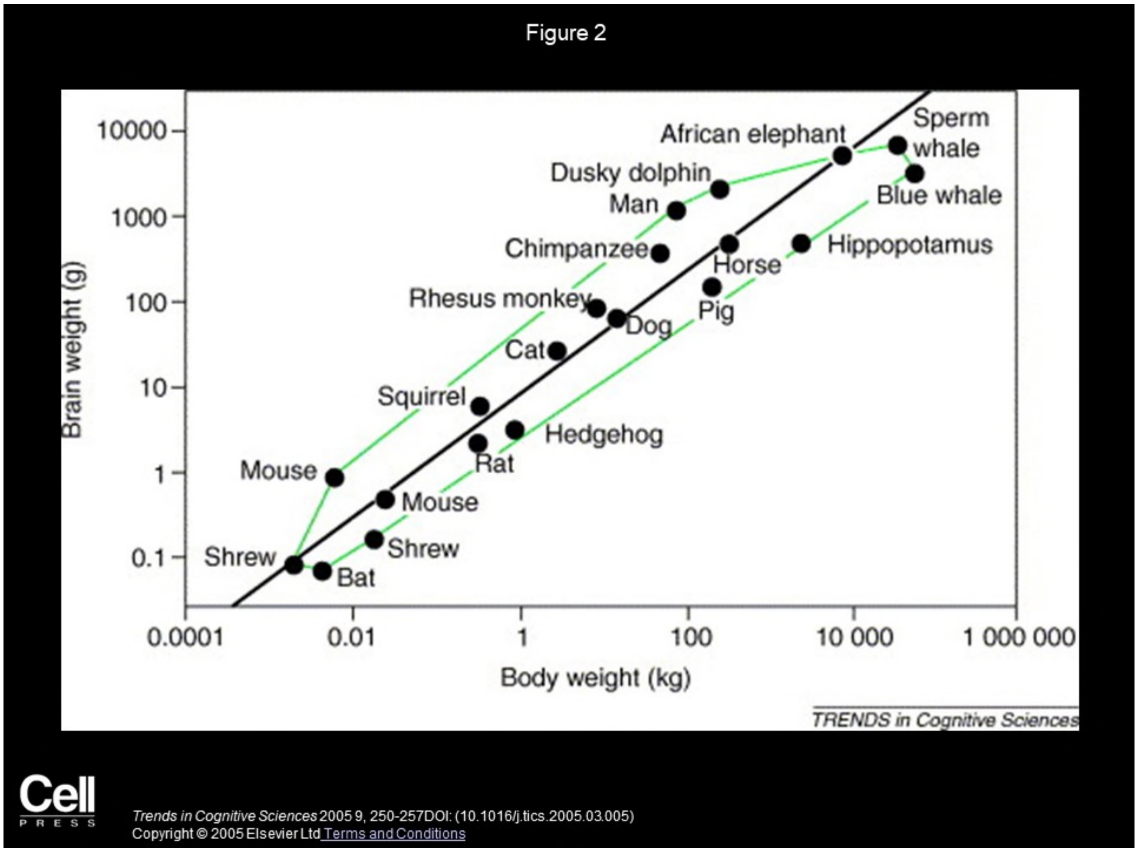

Figure 4. Relationship between brain size and body size in selected mammals species. Roth and Dicke, (2005)

What does the straight black line show?

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Where do humans sit in relation to the line?

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Name three species that, compared to their body size, have:

Larger brains than expected	***Smaller*** brains than expected
1.	1.
2.	2.
3.	3.

What information do we learn from this figure? What aspect of brain size may be important in the case of humans?

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DID YOU KNOW: This is very similar to what you could expect at an Oxford University interview. Tutors are interested in seeing how you can use your knowledge and skills to approach a new problem or piece of information.

The relationship between body size and brain size might tell us which brains are bigger for their size, but it doesn't tell us why. One proposed explanation is the role of larger social groups.

Why might having a larger brain be useful in a large social group?

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The neocortex is the section of the brain that plays a role in conscious thought, language, sensory perception, voluntary movement and a host of other functions (Molnár and Pollen, 2014).

In this paper, scientists measured the average group size (the average size of social gatherings) and neocortex ratio (ratio of the neocortex to the whole brain) of different species of primates. The results are shown below.

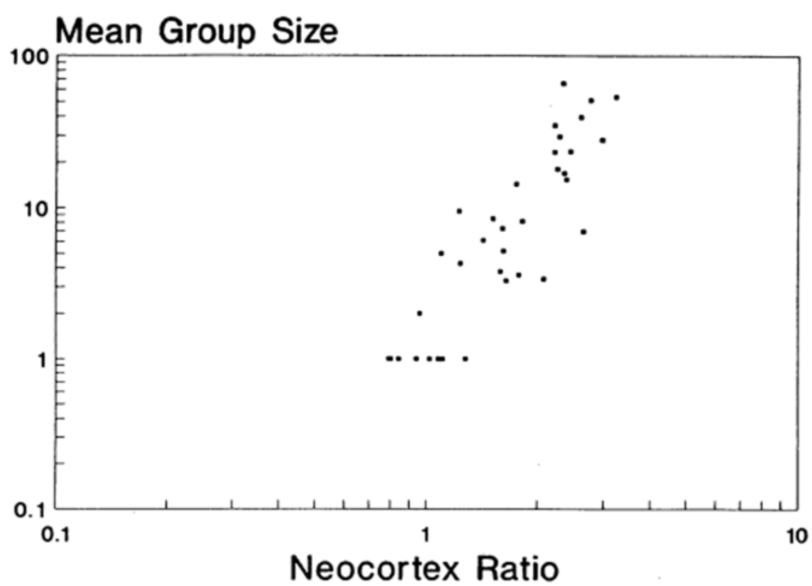

Figure 1. Group size plotted against neocortex ratio for nonhuman primates (redrawn from Dunbar 1992a).

Figure 5. Relationship between primate group size and neocortex ratio. Dunbar (1993).

What relationship does this data show? What could explain this?

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Is this data sufficient to explain how human brains evolved? What other information might scientists look for/ what questions might they ask?

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Human modes of Locomotion- Bipedalism

All primates have a tendency to walk on two legs at least some of the time. This is called **bipedalism**. It is commonly found when feeding, moving and transporting items, and avoiding predators (Druelle and Berillon, 2014).

Humans' main mode of locomotion is bipedalism.

To look at why humans are bipedal and the evolutionary benefit of bipedalism, we need to ask if other living things are bipedal, ask when we became bipedal and test some of the factors which might explain why. Unfortunately, behaviours don't fossilise. While there are indications in our skeleton that show how we move, when bipedalism first evolved, our ancestors probably didn't look like us.

When we examine how primates move around, there are indications in their limbs. Over thousands of years, natural selection has shaped limbs that are adapted to the ways in which each species moves. This can give us clues as to when their mode of locomotion evolved. When we put this in the context of other evidence, we can begin to piece together how and why different types of locomotion might have evolved.

Consider the dates that we know these species were alive:

Chimpanzee	- Modern (Common Ancestor with humans =~6.5mya)
Ardipithecus kadabba	- 5.8-5.2 million years ago
Australopithecus afarensis	- 3.85-2.95 million years ago
Homo erectus	- 1.89-0.143 million years ago
Human	- Modern

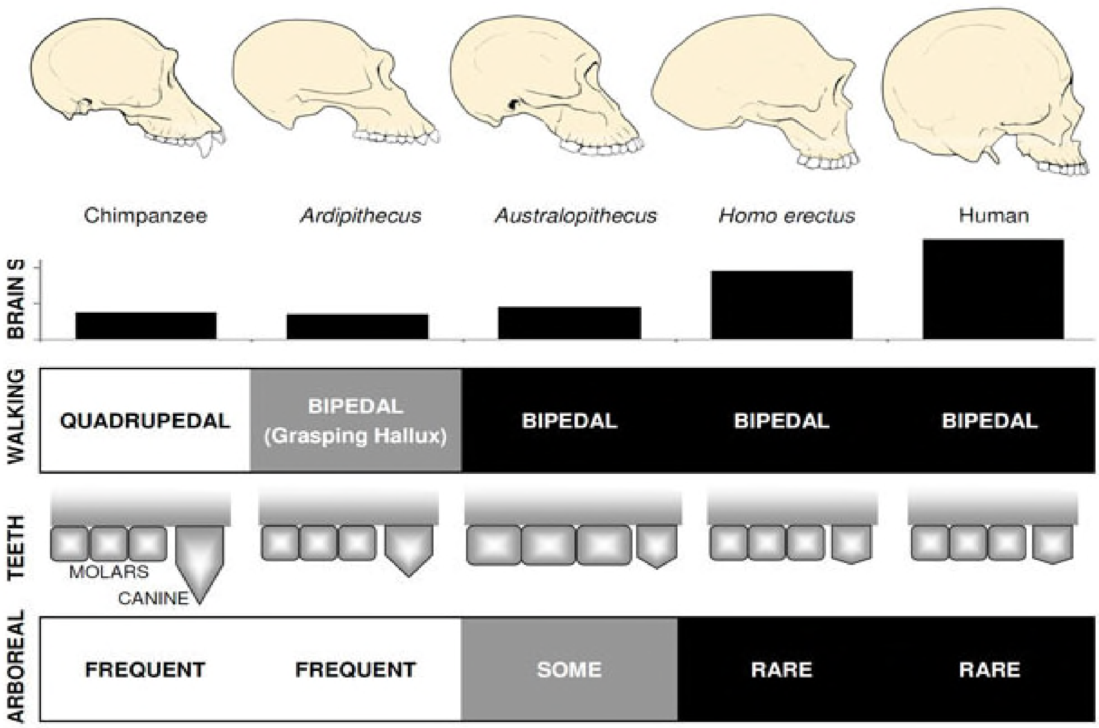


Figure 6: Anatomical comparisons of apes, early hominins, *Australopithecus*, *Homo erectus*, and humans. A male chimpanzee skull is shown as an example of modern apes. © 2012 Nature Education

What does the figure above tell us about the pattern of evolution of 'human' traits?

Our understanding of the evolution of bipedalism comes from more than comparing our anatomy to that of the living primates. We are also able to track the evolution of bipedalism through fossil records, and other evidence such as the Laetoli footprints, pictured below.

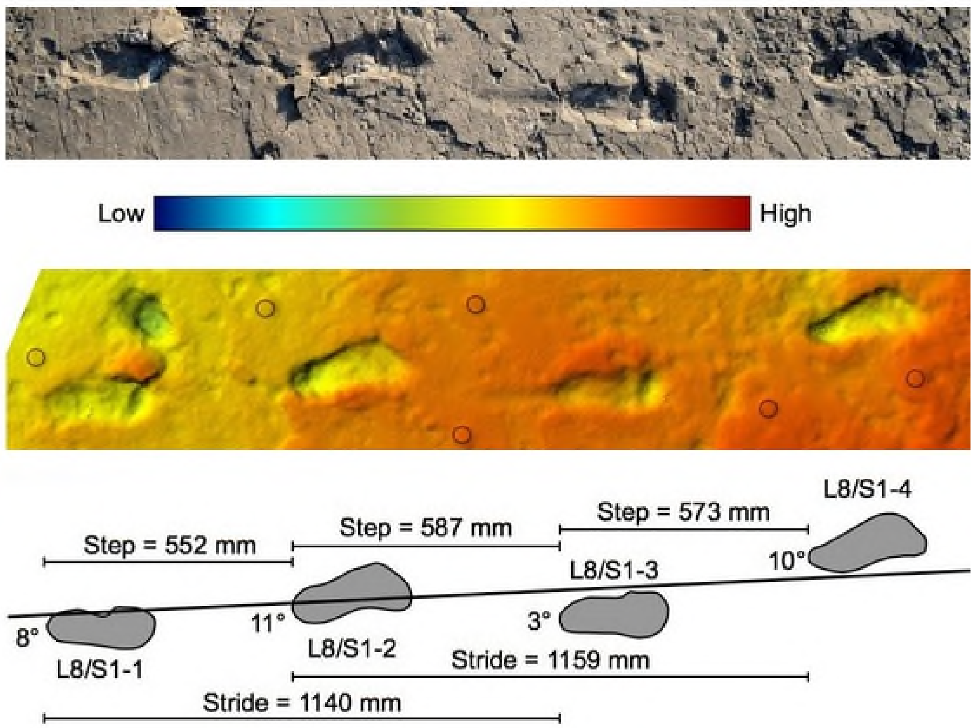


Figure 7 Photograph and analysis of the Laetoli footprints. Original figures by Masao et al.,

These footprints in Tanzania were uncovered in 1978. They are the fossilised footprints left by an early human, most likely *Australopithecus afarensis* (3.85-2.95 million years ago), while walking through volcanic ash.

Notice that the big toe is in line with the foot. This suggests they were more human-like than ape like.

What other information could we learn from these fossilised footprints?

What needs to happen for these footprints to be preserved?

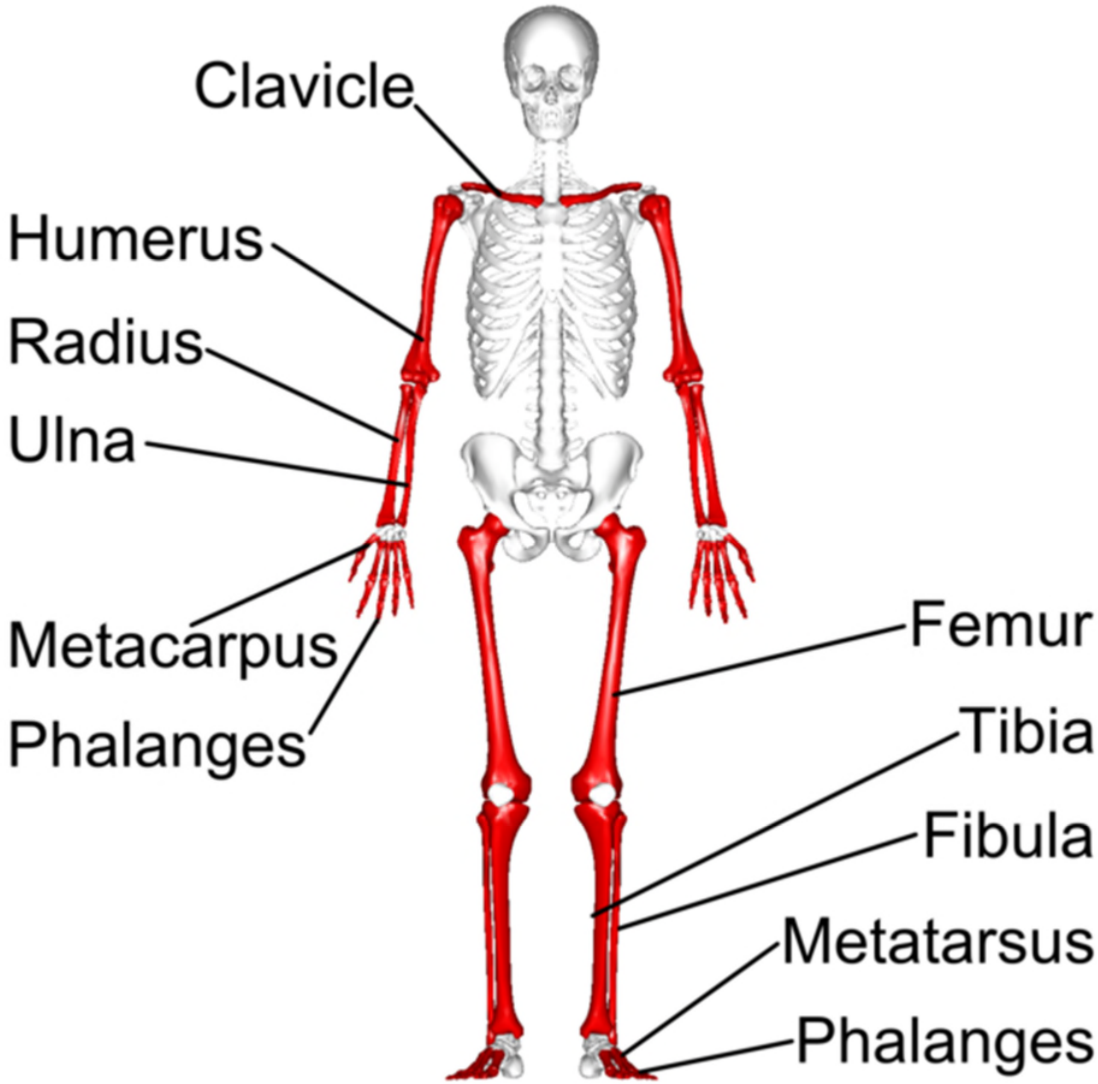
Anthropologists have developed methods that can help us to understand how a fossilised species may have moved. One such method is looking at the Inter-membral index.

On the following pages you will find images of different species of primate, including some of our proposed human ancestors. Using the rulers provided, measure the Humerus, Radius, Femur and Tibia lengths (as shown on the diagram overleaf).

Two of the species listed are hominins, i.e. other species of human. Lucy is the name for a fossil of *Australopithecus afarensis,* while the other image is of a Neanderthal, a species that lived in Europe.

Use the **Intermembral** formula to calculate the indexes from Figures 5-8.

Species	Mode of Locomotion	Humerus length (cm)	Radius length (cm)	Femur length (cm)	Tibia Length (cm)	Humerus +Radius Length (cm)	Femur + Tibia Length (cm)	Intermembral index (Humerus+radius) x 100 (Femur and tibia)
Gibbon	Brachiation (Suspension)							%
Orangutan	Quadrupedal on ground, some brachiation. Bipedality is rare.							%
Gorilla	Knuckle-walking							%
Chimpanzee	Knuckle-walking. Sometimes bipedal.							%
Ardipithecus ramidus	Bipedal on ground and quadrupedal in trees.							%
Lucy (*A.afarensis*)	Bipedal							%
Neanderthal	Bipedal							%
Human	Bipedal							%


Clavicle
Humerus
Radius
Ulna
Metacarpus
Phalanges
Femur
Tibia
Fibula
Metatarsus
Phalanges

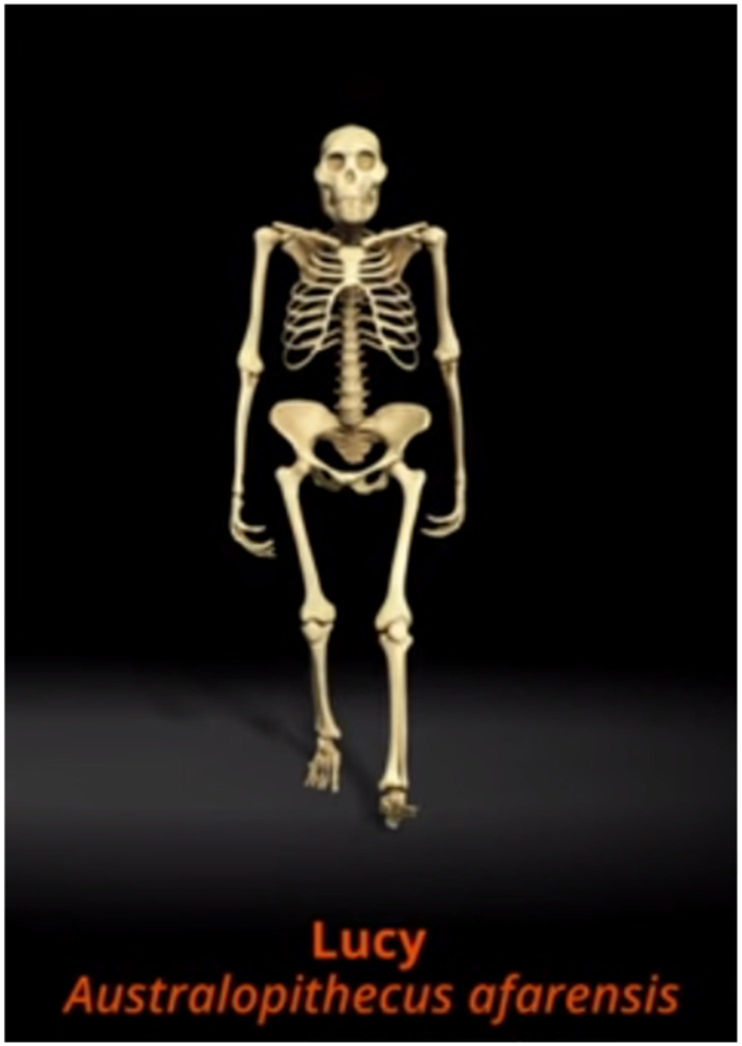


Figure 8. Source: California Academy of Science

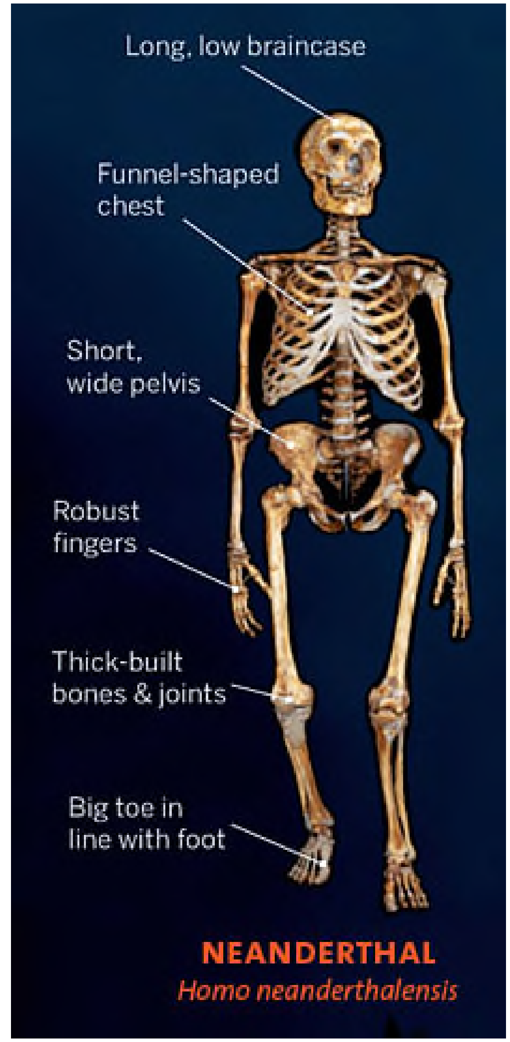
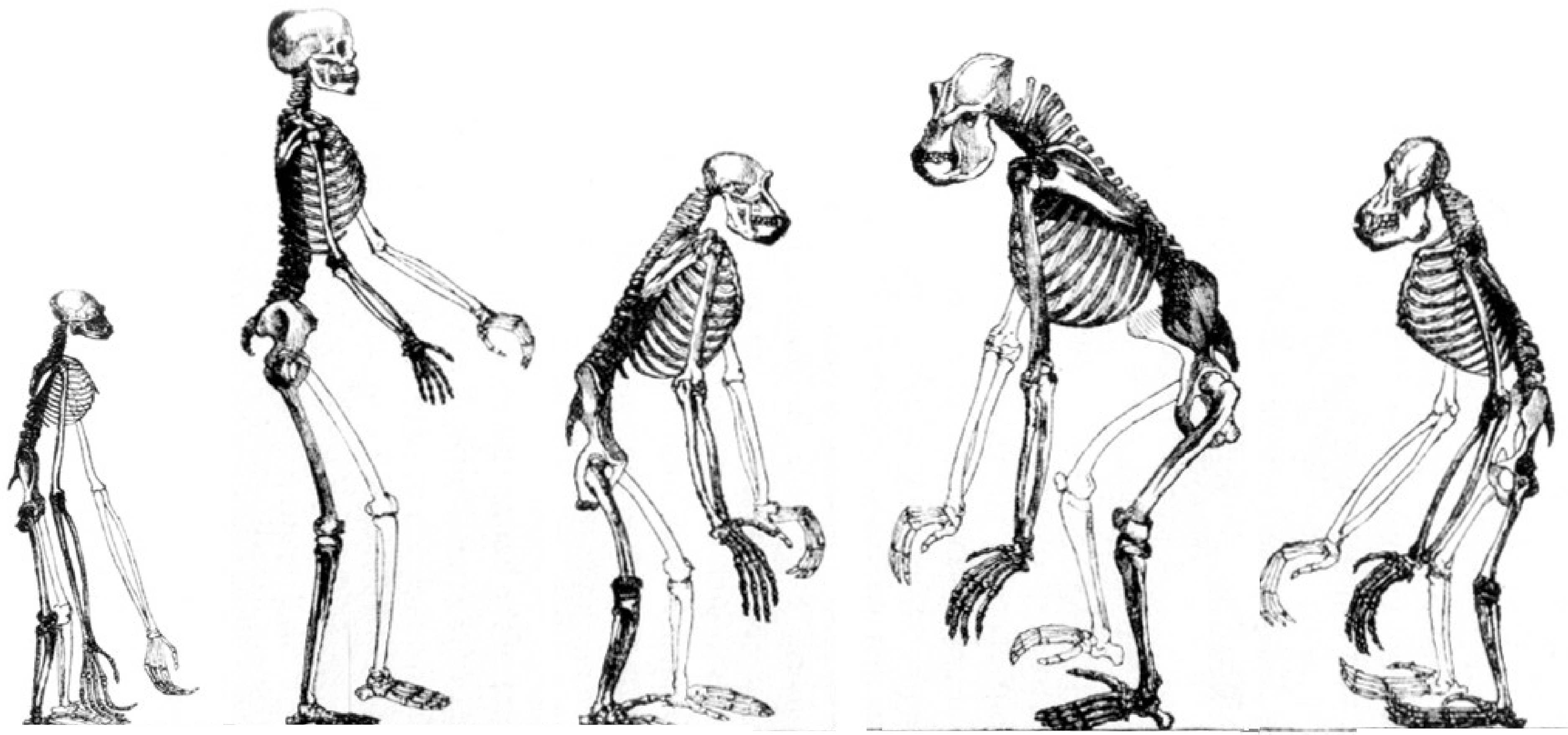


Figure 9. Source: American Museum of Natural History

Figure 10. Drawings of skeletons of five ape species



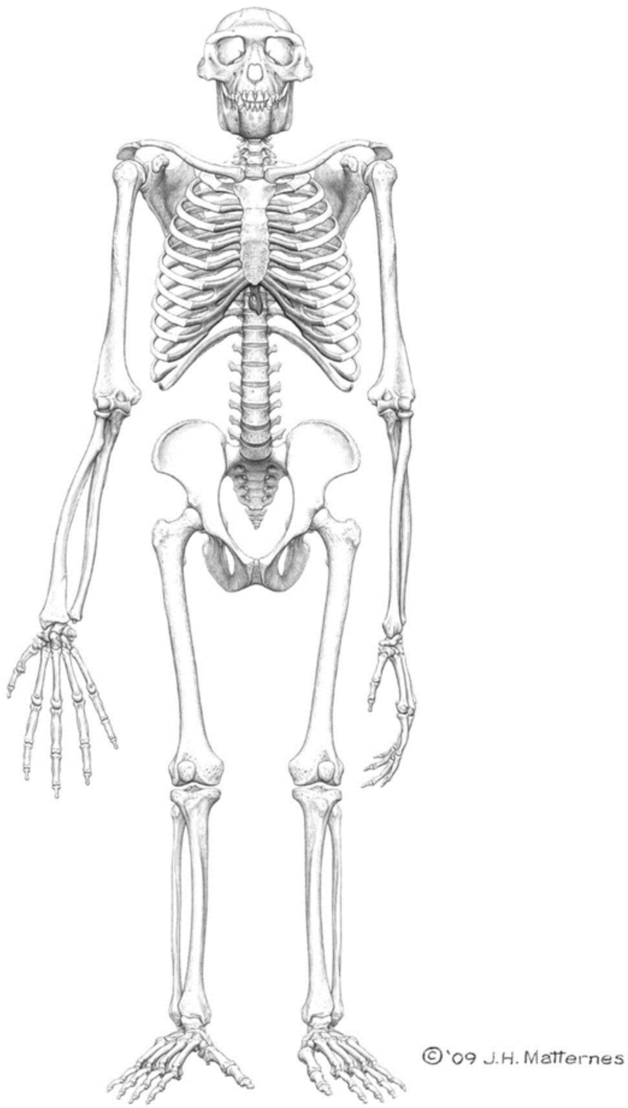


Figure 11. Drawing of a skeleton of *Ardipithecus ramidus.* Source: Lovejoy et al., (2009)

While the images are not as accurate as measuring real bones, they do show us the trends we see in different species and the reason that the intermembral index can be useful.

HOMEWORK: Fill in the blanks in the following five sentences.

Words: MOVE, FORE-LIMBS, KNUCKLEWALKING, HIND-LIMBS, QUADRUPEDAL, BIPEDALISM, RATIO, BRACHIATION,

1-The intermembral index is a __________ of _______-________ to _______-________.

2-The index correlates with how animals ___________.

3-Animals with scores around 100 tend to be ________________________ .

4-Animals with scores below 100 have longer hind limbs and may move by leaping or walking on two legs (_______________).

5-Animals with scores above 100 have longer forelimbs and may move by _________________ or ______________________.

Tutorial	Title
2	Summarise findings of Intermembral index activity (Due Tutorial 3)

Tutorial 3 –Genetic approaches

Learning Objectives

- To practice effective note-taking
- To build knowledge of how genetic approaches altered anthropological understanding of 'what makes us human'.

Notes

Tutorial 4 – Behavioural and Cultural approaches

Learning Objectives

- To learn how 'culture' is defined in anthropology.
- To explore how evidence of culture is collected and interpreted.
- To evaluate evidence of culture.

Above: This tool dates to 3.3 million years old. The earliest known appearance of our genus, *Homo* is at 2.8 million years ago (Harmand et al 2015).

In the first tutorial, we listed biological and behavioural traits which may be rare in non-human animals. In truth, this distinction is blurred, as our biology is adapted to facilitate our behaviour, and our behaviour is constrained by our biology.

Human Language

One of the interesting traits that humans exhibit, which links the biological to the behavioural is language. Not only do we engage in language, but we have adaptations to the way we control our breathing as well as the position of the tongue and hyoid which allow us to speak.

However, other animals can communicate too.

How do you think human communication differs to that in other animals?

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Watch this video- https://ed.ted.com/lessons/do-animals-have-language-michele-bishop

While watching the following video, please take notes

What are the 4 features of language identified in the video?

1. ………………………………………………………………………………………………

2. ………………………………………………………………………………………………

3. ………………………………………………………………………………………………

4. ………………………………………………………………………………………………

B) Which features do each of the species have? (tick)

Species	1.	2.	3.	4.	NOTES
Crabs					
Bees					
Prairie Dogs					
Chimpanzee					
Gorilla					
Dolphins					

From watching the video, how do you think human language might be different to that of other animals?

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Imagine a situation with two otherwise identical populations, one of which can talk, and the other cannot. What difference could language make to their daily lives, culture and productivity?

The concept of language links to another characteristics of humans that we can examine in more detail: that of **culture.**

What do we understand as culture? What is it? What is it not?

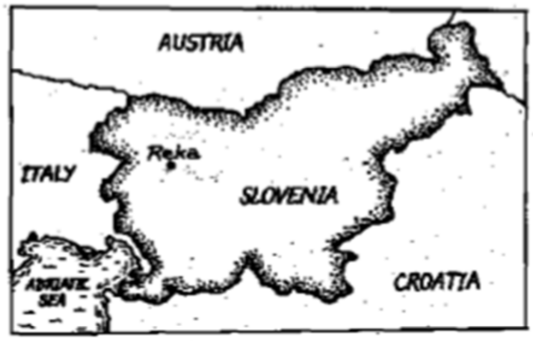
How do Anthropologists describe culture?

What kinds of evidence would we look for as culture? Which species would we look at?

Following is a worksheet from NOVA.

What is This?

NOVA Activity **Neanderthals on Trial**



The artifact at the bottom of the page was discovered in a cave in western Slovenia. It is believed to be between 43,000 and 82,000 years old and determined to be from the thighbone of a juvenile cave bear. It was found at a former Neanderthal camp known as Divje Babe I near the town of Reka. But what is this artifact? What, if anything, was it used for? Use the information about Neanderthal life below to see whether you can figure out what this artifact might be.

Neanderthal Life

Who were the Neanderthals, the *hominids* that existed before and during part of the same time as modern *Homo sapiens*? While scholars disagree about exactly who the Neanderthals were, they have some idea of how they lived from sites that have been excavated in Europe and Western Asia. The Neanderthals lived from about 200,000 years ago to around 30,000 years ago, during the Ice Age.

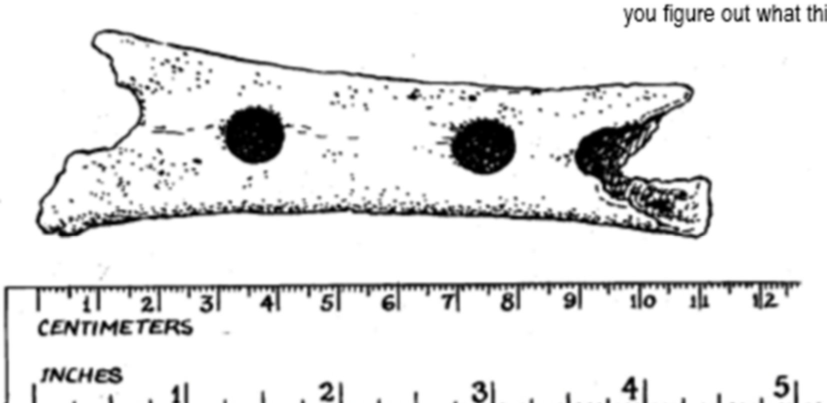
They made tools from stone gathered nearby their camps and presumably used them for such things as shaping wood, butchering animals, and scraping hides. They lived in caves, rock shelters, and open-air sites. They used fire. There is only limited evidence of artistic expression. A few pierced animal teeth have been found, probably worn as personal adornment, but no cave paintings or figurative carvings on bone or stone have been found. There is no way of knowing, however, whether their artistic talents took another form that would not be preserved, such as wood carving or storytelling.

In terms of diet, they subsisted on meat from hunting small game and herd animals such as wild horses, deer, and caribou. Larger and more dangerous animals such as mammoths and bears were either ambushed or trapped, or—more likely—scavenged after another predator had killed them. They also ate plant foods, although little of the evidence for this aspect of their diet has survived. The question of whether Neanderthals deliberately buried their dead, as opposed to merely disposing of bodies in trash heaps at their living sites, is still controversial. There is good evidence from at least one site that they cared for disabled individuals.

Questions

Write your answers on a separate sheet of paper.

1. What do you think this object is? What might it have been used for? What level of confidence do you have in your conclusion? Defend your reasoning.
2. What else could this be?
3. What other information would you want to get to help you figure out what this might be?



Worksheet Notes

Tool Use

One of the major transitions in the evolution of culture is the use of tools.

Define a 'tool':

List some common tools we use every day.

Examine some of the 3d tools on the human origins website.
http://humanorigins.si.edu/evidence/3d-collection/artifact/handaxe-europe

What skills are required to make tools? What do they tell us about the individuals that made them?

Watch the following video.
https://www.youtube.com/watch?v=o2TBicMRLtA

Would you describe this as evidence of tool use?
Do you think these are the same as human tools?
What could this tell us about the **evolution** of human culture?

Which of the following are examples of tool use?

- [ ] Using a stick to collect termites
- [ ] Using a stone to cut animal skin
- [ ] An animal using their claws to open a clam
- [ ] Throwing a stick in anger
- [ ] Using a tree as a scratching post
- [ ] Dropping a nut from a height to open in
- [ ] Using a stick to clear a nasal passage
- [ ] Placing sticks to walk over thorny bushes

Watch this second video. https://www.youtube.com/watch?v=xwVhrrDvwPM

Record your thoughts on the behaviours observed.

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Tutorial 5 –Group Presentations

Learning Objectives

- To develop research and writing skills in crafting a presentation which aims to inform.
- To collaborate in a team to create and deliver a group presentation.
- To effectively communicate a clear message and evidence to an audience of fellow students.

Notes

Notes

Notes

Further Reading

Web articles (note these links may no longer work after some time)

The other species of human

http://www.bbc.co.uk/earth/story/20150929-why-are-we-the-only-human-species-still-alive

Overview of human evolution timeline and traits

https://www.newscientist.com/article/dn9990-introduction-human-evolution/

Evidence and interpretation of human evolution

https://www.nature.com/scitable/knowledge/library/overview-of-hominin-evolution-89010983

General introduction to evidence and findings on human evolution

https://www.britannica.com/science/human-evolution

How did tools influence human evolution?

https://www.livescience.com/7968-human-evolution-origin-tool.html

Part One: Language Evolution

http://phenomena.nationalgeographic.com/2005/02/25/building-gab-part-one/?_ga=2.96322268.1360838470.1520196725-420354160.1520196725

Language evolution

http://phenomena.nationalgeographic.com/2009/01/31/chimps-show-that-actions-spoke-louder-than-words-in-language-evolution/?_ga=2.96322268.1360838470.1520196725-420354160.1520196725

Why don't apes have bigger brains?

http://phenomena.nationalgeographic.com/2012/10/23/apes-brains-energy-body-size/

A (relatively) new fossil find

https://news.nationalgeographic.com/2015/10/151006-homo-naledi-human-hands-feet-science-anthropology/?_ga=2.100077022.1360838470.1520196725-420354160.1520196725

Big brains in other species

https://www.forbes.com/sites/grrlscientist/2018/02/09/magpies-living-in-bigger-groups-are-brainier-birds/#5e627f734315

The Oxford Scientist- a student run science magazine:

http://oxsci.org/

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Diogo, R., Ziermann, J. M. and Linde-Medina, M. (2015), Is evolutionary biology becoming too politically correct? A reflection on *the scala naturae*, phylogenetically basal clades, anatomically plesiomorphic taxa, and 'lower' animals. Biol Rev, 90: 502–521. doi:10.1111/brv.12121

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Harmand, S. Lewis, J.E. Feibel, C.S. Lepre, C.J. Prat, S. Lenoble, A. Boës, X. Quinn, R.L. Brenet, M. Arroyo, A. Taylor, N. Clément, S. Daver, G. Brigal, J-P. Leakey, L. Mortlock, R.A. Wright, J.D. Lokorodi, S. Kirwa, C. Kent, D.V. Roche, H. (2015) 3.3 million-year-old strone tools from Lomekwi 3, West Turkana, Kenya. *Nature*. **521**, 310–313

Langdon, J.H. (2016) Case Study 1. The Darwinian Paradigm: An Evolving World View: In: The Science of Human Evolution. Springer. Cham.

Lovejoy et al., (2009) The Great Divides: *Ardipithecus ramidus* Reveals the Postcrania of Our Last Common Ancestors with African Apes. Science. 326 (5949) 73-106

Masao, F.T. Ichumbaki, E.B. Cherin, M. Barilli, A. Boschian, G. Iurino, D.A. Menconero, S. Moggi-Cecchi, J. Manzi, G. (2017) Footprints from Laetoli reported in 2016. Viewed 14.02.18 https://commons.wikimedia.org/wiki/File:LaetoliS1print4TC.jpg

Molnár, Z. Pollen, A. (2014) How unique is the human neocortex? *Development*. 141:11-16

Raimundus Lullus (1512) Die Leiter des Auf-und Absteigs. Viewed 23.01.18: https://commons.wikimedia.org/wiki/File:Die_Leiter_des_Auf-_und_Abstiegs.jpg

Sikkema, K. (2018) Curious gorilla sitting alone smiles. Viewed 28.03.18 https://unsplash.com/search/photos/gorilla

Oxford Dictionaries https://www.oxforddictionaries.com/oed

Quote Investigator. It Is Not the Strongest of the Species that Survives But the Most Adaptable. https://quoteinvestigator.com/2014/05/04/adapt/#more-8823

Referencing correctly

Accurate, complete and consistent references are essential in all academic work and are the key to avoiding plagiarism. Whenever you refer directly to the work or ideas of someone else, or are influenced by another's work, you must acknowledge this. Similarly if you quote directly from someone's work this must be referred to accurately.

There are a number of systems of referencing, but for the assignment we recommend that you use the Harvard system. Harvard is an author/date system, is very simple to use and is widely used. The Harvard system is widely used by academic journals and other academic publication.

What is a reference?

Referencing is an acknowledgement of the sources of the information, ideas, thoughts and data which you have used in your work. Referencing requires you to acknowledge your source in two places:

• An in-text citation in the main body of your text

• A full reference in the list of references at the end of your work

Why should I reference?

Referencing is the accepted way to acknowledge other people's work when you have used it in your own writing or have been influenced by it. Your tutors and examiners will require you to reference in your work and to be accurate, clear and consistent in how you do this. Referencing your work can also help you to:

• demonstrate that you have researched and read around the subject that you are writing about

• provide evidence for and add authority to your arguments

• allow any reader of your work to trace the original material you used

• give credit to the original author/creator

• avoid plagiarism

When should I use a reference?

You should use a reference when you:

- Quote directly from another source.
- Summarise or rephrase another piece of work.
- Include a specific statistic or fact from a source.

How do I reference?

The most important to thing is to be consistent. This means that you need to stick to the same system throughout your whole assignment. Here is a basic system of referencing that you can use, which consists of the following two parts:

1. **In-text citation**: Students use in-text citations to indicate specific parts of the assignment which were paraphrased or quoted directly from a source. Each in-text citation generally displays the last name of the author and the year the source was published. Where there are two authors, both names are included. However, if there are more than two authors, the first authors' name is included, followed by et al., (meaning 'and others' in latin), e.g. Brown et al., 2006).

   The in-text citation is usually located at the end of the quoted or paraphrased sentence.

   Example:

   Gatsby's infatuation with Daisy is often revealed in the story, often in simple phrases such as, "... he turned toward her with a rush of emotion" (Fitzgerald, 2004).

   Peggy Johnson defines collection development as "the thoughtful process of developing a library collection in response to institutional priorities and community or user needs and interests" (Johnson 2009, p. 1)

2. **Reference List**: This is just a list of the references you have used in your assignment.

Reference List

Reference lists are put at the end of your assignment. It allows readers to locate original sources themselves. Each citation in a reference list includes various pieces of information including the:

- For journal articles
  - Name of the author(s), Year published, Article Title, Journal Title, Issue (Volume), Pages
- For books
  - Name of the author(s), Year published, Title, City published, Publisher, Pages used

Generally, Harvard Reference List citations follow this format:
Last name, First Initial. (Year published). Title. City: Publisher, Page(s).
Dahl, R (2004) Charlie and the chocolate factory. New York: Knopf.

Citations are listed in alphabetical order by the author's last name.
If there are multiple sources by the same author, then citations are listed in order by the date of publication.

Glossary

Word	Definition	In a sentence
Anthropocentrism		
Anthropology		
Ardipithecus	An early genus belonging to the group of human ancestors and close relatives after the split from chimpanzees and other living apes. *Ardipithecus* species lived in Ethopia, may have walked bipedally for short periods, and shows a smaller brain size than modern bonobos.	

Australopithecus	Another group of species belonging to the group of human ancestors and close relatives, which does not include chimpanzees and other living apes. *Australopithecus* remains have been found across Africa, and include a number of different species. They were bipedal, with larger brains than *Ardipithecus*, but their brains were smaller than modern humans.	
Biological Trait	A distinct feature of a living thing.	
Bipedal	Using only two limbs for walking (locomotion).	

Cladistic Analysis	A method of hypothesising relationships among living things based on the presence of shared traits.	
Cladogram	A diagram used in cladistics to show the relationships between different living things based on the traits they share.	
Culture	"That complex whole which includes knowledge, belief, art, law, morals, custom, and any other capabilities and habits acquired by man as a member of society." Edward B. Tylor	
Evolution		

Foramen Magnum		
Fossil		
Hominin		
Intermembral index	A ratio used to compare limb proportions, expressed as a percentage.	

Neanderthal	A later genus belonging to the group of human ancestors and close relatives which does not include chimpanzees and other living apes. Neanderthals became extinct around 40,000 years ago and were common across Europe. They made stone tools, used fire and there is highly contested evidence of art.	
Parsimony	The assumption that the simplest hypothesis that explains the data is probably the correct one.	
Peer reviewed		

Tree of life	A metaphor used to describe the evolution of life, and the relationships between different living things.	
Variable (in a scientific experiment)		