WHAT MAKES HUMANS DIFFERENT?

DR CATHERINE SEED

Aims of this Seminar Series

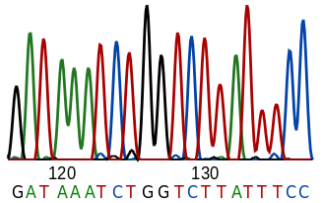
- To develop critical thinking and academic skills
- To experience undergraduate-level learning styles
- To develop communication and collaboration skills
- To provide subject specific content that goes beyond your A Level Syllabus and introduces new terminology

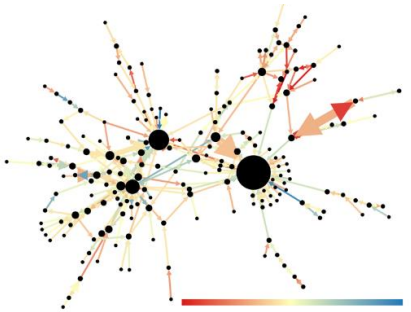
Today we will cover

- What features make us ‘human’?
- How we test ideas in biology (i.e. designing experiments)

Anthropology (Human Sciences)





The study of humans, both past and present.

Primatology, Human Evolution, Medicine, Genetics, Archaeology, Psychology, Ethnography.

What features/behaviours do humans have that make us ‘different’ to other species?

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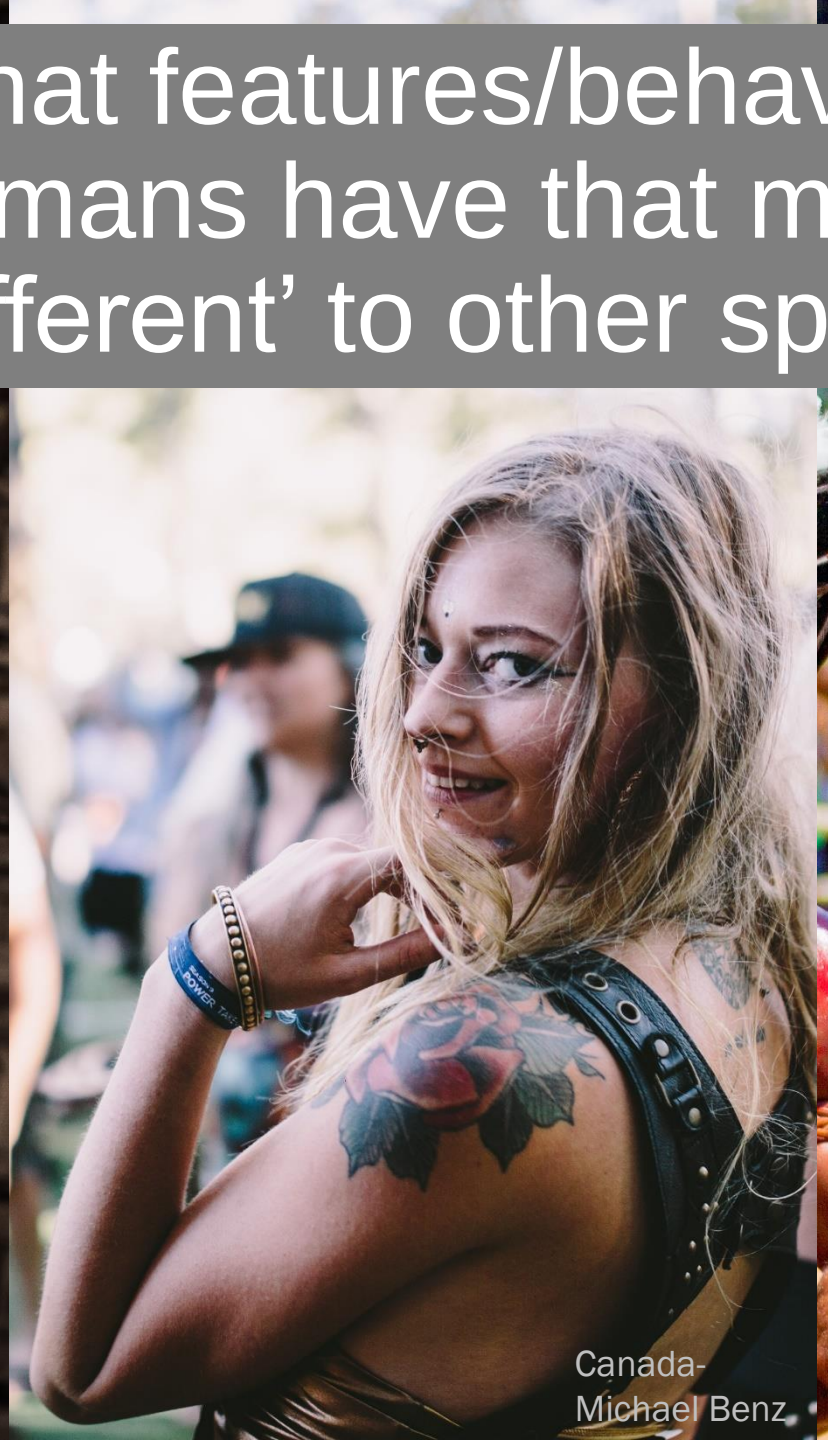
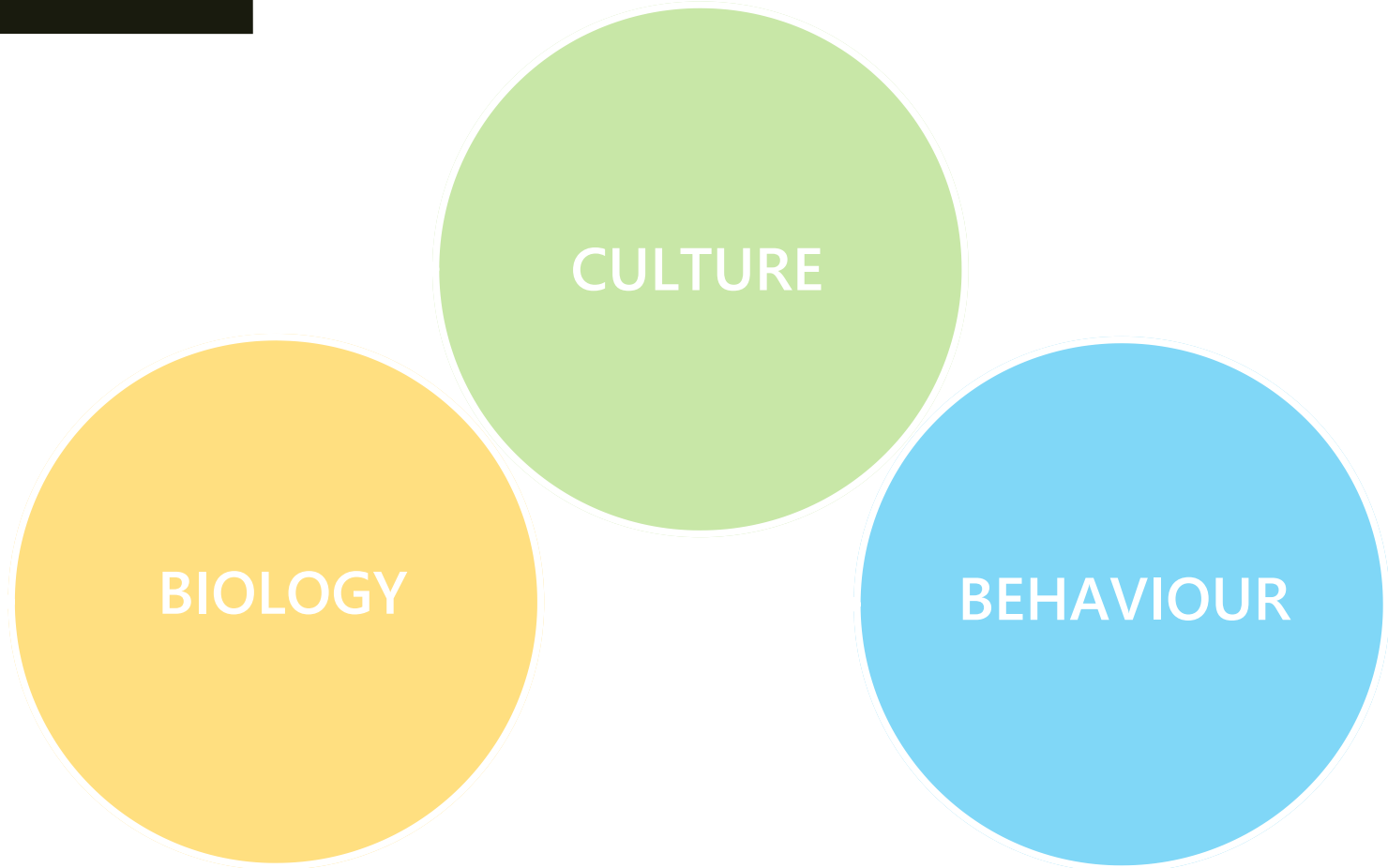
Mohammad Alashri



Canada-
Michael Benz

PNG-
Jordan Donaldson


CULTURE
BIOLOGY
BEHAVIOUR

What features/behaviours do humans have that make us different to other species?

- *Big Brains/Intelligence*
- *Bipedalism*
- *Language and Speech*
- *Culture and Social Complexity*

Many of these traits occur in some degree in other living things.

How can we explore what happened in human evolution?

Cataloguing Nature

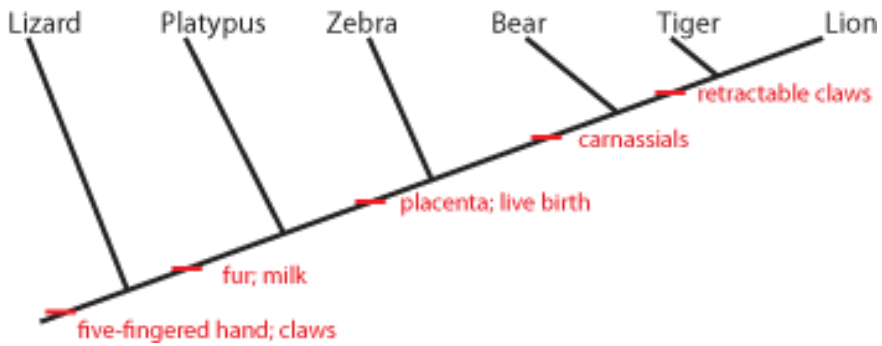
By cataloguing and comparing the traits of humans to other animals, scientists can ask;

1. What traits do we have?
2. Whether the ways in which we seem different are *actually* different from other animals.
3. *When* those differences may have evolved.
4. *Why* they arose.

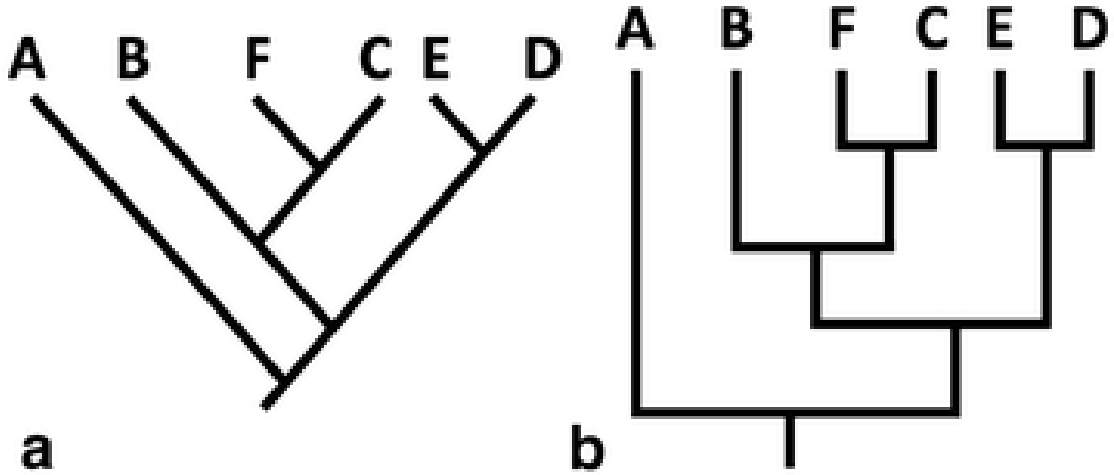
One method to do this is called Cladistics.

Cladistics

1. Cladistics is a method of biological classification that produces hypotheses about the relationship of species.
2. Cladistics enables us to hypothesise relationships between species based on their shared and derived characteristics.
3. Can work with data based on genetics, physiology or behaviour.
4. Results in the production of a tree



Below are two common styles of drawing cladograms (Dees and Momsen, 2016).



Cladistics (page 7 of handbook)

1. Scientists choose the species whose relationships they want to explore.
2. Determine the presence or absence of each feature in each species.
3. Group animals by the features not present in the ancestral population.
4. Use Parsimony.
5. Build a cladogram.

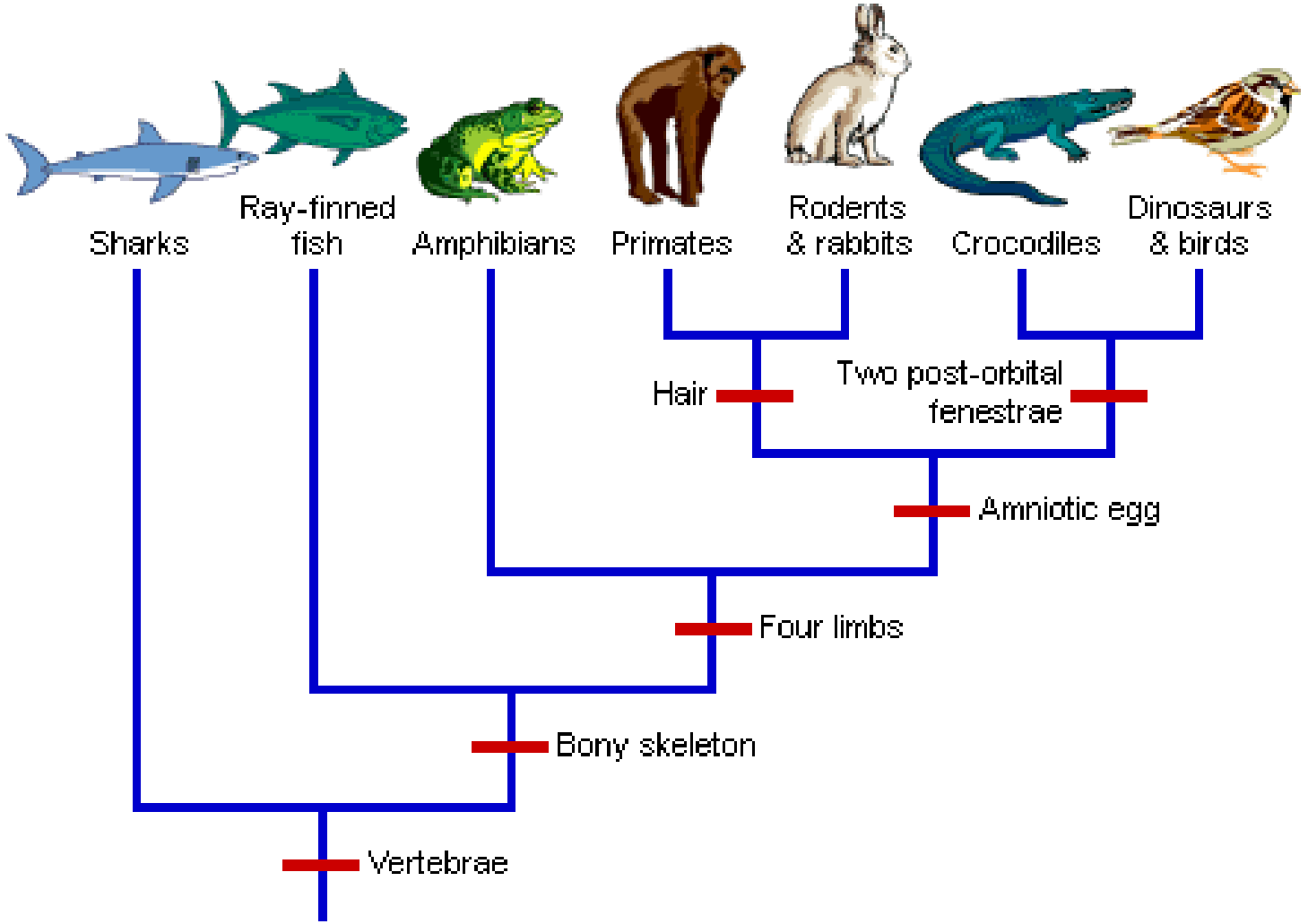
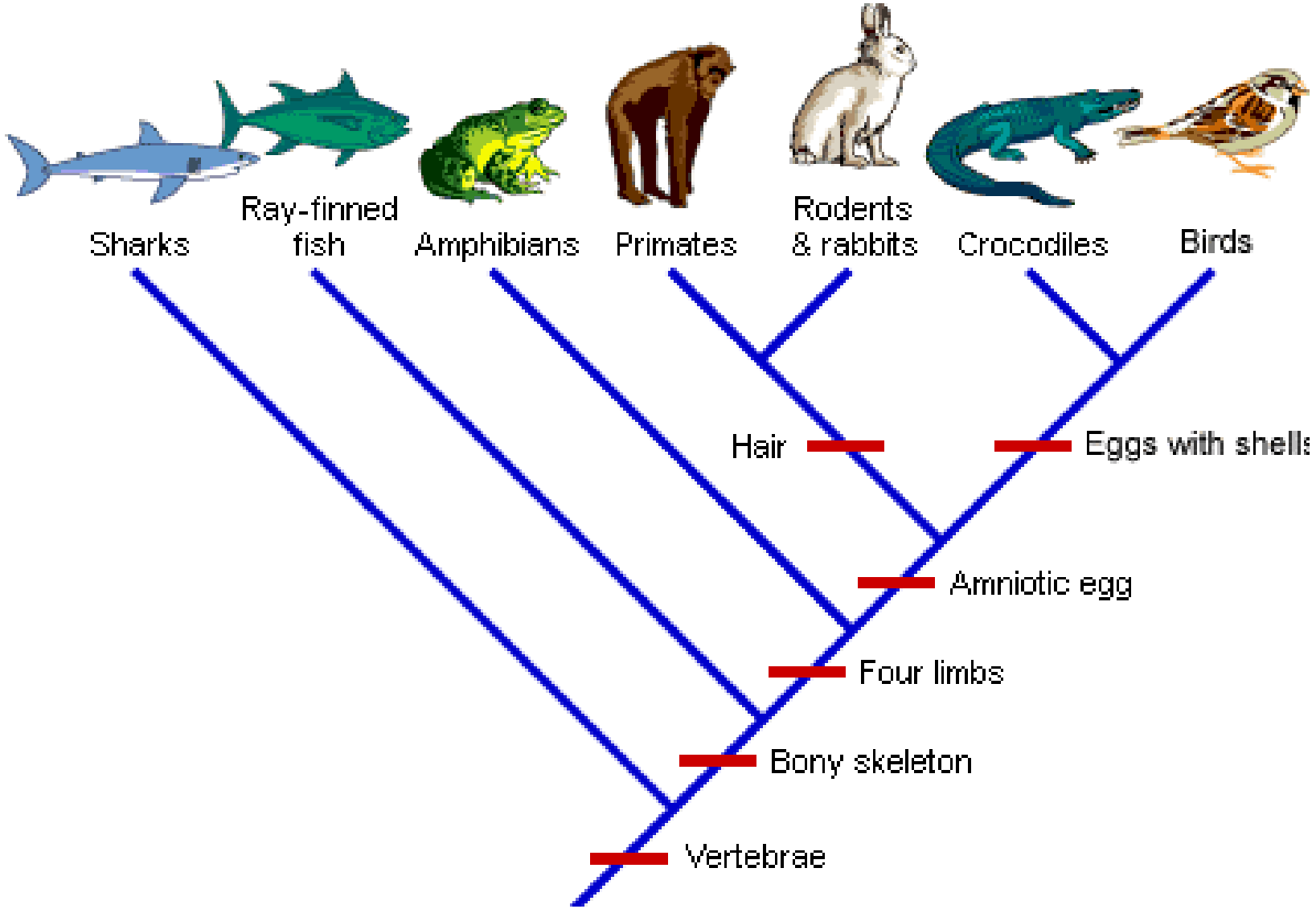


Figure 2. Cladistic tree based on presence of traits. Source: http://evolution.berkeley.edu

When considering cladograms

- No traits are more ‘primitive’ than others
- The species you choose can influence the resulting order
- We must be aware of possible convergent evolution


Sharks
Ray-finned fish
Amphibians
Primates
Rodents & rabbits
Crocodiles
Birds
Hair
Eggs with shells
Amniotic egg
Four limbs
Bony skeleton
Vertebrae

Bat

Lemur

Chimpanzee

Human

Mammals
5 finger-like bones
4 types of teeth, hair etc.

Primates
Stereoscopic vision,
Grasping hands and feet,
reduction of claws,
increased brain size,
small families.

Apes
Flattened ribcage
Mobile shoulders
lack of a tail
Increased brain size

Larger brains
Adaptations for walking on two feet,
Small flat face
Chin
Narrow chest
Reduced canines

Considering humans in context

1. Comparisons to other species enable us to view the traits across groups of living things.
2. We must be wary of anthropocentrism
    1. *ANTHROPOCENTRISM*

        - regarding humankind as the central or most important element of existence, especially as opposed to God or animals. (OED)

Designing experiments

Question explored	What was measured	Groups studied
When did bipedalism evolve in human ancestors?	Types of locomotion observed, and proportion of time spent moving in each type.	Primate species
Is bipedalism in humans best adapted for walking or running?	Metabolic costs of load carrying vs not carrying.	Human volunteers, animal tests.
Was bipedalism beneficial as it allowed freeing of the hands to carry?	Energy exerted walking/running at different speeds. Gait analysis.	Fossils (Paleoanthropology)
What did bipedalism evolve from?	Combinations of traits associated with bipedalism in dated fossils .	Human volunteers

Designing experiments

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Was bipedalism selected for to allow freeing of the hands to carry things?	Metabolic costs of load carrying vs not carrying.	Human volunteers
What did bipedalism evolve from?	Types of locomotion observed, and proportion of time spent moving in each type.	Primate species

Designing experiments

Question: Are humans the only species that can use symbols to communicate meaning?

What data could you collect? What species would you study? How would you design a study?

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).

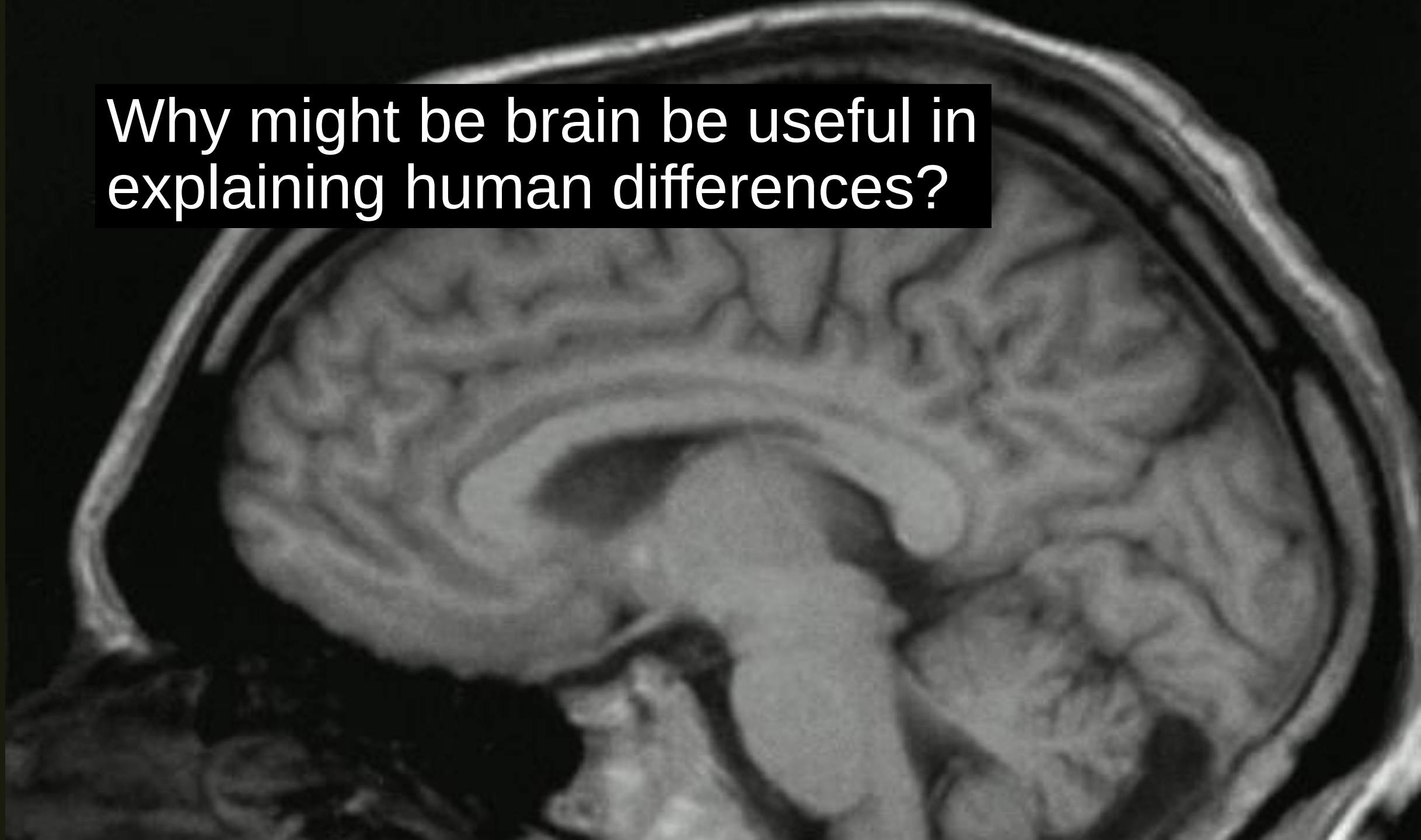
Levels of A –How A will be separated into different groups to test its effect.

Measurement of B- How will it be measured. What/who will be measured.

Other variables you will control or measure.

BRAINS AND BIPEDALISM

Why might be brain be useful in explaining human differences?



The Human Brain

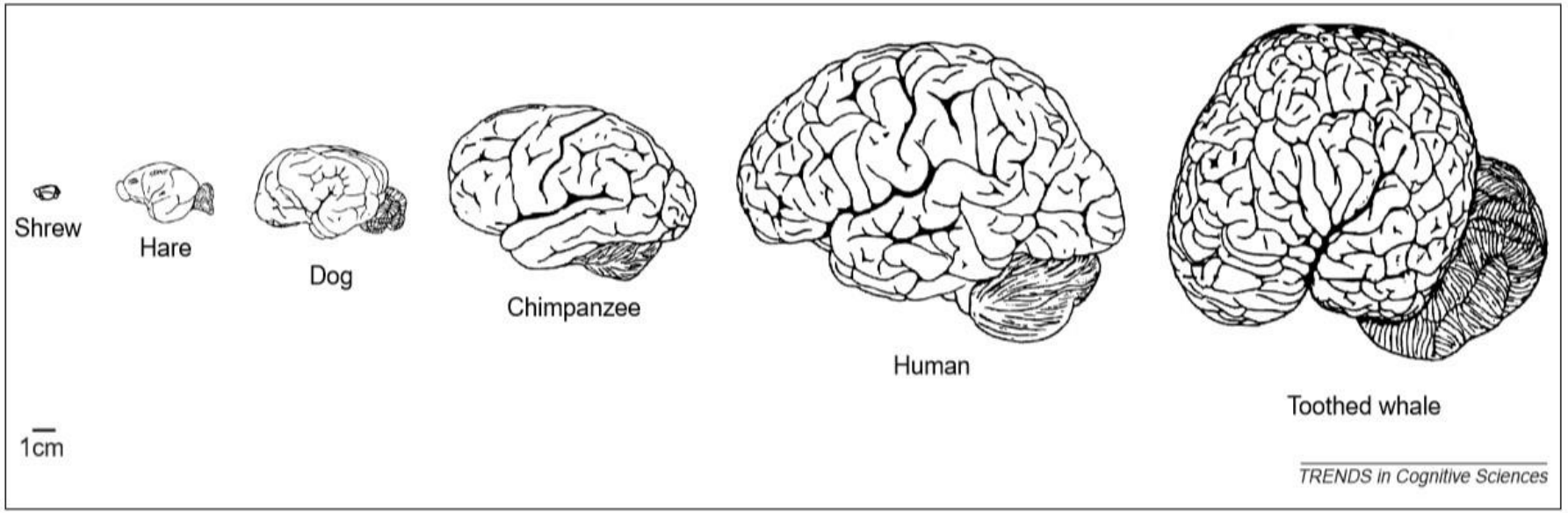


Figure 1. A series of mammalian brains. Humans do not have the largest brain in absolute terms and are exceeded in size by many cetaceans (whales, dolphins, porpoises) and the elephants. They also do not have the most convoluted cortex. With a few exceptions, convolution of the cortex increases in proportion to cortical size.

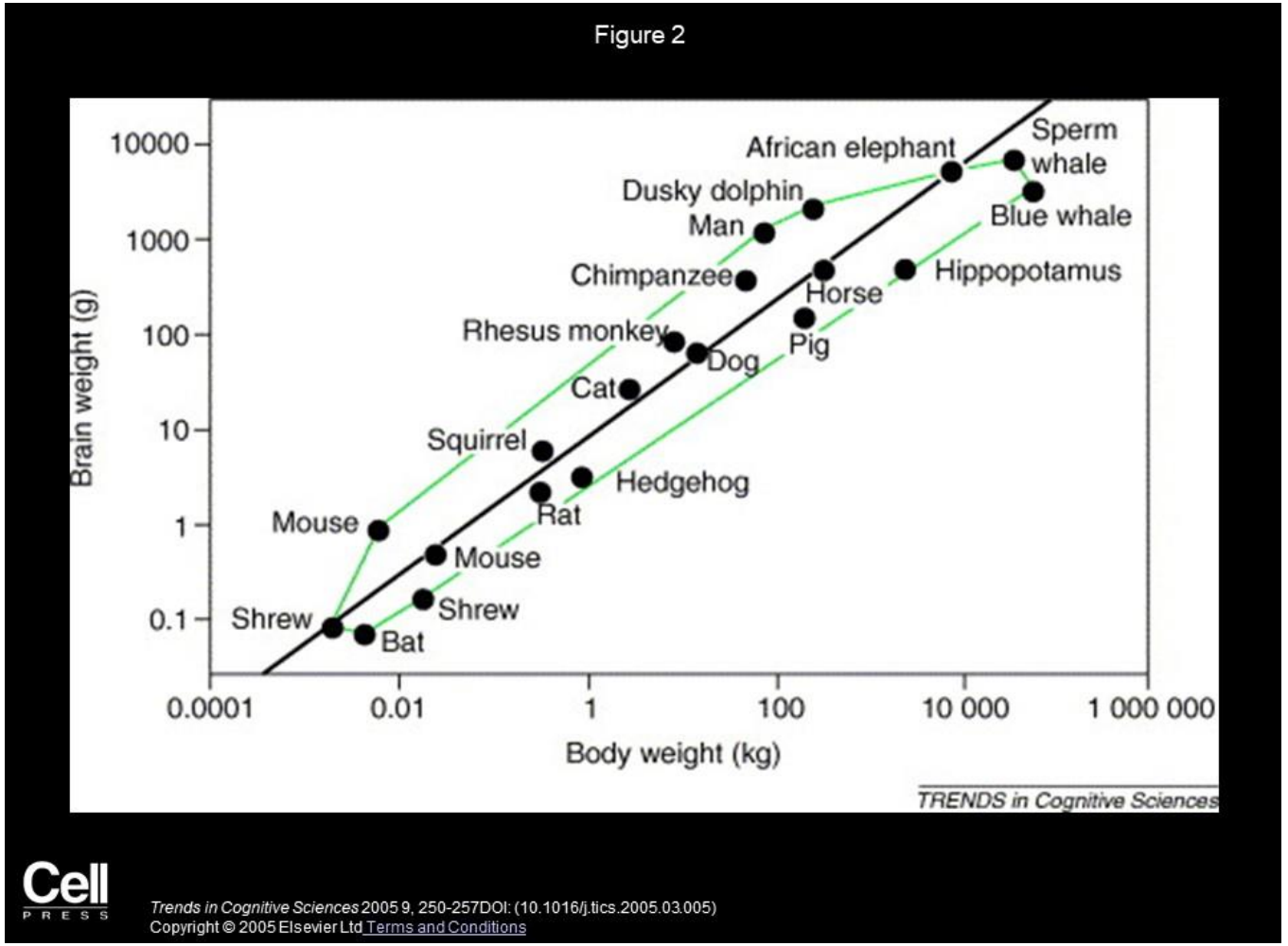
SOURCE: Roth, G. Dicke, U. (2005)Evolution of the brain and intelligence. Trends Cogn Sci. 9 (5) 250-257

How big is the human brain?

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)

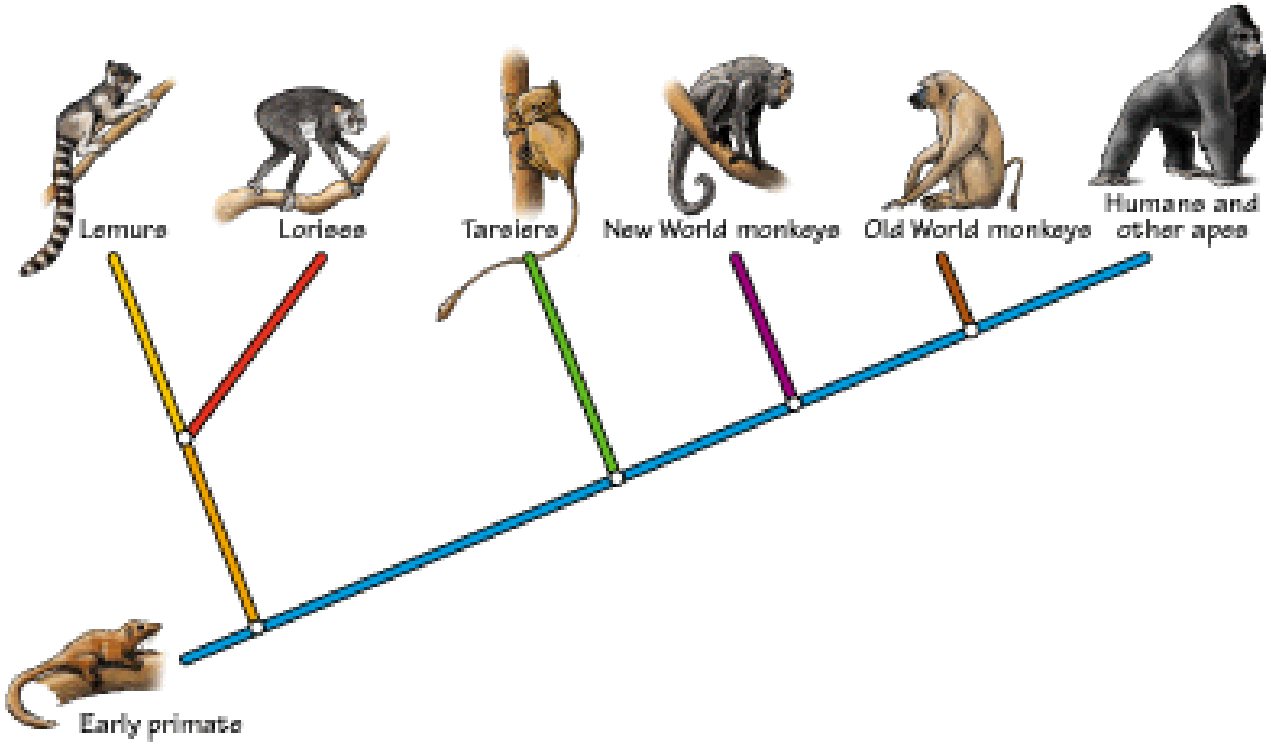
Is brain size everything?



SOURCE: Roth, G. Dicke, U. (2005) Evolution of the brain and intelligence. Trends Cogn Sci. 9 (5) 250-257

WHY is our brain bigger than expected for our size?

- Observation 1: Primates (Monkeys and Apes) generally have larger brains than expected.
- Observation 2: Compared to other mammals, primates tend to be social and live in groups.
- Hypothesis by Robin Dunbar: Larger brains are associated with managing complex social lives.
- Test: measure brain size and the size of a usual social group in primates.
- Results: Specific parts of the brain (Neocortex) correlates to social group size.
- Called the ‘Social Brain Hypothesis’



Living in groups

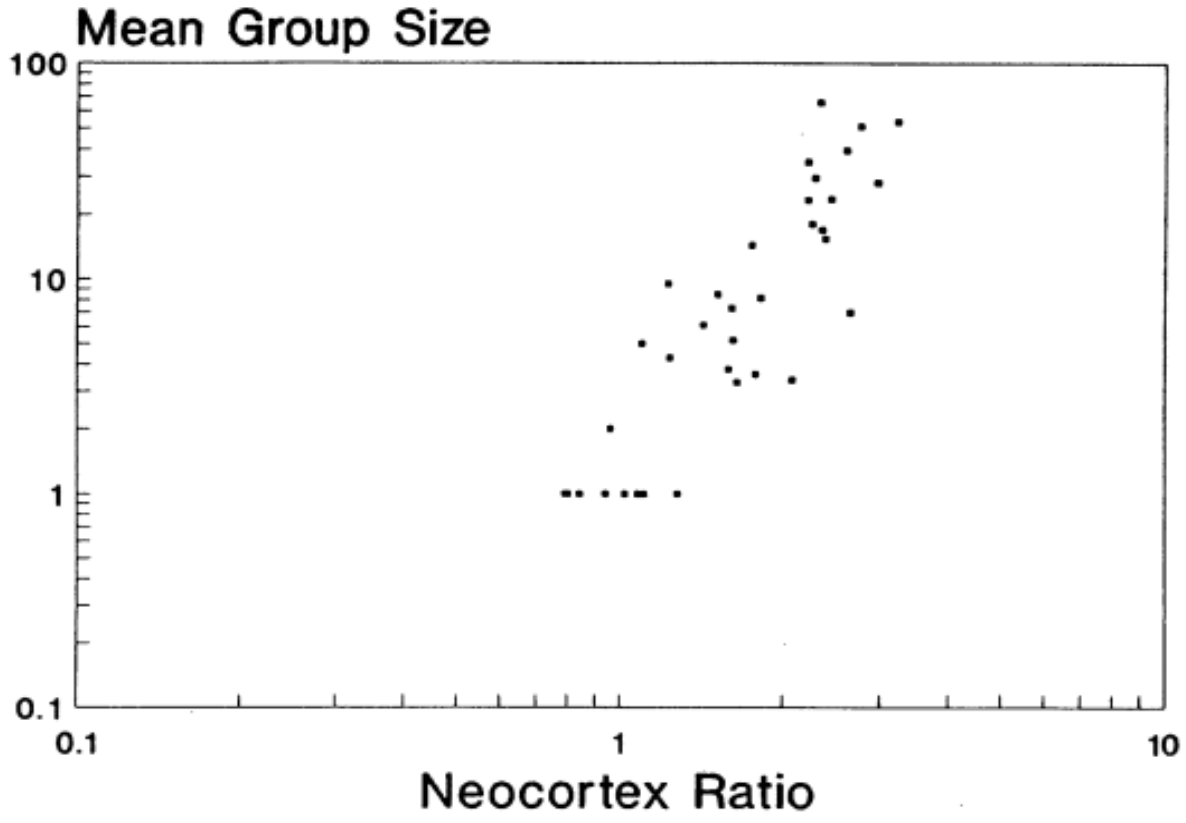


Figure 1. Group size plotted against neocortex ratio for nonhuman primates (redrawn from Dunbar 1992a).

SOURCE: Dunbar, R.I.M. (1993) Coevolution of neocortical size, group size and language in humans. *Behavioural and Brain Sciences*, 16, 681-735

Building a picture of change

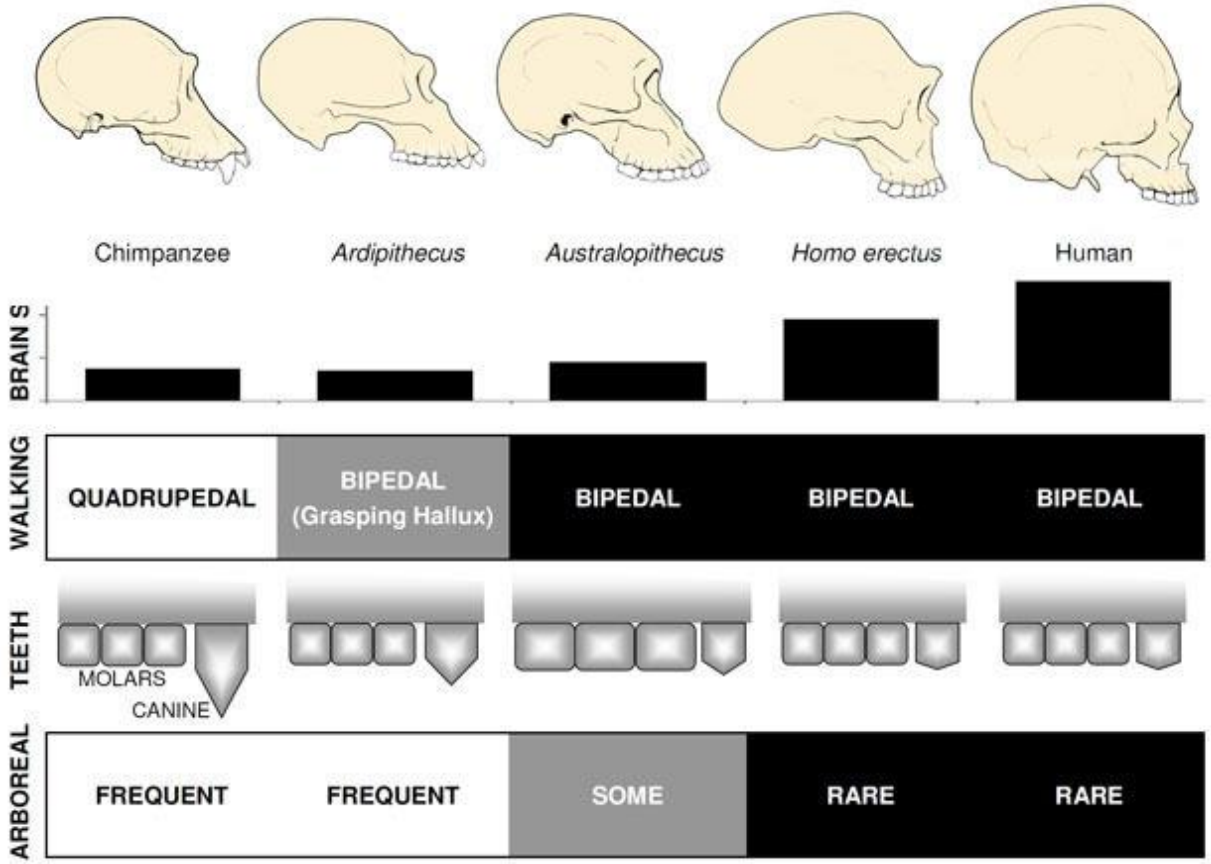
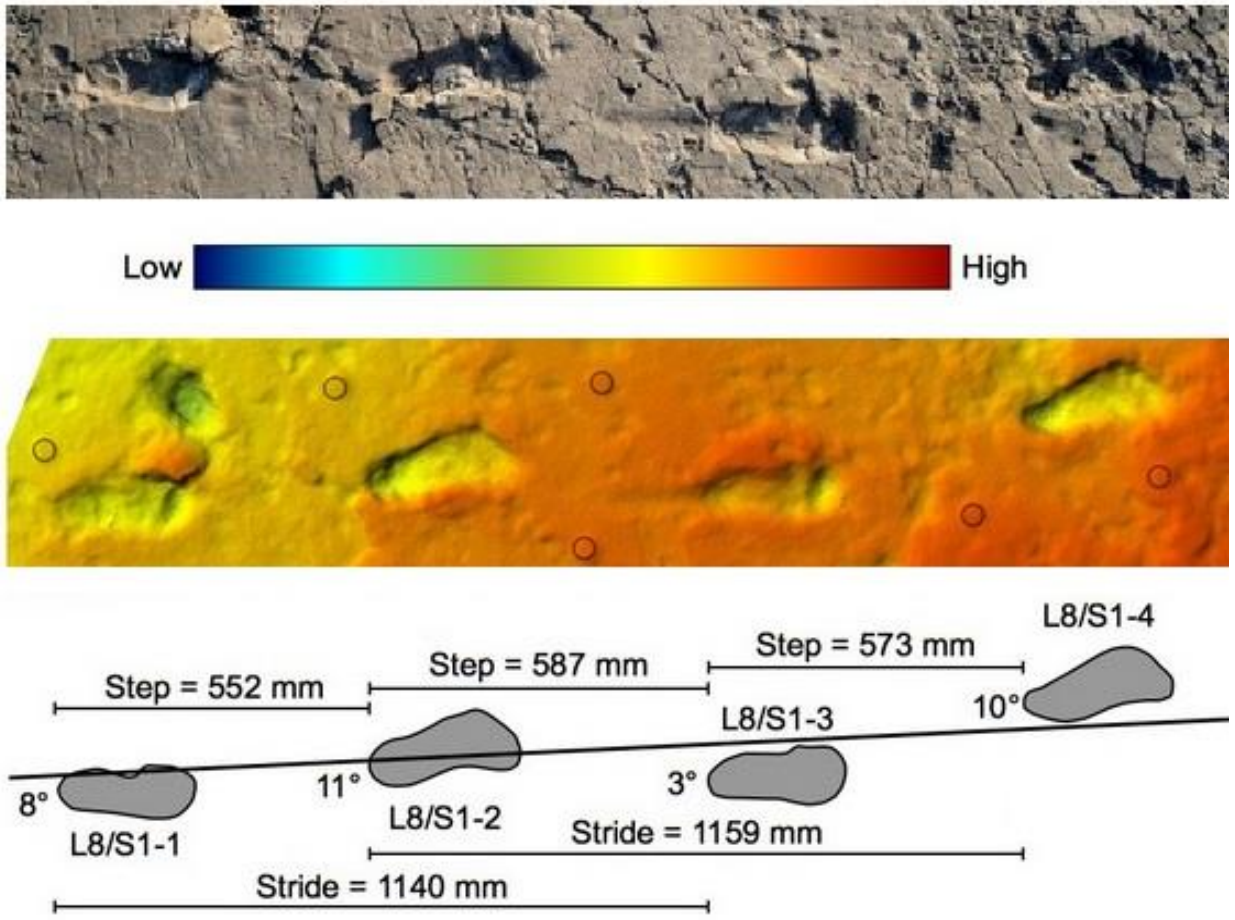


Figure 2: Anatomical comparisons of apes, early hominins, *Australopithecus*, *Homo erectus*, and humans..© 2012 Nature Education

Bipedalism



Original figures by Fidelis T Masao Elgidius B Ichumbaki Marco Cherin Angelo Barili Giovanni Boschian Dawid A Iurino Sofia Menconero Jacopo Moggi-Cecchi Giorgio Manzi
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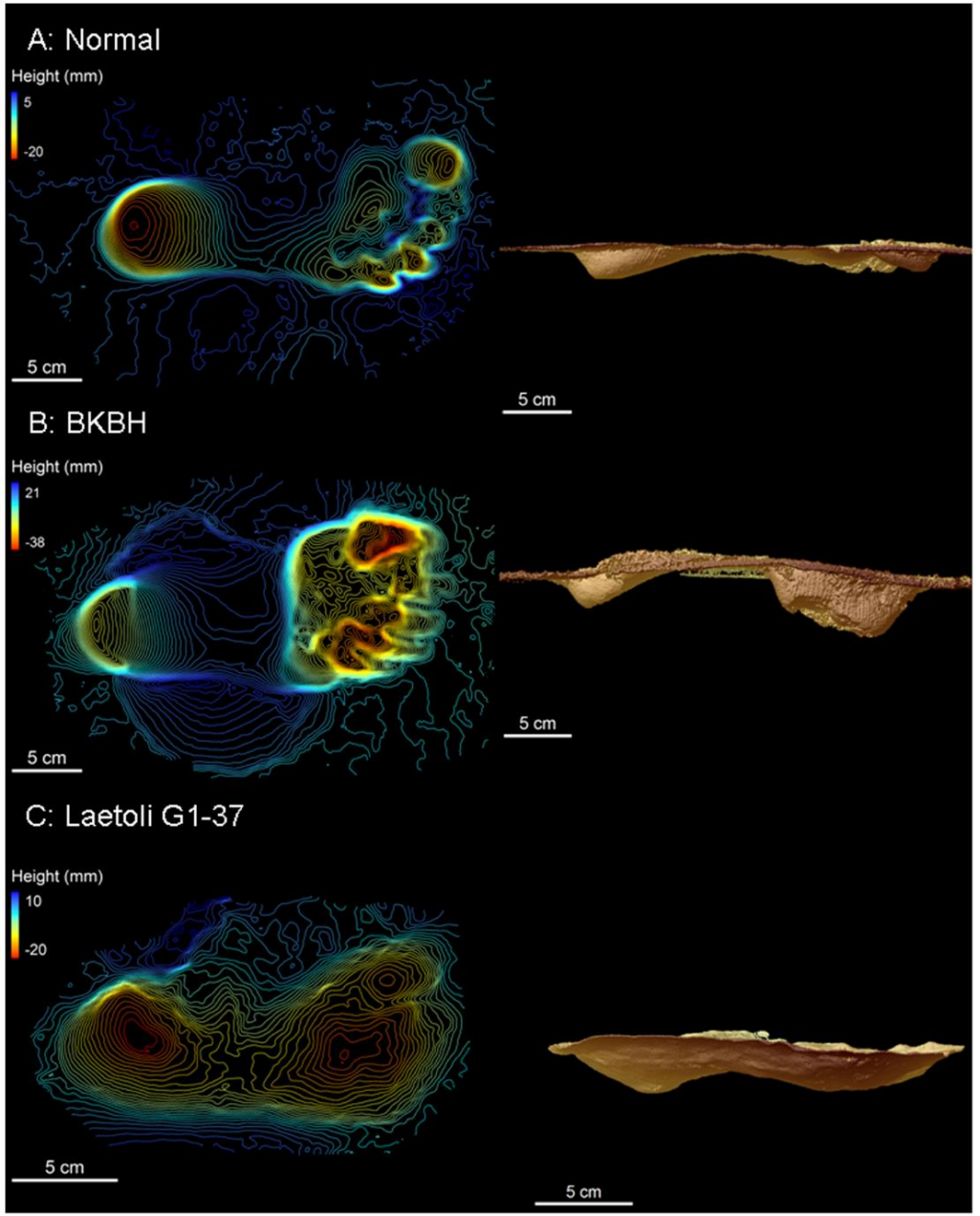
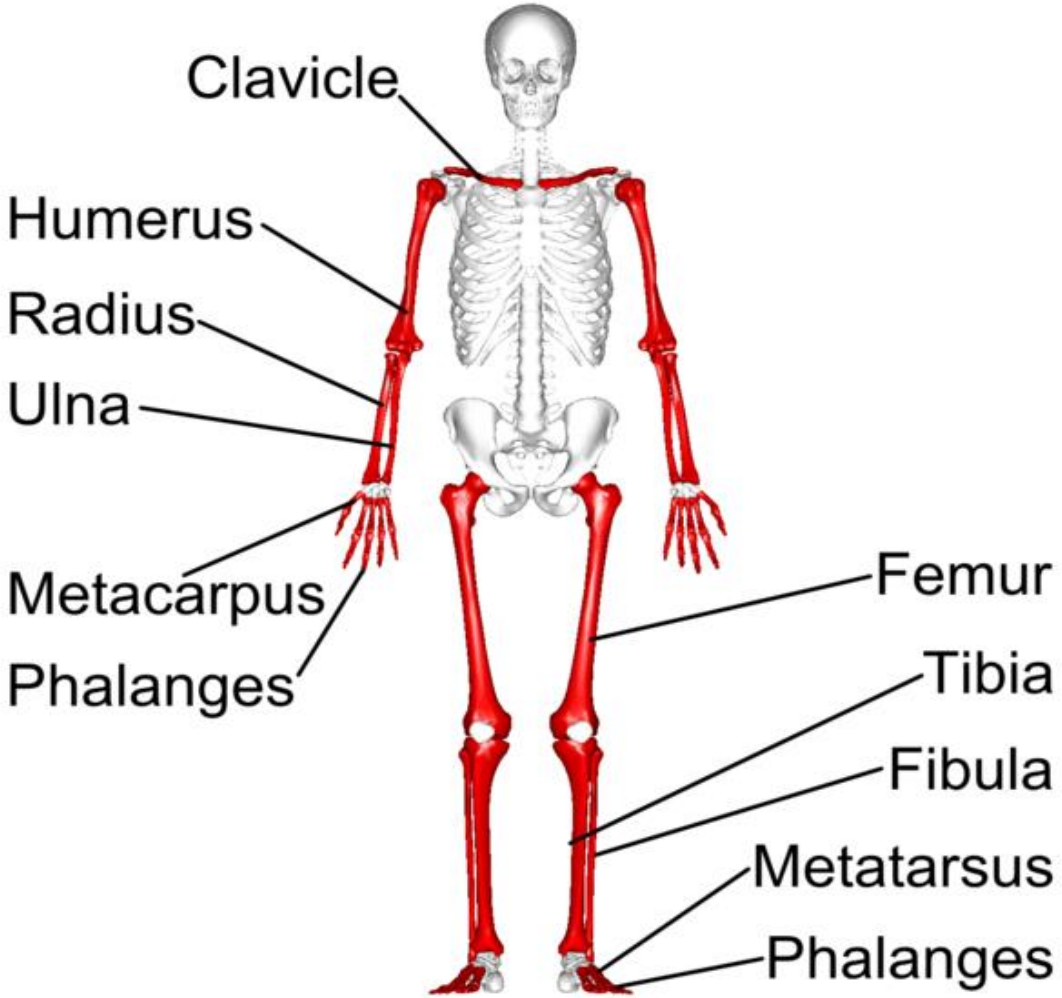


Source: Raichlen et al., (2010) Laetoli Footprints Preserve Earliest Direct Evidence of Human-Like Bipedal Biomechanics. PLoS ONE 5(3): e9769. doi:10.1371/journal.pone.0009769.g001

Credit: Natural History Museum, London

Homework – Inter-membral Index



BEHAVIOURAL AND CULTURAL APPROACHES

Review:
What ~~features/~~behaviours do humans have that make us different to other species?

What does language enable us to do?

Do other animals have the same components of language as humans?

Language in humans

What did human language evolve from?

Culture

- ‘That complex whole, which includes knowledge, belief, art, law, morals, customs and any other capabilities and habits acquired by man as a member of society.’

  E.B. Taylor 1871

- Culture is
  - *Range of behaviour that are learned from others.*
  - *Passed on from generation by generation.*
  - *Learned not genetic.*

Technology

- Technology/tools allow us to perform a task we can’t do naturally.
- The ability to plan how to make and use a tool is a complex mental process.
- The use of tools led to many of the changes that we associate with human culture and modern technology.
  - *Manipulate our environment*
  - *Build permanent houses*
  - *Allows specialised roles*
  - *Led to complex organised societies*

The first tools

- Were probably bio-degradable.
- The first tools in the archaeological record were made of stone.
- We group tools by how they were made and when. These two below are examples of the Oldowan and Acheulean industries.

Tools in time

Egyptian Pyramids: 4,500 years ago

First Farming: 12,000 years ago

First art sculptures: 40,000 years ago

First sewing needle: 50,000 years ago

First *Homo sapiens*: 315,000 years ago

First Acheulean Tools: 1,700,000 years ago

First Oldowan Tools: 2,600,000 years ago

First *Homo* species: 2,800,000 years ago

First partly-bipedal apes: 7,000,000 years ago

Ape common ancestor: 23,000,000 years ago

Primate common ancestor: 65,000,000 years ago

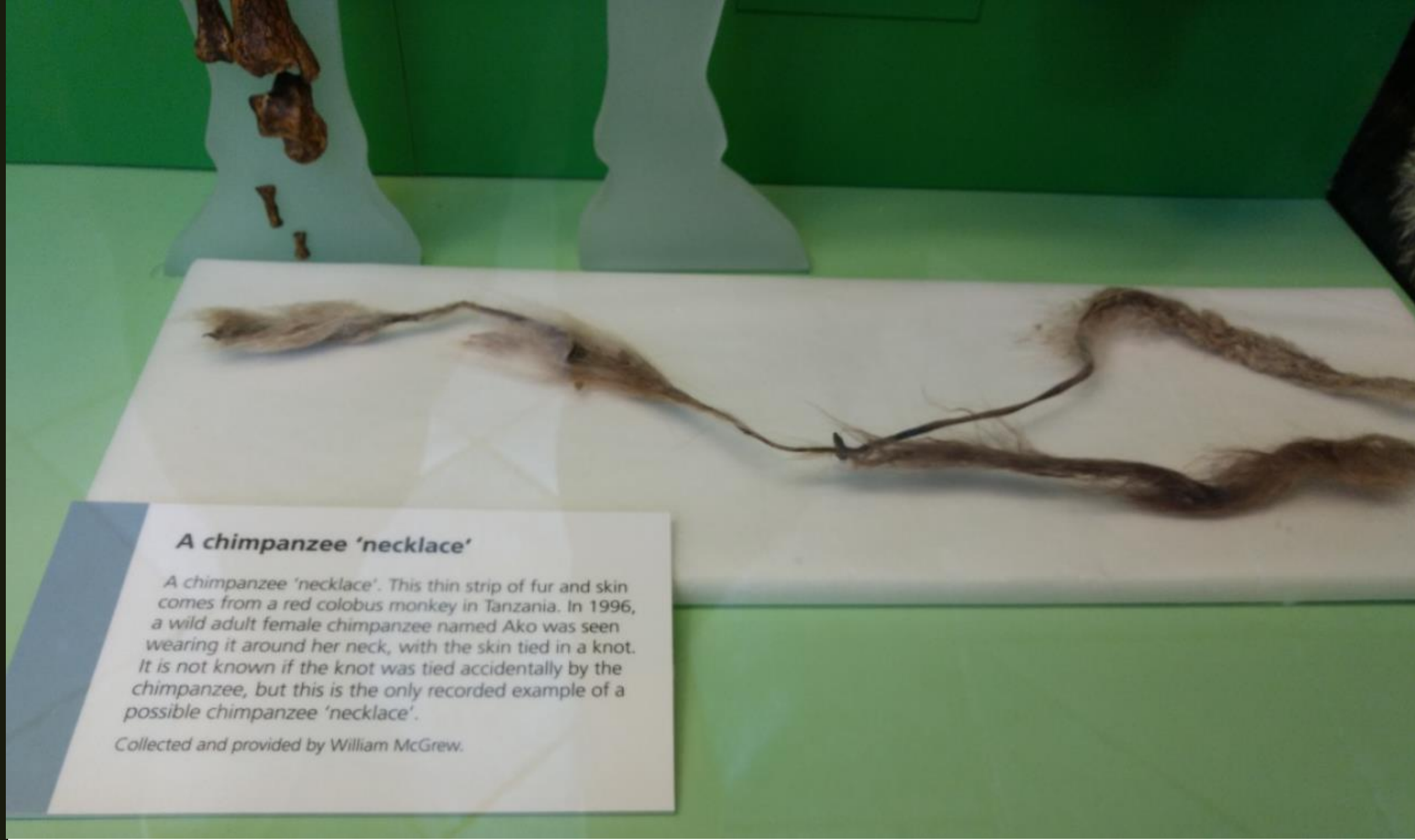
Technology and Culture

Divje Babe National Museum of Slovenia, Ljubljana

Technology and Culture

Figure 1. Female Leah Using a Walking Stick while Crossing Bipedally through an Elephant Pool at Mbeli Bai
Female Leah first looked at the new elephant pool and the branch she later used as the walking stick, and entered the water without the tool (not shown). After re-entering the pool and taking the branch with her right hand, she walked bipedally 8–10 m into the water, frequently testing water deepness.

Breuer et al (2005)


A chimpanzee 'necklace'
A chimpanzee 'necklace'. This thin strip of fur and skin comes from a red colobus monkey in Tanzania. In 1996, a wild adult female chimpanzee named Ako was seen wearing it around her neck, with the skin tied in a knot. It is not known if the knot was tied accidentally by the chimpanzee, but this is the only recorded example of a possible chimpanzee 'necklace'.
Collected and provided by William McGrew.

NEWS 2 July 2018

Some monkeys in Panama may have just stumbled into the Stone Age

One group of capuchins uses stone tools, but neighbouring groups do not – suggesting primates - including us - might enter the Stone Age simply by chance