COSMOS LESSONS

Biology

Human Evolution: How are we changing?

This lesson will explore the path of human evolution, from its origins to its future.

- We will look at questions such as:
- What is evolution by natural selection?
- What does the human family tree look like?
- How have humans evolved over the past 6 million years?
- What might humans look like 100,000 years from now?

This lesson will evolve your understanding of where we came from.

This is a print version of an interactive online lesson. To sign up for the real thing or for curriculum details about the lesson go to **www.cosmosforschools.com**

Introduction: Human Evolution (P1)

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Deep in a gloomy cave in eastern Europe, scientists recently found a skull of one of our human ancestors. It is 1.8 million years old and is the most complete skull of its kind ever found. The cave, in a place called Dmanisi, in Georgia, is famous for its skulls. Scientists have found five there over the past 20 years. Interestingly, they have found some sabre-tooth tiger bones in the cave as well, so perhaps the animals hunted and killed these early humans and dragged them into the cave to eat them.

The skulls have scientists puzzled. They can't decide where they fit into our family tree. If each of the five skulls had been found at different places around the world they would probably have been classified as different species. But as they were all found in the same cave, the scientists who found them are suggesting that they are all the same species, called *Homo erectus*. This is making them start to think that lots of other early humans we have discovered, that we previously thought were different species, are actually just *Homo erectus*. If they are right it would change the way we think about our earliest relatives.

But not everyone is convinced. Some scientists say that the individuals might have died in the same place but thousands of years apart and there is no reason to believe they belonged to the same species.

The cave hasn't been fully explored yet and so maybe scientists will find more skulls and bones that will help them unearth the true story of our ancestors.

Read the full *Cosmos* Magazine article here

Left: One of the skulls found in the Dmanisi cave. Right: Dmanisi, Georgia on a world map. Image credit: Guram Bumbiashvili & Georgian National Museum.

Question 1

Imagine: You are a palaeontologist digging in a cave in Dmanisi, Georgia, hoping to find a fossil of a human ancestor. To your astonishment, you find a complete, intact skeleton of a possible human ancestor who lived about 1.8 million years ago.

What do you think that ancestor would have looked like when they were alive? Describe as many physical characteristics as you can (such as height, weight, skull size, and so on).

Gather: Human Evolution (P1)

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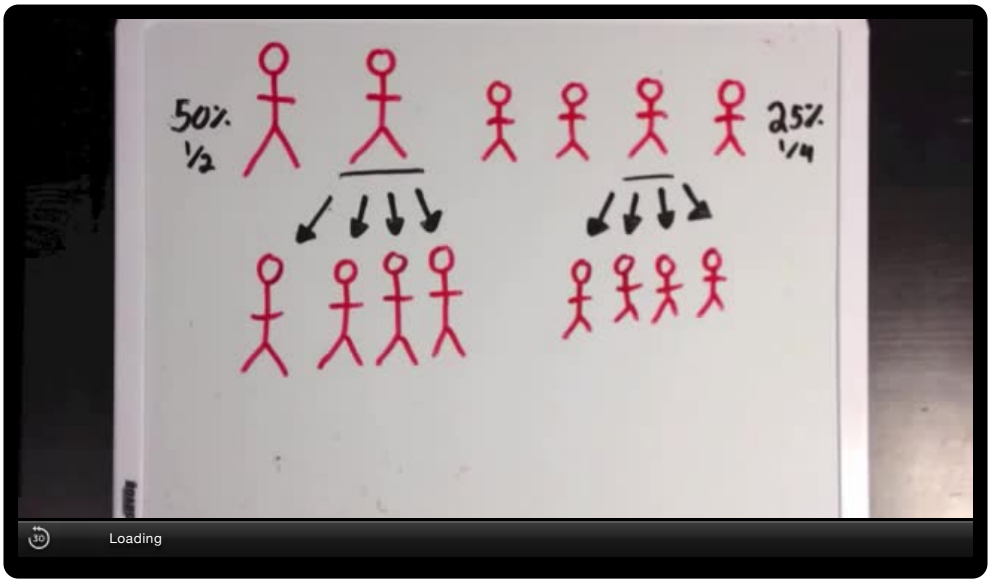


Video credit: Khan Academy & YouTube.

Question 1

Recall: A genetic trait is gained during an individual's lifetime.

- True
- False

Question 2

Recall: Evolution is a process that occurs to individuals, not populations.

- True
- False

Question 3

Recall: Which of the following statements are correct?

Hint: You may select more than one.

- [ ] Evolution describes the process via which a monkey becomes a human.
- [ ] Evolution describes the way in which an individual's traits change when it is in trouble.
- [ ] Advantageous genetic traits make an individual more likely to survive and reproduce.
- [ ] An advantageous genetic trait is more likely to spread throughout a population after successive generations than a disadvantageous genetic trait.

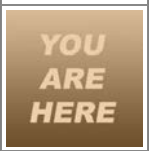
Question 4

Describe: How is an advantageous genetic trait 'selected' for?

Modern humans have evolved from human-like species, also known as hominin, that lived long, long ago. The *Cosmos Magazine* article made reference to one of these species, *Homo erectus,* however here are many more species of hominin that lived as far back as 6 million years ago. Not all of these are our direct relatives, however, and we don't yet fully understand how we are all related.

Question 5

Collate: Complete the table below. Use the Smithsonian Institution human family tree to help you, which you can find by clicking here.

Name of species	Artist illustration of species	When the species lived	Where the species lived	Brain size	Average female height (cm)	Interesting fact
Sahelanthropus tchadensis		5 - 6 million years ago		320 - 380 cm³	0.66 - 100 cm	One of the oldest known species of the human family tree
Ardipithecus ramidus		4.4 million years ago	Eastern Africa	300 - 350 cm³		Lived in a wooded environment.
Australopithecus afarensis			Eastern Africa	380 - 430 cm³	105 cm	One of the longest-lived and best-known early human species.
Australopithicus africanus		3.3 - 2.1 million years ago		400 - 500 cm³	118 - 135 cm	
Paranthropus robustus		1.8 - 1.2 million years ago	Southern Africa	410 - 530 cm³	100 cm	First fossil discovered in 1938. It was a jawbone with teeth.
Homo habilis		2.4 - 1.4 million years ago		550 - 687 cm³		Nicknamed 'handy man' because this species was thought to have made stone tools.
Homo erectus			Northern, Eastern, and Southern Africa; Western Asia (Dmanisi) East Asia	600 - 1000 cm³	145 - 185 cm	Oldest known early humans to have possessed modern human-like body proportions.
Homo neanderthalensis		200,000 - 28,000 years ago	Europe and southwestern to central Asia	1600 cm³	155 - 164 cm	
Homo sapiens		200,000 years ago to present	Evolved in Africa, now worldwide	1350 cm³	168 cm (2012 Australian average)	

The five different skulls found in the Dmanisi cave. Researchers wondered how the five diverse individuals were related.
Image credit: M. Ponce de León & Ch. Zollikofer, University of Zurich, Switzerland

Question 6

Identify: Describe the general trend in hominin brain size over the past 6 million years.

Question 7

Identify: Describe the general trend in hominin height over the past 6 million years.

Process: Human Evolution (P1)

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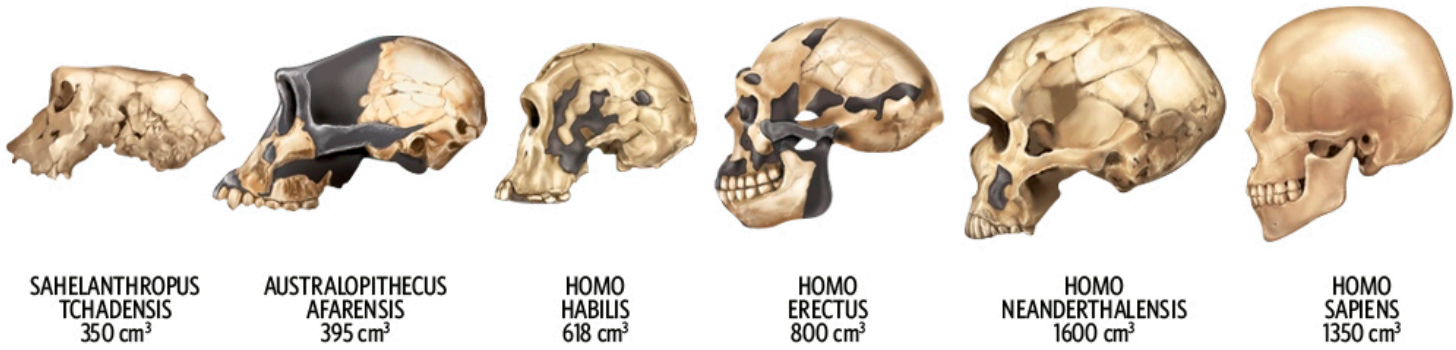

Some of our distant relatives and their brain sizes (in cubic centimetres). Image Credit: Universal Images Group & Getty Images

Question 1

Calculate: Use the information in the image above to calculate the relative increase in brain size from *Sahelanthropus tchadensis* to *Homo sapiens*.

Hint: For example, Homo erectus had roughly two times the brain size of Australopithecus afarensis (800 ÷ 395 ≈ 2).

Question 2

Reason: Suggest what selective pressure has resulted in hominins evolving to have larger and larger brains.

Question 3

Deduce: Why does the Smithsonian Institution human family tree (see previous activity) represent human ancestors in a tree instead of a simple timeline?

Question 4

Investigate: One of our relatives who lived in more recent history, *Homo floresiensis*, lived on the Island of Flores in Indonesia between about 95,000 and 17,000 years ago. Individuals of this species were significantly shorter and had smaller brains than other hominin species alive at the same time, such as *Homo neanderthalensis*. Propose why this species seems to break the height and brain size trends discovered in the previous activity.

Hint: You may find that the Smithsonian Institution web page on Homo floresiensis to be a helpful resource for this question.

Apply: Human Evolution (P2)

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Debate: Are we still evolving?

Image credit: iStock

Question 1

Introduction

In this lesson we have explored the evolution of humans over the past 6 million years, but are we still evolving? Are we still subject to selective pressures or have we reached a point where genetic characteristics are no longer being selected for?

Getting started

Your teacher will divide you into groups of three or four and each group will be assigned a side of the debate, *affirmative* or *negative.*

Affirmative groups are to argue the case that humans are still evolving, while *negative* groups are to argue the case that humans are no longer evolving.

Phase 1: Brainstorm

Once you have been placed into groups you are to brainstorm ideas for your case. Make sure that each member of your group types their ideas and thoughts below (*hint: the mind map tool may be useful*). Questions to consider include:

- What were the selective pressures on humans of the past? Are they still present in today's world?
- What is the role of modern medicine in this debate?
- What is the role of technology in this debate?
- What factors determine whether or not humans survive and have children in today's world? Are these new selective pressures?

Phase 2: Collate

Once you have brainstormed ideas for your case, assign one argument to each person of the group. Each person is to type up a short speech presenting your side of the debate based on that argument. You should aim for your speech to be roughly 2-3 minutes in length.

Phase 3: Debate

Conduct a 15-minute debate with a group who is arguing the opposite case to the one you were assigned. Each person in each group is to present their speech to the other side.

Make sure to have fun in your debates and don't forget to be respectful of other people's opinions. There are no winners and losers!

Career: Human Evolution (P2)

Brought to you by Edith Cowan University

Jeremy Austin is an evolutionary biologist from the University of Adelaide who uses ancient DNA to solve mysteries from the past.

Jeremy has a fascination with ancient DNA. Ancient DNA is DNA from animals or plants that lived a long time ago. Jeremy finds his specimens in museums, caves, and even deep underground. Some of the specimens Jeremy works with are over 10,000 years old! Ancient DNA is usually found in bones or teeth, as these parts do not decompose so quickly. Even so, DNA degrades over time and it's not easy getting DNA out of such old specimens. Every time he goes to work in the lab, Jeremy has to shower and change into a fresh set of clothes. Then, he meticulously puts on a full-body suit, gloves, shoe covers, a surgical face-mask, and a visor. He covers every inch of his skin to prevent contaminating his precious specimens with his own DNA. It certainly sounds troublesome, but Jeremy says his work is very rewarding.

Jeremy likes how his job lets him travel all over the globe to collect specimens, much like an explorer. But for Jeremy, what's even more fascinating is how ancient DNA lets him "travel back through time". It has given him the unique opportunity to study rare extinct animals: Jeremy has worked on dodos, moas, Tasmanian tigers, and mammoths. By studying their DNA, he can understand how these ancient animals lived and evolved in the past, and how they evolved to cope with changing environments and climate. It may be too late to save the animals that have already gone extinct, but Jeremy hopes to use his skills and knowledge to save modern endangered species like the Tasmanian Devil.

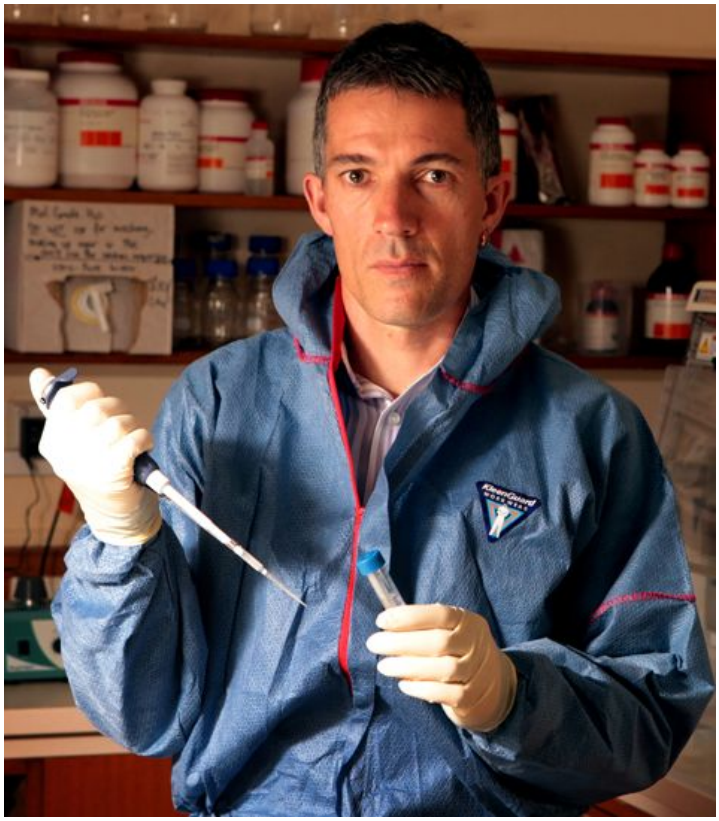

Image credit: Kelly Barnes & Newspix.

Question 1

Imagine: You are working as a evolutionary biologist, just like Jeremy. Which extinct species would you want to study? Why? Where in the world would you have to travel in order to study your chosen species?

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