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91606



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Level 3 Biology 2022

91606 Demonstrate understanding of trends in human evolution

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of trends in human evolution.	Demonstrate in-depth understanding of trends in human evolution.	Demonstrate comprehensive understanding of trends in human evolution.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

If you need more room for any answer, use the extra space provided at the back of this booklet.

Check that this booklet has pages 2–16 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (▨). This area may be cut off when the booklet is marked.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Merit

TOTAL

16

QUESTION ONE: *HOMO BODOENSIS*

Source: www.dailymail.co.uk/sciencetech/article-10140669/Meet-Homo-bodoensis-Newly-identified-ancient-human-species-lived-Africa-500-000-years-ago.html

Source: <https://atlasvirtual.com.br/homobodoensis.htm>

Researchers suggest that a skull found in Bodo D'ar, Ethiopia, East Africa in the 1970s belongs to neither *Homo heidelbergensis* or *Homo rhodesiensis*, but instead, is a new species entirely. Both mitochondrial DNA (mtDNA) and nuclear DNA (nDNA) have yet to be sequenced.

Homo bodoensis has been suggested as a direct ancestor of our species *Homo sapiens*. The *Homo bodoensis* species hasn't been identified from new fossils, but on the re-examination of old ones. *Homo bodoensis* is currently estimated to have lived between 770 000 and 126 000 years ago, with the specimen shown dated to around 500 000 to 600 000 years ago.

The fossil of the skull has an enlarged cranium compared to *Homo erectus*, but smaller than *Homo sapiens*, which suggests it is an intermediate species between them. *Homo bodoensis* is not thought to be an ancestor of the Neanderthals or the Denisovans, as the cranium does not share similar features. The endocranial capacity is estimated to be approximately 1250 cm³.

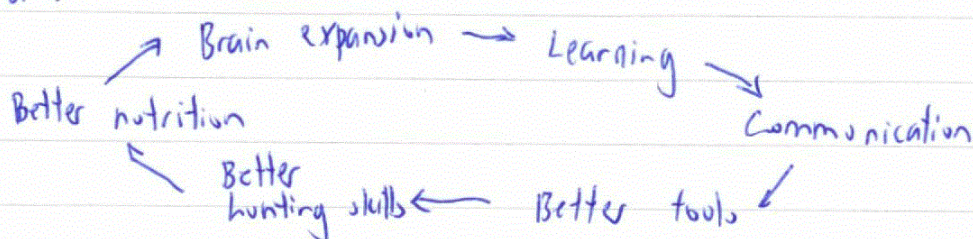
A number of other remains previously thought to be *Homo heidelbergensis* have also been reclassified as *Homo bodoensis*. Based on these remains, there are suggestions that *Homo bodoensis* may have reached south-east Europe, but died out there about 200 000 years ago.

Discuss how new knowledge can lead to changes in human evolution theories.

In your answer:

- describe what is meant by the terms hominin and endocranial capacity
- explain how new DNA evidence (from mitochondria (mtDNA) and nuclear (nDNA)) can be used to approximate times of species divergence, and how this DNA evidence might support the Out of Africa Theory of modern human origins
- discuss how changes to the cranium and hand bones would benefit the lifestyle of *Homo bodoensis* compared with earlier hominins.

Hominin is the ancestral lineage of humans not including our primates. Endocranial capacity is the brain size as endo means internal cranial means brain and capacity means size. As the hominins become bipedal, ~~they're hand~~ they started to have freed up hands. ~~The~~ Homo habilis started developing Oldowan tools which was used to cut up carcasses for bone marrow. This led to a better nutrition which led to brain expansion. From that point onward, endocranial capacity started increasing in size due to positive feedback loop of:



This caused brain expansions in different species and skull changes which then created differences in the hominin therefore speciation occurred.

The Out of Africa theory is when ^{some} Homo erectus left Africa 1.8 million years ago to Asia and Europe. Later on, the Homo erectus evolved into Denisovans in Asia and Homo ~~Neanderthalensis~~ Neanderthalensis in Europe. The remaining Homo erectus evolved into Homo sapiens which then migrated to Asia and Europe during the second wave of migration ~~as~~ and outcompeted or outlived the Denisovans, Homo Neanderthals and other hominin species. New DNA evidence ~~can~~ ^{might} ~~really~~ supports the Out of Africa Theory due to the fact that mtDNA and Y chromosome in the nuclear DNA does not undergo recombination. ~~Recombination occurs when the gametes are fused because mutation is random in other chromosomes~~

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Because mitochondrial DNA ~~does~~ and Y chromosome does not undergo recombination, it is possible that they are fairly consistent. ~~The only thing~~ MT DNA and Y chromosome also contains a fairly consistent mutation rate ~~(around 3%)~~. Using the mitochondrial DNA of one person and looking at the differences in the base sequence between our maternal's mitochondrial DNA base sequence allows us to know ~~how~~ how long apart they are. It is also ~~taught~~ thought that the Homo Bodoensis ~~may be~~ ~~changes to the cranium of Homo bodoensis~~ may be a ~~possible~~ direct ancestor of our Homo sapiens species as it ~~is~~ does not share the similar cranium sizes to Homo Neanderthals or Denisovan. Which means that it might ~~be~~ support the Out of Africa theory.

The changes of cranium and hand bones would benefit Homo bodoensis as it ~~is~~ indicates tool use and would explain why they managed to travel great amounts. This is because Homo Bodoensis. It ~~also suggest~~ ~~say~~ also suggests bipedalism as we stopped using our hands for swinging from branch to branch. Our opposable thumb helps with precision grips which became more accurate overtime the more we created tools. This is because as ~~the~~ ~~hominins~~ hominins evolve, the tools became more and more complex. Having greater precision grips allows us to create more complex tools, therefore bettering our hunting skills which means better fuels for our brains. Our brains are very expensive energy users and having better nutrition overtime by having better meat through better tools used for hunting will ~~expand~~ slowly increase our cranium capacity allowing Homo bodoensis to ~~be~~ have a ~~more~~

better lifestyle than other homonins.

Changes in cranium also indicate the development of language which allowed *Homo Bodoensis* to have better communication skills and therefore allowing exchanging of knowledge, further sustaining the population.

QUESTION TWO: NEANDERTHALS



<https://www.smithsonianmag.com/science-nature/rethinking-neanderthals-83341003/>

Neanderthals evolved in Europe and Asia while modern humans were evolving in Africa. Judging from fossil evidence from northern Spain and England, Neanderthals were already well established in Europe by 400 000 years ago.

Neanderthals ranged widely – from Portugal and Wales in the west across to the Altai Mountains of Siberia in the east. The range changed a lot, due to the effects of the ice age, when at times, there were land bridges and at other times, ice or water. Around 300 000 years ago Neanderthals developed a stone tool technology known as the Levallois technique. This involved making pre-shaped stone cores that could be worked into a finished tool at a later time. It meant Neanderthals were free to travel away from sources of raw material and yet be able to make tools when needed.

The bone damage found on Neanderthals suggests they were assisted in their recovery after injury.

Ancient DNA began to be recovered from Neanderthal fossils in 1997, and this has led to the reconstruction of several complete genomes. These indicate that Neanderthals living from Spain to Siberia were relatively low in both population and diversity during their last 20 000 years. The genome of one female individual from the Altai Mountains also shows signs of long-term inbreeding in her population.

It seems that regular, and sometimes extreme, climatic fluctuations continually fragmented Neanderthal groups during the last 100 000 years, preventing them from building up large populations and continuous distributions across their range.

Discuss reasons for both the success of, and the extinction of, Neanderthals.

In your answer:

- describe how the ice age influenced the movement of populations of Neanderthals
- explain an advantage and a disadvantage to Neanderthal society of caring for injured group members
- discuss how even though Neanderthals were advantaged by having the Levallois technique for tool manufacture, the species did not survive past approximately 39 000 years ago.

The ice age influenced the movement of population of Neanderthals to avoid the unfavourable temperatures so that the Neanderthals will not freeze to death.

The advantage to Neanderthal society of caring for injured group members is that they may be able to heal and nurse them back to prevent the deaths of the population. However, a disadvantage is that it takes up a lot of time and effort of individuals to nurse an injured member back to life. Because Homo Neanderthals are Hunter Gatherers, they have to often move where prey is most abundant. Having to carry their food and tools and on top of that their injured members may require a lot of effort.

Even though Neanderthals were advantaged by having the Levallois technique for tool manufacture, therefore allowing them to have better hunting skills and better nutrition, they still needed time and effort to gather and hunt for food. Homo sapiens outcompeted them due to their agriculture lifestyle which enabled the Homo sapiens to eat food when needed as their food source is always with them giving them more time to do other activities. Travelling and conquering other areas was also easier for Homo sapiens as their food did not require

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carrying, therefore further allowing them to care for their injured and young. As homo sapiens learned to settle (food sources can stay), Homo Neanderthals was on a constant walk and chase for their prey and soon died out due to less time spent caring for the young and injured and more time spent hunting for survival. This means that the injured had a higher mortality rate as less time spent tending and taking care of ~~them~~ them.

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QUESTION THREE: MOVEMENT OF HOMININS

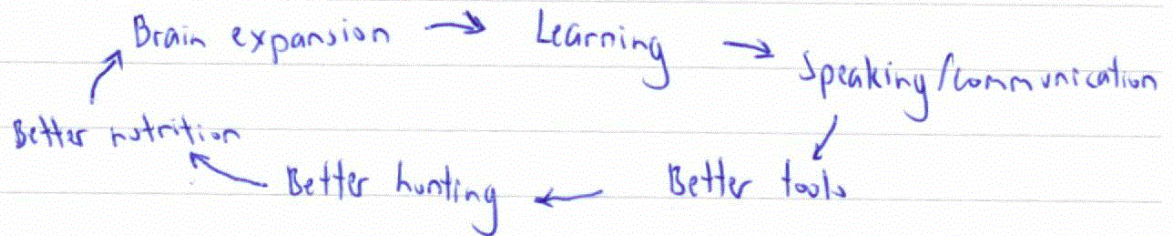
Fossil evidence shows that our ancestors became bipedal first, and this was followed by changes to the teeth and jaws. It was only much later that our larger and more complex brains set us apart as *Homo sapiens*, leading to the domestication of animals such as the dog about 10 000 years ago, and the pig about 8000 years ago.

Discuss aspects of *Homo sapiens* evolution and movement into the Pacific.

In your answer:

- describe how a cooler and drier Africa resulted in a selection pressure for bipedalism
- explain what smaller teeth can tell us about the hominin lifestyle
- discuss how the more complex brain would have led to the success of domestication of dogs and pigs and how these enabled *Homo sapiens* to successfully migrate through Europe and into the Pacific.

Agriculture and positive feedback loop



The cooler and drier Africa meant that there were more open grasslands. Because of the lack of food on trees, hominins were forced to go down to the open grasslands to search for more food. In the open grasslands, we risk being spotted by predators. Being able to stand upright to see above the grass gave us a huge advantage in not only spotting predators but in hunting for new food sources as well. Bipedalism also allowed our hands to be free and therefore, we are able to make tools for hunting.

Because we developed tools for hunting, we also developed tools for cutting up food. This allowed for easier digestion ~~and~~ as we can now chew smaller chunks of meat / plant material. This has then allowed us to lose our diastema which was used to show off our canine tooth and due to communication and exchanging of knowledge this led to us not needing to display

our canine teeth for aggressive behaviours. Another explanation for our smaller teeth is that we started being able to control fire. The first of our ancestors being able to do this is Homo erectus which also allowed them to travel and conquer colder regions of the earth. Fire also allowed us to "increase length of daylight" as in giving us extra time at night to do activities. It also helped keep away predators and ~~really~~ formed a close knit group within the community as several individuals would gather for warmth or cooked food. Cooked meat can be better preserved and has more flavour. It also provides us with better nutrients by killing off any possible pathogens or bacteria that are harmful to us. Cooked meat is also easier to digest as it breaks down easier compared to raw meat. We have slowly lost the robustness of chewing and temporal muscles that were used to chew hard plant material in the past. Our molars became smaller as we don't need as much effort to grind hard plant materials anymore as our diets changed from plant to animals to cooked plants and animals (which is ~~then~~ broken down for easier digestion through fire). Since fire also brought everyone together, we lost our diastema and ~~a~~ large canine teeth as there was lesser need to show aggression. As the fire provided more time for individuals to be around each other, we learnt to communicate and understand each other through the use of language. This heavily contributed to the positive feedback loop as we shared thoughts, ideas, planning and knowledge with each other through our own individual experience.

Because we cook meat over a fire, the scent

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may have attracted dogs / wolves which allowed us to domesticate them (by ~~us~~ feeding them while they provided protection). Early Homo sapiens were the first to start Agriculture and this has further enabled Homo sapiens to be more successful. Homo Neanderthals were Hunter gatherers and had to constantly hunt for food which was not very time or energy efficient. They also had to carry their food around. The domestication of dogs in Homo sapiens has really helped provide us with protection, especially when the dogs see predators, they can signal us. The domestication of pigs has enabled us to have a ready available food source giving us extra time and energy to do other things like raising the young, tool making etc. Although agriculture does increase the disadvantage of us being susceptible to diseases that may wipe out populations due to our close knitted population group, we still managed to pass down the agriculture behaviour after generations indicating that it benefited ~~us~~ us to domesticate these animals.

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Standard	91606	Display ID 615711	NSN 156886851 School 32	Total score	16
Q	Grade score	Annotation			
1	6	Two clear explanations of the out of Africa theory as well the fact that mtDNA has no recombination and has mutations that can be used (by counting) for time from divergence “ how long apart they are”. One fact only mentioned re hands linked well to advantage. For cranium no difference given but a general advantage. Resulting in a low 6 overall.			
2	4	Some nice descriptions of Homo sapiens, and around caring for others.			
3	6	Merit for the grasslands selection pressure and the change in teeth and domestication at weak Merit. No knowledge of travel to Europe and Pacific and too much about fire that was not asked for.			