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NZQA

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MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
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Level 3 Biology, 2017

91606 Demonstrate understanding of trends in human evolution

9.30 a.m. Thursday 16 November 2017
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 and clearly number the question.

Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

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

Excellence

TOTAL 20

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QUESTION ONE

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Biological evolution of the hand has been important in hominin evolution. Below are the hands of *Ardipithecus ramidus* and *Homo neanderthalensis*. Changes in the evolution of the hand are strongly linked to changes in the environment.

Ardipithecus ramidus | *Homo neanderthalensis*

http://scienceblogs.com/laelaps/2009/10/02/will-the-earliest-known-homini/
http://science.sciencemag.org/content/326/5949/70.full

https://iphesnews.wordpress.com/2015/06/30/why-did-neander-thals-use-the-teeth-as-a-third-hand/
http://pubpages.unh.edu/~jel/images/Neanderthal_grip.jpg
http://kids.britannica.com/students/assembly/view/202300

Analyse the evolutionary trends displayed in the hands shown above, AND discuss how changes in the environment and bipedalism would lead to these evolutionary changes.

In your answer:

- describe two evolutionary trends in the structure of the hands shown above
- explain how changes in the environment are likely to have led to the changes you have identified
- discuss the adaptive advantages that changes in the hand and bipedalism could have provided.

In the Ardipithecus ramidus, we can see that the fingers are long, with a shortened thumb. This hand structure would have been useful for brachiation, when the species was ~~quadrupedal~~ swinging off trees. In the Homo neanderthalensis, the fingers are shorter with a longer thumb. Therefore the trends are the shortening of the fingers and the lengthening of the

and the addition of precision grip.

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thumb. The changes in the environment during hominin evolution was forest type environments to savannah type environments This therefore reduced the need for brachiation in trees significantly as well as increased the need for effective locomotion This therefore led to the positive ~~feed~~ feedback loop which encouraged ~~the~~ bipedalism. Bipedalism meant that the hands no longer were needed for brachiating of quadraped movement (earlier on) so therefore biological evolution began to occur with the hand structure, and the changes such as the shortened fingers and longer thumbs were seen. The change in environment also presented new predators as well as new food sources available which presented the need for tools. The use of tools required power and precision grip, which was another evolutionary trend, as previous species such as ardipithecus ramidus did not require the use of tools. Again, a positive feedback loop allowed the precision and power grip to become a naturally selected advantage in the new environment, which ~~had~~ meant the cultural evolution of the tools in response to the environment, led to the biological evolution of the hand. Changes in the hand and bipedalism itself led to a numerous amount of adaptive advantages for the hominins. As mentioned, the hand being able to become more precise through the shortening and lengthening of the fingers and

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thumbs, allowed for the use of tools. The use of tool encouraged better diets, through being able to hunt meat. The better diets therefore encouraged brain growth which again led to more ~~complexity of the tools~~ and better hand precision again. ~~The use of tools~~ and eventually fore encouraged softer food, which was easier to chew, eradicating the need for a ~~nuchal crest flared~~ zygomatic arches and a sagital crest, ~~allowing~~ more room for brain growth. Bipedalism was also a huge advantage, as it allowed for better thermoregulation in the new savannah type environment, due to less of the body being directly opposed to the sun, as only the top of the head is exposed, as opposed to the whole back in quadropeds. Bipedalism also allowed for more efficient locomotion, as less energy was used than having to walk on all four. It also made the hominin appear more scary and menacing to predators, as well as the height the biped hominin could now spot incoming predators easier.

in a positive feedback loop

from evolved naivety

which aided more brain size

with

E7

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The examination continues on the following page.

QUESTION TWO

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Oldowan chopper

www.aggsbach.de/wp-content/uploads/2014/07/fighcehd.jpg

Acheulean hand axe

https://nz.pinterest.com/pin79376012161481249/

Neolithic axe

https://chw3m1.wikispaces.com/Neolithic+Types+of+Tools+or+Weapons-+Materials+and+Use?responseToken=e872917f8c94dca9e00d062639f33374

Fire

http://wonderopolis.org/wonder/how-was-fire-discovered

Birthing canal of selected hominins

https://aspergerhuman.files.wordpress.com/2014/10/800px-homo_erectus_pelvis21.jpg

Average size of cranial capacity in selected hominins

http://fhs-bio-wiki.pbworks.com/w/page/24003004/Hominid%20evolution

The advancement in cultural evolution such as the development of clothing, tools, language, and the use of fire has had an effect on biological evolution.

Explain how cultural evolution can affect biological evolution, AND justify the effect this had on the evolutionary trends of the skull and pelvis.

In your answer:

- describe the difference between cultural and biological evolution
- describe the trends in cultural evolution and biological evolution of the skull and pelvis, and explain the selective pressures that could lead to these cultural changes
- justify how cultural evolution has affected biological evolution of the skull and pelvis.

Cultural evolution is the learned adaptations that

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can be taught and passed on. This type of evolution is intergenerational, meaning it can be passed on up or down generations. In contrast, biological evolution is adaptations passed on through genes and mutations in genes. This can only be passed on to offspring and occurs at a slow rate, where cultural evolution occurs at a faster rate. The skull changed significantly due to evolution. Due to the cultural evolution of tools and fire, softer meat and a wider range of food was introduced. This food was easier to chew and more digestable, so there became less of a need for thick jaw muscles. This therefore decreased the need for the nuchal crest, sagital crest, and flared zygomatic arches which all allowed for the thicker jaw muscles. This in turn allowed for a larger brain, which enter encouraged cultural evolution, and allowed things such as better social interaction through the development of the Brocas area (speech interpretation) and the wernickes area (speech production), as well as the ability to develop more complex tools and social structures. As well as this, in the skull, the foramen magnum became more and more central due to the introduction of bipedalism, as it allowed the centre of gravity to become more central in order to walk on two feet. This bipedalism also led to changes in the pelvis, as the pelvis changed from a narrower taller quadraped pelvis to a more shallow and bowl shaped pelvis. However because of the larger brain biological trend due to skull chan

described, babies were born with

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larger brains. This meant they had to be born more under-developed than previously, leading to the cultural evolution of needing to spend more time looking after their young as they developed. Multiple different selection pressures led to these biological and cultural changes. The change from forest type environments to savannah environments was one of these, which encouraged the start of the positive feedback loop that brought on bipedalism and therefore the changes to the ~~brain~~ skull and pelvis structures, leading to ~~the~~ cultural evolution. The changing environment would have led to a large amount of different selection pressures, such as different climates, different predators and different food sources, all which contributed ~~in the same way~~ to the ~~changing~~ evolutionary trends of the skull and pelvis through bipedalism. For example the skull changes would have needed to happen for a larger brain to be able to think of tools to overcome new predators or new ways of food collection such as farming. These would have also required locomotion on two legs, which in turn led to pelvis evolution. Cultural evolution has impacted the biological evolution of the skull and pelvis in a big way. The increased complexity of tools, use of fire and development of social structures have ~~increased~~ required the need for a larger brain. The larger brain has hence required the need for a more spacious skull, which was made able by the cultural introduction of tools and fire softening the food to eradicate thick jaw muscle features in the skull and allow this bigger brain, therefore changing the biological evolution of

M6

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QUESTION THREE

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There is a lot of debate about how modern humans dispersed throughout the world. As more fossil evidence is discovered, and DNA is extracted and analysed, the ideas of human dispersal have changed in recent years. The two main widely accepted theories are the multiregional theory and the replacement theory (out of Africa theory).

Multiple sources of evidence are used to support each theory, such as DNA analysis, mtDNA analysis, and fossil structure.

Replacement theory (out of Africa theory)

Multiregional theory

Adapted from: http://anthro.palomar.edu/homo2/images/models_of_Hss_evolution.gif

Compare and contrast the replacement theory (out of Africa theory) with the multiregional theory, explaining how different evidence supports each theory, and any challenges involved.

In your answer:

- describe the replacement (out of Africa) and multiregional theories
- explain how different sources of evidence are used to support each theory, and the challenges with using fossil evidence
- compare and contrast the replacement theory (out of Africa theory) with the multiregional theory.

The out of Africa theory states that the first migration was the Homo Erectus ~~out of~~ migrated from africa 1.5 million years ago, and this species ~~travelled to~~ the different continents, where they formed different species due to the different niches. It is then in this theory, thought that homo sapiens evolved in Africa, before migrating ~~into~~ out into these continents, replacing and out competing all of the other species such as the neanderthals and denisovans, with little - no interbreeding, leaving homo

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sapiens to be the only living species. In contrast the multi regional theory states that while the Homo erectus migrated out of Africa 1.5 mya to different regions, there was interbreeding between the regions and a constant gene flow, which led to the concurrent evolution of homo sapiens in all regions of the world.
Scientists have gathered much evidence to support each theory. Starting with the out of Africa theory, they have found fossils of the same time period of Homo sapiens, Homo erectus and neanderthals all in the same area. This supports the out of Africa theory as it suggests that no interbreeding took place, and the homo sapiens did eventually out compete the other species. As well as this DNA evidence has been used to support this theory. The male Y-chromosome DNA has been used to suggest we all evolved from one male, which was the hominins that migrated out of Africa and took over the other species. This DNA is only traced down the male line and does not undergoe recombination. Another DNA method used to support this theory is the female MtDNA, which suggests we all originated from one female, mitochondrial eve which again supports out of Africa. This DNA only is through the female line, does not undergo recombination and can show the constant genetic change. ~~Another~~ Another piece of evidence supporting this theory is that the African population of modern humans show more genetic diversity than the non african population. This

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would fit the out of Africa theory because the African H. sapiens would have been there for the longest time (with no interbreeding) so therefore would have the most time to aquire genetic diversity. There are also multiple pieces of evidence which supports the multiregional theory. ~~If~~ Fossils that are ~~intermediate~~ h. erectus between two species of h. sapiens and ~~h. neanderthalensis~~ h. erectus for example have been found in migratory area. This suggests that ~~ultimately h. sapiens~~ the homosapiens evolved concurrently in all regions an there was interbreeding that took place. Also supporting this theory is the fact that Melanesians have been found with 4% Denisovan DNA. This again suggests that interbreeding occured, which supports the multiregional theory. Another piece of evidence of this theory was that 6% of Neanderthal DNA was found in some modern europe humans, again supporting the idea of interbreeding between the species. Using fossils as evidence can come with challanges. For example as opposed to DNA, fossils have been exposed to the environment for long periods of time, denaturing some of the vital telling structures. As well as this, its impossible to know exact time frames with fossils, in comparison the MTDNA where you can be sure of the constant changes to date back

The similarity between the two theories is that the H. erectus species migrated out of Africa 1.5 mya. However while multiregional theory suggests gene flow between the populations, in contrast the out of Africa theory does not, as it suggests homocapiens took over all the

E7

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Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

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2 the skull. The introduction of the cultural trends that came with bipedalism such as more efficient hunting (on two legs) ~~and~~ caring for the young for larger led to the pelvis changing from a narrow quadraped pelvis to a wide and shallow biped pelvis, capable of birthing fuses larger brained babies (which emerged from the cultural evolutionary trends that resulted in a large brain).

3. Other populations. As well as this, the out of ~~Africa~~ theory suggests that homo sapiens only evolved in Africa, and got to Other continents through migration, whereas in contrast, the multiregional theory suggests that homosapians evolved concurrently in all habitable parts of the world.

91606

Subject:	Biology	Standard:	91606	Total score:	20

Q	Grade score	Annotation
1	E7	The candidate discussed that the evolution of bipedalism has a positive effect on the evolution of the hand. Due to changes in the climate, the vegetation changed to forested outcrops. This meant that hominins that were better adapted to moving between forested outcrops, were also better adapted to bipedal movement. Bipedalism freed up the hands to carry babies, tools, manipulate tools etc. With the use of tools gave these early hominins an increase in meat in their diets which fuelled a bigger brain. The student use the positive feedback model to discuss this concept.
2	M6	The candidate discussed how the cultural changes in tool technology and the development of fire affected biological evolution in relation to the increase in the cranial capacity of these early hominins. The candidate explained this trend using the positive feedback model in relation to fire and cooking meat which fuelled the increasing brain size. In order to gain E7 the candidate needed to further discuss in detail how cultural evolution affected changes in the pelvis of these early hominins.
3	E7	The candidate was able to discuss both the RT and MR models of human dispersal by providing current evidence (both fossil and DNA) that is used to support these theories. In addition, the candidate was able to explain some of the challenges that may arise when using fossils as evidence.