

Assessment Schedule – 2016

Biology: Demonstrate understanding of trends in human evolution (91606)

Evidence Statement

Q	Evidence	Achievement	Merit	Excellence
ONE	Skull A is older, as it has a small sagittal crest compared to Skull B, which has none. The sagittal crest is a site for the attachment of large jaw muscles, which are required when the main diet of food is plant based, and is high in cellulose and low nutrition, which would mean more time required to chew and physically process the food. Because of the large jaw muscles, the zygomatic arch needs to be large to allow for these jaw muscles to go through. It has a U-shaped dental arch, which is common amongst earlier hominins. The brow ridge is pronounced, and is used to dissipate the stress on the cranial bones caused by eating hard low nutritious plant based food. There are not many teeth on Skull A, but the molars are larger to provide a larger surface area for the grinding of coarse low nutrient plant-based foods. In Skull B the canines are reduced showing less need of displays. The foramen magnum is centralised and situated further forward in Skull B, suggesting Skull A is not as well adapted to bipedalism as <i>Homo erectus</i> (Skull B). Skull A also has a larger nuchal crest that is for the attachment of strong neck muscles to help keep the head in an upright stance compared to the <i>Homo erectus</i>, which has a reduced / no nuchal crest, as its head is more balanced on the vertebrae (neck), which reduces the need for powerful neck muscles. Because Skull A was an earlier hominin, it has a smaller cranial capacity, 350 cc. It probably ate plant material that is lower in nutrient contents. Hominins that developed from <i>Sahelanthropus tchadensis</i> would have access to better food, richer in nutrition, providing more energy than a larger brain required. This larger brain would have given these hominins a selective advantage in gathering food, and avoiding predation. The position of the foramen magnum would have provided better / more efficient bipedal movement, saving	Describes four named features and location / function of Skull A, and Skull B, for example: • Skull A, brow ridge is larger and is located above the eyes • zygomatic arch is larger in Skull A and indicates muscles for a large jaw • in Skull B, foramen magnum more centrally positioned for better balance • sagittal crest in Skull A is reduced but present at the top of the skull but is absent in Skull B • Skull A has larger nuchal crest for attachment of large neck muscles • Skull A has larger molars because they ate harder lower nutrition value foods • reduced canines in Skull B not needed because they used less threat displays • reduced frontal lobe and a larger facial angle in Skull A whereas in Skull B increased cranial vault / cranium • change from U / rectangular (Skull A) to V / parabolic (Skull B) dental arch / teeth pattern / jaw shape.	Explains how identified features can be linked to support evidence of bipedalism and diet: • More central foramen magnum gives better balance for bipedal movement by having the head directly above vertebrae and the hips. • Skull A has a larger brow ridge, which is used to reinforce weaker bones to cope with the pressure on the cranium caused by powerful chewing OR Skull B, which has a more reduced brow ridge and larger fore brain as large chewing muscles are no longer required for the softer diet / more nutritious food. • Smaller zygomatic arch in Skull B, as they would have had smaller jaw muscles, as they ate food with a higher nutrient value / softer food / less energy spent on physical digestion OR vice versa for Skull A. • V-shaped dental arch / smaller molars in Skull B, as they ate higher quality foods / food softened by cooking and were able to process it better before ingestion OR vice versa for Skull A.	Discusses how the changes in the skull features have acted as selective forces which led to evolutionary trends. • The centralised foramen magnum reduces the amount of energy required by large muscles to keep the head balanced on the neck. This energy can be used to run the high energy, larger brain. (2% of the body mass and uses 20% of the total energy.) • Weakened jaw muscles are related to two changes in skull structure explained, which in turn enabled bigger cranial vault, which created space for brain expansion, (as attachment of larger muscles no longer selected for). • A change in diet (to foods that are easier to chew / softer eg meat) provided more energy / protein / nutrients which led to an increase in brain size and cranial capacity. • Adaptive advantage of increased cranial capacity eg increased cognitive ability / communication / planning / predicting – could be a positive feedback loop.

	energy, allowing greater movement and therefore better access to food resources. The changes to skull structure would have been a reduction in jaw / zygomatic arch size, loss of sagittal crest / reduction in brow ridge, prognathism, and tooth size etc. The weakened muscles would no longer have required a sagittal crest / large jaw for larger muscle attachment and brow ridges to compensate for larger forces from larger jaw muscles. Changes in diet was a selective force that led to weaker muscles, thus seeking nutrients from other sources that were softer, and required less chewing.			
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Not Achieved			Achievement		Merit		Excellence	
NØ = no response or no relevant evidence	N1 = 1 point	N2 = 2 points	A3 = 3 points	A4 = 4 points	M5 = 1 point	M6 = 2 points	E7 = 1 point	E8 = 2 points and must have first bullet point

Q	Evidence	Achievement	Merit	Excellence
TWO	Cultural evolution is the transmission of knowledge from generation to generation, not passed on by genetics, but by learning. <i>Homo habilis</i> is credited as being one of the first hominins to use stone tools, called oldowan tools. These tools had flakes struck off one side of the pebble. <i>H. habilis</i> had a small brain and were scavengers that were able to use the stone tools to break open bones and exploit the bone marrow, which is rich in protein and fats. This would have provided more energy required to support larger brains. As the tools developed for the following hominin species, the ability to access protein and fat rich food resources increased having a positive feedback on brain development. <i>Homo erectus</i>'s cultural evolution included the use of fire which enabled them to cook food and decreased the risk of food poisoning as well as softening the food allowing for the reduction in size of the molar. To exploit the food that would encourage the support of a larger brain. Fire would have also been able to provide protection from predators at night which would have been another adaptive advantage from the <i>Homo erectus</i> onwards. <i>Homo neanderthalensis</i> had a developed language, which is related to the Broca's and Wernicke's area. This would have developed over time in the preceding hominin species, as the brain expanded. Having a language gave the ability to pass on ideas, which would have been an adaptive advantage, as they would be better able to hunt together as they could plan hunts and were best to find the prey. Burying the dead would have been a selective advantage as it would have allowed the <i>Homo neanderthalensis</i> to decrease risk of disease and of predation.	Defines cultural evolution as: - The transmission of knowledge from generation to generation by teaching / learning or passing on of information that is not genetically derived. Describes the different forms of cultural evolution of <i>Homo habilis</i>, <i>Homo erectus</i> and <i>Homo neanderthalensis</i>. <i>Homo habilis</i> - Idea of simple tool, e.g. Oldowan tools are stone tools that have had flakes struck off one side of a pebble. OR Tools with flat faces at one end / flakes removed from one side. <i>Homo erectus</i> - Acheulean tools are stone tools that have had flakes struck off two sides / tools that are biface with flakes removed from both sides. <i>Homo erectus</i> is the first hominin that is associated with using fire cook food / keep predators away. <i>Homo neanderthalensis</i> - Mousterian tools are stone tools that have been made from large flakes. OR Tools had the sides more worked and more detail along the edges of the tools, (often made into	Explain how these different forms of cultural evolution are adaptive advantages for the species who employ them. <i>H. habilis</i> had a small brain and were scavengers that were able to use the stone tools to break open bones and exploit the bone marrow, which is rich in protein and fats. This would have provided a larger form of energy required to support larger brains. - Fire used by <i>Homo erectus</i> provided adaptive advantage of warmth / social gathering and protection from predators at night OR the use of fire enabled <i>H. erectus</i> to cook food which decreases the risk of food poisoning and softening the food to increase the access to more nutrients to support a larger brain. OR fire provides a survival advantage to <i>H. erectus</i> in making more time available for e.g. making tools (as cooked food provides more energy / less time involved in collecting food) <i>Homo neanderthalensis</i> - Tools made by the Levallois technique. This technique allows greater control over the size and shape of the flake products, but it also indicates a great leap from the cognitive requirements of previous Acheulean technologies.	Discuss the advantages and disadvantages that cultural evolution has had on biological evolution. - All of the cultural forms of evolution would have provided adaptive advantages for the hominin species who employed them, allowing them a greater chance at surviving, and being able to reproduce and pass on their favourable alleles / genes to the next generation. (The cost is the time and energy that it takes to develop the tool.) The benefits are the efficiency in using the tools to gain a higher nutrient value food, and less time processing their food. As the tools developed for the following hominin species, the ability to access protein and fat rich food resources increased having a positive feedback on brain development. The advantage of using fire allowed the food to be softened and more access to types of food, allowing a greater ability to physically digest foods (mastication). These provided a selective advantage because it decreased chances of sickness and vulnerability to the environment and predators. (The cost of speech would have been the time taken to develop a language.) The benefits that ideas and information like the best hunting ground and types of beasts to hunt were more easily transferred with a developed language. - The benefit of cultural evolution must outweigh the costs and associated risks for the adaptive advantage to have an effect on the hominin species. - Disadvantage may include discussion of natural selection / demonstration of higher thinking

	Art in the form of petrolithes would have also been a way to communicate by transfer of information from generation to generation. All of the cultural forms of evolution would have provided adaptive advantages for the hominin species who employed them, allowing them a greater chance at surviving and being able to reproduce and pass on their favourable alleles to the next generation.	short stabbing spears) OR Variety of materials used OR By Levallois involves very basically the striking of flakes from a prepared core. • Bury the dead shows care / idea of afterlife. • Caves / clothing as shelter (naturally occurring places to shelter from adverse weather conditions). • Speech and language. • Art provided the ability to communicate.	• Speech / development of language (in Broca's and Wernicke's area of expanded brain) allowed for effective co-ordination of activities (e.g. hunting, tool-making, building and manufacturing) and the exchange of ideas. • Burying the dead would have been a selective advantage, as it would have allowed the <i>Homo neanderthalensis</i> to decrease risk of disease and of predation. • Art would have also been a way to transmit their ideas / transfer information from generation to generation.	skills
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Not Achieved			Achievement		Merit		Excellence	
NØ = no response or no relevant evidence	N1 = 1 point	N2 = 2 points	A3 = 3 points (1 point only for each hominin species)	A4 = 4 points Must include definition	M5 = 2 points (across 2 hominin species)	M6 = 3 points (across 3 hominin species)	E7 = 1 point	E8 = 2 points 1st bullet point must be incorporated into discussion

Q	Evidence	Achievement	Merit	Excellence
THREE	The Out of Africa model suggests that <i>Homo sapiens</i> evolved in Africa and then spread, replacing hominin populations that had migrated earlier into Europe and east Asia. Reasons for dispersal include pressure on resources and climatic changes. As they dispersed, this model suggests that there was limited gene flow between the populations in Africa and the populations in Europe and east Asia. This is shown by mtDNA analysis that show the populations that developed in Africa to have more variation in their mtDNA as they have had longer to accumulate mutations in their mtDNA, while the <i>Homo sapiens</i> that have migrated have interacted with other pre-existing hominin populations as they dispersed further, e.g. Neanderthals. There is no evidence of Neanderthal mtDNA in humans but rather in their genes, which can be seen in the genome analysis. This means that Europeans and east Asian populations carry Neanderthal alleles in their genetic material. The <i>Homo sapiens</i> populations that interbred with Neanderthals would have been similar, as they shared a common ancestor / DNA link, and different as they subsequently evolved in different areas / came under different selection pressures that make them more fit to the environment. Regions that harbour a high frequency of Neanderthal alleles are enriched for genes affecting keratin filaments, suggesting that Neanderthal alleles may have helped modern humans to adapt to non-African environments. This means they would have been better suited to migration in these areas. The multi-regional model suggests that	Describe reasons for dispersal and any benefits gained from the dispersal of modern humans: - As the populations of <i>Homo sapiens</i> grew, the pressure on resources increased. - By moving, <i>H. sapiens</i> were able to exploit new resources. - Change of environmental conditions provides better access to new regions and resources. Describes climatic changes that would have influenced modern man's dispersal into Asia, Australia and Europe: - E.g. Ice sheets prevented migration in some areas, but lowered sea levels forming land bridges in other areas, allowing better access between islands and continents. Describes the Out of Africa model: - The Out of Africa model asserts that modern humans evolved relatively recently in Africa, migrated into Eurasia, and replaced all populations which had descended from <i>H. erectus</i>. - Mitochondria are inherited from the mother only (mtDNA). - Y chromosome is inherited from father only.	Explain the importance of the environment for the dispersal of modern humans: - During the time of dispersal, some areas had gone through an ice age where the sea level had dropped and the water stored in the polar cap and glaciers provided land bridges between some landmasses (e.g. from Palestine to Eurasia). - Climatic changes would have influenced modern man's rate of dispersal into Asia and Australia, compared to Europe, because the land bridges caused by glaciations allowed the migration along coastal routes through Asia and to Australia. Because of sheets of ice, the central Asian route to Europe was blocked. Explain the evidence used to support the Out of Africa dispersal model: - The Out of Africa (replacement) theory maintains that the genes in modern-day humans all came out of Africa. As humans migrated from Africa, they replaced all other human populations with minimal interbreeding. (Admixture). - mtDNA is useful because mitochondrial DNA does not undergo any recombination events – any changes in mtDNA are the result of (gene) mutation only. mtDNA is inherited from the mother only and passes through the maternal (female) line of the family. - Genetic analysis shows that African populations show much greater diversity than non-African, as would be expected if <i>H. sapiens</i> originated in Africa, and migrating populations took only a portion of the gene pool with them. - Y chromosome DNA can be used to trace	Discuss the advantages and disadvantages of taking the various migration routes: - Links the environmental conditions to the different rates of dispersal between Asia, Australia and Europe: eg The faster coastal routes would have had warmer conditions and a good food supply, while the more central Asian route (Georgia) into Europe would have had a limited food supply as well as cold conditions for travel. There was no migration directly to the Mediterranean region initially. - A later migration into North America occurred following a glaciation period. Land bridges across the Bering strait would have provided an easy way to cross from Europe through to the North American continent. This would have meant water levels were down during a period of cooling / glaciation. Discusses how the admixture could have helped the <i>Homo sapiens</i> to migrate: - From interbreeding with the Neanderthals, (interbreeding events only occurred outside Africa) resulting offspring would have an adaptive advantage caused by having the HLA gene, as they would be resistant to diseases that they would be exposed to by migrating out of Africa. Offspring carry this advantage enabling them to further disperse into new areas. - The <i>Homo sapiens</i> that interbred with Denisovans were able to adapt to living in higher altitudes, as their blood remained thin due to the EPAS1 gene. The following generations that inherited this gene could gain access to higher altitude routes the original migrants previously found difficult.

	<i>Homo sapiens</i> developed independently. During the dispersal the sharing of some DNA indicates the possibility of interbreeding between populations (or alternatively this was from ancient DNA source / ancestor). The lack of genetic variation in modern humans is due to relatively recent dispersal from Africa, and likely more than one dispersal event, as well as possibility of interbreeding with other hominin populations on the way. The DNA similarities were selected for, to continue to survive in modern human populations.		paternal ancestry to approximately 140 000 Y.A. This is useful because the Y chromosome does not recombine with X chromosome therefore only change by mutation.	
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Not Achieved			Achievement		Merit		Excellence	
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Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 8	9 – 14	15 – 19	20 – 24