Human Evolution
ANSWERS

The Basics

Classifications and Background
STOP AND CHECK (PAGE 5)

- Hominins are primates (and humans) that walk on two legs, have a large brain, little body hair, no tail, and small canine teeth. Hominids are all modern and extinct apes and monkeys that walk on all four legs.
- Spider monkeys, baboons, gorillas, orangutans, and gibbons.
- *Homo sapiens*.

Hominin Evolution
STOP AND CHECK (PAGE 9)

- *Australopithecus afarensis, Homo habilis, Homo erectus, Homo neanderthalensis, Homo sapiens*.
- *A. afarensis* was the first bipedal hominin and moved around in groups. *Homo habilis* developed Oldowan tools and were the first to have speech. *Homo erectus* discovered fire, therefore had larger brains and better tools (Acheulean). Homo neanderthalensis buried the dead and made more sophisticated tools. Homo sapiens have advanced tools and have large brains.

Bipedalism

STOP AND CHECK (PAGE 11)

- Bipedalism is where the hominids walk on two legs, and quadrupedalism is where hominids move around on all four limbs.
- Hominins could no longer move around amongst the trees because the dense forests became the savannah, so only the occasional tree was available. Therefore, bipedalism evolved so that hominins could walk around and see their surroundings the same as if they were in the trees.

Skull

STOP AND CHECK (PAGE 12)

- The foramen magnum allows the spinal cord to descend from the brain down through the spine.
- The nuchal crest is the part of the skull where the neck muscles attach, to help hold the head up.
- In bipeds the foramen magnum is located at the centre of the base of the skull, this is so that the skull sits directly on top of the spine. Because of this, less energy is needed to hold up the head, so the nuchal crest is small. In quadrupeds, the foramen magnum is located at the back of the underside of the skull, and the nuchal crest is very large so that it can hold the head up.

Spine

STOP AND CHECK (PAGE 13)

- The S-shaped spine in bipeds keeps the bodyweight above the hips and lets them stand with less stress of the legs, and acts as a shock absorber when walking.
- The C-shaped spine in quadrupeds counterbalances the force of the organs that push down when walking on all fours.

Pelvis

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- In bipeds, the pelvis is bowl-shaped which is short and wide. In quadrupeds, the pelvis is long and narrow for large muscle attachment.

Femur

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- The valgus angle is the angle of the femur that is away from the midline of the body, the femur is angled inwards. This is present in humans.
- Having the femur angle inwards from the pelvis allows the bodyweight of hominins through the middle of the pelvis when standing.

Foot

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- The forward-facing toe provides the thrust for forward momentum while walking.
- The arch in the foot acts as a shock absorber when walking, allowing us to walk long distances.
- The feet of humans have a forward-facing big toe and an arch. Whereas, apes have flat feet and an opposable big toe (like a thumb) for grabbing on to things.

Advantages and Disadvantages of Bipedalism

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- The upsides of bipedalism are; it frees up the hands for carrying things as well as use tools, shades most of the body from the sun so keeps them cool, and allows them to see further away.
- The downsides to bipedalism are; it makes it harder for blood to move around the body to organs, back problems because of standing upright, and the

problem of flat feet occurring in some hominins making it hard to walk long distances.

Effects of Bipedalism

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- Bipedalism led to the hands becoming free to use, this allowed for the craft of tools and fires, which lead to the change in diet because of the food being cooked. This then led to the change in the structural features of the skull. All of this together, lead to an increase in intelligence, cranial capacity, and development of speech.
- Humans have a U-shaped jaw and small teeth, less pronounced brow ridges and zygomatic arches than apes due to eating cooked food. So, they require smaller jaw muscles. Apes have a rectangular jaw and large teeth, large brow ridges and prominent zygomatic arches due to large jaw muscles from chewing hard raw foods.

Human Biological Evolution

QUICK QUESTIONS (PAGE 20)

- The skeletons of humans and Lucy show that they walk around of two legs due to having an S-shaped spine, allowing them to stand up. They both have the valgus angle present, which is where the femur angle inwards from the pelvis, which supports the body and allows for upright walking. They also have a short and wide bowl-shaped pelvis. The skeleton of the chimpanzee suggests that it is quadrupedal because of its C-shaped spine, which supports the body from the force of the organs pushing down. The femurs of the skeleton do not have the valgus angle, so upright walking isn't possible. The feet of the chimpanzees are flat and have an opposable big toe, so shows that they walk on all fours and climb in trees. The pelvis is also long and narrow, for large muscle attachment.
- With Lucy being bipedal, they would have been able to walk around on two legs due to the loss of trees to move around in, which would have allowed them to see far away, enabling them to see predators and food from far away. This frees the hands of Lucy, allowing them to carry things around and to carry

their young. The disadvantage of Lucy being bipedal was that they had higher chances of back problems because of standing upright, as well as varicose veins becoming more likely to form due to blood being harder to pump around the body.

Human Cultural Evolution

Defining Cultural Evolution

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- Cultural evolution is the passing of knowledge by social interaction from one generation to another. Biological evolution is the changes of DNA and biological and physical features over many generations.
- Cultural evolution may have involved the passing on of beliefs, knowledge, customs, language, and skills.

Tools

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- Oldowan, Acheulean, Mousterian, and Upper Paleolithic tools.
- The first hominin species to use tools was Homo habilis.
- *H. habilis* used Oldowan tools, *H. erectus* used Acheulean tools, *H. Neanderthalensis* used Mousterian tools as well as Upper Paleolithic tools alongside *H. sapiens*.
- Tools started off very basic, with the Oldowan tools being stones with one side chipped, and were used to cut meat. Then the Acheulean tools were flattened hand axes that were used to cut wood and carcasses. The Mousterian tools were then developed for spears/weapons for hunting and were more carefully shaped and involved more than one material. The Upper Paleolithic tools were made
  from stone, plant fibres, and bones, to make tools, ropes, needles, and clothes.

Fire

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- *H. erectus* was the first to use fire.
- Fire allowed for the cooking of food which made it easier and safer to eat and digest, making meat a part of their diet. It allowed them to stay warm in the winter months and provided light which led to more social interactions.

Farming

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- The advantages of farming include; hominins were able to settle down in one place, grow their own crops for food, domesticated animals such as sheep and pigs, the development of villages and large populations, less people died from starvation, and allowed for more time to be dedicated on other activities like arts and crafts.
- The disadvantages of farming include; the restriction of the hominin diet due to what they could grow, the growth of food and the health of animals depended on the weather, disease became a problem due to dense populations, and it led to fighting for animals and land.

Behaviour

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- Neanderthals were the first to bury their dead.
- Neanderthals would bury their dead amongst tools and flowers, sometimes with decorations, which indicates a ritualistic behaviour, suggesting that they believed in the afterlife.
- Language is thought to have started with *H. habilis*, with them making grunting sounds to communicate, but did have a large brain and a Broca's area present so were capable of speech. *H. erectus* had a larger brain, so were more likely to communicate with more advanced speech, but not words. *H. Neanderthalensis* and *H. sapiens* were the hominin species to make proper sounds when speaking.

Human Cultural Evolution

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- *H. habilis* created the first tools known as Oldowan tools. These were basically stones with a chipped side that was used for cutting meant and working wood. The creation of these tools allowed *H. habilis* to make basic things, which indicates that their brain size had increased from earlier species and that they were able to think creatively in a way to use such a tool for specific purposes. The creation of tools also coincided with their ability to communicate via grunting, which is due to their increase in brain size.
- The creation of fire affected cultural evolution by producing light. This allowed for a longer active day for *H. erectus*, so they were able to have more time for social interaction and for activities like arts and crafts. This allowed for further development of communication, tools, and the increase in brain size. Biological evolution was also affected by the creation of fire, with the hominins being able to easily eat and digest their food because of being able to cook it. The cooking of food also killed microbes, which made food safer to eat. With the food being digested better by the body, it led to an increase in brain development which helped with cultural evolution. The softer food meant that the jaw muscles could decrease in size due to not needing excessive force to chew the food. This lead to a decrease in the size of the zygomatic arches, teeth, jaw, brow ridges, and sagittal crest.
- The change from hunting and gathering to using agriculture to obtain food, led to an increase in cultural evolution with new skills and tools developing as a result of cultivating their own plants and domesticating animals. This provided the early humans with a constant source of food, which allowed for the development of communities and larger populations that stayed in a permanent location.
- The advantages of farming include; hominins were able to settle down in one place, grow their own crops for food, domesticated animals such as sheep and pigs, the development of villages and large populations, fewer people died from starvation, and allowed for more time to be dedicated to other activities like arts and crafts. The disadvantages of farming include; the restriction of the hominin diet due to what they could grow, the growth of food and health of animals depended on the weather, disease became a problem due to dense populations, and it led to fighting for animals and land.

Human Origin and Dispersal

Mitochondrial DNA and Y Chromosome Analysis

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- Mitochondrial DNA is passed down from mother to child, and Y chromosomes are passed down from father to son. Both of these do not get altered by crossing over in meiosis, so can be used to determine lineages of individuals.
- Mitochondrial DNA is found inside the mitochondria which encode for the proteins in the mitochondria, and is circular and inherited from your mother only. Regular DNA is found in the nucleus of a cell and encodes for the characteristics and traits of the organisms, and are shaped like a double-helix that can mutate.

What is Dispersal?

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- Dispersal means that the hominins left Africa and moved somewhere else around the world.
- Multiregional theory: some *H. erectus* left and some stayed in Africa, where the ones that moved evolved into Homo sapiens. Out of Africa: *H. erectus* evolved into *H. sapiens* in Africa, then some left Africa.
- Climate change would have caused the dispersal out of Africa. New land would have been exposed due to the drop in sea level, allowing Homo erectus to move out of Africa to find more food.

Replacement Theory

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- Dispersal occurred by some *H. erectus* leaving Africa 1-2 million years ago but died out. The *H. erectus* still in Africa evolved into Homo sapiens, which then left Africa 125,000 to 65,000 years ago, and replaced *H. neanderthalensis*.
- The Out of Africa Model is supported by fossil evidence. Where the oldest Homo sapiens fossils were found in Africa. As well as everyone is found to be originated from a small group of people who left Africa, and African populations are older and more diverse, therefore suggesting that *H. sapiens* originated from Africa.

Multiregional Theory

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- Dispersal occurred by *H. erectus* leaving Africa and forming different populations in different areas of the world, and then evolving into *H. sapiens*. But there was some gene flow between the populations so that the same species was formed.
- It was found that a few transitional fossils that were found in Asia that were older than *H. sapiens*, so suggests that they evolved simultaneously in different parts of the world.
- If the Multiregional model was true, then there would be a lot more genetic variation in the world than there already is.

Human Origin and Dispersal

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- The dispersal of hominins out of Africa has two theories; Out of Africa, and the Multiregional model. The Out of Africa theory suggests that dispersal occurred by some of the *H. erectus* leaving Africa 1-2 million years ago, but most of them died out due to environmental conditions. The *H. erectus* that still lived in Africa evolved into *H. sapiens*, which then left Africa 125,000 to 65,000 years ago, and replaced the *H. neanderthalensis* that would have evolved from the

first set of *H. erectus* that attempted dispersal. The Multiregional model suggests that dispersal occurred by *H. erectus* leaving Africa and forming different populations in different areas of the world, and then evolving into *H. sapiens*. But there was some gene flow between the populations so that the same species was formed. The scientific finding that states that Neanderthal species share as much as 4% more of their genome with non-Africans than with Africans support the Out of Africa theory well. This is because the *H. sapiens* that moved out of Africa interbred with the Neanderthal that had evolved from the first group of *H. erectus* that had moved out of Africa and into Asia and Europe 1-2 million years ago. This explains why there is a small amount of DNA that comes from non-African populations. The evidence, however, does not support the Multiregional model as it would have needed to be present in African populations too due to gene flow between populations. The evidence that Denisovans share 4-6% of their genome with living humans from Melanesia, but not with any other living group supports the Out of Africa model of human dispersal well. This is because the *H. erectus* that left Africa in the first lot of dispersal over 1-2 million years ago, would have moved to Melanesia and then evolved into Denisovans. The *H. sapiens* that then evolved in Africa would have left Africa and then interbred with the Denisovans. The evidence does not support the Multiregional model, due to occurring in only one area of the world, whereas it would have had to occur in each population due to gene flow. The evidence from a Y-chromosomal analysis that all living males have the same ancestor from 140,000 years ago from Africa really supports the Out of Africa theory of human dispersal. This is because the Y-chromosome not being able to be crossed over during meiosis, so can map the chromosome back to its original ancestor, which in this case is *H. sapiens* and originates from Africa at the time that the second wave of dispersal occurred. The evidence doesn't support the Multiregional model very well, as it suggests *H. sapiens* evolve from an African ancestor, not from various racial ancestors.

