Year 13 Science: How hominins spread across the world

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. Which hominin was the first known to leave Africa, and about when?

2. From which parent do you inherit your mitochondrial DNA?

3. A haploid human genome is about 3.1 billion bases. How many bases is 4% Denisovan DNA?

4. Explain why African populations are the most genetically diverse.

5. Put these in order of first settlement: Aotearoa, Tonga, the Society Islands.

Exam-style question: our mixed ancestry

Fossils show that Homo sapiens lived in Africa from about 300 000 years ago, while Neanderthals lived in Europe and western Asia and Denisovans in Asia. Living people of European and Asian descent carry about 1 to 2% Neanderthal DNA, and Papuans carry about 4 to 6% Denisovan DNA. African populations have the greatest mtDNA diversity of any region.

6. Describe the Out of Africa (replacement) model.

7. Explain how mtDNA evidence supports an African origin for Homo sapiens.

8. Explain why Papuans carry Denisovan DNA but most Europeans do not.

9. Discuss whether the evidence supports a strict replacement model, the multiregional model, or something between.

Fix the mistake

10. Correct this statement: "Homo sapiens was the first hominin to leave Africa."

11. Correct this statement: "Mitochondrial Eve was the only woman alive at the time."

12. Correct this statement: "Mitochondrial DNA comes from both parents."

13. Correct this statement: "The Out of Africa model is wrong because people carry Neanderthal DNA."

Answer key (for parents and tutors)

1. Which hominin was the first known to leave Africa, and about when?
   Homo erectus, about 1.8 million years ago (Dmanisi, Georgia).
2. From which parent do you inherit your mitochondrial DNA?
   Your mother only.
3. A haploid human genome is about 3.1 billion bases. How many bases is 4% Denisovan DNA?
   0.04 × 3.1 billion = 0.124 billion = 124 million bases.
4. Explain why African populations are the most genetically diverse.
   Humans have lived in Africa longest, so more mutations have built up there, and everyone outside Africa descends from small groups that carried only part of that diversity (founder effects).
5. Put these in order of first settlement: Aotearoa, Tonga, the Society Islands.
   Tonga (Lapita, about 2800 years ago), the Society Islands (about 1025 to 1120 CE), then Aotearoa (about 1250 to 1300 CE).
6. Describe the Out of Africa (replacement) model.
   Homo sapiens evolved in Africa only, then spread to the rest of the world and replaced the earlier hominins living there, with little or no interbreeding (Achieved).
7. Explain how mtDNA evidence supports an African origin for Homo sapiens.
   mtDNA is inherited from the mother without recombination, so lineages can be traced back; all human mtDNA traces to an ancestor in Africa, African populations hold the most diversity because people have lived there longest, and non-African lineages form one branch within the African ones, fitting a small founding group leaving Africa (Merit).
8. Explain why Papuans carry Denisovan DNA but most Europeans do not.
   The ancestors of Papuans travelled east through Asia, where Denisovans lived, and interbred with them before reaching New Guinea; the ancestors of Europeans moved west, where there were Neanderthals but few or no Denisovans, so they gained Neanderthal DNA but not Denisovan (Merit).
9. Discuss whether the evidence supports a strict replacement model, the multiregional model, or something between.
   The African fossils, the mtDNA tree and the fall in diversity away from Africa support a recent African origin, which the multiregional model cannot explain, because separate regional evolution would not produce a single African-rooted tree or the serial founder pattern. But the 1 to 2% Neanderthal and 4 to 6% Denisovan DNA shows that the replacement was not total: Homo sapiens interbred with the hominins it met. So the evidence supports something between, a mostly African origin with limited interbreeding (assimilation), with the small percentages showing that most of our genome is still African in origin (Excellence).
10. Correct this statement: "Homo sapiens was the first hominin to leave Africa."
    Homo erectus left Africa about 1.8 million years ago, long before Homo sapiens evolved.
11. Correct this statement: "Mitochondrial Eve was the only woman alive at the time."
    Many women lived then; only her mtDNA line happens to survive, because other lines ended with women who had no daughters.
12. Correct this statement: "Mitochondrial DNA comes from both parents."
    mtDNA comes only from the mother, through the egg's mitochondria; the Y chromosome traces the father's line.
13. Correct this statement: "The Out of Africa model is wrong because people carry Neanderthal DNA."
    The origin was still African; the DNA shows a small amount of interbreeding, so the replacement was not complete.