

Task

Developing a Molecular Clock Model

In this activity, you will develop a model of a molecular clock to show the evolution of a species' genome.

 Estimated time: 2 hours

Part A

You will create a molecular clock model for an arthropod gene. Follow these guidelines to make your model:

- Your timeline will span from 90 million years ago to the present. The common ancestor in your model is an arthropod that lived 90 million years ago. The gene that you'll track codes for a protein in the species' venom.
- The DNA sequence you'll track contains 10 nitrogen bases. You can choose the order of the bases and where the mutations occur.
- This gene mutates at a rate of approximately 0.76 base pairs every 17.1 million years. To build your model, calculate the estimated time period it takes for 1 base pair to mutate.
- The first time period will only show the common ancestor. At the beginning of the second time period, three lineages will diverge from the common ancestor, each with a different mutation in their gene sequences.
- The first and third descendant species will survive for the rest of the timeline. The second descendant species was extinct 50 million years ago.

Calculate how long it will take for one full base pair mutation to occur. Explain your reasoning by constructing a mathematical equation.

Answer:

Characters used: 0 / 15000

Part B

Using this [sample model](#) as a guide, create a molecular clock model. Use the flowchart tools in your word processing program to make your model. Make sure the mutations are clearly visible in the strand. Consider using a different font color for the mutations. Use the Insert Image button to insert a screenshot of your model in the answer space provided.

Answer:

Characters used: 0 / 15000

Part C

Examine the differences between the common ancestor's original gene and the genomes of the existing species. How can these changes affect the development of the protein in the descendant species?

Answer:

Characters used: 0 / 15000

Part D

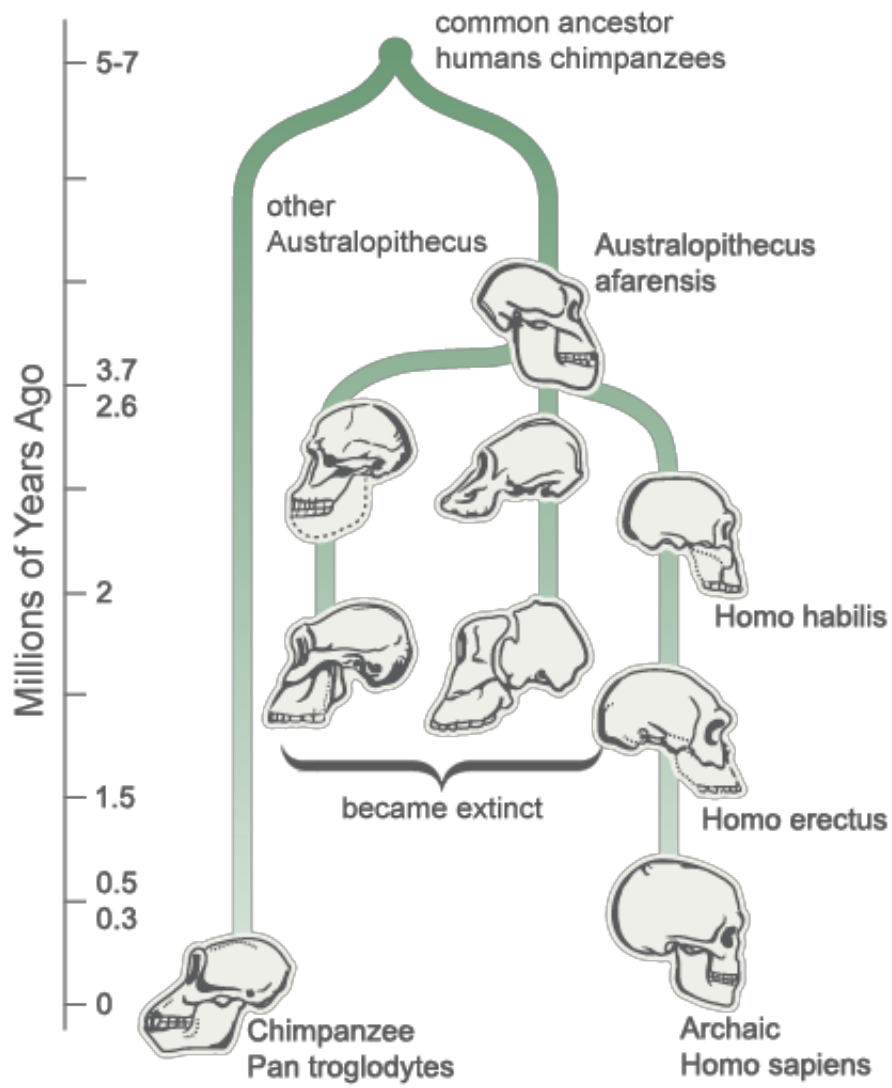
The idea of molecular clock genes has been studied for decades, but the hypothesis remains a controversial topic in evolutionary biology. Why do you think that is the case? What are three questions you still have about the use of molecular clocks?

Answer:

Characters used: 0 / 15000

Part E

Your molecular clock model resembles another branching chart, the phylogenetic chart, which you've used in this unit. Review the sample phylogenetic chart. What types of data are used to build a phylogenetic chart? How do phylogenetic charts differ from molecular models, such as the molecular clock model?



Answer:

Characters used: 0 / 15000

Part F

Woolly mammoths became extinct around 10,000 million years ago. A recent study conducted by scientists found that the last generations of woolly mammoths were plagued by harmful gene mutations. Some of the mutations caused them to have softer fur that didn't protect them from the cold, a diminished sense of smell, and digestive problems.



A species potential for evolution is based on four factors:

- the potential for a species to increase in number
- the heritable genetic variation of individuals in a species due to mutation and sexual reproduction
- organisms competing for limited resources such as food or water in their environment
- the proliferation of those organisms that are better able to survive and reproduce in the environment

In two to three paragraphs, explain why the last generations of woolly mammoths couldn't meet these factors to evolve in a changing environment. Also explain how data such as the fossil record and DNA evidence can identify the factors that can lead to the evolution of a species.

Answer:

Characters used: 0 / 15000