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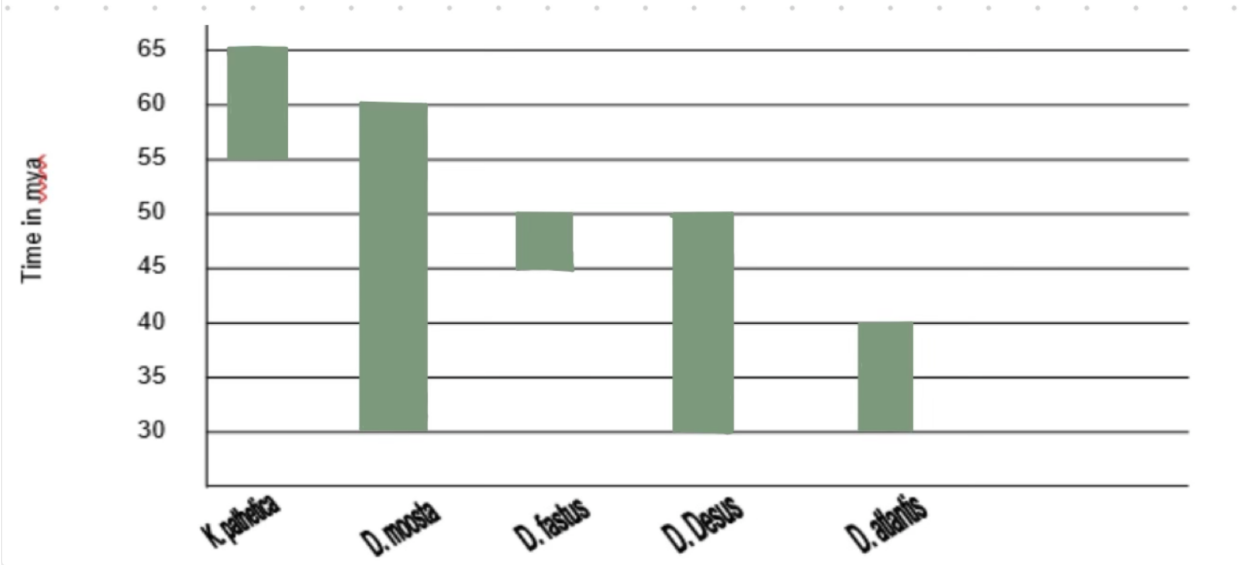
Mrs. Stott
AP Biology Section 3 Group 4
24 April 2023

Utopia Project: Use your textbook, and other sources. Use at least 5 independent, reputable, cited sources!!

Individual Questions: Thinking BOTH ecologically and evolutionarily

Each individual must answer the following questions
Indicate on the map which species appear in each area; then answer the following about their evolution.
Incorporate specific examples and use as much of your evolution vocabulary as possible! Use timelines and dates. Draw pictures. Make graphs. Be explicit about the type of evidence you are using, anatomical ,geological, hydrological. **You must cite where you got your information from.**

1. Use the space below to make a graph of the time span each of the different species occupied.



Explain all questions below from both an evolutionary point of view and an ecological point of view. Be specific!

2. Why does D. moosta appear on both Mainlandia and Utopia Major?
   - The fossils of D. moosta appear on both Mainlandia and Utopia Major as a result of the splitting of land under 60 million years ago. Because of this geographical separation, it is possible that this was one collective area that the species was found in and died, leaving fossils that were eventually taken with the land as it split. Because the fossils were from the same species, it is more likely that the species lived before the land had split because once the geographical separation sets in, allopatric speciation is likely, and the fossils left behind would then more likely be from species that evolved from D. moosta after

separation, rather than D. moosta itself. There is supportive evidence of this in history. Fossils of the reptile cynognathus were found on both South America and Africa, continents that were once adjacent. This reptile was unable to swim, and thus, the only way for the fossils to have been found on both is if the species lived together while the continents were connected, and died, leaving the fossils on the land that would then be separated.

3. Explain the distribution of D.fastus, D desus and D. atlantis on Utopia Major.
    - D. fastus - There is evidence to suggest that D. fastus was the main prey of a large jungle cat, indicating that the area that D. fastus populated was jungle-like. It also ate leaves off trees, which was likely made easier by its long legs that allowed it to reach the leaves on trees. It was only found in location F, which likely was a jungle landscape. Additionally, the mountains provided a geographical barrier which may be the reason that this specific species was only found in one location on the west of the island.
    - D. desus - D. desus lived in the area east of the mountain range, which was a desert. There is evidence in history of this being because of the phenomenon known as a rain shadow. Because the mountain range blocks most of the rain from hitting that land, a desert is created.
    - D. atlantis - D. atlantis was found on Utopia Major after evolving from another Deeropsus species, likely D. desus. They were found to eat seaweed and had a flattened tail, making it likely they were able to swim. Thus, while they originated on Utopia Major and lived on the coast, they may have swam back to Mainlandia which is why their fossils were found there from a later date.
4. Explain the disappearance of K. pathetica on Mainlandia and Utopia Major. Be detailed.
    - The Paleocene-Eocene Thermal Maximum occurred 55 million years ago, which increased the global temperatures, leading to widespread extinction. The global temperatures increased so dramatically, that the polar ice caps melted, and the North Pole reached a temperature of 73 degrees fahrenheit, meaning the temperature near the equator was much higher. The increase of temperature also called for the increase of sea levels. K. pathetica lived near the coast in every site, and with the increase in sea levels, the water may have flooded the area, which was once a grassland. Because of this, given that K. pathetica relied on low lying shrubs and leaves to eat which were likely wiped out by floods, K. pathetica lost its main food source and thus, began to die out.
5. Explain the distribution of D. atlantis.
    - D. atlantis was an organism that was able to swim. It began on Utopia Major after evolving from a previous Deeropsus species. Its flat tail is used, as platypus do, to propel it through the water since its hooves don't help. It resides on the coast, almost completely surrounded by water where it can access its main food source, seaweed. Once it reached its carrying capacity, likely brought about early by the beginning of the Oligoeocene epoch, where the global temperatures began cooling and the sea levels began to fall again, it opted to migrate elsewhere in search of food and resources. This is when it migrated east back to Mainlandia, 35 mya, as indicated by the dating of the fossils.
6. Why were none of these species found on Utopia Minor? Be detailed.
    - Utopia Minor was an island of volcanic origin, depicted to have a volcano still on it. There are several reasons why animals wouldn't want to live near a volcano. But, given that only one of our species can swim, and not at terrible long distances, it is highly unlikely that any of the species would be able to travel to Utopia Minor to begin with.

Other than the travel, the constant threat of volcanic eruptions or repeated eruptions themselves can interfere with the likelihood of a long lasting species on the island. Additionally, volcanic gasses pose a threat to life as well. Too much carbon dioxide can lead to death. Sulfur dioxide can irritate skin, eyes, and lungs. Breathing in high levels of hydrogen sulfide can cause death and hydrogen halides can poison drinking water or crops.

7. What effect, if any, does the presence of the mountain range on Utopia Major have on the divergence of species? Under what types of conditions are new species formed.

- The presence of the mountain range on Utopia Major acted as a barrier that influenced the divergence of species. by separating species and isolating them. the mountain range can cause species to evolve through allopatric speciation, where the mountain acts as a geographical barrier. With allopatric speciation, a second species will evolve from the first because it is forced into isolated reproduction. The species adapts to the new environment it is in because of the barrier and reproduces with other individuals that were also forced into that same new environment.

8. Why did D.fastus become extinct 15 million years earlier than the other Deeropsi on Utopia Major?

- D, fastus was localized to a small area bounded by geographical features on all sides. With the ocean on one side and mountains on the other, it was essentially trapped. Partnered with the fact that they were listed as the main prey of a jungle cat species, it is entirely possible that they were overhunted by these jungle cats. Cats are known to hunt and kill, even when not hungry. They also have driven several species toward extinction.

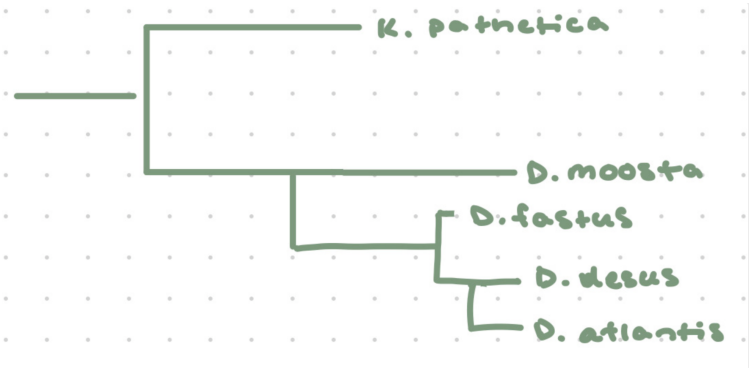
9. Using your knowledge of evolution come up with a theory that explains the distribution of species on both Mainlandia and Utopia Major. Give plenty of geological detail, and time frame details here.

- K. pathetica was first found in locations A and C and shared a common ancestor with D. moosta around 160 million years ago. They likely evolved together to both be fit in their environment which was mostly grasslands. Once D. moosta came into the environment, also competing for the same resources, K. pathetica individuals migrated north 60 mya, to site B. Sometime over 50 million years ago, Utopia Major broke off of Mainlandia, taking D. Moosta individuals with it. The individuals gradually explored the island, moving into deserts and jungles and establishing populations 50 mya. D. fastus, which lived in the jungle in Site F, was quickly outnumbered by its main predator, the jungle cat, and went extinct soon after establishment, 45 mya. D. desus lived in the desert in Site D, but as they reached carrying capacity, individuals migrated north to the coastal areas or wetlands of Site E, allopatrically evolving into D. atlantis, a semi-marine Deeropsus 40 mya.

10. Come up with a theory to explain why all the Deeropsi became extinct 30 mya.

- All the Deeropsi became extinct 30 mya because as the Oligocene epoch settled in, the global temperatures cooled. This caused the sea levels to fall once again and for ice sheets to form. This transition between epochs wiped out 63% of all African and Arabian mammalian species. Carbon dioxide levels decreased and forests or swamps turned into grasslands. This would have disrupted the habitats of the Deeropsi. In disrupting the habitats it would have further impacted their food sources. A combination of all these factors would have been the reason for the extinction of all Deeropsi 30 mya.

11. Draw a phylogenetic tree of these species.



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12. Would you argue the evolution of these species from a gradualist or a punctuated equilibrium point of view? Support your answer.

- I would argue the evolution of these species from a punctuated equilibrium point of view based on the provided evidence. These species emerged in intervals, without mention of prominent intermediary fossils. Thus, it is likely the evolution occurred in short bursts, with a long period in between with no significant change.

13. Is this micro or macro evolution? Explain.

- This is macroevolution. Macroevolution involves the evolution and patterns of change in several species involving global events like extinction. These fossils come from several different species that are related in some way, and show evidence of involvement with mass extinctions.

14. What kind of fossil evidence could determine the difference between marsupial and placental mammals, where an organism dwelled?

- Fossil evidence of the pelvic structure can be useful to determine the difference between marsupial and placental mammals as marsupials had pouches in which they would raise their young and had different reproductive structures. However, in addition to that, one can examine the actual bones individually, where in placental mammals, there is a layer of woven bone in between two layers of “organized” bone. In marsupials, though, all of the bone was “organized” in which the bone tissue is arranged parallel to one another.

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