



How do college students think that horse features changed over time as horses evolved?



The Scientific Perspective

What do scientists believe?

- Scientists focus on how the horse evolved from an ancestor with five toes to the animal we know today.
- Horses evolved to live on open grasslands. They adapted to their environments.
- They believe that all five digits have merged to form the compacted forelimbs with hooves that we know today.
- Scientists accept that small bones found along the outer sides of the metacarpal in modern horses, are partially formed remnants of second and fourth digits.



What is the goal of this study?

- The goal of this study is to answer the question: how did horse features change over time as horses evolved?

Methods Used

How was data collected?

In order to accurately collect data, a questionnaire was distributed to 10 CCRI college students.

- The research question is: **How do students think that horse features changed over time as horses evolved?**
- The questionnaire is: **List two features of early horses that are different than modern day horses.**

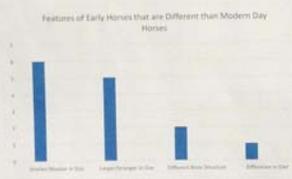
This type of questionnaire was asked to truly see what college students could say about the evolution of horses based on their knowledge of the features of modern day horses. Even if they had very minimum knowledge regarding modern and ancient horses, they could make an educated guess.



Results/Data Analysis

Questionnaire: List two features of early horses that are different than modern day horses.

Below is a graph displaying the students answers to the questionnaire in four main categories:



Based on the results, it is clear that students focused more on the size of the horses more than any other feature. This may be due to their limited knowledge of the evolution of the horse but it is a well-educated guess.

Discussion

The Research Question Answered:

- College students believe that the most significant change throughout horse evolution is its size, and they are correct.
- This brings us to the conclusion that college students have a good educational background to answer a question about evolution.

The Results:

- The results show that college students do have limited knowledge about horses and their evolution process.
- The results answer my research question because they show what college students know about horses, the theory of evolution and how they can put both together to make their best educated guess.
- What interested me most was that a majority of the students described the difference in size of the horses

Conclusion/The Big Picture

Why is this important? What does it show?

The data and results provide an outlook on what college students idea of horse evolution is. When they were asked the questionnaire, they answered mainly about the size of the horse along with various other ideas.

The Big Picture:

- How horses evolved
- Students can learn from this and apply their knowledge of how evolution works to other animals
- Students make their best educated guess when given a question they are unsure about



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How did the mass extinction of dinosaurs occur?



Introduction:

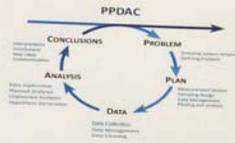
Around 65.5 million years ago the mass extinction of the dinosaurs occurred killing off around sixty percent of the living species at the time. Over the years many scientists have conjured up their theories on what caused this mass extinction but none had actual evidence to support their theories. That is until the father and son paleontologists duo of Luis and Walter Alvarez discovered a layer of Iridium in the Earth's crust that can only be found in outer space. It was also found that this layer was dated back to the time that the mass extinction occurred as well.

Research Question: What do college students think about what caused dinosaurs to become extinct?

Questionnaire Question: About 65 Million years ago dinosaurs went extinct. Explain in your own words what event(s) occurred that caused the mass extinction of dinosaurs?

Methods:

To explore college students understanding and comprehension of the events that occurred 5 million years ago I handed out fifteen pieces of paper that contained nothing but my questionnaire question on it. The fifteen students were to then answer the question in their own words and return it to me. Five of the fifteen answered with I do not know or not sure so those five were not included in my data. The other ten students responses were then grouped together by similarities and then analyzed.

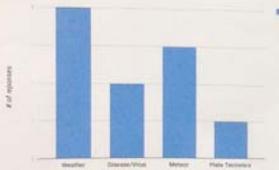


Responses:

Pile Name	Description	# of responses
Weather	Answer involved climate weather conditions	4
Disease/Virus	Answer involved the words "virus" and or "disease"	2
Meteor	Answer discussed a meteor hitting the Earth and wiping out dinosaurs	3
Plate Tectonics	Answer said plates shifting caused massive Earthquakes killing off all the dinosaurs	1

- These ten responses were grouped into four different sections depending on their similarities to one another

Results:



Data Analysis:

A majority of the students wrote down an answer involving harsh weather conditions such as floods and or earthquakes. The next most abundant answer was that a meteor hit the Earth which killed off all the dinosaurs. I had predicted that this would be the most common answer among the college students but it was the second most common. Next was that a disease and or virus killed off the dinosaurs. And finally, a student wrote that severe shifts in the Earth's plates killed off all the dinosaurs.

Incorrect Responses:

Incorrect answer 1: Extreme weather conditions such as a severe flood caused the dinosaurs to die off.

Incorrect answer 2: A virus or disease caused the mass extinction of the dinosaurs.

Incorrect answer 3: The Earth's plates shifted dramatically at this time and caused all the dinosaurs to die; whether they were buried, crushed or drifted away from their food supplies.



Correct Answer:

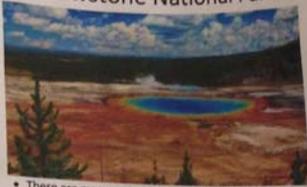
The Cretaceous-Tertiary extinction event, or the K-T event, is the name given to the mass extinction of the dinosaurs and other species that inhabited Earth around 65.5 million years ago. For years now, paleontologists have believed that this event was caused by climate and geological changes that interrupted the dinosaurs' food supply, so therefore they could no longer survive. But in the 1980s, father-and-son scientists Luis and Walter Alvarez discovered in the geological record a distinct layer of iridium—an element found in abundance only in space—that lines up correctly with the time the dinosaurs became extinct. This new found layer of iridium suggests that a comet, asteroid or meteor impact event may have caused the extinction of the dinosaurs. This is fairly huge because previously there had been many theories of how the dinosaurs went extinct but no proof and now there is evidence to back up a theory.



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Yellowstone National Park



- There are many varieties of life as well as geological features present in the Park.
 - Some animals include Wolves, wolverines, bison, and tiger salamanders.
 - Geological features include: Geysers, calderas, lava flows, and many earthquakes.
- Yellowstone has been home to 3 eruptions in the past, 2 of which were super eruptions
 - The eruptions were around 640,000, 1.2 mya, and 2.1 mya, each one being more than 700 times larger than the Mt. St. Helens eruption with the largest being 6,000 times the size.
 - The calderas form because of magma chambers rapidly releasing most of their contents, leaving behind a cavity that causes ground above to cave in.

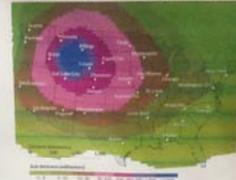
Methods



- An open-ended question was used because the research question needed to pull information about what people knew about Yellowstone.
- The question asked is, "What do college students know about the geology of Yellowstone and the Super volcano contained there?"
- The people included in this study are 11 college students picked from the school's cafeteria randomly at lunch.

Discussion

- Most students know that geographically, Yellowstone is in the western United States.
- Students also tend to know that there is some sort of a volcano there.
 - Many of them also know that in the event of an explosion from the volcano many issues may arise.
- The student population is generally well aware of Yellowstone's existence and possible future, however, many of the students were unsure of their answer or took educated guesses as to the possible effects.
 - The magnitude of the events was also either exaggerated or underplayed. Many assumed that the initial explosion would be the worst occurrence, when it's the ash fallout and subsequent cooling of the Earth that

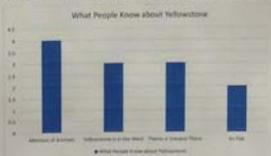


- If the super volcano were to erupt again, it could have devastating, but not world ending effects.
 - An eruption would cause immediate damage to Yellowstone; the ground would collapse forming another caldera, magma eruptions would burn everything and heat up surrounding air to a possible 300 degrees.
 - Air quality further out would drop as ash and escaped volcanic ashes disperse.
 - Ash fallout would disperse across most of the US causing machinery such as cars and airplanes to malfunction due to the fineness of the ash.
 - With the dispersion of the ash also comes the darkened skies. The sun would be obscured for a time causing plant life and subsequently animal life to suffer.
 - The release of sulfur into the atmosphere would cause a rapid change in global temperature, cooling the Earth and creating climate change.

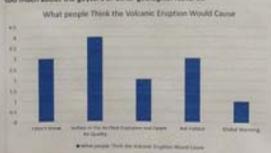


Results

- 1) What do you know about the geology of Yellowstone National Park?
- 2) What do you think would happen if the super volcano there was to erupt?



Most people know about where Yellowstone is and that animals live there but not too much about the geysers or other geological features.



would have to most devastating effects on the world as we know it.

- For the most part though, students understanding, and perspective matched the scientific understanding, save for some who thought the volcano was due to erupt, which is untrue.
 - The fact that many thought the volcano to be due for an explosion is interesting because it shows the media's propensity to exaggerate or inflame an issue's urgency.

Conclusion

- Students know that Yellowstone does contain a super volcano and know that the effects of an eruption from it would be impactful.
- Students also know where Yellowstone is but not much about the rich features of its geology.
- In general, students are correct in their knowledge of the events that would come out of an explosion from Yellowstone.

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Why do college students think the size of the oceans change, if at all?



Introduction

Do Oceans Change in Size?

- Yes, all oceans are currently changing in size.
- Oceans change in size due to plate tectonics.
- Depending on the plate boundaries, oceans can either be growing, or shrinking.

How do plate tectonics and plate boundaries play a role?

- There are three types of plate boundaries; Convergent, Divergent, and Transform.
- Convergent and Divergent lead to the change in ocean size.
- Convergent boundaries are when two plates are colliding, reducing the space between the two plates. Shrinking Oceans
- Divergent boundaries are when two plates are separating, creating more crust and space. Growing Oceans

The goal of this study is to understand what college students think is happening to the size of the oceans and why.

Methods

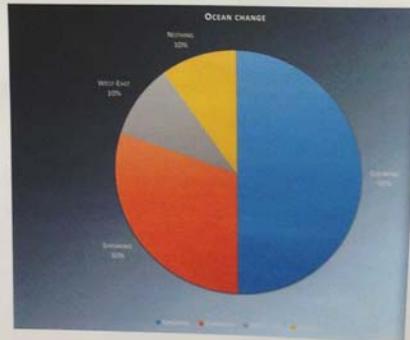
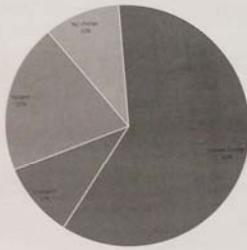
- In order for my research question to be answered, I needed to design how it would be asked.
- I chose to use a labeling question, where the students would use arrows on a map to explain how they felt the ocean size was changing, if at all.
- The labeling question allows for a student without much Geology background, to answer the question definitively with arrows, followed by a brief description as to why they chose the direction of the arrows.

Why do college students think the size of oceans change, if at all?

The above question was asked to 10 CCRI students, who have not taken a Geology course while at CCRI.

The students were chosen at random in both the library and cafeteria.

Reason for Ocean Change



Discussion

1. 90% of the CCRI students who answered the question, believed that the oceans were changing in size, somehow.
 - This is significant because it shows that a vast majority of the students understand that the oceans do not just sit still forever.
 - It also shows that most students understand a broader concept of plate tectonics, without realizing the specifics of plate tectonics.
2. 10% of the students or 1/10 answered the question correctly with the arrows followed by the proper reasoning.
 - Most students do not understand the specific concepts of plate tectonics, which consists of Divergent, Convergent, & Transform Boundaries.
3. 60% of the students believe that the oceans are changing in size due to climate change.
 - The concept of climate change and oceans usually go hand in hand, which is probably why most students answered this way.
 - The specific reasons for climate change aren't fully understood by most students, but they often hear about how glaciers are melting and the sea level is rising, hence why 50% of the students believed the oceans were growing.

*I feel strongly that these results would hold up on a larger scale as well, due to the lack of understanding about plate tectonics and how it affects ocean size. Many are aware the oceans aren't static, but do not know specifically why.

Climate change is a very important topic in today's society, and many hear about sea level rising, which is why the assumption is placed on ocean size is growing. The two concepts of plate tectonics and climate change need to be understood separately.

Conclusion

1. We can conclude that the vast majority of students polled, believe the oceans are growing, but do not have the correct reasons as to why.
2. Climate Change seems to be a safe answer when dealing with a question regarding oceans.
3. Students are unaware of how plate tectonics work, which is why many were not able to answer the question correctly.
4. Students understand that Earth is not just remaining static, and even reference Pangea as to how the continents and oceans were once located, but many do not understand why and how it has changed.

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Animals Evolving

Introduction

Scientific Perspective-

- When animals evolved-
600 Million years ago
- What time era animals evolved in -
Precambrian (End of Proterozoic)
- What paleontologists used to prove when animals evolved-

Imprints and Tracks

Goal of my Study-

- **The goal of my study is to answer the question: When do college students think animals first evolved?**

Methods

Justification- I choose to do an open-ended question for my questionnaire. Each college student had to answer how long ago they thought animals first evolved, and then they had to explain their answer. I thought this was the best type of question to use because once I collected my data, I was able to group the numbers into each time era on the geologic time scale. There are four-time eras on the geologic time scale which are Precambrian (4,600-540 mya), Paleozoic (540-250 mya), Mesozoic (250-66 mya) and Cenozoic (66mya -now).

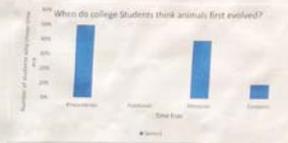
My study instrument- The question that I asked was: **How many millions of years ago do you think animals first evolved? Remember that Earth is 4,600 million years old. Explain your number.**

My study population- I studied a group of ten college students that are in my other classes at CCRI



Results

Summarizing results- I found out that most college students think that animals evolved in the Precambrian era or the Mesozoic era. This is because 50% of the college students I surveyed said they think animals evolved in the Precambrian, and 40% of the college students said that animals evolved in the Mesozoic. The last 10% of college students I surveyed said that animals evolved in the Cenozoic era.



Discussion

What my results mean-

My results showed me that most college students are not aware of when animals evolved. Although half of the surveyed students were in the right era, it was for the wrong reasoning. Animals didn't evolve until long after earth formed, but since the Precambrian era was so long, many answers fell into that era.

My results were very interesting-

I found my results interesting because most college students gave the same reasoning. The students who choose the Precambrian era said this was because animals evolved right after earth formed. If the college students choose the Mesozoic era, they gave the reasoning that animals didn't evolve until long after earth formed.

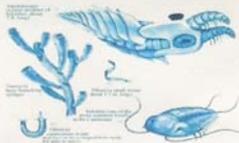
What these results showed me-

These results showed me that unless a college student takes a geology class, they most likely are not aware of when animals evolved. Before I took this geology class, I was not aware of when animals evolved. I probably would have answered that they evolved soon after earth formed.

Conclusion

After doing this survey and analyzing my results I have concluded that-

- College students think that animals evolved soon after earth formed which was 4,600 million years ago.
- This showed me that most college students are not aware of when animals evolved because they evolved 600 million years ago. This was at the very end of the Precambrian.
- Unless a college student takes geology, they most likely will not be aware of when animals evolved.
- I think all college students should take geology because it is important we are aware of how evolution works and when these first multi-celled animals evolved.



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Introduction

Survival of the Fittest

The Scientific Perspective on Survival of the Fittest.

→ The continued existence of organisms which are best adapted to their environment, with the extinction of others, as a concept in the Darwinian theory of evolution

What does that really mean?

→ Darwin meant "fittest" to mean the one best suited for the immediate environment. This means that just because an animal is stronger or faster does not mean they are the "fittest" for every environment.

Goal for this study

→ The goal of this study is to determine what various college students believe "Survival of the fittest" means when connected to Evolution.



Methods

Type of Question asked

→ Labeling Question with an open ending to explain. I used this type of question because it allowed me to set up two different scenarios for the college students and gave them room to give their reasoning.

Questionnaire Question

1) On the numbers below, label each picture from most fit to least fit for living in a cold and snowy environment. Explain your answer.



Most Fit _____ Least Fit

Explain:

2) The cold and snowy environment changed to a warm and dry environment. Now label the most fit to the least fit. If at all, how did the order change and why?

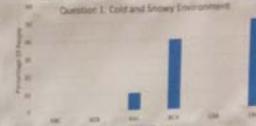
Most Fit _____ Least Fit

Explain:

Results

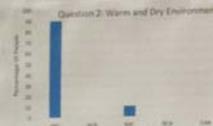
Question 1: The question regarding the cold and snowy environment had more of a diverse outcome of answers.

- 10% = White lion, Lion, Penguin
- 40% = White lion, Penguin, Lion
- 50% = Penguin, White lion, Lion



Question 2: The question regarding the warm and dry environment showed much more agreement among the college students.

- 10% = White lion, Lion, Penguin
- 90% = Lion, White lion, Penguin



Discussion

Correct answer to questions:



What did the results mean?

- 50% of college students got question 1 correct.
- 90% of college students got question 2 correct.

Why are these results interesting?

→ This is interesting to me because only 50% of the students got question one correct while 90% got question two correct. I believe that is because many students think that lions will always be more fit than penguins.

How I could build on this study.

→ If I were to build on this study I would like to see animals that all had similar strength. This would then force the people in the survey to only focus on the best characteristics for the environment rather than on the strength of the animal. This would allow students to understand better that your environment is what determines the animal's "fitness".

Conclusion

→ Most College students believe that "Survival of the fittest" when connected to evolution means the strongest and largest animals.

→ I came to this conclusion because only half of the students were correct when the penguin was the most fit. When I switched the situation to an environment where the lion would be the most fit nine out of ten people knew that the lion was the fittest.

→ It is important to know that the "fittest" is not always the strongest, it is the one best suited for that certain environment.



References

The meaning and origin of the expression: Survival of the fittest, <https://www.phrases.org.uk/meanings/survival-of-the-fittest/>, accessed March 20, 2018.

Definitions, <https://www.definitions.net/definition/survival-of-the-fittest>, accessed March 22, 2018.



Animal Fossilization

Questionnaire / Research question

What do college students think are the characteristics of animals that are most likely to become fossilized?

Conclusion

Based on the results that I asked many other students and friends is that many people are not that aware of how animal fossils are formed. Animals fossils are formed based on the parts of an animal such as hard parts or soft parts. Also the sediments they are formed in such as the environment can tell alot about the animal.

References

"How Are Fossils Formed?" *Fossils Facts and Finds.com*, 23 Apr. 2018, www.fossils-facts-and-finds.com/how_are_fossils_formed.html.

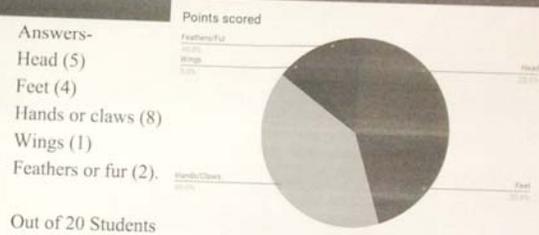
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Research Question/Intro

How are animals fossils preserved? Which parts of an animals are preserved better than other parts of an animal's body?

Questionnaire results



How are animals mostly fossilized.

Fossils are the record of life preserved in monuments of stone. Almost all living organisms can leave fossils, but usually only the hard parts of plants and animals fossilize. Soft internal organs, muscle, and skin rapidly decay and are rarely preserved, but the bones and shells of animals are good candidates for fossilization. Almost no fossil record exists for soft organisms such as jellyfish and worms.

INTRODUCTION

- Quartz crystals form through a process called crystallization.
- Quartz crystals are formed by the hydrothermal process. The word, when broken down is hydro, meaning water and thermal, meaning temperature.
- Quartz crystals form under conditions of high temperature, in the presence of water and under high pressure, deep beneath the Earth's surface.
- The majority of quartz crystallizes from molten magma; some quartz also can be produced through hydrothermal veins.
- The goal of this study is to answer the question, "What do college students think about how quartz crystals form?"

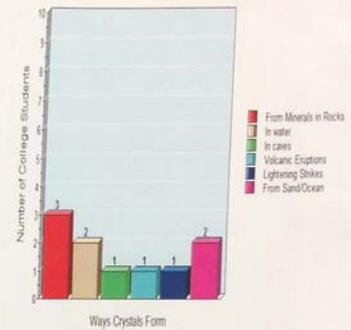
METHODS

- For this study, I chose an open ended question. I chose this because I felt it was the best way to answer my research question.
- I asked college students the question "How do you think quartz crystals are formed?"
- I studied the answers from a group of ten college students. I chose them at random from around the CCRJ campus.



RESULTS

How Do Quartz Crystals Form



DISCUSSION

- The results of my project show that the majority of college students polled do not know how quartz crystals are formed.
- Interestingly, many students knew about some of the elements required for crystallization, even if they didn't understand the entire process.
- These results prove to me that students are not being taught enough about this very interesting topic. Quartz is the second most abundant mineral on earth, but little is known about its creation by most.

CONCLUSION

- The research shows that most college students do not have knowledge of the process by which quartz crystals are formed.
- Most students did understand that it was a process in nature, and had some understanding of the elements needed for crystallization.
- More geologic education would be beneficial to students to better understand the world around them.



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