

Performance Task Organizer

Unit 2 Probability of Life
Elsewhere

Earth and Space Science

Student Name:

Evolution of Life on Earth

Directions:

1. Silently read or watch the “text” provided to you.
2. Record or annotate three details that are most important to the phenomenon being described for each text.
3. Share with your group. Each person should identify the details that they circled.
4. Discuss as a group, and determine the overall story. What is the phenomenon?

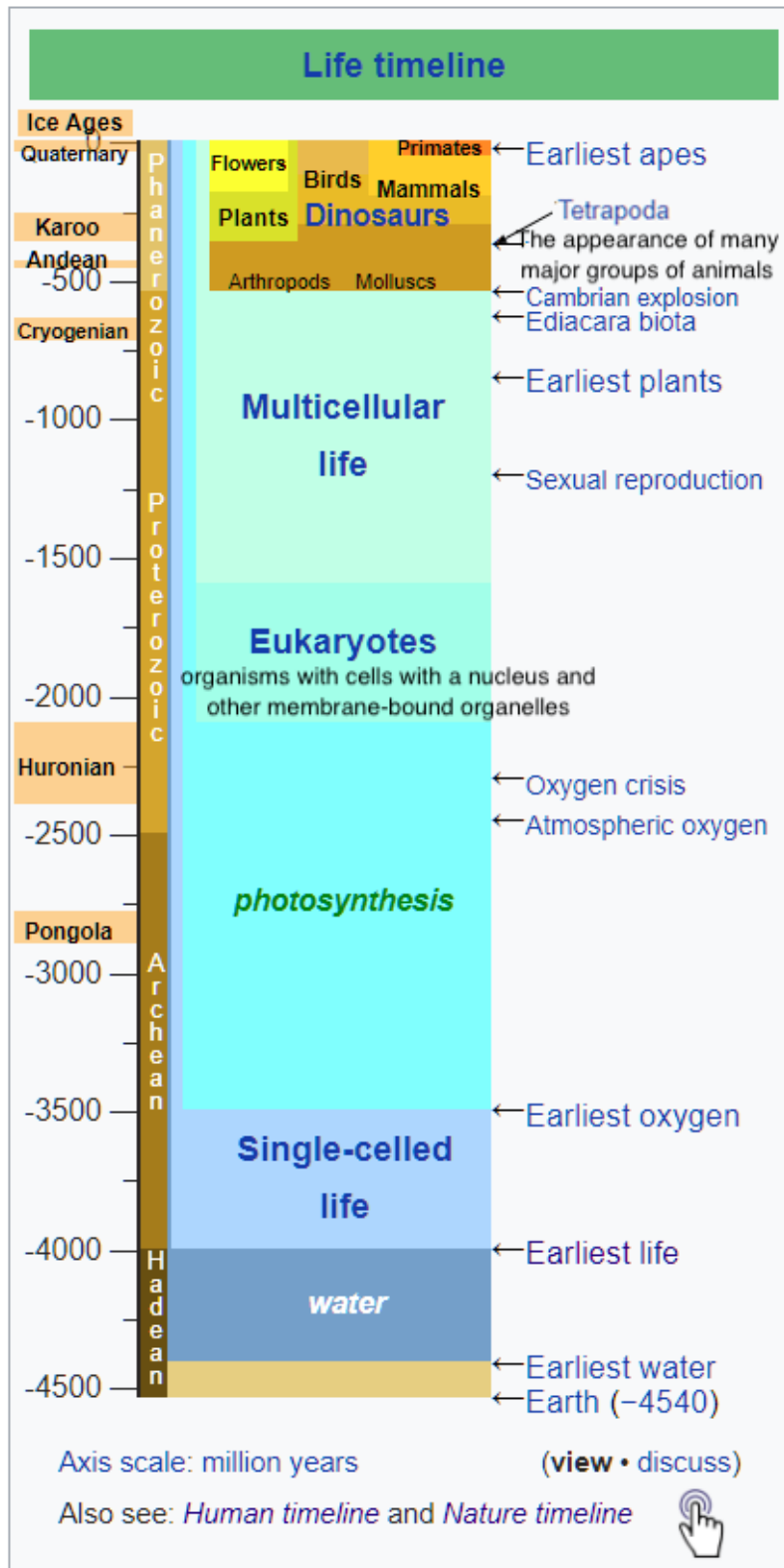
Text 1: [The History of Life on Earth](#)

1.

2.

3.

Text #2: Visual Representation of the History of Life on Earth



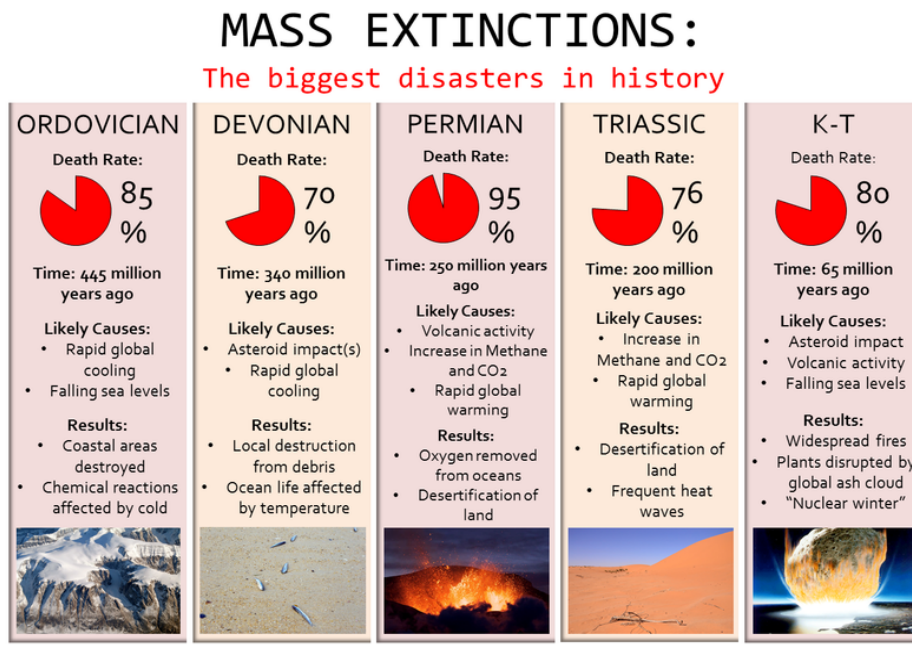
Evolution of Life Timeline

1.

2.

3.

Text #3: Mass Extinction throughout Earth's History



Mass Extinctions

1.

2.

3.

Important details our group surfaced (provide at least 5):

1.

2.

3.

4.

5.

Overall Story of the Phenomenon (based on group discussion):

Introduction to the Unit Performance Task

Are We Alone?

Does life exist somewhere outside of Earth? What about life that has technology and can communicate like humans?

4.5 billion years passed and 5 mass extinctions occurred before humans appeared on Earth. So far we have yet to come in contact with any other beings from another planet or even find evidence that proves any sort of life exists elsewhere.

So are we alone?

Your task in this unit is to work with classmates to investigate some factors that influence the evolution of life on Earth and explain why modern human's emergence on Earth required nearly 4.5 billion years. Then use your findings to make and defend an argument about the probability of intelligent life existing somewhere outside Earth.

Developing an Initial Explanation

What set of conditions allowed for the evolution of humans on Earth, and why did it take so long?

Your first step in this investigation is to consider details from the Tell the Story texts and work with classmates to develop an initial model that illustrates your group's ideas about why it took so long for humans to appear on Earth.

Initial Explanation

Directions

1. Review the important details from the Tell the Story texts.
2. In your group, identify the following:
 - Factors that support the existence and evolution of life
 - Factors that prevent or limit the existence and evolution of life.
3. Explain what combination of supportive and limiting factors could result in the evolution of intelligent life on Earth

You can represent your ideas in words or drawings

Revisiting the Performance Task: Stability of the Solar System 5E

What set of conditions allowed for the evolution of humans on Earth, and why did it take so long?

Scientists think that one reason life may not have appeared until approximately 3.5 billion years ago is that it could not evolve during a time of instability in the solar system. Despite Earth having relatively few asteroid impact craters, scientists believe that it was constantly being bombarded by asteroids about 4 billion years ago. Use the evidence from this 5E to explain why scientists believe that to be true.

In your explanation, be sure to include:

1. The evidence for the late heavy bombardment and the time it occurred
2. An explanation of why Earth has relatively few impact craters, including citing evidence from the activities you completed in this 5E
3. The evidence that life appeared after the time of the late heavy bombardment
4. A discussion of the strength or limitations of this evidence in supporting this explanation

For each component of your explanation, you should be citing evidence from the activities in this 5E and linking the evidence to the claim using logical reasoning and scientific concepts to link the evidence to the claim

Claim: Life did not appear until 3.5 billion years ago because the Earth was undergoing a period of heavy asteroid bombardment 4 billion years ago.

Reflection on your Explanation:

For each piece of evidence you used in your explanation, describe the scientific concept and/or logical reasoning you used to link the data to the claim.

Revisiting the Performance Task: Coevolution of the Earth and Life 5E

What set of conditions allowed for the evolution of humans on Earth, and why did it take so long?

Scientists think that the pace of evolution increased, resulting in much more complex life including humans, in the past billion years as a result of oxygen increasing above a certain threshold. Use what you've learned in this 5E about the dynamics of Earth's systems to explain the complex interactions that had to occur in order to result in the evolution of intelligent life.

In your explanation, be sure to include:

1. At least two examples of an organism that led to changes in the amount of oxygen in one of Earth's systems. Include your evidence and reasoning.
2. At least three examples of a time that a change in oxygen in one of Earth's spheres led to the evolution of more complex life. Include your evidence and reasoning

Claim: Earth's systems and life coevolved over 3.5 billion years, resulting in the evolution of humans, with oxygen playing a central role.

Reflection on your Explanation:

For each piece of evidence you used in your explanation, describe the scientific concept and/or logical reasoning you used to link the data to the claim.

Could life-supporting conditions exist elsewhere?

Given that the universe started as one single mass and expanded outward in every direction, and we know that the processes that formed galaxies and solar systems were the same everywhere, scientists think it is likely that other Earth-like planets exist. Use what you've learned in this 5E to explain how scientists are confident that the big bang theory is correct and why that would result in a universe with similar types of planets and stars throughout.

In your explanation, be sure to include:

1. Evidence that supports the expansion of the universe, called the big bang theory
2. Evidence that supports stars and planets being similar throughout the universe
3. Include your scientific reasoning that links the evidence to the claim

Claim: The way the universe has formed resulted in a universe with similar stars and galaxies throughout.

Reflection on your Explanation:

For each piece of evidence you used in your explanation, describe the scientific concept and/or logical reasoning you used to link the data to the claim.

Given that all the stars and solar systems throughout the universe are similar to what we see in our own galaxy, how likely do you think it is that one of them has intelligent life?

Revisiting the Performance Task: Asteroid Orbits 5E

In order to have a civilization that is able to communicate with other forms of intelligent life in the universe, that civilization needs to exist for long enough to develop the technology to make contact with and receive messages from other advanced societies. As you've learned, asteroid impacts can have devastating effects on species, potentially extinguishing a civilization before it reaches that technological point.

However, as you've also learned, an advanced society can use a piece of technology called a gravity tractor to redirect an asteroid that is on a path to impact a planet.

Use what you've learned in this 5E to explain how a gravity tractor works to protect a planet from impact.

In your explanation, be sure to include:

1. How scientists can predict where an asteroid will be
2. How a gravity tractor works to change the trajectory of an asteroid if it were on a path to hit Earth
3. Include your scientific reasoning that links the evidence to the claim

Claim: scientists can pinpoint where an asteroid is and will be, and then use a gravity tractor to deflect it

Reflection on your Explanation:

For each piece of evidence you used in your explanation, describe the scientific concept and/or logical reasoning you used to link the data to the claim.

Unit Closing Task: Construct and Defend an Argument

Why haven't we found life outside Earth?

In 1961, a scientist named Frank Drake created an equation to predict the likelihood of intelligent life capable of communicating with humans on Earth existing on other planets in the Milky Way.



This equation cannot be solved definitively, because scientists do not yet know what numbers to assign to each factor in the equation.

Given this equation and everything you have learned in this unit, construct an argument about whether or not it is likely that there is intelligent life somewhere else in the Milky Way or in the Universe, and whether or not we will make contact with it.

In your argument, consider the likelihoods following points:

1. There being stars with planetary systems similar to Earth
2. Other planets being stable enough to support life
3. Other planets having the right conditions to produce life and sustain evolution
4. Evolution occurring for long enough on those planets to produce intelligent life
5. Those societies surviving long enough to develop interstellar communication
6. Those societies overlapping with our society such that our signals would be detectable to each other

