Shape of Life

The Cambrian Explosion

Preconceptions about the Cambrian Explosion

Student Name_____

Instructions: What do you know, or think you know about the Cambrian Explosion? Today, you will be watching a short film about it and one of the scientists that studies it. Before you watch the film, read each of the statements below and decide whether it is a true statement or a false statement. Circle the appropriate letter (T or F) and jot down your reasoning. It is completely fine if you are only guessing—you are not expected to know these answers yet.

As you watch the video*,* note any of your answers that change. Do not erase or cross out your original answers. Instead, take notes in the appropriate space after each question. Be prepared to discuss your answers with the class.

1. Paleontologists study fossils. T/F
reasoning:

Did your answer change?

2. The first organisms that evolved on Earth were animals. T/F
reasoning:

Did your answer change?

3. The animals that evolved during the Cambrian explosion are the first animals that ever lived on Earth. T/F
reasoning:

Did your answer change?

4. The first animals lived in the oceans. T/F
reasoning:

Did your answer change?

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5. Sponges, like this one, are animals. T/F
reasoning:

Did your answer change?

6. Dinosaurs are among the first animals that lived on Earth. T/F
reasoning:

Did your answer change?

7. The Cambrian explosion happened quickly. T/F
reasoning:

Did your answer change?

8. The evolution of predation (when animals kill and eat other animals) sped up the pace of animal evolution. T/F
reasoning:

Did your answer change?

9. Scientists can trace the direct ancestry of every living thing back to the Burgess shale. T/F
reasoning:

Did your answer change?

10. Humans share a basic body plan with all mammals, reptiles, birds, and amphibians. T/F
reasoning:

Did your answer change?

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An Explosion of Part A: Analogy Timeline

Student Name_____

Introduction: When you think about the past life on Earth, what do you picture? Dinosaurs, maybe? Or human ancestors covered in hair? Perhaps you have seen reconstructions of early whales with legs, or early amphibians with fins? But from watching the short film The Cambrian Explosion, you know that all of those creatures appeared on the scene relatively recently in Earth's history.

Instructions: In the first part of this activity, you'll build a timeline to model events in the history of life, and come to appreciate just how new we humans are to the scene. Then, in the second part, you'll zoom in on the Cambrian to answer questions based on the film and demonstrate your understanding of common misconceptions. You may watch and re-watch The Cambrian Explosion as many times as you need to answer these questions.

Part A: Timeline Analogy

It can be very hard to comprehend numbers in the millions and billions. Earth is about 4.54 billion years old. Based on chemical analyses, scientists think that the first life appeared around 3.8 billion years ago, though the oldest true fossils we have (of cyanobacteria mats called stromatolites) are 3.45 billion years old, so it took about 100–350 million years for life to get going. But what does that really mean? Is that a long time? Or a relatively short time?

To help put events in the history of life in context, we can use an analogy. What if Earth's 4.54 billion year history was compressed into one 24-hour day? So Earth forms at 12:00 midnight and the present is 12:00 midnight the next day. In this model, each hour represents about 190 million years (190,000,000).

So, let's do some math!

The oldest fossilized organisms we have (3.45 billion years old) showed up about 1.1 billion years after Earth formed. So if Earth formed at midnight, then these organisms evolved a little bit before 2:00 A.M.

1 hour = 190,000,000

x hours = 1,100,000,000

x = 5.8 = 1 hour, 48 minutes = 5:48 AM [0.8 hours*60 min/hour = 48 minutes]

For later events, it's easier to calculate the time since present, instead of the time since Earth formed.

For example:

Multicellular life evolved about 600 million years ago.

1 hour = 190,000,000

x hours = 600,000,000

x = 3.2 = 3 hours, 12 minutes

This is the time since present, which would be midnight, so 3 hours earlier is 9:00 PM and 12 minutes before that is 8:48 PM.

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An Explosion of life Part A: Analogy Timeline

Student Name_____

Follow the examples to determine the approximate time the following events occurred in the 24-hour clock model. Show your work.

1. Middle of the Cambrian explosion: 550 million years ago

- TIME:

2. Time of the Burgess Shale: 508 million years ago

- TIME:

3. Tiktaalik (the "fishapod"): 360 million years ago

- TIME:

4. Early dinosaurs: 250 million years ago

- TIME:

5. Early mammals: 210 million years ago

- TIME:

6. Archaeopteryx (first bird): 140 million years ago

- TIME:

7. Early flowering plants: 120 million years ago

- TIME:

8. Non-avian dinosaur extinction: 66 million years ago

- TIME:

9. "Lucy" (Australopithecus afarensis, an early human relative): *3,200,000 years ago **For this calculation, use the fact that each minute in our 24-hour clock represents about 3.2 million years (3,200,000)***

- TIME:

10. Homo sapiens: 200,000 years ago *****For this calculation, use the fact that each minute in our 24-hour clock represents about 3.2 million years (3,200,000)*****

- TIME:

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The Cambrian Explosion

An Explosion of life Part B: Film Guide

Student Name_____

1. Des Collins is a paleontologist. What is a paleontologist?

2. In what country is the Burgess Shale located?

3. True or False: The Burgess Shale contained just a few hundred fossils.

4. What type of animal were the first animals that evolved?

5. Sketch Aysheaia.

6. What is special about Anamalocaris?

7. What do scientists infer to be the function of the bristles along Canadia's body?

8. What type of animal is this?

9. Complete the sentence: The first animals to have a head and primitive sensory organs were_____

10. According to paleontologist Rudy Raff, what ecological change might have enabled organisms to get bigger during the Cambrian?

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An Explosion of life Part B: Film Guide

Student Name_____

11. What does Rudy Raff mean when he says that an “arms race” might help to explain the Cambrian Explosion?

12. What is special about the organism seen here?

13. If the history of life on Earth took place over 24 hours (part A), the first life for which we have direct fossil evidence evolved after 5.8 hours, or around 5:48 A.M. What percent of Earth’s history was therefore lifeless? Show your work.

14. Based on your calculations from Part A, for how many “hours” was there life on Earth before the Cambrian Explosion? Show your work.

15. There are many misconceptions about the organisms of the Burgess Shale. Based on what you’ve learned, what would you say to someone who tells you that the origin of life is captured in the fossils of the Burgess Shale?

16. How can the clock analogy from Part A help to correct misconceptions that people might have about the history of life on Earth?