

Name: \_\_\_\_\_

Period: \_\_\_\_\_ Date: \_\_\_\_\_

## Exploring Life's Origins: Student Learning Guide

### Instructions:

1. Work in pairs (share a computer).
2. Go to [exploringorigins.org](http://exploringorigins.org). Note that this is not a sciencemusicvideos tutorial: no log-in is required.
3. Start with the "Timeline of Life's Evolution" on the left side of the 3 part panel.

**Before you read:** *How do you think life began? At this point you know a lot of biology. How could the first cells have arisen from non-living matter?*

### Part 1a: A Timeline of Life's Evolution

Drag your cursor to each of the red dots in the timeline. Write down **at least one** noteworthy fact or idea about each time period. Write small.

1. 4.57 bya (billion years ago): formation of the solar system:
2. 4.53 bya: Formation of the Moon
3. 4.1 bya: Late heavy bombardment
4. Formation of the crust and oceans
5. 3.5 bya: Oldest geological evidence for life.
6. 3.0 - 2.5 bya: proliferation of cyanobacteria
7. 2.0 bya: 1<sup>st</sup> eukaryotes
8. 1.2 bya: origin of multicellularity
9. 600 mya (millions of years ago): Cambrian explosion of animal life.
10. 230 - 65 mya: Reign of the dinosaurs
11. 200,000 ya: appearance of modern humans

**Part 1b.** If you need to, scroll back through the timeline to answer the following questions.

12. It's reasonable to assume that life could only start after the period of \_\_\_\_\_ came to an end.
13. Stromatolites are
14. Cyanobacteria are important to earth history because

Continue by clicking "What's so Special about RNA" on the bottom of the page, or by going to "Understanding the RNA World" and clicking "What is RNA?"

### Part 2: Understanding the RNA world

15. Read the five paragraphs on this page, which review the differences between DNA and RNA. Summarize these differences in the space below.
16. Watch the RNA folding video. In the space below, write a brief explanation of how RNA folds up into a specific, predetermined shape.

Continue by clicking "Exploring the RNA World."

17. What are ribozymes?

18. What is the "RNA World" hypothesis?

19. According to the text, what's "perhaps the strongest piece of evidence" for the RNA world hypothesis?

To continue, click "Explore the role of ribozymes in protocells."

### Part 3a: Building a Protocell: Nucleic Acids

You can get here from the previous section, or by clicking on "Building a Protocell," then "Nucleic Acids."

Read *RNA on the Early Earth*, and answer the following questions.

20. What's one chemistry-related difficulty with the the RNA world hypothesis?

21. Click the link the Wikipedia page about the Murchison meteorite. Scan the text and briefly describe this meteorite (where it landed, what it's made of, etc.), and explain why it's been important to studies of the origin of life?

22. Return to the Exploring Life's Origin's Page, and study the picture on the top right. It shows \_\_\_\_\_ being converted into \_\_\_\_\_ in lakes; and four gases in the atmosphere (\_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_) being converted into nucleobases.

### Read Prebiotic RNA Replication

23. Summarize the two descriptions of how RNA monomers could have become polymers.

### Read Prebiotic RNA Replication

24. Read the 1<sup>st</sup> paragraph in this section, and then watch the video of template directed polymerization. Summarize how this process works.

25. Now read the last three paragraphs in this section (starting with "This process of non-enzymatic...") and watch the video on the lower left that shows a theoretical replicase ribozyme replicating another replicase. In the space below, summarize how this process might work.

To continue, click "Explore the role of ribozymes in protocells."

### Part 3b: Building a Protocell: Fatty Acids

You can get here from the previous section, or by clicking on "Building a Protocell," and then "Fatty Acids." Start by reading the section **Membrane Lipids of the Past and Present**

26. Describe how fatty acids and phospholipids are similar.

27. Draw a diagram of a vesicle and a micelle

28. Describe the two functions of membranes.

29. Read **Why Life Needs a Membrane Compartment**, and watch the accompanying video (the one with the caption "Without compartmentalization...") Describe two reasons why membranes were so important in the RNA world.

30. Read **Forming Fatty Acids on the Early Earth**, and watch the accompanying animation (the one with the caption "Fatty Acids may have formed near hydrothermal vents...") Summarize these explanations of how fatty acids would have formed on the early earth.

Read **Studying Fatty Acid Vesicles in the Lab**, and watch the three accompanying animations.

31. How can micelles give rise to vesicles?

32. Describe the behavior of fatty acids in vesicles. Why might this have been important to early cells?

33. How do vesicles grow?

To continue, click "Putting it all together in a protocell."

### **Part 3c: Building a Protocell: Protocells**

You can get here from the previous section, or by clicking on "Building a Protocell," and then "Protocells."

Read this entire section.

34. In the space below, draw your own diagram of a protocell. Label the parts (there are only two).

35. Summarize the protocell life cycle.

### **PULL IT ALL TOGETHER**

You're having lunch with a friend who says, "You know. One thing about evolution will never make sense to me. How could life have evolved in the first place? It just seems that life is too complex to have evolved on its own."

In the space below and on the back, write a response that summarizes the material in the Exploring Life's Origin's website.

