SN EDUCATOR GUIDE

April 11, 2020

A Tiny Dino and Iron Rain

Student Comprehension Worksheet

Directions: After reading "This ancient dinosaur was no bigger than a hummingbird," answer the following questions.

1. What is *Oculudentavis khaungraae*? Why does the story refer to the creature as a dinosaur and a bird?

2. During what geologic era did *O. khaungraae* live? Where was it found?

3. What makes the creature unique?

4. What is the length of the creature's skull? Describe its relative length compared with the average length of a human thumb, which is around 6.6 centimeters.

5. What do scientists think *O. khaungraae* ate during its lifetime? How did they come up with this idea?

6. What modern animals is *O. khaungraae* compared to? How is *O. khaungraae* similar to these animals?

7. How are *O. khaungraae*'s eyes different from one of the animals? What could explain this difference?

8. Why might it be hard for scientists to figure out where this ancient bird fits on the tree of life?

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Student Discussion Worksheet

Directions:

After reading the *Science News* article "Heavy metal may rain from the sky of an exoplanet," answer the following questions.

Partner questions

1. What substance was identified as a gas in the atmosphere of exoplanet WASP 76b? When was the gas seen and when was it not seen in the atmosphere? What do scientists think happens to the substance over the course of a day and night on the planet? What does that mean in terms of the substance's phase of matter? (In explaining your answer, it might be helpful to sketch what happens to the substance during the transition from daytime to nighttime and back again.)

2. Name the phases of matter of a substance, and describe the general differences in their shape and volume. Explain your answers in terms of the phase's relative strength of intermolecular attraction forces, or the forces of attraction between the atoms or molecules within a substance.

3. Based on the article, what factor affects the phase of matter of a substance? Explain.

4. A phase diagram shows how temperature and external pressure on a substance affect its phase of matter. Draw a general phase diagram including regions for solid, liquid and gas. Use this Purdue University page (https://chemed.chem.purdue.edu/genchem/topicreview/bp/ch14/phase.php) as a reference, if needed. Label your axes with appropriate titles and units, and include regions for each phase of matter.

5. A normal boiling point is the temperature at which a substance in the liquid phase becomes a gas at an external pressure of 1 atmosphere. The term "normal" refers to an external, or atmospheric, pressure equal to 1 atmosphere. Assume that you drew the phase diagram for H_2O in the question above. Mark the normal melting, boiling and condensing points for water on the phase diagram, and appropriately label the points with pressure and temperature values. Then, explain how condensation differs from boiling in terms of energy. (Please note: The phase diagram for H_2O would actually have a negatively sloping line between the solid and liquid phase.)

6. How can a change in pressure affect the phase of matter of a substance at a constant temperature (assume the temperature is one where all three phases of matter can exist)? Explain your answer using the diagram and your knowledge about the strength of attraction between molecules.

7. Based on the info in the article and your knowledge of iron, how do you think the phase diagram for iron would compare with the phase diagram of H_2O? Explain. Then draw a quick sketch of iron's phase diagram. Draw a line to represent the phase transition described in the article. Mark any data points that you can on the diagram.

8. How do you think Earth's atmosphere compares with that of WASP 76b's? Explain your answer in terms of temperature and pressure and potential composition.

9. What are some factors of the atmosphere that affect weather patterns? Given these factors, what might contribute to differences in wind weather patterns on WASP 76b and Earth? How does the "iron weather" on WASP 76b compare with "water weather" on Earth?

Class discussion prompt

Imagine your own exoplanet with an atmosphere different from Earth's. Explain the general conditions on the planet, as well as the atmospheric composition and general weather patterns that make the planet special. Research an additional phase diagram to inform your answer. Include at least two data points from a substance's phase diagram in your response. For additional inspiration, check out NASA's Exoplanet Exploration, which describes known exoplanets.