Investigation: Fire Ice in the Deep Sea Student Worksheet

Name: _____ Date: _____ Class: _____

PART 1: Experience the Phenomenon

Your teacher will be sharing a short deep-sea phenomenon video and image slide with you.

A. Write down 2 observations and 2 questions based on the video clip and/or pictures you observed.

My observations:

1. _____

2. _____

My questions:

1. _____

2. _____

B. Briefly discuss your observations and questions with your group. Then, share 1 of your observations and 1 of your questions with the class in the space provided by your teacher.

C. What is the main question you are trying to answer about the phenomenon?

_____

PART 2: Investigate

Simulating methane hydrate formation

You will perform an investigation (or your teacher will conduct a demonstration) that will simulate or model the formation of methane hydrate in order to help the class answer the question, "How does methane hydrate (ice) form on the ocean seafloor?" As you conduct the activity, think about what each part of your model (dry ice, coffee water) represents in an actual methane hydrate.

NOTE: Before beginning your investigation, please READ over the questions 1-5 so you know what you will be looking for in the lab.

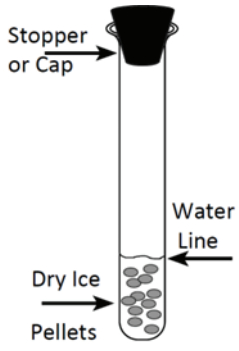
SAFETY PRECAUTION

DO NOT handle the dry ice. The dry ice pellets will be placed in the test tube by your teacher. You MUST wear safety goggles, a lab coat, and thermal gloves. Follow all lab safety rules!

Instructions:

1. Your teacher will place several small pieces of dry ice into the bottom of the test tube. These pieces should almost fill the diameter of the test tube and should take up about 1 inch of the height of the test tube. The number of pellets needed will depend on the size of pellets obtained.
2. Add enough diluted coffee to just completely cover the dry ice. Place the rubber stopper or cap in/on the test tube. If you have a cap, DO NOT tighten onto the test tube. Make sure it is loosely placed so the pressure does not build up too much. If you have never seen dry ice before, the smoke-like gas is carbon dioxide that is *sublimating* from the "ice." This means it is going directly from a solid to a gas state with no liquid state in between.

Diagram of Set-up



NOTE: If the liquid begins to bubble up through the tube, REMOVE some of the coffee water. If bubbling stops while the dry ice is still present in the tube, ADD a small amount of coffee water.

PART 2: Investigate cont.

Observations

1. What did you observe when the coffee water was added to the dry ice in the test tube?

2. As the water freezes within the test tube, where does the carbon dioxide from the dry ice go? Support your answer.

3. Once the coffee water has frozen, describe the model "hydrate" you helped create. After a few minutes, the formation should begin to melt. Help this process along by rubbing the bottom of the test tube.

   What do you observe as the as the ice melts? Be specific. What happens to the ice (describe the state of matter)?

4. Given your observations, compare the density of the gas (carbon dioxide) to that of coffee water. Support your answer.

Dry Ice Model versus Methane Hydrate

5. Remember this investigation was a simple model to demonstrate how methane hydrate forms. What represented the following in your model?

- Methane gas? _____
- Water? _____
- Methane hydrate? _____

PART 2: Investigate cont.

Review and discuss the chemical structures and phase diagram slides to help you answer the questions below.

6. Is the methane hydrate formation a physical or chemical change? Explain your answer. (Hint: Think about your investigation.)

7. What are the two main environmental forces helping to create the methane hydrate in the deep sea?

8. If methane is less dense than water, what will happen to methane from the gas hydrates on and below the seafloor if the temperature increases enough for the ice to melt? Support your answer.

9. Gas hydrates form on and below the seafloor where the pressure is much greater than it is at the surface. If you could increase the pressure on your test tube "system," how might your results differ? Support your answer.

PART 3: Put the Pieces Together

Now that you have collected all your evidence, use what you have learned from your modeling investigation, class discussions, videos, and diagrams to draw a model explaining **how methane hydrate forms** and **how the methane gas is released** (Hint: Think about what is happening at the molecular level.). Please make sure to label all the parts of your drawing explanation.

Methane Hydrate Formation

Methane Gas Release