UC RIVERSIDE UNIVERSITY OF CALIFORNIA | College of Natural & Agricultural Sciences

UC RIVERSIDE UNIVERSITY OF CALIFORNIA | Department of Chemistry

Boo Bubbles (45 min)

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Course Name		**Day/Date**	
Objective(s)	• **Study the unique physical properties of dry ice** • **Describe states of matter** • **Design and conduct a scientific investigation**		
Materials	A. **<u>Experiment Design</u>** - Notebook - Pencil B. **<u>Making Dry Ice Bubbles</u>** - Dry Ice - Warm water - Bowl - Towel/rag - Soap	**Key Points**	**Solid** **Liquid** **Gas** **Sublimation** *<u>Other key words:</u>* *Hypothesis* *Observation* *Variable*
Big Questions	What are the three states of matter? What factors cause an object to change its state of matter?		

Do First (10 min)	**1) Personal introduction:** We are students and researchers from UC Riverside (can calculate "grade level" for the students) studying chemistry! We are from all over the world, but we all share a passion for science! **2) Topic introduction:** a) Introduce the three states of matter. b) Compare water ice to dry ice. c) Explain Melting point vs. Sublimation point
Lesson Execution (40 min)	**Learning Experiences:** ***As a class*** **A) Experiment Design (5-10 min.)** <u>Concepts:</u> Hypothesis, Observation <u>Instructions:</u> (Have students work in small groups) 1. Outline a scientific notebook on a piece of paper or a notebook 2. Collectively form a <u>hypothesis</u>, based on above introduction, to what might happen when we increase the temperature of the water bath the dry ice is in. 3. Create, in advance, a systematic method for recording results (<u>methods</u>) a. Time for dry ice to decompose b. Change in state of matter 4. Discuss appropriate <u>variables</u> to test our hypothesis

	a. Changing the temperature of the water bath ***b.*** Comparing the two experiments done. ***In separate groups*** **B) Making Boo Bubbles (30-40 mins)** Concepts: control experiment, variable Instructions: (Students will observe the graduate student conduct the experiment over zoom) Each group of students will perform the following: 1. Students will break into three separate groups. 2. Each group will be responsible for "helping" the graduate student carry out a scientific investigation by recording results of the experiments and completing the attached worksheet. Graduate student will perform the following: Experiment 1: 1. Obtain three pieces of dry ice of roughly the same size. 2. Place the first piece of ice in an empty beaker. 3. Place the second piece of dry ice in a beaker filled with 500 mL of room temperature of water. 4. Place the third piece of dry ice in a beaker filled with 500 mL of water at 55°C. 5. Have students record the time it takes for each piece of dry ice to sublime. (Simply based on observation) Experiment 2: 6. Graduate student will capture the carbon dioxide generated by the dry ice, by applying a film of soap over the lid of the beaker. This should produce bubbles filled with carbon dioxide "fog". 7. Students will help graduate students count the number of bubbles produced in one minute. Each group of students will perform the following: 1. The students will form a hypothesis about the relationship correlating temperature to the rate of sublimation. 2. Students will "quantify" rate of sublimation by timing how long it takes for the solid to turn to gas. 3. Students will "quantify" rate of sublimation by timing how many bubbles are produced in one minute. 4. Students will compare the results of each experiment. Do their findings support one another?
Wrap-up: Sharing Experiences and Building Connections (10 min)	We will bring everyone back as one group and review the key concepts. Each group's ambassador(s) can lead a part of the discussion, presenting the results. Ask each ambassador if their findings in the second experiment supported or contradicted the findings of the first. What changes could be made to improve the experiment? Ask students if they have any last questions about the experiments or about being a scientist in general.