

Non-Newtonian Fluids - Oobleck

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Course Name	Elementary School Outreach		Day/Date	
Objective(s)	Students will be able to list out the three states of matter. Students will be able to give examples of each of the three states of matter. Students will be able to explain how the atoms move within each of the different states of matter.			
Materials, Texts & Reminders	Warm-up: Poster Paper - pre-printed columns and laminated* (*see alternatives - magazines/pre-written note cards) Intro to 3 States of Matter: Molecular Model Kit Oobleck: Cornstarch, Water, Measuring Cups, Plastic Cups, Spoons, Food Coloring (Optional) Prizes	Key Points	There are 3 states of matter: solid, liquid, and gas. Non-newtonian fluids, like oobleck, display properties from 2 of these states of matter at the same time: solid and liquid!	
Big Questions	What are the three states of matter? What happens on a molecular level with these three states of matter?			
Assessment	Discussion - What makes Oobleck solid? Liquid? Review Questions for Prizes - see review questions at the end of this document			

Do First	*Warm-up (10 minutes): Using a large poster sized paper (or white board) with three different columns, have students write examples of each state of matter.
Lesson Execution	Introduction to the Three States of Matter: (10 minutes) What are the three states of matter? Solid, Liquid, and Gas What are examples of each of the three states of matter? • Solid - desk, chair, pencil • Liquid - water, milk, juice • Gas - air, farts Each state of matter is composed of tiny particles called atoms. Use molecular model kit to demonstrate. How do the particles move in each state? • Solid - frozen in place; do not move, rather vibrate in place (like to hug, love each other) • Liquid - slide past one another, intermediate moving (like a stroll in the park) not as frozen, do not stay in one place (need to go somewhere, so they walk, swim over there), will bump into each other, won't stick together • Gas - slide past one another, lots of collisions, random motion, rapid, erratic behavior (analogous to a race car, Lightning McQueen, The Flash, basically anything fast) Interactive Demonstration - Let's Make Oobleck!: (20 minutes) Go over safety precautions, let students know what we are making, and start the procedure. 1. If time permits, pre-measure cornstarch into plastic cups ready for students to add water when the experiment begins. 2. Dismiss students by table or a few at a time to get water from the classroom sink. Volunteers will measure the correct amount of water using the measuring cup and pour it into each student's cup.

	a. RATIO: 2 cups cornstarch to 1 cup water; we usually use $\frac{1}{2}$ cup cornstarch to $\frac{1}{4}$ cup water 3. Make sure to have all students start stirring once the water is poured in and to make sure all the cornstarch, even at the very bottom of the cup, is incorporated. 4. Optional: Go around and add 2-3 drops of food coloring to each cup if desired. 5. Touch the Oobleck and discuss in your groups observations. Why are things the way they are? How does what you just made relate to the lesson we had in the beginning? Discussion - What is/are the state(s) of matter present in the final product?: (10 minutes) What states of matter are present in Oobleck? Just one or more than one? Oobleck is a solid and liquid. What makes it a solid and what makes it a liquid? • Solid ○ punch it ○ apply pressure • Liquid ○ pour solution ○ slowly stir the solution Did the experiment fail? If so, why? This proves the importance of multiple trials and the necessity of repeating experiments.
Closing and Assessment	Review Questions for Prizes (5 minutes) - see review questions at the end of this document Question and Answer (5 minutes)

****Review Questions:**

1. What are the three states of matter?
2. What do we call the individual molecules that move around differently in each of these states of matter?
3. What are examples of:
 - a. Solid?
 - b. Liquid?
 - c. Gas?
4. How do the atoms move in:
 - a. Solid?
 - b. Liquid?
 - c. Gas?
5. What states of matter are present in the Oobleck you created?