

# LESSON 1: OOBLEK!

## SUPPLIES

### TEACHER BRINGS

- Water (if no sink access in classroom)
- Cornstarch (4 cups)
- Flour (4 cups)


### MAIN BIN

- Bowls (15)
- Spoons (15)
- Food coloring
- Ziploc Bags (15)
- Tablecloth (2)

### OBJECTIVES

- Define & explain what a non-Newtonian fluid is.
- Know the difference between the three states of matter (solid, liquid, & gas) and understand how Ooblek has traits of both liquids and solids.


### HOOK

 1-2 min

Ask students if they have ever made slime before. What did they notice about how it acted? Was it a solid or a liquid?

Tell students that slime is a **non-Newtonian substance**. Today we will explore non-Newtonian substances and their properties, as well as the change that happens when they are formed.

### INTRODUCTION

 3-5 min

What is Ooblek? Ooblek is a goo that you can make with two simple ingredients: cornstarch and water! It looks like slime, but it's not like anything you've ever touched before. What makes Ooblek so special? It's a non-Newtonian fluid, depending on how you interact with it.

If you smack it hard with your hand, it feels like a rock! If you gently poke it with your finger, it oozes and drips like water! If you grab a handful of Ooblek and squeeze it into a ball, it feels solid—until you let go!

### COLOR FACTOR


Color change is a sign of a chemical reaction, but in the case of our Ooblek, the color change when you add dye is actually just a physical change!

Adding the dye to the mixture impacts the color, but this change is just a result of the substances mixing with each other. The cornstarch is white, so when it mixes with the dye, it takes on the color of the dye. The dye tints the Ooblek, but does not chemically change it. In other words, no reaction occurs.

### SIGNS OF CHEMICAL REACTIONS

- color change
- temperature change
- smell change
- production of gas
- production of a solid
- emission of light

## DISCUSSION

 3-5 min

Ask students to think about an ice cube. An ice cube is a solid. How could you make the ice cube become liquid? How could you make that water become a gas, or water vapor? If you heat up an ice cube, it will melt. If you heat up the resulting water until it boils, it will evaporate and turn into gas.

Most substances change their state of matter when the temperature changes--just like water freezes, melts, and evaporates. A Non-Newtonian substance, however, can act like a solid or a liquid, depending on how much force is applied. The viscosity (how thick or thin it is) changes depending on the force being applied.

Ooblek is a non-Newtonian substance, so it can transform from a liquid to a solid when physical pressure is applied, even though the temperature doesn't change!

Show students the flour and cornstarch. Tell students that one of these solids will make a non-Newtonian substance when mixed with water. Ask students to predict:

- Which solid will create a non-Newtonian substance when mixed with water?
- What properties will a non-Newtonian substance have?


Remind students that a non-Newtonian substance should behave like a solid when under pressure (or force) and a liquid when there is less, or no pressure applied.



## OUBLEK RULES

- Ooblek is not a food!
- Keep your ooblek in your bowl! Do not play with ooblek near carpets, electronics, backpacks, etc.
- Students should not use food dye! The dye should only be handled by adults.
- Wash Your Hands before touching any item after playing with ooblek. Remind students not to wipe their hands on their clothes!
- Report Spills Immediately so that the teacher can take care of them. If you see Ooblek on the floor, back up and do not step in the area
- When you take your Ooblek home, Do Not Take The Ooblek Out until you have adult permission. Do not take it out in the car or while sitting on the couch.

## ACTIVITY


 20-25 min

1. Go over the **Ooblek Rules** (above.  
**NOTE: make sure to use tablecloths to protect tables.**
2. Split students into groups of 2-3.
3. Give each group 2 bowls: one with one cup of flour, and the other with one cup of cornstarch.
4. Have students SLOWLY add approximately 1/2 cup of water to each bowl, slowly.
5. Mix SLOWLY with a spoon.
6. Try the following with each substance and note what happens (you can write the findings on the whiteboard if you wish)
  - "Punching" with your finger
  - Rolling it into a ball
  - Squeezing it in your hand
  - Picking it up on the spoon and pouring it back
7. Make sure to allow extra time for clean up during this lesson.

Pass out a ziploc bag to each student. They can take home their Ooblek, but only if they put it in a sealed ziploc bag and clean their station. Remind the students of the Ooblek rules, especially about not opening their ziploc bag in the car on the way home.

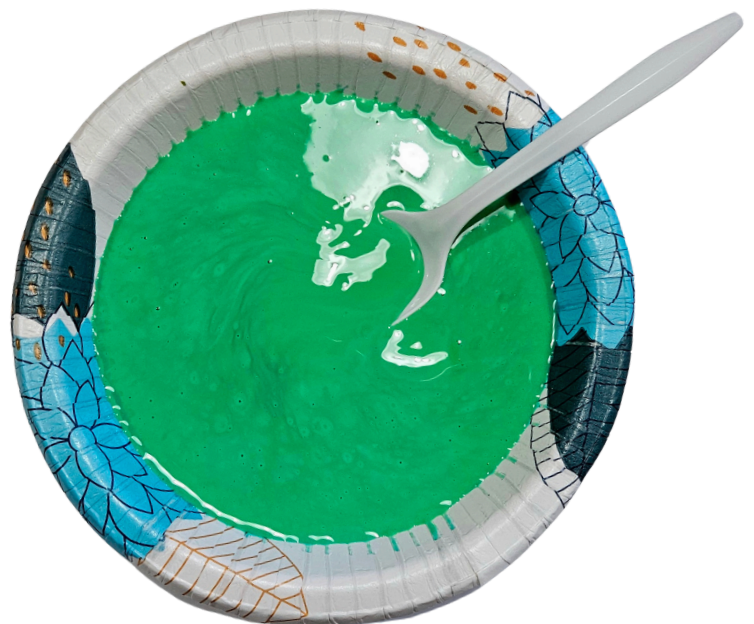
Make sure the students clean their stations and wash their hands!

## OBSERVE & EXPLAIN


 3-5 min

Ask students to discuss their findings.

- Which mixture was the non-Newtonian substance, and which was the Newtonian substance?
  - Answer: the cornstarch and water was non-Newtonian, and the flour and water was Newtonian.
- What properties did the non-Newtonian substance have?
  - Answer: The non-Newtonian substance acted like a solid when under pressure (it could be rolled into a ball) and like a liquid when no pressure was applied (it could be poured from the spoon). This means the viscosity of the mixture changed depending on the force applied.
- What properties did the Newtonian substance have?
  - Answer: The flour kept the same viscosity regardless of the pressure applied. It could form a (messy!) ball but could not pour easily like a liquid.
- Was there any evidence of a chemical reaction occurring?
  - Students may struggle to articulate how a chemical reaction happened, as there was no evidence of a gas, a change in temperature, a change in color, or a smell.



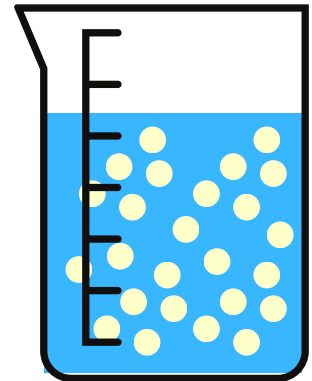
## EXPLANATION CONTINUED

 5-7 min

### Flour & Water

The flour and water formed a suspension. This means that, instead of dissolving, the flour particles just floated in the water, making it a cloudy color.

The mixture maintained its viscosity—in other words, it still moved like water usually flows. Putting pressure on the mixture did not change its viscosity, meaning that flour + water does NOT make a non-Newtonian substance.



### Starch & Water

The cornstarch/water mixture is a Non-Newtonian fluid. Under pressure, it acts like solids, but when the pressure is released, they act like liquids.

Like the flour and water, these mixtures are also suspensions, but they act a little differently.

The water molecules can flow around each other and between the starch molecules, allowing the chains of the starch molecules to slide and flow. This takes on the appearance of a liquid. However, when pressure is applied, the starch molecules press against each other, leaving no room for the water molecules to flow between them, so it feels like a solid. As soon as the pressure is released, the water can flow between the starch molecules again and it acts like a liquid.



### Exit Ticket



Ask each student one of the following questions as they walk out of the door:

- Q: What is a Non-Newtonian fluid?
  - A: a liquid that acts like both a liquid and a solid, changing how thick it is depending on how much force is applied to it
- Q: What is an example of a liquid?
  - A: water, milk, juice, etc.!

