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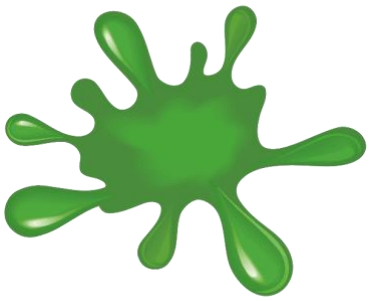
Bruce Museum at Home
STEAM Activities for Children

Lesson # 11: *Whatsa Matter? Liquids vs. Solids*

Week of June 1, 2020



This week's STEAM at Home lesson is a continuation of last week's exploration of physical interactions and reactions. Learners will experiment with creating a non-Newtonian fluid (oobleck) and explore its physical interactions. The experiments in this activity do not use difficult-to-source materials but are messy and require specific materials. Please plan accordingly before beginning any of these projects with your learners.

Learners will use their science journal to predict, record, and explore their experiments. If your learner hasn't made a science journal, instructions can be found here. If learners have a notebook, or other paper they prefer to use, that's fine.

In order of appearance, this lesson contains: a materials list for *Whatsa Matter*, instructions for *Whatsa Matter*, three experiments that add on to the activity, a simple art activity, and NGSS Performance Expectations. Additionally, a list of chemistry vocabulary words is available as a separate document, and can be found here.

A tip for adults: *Oobleck is fun to make and will keep in an airtight container indefinitely! Do not dispose of oobleck by pouring it down the sink; this can clog the pipes. Always throw it away in the trash. Oobleck is not hard to clean up, but using a tray with raised sides can be helpful.*

Materials for *Whatsa Matter*: cornstarch (you will need a significant amount for Experiment 2), mixing bowls or containers, a spoon or spatula, room temperature water, a table covering or tray, a speaker with subwoofer, kitchen instruments for

experimentation, objects to sink into oobleck, plastic wrap, a drop cloth or plastic covering.

Materials for art project: tempera paint or food coloring, a large tray, essential oils, one large container, and several small containers.

Most of us have played with, or know about, oobleck, a mixture made of cornstarch and water made popular in Dr. Seuss's book "Bartholomew and the Oobleck". If your learner has experimented with oobleck before, ask them to write down what their experience was like in their science journal. If this is their first time, ask them to write down some questions about the material; some examples of questions are below.

- What is oobleck?
- How will oobleck feel?
- What can we do with oobleck?

Now it's time to make a big batch of oobleck for experimentation.

Basic Oobleck Recipe (you will need more to do Experiment 2)

- 1 ½ cups of cornstarch
- 1 cup of room temperature water

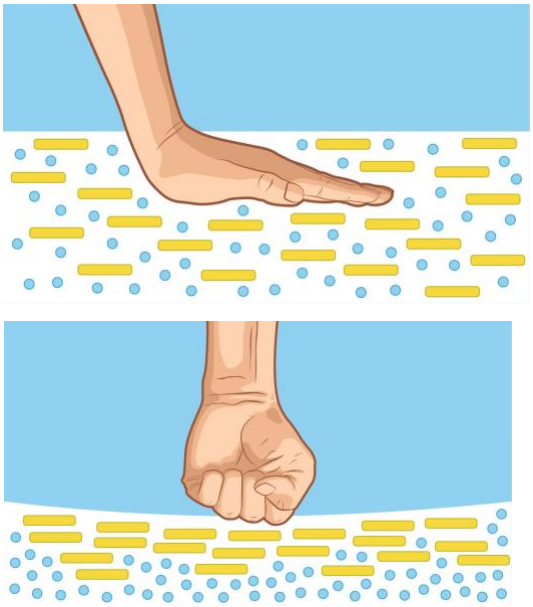
To Make the Oobleck

- Have your learner take a spoonful of cornstarch and roll it around in their hands.
    - What do they notice?
    - How does it feel?
    - What does it look like?
- The particles of cornstarch are uniquely small and smooth; this allows them to have an unusual effect when mixed into water.
    - This effect is so unusual that many scientists have studied oobleck and its properties.
- Ask your learner to move a spoon, or their fingers, through the cup of water.
    - What do they notice?
    - How does the water feel when they move through it?
        - Does anything change about the texture of the water as they move through it?
        - Does the speed of their motions matter?
- In a large container, mix together the cornstarch and water.

    - If your learner is old enough, have them mix the oobleck themselves.
        - Consider not giving your learner a specific measurement and have them experiment with ratios of water and cornstarch.
    - How does the oobleck change if they add more cornstarch?
    - How does the oobleck change if they add more water?
- Oobleck has some interesting physical properties which can be discovered by playing with the oobleck.

    - Your learner should stick their hand in, or a utensil, if they don't like the sensation of the oobleck, and pull out a large handful or spoonful.
        - Is it a solid or a liquid?
        - Does the oobleck's behavior change depending on how you move it?
        - Can a long thread of oobleck be drizzled slowly back into the container?
        - What happens if oobleck is squeezed tightly, either in a fist or between two hard objects?
        - What happens if you try to move through the oobleck quickly?
        - What happens if you try to move through the oobleck slowly?
        - Try experimenting with different kitchen tools and household objects like colanders or slotted spoons, potato mashers, or a tea strainer. How does the oobleck move through the holes in these tools?
    - What does your learner notice about how the oobleck responds to these experiments?
        - Learners should write their observations into their science journal.
    - Oobleck is a non-Newtonian fluid, which means that it behaves in a different way than most liquids. Newtonian fluids have the same texture regardless of pressure or agitation; non-Newtonian fluids will change under pressure.
        - Heavy cream is a non-Newtonian fluid which gets thicker as friction/movement is applied.
        - Honey is a non-Newtonian fluid which gets thinner as friction/movement is applied.

- Oobleck is a non-Newtonian fluid created by a specific kind of mixture, called a suspension, of cornstarch and water.
    - The cornstarch particles in oobleck are so small that they are susceptible to the tiniest of thermal and electric forces.
    - Cornstarch particles, when mixed with water, will repel each other slightly, held apart by electrical forces too weak to impact anything larger than themselves.
    - When at rest, the cornstarch particles are suspended in the water with a thin layer of H_20 in between themselves. Their electrical repulsion keeps them from clumping or sinking quickly.
    - When squeezed together, friction takes over and vanquishes the weak electrical repulsion and the cornstarch particles press together and move like a solid.



Experiment 1

- Fill a small Tupperware container with oobleck so that it is at least an inch or two deep. The amount of oobleck you will need to make depends on the size of your container.
- Have your learner try placing small objects (figurines, coins, etc.) on top of the oobleck.
    - Learners should note what happens in their science journal.
        - The objects should sit on top of the oobleck initially, then slowly sink as the cornstarch particles spread out from an initial moment of being packed together.
    - How long does it take the object to sink?
    - Try different objects; how do their size and shape affect their sinking time?
    - What can learners do to make an object sink more quickly?
    - What can learners do to make an object sink more slowly?

Experiment 2

- If you have an outdoor space for this activity, use it, as it can be messy; otherwise, put down a drop cloth to protect your floors. Disposable tablecloths are also a good option.

- Fill two or more containers with at least an inch of oobleck; this will take a significant amount of cornstarch, for 2 adults to walk on oobleck we used four 16oz boxes.
    - Containers should be big enough to fit your learner's feet with room to spare. Disposable tin foil roasting ½ pans are a good option.
- Place the containers on the ground with a step worth of space in between them.
- Ask your learners to take off their shoes and socks and try walking so that they take steps through the oobleck-filled pans.
    - They should walk quickly and with purpose.
- Were your learners able to walk on top of the oobleck?
    - What happens if they walk slower?
    - What happens if they walk fast?
    - What if they stand directly on top of the oobleck?
    - How does it feel?
    - Does this remind them of anything?
- If you are interested in this experiment but don't want to make a gallon of oobleck, check out videos of this experiment online, and see how scientists have discovered a trick to make the experiment fail!

Experiment 3: Feeling the Vibe

- Fill a lightweight container with oobleck, at least an inch deep.
- Put the container on top of a speaker that has been laid on its back, speaker side up.
- Turn on something with a deep, heavy, repetitive beat and a good amount of bass.
    - You will need a speaker with a subwoofer for this to work.
- Turn up the beats and watch your oobleck dance!
    - Learners should use their science journal to note what happened.
    - Why did the oobleck behave the way it did?
        - The vibrations of the soundwaves are shaking the corn starch particles, causing the oobleck to transition from liquid to seemingly solid.
    - How does the oobleck react to different songs?
    - Would this work with any other materials?

Art Project: Drip Painting

Oobleck is a fun material to play with, but you can use it as an art material as well.

- Separate your oobleck into one large container and several small containers.
    - Empty, single-serving yogurt containers are great for projects like this.
- Mix your pigment of choice into each of the small containers; you can use:

    - A few drops of food coloring or liquid watercolor.
    - A spoonful of tempera paint.
    - A spoonful of colorful, dried spices like turmeric or paprika.
- Using either a spoon, your hands, or the container itself, drizzle your colorful oobleck onto the large container of uncolored oobleck.
    - The colorful oobleck will sink in slowly, leaving a colorful pattern on the surface with no texture.
    - The images on the right were made with turmeric and paprika and illustrate the colors pre and post being swirled together, considering swirling and marbling your colors.

NGSS Performance Expectations

2-PS1-2 Matter and Its Interactions: Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.

5-PS1-4 Matter and Its Interactions: Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

5-PS1-3 Matter and Its Interactions: Make observations and measurements to identify materials based on their properties.