SWEducational

ACTIVITY PACKET

Mechanical & Thermal Engineering Edition

WHAT IS MECHANICAL ENGINEERING?

Mechanical engineering is the study of objects and systems in motion. Mechanical Engineers combine physics and materials science to design, analyze, manufacture and maintain mechanical systems. They deal with anything that moves, from components to machines to the human body. Mechanical engineers use thermodynamics and thermal engineering in converting heat to design engines, power plants, and HVAC systems.

Photo Raffle

Do you like prizes? How about showing off your project work? Send in a photo of your **completed Mechanical Engineering and/or Thermodynamics activity** through the Google form on the classroom! You'll see your project featured on the class page, and even be entered into a raffle for the chance to win a **GIFT CARD**!

Prize List

Gift Cards to…
- Ice Cream Shops
- Target
- Walmart
- Amazon
- Many more!

Get your cameras ready and stay tuned...these photo raffles will be in every summer packet!

ACTIVITY 1: HOMEMADE ICE CREAM

IMPORTANT TERMS

Energy: power to make machines work

- When you microwave a bowl of popcorn, the microwave uses energy.
- In this activity, shaking your bag of ingredients gives the system energy to turn itself into ice cream.
- What other machines in your house need energy?
- Challenge question: Where could this energy come from?

Heat: the flow of energy

- When you put a bag of popcorn in the microwave, heat flows from the microwave to your popcorn kernels.
- In this activity, the ice cream ingredients will release heat until they cool down to a temperature that turns them into ice cream.
- If heat enters a system, does it heat up or cool down? What if heat leaves the system? (Hint: How does the temperature change when heat leaves the ice cream ingredient system?)

Thermodynamics: the study of heat and how it moves and works as energy

- When you think about how energy lets your microwave turn on, and why the popcorn pops as a result, you're thinking about the thermodynamics!
- In this activity, you will be able to look at the thermodynamics of ice cream creation.
- Cooking involves a lot of thermodynamics. Pick something you our your parents cooked recently. How could thermodynamics have been involved in making the food?

Freezing Point: the temperatures that a liquid turns into a solid

- Water's freezing point of 32F (or 0C) is the temperature that it turns into ice.
- In this activity, you will see the freezing point for your ingredients when they begin turning into solid ice cream.
- How do water, or other liquids, look different once they reach their freezing point? What are some ways you can tell that something has reached its freezing point?

ACTIVITY INSTRUCTIONS

Today we will be making homemade ice cream!

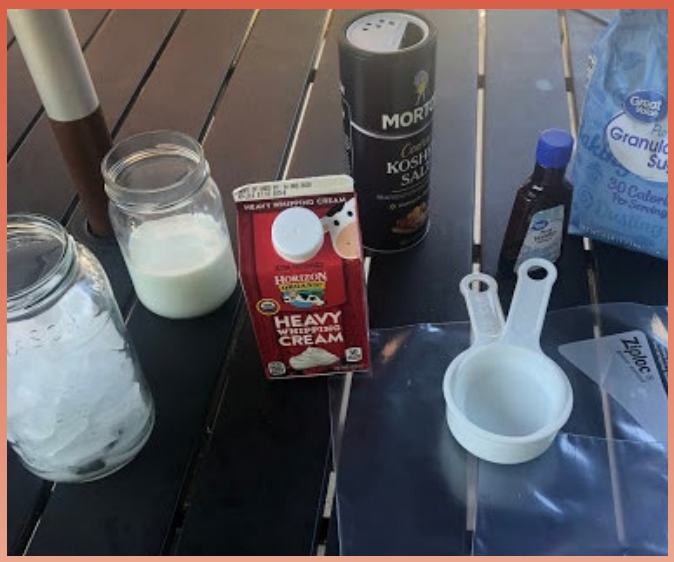
When water reaches its freezing point and changes into its solid state, or ice, the temperature is 0 degrees Celsius or 32 degrees Fahrenheit, but if you add salt, then that freezing temperature drops. That's because salt lowers water's freezing point! Have you ever noticed how when the sidewalk is icy they put salt on it to melt the ice and make it safer for walking? That's the same principle. The salt they put on the sidewalk mixes with the ice and because

it's freezing point is lower than the temperature of the unsalted ice, the sidewalk melts. When you're making ice cream the lower temperature of the ice and salt mixture, which surrounds the cream and sugar mixture, is cold enough to change the state of the cream from a liquid to a solid!

SUPPLIES

Remember to ask an adult before using materials!

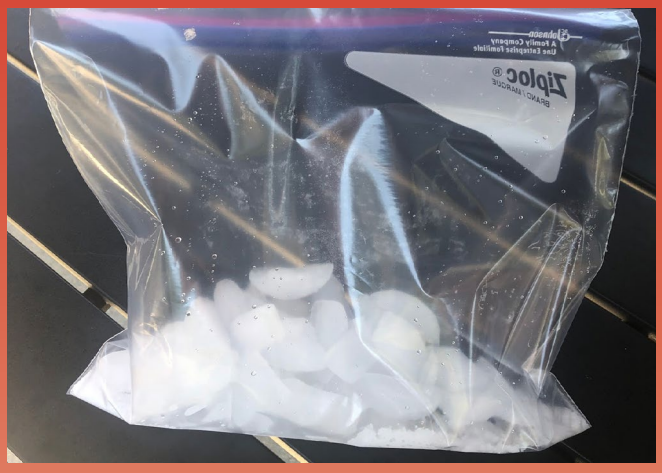
- 1/2 cup milk
- 1/2 cup whipping cream or heavy cream
- 1/4 cup white sugar
- 1/4 teaspoon vanilla extract (or another flavor like chocolate sauce)
- 1/2 to 3/4 cup table salt or rock salt
- 2 cups ice
- 1-quart Ziploc bag
- 1-gallon Ziploc bag
- Measuring cups and spoons



STEPS

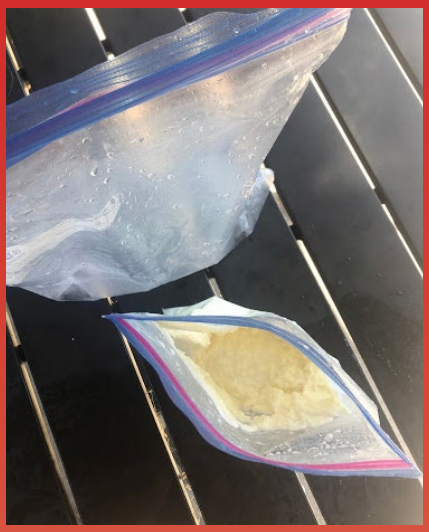
1. Add the sugar, milk cream, and vanilla to the quart Ziploc bag. Zip that bag up so nothing leaks!

2. Put the 2 cups of ice and the ½ to ¾ cup of salt into the gallon Ziploc bag.



3. Place the sealed quart bag inside the gallon bag of ice and salt. Seal the gallon bag securely.

4. Go outside (in case anything spills) and shake the gallon bag from side to side. Hold it at the seal so that the cold ice doesn't freeze your hands instead of your ice cream. You can also use gloves or a cloth to protect your hands, just remember it will be colder than 0 degrees Celsius!
5. Continue to shake the bag for 5-10 minutes or until the contents of the quart bag have become solid.



6. In bowls or cones (or even right out of the bag) serve and most importantly enjoy your homemade ice cream!

ACTIVITY 2: OOBLECK ACTIVITY

IMPORTANT TERMS

Pressure: the continuous physical force on an object

- For this project putting pressure on Oobleck makes it a solid!
- An example of using pressure is when doctors press on an injury to stop it from bleeding.
- Can you think of another example of pressure?

Compression: the force when you push down on something

- If someone were to crush a soda can they would be using compression.
- In this activity compression occurs when you put pressure on the Oobleck, making it a solid.

Viscosity: describes something thick and sticky

- For example caramel has a higher viscosity than water
- In this activity the pressure you put on the Oobleck changes the viscosity, or thickness of the material making it have a higher viscosity.

Newtonian Fluid: has a constant viscosity like water. Water does not change its thickness from pressure.

- Oobleck is a non-Newtonian fluid because the thickness changes depending on how much pressure is put on it.
- Can you think of another example of a Newtonian or non-Newtonian fluid?

ACTIVITY INSTRUCTIONS

In this activity, we'll be making Oobleck!

With just a few supplies, you can make a fun toy to play with. If you squeeze it, then it's a solid. But, if you release the Oobleck in your hand, it turns into a liquid. This is because of the properties of the molecules that make up Oobleck. When you're squeezing the Oobleck, the cornstarch particles are quickly smashed together and trap water, which makes a solid. When

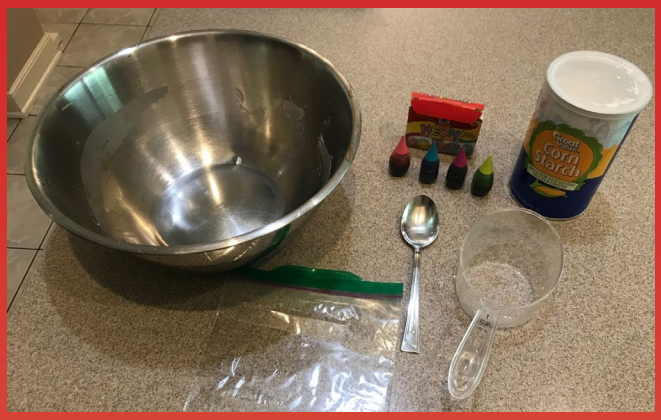
releasing, the particles are able to flow freely around, making the Oobleck seem more like a liquid.

Let's start experimenting with Oobleck!

SUPPLIES

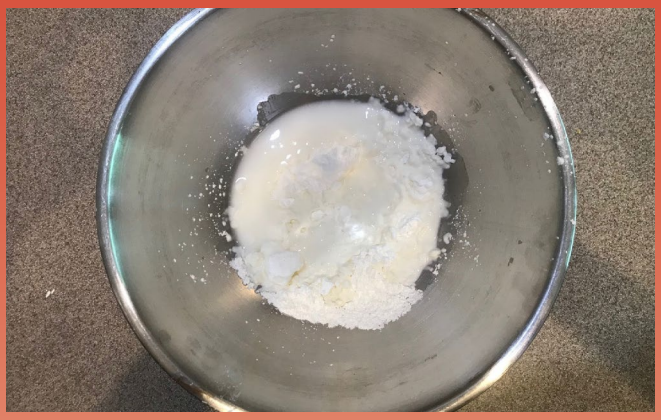
Remember to ask an adult before using materials. **Do not eat the Oobleck.**

- 2 cups cornstarch
- 1 cup water
- Food coloring
- Mixing bowl
- Spoon or other mixing utensil
- Measuring cup
- Ziploc Bag



STEPS

1. Measure and pour the cornstarch and water into your mixing bowl.



2. Add food coloring of the color of your choice! You can even mix different dyes for a fun, new color.

3. Slowly stir all of the ingredients until the mixture looks like the picture below. If it's too runny, add more cornstarch. If it's too stiff, add some more water.

If you need some help with this step, ask your parents!

4. Have some fun playing with your Oobleck! Try squeezing it, then letting it go to see what happens.
5. To store, scoop the Oobleck into a ziploc bag or air-tight container and seal it.

OTHER LINKS AND VIDEOS

- Make Your Own Ice Cream Activity: https://www.kidzworld.com/article/26683-science-project-make-homemade-ice-cream/
- What Is A Mechanical Engineer Video: https://www.youtube.com/watch?v=JhzjIPvWG7Y
- What Does a Mechanical Engineer Do Video: https://www.youtube.com/watch?v=O9JBt-3COFI
- Mechanical Engineer Video: https://www.youtube.com/watch?v=dGPP5rHn8ko
- Crash Course Video on Mechanical Engineering: https://www.youtube.com/watch?v=A1V-QQ5wFU4
- What Is Thermal Engineering Video: https://www.youtube.com/watch?v=1qmfKoLdv-U
- Three Minutes with a Thermal Engineer Video: https://www.youtube.com/watch?v=82oNawXBkOs
- Thermal Engineer Video: https://www.youtube.com/watch?v=9MCfkDFwF7M

CAL POLY ENGINEER SPOTLIGHTS

LAUREN

I love Mechanical Engineering because it's allowed me to explore so many different aspects of engineering. I've gotten to work in the machine shops, 3D print my own designs, write programs, test structures and materials, and more. My favorite project was building an escape room. It was such a unique project, and I enjoyed developing all the different aspects of the room, from the puzzles to physically building it. My favorite part of building an escape room was considering and seeing how people interacted with the different engineered pieces and puzzles of the room.

SAMI

Mechanical engineering includes the design and analysis of anything and everything that moves, from cars to catapults. I love studying mechanical engineering because it gives me the opportunity to explore how individual parts work together to make a system and complete a task that could make someone's life better. I especially enjoy projects that focus on the movement of heat and energy such as creating an ice rink indoors or utilizing solar energy to power a school. An interesting project that I worked on at my internship was designing air conditioning systems for a wildlife education center that ran only on renewable energy generated on site!

MICHELLE

I love mechanical engineering because I get a very broad understanding of the world and how it works. From how a skateboard moves forward to how the international space station was built, we study how physical objects and assemblies move and interact with each other. Mechanical engineers can extend their skills into any field of engineering and therefore help people and the world in any way imaginable! My typical day as a mechanical engineer right now includes sketching detailed drawings of my designs, then modeling them in 3D using a computer. In the past I have used my skills in fluid dynamics and mechanical design to make "labs-on-a-chip" with the Biomedical Engineering department. I have used my manufacturing skills to develop components of an overboard detection system for ships, and my finite element analysis skills to design a collapsible treadmill mechanism for airplanes! I am also working on designing and testing mission tools for an underwater rover for the Cal Poly Robotics Club. The possibilities are endless with mechanical engineering!

SOME COOL CAL POLY PROJECTS!

In-Flight Treadmill

Overboard Detection

Underwater Rover