SEAWEED GUMMIES

This experiment uses sodium alginate powder to illustrate the concept of cross-linking of polymer chains.

BACKGROUND INFORMATION:

Bounty from the Sea

Sodium Alginate is a naturally occurring polymer that is extracted from giant kelp and other brown seaweeds that grow in the ocean coastlines of North and South America, New Zealand, Australia and Africa. Kelp is known for its high growth rate, growing up to a half a meter a day. The kelp is mixed with water and salts to extract the sodium alginate polymer.

Culinary Uses

Sodium alginate is commonly used in the food industry. It acts as a thickener and emulsifier for salad, pudding, jam, tomato juice, and canned products. It is a hydration agent for noodles, bread, cool and frozen products. It is also used as a stabilizer for ice cream, yogurt, cream, and cheese. Sodium Alginate and Calcium Chloride can be found at cooking supply stores online.

As with any kind of cooking project, make sure you start with safe ingredients and clean tools.

MATERIALS NEEDED:

Food grade Sodium Alginate
Distilled water
Digital scale minimum 0.1 grams increments
Food coloring
Portion cup
Spoon or small strainer
Calcium Chloride ($CaCl_2$)
Tap water
Blender (classic or immersion)
Flavored simple syrups
Several small bowls
Pipette or eye dropper

PRE-ACTIVITY PREPARATION

Making the alginate solution

Alginate powder is very difficult to mix into water by hand, but a blender makes this prep easy.

- Measure 250 grams of distilled water and pour into a classic blender.
- Put the blender lid on, but take off the center handle.
- Turn the blender on and slowly pour in 2.0 grams of alginate powder
- Blend until thoroughly mixed (about 30 seconds).

Pre-Activity Preparation Continued…

Making the calcium chloride solution (activation solution)

- Measure 500 grams of water (tap water is fine for this step).
- Add 2.0 grams of calcium chloride and stir until dissolved.

Making flavored simple syrups

- Measure out 1.5 parts sugar to 1 part water
- Pour into a saucepan and stir well
- Place the saucepan over medium heat and heat until the liquid is clear and no longer cloudy
- Remove from the heat source. Divide liquid into batches and add flavoring to taste. Let cool
- Store simple sugars in an airtight container in the refrigerator for up to -2 weeks

WHAT TO DO:

- Pour the calcium chloride solution into a small bowl and set aside. This is your activation solution.
- Pour plain water into another bowl and set aside. This will be used for rinsing your completed gummies.

Personalizing your Alginate Sample

- Pour a small amount of alginate solution into a portion cup
- Mix in a small amount of flavored simple syrup
- Add a drop of food coloring and mix thoroughly for colored gummies (skip this step if you want them to be clear)

Making Gummies:

To make gummy eggs or worms, use an eyedropper or pipette to drip drops or squirt the flavored alginate solution into the calcium chloride solution. The worms or spheres should form instantly. The outside will be gelled while the inside will still be liquid. Use a spoon or strainer to remove the gummies from the calcium chloride solution. Rinse in plain water before consuming.

OPEN EXPLORATIONS:

Experiment with different variables in making the gummies:

- How does the time the alginate is left in the calcium chloride solution before rinsing impact the final gummy? What "soak time" makes the best gummy to you?
- Instead of a dropper, explore other means of distributing the alginate solution into the calcium chloride solution. How would a colander or sifter change how the gummies turn out?

OKLAHOMA MUSEUM NETWORK
FUNDED BY THE DONALD W. REYNOLDS FOUNDATION

SCRIBBLE BOTS

Create a motorized contraption that moves in colorful and unusual ways.

MATERIALS NEEDED:

AA battery
1.5 – 3V hobby motor
Light insulated electrical wire or alligator test lead
Wire strippers
Glue stick – cut to a length of about 1-2 inches
Masking Tape
Felt-tip Markers
Cup or similar recycled container
Paper

WHAT TO DO:

- Cut two pieces of wire about 6 inches in length or cut an alligator test lead in half.
- Use the wire strippers to expose the wire.
- Push the side of a 1 to 2 inch piece of glue stick onto the motor shaft so that one end of the glue stick is longer than the other. It should look like an off-balance propeller.
- Attach one end of each wire to the metal tabs on the motor.
- Tape the motor on to the top of cup or container, so that the glue stick hangs over the edge and spins freely.
- Tape the battery to the cup behind the motor.
- Give your bot "legs" by attaching markers to the sides of the container with tape.
- To complete the electrical circuit, tape the other end of the wires to the battery, one to the positive and the other to the negative terminal of the battery.
- Remove the caps from the markers and place the bot on to a piece of paper.

OPEN EXPLORATIONS:

Now that you have the foundation of a Scribble Bot, modify different variables one at a time to explore how they affect the path across the paper. Things to try:

- ***The length or position of the glue stick on the shaft***
- ***Switching the wires on the motor***
- ***Length or number of legs***
- ***Different heights or widths of containers***

Also explore different ways to make your bot function better. Design a switch to turn the motor on and off without disconnecting the wires.

OKLAHOMA MUSEUMS NETWORK
FUNDED BY THE DONALD W. REYNOLDS FOUNDATION

ENGINEERING CHALLENGE: STRONG SHAPES

Explore the structural nature of different shapes and apply it to different designs in this engineering activity.

MATERIALS NEEDED

Colored Paper Sheet (normal weight – not cardstock)
Tape
A number of hardback books or a cookie sheet or tray
Small weights of known value, *or* items to use as weights with a scale to measure

WHAT TO DO

- Fold pieces of paper into at least three different shapes of tube. Circular, triangular and square are three good ones to start with, but you can do more if you want a larger amount of data.
- Make four tubes of each shape you have chosen
- Secure the seams on each tube with tape
- Stand four same-shaped tubes on end and arrange in a manner to support a book or tray on top of all of them
- Add additional books or weights to the tray until the tubes crumple or collapse. Record the amount of weight you added before the tubes failed.
- Repeat this process with remaining shapes one shape at a time, keeping the support setup arrangement the same. Record the maximum weight each shape holds before it collapses. Which shape was the strongest? Which was the weakest? Compare the data and discuss why you think certain shapes can hold more weight than others.

OPEN EXPLORATION

Using your knowledge about the strength of different shapes, create your own experiment with the following paper design challenges:

- A table at least 5 inches high that can hold two pounds of weight
- A bridge with a minimum height of 4 inches and a minimum span of 8 inches that can support five pounds of weight
- A sandal with a 1 inch thick sole that someone can step into without crushing

OKLAHOMA MUSEUM NETWORK
FUNDED BY THE DONALD W. REYNOLDS FOUNDATION

MELTS IN YOUR MOUTH

This is fun demonstration can be used to show how substances with similar chemical attributes interact with one another.

BACKGROUND INFORMATION:

Chew on this…

"Natural" chewing gum is a combination of flavoring (such as sugar and natural flavors) and a gum base. The common natural gum base used was chicle, a tree sap obtained from several trees of the Manilkara genus (specifically the Sapodilla tree). The chicle is effectively a natural rubber polymer, like latex.

Choco-yum!

The primary component of chocolate is *cocoa butter*, a fat made of up of many different triglycerides. These long alkyl chains are also polymers in nature. Let's explore what happens when you combine two substances with similar polymer properties.

MATERIALS NEEDED:

Hershey's Milk Chocolate Kisses (or any other "true" chocolate with cocoa butter)
Chicle gum (Glee Gum is a great option – can be obtained online or at specialty retailers (http://www.gleegum.com)

WHAT TO DO:

- Unwrap a piece of gum and chew for a short time. You should be able to manipulate the gum easily in your mouth
- Unwrap the piece of chocolate and mix it with the gum in your mouth. "Embed" the gum in the chocolate, wrap the chocolate around the gum.
- Spend time sucking on the gum/chocolate mixture.
- What do you notice about the gum and/or chocolate as they mix? Describe what you think is happening.

OPEN EXPLORATIONS:

- Why do you think it is important to use natural gum instead of the more readily available options? Test with normal gum and record the differences. Try with various chocolates.
- Do you get the same results if you don't mix them right away?

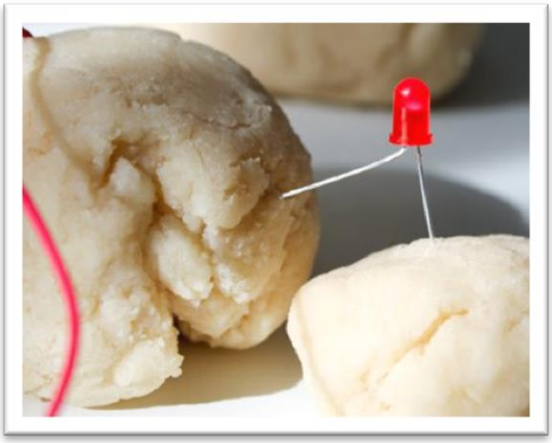
This is a fun and safe demo that allows you to explore the topic of "like dissolving like". This exploration is adapted from FLINN Scientific's "Melt in Your Mouth, Not in Your Hand" activity.

OKLAHOMA MUSEUM NETWORK
FUNDED BY THE DONALD W. REYNOLDS FOUNDATION

SQUISHY CIRCUITS

Explore the basics of electrical circuits with conductive dough

MATERIALS NEEDED



FOR DOUGH

1 ½ cups flour
¼ cup salt
3 tablespoons Cream of Tartar
1 tablespoon vegetable oil
Food coloring
1 cup water
Sauce pan
Spatula

FOR EXPLORATION

Battery Pack (recommended: 4 AA holder with wires)
Alligator Test Leads or insulated wire fitted with spade or probe ends
Motor
Light Emitting Diodes (LEDs) (recommended 10mm, any voltage under ~3.5V)
Optional: additional components (buzzers, switches, etc.)

PRE-ACTIVITY PREPARATION

Making Conductive Dough

- Set ½ cup of the flour aside.
- Mix the remaining flour, salt, cream of tartar together in a medium sized sauce pan.
- In a separate container combine the water, vegetable oil and food coloring.
- Pour the liquid mixture into the dry ingredients and stir until thoroughly combined.
- Cook over medium heat stirring continuously until the mixture starts to thicken and solidify into a ball.
- Flip the mixture over in the pan and flatten the ball like a pancake. Wait a few seconds, fold the pancake in half, flip and repeat the process until the dough firms and darkens slightly.
- Lightly flour a cookie sheet or a clean flat surface with the reserve flour. Transfer the dough to the floured surface and let it cool slightly.
- Slowly knead the remaining flour into the ball until you've reached a desired consistency.
- Store in an airtight container or plastic bag. While in the bag, water from the dough will create condensation. This is normal. Just knead the dough after removing it from the bag, and it will be as good as new. If stored properly, the dough should keep for several weeks.

WHAT TO DO:

The Foundation – Making Circuits:

- Place the batteries into the battery holder. **IMPORTANT - Never connect the battery pack's terminals directly to each other; this is called a short circuit and can make the batteries and wires get very hot**
- Divide the dough into two pieces and roll each piece into long cylinders about an inch in diameter Lay the two piece side by side, but not touching.
- Connect the power supply to your dough by pushing one of the battery contacts into each of the rolls of dough.
- Try completing the circuit with an LED (Light Emitting Diode). An LED produces light from electrical power, but in order to get it to work, it has to be oriented properly . Usually the two leads are different lengths. The longer lead goes to the positive, or red, side of the battery pack. The shorter goes to the negative, or black, side of the battery pack. **IMPORTANT Do not connect the LED directly to the battery pack. Make sure that there is dough between the LED and battery terminals or the LED will burn out.**

Open Explorations:

- Explore different configurations to get multiple lights to light up. Draw a diagram to show the connections.

- Explore connections with the motor and see how you can get it to spin. The motor has two leads like the LED, does the way they are connected affect the direction the motor spins?

- What happens to the LED when the two stands of conductive dough touch? Explain what you believe is happening.

- Does the length or thickness of the dough affect how well the components work?

- Experiment with the distance from the battery pack in the dough. How does distance affect the way components work?

- Does the number or type of components on the circuit affect how well they function?

When you are finished exploring Squishy Circuits, clean off all of the metal parts on the components and battery connectors with a damp paper towel. This prevents the salt in the dough from corroding the contacts.

Squishy Circuits were developed by Anne Marie Thomas of the St. Thomas Lab at the University of St. Thomas.

The official Squishy Circuits website:
http://courseweb.stthomas.edu/apthomas/SquishyCircuits/buildingCircuits.htm

OKLAHOMA museum NETWORK
FUNDED BY THE DONALD W. REYNOLDS FOUNDATION