

LEMON BATTERY BRAINDOUGH™

National Science Standards- Properties of Objects and Materials, Light, Heat, Electricity, and Magnetism

Science Process Skills -Observing, communicating, estimating, measuring, inferring, making models and investigating

Ingredients

- 2-3 fresh lemons
- 2- tablespoons of olive oil
- 1- cup of water
- 1/3 - cup of lemon juice
- 2 ½ - cups of flour
- 2-tablespoons of cream of tartar
- ½ cup of salt
- Yellow liquid watercolor or food coloring as desired

Procedure

1. Remove the ends from two lemons, cut into four pieces, and place in a blender with the water.
2. Blend at a high speed until the lemon is well-blended. Do not remove the solids and pour the mixture into a nonstick saucepan.
3. Add the salt, oil, and cream of tartar.
4. Stir the mixture until it is it that creamy paste. You may add a little water if the mixture is too stiff to stir.
5. Ask an adult to cook the mixture over medium heat while stirring until the mixture clumps and looks like thick lumpy mashed potatoes.
6. Remove from the heat and let it stand for 2 minutes. The mixture will finish cooking but will not burn. The mixture will be hot so use caution when working with hot materials.
7. Spoon braindough mixture all the pan onto a generously floured board and let it cool to the touch.
8. When the braindough is cool, knead it until it is the desired consistency. Place it in a sealed plastic bag.

Color: Light yellow to tan	Texture-Soft but pliable with lemon flecks	Scent: Lemon Use as aromatherapy braindough	Variations; add lemon fragrance oil if it is not strong enough. Add shells, rocks, beads, etc.
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Assignments, Assessment Ideas, and Activities

Lemon is an essential oil adaptogen that may have a balancing effect on the brain as far as moods are concerned. According to Dr. Daniel Amen, a noted psychiatrist who uses brain scans to understand and evaluate behavior, the scent of lemon may improve memory and cognition. Lemon is a natural stress reliever and may have anti-anxiety properties by altering the neurotransmitters in the brain.

Science Connections- Electricity and cause, and effect. This braindough can be used to observe the properties of electricity. Lemons can be used to make a weak voltaic battery. Lemon juice was used in making this braindough. This battery will not be strong but will power a Christmas tree bulb, digital watch, or register on a voltmeter.

Assembling a Lemon Battery

Materials

- 4 - balls of lemon battery braindough
- 2- yds. speaker wire
- Hammer
- Wire cutters
- Digital clock watch or Christmas tree bulb
- Current meter

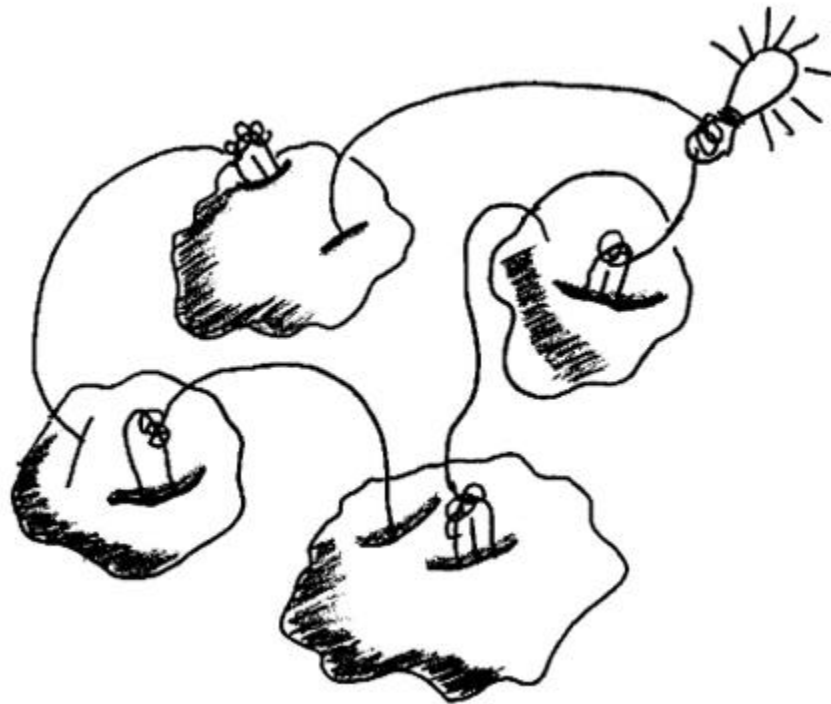
Procedure

1. Using the lemon battery braindough, make four equal-sized balls about the size of a plum and set aside. Label the braindough balls #1-4
2. Cut the speaker wire into four 6-inch pieces. With the assistance of an adult, take a pair of scissors and separate the copper side (orange color) from the zinc (gray color) side. There should now be eight sections of wire, four copper and four zinc. Set aside the zinc wire to use in another experiment.
3. Remove one inch of insulation from both ends of the copper speaker wire. Label the copper wires #1-4. Place a paper clip on the other end of the copper wire. Repeat the same process for all pieces.
4. Starting with braindough ball #1, push the copper end of the copper wire into braindough ball #1. Push the paper clip end of wire #1 into braindough ball #2. Using wire #2, push the copper end of wire #2 into braindough ball #2 about ½ inch away from the paper clip on wire #1. Make sure it is near the paper clip end but not closer than ½ inch. Put the end of wire #2 in braindough ball #2 and stick the paper clip end of wire into braindough ball #3. Stick the copper end of wire #3 into braindough ball #3 about ½ inch away from paperclip on wire #2. Put the paper clip end of wire #4 into

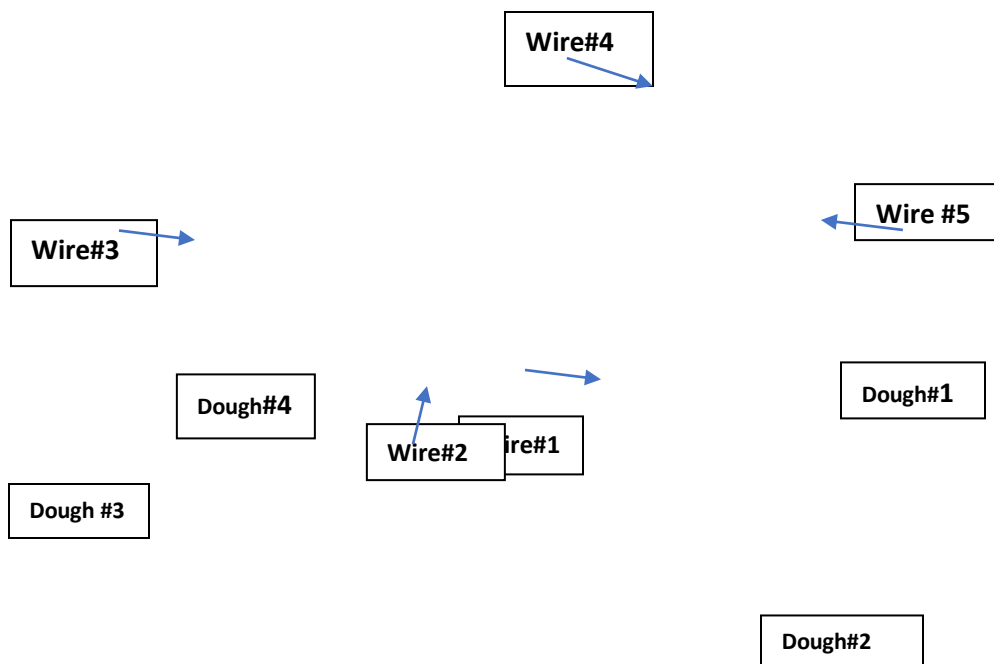
braindough ball#4. Put the copper end of wire #4 into braind ball #4 Wrap one end of wire #4 around the end of a bulb. Take a copper wire #5 and put the paper clip end into braindough ball #1 at least ½ inch away from the zinc wire. Place the wire on the

end
the
wire
be

other
around
bulb
near
#4. The
circuit
should



complete and the bulb light.



About Electricity-

The metal strips and the braindough balls make a simple cathode battery which produces enough electricity to power a small digital watch. Each braindough ball is an electrochemical cell which changes the chemical energy stored in the metal strips into electrical energy. The braindough acts as a conduit for the protons leaving the copper. Copper gives up protons and zinc collects them

The electrochemical cell works because the metal wire, copper, and zinc, have different properties. They have a different number of atoms. Atoms are the smallest particles that make up an element. On the periodic table, copper has 29 atoms and zinc is 30. The different properties of these metals cause tiny charged particles or ions to move from one metal to the other. This movement or flow is the electrical current. The braindough ball keeps the metals in the wire from touching and allows the current to flow through the wires and on to the next dough ball until the current reaches the bulb element.

Italian scientist, Alessandro Volta (1745-1827), made the first battery with metal disks soaked with saltwater. A voltaic battery converts chemical energy into electrical energy and carries the name of the battery inventor, Volta. The metal strips are called electrodes and the brain dough ball is an electrolyte. The chemicals are consumed which is why a battery dies. Batteries are named after the chemicals used in them. Nickel, cadmium, and zinc are common chemicals used in making a battery. Conductors allow electricity to flow and non-conductors do not

Vocabulary

Vocabulary and words that learners will use in the making, manipulating and experimenting with this dough are:

voltage	insulation	chemical changes
ampere	AC (alternating current)	battery
resistance	DC (direct current)	charge
current	solar power	recharge
power	voltaic	atoms
lightening		

Properties and Principals to Observe and Think About

1. Do braindoughs made with different fruits or vegetables behave in a similar fashion?
2. If the current does not flow, what could be the cause?
3. Those moving the metal strips further apart affect the flow of electricity?
4. What other metals have a similar effect? How can you find out?
5. If the metal strips touch, what happens to the flow of electricity?
6. What other brain goes work is a well to produce electricity?
7. Why can birds stand on electrical wires and not be electrocuted?

8. What happens to the current if you touch the braindough? (Hint: You will need either a digital watch or a current meter to see the effect)

Did You Know - Fun Electricity Facts and History

1. Lightning is an electrical current that is discharged into the atmosphere. It travels at about 130,000 miles per hour that is faster than sound. Therefore, you see lightning before you hear the thunder.
2. Lightning is very hot reaching 30,000° C or 54,000° F.
3. Eels produce an electrical shock equivalent to 500 volts.
4. Electricity is like a magnetism in that two positive charges repel each other as do two negative charges. Opposite poles attract each other.
5. Electricity plays a role in the beating of the heart. Specialized cells contract producing the electrical heartbeat. If you place two beating hearts side-by-side, they will synchronize their beats.
6. Electricity flows two ways. Direct current (DC) flows one way while alternating current (AC) flows in two directions, backward and forward. The electricity in houses is AC and the current in car batteries is DC.
7. In the 1880's, Nicholas Tesla won the war of the currents. His alternating current (AC) selected to produce power at Niagara Falls. AC current was safer and could serve more customers in a large geographical area. This type of electricity is responsible for the growth of the consumer appliance market.
8. Thomas Edison invented direct current (DC) which is more dangerous and cannot accommodate as many customers at one time.
9. Benjamin Franklin invented the lightning rod in the 18th century.
10. Dams are used to produce electricity by capturing the current produced by the flowing water turning turbines attached to generators.
11. Solar cells use the sun's light to convert into electricity. The largest solar plant in the world is in the Mojave Desert.
12. Electrical current travels to the ground.

