Experimenting with Elements

Grades 4-5

Explore different elements and their reactions.

**PBL Problem to Solve:** A group of fisherman discovered a substance spilled in the Atlantic! We need to identify the substance and determine how to clean it up. You need to work quickly! This could potentially be very dangerous to the ecosystem.

**(Set up cornstarch and water prior to starting and let student's explore. This is our mystery substance!)**

**Posing The Problem**

**Activity Title**: Problem-Based Learning

**Goal Alignment:** Reinforce students' problem solving skills

**Approximate Time Frame of Activity**: 30 minutes

**Materials Needed:**

|  |  |
| --- | --- |
| Butcher Paper | 1 larger piece |
| Pencils / Pens | 1 per student |
| Worksheet: PBL Page 1: The Problem | 1 per student |
| Worksheet: PBL Page 2: The Questions | 1 per student |

**Activity Overview and Objective:**

1. Teacher will tell the students:

**Problem: A group of fisherman discovered a substance spilled in the Atlantic! We need to identify the substance and determine how to clean it up. Work quickly! This could potentially be very dangerous to the ecosystem.**

Split students into arbitrary groups of 3 – 5

1. Once students are in groups
	1. Pass out pg. 1: The Problem
	2. Have students brain storm different chemicals, elements, and cleaning strategies/cautions. (20 min)
2. Come together as a group and make a comprehensive list from the students brain storm (15 min)
3. Send students back to their groups
	1. Have students’ discuss what types of questions they would need to ask to determine the best way to identify and clean a spill. (20 min)
		1. Make sure to circulate and assist students in this brain storm the comprehensive list should lead to experiments on identifying elements and chemicals, and clean up strategies with proper safety in mind.
		2. Questions such as: What are the different elements? What are ways to identify the chemical? What elements combine together to form the chemical? How would we clean it up? How will we stay safe?
4. Come together as a group and make a comprehensive list of questions from the students brain storm (15 min)

**Results and scientific background:**

* Students will note many different elements, chemicals, and strategies on how to safely clean up chemical spills.

Activity Title: Chemistry Lab Journal

Activity Goal/Objective: Students will design their own lab journals to use throughout the week to record observations, hypothesis, ideas, etc. about each activity. This will promote creativity, critical thinking, and using prior knowledge to explain new concepts.

Approximate Time Frame of Activity: 10-15 min.

Materials Needed:

* Approx. 7 sheets of computer paper (per student)
* Stapler
* Assorted markers, crayons, colored pencils

Activity Overview and Scientific Background: Recording observations, hypothesis, materials used, procedures followed, diagrams, etc. are all an important part of being a chemist. Being able to make predictions about what will happen and then analyze the results of the experiment to determine whether or not the predictions were correct is necessary to fully understand activities, labs, demos, etc.

1. Put sheets of computer paper together in a pile and fold in half (hamburger style). Staple the binding of the journals. *(This can all be done ahead of time during previous activity so students don’t have to wait for journals.)*
2. Prepare containers of art utensils for each table (i.e. putting markers into a cup or on a plate works well—easy for clean-up as well!).
3. Allow students to design the cover of their lab journals. Be sure that they include their names—they can leave their journals at camp at the end of each day and take them home at the end of the week!

Extension Higher: Allow students to design their own journals from scratch (using staples or hole punches with yard, string, etc. to hold journal together).

Extension Lower: none

Activity Title: Mystery Bags

Activity Goal/Objective: During this activity, students will be able to use quantitative and qualitative descriptions to attempt to identify mystery objects hidden inside paper bags by using only their sense of touch. This demonstrates how we have to use our senses to identify the substance.

Approximate Time Frame of Activity: 10-20 min.

Materials Needed:

* 4 paper bags per group/table (approx. 3-5 students per group)
* 4 different objects of your choice (must be identical for each group—i.e. if there are 5 groups, you will need 5 “identical” objects so each group can identify similar objects. This is easily modified—just an idea to make set-up easier.)
* Marker (to label bags)
* Lab journals
* Pencils

Activity Overview and Scientific Background: Being able to make detailed observations is an important part of being a chemist. Chemists need to be able to describe substances with both quantitative (number/amount) and qualitative (descriptive) observations. *(This was practiced in the previous activity—now students can build on what they learned with blind objects.)*

1. Set-up: Label paper bags #1, #2, #3 and #4 for each group. Find similar objects to place in each #1 bag and so on (i.e. every #1 bag has a film canister; every #2 bag has a bottle of glue, etc. *Stay away from sharp/dangerous objects—students will blindly feel objects in this activity!)*
2. Guide students to title and date their activity; help them develop a chart to identify 4 blind objects (a simple table with Object #1, #2, etc. will suffice!). Explain that they will be using only their sense of touch to identify the objects inside the paper bags!
3. Provide each group with numbered bags. Allow time for each student to blindly feel the object in each bag and make observations. They should be using qualitative AND quantitative data if possible!!
4. Allow groups to discuss contents of each bag. Bring room together to allow groups to share ideas/specific descriptions that allowed them to identify each object. Explain that using this type of inference in science can help them draw conclusions about experiments!

Extension Higher: Put completely different objects in each bag. Allow students to feel objects in one set of bags, then rotate each set of bags to a different group until students have had an opportunity to identify 8-16 total objects. This can take more time and help them develop a more complex data table.

Extension Lower: Replace vocabulary “quantitative” and “qualitative” with descriptions that students should use measurements or numbers to describe objects as well as descriptive words.

Activity: States of mateer

What state of matter is the substance?

Discussion: States of Matter

*(Have students draw diagrams of particle arrangements for each state of matter in lab journals and label solid, liquid, and gas)*

Almost all substances can be classified into three states of matter: solids, liquids and gases. The arrangement of the particles (atoms/molecules) within the substance identifies which state of matter that substance will be!

* SOLID—particles are packed closely together and cannot move around one another. Particles are still MOVING, but they move within fixed positions. Their inability to “flow” creates the shape that solids hold.
* LIQUID—particles are close together, but have the ability to move around one another. This allows liquids to flow and change shape but maintain their volume.
* GAS—particles are spread far apart and can move freely; they have no attraction to one another, so there is nothing holding them close together. This allows gases to expand in volume and change shape based on their container.

Activity Title: States of Matter Body Models

Activity Goal/Objective: Students will be able to use their bodies to perform a kinesthetic activity in which they properly model the 3 states of matter.

Approximate Time Frame of Activity: 10-15 min.

Materials Needed:

* Just your bodies!

Activity Overview and Scientific Background: (see discussion above)

* You can pick from or do both of the following kinesthetic activities to help students understand how the state of matter behave differently from one another:

ACTIVITY #1: Attractions between particles in S, L, G

* 1. Explain to students that they are going to use their bodies to represent the three states of matter. Have students spread out around classroom.
	2. When you yell, “form a SOLID!”—students must place each hand on a different shoulder of someone else. Instruct them to move in certain directions as a whole mass—this will be difficult, which explains why solids maintain their shape.
	3. When you yell, “form a LIQUID!”—students must place one had on another shoulder of someone else but leave one hand free. Instruct them to move in certain directions as a whole mass.
	4. When you yell, “form a GAS!”—students drop both hands by their sides and move freely around the room without restrictions. This illustrates how gas particles have no attraction to other particles and have the ability to move anywhere within the container.

ACTIVITY #2: How kinetic energy determines the state of matter!

1. Explain to students that they are going to still use their bodies to represent the three states of matter, but in a different way. Have students stand in a clump (close together) within the room (depending on size of group, sectioning off a smaller space may be helpful).
2. Explain that the amount of energy the particles have can determine what state of matter that particle is. Energy is directly linked to the temperature—generally, the colder the temperature, the more “solidified” the substance (think: water freezes to make ice).
3. When you yell, “form a SOLID!”—students should stay clumped together and move within their positions VERY SLOWLY.
4. When you yell, “form a LIQUID!”—students should spread out SLIGHTLY and move a little faster. They can weave in and out between one another because they are no longer in fixed positions.
5. When you yell, “form a GAS!”—students should spread throughout the entire space and move quickly (CAREFULLY)!

Extension Higher: Allow students to figure out on their own how to simulate each state of matter by changing the speed of their motion.

Extension Lower: none

DISCUSSION: Changes of State

Can we clean the substance by changing the state of matter?

*(Have students draw SLG diagram in lab journal and use arrows to demonstrate changes between each state)*

**

EXAMPLE

DIAGRAM:

* Solids, liquids and gases are 3 completely different states of matter, but one of them can transform into the others with just a change in temperature, pressure or volume!
* When solids change to liquids, the process is called MELTING (i.e. ice🡪water).
* When liquids change to back solids, the process is called FREEZING (i.e. water🡪ice).
* When liquids change to gases, the process is called EVAPORATING or VAPORIZING (i.e. water🡪steam)
* When gases change back to liquids, the process is called CONDENSING (i.e. steam forming water droplets on the lid of a pot of boiling water)
* There are 2 changes of state that might seem strange—solids can also change directly to gases without melting! This is called SUBLIMATION. These gases can also change directly back to solids without going through the liquid stage; this is called DEPOSITION. (i.e. dry ice, solid air fresheners)

Activity Title: Carbon Dioxide Bubbles

Activity Goal/Objective: During this demonstration, students will experience sublimation—the change of state directly between a solid and a gas without going through the liquid phase.

Approximate Time Frame of Activity: 10 min.

Materials Needed:

* 3-4 chunks Dry ice (broken into 2x2” pieces)
* Dry ice glove
* Warm water
* CO2 bubbles demo container
* Dish soap/water
* Small cup/plastic container

Activity Overview and Scientific Background: Sublimation is one of 6 changes of state, specifically between a solid and a gas. Dry ice is made of a different substance than regular ice—it is carbon dioxide cooled to a very low temperature. This substance never “melts” like regular ice—when it reaches a warm enough temperature, it turns directly into a gas!

1. Fill the small cup with a mixture of dish soap and water. Mix to make a soapy water solution.
2. Fill the CO2 bubbles container with warm water.
3. Use a cryo glove to put a chunk of dry ice into the container with warm water. The dry ice should immediately begin “bubbling”—this is the process of sublimation.
4. Stick the hose from the bubbles container into the soapy water. The hose should create bubbles filled with CO2 gas.
5. The bubbles will either pop by themselves OR you can have students poke the bubbles!

Extension Higher: Have students try to hold CO2 bubbles in their hands without allowing them to pop. Let them come up with methods on how this may work!

Extension Lower: none

Activity Title: Oobleck!

Activity Goal/Objective: Students will use their knowledge of the states of matter to make observations about how a substance can act as both a solid AND a liquid!

Approximate Time Frame of Activity: 15-20 min.

Materials Needed:

* 1 box of corn starch
* 1 pitcher of water
* Large bowls (1 per group; may be broken into “bigger groups” to save supplies)
* Food coloring (optional)

Activity Overview and Scientific Background: Oobleck is known as a non-Newtonian fluid (basically, the viscosity, or resistance to flow, is much higher than most fluids… ex: ketchup). Its unusual physical characteristics allow it to act as a solid and a liquid at the same time—depending on the amount of force applied to the substance, it will feel and act like a solid with more force (smacking the oobleck) and will act like a liquid with less force (just putting a finger or two into the oobleck slowly).

The oobleck contains so much corn starch that applying quick pressure or force doesn’t allow the corn starch molecules to move out of the way fast enough, allowing it to appear as a solid. Putting your fingers in slowly allows the molecules to part, allowing it to appear as a liquid.

1. Combine 2 parts corn starch with 1 part water into a large bowl. Add food coloring if desired. Knead with hands until consistency is smooth & liquidy, but firm upon smacking the surface with a couple fingers. (This can be done in front of students so they can see the mixture transform; students can even be put to work kneading so you can add ingredients as needed to reach the perfect consistency.)
2. Instruct students to use two fingers to lightly smack the surface of the oobleck. What happens? Then, allow them to dip two fingers into the oobleck. What happens?
3. Can you form a ball from oobleck? What happens if you let go of the ball?
4. Brainstorm another substance that acts like oobleck (quicksand). How should you move through quicksand?

Extension Higher: Allow students to explain why they think oobleck acts the way it does BEFORE the science is explained.

Extension Lower: Mix oobleck ahead of time/make sure mixing is done by adults and not students if necessary.

Activity Title: Ice Cream in a Baggie

Activity Goal/Objective: During this activity, students will be able to experience freezing point depression by using rock salt to lower the freezing point of water.

Approximate Time Frame of Activity: 30 min.

Materials Needed: (per student)

* 1 tbsp sugar
* ½ cup half & half cream
* ¼ teaspoon vanilla extract (imitation may be used)
* 6 tablespoons rock salt
* 1 quart-size Ziplock baggie
* 1 gallon-size Ziplock baggie
* Ice cubes
* 1 plastic cup
* 1 spoon
* Set of measuring spoons (one set for entire group)

Activity Overview and Scientific Background: Freezing point depression is the same concept as how adding salt to the roads in the winter can help melt ice! When salt is added to water, it lowers the freezing point of water (which is normally 32°F or 0°C). This allows water to remain a liquid at colder temperatures which makes driving conditions safer! The type of salt added will actually lower the freezing point more (for example, NaCl can be used, but CaCl2 is more effective because there are more particles that break apart upon being dissolved!). In your experiment, adding rock salt to the ice will create a colder environment for the ice cream to properly form!

1. Fill the gallon bag half full of ice and add the rock salt. Seal it so nothing spills.
2. Combine the cream, sugar and vanilla extract into the small bag and seal it. Make sure all excess air is squeezed out so the bag doesn’t pop open!
3. Put the small bag inside the big bag and seal the entire system.
4. Shake or flip the bag until the liquid mixture becomes solidified (consistency should be similar to a thick milkshake or soft-serve ice cream).
5. Pour your ice cream into a cup and enjoy!

Extension Higher: Ask students to explain what they think is happening to allow the liquid to turn into a solid and how rock salt will help!

Extension Lower: none

Discussion: ATOMS/MOLECULES

All substances are made up of tiny particles called atoms. Atoms are the smallest particle and are therefore known as the “building blocks of matter.” The types and amounts of atoms and how they combine to make molecules or compounds defines the type of substance. Molecules are simply 2 or more atoms bonded together!

* Atoms are made up of 3 smaller particles called protons, neutrons & electrons.
* Protons & neutrons are located in the nucleus (the center of the atom); protons are positively charged and neutrons are not charged (neutral). These two particles make up the majority of the atom’s mass.
* Electrons are located outside of the nucleus around the atom in rings (or orbitals). These particles are negatively charged and are much smaller than protons or neutrons.

Discussion: Elements & the Periodic Table

* Pass out ***Periodic Table handout*** to students. Explain that elements are pure substances that only contain one type of atom; 2 or more elements can combine to create a compound. Have students brainstorm a list of compounds?
* Humans have been discovering elements since they began exploring the wonders of the world. Elements like gold, copper, and iron are all useful metals for things like tools, jewelry, weapons, etc.
* There are currently 118 elements that we know of, each with different properties. How do scientists classify all of this information??
	+ The periodic table of elements is a chart designed to organize the elements by atomic number (#1-118). This number tells us how many protons and how many electrons each element has. These numbers are equal because the total positive charge (protons) equals the total negative charge (electrons) for each atom.
	+ The other number on each element symbol tell us the atomic mass, or another way of saying approximately how much each atom “weighs.” Most of the mass is made up of the protons and neutrons; therefore, ***MASS – ATOMIC NUMBER = # of neutrons!***
* Mini Activity: teach students how to read each element symbol box on the periodic table. ***(HANDOUT)***
* Mini Activity: A Periodic Poem***(HANDOUT)***
* Mini Activity: Tom Lehrer’s “The Elements” song *(flash animation online)*

<http://www.privatehand.com/flash/elements.html>

Activity Title: Build your own Atom!

Activity Goal/Objective: During this activity, students will create their own unique models of atoms in order to learn about protons, neutrons and electrons and their locations.

Approximate Time Frame of Activity: 15-20 min.

Materials Needed:

* Gallon-sized baggie of large pom-poms (assorted colors OK)
* Gallon-sized baggie of small pom-poms (assorted colors OK)
* Several sheets of computer paper per student

 ***(the above supplies can be substituted with beads and string/yarn—keep large pom-poms to use as particles in nucleus)***

* Assorted markers, crayons, colored pencils
* 1 periodic table per pair
* “The Refined Bohr Model” reference for counselors

Activity Overview and Scientific Background: *(see discussion above for science)*

All atoms fill their rings (orbitals) in the same way. Each ring will fill to its maximum amount of electrons (as listed below) before more electrons can be put into a new ring.

* Ring #1: 2 electrons
* Ring #2: 8 electrons
* Ring #3: 8 electrons

Ex: Nitrogen has 7 protons and 7 electrons. The 7 electrons need to be put around the nucleus in rings—Ring #1 has 2 electrons, Ring #2 has 5 electrons (making a total of 7).

Students can pick their own pom-poms to represent an element of their choice (I would stick with elements #3-18 to make a decent model without using a TON of pom-poms).

* 1. Have each student pick an element (#3-18 advised) to create a model of. Students should find their element on the periodic table. Each element tells them how many protons, neutrons and electrons to add to their model.
	2. Allow groups/pairs of students to come to a supply table and pick pom-poms (or beads) to represent their subatomic particles. (Ex: if they picked nitrogen, they will need 14 large pom-poms for protons & neutrons and 7 small pom-poms/beads for electrons. Large = protons/neutrons; small = electrons)
	3. Have students design a model of their atom. Assist them to make sure they’re putting electrons in the correct rings.
	4. Once models are complete, have students create a label for their model with its name, # protons, # neutrons, and # electrons. They can list this info OR recreate an element symbol from the table. Then, allow students to “show off” their models by playing “Element Museum”—students leave their models at their table space; they can walk around and view other models for 5 min. or so.

Extension Higher: Allow students to design two models or pick a number up through #20 (19 and 20 add a fourth ring to the model). Replace “museum” with a couple volunteers to explain their atoms.

Extension Lower: Allow these students to pick models from #1-10 (1 or 2 rings). Students may work in pairs to complete one model.

Activity Title: Periodic Table Word Challenge

Activity Goal/Objective: Students will use their knowledge of the periodic table and use element symbols to spell common words.

Approximate Time Frame of Activity: 10-30 min. (can easily be extended)

Materials Needed:

* Periodic table (1 per pair)
* Pencils
* Lab journals

Activity Overview and Scientific Background: Students will become more familiarized with elements on the periodic table by using them to spell words they already know. All symbols have one or two letters; the first letter is always capitalized and the second letter is always lowercase. This should be modeled correctly during the activity.

1. Explain to students that their challenge is to pick a partner and come up with the longest word they can by only using symbols from the periodic table.
2. Provide an example: “cat” can be spelled with C + At. “Car” can be spelled with C + Ar.
3. Give students a time frame with which to work (i.e. “you have 10 minutes to find the longest word you can spell using only symbols!”). Make sure to time the activity! Warn students at 5 min, 2 min and 30 sec. intervals.
4. When time is up, allow groups to share their longest word—the winning team can pick a game to play during free time!

Extension Higher: This activity can have several rounds. You can challenge students to use “only metals” to spell words (if they know which sections to use) or challenge them to find as many different words as they can (plurals don’t count—the symbol “S” can be added to almost any word!). See if students can spell their full names with symbols!

Extension Lower: Challenge teams to come up with 10 different words (rather than “the longest word” if they have trouble spelling or with vocabulary). The team to find 10 different words in the shortest amount of time wins!

Daily Focus: Physical & Chemical Changes; Types of Elements

Questions to consider:

* How is a physical change or reaction different from a chemical change/reaction? Can you name examples or characteristics of each?
* Why is learning and following laboratory safety SO important when working with chemicals to create reactions?
* Why do you think the nonmetals are all clumped in one area of the periodic table? (Think properties/characteristics.)
* What types of observations can tell you if a chemical reaction has occurred?
* Are all chemicals “dangerous”? Give some examples that are not!

Activity Title: Create a Periodic Name Tent (ice breaker)

Activity Goal/Objective: During this activity, students will use their knowledge of the periodic table to create a name tent they can use all week (and take home!).

Approximate Time Frame of Activity: 10-15 min.

Materials Needed:

* Periodic table handout
* Construction paper (1 piece per student, additional for mistakes)
* Assorted markers, crayons, colored pencils

Activity Overview and Scientific Background: Students learned about element symbols on Monday. They will pick an element symbol that fits within their name to design a creative name tent.

EX: Matt = M[At] t Kristin = Kris[Ti]n Audrey = [Au]drey

1. Create a name tent from a piece of construction paper. (folding the paper in thirds and making a “long triangle” shape has been effective)
2. Use the periodic table to find an element that would fit within your name. It doesn’t have to be just the first letter—be creative!
3. Design your name tent using that element symbol. Be sure to include the atomic number and atomic mass values!

Extension Higher: Try to see if students can find two element symbols that fit their name… or if they can spell their entire name out of symbols!

Extension Lower: Assist students in finding an element symbol that would fit within their name.

Discussion: Physical vs. Chemical Changes

* **Physical change:**
	+ A substance undergoes a change in appearance but NOT chemical composition
		- EX: ripping, breaking, melting, freezing
		- All changes in state of matter are physical changes!
	+ 2 substances are combined to form a mixture
		- EX: when mixing sugar and water, the sugar appears to be no longer present so children often assume a chemical change has happened. In reality, the mixture can be separated back into its original substances.
* **Chemical change:**
	+ 2 substances are mixed together to form something new. Sometimes when a mixture is made it can be hard to tell if a chemical change has occurred. There are 4 main clues that a chemical change has occurred:
		1. There is a formation of gas which can be seen by a fizzing or bubbling
		2. The reaction will cause heat, light or odor to be emitted
		3. A color change is produced
		4. A solid is formed during the change

Discussion: Safety in the Lab

Activity Goal/Objective: Students will review or learn laboratory safety when working with chemicals *(allow students to come up with their own safety rules and add any they missed!)*

Approximate Time Frame of Activity: 10 Minutes

Materials Needed:

* Lab journals
* Pencils

Activity Overview and Scientific Background:

*Safety: In every lab class there is always the danger that you may expose yourself to injury. The chemicals and equipment that you use and proper lab techniques are very important, not only for your safety, but for the safety of those working around you. Please observe the following rules at all times. Failure to do so increases your risk of accident.*

* *Goggles*
	+ Goggles should always be worn when chemicals are being heated or mixed. This will protect your eyes from chemicals that spatter or explode. Running water should be available. If you happen to get some chemical in your eye, flush thoroughly with water. If irritation persists, you should immediately go to an emergency room.
* *Smelling Chemicals*
	+ If you need to smell a chemical to identify it, hold it 6 inches away from your nose and wave your hand over the opening of the container toward your nose. This will waft some of the fumes toward your nose without exposing you to a large dose of anything noxious.
* *Chemical Contact with Skin*
	+ If you happen to spill a chemical on your skin, flush it with water for 10 minutes. If irritation persists contact a physician.
* *Clean up all Messes Immediately*
	+ This is no time to be a pig! Your lab area should be spotless when you start experimenting and spotless when you leave. If not, clean it.
* *No Eating During the Lab.*
	+ When you eat you run the risk of internalizing something inedible. This is never done unless the lab calls for it. Make sure your hands and lab area are clean.
* *No horseplay*
	+ Horseplay can lead to chemical spills, accidental fires, broken containers, and damaged equipment. Never throw anything to another student, be careful where you put your hands and arms, and no wrestling, punching, or shoving in the lab.
* *Better Safe Than Sorry*
	+ If you have questions, or if you are not sure how to handle a particular chemical, procedure, or part of an experiment, ask for help from your instructor or an adult. If you do not feel comfortable doing something, ask for help.

Activity Title: Physical & Chemical Reactions (demo)

Activity Goal/Objective: During this demonstration, students will be able to use their knowledge of physical and chemical reactions to predict the outcome of several demonstrations.

Approximate Time Frame of Activity: 10 min.

Materials Needed:

* 1 piece of paper (any style)
* 1 balloon
* 1 ice cube
* Vinegar
* Baking soda
* Milk (1 pint)
* 4 clear plastic cups (12-20 oz)
* “Curds and Whey” reference for counselor

Activity Overview and Scientific Background: (see discussion above)

* Vinegar (CH3COOH) combines with baking soda (NaHCO3) to produce entirely new products, one of which is carbon dioxide (CO2). *(This reaction can be messy—it will bubble and possibly spill out of the container!)* Where else is carbon dioxide found?
* Milk and vinegar will combine and curdle as a result. The “curds” that are formed are an example of a precipitate: a solid that forms as a result of a chemical reaction.
1. ***(before discussion)*** Have the ice cube sitting on a surface that is visible to all students. Throughout the demos, they should notice that it is changing in physical appearance.
2. Ask students to define and give some examples of physical changes. They may mention that all physical changes are reversible (or can be undone); this is a huge misconception that they will see shortly!
3. After students have shared their thoughts, take the piece of paper and ask them how it can change physically. Tear the paper in half. Is this reversible? (NO.) Did this change the chemical composition of the paper? (NO—only its appearance.)
4. Pick up the balloon. Ask students how we can change the physical appearance of the balloon. Once someone suggests that you can blow it up, do so! Tie the balloon blown up. Has its physical appearance changed? (YES!) This change is reversible if we let the air out… but blowing the balloon up can’t be reversed if we POP it! (Pop the balloon!!)
5. See if anyone has observed the physical change that has been occurring with the ice cube… all changes of state are also physical changes!
6. Allow one student to share something they learned about physical changes.
7. Ask students to define and come up with examples of chemical changes. They may mention that chemical changes are never reversible—MOST of the time, this is true! A chemical change will form one or more new products that have undergone a change in the chemical makeup of that substance.
8. After students have shared their thoughts, pour vinegar into one plastic cup and baking soda into another cup. Most students will already know what happens (they will fizz and possibly bubble over the cup!)… but can any of them explain why this is a chemical reaction? (see activity overview) Combine these substances into one cup and watch the chemical reaction!
9. In two new cups, pour vinegar into one and milk into the other. Ask students to hypothesize the outcome of this chemical reaction! (see activity overview)
10. Discussion question: we have already discussed 4 clues that a chemical change has occurred—what types of clues did you see during these last two demos that show a chemical change has taken place?

Extension Higher: What other types of physical or chemical changes can students come up with on their own? Brainstorm a list of ideas. How do they know it’s physical or chemical?

Extension Lower: none

Activity Title: Mystery Powders

Activity Goal/Objective: Students will compare how unknown white powders (cornstarch, baking soda and baking powder) react with iodine.

Approximate Time Frame of Activity: 10-15 min.

Materials Needed:

* Baking Soda
* Baking powder
* cornstarch
* 2 spoons/scoopers
* iodine
* Small, shallow plastic cups (4 per pair)
* Sharpie (for labeling)

Activity Overview and Scientific Background:

Big Question to Investigate: How can you use the characteristic ways substances react to tell similar-looking substances apart?

Question: Can you use iodine to determine our mystery substance?

 *(Prep: put a scoop of each powder into cups labeled #1 #2 #3. Each pair of students gets one of each powder. Pour a small amount of iodine into the remaining cups; each cup should have the same amount.*

1. Title the activity and date in your lab journal. Make a data table (ex: Substance #1 vs. Substance #2) for observations.
2. Look closely at the samples of cornstarch, baking soda and baking powder that have been provided. How are these powders similar and different? Write some observations.
3. With the help of your lab partner, pour iodine from each cup directly onto the cornstarch, baking soda and baking powder at the same time.
4. Observe until you think reactions are over.
5. Record your observations in your journal.

*(Expected Results:* cornstarch will be the only powder to react.)

\*Ask:

* Could you tell cornstarch, baking soda and baking powder apart just by looking at them?
* What differences did you observe when they reacted with iodine?
* Did you identify the mystery substance?

Extension Higher: Ask students what gas was produced when they observed fizzing (rather than telling them). What type of reaction can this be classified as?

Extension Lower: none

Activity Title: Fake Snow-Potential Clean up?

Activity Goal/Objective: During this activity, students will observe a physical change by combining sodium polyacrylate and water.

Approximate Time Frame of Activity: 15-20 min.

Materials Needed:

* Sodium polyacrylate (fake snow polymer)
* Water
* Larger plastic cups (12-20 oz)—1 per group
* Small plastic cups with lids (1 for each student)
* Pipets or straws (1 per student)—*cut straws in half to use as pipets*
* 250-mL beaker or clear container
* Cookie sheet or pie pan (optional for demo)

Activity Overview and Scientific Background: Sodium polyacrylate is a polymer that appears to be a white powder (or TINY white beads) when dry. When exposed to water (or various other liquids), it will absorb the liquid and expand to be much larger than its actual size. This chemical is commonly used as fake snow, as a compound to absorb large spills and in diapers to absorb wetness! (The magic behind how diapers don’t leak!) Because this reaction doesn’t match any of the 4 clues that a chemical reaction has occurred, it can be classified as a physical reaction.

1. Each student should get a small cup with a scoop of polyacrylate and a pipet or half-straw. Ask students to make observations before anything is added to this compound.
2. Provide each group or pair with a larger plastic cup with water. Model how to use a half straw as a pipet by using your finger to change the pressure inside the straw (if necessary).
3. Allow students to drop water over and over into the small cup until they begin to see a change in the compound. It should look like it’s expanding or growing and appears snow-like! This compound is safe to touch—does it feel like real snow? What type of reaction is this—physical or chemical?
4. If students want to take their fake snow home, give them a lid. If it dries out, they can simply add more water and it will fluff back up!
5. DEMO: Pour ~1/3 of the beaker/clear container with polyacrylate. Fill most of the rest of the container with water (make sure to pour FAST) and watch the fake snow form! If you do it correctly, the snow should overflow and “fall” over the edges of the container. (Depending on the level of clean-up you’re up for, you can even pour this out onto the table/baking sheet and allow students to play with it!)

*Fake snow can simply be thrown into the trash once you are done!*

Extension Higher: Have students try to come up with practical uses of this compound—why was it developed OTHER than to use for fun?

Extension Lower: none

Discussion: Periodic table sections: Solids, Liquids & Gases and Metals/Nonmetals

* Most elements are solids at room temperature. There are two liquids on the table: bromine and mercury. The other elements fall into the gas category; this includes the noble gases and elements such as oxygen, nitrogen, fluorine and chlorine.
* The table is also divided into metals, nonmetals and metalloids (that have properties of both metals AND nonmetals).
	+ Metals are typically solid, shiny, malleable (they can be bent into different shapes) and ductile (they can be formed into wires).
	+ Nonmetals can also be solids, but they are also liquids and gases. They are dull and brittle (they break easily).
	+ Can you give examples of metals and nonmetals?

Discussion: Mixtures & Separation Techniques

* Mixtures are 2 or more phases (different types of substances) combined. All mixtures can be physically separated—meaning they do not need to be broken down with a chemical process.
* **Two main types of mixtures:**
	+ Heterogeneous—not uniform composition (different throughout). Taking a sample will not provide the same result each time. Ex: soil, fruit salad, rocky road ice cream, Chex mix.
	+ Homogeneous—uniform composition (same throughout). Taking a sample will provide the same result each time. Ex: homogenized milk (where the name comes from!), lemonade, tap water.
* **Separation techniques:**
	+ Sorting pieces by hand—not often used in chemistry, but it works for larger objects! Ex: Legos, beads, fruit salad, etc.
	+ Filtration—usually separating a solid from a liquid (or solids from solids). Ex: using a sieve in a sandbox, coffee filters, colanders, etc.
	+ Distillation—the process of boiling water and condensing the steam to form pure water (tap water is a mixtures because it contains impurities and additives!)
	+ Chromatography—method to separate a mixture of dyes, such as inks. The solvent (alcohol) moves across the surface and drags the dyes with it. Some dyes will travel further than other dyes.
* ***Mini Activity: separate a mixture! (5 min)***
	+ In a large bowl, combine 2 different types of cereal and pretzel sticks (or use Chex mix!). Ask students if we can separate this physically. *(Yes! We can pick out the different types of pieces and sort them!)*

Activity Title: Separation of a Mixture

Activity Goal/Objective: During this activity, students will develop methods for separating iron, sand and salt into 3 different containers by using separation techniques.

Approximate Time Frame of Activity: 30 min.

Materials Needed:

* Iron filings
* Sand
* Salt (Morton’s is OK)
* Water and pitcher
* Craft sticks
* 2 clear plastic cups (12 oz. ish) per student
* Small paper plates—1 per student
* Coffee filters (or filter paper)—1 per pair
* Funnels (1 per pair)
* Magnets—1 per pair
* Lab journals
* Pencils

Activity Overview and Scientific Background: (see discussion)

1. Have students title and date this activity in their lab journals. Show them a mixture of dry iron, sand and salt in a clear cup/beaker. Tell them their challenge is to work with a partner to develop a procedure for separating each of these substances into a totally separate container. Students should consider properties of these substances to do this correctly.
2. Once ideas are developed, give some groups a chance to share their ideas with everyone. *(Magnets should be used to remove iron because iron is magnetic; the sand/salt mixture can be mixed with water next to dissolve the salt. Use the filter to separate the sand and salt; salt will stay dissolved as ions in the water and filter through.)*
3. Once the proper procedure has been determined, provide partners with supplies to complete the separation. Assist them as necessary. *Hint: the filter paper can be dampened to stick to the funnel—this will help the final separation process.*
4. Ask students how we could “prove” there was salt dissolved in the water.  *(We could boil the water and leave salt behind; allow water to evaporate over time and see salt crystals—try the 2nd method and check back tomorrow! Make sure to pour most of the water out so it will evaporate overnight—leave a TINY bit of water!)*

Extension Higher: Allow pairs to try their own methods instead of determining one correct method as a class. Students may have to ask for certain supplies instead of them being provided.

Extension Lower: This can be performed as a demo or within larger groups with one counselor/volunteer each demonstrating.

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***Extra Element Practice:***

Activity Title: Teeth: Fragile as Eggshells

Activity Goal/Objective: During this activity, students will model how fluoride (a nonmetal ion) added to toothpaste helps to protect tooth enamel.

Approximate Time Frame of Activity: 10 min. (process will take 24 hrs. then check!)

Materials Needed: *(per group/table)*

* 1 permanent marker
* 2 eggs
* 2 tbsp fluoride toothpaste (check label)
* Warm water
* Glass container large enough to contain both eggs
* White vinegar
* Aluminum foil
* Lab journals (1 per student)
* Pencils (1 per student)

Activity Overview and Scientific Background: Vinegar is an acid that dissolves the element calcium, the chemical eggshells are made of. The fluoride in toothpaste is an ion that combines with calcium to prevent the vinegar from attacking it. Therefore, the shell without any fluoride will disappear faster than the one covered in fluoride. Your teeth are made out of a similar material as eggshells and can be protected in a similar manner. This is why fluoride is added to tap water and toothpaste and can be given as a treatment at the dentist’s office!

1. Title and date this activity in your lab journal.
2. Mark one egg with an X. This egg will remain untreated and should be set aside.
3. Apply the toothpaste onto the other egg and smear until the entire surface is covered. Let the egg set for 24 hours, then wash the toothpaste off with warm water.
4. After smearing one egg with toothpaste, make a hypothesis in your lab journal—what do you think will happen to each egg once they are exposed to an acid?
5. Place both eggs into the glass container and pour in enough vinegar (acid) to cover them. What do you notice after a short amount of time?
6. Cover the jars loosely with foil so the vinegar smell stays contained. Check on the eggs every few hours and compare. What do you notice? Make some observations in your lab journal.

Extension Higher: Are there other substances that could possibly protect the eggshell from the acidic vinegar? Brainstorm some other ideas by using your periodic table! Could any of these substances be tested along with the other 2 eggs? *(NOTE: be sure whatever students come up with is safe to use with eggs/vinegar!)*

Extension Lower: Perform this activity as a demo.

Daily Focus: Mixtures & Colors

Questions to consider:

* What is the difference between a mixture and a compound? *(A mixture is made of two or more substances mixed together and can be separated physically; a compound is two or more elements chemically combined.)*
* Compare objects with two different densities. How do they differ? *(Ex. Water and ice—what happens and which one has a larger density value?)* What variables are important to consider when describing density? *(mass and volume)*
* How can mixtures be separated? Think of common examples. Can colors be separated??

Discussion: Density

* All substances that have mass also have density (which is basically everything!). Density is the amount of mass per volume an object has; in other words, it’s how “compact” a substance is.
* Objects with greater densities will sink whereas objects with lower densities will float. If two liquids have the same volume but different densities, the less dense liquid will float on top of the more dense liquid! (Think oil and water.)

Activity Title: Take-Home Density Columns

Activity Goal/Objective: During this activity, students will attempt to correctly predict the order that five liquids will float of top of one other based on their densities.

Approximate Time Frame of Activity: 15 min.

Materials Needed:

* 1 plastic test tube with cap (per student)
* Rubbing alcohol—original container
* Vegetable oil—original container
* Water (room temperature)
* Dish soap—original container
* Karo syrup—original container
* Clear pitcher (for water)
* Food coloring (mix with alcohol OR water to distinguish them from one another)
* Lab journals
* Pencils

Activity Overview and Scientific Background: Just like solids and gases, liquids have unique densities based on how much mass they have in a certain amount of space/volume. Can we get liquids to stack on top of each other like Legos?

*(correct order from most dense to least dense: syrup, soap, water, oil, alcohol—be sure to pour SLOWLY to prevent the liquids from mixing. Tipping the container at an angle may help.)*

1. Display the five liquids (in their original containers) in a random order at the front of the room. Challenge each group/table to come up with the correct order from most to least dense with an explanation of why they think they are correct! Have them title and date this activity in their journals and create a hypothesis about the order.
2. After each group has had enough time to make hypotheses, select one volunteer from each group to come to the front of the room. Give them each a test tube and have them (one at a time) rearrange the liquids in the order that their group hypothesized to be correct.
3. Pick an order (the most guessed? The least correct?) and show the rest of the students as you pour the liquids into the test tubes. What is happening? Is the order the same as the prediction?
4. Have all counselors & volunteers assist in filling each student’s test tube with the liquids. Make sure the lids are shut completely—students may take these home!

Extension Higher: Hypothesize other liquids that could be used—where would they fit within the density column? Could we even get solids to fit within the layers? Show the link OR use for ideas…

<http://www.stevespanglerscience.com/lab/experiments/density-tower-magic-with-science>

Extension Lower: Have the entire camp group participate with the hypothesis—point to each liquid and allow students to vote on which order to use.

Activity Title: Lava Lamps

Activity Goal/Objective: During this activity, students will use their knowledge of the density difference between oil and water to create a lava lamp by using Alka-Seltzer tablets.

Approximate Time Frame of Activity: 15 min.

Materials Needed:

* Water
* Food coloring
* Vegetable oil
* Empty plastic water bottles w/ wrapper removed (16.9 or 20 oz.)—1 per group
* Alka-Seltzer tablets (generic OK)—at least 1 per group, extra preferred

Activity Overview and Scientific Background: Oil will float on top of water because of the difference in densities. Once an Alka-Seltzer tablet is dropped in, it will begin dissolving in the bottom layer (water). Carbon dioxide gas is released inside the water and the trapped gas will begin to rise into the oil layer, then fall back down once the gas is released out of the container.

1. Fill the bottle about 1/4 of the way with water. Food coloring may be added and swirled to mix!
2. Fill the other 3/4 of the bottle with oil. (These two liquids do not have to reach the “top” of the bottle—ratios are approximate. Too much water will make the lava lamp look overwhelming when it starts to bubble!)
3. You should now have two distinct layers. Add an Alka-Seltzer tablet (might need to be broken in half to fit) to your lava lamp. Watch it work!!
4. Once the tablet dissolves, the lamp will stop. Simply add another tablet—this can be done over and over again!
5. Students can take lava lamps home—come up with a competition or game to determine the winner of each group (or draw a random name)! Remind students that if they didn’t get to keep one, they can easily make one at home!

Extension Higher: Ask students what we could add to the oil/water bottle to make the “lava lamp” effect and why they think it would work! (instead of directly telling them about tablet)

Extension Lower: none

Activity Title: Milky Water Colors

Activity Goal/Objective: During this activity, students will watch what happens as food coloring is added to milk—then again as soap is added to the mixture!

Idea from: <http://www.stevespanglerscience.com/lab/experiments/milk-color-explosion>

Approximate Time Frame of Activity: 15 min.

Materials Needed:

* Whole milk (can substitute Elmer’s glue, then let it dry and peel off of tin!)
* Food coloring (4 different colors)
* Pie tin (shallow pan with sides)—1 per group
* Dawn dish soap
* Cotton swabs

Activity Overview and Scientific Background: Milk is mostly water but it also contains vitamins, minerals, proteins, and tiny droplets of fat suspended in solution. Fats and proteins are sensitive to changes in the surrounding solution (the milk). The secret of the bursting colors is the chemistry of that tiny drop of soap. Dish soap, because of its bipolar characteristics (nonpolar on one end and polar on the other), weakens the chemical bonds that hold the proteins and fats in solution. The soap's polar, or *hydrophilic* (water-loving), end dissolves in water, and its *hydrophobic* (water-fearing) end attaches to a fat globule in the milk.

The molecules of fat bend, roll, twist, and contort in all directions as the soap molecules race around to join up with the fat molecules. During all of this, the food coloring molecules are bumped and shoved everywhere, providing an easy way to observe all the invisible activity. As the soap becomes evenly mixed with the milk, the action slows down and eventually stops.

1. Pour enough milk in the dinner plate to completely cover the bottom to the depth of about 1/4 inch. Allow the milk to settle.
2. Add one drop of each of the four colors of food coloring to the milk. Keep the drops close together in the center of the plate of milk.
3. Find a clean cotton swab for the next part of the experiment. Predict what will happen when you touch the tip of the cotton swab to the center of the milk. It's important not to stir the mix. Just touch it with the tip of the cotton swab. Go ahead and try it. Did anything happen?
4. Now place a drop of liquid dish soap on the other end of the cotton swab. Place the soapy end of the cotton swab back in the middle of the milk and hold it there for 10 to 15 seconds. Look at that burst of color!
5. Add another drop of soap to the tip of the cotton swab and try it again. Experiment with placing the cotton swab at different places in the milk. Notice that the colors in the milk continue to move even when the cotton swab is removed. What makes the food coloring in the milk move?

Extension Higher: Try this experiment with skim, 1%, and 2% milk—even half & half! Which substance works the best? Can you explain why?

Extension Lower: Perform this as a demo for the entire group.

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Activity Title: Chromatography T-shirts

Activity Goal/Objective: During this activity, students will use the separation method chromatography to design their own shirts and separate the dyes within permanent markers.

Approximate Time Frame of Activity: 30 min – 1 hr (depending on interest level)

Materials Needed:

* Plain white t-shirt (1 per student)
* Assorted Sharpies (colored)
* Newspaper or cardboard (several editions or 1 cardboard square per student)
* Pipets (1 per student)
* Rubbing alcohol
* Plastic cups (1 per group)

Activity Overview and Scientific Background: Chromatography is a method to separate a mixture of dyes, such as inks. (Ex: green is made of blue and yellow dyes.) The solvent (alcohol) moves across the surface and drags the dyes with it. Some dyes will travel further than other dyes.

1. Tip: work outside if weather permits; choose a well-ventilated area otherwise.
2. Give each student a t-shirt and a cardboard square (or newspaper). Put the cardboard between the front and back of shirt on the INSIDE. (This will prevent the markers from bleeding through.) Allow students to use Sharpies to design the FRONT of their shirts only!
3. Give each student a pipet; they will need to share a plastic cup of rubbing alcohol as a group. Add drops of alcohol to the design and watch the colors separated!
4. Allow shirts to dry for the rest of the day before students bring them home!

Extension Higher: none

Extension Lower: none

Discussion: Acids & Bases

* Acids and bases are chemicals, but can also be many common household items and are found in plants, animals and even humans! Acids and bases have different properties and are identified by their pH value.
* Acids have pH values of 0-6 and bases have pH values of 8-14. Any substance with a pH of 7 is considered a neutral substance—neither an acid nor a base! Water is a neutral substance. Acids and bases get stronger as they move farther away from a pH of 7.
* Properties of acids:
	+ The word acid comes from the Latin word for “sour,” which is a property of all acids. The sour taste added to sour candies comes from tartaric and citric acids!
	+ Acids are corrosive, meaning they eat away at other substances.
	+ Acids are neutralized by bases.
	+ Acids have pH levels less than 7 and turn blue litmus paper red.
	+ Dangerous or strong acids can be made less corrosive by adding water to dilute!
* Common acids:
	+ Your stomach is like a big bag of acid! Stomach acid is actually hydrochloric acid (HCl), a very strong acid (pH = 1-2). Why doesn’t stomach acid eat through your stomach? It contains a special mucus lining that protects your stomach walls from being eaten… unless you form an ulcer!
	+ Vitamin C is a common chemical found in many foods, especially fruit. It is also known as ascorbic acid! Vinegar (acetic acid) and carbonated soda (carbonic acid) are also common examples.
	+ Ants, bees and some plants can sting you by injecting tiny amounts of acid into your skin. Stings swell up because your body sends tons of water to the area of the sting in an attempt to dilute the acid (or make it weaker)!
* Properties of bases:
	+ Bases feel slippery or soapy.
	+ Bases can also be corrosive if they are strong enough!
	+ Bases are neutralized by acids.
	+ Bases have pH levels greater than 7 and turn red litmus paper blue.
* Common bases:
	+ Detergents, soaps, and household cleaners are all bases.
	+ Ammonia (found in hair dye, cat urine, and a chemical used to clean—has a very distinct smell!)
	+ Alka-Seltzer or Tums—bases used to neutralize stomach acid.
	+ Labs and factories often use sodium hydroxide and calcium hydroxide.

Activity Title: Using Red Cabbage as a pH Indicator

*(HINT: Red cabbage indicator should be made ahead of time… unless you want students to create their own indicator—tear up leaves and put in baggie with warm water. Smash leaves around inside baggie to release color. Looking for deep purple/blue color!)*

Activity Goal/Objective: During this activity, students will use red cabbage as a natural indicator to determine how to make common household substances stronger or weaker. Then, they will test a variety of substances to see where they fall on the pH scale.

Approximate Time Frame of Activity: 45 min.

Materials Needed: ***“The Art of Acid Indigestion” reference for counselor***

* Activity 1:
	+ Warm water
	+ Red cabbage (1 head)
	+ Small clear plastic cups
	+ Quart-sized baggies
	+ Lemon juice
	+ Baking soda
	+ Marker
* Activity 2:
	+ From #1: use red cabbage indicator, more small cups, lemon juice, baking soda, marker
	+ Sprite (or cream soda or tonic water; any clear soda works!)
	+ Vinegar
	+ Ammonia
	+ Bottled water
	+ Tap water
	+ Lab journals
	+ Pencils

Activity Overview and Scientific Background: Chemists test substances using chemicals called indicators. When an indicator is put into a liquid, it will change color to show whether the liquid is an acid, a base or neutral. The strength of acids and bases are measured on the pH scale (0-14).

Activity 1: refer to “The Art of Acid Indigestion” handout.

Activity 2: (do as a demo to save on materials!)

1. Pour a small amount of each liquid into separate clear cups. Explain that we can determine if these substances are acids or bases AND approximately how strong they are simply by using our cabbage juice indicator!
2. Pour the cabbage juice into the tap water first. Did it change much? Why do you think that is?
3. Share the red cabbage pH color scale with students (from Activity #1 handout). Have students predict which substances are acids and bases.
4. Pour a small amount of cabbage juice into each cup and watch as they change colors. Have students help you order them on the table according to the pH scale. Were predictions correct? Any surprises?

*(bottled water seems like it would be completely pure pH =7, but there are a lot of additives to keep water fresh and for taste; these ionic compounds often contribute to weakly basic properties!)*

Extension Higher: When students predict acids/bases, they can also predict relative strengths (i.e. “lemon juice will be a stronger acid than vinegar”) or they can draw a pH scale to place their predictions!

Extension Lower: Pick one activity & skip the other!

Mini Activity (for snack time?)—Glowing drinks!

* Materials: tonic water, black light, dark room, clear cup(s)
* Ask students if anyone is willing to volunteer to drink a glowing substance! Would they trust their counselors?? Pour a small amount of tonic water into a clear cup (a few students may try with different cups), turn off the lights and turn on the black light!
* Have students try to identify the drink (warning: it doesn’t taste that great!).

Activity Title: Glow Stick Chemistry

Activity Goal/Objective: During this activity, students will learn how glow sticks work!

Approximate Time Frame of Activity: 10 min.

Materials Needed:

* Glow sticks (1 per student)
* A dark room
* Yarn
* Scissors

Activity Overview and Scientific Background: Glow sticks are made of two parts: hydrogen peroxide and solution of a phenyl oxalate ester with a fluorescent dye. When the stick is bent, the glass tube containing hydrogen peroxide breaks, releasing that chemical to mix with the other solution. This allows the fluorescent dye to become illuminated; when using chemicals to do so, this is called chemilluminescence!

1. Give each student a glow stick. Explain the science… then let them bend the sticks!
2. Yarn can be used to make a glow stick necklace so students don’t lose the glow sticks—they can take these home!

Extension Higher: none

Extension Lower: none

**Daily Focus:** Heat & Explosions!

Questions to consider:

* What are some clues or pieces of evidence that a chemical reaction has taken place?
* What is the difference between an endothermic and exothermic reaction? Can you name some examples? What other vocabulary words use “endo-“ or “exo-“ as prefixes?
* What happens to the temperature of a system during an endothermic reaction? What about during an exothermic reaction?

Discussion: Endothermic and Exothermic Reactions

* Consider the prefixes “endo-“ and “exo-“… where have you heard these before? *(Most likely “exoskeleton” meaning “outer skeleton”)*
* Endothermic reactions absorb heat from the surrounding environment to complete a reaction. They feel cold to the touch because all of the heat is being drawn INTO the reaction environment.
* Exothermic reactions are the opposite—they release heat from the reaction to the surrounding environment (the container, the air, etc.). The reaction (or container) will feel warm to the touch because all of the heat is being expelled into the surrounding environment.

Activity Title: Endothermic Cold Wave

Activity Goal/Objective: During this activity, students will create an endothermic reaction using Epsom salt and water.

Approximate Time Frame of Activity: 15 min.

Materials Needed:

* Thermometer (1 per pair)
* Spoon or stirring rod (1 per pair)
* 1 med-sized glass jar or beaker (per pair)
* Room temperature tap water
* 1 tbsp Epsom salt (per pair)
* Lab journals
* Pencils

Activity Overview and Scientific Background: An endothermic reaction is one that absorbs surrounding heat, causing the environment or container to feel cool to the touch. When Epsom salt (magnesium sulfate) is added to water, it uses the water’s natural heat energy to split magnesium ions apart from sulfate ions.

1. Title and date this activity in your lab journal. Create a data table to compare the temperature before and after Epsom salt is added to water.
2. Fill the glass jar with tap water. Place the thermometer in the water and allow the temperature to register. While this is happening, place your hand on the outside of the jar— how does it feel?
3. Record the initial temperature into your lab journal.
4. Stir in the Epsom salt. Feel the jar again—what do you notice? Allow the thermometer to settle, then record the new temperature into your journal.

Extension Higher: Explain more about “ions”—positively or negatively charged atoms. Atoms become charged when they combine to make ionic compounds (such as magnesium sulfate).

Activity Title: Elephant Toothpaste!

Activity Goal/Objective: During this demo, students will be able to observe an exothermic reaction as well as a decomposition reaction in one!

Approximate Time Frame of Activity: 20 min.

Materials Needed:

* 6% (or stronger) hydrogen peroxide (can be found at beauty supply stores/chemical supply companies sell 30%)
* Yeast (1 packet)
* Warm water
* 16.9 oz empty plastic bottle
* Dawn dish soap
* Food coloring (optional)
* Cake pan or pie tin
* Funnel
* ½ cup measuring cup

Activity Overview and Scientific Background: This reaction shows the decomposition of hydrogen peroxide (H2O2) into water (H2O) and oxygen gas (O2). Hydrogen peroxide breaks down slowly over time (which is why it is sold in dark bottles—to prevent reacting with light!), but adding a catalyst (yeast) can speed up this chemical reaction. Adding dish soap makes the reaction “bubbly” because of the presence of oxygen gas, appearing to look like elephant’s toothpaste. Food coloring is just for some added fun (caution: food coloring may stain hands if students choose to play with the final product!). The bottle and final product will feel warm to the touch, indicating an exothermic reaction has taken place.

1. Set out a cake pan/pie tin, a plastic bottle, and the rest of the ingredients. Have a counselor or volunteer prepare VERY warm water to activate the yeast.
2. Dissolve 1 tsp. yeast in 2 tbsp. warm water. Wait a few minutes for the yeast to activate. During this time, explain the demonstration!
3. Put the bottle in the center of the pan. Using the funnel, pour a ½ cup of hydrogen peroxide into the bottle. Add a squirt of Dawn and swirl inside the bottle.
4. Add 3-4 drops of food coloring if desired. (Adding them to the sides of the bottle so they run down the sides may cause the toothpaste to appear striped!)
5. When you’re ready for the reaction, pour the yeast mixture through the funnel and into the bottle. Watch the elephant toothpaste bubble over!
6. Students may play with this product (it’s just soap bubbles, water and maybe food coloring) if they wish. Have them note the temperature of the bottle/product—it should be warm!

Extension Higher: Can students name other examples of catalysts, or things that speed up a chemical reaction*? (Answers may include: certain elements/compounds, heat, fire, light, electricity, etc.)*

Extension Lower: none

Activity Title: Warm Wool!

Activity Goal/Objective: During this activity, students will create an exothermic reaction using steel wool and an acid.

Approximate Time Frame of Activity: 20 min.

Materials Needed:

* Steel wool (NOT Brillo pads)
* Vinegar
* Small jars with lids (1 per group—6 total)
* Small thermometers—must fit inside jar (1 per group—6 total)

Activity Overview and Scientific Background: Vinegar, an acid, is used to remove the protective coating from steel wool, allowing it to rust. The acidity aids in the oxidation (rusting) of the iron in the steel. When the iron combines with oxygen, heat is released.

1. Title and date this activity in your lab journal. Make a hypothesis as to what you think will happen once steel wool is exposed to vinegar. Make a data table to record the temperature before and after the reaction occurs.
2. Place the thermometer in the jar and close the lid. Allow the thermometer to settle on the proper temperature inside the jar and record the initial temperature in your lab journal.
3. Soak a piece of steel wool in vinegar for approx. 1 minute. Squeeze any excess vinegar out of the steel wool and wrap the wool around the thermometer.
4. Place the wool/thermometer in the jar and seal the lid. Allow this system to react for 5 min. and take the final temperature. Record this value in your data table.
5. Compare the two temperature readings. How did they change? What type of reaction does this show?

Extension Higher: Ask students what we could add to the oil/water bottle to make the “lava lamp” effect and why they think it would work! (instead of directly telling them about tablet)

Extension Lower: none

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Activity Title: Change in Temperature—Exothermic Reaction

Activity Goal/Objective: Participants will add calcium chloride to a baking soda solution so that they can observe an increase in temperature during a chemical change.

Approximate Time Frame of Activity: 15 Minutes

Materials Needed:

* Baking soda solution (1/4 cups baking soda to 2 cups water)
	+ ¼ cup baking soda solution for each group
* Calcium chloride (can find in hardware stores as a moisture absorber under the name DampRid)
	+ 1 tbsp of calcium chloride or 2 tbsp DampRid for each group
* Water
* Thermometer (1 per group)
* Graduated cylinder, 50 mL (1 per group)
* ½, ¼ and 1/8 tsp measuring spoons
* 2 small cups for each group
* Paper towels

Activity Overview and Scientific Background:

***Preparing materials***

* Label 2 small cups calcium chloride (CaCl2) and baking soda solution (NaHCO3).
* Place about 1 rounded tablespoon of calcium chloride in its labeled cup for each group. If using DampRid® place about 2 tablespoons in the calcium chloride cup.
* Make the baking soda solution for the entire group by adding 1/4 cup of baking soda to 2 cups of water. Stir until the baking soda is as dissolved as possible. It’s ok if some is left undissolved.
* Pour about 1/4 cup of baking soda solution in its labeled cup for each group.

Big Question to Investigate: Can temperature increase during a chemical reaction?

Participants will observe and record the temperature change of calcium chloride reacting with a baking soda solution. Then they will adjust either the amount of baking soda solution or calcium chloride to try to reach a target temperature.

***Procedure***

1. Use a graduated cylinder to measure 10 mL of baking soda solution and pour it into a clear plastic cup.
2. Place a thermometer in the baking soda solution. Read the thermometer and record the temperature in the chart next to the words “Initial temperature”.
3. While the thermometer is in the cup, add 1/2 teaspoon of calcium chloride.
4. Watch the thermometer to observe any change in temperature. Record the highest temperature on your journal sheet.

***Expected results***: The temperature of the solution increases from about 20 °C (about 70 °F) to about 45 °C (about 110 °F). Carbon dioxide gas is produced and a white cloudy precipitate, calcium carbonate, is formed.

Discuss with students what they might change to make the reaction get even hotter.

Ask students what they might change to increase the temperature by another 5 °C or about 10 °F.

Students may suggest increasing the amount of calcium chloride or baking soda solution or both. Discuss whether it makes sense to change the amount of both at the same time or if it would be better to change the amount of just the calcium chloride or baking soda solution first. Try to have students understand that dealing with one variable at a time is a good strategy at first. That way, students can see how much each variable affects the result.

Have students conduct their trials.

Remind students that the goal is to increase the temperature by 5 °C or about 10 °F, not as much as possible. You may choose to limit students to a maximum of three tries or let them experiment further if time and supplies allow.

***Optional Procedure***

Students should follow the same procedure as before except adjust the amounts of calcium chloride or baking soda solution. As expected, increasing the amount of calcium chloride increases the temperature of the reaction. However, if students try increasing the amount of baking soda solution, they will find that the temperature does not increase as much. This is because any possible advantage gained by adding more baking soda is counterbalanced by the additional volume of solution that needs to be heated. It may not be intuitive; but *decreasing* the amount of baking soda solution is actually one way to increase the temperature of the reaction.

1. After conducting the activity according to the procedure, add another 5 °C or about 10 °F to the highest temperature. This is your *target temperature.* Write this target temperature in your chart for each of the 3 trials.
2. Try changing the amount of baking soda solution or calcium chloride to reach your target temperature

***Expected results:***Adding 3/4 teaspoon of calcium chloride instead of 1/2 teaspoon is one way to reach the target temperature. Using 5 mL of baking soda solution instead of 10 mL is another way to reach the target temperature.

Once students have discovered the effect of changing the amount of each of the reactants, they may try increasing the amount of calcium chloride while also decreasing the amount of baking soda solution.

\*When the temperature increases during a chemical reaction, it’s called an *exothermic* reaction.

Mini Activity Title: Burning Money

Materials Needed:

* Dollar bill
* Metal tongs
* Grill lighter
* Water
* 95% ethanol (70% isopropyl OK, just need 50/50 mix of water and alcohol)

Activity Overview and Scientific Background: Alcohol’s vapors are very flammable; soaking the dollar bill in a mixture of alcohol/water will allow the vapors around the bill to burn but keep the actual bill from burning (the water “puts out” the fire).

* + 1. Make a mixture of 50/50 alcohol/water. If the alcohol is less than 95%, use judgement—add more alcohol than water since alcohol already contains some water content.
		2. Completely soak a dollar bill in a 50/50 mixture of water and alcohol solution. Ask students if they “trust you” not to burn a dollar!
		3. Holding the dollar bill with metal tongs, use the lighter to ignite the bill. It should light with a blue flame and go out shortly. The dollar will be intact and slightly damp!

Mini Activity Title: Baking Soda & Vinegar

Materials Needed:

* Baking soda solution (1/4 cups baking soda to 2 cups water)—same as DampRid act.
	+ small cup baking soda solution for each group
* Vinegar—small cup for each group
* 2 small cups per group (for baking soda/vinegar)
* 1 plastic cup (~12 oz) for each group
* OPTIONAL: red cabbage juice (add a few drops to each cup and watch the color change when the reaction takes place!)

Activity Overview and Scientific Background: Baking soda (base) & vinegar (acid) will combine and create a neutralization reaction. It also releases CO2 gas as a product so it will bubble up and fizz! (If red cabbage juice is used, the baking soda should be green & vinegar should be pink—when combined, the reaction will cause the color to change to purple to show a neutral pH!)

1. Pour a small amount of baking soda solution into one cup and a small amount of vinegar into the other. Add red cabbage juice drops if preferred. Give one set of liquids and one empty plastic cup to each group.
2. Ask students to predict the outcome if they mix the two liquids together (will it form a chemical reaction? How could we tell?). Once predictions are made, allow groups to combine the liquids into the larger cup. What happens?

Activity Title: Alka Seltzer rockets

Time Frame of Activity: 20-30 min.

Activity Objective: Using Alka-Seltzer tablets, students will propel an object into the air. The film canister rocket will fly into the air because of carbon dioxide gas build-up, a product of the chemical reaction created from the combination of Alka-Seltzer and water. A scientist from the early 1700’s, named Isaac Newton, came up with an idea about how things move through space. He said a force pushing on an object will create a second force, with the same strength as the first, going in the opposite direction. This idea is now called Newton’s Third Law of Motion.

Materials Needed:

* Alka-Seltzer tablets—minimum of 1 per student/12 pkgs.
* Pitcher
* Water
* Goggles (1 per student OR share)
* Tarp
* Clear film canisters w/ lids (1 per student OR share)

Before the activities begin:

Prepare the “launch area” by spreading out the tarp and filling a pitcher with water.

Procedure:

1. Pass out film canisters to students and help them practice “snapping” the lid on (this seems silly but many rockets have failed simply because the lid wasn’t on!). Make sure students are wearing goggles (at least the ones near the launch pad).
2. Open film canister and fill 1/2 with water.
3. Drop 1/2 Alka-Seltzer tablet inside.
4. Very quickly put the lid back on the plastic film canister and place it on the launch pad. Wait for the lid to blow off!
5. Repeat the process, but this time place the rocket upside down with the lid on bottom. Place it on the launch pad and allow the rocket to fly!
6. Here are some things to consider: How long did it take for the reaction to begin? How long did it take to make the lid blow? You can experiment with different levels of water and amount of tablets (1/4, 1/2, 3/4, 1) to get the best result!

CAUTION: There is danger of eye or facial injury if rockets are launched upward instead of horizontally. The canisters sometimes discharge prematurely. If canisters are launched upward (vertically), safety glasses should be worn and the activity should be under strict adult supervision.

Activity Title: Black Sugar Snake Fireworks!

Activity Goal/Objective: During this demo, students will observe a reaction between baking soda and sugar that produces two separate reactions: one that breaks down baking soda (NaHCO3) and one that combusts alcohol.

Approximate Time Frame of Activity: 10 min.

Materials Needed:

* Sand
* Alcohol (ethanol) or fuel oil
* Baking soda
* Powdered sugar
* Grill lighter
* Baking sheet or pie plate
* “Black Snakes” reference for counselor

Activity Overview and Scientific Background: Black sugar snakes are a form of small fireworks (perfect for July 4th!) that burn to produce a long black “snake” of ash. Sodium bicarbonate (baking soda) breaks down into sodium carbonate (Na2CO3), water vapor (H2O) and carbon dioxide (CO2) while burning the sugar in oxygen produces water vapor and carbon dioxide. The snake is carbonate with black carbon particles!

1. Mix 4 parts powdered sugar with 1 part baking soda. (ex: 4 tsp sugar and 1 tsp baking soda)
2. Make a mound of sand. Push a depression in the middle of the sand.
3. Pour the alcohol or fuel inside the sand to wet it.
4. Pour the sugar/baking soda mixture into the depression.
5. Ignite the mound using a lighter.

Extension Higher: Show students the chemical reactions/formulas that accompany this demo!

2 NaHCO3 🡪 Na2CO3 + H2O + CO2

C2H5OH + 3 O2 🡪 2 CO2 + 3 H2O

Extension Lower: none

Demo Title: Diet Coke & Mentos

Materials Needed:

* 1 2-liter bottle of Diet Coke (sealed)
* 3 20-oz bottles of Diet Coke (sealed)
* 1 sleeve of Mentos (mint)
* 1 Steve Spangler Mentos release system (for top of 2-L bottle)
* Sand
* Nerds (handful in a small baggie/individual box)
* Lemonheads (handful in a small baggie/individual box)
* Garbage bag (for clean-up)

Activity Overview and Scientific Background: (taken from <http://www.stevespanglerscience.com/lab/experiments/original-mentos-diet-coke-geyser>)

When you drop the Mentos into the Diet Coke, the gelatin and gum arabic from the dissolving candy break the surface tension of the water molecules in the soda. This disrupts the water mesh, so that it takes less work to expand and form new bubbles. Each Mentos candy has thousands of tiny pits all over the surface. These tiny pits are called nucleation sites - perfect places for carbon dioxide bubbles to form. As soon as the Mentos hit the soda, bubbles form all over the surface of the candy. This, along with the fact that the Mentos candies are heavy and sink to the bottom of the bottle, equals a double-whammy. When all this gas is released, it literally pushes all of the liquid up and out of the bottle in an incredible soda blast!

1. Bring all of your supplies to an outdoor location for your geyser (less mess!). Select a flat surface on the lawn or driveway to place the bottle.
2. Open the bottle of soda and attach the Geyser Tube. Put the trigger pin into the hole at the base of the Geyser Tube.
3. Twist off the top cap on the Geyser Tube and drop 7 Mentos candies into the tube. The trigger pin will keep the candy from falling into the soda before you’re ready. Replace the twist-on cap.
4. Warn everyone to stand back. Countdown… 3-2-1… and pull the trigger. The Mentos will drop and the soda will go flying into the air!
5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

GAME: Let’s bond!

In looking at the types of elements, there are rules when it comes to which ones can combine and which ones can’t! Metals can ONLY bond to nonmetals (never to themselves!); nonmetals can bond with either metals OR nonmetals.

Assign each gender to be “metals” or “nonmetals.” (This may change whenever you play or even during the game itself!) Allow students to “mingle” randomly, then when you yell out “BOND!” everyone has to bond with another person. If they’re a metal, they CANNOT be with another metal (i.e. if metals are girls, 2 girls are not allowed to pair together! Boys are allowed to bond, however, because they are all nonmetals.) Anyone who is bonded incorrectly is out!

This can be modified—instead of using genders, you could create 2 different “name tags” or markers of some sort and assign random students to be metals and nonmetals.

GAME: Toxic Waste

* Your team is stranded in a radioactive factory. In an emergency attempt, your team must use the steel blocks provided to safely cross the spreading toxic waste.
* Create a start to finish line of approx. 20 feet.
* Provide your team with 1 square per person (sheet of paper) and tell them they must figure out a plan to safely cross the toxic waste.
	+ Every team member must occupy a square at all times or the square will be lost.
	+ The first team member attempting to cross the toxic waste cannot cross into the safety zone until all the other team members are on their squares.
	+ There is a time limit of 5 min. to complete the activity!
	+ Hint: it may take several attempts to figure out a good plan. After each attempt, allow the team to discuss their successes and what they should change.

**ACTIVITY:** Human Periodic Table

**Materials:** Paper (1 per student), assorted coloring materials, periodic tables

1. Pass out supplies
2. Assign an element number 1-24 to each student (go up through the number of students you have!). Each student is responsible for designing an element symbol for their assigned element. Paper should include element symbol, atomic number, mass number and name.
3. When everyone is done, allow students to organize themselves into a human periodic table. What does each “human element” add to themselves as they increase in atomic number? (A proton and an electron!)

**ACTIVITY:** LN Ice Cream (can replace Ice Cream in a Baggie)

**Materials:** LN Ice Cream bin w/ all supplies & cryo gear

*NOTE: you MUST be cryo trained in order to work with LN! Volunteers may NOT replace counselors to do this experiment! Wear all safety gear and be sure all skin is completely covered.*

1. Intro with explanation of LN/show demos/explain safety.
2. Explain how ice cream can be made with LN ice cream (creates much colder environment to “freeze” liquid ice cream ingredients).
3. Make ice cream!

**Tuesday:** Physical/Chemical Changes, Types of Elements

**ACTIVITY**: Wrapper Worm

**Materials**: Straw with wrapper, water, pipet (per student)

1. Carefully rip the end of the straw wrapper. Rip the least amount you can.
2. Gently slide the opened wrapper down the straw. By the end, the wrapper should resemble a spring or an accordion.
3. Get some water in a pipette.
4. Drop 1-3 drops of water onto the spring-like strong wrapper.
5. WHOA! It looks just like a worm is coming out of the wrapper.

Taken from: <http://www.stevespanglerscience.com/lab/experiments/wrapper-worm>

**ACTIVITY:** Vanishing Styrofoam (demo only)

**Materials:** Acetone (or nail polish remover), Styrofoam cup, plastic bin

1. Want to see a Styrofoam cup “vanish?”
2. Stand the cup upside down inside the bin. Pour acetone over the cup (enough so there’s a small “pond” of liquid it is sitting in). Watch the cup melt!

The polystyrene (Styrofoam) is dissolved by the acetone and will “break down” its original form!

**Activity:** The Power of Bleach

**Materials:** Water, Bleach, Food Coloring (red), 2 clear cups

1. Fill one of the clear cups 3/4-full with room temperature tap water.
2. Add 2 drops of food coloring to the water and observe the vividness of the food coloring while it mixes in the water.
3. Fill the other cup 1/4-full with bleach before mixing it with the colored water. Pour the mixture back and forth between cups 3 or 4 times.
4. Let the mixture sit, in open air, for several minutes, observing the changes in color.

Taken from: http://www.stevespanglerscience.com/lab/experiments/the-power-of-bleach

GENERAL SUPPLY BIN

|  |  |  |
| --- | --- | --- |
| **QUANTITY** | **UNIT DESCRIPTION** | **SUPPLY** |
| 2 | CONTAINERS  | CRAYONS |
| 4 | BOTTLES | GLUE |
| 2 |  | HOLE PUNCHERS |
| 1 | CONTAINERS  | MARKERS |
| 2 | ROLLS | MASKING TAPE |
| 1 | CONTAINER | PAPER CLIPS |
| 1 | ROLL | PAPER TOWELS |
|  | MULTIPLE COLORS | CONSTRUCTION PAPER |
|  |  | DRAWING PAPER |
| 4 |  | RULERS |
| 1 | ADULT  | SCISSORS |
| 10 | CHILD | SCISSORS |
| 2 | ROLLS | SCOTCH TAPE |
| 1 |  | STAPLER |
| 1 | BOTTLE | TABLE CLEANER |
| 1 | SKEIN | YARN |

EXPERIMENTING WITH ELEMENTS

SUPPLY BIN

\*NOTE: *same supplies for different activities have been combined into “one supply” (i.e. Dawn dish soap will be used in 4-5 different activities, but total amount needed for week is provided under “CO2 bubbles”)*

|  |  |  |
| --- | --- | --- |
| **Supply Needed** | **Quantity Needed** | **Name of Activity** |
| Balloons | 50 | **MONDAY**Keep the Gas Afloat! |
| Poster board/paper roll | 2 boards/1 large section | Chemistry Graffiti Wall |
| Computer paper | 200 sheets | Lab Journals |
| Rulers | 24 | Making Scientific Observations |
| Clipboards | 12 |
| Paper bags (large) | 6 |
| Pennies | 40 | Drops on a Penny |
| Pipets (plastic, disposable) | 72 |
| CO2 bubbles container | 1 | CO2 Bubbles***\*see end of list\*******(perishable list)*** |
| Dawn dish soap | 1 large container |
| Plastic container/dish | 1 |
| Boxes of corn starch | 2 | Oobleck |
| Plastic pitcher (large) | 1 |
| Large plastic bowls | 3-6 |
| Food coloring | 1 box/at least 4 full bottles |
| Borax | 1 box | Bouncing Polymer Balls |
| Measuring spoons | 1 set |
| Measuring cups | 1 set |
| Craft sticks | 60 |
| Plastic spoons | 60 |
| Small clear plastic cups (8-12 oz) | 170 |
| Quart baggies (Ziplock) | 48 | Ice Cream in a Baggie***\*see end of list\*******(perishable list)*** |
| Gallon baggies (Ziplock) | 24 |
| Sugar | 1 container |
| Vanilla extract | 1 bottle |
| Rock salt | 1 small bag |
| Large pom-poms | 1 baggie full | Design your own Atom |
| Small pom-poms | 1 baggie full |
| Vinegar (white) | 1 gallon | **TUESDAY**Mystery Powders |
| Baking soda | 2 boxes |
| Baking powder | 1 small container |
| Shallow plastic cups w/ lids | 72 |
| Sodium Polyacrylate (fake snow polymer) | 1 container | Fake Snow |
| Large clear plastic cups (20 oz.) | 20 |
| 250 mL glass beaker | 12 |
| Baking sheet | 1 |
| Pie pans (disposable) | 8 |
| Lemon juice | 1 container/bottle | Copper-Topping |
| Iron nails (not galvanized) | 2 |
| Steel wool scouring pads | 6 |
| Fluoride toothpaste | 1 tube (travel sized OK) | Teeth: Fragile as Eggshells***\*see end of list\*******(perishable list)*** |
| Glass container/jar (large enough to submerge 2 eggs) | 1 |
| Aluminum foil | 1 roll |
| Plastic test tubes w/ blue lids | 24 | **WEDNESDAY**Take-Home Density Tubes |
| Rubbing alcohol | 1 bottle |
| Vegetable oil | 2 bottles |
| Karo syrup | 1 bottle |
| Empty plastic water bottles | 7 | Lava Lamps |
| Alka-seltzer tablets | 2 boxes |
| Chex mix OR 2 types of cereal | 1 small bag/2 travel boxes | Mixtures demo |
| Elmer’s glue | 2 containers | Milky Watercolors***\*see end of list\*******(perishable list)*** |
| Cotton swabs | 20 (in baggie) |
| Iron filings | 1 small container | Iron, Sand & Salt |
| Sand | 1 large container |
| Salt (Morton’s or other “edible” NaCl OK) | 1 small container |
| Coffee filters (small) | 12 |
| Funnels | 12 |
| Magnets  | 12 |
| Small paper plates | 24 |
| White t-shirts | 24 | Chromatography T-shirts |
| Newspaper/cardboard squares | 24 |
| Permanent markers | Approx. 24 assorted colors |
| Sprite | 1 20-oz bottle | Red Cabbage pH Indicator***\*see end of list\*******(perishable list)*** |
| Ammonia | 1 small container |
| Sealed bottle of water | 1 |
| Tonic water | 1 small bottle | Glowing Drinks demo |
| Black light | 1 |
| Glow sticks | 24 | Glow Stick chemistry |
| Thermometers | 12 | **THURSDAY**Endothermic Cold Wave |
| Epsom salt | 1 box |
| 6% hydrogen peroxide (or stronger)—can find at beauty supply stores | 1 bottle | Elephant Toothpaste |
| Yeast | 1 packet |
| Small glass jars w/ lids | 6 | Warm Wool |
| Small thermometers (to fit inside small glass jars above) | 6 |
| Calcium chloride/DampRid | 1 box | Change in Temp—Exothermic Reaction |
| Graduated cylinders, 50 mL | 6 |
| Dollar bill | 1 | Burning Money |
| Metal tongs | 1 pair |
| Grill lighter | 1 |
| 95% ethanol | 1 bottle |
| Clear film canisters & lids | 24 (or as many as available) | Alka-Seltzer Rockets |
| Goggles | 12-24 |
| Tarp | 1 |
| Powdered sugar | 1 small container | Black Sugar Snake Fireworks |
| 2 liter bottle Diet Coke | 2 | Diet Coke & Mentos |
| 20 oz bottle Diet Coke | 3 |
| Mentos (mint) | 2 sleeves |
| Diet Coke geyser tube | 1 |
| Nerds (candy) | Handful in baggie |
| Lemonheads (candy) | Handful in baggie |
| Garbage bag | 2 |
| ***Extra activities…*** |
| LN Ice cream bin | 1 (all supplies included) | LN ice cream (Mon.) |
| Straws with wrappers | 24 | Wrapper Worm (Tues.) |
| Acetone OR nail polish remover | 1 bottle/small container | Vanishing Styrofoam (Tues.) |
| Styrofoam cup/ball | 2-3 |
| Bleach | 1 bottle/small container | The Power of bleach (Wed.) |
| ***\*\*MUST BE REFRIGERATED/PERISHABLE LIST FOR WEEK\*\**** |
| **Dry ice** | **1 thermos-full of small chunks** | **MON—CO2 bubbles** |
| **Half & half cream** | **12 pints/6 quarts** | **MON—Ice cream** |
| **Ice cubes** | **All trays available** | **MON—Ice cream in baggie** |
| **Milk (2% or whole)** | **1 pint** | **TUES—Phys/Chem Change demo**  |
| **Eggs** | **2** | **TUES—Fragile as eggshells** |
| **Whole milk** | **1 pint** | **TUES—Milky watercolors** |
| **Red cabbage** | **1 head** | **WED—pH indicator** |

**Bibliography**

* Experimenting with Elements Summer Science Camp (gr. 6-8), 2010
* Experimenting with Elements Winter Break Camp, Sept. 2013
* Audrey Wilson, Manager of YFE, 2014
* The Elements Song: <http://www.privatehand.com/flash/elements.html>
* Density Columns: <http://www.stevespanglerscience.com/lab/experiments/density-tower-magic-with-science>
* Glo-Stick Chemistry: <http://chemistry.about.com/od/howthingsworkfaqs/a/howlightsticks.htm>
* Diet Coke & Mentos: <http://www.stevespanglerscience.com/lab/experiments/original-mentos-diet-coke-geyser>
* The Power of Bleach: <http://www.stevespanglerscience.com/lab/experiments/the-power-of-bleach>
* Wrapper Worm: <http://www.stevespanglerscience.com/lab/experiments/wrapper-worm>

**Resource Lists**

* Theo Gray’s Mad Science: Experiments You Can Do at Home—But Probably Shouldn’t! (Theodore Gray)
* Theo Gray’s The Elements: <http://www.periodictable.com/theelements/pages.html>
* Interactive Periodic Table: [www.ptable.com](http://www.ptable.com)
* The Cartoon Guide to Chemistry (Larry Gonick & Craig Criddle)
* Steve Spangler Science Experiments: <http://www.stevespanglerscience.com/lab/experiments>
* Compilation of Awesome Chemistry Experiments (YouTube): <http://www.youtube.com/watch?v=afD6eiKBdD4>
* Experiments you can do AT HOME! (BuzzFeed): <http://www.youtube.com/watch?v=ia8CKDIur3s>