## Concepts

*In a chemical reaction, there is a change in the way atoms and molecules combine. Signs of a chemical reaction include a temperature change or the production of light, electricity, or a new material.*

## Words to Know

**Atom**—a tiny particle that makes up all matter.

**Molecule**—a small particle made of two or more atoms that are chemically bonded together.

**Ion**—an atom or molecule with an electrical charge.

**Electron**—a tiny, negatively charged particle found in atoms.

**Chemical bond**—a connection that holds two or more atoms or molecules together.

**Chemical reaction**—an interaction of atoms or compounds to form new elements or compounds.

**Physical state of matter**—the form a substance takes, based on the behavior of its molecules or atoms: solid, liquid, or gas.

**Solid**—a state of matter in which the molecules or atoms are close together and form a rigid structure.

**Liquid**—a state of matter in which the molecules or atoms are close together but also move around each other.

**Gas**—a state of matter in which the molecules or atoms are very far apart and move very fast.

**Exothermic reaction**—a chemical reaction that gives off heat and that may feel hot.

**Endothermic reaction**—a chemical reaction that absorbs heat and that may feel cold.

**Solution**—a completely uniform mixture of atoms, ions, and/or molecules.

**Concentration**—the relative amount of a particular atom or molecule in a solution. A large amount is a high concentration; a small amount is a low concentration.

**Acid**—a compound that increases the number of hydrogen ions ($H^+$) in solution with water. All acids have a pH below 7.

**Base**—a compound that decreases the number of hydrogen ions ($H^+$) in solution with water. All bases have a pH above 7.

**pH**—a scale that measures relative acidity and basicity.

**Indicator**—a chemical that changes color with changes in pH.

**Reversibility** - the ability of a chemical reaction to return to its pre-reaction state.

**Equilibrium**—a point reached during a chemical reaction when no further net changes occur.

**Electrochemistry**—chemical reactions that use or generate electricity or electrical charges.



## Circle these words as you find them in the puzzle below:

*ATOM*
*CHEMICAL BOND*
*CHEMICAL REACTION*
*CONCENTRATION*
*ELECTROCHEMISTRY*
*ENDOTHERMIC*
*EXOTHERMIC*
*GAS*
*INDICATOR*
*ION*
*LIQUID*
*MOLECULE*
*REVERSIBILITY*
*SOLID*

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OREGON MUSEUM OF SCIENCE AND INDUSTRY

# Chem lab

## Take-Home Activities

# Chemical Reactions

This project funded by the National Science Foundation

# Cloudy Globs

***Can you make a white gel from two clear liquids?***

**Materials:**

1/2 teaspoon alum (in the spice aisle at grocery stores)
Water
2 teaspoons ammonia
Two small (about 4-oz) jars

**To do and notice:**

1. Fill one jar half full with warm water.
2. Add 1/2 teaspoon alum. Stir or shake the ingredients to mix them thoroughly.
3. Add 2 teaspoons ammonia to the other jar.
   **What do the solutions look like in each jar?**
   **Are the solutions clear or cloudy?**
4. Pour the contents of the jar with ammonia into the jar with water and alum.
   **What happens?**
5. Allow the jar with the new mixture to sit for a while.
   **What collects at the bottom of the jar?**


**A closer look:**

Alum contains either aluminum potassium sulfate ($AlK(SO_4)_2$) or aluminum ammonium sulfate ($AlNH_4(SO_4)_2$). When alum is mixed with ammonia ($NH_3$), a chemical reaction occurs. Aluminum hydroxide ($Al(OH)_3$) is formed as a product of the reaction. Aluminum hydroxide does not dissolve in water and forms cloudy white globs. As the globs settle, they form a solid gel at the bottom of the jar.

# Glow Fast, Glow Slow

***Alter the rate of a chemiluminescent reaction!***

**Materials:**

Two identical "lightsticks"
Two clear jars or glasses
Water
Ice
A dark room or area

**To do and notice:**

1. Fill one jar with ice and water.
2. Run hot water from the faucet until it is quite hot. (**Caution**: be careful not to burn yourself.) Fill the other jar with the hot water.
3. Activate both lightsticks by bending them until they snap and then shaking them. **What do you observe?**
4. Put one lightstick into each jar.
   Turn out the lights or take the jars to a dark room or closet.
   **Which lightstick is glowing brighter?**
   **Which lightstick glows longer?**

**A closer look:**

Energy transfer is part of all chemical reactions. Sometimes energy is given off as heat or radiation. Usually energy is also stored in the chemical bonds of new compounds. The reaction in lightsticks releases energy in the form of chemical light called "chemiluminescence."

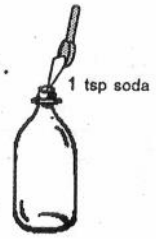
Sometimes a temperature change causes a chemical reaction to go faster or slower. Heat speeds the rate of the chemical reaction, so the lightstick in hot water glows brighter. Cold slows the rate of the reaction, so the cold lightstick's supply of chemicals lasts longer. (Depending on the brand you use, they may last 20 min. to several hours.)

# Gas Production

***Blow up a balloon!***

**Materials:**

One 12-oz plastic bottle
One large balloon (8" or 9" size)
One tablespoon baking soda ($NaHCO_3$)
1 1/2 tablespoons vinegar (acetic acid)
One funnel
One measuring spoon
One measuring cup




**To do and notice:**

1. Measure 1 tablespoon of baking soda with a measuring spoon.
   **What does it look like?** Pour the baking soda into the plastic bottle. Rinse the tablespoon.
2. Measure 1 1/2 tablespoons of vinegar into the measuring cup. **What does it look like?**
3. Using the funnel, pour the vinegar into the balloon.

4. Attach the lip of the balloon onto the mouth of the bottle, being careful not to spill the contents of the balloon.
5. After the balloon is attached, dump the vinegar in the balloon into the bottle. **What do you hear?**
   **What do you see happening inside the bottle?**
   **What is happening to the balloon?**

**A closer look:**

As the baking soda ($NaHCO_3$) and vinegar (acetic acid, $CH_3COOH$) mix, a chemical reaction produces carbon dioxide gas ($CO_2$), which creates bubbles inside the bottle and inflates the balloon.

## Concepts

*Substances in the home are made of chemicals. Chemical reations are important in many processes in your daily life.*

## Words to Know

**Atom**—a very, very small particle that makes up all matter.

**Molecule**—a small particle made of two or more atoms that are chemically bonded together.

**Ion**—an atom or molecule with an electrical charge.

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**Acid**—a compound that increases the number of hydrogen ions ($H^+$) in solution with water.

**Base**—a compound that increases the number of hydroxide ions ($OH^-$) in solution with water.

**pH**—a scale measuring relative acidity and basicity.

**Indicator**—a chemical that changes color with changes in pH.

**Oxidation**—a chemical process in which a substance loses electrons (often accompanied by the gain of an oxygen atom).

**Reduction**—a chemical process in which a substance gains electrons (the opposite of oxidation).



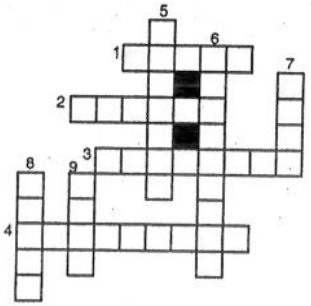
## Fill in the crossword puzzle below with the "Words to Know."

### ACROSS

1. Ice, which has molecules that form a rigid structure, is an example of a _____.
2. Water, which has molecules that can flow around each other, is an example of a _____.
3. When two or more atoms bond together, they form a _____.
4. Iron undergoes _____ when it loses electrons and combines with oxygen to form iron oxide, or rust.

### DOWN

5. Sugar is _____ in water because it dissolves in water.
6. An _____ is a substance that has a different color in an acid from what it has in a base.
7. When sodium hydroxide (NaOH), a _____, is added to water, the number of hydroxide ions in solution increases.
8. Molecules are made of tiny particles called _____.
9. When hydrochloric _____ (HCl) is added to water, the number of hydrogen ions in solution increases.

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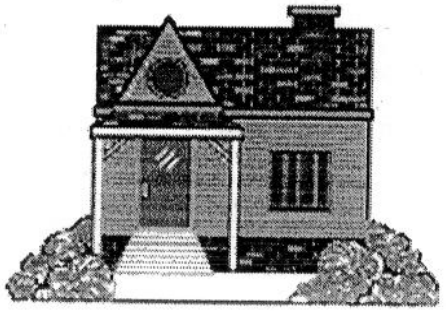
# Chem lab

## Take-Home Activities



# Household Chemistry

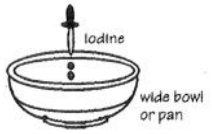
This project funded by the National Science Foundation

# Mystery Writing

***Use iodine to expose lemon-juice writing!***

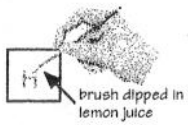
**Materials:**

One wide bowl or small cake pan
2 tablespoons lemon juice
One cup or other small container
10 drops tincture of iodine (available from a drugstore)
One small brush or cotton swab
One spoon
Rubber gloves (optional)
One piece of white paper
One plate
Paper towels
Water

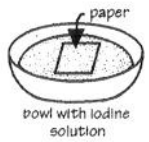



**To do and notice:**

1. Cut a piece of paper to fit flat on the bottom of the bowl or pan. Set the paper aside, outside the bowl. Fill the empty bowl with 1/2 inch of water. Add 10 drops of iodine to the water, and stir with the spoon to mix the liquids thoroughly. This is your developer. (**CAUTION:** Iodine can stain skin and clothes. Handle it carefully and wear rubber gloves if they are available.)




2. Pour the lemon juice into the cup. Dip the brush or swab into the lemon juice, and use it to write on the piece of paper. Allow the paper to dry completely (about 15 minutes). **Can you see the writing?**




3. Place the paper into the bowl with the iodine solution. Use the spoon to push it under the surface of the solution. After a few moments, remove the paper from the bowl and let it dry on paper towels on a plate.

**Now what does the paper and the writing look like?**

**A closer look:**

Iodine molecules combine with starch molecules in the paper to form a dark blue compound. However, when iodine combines with vitamin C in the lemon juice, it forms a colorless compound instead. Thus, the writing on the paper stays white, while the rest of the paper turns blue.

# Egg Coloring

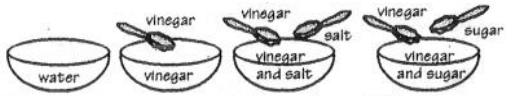
***What makes food coloring stick to an egg?***

**Materials:**

2 teaspoons food coloring
3 tablespoons vinegar
1 tablespoon salt
One small mixing bowl
One large mixing bowl (or tub) of water
Paper towels or a cardboard egg carton
Four cups or bowls big enough to hold an egg
Four spoons large enough to hold an egg
1 tablespoon sugar
2 cups water
One pencil
One timer or clock
Masking tape
Four eggs

**To do and notice:**

1. Label the eggs with the pencil, and label the cups with tape, as follows: water, vinegar, vinegar and salt, and vinegar and sugar.
2. In the small mixing bowl, mix 2 teaspoons food coloring with 2 cups water. Pour 1/2 cup of this solution into each cup.




3. Add 1 tablespoon vinegar to each "Vinegar" cup. Add 1 tablespoon salt and 1 tablespoon sugar to the appropriate cups. Stir each solution to mix it well.
4. Use the spoons to lower each egg into the matching cup. Wait 10 minutes, then remove the eggs with the spoons. Rinse each egg five times in the tub of water, and set it on paper towels or in an egg carton to dry. **Which egg was colored the most? The least?**

**A closer look:**

On the surface of an eggshell is a thin layer of protein molecules called the "cuticle." These molecules normally have a neutral electrical charge. When an acid is added, the molecules become positively charged. Vinegar is an acid. Food-coloring molecules have a negative electrical charge, so they are attracted to the positively charged molecules on the eggs in vinegar. They are much less attracted to the neutral molecules of the egg in water.

When salt is added to the vinegar solution, it breaks down into both positive and negative ions. The salt's negative ions bind to the positive protein molecules, so the food-coloring molecules are unable to bind to the egg. Sugar is neutrally charged in solution, so it does not interfere with the food-coloring molecules.

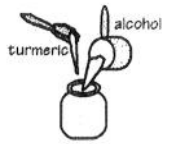
# Spicy Indicator

***Use turmeric to test for bases in your home!***

**Materials:**

1/4 teaspoon turmeric powder
1/4 cup rubbing (isopropyl) alcohol
One small jar with a tight-fitting lid
One eyedropper or small spoon
Several small bowls or cups
Household chemicals to test (for example: soap, household spray cleaner window cleaner, ammonia, vinegar, baking soda, baking powder, milk, soda water, and lemon juice)

**To do and notice:**




1. Combine the turmeric with the alcohol in the jar. Mix the two thoroughly. This is your indicator. (An indicator is a chemical that changes color with a change in pH (acidity/basicity).) **What color is the turmeric-and-alcohol solution?**


2. In small bowls or cups, mix one teaspoon of each household chemical to be tested with a few drops of turmeric indicator. (You will be able to test only white or colorless substances.) Turmeric is yellow in an acid or neutral solution, but it turns red in a base. **What household chemicals are bases?**

**A closer look:**

The compound that creates the yellow color in turmeric will react with a base to form a red compound. Alcohol is used to prepare the indicator because tumeric is more soluble (dissolves better) in alcohol than in water.

Many soaps and household cleaners are bases. Baking soda is also a base, but baking powder has added ingredients that make it acidic.