1. Make Slime:

There are lots of recipes for slime. Since most recipes are easy, look for one using ingredients you have on hand.
Difficulty: Easy
Time Required: 15 mins

Here's How:

1. Pour the glue into the jar. If you have a big bottle of glue, you want 4 oz or 1/2 cup of glue.
2. Fill the empty glue bottle with water and stir it into the glue (or add 1/2 cup of water).
3. If desired, add food coloring. Otherwise, the slime will be an opaque white.
4. In a separate, mix one cup (240 ml) of water into the bowl and add 1 teaspoon (5 ml) of borax powder.
5. Slowly stir the glue mixture into the bowl of borax solution.
6. Place the slime that forms into your hands and knead until it feels dry. (Don't worry about the excess water remaining in the bowl.)
7. The more the slime is played with, the firmer and less sticky it will become.
8. Have fun!
9. Store your slime in a zip-lock bag in the fridge (otherwise it will develop mold).

Tips:

1. Use white glue, such as Elmer's brand. Most 'school glues' do not have the correct composition.
2. Don't eat the slime - it isn't especially toxic, but not good for you either!
3. Slime cleans up pretty easily. Remove dried slime after soaking with water.

What You Need:

- borax powder
- water
- 4 ounce (120 ml) glue (e.g., Elmer's white glue)
- teaspoon
- bowl
- jar or measuring cup
- food coloring (optional)
- measuring cup

How to grow a Borax Snowflake

Do real snowflakes melt too quickly? Grow a borax snowflake, color it blue if you like, and enjoy the sparkle all year long!

Difficulty: Average

Time Required: Overnight

Here's How:

1. Cut a pipe cleaner into three equal sections.
2. Twist the sections together at their centers to form a six-sided snowflake shape. Don't worry if an end isn't even, just trim to get the desired shape. The snowflake should fit inside the jar.
3. Tie the string to the end of one of the snowflake arms. Tie the other end of the string to the pencil. You want the length to be such that the pencil hangs the snowflake into the jar.
4. Fill the widemouth pint jar with boiling water.
5. Add borax one tablespoon at a time to the boiling water, stirring to dissolve after each addition. The amount used is 3 tablespoons borax per cup of water. It is okay if some undissolved borax settles to the bottom of the jar.
6. If desired, you may tint the mixture with food color.
7. Hang the pipe cleaner snowflake into the jar so that the pencil rests on top of the jar and the snowflake is completely covered with liquid and hangs freely (not touching the bottom of the jar).
8. Allow the jar to sit in an undisturbed location overnight.
9. Look at the pretty crystals!!! You can hang your snowflake as a decoration or in a window to catch the sunlight :-)

Tips:

1. Borax is available at grocery stores in the laundry soap section, such as 20 Mule Team Borax Laundry Booster. Do not use Borax soap.
2. Because boiling water is used and because borax isn't intended for eating, adult supervision is recommended for this project.
3. If you can't find borax, you can use sugar or salt (may take longer to grow the crystals, so be patient). Add sugar or salt to the boiling water until it stops dissolving. Ideally you want no crystals at the bottom of the jar.

What You Need:

- string
- wide mouth jar (pint)
- white pipe cleaners
- borax (see tips)
- pencil
- boiling water
- blue food coloring (opt.)
- scissors

Mentos and Diet Coke

Chemical volcanoes are classic projects for science fairs and chemistry demonstrations. The mentos and diet soda volcano is similar to the baking soda volcano, except the eruption is really powerful, capable of producing jets of soda several feet high. It's messy, so you might want to do this project outdoors or in a bathroom. It's also non-toxic, so kids can do this project.
Difficulty: Easy
Time Required: chemical volcano takes a few minutes to set up and erupts for a few seconds

Here's How:

1. First, gather your supplies. You can substitute another candy for the Mentos, such as M&Ms or Skittles, but ideally you want candies that stack into a neat column with minimal space between them, have a chalky consistency, and barely fit through the mouth of a 2-liter bottle.

2. Similarly, you could substitute normal soda for diet soda. The project will work just as well, but the resulting eruption will be sticky. Whatever you use, the beverage has to be carbonated!

3. First, you need to stack the candies. The easiest way to do this is to stack them in a test tube narrow enough to form a single column. Otherwise, you can roll a sheet of paper into a tube just barely wide enough for a stack of candies.

4. Place an index card over the opening of the test tube or end of the paper tube to hold the candies in the container. Invert the test tube.

5. Open your full 2-liter bottle of diet soda. The eruption happens very quickly, so set things up: you want the open bottle - index card - roll of candies so that as soon as you remove the index card, the candies will drop smoothly into the bottle.

6. When you're ready, do it! You can repeat the eruption with the same bottle and another stack of candies. Have fun!

What You Need:

- roll of mentos candies
- 2-liter bottle of diet soda
- index card
- test tube or sheet of paper
- a mop for cleanup

Shiny Pennies

Use pennies, nails, and a few simple household ingredients to explore some of the properties of metals:

Materials

- 20-30 dull pennies
- 1/4 cup white vinegar (dilute acetic acid)
- 1 teaspoon salt (NaCl)
- 1 shallow, clear glass or plastic bowl (not metal)
- 1-2 clean steel screws or nails
- water
- measuring spoons
- paper towels

Shiny Clean Pennies

1. Pour the salt and vinegar into the bowl.
2. Stir until the salt dissolves.
3. Dip a penny halfway into the liquid and hold it there for 10-20 seconds. Remove the penny from the liquid. What do you see?
4. Dump the rest of the pennies into the liquid. The cleaning action will be visible for several seconds. Leave the pennies in the liquid for 5 minutes.
5. Proceed to 'Instant Verdigris!'

Pennies get dull over time because the copper in the pennies slowly reacts with air to form copper oxide. Pure copper metal is bright and shiny, but the oxide is dull and greenish. When you place the pennies in the salt and vinegar solution, the acetic acid from the vinegar dissolves the copper oxide, leaving behind shiny clean pennies. The copper from the copper oxide stays in the liquid. You could use other acids instead of vinegar, like lemon juice.

Instant Verdigris!

1. Note: You want to keep the liquid you used to clean the pennies, so don't dump it down the drain!
2. After the 5 minutes required for 'Shiny Clean Pennies', take half of the pennies out of the liquid and place them on a paper towel to dry.
3. Remove the rest of the pennies and rinse them well under running water. Place these pennies on a second paper towel to dry.
4. Allow about an hour to pass and take a look at the pennies you have placed on the paper towels. Write labels on your paper towels so you will know which towel has the rinsed pennies.
5. While you are waiting for the pennies to do their thing on the paper towels, use the salt and vinegar solution to make 'Copper Plated Nails'.

Rinsing the pennies with water stops the reaction between the salt/vinegar and the pennies. They will slowly turn dull again over time, but not quickly enough for you to watch! On the other hand, the salt/vinegar residue on the unrinsed pennies promotes a reaction between the copper and the oxygen in the air. The resulting blue-green copper oxide is commonly called 'verdigris'. It is a type of patina found on a metal, similar to tarnish on silver. The oxide forms in nature as well, producing minerals such as malachite and azurite.

Copper Plated Nails

1. Place a nail or screw so that it is half in and half out of the solution you used to clean the pennies. If you have a second nail/screw, you can let it sit completely immersed in the solution.
2. Do you see bubbles rising from the nail or the threads of the screw?
3. Allow 10 minutes to pass and then take a look at the nail/screw. Is it two different colors? If not, return the nail to its position and check it again after an hour.

The copper that coats the nail/screw comes from the pennies. However, it exists in the salt/vinegar solution as positively charged copper ions as opposed to neutral copper metal. Nails and screws are made of steel, an alloy primarily composed of iron. The salt/vinegar solution dissolves some of the iron and its oxides on the surface of the nail, leaving a negative charge on the surface of the nail. Opposite charges attract, but the copper ions are more strongly attracted to the nail than the iron ions, so a copper coating forms on the nail. At the same time, the reactions involving the hydrogen ions from the acid and the metal/oxides produce some hydrogen gas, which bubbles up from the site of the reaction - the surface of the nail or screw.

Invisible Ink

These are instructions for making non-toxic invisible ink using baking soda (sodium bicarbonate).

Difficulty: Easy

Time Required: A Few Minutes

Here's How:

1. There are at least two methods to use baking soda as an invisible ink. Mix equal parts water and baking soda.
2. Use a cotton swab, toothpick, or paintbrush to write a message onto white paper, using the baking soda solution as 'ink'.
3. Allow the ink to dry.
4. One way to read the message is to hold the paper up to a heat source, such as a light bulb. The baking soda will cause the writing in the paper to turn brown.
5. A second method to read the message is to paint over the paper with purple grape juice. The message will appear in a different color.

Tips:

1. If you are using the heating method, avoid igniting the paper - don't use a halogen bulb.
2. Baking soda and grape juice react with each other in an acid-base reaction, producing a color change in the paper.
3. The baking soda mixture can also be used more diluted, with one part baking soda to two parts water.
4. Grape juice concentrate results in a more visible color change than regular grape juice.

What You Need:

- Baking Soda
- Paper
- Water
- Light Bulb (heat source)
- Paintbrush or Swab
- Measuring Cup
- Purple Grape Juice (opt.)

Column of Density

Make a density column with many liquid layers using common household liquids. This is an easy, fun and colorful science project that illustrates the concept of density.

Density Column Materials

You can use some or all of these liquids, depending on how many layers you want and which materials you have handy. These liquids are listed from most-dense to least-dense, so this is the order in which you pour them into the column.

1. honey
2. corn syrup or pancake syrup
3. liquid dishwashing soap
4. water (can be colored with food coloring)
5. vegetable oil
6. rubbing alcohol (can be colored with food coloring)
7. lamp oil

Make the Density Column

Pour your heaviest liquid into the center of whatever container you are using to make your column. If you can avoid it, don't let the first liquid run down the side of the container because the first liquid is thick enough it will probably stick to the side so your column won't end up as pretty. Carefully pour the next liquid you are using down the side of the container. Another way to add the liquid is to pour it over the back of a spoon. Continue adding liquids until you have completed your density column. At this point, you can use the column as a decoration. Try to avoid bumping the container or mixing its contents.

The hardest liquids to deal with are the water, vegetable oil, and rubbing alcohol. Make sure that there is an even layer of oil before you add the alcohol because if there is a break in that surface or if you pour the alcohol so that it dips below the oil layer into the water then the two liquids will mix. If you take your time, this problem can be avoided.

How the Density Column Works

You made your column by pouring the heaviest liquid into the glass first, followed by the next-heaviest liquid, etc. The heaviest liquid has the most mass per unit volume or the highest density. Some of the liquids don't mix because they repel each other (oil and water). Other liquids resist mixing because they are thick or viscous. Eventually some of the liquids of your column will mix together.

Ice Cream in a Bag

- 1/2 cup milk
- 1/2 cup whipping cream (heavy cream)
- 1/4 cup sugar
- 1/4 teaspoon vanilla or vanilla flavoring (vanillin)
- 1/2 to 3/4 cup sodium chloride (NaCl) as table salt or rock salt
- 2 cups ice
- 1-quart Ziploc™ bag
- 1-gallon Ziploc™ bag
- thermometer
- measuring cups and spoons
- cups and spoons for eating your treat!

Procedure

1. Add 1/4 cup sugar, 1/2 cup milk, 1/2 cup whipping cream, and 1/4 teaspoon vanilla to the quart Ziploc ™ bag. Seal the bag securely.
2. Put 2 cups of ice into the gallon Ziploc ™ bag.
3. Use a thermometer to measure and record the temperature of the ice in the gallon bag.
4. Add 1/2 to 3/4 cup salt (sodium chloride) to the bag of ice.
5. Place the sealed quart bag inside the gallon bag of ice and salt. Seal the gallon bag securely.
6. Gently rock the gallon bag from side to side. It's best to hold it by the top seal or to have gloves or a cloth between the bag and your hands because the bag will be cold enough to damage your skin.
7. Continue to rock the bag for 10-15 minutes or until the contents of the quart bag have solidified into ice cream.
8. Open the gallon bag and use the thermometer to measure and record the temperature of the ice/salt mixture.
9. Remove the quart bag, open it, serve the contents into cups with spoons and ENJOY!

Explanation

Ice has to absorb energy in order to melt, changing the phase of water from a solid to a liquid. When you use ice to cool the ingredients for ice cream, the energy is absorbed from the ingredients and from the outside environment (like your hands, if you are holding the baggie of ice!). When you add salt to the ice, it lowers the freezing point of the ice, so even more energy has to be absorbed from the environment in order for the ice to melt. This makes the ice colder than it was before, which is how your ice cream freezes. Ideally, you would make your ice cream using 'ice cream salt', which is just salt sold as large crystals instead of the small crystals you see in table salt. The larger crystals take more time to dissolve in the water around the ice, which allows for even cooling of the ice cream.

You could use other types of salt instead of sodium chloride, but you couldn't substitute sugar for the salt because (a) sugar doesn't dissolve well in cold water and (b) sugar doesn't dissolve into multiple particles, like an ionic material such as salt. Compounds that break into two pieces upon dissolving, like NaCl breaks into Na^+ and Cl^-, are better at lowering the freezing point than substances that don't separate into particles because the added particles disrupt the ability of the water to form crystalline ice. The more particles there are, the greater the disruption and the greater the impact on particle-dependent properties (colligative properties) like freezing point depresssion, boiling point elevation, and osmotic pressure. The salt causes the ice to absorb more energy from the environment (becoming colder), so although it lowers the point at which water will re-freeze into ice, you can't add salt to very cold ice and expect it to freeze your ice cream or de-ice a snowy sidewalk (water has to be present!). This is why NaCl isn't used to de-ice sidewalks in areas that are very cold.

Coffee Filter Chromatography

Most plants contain several pigment molecules, so experiment with different leaves to see the wide range of pigments.
Difficulty: Average
Time Required: 2 hours

Here's How:

1. Take 2-3 large leaves (or the equivalent with smaller leaves), tear them into tiny pieces, and place them into small jars with lids.
2. Add enough alcohol to just cover the leaves.
3. Loosely cover the jars and set them into a shallow pan containing an inch or so of hot tap water.
4. Let the jars sit in the hot water for at least a half hour. Replace the hot water as it cools and swirl the jars from time to time.
5. The jars are 'done' when the alcohol has picked up color from the leaves. The darker the color, the brighter the chromatogram will be.
6. Cut or tear a long strip of coffee filter paper for each jar.
7. Place one strip of paper into each jar, with one end in the alcohol and the other outside of the jar.
8. As the alcohol evaporates, it will pull the pigment up the paper, separating pigments according to size (largest will move the shortest distance).
9. After 30-90 minutes (or until the desired separation is obtained), remove the strips of paper and allow them to dry.
10. Can you identify which pigments are present? Does the season in which the leaves are picked affect their colors?

Tips:

1. Try using frozen chopped spinach leaves.
2. Experiment with other types of paper.
3. You can substitute other alcohols for the rubbing alcohol, such as ethyl alcohol or methyl alcohol.
4. If your chromatogram is pale, next time use more leaves and/or smaller pieces to yield more pigment.

What You Need:

- Leaves
- Baby Food Jars with Lids
- Rubbing Alcohol
- Coffee Filters
- Hot Water
- Shallow Pan
- Kitchen Utensils

Hot Ice

Hot ice is an amazing chemical you can prepare yourself from baking soda and vinegar. You can cool a solution of sodium acetate below its melting point and then cause the liquid to crystallize. The crystallization is an exothermic process, so the resulting ice is hot. Solidification occurs so quickly you can form sculptures as you pour the hot ice.

Sodium Acetate or Hot Ice Materials

- 1 liter clear vinegar (weak acetic acid)
- 4 tablespoons baking soda (sodium bicarbonate)

Prepare the Sodium Acetate or Hot Ice

1. In a saucepan or large beaker, add baking soda to the vinegar, a little at a time and stirring between additions. The baking soda and vinegar react to form sodium acetate and carbon dioxide gas. If you don't add the baking soda slowly, you'll essentially get a baking soda and vinegar volcano, which would overflow your container. You've made the sodium acetate, but it is too dilute to be very useful, so you need to remove most of the water.

   Here is the reaction between the baking soda and vinegar to produce the sodium acetate:

   $Na^+[HCO_3]^- + CH_3–COOH \rightarrow CH_3–COO^- Na^+ + H_2O + CO_2$

2. Boil the solution to concentrate the sodium acetate. You could just remove the solution from heat once you have 100-150 ml of solution remaining, but the easiest way to get good results is to simply boil the solution until a crystal skin or film starts to form on the surface. This took me about an hour on the stove over medium heat. If you use lower heat you are less likely to get yellow or brown liquid, but it will take longer. If discoloration occurs, it's okay.
3. Once you remove the sodium acetate solution from heat, immediately cover it to prevent any further evaporation. I poured my solution into a separate container and covered it with plastic wrap. You should not have any crystals in your solution. If you do have crystals, stir a very small amount of water or vinegar into the solution, just sufficient to dissolve the crystals.
4. Place the covered container of sodium acetate solution in the refrigerator to chill.

Activities Involving Hot Ice

The sodium acetate in the solution in the refrigerator is an example of a super cooled liquid. That is, the sodium acetate exists in liquid form below its usual melting point. You can initiate crystallization by adding a small crystal of sodium acetate or possibly even by touching the surface of the sodium acetate solution with a spoon or finger. The crystallization is an example of an exothermic process. Heat is released as the 'ice' forms. To demonstrate supercooling, crystallization, and heat release you could:

- Drop a crystal into the container of cooled sodium acetate solution. The sodium acetate will crystallize within seconds, working outward from where you added the crystal. The crystal acts as a nucleation site or seed for rapid crystal growth. Although the solution just came out of the refrigerator, if you touch the container you will find it is now warm or hot.

- Pour the solution onto a shallow dish. If the hot ice does not spontaneously begin crystallization, you can touch it with a crystal of sodium acetate (you can usually scrape a small amount of sodium acetate from the side of the container you used earlier). The crystallization will progress from the dish up toward where you are pouring the liquid. You can construct towers of hot ice. The towers will be warm to the touch.
- You can re-melt sodium acetate and re-use it for demonstrations.

Hot Ice Safety

As you would expect, sodium acetate is a safe chemical for use in demonstrations. It is used as a food additive to enhance flavor and is the active chemical in many hot packs. The heat generated by the crystallization of a refrigerated sodium acetate solution should not present a burn hazard.