PHARMACHEMICAL IRELAND
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Presents

Cool Chemistry

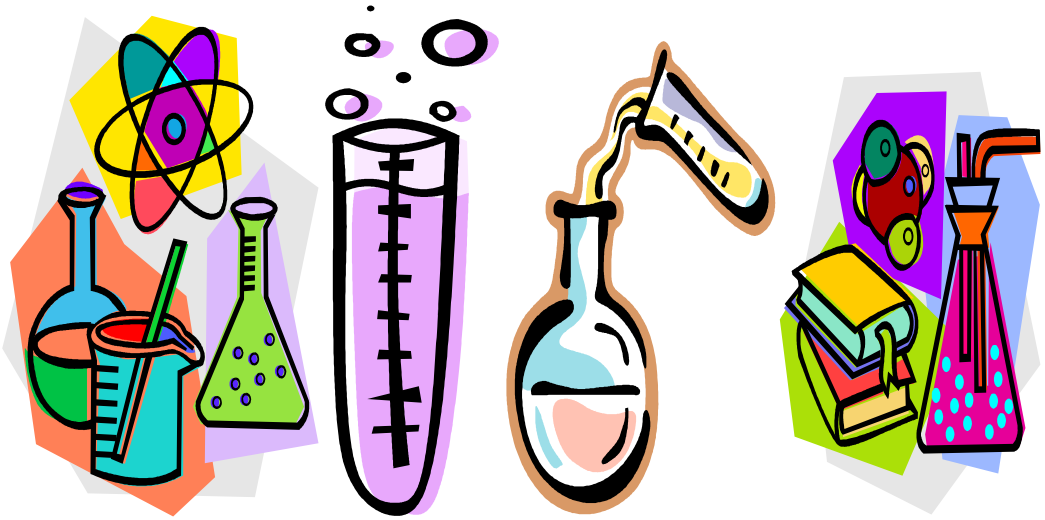

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Table of Contents

Activity 1: Baking Soda Volcano

This activity is aimed at introducing the student to chemical reactions, in an eye catching and user friendly manner. You can make this activity as simple or as fancy as you like. In simple terms, you can just use a 2 L plastic bottle, but if you want to make this activity look better, then you can get the class to build a volcano mountain around the bottle, using putty or plaster of Paris or a similar product.

One of the basic rules of chemistry is that acids and bases are opposite, and when they are mixed together, they react. The baking soda is the base and the vinegar is the acid in this case. When they react they form salt, water and CO_2. The vinegar neutralises the baking soda and the CO_2 results in the spluttering and popping noises.

Materials

6 cups flour, 2 cups salt , 4 tablespoons cooking oil, warm water, plastic soda bottle, dishwashing detergent, food colouring, vinegar, baking dish or other pan, 2 table spoons baking soda.[1]

[1] **Toxic house plants poison more children than household chemicals.**

Procedure

1. First make the 'cone' of the baking soda volcano. Mix 6 cups flour, 2 cups salt, 4 tablespoons cooking oil, and 2 cups of water. The resulting mixture should be smooth and firm (more water may be added if needed).
2. Stand the soda bottle in the baking pan and mold the dough around it into a volcano shape. Don't cover the hole or drop dough into it!
3. Fill the bottle most of the way full with warm water and a bit of red food color (can be done before sculpting if you don't take so long that the water gets cold).
4. Add 6 drops of detergent to the bottle contents.
5. Add 2 tablespoons baking soda to the liquid.
6. Slowly pour vinegar into the bottle. Watch out - eruption time!
7. Chemistry is Cool :-)

The cool red lava is the result of a chemical reaction between the baking soda and vinegar.

In this reaction, carbon dioxide gas is produced, which is also present in real volcanos.

As the carbon dioxide gas is produced, pressure builds up inside the plastic bottle, until the gas bubbles (thanks to the detergent) out of the 'volcano'.

Adding a bit of yellow food coloring too will result in lovely red-orange lava![2]

[2] **People spend about two weeks of their lives at traffic lights!**

Activity 2: How to be Willie Wonka

This activity is aimed at allowing the students to watch chemistry in action, as the sugar crystals grow over time to form an edible end product a bit like Willie Wonka but without the Umpa Loompas. It's easy to grow your own sugar crystals! Sugar crystals are also known as rock candy since the crystallized sucrose (table sugar) resembles rock crystals. You can grow beautiful clear sugar crystals with sugar and water or you can add food colouring to get coloured crystals. It's simple, safe, and fun. Boiling water is required to dissolve the sugar, so adult supervision is recommended for this project.

Materials

1 cup water, 3 cups table sugar (sucrose), clean glass jar, pencil or butter knife, string, pan or bowl for boiling water and making solution, spoon or stirring rod.

Procedure

1. Gather your materials.
2. Tie the string to a pencil or butter knife.[3]

[3] **Human jaw muscles can generate a force of 200 pounds (90.8 kilograms) on the molars.**

3. Set the pencil or knife across the top of the glass jar and make sure that the string will hang into the jar without touching its sides or bottom. However, you want the string to hang nearly to the bottom. Adjust the length of the string, if necessary.
4. Boil the water. If you boil your water in the microwave, be very careful removing it to avoid getting splashed!
5. Stir in the sugar, a teaspoonful at a time. Keep adding sugar until it starts to accumulate at the bottom of the container and won't dissolve even with more stirring. This means your sugar solution is saturated. If you don't use a saturated solution, then your crystals won't grow quickly. On the other hand, if you add too much sugar, new crystals will grow on the undissolved sugar and not on your string.
6. If you want coloured crystals, stir in a few drops of food colouring.
7. Pour your solution into the clear glass jar. If you have undissolved sugar at the bottom of your container, avoid getting it in the jar.
8. Place the pencil over the jar and allow the string to dangle into the liquid.
9. Set the jar somewhere where it can remain undisturbed. If you like, you can set a coffee filter or paper towel over the jar to prevent dust from falling into the jar.
10. Check on your crystals after a day. You should be able to see the beginnings of crystal growth on the string or seed crystal.
11. Let the crystals grow until they have reached the desired size or have stopped growing. At this point, you can pull out the string and allow the crystal to dry. You can eat them or keep them. [4]

[4] **The Hubble Space Telescope weighs 12 tons (10,896 kilograms), is 43 feet (13.1 meters) long, and cost $2.1 billion to originally build.**

Activity 3: Mentos Madness

This activity is aimed at showing the students that chemical reactions can happen in all situations in everyday life. Chemical volcanos are classic projects for science fairs and chemistry demonstrations. The mentos and fizzy drink 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.

Materials

roll of mentos candies, 2-liter bottle of fizzy drink, index card, test tube or sheet of paper, a mop for cleanup

Procedure

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! [5]

[5] [5] **The largest flying animal was the pterosaur which lived 70 million years ago. This reptile had a wing span of 36-39 feet (11-11.9 meters) and weighed 190-250 pounds (86-113.5 kilograms).**

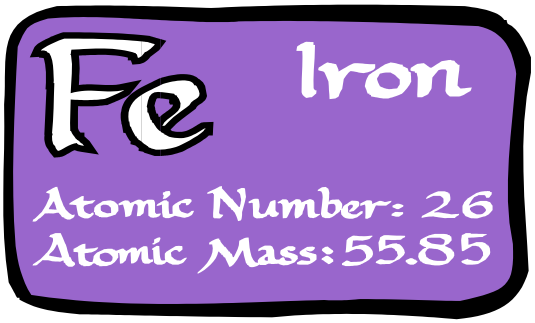
3. First, you need to stack the candies. The easiest way to do this is to stack them in a test tube narrow enough to form a single column. Otherwise, you can roll a sheet of paper into a tube just barely wide enough for a stack of candies.
4. Place an index card over the opening of the test tube or end of the paper tube to hold the candies in the container. Invert the test tube.[6]
5. Open your full 2-litre 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.

[7]

[7] **The tentacles of the giant Arctic jellyfish can reach 120 feet (36.6 meters) in length.**

Activity 4: Metal for Breakfast

This activity is designed to show kids that metals are present in everyday life and are in the food we eat and how essential they are to living a healthy life. Iron has the chemical symbol Fe.



Iron in Your Diet

Iron is an essential mineral for health. Too little iron can cause iron deficiency anemia. This can make you feel run down and increase your risk of illness or disease. Anemia is fairly common. It is seen more often in the elderly and in teens.
Iron needs vary with age and sex. The need for iron increases during growth periods (pregnancy, infancy, childhood, teen years) and for women having menstrual periods.

Iron Supplements

Men: Since men's needs are much lower than women's, it's easy to get the needed amounts from food sources alone. Taking an iron pill is not often needed. If you choose to take a daily multivitamin-mineral, be sure it provides no more than 10-11 mg iron. Large amounts of iron are toxic.
Women: Women who are menstruating, very active, or pregnant, may need a daily multivitaminmineral with 18 mg iron (more is needed for pregnant women). You should only take a greater amount of iron if told to do so by your doctor. Large amounts of iron can be toxic. [8]

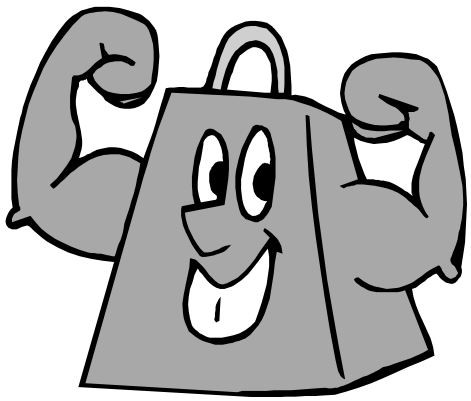
Materials

[8] **A new born blue whale measures 20-26 feet (6.0 - 7.9 meters) long and weighs up to 6,614 pounds (3003 kg).**

2-3 cups fortified cereal**,** magnet**,,** bowl, spoon or other utensil, water, blender (optional), napkin

Procedure

1. Pour the cereal into the bowl or blender.
2. Add sufficient water to completely cover the cereal (it's not an exact measurement - you can add as much as you like as iron doesn't dissolve in water)
3. Mash the cereal with a spoon or mix it with the water using a blender. The more finely ground the cereal is, the easier it will be to get the iron.
4. Stir the magnet through the crushed cereal. Iron is heavy and will sink, so be sure to pay attention to the bottom of the bowl. If you used a blender, make sure you can get to the particles at the bottom of the jar.
5. Look for the black 'fuzz' or iron on the magnet. It's easiest to see the iron if you wipe the iron on a white napkin or paper towel.[9]



[9] **The Stegosaurus dinosaur measured up to 30 feet (9.1 meters) long but had a brain the size of a walnut.**

Activity 5: Penny Pinching

This activity is designed to show the students how the action of an acid on items such as pennies can remove dirt. Hence it is a good way of explaining how acids are corrosive. Pennies dull because they get covered by a thin layer of CuO, copper oxide. Vinegar [5% acetic acid] should dissolve this layer leaving a clean layer of shiny copper metal.

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

Procedure

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.
5. The cleaning action will be visible for several seconds. Leave the pennies in the liquid for 5 minutes.
6. 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. [10]

[10] **The largest meteorite crater in the world is in Winslow, Arizona. It is 4,150 feet across and 150 feet deep.**

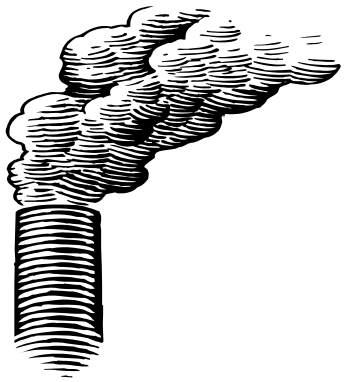
7. Note: You want to keep the liquid you used to clean the pennies, so don't dump it down the drain!
8. After the 5 minutes required for 'Shiny Clean Pennies', take half of the pennies out of the liquid and place them on a paper towel to dry.
9. Remove the rest of the pennies and rinse them well under running water. Place these pennies on a second paper towel to dry.
10. 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.

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. [11]

[11] **The Skylab astronauts grew 1.5 - 2.25 inches (3.8 - 5.7 centimeters) due to spinal lengthening and straightening as a result of zero gravity.**

Activity 6: Smoke Bomb

This is a fun and visual experiment that helps explain the chemistry behind fire reactions. The smoke bomb you would purchase from a fireworks store usually is made from potassium chlorate ($KClO_3$ - oxidizer), sugar (sucrose or dextrin - fuel), sodium bicarbonate (otherwise known as baking soda - to moderate the rate of the reaction and keep it from getting too hot), and a powdered organic dye (for coloured smoke). When a commercial smoke bomb is burned, the reaction makes white smoke and the heat evaporates the organic dye. Commercial smoke bombs have small holes through which the smoke and dye are ejected, to create a jet of finely dispersed particles. Crafting this type of smoke bomb is beyond most of us, but you can make an effective smoke bomb quite easily. There are even colorants you can add if you want to make coloured smoke.



Materials

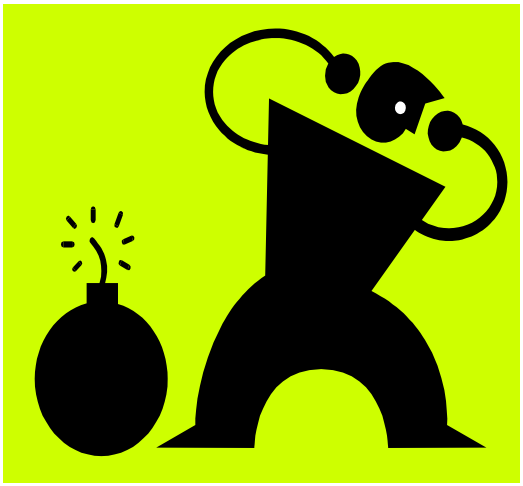
sugar (sucrose or table sugar), potassium nitrate, KNO_3, also known as saltpeter (you can find this at some garden supply stores in the fertilizer section, some pharmacies carry it too), skillet or pan, aluminum foil.

Procedure

1. Pour about 3 parts potassium nitrate to 2 parts sugar into the skillet (5:3 ratio is also good). Measurements don't need to be exact, but you want more KNO_3 than sugar. For example, you can use 1-1/2 cups KNO_3 and 1 cup sugar. If you use equal amounts of KNO_3 and sugar, your smoke bomb will be harder to light and will burn more slowly. As you approach the 5:3 KNO_3:sugar ratio, you get a smoke bomb that burns more quickly. [12]

[12] **The Atlantic Giant Squid's eye can be as large as 15.75 inches (40 centimeters) wide.**

2. Apply low heat to the pan. Stir the mixture with a spoon using long strokes. If you see the grains of sugar starting to melt along the edges where you are stirring, remove the pan from the heat and reduce the temperature before continuing.
3. Basically you are caramelizing sugar. The mixture will melt and become a caramel or chocolate colour.
4. Pour the liquid onto a piece of foil. You can pour a smaller amount onto a separate piece, to test the batch. You can pour the smoke bomb into any shape, onto an object, or into a mold. The shape and size will affect the burning pattern.
5. If you aren't going to clean your skillet immediately, pour hot water into the pan to dissolve the sugar (or else it will be harder to clean). Clean up any residue you may have spilled out of the pan, unless you want mini-smoke bombs on your stovetop.
6. Allow the smoke bomb to cool, then you can peel it off the foil. [13]



[13] **The most powerful laser in the world, the Nova laser at Lawrence Livermore National Laboratory, CA, USA, generates a pulse of energy equal to 100,000,000,000,000 watts of power for .000000001 second to a target the size of a grain of sand.**

Activity 7: Lava Lamps

This activity is aimed at explaining the chemistry behind mixing and non mixing chemical in this case, oil and water. The factor that prevents the water and oil mixing is the fact that the water is polar, whilst the oil is not. When the two are put together the mixture separates into two layers, with the less dense oil layer lying on top of the water layer. This activity does not have the visual effect that a normal lamp would have but it is non toxic, and realistically the only one that is suitable to be carried out by children.

Materials

Vegetable Oil or Baby Oil, Water, Food Coloring, Glitter or Small Beads, Glass Jar with Lid

Procedure

1. This version of a lava lamp (unlike the real thing) is great for young kids! First, fill the jar about a third full of oil.
2. Next, sprinkle on glitter, sequins, small beads, that catch your eye.
3. Add water to nearly fill the jar.
4. Add a drop or so of food colouring.
5. Finish filling the jar with water, then screw the lid on tightly.
6. Flip the jar over. Flip it back. Shake it up. Have fun![14]

[14] **The fastest computer in the world is the CRAY Y-MP C90 supercomputer. It has two gigabytes of central memory and 16 parallel central processor units.**

Let the liquids settle, then open the jar and sprinkle a tiny bit of salt on top. What happens? Why? Water is a polar molecule, while oil is non polar. Polar molecules stick to each other, but not to non polar molecules. Oil and water don't mix! The oil is less dense than water, so it floats on top. Is the food colouring in the oil or the water? How can you tell? Is food colouring polar or non polar?[15]

[15] **The largest cave in the world (the Sarawak Chamber in Malaysia) is 2,300 feet (701 meters) long, 980 feet (299 meters) wide, and more than 230 feet (70 meters) high.**

Activity 7: Eggs Without Shells

This activity again tries to explain the corrosive nature of acids, using vinegar as our acid. Using vinegar, you can dissolve the eggshell—without breaking the membrane that contains the egg. When you submerge an egg in vinegar, the shell dissolves. Vinegar contains acetic acid, which breaks apart the solid calcium carbonate crystals that make up the eggshell into their calcium and carbonate parts. The calcium ions (ions are atoms that are missing electrons) float free, while the carbonate goes to make carbon dioxide—the bubbles that you see.

Materials

a few eggs, white vinegar, a container big enough to hold all your eggs and a cover for the container, a big spoon

Procedure

1. Place your eggs in the container so that they are not touching.
2. Add enough vinegar to cover the eggs. Notice that bubbles form on the eggs. Cover the container, put it in the refrigerator, and let the eggs sit in the vinegar for 24 hours.
3. Use your big spoon to scoop the eggs out of the vinegar. Be careful—since the eggshell has been dissolving, the egg membrane may be the only thing holding the egg together. The membrane is not as durable as the shell.
4. Carefully dump out the vinegar. Put the eggs back in the container and cover them with fresh vinegar. Leave the eggs in the refrigerator for another 24 hours.[16]

[16] **There are between 100,000,000,000 and 1,000,000,000,000 stars in a normal galaxy.**

5. Scoop the eggs out again and rinse them carefully. If any of the membranes have broken, letting the egg ooze out, throw those eggs away.
6. When you're done, you'll have an egg without a shell. It looks like an egg, but it's translucent—and the membrane flexes when you squeeze it. Very cool![17]

[17] **Scientists have discovered that copper pollution of the atmosphere occurred about 2500 years ago. This was discovered by analyzing ice cores from Greenland. The pollution was attributed to the Romans who used copper for military purposes and to produce coins.**

Activity 9: How Not to Blow up a Can

Have you ever wondered why shaking a fizzy drink results in a great explosion when it's opened? What causes a 2-liter bottle of soda to go flat?

Since the fizz in the soda is actually dissolved carbon dioxide gas, the goal is to keep as much of the gas in the bottle as possible. Soda fizzes when dissolved carbon dioxide gas is released in the form of bubbles. At the bottling plant, carbon dioxide molecules are forced into the soda in an amount that is greater than would ordinarily dissolve under atmospheric conditions. As soon as you open the bottle, most of the excess gas escapes into the room – that's a given! So, it's your job to find a way to keep the remaining gas in the liquid.

Materials

Cans of regular fizzy drinks, not diet.

Procedure

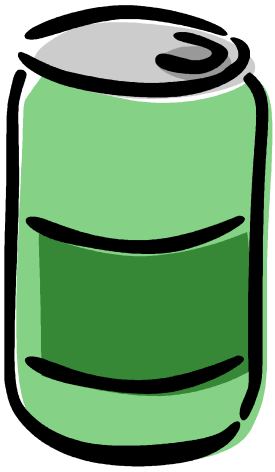
1. Vigorously shake a sealed can of soda.
2. Invite a dinner guest to immediately open the can! Of course, most sane people will refuse the offer. [18]

[18] **A large sunspot can last for about a week.**

3. With a little science know-how, you'll be able to open the can without spilling a drop. The secret is to use your finger to snap the side of the can. This action dislodges the bubbles attached to the side of the can and they float to the top. When the can is opened, the gas simply escapes. As you will soon discover, tapping the top of the can does nothing.

Shaking the unopened can of soda causes bubbles of carbon dioxide to line the inside walls of the can. When you open the can, the pressure in the can goes down and the volume of each bubble goes up (Boyle's Law). The quickly expanding bubbles force the liquid that rests above it out of the can.

Most people have learned to tap the top of the can before opening it. Scientifically speaking, this is crap! However, tapping the side of the can knocks bubbles off the bottom and sides of the can, at which point they rise to the top. The trick is to dislodge the bubbles from the sidewalls and bottom of the can so they can float to the top of the can (because gas is lighter than liquid) and there is only a small amount of liquid blocking their escape when you open the can. Remember, SNAP the SIDE instead of tapping the top.[19]



[19] **If you could throw a snowball fast enough, it would totally vaporize when it hit a brick wall.**

Activity 10: The Chemistry Quiz

1. What is the chemical symbol for water? H_2O

2. What is the hardest substance known to man? Diamond

3. What makes fizzy drinks fizzy? Carbon Dioxide

4. Drinking cans are made out of which material? Aluminium

5. What chemical element helps to make our bones strong? Calcium

6. What chemical element makes our voices squeaky when it is inhaled? Helium

7. What is the chemical symbol for gold? Au

8. Give an example of an acid we eat? Lemon juice, vinegar etc.

9. What happens when you mix oil and water? They separate into two layers

10. What chemical elements make up table salt? Sodium and Chloride[20]

[20] **The only letter not appearing on the Periodic Table is the letter "J".**