FIRE Extinguisher / FIRE Igniter LAB

NAME _____ PER____ MAILBOX # _____ DUE DATE _____

(2pts for complete header)

CREATE CARBON DIOXIDE AND PUT OUT A FLAME

Fire needs oxygen to burn. Carbon dioxide cuts off oxygen, so the flame goes out.

Carbon dioxide actually pushes air up and away from the flame because carbon dioxide is heavier than the air it displaces. Carbon dioxide throws a sort of invisible blanket over a flame. That's how many fire extinguishers work.

You can create carbon dioxide to put out a candle flame.

Perform this experiment in or near a sink. You need an adult to assist you.

Here's what you need:

2 to 4 tablespoons (30–60 ml) baking soda

A heatproof glass or stainless steel mixing bowl

A short, thick candle, such as a food-warmer,

scented, or votive candle

A kitchen match

About ¼ cup (60ml) vinegar

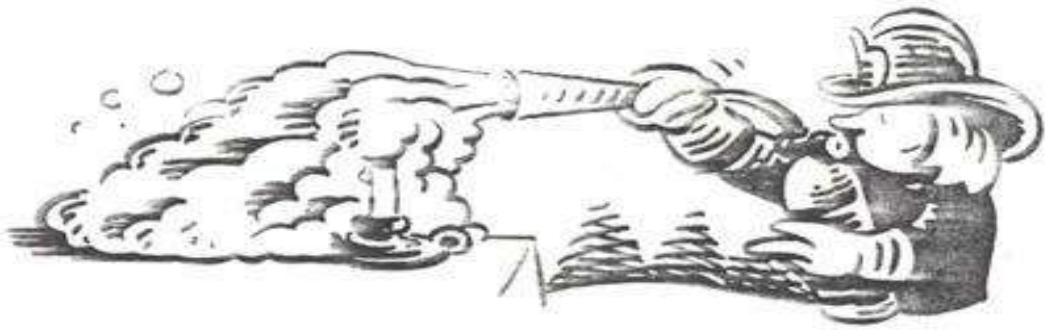
Here's what you do:

1. Sprinkle the baking soda into the bowl until it covers the bottom of the bowl.
2. Set the candle in the middle of the bowl. Light the candle.
3. Carefully pour the vinegar into the bowl without touching the candle.

Note *how much time goes by before the flame goes out.*

Vinegar is an acid, and baking soda is a base. When you mix them, you set off a chemical reaction. The reaction produces carbon dioxide. And, of course, carbon dioxide smothers flames.

YOUR CANDLE GOES OUT BECAUSE IT HAS NO MORE OXYGEN AROUND IT TO HELP IT BURN.



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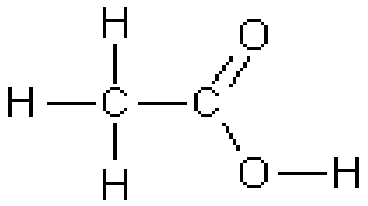
Background: The compounds we will be working with.

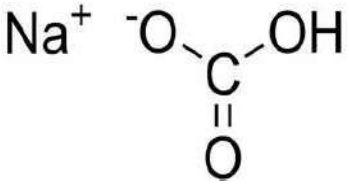
The chemistry of Vinegar



reactant (1)

Vinegar is composed of about 5% acetic acid. This is the major chemical component of vinegar. The systematic or proper chemical name of acetic acid is ethanoic acid. Vinegar is a weak acid produced by the oxidation of alcohol from wines and ciders by bacteria. It has a pleasant sour taste and is used in cooking and quite commonly in salad dressings. It is often commercially sold as white vinegar, brown vinegar, cider vinegar and balsamic vinegar. The structural formula for acetic acid (the main component in vinegar) is CH_3COOH. This formula is a shorthand way of representing the compound. Another way is illustrated in the above picture by diagrammatically showing the elements positions and the bonds between them with lines. The first carbon atom is surrounded by three hydrogen atoms. The second carbon atom is surrounded by one oxygen atom and then a (OH) *hydroxyl group*.

The chemistry of Baking soda



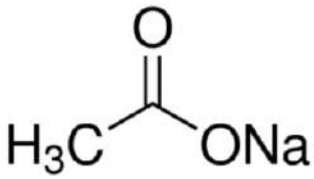
The molecular mass or molar mass of sodium bicarbonate is 84.007 g/mol

reactant (2)

The proper chemical name for baking soda, is sodium hydrogen carbonate, but it is often referred to as just sodium bicarbonate. The chemical formula for baking soda is $NaHCO_3$. Sodium bicarbonate is a white powder which is typically used in cooking as a leavening agent (*makes dough rise*) as it reacts with acidic ingredients such as buttermilk and yogurt. Other applications include things like, being used as a cleaning agent and as a deodorizer. Because it is such a weak base, it is safe to use as an antacid for upset stomachs in small doses or even as an ingredient in toothpaste for whitening teeth.

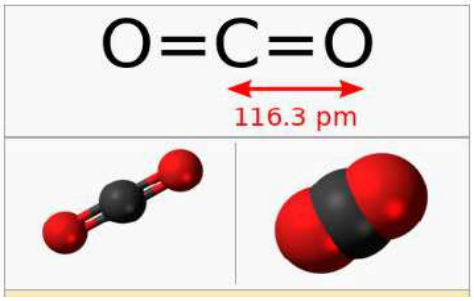
Resource - khanacademy.org

The chemistry of Sodium acetate product (1)



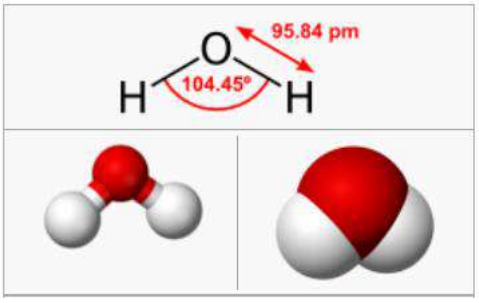
Here is one of the products we will be producing. It is also known as sodium ethanoate and is a type of salt. It will be dissolved in water that we will be simultaneously producing as well. In its pure form, it is white and crystalline. It has a huge range of industry uses. In processing cotton for disposable cotton pads, sodium acetate is used to eliminate the buildup of static electricity. To promote longevity of concrete it is used as an additive for sealants to prevent water damage. It is even used in the food industry as a seasoning with sodium acetate and acetic acid. It gives salt and vinegar potato chips that special flavor and can be seen listed on the packing under ingredients as ***E262***.

The chemistry of Carbonic oxide product (2)



Carbon dioxide (chemical formula **CO_2**) is a colorless and odorless gas vital to life on Earth. This naturally occurring chemical compound is composed of a carbon atom covalently double bonded to two oxygen atoms. Some of its practical uses include safety, as an inert gas that won't react when welding or as a compound in fire extinguishers. It is added to drinking water and used to carbonate beverages. The frozen solid form of CO_2, known as dry ice is used as a refrigerant. Of particular interest to our experiment is its fire extinguishing properties. CO_2 is slighter denser as a gas than O_2 and so tends to displace O_2 during combustion. Without oxygen, a fire dies out.

The chemistry of Dihydrogen monoxide product (3)



This is of course water (chemical formula **H_2O**) but can be referred to as dihydrogen oxide, hydrogen monoxide, or hydroxic acid among other various names from obscure reaches of chemical science or just for fun. At room temperature, it is a tasteless and odorless liquid, nearly colorless with a hint of blue in certain lights. Many substances dissolve in water and it is commonly referred to as *the universal solvent*. Because of this, water in nature and in use is rarely pure and some properties may vary from those of the pure substance. Water is the only common substance found naturally in all three common *states of matter* and it is essential for all life on Earth. Water makes up 55% to 78% of the human body. Water is a common **product** of chemical reactions, like for example *combustion* ironically enough, or the reaction we will be observing in lab.

Resource - khanacademy.org
wikipedia.org

WORKSHEET

Baking soda vigorously reacts with vinegar to produce carbon dioxide gas, water and sodium acetate. The chemical equation for the reaction is as seen below. This is the first reaction we will observe in lab.

Prelab - DIRECTIONS

1. **Fill in the names of the compounds below each of their molecular formulas. Then complete the supporting data table.**

$NaHCO_3 + CH_3COOH \Rightarrow CH_3COO^-Na^+ + H_2O + CO_2$

_____ + _____ -> _____ + _____ + _____

List names:	Atom count on L-side of equation (reactant side)	->	Atom count on R-side of equation (product side)
Na _____	_____		_____
H _____	_____		_____
C _____	_____		_____
O _____	_____		_____

_____

2. **Now, record the atomic mass of each element on the lines below**

$NaHCO_3 + CH_3COOH \Rightarrow CH_3COO^-Na^+ + H_2O + CO_2$

Na _____ (1)		Na _____ (1)		
H _____ (1)	H _____ (4)	H _____ (3)	H _____ (2)	
C _____ (1)	C _____(2)	C _____ (2)		C _____ (1)
O _____ (3)	O _____ (2)	O _____ (2)	O _____ (1)	O _____ (2)

3. **Next multiple the atomic mass by the number of atoms from each line. Then add up each column, going downward. Record totals below.**

_____ + _____ => _____ + _____ + _____

4. **Now**
   Add up the left side reactant totals. Record here: _____
   Add up the right side product totals. Record here: _____

RECALL:

What is the law demonstrated by this mathematical exercise? _____

FUN FACT & REVIEW

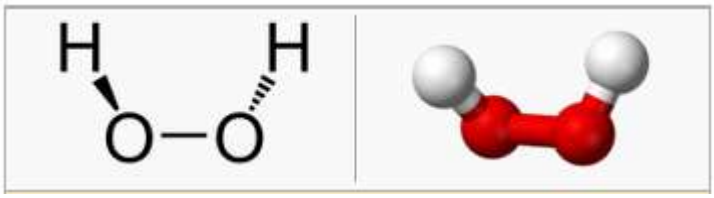
Once understood, the law of conservation of mass was of great importance in progressing from alchemy to modern chemistry. Once early chemists realized that chemical substances never disappeared but were only transformed into other substances with the same weight, these scientists could for the first time start to study the transformations of substances. This in turn led to an understanding of chemical elements as we know them today. It helped to further the idea that all chemical processes and transformations (such as the burning of wood or metabolic reactions in cells) are reactions regulated by laws of nature. This means that chemistry has predictable and distinct reactant / product outcomes. (KRAUSS, 2015)

Hydrogen peroxide reacts with yeast to produce oxygen gas in abundance. The chemical equation for the reaction is as seen below. This is the second reaction we will observe in lab.

Yeast + H_2O_2 => O_2 + yeast proteins + other stuff

The chemistry of Hydrogen peroxide

reactant (1)



Hydrogen peroxide has a chemical formula of H_2O_2. It is commonly used as a disinfectant for minor wounds or as a bleaching agent for getting laundry whites, whiter. However, when used commonly around the house it always found diluted in solution with water, because of its extreme reactivity. In the pure form it is used as an additive for rocket fuels.

Yeast is our other reactant in this experiment

reactant (2)

Yeast, as you may know, are not compounds in a chemical sense, but microorganism. They are small animal-fungi that live and breed. They are of particular importance in the baking and brewing of food or alcohol in kitchens. We will be observing the reactant they have with hydrogen peroxide.

READING COMPREHENSION QUESTIONS

1. What is the common household substance that acetic acid is found in? _____

2. What is a common use for sodium hydrogen carbonate? Describe what it does.

3. Research sodium acetate. Describe one of the many things it is used for.

4. Why is carbonic oxide of particle interest in this experiment?

5. What is dihydrogen monoxide? _____

6. What are two common chemical reactions where H_2O is a product of the reaction?
   _____ &_____

_____

LABORATORY PROCEDURES

Safety – goggles must be worn at all times, **(no exceptions)**

ASSIGN TASKING to individuals within groups.

1. Inventory your group materials: two erlenmeyer flasks 250ml
   two wood splints
   triple beam balance
   graduated cylinder
   chemical reactants listed in formulas above

2. Measure out _____ milliliters of vinegar / measure out _____ grams of baking soda for **flask #1** (Utilize graduated cylinder for vinegar and triple beam balance for baking soda.)

3. Add baking soda to **flask #1**

   _____

4. Measure out _____ milliliters of hydrogen peroxide / measure out _____ grams of yeast for **flask #2** (Utilize graduated cylinder for hydrogen peroxide and triple beam balance for yeast.)

5. Add yeast to **flask #2**
   _____

6. Ignite Bunsen burner – turn down low (being used to ignite splint only)
   After step 7-8 turn off burner once splint is ignited.

7. Add **vinegar** to **flask #1** – swirl the solution (leave it sit to react)

8. Add **hydrogen peroxide** to **flask #2** – swirl the solution (leave it sit to react)

   DO NOT MIX anything that you are not instructed to.
   _____

9. Ignite splint with Bunsen burner. Using caution, lower the splint down into the **flask #1** where the vinegar and baking soda reaction is occurring. DO NOT SUBMERGE IT in liquid.

10. Remove the splint then place the splint with a glowing cinder into **flask #2** with the hydrogen peroxide and yeast reaction. USE EXTREME CAUTION

LABORATORY WRITE-UP

1. In step (7) of the procedure, (our 1st reaction) what compound of interest are we producing? _____

2. Why is it that the flame goes out when the burning splint is placed in flask #1 in step (9)? Explain

   _____
   _____
   _____

3. How is it that the hot ember on the tip of the splint is re-ignited when placed into flask #2 in step (10)? Explain

   _____
   _____
   _____

Review

4. What are the signs that a chemical change has occurred and not just a physical one?
   (HINT) Refer back to the Chem. & Phys. Changes Lab. There are 6, list them.

   _____
   _____
   _____

5. Which chemical signs of change were observed during step (9) of the lab? When and how were they observed? Use the words: **reactant** & **product** in your response.

_____
_____
_____
_____
_____
_____

6. Which chemical signs of change were observed during step (10) of the lab? When and how were they observed? Use the words: **reactant & product** in your response.

_____
_____
_____
_____
_____
_____

Preparatory Assignment - *Making Science Relevant*

Types of Fire Extinguisher and their uses. **Video 1**
https://youtu.be/GjSoxJF3RD4

1. List the types of fire extinguishers:

_____
_____

Extinguisher Use - How to Use a Fire Extinguisher - Safety/Health/Workplace **Video 2**
https://youtu.be/k5HNHUGCFZw

2. Here several fire extinguisher types are demonstrated on actual flame. In lab we will be closely demonstrating the chemical properties in action behind which one of the fire extinguishers demonstrated?
   _____

3. Explain how it works in practice in the video.
   _____
   _____
   _____

4. Now read ahead in the lab (pg1 and the procedures page) and explain how it will work there.
   _____
   _____
   _____

5. What will the reaction produce, that is going to extinguish the flame? _____
6. Where will the reaction take place exactly? *"lab procedure tells you where"* _____

The Self-Expanding Foam System (SEFS) **Video 3 bonus pt.**
https://youtu.be/OxLPvNdv2t4 (watch minutes 2-4) "simply amazing"

7. What are they extinguishing in the film? How are they extinguishing it and with what?
   _____
   _____
   _____
   _____