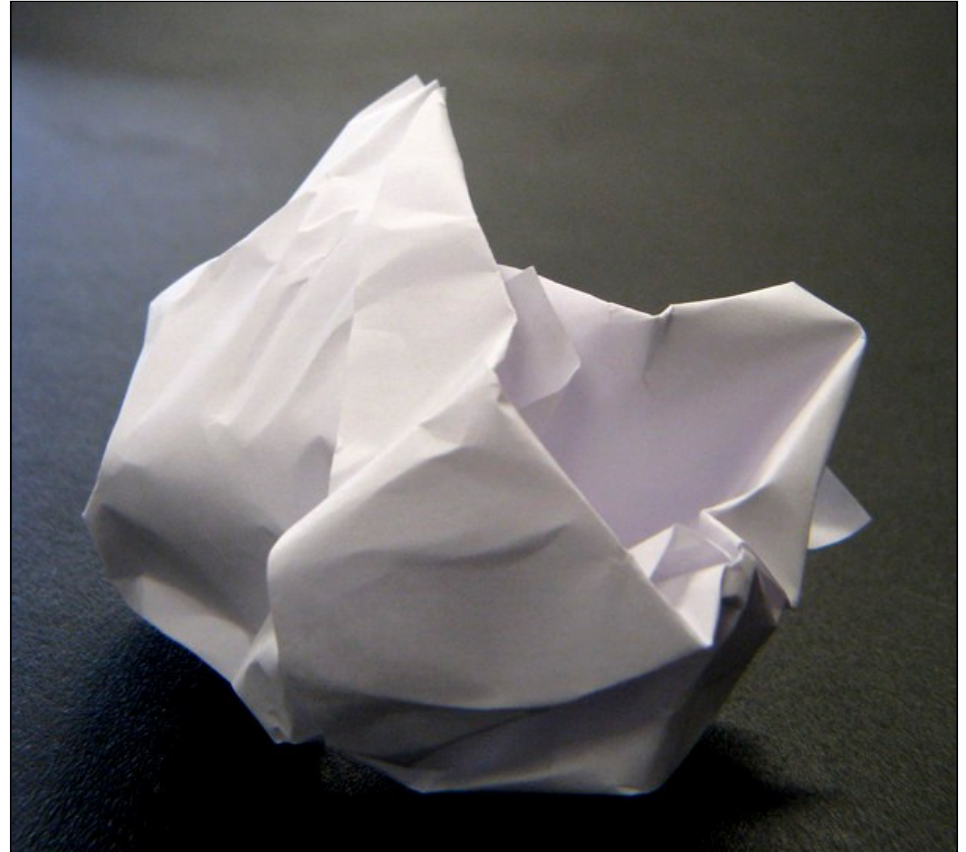


Physical Changes vs Chemical Changes Lab

- What was done?
- What can you observe?
- Is it a physical or chemical change and why?
- What else have you learned during the demonstration?

#1) Crumpling Paper

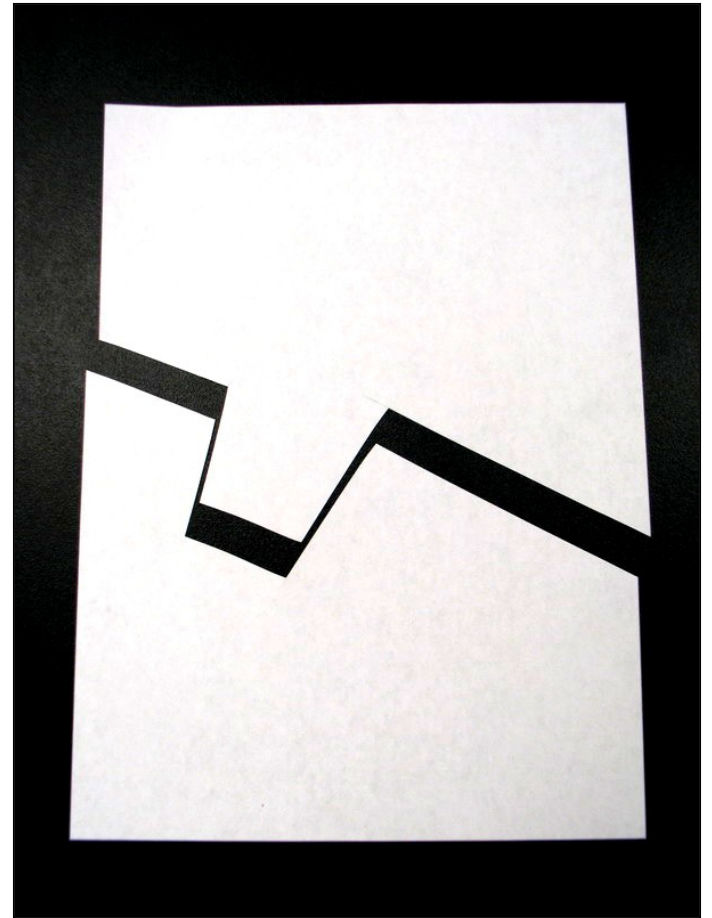
- Notice the creases and folds
- Is it still paper?
- Is this a physical or chemical change?



Crumpling paper does NOT change the nature of the paper. It puts creases and folds in the paper, but does not alter the paper's nature. It's still paper. The shape has changed and there are now creases and wrinkles, but it's still paper.

#2) Cutting Paper

- The paper is cut into two pieces.
- Is it still paper?
- Was this a physical or chemical change?



When you use a pair of scissors to cut paper, you are separating a larger sheet of paper into smaller portions. Are you changing the nature of paper? NO! By creating smaller pieces you are just dividing the paper into smaller sections. You have not altered the nature of paper and the smaller sections do not have different properties.

#3) Red dye in water

- 3 drops of red food coloring are added to water. The dye spreads out to fill the container and does NOT settle out over time.
- It is a physical change IF you can separate the red from the water.



#3 & 4) Adding Food Coloring, Salt, or Sugar to Water

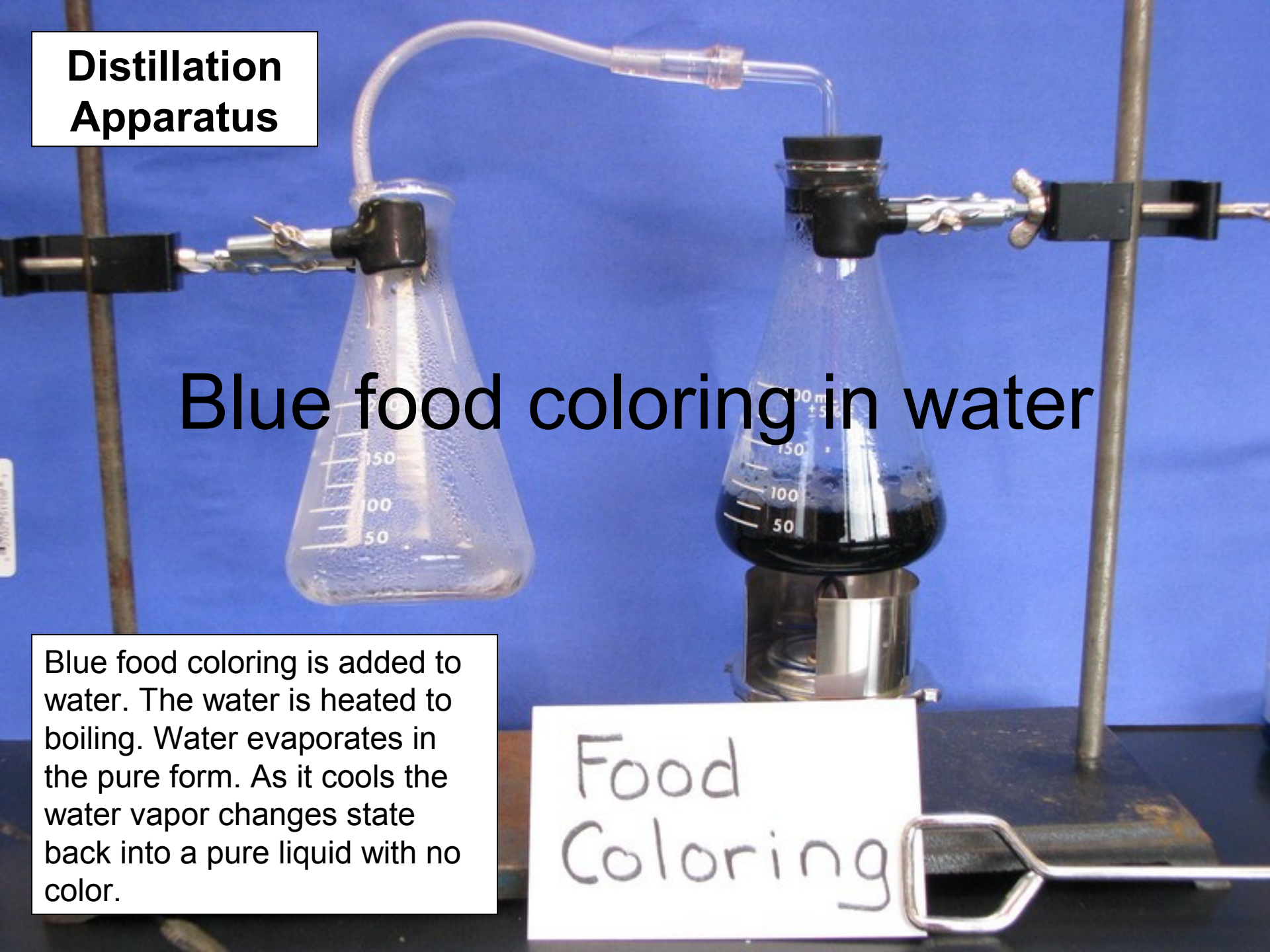
- Water boils at 212°F
- It changes from a liquid into a gas (water vapor). This is called **evaporation**.
- When it cools, it condenses back into a liquid. This is called **condensation**.
- When water evaporates only the H₂O molecule changes state. All other substances stay behind.
- Evaporating and then condensing water in order to purify the water is called **distillation**.

Distillation Apparatus

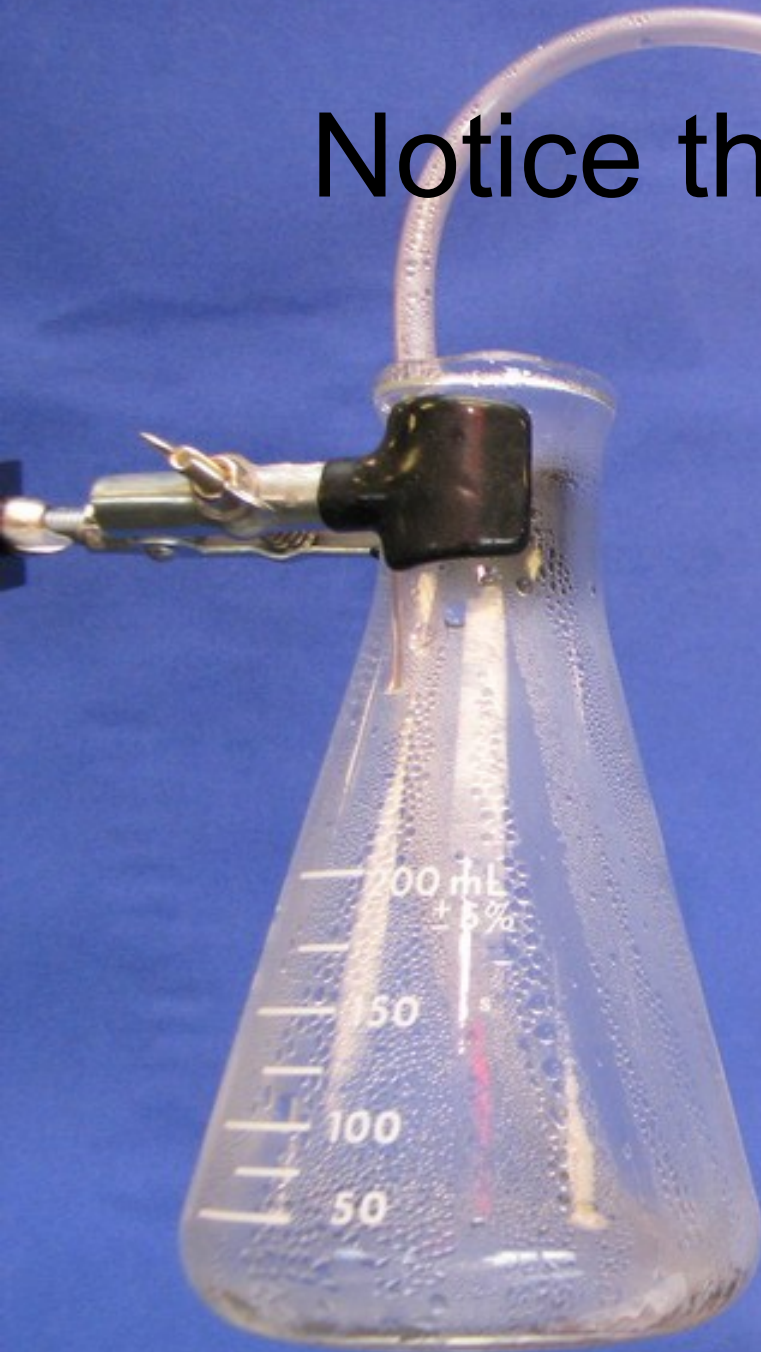
Blue food coloring in water

Blue food coloring is added to water. The water is heated to boiling. Water evaporates in the pure form. As it cools the water vapor changes state back into a pure liquid with no color.

Food
Coloring



Notice the water droplets



Notice that the droplets of water vapor on the sides of the two flasks are clear – no color is transferred in the distillation process.



Salt is added to water. The water is heated to boiling. Water evaporates in the pure form. As it cools the water vapor changes state back into a pure liquid leaving the salt behind.

Salt in water

Distillation Apparatus

When the alcohol burner is removed, why does the distilled water move back through the tubing into the flask on the right?

Salt



Sugar in water

Sugar is added to water. The water is heated to boiling. Water evaporates in the pure form. As it cools the water vapor changes state back into a pure liquid with no taste of sugar.

**Distillation
Apparatus**



Sugar

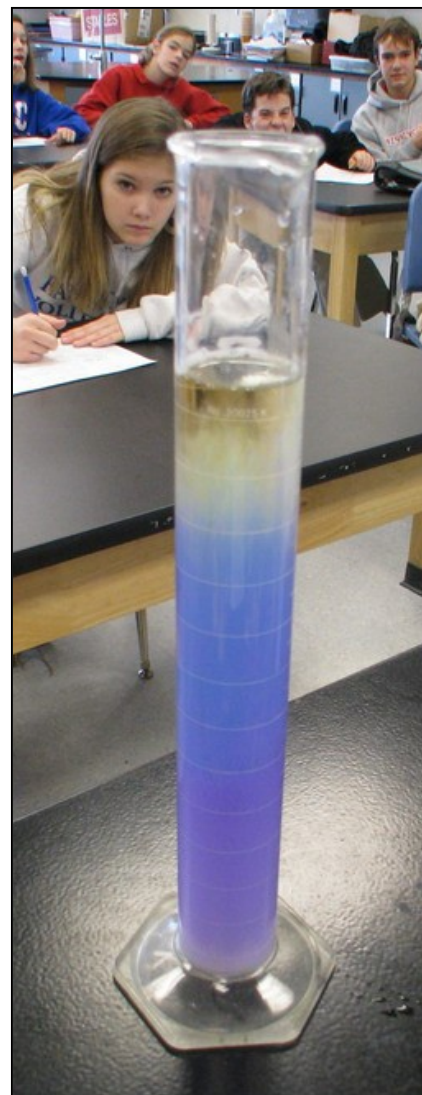
#5) Melting & Hardening Wax

- At room temperature wax is a solid.
- When you light a candle, the wax melts and can be poured like a liquid.
- When the wax cools, it hardens into a solid.
- Is it still wax?

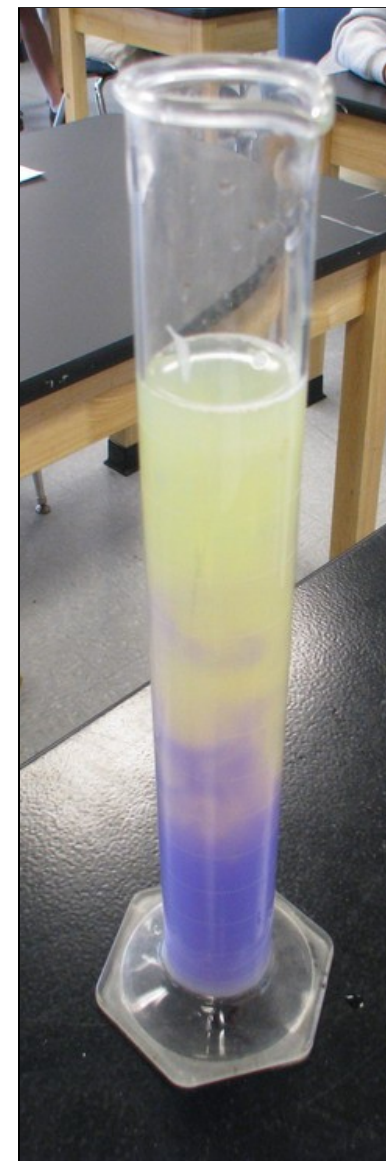


#6) Milk of Magnesia + Vinegar

- Milk of magnesia $\text{Mg}(\text{OH})_2$ is a strong base.
- Vinegar is a weak acid made up of 95% water and 5% acetic acid
- Universal indicator uses color to show the presence of an acid or a base in a solution.
- The vinegar neutralized the base, eventually turning the water clear.
- No base was left. No acid was left. The resulting water had a neutral pH.



#1

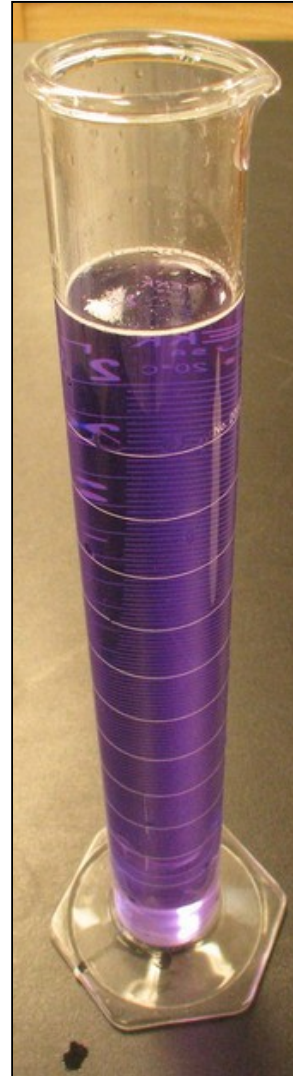


#2

#7) Ammonia +

Alkaseltzer

- Ammonia NH_3 is a strong base.
- Alka-seltzer has aspirin, citric acid, and sodium bicarbonate in it.
- Citric Acid and sodium bicarbonate react chemically and give off CO_2
- The CO_2 is slightly acidic, so putting several alkaseltzer tablets into the water eventually neutralizes the base (Ammonia) until the water turns into a pH of six.
- There are actually two chemical reactions occurring with this demonstration: 1) The citric acid + baking soda; and, 2) the CO_2 neutralizing the ammonia.



#1



#2



#3

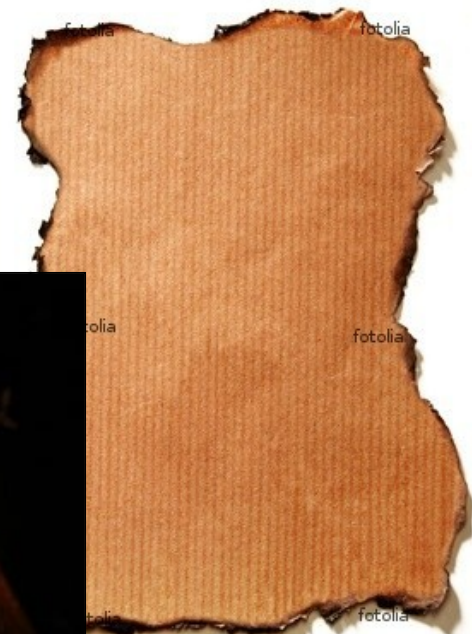
#8) Burning Paper

The ancients thought that FIRE was an element along with Earth, Wind, and Water.



In order for combustion to occur you need a fuel, sufficient heat, and oxygen

Combustion is evidence that a chemical reaction is taking place. Heat is given off (it's exothermic). Light is given off; and, the substance (in this case, paper) is no longer the same. When paper is burned carbon dioxide and water are also produced in the chemical reaction.



Why is Fire not an element?

- Fire does not have an atomic structure with electrons, protons, and neutrons the way elements do.
- Fire can be increased or reduced by managing oxygen content, fuel, or heat.
- It does not exist on its own in nature the way elements do.
- Fire is not found on the Periodic Table.

#9) Candles: Capillary Action

Heat from the flame melts wax below the wick and causes wax to travel UP the wick (capillary action). The wax continues to heat up until it vaporizes and bursts into flame. So, when a candle burns, it is the WAX that is really the fuel!



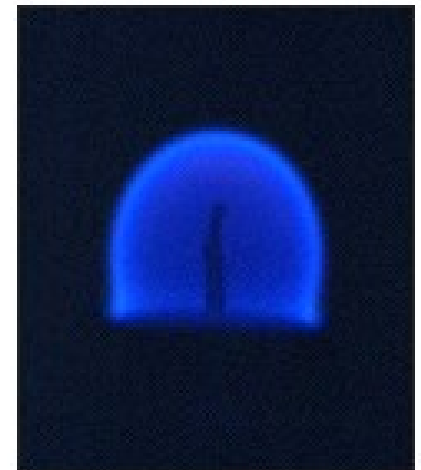
Normal
Flame



Wax
Vapor



Extended
Flame



A candle flame in
microgravity.

Candles: Wax Hardness & Melting Points



By adding Stearic Acid or other additives you can increase the melting point of wax so that the candle will burn more slowly.

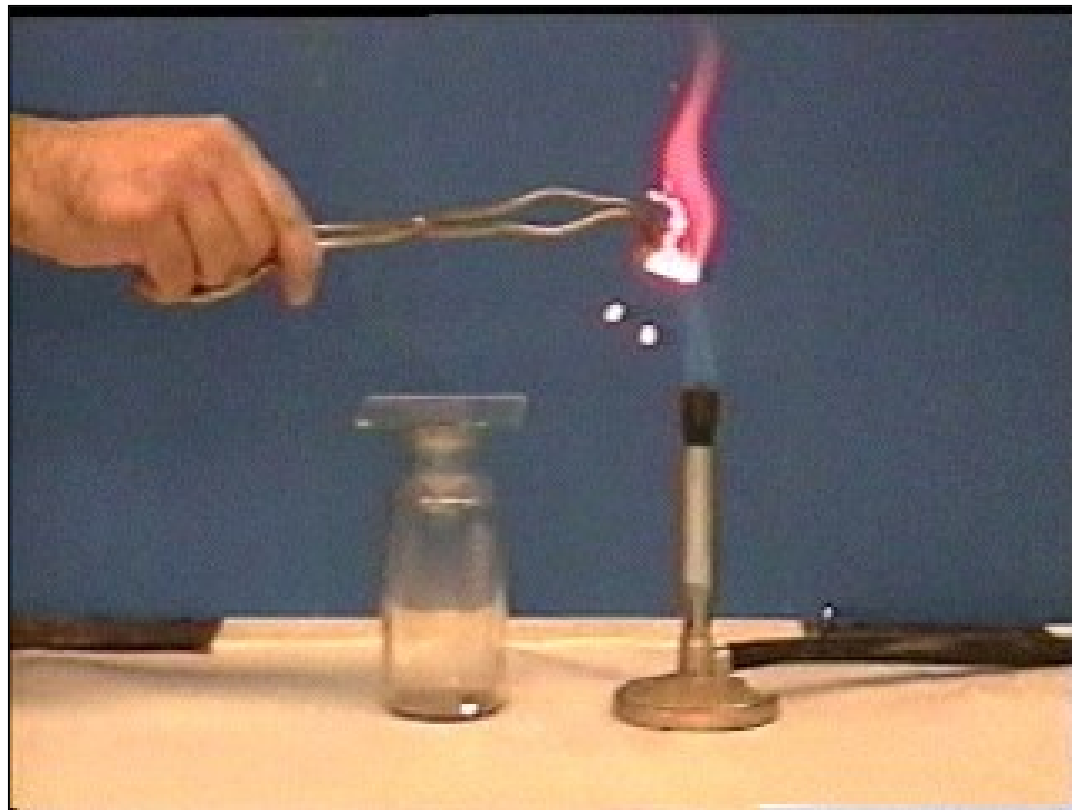


Wax melting points range from 121° F to approximately 160° F

#10) Burning steel wool

Click on the picture to see a YouTube video of how steel wool will burn when flame is placed next to it.

Most substances, even metal (in this case -- steel wool), will burn if the heat source is hot enough.



- [Youtube video](#)

#11) Baking soda + vinegar



Base: Sodium bicarbonate



Acid: 95% water + 5% acetic acid



This is an endothermic reaction (it gets cold!). Carbon dioxide is given off.

$\text{NaHCO}_3 + \text{CH}_3\text{HOOC} \rightarrow$ (yields) $\text{CH}_3\text{COONa} + \text{H}_2\text{O} + \text{CO}_2$
baking soda (a base) + vinegar (an acid) \rightarrow (yields) sodium acetate (a weak acid) + water + carbon dioxide (a gas)

CO₂ Tests

- CO₂ is not flammable.
- CO₂ is colorless and odorless.
- CO₂ is heavier (more dense) than air because we could “pour” the gas.



Baking soda + vinegar are added to the bag.



As soon as the bag is sealed, the two ingredients react producing carbon dioxide. Also, the bag gets cold, meaning it is an endothermic reaction.

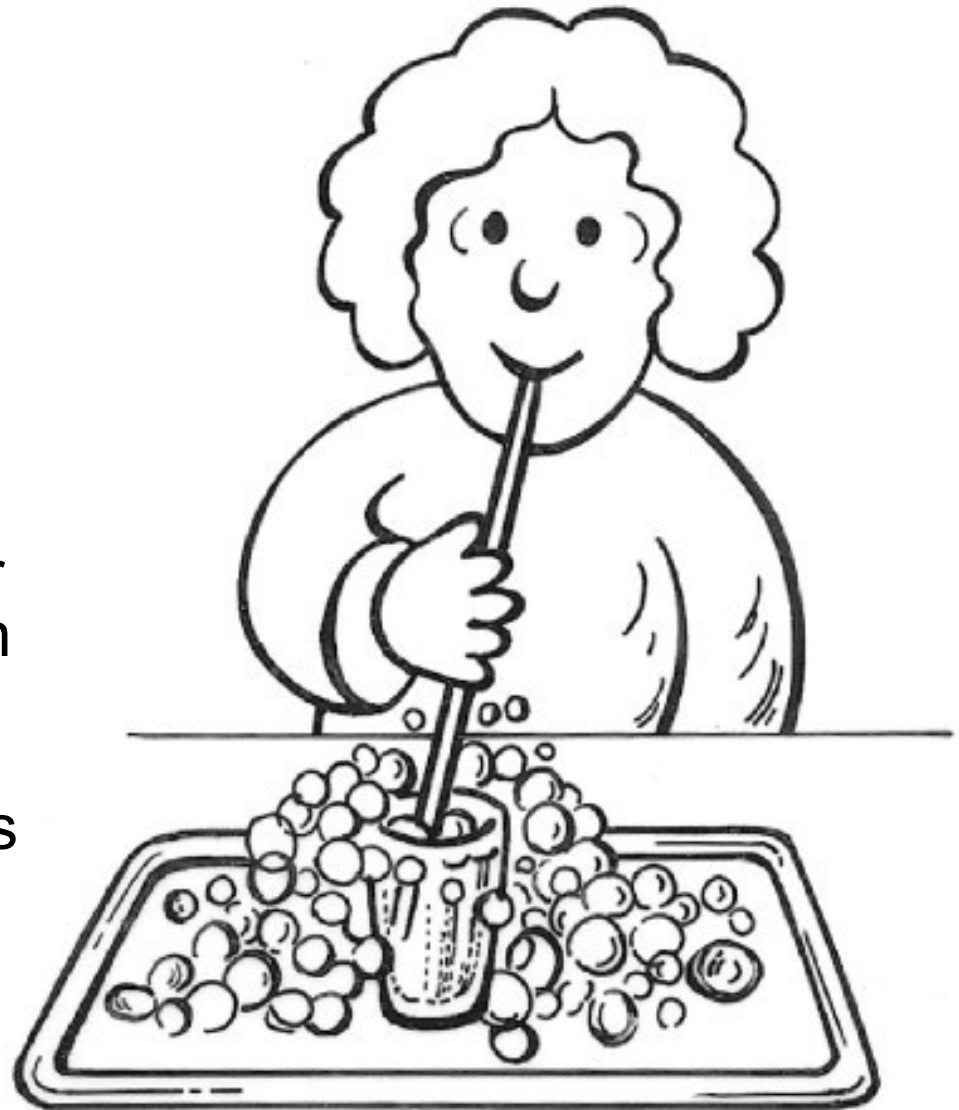


To test flammability, we placed a candle inside the bag. The flame went out proving that CO₂ is non-flammable.

#12) Blowing bubbles

in water

- Not all bubbling indicates a chemical reaction.
- Here, bubbling is not associated with making something new.
- You are just passing air from your lungs through H_2O . This is called a self-extracting mixture. The air bubbles are less dense than water & so they float to the top and pop.



#13) Carbonated soft drink

The carbonation or fizz is actually CO_2 gas put into the bottle under pressure. As long as the top is on the higher pressure causes the CO_2 bubbles to become microscopic in size and spread out through the entire liquid. When you walk down a grocery store isle you don't see the carbonation bubbles because of the effect of pressure on the gas inside the bottle.



When you open the bottle you are changing the pressure, allowing the CO_2 to escape from the high pressure area inside the bottle to a lower pressure area outside the bottle. This is called a **self-extracting mixture**, because it separates all by itself. The bubbles of CO_2 are less dense than water & as the pressure is reduced, they come out of solution, combine to form larger bubbles, and then float to the top and pop.

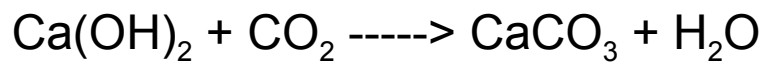
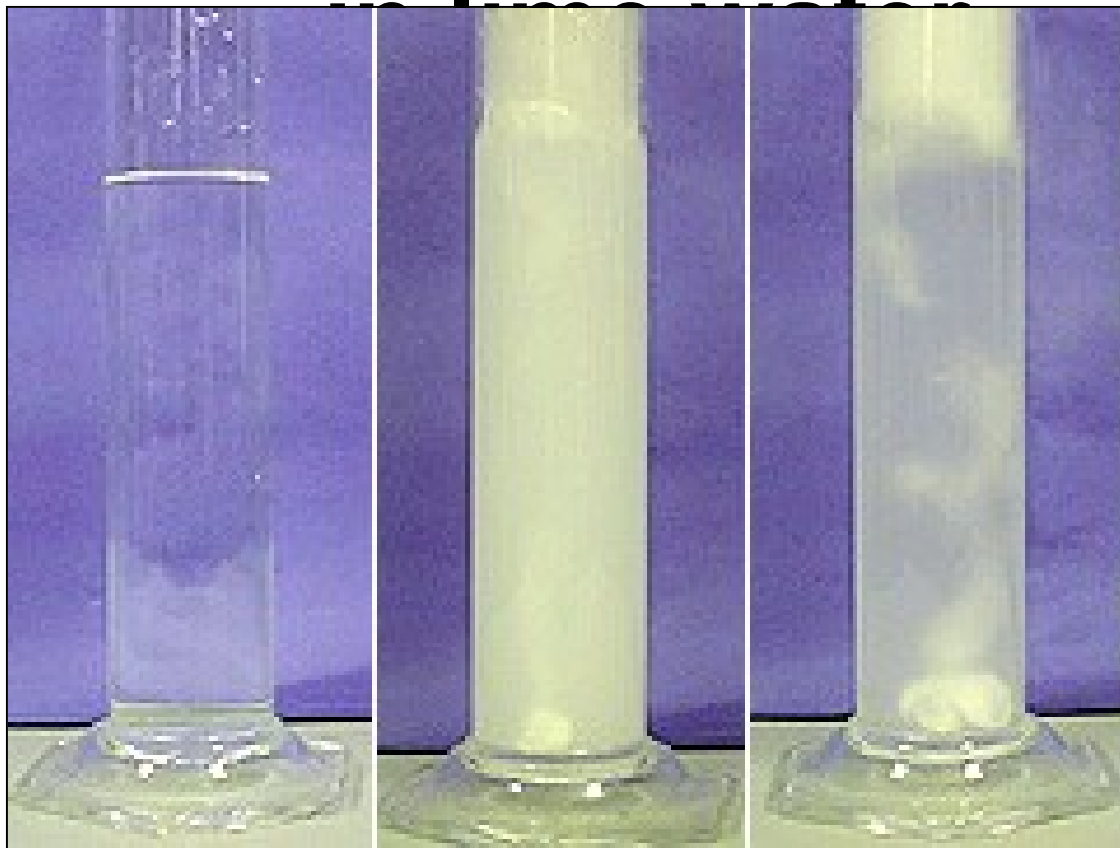


#14) Alka-seltzer in water

- Alka-seltzer has in each tablet:
 - 325 mg Aspirin
 - citric acid
 - sodium bicarbonate
(baking soda)
- When you drop Alka-seltzer into water the powdered citric acid and powdered baking soda combine in a chemical reaction to produce carbon dioxide, a weak acid, and water.
- A gas CO_2 is given off due to the reaction
- $\text{NaHCO}_3 + \text{CH}_3\text{HOOC} \rightarrow$ (yields)
 $\text{CH}_3\text{COONa} + \text{H}_2\text{O} + \text{CO}_2$
- baking soda (a base) + vinegar (an acid) \rightarrow (yields) sodium acetate (a weak acid) + water + carbon dioxide (a gas)



#15) Blowing bubbles



calcium hydroxide + carbon dioxide -> calcium carbonate + water

- Bubbles are blown into lime water causing a chemical reaction.
- A new substance is produced (Calcium Carbonate – CaCO_3 (lime stone) and it falls out to the bottom of the container.
- The substance that falls out of solution is called a precipitate.
- This happens because the CO_2 in your breath combines with the suspended lime to produce calcium carbonate, CaCO_3 as a precipitate.

#16) Elmer's Glue + Borax

- When you add borax to Elmer's glue, you create a long-stringed polymer with cross-links. These cross-links keep the Elmer's glue from flowing and it clumps up, making "silly putty."
- This substance has different properties from the glue or the borax, so a chemical change has occurred.



Vocabulary #1

- **Physical Change** – the object is not changed substantially. Its basic qualities have not changed.
- **Chemical Change** – a new substance has been created
- **Evaporation** – change of a liquid into a gas
- **Condensation** – change of a gas into a liquid
- **Distillation** – process by which water is evaporated and then condensed back into a liquid
- **Mixture** – combination of substances not chemically combined.
- **Solution** – a liquid mixture. Can be homogenous or heterogeneous
- **pH** – a measure of how acid or base a liquid may be

Vocabulary #2

- Universal Indicator – a liquid pH indicator
- Acid – a low pH substance (<7), bitter to taste
- Base – a high pH substance (> 7)
- pH of purple – indicates a strong base
- pH of red – indicates a strong acid
- Self-Extracting Mixture – a mixture that comes apart all by itself (ie, Sprite)
- CO₂ - carbon dioxide; non-flammable, colorless, odorless, denser than air
- Combustion – an exothermic chemical reaction. Release of heat in form of light or flame

Vocabulary #3

- **Precipitate** – a substance that “falls out” of a solution (as in lime water with calcium carbonate)
- **Exothermic** – gets hot; as in combustion
- **Endothermic** – gets cold; as with baking soda and vinegar
- **Capillary Action** – the movement of a liquid up a wick
- **Examples of acids found in this lab:** citric acid (in Alka-seltzer), acetic acid (5% in vinegar), stearic acid (for candles)
- **Chemical formulas:** CO_2 (carbon dioxide), H_2O (water), CaCO_3 (calcium carbonate), NH_3 , (ammonia)

Vocabulary #4

- Neutralize – to wipe out or make it not powerful -- as in an acid/base reaction such as milk of magnesia + vinegar when the vinegar “neutralized” the base and changed the pH from a strong base to neutral pH
- Flammability – whether or not a substance will burn
- Density – mass / volume As in Sprite when the bubbles are less dense than the water and so float to the top.

Summary

- What are some evidences of physical changes?
- What are some clues to chemical changes?