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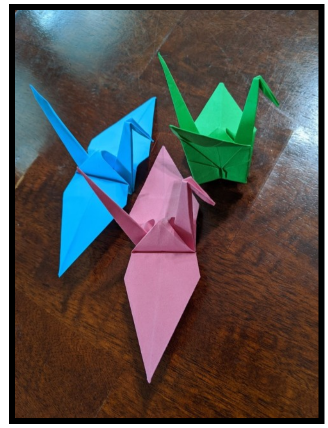


Materials needed:

- One origami sheet OR
  1 square piece of paper (all sides equal)

See the next page for step-by-step images or check out this instructional video of how to fold a paper crane.

Paper Cranes and WWII

According to Japanese legend, a person is granted one wish or good luck if they fold 1000 paper cranes. Cranes, in Japanese culture, are symbols of loyalty and are considered holy creatures thought to live for 1000 years—hence, 1000 paper cranes. When someone falls ill, it is customary to present the ill person with a gift of 1000 cranes as a wish for their recovery.

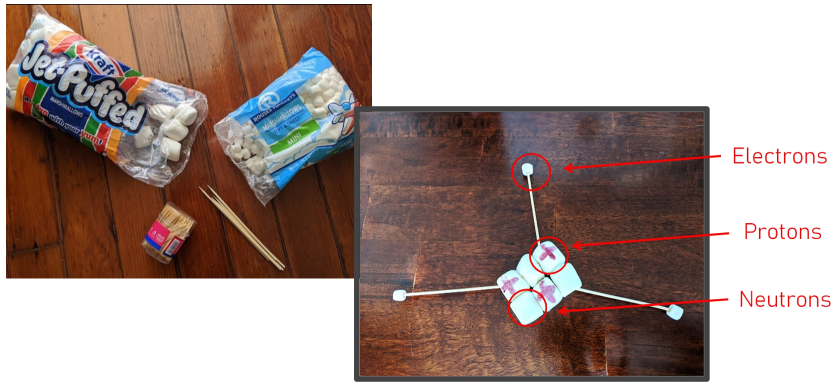
When the US dropped the first atomic bomb on Hiroshima, Japan, a 2 year old girl named Sadako Sasaki was exposed to the radiation. By the time she reached the age of 12, she was diagnosed with leukemia.
Hearing about the legend of the paper cranes, she spent her last year folding 1000 paper cranes in the hopes that she would be granted the wish of recovery. Soon after, she passed away. Her classmates made a promise to each other to honor Sadako's death with a monument. They raised funds to build the Children's Peace Monument, which is located at the Hiroshima Peace Memorial Park. Every year, the anniversary of the bombing of Hiroshima, August 6th, is honored as Annual Peace Day in memory of Sadako.

If you're interested in learning more about the story of Sadako and the legend of the paper cranes, check out these two books on our reading list:

- *The Paper Crane* by Molly Bang
- *Sadako and the Thousand Paper Cranes* by Eleonor Coerr

Materials Needed:

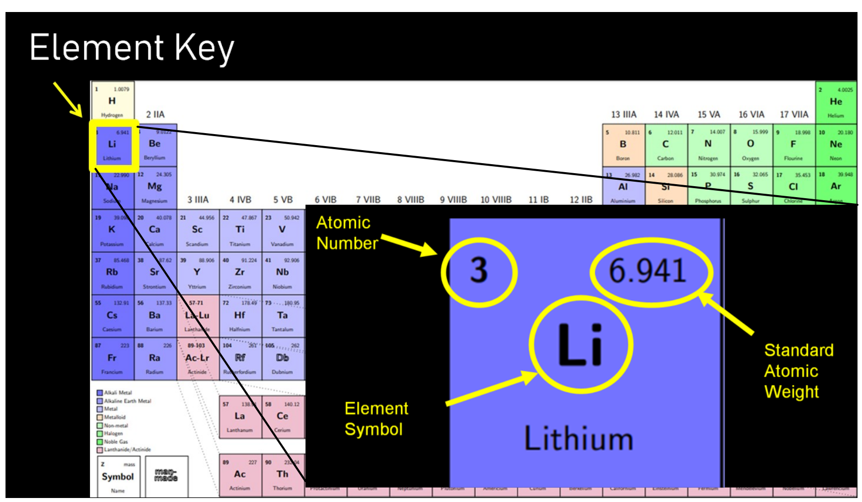
- Toothpicks
- Skewers
- Mini Marshmallows
- White Marshmallows
- Edible dye (like blueberries or food coloring)
- Atom cards (next page)



In these instructions, we will be using the above materials. If you don't have marshmallows, feel free to substitute with fruit (grapes, apples, mangos, etc), cheese (white and orange), vegetables (peppers of different colors, mushrooms, etc) or anything else you have available. You need 3 different items to represent electrons (small), neutrons and protons (the same size but different colors to differentiate) and something to connect them together (like toothpicks and skewers).

Choose the element you would like to make a model of. Look at the element key to find out how many neutrons, protons and electrons you will need. The Atomic Number (the whole number) is how many protons you will need. This is also the equal to the number of electrons your atom will have. To find the neutrons, you will have to look at the Standard Atomic Weight. Round this number off to the nearest whole number and subtract the Atomic Number from it. This will give you the number of neutrons.

Let's look at an example: Lithium's atomic number is 3. That means it will have **3 protons** and **3 electrons**. It's standard atomic weight is 6.941. If we round this to the nearest whole number, we have 7. We subtract the atomic number (3) from 7, and we get 4. This means Lithium will have **4 neutrons**.



Our regular sized marshmallows are our neutrons and protons. Draw a + on the protons with edible dye. Our small marshmallows represent our electrons. Combine the neutrons and protons into a ball with toothpicks to make the nucleus. Attach the electrons with skewers.

Check out this video for more information on subatomic particles!

1 ← *Atomic Number* **H** Hydrogen 1 *Atomic Weight*	2 ← *Atomic Number* **He** Helium 4 *Atomic Weight*
3 ← *Atomic Number* **Li** Lithium 7 *Atomic Weight*	4 ← *Atomic Number* **Be** Berylium 9 *Atomic Weight*
5 ← *Atomic Number* **B** Boron 11 *Atomic Weight*	6 ← *Atomic Number* **C** Carbon 12 *Atomic Weight*

NUCLEUS (center):

- # of Protons = Atomic Number
- # of Neutrons = Atomic Weight ***MINUS*** Atomic Number

OUTER RINGS:

- # of Electrons = Atomic Number

NUCLEUS (center):

- # of Protons = Atomic Number
- # of Neutrons = Atomic Weight ***MINUS*** Atomic Number

OUTER RINGS:

- # of Electrons = Atomic Number

NUCLEUS (center):

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OUTER RINGS:

- # of Electrons = Atomic Number

NUCLEUS (center):

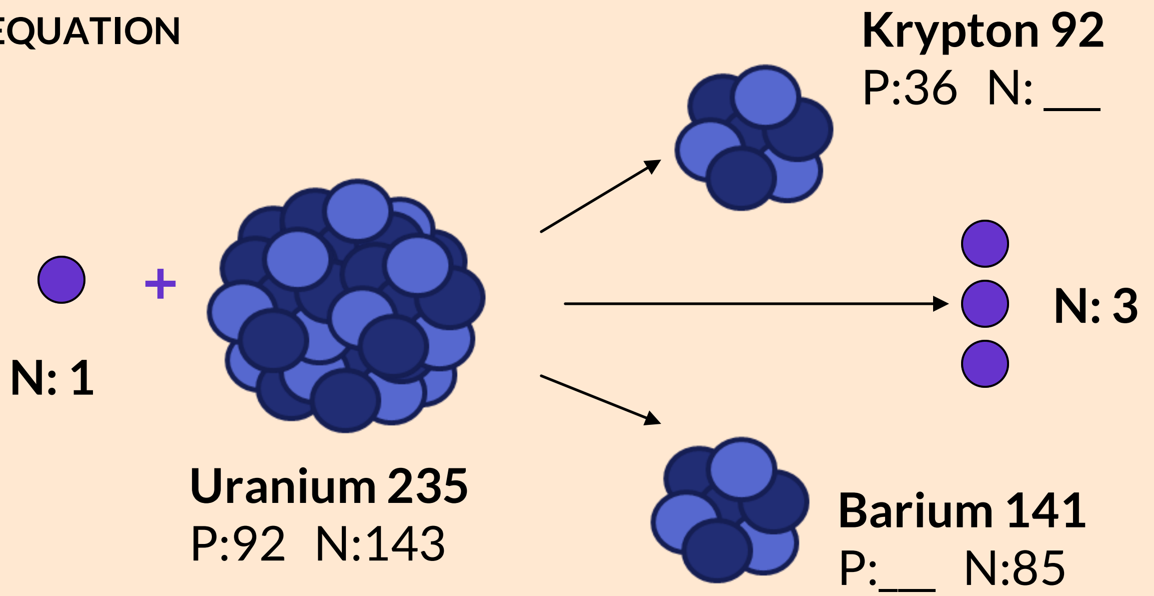
- # of Protons = Atomic Number
- # of Neutrons = Atomic Weight ***MINUS*** Atomic Number

OUTER RINGS:

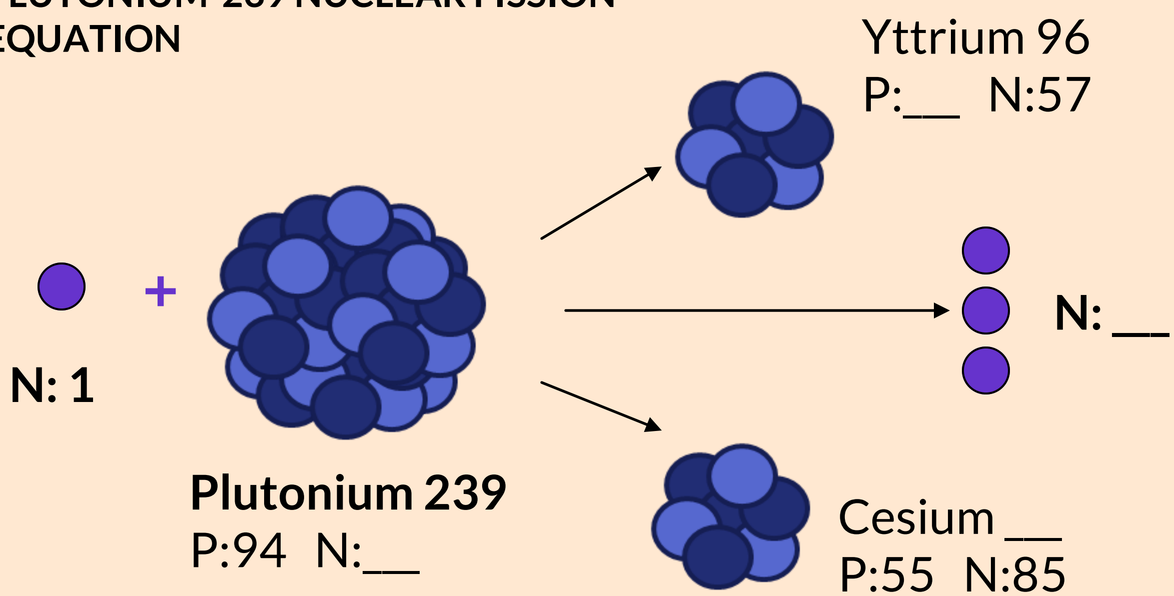
- # of Electrons = Atomic Number

Check out this [video]() to learn about nuclear fission and the Manhattan Project!

URANIUM-235 NUCLEAR FISSION EQUATION

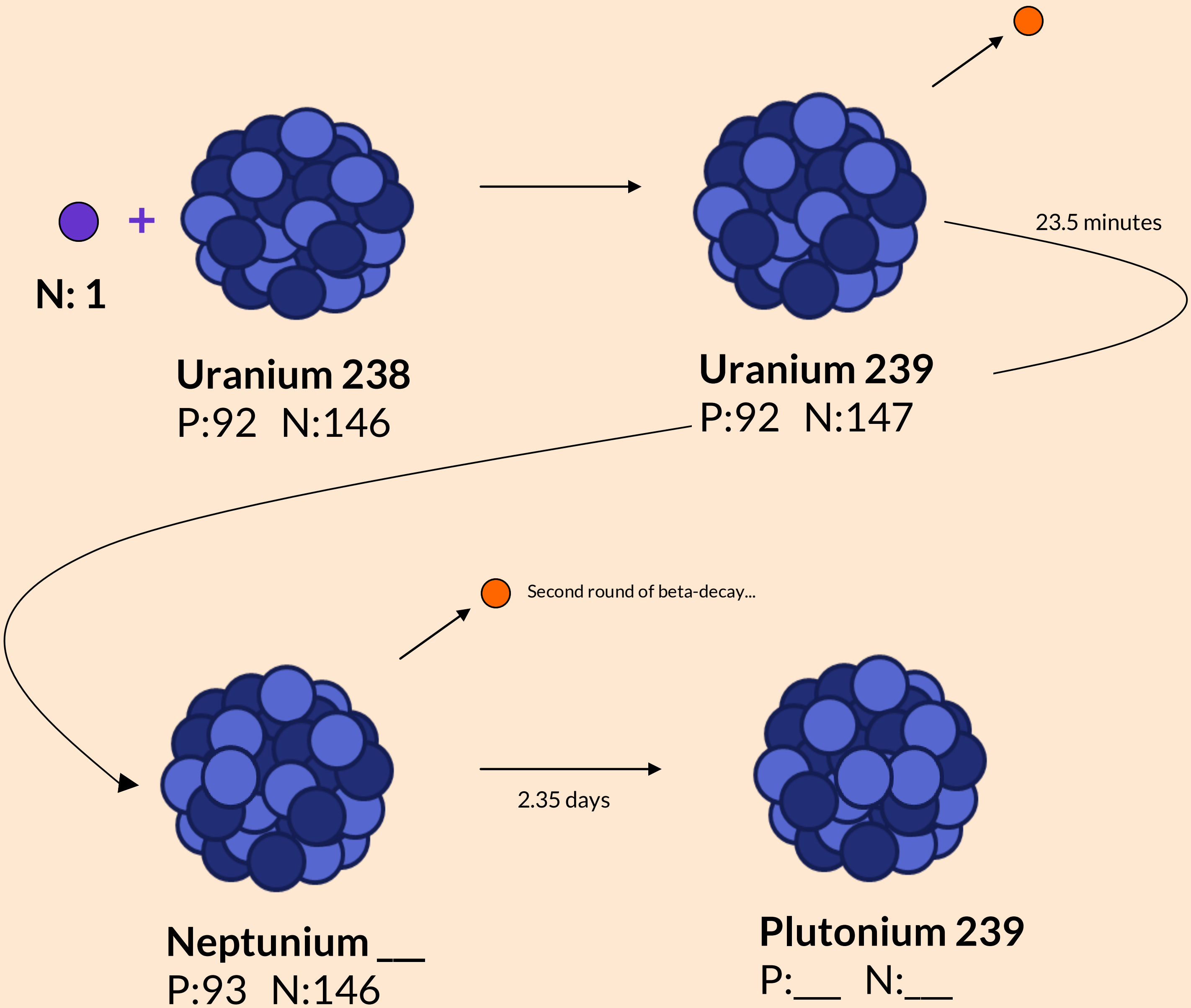


PLUTONIUM-239 NUCLEAR FISSION EQUATION



PLUTONIUM REFINEMENT EQUATION

Within the span of 23.5 minutes, the atom undergoes beta-decay, and a neutron gets broken down into an electron and proton. The electron is discarded. The proton is kept.



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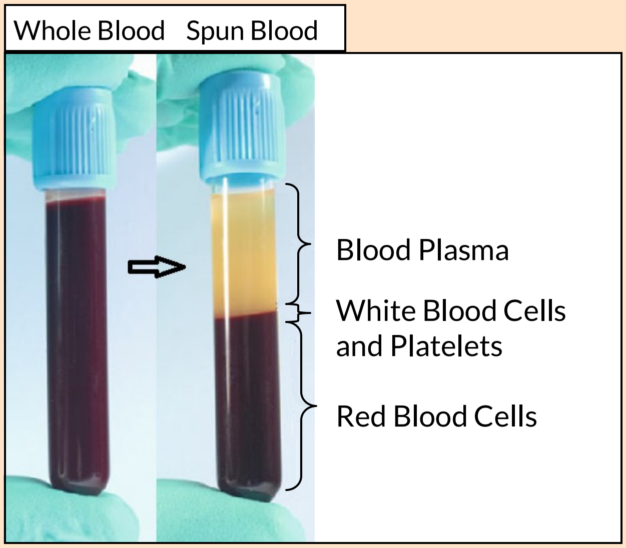

Match the part of the blood with its function:

Red Blood Cells	Fight Infections
White Blood Cells	Clot Blood
Blood Plasma	Carry Oxygen
Platelets	Maintain Volume

Make a model of a blood tube!

Red blood cells make up about 45% of whole blood, while blood plasma makes up the majority of the other 55%. The platelets and white blood cells are so tiny, that they make up less than 1% blood volume. In one drop of blood, there can be up to 10,000 white blood cells and 400,000 platelets.

Using materials you have available, make a model of a vial of blood with each of the four parts in their proper ratios. Use this “formula” as a rough guide:

- Red Blood Cells (small and red items): 30 pieces
- White Blood Cells (white items): 3 pieces
- Platelets (tiny): 30 pieces
- Plasma (some type of liquid): 50 mL

Here are three possible versions for inspiration:

Craft Version: red beads, small white pom poms, glitter and water

Candy Version: hot tamales, small marshmallows, purple sugar sprinkles and soda

Nature Version: [*please use only materials you find on the ground*] Possumhaw berries, clover flowers, live oak pollen or dirt and water

During WWII, field hospitals and medics relied on blood transfusions to save the lives of servicemen. In order to use whole blood, field hospitals would need to have large amounts of each blood type on hand, as well as the capability to refrigerate this blood in order for it to remain usable.

National WWII Museum, 2013.495.1524

Charles Drew was an African-American surgeon who developed a life-saving method of processing and preserving blood plasma so that it could be easily transported in a dried state and reconstituted on the battle field.

Harmon Foundation Collection, NARA, 559199

During WWII, he supervised the "Blood for Britain" program which met the desperate need for blood to treat those wounded during the Blitz—the bombing of British cities by Nazi Germany. To encourage blood donation, Drew first devised the use of bloodmobiles: trucks with refrigerators serving as donation centers.

He served as the head of New York's Red Cross blood bank, until he resigned in protest after a policy was instated that required blood to be separated by race.

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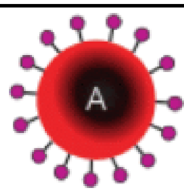
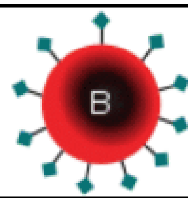
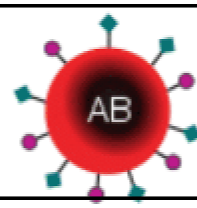
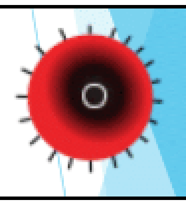
During WWII, soldiers were required to wear dog tags that specified their blood type, in case they needed a blood transfusion. Four major blood types include: A, B, AB, and O. Each one of these types of blood have different surface proteins, which affect their ability to mix well with other blood types.

Blood Type:	A	B	AB	O
Protein Structure				
Can Donate To:	A, AB	B, AB	AB	A, B, AB, O
Can Receive From:	A, O	B, O	A, B, AB, O	O

FOOD DYE TRANSFUSIONS:

Using water, create four "blood types". For type A, add a couple drops of red. For type B, add a couple drops of blue. For type AB, add equal amounts of red and blue to make purple. For type O, leave the water clear. Using small cups or containers found around your house, experiment with mixing blood types (in small amounts). In this experiment, if the blood color **doesn't change**, that means they are **compatible**. Which blood types are compatible with each other and which aren't? Do your findings match the chart?

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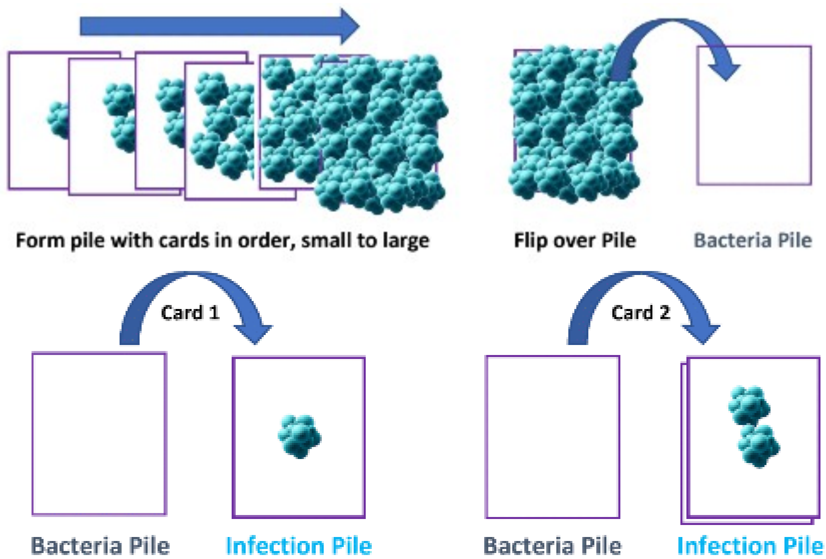
<u>Materials Needed:</u>

- Di (if unavailable, look up DIY template online)
- Set of Bacteria Cards
- Set of Immune System + Penicillin Cards



<u>Object</u>:
In this game, you will be immune system cells inside a patient with a bacterial infection. Each turn, you will try to kill the bacteria. If you roll the correct number, you kill the bacteria. If not, the bacteria multiply. If you get to the end of the Bacteria Card Deck, then the patient dies due to infection. To win and save the patient, kill all the bacteria by removing all of the Bacterial cards from the Infection Pile.

<u>Game Set Up:</u>
Remove the Penicillin. All players should select an Immune Cell card. If your group has more than 3 players, add an additional Neutrophil card. Order the Bacteria Card Deck so that when they are placed face down in a stack, you can flip over the cards and the number of bacteria clusters increases. Some bacteria can be present before the immune system is alerted (or before a patient would begin to see symptoms). Flip over the first 2 cards in the Bacteria Pile to create the Infection Pile.

<u>Game Play:</u>

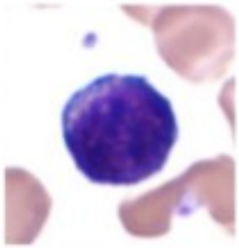
Step 1: The Neutrophils go first, then the Macrophage, then the B Cell. Arrange your seating so that you play in order around the circle.
Step 2: Roll the dice. Follow the instructions on your immune cell card. If you kill the bacteria, pick up the Bacteria Card from the top of the Infection Pile and place is back onto the Bacteria Pile, face down. If you did not kill the bacteria, pick up the top card from the Bacteria Pile and place it face up on the Infection Pile. Play passes to the next player.
Step 3: Keep playing until all of the Bacteria Pile cards have been flipped over into the Infection Pile (and your patient dies) OR until all of the Bacteria Cards have been successfully returned to the Bacteria Pile (and your patient lives!).

Play at least 3 games. Did you win or lose most often? Did it take a long time or was it quick?

<u>Now try the Antibiotic Version</u>

Replace 1 or 2 of the Neutrophils with the Antibiotic Card: Penicillin. Whoever has the Penicillin, goes first, followed by the Neutrophil, Macrophage and B Cell in the same order. Play as above.

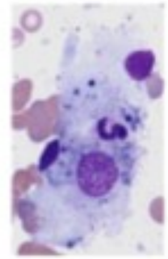
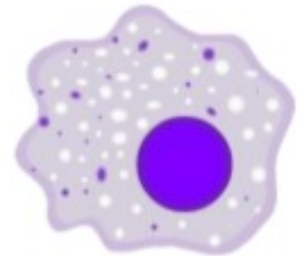
Did you win or lose this time? Was the outcome different than play without Penicillin?




B Cell

Roll Odd: Remove 1 Bacteria Card

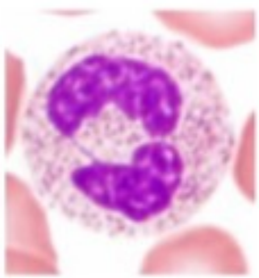
Otherwise: Add 1 Bacteria Card

Macrophage

Roll 3 or 5: Remove 1 Bacteria Card

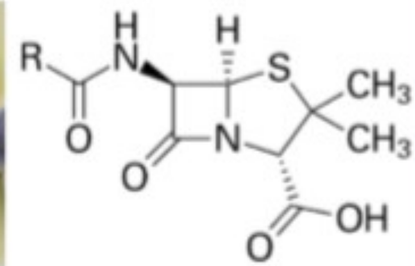
Otherwise: Add 1 Bacteria Card




Neutrophil

Roll 6: Remove 1 Bacteria Card

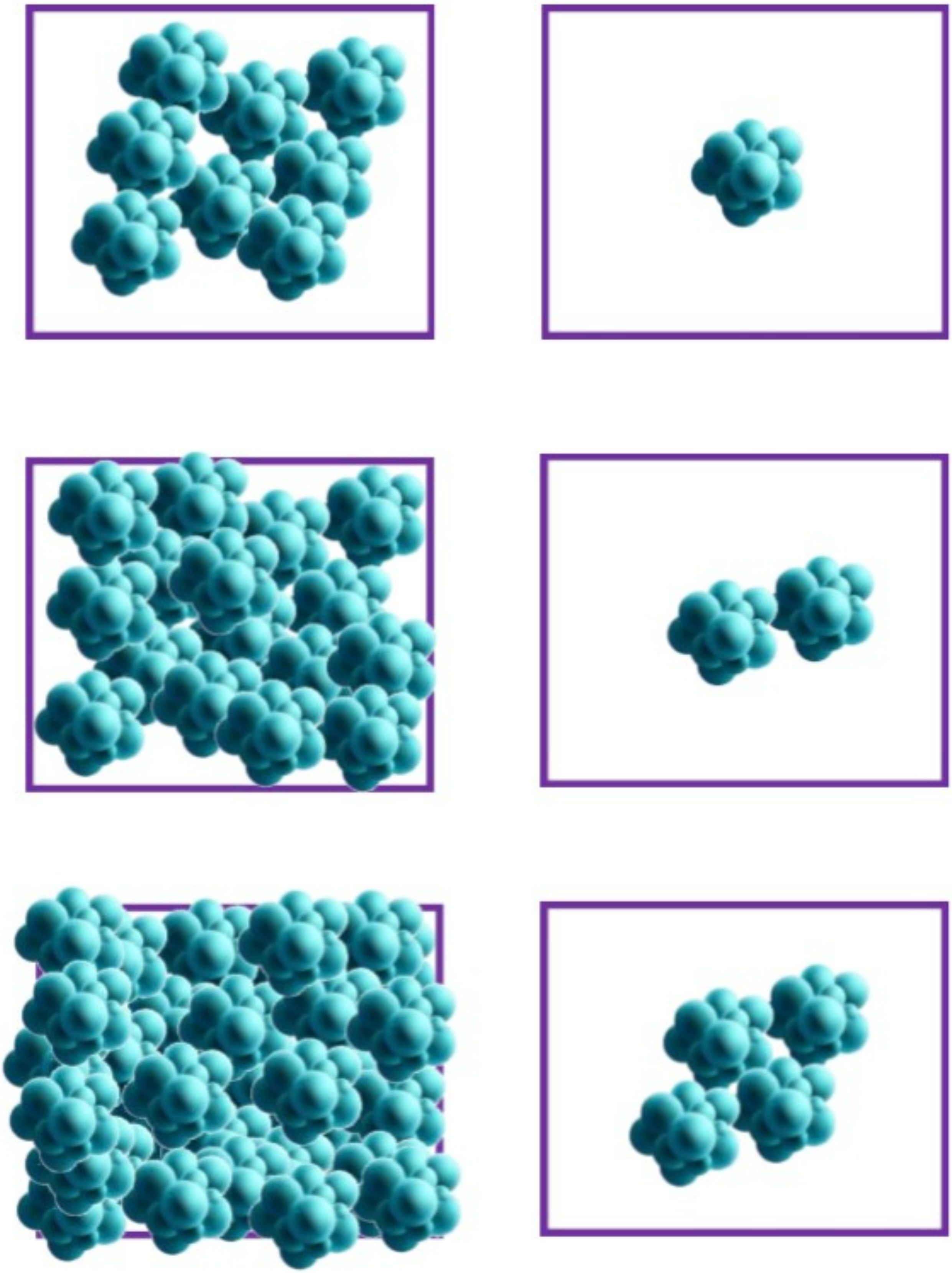
Otherwise: Add 1 Bacteria Card

Penicillin

Roll >1: Remove 1 Bacteria Card

Otherwise: Add 1 Bacteria Card



WORLD WAR II AT HOME

SCIENTIST HIGHLIGHT: MARGARET ROUSSEAU

Ochsner Education Outreach

The immune system has multiple lines of defense against "intruders", like viruses, bacteria and fungi. Our skin is one of our body's most important defenders, which is why we're much more likely to get an infection after a cut or a scrape. Once the intruder has made it past our skin, our body uses specialized white blood cells called neutrophils and microphages to locate and "eat" the intruders. After this, another type of white blood cell called a B Cell helps develop specific "antibodies" to fight off the infection.


US Food and Drug Administration (FDA 123)

Before WWII, even a small scratch could lead to infection and even death. Penicillin was the first antibiotic, or medicine able to kill bacteria. At the time of its discovery, it was considered a miracle drug, but there was still the issue of producing it on a large scale.


Walter P Ruether Library, Wayne State University

Margaret Rousseau was the first American woman to get her PhD in chemical engineering at the Massachusetts Institute of Technology (MIT) and, during WWII, helped oversee the development of the first "deep tank fermentation" plant. Deep-tank fermentation is a method of quickly growing the Penicillium mold in large tanks by feeding it a special kind of sugar and other "food".

In all wars before WWII, more soldiers died off of the battlefield than on it, due to medical complications, disease and infection. After WWII, thanks to antibiotics and other medical advancements, the number of soldiers dying off of the battlefield was able to be greatly lowered.

Cup and Card

Air Pressure Activity

Materials:

- Cup
- Water
- Laminated card, an old index card or a playing card you don't mind getting ruined

Set up your magic trick somewhere that can get wet. Fill up a cup with water. Place your card on top of the cup, making sure that the entire opening of the cup is covered with the card. Flip the cup over, holding onto the card for a few seconds to make sure that the connection between the cup and card is secure. Make sure your cup is not at any angle, just straight upside-down.

Let go of the card. Your card should stay stuck to the opening of the cup, keeping the water inside.

Play around with different cups and amounts of water. What works best?

Air Pressure in WWII

Air pressure was something that many scientists and engineers had to learn to work with during WWII as they made advancements in flight technology. Have you ever flown in an airplane? Why were you able to breathe normally in the airplane, even though you were flying at 30,000 feet in the air? Pressurized air cabins were invented during WWII, which allowed pilots and passengers to breathe normally without the use of oxygen masks.

What does that have to do with my magic trick?

The air around us, whether we notice it or not, is constantly putting pressure on everything around us. The pressure of the air influences how much oxygen we have to breathe. As we move higher up in the sky, the air pressure decreases and the oxygen molecules spread out. There is less oxygen available for us to breathe and we can get very sick. When airplane is pressurized, air is forced inside the plane, like pumping up a tire, so there's enough oxygen to breathe.

In the cup and card activity, the air inside of the cup is pushing out and the air outside the cup is pushing in. At first, both air pressures are equal. But when you turn the cup upside-down, a little bit of water escapes. This increases the amount of space inside the cup and allows the air to spread out more, decreasing the pressure of the air. Because the air pressure inside the cup is now less than the air pressure outside the cup, the air pressure outside the cup is able to push the card against the cup and hold it in place.

Did you notice what happens if you hold the cup at an angle or break the connection between the cup and the card? Air is allowed inside the cup and the trick no longer works.

Friction in WWII

In WWII, tracked tanks were very important. The tracks on vehicles like the tank dig into the sand and give it more traction and friction. Because of this, the tank is able to move through softer material and over rocky terrain. The tracks also help distribute weight the tank over a larger surface area. This keeps the tank from simply sinking into the mud and getting stuck.

Freaky Friction

Friction Activity

Materials:

- Plastic bottle
- Chopstick or long pencil
- Uncooked rice

Take a plastic bottle and fill it with rice. Then, insert a pencil into the bottle. Lift up on the pencil. The pencil just slides right out, right?

Now, take the bottle and tap it against the table so that the rice settles and becomes more tightly packed. Insert the pencil into the bottle of rice. Now pull up on it.

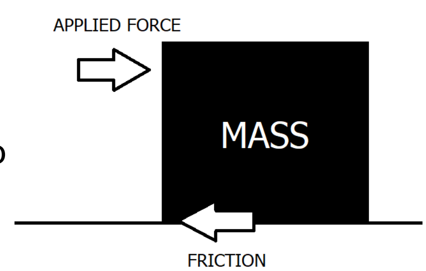
The rice should be so tightly packed against the pencil that the friction will prevent the pencil from coming out of the bottle and allow you to lift the bottle of rice with just the pencil.

What is friction?

Friction is a force between two objects rubbing together. It is the force that slows the movement of two objects sliding against each other.

Many times, such as in flight, people try to design things that reduce friction. Sometimes friction can work for us. We wouldn't be able to walk or drive in a controlled fashion without friction. The friction between your shoes and the ground allow you to stay upright – which is why walking on ice, where there is very little friction, is very difficult.

In the Freaky Friction activity, the chopstick is able to lift to the bottle of rice because of friction. Because the rice is tightly packed in the bottle and the chopstick is inserted, the friction of the grains of rice push against the chopstick and prevent it from sliding out. When the rice is loose in the bottle, the force of the friction is less than the weight of the rice and so the chopstick just slides out.



Secret Sounds

Sound Wave Activity

Materials:

- String
- Large metal utensils

Cut a piece of string about 3 feet in length. Create a loop in the middle of the string and tighten the loop around one end of a metal utensil. Make sure the utensil is completely metal.

Wrap both ends of the string around each of your index fingers and hold the string so that the utensil is swinging freely in the air. Swing the utensil so that it knocks against the edge of the table. Sounds pretty normal, right?

Now, lift the ends of the string to your ears, like you're going to plug your ears. You don't need to shove the string into your ears, just hold them against the opening. Now, lean forward and swing the utensil against the table.

What did you hear this time? You should have heard something more like a church bell or gong vibrating through the string.

Sound Waves

Sound is a vibration that travels in waves through matter that can be heard. The sound is started by something doing something: some mechanical action, like plucking a guitar string or knocking on a door. This action initiates vibrations that travel through a "medium", or matter: a solid, gas or liquid.

The sound waves vibrate the molecules within a medium. Within solids, the molecules are packed very closely together. Because of this, it is easy for these molecules to vibrate against each other and transmit a sound wave. Liquids are less tightly packed, and gases are even less tightly packed. Because of this, sound travels better in water than air, and even better through solids than water or other liquids. The "secret sounds" activity works because the sound is traveling up the string—which is a solid—rather than through the air, transmitting the sound waves much more effectively.

Sound Waves in WWII

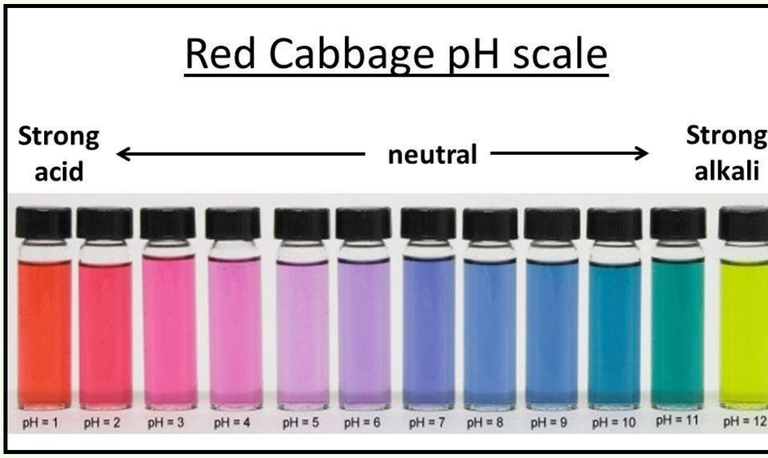
In WWII, both the Allies and the Axis used "acoustic listening devices", which were a pre-radar enemy detection technology. These devices were funnel shaped in order to capture sound waves and direct them into one particular spot, amplifying the sound of approaching aircraft. The crews using the device could then determine speed, direction and range at which the planes or objects were coming.

WORLD WAR II AT HOME

KITCHEN SCIENCE: CABBAGE JUICE PH*

Materials:

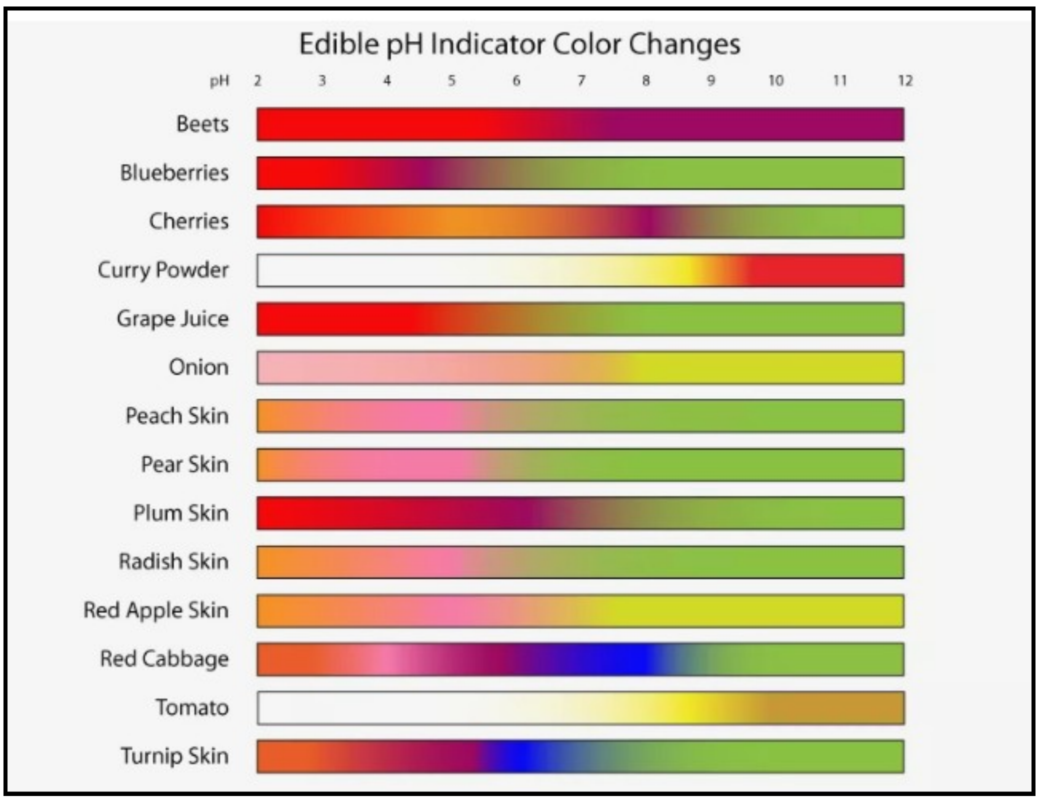
- Red Cabbage
- Household acids, like lemon juice and vinegar
- Household bases, like baking soda and ammonia
- Anything other substances you would like to test!



Preparation:

Boil about 10 cups of water with about half a red cabbage. Let the cabbage boil for about 5 minutes. Allow the liquid to cool. This cabbage juice will keep in the refrigerator as a pH indicator for at least three weeks.

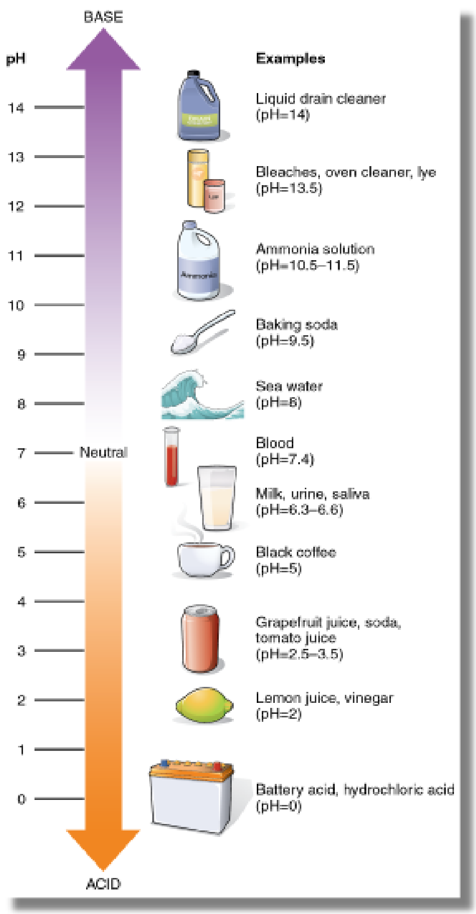
Pour small amounts of the cabbage juice into separate containers. In each container, add a small amount of the liquid or substance you would like to test. What color does the cabbage juice turn? Use the chart above to determine each substance's approximate pH level.



Don't have cabbage? Want to experiment with other natural pH indicators? Use this chart to explore other pH indicators that you may have in your kitchen. Check back with us—did they work? How did they compare to the cabbage juice?

Image Source: Helmenstine, Anne Marie, Ph.D. "Edible pH Indicators Color Chart." ThoughtCo, Feb. 11, 2020, thoughtco.com/edible-ph-indicators-color-chart-603655.

**To be performed with adult supervision in a well-ventilated area. Gloves and eye protection recommended.*



Anatomy & Physiology, Connexions Website. http://cnx.org/content/col11496/1.6/, Jun 19, 2013.

What is pH?

Has eating too much sour candy ever made your mouth sore? Have you ever opened your eyes underwater in a pool and felt the water burn your eyes? In both of these situations, you're experiencing the effects of the pH.

pH is the measure of hydrogen ions in substance. The amount of these hydrogen ions determines whether or not something is "acidic" or "basic/alkaline". pH is measured on a scale of 1-14. The middle of the scale, 7, is neutral. Pure water is a 7. Anything below 7 is acidic, and anything above 7 is basic or alkaline. A 1 and 14 on the scale are equally powerful and corrosive, just in different ways.

Sour candies have acidic ingredients that make them taste sour. These acids can start to break down parts of your mouth and cause it to become sore. Our eyes are close to neutral, so exposure anything above or below neutral can cause them to

Why does pH matter?

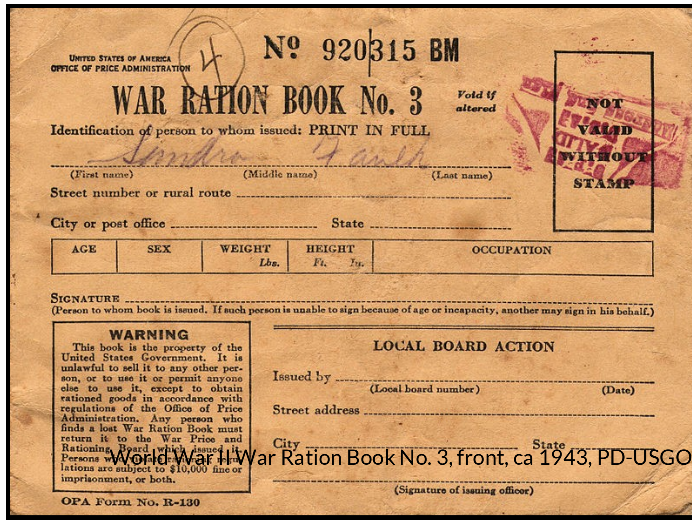
Boston Public Library, 07_01_000030

pH is important in many aspects of daily life. Whenever you bake, the pH of different ingredients affect how they will interact together. pH affects whether or not your cake will turn out fluffy or flat. pH is used in almost every discipline of science, including water purification and food preservation.

During WWII, the general public was encouraged to can goods to help deal with rationing and food shortages. Knowing the pH of different foods helps determine the safest way to can these goods, to avoid bad bacteria growth.

Overseas, in South-east Asia, soldiers used water purification tablets called Halazone. The main ingredient in these tablets is *hypochlorous acid*, a strong acid that kills or neutralizes harmful things in drinking water.

Rationing During the War


UNITED STATES OF AMERICA
OFFICE OF PRICE ADMINISTRATION
Nº 920315 BM
WAR RATION BOOK No. 3
Void if altered
Identification of person to whom issued: PRINT IN FULL
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SIGNATURE
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Street address
City State
(Signature of issuing officer)
NOT VALID WITHOUT STAMP

World War II War Ration Book No. 3, front, ca 1943, PD-USGOV

Families had to be resourceful during the war. On the Home Front, there was food rationing, including milk and butter. During the early 1940s, each adult was allowed 2oz of butter and 3 pints of milk per week. In this set of activities, we will learn how to turn milk into other things like butter and ice cream.

Physical Change

Physical changes affect the physical form a substance takes. Physical changes can affect characteristics like color, texture, size, volume, density and durability. A physical change could be boiling water into water vapor.

In these activities, heavy whipping cream undergoes a physical change into butter or ice cream. As you shake your whipping cream, you are separating out the fat molecules, that begin to clump together to form a solid.

In the Ice Cream activity, it’s not just the shaking that assists in this physical change—the cold of the ice causes the liquid cream to freeze into a more solid state.

SHAKE YOUR OWN BUTTER

Materials:

- Whipping Cream
- Glass Jar
- Cinnamon (optional)
- Minced Garlic (optional)


NCI Visuals Online

Instructions:

1. Fill your jar 3/4 full with whipping cream.
2. Choose what type of butter you would like to make: plain butter, cinnamon butter or garlic butter.

-Plain Butter: Move on to step 3.

-Cinnamon Butter: Add 1 Tablespoon of cinnamon to your milk and mix well. Move on to step 3.

-Garlic Butter: Add 1 Tablespoon of minced garlic to your milk and mix well. Move on to step 3.

1. Shake your jar until it has formed a solid (about 10 minutes). Along the way, your whipping cream will turn into whipped cream before it turns into butter! Stop here and have a taste. Continue shaking until you have butter.
2. Try out your butter on toast or crackers!

ICE CREAM IN A BAG

Materials:

- 1 cup Half and Half
- 2 tbsp granulated sugar
- ½ tsp vanilla
- 3 cups ice
- 1/3 c kosher salt
- Gallon ziplock
- Quart ziplock
- Gloves

Instructions:

1. In a small re-sealable plastic bag, combine half-and-half, sugar, and vanilla. Push out all excess air and seal.
2. Into a large re-sealable plastic bag, combine ice and salt. Place small bag inside the bigger bag and shake vigorously, 7 to 10 minutes, until ice cream has hardened. The bag will get very cold so the gloves will protect your hands from freezing.
3. Remove your ice cream from the bag. Add toppings and enjoy!

Variation: Try adding cocoa powder for chocolate ice cream.