PROJECT CHALLENGE

SCIENCE SECRETS

of

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What is the name of the 5-step plan that scientists use to answer questions?

What is the name of the first step?

What is a Hypothesis?

Why do water molecules like to stick together?

Science Secrets

Week One:

Monday: The Scientific Method, Microbes in Dead Leaves – part 1

Tuesday: The Hunt for Bacteria – part 1

Wednesday: The Purple Play-Dough

Thursday: Sprouting Beans – part 1

Friday: The Hunt for Bacteria – part 2

Week Two:

Monday: Water Drop Races – water molecules love each other!

Tuesday: Traveling Water – Separating Colors, Thirsty Celery

Wednesday: Blobber – part 1

Thursday: Volcanoes outside!!

Friday: Microscopes:
- Microbes in Dead Leaves – part 2
- Cheek Cells and Onion Cells
- Blood Cells – Three Jobs!

Week Three:

Monday: Blobber – part 2: Experiments with the Recipe

Tuesday: Liquid Density Necklace

Wednesday: Milk Art, Advanced Water drop races, Beans – part 2

Thursday: More with Microscopes – potatoes?

Friday: MAKING ICE CREAM!!!

Monday, July 12, 1999

What is a **scientist**? A **scientist** is a person who:

- is curious
- always wonders who, what, when, where, why, how
- likes to solve puzzles
- likes to explore, to invent
- likes adventures
- likes to figure out how things work

Types of Scientists:

Zoologist – studies animals

Botanist – studies plants

Microbiologist – studies microscopic life (microbes, germs, bacteria, viruses)

Entomologist – studies bugs, insects

Paleontologist – studies dinosaur bones

Astronomer – studies stars

Chemist – studies chemical reactions

Forensic Scientist – studies crime scenes for clues

Immunologist – studies how people fight disease

How do scientists answer questions?
How do scientists figure things out?

First the scientist decides what he wants to figure out. The scientist is curious about something. He has a question. Then he makes a plan to help him answer the question. Scientists all over the world use the same method to solve problems and answer questions. They use **The Scientific Method**.

The **Scientific Method** is a **plan** that has five steps:

1. Hypothesis:	What I think will happen. My BEST GUESS about what the results of my experiment will be.
2. Materials:	What do I need for my experiment?
3. Procedure:	What will I do to prove it? What will my experiment be?
4. Results:	What happened?
5. Conclusion:	Was my hypothesis right or wrong?

<u>Example of the Scientific Method in Action</u>

Question: What do plants need to grow?

The Scientific Method for answering this question:

1. **<u>Hypothesis</u>** (best guess): Plants do <u>not</u> need water to grow.

2. **<u>Materials</u>**: Soil, 2 plants, water

3. **<u>Procedure</u>**: Give one plant water for two weeks.
   Give the other plant no water for 2 weeks.

4. **<u>Results</u>**: The plant with water grew.
   The plant with no water died.

5. **<u>Conclusion</u>**: My hypothesis was wrong.
   These plants needed water to grow.

Small Things

What is the smallest thing you have ever seen with your own eyes?

- ant
- grain of sand
- dust
- tick

What is a **microbe**?

Microbes are living things that are so small we can only see them with a microscope.

Examples of microbes are:

- bacteria
- virus

Experiment 1

Question: Do any microbes live in dead leaves and grass?

The Scientific Method:

1. Hypothesis:

2. Materials: Bowl with lid, dead leaves, dead grass, twigs, bark, water, microscope, microscope slides, dropper

3. Procedure: Fill bowl with dead leaves, bark, twigs, grass, acorns. Fill with water. Seal bowl water-tight lid. Wait 7 – 10 days. Look at drops of water under microscope.

4. Results: Draw what you see through microscope:

Experiment 2: Going on a hunt for bacteria.

Question: Where do we find the most bacteria?

The Scientific Method:

1. Hypothesis: The most bacteria are on ____________.

2. Materials: Cotton swab to collect samples
   Agar plate (food for bacteria)

3. Procedure: Choose many locations where there might be bacteria (trash can, floor, counter, ear, throat, nose, sponge, dirt)
   Swab the area.
   Wipe the swab on the agar plate.
   Wait 2 or 3 days to see if bacteria grow.

4. Results: The agar plate is food for bacteria. If there is bacteria, it will eat this food and multiply. Two bacteria will become four. Four will become eight. After a few days, there may be millions of bacteria all together in a little circle. We call this little circle a **colony** of bacteria. Even though we can't see one bacteria by itself, we can see a colony of bacteria. Count how many colonies of bacteria you see on each agar plate. Look at what color the colonies are. Are the colonies shiny or fuzzy? Different types of bacteria make different colonies. Draw what you see. Which agar plate has the most colonies?

The Hunt for Bacteria

Period One:

	Plate One	Plate Two	
Katherine	bathroom floor	bottom of shoe	
Doug	dirt	green marker	
Myles	hallway floor	table top	
Jeffrey	floor	fire extinguisher	
Brian	throat	inside nose	
Chris	door handle	computer mouse	
Garrett	wall	inside of cheek	
Ryan	under chair	wet sponge	
Miss Camp	light switch	inside ear	
Extra	toilet	tap water	yogurt

Period Two:

	Plate One	Plate Two	Plate Three
Ryan	hallway floor	front door	
Travis	computer	tongue	
Daniel	chair seat	inside of cheek	
Scott	inside table	door handle	
Kelly	table top	Kelly's leg	
Chris	dirt	fire extinguisher	
Emily	bathroom floor	trash can	inside nose
Robert	floor	dry erase board	
Michael	throat	inside ear	
Harrison	globe	wet sponge	
Kyle	sink	counter by sink	soap dispenser
Zachary			
Miss Camp	light switch	ear	
Extra	toilet	tap water	yogurt

Growing Bacteria

______________________________ ______________________________

______________________________ ______________________________

Conclusion: ____

Results of our Hunt for Bacteria

How Much Bacteria? (after 2-3 days at room temperature)

	A Lot	A Little	None (0-5 colonies)
class 2			
	inside cheek	chair seat	dry erase board
	throat	floor	inside ear
	wet sponge	globe	soap dispenser
	dirt	fire extinguisher	front door
	sink	counter	light switch
	nose	table top	tap water
	hallway floor	Kelly's leg	
	tongue	trash can	
	toilet	computer	
		bathroom floor	
		ear	
class 1			
	bottom of shoe	bathroom floor	door handle
	wet sponge	hallway floor	green marker
	under chair	table top	wall
	dirt	computer mouse	fire extinguisher
	throat	floor	tap water
	nose	ear	
	inside cheek		
	toilet		
what is in common?	wet, damp	dry	dry (except water)

Conclusion to our Hunt for Bacteria:

A lot of bacteria grew in the wet, damp areas. Not as much bacteria grew in most of the dry areas. Bacteria like wet and damp places. The reason there is no bacteria in the tap water is because bacteria is filtered out of drinking water. Our bodies have lots of GOOD bacteria which help us. The GOOD bacteria help us to digest our food. There are bacteria in our noses and throats which are GOOD!

Some interesting notes about this experiment:

1. Bacteria which grew on the agar plates after 2 or 3 days are not important. We can't make conclusions about them. They could be from contamination.

2. It is very important how we take the sample. We tried hard to keep our samples from being contaminated. We know that if we dropped the cotton swab on the floor before we took a sample from the table top, we wouldn't be able to make a conclusion. We wouldn't know whether the bacteria came from the table top or from the floor!

3. Not all of the colonies look the same. Some are white. Some are black. Some are shiny. Some are furry. Some are small. Some are big. Some ate right through the agar so we could see through the plate! The reason the colonies look different is that they are different kinds of bacteria. We found many different kinds of bacteria.

4. When there is a LOT of bacteria on the plate, the colonies are smaller because they don't have as much room. (When a neighborhood is crowded with houses, each house may only have room for a small yard!) When there is only a few colonies of bacteria on the plate, they have room to spread out and be bigger. (When a neighborhood only has a few houses, there is room for the yards to be bigger!)

Wednesday, July 14, 1999 **Experiment 3: Purple Play-dough**

Question: How can we make play-dough purple?

The Scientific Method:

1. **Hypothesis**: I think that the best purple play-dough will come from mixing the following food coloring:

________drops blue		________drops blue
________drops red	**OR**	________drops red
________drops green		________drops green
________drops yellow		________drops yellow

2. **Materials**: 1 ½ cups flour
   ½ cup salt
   ½ cup water
   ¼ cup vegetable oil
   food coloring: red, blue, yellow, green
   bowl and stirring spoon

3. **Procedure**:
   1. Mix the flour and salt together in a bowl.
   2. Slowly add the water and oil.
   3. Choose two different combinations of food coloring (ideas: red, red/yellow, green/blue, yellow/red/blue, blue, yellow/red, red/blue). Decide how many drops of each color you will use!
   4. Divide the dough in half. Add a different combination of food coloring to each.
   5. Knead the dough well. Shape into several balls.

4. **Results**: Which ball of dough looks closest to purple?
   What combination of food coloring made this color?
   What other colors did you make? How?

5. **Conclusion**: Is my hypothesis right or wrong? How many drops of each color made the best purple?

Purple Play-dough

period 1

Team	Hypothesis (best guess)	Second try
Boston Red Sox (BoSox) (Ryan, Garrett)	5 drops green 4 drops red 6 drops yellow 3 drops blue	3 drops red 4 drops blue 7 drops yellow
Team USA (Doug, Brian)	1 drop green 3 drops red 6 drops yellow 2 drops blue	1 drop green 8 drops red 6 drops blue
Lavender Town (Jeffrey, Myles)	1 drop blue 1 drop red	1 drop green 1 drop red 1 drop blue
Team Marlborough (Katherine, Chris)	4 drops blue 3 drops red 2 drops yellow 1 drop green	14 drops red 9 drops blue 2 drops yellow 1 drop green

Purple Play-dough

period 2

Team	Hypothesis (best guess)	Second try
The Superstars (Emily, Daniel)	4 drops blue 4 drops red	10 drops blue 10 drops red
The Gyrados (Harrison, Kyle)	10 drops red 10 drops blue	5 drops red 5 drops blue
The Targets (Michael, Robert)	3 drops blue 3 drops red	10 drops blue 10 drops green
The Zapdos (Ryan, Trav)	1 drop yellow 1 drop green 2 drops blue	1 drop rred 1 drop blue 1 drop green
The Parrots (Kelly, Miss Camp)	10 drops red 10 drops blue	4 drops blue 3 drops red 1 drop yellow
The Cardinals (Chris, Scott)	15 drops blue 15 drops red	10 drops blue 10 drops red

<u>Conclusion to the Purple Play-Dough</u>

The Winners of the **Best Purple color** are:

Class 1: Team USA (Brian and Doug)

Recipe: 6 drops blue
8 drops red
1 drop green

Class 2: The Superstars (Emily and Daniel):

Recipe: 10 drops blue
10 drops red

ANOTHER RECIPE FOR PLAY-DOUGH

The recipe we used for play-dough didn't work very well. The play-dough was too sticky. Here's a different recipe for play-dough that the Cooking Teacher says is great!

What you need:

1 cup flour
1 cup water
$\frac{1}{2}$ cup salt
2 teaspoons Cream of Tartar
2 Tablespoons vegetable oil
Food coloring

What you do:

1. Mix all the ingredients together in a pot.

2. Cook over low heat until thick. Keep stirring.

3. Take dough out of pot. Knead the dough until it becomes soft.

4. Store in a air-tight container. Have fun!

Thursday, July 15, 1999 **Experiment 4: Sprouting Beans**

Question: How do beans sprout?

The Scientific Method:

1. Hypothesis: Beans need water but no light to sprout.

2. Materials: Kidney beans, White beans, Chick peas, 4 plates, water, a box

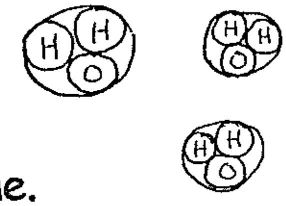
3. Procedure:
    1. Label the plates 1, 2, 3, and 4.
    2. Put beans on each plate.
    3. Plate 1 will get water and light.
       Plate 2 will get water and dark.
       Plate 3 will get no water and light.
       Plate 4 will get no water and dark.
    4. Add water to Plates 1 and 2.
    5. Put Plates 2 and 4 into a dark box.
    6. Put Plates 1 and 3 near the window sill.
    7. Keep adding water to plates 1 and 2 for a week.

4. Results:
    Plate 1 (water, light):
    Plate 2 (water, dark):
    Plate 3 (no water, light):
    Plate 4 (no water, dark):

5. Conclusion: After one week, the beans on the plate with water and light started to sprout. The beans on the plate with water in the dark sprouted the most, but they grew a lot of smelly mold. We learned that mold grows in dark and damp places. We had to throw those out. The beans without water did not sprout.

Monday, July 19

Water Molecules



Scientists call WATER by a different name.
They call it H_2O.
One molecule of H_2O is two Hydrogens + one Oxygen!
Water molecules like to stick together. Why?
Because THEY LOVE EACH OTHER!

Let's play two games that show how water molecules like to stick together! (Directions on next two pages)

Game 1: Water Ball Games

The water drops roll across the wax paper because the water molecules in each drop like to stick together. If a water drop breaks apart, it is easy to push the pieces back together.

Game 2: Penny Challenge

If you drop the pennies very slowly and carefully into the glass of water, you will see the water level rise above the top of the glass without spilling! Why doesn't the water spill even though it is over the rim of the glass? Because the water molecules want to stick together! Why? BECAUSE THEY LOVE EACH OTHER!!!

Water Ball Games

On your mark, get set, GO! Make a tiny water ball for yourself and a friend. Roll them across a miniature track and see whose water ball makes it to the finish line first…and in one piece!

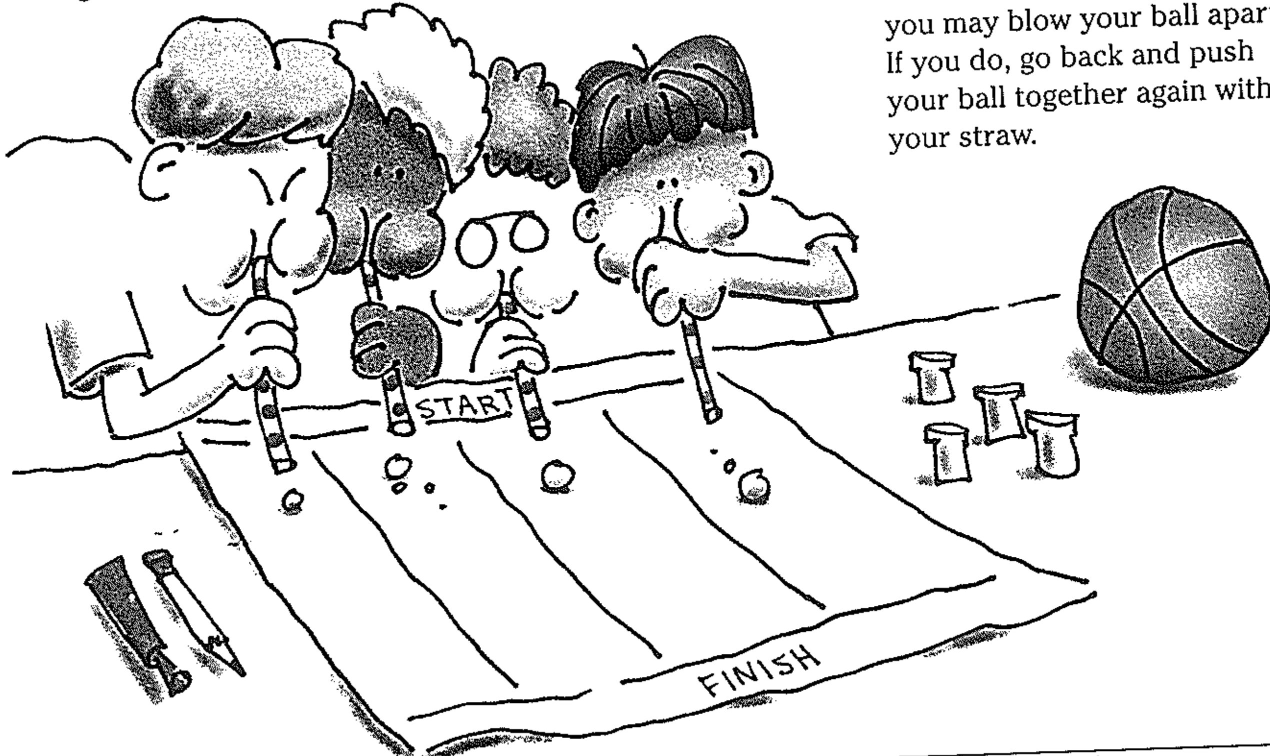
WHAT YOU NEED

- Water
- Food coloring
- Medicine-style dropper
- Film canisters
- Waxed paper
- Waterproof marker
- Ruler
- Pencil
- Drinking straws

WHAT YOU DO

1. For your water ball supply, place a spoonful of water in a film canister for each contestant. Add a couple of drops of coloring.
2. Using a ruler and a marker, draw 2 tracks about 10" (25 cm) long and about 3" (7.5 cm) apart on a sheet of waxed paper. Draw starting and finishing lines at either end.
3. Using the dropper, place same-size water ball droplets at the starting line, one for each player.
4. Now use straws to blow your balls to the finish line.

Note: If you blow too hard, you may blow your ball apart. If you do, go back and push your ball together again with your straw.



Drag it: Water adheres to other materials and coheres to itself, so try using a wet toothpick to pull your ball along. Set it on top of the drop and pull gently.

Bounce it: "Bounce" your ball forward by placing a wet cotton swab in front of your ball.

Solitaire: Cut a circle of waxed paper to fit inside a paper plate. Draw a spiral track that starts at the outer edge and winds its way to the center. Punch a hole or draw a spot in the very center to mark the finish line. By tilting the plate, see if you can guide your drop along the track. Too easy? Poke trap holes along the way.

Heap up: Splatter water on a sheet of waxed paper. Can you join all the small water balls into a single water heap by tilting the paper? Remember, water likes to cohere to itself.

Penny Challenge

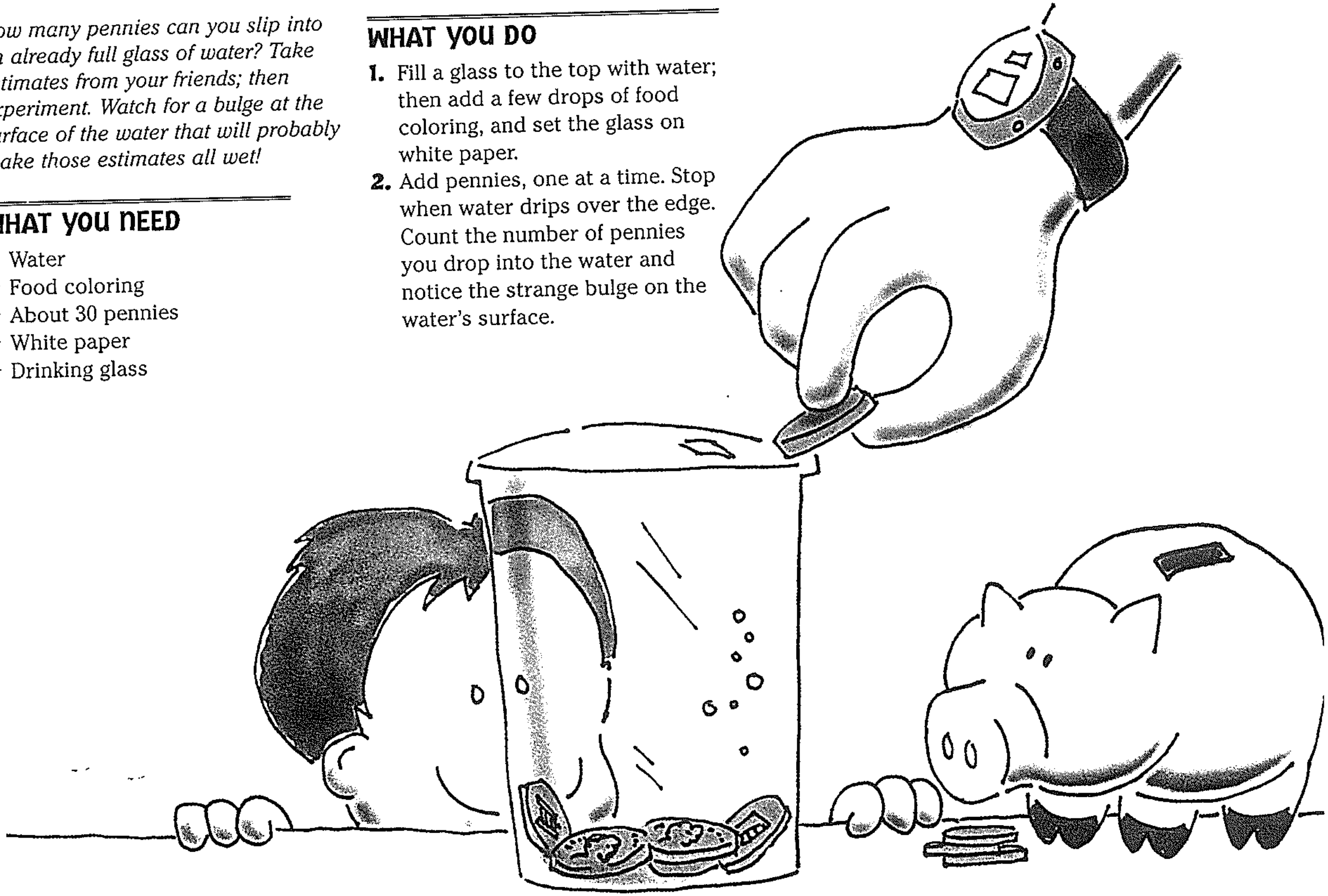
How many pennies can you slip into an already full glass of water? Take estimates from your friends; then experiment. Watch for a bulge at the surface of the water that will probably make those estimates all wet!

WHAT YOU NEED

- Water
- Food coloring
- About 30 pennies
- White paper
- Drinking glass

WHAT YOU DO

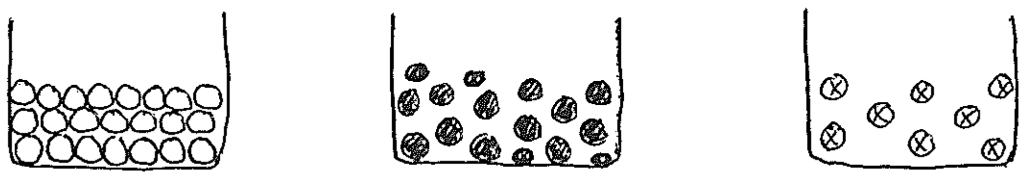
1. Fill a glass to the top with water; then add a few drops of food coloring, and set the glass on white paper.
2. Add pennies, one at a time. Stop when water drips over the edge. Count the number of pennies you drop into the water and notice the strange bulge on the water's surface.



Monday, July 19

Liquid Layers

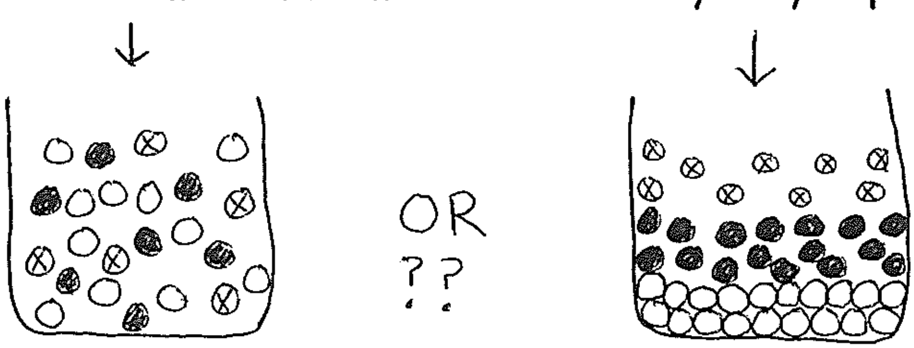
Water is made up of water molecules.
Vegetable Oil is made up of a different kind of molecule.
Rubbing Alcohol is also made up of a different kind of molecule.



Water **Vegetable Oil** **Rubbing Alcohol**

I want to mix water, vegetable oil, and rubbing alcohol together. First I pour some red water into my jar. (I use a jar with straight sides.) Then I pour some vegetable oil down the side of the jar. The last thing I do is dribble some blue rubbing alcohol down the side. (I use a medicine-style dropper for the rubbing alcohol.)

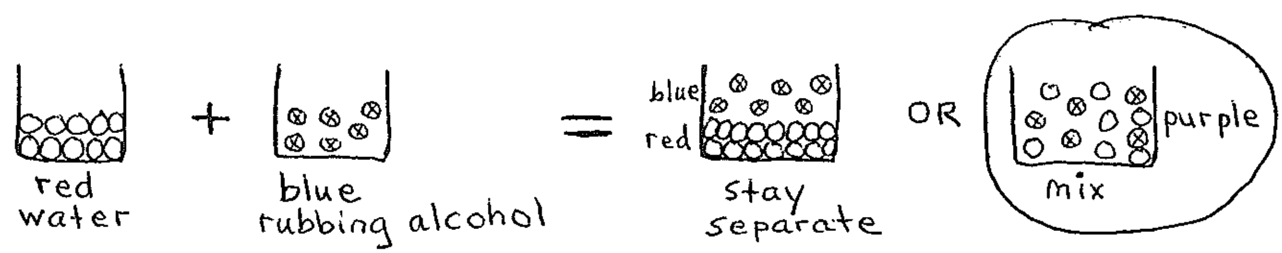
Will all the molecules mix? Or will they stay separate?



They stay separate. Why? Because each liquid has a different DENSITY. The DENSITY is how closely the molecules are together in the liquid.

The water has the greatest density because its molecules are closest together. The molecules in the oil have more space between them. They aren't as densely packed as the water. Because there are more molecules in water than there are in the same amount of oil, the water is heavier than the oil. The oil floats on top of the water. The molecules of the rubbing alcohol have the most space between them. They are the lightest, or the least dense. They stay on top.

If I mix red water and blue rubbing alcohol together, will the rubbing alcohol float on top of the water? They each have a different density. I think they would stay separate. Let's try it.



They mixed! Why did they do that? Even though the rubbing alcohol has a different density than the water, the two liquids are <u>chemically very similar</u> to each other. They like to mix together. Oil and water are very different from each other chemically. They don't like each other at all. They don't want to mix.

Tuesday, July 20

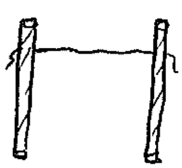
Traveling Water

We know that water molecules like to stick together. They also like to stick to other things. When you put a paper towel over a spill of water, the water spreads out across the paper towel. It travels! In this experiment, we will watch how traveling water can separate colors. The scientific name is CHROMATOGRAPHY.

What you need:

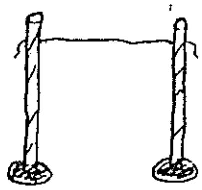
1. Filter paper or Blotting paper (Coffee filters)
2. Food coloring, magic markers, tempera paint
3. Drinking Straws (straight)
4. Clay
5. String, scissors
6. Small plate
7. Cup of water (paper cup okay)
8. Tape

What you do:



1. Cut a string that is a little longer than the width of your plate. (About 8-inches long). Tape one end of the string to the top of one straw. Tape the other end of the string to the top of the other straw.

2. Break a piece of clay in half. Roll each half into a ball. Now you have two balls. Each ball should be about $\frac{1}{2}$-inch or 1-inch wide.

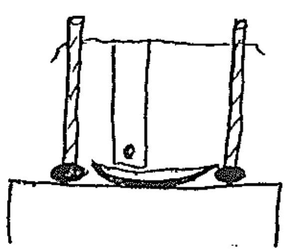


3. Stick one straw into one ball of clay (not the end with the string). Stick the other straw into the other ball of clay. Set the balls of clay on the table so that the straws are standing up with the string tight between them. It should look like a clothesline or a volleyball net. Push the clay onto the table so the balls don't move. Push the clay tight around the straws so the straws don't move.

4. Set the plate on the table between the balls of clay. The plate should be under the string.

5. Cut a piece of filter paper that is long enough to hang from the string and just touch the plate. The paper only needs to be one or two inches wide.

6. Use the food coloring, magic marker, or paint to make a dot near the bottom of the strip of paper. Don't let the dot touch the bottom of the paper. The food coloring will spread, so make the dot a little higher.



7. Tape the paper to the string so that the dot is hanging just over the plate.

8. Add a little bit of water to the plate. Only add enough water for the bottom of the paper to get wet. Let it sit for about an hour. Watch the water travel up the paper. What do you think will happen?

<u>What happens</u>? Turn the page!

What happens:

The water molecules are very happy to travel up the paper. They are going on a trip. Paper is woven with lots of spaces that the water molecules use as roads for traveling. When the water hits the drop of color, the water picks up the color and keeps traveling. But different colors can travel farther than other colors. What happens to a purple dot? Purple is made up of red and blue. Red and blue can't travel the same distance. So the purple gets separated into red and blue. Which color travels farther?

An interesting note:
We tried using watercolor paint and poster paint. These dots didn't move.

Thirsty Celery

Do you think water will travel up a stick of celery? Let's try an experiment. Fill a glass with water. Add a few drops or red or blue food coloring. Cut off the end of a stick of celery (not the end with leaves). Put the celery in the glass so that the end with leaves are on top. Let the celery sit there for a few days. Do you think the red water will travel up the celery? How far do you think it will get? After a few days, cut the celery at different points up the stick. Use a magnifying glass to look at the inside of the celery where you cut. How far did the colored water travel? The celery was drinking the water!

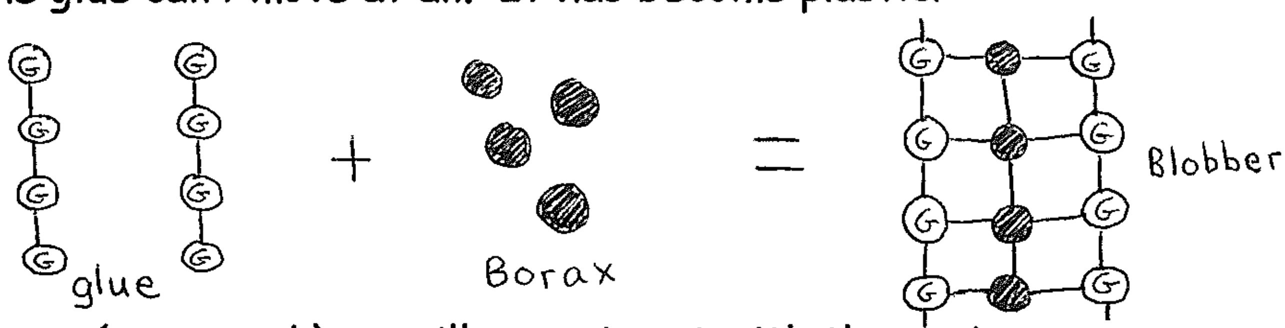
Wednesday, July 21

Making Blobber (recipe on next page)

Blobber is plastic. It is like Silly Putty. Do you believe that we can make plastic by mixing powder and glue? Think of glue as a long string of molecules. Glue doesn't flow as quickly as water because the molecules aren't free like they are in water. Glue molecules are attached to each other in a long string so they can't move as fast as they could if they were free.

Water Molecules | **Glue Molecules**

Now think of two strings of glue molecules lying next to each other. When we add Borax water to the glue, the Borax molecules attach the two strings together (like rungs of a ladder). The chemical structure changes. Now the glue can't move at all. It has become plastic!



Later (next week) we will experiment with the recipe. We will see what happens when we vary how much Borax we add to the glue. Will the Blobber change if we add more Borax, or if we add less Borax? Stay tuned!

The Recipe for Blobber *(from Super Science Concoctions)*

You need:

1. White glue
2. Borax (at grocery store, laundry detergent aisle)
3. Water
4. Food Coloring
5. Two Paper Cups
6. Tablespoon, Teaspoon, $\frac{1}{2}$ cup

What you do:

1. In one cup, add **$\frac{1}{2}$ cup of water**. Then add **$\frac{1}{2}$ teaspoon of Borax**. Stir until the Borax dissolves. Set this cup aside.

2. In the other cup, add **1 Tablespoon of glue**. Add about **4 drops of food coloring**.

3. Now take **1 Tablespoon of Borax water** from the first cup and add it to the glue in the second cup. (You don't need the first cup anymore. Set it aside.)

4. Stir the glue with a stick or spoon. In a few seconds it will become hard to stir. You may take it out of the cup and squoosh it with your hands for several minutes. You've got Blobber!

Thursday, July 22

VOLCANOES !!!!

WARNING: This experiment is very messy! It is best to do outside!

What you need:

1. Jar – baby food jar works great.
2. Baking Soda
3. Vinegar
4. Red Food Coloring
5. Dirt

What you do:

1. Add Baking Soda to your jar until it is about half-full. Add a few drops of red food coloring.

2. Put your jar down on the dirt. Pile up the dirt around the jar until it looks like a hill with the opening at the top.

3. Pour a little bit of vinegar into the opening. Watch the volcano erupt! After it erupts, you can pour some more vinegar into the opening and it will erupt again. It will continue to erupt until all the Baking Soda is gone.

Friday, July 23 **MICROSCOPES !!!**

Microscopes let us see things which are too small for us to see with our own eyes! Scientists use microscopes to look at molecules, cells, and microbes.

MOLECULES:

Most microscopes can't see molecules because molecules are just too small. There are some special microscopes which can see molecules. These microscopes are called ELECTRON MICROSCOPES. Some electron microscopes are as big as a room. They have to be very powerful to see something as small as a molecule.

CELLS:

Some scientists call CELLS the BUILDING BLOCKS of life. A cell is the smallest unit of life. Each cell has something that is like its own brain. It is called a nucleus. The nucleus contains all the instructions for the cell. It tells the cell what to do. Every part of the cell has its very own special job to do. Cells make up animals. Cells also make up plants. People are made up of millions of cells. People have many different types of cells. We have skin cells, muscle cells, bone cells, blood cells, and brain cells. Different types of cells look different. But every cell has a nucleus. We will look at cheek cells and onion cells.

MICROBES

Microbes are living things which may only be one cell big. They are so small we need a microscope to see them. We call their size MICROSCOPIC. Remember the nature soup we made last week? We will look at it under the microscope to see if we can find any one-cell microbes swimming around.

Microscopes continued

What you need:

1. A microscope
2. Microscope slides
3. Cover slips (small plastic square that goes on slide)
4. Medicine-style dropper
5. Water
6. Iodine?
7. Toothpick
8. Onion
9. Nature soup (water, sticks, dead grass, dead leaves, nuts, etc. in sealed container for one week – it will smell. Use gloves.)

What you do:

1. For nature soup: Place a drop of nature soup on microscope slide. Cover with cover slip. (Remember how to avoid air bubbles? Hold edges of cover slip with two fingers. Place one free edge of slip next to drop – not in it. Slowly lower cover slip over drop.) Put slide on microscope. Turn on light. Look under low power. When you can see something clearly, turn to medium power. Only use the fine-tuner knob now. Look for small circles that are moving fast across your view. Those are alive! They are only one-cell big! They live in that nature soup! They are swimming around and having a great time!

2. **For cheek cells**: Get a new microscope slide. Use the dropper to place a drop of water on the slide. (A whole drop may be too much water. You can just move the end of the dropper around on the slide to make a small wet area.) Take a toothpick and lightly scrape the inside of your cheek so it tickles. Then mix the end of the toothpick in the drop of water on your slide. Cells are more fun to look at it they are stained. Scientists have special stain. I don't know if food coloring would work or not, but it would be a fun experiment. Iodine may also work. We used some special stain from the lab. Cover with a cover slip. Put your slide in the microscope. Get a clear view under low power. Then switch to medium power. Be careful to only use the fine-tuner under medium power. (Only experts should use high power because using it wrong can break the lens!) We saw many cheek cells that were stained yellow. We saw dark yellow dots in each cell. The dark dot in the cell was the nucleus of the cell!

3. **For onion cells**: Get a new microscope slide. Put a wet drop of water on the slide like you did for the cheek. Peal the outer skins of the onion until you get to the very thin, wet onion skin. It might be easier with a knife. Ask your parents for help. The skin should be so thin that you can almost see through it! Use some tweezers to place the skin onto the wet dot on the slide. Try not to let the skin fold over. Add some special dye. Cover with a cover slip. Look under the microscope (same way as for the cheek).

What do Blood Cells do?

Our blood is made up of 3 things that do 3 jobs:

1. **Red Blood Cells** – (the buses which) carry oxygen

2. **White Blood Cells** – Fight disease (the body's military or Department of Defense)

3. **Other stuff** – fix leaks.
   The body doesn't want to leak blood! If a finger gets a cut and starts bleeding, a leak alarm (like a fire alarm) goes off in the body! The brain says, "There's a leak at the corner of the second finger and left hand!" Then the leak-fighters in the blood go to that scene and repair the damage! They make a clot that turns into a scab. No more blood gets out.

Other parts of the body that the blood uses:

1. **Blood Vessels** (veins, arteries) – The body's Transportation System of roads for the blood. These roads are tubes that start at the heart and branch out to every part of the body. Blood travels through the tubes like water travels through a straw.

2. **Heart** – The pump (engine) that keeps the blood moving.

3. **Lungs** – The blood's "pit stop" for picking up oxygen.

The Red Blood Cells

The Job:

The job of the Red Blood Cells is to carry oxygen to every part of our body.

What is oxygen? Oxygen is the air we breathe.

Why is it important for every part of the body to get oxygen? If the brain doesn't get oxygen, the body will die!

How does the blood get oxygen to every part of the body? The body breathes oxygen into the lungs. The blood moves from the heart to the lungs where it makes a pit-stop to pick up oxygen. Then the blood moves back to the heart where it is pumped to our fingers, toes, head, elbows, etc. The blood travels through the tubes (veins, arteries) of the body's Transportation System!

What problems are caused by smoking?

1. There is tar in cigarettes. The tar coats the inside of the lungs so that less oxygen can get through to be picked up by the red blood cells.

2. Cigarette smoke contains a chemical called Carbon Monoxide. Carbon Monoxide is poisonous to our bodies. It tries to stop the red blood cells from picking up oxygen in the lungs. Less oxygen gets transported to the rest of the body. A person who doesn't smoke breathes in Oxygen. A person who smokes will also breathe in Carbon Monoxide. Carbon Monoxide is the enemy of Oxygen.

3. Cigarettes also contain nicotine. Nicotine is a drug which is poisonous to the body. It increases the chances of getting lung cancer and having heart problems. It is also addictive. It changes the way the brain works so that if one stops smoking, the body gets jittery and tense, and the person feels upset. Nicotine makes it VERY HARD to stop smoking. It is MUCH EASIER never to start!!!!

What happens if the Heart has problems?
If a blood vessel leading to the heart gets clogged, it is like having gum in one end of a straw. Can water get through a straw that is plugged with gum? No! Blood can't get through either! Sometimes the doctor needs to do a BYPASS OPERATION on the person. That operation will re-route the blood. It is like closing a road and putting up a DETOUR sign.

The White Blood Cells

The Job:
The Job of the White Blood Cells is to fight invaders! If bad bacteria get into the body, the White Blood Cells are sent out to kill them! The White Blood Cells are like the body's army. They fight the enemies of bad viruses and bacteria.

There are different types of White Blood Cells. Some simply EAT the enemy. Others are a little smarter. They make "**antibodies**" to the enemy. The antibodies attach themselves to the virus just like a cop puts handcuffs on a robber. The virus and the robber can no longer do any harm! The reason these White Blood Cells are so smart is that the antibodies have a great memory! The next time the same virus shows up, the antibodies will remember how to get rid of it! Once we have the antibody for the disease, we have "**immunity**" for that disease. That is why we only get Chicken Pox once!

Why do we only get Chicken Pox once?

The first time the Chicken Pox virus invades the body, the body has to figure out what it is and make an antibody for it. The next time the Chicken Pox virus invades the body, the body is ready for it. It has the antibody. The antibody remembers it. The antibody stops the virus before it has a chance to make us sick!

If we only get Chicken Pox once, why do we keep getting a Cold again and again?

The Cold virus is too smart for us. It keeps changing shape so that our antibodies don't recognize it!

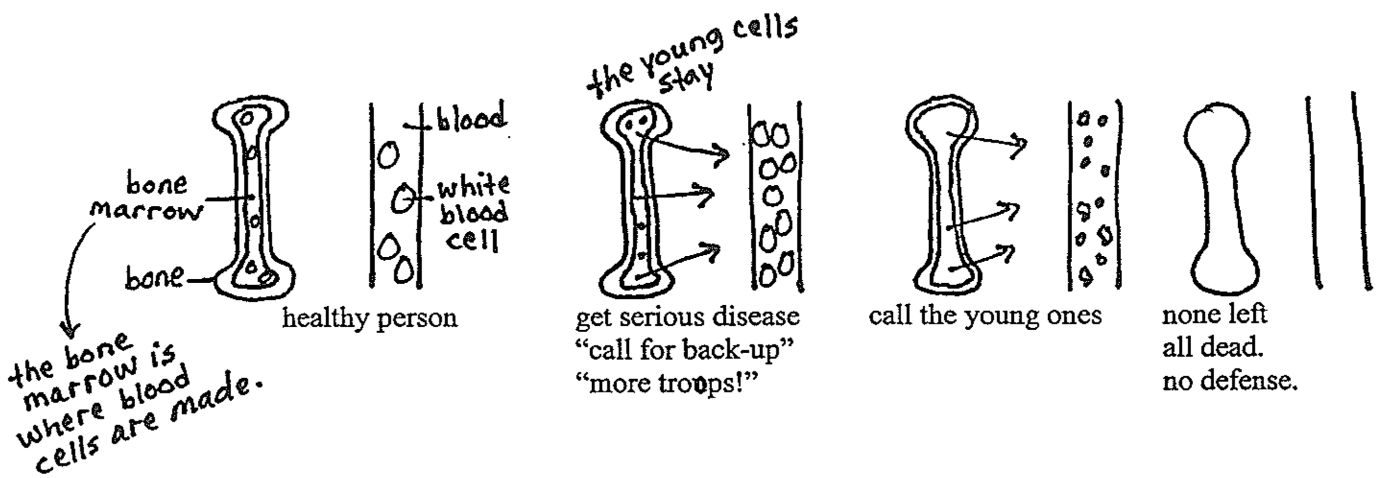
What does it mean to get immunized?

When we were little, the doctor gave us lots of shots to immunize us against certain diseases. Some shots are antibodies to certain bad viruses. These antibodies will protect us from those bad viruses for the rest of our lives. Other shots help our bodies to make the antibodies to certain viruses. Once our bodies have the antibodies, we will keep them forever to protect us.

How do the White Blood Cells fight diseases like Cancer or AIDS?

White Blood Cells are made in the bone marrow of the bones. That is where the blood cells grow up. When the blood cells are old enough, they move into the blood where they do their jobs. A healthy person doesn't have a huge number of white blood cells in the blood. When someone gets sick with a very bad virus, the Generals or Captains of the White Blood Cell army may request more troops from the bone marrow. New recruits will increase the number of White Blood Cells in the blood. As soon as the enemy is beaten, the number of White Blood Cells goes back to normal. If a person is sick for a very, very long time, like with Cancer or AIDS, the Captains will keep requesting more and more troops from the bone marrow. The body can't make White Blood Cells fast enough. After a while, the only available White Blood Cells are the young ones which usually stay in the bone marrow until they are old enough to be effective in the blood. But they are needed. So the young ones move into the blood too. Eventually, all the White Blood Cells are defeated, and there are no more reserves left in the bone marrow. The body has no more defense.

When a doctor wants to see how a person with cancer or leukemia is doing, he takes a sample of the person's blood and looks at it under a microscope. He counts how many white blood cells he sees. If he sees a lot more than normal, he knows that the body is fighting a serious enemy. If he sees a lot less than normal, or almost none, he knows that the enemy is winning and the body's defense is almost wiped out. If he sees a lot of young white blood cells, he knows that the body isn't doing very well. It has had to request reserves from the bone marrow. The doctor can usually tell what type of cancer or leukemia a person has by what the White Blood Cells look like.



healthy person

get serious disease
"call for back-up"
"more troops!"

call the young ones

none left
all dead.
no defense.

Monday, July 26: Experimenting with the Recipe for Blobber

I work for a toy company. My customers want Blobber to be able to:

1. Hold its shape.
2. Hold an impression for five seconds.
3. Bounce 4 feet (48 inches).
4. Not make bubbles when using a straw.

I have many scientists who work for me. I divide them into four teams. I give each team a different recipe for Blobber. The regular recipe is:

1. In one paper cup, add <u>1/2 cup water</u> and <u>1/2 teaspoon of Borax</u>. Stir well.
2. In another paper cup, add <u>1 Tablespoon of glue</u> and <u>4 drops of food coloring</u>.
3. Take 1 **Tablespoon** of the Borax water and add it to the glue. Stir well.
   Finish mixing with hands.

For this experiment, I want each team to use a different amount of Borax:

<u>Team 1</u> (Team USA) will use <u>1 1/2 teaspoons</u> of Borax. Their Blobber will be <u>green</u>.

<u>Team 2</u> (Boston Red Sox) will use <u>1 teaspoon</u> of Borax. Their Blobber will be <u>red</u>.

<u>Team 3</u> (Team Marlborough) will use <u>1/2 teaspoon</u> of Borax. Their Blobber will be <u>orange</u>.

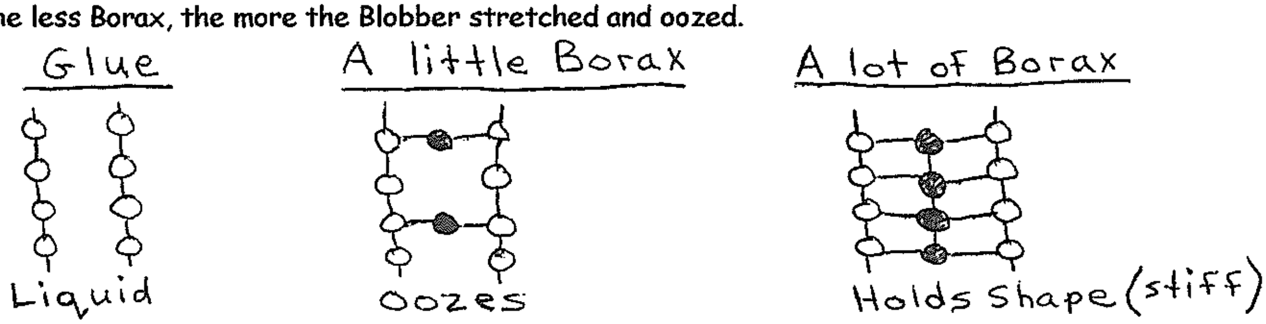
<u>Team 4</u> (Lavender Town) will use <u>1/4 teaspoon</u> of Borax. Their Blobber will be <u>yellow</u>.

I want to test which recipe is the best for what the customer wants.
I set up a contest with 4 tests:

	ooze or hold shape	squeeze in fist how long holds shape?	bounce (height)	blow into straw (make bubble?)
Team USA	hold shape	18 seconds	46 inches	no
BoSox	hold shape	25 seconds	36 inches	no
Team Marlborough	hold shape	25 seconds	26 inches	yes
Lavender Town	ooze	10 seconds	3 inches	yes
What customer wants:	hold shape	5 seconds	48 inches	no

<u>**Conclusion**</u>: The recipe closest to what the customer wants is Team USA with 1 1/2 teaspoons of Borax.

The more Borax, the higher the Blobber bounced and the stiffer it was.
The less Borax, the more the Blobber stretched and oozed.



Water, Glue, and Blobber Molecules

When we added a lot of Borax to the glue, our Blobber didn't want to stretch at all. It bounced great, but it wouldn't stretch. It was a SOLID. What happened to the glue?

Let's pretend we are the molecules. First we made a huge circle of chairs in the room (chairs pointing outward). Everyone got in the middle of the circle.

Water molecules:

I said that every single person was a water molecule. When I said, "GO," everyone moved around in the middle of the circle until I said, "STOP." It was very easy for everyone to move. The water molecules are free to move around. They are a liquid.

Glue molecules:

Then I told everyone to hold hands and form a chain inside the circle. Now everyone is a Glue molecule. When I said, "GO," everyone moved around inside the circle – but they couldn't let go of anyone's hand! When I said, "STOP," I asked how easy it was to move. They could still move, but it wasn't as easy.

> If I filled a cup with water and poured it onto the floor, the water molecules would move fast. If I filled a cup with glue and poured it on the floor, the glue molecules would move slowly. They would still move, but not as fast as the water. Glue molecules aren't free like water. They are holding onto each other. That makes them move slower.

Blobber Molecules:

After that, I broke the chain of people into two lines. I put both lines of people next to each other. Each pair of holding hands had to find a pair of holding hands in the other line and figure out how to hold on to them too. When everyone was ready, I said, "GO." Everyone tried to move but they all fell down. They were Blobber molecules! They had become a solid. None of the molecules were free to move around. They were all tied to each other.

Tuesday, July 27

<u>Liquid Density Necklace</u>

Last week we learned that water and oil have different densities and don't like to mix. Let's see if we can make a liquid necklace with stripes of color that stay separate.

<u>What you need:</u>

1. 2 $\frac{1}{2}$ - 3 feet of $\frac{1}{4}$-inch clear plastic tubing (hardware store)
2. $\frac{1}{4}$-inch wood dowel (hardware store)
3. Duct tape, or Clear Package tape
4. Water
5. Rubbing Alcohol (optional)
6. Corn Syrup (optional)
7. Vegetable Oil
8. Food Coloring
9. Medicine-style dropper
10. Empty jars or bottles

<u>What you do:</u>

1. In different jars or bottles, make different colors of water (purple, green, blue, red, orange, yellow).

2. In different jars or bottles, make different colors of rubbing alcohol (blue, green, etc.)

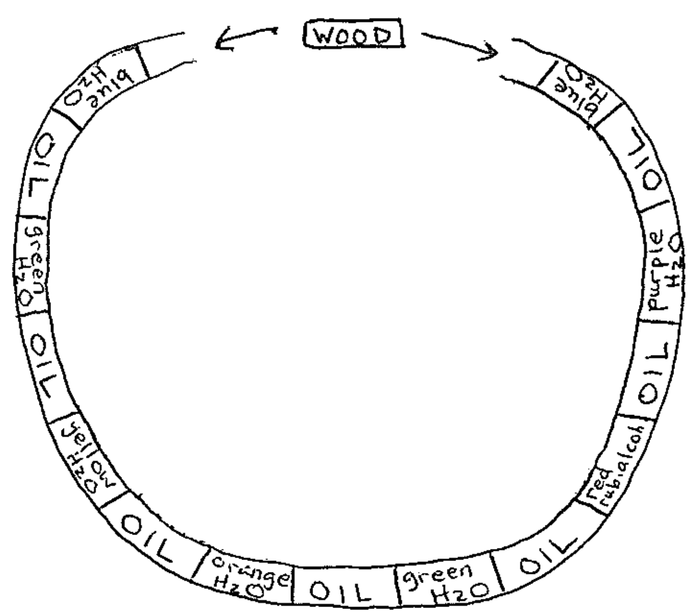
3. In different jars or bottles, make different colors of vegetable oil. (Adding red to yellow vegetable oil makes a nice orange (with red dots because doesn't quite mix.)

4. Have one person hold the tube in a U shape. It is important for both ends to be held at the same level.

5. With a dropper, add a dropper-full (or less) of colored water to one end of the tube. (Only add enough to make a one to two inch stripe in the tube.)

6. Use one dropper for water, one dropper for rubbing alcohol, and one dropper for the oil. (If you use the corn syrup, the syrup may eventually mix the water.) After adding the water, add an inch of oil to each end of the tube. Then add an inch of colored water to each end of the tube. Add another inch of oil to each end of the tube. Always make sure that you have oil separating water and rubbing alcohol. Vary the colors you use.

7. When the tube is almost all full (1/2 - 1 inch of space at each end left), be careful to hold the ends AT THE SAME LEVEL. Put the cork in one end, and then in the other end. Push the ends of the tube together over the cork. Wrap with clear packaging tape. You're done!



Wednesday, July 28

MILK ART

We can make our own fireworks display using milk, food coloring, and liquid soap! How do we do that? We have learned that different liquids don't like to mix at all. Some liquids try very hard to stay away from other liquids. Let's try this experiment:

What you need:

1. Milk
2. Food Coloring
3. Liquid Detergent
4. Plate (with sides) or pan
5. Toothpick

What you do:

1. Pour enough milk on the plate to coat the bottom.
2. When the milk is still, drip drops of different food coloring onto the mix. Don't bump the plate! Don't mix the food coloring into the milk!
3. Dip a toothpick in liquid soap and place it in the middle of the color drops. Watch the drops of coloring explode and swirl.
4. Optional: Lightly rest a piece of paper on top of the milk. After a few seconds, carefully pick up the paper. Turn it over and let it dry. You have created MILK ART!!!

Friday, July 30

LET'S MAKE ICE CREAM

What you need:

1. Whole milk and cream (half 'n half)
2. Sugar
3. Vanilla
4. Ice
5. Salt
6. Small and large zip-loc bags
7. Patience!

What you do:

1. In a small zip-loc bag, add 1 cup milk, 1 cup cream, ½ cup of sugar, and about ½ teaspoon vanilla.
2. Put this bag in another small zip-loc bag so it is double-bagged for extra protection.
3. Add ice to a large zip-loc bag. Sprinkle in some salt.
4. Put the double-bagged milk into the large bag of ice. Zip it up.
5. Start shaking....and shaking.
6. Keep shaking until the milk thickens into ice cream! This may take a while! Keep the bag moving. Toss it back and forth with a friend. Roll it on the floor. About half an hour? It's an experiment.

Experiment with the Recipe:

Try different amounts of milk and cream. Try a total of 1 ½ cups or 2 ½ cups of milk/cream. Try using strawberries, chocolate, or real maple syrup. Try rock salt instead of table salt. Have fun!

EXPERIMENTS WITH MAKING ICE CREAM

I have some questions that I don't know the answer to.

Why do we have to add salt to the ice when we make ice cream?

Aren't we supposed to use **rock salt** instead of **table salt**?

I've heard that salt makes ice colder, and that salt makes ice melt faster. Why doesn't the ice melt slower if it is colder? If we want the ice to turn the milk/cream into ice cream, why do we want the ice to melt fast? What would happen if we didn't add any salt at all?

I am going to use the **Scientific Method** to answer some of these questions.

1. My **Hypothesis** is that we don't need to add any salt to the ice.
2. **Materials**: To do an experiment, I will need all of my ingredients for making ice cream, plus rock salt.
3. **Procedure**: I want to make three batches of ice cream:
    1. Batch 1: Use table salt like the recipe says.
    2. Batch 2: Use rock salt instead of table salt.
    3. Batch 3: Don't use any salt at all. NO SALT.
4. **Results**: Which batch tastes like the best ice cream?
5. **Conclusion**: Was my hypothesis right?

The Answers ☺

(from front page)

The Scientific Method

The Hypothesis

Best Guess

(for answer to question, for what results of experiment will be)

BECAUSE THEY LOVE EACH OTHER !!!

Thank you to two great classes! Have fun being curious! When you are curious and explore, you are a SCIENTIST !!!