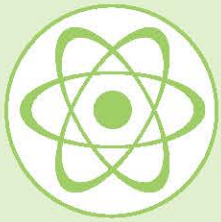
Unit 1: Properties of Water



Student Journal

Name

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The Scientific Method

Science is examined using a process known as the **scientific method.** There is no magic formula to doing science, but there are commonly accepted techniques that help scientists conduct fair and unbiased experiments.

The scientific method involves the following steps:

1. Develop a question about something interesting, puzzling or problematic;
2. Gather information about your questions;
3. Form a hypothesis (a proposed explanation or an educated guess) and make predictions based on the information gathered;
4. Perform experiments and make observations to test the hypothesis and predictions;
5. Analyze your findings or results of the experiments;
6. Make conclusions based on the findings; and
7. Share the results of your investigation.

Good scientists use their senses (in a safe manner) to investigate certain subjects; however, because some substances are harmful, we will not be using our sense of taste during these experiments.

Scientists also record their questions, predictions, observations, diagrams and findings in a field journal similar to this one so they may refer back to them at a later time. Keep in mind that scientists don't usually have answers until they seek them out by investigating and exploring possible answers to questions.

The beauty of science is that you don't have to know the answers before you get started!

Student Lab Safety Agreement

Hands-on activities are important to learning in any science program. Students must be safe while doing any science investigations.

1. Never eat, chew gum, or drink while doing these investigations.
2. Never taste any of the materials that you will be handling in these investigations.
3. Follow all instructions carefully. If you do not understand a direction or part of a procedure, ask the instructor before you continue.
4. Don't touch any equipment, or other materials until you are told to do so.
5. Keep hands away from your face, eyes, mouth and skin while using investigation materials. Wash your hands with soap and water after doing all experiments.
6. Clean, rinse, and wipe dry all work surfaces (including the sink) and equipment at the end of the experiment. Return all equipment clean and in working order to the proper storage area.
7. When transferring materials from one container to another, hold the containers over a table or sink.
8. Carry glass tubes in a vertical (straight up) position to prevent damage and injury.
9. Never handle broken glass with your bare hands. Use a brush and dustpan to clean up broken glass.
10. When removing an electrical plug from its socket, grasp the plug, not the electrical cord. Hands must be dry before touching an electrical switch, plug or outlet.
11. Examine glassware and other containers before each use. Never use chipped, cracked or dirty containers.
12. Notify your instructor immediately if you find damaged equipment or materials. Look for cracks, chips, frayed cords, exposed wires, and loose connections. Do not use damaged equipment.
13. If you do not know how to use a piece of equipment, ask the instructor for help.
14. Do not place hot glassware in cold water – it may shatter.
15. Allow heated metals and glass to cool before use. Use tongs or heat-protective gloves if necessary.
16. Never look into a container that is being heated.
17. Do not place hot equipment directly on the desk. Always use an insulating pad. Allow plenty of time for hot equipment or tools to cool before touching them.
18. Use a wafting motion of the hand to check odors or fumes.
19. Never force rubber stoppers into glassware.
20. Know where the fire extinguisher, eyewash, shower, and exits are located.
21. Report all injuries to the instructor immediately.

I, _____ (student's name) have read and agree to follow all of the safety rules stated in this contract. I realize that I must obey these rules to insure my own safety, and that of my fellow students and instructors. I will cooperate with my instructor and fellow students to maintain a safe lab environment. I will also closely follow instructions provided by the instructor. I understand that if I violate this safety contract, I may be removed from the after school science laboratory.

_____ _____

Student Signature Date

_____ _____

Parent / Guardian Signature Date

LESSON 1

Let's Look at Water & the Scientific Method

Investigation: Getting Our Feet Wet

OBJECTIVE

In this investigation you will be conducting several experiments using parts of the scientific method to learn about some of water's unique physical properties. Identify the steps to the scientific method as you conduct the investigation.

GET READY!

As the group is brainstorming, make a list of the things that come to mind.

Brainstorm

What do you think of when you hear the word "water"?

Part 1: Making Sense of Water

PROCEDURE

1. Select WATER and TWO additional liquids to investigate.
2. Label each cup with masking tape.
3. Fill the cups with 100 mL (approximately 7 tablespoons or 3 oz) of the three liquids.
4. Use your senses to complete the following chart.

PREDICT

As you go through each part of this activity, predict the differences and similarities you expect to find between water and the other liquids in this experiment.

OBSERVE

Properties of Liquids

	Liquid One: **Water**	Liquid Two:_____	Liquid Three:_____
Describe each liquid: Look /color /clarity			
Odor: Strong, sweet, sour, etc.?			
Texture: How does it feel when you rub it between two fingers? Smooth? slimy, sticky, etc.			
Viscosity: How does it flow? Is it runny, thick, etc.?			

Part 2: This Way and That Way

OBSERVE

Use the popsicle sticks and plastic spoons to observe how water and other two liquids move.

How Do They Move?

	Liquid One: Water	Liquid Two:_____	Liquid Three:_____
Stir with popsicle stick			
Swirling cup in a circular motion			
Spoon scoop-up			
Drop liquid in cup with the spoon			
Does it make any sound?			

Words of Wisdom!

"If we knew what it was we were doing, it would not be called research, would it?"

--Albert Einstein

Part 3: A Little at a Time

OBSERVE

Use eyedroppers or straws to pick up the liquids and drop them, a little at a time, onto the various materials provided. Discuss your observations with your partner or group.

- How do the liquids look when dropped onto each material?
- How does each liquid react when you move it around with a toothpick on the material?
- What happens to each liquid when you tilt the material to one side?

Part 4: Drop, Plop

OBSERVE

Select three objects to drop in your three liquids. Observe and discuss what occurs when each material is dropped into the liquids.

- Which floated? Which sank?
- Which disappeared?
- Which caused a reaction?

WRAP-UP

It is important to share results so that everyone has a clear picture of what happened. Scientists learn from each other through discussion and build upon the work of others to make new discoveries. Just as scientists come to conclusions based on the findings of their investigations, we will now come together as a group to make conclusions in this wrap-up part of the lesson.

GROUP DISCUSSION

What did you learn from the group discussion? Did everyone have the same results? Did someone have a different opinion than you?

REFLECTION

What are your own ideas about this investigation? What new things did you learn? What surprised you? Record any thoughts that you might have.

Curriculum Match-Up

Here are some additional activities you can do to enhance what you learned in this investigation:

- Create charts showing properties of each liquid.
- Create charts or graphs comparing how the different liquids behaved during each test.
- Create a graph for the distance each liquid spread out on the coffee filter.
- Create a graph or chart of the evaporation time for each liquid.
- Make a chart or graph of the group's findings for a particular liquid.
- Investigate other liquids and objects.
- Identify and list five ways that you use water in your daily life.

Science @ Home!

Water on the Home Front

The average American uses 100 gallons of water every day to cook food, drink, bathe, water gardens and wash clothes, dishes and cars. This investigation will demonstrate how important water is in your home. Record your observations and findings.

Materials

- Pen or Pencil

Investigation

1. With the help of an adult, make a list of all the food in your kitchen that needs water to prepare. Make sure to read the cooking or preparation instructions on the boxes, cans, or other food containers to see if water is used to make any of the foods in your home.

2. Next, go to each room of your home and identify ways that water is used in each room. Record your findings.

Explanation

Water remains a mystery despite its widespread presence in our lives. Our survival depends especially upon liquid water. All living things need water to survive. Humans need 2.5 quarts of water every day, which we get from drinking water and breathing and absorbing moisture from the air. Did you know that 75% of the human body is made up of water?

LESSON 2

A Little Drop of Water: Cohesion

Investigation 1: Drops on a Penny

OBJECTIVE

In this investigation you will learn that water molecules are attracted to other water molecules, a property known as cohesion.

Introduction to Cohesion: Build a Water Molecule

Diagram a picture of a water molecule in the space below:

Part 1: How Many?

GET READY!

You will now investigate why water forms into droplets.

PREDICT

How many drops of water will fit on the head of the penny before the water spills over?

_____ number of drops

TIP
Be careful not to shake the table!

PROCEDURE

1. Place the penny "heads up" on a piece of paper towel on a flat surface.
2. Begin by placing one drop of water at a time on the head of the penny.

OBSERVE

- Count the number of drops and make observations about how the water looks as you drop the water on the penny.
- If you reach the number of drops predicted, pause and make observations. Make a new prediction and continue dropping water onto the penny.

_____ revised prediction

- When the water spills over, think about why this happened.

- Now, repeat the procedure and make the following observations:
  How does the water drop on the penny look from the top? From the side? Draw what you observe.

Part 2: What If?

Share questions that might have come up as you did the investigation. If you could change one thing about this investigation to learn something new, what would you try? When we change one part of an experiment to see how it affects our results, this change is known as a **variable.**

PROCEDURE

1. Choose one variable to test (salt water, soapy water, angle that you're holding the dropper, pressure on the dropper, type of coin).
2. Predict how many drops of liquid will fit on the head of the coin before it spills over.
3. Repeat the procedure from Part 1 with your new variable.
4. Do you think you will get the same results?
5. Record your observations and results. What new things did you learn? What surprised you? Record any thoughts that you might have.

Investigation 2: Filled to the Brim

OBJECTIVE

In this investigation, you will discover that an elastic "skin" on water, known as surface tension, forms to keep water from overflowing.

Part 1: What Happens?

GET READY!

You will do another experiment to explore the cohesive properties of water.

1. Place a cup on top of a paper towel.
2. Fill the cup with water until the water reaches the very top of the cup and almost spills over.

PREDICT

How many paperclips do you think the cup will hold before the water spills over?

_____ number of paperclips

TIP

Be careful not to shake the table!

PROCEDURE

1. Slowly begin placing paperclips into the cup.
2. Count the number of paperclips and make observations about the water level as you place the paperclips into the cup.
3. If you reach the number of paperclips predicted, pause and make observations. Make a new prediction and continue placing paperclips into the cup.
4. If the water spills over before you reach your predicted number, think about why this may have happened.

OBSERVE

Draw a picture of what you observe about the water in the cup.

Part 2: What If?

If you could change one thing about this investigation to learn something new, what would you try? When we change one part of an experiment to see how it affects our results, this is known as a variable.

PROCEDURE

1. Choose one variable to test (e.g., different sized cups, different sized paperclips, plastic coated paperclips, marbles, beads or pennies, etc.).
2. Repeat the Get Ready from Part 1 with your new variable.

PREDICT

- Predict how many objects will fit into the cup before the water spills over.
- Repeat the procedure from Part 1 with your new variable.

OBSERVE

- Do you think you will get the same results?
- Did you get different results when dropping different items in the cup?

- Record your observations and results.

WRAP-UP

It is important to share results so that everyone has a clear picture of what happened. Scientists learn from each other through discussion and build upon the work of others to make new discoveries. Just as scientists come to conclusions based on the findings of their investigations, we will now come together as a group to make conclusions in this wrap-up part of the lesson.

GROUP DISCUSSION

What did you learn from the group discussion? Did everyone have the same results? Did someone have a different opinion than you?

REFLECTION

What are your own ideas about this investigation? What new things did you learn? What surprised you? Record any thoughts that you might have.

Words of Wisdom!

"There are many hypotheses in science which are wrong. That's perfectly all right; they're the aperture to finding out what's right."

- Carl Sagan

Curriculum Match-Up

Here are some additional activities you can do to enhance what you learned in this investigation:

- Use the same variable ten times and find the average number of drops / paperclips for your results.
- Using the group results from Part 1, find the range, the mode and the median.
- Create a small pile of sand or soil and pour water over the pile to observe what the water does once it hits the sand. What does this tell you about how bodies of water are formed?
- Find the ratio between your prediction and your result.
- What percentage of your predictions was correct? What percentage of your predictions was incorrect? Calculate the percentage of your prediction in relationship to your result.
- Create a story using water drops as characters. Tell how water drops are attracted to each other.

Science @ Home!

Sticky Water

Water has a "stretchy skin" quality to it called surface tension. This experiment demonstrates how water molecules stick together even though they are being pulled in different directions.
Record your predictions and observations.

Materials

- 1 soda can, or a Styrofoam or paper cup
- 1 sharp nail or something that can be used to safely poke a small hole
- 1 cup of water

Investigation

1. Ask an adult helper to make five holes in the base of the can or cup, using the nail or another sharp object. Make sure the holes are made in the base of the cup or can.

2. Fill the can with a cup of water.

3. Try to pinch the streams of water coming out of the bottom of the cup with your thumb and pointer finger. Watch how the water forms one stream of water.

4. Repeat the experiment. Take turns doing the experiment with your family and friends.

Explanation

The streams of water are held together by the water's "stickiness" or surface tension. Surface tension is the tendency of the surface of a liquid to behave as if it's covered with a skin. This is because of the cohesive forces between the water molecules at and near the surface.

Document your findings from this experiment.

Source: http://www.spartechsoftware.com/reeko/Experiments/ExpStickyWater.htm (modified)

LESSON 3

Water Illusions: Refraction & Magnification

Investigation 1: Underwater Differences

OBJECTIVE

In this investigation you will learn about the unique properties that cause water to distort, or change, images.

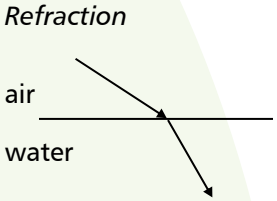
Part 1: Broken Pencil

GET READY!

You will conduct an experiment to see how water bends light and changes the images we see. Fill the jar with water.

PREDICT

What will happen when you place the pencil in the glass of water? Will the pencil appear the same as it does out of the water? Why or why not?



OBSERVE

Place the pencil in the jar of water and make observations. Look at the jar from the top and the sides. Discuss your observations with your partner.
Diagram your observations about the pencil in the water:

Part 2: Stick it to the Bottom

PROCEDURE

1. Place a sticker onto the table. Don't remove the sticker from its coated backing.
2. Place a small glass or jar over the sticker.
3. Fill the glass or jar with water.
4. Look throught the glass of water as you slowly slide the glass back and forth over the sticker.

OBSERVE

Make and discuss the following observations:

- What happened placed the glass of water over the sticker?
- Diagram what you see after you placed the jar over the sticker.

WRAP-UP

It is important to share results so that everyone has a clear picture of what happened. Scientists learn from each other through discussion and build upon the work of others to make new discoveries. Just as scientists come to conclusions based on the findings of their investigations, we will now come together as a group to make conclusions in this wrap-up part of the lesson.

GROUP DISCUSSION

What did you learn from the group discussion? Did everyone have the same results? Did someone have a different opinion than you?

REFLECTION

What are your own ideas about this investigation? What new things did you learn? What surprised you? Record any thoughts that you might have

Curriculum Match-Up

Here are some additional activities you can do to enhance what you learned in this investigation:

- Diagram the angles of refraction and reflection that occur in the sticker experiment.
- Draw two fish of the same size (2 inches in length and ½ inch in width) on a piece of lined paper. Place a beaker filled with water over one of the fishes. Notice that the "underwater" fish looks higher up and a little further back than where you know it is on the paper. The second fish acts as a "control" to help you make the comparison.
- Shine a flashlight through a beaker filled with salt water and a beaker filled with fresh water. Add some drops of food coloring to the beakers and predict which transmitted light will be brighter. Which beaker transmitted more light? Record your observations. How do you think the sunlight that travels through water affects animals and plants that live in water environments?
- Repeat the investigation using different objects and different liquids. What would happen if you used oil in the beaker instead of water? Diagram the images that you see inside the glass jar.

Investigation 2: Bigger Through Water

Part 1: Water Through a Loop

GET READY!

You will now conduct an experiment that shows how water can magnify, or enlarge, objects.

PROCEDURE

1. Choose two (2) nails of different sizes.
2. Using one of two nails, wrap one end of the wire tightly around the nail. Tighten the wire by twisting it.
3. Carefully slide the wire loop off the nail.
4. Dip the wire in a cup of water so that water collects in the loop.
5. Repeat these steps with the second, different-sized nail.

OBSERVE

Discuss your observations with your group or partner.
What do you notice as you look through the loop?

Part 2: Reading Through Water

Use the wire loops to read small and large letters on the newspaper or magazine. Try to place more and then less water on the loop and read the letters again through the loop.

OBSERVE

Observe and discuss the following:

- Which loop is the better magnifier, the loop with more or less water? Is it the larger loop, or the smaller loop?
- Describe and diagram the shape and direction of the water drop in the loop.

WRAP-UP

It is important to share results so that everyone has a clear picture of what happened. Scientists learn from each other through discussion and build upon the work of others to make new discoveries. Just as scientists come to conclusions based on the findings of their investigations, we will now come together as a group to make conclusions in this wrap-up part of the lesson.

GROUP DISCUSSION

What did you learn from the group discussion? Did everyone have the same results? Did someone have a different opinion than you?

REFLECTION

What are your own ideas about this investigation? What new things did you learn? What surprised you? Record any thoughts that you might have.

colors of the rainbow

Words of Wisdom!

"Almost all really new ideas have a certain aspect of foolishness when they are first produced."

- Alfred North Whitehead

Curriculum Match-Up

Here are some additional activities you can do to enhance what you learned in this investigation.

- Draw the way the printed words look through the drop of water inside the loop.
- Repeat the investigation using different liquids (variables). For example, what would happen if you used oil instead of water?

Science @ Home!

Refraction Made Simple

A water drop is like a lens, bending the light and changing the image of the things we see. This experiment demonstrates how water scatters light in different directions. Record your predictions and observations.

Materials

- 1 clear glass or jar
- Water
- 1 flashlight
- A room that you can make dark

Investigation

1. Put the jar of water on a table.
2. Turn off the lights in the room.
3. Shine the flashlight at an angle at the surface of the water.
4. What do you observe? How does this happen? Document your observations and findings.

Explanation

You will see that the light beam changes direction when it hits the surface of the water, and the angle of the light changes. Why? Because light rays "bend" as they travel through the glass and through the water. Water slows the light down causing the light to bend. This bending is called "refraction". You may have observed refraction if you've ever dropped a fork into a sink filled with water. The fork seems to be in a certain spot in the sink, when in reality it is in a different place. The water has distorted or changed the fork's image so that it appears to be in a specific place.

Source: http://library.thinkquest.org/11771/english/hi/physics/refraction.shtml (modified)

LESSON 4

Stuck on You: Adhesion I

Investigation: Fabric Frenzy

OBJECTIVE

In this investigation you will learn why water molecules stick to the molecules in other kinds of materials, a property known as adhesion.

Part 1: Exploring Fabrics

GET READY!

You will conduct an experiment to determine how well water sticks, or adheres, to different fabrics.

Brainstorm

As the group is brainstorming, make a list of the things that come to mind.

What kind of materials would you use to clean up a water spill?

OBSERVE

Examine each of the fabrics by looking at them with the magnifying lenses and by touching them with your fingers. Record your observations in the chart in Part 2.

- Which fabric would make the best raincoat? Why?
- Which fabric would make the best mop? Why?

Part 2: Testing the Fabrics

GET READY!

Weigh each dry piece of fabric on the balance and record the weights in the chart in Part 2.

PREDICT

How the water will affect the weight of the fabric. Why did you make this prediction? Record your predictions.

TIP

The pan balance needs to be balanced with the needle in the center between each fabric test. Be sure to dry the balance pans after weighing each piece of wet fabric.

PROCEDURE

1. Pour 200 mL (7 oz or 14 Tbsp) of water into the jar.
2. Using the tongs, place one of the fabrics into the water until it becomes completely wet.
3. Once it is wet, lift the sheet out of the jar with the tongs, holding it over the beaker until it no longer drips.
4. Place the wet fabric on the balance and weigh it again.
5. Calculate how much water each piece of fabric absorbed by subtracting the dry fabric weight from the wet fabric weight, and record these amounts below.
6. Repeat this process with the remaining fabrics and record your results.

Testing the Fabrics

	Cotton	*Nylon*	*Polyester*	*Linen*	*Twill*	*Wool*
Look						
Feel (touch/texture)						
Dry Weight						
Wet Weight						
Amount absorbed *(wet weight-dry weight)*						

WRAP-UP

It is important to share results so that everyone has a clear picture of what happened. Scientists learn from each other through discussion and build upon the work of others to make new discoveries. Just as scientists come to conclusions based on the findings of their investigations, we will now come together as a group to make conclusions about our results.

GROUP DISCUSSION

What did you learn from the group discussion? Did everyone have the same results? Did someone have a different opinion than you?

REFLECTION

What are your own ideas about this investigation? What new things did you learn? What surprised you? Record any thoughts that you might have.

Curriculum Match-Up

Here are some additional activities you can do to enhance what you learned in this investigation.

- Repeat the investigation and find the ratio of the weight of the fabric to the amount of water the fabric absorbed.
- If you dropped a cup of water on the floor in your kitchen and wanted to clean it up fast, which fabric would you use?
- Watermelon is a fruit that is made up of 85% water. Using the following words, can you explain how water can stay inside of the skin of a watermelon?
    - Attraction
    - Molecules
    - Adhesion
- Imagine that it is raining outside and you need to get from your home to the car without getting wet? What materials would you use to keep dry? How will this object keep you from getting wet?

LESSON 5

Stick to It: Adhesion II

Investigation: Walking the Tightrope

OBJECTIVE

In this investigation you will continue your exploration of adhesion by examining how water sticks to different types of string.

Part 1: Water on a String

PROCEDURE

1. Measure 60 cm using the measuring tape and then mark this distance on the table with masking tape.
2. Cut 70 cm of cotton string to use in the investigation.
3. Label two cups "A" and "B".
4. Fill cup A 3/4 full of water.
5. Try getting the water from one cup to another while keeping the cups 60 cm apart.

OBSERVE

As you are conducting the investigation make the following observations and discuss them with your partner:

- What methods did you try? What worked and what did not?
- How much water were you able to transport into cup B?

Part 2: A String of Strings

PROCEDURE

Repeat the procedure from Part 1, experimenting with different lengths and types of string such as thread, yarn, twine, waxy string and fishing line. Record your data in the chart below.

Type of String	Length	Observations

Part 3: One String or Two?

Repeat the experiment using two strings instead of one to create a water bridge. Compare and contrast these results with the results you achieved when using only one string.

Part 4: Going the Distance

Try to transport water across the entire room using the string of your choice. Record your results.

Write or draw an explanation of one method you tried during this investigation and why you think it worked.

WRAP-UP

It is important to share results so that everyone has a clear picture of what happened. Scientists learn from each other through discussion and build upon the work of others to make new discoveries. Just as scientists come to conclusions based on the findings of their investigations, we will now come together as a group to make conclusions about our results.

GROUP DISCUSSION

What did you learn from the group discussion? Did everyone have the same results? Did someone have a different opinion than you?

REFLECTION

What are your own ideas about this investigation? What new things did you learn? What surprised you? Record any thoughts that you might have.

Curriculum Match-Up

Here are some additional activities you can do to enhance what you learned in this investigation.

- Repeat the experiment and create a graph of the time it took for water to travel along the different types of string.
- Calculate the ratio of length to speed for different strings.
- Calculate the average speed for different trials or different types of string.
- Create a graph for how long it took to get water across the room for the entire class.
- List five ways that you might observe the property of adhesion as you walk home on a rainy day.

Words of Wisdom!

"Exploratory research is really like working in a fog. You don't know where you're going. You're just groping. Then people learn about it afterwards and think how straightforward it was."

- Francis Crick

Science @ Home!

Does Water Stick Like Glue?

Is water like glue? Why does water roll off a duck's back? It's because of a property of water known as adhesion. The following experiment will test the adhesive (sticky) quality of water. Record your observations and findings.

Materials

- Smooth plastic surface to work on
- Smooth metal pan with no dents
- Large cup of water

Investigation

1. On a flat, even plastic surface, pour out a puddle of water.
2. Set a smooth pan firmly in the puddle, making sure it is completely wet underneath.
3. Now ask an adult helper to pull straight up on the pan.

Record your observations.

Now try to pull the pan straight up off of the plastic surface. It will be hard to pull up. Be careful not to pull up too hard to avoid hurting yourself.

Explanation

A property called adhesion (add-HEE-zhun) makes water act "sticky" like tape or glue. Adhesion occurs when two different substances are attracted to each other. The adhesive forces between water and certain materials can be very strong.

Source: http://www.nationalgeographic.com/ngkids/trythis/trythis_water/stuck-up.html

LESSON 6

Breaking the Tension: Surface Tension I

Investigation: Walk on Water

OBJECTIVE

In this investigation you will learn that attractive forces between water molecules cause an invisible "skin" known as surface tension, to form on the surface of water.

Part 1: Floating Paperclips

GET READY!

You will conduct an experiment to determine whether water can support a paperclip.

How do you think the water strider and other insects are able to walk across water without falling in?

PREDICT

As you proceed with each part of this investigation, think about what will happen before you move to the next step. Record your prediction:

Will the paperclip sink or float? _____

PROCEDURE

Using the materials provided, try to get the paperclip to float on the surface of the water in the cup. Start with the small paperclips first before trying paperclips of larger sizes.

OBSERVE

As you conduct the investigation, make and record your observations.
What do you observe about the paperclip as you look at it under the magnifying glass?

Part 2: Sink to the Bottom

PREDICT

What will happen to the floating paperclip when you add detergent to the water?

OBSERVE

While your paperclip is floating in the cup, add a drop of dish detergent to the water. Discuss your observations with your partner or group.
What happened to the paperclip when you added the detergent to the water? Why do you think this happened?

WRAP-UP

It is important to share results so that everyone has a clear picture of what happened. Scientists learn from each other through discussion and build upon the work of others to make new discoveries. Just as scientists come to conclusions based on the findings of their investigations, we will now come together as a group to make conclusions about our results.

GROUP DISCUSSION

What did you learn from the group discussion? Did everyone have the same results? Did someone have a different opinion than you?

REFLECTION

What are your own ideas about this investigation? What new things did you learn? What surprised you? Record any thoughts that you might have.

Joke of the Day

Teacher: What is the formula for water?
Student: H, I, J, K, L, M, N, O
Teacher: That's not what I taught you
Student: But you said the formula for water was... H to O.

Curriculum Match-Up

Here are some additional activities you can do to enhance what you learned in this investigation.

- Imagine that you are a water strider and write a story about what it is like to be able to walk on water.
- Create a chart or graph for the results of different-sized paperclips.
- Try the investigations again with different water solutions: salt water or carbonated water, for example.

LESSON 7

Below the Surface: Surface Tension II

Investigation 1: A Soapy Sloop

OBJECTIVE

In this investigation you will continue your exploration of surface tension by examining whether water will support different types of materials.

Part 1: Floating Along

GET READY!

You will conduct another experiment about surface tension, this one involving a boat.

1. To create your boat, cut a 2.5 inch high and 1.5 inch wide triangle out of your index card.
2. Then cut a smaller triangle directly in the center of the back edge of the boat for the "motor".

PREDICT

As you proceed with each part of the investigation, think about what will happen before you move to the next step.

What do you think will happen when you place your boat in the water?

PROCEDURE

1. Place your boat in the water near the edge of the pie tin and make observations.
2. Next, place a drop of boat's "fuel" (dish detergent) inside the smaller triangle at the back of the boat.
3. What happened to the boat just after adding the detergent? Why do you think this happened?

Part 2: A Different Boat

Try this investigation again with a different type of paper and compare your findings. Choose a different paper and build a new boat.

Investigation 2: Petrified Pepper

Part 1: A Dash of Pepper

GET READY!

You will be conducting another experiment to explore the surface tension of water.

PREDICT

As you proceed with each part of the investigation, think about what will happen before you move to the next step.

What will happen if you sprinkle some black pepper into the cup?

PROCEDURE

1. Half-fill your cup with water.
2. Sprinkle some pepper on the surface of the water and observe.
3. Think what will happen if you add a drop of dish detergent.
4. Add a drop of dish detergent to the water and make observations.

OBSERVE

Make and record the following observations:

- What happened to the pepper when you first sprinkled it on the water?
- What happened when you added the detergent?
- Why do you think this occurred?

Part 2: What If?

What if we used different liquids in this experiment? Record your ideas about what might happen if you change some of the variables. Would your results change? Try it and observe what happens!

Various Liquids & Floating Pepper

Different Liquids	Prediction	Observations

WRAP-UP

It is important to share results so that everyone has a clear picture of what happened. Scientists learn from each other through discussion and build upon the work of others to make new discoveries. Just as scientists come to conclusions based on the findings of their investigations, we will now come together as a group to make conclusions in this wrap-up part of the lesson.

GROUP DISCUSSION
What did you learn from the group discussion? Did everyone have the same results? Did someone have a different opinion than you?

REFLECTION
What are your own ideas about this investigation? What new things did you learn? What surprised you? Record any thoughts that you might have.

Curriculum Match-Up

Here are some additional activities you can do to enhance what you learned in this investigation.

- Try changing one variable and test your paper boats again. Add oil to the water in place of detergent, or try using saltwater instead of freshwater.
- Create additional boats of your own design using different materials. Test your new boat and document your results.
- Create a chart or graph for different liquids, soaps, condiments, spices or water temperatures that you used.

Science Factoid

A tsunami is series of catastrophic ocean waves generated by underwater movements, which are caused by earthquakes, volcanic eruptions, landslides beneath the ocean, or an asteroid striking the earth. Tsunami principally occur in the Pacific Ocean following earthquakes over magnitude 6.5 on the Richter scale.

Science @ Home!

What is Surface Tension?

A drop of water is small, but it is made of even smaller parts called molecules. Water molecules have strong attractive bonds that hold them together. At the surface of the water, the molecules hold on to each other even more tightly, forming an invisible "skin". The force of the molecules on the surface sticking together is called surface tension.

Water striders and other insects can walk on water without sinking. The force of the water's surface tension is strong enough to hold the weight of the insects. The insects' feet make dents in the water's surface, but it doesn't break. The following experiments demonstrate that surface tension is there, even if you can't see it.

Materials

- Cooking oil
- Water

Investigation

1. Rub a few drops of cooking oil on your hand. What do you notice about your hand?

2. Next, let water from a faucet (tap) run over your hand. Turn off the faucet. What happens?

3. Wash your hands with soap. Does this make the oil go away?

4. How many times did you have to wash your hands to get rid of the oil?

Explanation

The water molecules stick together tightly and will not mix with the oil on your hand. Since water molecules are attracted to each other so strongly, you formed small balls or drops which rolled over your oil-coated hand. There is an invisible "skin" of surface tension around each drop of water.

Source: http://www.epa.gov/OWOW/NPS/kids/TENSION.HTM

LESSON 8

Moving On Up: Capillary Action I

Investigation: Colorizing Carnations

OBJECTIVE

In this investigation you will learn how water can travel through plants and other materials by a process known as capillary action.

Part 1: Color Me Happy

GET READY!

You will conduct an experiment to understand how a paper towel can soak up a spill, and how water gets from the roots to the leaves of a tree.

PROCEDURE

1. Measure out 75 mL of water.
2. Place 20 drops of blue or red food coloring into the beakers or measuring cups. Observe what happens after you add the food coloring to the water. Record the amount of water and number of drops in their student journals.
3. Place the celery stalks and carnations in each of the cups and set them aside. As an option, you can split some of the carnation stems down the middle, keeping them attached to the flower, and placing each half in a different colored container of water.
4. Record the date and what time it is when they place the carnations and celery in the water.

Amount of water: _____
Number of drops: _____
Date: _____
Time: _____

PREDICT

What do you think will happen to the celery and carnations as they sit in the colored water?

OBSERVE

As you conduct the investigation, make and record the following observations:

- What do you observe about the stem/stalk of the plants? Pick up the carnation/celery and examine the bottom of the stem where it was cut. Diagram what you observe.

- What do you notice about the petals and leaves? How do they look under magnifying lenses? Diagram what you observe.

- Examine the carnations and celery each day and record your observations on the next page. Measure and record how high the food coloring traveled up the plants.

Celery and Carnation Observations

	Celery Observations	Carnation Observations
Day 1		
Day 2		
Day 3		
Day 4		
Day 5		
Day 6		

Part 2: What If?

If you could change one thing about this investigation to learn something new, what would you try? When we change one part of an experiment to see how it affects our results, this change is known as a variable. Try the same experiment with some variations. Use the chart to record your results.

PROCEDURE

Measure and record your results from the celery or carnation experiment using 1-2 variables of your choice (e.g. different liquid, different temperature, wilted celery etc.).

Celery and Carnation Variations

	Variable 1_____		Variable 2_____	
	Carnation	Celery	Carnation	Celery
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Day 6				

WRAP-UP

It is important to share results so that everyone has a clear picture of what happened. Scientists learn from each other through discussion and build upon the work of others to make new discoveries. Just as scientists come to conclusions based on the findings of their investigations, we will now come together as a group to make conclusions in this wrap-up part of the lesson.

GROUP DISCUSSION

What did you learn from the group discussion? Did everyone have the same results? Did someone have a different opinion than you?

REFLECTION

What are your own ideas about this investigation? What new things did you learn? What surprised you? Record any thoughts that you might have.

Words of Wisdom

"The universe is wider than our views of it."

- Henry David Thoreau

Curriculum Match-Up

Here are some additional activities you can do to enhance what you learned in this investigation.

- Graph the distances the water traveled in the celery and carnations for a particular time period.
- Create a graph for the time it took for the water to travel all the way up the celery and carnations.
- Graph the speeds or distances for different colored water.
- Repeat the experiment using other materials such as cotton string. What do you observe?

Lesson 9

Moving On Up: Capillary Action II

Investigation 1: Paper Blooms

OBJECTIVE

In this investigation you will continue your exploration of capillary action by examining how water travels through other types of materials.

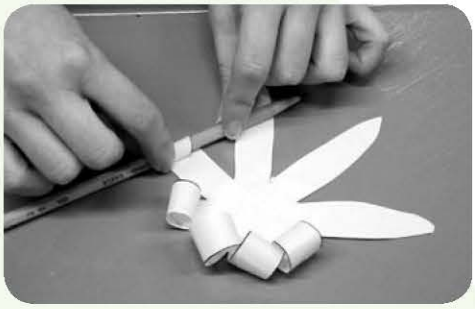
Part 1: Unfurling Flowers

GET READY!

You will be conducting another experiment about capillary action, this one involving paper flowers.

PROCEDURE

1. Fill your pie tins halfway with water and add two drops of food coloring.
2. Use the flower template to trace a flower on the notebook paper and cut it out.
3. Use a pencil to roll up the petals so that it looks as if the flower is closed.



PREDICT

Think about what will happen before you proceed with the investigation and record your predictions. What will happen when the paper flower is placed into the colored water? Why do you think this will happen?

OBSERVE

Place the flower (curled petals up) in the pie tin. Make the following observations and discuss them with your partner or group:
What happened to the paper flower when it was placed in the pie tin?

Part 2: What If?

Share questions that might have come up as you conducted the first part of this investigation, "Unfurling Flowers". Think of other questions you would like to explore. Repeat the experiment again using a different variable (soapy water, salt water, hot water, different paper, different amounts of food coloring, differently sized or shaped flowers). Record your results.

Investigation 2: Toothpick Tricks

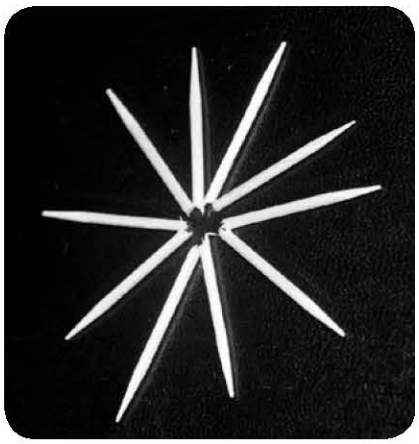
Part 1: Toothpick Flowers

GET READY!

You will be conducting another experiment about capillary action, this one involving toothpicks.

PROCEDURE

1. Prepare colored water in the 16 oz cups by pouring water into the cups and adding several drops of food coloring to the water.
2. Bend five flat toothpicks in half without breaking them, so that each one is in the shape of a "V".
3. Arrange the five toothpicks on a waterproof surface with the base of the V's touching, to resemble a flower.



PREDICT

Make a prediction about what you think will happen if you place a drop of water in the center of the toothpick flower. Why do you think this will occur?

OBSERVE

Place the end of your straw into the colored water. Hold a finger over the other end of the straw and lift the straw out of the water. Place a drop of water into the center of the toothpick flower making sure to cover the bent part of each toothpick and record your observations of the following:

- What happened to the toothpicks?

- Draw your "before" and "after" observations of the toothpicks.

Part 2: What If?

Think of other questions you would like to explore. Change a variable and repeat the experiment. Some possible variables to try include: using a different type of toothpick, popsicle sticks, a different liquid, etc. Record your observations in the chart below.

Toothpick Flowers Investigation

Variable	Observations

WRAP-UP

It is important to share results so that everyone has a clear picture of what happened. Scientists learn from each other through discussion and build upon the work of others to make new discoveries. Just as scientists come to conclusions based on the findings of their investigations, we will now come together as a group to make conclusions in this wrap-up part of the lesson.

GROUP DISCUSSION

What did you learn from the group discussion? Did everyone have the same results? Did someone have a different opinion than you?

REFLECTION

What are your own ideas about this investigation? What new things did you learn? What surprised you? Record any thoughts that you might have.

Words of Wisdom

"Only a fool of a scientist would dismiss the evidence and reports in front of him and substitute his own beliefs in their place."

- Paul Kurtz

Curriculum Match-Up

Here are additional activities you can do to enhance what you learned in this investigation.

- Tie-dye shirts to see capillary action happen before your eyes.
- Experiment with white paper towels to see which liquids travel the farthest and fastest, and does the print on the paper towel effect the absorption rate.
- Graph the speeds or distances for the different liquids or different colored water.
- Diagram the path of water as it flows through a tree or plant by capillary action.

Science @ Home!

Rising to the Top: Capillary Action

Plants contain many vein-like tubes that carry water from the plant's roots upwards to its highest leaves. Try this experiment at home to see capillary action at work.

Materials

- A clear drinking straw
- Food coloring
- Glass
- Water

Investigation

Record your predictions and observations as you do this experiment:

1. Pour four (4) drops of the food coloring into a glass half filled with water.
2. Now place your clear straw into the glass of water.
3. Examine the straw carefully. The dye should climb up the straw above the level of the liquid in the glass.

Explanation

Even though we usually think of water as moving downhill, it can flow upwards using a process called capillary action (pronounced kap-uh-LAR-ee), is the tendency of liquids to move into or out of tiny, hairlike passageways. This is the same scientific rule that explains how water travels from the soil upwards through the stems of plants. Try this experiment again with varying levels of water in the glass. Does this make a difference?

LESSON 10

Uplifting Force: Buoyancy & Density

Investigation: Sink or Float?

OBJECTIVE
In this investigation you will conduct experiments to find out how objects can stay afloat.

Part 1: Marble vs. Clay

GET READY!
For each part of this lesson, you will make predictions about whether the objects will sink or float. After making your prediction, place the object in the water and record your observations.

PROCEDURE
Divide students into groups of two or three.
1. Mold a small piece of modeling clay into a ball the same size as the marble in their supplies.
2. Make observations about the properties of the clay ball and the marble. Describe the differences and similarities between the clay and the marble.
3. Weigh the marble and the ball of clay using the pan balance.

PREDICT
- What will happen when you put the marble in the water?

  Circle your prediction:

  Sink or Float

- What will happen when you put the ball of clay in the water?

  Circle your prediction:

  Sink or Float

OBSERVE
Place the marble and the ball of clay into the water. What do you observe?

Part 2: Bottle Basics

Seal the lid of bottle. Weigh the bottle using the pan balance.

PREDICT

What will happen to the bottle when you place it in the water?

Circle your prediction:

Sink or Float

Record your observations.

OBSERVE

Place the airtight bottle in the water and make observations.
What happened to the bottle after you placed it in the water?

Part 3: Marble in a Bottle

Remove the bottle from the water. Next, place the marble into the bottle and replace the cap. Before you place the bottle in the water, make some predictions about what will happen.

PREDICT

What will happen to the bottle with the marble in it when you place it in the water?

Circle your prediction:

Sink or Float

Record your observations.

Part 4: Clay in a Bottle

Remove the bottle from the water. Remove the marble from the bottle. Next, place the ball of clay into the bottle and replace the cap. Before you place the bottle in the water, make some predictions about what will happen.

PREDICT

What will happen to the bottle with the clay in it when you place it in the water?

Circle your prediction:

Sink or Float

Record your observations.

Part 5: Bottle Full of Water

Remove the bottle from the water. Remove the ball of clay from the bottle. Next, fill the bottle with water and replace the cap. Weigh the bottle of water using the pan balance. Predict what will happen when the bottle is placed in the water.

PREDICT

What will happen to the bottle of water when you place it in the water?

Circle your prediction:

Sink or Float

Record your observations.

WRAP-UP

It is important to share results so that everyone has a clear picture of what happened. Scientists learn from each other through discussion and build upon the work of others to make new discoveries. Just as scientists come to conclusions based on the findings of their investigations, we will now come together as a group to make conclusions in this wrap-up part of the lesson.

GROUP DISCUSSION

What did you learn from the group discussion? Did everyone have the same results? Did someone have a different opinion than you?

REFLECTION

What are your own ideas about this investigation? What new things did you learn? What new ideas do you have about water? What surprised you? Record any thoughts that you might have.

Curriculum Match-Up

Here are some additional activities you can do to enhance what you learned in this investigation.

- Make a chart of the items that sink and float in this investigation.
- Repeat the investigation using a ball of aluminum foil, cornflakes, paperclips or pennies in place of marbles and clay. Predict whether or not these items will sink or float. How many will it take to sink the bottle?
- Add ½ cup of salt to the water and try the investigations again. What do you observe?

Words of Wisdom

"Everyone takes the limits of his own vision for the limits of the world."

- Arthur Schopenhauer

LESSON 11

Above Water: Buoyancy & Displacement

Investigation: Shape It!

OBJECTIVE
In this investigation you will conduct experiments to find out how shape affects an object's ability to stay afloat in water.

Part 1: Float Your Clay

GET READY!
1. Mold a ½ stick of modeling clay into a ball.
2. Think about how you can get your ball of clay to float in the water.

PREDICT
Before you place the ball of clay into the water, make and record some predictions.

Will the ball of clay float, or will it sink? _____

PROCEDURE
1. Place your ball of clay into the water and make observations. What happens?

2. How can you the shape clay differently so it will float?

3. Place the re-shaped clay into the water. Keep working on the shape until you can get your clay to float.

OBSERVE
Describe and draw the shape of the molded clay that you were able to float.

Part 2: How Many Paperclips Can You Float?

PREDICT
How many paperclips will the clay boat hold until it can no longer stay afloat?
_____ number of paperclips

PROCEDURE
1. Slowly begin placing paperclips into the clay boat.
2. Count the number of paperclips and make observations about the water level as you place the paperclips into the boat.
3. Continue adding paperclips until your clay boat sinks.

Record the number of paperclips that it took to sink your boat. _____

Part 3: How Many Marbles Can You Float?

Re-shape the clay boat and make sure it floats before continuing.

PREDICT

How many marbles can your boat hold until it can no longer stay afloat?

_____ number of marbles

PROCEDURE

1. *Slowly* begin placing paperclips into the clay boat.
2. Count the number of paperclips and make observations about the water level as you drop the paperclips into the boat.
3. Continue to add paperclips until your clay boat sinks and record the number of paperclips used.

OBSERVE

Discuss your observations with your partner or group.

- Do the results of the paperclips and the marbles differ? If so, why?
- Record the number of marbles that it took to sink your boat.

_____ number of marbles

WRAP-UP

It is important to share results so that everyone has a clear picture of what happened. Scientists learn from each other through discussion and build upon the work of others to make new discoveries. Just as scientists come to conclusions based on the findings of their investigations, we will now come together as a group to make conclusions in this wrap-up part of the lesson.

GROUP DISCUSSION

What did you learn from the group discussion? Did everyone have the same results? Did someone have a different opinion than you?

REFLECTION

What are your own ideas about this investigation? What new things did you learn? What new ideas do you have about water? What surprised you? Record any thoughts that you might have.

Words of Wisdom

"There are some people that if they don't know, you can't tell 'em."

- Louis Armstrong

Curriculum Match-Up

Here are some additional activities you can do to enhance what you learned in this investigation.

- Graph the number of items that it took to sink your clay boat.
- Repeat the investigation using aluminum foil in place of clay, or pennies in place of marbles or paperclips.
- Rework the clay into a few different-shaped boats to see which model will carry the most marbles.
- Add salt to the water and try the investigations again. Are the results different? What do you observe?
- Discuss why objects seem lighter in water than they do on dry land.
- Research how a ship's crew knows just how much cargo a ship can hold.

Science @ Home!

Why Ice Cubes Float

An ancient Greek mathematician name Archimedes first recorded the physical law of buoyancy. You can see this law is in action by placing an object in water. As gravity pulls the object downward, you will notice that the object moves (displaces) the water. In turn, the water pushes upward on the object. But where does the displaced water go? Learn more by doing this simple experiment at home with an adult helper.

Materials

- 3 cups of water, filled half-way
- Ice cubes
- Several small rocks
- 1 small leaf

Investigation

Record your predictions and observations.

- **Activity 1**

  In one cup of water, add an ice cube. See how the water rose? Add another ice cube, and another, and finally the last one. The water rises with each ice cube that you add. Did the ice cubes float or sink?

Explanation

The ice cubes float because the density of the ice cubes is less than the density of the water. The water rose because of the liquid that was displaced (moved out of the way) with the addition of each ice cube. The ice and the water can't occupy or be in the same space at the same time, so one object has to make room for the other by moving out of the way. In this case, the water level rises as the water moves up.

- **Activity 2**

  In the second cup of water, add a small rock. Did the water rise? Did the rock sink or float? Add a rock, one at a time, until they all are in the water.

Explanation

The rocks sank because they are denser than the water. The water rose for the same reason as the ice cubes – the water was displaced, or moved out of the way, by the ice.

- **Activity 3**

  In the last cup of water, add the leaf. Did it sink or float? Is the leaf more dense or less dense than the water? Did the water rise? What role does surface tension play here?

Explanation

The downward force on the leaf is the same as the upward force (buoyant force) from the water. Also notice the shape of the leaf. The flat shape of the leaf allows it to evenly distribute its mass across the surface of the water.

Source: http://www.kinderart.com/teachers/waterweigh.shtml (modified)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