21st Century
Literacy Through Science

Water Science

Name: ______________________________

Summer Camp
Willinboro, NJ
2010

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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.

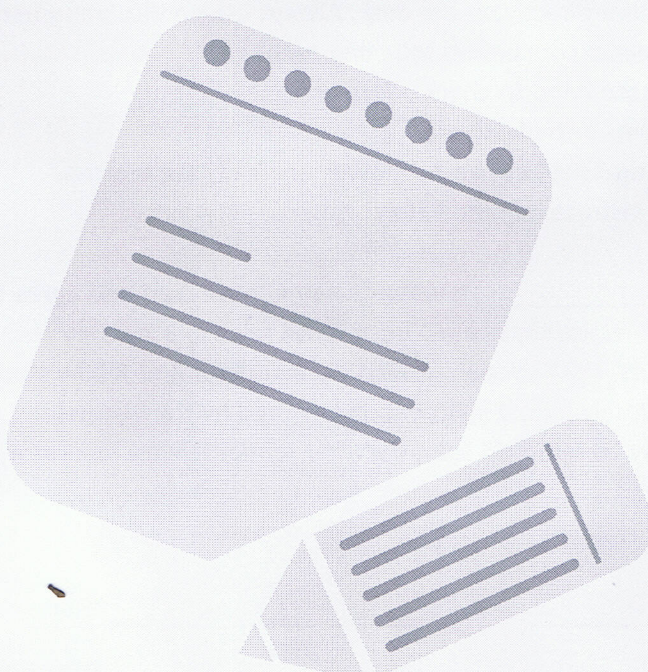
The scientific method involves the following steps:

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

What's the Method?

By Trista L. Pollard

1 Some of the best inventions happen by accident, like Toll House cookies. However, most inventions happen after many years of research. Scientists test and retest ideas hoping to solve **scientific** puzzles. Good scientists use a process called the **scientific method**.

2 The scientific method is a series of problem solving steps that help scientists answer scientific questions. You also use the scientific method when you work on **experiments** in your classroom. Scientists use this method to prove a scientific question true or false. These questions usually are asked after scientists have made **observations**. An observation happens when you use your senses (i.e., sight, smell, hearing, etc.) to notice what is going on around you. For example, your mom packs cut apples wrapped in plastic wrap in your lunch everyday. You notice at lunch time that the apples are slightly brown. This is an observation.

3 After observing your brown apples, you ask yourself, "Why does this apple turn brown when it is cut?" This is your **scientific question**. You start to guess or think about possible reasons for your brown apple. The time has come for you to make a good guess or a **hypothesis** based on your observations. You predict that the apple turns brown because air or oxygen has touched your apple. To prove your hypothesis, you need to develop a **procedure** or plan to test your **prediction**.

4 Your plan is very simple. You decide to (1) cut an apple into four pieces, (2) put the apple into a bowl, and (3) let the bowl with the apple sit on your kitchen counter overnight. These three steps will allow you to see if oxygen causes cut apples to change color. When you wake up in the morning, you decide to look at your apple pieces. You are met with four brown apple pieces staring at you from the bowl. Now you are ready to **record** your **results**.

5 Scientists record their results either with pictures or with words. Pictures can be charts, diagrams, or graphs. Words are usually summaries or short paragraphs that explain what happened during your experiment. In this case, you may wish to mentally or in your mind record your results about your apple. You might also choose to share the results or **data** with your friends at the lunch table in school. You could also write a short paragraph about your experiment and give it to your teacher. However, before you record your results make sure you include a **conclusion**. This conclusion or statement tells the results of your experiment. Your conclusion is, "When apples are cut and oxygen makes contact with the apples, they turn brown." When the chemicals in the oxygen combine with the natural chemicals in the apple, a change or **reaction** occurs. This

change makes the apples turn brown.

6 You are probably feeling good about your results and think that your scientific study is over. However, good scientists also ask more questions, record more observations, and offer more suggestions about the subject they are studying. You may ask, "Is there a way to prevent cut apples from turning brown when they are exposed to oxygen?" After researching your new question, you could offer suggestions to other mothers for the best way to wrap apple slices to prevent browning. Keep in mind, that whatever scientists investigate, they know that the scientific method is the key to unlocking scientific secrets.

Name ______________________________ Date ____________________

What's the Method?

1. A hypothesis is______________. Ⓐ An experiment Ⓑ A good guess based on observations Ⓒ A result of an experiment Ⓓ None of the above	2. The scientific method is one step scientists use to solve scientific problems. Ⓐ False Ⓑ True
3. What is an observation? ______________________________ ______________________________	4. Which statement is **<u>not</u>** a prediction? Ⓐ I think I will stay home tonight. Ⓑ I think the balloon will pop when the chemicals react. Ⓒ I think the salt will dissolve when I add water to the cup. Ⓓ I think the wood will float when I put it into the water.
5. What is a conclusion? ______________________________ ______________________________	6. After leaving the apple slices in the bowl on the counter, they turned brown. Ⓐ False Ⓑ True

WATER

What I KNOW:	What I WANT to know:	What I LEARNED:

The Water Cycle

By Sharon Fabian

1 If you haven't heard this before, it might sound a little disgusting, but it's true. The water that you drink today might be the same water that your little brother took a bath in last year. It might be the same water that people on the other side of the world used to wash their clothes or cook their vegetables one thousand years ago. It might even be the same water that a tyrannosaurus rex drank to wash down a hearty meal millions of years ago!

2 The water that we have on the earth today is the same water that the earth has always had, and the same water that it always will have. The earth's water constantly recycles itself in a process that is called the **water cycle**.

3 The water cycle has three main stages, evaporation, condensation, and precipitation, which repeat over and over again endlessly. This process cycles water from the earth, through the air, to the clouds, and back to earth again.

4 **Evaporation** is when heat, usually from the sun, changes liquid water on the earth to water vapor which rises up into the air. When the sun dries up a puddle of water, this is evaporation. You can also see evaporation in everyday events. When you put wet clothes into your clothes dryer, and later take out dry clothes, evaporation has gotten rid of the water for you. When you paint a picture, and let it sit to dry, evaporation dries the paint.

5 **Condensation** is the part of the process that changes water vapor back into liquid water or ice. As warm air rises, it meets cooler air in the atmosphere, which changes it back to water or ice and forms a cloud. This is condensation. The water drops that collect on the outside of a glass of ice water or soda are also condensation. These water drops don't come from inside the glass, they condense from the air around the glass.

6 **Precipitation** is rain, sleet, or snow. It is the part of the water cycle that brings our water back down to earth. As a cloud fills up with water drops or ice crystals, it starts to get heavy. Sooner or later gravity takes over, and pulls the water back to earth. It rains, or it snows.

7 After the rain falls to earth, it may stay here for a long time. Some water stays underground among the rocks for thousands of years. Eventually, however, the water will end up someplace where it can be evaporated, often in the ocean, and then the water cycle repeats itself. Evaporation, condensation, precipitation, evaporation, condensation, . . .

8 So, if we have as much water as we ever did, why are people trying to conserve water? The problem with water is not that we might run out of it; the problem with water is keeping enough of it ready to use. The water cycle can take a long time. Much of the water that falls back to earth ends up in the oceans, which of course are salt water, or in glaciers, which are frozen. Only a small part of the earth's water is available for our use at any particular time. And people are using more and more water all the time. So the challenge is to keep a supply of clean, fresh water available for people to use. Drinking water that a dinosaur once drank might seem a little strange, but having to drink polluted water -- now, that would be really disgusting.

Name ______________________________ Date __________

The Water Cycle

1. This is the name for rain or snow.
   - (A) Evaporation
   - (B) Precipitation
   - (C) Condensation

2. As the sun warms the earth, it turns water on earth into water vapor that rises into the air. This is called _____.
   - (A) Condensation
   - (B) Evaporation
   - (C) Precipitation

3. As water vapor rises, it meets cooler air that changes it back to water drops or ice crystals, which form clouds. This is called _____.
   - (A) Precipitation
   - (B) Condensation
   - (C) Evaporation

4. The water that the dinosaurs drank _____.
   - (A) Was salt water
   - (B) Is still in the water cycle
   - (C) Was not the same kind of water that we drink today
   - (D) Is gone

5. The process that keeps the earth's water constantly recycling is called _____.
   - (A) The water cycle
   - (B) Precipitation
   - (C) Evaporation
   - (D) Condensation

6. After rain falls on the earth, it may _____.
   - (A) Evaporate again very soon
   - (B) Travel downhill until it reaches the ocean
   - (C) Stay underground for years
   - (D) All of the above

7. If we use too much water, we could use up all of the water on earth.
   - (A) True
   - (B) False

8. Conserving water is not important.
   - (A) True
   - (B) False

Water

1 Water, making up to nearly 70% of our body weight, is the most important essential nutrient that we cannot live without for more than a few days.

2 In comparison to the other five essential nutrients -- carbohydrates, fats, proteins, vitamins, and minerals, water plays a less obvious role. It does not generate energy as carbohydrates, fats, and proteins do. It does not keep our eyes healthy as vitamin A does. Furthermore, it does not make our bones strong as mineral calcium does. In a way, water is like a puppet master that runs the show from behind the curtain. Although water makes no energy, it helps dissipate heat, a by-product of the energy production. Through perspiration, excess heat gets expelled and our body temperature gets regulated.

3 Aside from preventing us from being overheated, water also carries out three other vital functions to ensure that our bodies perform properly. The first is to deliver nutrients and oxygen to cells around our bodies, the second is to lubricate our joints and organs, and the third is to remove body wastes through sweat or urine.

4 Scientists recommend that we drink at least 8 glasses of water (from a 250-ml glass) a day. "Sure, no problem!" is probably what everybody thinks at first. Nevertheless, if we keep a tab on how many glasses of plain water, not how many glasses of water-added beverage such as soda and coffee, we drink a day, we may soon realize that we fall far short from meeting the requirement. Additionally, scientists also remind us to drink water throughout the day. A common mistake we make is to drink water only when we feel thirsty. This misperception can lead to chronic dehydration and cast a negative impact on our health.

5 So, however busy you are, remember to replenish your body with water -- at least 8 glasses of water, to be exact!

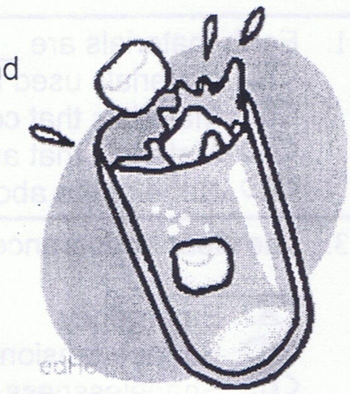
Name ______________________________ Date ____________________

Water

1. Which of the following essential nutrients makes up most of our body weight? (A) Vitamins (B) Carbohydrates (C) Fats (D) Water	2. Water regulates our body temperature. (A) False (B) True
3. Which of the following is **not** a function that water performs? (A) Water helps to eliminate body waste. (B) Water helps to generate energy. (C) Water helps to lubricate joints and organs. (D) Water helps to transport substance to cells.	4. If we drink 10 glasses of water from a 250-ml glass a day, how many liters of water would we drink in one week? (A) 17.5 liters (B) 12.75 liters (C) 19.5 liters (D) 14.25 liters
5. Which of the following essential nutrients does **not** produce energy? (Please choose two of the best answers) (A) Proteins (B) Vitamins (C) Fats (D) Minerals	6. Which of the following about water is correct? (A) We should drink water even if we don't feel thirsty. (B) Water makes our bones strong and keeps our eyes healthy. (C) Water makes up 30% of our body weight. (D) Because it produces no energy, it is not an essential nutrient.

Caution: Wet Property! (Properties of Water)

By Trista L. Pollard



1 It's a liquid! It's an earth material! It's water! Water is one of the most important substances that comes from the earth, and humans and animals need it to survive. Most people think of water as a daily thirst quencher and dirt washer. However, that clear liquid in your bathtub and in your cup has many properties or qualities that we can see.

2 Water has transparency. This means that when you stick your finger into a cup of water, you should still see your finger through the water. If the water was not clear or did not have transparency, you would have a hard time trying to find your finger. Water has no shape, so it is able to become the shape of its container. If you poured water into a bowl that was shaped like a teddy bear, you would have water that looked like a teddy bear. However, once you pour the water out, it would not be shaped like a teddy bear.

3 Water also has movement or flow. The reason scientists call water a liquid is because it can be poured and it can flow or move over surfaces. Water always flows downhill, unless, there is a force or machine to push it uphill. Imagine if your parents asked you to wash their car. While you were completing this exciting job, you decide to point the water hose into the air. Where would the water go? Well, it would go up, of course, because of the pump pushing the water through the hose. However, like most things, the water will come down. If your driveway has even the slightest hill, the water will flow to the bottom of your driveway. The steeper or more slanted the hill, the faster the water will flow down that slope or hill.

4 Water acts differently when it is dropped or placed on different surfaces. When you pour water onto a rug, it appears to disappear leaving behind only a spot. The rug absorbed or soaked up the water. If you place a drop of water on your kitchen counter, you may notice that the counter does not absorb the water. Instead the water beads or forms a sphere. This drop forms a skin like surface when it meets the air. Water in cups and in lakes also form the same tight surface. Scientists call this surface tension. If you pour water into a cup and carefully place a sewing needle flat on the water's surface, you would find that it does not sink to the bottom. The tight surface of the water allows the needle to float without sinking. If you were to place the needle into the cup so that it was not lying flat (point first), the surface of the water would be broken, and the needle would sink. Due to surface tension, there are insects called water striders that can actually walk on water.

5 As you can see, water is one of the most important substances on earth. Over 70 percent of our world is covered by water. (That would be about three slices of a four piece pizza pie. The one piece left over would stand for the amount of land on the earth.) Water's many properties allow it to do amazing things and to be used in amazing ways.

Name ______________________________ Date ______________

Caution: Wet Property! (Properties of Water)

1. Earth materials are ____________. (A) Materials used to farm on the earth (B) Materials that come from the earth (C) Materials that are made by people (D) None of the above	2. Water can be absorbed on all types of surfaces. (A) False (B) True
3. The clear appearance of water is called ____________. (A) Emergency (B) Surface tension (C) Shapelessness (D) Transparency	4. Water flows downhill, unless ____________. (A) There are trees in its path (B) The water is flowing through grass (C) There is a force or machine that pushes it in another direction (D) There are rocks in its path
5. What is surface tension? ______________________________ ______________________________	6. Water has no shape and becomes the shape of its container. (A) False (B) True
7. Water is flowing down Hill A. There is also water flowing down Hill B, which is steeper than Hill A. Which will get to the bottom quicker, the water flowing down Hill A or Hill B? ______________________________ ______________________________	8. Water striders can walk on water due to the water's ____________. (A) Surface tension (B) Volume (C) Shapelessness (D) Transparency

Name ______________________________ Date ____________________

Caution: Wet Property! (Properties of Water)

You Are The Scientist: Some materials absorb water better than others. Do a little scientific research. Collect different materials (for example, paper towels, wax paper, tin foil, etc.) and test how water reacts on these surfaces. Write a journal entry that explains what you observed during your experiment.

Daily Science Journal

Science Question of the Day # 1

Experimentation is an important aspect of science. What is the most interesting experiment you have ever done? Why did you enjoy it so much?

Math Question of the Day # 1

Use the order of operations correctly to compute the answer:

27 x (35 + 46) = ______

Science Question of the Day # 2

A process called "cloud seeding" allows scientists to make rain or snow. Should scientists interfere with natural weather patterns? Support your opinion.

Math Question of the Day # 2

Complete the table below using the following equation:

$$Y = 2x + 1$$

X	Y
-1	
0	
1	

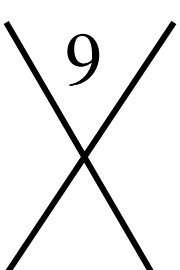
Science Question of the Day # 3

The earth's distance from the sun may be one of the most important factors contributing to the existence of life on this planet. Why do you think this is true?

Math Question of the Day # 3

In each diagram below, write the two numbers on the sides of the "X" that are *multiplied* together
to get the <u>top</u> number of the "X," but *added* together to get the <u>bottom</u> number of the "X."

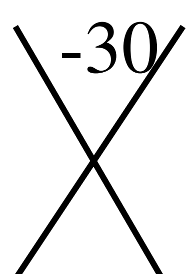
1.

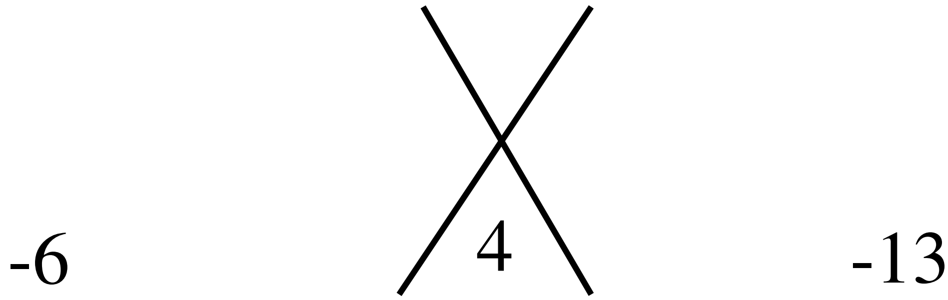


2.

4

3.




-6
4
-13

Science Question of the Day # 4

Scientists are making new discoveries every day. Name three discoveries you would like scientists to make in the near future. Tell why you are hoping for these discoveries.

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Math Question of the Day # 4

Use your knowledge of weights and measures to determine the answer:

a. 32 lbs = ____ ounces

b. 2 ½ yards = ______ inches

Science Question of the Day # 5

Imagine you are the environmental advisor to the President of the United States. A state wants to build a dam that would provide water for an entire city yet kill an endangered plant. What is your advice to the President?

Math Question of the Day # 5

The length of a rectangular room is 5 more than four times the width, w, of the room. Write the expression that represents the area of the room.

A = ________________

Science Question of the Day # 6

An ecosystem is made up of plants and animals that interact with their physical environment and with each other. Describe the ecosystem in one of the following environments: forest, pond, lake, or ocean.

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Math Question of the Day # 6

Use your skill in working with variables to solve the following:

If $x = 7$ and $y = 8$

Then

a) $x + y =$ _______ b) $2x + y =$ ________ c) $4x = y +$ ________

Science Question of the Day # 7

In a food chain, one kind of organism serves as food for a second, the second serves as food for a third, and so on. Describe an example of a food chain in action. Try to include at least four organisms.

Math Question of the Day # 7

Will 10 squared be less than, greater than, or equal to 589 – 256? Explain.

Science Question of the Day # 8

Aquaculture is the farming of water animals and plants. How important do you think aquafarms will be as food sources for people in the twenty-first century? Explain your answer.

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Math Question of the Day # 8

Use the order of operations and understanding of math terms to compute the answer:

56 + (12 divided by 2) – 15 = ________

Science Question of the Day # 9

Name and describe some of the scientific instruments you've used. Remember that everyday items such as thermometers are scientific instruments.

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Math Question of the Day # 9

Use you knowledge of exponents to determine the result:

8 x 8 x 8 x 8 x 8 x 8 in exponential form is ____________

Science Question of the Day # 10

Few plants are able to live in the polar regions of the earth, but several species of animals are able to live in these regions. Why do you think this is so?

Math Question of the Day # 10

The time in the Rocky Mountains is two hours behind New Jersey time. If it is 11:00 pm in Utah, what time is it in Willingboro?

Science Question of the Day # 11

Some lizards are green so they can't be seen by predators when they sit on green leaves or in green grass. Describe some other types of animal camouflage.

Math Question of the Day # 11

Use your knowledge of statistics to determine the answer:

Data: 29, 33, 28, 30, 25, 24, 21

The median of the data is _________

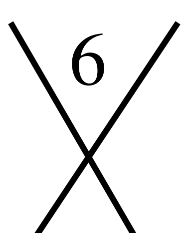
Science Question of the Day # 12

A balanced diet contains foods from these groups: bread, cereal, rice and pasta; milk, yogurt, and cheese; fruits; vegetables; and meat, poultry, fish, dried beans, eggs and nuts. Describe a meal a teenager would like that contains items from each of these groups.

Math Question of the Day # 12

In each diagram below, write the two numbers on the sides of the "X" that are *multiplied* together to get the <u>top</u> number of the "X," but *added* together to get the <u>bottom</u> number of the "X."

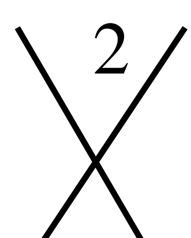
1.

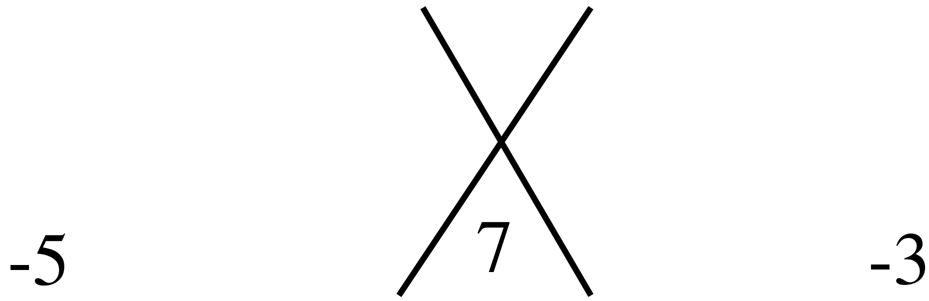


2.

-8

3.




-5
7
-3

Science Question of the Day # 13

What do you think is the most beautiful thing in nature? Explain your answer.

Math Question of the Day # 13

Write the number that is two less than one million:

Science Question of the Day # 14

A stimulus is something in the environment that triggers a response from a living thing. For example, a loud noise might make you flinch. What are some of the stimuli in your current environment? How do you respond to them?

Math Question of the Day # 14

Use your knowledge of statistics to determine the answer:

Data: 7, 8, 9, 10, 6, 5, 7

The mode of the data is __________

Science Question of the Day # 15

Write two complete sentences that begin with "Science is..."

Math Question of the Day # 15

Order the following numbers from least to greatest:

1.8, 0.2, 3.1, 2.4, 0.9, 2.0, 1.4

Science Question of the Day # 16

It seems that the earth has an endless supply of water. Why do you think it is necessary for people to conserve and protect sources of fresh water?

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Math Question of the Day # 16

Use your knowledge of figures to define the following terms:

a. acute angle: ______________________________

b. obtuse angle: ______________________________

c. right angle: ___________________________________

d. reflex angle: __________________________________

Science Question of the Day # 17

Describe all the ways water is an important part of your life.

Math Question of the Day # 17

Name three numbers between 12 and 13:

Science Question of the Day # 18

What area of science do you find most interesting? Why?

Math Question of the Day # 18

Use your knowledge of equations to determine the answer:

Solve for f, $f - 12 = 6$

f = __________

Science Question of the Day # 19

Do you think it is easier to discover new thing today than it was 200 years ago? Explain your answer.

Math Question of the Day # 19

Use your skills in arithmetic and word problems to determine the answer:

Ten people are at a picnic. Each purchases a .59 cent hot dog and a .49 cent soda. What is the total amount the group spends on food?

Total spent on hot dogs and sodas = _____________

Science Question of the Day # 20

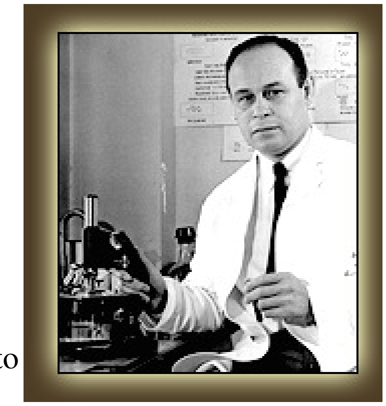
Do you think human beings should focus on travelling to other planets or exploring the deepest parts of the ocean? Explain your answer.

Math Question of the Day # 20

27,458 rounded to the nearest tens = __________

Charles Drew

By Sharon Fabian



Charles Drew was born in 1904 in Washington, DC. He attended DC public schools, including Paul Lawrence Dunbar High School, named after a famous African American poet. At Dunbar High School, Charles excelled in sports. He played football, baseball, basketball, and track. In both his junior and senior years, he won medals for his achievements in sports. He was awarded the James E. Walker Memorial medal for being his school's best all around athlete.

Next, Charles applied to Amherst College in Massachusetts. He was accepted there on an athletic scholarship. Amherst must have been glad that they had offered Drew the athletic scholarship, because he went on to be a star quarterback on their football team. He was also a MVP in baseball; he was captain of his track team. He was also a high hurdles champion, not just of his college but also on the national level. In 1926, Charles Drew graduated from Amherst, one of only 16 African-American graduates in the decade of the 1920's.

With all of his athletic achievements and honors, you might wonder why Charles Drew is not a well-known name in sports today. Charles Drew is not the name of a famous Olympic athlete. He did not become a football or basketball star. This is because Charles Drew was not only a star athlete; he was also an academic star. As he progressed through high school and college, Drew excelled in both academics and athletics. Eventually, however, he had to choose one or the other, and for Charles Drew it was no contest. He chose to follow his interest in science and health and to go on to medical school to become a doctor.

At that time, there were few opportunities for African-American students, but Drew found a good medical school called McGill University in Montreal, Canada. There he studied medicine and continues to play sports on the side. When his father died, in 1934, he returned to Washington, D.C. To be near his family. He continued to study and practice medicine in the Washington, D.C. Area.

Drew became interested in the study of blood transfusions. It had recently been discovered that people had different blood types – A, B, AB, or O. A transfusion of the right type of blood could save a person's life. However, blood was perishable; it would only keep for about a week. Drew found a way to store blood much longer by only using the part of the blood called plasma. The use of dried plasma later made transfusions even more widely available.

In 1940, Dr. Drew was put in charge of a transfusion program for people in Britain wounded in World War II. Since British cities were being bombed daily for much of the war, there were many people who were badly wounded and in need of a transfusion. Dr. Drew's program saved many, many lives.

Next, he returned to the United States to manage a transfusion program for the US military services. Again, he ran a life-saving program. A year later, he resigned in protest when he was required to separate the blood supply according to he race of the donor. Dr. Drew knew that blood could be different from person to person according to blood type, but not by race. A wounded soldier could die while waiting needlessly for a blood transfusion from a donor of a certain race.

Dr. Drew continued to practice medicine and surgery. He taught many students who went on to become accomplished doctors. He received many honors. One of these was the Springarn Medal awarded by the NAACP. Another was his own US postage stamp.

Dr. Drew's blood bank program was continued by the Red Cross. The Red Cross still maintains blood banks that save the lives of countless accident and crime victims every year.

In 1950, when he was 45 years old, Dr. Drew dozed off while driving in his car. His car crashed and Dr. Drew suffered massive injuries. Despite the efforts of the other doctors traveling with him. Dr. Drew died. Now he is remembered, not for his skill on the basketball court or the football field, but as a great doctor who started the blood bank program that has saved so many lives.

Charles Drew

1. Charles Drew is best known for _____. (A) Basketball (B) Track (C) Medicine (D) Football	2. Dr. Drew was a ______. (A) Medical doctor (B) Surgeon (C) Researcher (D) All of the above
3. Dr. Drew supervised a blood bank in Britain ____ he supervised one in the Untied States (A) Before (B) After (C) At the same time (D) None of the above	4. Dr. Drew grew up in ______. (A) The District of Columbia (B) A New England state (C) A country other than the United States (D) None of the above
5. Dr. Drew invented _______. (A) The blood bank (B) Football (C) Surgery (D) Medical school	6. Dr. Drew resigned from the blood bank program in the United States because ___. (A) He preferred to work in Great Britain (B) It insisted on separating blood by race (C) It refused to give blood to African-American soldiers (D) It refused to hire African-American doctors
7. Plasma is _______. (A) One part of blood (B) Easier to store than whole blood (C) Both a and b (D) Neither a nor b	8. Blood banks _______. (A) Saved lives in World War II (B) Save lives today (C) Both a and b (D) Neither a nor b

Newton's Three Laws of Motion

By Sharon Fabian

Isaac Newton was born in 1643. His family was wealthy, so in some ways he had advantages over other kids his age, but in other ways he was disadvantaged. Isaac's father had died before Isaac was born, and he was raised by his grandmother and other relatives. At first he probably was not encouraged to learn much in school. He didn't pay attention in school, and was described as lazy. It was only after an uncle encouraged him to prepare to go on to college that he began to take an interest in school and to develop his talents. One of the skills he developed while still in school was making model machines, including clocks and windmills. In college he began studying the latest theories in math. Soon he was coming up with theories of his own, and today Sir Isaac Newton is well known for his three laws of motion as well as for other scientific breakthroughs.

Here are Sir Isaac Newton's three laws of motion.

Law 1 - An object moving in a straight line will continue moving in a straight line, unless acted on by an outside force. Also, an object at rest will stay at rest. The word for this is inertia.

Law 2 - Force will cause a change in the motion of an object. The change in motion depends on the amount of force and the mass of the object. There is a formula for this F=ma (force equals mass times acceleration).

Law 3 - For each action, there is an equal and opposite reaction.

These three laws will make more sense, and be a lot more interesting, if you do some experiments to demonstrate each law. Maybe Sir Isaac did some similar experiments when he was testing out his theories.

To demonstrate the first law, you might want to try the old trick of pulling the tablecloth out from under the dishes on the table. If you do it just right, you will remove the table cloth without causing the dishes to crash to the floor. Then again, maybe you wouldn't want to try that one, even though Newton's first law says that objects at rest, like the dishes, will stay at rest.

Another way to demonstrate inertia is to show what can happen when you don't wear your seat belt. A safe way to demonstrate this is with a small toy truck, a clay figure, a ramp, and a brick. Place the little clay figure in the toy truck. Place the brick just a short distance past the end of the ramp. The toy truck can roll down the ramp until it hits the brick. When it hits the brick, the truck will stop suddenly, but the clay figure will keep moving forward and fly out of the truck because of inertia.

For the second law, there are many demonstrations that you can do. Anything that involves using a force to move an object would demonstrate Newton's second law. You might want to try an experiment in which you change the amount of force that you use, or change the mass of the objects that you try to move. For example, you could set up a little seesaw, made from a ruler balanced on a pencil. Try objects of different weights at the one end, and drop something on the other end to see which object moves the farthest. Or, try dropping the objects from different heights.

The third law is fun to demonstrate. One way is with a basketball and roller skates. Two kids, each wearing roller skates, stand facing each other and throw a basketball back and forth. As each kid pushes the basketball forward, he will roll backwards on his skates. That is the equal and opposite reaction described in the third law. You can also build a balloon racer to demonstrate the third law. Tie a string between two chairs, pretty far apart. Put an empty pen case or a section of a straw on the string so that it can slide along the string. Now blow up a balloon but don't tie it. Carefully tape the balloon to the pen case or straw, then let go. The action of the air shooting out of the balloon causes a reaction of the balloon racing across the string towards the opposite end.

If you don't feel like doing experiments, you can always observe Newton's laws of motion in another location, an amusement park. Roller coasters, merry-go-rounds, and bumper cars all follow Newton's three laws of motion, and are part of the science of force and motion.

Newton's Three Laws of Motion

1. Sir Isaac Newton's only discovery was the three laws of motion. (A) True (B) False	2. According to the first law, an object that is sitting still will stay that way. (A) True (B) False
3. The formula F=ma means "force equals motion times acceleration." (A) True (B) False	4..The third law says that some actions will produce an equal and opposite reaction. (A) True (B) False
5. Sir Isaac Newton probably never conducted any experiments. (A) True (B) False	6. One word that sums up the first law is (A) Inertia (B) Acceleration (C) Motion (D) Force
7. Bumper cars are an example of Newton's third law. Explain. ______________________________ ______________________________ ______________________________	8. A roller coaster is a good example of more than one of Newton's laws of motion. Explain. ______________________________ ______________________________ ______________________________

George Washington Carver

George Washington Carver was born to slave parents on July 12, in Diamond Grove, Missouri. One night, as an infant, he and his mother were kidnapped by raiders. Though George was unharmed and returned to the farm, his mother disappeared and that would be the last George would see of her. Therefore, Moses and Susan Carver, owners of the farm, took responsibility for George and raised him and his brother.

Unlike children today, George's education didn't start until he was twelve years old. At the time, schools were segregated and George was unable to attend the local school. As an alternative, he moved to a different county in Missouri where he attended a one room schoolhouse. George excelled in his studies and was accepted into Iowa State's College of Agriculture and Mechanical Arts (now known as Iowa State University). Upon graduation, he was offered a position on the school's faculty.

Soon after that George, invited by Booker T. Washington, the founder of Tuskegee Normal and Industrial Institute (now Tuskegee University), became the head of the agricultural department at the school. George accepted and spent nearly fifty years developing new farming methods and techniques and improving crop production. During his work, George created almost five hundred agriculture-based inventions. George never patented many of his discoveries. In regard to why he didn't, he said, "God gave them to me, how can I sell them to someone else?"

Because of George's new and improved farming techniques, farmers were able to produce more crops than they could use. For example, with the extra peanuts that farmers had, George developed over 300 different uses for them. He did the same with the sweet potato and the pecan.

Over the years, his discoveries brought him fame across the country. His opinion and ideas were sought after by leaders. But George remained humble and steadfast in his work. He donated his life savings to the George Washington Carver Foundation. In 1916, he was appointed to The Royal Society of Arts in London and in 1923 he was awarded the Springarn Medal. On January 5, 1943, George died on the campus of Tuskegee Institute.
George's contributions to agriculture were monumental. Since his death, George has been honored in multiple ways, including having been inducted into the National Inventors Hall of Fame.

George Washington Carver

1. What state was George born in?
____

2. What happened when he was an infant?
____

3. Who raised him?
____

4. At what age did George start his education?
____

5. What state did George attend college in?
____

6. What did George do after he graduated from college?
____

7. Who invited George to work at Tuskegee Institute?
____

8. How many agricultural inventions did George create?
____

9. What did George say when asked about his patents?
____

10. How many different uses did George create with the excess peanuts?
____

11. Other than peanuts, what other two crops did George invent uses for?
____
_____

12. What was the name of the medal George received in 1923?
____

13. In what year did George die?
____

14. After his death, what Hall of Fame was George inducted into?
____

Louis Pasteur

By Sharon Fabian

1 Louis Pasteur grew up in a time when people still couldn't decide whether or not to believe that germs existed. And if germs really did exist, where did they come from? Many people still held to the theory that germs were spontaneously generated, or created from non-living matter.

2 Pasteur had a chance to work on the problem of germs in one of his early positions as a professor of chemistry at the University of Lille. Part of his university's mission was to help solve problems for industries in the community. The local beer and wine producing industry asked for the university's help when their products began to go sour. Pasteur proved that germs, or bacteria, were causing the problem. He showed that the problem could be solved by heating the liquids.

3 Later he applied the same solution to the problem of sour milk. The process of heating liquids to kill germs became known as pasteurization.

4 Pasteur also proved that bacteria were not spontaneously generated. He did a famous experiment with a swan-necked flask. In this experiment, he prepared two flasks of broth. One was left open to the air. The other was fitted with a long bent neck; this allowed no dust or other particles to enter the flask. No germs grew in the flask with the swan-neck proving that the germs must have been introduced into the other flask from particles in the air and, so, were not spontaneously generated.

5 Pasteur's discoveries became known as the germ theory. In his time, it was a controversial theory. Many people were not ready to believe that something as tiny as a germ could kill people. Today this theory is one of the most important ideas in modern medicine. Pasteur and another scientist, Robert Koch, are known as the fathers of germ theory.

6 Soon Pasteur found another practical application for his germ theory. He discovered this one by accident. Over the course of a long experiment with chickens and the disease called cholera, some of the chickens were accidentally given a culture of cholera germs that had been allowed to sit around for a month. The culture made the chickens sick, but they recovered. Ordinarily, chickens infected with cholera had died. Not only did they live, but the chickens had now become immune to the disease. Pasteur had discovered immunization, a way to prevent animals and people from catching deadly diseases by first infecting them with a weakened form of the disease.

7 Next, he tackled the problem of cattle with anthrax. Pasteur found a way to create a vaccine for anthrax and saved the cattle.

8 Then it was time to tackle a disease that affected humans. Rabies was a deadly disease for humans that affected their brains and spinal cords. Pasteur used spinal cord from dead animals to create a vaccine that could save humans from this painful and deadly disease.

9 Pasteur was a great scientist who made tremendous contributions to society. Like all good scientists, he carefully used the scientific method to prove his theories, but he knew that to

make a real breakthrough, a scientist needed to use his imagination, too. His own imagination had led him to ideas that he later proved through scientific experiments.

10 "Imagination should give wings to our thoughts but we always need decisive experimental proof, and when the moment comes to draw conclusions and to interpret the gathered observations, imagination must be checked and documented by the factual results of the experiment." This is the way the great scientist Pasteur expressed his advice to future scientists.

Name ______________________ Date ______________

Louis Pasteur

1. Louis Pasteur _____.
   (A) Was the first person to suggest that germs existed
   (B) Proved the germ theory through experimentation
   (C) Found a way to get rid of all germs
   (D) All of the above

2. The theory of spontaneous generation _____.
   (A) Was believed by many people
   (B) Was disproved by Pasteur
   (C) Both A and B
   (D) Neither A nor B

3. Pasteur's work helped the beer and wine industry in his town by _____.
   (A) Killing the germs that made beer and wine go bad
   (B) Taking the alcohol out of beer and wine
   (C) Making beer and wine cheaper
   (D) None of the above

4. Pasteurization kills germs in _____.
   (A) Chickens
   (B) Cattle
   (C) Laboratories
   (D) Milk

5. The germ theory was difficult for many people to believe, probably because _____.
   (A) Germs have good effects too
   (B) Germs had been sighted in Roswell
   (C) Germs made few people sick
   (D) Germs are so small that they couldn't be seen

6. Pasteur studied cholera in _____.
   (A) Cattle
   (B) Chickens
   (C) Humans
   (D) Insects

7. He found a vaccine for anthrax in _____.
   (A) Insects
   (B) Humans
   (C) Chickens
   (D) Cattle

8. Pasteur believed that scientists should use only the scientific method and not their imaginations.
   (A) False
   (B) True

A Vaccine to Fight Polio

By Jane Runyon

1 In the first half of the 1900's, parents had a lot to worry about. There were several diseases they wanted to protect their children from getting. Polio was one of these diseases.

2 Polio is caused by virus. The virus gets into a body through the nose or mouth. Once in, it goes to the person's intestines. It makes a home for itself there to grow. In a few days, the virus is strong enough to cause trouble. The person might feel like he has the flu. He might have a fever, a headache, and vomiting. While all of this is happening, the person is likely passing the virus on to another person.

3 After leaving the intestines, the virus enters the person's bloodstream. In most people, the body creates antibodies which stop the virus where it is. The antibodies make the person immune to the virus.

4 Ten of every one hundred people infected by the virus will not be able to create the antibodies needed to stop the virus. These ten will get sicker. The virus can go to the brain or the spinal column where it will do damage. It can destroy nerve tissue which will cause pain and stiffness. One of these ten will become paralyzed by the virus. The muscles will no longer be able to move the arms or legs.

5 A famous person who suffered from the paralyzing form of polio was President Franklin Roosevelt. He was stricken by the disease as a young man. He decided not to let the disease keep him from pursuing his choice of careers as a politician. Most pictures you see of President Roosevelt will find him sitting. His legs were paralyzed.

6 During Roosevelt's long tenure as president, he was a great supporter of funding research to find a cure for this crippling disease. He helped found an organization called the March of Dimes. It was the goal of this group to see children freed from the fear of this disease. They wanted children to be able to walk on their own, not with the crutches that came with polio.

7 Dr. Jonas Salk began to study diseases and ways to create immunity to diseases in 1947. He wanted to find a way to isolate the polio virus and make it less likely to infect people. He was able to develop a vaccine using weakened, live virus in 1952. It was his belief that by injecting the weakened, live virus into children, their bodies would build their own immunity to the disease.

8 Salk and his team began to test his vaccine on people in 1954. The number of cases among the vaccinated people dropped dramatically. The government immediately wanted the vaccine used on every child. There was a period at the beginning of the vaccinations

that brought cause for worry. Some 260 children actually got polio from the vaccination. Ten of those children died. A problem with the virus used in the vaccination was found and corrected. The immunization program continued.

9 Dr. Albert Sabin worked on improving the Salk vaccine. In 1957, he developed a vaccine using dead virus which could be taken by mouth. After several years of study and testing, the Sabin polio vaccine was made available in 1963. Since the introduction of the Salk and Sabin vaccines, polio has almost disappeared. Between 1980 and 1990, only eight cases of the disease were reported. And each of those eight cases was caused by the vaccine. The goal of the World Health Organization is to erase polio from the earth. Smallpox was eliminated; now is the time for polio to go with it.

Name ______________________________ Date ____________________

A Vaccine to Fight Polio

1. Polio is a disease that affects growth.
   - (A) False
   - (B) True

2. What causes polio?
   - (A) A virus
   - (B) A chill
   - (C) A cold
   - (D) Overheating

3. How does a person's body fight off polio?

   ____

   ____

4. Where does the polio virus go in the body to grow?
   - (A) The heart
   - (B) The intestines
   - (C) The feet
   - (D) The lungs

5. What is one problem associated with the Salk polio vaccine?

   ____

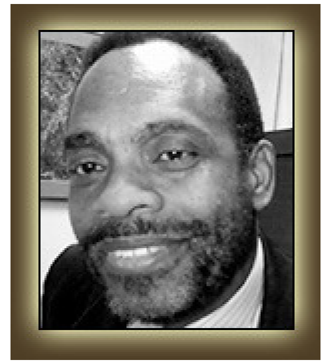
   ____

6. How was the Salk vaccine administered?
   - (A) By mouth
   - (B) With a spray
   - (C) By a shot
   - (D) By pill

7. How was the Sabin vaccine administered?
   - (A) By sneezing
   - (B) By a shot
   - (C) By mouth
   - (D) On a tongue depressor

8. Polio has been almost entirely wiped out.
   - (A) False
   - (B) True

George Edward Alcorn, Jr.



A noted academic and administrator, George Edward Alcorn, Jr. is a pioneer in the field of semiconductor devices and one of the top inventors in the field of aerospace.
Born March 22, 1940 in Indianapolis, Indiana, George was the son of Arletta and George Alcorn, Sr., an auto mechanic. Both parents promoted the virtu of education to George, Jr. and his younger brother Charles.

George was an excellent student in high school and entered Occidental College in Los Angeles, California on an academic scholarship. He was a remarkable athlete and received varsity letters in baseball and football. He also graduated with honors with a degree in physics in 1962 and followed this by enrolling in the Nuclear Physics program at Howard University. He completed his Master's work in 1963.

He obtained work during the summers of 1962 and 1963 at North American Rockwell, a leading aerospace company. He worked in the company's the space division and was assigned to perform computer analysis on the orbital mechanics and launch trajectories for rockets and missiles. Some of his work involved the Titan and Saturn rockets from the National Aeronautics and Space Administration's (NASA) Apollo space missions and well as the NOVA missile.

In 1964, Alcorn applied for a research grant from NASA to study the concept of negative ion formation. He was awarded the grant and conducted his research from 1965 to 1967. At the same time, he was enrolled in the Physics program at Howard University and received a PhD in Atomic and Molecular physics in 1967. Finally, after tremendous success and researcher, George took a moment to focus on his personal life and got married to Marie DaViller in 1969.

Alcorn signed on with Philco-Ford, a division of the Ford Motor Company. Philco-Ford produced a wide array of products, ranging from car radio to television set. It also had an aerospace division which developed satellite tracking systems for NASA's manned space program. Alcorn served as a senior scientist for the aerospace division. He later worked as a senior physicist for PerkinElmer, a multinational technology corporation and then as an advisory engineer for International Business Machines (IBM). His relationship with IBM proved quite valuable in 1973 when he was selected to teach as an IBM Visiting Professor in Electrical Engineering at Howard University (eventually becoming a full professor). As if his schedule was not already busy enough, he also taught Electrical Engineering at the University of the District of Columbia as a full professor.

In 1978, Alcorn left IBM and joined NASA where he invented an imaging X-ray spectrometer which used thermomigration of aluminum. X-ray spectrometry is used to provide data which can be analyzed for a number of applications, including for obtaining information about remote solar systems and other space objects. He would receive a patent for the device in 1984. As a result of the significance of this work, he was the NASA/GSFC Inventor of the Year (GSFC is an acronym for the Goddard Space Flight Center, NASA's first space flight center established in May of 1959). In 1986 he developed an improved method of fabrication using laser drilling.

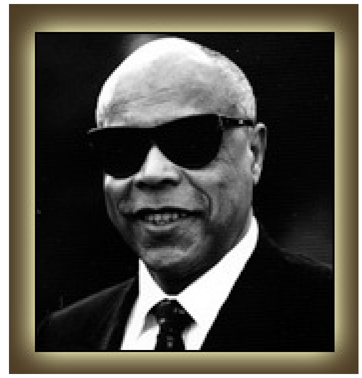
Because of his success in his endeavors, NASA placed him in an administrative/management position as the deputy project manager for advanced development of new technologies for use in the International Space Station, Freedom. In 1990 he was named the manager for advanced programs for NASA/GSFC and in 1992 became the head of the Office of Commercial Programs at GSFC, helping to find commercial uses for the new technologies developed at GSFC. Later he ran the GSFC Evolution program which oversaw the development and running of the space station. In 1994, he oversaw a space shuttle experiment which utilized a "Robot Operated Material Processing System" to conduct the manufacturing of material in the microgravity of space.

In 1999, he was awarded the Government Technology Leadership award and two years later was awarded special congressional recognition for his work for aiding business in the Virgin Island in employing technology. Finally in 2005 he was named the Assistant Director for Standard/Excelent - Applied Engineering and Technology Directorate for GSFC.

Over his career, Alcorn created numerous noteworthy inventions and secured more than 25 patents. He is seen as a pioneer in the field of plasma semiconductor devices. His concept and implementation of "plasma etching" has become a standard in the industry. He also served his community well over the years, involving himself in programs aimed at recruiting minorities and women to NASA as well as programs to encourage inner-city children to focus on science. In 1984, Alcorn was awarded the NASA-EEO medal for his efforts and was honored by Howard University with its Heritage of Greatness award.

George Alcorn is a well-rounded academic and leader in the field of space science, but his contributions as a manager as well as a community leader distinguishes him in the field of science.

Meredith Charles "Flash" Gourdine



Meredith Charles "Flash" Gourdine was born on September 26, 1929 in Newark, New Jersey. His father worked as a painter and janitor and instilled within his son the importance of a strong work ethic. Meredith attended Brooklyn Technical High School and after classes he helped his father on various jobs, often working eight hour days. However, his father believed that education was more important than just developing into a hard worker and he told him "If you don't want to be a laborer all your life, stay in school." Meredith minded his father's advice, excelling in academics. He was also an excellent athlete, competing in track and field and swimming during his senior year. He did well enough in swimming to be offered a scholarship to the University of Michigan, but he turned it down to enter Cornell University. He paid his way through Cornell for his first two years before receiving a track and field scholarship after his sophomore year. He competed in sprints, hurdles and the long jump. Standing 6' and weighing 175 lbs., he starred for his school, winning four titles at the Intercollegiate Association of Amateur Athletes of America championship and led Cornell to a second place finish at the 1952 NCAA Track and Field Championship (The University of Southern California won the meet but boasted 36 athletes while Cornell had only five c). Gourdine was so heralded that he was chosen to represent the United States at the 1952 Summer Olympic Games in Helsinki, Finland. He received a silver medal in the long jump competition, losing to fellow American Jerome Biffle by one and a half inches. "I Would have rather lost by a foot," he would later say. "I still have nightmares about it."

After graduating from Cornell with a Bachelor's Degree in Engineering Physics in 1953, he entered the United States Navy as an officer. He soon returned to academia, entering the California Institute of Technology, the recipient of a Guggenheim Fellowship. He received a Ph.D. in Engineering Science in 1960. During his time at Cal. Tech., he served on the Technical Staff of the Ramo-Woolridge Corporation and then as a Senior Research Scientist at the Cal. Tech. Jet Propulsion Laboratory. After graduation, he became a Lab Director for the Plasmodyne Corporation until 1962 when he joined the Curtiss-Wright Corporation, serving as Chief Scientist.

In 1964, Gourdine borrowed $200,000.00 from family and friends and opened Gourdine Laboratories, a research laboratory located in Livingston, New Jersey and at its height he employed 150 people. In 1973, he founded and served as CEO for Energy Innovation, Inc. in Houston, Texas which produced direct-energy conversion devices (converting low-grade coal into inexpensive, transportable and high-voltage electrical energy). His company's performed research and development, specifically in the fields of electrogasdynamics. Electrogasdynamics refers to the generation of energy from the motion of ionized (electrically charged) gas molecules under high pressure. His biggest creation was the Incineraid system, which was used to disperse smoke from burning buildings and could be used to disperse fog on airport runways. The Incineraid system worked by negatively charging smoke or fog, causing the airborne particles within to be electro magnetically charged and then to fall to the ground. The result was clean air and a clear area. He also received patents for the Focus Flow Heat Sink, which was used to cool computer chips as well as for processes for desalinating sea water, for developing acoustic imaging, and for a high-powered industrial paint spray.

Over his career Gourdine held over 30 patents and many of his creations serve as the basis for allergen-filtration devices common to households across the world. He was inducted into the Engineering and Science Hall of Fame in 1994. Towards his latter years, he suffered from diabetes, and lost his sight as well as one leg due to the disease.

Meredith Gourdine died on November 20, 1998, due to complications from multiple strokes. He left behind a legacy of research, design and innovation that will continue to have an impact for many years.

Valerie Thomas

As a child, Valerie Thomas became fascinated with the mysteries of technology, tinkering with electronics with her father and reading books on electronics written for adolescent boys. The likelihood of her enjoying a career in science seemed bleak, as her all-girls high school did not push her to take advanced science or math classes or encourage her in that direction. Nonetheless, her curiosity was piqued and upon her graduation from high school, she set out on the path to become a scientist.

Thomas enrolled at Morgan State University and performed exceedingly well as a student, graduating with a degree in physics (one of only two women in her class to do so). She accepted a position with the National Aeronautics and Space Administration (NASA), serving as a data analyst. After establishing herself within the agency, she was asked to manage the "Landsat" project, an image processing system that would allow a satellite to transmit images from space.

In 1976 Thomas attended a scientific seminar where she viewed an exhibit demonstrating an illusion. The exhibit used concave mirrors to fool the viewer into believing that a light bulb was glowing even after it had been unscrewed from its socket. Thomas was fascinated by what she saw, and imagined the commercial opportunities for creating illusions in this manner.

In 1977 she began experimenting with flat mirrors and concave mirrors. Flat mirrors, of course, provide a reflection of an object which appear to lie behind the glass surface. A concave mirror, on the other hand, presents a reflection that appears to exist in front of the glass, thereby providing the illusion that they exist in a three-dimensional manner. Thomas believed that images, presented in this way could provide a more accurate, if not more interesting, manner of representing video data. She not only viewed the process as a potential breakthrough for commercial television, but also as scientific tool for NASA and its image delivery system.

Thomas applied for a patent for her process on December 28, 1978 and the patent was issued on October 21, 1980. The invention was similar to the technique of holographic production of image recording which uses coherent radiation and employs front wave reconstruction techniques which render the process unfeasible due to the enormous expense and complicated setup. Parabolic mirrors, however, can render these optical illusions with the use use of a concave mirror near the subject image and a second concave mirror at a remote site. In the description of her patent, the process is explained. "Optical illusions may be produced by parabolic mirrors wherein such images produced thereby are possessed with three dimensional attributes. The optical effect may be explained by the fact that the human eyes see an object from two view points separated laterally by about six centimeters. The two views show slightly different spatial relationships between near and near distant objects and the visual process fuses these stereoscopic views to a single three dimensional impression. The same parallax view of an object may be experienced upon reflection of an object seen from a concave mirror." (http://www.freepatentsonline.com/4229761.html). The Illusion Transmitter would thus enable the users to render three-dimensional illusions in real-time.

Valerie Thomas continued working for NASA until 1995 when she retired. In addition to her work with the Illusion Transmitter she designed programs to research Halley's comet and ozone holes. She received numerous awards for her service, including the GSFC Award of Merit and the NASA Equal Opportunity Medal. In her career, she showed that the magic of fascination can often lead to concrete scientific applications for real-world problem-solving.

Hands On Experiments

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.

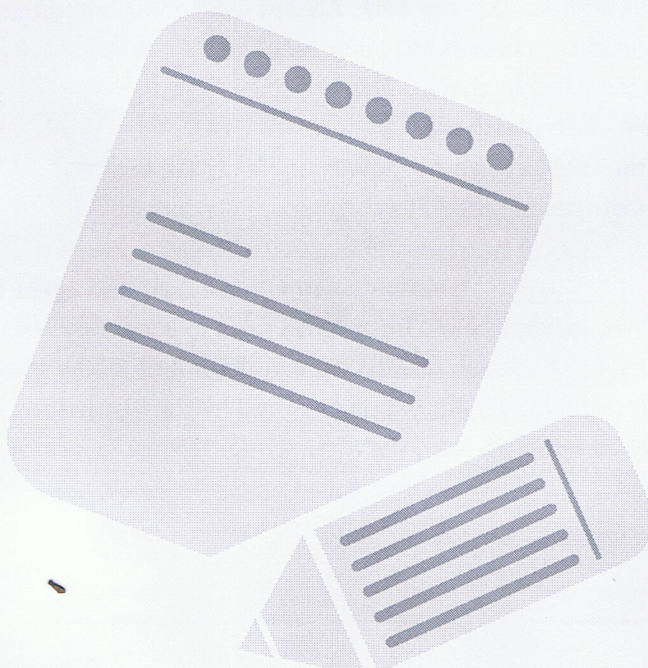
The scientific method involves the following steps:

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

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?

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.

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

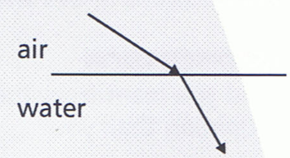
GET READY!

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?

Refraction



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.

R	RED
O	ORANGE
Y	YELLOW
G	GREEN
B	BLUE
I	INDIGO
V	VIOLET

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)

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?

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

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.

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

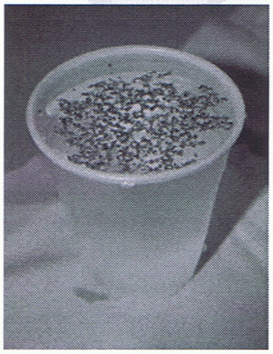
Try this investigation again with a different type of paper and compare your findings. Choose a different paper and build a new boat.

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.

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 !

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?

Moving On Up: Capillary Action II

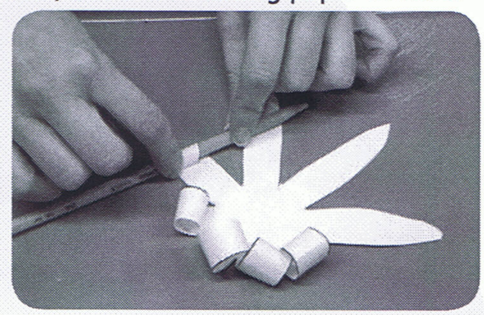
Investigation 1: Paper Blooms

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

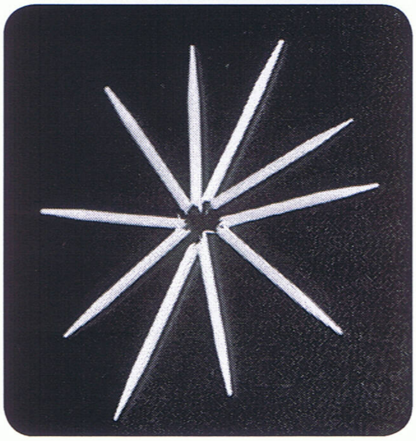
Part 1: Toothpick Flowers

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?

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

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

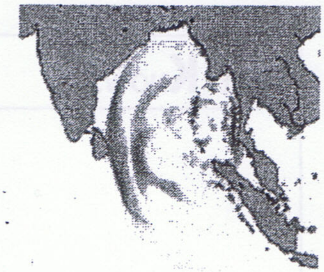
The downward force on the leaf is the same as the upward force (buoyant force) from the water. Also notice the shape of the leaf. The flat shape of the leaf allows it to evenly distribute its mass across the surface of the water.

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

Literature Study
Escaping the Giant Wave
by Peg Kehret

Raging Tsunami

By Brenda B. Covert



1 Warm breezes ruffled the palm leaves. The sun had risen to warm the sand. People from around the world relaxed on the beach. Some children splashed in the waves. Others built sandcastles on the shore. It was December 26, 2004. People were loving their summer vacation on the coast of the Indian Ocean. They were far away from the snowy winter weather in the USA.

2 Far out in the ocean floor, an earthquake occurred.

3 It disturbed the water. The huge quake stirred up the water. It became a large ocean wave! The water formed a tsunami. The angry water moved quickly away from the point of the quake. It moved faster and faster. It grew taller and taller. For two hours it rushed toward land.

4 On the beach, children wondered where the water was going. It seemed to be sucked away from the shore. Because tsunamis don't come very often, no one knew what was happening. No one sounded an alarm. While some coasts have tsunami alarms, there are none in the Indian Ocean area.

5 One young child cried because the water "ran away." Then, far in the distance someone spotted a wave. It looked like a small wave. However, it was not small. It looked small because it was so far away. As it came closer, it showed itself to be taller and wider than anything anyone had ever seen. It pulled all the water up into itself! The tsunami came rushing at the beach!

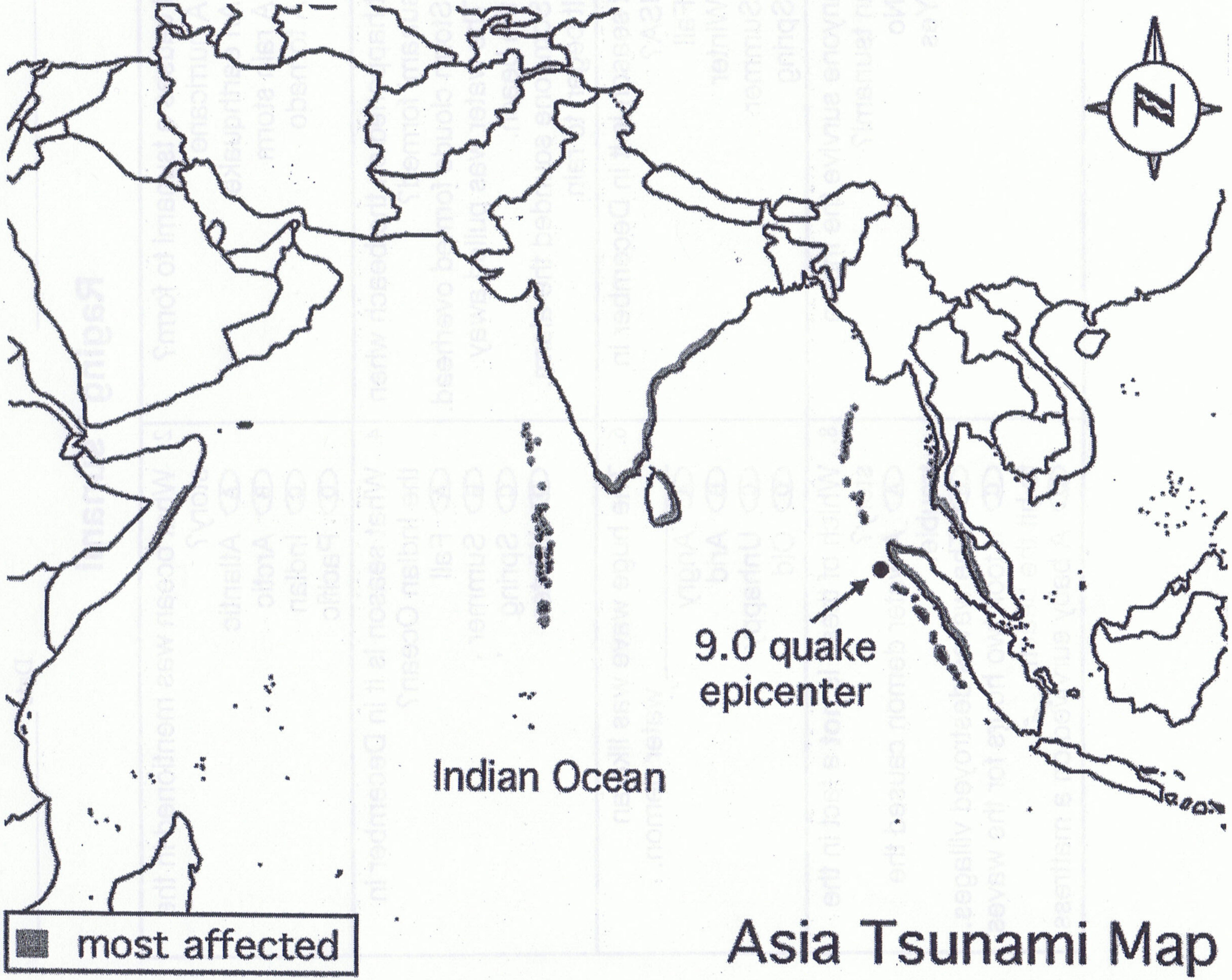
6 The ocean had been calm earlier. Now it was like a raging water demon racing along the surface of the water! It was set on destroying everything in its path. When the people on the beach saw the danger, they screamed and ran. The one hundred foot wave plowed toward them. In an instant, everything was gone. The wave destroyed villages and tossed cars and boats as if they were toys. The beachgoers, scuba divers, and fishermen were swept away.

7 Many people were killed. Some were not. A baby was found alive after the disaster. It had been floating on a mattress. Another person had clung to a tree. Here and there, survivors were found. They told their stories. They gave us hope. In all the bad that has happened, some good things have happened. We cannot help those who are lost, but we can help the survivors. We will feed them. We will build shelter for them. We will give them new clothes. Maybe we will even give them a tsunami alarm. Then the next time there is danger, the people will be warned. They will make it to safety.

Name ______________________________ Date ____________________

Raging Tsunami

1. What causes a tsunami to form? Ⓐ A hurricane Ⓑ An earthquake Ⓒ A rain storm Ⓓ A tornado	2. What ocean was mentioned in the story? Ⓐ Atlantic Ⓑ Arctic Ⓒ Indian Ⓓ Pacific
3. What happened on the beach when the tsunami formed? Ⓐ Storm clouds formed overhead. Ⓑ The water was pulled away from the beach. Ⓒ Someone sounded the alarm. Ⓓ It began to rain.	4. What season is it in December in the Indian Ocean? Ⓐ Fall Ⓑ Summer Ⓒ Spring Ⓓ Winter
5. What season is it in December in the USA? Ⓐ Fall Ⓑ Winter Ⓒ Summer Ⓓ Spring	6. The huge wave was like an ______________ water demon. Ⓐ Angry Ⓑ Arid Ⓒ Unhappy Ⓓ Old
7. Did anyone survive the Indian Ocean tsunami? Ⓐ No Ⓑ Yes	8. Which of these is **not** a fact in the story? Ⓐ A water demon caused the trouble. Ⓑ The waves destroyed villages. Ⓒ It took two hours for the waves to hit the beach. Ⓓ A baby survived on a mattress.



Asia Tsunami Map

Chapter One

Vocabulary

accumulation(5)	appreciates(8)	baffled(6)	confrontations(4)	devious(4)
frugality(13)	indentation(4)	mischief(2)	native(12)	retrieved(3)

accumulation: several things grouped together or considered as a whole

appreciates: to raise in value or price especially over time

baffled: to frustrate by confusing

confrontations: a hostile disagreement face-to-face

devious: not straightforward; shifty

frugality: the quality of being frugal (avoiding waste)

indentation: a cut or deep notch

mischief: reckless of malicious behavior

native: originating naturally in a particular country or region, as animals or plants

retrieved: to find and carry back; fetch

Write a paragraph using (5) vocabulary words.

Discussion questions

1. Mrs. Hoke asks her class to create goals for the summer, but doesn't force them to share them with anyone. Why? What are Kyle's goals? Write down 3 goals you have for yourself.

My goals:

*

*

*

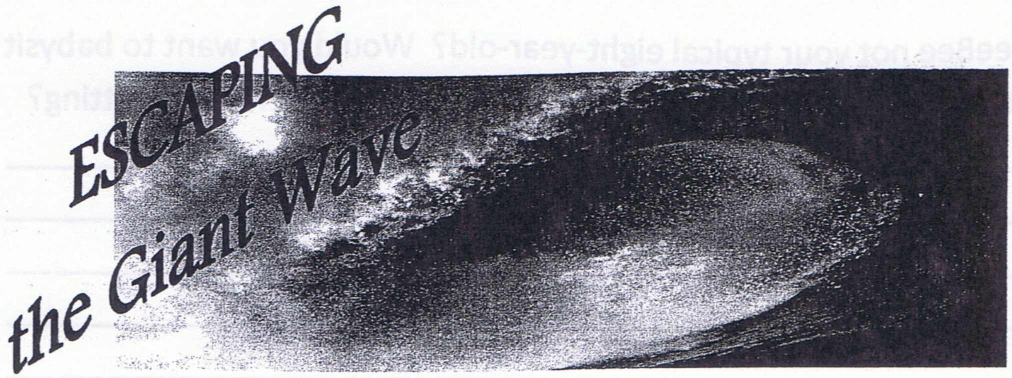
2. Describe Daren Hazelton. What is the history between Daren and Kyle? Why do you think some kids get away with being bullies? Can bullies change?

3. Make a list titled "The Top 10 Nonviolent Ways to Handle a Bully." Be creative. Choose one from the list to illustrate.

THE TOP TEN NONVIOLENT WAYS TO HANDLE A BULLY

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

4. How is BeeBee not your typical eight-year-old? Would you want to babysit her? Why or why not? What rules does Kyle put in place for babysitting?



Chapter Two

Vocabulary

accommodations(23) brochure(21) convention(18) nonchalant(17)

scaffolding(22) souvenir(16) yacht(15)

Word	Definition
accommodations	
brochure	
convention	
nonchalant	
scaffolding	
souvenir	
yacht	

Choose 4 vocabulary words. Write 2 sentences using 2 words in each sentence.

1.____

2.____

Discussion Questions

1. What is the reason for the trip to Oregon? Where will the Davidson's stay? Is this a typical vacation for them? How is it not what they expected?

2. What threatens Kyle's enjoyment of the whole vacation? What would you do in his shoes?

3. Have you ever taken a vacation with your family? Describe either your best or worst vacation.

Chapter 3

Vocabulary

anemones(28) parallel(30) sandpipers(27) series(30)
tsunami(29)

Word	Definition
anemones	
parallel	
sandpipers	
series	
tsunami	

Use a vocabulary word to complete the following analogies.

1. Jungle is to lion as sea is to ________________________________.
2. Fins are to fish as wings are to ______________________________.
3. Avalanche is to land as ___________________________ is to ocean.

Discussion questions

1. How could Kyle have paid Daren back for years of bullying? Kyle chooses to help Daren instead. Do you think he made the right decision? Why or why not?

2. Tell about a time when it was difficult for you to do the right thing.

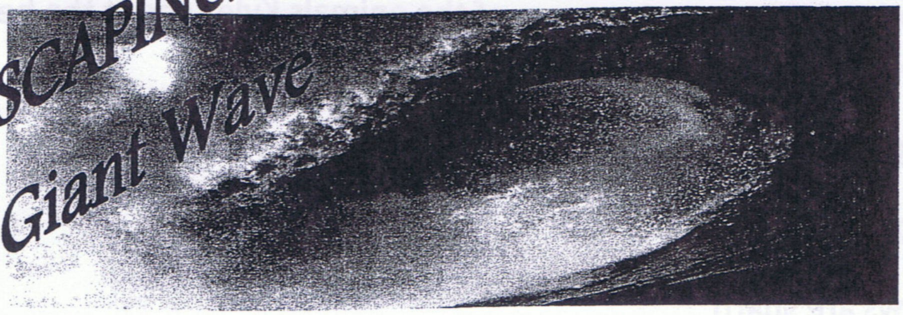
3. Write an acrostic poem about one of the animals Kyle sees at the beach (sandpiper, gull, sea anemone, starfish, crab).

Ex: <u>Catches mice</u>

<u>And meows</u>

<u>Their claws are sharp</u>

ESCAPING the Giant Wave



Chapters 4-5

Vocabulary

billowed(54) crouched(48) shrill(54) silhouetted(49) source(54)

1. billowed: to swell out or bulge
2. crouched: to stoop, especially with the knees bent
3. shrill: high pitched and piercing in sound quality
4. silhouetted: to appear as a dark image outlined against a lighter background
5. source: the point at which something begins

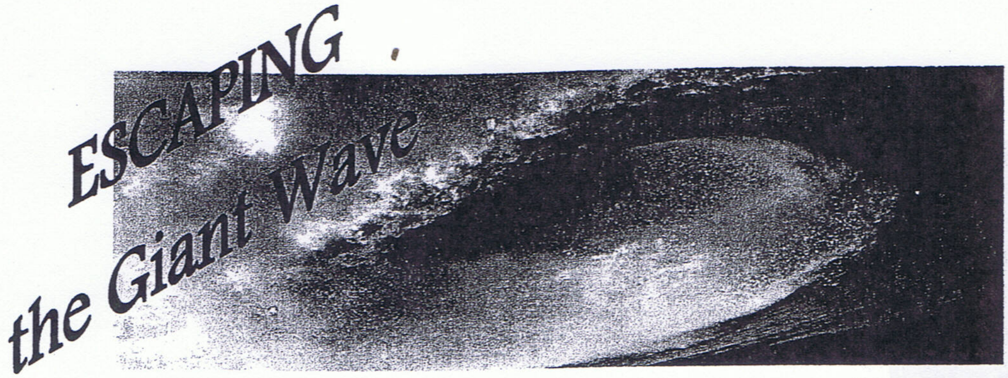
Complete the vocabulary graph.

Word	Part of Speech	Synonym/ Antonym	Word forms	Sentence	Illustration
billowed					
crouched					
shrill					
silhouetted					
source					

Discussion questions

1. How does BeeBee give Kyle a scare while he's watching her in the hotel? What was he worried about? Do you think he is a good babysitter? Why or why not?

2. How does Kyle save Daren again? Does this change Daren's behavior toward Kyle?



Chapters 6-7

Vocabulary

premises(64) quavered(73) random(65) skirted(68)

Word	Definition
premises	
quavered	
random	
skirted	

Write a weather report using all 4 vocabulary words.

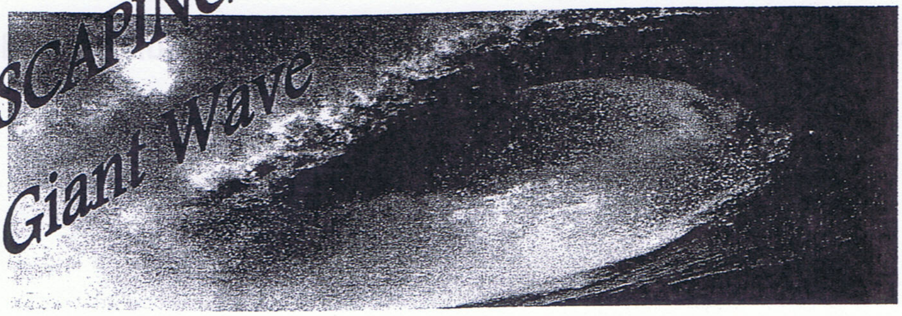
Weather Report

Discussion questions

1. Kyle is forced to make a series of important decisions. Which one is most critical? Why? What are the steps in making a serious decision? What does Daren decide to do?

2. What do you think of the coastal town's warning system for tidal waves? Why don't some people take it seriously? Have you seen this type of attitude repeated in the news? In light of the Asian tsunami and the devastation in New Orleans with Hurricane Katrina, do you think people's actions will change?

ESCAPING the Giant Wave



Chapters 8-9

Vocabulary

crick(95) foolhardy(86) groves(104) guffawed(100)

Word	Definition
crick	
foolhardy	
groves	
guffawed	

Write a conversation between Kyle and Daren using all 4 vocabulary words.

Kyle:

Daren:

Kyle:

Daren:

Discussion questions

1. Mr. and Mrs. Davidson are out on the Elegant Empress. How do they learn about what has happened on shore? Why doesn't the yacht's captain return to shore?

2. What do you think of the teenagers' decision to stay and watch the waves? Why do you think Daren takes so long before he decides to leave? Do you know anyone like Daren?

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3. How did Norm, Josie, and Pansy help the children survive?

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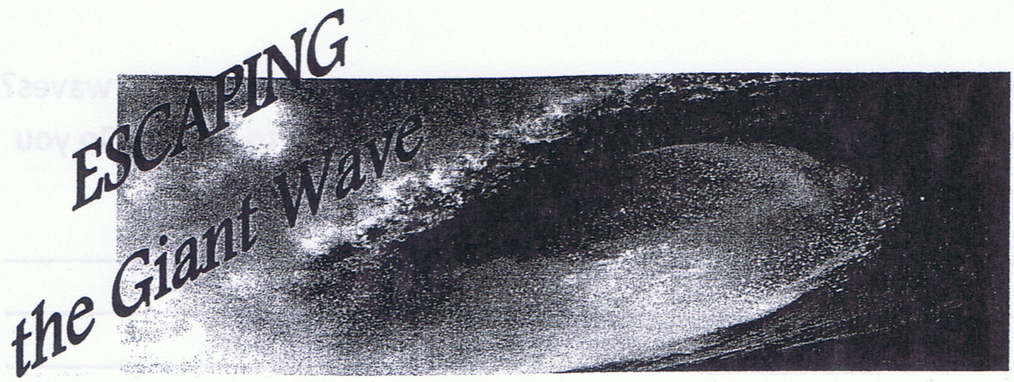


Chapters 10-12

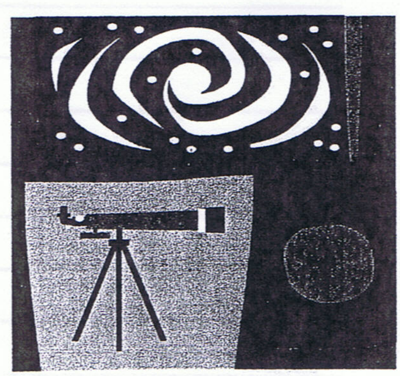
Vocabulary

fretted(123) gaped(140) optimistic(130) pathetically(118)

skeptical(147) stewed(123)

Word	Definition
fretted	
gaped	
optimistic	
pathetically	
skeptical	
Stewed	

Write a horoscope using at least 4 vocabulary words.



Discussion questions

1. What steps do the kids take to survive the second wave? What warning do they have that something is coming? What do they make to save Pansy too? What prevents them from dehydrating?

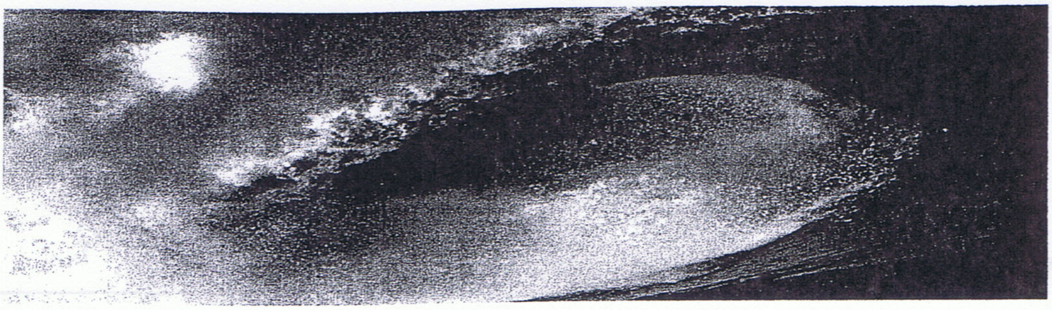
2. What happened to each character during the tsunami (Norm, Josie, Daren, Mr. and Mrs. Davidson)?

3. At the beginning of the story Kyle says that he felt like a coward. How do his feelings about himself change by the end of the story? What happens to cause these changes?

4. What was the most interesting thing you learned while reading this novel? Do you think novels can sometimes be more valuable for teaching facts that non-fiction? Why or why not?

5. How did your understanding of tsunamis change? What images will stick with you after closing the last page of this novel?

6. Would you recommend this book to others? Why or why not?



Figurative Language in Escaping the Giant Wave

"Daren's feet made a soft thunk, thunk…"

"…the waves licked against the shore"

"Remorse settled on me like a quilt…"

Figurative Language	Definition	Examples
simile		
personification		
onomatopoeia		
metaphor		
hyperbole		

Name ____

Tsunami Work Sheet

What does tsunami mean? ________________________________

Source? ____

What is a tsunami? ________________________________

Is tidal wave an accurate name for a tsunami? ______________

Why/why not? ____

Source? ____

On page 29 the Davidsons saw a warning sign for tsunamis, while the walked on the beach.

Can tsunamis really happen in Oregon? ____________________

What state has the greatest risk of having a tsunami? ________

How often does this state experience a tsunami? ______________

On page 31, directions were given for escaping a tsunami.

Check out these directions on the **FEMA for kids** website under things to know, was the information given fact or fiction? ________

Why or why not? ________________________________

Look on the National Geographic website:

What is the "Ring of Fire"? ______________________________

How fast can a tsunami travel? ___________________________

What is the Pacific Tsunami Warning System? _______

____

Where is it located?_____________________________________

At the bottom of the page on Tsunami, killer wave, click on the topic "How I Survived a Tsunami". Describe Miki's closet.

____

Another source for information is in the book itself. In the **Author's Note** Peg Kehret gives factual information she gathered while writing this book.

Where did she get her idea of using cows mooing as a tsunami warning instead of a siren? ______________________________

Why don't towns like to use sirens as a warning signal for tsunamis? ____

WEBSITES

www.tsunami.org
http://pubs.usgs.gov/circ/c11871
http://school.discovery.com/teachers/tsunami
http://www.cln.org/themes/tsunamis.html
www.fema.gov/kids/tsunami.htm
www.nationalgeographic.com/ngkids/9610/kwave
http://walrus.wr.usgs.gov/tsunami/
http://www.pmel.noaa.gov/tsunami-hazard/kids.html