Name _____

Science Activities

Required Vocabulary

Analyze – Review the data from an experiment to find out what they mean.

Assumption – Something that is believed to be true without proof.

Compare – Look at to find similarities and differences.

Conclusion (Conclude) - The summary of an experiment, based on data.

Control – A part of the experiment that is different from the experiment. For example, if you're testing the effects of hot water on yeast, your control would be either room temperature water or cold water.

Data – Information from an experiment.

Describe – Explain something with words.

Evidence – Data used to support a conclusion.

Experiment – A test that is done to support or disprove a hypothesis.

Hypothesis (hy-PAW-thuh-suhs) – An idea or question that can be tested.

Inference (Infer) – Assume a fact, without proof, based on previous experience.

Interpret – Explain what something means; explain results of an experiment.

Investigation – A process designed to answer a question.

Measure – Obtain information about something (weight, length, width, height, etc.)

Observe – To watch or look at something to get information.

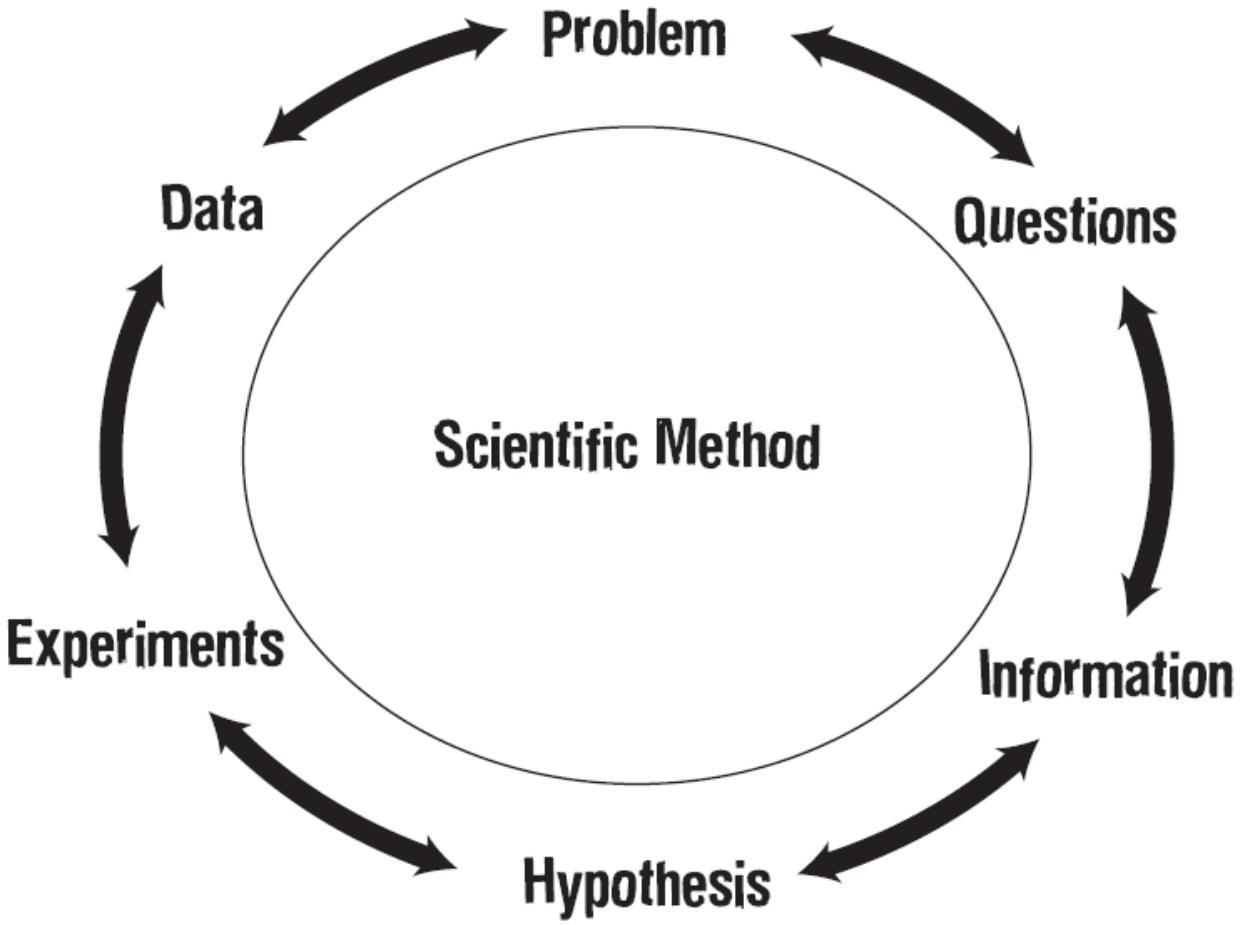
Predict – Determine what you think will happen when you do an experiment *before* you do the experiment.

Theory – A well-supported explanation for something that occurs in nature.

Variable – A part of an experiment that is changed.

A mushroom walked into a bar. The bar tender said, "Get out of here! We don't serve your kind."
"Hey, what's the problem?"
"Just get out of here. We don't serve mushrooms."
The mushroom says, "Why not? I'm a fun guy."

Doctor, doctor, I keep seeing spots before my eyes!
Have you seen a doctor before?
No, just spots!



Doctor, Doctor my son has swallowed my pen, what should I do?
Use a pencil till I get there

Patient: Doctor Doctor! Will I be able to play the piano when you've fixed my hand? Doctor: Of course!
Patient: Great! I've never been able to play before!

Scientific Method Worksheet

Match the word with the definition.

A. Problem
B. Research
C. Materials
D. Data
E. Procedure
F. Variable
G. Hypothesis

____1. Looking through books, web sites, or newspapers for information on a topic.

____2. The experiment.

____3. A list of things needed for the experiment.

____4. Always asked as a question.

____5. Observations recorded and put into charts or graphs.

____6. An educated guess as the answer to the problem.

____7. Factor that is changed during an experiment to see what will happen.

8. In the following experiment, which variable is being manipulated (changed)?

Brands A, B, and C of hamburger meat are tested for the amount of fat in each. Each brand will be cooked for exactly 7 minutes. The same pan will be used for each test. The brands will each be drained for exactly 2 minutes by using a strainer and a measuring cup to determine the amount of fat that is drained.

❑ The cooking time

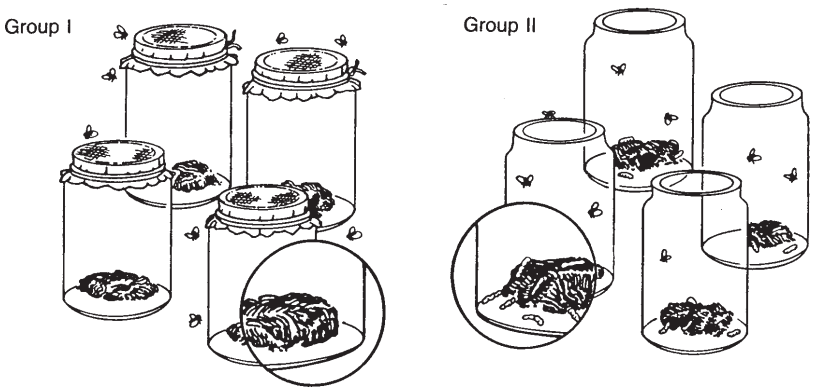
❑ The pan

❑ The brands being tested

❑ The straining of the meat after cooking

Scientific Method

Long ago, many people believed that living things could come from nonliving things. They thought that worms came from wood and that maggots came from decaying meat. This idea was called spontaneous generation. In 1668, an Italian biologist, Francesco Redi, did experiments to prove that maggots did not come from meat. One of his



experiments is shown below.

Redi placed pieces of meat in several jars. He divided the jars into two groups. He covered the first group of jars with fine cloth. He left the second group of jars uncovered. Redi observed the jars for several days. He saw flies on the cloth of the covered jars, and he saw flies laying eggs on the meat in the uncovered jars. Maggots appeared only on the meat in the group of jars left uncovered.

1. Scientists use a series of organized steps called scientific method to solve problems. List the steps that are often used. _____

_____

2. What was the problem in Redi's experiment ? _____

3. What do you think his hypothesis was? _____

_____

4. How did he test his hypothesis? _____

_____

5. What was the variable in his experiment? _____

6. What was the control in his experiment? _____

7. What do you think Redi's conclusion was.? _____

CAN YOU SPOT THE SCIENTIFIC METHOD
CRITICAL THINKING/PROBLEM SOLVING

Name _____

Date _____

Class _____

Each sentence below describes a step of the scientific method. Match each sentence with a step of the scientific method listed below.

A. Recognize a problem
B. Form a hypothesis
C. Test the hypothesis with an experiment
D. Draw conclusions

____ 1. Stephen predicted that seeds would start to grow faster if an electric current traveled through the soil in which they were planted.

____ 2. Susan said, “If I fertilize my geranium plants, they will blossom.”

____ 3. Jonathan’s data showed that household cockroaches moved away from raw cucumber slices.

____ 4. Rene grew bacteria from the mouth on special plates in the laboratory. She placed drops of different mouthwashes on bacteria on each plate.

____ 5. Kathy used a survey to determine how many of her classmates were left-handed and how many were right-handed.

____ 6. Jose saw bats catching insects after dark. He asked, “How do bats find the insects in the dark?”

____ 7. Justin wondered if dyes could be taken out of plant leaves, flowers, and stems.

____ 8. Alice soaked six different kinds of seeds in water for 24 hours. Then she planted the seeds in soil at a depth of I cm. She used the same amount of water, light, and heat for each kind of seed.

____ 9. Bob read about growing plants in water. He wanted to know how plants could grow without soil.

____ 10. Kevin said, “If I grow five seedlings in red light, I think the plants will grow faster than the five plants grown in white light.”

____ 11. Angela’s experiment proved that earthworms move away from light.

____ 12. Scott said, “If acid rain affects plants in a particular lake, it might affect small animals, such as crayfish, that live in the same water.”

____ 13. Michael fed different diets to three groups of guinea pigs. His experiment showed that guinea pigs need vitamin C and protein in their diets.

____ 14. Kim’s experiment showed that chicken eggshells were stronger when she gave the hen feed, to which extra calcium had been added.

Name _____

Class _____

Date _____

Performing an Experiment

Read the following statements and then answer the questions.

1. A scientist wants to find out why sea water freezes at a lower temperature than fresh water.

2. The scientist goes to the library and reads a number of articles about the physical properties of solutions.

3. The scientist also reads about the composition of sea water.

4. The scientist travels to a nearby beach,and observes the conditions there. The scientist notes the taste of the sea water and other factors such as waves, wind, air-pressure, temperature, and humidity.

5. After considering all this information, the scientist sits at a desk and writes, “My guess is that sea water freezes at a lower temperature than fresh water because sea water has salt in it.”

6. The scientist goes back to the laboratory and does the following:

    a. Fills each of two beakers with I liter of fresh water.
    b. Dissolves 35 grams of table salt in one of the beakers.
    c. Places both beakers in a refrigerator whose temperature is - 1degree C.
    d. Leaves the beakers in the refrigerator for 24 hours.

7. After 24 hours, the scientist examines both beakers and finds the fresh water to be frozen. The salt water is still liquid.

8. The scientist writes in a notebook, “It appears as if salt water freezes at a lower temperature than fresh water does.”

9. The scientist continues, “Therefore, I suggest that the reason sea water freezes at a lower temperature is that sea water contains dissolved salts while fresh water does not.”

Questions

A. Which statements contain *conclusions?* _____

B. Which statements refer to *research?* _____

C. Which statement contains a *hypothesis?*_____

D. Which statements contain *observations?* _____

E. Which statements describe an *experiment?* _____

F. Which statement supports the *hypothesis?* _____

G. In which statement is the *problem* defined? _____

H. Which statement contain *data*? _____

I. Which is the *variable* in the experiment?_____

J. What is the *control* in the experiment? _____

K. Which statement includes an *inference*? _____

Inferences and Observations QUIZ

An observation is anything that can be taken in through the senses. This would be things that you see, hear, taste, smell, touch, or taste. An inference is a statement that explains the observations.

Suppose your friends went to the beach at noon on a warm day. They saw some black and white birds. Which of the following statements are observations and which are inferences? Indicate your answer with either the letter “O” for an observation, or the letter “I” for an inference.

1. _____ It is summertime.

2. _____ It is day time.

3. _____ They saw birds.

4. _____ They saw seagulls.

5. _____ They went swimming.

6. _____ One friend’s name was Bob.

7. _____ It was a warm day.

8. _____ The birds were black and white.

9. _____ They ate lunch and drank Coke.

10. _____ The people are friends.

Dinosaur Scene:
A time machine has been invented that travels into the past and takes pictures, sending them to the present. You are asked to look at one of the pictures and interpret what you see. Put an “O” before the statements that are observations and an “I” before the statements that are inferences.

____ 1. The volcano is erupting.

____ 2. The camptosaurus is going to eat the stegosaurus.

____ 3. The stegosaurus will run into the water to escape.

____ 4. The camptosaurus is leaving tracks in the ground.

____ 5. The ground where the camptosaurus is walking is wet.

____ 6. There are plants growing in the water.

____ 7. The camptosaurus is going into the water to eat the plants.

____ 8. There is a tree growing next to the river.

____ 9. The tree looks like a palm tree.

____ 10. The climate is warm.

____ 11. The stegosaurus is eating the plant.

____ 12. The stegosaurus is an herbivore.

____ 13. There are bones from a dead animal by the shore.

____ 14. The camptosaurus killed the animal.

____ 15. Some more bones are in the water.

____ 16. The camptosaurus can’t swim and will drown.

____ 17. Lava is corning down the sides of the volcano.

____ 18. The camptosaurus has sharp teeth for eating meat.

Suppose you are a paleontologist and you have just discovered a layer of rock with many fossils in it, both petrified bones and tracks. Decide whether the following statements are observations or inferences.

_____ There are tracks from three different animals in the rock.

_____ One animal was chasing another animal.

_____ Two different animals died in this spot.

_____ When the animals walked here the ground was wet.

_____ One of the animals that died here had bony plates.

_____ One of the animals that died here had sharp teeth.

_____ The animal that had sharp teeth ate meat.

Inferences and Observations QUIZ

An observation is anything that can be taken in through the senses. This would be things that you see, hear, taste, smell, touch, or taste. An inference is a statement that explains the observations.

Suppose your friends went to the beach at noon on a warm day. They saw some black and white birds. Which of the following statements are observations and which are inferences? Indicate your answer with either the letter “O” for an observation, or the letter “I” for an inference.

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8. _____ The birds were black and white.

9. _____ They ate lunch and drank Coke.

10. _____ The people are friends.

Qualitative and Quantitative Observations

(from *The Truth About Science,* NSTA Press, 2001, pgs. 1-2)

Qualitative observations describe the qualities of an object. ***Quantitative observations*** describe the quantity of something. An easy way to remember…

- ***quantitative observations*** can be summarized with a number. Because they use numbers, quantitative observations can be precisely and objectively compared.
- ***qualitative observations*** cannot.

The following are examples of ***qualitative observations***…

- *A leaf is green.*
- *A leaf is dark green.*
- *A leaf is bumpy.*
- *A leaf has veins.*
- *A leaf has a lot of veins.*
- *A chair is hard.*
- *A flower smells good.*
- *A flower is stinky.*

These ***qualitative descriptions*** can be compared but not precisely. You can say, "This flower smells good, but this flower is stinky." But how much more stinky is it?

A ***quantitative observation*** has a precise number attached to it...

- *The flower has seven petals.*
- *The leaf has 34 veins.*
- *The car weighs 1.2 tons.*
- *The dog blinked 37 times in one minute.*
- *The chicken took 34 seconds to cross the road.*

These ***quantitative observations*** can be compared precisely and objectively.

Some things are easier to quantify than others. ***Time, length, and weight are easy to quantify,*** but ***smell, taste, and attitudes are very difficult.*** Researchers often have to find innovative methods for summarizing qualitative observations in a quantitative way—for example…

- *Seven people thought the flower was smelly while four people could not smell anything.*

These numbers can be compared. You could then ask whether more people think a daisy is smelly or whether more people think a rose is smelly. ***You didn't quantify the smelliness but you created an alternate measure.*** You could quantify smelliness with a rating—for example, a scale of 1 to 5, with 1 being the most pleasant and 5 being the least.

The best rule of thumb for deciding if something is ***qualitative*** or ***quantitative*** is to ask

- ***Can I summarize the information in a number?***

This is, however, only a rule of thumb; occasionally a ***qualitative observation*** can have a number in it—for example…

- *That smells like five-day-old cornbread.*

A ***quantitative observation*** is a measurement of something. A ***qualitative observation*** is a description of something.

The reason we care about ***quantitative observations*** versus ***qualitative observations*** is that ***quantitative observations*** tend to be more objective (though not always), more precise, and much easier to compare.

You may also record ***qualitative observations*** to help them remember certain conditions or observations that don't lend themselves to ***quantitative measures***.

A person who never made a mistake never tried anything new.

-Albert Einstein

QUALITATIVE VS. QUANTITATIVE WORK SHEET

All of the observations in this worksheet were qualitative; that is, you observed a quality about an object (it smelled good, it was green, etc.). Another type of observation is quantitative, meaning that it can be described or measured in concrete numerical terms. The following observations are quantitative:

There are 30 students in my class. I weigh 98 pounds. 1 ate a pound of potatoes.

Determine which of the following statements are quantitative and which are qualitative.

1. _____ The cup had a mass of 454 grams.
2. _____ The temperature outside is 25^0 C.
3. _____ It is warm outside.
4. _____ The tree is 30 feet tall.
5. _____ The building has 25 stories.
6. _____ The building is taller than the tree.
7. _____ The sidewalk is long.
8. _____ The sidewalk is 100 meters long.
9. _____ The race was over quickly.
10. _____ The race was over in 10 minutes.

CONSTRUCTING INFERENCES FROM OBSERVATIONS

Suppose your friends went to the beach at noon on a warm day. They saw some black and white birds. Which of the following statements are observations and which are inferences? Indicate your answer with either the letter “O” for an observation, or the letter “I” for an inference.

1. _____ It is summertime.
2. _____ It is daytime.
3. _____ They saw birds.
4. _____ They saw seaguils.
5. _____ They went swimming.
6. _____ One friend’s name was Bob.
7. _____ It was a warm day.
8. _____ The birds were black and white.
9. _____ They ate lunch and drank Coca-Cola&.
10. _____ The people are friends.

Penny Water

Key Words

- ☑ ***mean***—a number that is midway in value between other numbers; the average.
- ☑ ***median***—(1) the middle number in a sequence of numbers listed from smallest to largest if there is an odd number of numbers. In the sequence 3, 4, 14, 35, 280, the median is 14. (2) the average of the two middle numbers of a sequence of numbers listed from smallest to largest if there is an even number of numbers. In the sequence 4, 8, 10, 56, the median is 9 (the average of 8 and 10).
- ☑ ***mode***—the value that occurs the most in a set of data. In the set {25, 40, 72, 64, 40, 10}, the mode is 40.
- ☑ ***predict***—to foretell on the basis of observation, experiences, or scientific reason.
- ☑ ***range***—the difference between the smallest and largest number in a set of data. If the lowest test score of a group of students is 54 and the highest is 94, the range is 40.
- ☑ ***reliability***—the extent to which an experiment, test, or measuring procedure yields the same results on repeated trials
- ☑ ***validity***—the extent to which a study or test measures what the researcher says it measures.
- ☑ ***variable***—a part of a scientific experiment that is allowed to change in order to test a hypothesis.

Materials (per group of 2 students)

- ☑ Eyedropper/pipette
- ☑ 1 cup water
- ☑ 3 paper towels
- ☑ 4 pennies

Procedures

1. How many drops of water will fit on the head of a penny? Record your prediction.

2. Using your supplies, determine how you can answer the question asked in step 1. On a separate sheet of paper, write down how you are going to come up with an answer to the question. Get your proposal approved.

3. Determine how many times you will need to conduct the test (count water drops they place on a penny) to obtain an accurate answer.

4. Record your results on the table on your worksheet.

Penny Water

Proposal approved. Teacher initials _____

Predicted number of water drops on a penny _____

Data Table

Penny 1								
Penny 2								
Penny 3								
Penny 4								

1. Analyze your data (what does it mean)?

_____

_____

_____

_____

2. Is there any way you can determine ***one exact*** answer. Explain (if yes, how; if no, why not).

_____

_____

_____

_____

3. Compare your results to your prediction. Were you close? How far off were you? If asked to predict again, what would you say? Would you be closer? Why or why not?

_____

_____

_____

_____

_____

_____

_____

_____

4. What is your mean, median, and mode? (Will be explained in class)

Mean _____

Median _____

Mode _____

Teacher's Notes

Step 3 – encourage students to repeat the test ***at least*** five times.

After completing step 3, conduct a class discussion. Have some groups share their results. Record the raw numbers on the board or on an overhead. Put the numbers of drops in order from smallest to largest. Lead students to and through a discussion of mean, median, mode, and range. Allow each group of students' time to arrange their results in order and to determine mean, median, mode, and range with their data.

Discuss the difference between a "wild" and an "educated" guess. How can we develop a pattern of thinking or a process approach that is generally accepted? Posting and referring to the seven steps of scientific processes (cited in the "Objective" section of this activity - *Students will be able to use scientific process skills—problem solving, discovering or determining cause and effect, making inferences, drawing conclusions, classifying, predicting, and building models—to solve a problem.*) at this point will be much more relevant to students than if they see the steps "cold." Referring back to the processes after students have seen the phenomena in action will add relevance to the activity and enhance consistency and reliability in later lab activities.

While discussing results with the class, make sure you are using the vocabulary identified at the beginning of the lesson.

Extension

- ☑ Re-do the activity with three additional sizes of eyedroppers/pipettes.
- ☑ Repeat this activity using other coins (nickels, dimes). Ask students to list variables involved and how to control them to influence a fair test (e.g., same size droppers). You could give them a description of a test involving different variables—some of which would be viable and measurable, and others not—and then let them evaluate the test.
- ☑ Have the students set up the "rule book" for and conduct a fair test to see which group can get the most drops of water on a penny. (The students will control variables if they've learned from the activity—same penny, same water, same dropper, and so forth.) The winning group will be able to get the most drops on the penny *and* explain why their technique worked.

Let's Get Fired Up!

Materials

- Piece of paper
- Tongs
- Candle
- Ruler

Safety Concerns: Fire. All students will wear goggles while doing this experiment. Students with long hair will make sure they tie it back.

Procedure
(Note – each group member is required to complete a worksheet on their own!)

1. Look at the object in the bag (you may take the paper out of the bag and ***carefully!*** examine it). Describe how it:

a. looks - _____

_____

b. Sounds - _____

_____

c. Feels - _____

_____

d. Smells - _____

_____

e. Tastes: (***DO NOT*** taste this object. If you do, you will get an all expenses paid trip to the Vice Principal's office!)

2. Measure the object:

Length: _____ cm Width: _____ cm

3. Initial inference (coming to conclusions based on your prior knowledge and experience with similar objects or conditions) (***based on your observations***):

a. What do you think the object is? _____

b. What is the evidence from your observation to support this inference?

_____

_____

4. ***Prediction:*** Based on your inferences, what do you think will happen when the paper contacts the flame from the candle? Why do you expect this?

_____

_____

_____

5. Record your observation of what happened when the paper contacted the flame.

_____

_____

_____

6. Based on your observations, do you believe your initial inference was correct? Explain.

_____

_____

_____

7. Based on this experiment, what is the difference between an observation and an inference?

_____

_____

_____

String 'em Up

Question

"How many *wrists* equal one *neck*?"

Materials

- ☑ String
- ☑ Scissors
- ☑ Tape

Procedure

1. Have each group member cut a piece of string to match the circumference of his or her wrist. This will be used to measure other body circumferences.

2. Cut pieces of string to match the circumference of each person's neck. Use wrist strings to measure the length of the neck strings. Record the data on the Body Parts Chart on your worksheet.

3. List the neck measurements of each group member in order from "least wrist" to "most wrist."

4. Determine—in "wrists"—what the median (or middle) neck size is for each group.

5. Cut a piece of string for the circumference of the body parts listed in the chart. Measure each in "wrists."

String 'em Up

Body Parts Chart						
	Student 1	Student 2	Student 3	Student 4	Student 5	Median
Neck						
Head						
Ankle						
Upper Arm						
Knee						

"It's not my fault the rope's too short - you dug the hole!"

After cutting the strings for the body parts below, tape them on the line under each column.

Neck	Head	Ankle	Upper Arm	Knee

A Fishy Future

(modified from a lesson plan from Terrific Science Press)

Materials

- Two Fortune Telling Fish with wrapper
- Spray bottle of water
- Lamp

Safety Concerns: None.

Procedure

1. Remove the fish from their wrappers. Keep the wrappers for the next step. Place on one your desk and one into the palm of one group member's hand. Record your observations below, comparing and contrasting how their responses are different.

Fish on Desk	*Fish in Palm*

2. Look at a wrapper and record the "fortune" of the group member who is holding the fish.

_____

_____

_____

_____

_____

3. Experiment to try to determine why the fish behaved as they did on the two surfaces. Try the following and observe what happens.

- Lay the plastic wrapper on a group member's hand and then place the fish on it. Record your observations below.

  _____

  _____

  _____

- Lay the fish on the table. Bend the lamp so it is close to the fish. Turn it on and let it shine on the fish for a few minutes. Record your observations below.

  _____

  _____

  _____

- Spray a very ***fine*** mist of water on a desk. ***DO NOT MAKE A PUDDLE, JUST MAKE THE DESK DAMP.*** Lay the fish on the water.

  _____

  _____

  _____

4. Based on your experiments, explain below why your fish behaves the way it does.

_____

_____

"Whoa! I didn't see ***THAT*** coming!"