Communicating Science Workshop
Improving Observational Skills

Teacher Background:

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Biology

Overview: The research project I was involved in dealt with trying to make hollow Ti_2 spheres. They were viewed under 100X objective. Visual observations were made of the spheres. Based on this experience, my curriculum project involved ways of helping students became better observers. Students can either very unobservant or make very superficial observations. The focus of this project is to come up with ways of helping students to make better observations.

Learning Activities: Student were involved in several learning experiences, which will be geared to improving their observational skills.

- **Lab Activities:** Student will do a variety of labs that emphasize making observations. Such as:
  - Observation lab – scientific method
  - The pH Scale – acid and bases
  - If It's Sour, If It's Slippery – pH and buffer lab
  - Variation Lab – genetic

- **The Write Picture:** Students made observations of pictures relating to different science themes. After making observation, they wrote about the picture from the prospective of something within the picture, and in response to specific prompts.

- **The Private Eye:** Students made observations of various objects using a 5X jeweler's loupe, then drew the object. They also drew the object without the aid of the loupe.

Standards:

- The main standard that will be addressed will be Grades Nine Through Twelve—Investigation and Experimentation
- Other Content Standards to be address will be:
  - Biology/Life Science 9-12
    - Cell Biology 1a, 1b, 1c, 1d, 1e
    - Genetics 3a, 3b, 3c, 4b, 4c, 4e, 5c, 5e
  - Chemistry 9-12
    - Chemical Bonds 2a, 2b, 2c,
    - Acids and Bases 5a, 5b, 5d, 5g
    - Organic Chemistry and Biochemistry 10a, 10b, 10c

Assessments: Students will keep portfolios of their work throughout the year. Students will do a self-assessment at the end of the year.

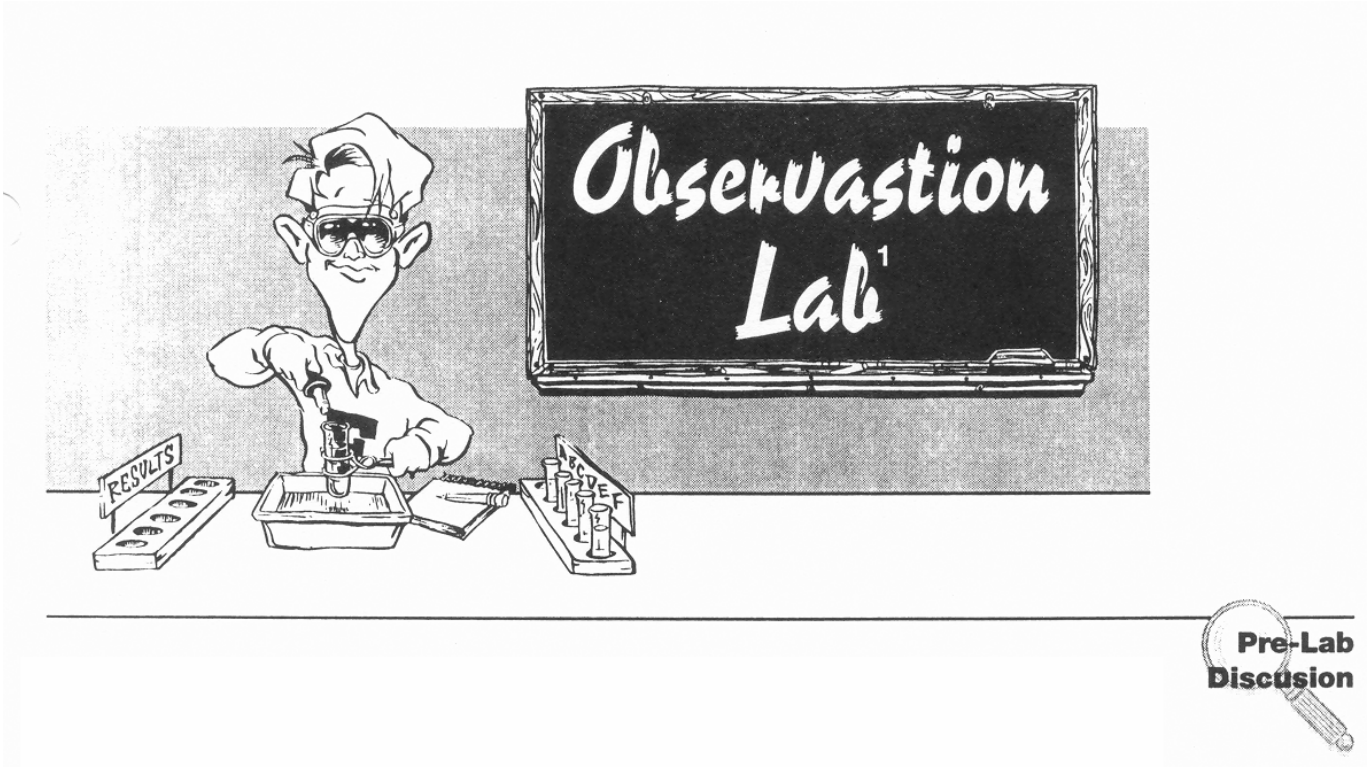
Resources:

Web sites for Science teachers

- Biology Links: www.teleport.com/~amobb/biology
- Best on the Web: http://teachers.teach-nology.com/index.html
- Internet Scout Project: http://scout.cs.wisc.edu/
- Information Literacy and Technology Project: http://www.library.ucsb.edu/infolit
- Blue Web'n: http://www.kn.pacbell.com/wired/bluewebn/
- Exploratorium: http://www.exploratorium.edu/learning_studio/sciencesites.html
- The Private Eye: www.the-private-eye.com

Web sites of Images

- Molecular Expressions: http://micro.magnet.fsu.edu/
- The Getty's Art Education Site: www.getty.edu/artednet/
- Genomic Art: http://www.geneart.org/



A friend and you are out bicycling. You both see an object in the sky, but it doesn't resemble anything you've seen before. How would you describe it? Would you say it was, big, large, small, tiny, green, blue, or round? What's the difference between big and large, small and tiny? You describe it as "beautiful" while your friend says; it's "ugly." Who's correct?

In this lab you are going to mix materials together and then describe your observations. You may have seen similar results before but were never required to explain your observations. This doesn't mean you can't or are unable to; it means you probably never had to.

When you are asked to describe something as *objectively* as possible, you are being asked to state your observations without personal bias or prejudice. Avoid the use of words or phases that may mean different things to different people. People who allow personal bias or prejudice to influence their observations and decisions are acting subjectively (the opposite of objectively).

In the field of forensic science, the subjective gathering or analysis of evidence from a crime scene is neither allowed nor tolerated. If a forensic scientist is analyzing evidence taken from the scene of a murder with the idea that a particular individual is guilty, that preconceived idea may influence their observations. If the person who is guilty, that preconceived idea may influence their observation. If the person who is charged with the crime is found guilty based on subjective analysis of the evidence the person who actually committed the crime may go unpunished. Wrongly handled or analyzed evidence may also result in the truly guilty party (with an alert defense attorney) going free.

You are to describe your observations as objectively as you can in the following laboratory experiment.

Materials Provided

Four 13 X 100 mm test tubes
Test tube rack
Wax marking pencil
Dropper bottles with chemicals labeled 1-5 (see above)
Distilled water bottles
Chemical splash goggles
Chemical-resistant aprons
Chemical-resistant gloves

[1]From: Schiltz, Gary, *Forensic Laboratory Science and Detective Mystery Writing*,, Flinn Scientific, Inc. 1994, 3a-6

Observation Lab

Lab Safety: Always assume that chemicals are dangerous when handling them. Always follow laboratory safety rules while performing the laboratory experiment.

Procedure: Your objective is this laboratory is to make all the "tests" indicated by the data table. Note that each blank box has two corresponding numbered boxes and should be filled in with your observations following your mixing of those two chemicals. Follow the step-by-step instructions below.

1. Describe the physical appearance of each chemical in the corresponding numbered box in the data table along the top of the table.

2. Label the 4 test tubes 1 through 4 with a wax pencil. Rinse each with distilled water, and place in the test tube rack. Note: if you get a reaction with only one chemical in the test tube **the test tube is dirty.** Rinse the test tube again and repeat if necessary.

3. Add 10 drops of chemical number 5 to each of the four test tubes labeled 1 through 4.

4. Add 10 drops of chemical 1 to test tube number 1 and record your observations in the data table.

5. Add 10 drops of chemical 2 to test tube number 2 and record your observations in the data table.

6. Add 10 drops of chemical 3 to test tube number 3 and record your observations in the data table.

7. Add 10 drops of chemical 4 to test tube number 4 and record your observations in the data table.

8. Pour test tube chemicals into sink and rinse test tubes with distilled water. Flush sink with tap water.

9. Add 10 drops of chemical number 4 to the three test tubes labeled 1 through 3.

10. Perform the three chemical combinations (1 + 4, 2 + 4, and 3 + 4) by repeating steps 4, 5, and 6.

11. Pour test tube chemicals into sink and rinse test tubes with distilled water. Flush sink with tap water.

12. Add 10 drops of chemical number 3 to the two test tubes labeled 1 through 2.

13. Perform the two chemical combinations (1 + 3, 2 + 3) by repeating steps 4 and 5.

14. Pour test tube chemicals into sink and rinse test tubes with distilled water. Flush sink with tap water.

15. Place 10 drops of chemical number 2 in test tube 1.

16. Add 10 drops of chemical number 1 to test tube 1 and record your results.

17. Pour test tube chemicals into sink and rinse test tubes with distilled water. Flush sink with tap water.

18. **Wash hands thoroughly with soap and water.**

Data Table

	1	2	3	4	5
5					
4					
3					
2					
1					

Questions:

1. Examine the experimental conditions listed below:

a. Explain how the size of the test tube is important when performing this or any other experiment.

b. Explain how the amount of chemical used each time is important when performing this or any other experiment.

c. Explain how the time of day when the experiment was performed is important when performing this or any other experiment.

2. What are some possible sources of error in this lab? List as many as possible.

3. Examine your data. Describe at least one observation that is objective and one that is subjective.

Conclusions: Write a conclusion based on your data. (Your conclusion is to answer the lab purpose.)

1. What did you learn from doing this experiment that you didn't know before?

2. How can you apply what you have learned from this lab to science?

If It's Sour, If It's Slippery

Name _____
Period _____ Date _____

1. Define the following: acid, base, pH, buffer, and indicator.

Record the pH value of the samples.

Sample	pH	Sample	pH	Sample	pH
salt				Red liquid	

2. Are the pH values for these substances consistent with the story of the suspect that the powders are table salt? Can you tell form the pH values alone the identity of these substances?

Record the pH value and color of the *Purple Liquid*

substances	pH	color	Number of drops
Purple liquid			
Purple liquid and HCL			
Purple liquid and NaOH			
Purple liquid and *Colorless liquid*			
Purple liquid and *Colorless liquid* plus HCL			
Purple liquid and *Colorless liquid* plus NaOH			

3. What type of chemical is the purple liquid?

4. Why is there a difference in the number of drops of acid or base required to bring about a significant change in the color of the liquid in Steps 4 and 6 or steps 5 and 7? What type of chemical if the colorless liquid? What does this kind of solution do?

5. From a consideration of only its pH, do you think it is blood? Why or why not?

If It's Sour, If It's Slippery Teacher Notes

The students are encouraged to work in groups, to share expertise and ideas in determining the best course of action to solve the crime. This helps students learn to work cooperatively and motivates them to share their individual knowledge for the good of the team. Everyone is expected to participate in the decision making and to be able to report the data and results.

Objectives

This laboratory is intended to help students understand the properties of acids, bases, and buffer solutions, while encouraging them to investigate some evidence from a crime scene to determine whether it will be useful in solving the case.

Materials:

microplates	pH indicator paper	10 mL pipets
blank labels	Buffer solution, pH7	0.1 M hydrochloric acid
red cabbage juice	0.1 M sodium hydroxide	aspirin powder
sodium chloride	sodium bicarbonate	tomato juice
microspoons	plastic cups	

Preparation:

1. There are six samples that should be labeled as unknown crime scene evidence. These include aspirin powder, sodium chloride, sodium bicarbonate, 0.1 M hydrochloric acid, 0.1 M sodium hydroxide, and tomato juice. Assign a letter to each of the six unknown samples. Be sure to note which samples are corresponding to each label letter for use in data analysis.

2. Label the red cabbage juice *Purple Liquid*, and label the pH 7 buffer *Colorless Solution.*

3. Make sure one portion each of sodium chloride, 0.1 M hydrochloric acid, 0.1 M sodium hydroxide are labeled with their chemical names so they may be used as known reagents by students as they analyze their unknowns.

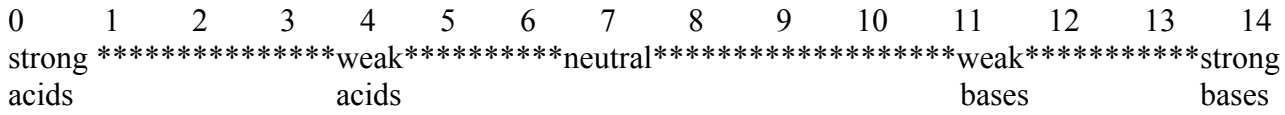
4. To add even more "unknown" crime-scene solutions, place other reagents such as dry milk, boric acid, and white vinegar at the materials station.

pH of Common Substances

Name _____

Period _____ **Date** _____

The measurement of the concentration of hydrogen ions in a solution is the pH. Solutions with a pH below 7 are acidic. Solutions with a pH above 7 are basic. A pH of 7 represents a neutral solution, one that is neither an acid nor a base. Pure water has a pH of 7. The pH scale from 0 to 14 is shown below.



Solutions can be identified as being acidic or basic by testing them with certain indicators. Some indicators can be used determined the specific pH of a solution as it changes within a specific range. In this investigation, you will use indicators to determine the pH of some common substances.

Prelab Questions:

1. What does pH measure? _____
2. What is a neutral solution? _____
3. Is the pH of a strong base higher or lower than the pH of a weak base? _____
4. Is the pH of a strong acid higher or lower than the pH of a weak acid? _____

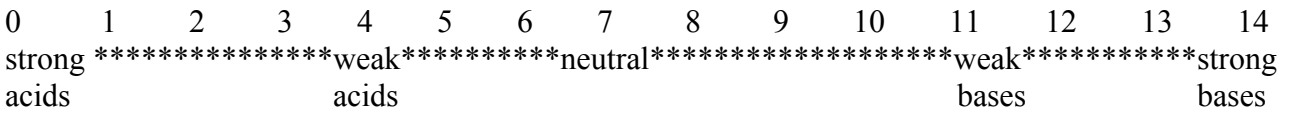
Observations and Data:

PART A: pH of Common Substances

1. pH of common substances

substance	Color of blue Litmus paper	Color of Red Litmus paper	ph determined by pH test paper

2. Using the data from item 1, add labels showing the pH of each test substance to the pH scale below.



3. Which of the test solutions are acidic? _____

4. Which of the test solutions are basic? _____

5. Which of the test solutions is the strongest acid? _____

6. Which of the test solutions is the strongest base? _____

7. Which of the test solutions are neutral? _____

PART B: Neutralization

1. Finish filling in the chart based on the information given.

Substance	pH
HCl	2
NaOH	13
HCl + NaOH	

2. Predict the number of drops of NaOH that would be needed to neutralize 25 drops of HCl.
_____

3. What would remain in the test tube containing the neutralized acid-base mixture if the liquid were allowed to evaporate? _____

The Write Picture

Purpose:

- To expose students to creative writing-across-the-curriculum
- To exercise student critical questioning and thinking
- To elicit metacognitive thinking and writing
- To help students to identify personally and emotionally with your subject's personalities and events.

Materials:

Choose an interesting and thought-provoking painting, drawing or photograph related to the unit being taught. Either have a slide, overhead, or PowerPoint slide, or duplicate of the visual for the students. Each student needs paper and pencil/pen.

Procedure:

1. Instruct the students to study the picture. Have them list every physical thing they see in the picture. Take volunteers to read their lists to make sure everyone sees the same details.
2. Next tell them to choose one of the people/objects to become in the picture. This will be their "point of view."
3. Tell them they will be writing from the point of view of the person or item they chose, and give them the lead-in lines from below to guide their writings:

   I see… I hear… I feel…. I touch … I taste … I am…

   Other possibilities of lead-ins are: …hate, love, embrace, reject, fear, long for, celebrate, ponder, wait for, applaud, attempt to, work for, live for, want, cannot, can, sense, predict, stand for, contemplate, strive for, never, always, sometimes, might, should, would….

4. When they are finished, have them share in-groups of three or four by reading aloud to each other. Make sure they have the picture available to view during the readings. Instruct each member of the group to be an *active listener*. The *active listener* must relate to the reader the line(s) he/she believes are most interesting/compelling or best written. This feedback is important for giving direction to second for final drafts for possible inclusion in a student portfolio.

The Private Eye®

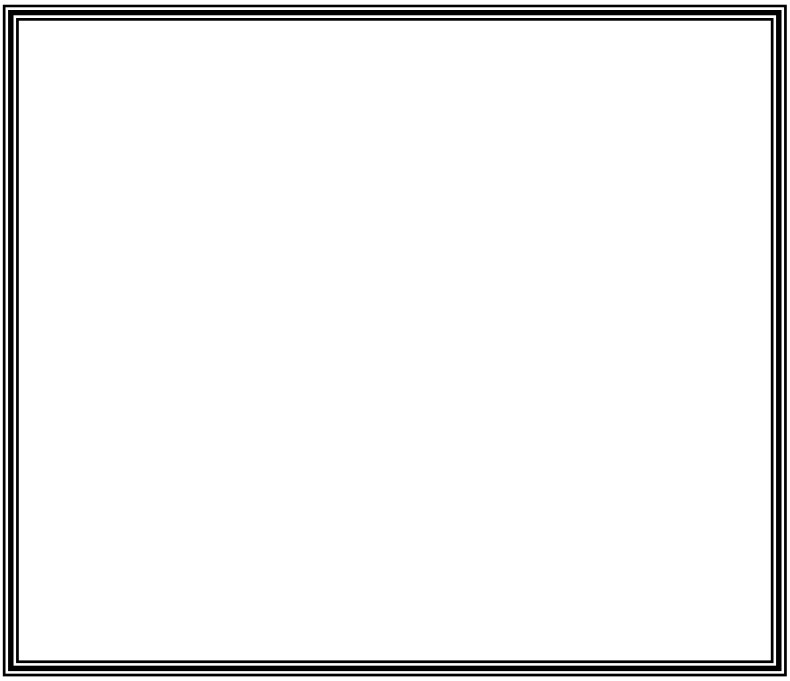
Theorizing template

(We include the term "hypothesizing" in with the term "theorizing.")

Name_____

Date_____ period _____

Object: _____



loupe
drawing

Loupe-look Analogies:

"What _____ does it remind me of?"
"What else does it look like?"

1._____

2._____

3._____

4._____

5._____

6._____

7._____

8._____

9._____

10._____

"Why did it remind me of that?"

From your analogy list pick any five and explain why it reminded you of that. Consider shape, texture, color, smell, size, movement, feeling etc.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Why is it like that?

Use your analogies above as "clues"!!!

Ask yourself: If it reminds me of _____, I wonder if it might act like that to help this plant (or critter) survive?

Choose 3 analogies from above as clues to help you answer, "Why is it like that?"

1. It could be because... _____

_____

2. It could be because... _____

_____

3. It could be because..._____

_____

The Private Eye

Lesson 1

1. **LOOK:** Using the loupe explore an object. Ask the questions "**What does it remind me of? What else does it look like"**
2. **WRITE:** List all the things it reminds you of. (This is making an analogy). The number of analogies could be increased over time.
3. **DRAW:** Alternate between a) visually exploring the subject with the loupe, and b) drawing it on paper. Loupe-look, draw, loupe-look, draw, etc. Use a 5" square to put the drawing in. Fill the frame as you draw. Use a pen
4. **THEORIZE:** As you observe some feature on your object: ask, **"Why is it like that?"** Use your list of analogies to help answer the question. *Since 99% of what's found in nature is functional, and since form follows function,* ask, "**IF it reminds me of *that*, I wonder if it might function like *that*—in some way that helps it to survive?"**

Lesson 2: Changing Scale

1. Using a single loupe, observe an object and list what it reminds you of. Draw it.
2. Using two loupes nested together, (10x), observe the same object again. Once again list what it reminds you of and also draw it.
3. Using a microscope or dissecting scope observe and draw the same object again.

Lesson 3: Genetics, Environment and Evolution: Variation within a species.

1. Collect 10 specimens of the same natural object.
2. Look-by-analogy for variations between the same species.
3. Record and draw observations.

From: Ruef, Kerry, The Private Eye, (5X) Looking / Thinking by Analogy,