I'm a Water Scientist! Lesson 9

Objectives
The student will be able to do the following:

- Connect water quality test names to types of pollution or other water parameters
- Describe what each type of test investigates
- Define hypothesis
- Make a hypothesis about water quality
- Explain why replication is necessary in a scientific study

Materials
Copies of the reading material/hypothesis table sheet for students to read aloud
Copies of activity/homework sheets for every student (if desired)
Pennies or nickels for every student (to be returned)

Background
This unit builds on previous units that introduced water quality tests and pollution. This unit formally connects the water quality tests (and their scientific names) to the types of pollution or stream health parameters that they investigate. This unit also briefly touches on replication, as explanation for why multiple tests will be used in the future, and builds on introductory material on hypotheses by asking students to define and make hypotheses.

Advance Preparation
This unit requires little preparation other than previous introduction to pollution and water quality. Enough materials (including coins) should be printed/collected for distribution to each student.

Procedure

1. Begin by saying that today the students will continue being scientists, specifically water scientists. Ask them if they know what they have to do be scientists (do experiments, make observations, make hypotheses, etc.).
2. Have the students read the worksheet aloud. Pause to go over concepts and vocabulary words.
    a. Water quality refers to both pollution and non-pollution health parameters (e.g. presence of oxygen).
    b. Remind students of previous observations they made, particularly when they examined plants, animals, trash, and the riparian buffer zone.
    c. Stress that scientists make hypotheses rather than just blindly doing experiments. Hypotheses guide scientists in their investigations and give structure to supporting or denying findings.

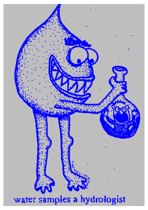
d. Explain that many things can go wrong during an experiment, requiring replication (e.g. think about using the temperature strip – perhaps students took the temperature of a hand or the air instead of the temperature of the water).

3. Work through the hypothesis table. Have students recall what their observations were previously and use those observations to make hypotheses. For instance:
    a. Students may recall that they saw fish living in the stream's waters, thus there is likely to be enough oxygen there for fish to survive. They might hypothesize high or excellent levels of dissolved oxygen.
    b. They might remember the small farm next to the stream, and might hypothesize that fertilizers from the farm reach the stream, so there might be medium or high levels of nitrate. Or, they may think that the farm is too small or does not use fertilizer. If they know the Kalihi watershed well enough, they may know that there are not very many farms in the watershed, so they may hypothesize no or little nitrate.
    c. Because the students saw people washing their cars next to the stream, they may hypothesize high levels of phosphate.
    d. Because they can see the bottom of the stream they may hypothesize low levels of turbidity. However, if they can tell that the water is dirty, say after a rain, they may hypothesize high levels.
    e. They might hypothesize that water will be cooler under the riparian buffer zone.
    f. They might hypothesize that water in the stream has a high pH, because of people using soap, or a medium pH, because there is no sign of any acids or bases.
    g. Students may remember seeing the pile of dog poop next to the stream, and might hypothesize that there will be bacteria present in the water.
4. Stress that when making a hypothesis, there is no wrong or right. What matters is that students think about what they already know and make a prediction based on that.
5. Time permitting, do a short exercise to illustrate the importance of replication:
    a. Give each student a penny
    b. Ask the students, if they flip the penny ten times, how often will be heads?
    c. Students can answer any number, but will likely answer ½ (one-half/ 5 times). (Teachers may use this as an opportunity to discuss fractions).
    d. Ask students how they can be sure of that answer. Do one example with the teacher flipping a coin. Teachers may choose to fudge answers or not, but likely it will not be one-half. Ask students how we can be sure that ½ is the answer?
    e. The best way to be sure about the answer is to do the test many times over – replication.
    f. Have each student flip their coin 10 times, keeping track of how many times it was heads.
    g. Take a tally of all students' heads on the board. Take a quick average of all of the tallies. The average should be approximately ½ for all throws. Illustrate that each individual test alone was not enough to be sure (as

there will be individual variability), but by replicating data and pooling data from multiple tests, we can have more certainty about our data.

Worksheets/Homework sheets
Two worksheets are provided as in-class activities or as homework.

Materials have been developed as part of the University of Hawaii-Manoa GK-12 program (NSF grant #05385500) in conjunction with the Kalihi Waena Elementary School, Honolulu, HI.



I'm a Water Scientist!

How can we be water scientists?
By testing the water! We are going to test the Kalihi Stream to see if there is any pollution. We are also going to test the water to see if is acceptable for animals to live in. This will tell us our water quality.

What do we have to do to be water scientists?
First, we have to learn about the stream. That is why we have been learning about water, the Kalihi Watershed, and the animals and plants that live in the stream. When we went outside to look at the stream, we were making observations.

What do we do with our observations?
We will use our observations to make a hypothesis about the stream. A **hypothesis** is a **prediction based on observation**. We will make a guess about the future using what we already know.

What do we have to make a hypothesis about?
There are many types of pollution, such as fertilizer or dirt, and many tests. So we have to make many hypotheses, one for each kind of test.

What do scientists do after they make a hypothesis?
We are going to check our hypothesis by doing an experiment! We will investigate the water by doing water quality tests to see if our hypothesis is right or wrong.

How do we know for sure if our hypothesis is right?
There are always possibilities that things can go wrong. Sometimes we can make mistakes or **errors**. If we want to have certainty, we should repeat the test many times. This is called **replication**.

Materials have been developed as part of the University of Hawaii-Manoa GK-12 program (NSF grant #05385500) in conjunction with the Kalihi Waena Elementary School, Honolulu, HI.
Duplication for educational purposes only.

Name _______________

A Hypothesis for Every Test

Test Name	**What the test looks for**	**My hypothesis is:**
Dissolved Oxygen	Enough oxygen in the water for animals to live	
Nitrate	Too many nutrients from fertilizer	
Phosphate	Too many nutrients from soap	
Turbidity	Any Dirt (sediment)	
Temperature	Too much heat in a part of the stream	
pH	Whether the water is acidic (like a lemon), basic (like slimy with soap), or just right	
Coliform Bacteria	Germs from poop or decomposing animals	

Materials have been developed as part of the University of Hawaii-Manoa GK-12 program (NSF grant #05385500) in conjunction with the Kalihi Waena Elementary School, Honolulu, HI.

Name _______________

What am I testing?

Draw a line to connect the test name to the picture that describes what the test investigates. Connect each picture to the word that describes the picture.

<u>Test names</u>

Nitrate

pH

Coliform bacteria

Turbidity

Phosphate

Dissolved Oxygen

Temperature

Heat

Germs

Things in the water – like acids

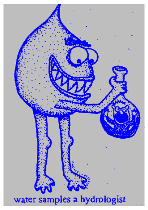
Fertilizer

Whether animals can breathe enough in the water

Dirt

Soaps

/ of Hawaii-Manoa GK-12 program (NSF grant #05385500) in conj
Duplication for educational purposes only.



I'm a Water Scientist!

1. Make a drawing to show where NITRATE comes from	2. Make a drawing to show where PHOSPHATE comes from

3. What is pollution?_______________________________________

____

4. Where are three places you can find pollution?

______________ ______________ ______________

5. What is a hypothesis?

____Something you don't know

____Something you have to repeat

____Something you predict based on what you know

6. Why do you do replication?

_____Because by repeating the test, you can be sure of your answer

_____Because you like doing the tests a lot

_____Because you might forget how to do the test

Materials have been developed as part of the University of Hawaii-Manoa GK-12 program (NSF grant #05385500) in conjunction with the Kalihi Waena Elementary School, Honolulu, HI.