Aquatic Systems #2

Goals

Students learn to use, read, and interpret data from available measurement tools in the process of setting up their aquatic habitats. They are introduced to photosynthesis via video. They determine their research question for the aquatic habitats.

Introduction

This set of lessons introduces students to the various measurement tools they will be using to answer their research questions. Some of these tools are familiar (ruler, thermometer, hand lens, microscope), but not necessarily correctly understood. Others may be completely new (triple-beam balance, graphing calculator, CBL/LabPro probes) and need to be demonstrated as well as experienced. Students also explore the units of measure for each tool. Finally, "good" question characteristics are developed by the class. Using those characteristics as a guide, each student writes a "good" question.

Outcomes

Students will:

1. demonstrate appropriate measurement tool selection
2. demonstrate appropriate measurement tool use
3. apply appropriate measurement unit
4. read data from various measurement tools accurately
5. reasonably interpret data from measurement tools
6. use appropriate measurement vocabulary
7. develop the characteristics of a good question
8. write a good question using those characteristics

Vocabulary*

water chemistry
ph
dissolved oxygen
turbidity
metric: milimeter, centimeter, meter, gram, kilogram, mililiter, liter
English or customary: inch, foot, yard, ounce, pound, pint, quart, gallon
nitrogen
acidic
alkaline

Materials**

Basic: hand lens
flash light
microscope

ruler (metric and English)
triple-beam balance
thermometer
stop watch
calculator (scientific and graphing).

Desirable: water chemistry test kit or
Vernier CBL/LabPro sensors/probes for water quality
computer for storing and graphing data
graphing software

Prerequisites

Aquatic Systems #1

Familiarity with graphic representations, their application, production, and interpretation [table, stem-and-leaf plot, line plot (frequency distribution), bar graph, line graph (coordinate), pie graph (circle), box-and-whisker plot]. By the time we began this study, my sixth graders had had extensive experience with all of the above representations through our math program.

Some familiarity with all of the basic measurement tools.

Time Required

Procedure

The delay between order and receipt of plants and animals is useful because it allows time to

1. assess/teach measurement tool use and unit knowledge
2. assess/teach interpretation of measurement scores
3. review characteristics of a good question
4. develop a good question and research plan
5. perform water quality tests if tools are available
    a. on tap water immediately after filling the jars
    b. again after a few days of settling
    c after adding the substrate at intervals of 1, 3, 5, 7, and 14 days to determine appropriate changes in water chemistry for the plants and animals chosen.
6. learn to use available measurement tools
7. create new measurement tolls as necessary
8. develop a research plan for their jars
    a. a good question they wish to anwer
    b. what they will do to answer it
    c. what evidence they will need

d. how they will document it all

Each table group develops a question and each member has a piece of that question.

For example, a group chose this question: Is this (jar) environment healthy for duckweed? To answer, they first had to define healthy. Then they had to develop a scale with which to measure health. This group decided that healthy meant there was more duckweed with the passage of time (growth). That meant students had to devise a measurement tool for duckweed. Unfortunately, they hadn't counted the duckweed when it was put in the jar and several days passed before they settled on their final question. They had to assume growth had been taking place, but they didn't know how much (rate of growth would be another measurement tool). They could only begin measurement from that point. As time passed this group counted more, but the ones they counted didn't look as good as originally. They had to develop a scale to measure how healthy using appearance. Since they hadn't anticipated this outcome, they had not measured the duckweed using their health scale at the beginning of the study. Therefore, they couldn't prove the duckweed had degenerated and because there was more of it, the group wasn't worried (not long afterward, their entire system crashed and they added the question: What is the effect of growth of duckweed on the health of the other plants? the system?). They also had to distinguish growth from reproduction. This group learned valuable, if frustrating, lessons about doing science. A major aspect of their learning involved the necessity of making tools to serve their purposes. This involved recognizing a need, analyzing the conditions, and creating a tool to accomplish a task; to then use that tool and in the use discover where it needs revision and revising it as needed. How many learning situations require that level of thought and ingenuity? And, this was a common, not isolated event for table groups during the study.

Last year our water garden crashed completely once--everything had to be replaced--and died back to near crash two more times (many plants and animals had to be replaced, but not all) before we were able to stabilize it. All three experiences were wonderful learning opportunities as we group problem-solved, called in experts, and tried interventions in several eventually successful attempts to figure out what caused the crash and prevent another.

* Vocabulary may expand far beyond what is listed here depending on the variety of measurement tools available at your school, and the age and sophistication of your students.

**Measurement tools may be limited or extensive depending on your budget and the age and sophistication of your students.

***Time required will vary depending on the conditions mentioned above. During our first year, available tools were the common variety: ruler, triple-beam balance, microscope, hand lens, thermometer, stop watch, calculator (scientific and graphing). Students' questions informed tool purchase when money became available last summer. For example, a tool for measuring light in both terrestrial and aquatic environments was critical to answering many student questions during last year's study. However, we didn't have such a tool and there was no substitute. Therefore, those questions could not be answered. Just like real science. This year we purchased such a tool in anticipation of student question. Time to teach appropriate use, unit, reading, and interpretation of this tool will have to be included.