



Harvard Forest LTER Schoolyard Ecology

## Vernal Pool Data Analysis Lesson Plan: Choose the Appropriate Graph

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### Acknowledgements:

Dr. Betsy Colburn, Harvard Forest Ecologist  
Pamela Snow, Harvard Forest Schoolyard Coordinator

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<http://www.massenvironmentaltrust.org/>

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**Curricular areas:** Mathematics: Data analysis/ Graphing, Science: Ecology

**Grade Level:** 5

### Topic:

This lesson is designed to teach students how information can be organized in many different ways to make it easy for us to understand. The students will learn to choose an appropriate graph to illustrate our Schoolyard Ecology Vernal Pool project data in a manner that allows for analysis and understanding of the data. Working in groups, the students will graph a given data set using the type of graph they have chosen.

## **Rationale:**

It is important that students learn/practice this concept so that they can both be able to understand what their data show, and effectively present/communicate data to others. Students will be prepared, for example, to present our vernal pool data to the school during a weekly assembly.

## **Instructional Objectives:**

Students will be able to:

- Choose the best graph for a set of data, depending on the question being asked of the data
- Create a graph using appropriate scale, intervals, and titles
- Interpret the graph to determine if it is showing any patterns or relationships among the data

## **MA Curriculum Frameworks:**

- Mathematics Grades 5-6, Patterns, Relations, and Algebra # 6.P.4: “Represent real situations and mathematical relationships with concrete models, tables, and graphs”.
- Mathematics Grades 5-6, Patterns, Relations, and Algebra # 6.P.6: “Produce and interpret graphs that represent the relationship between two variables in everyday situations”.
- Science Grades 3-5, Earth and Space Science, Weather, # 6: “Explain how air temperature, moisture, wind speed and direction, and precipitation make up the local weather in a particular place and time”.
- Science Grades 3-5, Earth and Space Science, The Water Cycle #10: “Describe how water on earth cycles in different forms and in different locations, including underground and in the atmosphere”.
- Science Grades 3-5, Life Science, Energy and Living Things #11: “Describe how energy derived from the sun is used by plants to produce sugars (photosynthesis) and is transferred within a food chain from producers to consumers to decomposers”.

## **Materials:**

- *Diagrams /Illustrations to Teach Concept(s)*
- Vernal pool data set from Harvard Forest Schoolyard Study: Freshwater Ecology: Vernal Pools
- *Cooperative Group Work Rubric*
- *Group Presentation Rubric*
- *Examples of the Types of Graphs Students Might Create*
- graph paper
- pencil
- various colored pencils
- Large poster sized graph paper (one piece for each small group of students)

## Procedure:

### Initiation:

1. Ask students: Have you ever been curious to know how one event affects another event? For example, if you study longer for your next math test, will you get a better grade? Scientists and statisticians gather data to determine relationships between such events. You, as student scientists, have been gathering data about our vernal pool. We can use those data to examine if there is a *possible* relationship between the natural cycles of weather, and the seasons, and the water depth of our pool. If we were to graph the data we have, the graphs would not show that one thing actually *affects* something else, but the graphs will help us see if there are *relationships*, or patterns, within the data.

2. Tell students: We need to be careful how we choose to display the data that we have collected. We have already discussed several ways to display data: bar graphs, circle graphs (pie charts), stem and leaf plots, line graphs, scatter plots, and histograms. Today we will need to decide which type of graph would be best to display our data.

### Development:

1. Review the six types of graphs previously discussed and drawn by the students. Have a volunteer record the name of each type of graph on the board (line graph, bar graph, circle graph (pie charts), scatter plot, stem-and-leaf plot, and histogram).

2. Ask students to give an example of when each type of graph might be used. Possible answers: line graph shows continuous data over time, bar graphs are used to compare facts about groups (or to show patterns over time), circle graphs are used to compare parts of a whole, scatter plots are used to show how change in one variable is related to change in another variable, and histograms show data within intervals.

3. Show the students examples of each of these graphs. Discuss.

4. Tell the students that their job today is to determine which type of graph would be best to display our vernal pool data in relation to specific questions we have about the pool (How does water level change over time? How does water level change in relation to rainfall, air temperature, trees leafing out, or other variables? Is pool diameter related to water depth?, etc.).

5. Discuss what types or kinds of data have been collected so far during our study of the vernal pool (water depth, air temperature, water temperature, pool diameter).

6. Show the vernal pool data set from November 2005-November 2006 to the students to remind them of our findings. These data sets need to be displayed for the remainder of the lesson.

7. Ask: "If we wanted to determine whether or not there is a relationship, or a pattern, between air temperature and the water depth of our pool, which type of graph would we want to use to communicate our findings?" *Do not openly discuss their decisions with the whole class yet!*

8. Ask each small group of students to discuss this question, and come to a conclusion within the group about which type of graph would be best to use for this situation/data set.

9. Tell the students that they will be drawing this type of graph within their group today on a large poster sized piece of graph paper. On the back of their graph, the group must write an explanation of why they chose that type of graph to display their data.
10. Tell the students that they will be graded on their choice of graph, their explanation of why they chose to use this type of graph, whether or not they used an appropriate scale and interval for their data, and whether or not they included titles on their graph.
11. Remind students that I will be using the “Cooperative Group Work Rubric” to score their individual participation within the group today. Each person needs to participate in the creation of the graph in some way.
12. When each group has decided on which graph would be best to use, hand them a large poster sized piece of graph paper so they may begin creating their graph.
13. Rotate amongst the groups to check on progress and to assess individual participation.
14. Give the groups an occasional reminder regarding how much time they have left to complete their graphs.

#### Closing:

Have each group come to the front of the class to display their graph to the rest of the class. Ask each group to include the following in their presentations:

1. Read their written explanation of why they chose that type of graph.
2. Point out the titles, scale and interval.
3. Tell the class about their findings. Did they see any patterns or relationships in the data that they graphed?

Close the lesson by having a discussion about what effects the students feel that the changing water level may have on animal and plant life in the pool. Things that might come up in discussion include: When is there enough water to allow amphibians to lay their eggs? How do dropping water levels affect amphibian eggs in the water? Tadpoles and larvae? Insects and crustaceans? Other animals? How might interactions between temperature and water level affect how fast animals grow and whether they finish growing before the pool dries up?

Tell the students that we will be continuing our field visits through the rest of the school year, and the water level of our pool will continue to change as the seasons change.

## **Assessment Measures:**

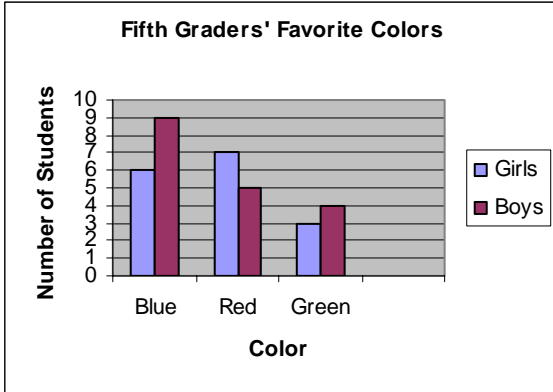
- In order to determine which students have met my goals/objectives for this lesson I will assess the graphs that were made during class. I will focus on two questions:
  1. Did the students choose the appropriate graph for the chosen data analysis?  
(In this case a scatter plot showing water depth vs. air temperature, or a bar graph showing water depth and air temperature, over time, would be best).
  2. For the chosen graph, did the student groups use appropriate scale, interval, and titles as necessary?
- I will also assess their written explanations of why their group chose to use that particular type of graph, and their interpretation of their findings. Did the group find any patterns or relationships amongst the data they graphed?
- Next, I will assess their presentation of the graph to the rest of the class. Was the group able to explain what the graph was showing?
- Assessment of individual participation will also occur as the group is working on their graphs. I will use the “Cooperative Group Work Rubric” for this assessment.

## **Sources:**

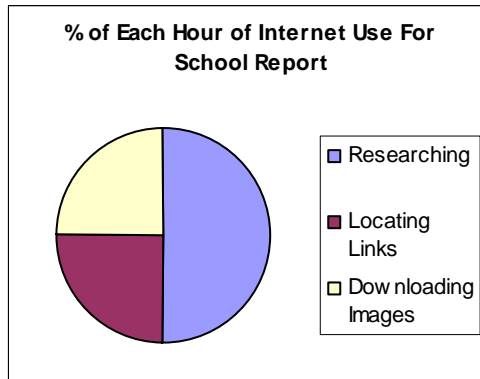
- Harvard LTER Schoolyard Program Protocols and Data-suggested reading on vernal pools, related research: <http://harvardforest.fas.harvard.edu/museum/vernal.html>
- Harcourt Math Grade 5 Volume 1: Maletsky, E.M., et al., Harcourt Math: Boston, Mass., Harcourt School Publishers, 2002.

Diagrams /Illustrations to Teach Concept(s):

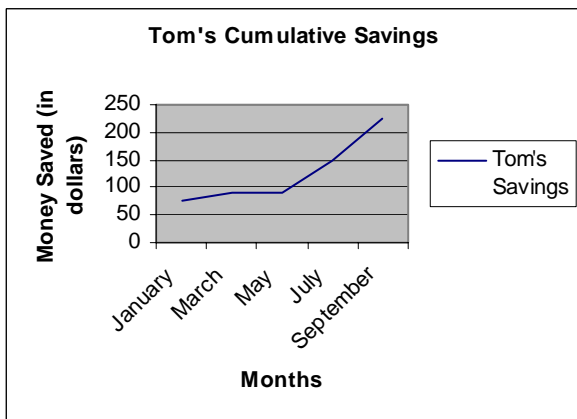
**Bar Graph**  
Compares data by category



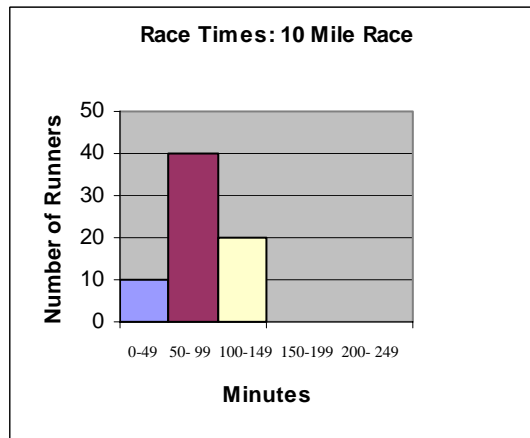
**Circle Graph**  
Compares parts of a group to the whole group



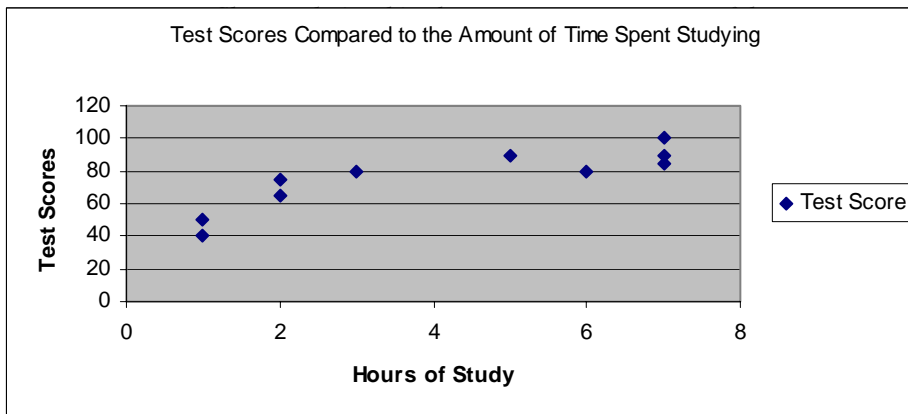
**Line Graph**  
Shows how data changes over time



**Histogram**  
Shows the number of times data occurs within certain intervals



**Scatter Plot**



**Cooperative Group Work Rubric**

Name: \_\_\_\_\_

Date: \_\_\_\_\_

4- EXEMPLARY – you *consistently and actively* help your group achieve its goals by communicating well with other group members, by encouraging the group to work together, and by willingly accepting and completing the necessary work of your daily role.

3- EXPECTED – You *usually* help your group achieve its goals by communicating with other group members, by encouraging your group to work together, and by accepting and completing the necessary work of your daily role.

(If your evaluation is less than EXPECTED,  
try to use your cooperating skills more consistently.)

2- You *sometimes* help your group achieve its goals.

1- You *do very little* to help your group achieve its goals.

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**Your Score:** \_\_\_\_\_

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**Group Presentation Rubric**

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Title of Presentation: \_\_\_\_\_

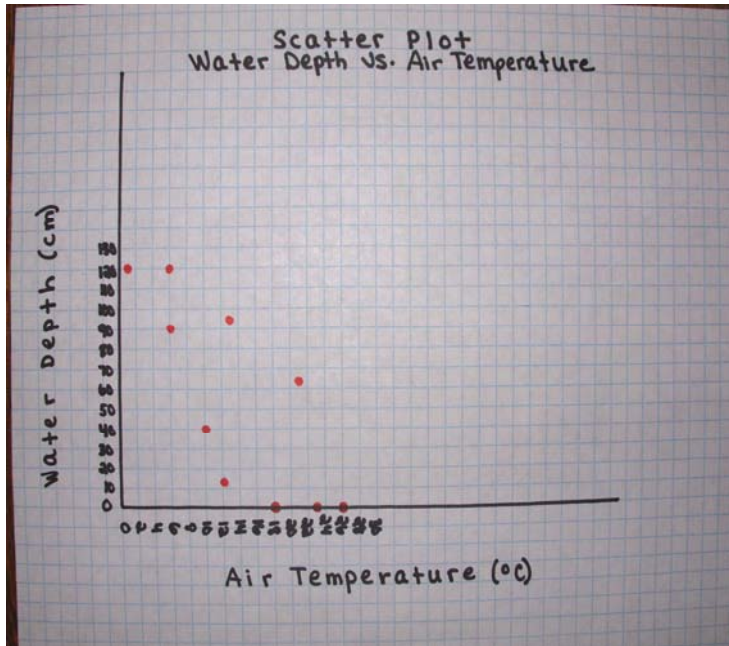
Criteria	4	3	2	1	Points
<b>Explanation of Graph Choice</b>	A complete response with a detailed explanation.	Good solid response with clear explanation.	Explanation is unclear.	Misses key points.	
<b>Use of Visuals</b>	Clear, neat, graph that includes appropriate details	Clear, neat, graph. Some details missing.	Inappropriate or unclear graph. Missing important details.	No graph completed.	
<b>Mechanics</b>	No math errors within the graph.	No <i>major</i> math errors or serious flaws in reasoning within the graph.	May be some serious math errors or flaws in reasoning within the graph.	Major math errors or serious flaws in reasoning within the graph.	
<b>Demonstrated Knowledge</b>	Shows complete understanding of the questions, mathematical ideas, and processes.	Shows substantial understanding of the problem, ideas, and processes.	Response shows some understanding of the problem.	Response shows a complete lack of understanding for the problem.	
<b>Requirements</b>	Goes beyond the requirements of the problem.	Meets the requirements of the problem.	Hardly meets the requirements of the problem.	Does not meet the requirements of the problem.	

## Vernal Pool Schoolyard Ecology Data Set

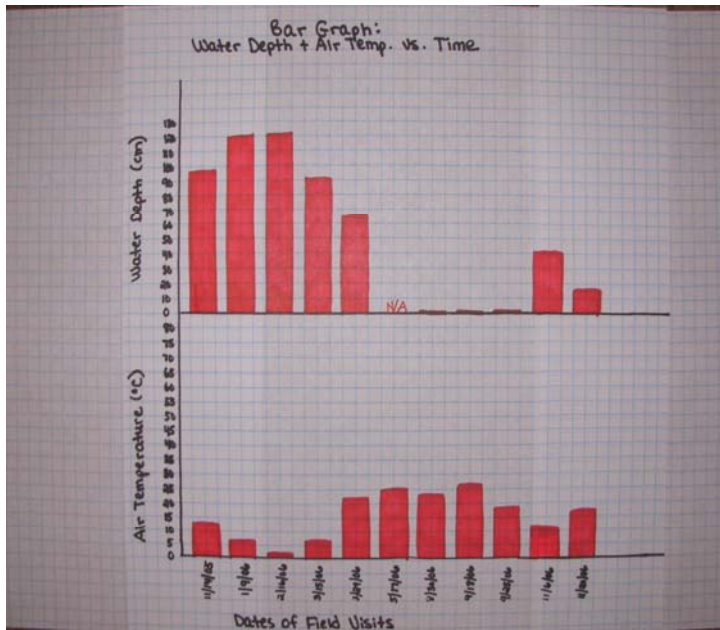
Dates of Field Visits	Air Temperature (°C)	Water Depth (cm)
11/14/05	13°C	95 cm
1/9/06	6°C	120 cm
2/16/06	1°C	120 cm
3/15/06	6°C	90 cm
3/29/06	21°C	63 cm
5/17/06	25°C	N/A
8/30/06	23°C	0 cm
9/18/06	26°C	0 cm
9/25/06	18°C	0 cm
11/6/06	10°C	40 cm
11/20/06	12°C	12 cm



## Examples of the Types of Graphs Students Might Create



This scatter plot is a good choice of graph to use to help answer the question being asked, as it shows how one variable (our water depth) *might* be affected by another variable (the air temperature). The points show a possible negative correlation between air temperature and water depth. The water depth increases as the temperature decreases.



This bar graph would also be a good choice to use as it helps to compare groups, or to show patterns within the data over time. Again we see that the water depth increased as our temperature decreased.