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Harvard LTER Schoolyard Program

Teacher Developed Lessons and Documents that integrate Harvard Forest Schoolyard Ecology Themes into curriculum.

- **Lesson Plan Title:** *Graphing Activities*
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- **School:** Overlook Middle School
- **Level:** 7th Grade
- **Subject:** Life Science
- **Date:** April 13, 2011

Graduate Course Lesson Plan
JoAnn Mossman
Overlook Middle School
Gr. 7 Life Science
Due April 13, 2011

Title: ***Graphing Activities for the Harvard Forest Study Trees***

Harvard Forest Schoolyard Ecology Program Goals Addressed:
Goal:
A. Enhance science learning through teacher professional development that focuses on the implementation of field-based ecological research projects for K-12 students.
Primary Objectives:
B. Link student work to the research of Harvard Forest: #2, 3, &4.
D. Use of teaching techniques that provide opportunities for participants to use critical thinking skills: #1, 3, 4, 5, 6, 7.

My Goal:

To add a formal graphing and reporting piece to the Harvard Forest Data my students have collected from Fall 2009 to Fall 2010.

Learning Objective:
Students will analyze and graph Overlook's Harvard Forest data from fall 2009 to fall 2010 in a number of different graphing activities.

Estimated Time: 3 to 4 /55 min. class periods

Overarching Question:
By how much and why do leaf fall dates and growing seasons vary from year to year?

Student Work:
see attached

Procedures: (an ideal time to do this lesson is in March prior to starting the spring protocol)

1. Prior to doing these graphing activities with the students, manipulate the excel data for the fall and spring seasons you wish to graph. Such changes might include adding a % fallen column, calendar date, Julian date, etc. Copy enough packets of each season for students to use. (attached)

2. Change dates each year on "Graphing Activities 1-6" and copy for students. (attached)

3. Pass back the student vocab. and question packet (student sample attached) that was collected at the conclusion of the fall season. Go through the packet with the students to refresh their memory of the vocabulary of the protocol, their tree, and predictions they made. After reviewing #3 "What are the factors affecting leaf out?" have them write their predictions for their tree this spring on the last page.

4. Pass out the "Fall 2010" packet (attached) and rulers. Going line by line, explain what each column means. Who had which tree #, what the Julian # means, how many leaves total were observed, how many fell, what was the %. Once students have a good understanding of how to read the data, ask, "What kind of graphing activities might we be able to do with this data?" Write down their ideas and discuss how each might be done.

5. Put up on the overhead or smart board, 4 of Dr. O'Keefe's graphs: (attached)
   Go over what each graph is showing through questioning, student analysis and teacher explanation.
   - Mean LF50 (leaf fall 50%) 1991-2009
     - Notice the overall trend for a later leaf fall.
     - What could have caused the spike in '03 and drop in '07?
   - Mean BB50 (bud break 50%) 1990-2010
     - Notice the overall trend for earlier bud break.
     - Notice how '10 may skew the overall data.
     - What will happen in '11?
   - 50% BB 75% leaf development 19900-2008

    - When we accumulate enough data, we will be able to graph leaf out and leaf fall for each species, each year.
- Leaves on Days 1991-2009
    - Notice the trend for the growing season is increasing.
    - The most recent years it is because of earlier bud break.
    - How might this info. help Dr. O'Keefe answer his original questions? (These are listed on the front of our student vocab. packet.)

6. Any other discussion surrounding graphing. Show students exemplars from previous years' graphing activities. Review what makes a good graph, title, labeled axes, color, using the appropriate type of graph for what they are trying to show. Pass out "Harvard Forest Graphing Rubric" for the graphs and follow-up questions. (attached) Read together. Encourage them to make data tables prior to graphing.

7. Break up students into six lab groups. (Graphing Activities 1 and 2 are easier; 3, 4, and 5 are more challenging; 6 requires a computer with internet access and a printer. All activities are attached. Larger poster paper can be used instead of graph paper at anytime.)
   At each lab station are the appropriate materials and data sheets.
    - Lab Group 1: rulers, graph paper, Graphing Activity 1 worksheet, Fall '09 and Fall '10 data packets with %, colored pencils, lined paper or science journals for answering questions.
    - Lab Group 2: rulers, graph paper, Graphing Activity 2 worksheet, Fall '09 and Fall '10 data packets with %, colored pencils, lined paper or science journals for answering questions.
    - Lab Group 3: rulers, graph paper, their own student packets, Graphing Activity 3 worksheet, Fall '10 data packet with % and calendar date, calculators, colored pencils, lined paper or science journals for answering questions.
    - Lab Group 4: rulers, graph paper, Graphing Activity 4 worksheet, Fall '09 and Fall '10 data packets with %, colored pencils, lined paper or science journals for answering questions.
    - Lab Group 5: rulers, graph paper, Graphing Activity 5 worksheet, Spring '10 and Fall '10 data packets, calculator, colored pencils, lined paper or science journals for answering questions.
    - Lab Group 6: computer with internet access and printer, Graphing Activity 6 worksheet, Fall '09 and Fall '10 data packets with %, colored pencils, science journals for answering questions.

8. They are working on individual graphs but they are helping each other and discussing the follow-up questions together. Students need to bring the following to the lab station with them:
    - Pencil and eraser
    - Science journal
    - Vocab. packet
    - "Harvard Forest Graphing Rubric"
    - "Lab Group Rubric" (attached: this rubric helps them monitor and assess their effort in the group)

9. When all graphs are complete, have students jigsaw into 4 groups of 6 kids (one from each station) to share their graphs and follow-up questions. They should bring their rubrics with them to discuss any corrections or additions which may have to be made before passing in their final products.

10. Follow-up with a whole class discussion:
    - What was easy/hard?
    - How does your graph help you better understand the data?
    - What are your thoughts on other student's graphs?
    - Share some of the follow-up questions.
    - Once we have more years of data, what will we be able to graph?
    - Is there any data you would still like to see in graph form? (Add ideas to their original list from Procedure #4. Use these ideas for future graphing activities.)

11. Students will pass in their final copy graph, Harvard Forest Graph Rubric, Lab Group Rubric and answers to follow-up questions.

12. Create a bulletin board of the different types of graphs. Have students write (or type) some of their analysis from their follow-up questions on index cards to post with their graphs.

Reflection:

How the lesson met my goals:
This lesson met my goals on many levels. I knew it would be a challenging activity and I wasn't disappointed. The students understood the Fall'10 Excel spreadsheet of data. They needed help understanding the graphing question and deciding what information they needed to extract from the large amount of data they had. This led to some good understanding on my part as to what parts of graphing they do and don't understand on an independent level. Once their data was manipulated, they were able to do the actual graphing more independently. Many tried to "connect the dots" because of the graphs I showed them from Dr. O'Keefe. Again, this led to some good understanding on my part as to who understands the data because my graphing activities don't warrant line graphs. It showed me which students understood what types of graphs are appropriate for certain data. Another problem many had was giving the graph a title. I helped them look back at the question and give their graphs appropriate titles. What is the graph *really* showing? The follow-up questions ended up being done mostly as homework. Getting them to use the data to support their ideas continues to be a challenge. I have taken many courses with science teachers over the years and this is frequently a problem in all lab conclusions. As I see this continuing to be a problem even in April, I will add a specific line regarding use of data in the follow-up questions to the rubric for next year. The follow-up questions really got them thinking about influences on trees. We discussed competition, overall health of the tree, air temperature, water, available sunlight, etc. They looked more closely at where the trees are growing. When they are going outdoors observing their own tree, they don't stop to look at where the other ones are. This activity got them to look back at all of the study trees and how they might relate to the overall environment. As with most lessons, it took one class longer than expected, but that's not too bad. They weren't just reading a problem in a math book, this was authentic data they helped collect. They owned it. It is much more pertinent to analyze real-life data.

How the lesson met the Harvard Forest program goals:
This lesson certainly supported the goal, "Enhance science learning through teacher professional development that focuses on the implementation of field-based ecological research projects for K-12

students." The entire graphing activity could not have occurred without a few years of research to analyze. I look forward to adding more years of data and expanding the graphing.
The lesson also met *Primary Objectives C. Link student work to the research of Harvard Forest* #2, 3, &4 because the students are responsible for collecting, analyzing and graphing the data.
D. Use of teaching techniques that provide opportunities for participants to use critical thinking skills #1, 3, 4, 5, 6, 7 because of the rubrics used, they work both in a lab group and independently, and they used classroom resources (tree ID and informational books) to answer the follow-up questions. The students were challenged in the data analysis but they were proud of their final products. (The words "Wall Worthy" on the rubric really had an impact!) The range of graphing activities accommodated the different learning styles and levels of learners in the classroom.

Assessment Tools:
See "Harvard Forest Graphing Rubric" and "Lab Group Rubric" which are attached. My students are familiar with using rubrics and scoring themselves first. I score them on the same rubric after they score themselves. If our scores are more than a point apart, we have a discussion and decide how to proceed.

Skills Involved:
- Analyzing data lists.
- Creating data tables prior to graphing.
- Choosing the appropriate graph to use based on the data.
- Graphing data neatly. (Using "Create a Graph" to input data.)
- Analyzing data by answering follow-up questions.
- Sharing graphs, analysis, asking questions of others' data.

Materials Needed:
- Excel data lists manipulated for specific graphing activities (adding/deleting necessary info.)
- Overhead projector or smart board
- 4 of Dr. O'Keefe's graphs (Mean LF50 (leaf fall 50%) 1991-2009, Mean BB50 (bud break 50%) 1990-2010, 50% BB 75% leaf development 19900-2008, Leaves on Days 1991-2009
- Student vocab. packet
- Scrap paper
- Rulers
- Pencils, erasers
- Colored pencils or other coloring supplies
- Graph paper
- Larger poster paper
- Calculators
- Graphing rubric
- Lab group rubric

Massachusetts State Frameworks Addressed:

Gr. 7 Mathematics

8.D.2 Select, create, interpret, and utilize various tabular and graphical representations of data, e.g., circle graphs, Venn diagrams, scatterplots, stem-and-leaf plots, box-and-whisker plots, histograms, tables, and charts. Differentiate between continuous and discrete data and ways to represent them.

8.D.3 Find, describe, and interpret appropriate measures of central tendency (mean, median, and mode) and spread (range) that represent a set of data. Use these notions to compare different sets of data.

8.D.4 Use tree diagrams, tables, organized lists, basic combinatorics ("fundamental counting principle"), and area models to compute probabilities for simple compound events, e.g., multiple coin tosses or rolls of dice.

8.M.5 Use models, graphs, and formulas to solve simple problems involving rates, e.g., velocity and density.

Gr. 7 English Language Arts/Speaking and Listening

#4. Present claims and findings, emphasizing salient points in a focused, coherent manner with pertinent descriptions, facts, details, and examples; use appropriate eye contact, adequate volume and clear pronunciation.

#5. Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points.

Gr. 6-8 Life Science(Biology)

#17. Identify ways in which ecosystems have changed throughout geologic time in response to physical conditions, interactions among organisms, and the action of humans. Describe how changes may be catastrophes such as volcanic eruptions or ice storms.