COLLECTING AND ORGANIZING DATA

Using Graphs to Help Tell a Story

Rationale and Objective

In science, information is communicated through a variety of means including specialized graphic organizers such as tables, charts, and graphs. Few students, however, have the skills training and experience necessary to communicate their data on self-designed organizers**.** The purpose of this activity is to assist students in developing the strategies and skills necessary to successfully communicate experimental data in Coastal Roots activities and other science investigations.
Students will:

- Develop data table construction skills.
- Define terms associated with experimental design and data record keeping: independent variable, dependent variable, data, derived quantity
- Practice the math skills involved in calculating derived quantities (averaging, finding percent values,)
- Define, be able to identify, and be able to apply these terms associated to graphing: discrete data, continuous data, interpolate, axis, X axis, Y axis, grid paper
- Compare and contrast bar, line, and pie graphs and their use.
- Utilize basic graphing guidelines in developing graphs
- Model vocabulary comprehension and skills development via application of the concepts to sample labs or student-designed lab activities

Teacher Background

By the time they complete middle school, most students have experience in recording information into pre-made data tables and in plotting points on pre-labeled grids. Few students, however, have the skills training and experience necessary to communicate their data on self-designed organizers.

Coastal Roots Science Skills: Collecting and Organizing Data activities provide guidelines for constructing tables and graphs, definitions, opportunities for the application of skills and concepts, and additional resources. As development of skills takes multiple experiences and review, students should each be issued copies of the STUDENT NOTEBOOK PAGES. These sheets should become a permanent part of each student's notebook where they can be referenced throughout the year.

This exercise includes completion of a lab investigation in order for students to collect data. Many simple activities could be incorporated for this exercise. These might include: measuring germination rate of one type of seed soaked in varying amounts of water (continuous data), germination rate of one seed type soaked in equal quantities of various solutions (discrete data), distance a paper air plane travel s when weighted down with first 1, then 2, and then 3 paperclips (continuous data), distance paper airplanes of various shapes travel when tossed from the same height (discrete data)…Only time restraints and available materials limit the teacher's choice of activities. Several excellent examples of experiments and strategies useful in teaching data tabulation and organization are described in Students and Research Cothron, Julia, et al, 1989, Kendall Hunt Publishing.

Procedure: Setting the Stage

1. Prior to teaching the unit, prepare copies of the student worksheets and select a sample data collecting activity. These sheets should become a permanent part of each student's notebook where they can be referenced throughout the year.
2. Select a sample activity for use in data collection and organization practice. This exercise includes completion of a lab investigation in order for students to collect data. Many simple activities could be incorporated for this exercise. These might include: measuring germination rate of one type of seed soaked in varying amounts of water (continuous data), germination rate of one seed type soaked in equal quantities of various solutions (discrete data), distance a paper air plane travel s when weighted down with first 1, then 2, and then 3 paperclips (continuous data), distance paper airplanes of various shapes travel when tossed from the same height (discrete data)…Only time restraints and available materials limit the teacher's choice of activities. Several excellent examples of experiments and strategies useful in teaching data tabulation and organization are described in Students and Research Cothron, Julia, et al, 1989, Kendall Hunt Publishing.
3. Distribute copies of the Student Worksheets.
4. Review data table construction guidelines with the students (Student Worksheets #1-2).
5. Divide students into cooperative lab groups. If this is their initial cooperative group experience, issue copies of the COOPERATIVE LEARNING GROUPS: GROUP MEMBER TASK ASSIGNMENTS (attached) and discuss the role of each group member.
6. Introduce the sample data collection exercise.
7. Working in their lab groups, have students design appropriate data tables in their notebooks. Each group should share their data table design (verbally, on the chalkboard, on a poster…) with the class. Have the students modify their data tables as necessary.
8. Monitor student lab work and data collection.
9. After students have completed the data collection exercise, have them read and discuss the GRAPHING SKILLS (Student Worksheet page # 2) and GRAPHING RULES AND TIPS (Student Worksheet #3). Younger students may need assistance in selecting a scale (to cover the range of measurements) and in numbering the axes. Math textbooks and Students and Research provide review appropriate for both the teacher and students
10. Have students complete and verbally discuss Student Worksheet page #3 problems.
11. Students should then construct a graph for the data collected in the sample exercise. Grid paper is provided on Student Worksheet page #4.
12. Have each group present their data table and graph to the class. (This could be used as a form of assessment.) If available, students could utilize computer data collection/graphing software.
13. Have students modify their graphs as needed.
14. Provide students with additional data collection/ graphing "practice" experiences.
15. As review or remediation, students should be referred to other sources such as:

    How Graphic!
    Science World Sept 20, 1999 by Mona Chiang
    www.findarticles.com/cf_0/m1590/2_56/56177037/p1/article.jhtml

    Sample graphs and charts
    http://www.hallogram.com/grphsrvr/samples/area.html

Louisiana Science Benchmarks

LOUISIANA BENCHMARKS:

Science Benchmarks:	SI-H--A1, A2, A3	PS-H--A1
	SI-M--A2, A3, A4, A5	PS--M-A1
Math Benchmarks:	D-2-H, D-7-H	D-1-M, D-6-M

Materials

For each student:
Copies of Student Worksheets #1- 4
(Optional) COOPERATIVE LEARNING GROUPS: GROUP MEMBER TASK ASSIGNMENTS
For each cooperative learning group:
Materials necessary for the teacher-selected activity

References

Students and Research Cothron, Julia, et al, 1989, Kendall Hunt Publishing.

On-Line Resources

Additional tips, ideas, and lab examples can be found at:
How Graphic! Science World September 20, 1999 by Mona Chiang
www.findarticles.com/cf_0/m1590/2_56/56177037/p1/article.jhtml

Sample graphs and charts
www.hallogram.com/grphsrvr/samples/area.html

Chill out with graphs: serve your data in tables, graphs, and charts-with a cherry on top!
Science World September 21, 1998 by Rachel Rivera

COOPERATIVE LEARNING GROUPS
GROUP MEMBER TASK ASSIGNMENTS

All group members will:

1. **Work cooperatively.**
2. **Be prepared.**
3. **Remain on task.**
4. **Employ good lab safety measures and techniques.**
5. **Participate in clean-up procedures.**

Each group member will also carry out specific tasks. Job positions and their specific tasks are:

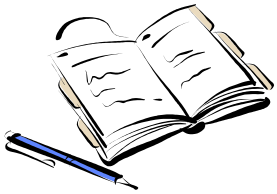
PRINCIPAL INVESTIGATOR

1. *RE-READ INSTRUCTIONS.*
2. *LEAD GROUP DISCUSSIONS.*
3. *KEEP GROUP ON TASK.*
4. *ASK QUESTIONS OF TEACHER.*
5. *MONITOR DATA COLLECTION.*

CHIEF TECHNICIAN

1. *ASSEMBLE AND OPERATE EQUIPMENT.*
2. *COLLECT AND REPORT ALL OBSERVATIONS/DATA TO THE REPORTER.*

REPORTER



1. *MONITOR DATA COLLECTION.*
2. *RECORD DATA FOR THE GROUP.*
3. *SUBMIT THE GROUP'S COMPLETED WORKSHEETS/ LAB REPORTS.*

MATERIALS MANAGER

1. *COLLECT AND RETURN MATERIALS.*
2. *REPORT BROKEN OR MISSING EQUIPMENT.*
3. *MAINTAIN A SAFE, CLEAN WORKING AREA*
4. *MONITOR TIME.*

Collecting and Organizing Data

Student Name: _____

Imagine that last week your class completed an interesting experiment on the effects storage temperature has on germination of cypress seeds. Today, while watering cypress seedlings, you remember that the storage temperature lab report is due tomorrow. After school you and your lab partners meet to write the report. Each person in the group wrote things down but today your notes seem to be just a jumble of numbers and phrases that you and your friends can't decipher. After doing what you can to salvage this report, you decide to make sure this problem doesn't occur again.

Your *Coastal Roots* projects will involve collecting lots of numbers. To record these results (and the results of any experiment) accurately and efficiently you will need to organize your data into a format that is simple to complete and easy to read. Data tables are one way to do this.
You are probably familiar with the data tables provided in many lab books, but may have never been taught how to construct data tables of your own. It really isn't hard once you are given the guidelines and an opportunity to practice.

GUIDELINES FOR CONSTRUCTING A DATA TABLE

1. Make a table of vertical columns for the variables. Record the independent variable (IV) in the first column, the dependent variable (DV) in the second; reserve the third for any derived quantity (average or percentage, for example).

For example:
If your experimental question is, "How will storage temperature affect the number of cypress seeds that germinate?" the independent variable will be the temperatures at which the seeds are stored and would be recorded in the first box. The number of seeds that germinate will be recorded in the second box, and the average number of seeds that germinate might be recorded in the third.

The Effect of Storage Temperature on Cypress Seed Germination

IV: Seed Storage Temp. (^{0} C)	DV: Number of Seeds Germinating	Derived Quantity: Avg. Number of Seeds Germinating

SPECIAL HINT: ***Give your table a descriptive title and clearly label all variables with the units of measure employed.***

2. Now subdivide and label the DV column to provide space for each of the trials. In our example we are running 4 trials.

3. Record the values of the independent variable from smallest to largest.

Collecting and Organizing Data

Student Name: _____

The Effect of Storage Temperature on Cypress Germination

Seed Storage Temp. (^{0}C)	Number of seeds germinating **TRIAL #**				Average number of seeds germinating
	1	**2**	**3**	**4**	
0					
20					
40					

4 As you complete the activity, record the data (DV) results that correspond to the level of each IV.

5 Calculate the derived quantities and enter the values into the table.

Your teacher will assign you to a cooperative lab group and will issue and discuss the lab activity your group is to perform. You and your partners will practice your newly acquired skills by designing and completing an appropriate data table.

 Remember to record the title (including the lab version: A or B) and to indicate the units of measure!

Once you have your data table complete, it is now time to make some sense of or analyze all those collected observations. Usually, the best way to do this will be through a graph. Graphs can help you to visualize the data, to recognize trends, and to communicate the information to others. But what kind of graph would be best? Is one graph enough? And which numbers go where?

GRAPHING SKILLS

While there are several variations of each, the three basic types of graphs are line, bar, and pie. The type of graph appropriate for your report depends upon the type of observations and measurements.

Bar graphs are the most appropriate graphs for depicting discrete data. *Discrete data* are categorical or counted (for example- gender, months of the year, countries, types of seeds germinated). If the intervals between the data do not have meaning, like brand name of fertilizers, a bar graph is the best choice.

Line graphs are generally used to plot *continuous data (m*easurements associated with a standard scale or continuum). Examples would include the height of seedling in centimeters or the exposure to sunlight in hours. Line graphs allow us t interpolate the values of points not directly measured and allow for inference /prediction of future events.

Pie graphs are also known as pie charts. They are typically used to indicate how different parts make up a whole.

Graph construction is more difficult than table construction, however using your past experiences, the rules and tips below, and assistance from your teacher and references, you should soon be a graphing expert.

Collecting and Organizing Data

Student Name: _____

GRAPHING RULES AND TIPS

Instructions: Follow your teacher's instructions and guidelines and remember:

1. Graphs contain an "X" axis. This is the horizontal axis and is used for recording the independent variable.
2. The "Y" axis is the vertical axis and is used for recording the dependent variable.
3. The "Y" axis always displays numbers.
4. Both axes should be labeled. Units of measure must be indicated and are usually indicated in parentheses next to or beneath the variable. For example, average height of seedlings (cm)
5. Increment marks should be evenly spaced and numbered appropriately. (Numbers should be listed in chronological order, generally from smallest to largest.) This is sometimes difficult to determine. If you have difficulty determining increment size, ask for help! (The Students and Research) book would be very helpful.)
6. Give the graph a title.

☑ ***Reminder: Titles should be clearly and plainly stated.***

Instructions: Read and discuss graphing principles and then complete the problems.

1. Describe the means of determining a scale to cover the range of measurements for a variable.

2. Define and state examples of discrete data and continuous data.

3. When data may be any value in a continuous range of measurements, a _____ graph is better.

4. If the intervals between recorded data have meaning, then a _____ graph is better. When the intervals between the data do not have meaning, like product brands, a _____ graph should be used.

5. Now construct a graph for the data collected. Include a title and all necessary labels. Indicate which form of the lab you completed. Use the provided grid paper.

***REFERENCE*:**

Students and Research Cothron, Julia, et al, 1989, Kendall Hunt Publishing, pages 32-42.

***INTERNET SITES OF INTEREST*:**

How Graphic! Science World Sept 20, 1999 by Mona Chiang
www.findarticles.com/cf_0/m1590/2_56/56177037/p1/article.jhtml

Sample graphs and charts: http://www.hallogram.com/grphsrur/sample.html

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Collecting and Organizing Data

Student Name: _____

LAB VERSION_____