**LESSON PLAN**

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**Using Data Sets in Science**Florida Coastal Everglades Long-Term Ecological Research  
Water Level and Climate Metadata Set

**OVERVIEW:**Teaching science by introducing the use of actual data sets developed by the scientific community is an excellent way to encourage students’ interest and engagement in authentic science. By using real data sets, students are encouraged to develop their scientific reasoning as they expand on the experimentation that takes place in the classroom. In order to support students’ inquiry learning, it is important that the teacher’s role become that of a facilitator, allowing the students to ask questions and propose valid hypothesis. By having students propose their own questions, they gain interest and become more involved in the learning process. As students access databases, they are faced with a large amount of data. It is important to guide them in selecting sources that are reliable and data that is aligned and useful for the purpose of their study. Research done using data sets should focus not only on the technical aspects of handling the data, but should emphasize the scientific processes of making inferences, proposing hypothesis, analyzing patterns and drawing conclusions. Throughout the process of selecting, manipulating and reporting data, students should follow the protocols and ethical responsibilities of handling scientific data. By allowing students to work in teams, they are encouraged to interact as scientists do to reach consensus and communicate their findings. This last process is crucial in developing the inquiring minds that will be able to study and propose solutions for the complex issues of the future. (See the section titled Teaching with Data in Resources for more ideas on how to incorporate datasets in the classroom.)

**BENCHMARKS:**   
SC.912.E.7.1 -Analyze the movement of matter and energy through the different biogeochemical cycles, including water and carbon.

SC.912.E.7.3- Differentiate and describe the various interactions among Earth systems, including: atmosphere, hydrosphere, cryosphere, geosphere, and biosphere.

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SC.912.E.7.4- Summarize the conditions that contribute to the climate of a geographic area, including the relationships to lakes and oceans.

SC.912.N.1.2-Describe and explain what characterizes science and its methods.

SC.912.N.1.6- Describe how scientific inferences are drawn from scientific observations and provide examples from the content being studied.

SC.912.N.3.5-Describe the function of models in science, and identify the wide range of models used in science.

SC.912.N.4.1 -Explain how scientific knowledge and reasoning provide an empirically-based perspective to inform society's decision making.

**LEARNING OBJECTIVES**

The students will:

* To design and conduct an experiment using the scientific method.
* To learn how to organize and analyze datasets using the appropriate tools.
* To learn how to summarize and draw conclusions from data.
* To explore climatic factors affecting the Everglades by using FCE LTER datasets.

**UNIT TIME FRAME**

The estimated time to complete this unit is one week with the possibility of expanding the time frame if other data sets are also analyzed.

**ASSESSMENT**

The assessment will incorporate alternative assessment strategies suited to the needs of different styles of learners. The assessment involves:

* Active participation in class discussions. (Teacher observation)
* Organization and design of graphs with selected climatological data (Rubric)
* Interaction and problem solving in collaborative groups (Group work)
* Analysis and Interpretation of Climatological Data (Written Assignment)
* Construction of geospatial maps and other visual supports. (Rubric)
* Presentation of research or scientific investigation (Written assignment)

**Activity 1. – Manipulation of Climatological Data**

**Background**

Scientists systematically observe, collect and analyze data as they carry out their experiments. The data must then be manipulated or processed to facilitate the interpretation of the results. Depending on the amounts and types of data, scientists will choose the most appropriate tools to organize and display it. Some studies such as climatological research that take place over large periods of time require additional information regarding the who, what, when, where and why that describes the original data. This additional clarifying information referred to as metadata is particularly handy for those who did not generate the data themselves. Normally, datasets of this size are best presented in spreadsheets, tables or charts and then displayed visually in graphs. Other tools commonly used to handle large amounts of data include statistics and geospatial mapping programs that help scientists uncover patterns and find possible relationships in the data. Careful processing of the data enables scientists to describe, establish correlations or determine cause and effect between the variables’ studied thus enabling them to reject or accept their hypothesis. In this lesson, you will work with data collected directly by scientists from the Florida Coastal Everglades Long Term Ecological Research project (FCE LTER).

**Objectives**

Given a climatological dataset, students will propose and conduct a research study based on a viable hypothesis, and supported by organized and clearly displayed data.

**Materials and resources**

Access to the Internet

Spreadsheet Program: Excel Software program (or any similar open source software)

FCE\_Schoolyard\_WaterLevel\_Climate Metadata Set

Metadata  
Daily Water Levels  
Yearly Water Levels  
Monthly Water Levels  
Daily Water Level Climate  
Yearly Water Level Climate  
Monthly Water Level Climate  
Daily RPRS Climate Data  
Daily RPRS Climate Data  
Monthly RPRS Climate Data  
3 Day Total Phosphorus  
Yearly Total Phosphorus  
Monthly Total Phosphorus  
Monthly Data for 4 Parameters (Phosphorus, Water Level, Monthly Precipitation and Average Monthly Mean Air Temperature

**Procedures**

**Part 1- Using Metadata**

You will be using the data found in your [**FCE\_Schoolyard\_WaterLevel\_Climate Metadata Se**](FCE_Schoolyard_WaterLevel_Climate.xls)**t** to create scatter plot graphs and interpret any similarities and differences between the two Everglades sites of study: Taylor Panhandle River Slough Site 2 and Taylor Panhandle River Slough Site 3. The data sets provided are described for you in the first workbook of your data sheet. You may select data from any of the workbooks (tabs) for your study and use the graphing and statistical capabilities of Excel to facilitate the analysis of the data *(See the section titled* ***Datasets*** *in Resources to locate other datasets including real time data).*

**Part 2- Graphing your Data**  
a. Using the [**FCE\_Schoolyard\_WaterLevel\_Climate Metadata Set**](FCE_Schoolyard_WaterLevel_Climate.xls), highlight the block of cells containing the data that you plan to graph. Be sure to include column titles and the row headings as you select the information.

b. Click on the Insert tab and choose a chart category, the options available are visible in a drop down list of graph types. (If you hover your mouse pointer over a graph icon you will see a brief description of the graph). Click on a graph type to select it.

c. Data illustrates change over time is best represented by a scatter plot. To select this type of graph simply click on Insert > Scatterplot > Scatterplot with Markers.

d) Graphs created in Excel can be enhanced with different features. For example, you can add a title either within or outside the graph area. You can also add subtitles for the x and y axis, change the font color, add a background color or use color to highlight the plot area. You can modify the appearance of your graph to make more legible.

e) Graphs can be copied and pasted directly on the worksheet, next to the data, or into a blank document in your word processor. Save your graph to include in your report that you will elaborate through Activity 4 *(See the section titled* ***Excel Graphing*** *in Resources for additional help)*

**Activity 2. – Use of Geospatial Data and Statistical Tools (Optional)**

**Background**

Data can also be represented in geospatial images that provide the exact location from where the data is obtained directly on a map. Maps can be constructed showcasing different layers in a 3D format which combine additional information such as land elevations, infrastructure, population and available resources such as vegetation. The additional data can add another dimension and facilitates the identification of variables that interact in a geographical area. Two geospatial mapping programs that are fairly easy to learn and use are Google Earth and My World GIS from Pasco.

Another way of enhancing the analysis, interpretation and even the presentation of your data is through the use of descriptive statistics such as the mean, mode, median, range and standard deviation. It is not uncommon for some of the data managing software programs such as spreadsheets and geospatial mapping tools to perform some simple statistical analysis (ie. Microrsoft Excel). Although optional for this project, the correct use of these tools would definitely enhance the analysis of the climatological datasets.

**Materials and resources**

Spreadsheet Program: Excel Software program or any similar open source software  
Google Earth   
My World GIS software from Pasco

**Procedures**

**Display Geospatial Data**a. You may download and use a geospatial mapping program such as *Google Earth* or purchase *My World GIS* from Pasco..

b. Find the exact location of your study site using the coordinates for latitude and longitude.

3. You can add layers, photos and statistics to enhance the information provided through your graphed data. Once you have added the layers that you believe can relate to your variables, save your geospatial image for further analysis. Refer to the tutorial of your software program as needed. Attach a copy of your map to your report for the next section. *(See the section titled* ***Geospatial Software*** *in the Resource section for the online addresses).*

**Activity 3. – Communicating the Research Findings**

a) Answer the questions below to help you plan and write your Final Report. Make sure to include any graphs and maps that you created from the raw data obtained in the dataset.

b) Select a Web 2.0 Tool as a means to communicate your data. Options include but are not limited to a blog, a podcast, a Facebook page, or any other Web 2.0 tool that select. *(See the section titled* ***Web 2.0*** *for more ideas).*

c) You can also present your study through an online Science Fair known as Virtual Science Fairs. You can read more about these and perhaps select one that interests you the most. *(See the section titled* ***Virtual Science Fairs*** *in Resources for available competitions)*

**Planning Questions**

1. What question were you attempting to answer through your data analysis? (For example, if you are observing water levels per month, write a problem statement that incorporates these variables within the question that you were seeking to answer)
2. What was the hypothesis that you proposed? Include the variables and any trend you were expecting to find from your data.
3. After inspecting the graphs that you created, were there any visible trends in your data? How can you explain these results?
4. Read about John Snow’s study of cholera. How did he use maps to demonstrate how cholera spread? How can the use of geospatial mapping software help you with your study?
5. How will you communicate your findings to your peers?

**Resources:**

**Datasets**

[**FCE\_Schoolyard\_WaterLevel\_Climate Metadata Set**](FCE_Schoolyard_WaterLevel_Climate.xls)

The World’s Water from the Pacific Institute

<http://www.worldwater.org/data.html>  
  
LT Technology Ink-Spreadsheet Resources  
<http://www.csun.edu/science/ref/spreadsheets/index.html>

**Excel Graphing**

Excel Graphing Instructions from Purdue University  
<http://web.ics.purdue.edu/~braile/edumod/sv/19excel.pdf>

Graphing with Excel from North Carolina University  
http://www.ncsu.edu/labwrite/res/gt/gt-menu.html

Instructions for Making Graphs in Excel 2007

<http://www.biosci.ohiou.edu/introbioslab/Bios170/170_1/Microsoft%20Excel%20Graphs%2008.htm>

Math Resources for Teachers (see Excel Graphs- Box and Whisker Diagrams  
<http://home.clara.net/dkeith/maths/index.htm>

Making graphs with Excel

<http://qrc.depaul.edu/StudyGuide/MakingGraphsWithExcel.htm>

**Geospatial Software**

*Google Earth* <http://www.google.com/earth/index.html>

*My World GIS* from Pasco   
<http://www.myworldgis.org/software/>),

**Statistics**

Dig Stats  
<http://www.cvgs.k12.va.us/digstats/>

**Teaching with Data**

Pedagogy in Action- What is teaching with Data?  
<http://serc.carleton.edu/sp/library/teachingwdata/What.html>

NSDF Using data in the classroom – a site for educators and resource developers  
<http://serc.carleton.edu/usingdata/index.html>

Teaching with Google Earth  
<http://serc.carleton.edu/sp/library/google_earth/index.html>

**Virtual Science Fairs**

eCyberMission  
<https://www.ecybermission.com/public/Login.aspx?ReturnUrl=%2fDefault.aspx>  
  
Google Science Fair  
<http://www.google.com/events/sciencefair/>

Internet Science and Technology Fair- University of Central Florida

<http://istf.ucf.edu/>  
  
The International Online Science Fair  
<http://www.super-science-fair-projects.com/online-science-fair-contest.html>

**Web 2.0**

Web 2.0 Teaching Tools   
<http://www.web2teachingtools.com/index.html>