Section Two: Cumulative Student Project

Surface Water Quality Data Interpretation Worksheet 1

Multiple Choice
Choose the best answer from to the questions below.
1.) During the day the oxygen levels increase due to
      a.) production greater than consumption
      b.) consumption greater than production

2.) Oxygen is added to a water body by
      a.) Photosynthesis
      b.) Wind
      c.) Rain
      d.) Water Currents
      e.) All of the above
      f.) None of then above

3.) Muddy tan to light brown water color indicates
      a.) Raw Sewage
      b.) Deposits on stream beds associated with oil production
      c.) Generally indicates plankton bloom
      d.) Suspended sediments common after rainfall

4.) The X-axis of a graph is used to plot
      a.) independent variable (time, location)
      b.) dependent variable (event, or cause)

True or False
Mark each statement with a T if the statement is true, or an F is the statement is false.
5.) Oxygen in a system increases as organic substances decompose.
6.) Nutrients, primarily nitrogen and phosphorus, are essential for plant growth.
7.) The effects of oxygen-demanding substances and high plant nutrient concentrations are enhanced by low water temperatures.
8.) Metabolism rates in aquatic organisms double with every 10ºC rise in temperature.
9.) As turbidity increases, the amount of light penetration into the water column increases.

List
10.) List two examples of oxygen demanding substances.

11.) List two common land use practices that lead to the deposition of suspended solids.


12.) List two potential impacts of residential land use.

Surface Water Quality Data Interpretation Worksheet 1
Answer Key

1. A
2. E
3. D
4. A
5. F
6. T
7. F
8. T
9. F
10. plant nutrients, algae growth, raw sewage, poorly treated wastewater, food processing, animal feedlot wastes
11. construction activities, erosion of agricultural lands, surface-mined land
12. lawn fertilizers, oil drained from cars, septic tank overflows, detergents used to wash cars, trash

WATER QUALITY PUZZLE

Directions: Using the clues below and your glossary, fill in the blanks with the appropriate term from the word bank.
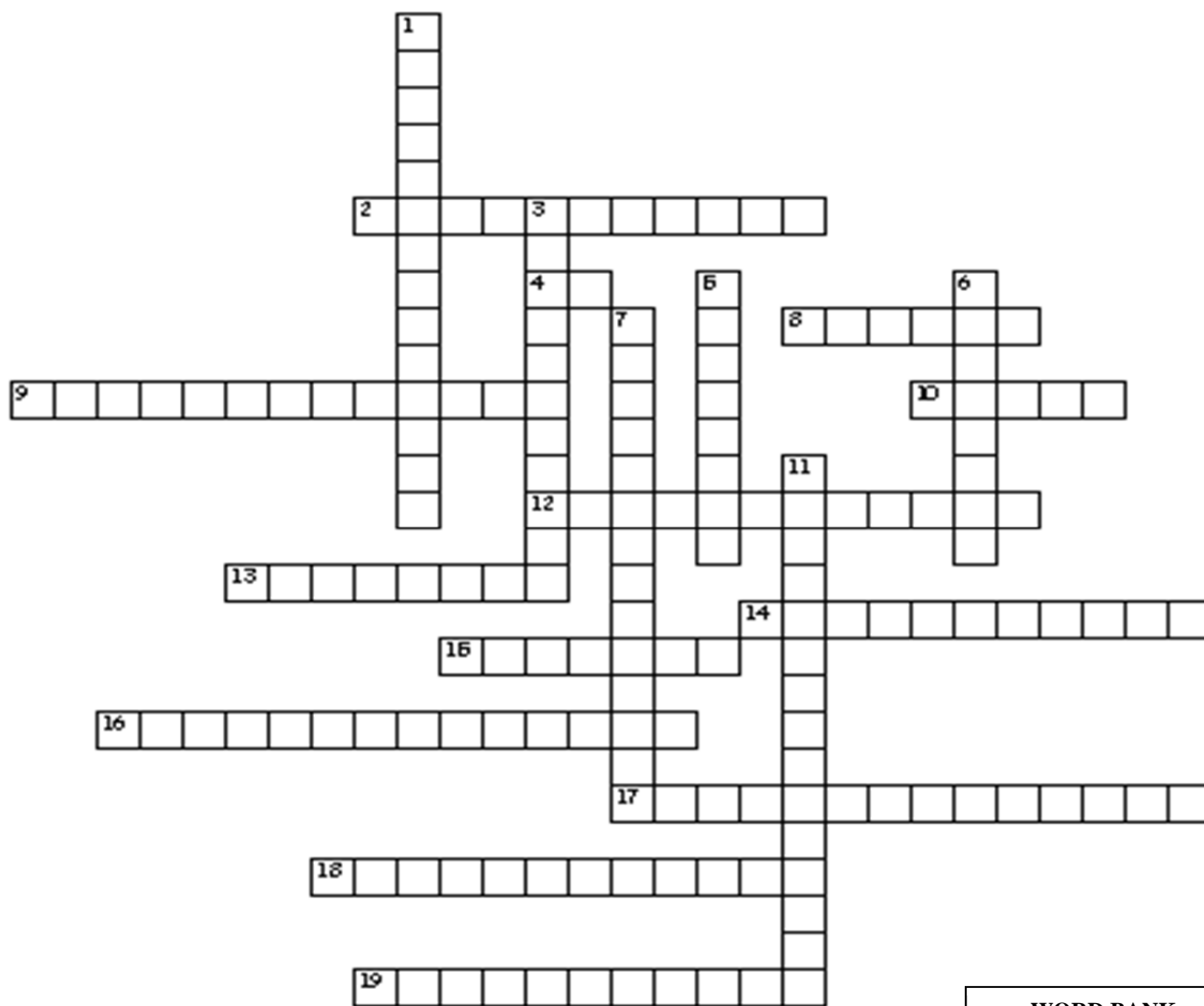
ACROSS

2. plants and animals do this
4. lemon on one end, bleach on the other
8. not absorbed
9. making new ground
10. can occur from an excess of nutrients
12. light reaching from here to there
13. nitrogen and phosphorus
14. pipe
15. drop used water here
16. sunlight as energy source
17. no specific location
18. electric water
19. making necessary adjustments

DOWN

1. stop meandering
3. a reservoir is this
5. floating critters
6. used water
7. lake to bog
11. required by fish

Water Quality Puzzle Answer Key

ACROSS	**ANSWERS**
2. plants and animals do this	respiration
4. lemon on one end, bleach on the other	pH
8. not absorbed	runoff
9. making new ground	sedimentation
10. can occur from an excess of nutrients	bloom
12. light reaches from here to there	euphotic zone
13. nitrogen and phosphorus	nutrient
14. pipe	point source
15. drop used water here	outfall
16. sunlight as energy source	photosynthesis
17. no specific location	nonpoint source
18. electric water	conductivity
19. making necessary adjustment	assimilation

DOWN	
1. stop meandering	channelization
3. a reservior is this	impoundment
5. floating critters	plankton
6. used water	effluent
7. lake to bog	eutrophication
11. required by fish	dissolved oxygen

Surface Water Quality Data Interpretation Project

Teacher Background

The purpose of this project is for students to collect real-world data, interpret the data and present the conclusions. Students are to use either data they have collected as part of monthly Texas Stream Team monitoring or to download data from the Texas Stream Team DataViewer. Information on how to download data from the Texas Stream Team DataViewer is included with the Graphing Data in Excel Worksheet. In addition to the Texas Stream Team data, USGS and TCEQ offer a variety of data that can supplement the Texas Stream Team data. Information on accessing water quality data from the USGS and TCEQ websites is included with the resource list for student projects.

To complete this project, students should be divided into groups of no more than four students per group. This is an extensive project including classroom time as well as work outside of the classroom. A reasonable timeframe for project completion is approximately two weeks. Students must choose a section of a river, preferably within their water basin, that has enough water quality data collected to analyze. It is important when analyzing water quality data that there is enough data and that the data was collected around the same time of day. If there are no sites in your area with data collected consistently consider allowing your students to choose from other areas of the state. USGS does offer consistent data to supplement this exercise, but there are only about 30 sites around the state with data from the USGS.

Once students select a river for their project, students must collect the data. It is important to review the data in site selection. A river without proper data will not work for this project. Proper data includes consistent data for at least a year. Students should follow the instructions in the Graphing Data in Excel Worksheet for information on how to download data into Excel for graphing and analysis. It is important for students to use the scientific method when interpreting the data. First, students should describe a problem and formulate a question to answer. For example, "What is the water quality of the river in my community?" This step can also include gathering additional information such as the history of the water body, the importance of the water body to the local community, and if the Texas Commission on Environmental Quality assessed the water body for any impairments. Instructions for how to determine if the stream has been assessed are included with the resource list for student projects. It is also possible to have students prepare summary statistics (mean, median, minimum and maximum) and trend analysis for each of the water quality parameters; this will help students to formulate hypotheses about the health of the stream. Trend analysis involves graphing a parameter over a period of time, typically one year.

Once the question has been formed, have students state a hypothesis based on their previous experience with the river. Maybe the river has changed overtime, or the summary statistics suggest an impairment or the river is always clear and therefore most likely is a healthy water body. Students might hypothesize that as temperature increases with the seasons that dissolved oxygen levels will decrease. Once students have formulated testable hypotheses, have the students analyze the information such as comparing dissolved oxygen readings and temperature readings throughout the year, or if conductivity values change with flow values. Have students refer to the exercises in the Surface Water Quality Data Interpretation Workbook for ideas. Finally have the students state their conclusions. Was their hypothesis correct? Based on the information they have collected, what have they learned?

The groups should turn-in a paper that includes graphs and detailed text explanations. The students should provide a 5-7 minute presentation with everyone in the group participating in the presentation that includes the following:

1.) **Background**
   Where is the waterbody?
   What river basin is it a part of?
   Where are the headwaters of the waterbody?
   Where does the waterbody empty into the Gulf of Mexico?
2.) **Importance of the waterbody to communities**
   What communities depend on this waterbody?
   How do these communities depend on this water? drinking, fishing, recreation,   boating, navigation, etc.
   Map any possible pollution sources such as parking lots, neighborhoods, or industry along the river?
   Identify any wastewater treatment facilities along the river or any points where water is pulled from the river for drinking water.
3.) **TCEQ Listing**
   Determine if the TCEQ has assessed the waterbody?
   What are the designated uses assigned to the waterbody?
   What are the standards associated with this section of the waterbody?
4.) **Summary Statistics**
   Determine the Minimum, maximum, mean, and median for each parameter.
   Give the trend analysis for each parameter over time.
5.) **Hypotheses**
   What are possible relationships between the data?
6.) **Analysis**
   Provide Excel graphs that correlate different parameters and test the hypotheses.
7.) **Conclusions**

Water Quality Interpretation Project Guideline

The purpose of this project is for groups of students to collect real-world data, interpret the data, and present conclusions. The first step is to collect the data. Data can be found on the Texas Stream Team website, USGS website, TCEQ website (all website addresses found on the resources hand-out), or from another source approved by your instructor. Choose a section of a river, preferably within their basin, that has enough water quality data collected to analyze, enough includes at least one data point from each season for at least a year. In addition to the amount of data, the data should be review for accuracy. For instance, was the data collected around the same time of day?

In addition to water quality data, collect supplemental data such as background information, and importance of the waterbody to the community, and if the Texas Commission on Environmental Quality assessed the water body for any impairments. Instructions for how to determine if the stream has been assessed are included with the resource list. With this background information, students should develop a hypothesis. The hypothesis should then analyze the information through trend analysis and comparison charts. For ideas and help developing hypothesis review the lessons covered in the Surface Water Quality Data Interpretation Workbook. Finally, students should state whether the hypothesis was correct, and what they have learned.

Each group should turn-in a paper that includes graphs and detailed text explanations, and provide a 5-7 minute presentation with everyone in the group participating in the presentation.

Each presentation and paper is to include the following information:
1.) Background Information
   Where is the waterbody?
   What river basin is it a part of?
   Where are the headwaters of the waterbody?
   Where does the river empty into the Gulf of Mexico?
2.) Importance of the waterbody to communities
   What communities depend on this waterbody?
   How do these communities depend on this waterbody? drinking, fishing, recreation, boating, navigation, etc.
   Map any possible pollution sources such as parking lots, neighborhoods, or industry along the water body.
   Identify any wastewater treatment facilities along the waterbody or any points where water is pulled from the water body for drinking water.
8.) TCEQ Listing
   Determine if the TCEQ has assessed the waterbody.
   What are the designated uses assigned to the waterbody?
   What are the standards associated with this section of the waterbody?
9.) Baseline data for each parameter
   Determine the summary Statistics (mean, median, minimum, maximum).
   Give the trend analysis for each parameter over time.
10.) Hypotheses
   What are the possible relationships between the data?
11.) Analysis
   Provide Excel graphs that correlate different parameters and test the hypotheses.
12.) Conclusions

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Resource List

TCEQ

It is important when analyzing stream data to refer to the TCEQ's Water Quality Inventory report. Below are several links to the TCEQ website that will help to determine the designated use of the water body and, the standards associated with the water body.

http://www.tnrcc.state.tx.us/water/quality/04_twqi303d/04_overview.pdf
How surface waters are assessed, highlights of the results of the 2004 assessment, and information about the actions the TCEQ is taking to improve the quality of waters on the 303(d) List.

http://www.tnrcc.state.tx.us/water/quality/04_twqi303d/04_index.html
Provides links to the 2004 Water Quality Inventory report, information on how to read the report, and how to determine if a water body is listed for an impairment.

http://www.tnrcc.state.tx.us/water/quality/data/
The TCEQ Data Viewer displays information developed for the state's assessment of surface water quality in 2000 and 2002. Look up uses, standards, and water quality assessment information for bodies of surface water in Texas. Search using a Texas map, by the name of a body of water, or by its segment identification number.

USGS
http://waterdata.usgs.gov
The United States Geological Survey offers additional water quality data that can be used to supplement Texas Stream Team data. A tutorial explains how to access real-time data. The surface water or water quality link will provide helpful additional data.

Graphing Help

http://www.microsoft.com/education/Excel2002Tutorial.aspx
Learn how to use Excel from the creator. This site includes a tutorial and covers graphs and other functions available in Excel.

http://www.swrp.org/Student_Presentations/preparation/poster/graphinstructions.htm
From the Student Watershed Research project, this site offers specific instructions for graphing in Excel as well as tips for presenting graphs.

Microsoft Excel Help
http://www.usd.edu/trio/tut/excel/
http://www.cas.suffolk.edu/birtwell/charting.htm
http://www.gla.ac.uk/services/computing/documentarchive/windows/un528/un528.html

STEPS TO GRAPHING TEXAS STREAM TEAM DATA IN EXCEL

To graph the data currently available through the Texas Stream Team Data Viewer you will need a compatible browser, such as Firefox or Internet Explorer and Microsoft Excel.

STEP ONE
Obtain the data
Until the new database and Google data viewer is online, we ask that you call (Phone: 512-245-1346 Toll free 877-506-1401) or email (txstreamteam@txstate.edu) us to obtain the data.

Table 1: Resulting table of the query for site 15516, Friends of Lake McQueeny, located on the Guadalupe River, downstream from Lake Dunlap.

Sampling Data for Requested Values

Group ID	Site ID	Sample Date	Sample Time	Sample Depth (m)	Conductivity (µS)	Air Temperature (°C)	Water Temp. (°C)	Dissolved Oxygen (mg/l)	pH	Secchi Disk (m)	Total Depth (m)
CA	15516	10/29/1995	9:15:00 AM	0.3	550	20	21	7	8.2	1.4	1.4
CA	15516	9/2/1996	8:10:00 AM	0.03	520	22	26	5	7.8	0.4	2.2
CA	15516	7/2/1996	8:55:00 AM	0.03	530	26	29	4.3	7.8	0.5	2.2
CA	15516	6/30/1996	6:00:00 PM	0.03	520	30	26	7.5	8.25	0.5	2.2
CA	15516	6/10/1996	5:10:00 PM	0.03	490	34	27	8.6	8.25	0.7	2.2
CA	15516	5/4/1996	8:50:00 AM	0.03	470	23	22	6.8	8	0.3	2.2
CA	15516	4/6/1996	10:05:00 AM		500	11	17	8.9	8	1.1	1.9
CA	15516	3/2/1996	11:00:00 AM	0.03	500	16	15	8	8	1.4	1.4

15516	FRIENDS OF LAKE MCQUEENY	GUADALUPE RIVER DOWNSTREAM OF LAKE DUNLAP

STEP TWO
Format Data
Before the data can be graphed, the data must be in columns next to each other. The order of the data determines where that data will appear on your graph. The first column will be used in the X-axis, the second column will be found on the Y_1 axis (left hand side of graph) and the third column will be found on the Y_2 axis (this is when you are needing to use two Y-axes). See Table 2.

- Select the data to be transferred by left clicking at the top of one of the columns to be used in the graph and highlighting the whole column.

- Next, under **EDIT** select *COPY* or right click and select *COPY*.

There are a couple of ways of ordering your data. You could go to the Sheet 2 view of the Excel workbook. This makes moving to and from your data table (located on Sheet 1) very easy. This method is described below.

- At the bottom of the Excel view is a tab menu that reads Sheet 1, Sheet 2, and Sheet 3. After copying your data column, click on *SHEET 2.*

- The first column (A1) should be selected. Under the **EDIT** menu select *PASTE* or right click and select *PASTE* (or Ctrl "v").

- Your copied data should appear intact. Continue collecting the data from **SHEET 1**, and transferring the data in order to **SHEET 2.** When all your data collection is complete, skip to **STEP 3.**

Another method for ordering your data is described below.

- After copying one of the columns to be used in the graph, next right click over the other column to be included in the graph and select *INSERT*. This will create a blank column.

- The next step is to left click over the blank column and select *PASTE*. Repeat this step until all the columns you wish to include in the graph are side-by side.

Once the columns are in order, the next step is to format the cells to the correct format. To do this, left click at the top of the column to be used in the graph and select format cells. If you are working with the date, select date, if you are working with numbers simply select numbers.

Table 2. Correctly Formatted and Ordered Data

Sample Date	Conductivity (µS)	Water Temp. (°C)
3/1/1997	420	15
3/29/1997	440	18
5/11/1997	450	19
6/7/1997	410	23
7/20/1997	360	23
8/2/1997	410	24
9/5/1997	500	27

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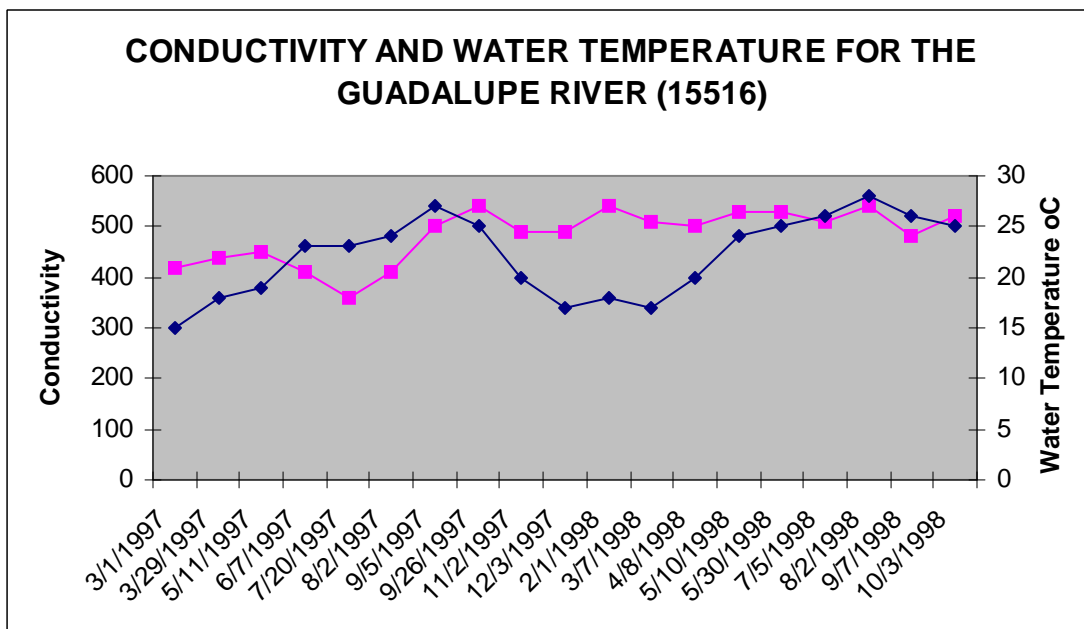|		
9/26/1997	540	25
11/2/1997	490	20
12/3/1997	490	17
2/1/1998	540	18
3/7/1998	510	17
4/8/1998	500	20
5/10/1998	530	24
5/30/1998	530	25
7/5/1998	510	26
8/2/1998	540	28
9/7/1998	480	26
10/3/1998	520	25

STEP THREE
Excel Chart Wizard
The data is now ready to be graphed.

- First, **HIGHLIGHT** all the columns to be used in the graph.

- Then select the *CHART WIZARD* either from the toolbar or from the Insert menu. The chart wizard window will pop-up on the screen.

- Select the standard *CHART TYPE* you wish to create. These example use line charts but the data can also be graphed in several different types of graphs. After selecting the chart type, you may hold down the preview button to view a basic layout of the chart.

- Click the *NEXT* button. The next window is an example graph, select next. Step 3 of 4 of the chart wizard allows the user to create titles, a legend, and data labels. Click on each tab you wish to use.

- After completing and selecting the chart options, select *NEXT*.

- The last step of the chart wizard asks if you would like the chart as a new sheet or imbedded as an object in your current data sheet. After making your selection, click *FINISH*. The results will be a graph of Texas Stream Team data.

CONDUCTIVITY OF GUADALUPE RIVER (15516)

(chart: Conductivity (µS) vs Date, 3/1/1997 to 10/1/1998)
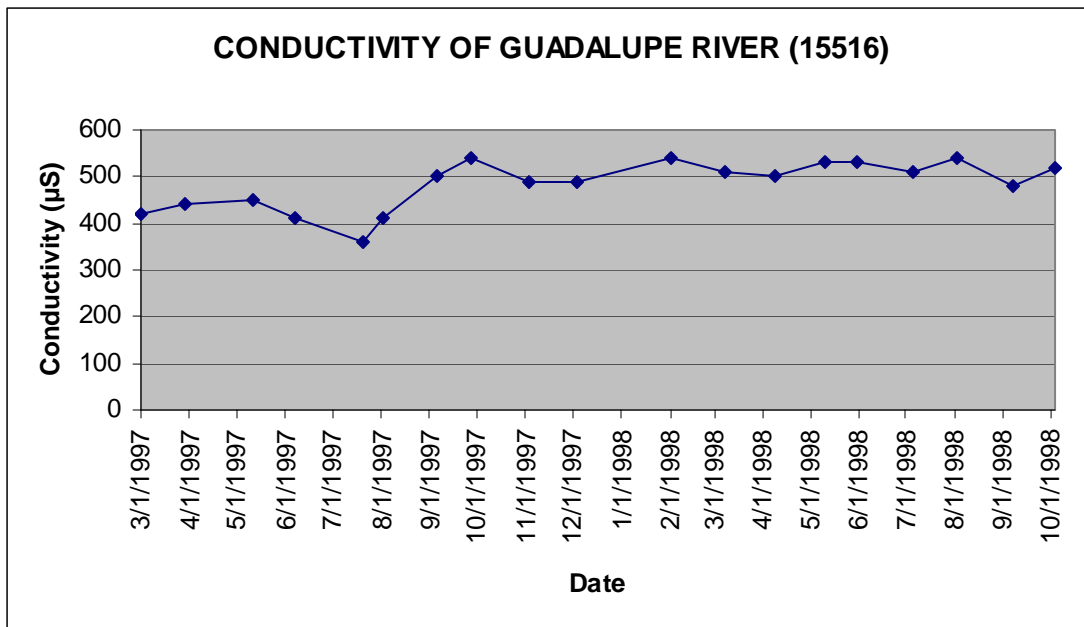
To create a chart with more than one axis, highlight the columns that will be included in the chart, select the chart wizard. Next select the *CUSTOM TYPES* table tab, and scroll down to the *LINES ON TWO AXES* option. To change the label of the legend click on the series tab and name each series.

CONDUCTIVITY AND WATER TEMPERATURE FOR THE GUADALUPE RIVER (15516)

(chart: Conductivity and Water Temperature °C vs Date, 3/1/1997 to 10/3/1998)

STEP FOUR
Formatting the Graph
If you would like to make any changes to the graph, simply double click on either the axis, the graph itself, or the legend or wording. A formatting window will appear that allows the graph to be customized to your needs. Graphs can also be copied and pasted into word documents and formatted as part of a word document.

Surface Water Quality Data Interpretation Project
Grading Rubric

Points		Exceeds Expectations	Meets Expectations	Below Expectations
10	**Background of the waterbody**			
2	Where is the water body?			
4	What river basin is waterbody part of?			
2	Where are the headwaters of the water body?			
2	Where does the river empty into the Gulf of Mexico?			
10	**Importance of the stream to communities**			
2	**What communities depend of this river?**			
2	How do these communities depend on this water body?			
4	Mapping of possible pollution sources			
2	Identify wastewater treatment facilities and where drinking water is pulled			
10	**TCEQ Listing**			
4	Determine if the TCEQ has assessed the waterbody.			
4	What are the designated uses assigned to the waterbody?			
2	What are the standards associated with this section of the waterbody?			
20	**Initial Data Analysis**			
10	Summary Statistics (mean, median, minimum, maximum) Data is organized in a way to facilitate forming hypotheses.			
10	Trend Analysis for each parameter over time. Graphs are accurate (dependent variable on the y-axis and independent variable on the x-axis). Graphs are titled and axes are labeled.			
10	**Hypotheses**			
	Demonstrates careful, logical and subtle use of evidence to support problem definition.			
30	**Analysis**			
	Graphs accurately represent the data.			
	Relationships between water quality variables are accurately displayed.			
10	**Conclusions**			
	Can draw conclusions and explain relationship of water quality data through analysis and graphing.			
100	**Total Points**			