

Unit 2: Applying Graphing Calculators to Garbology Data

The Lesson Objectives

The focus of this unit is the use of the graphing calculator to analyze Garbology data through the use of pie charts and distribution graphs. This lesson will provide insight into how pie charts are used to demonstrate the ratio of variable parameters to an overall data set. In addition, students will learn how distribution graphs can assist in decision-making and problem solving processes.

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Step 2. Create a Pie Chart

Step 3. Capture the Chart



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Overheads/Handouts:

Step 1. Transfer the Data from the Computer to the Calculator

Step 2. Create a Distribution Graph

Step 3. Capture the Graph



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Part 1: Percentage of Types of Garbage Found in Garbology –
Understanding the Function of a Pie Chart

Part 2: Distribution of Garbage Over Distance –
Understanding the Function of a Distribution Chart



Section 4 – Long Term Projects: Other Exercises and “Take Action” Activities

Materials Needed:

- A TI-83 Plus S.E. graphing calculator
- A computer
- Internet access

Time Frame: Two 45 minute class periods.

Grade Level: Grades 9 thru 12.

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Understanding the Calculator Keypad

The keys of the calculator keyboard are each assigned three functions:

- 1) The normal function as labeled on each key,

For example: 

- 2) The 2nd function as labeled in yellow to the top left of each key and accessed by pushing:



the function key and the normal key,

- 3) The ALPHA function as labeled in green to the top right of each key and accessed by pushing:



the function key and the normal key.


When describing 2nd and ALPHA functions within the lesson plans:


- The function will be notated in capitalized text
- The appropriate function key and the corresponding normal key will be displayed.

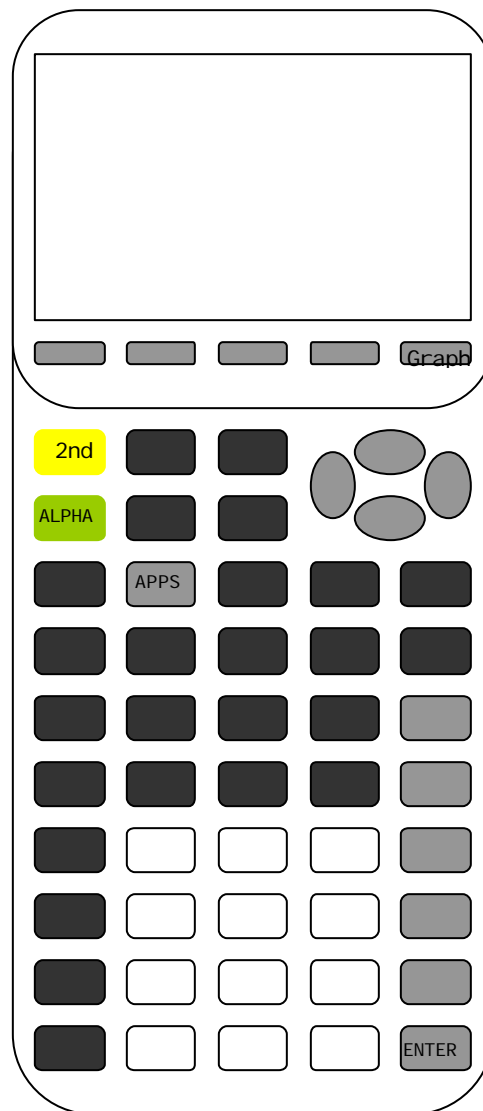
For example:

Step 1:
DRAW a circle 

Other keys used throughout the lesson plans include:

 Accesses program applications installed within the calculator

 Displays graphs and accesses menus within program applications



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Section 1 – The Lesson

Part 1. Overview of Garbology Data

Review the *Garbology* information provided at www.4empowerment.com/en/dataprojects/ within the site data information. Discuss various types of information the datasets provide. Some things to cover include:

- 1) Garbage types
- 2) Indication of land based activities and pollution impacts
- 3) How garbage can be distributed based on weight, stream flow, and stormwater events.

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Part 2. Understanding Pie Charts

Pie charts represent the distribution of several variables across a total sum. Each area shaded in the pie chart represents the ratio or percentage of one variable in relation to the overall total. The area is represented by the formula $Y\% = X/T \times 100$ where:

Y is the resulting percentage when the category variable (**X**) is divided by the total of all categories (**T**). Multiplying by 100 converts the result into a whole number.

For example:

After a full day of fishing, Lea, Ava, and Luke caught a total of 10 fish. Lea caught 5, Ava caught 2, and Luke caught 3. What percentage of the total number of fish did each child catch?

Organize the data in a table with the number of fish caught by each child and use the equation $Y\% = X/T \times 100$ to determine the percentage of fish caught by each child.

Total # Fish	Lea	Ava	Luke
10	5	2	3
Equation	$=5/10 \times 100$	$=2/10 \times 100$	$=3/10 \times 100$
Percent of Total	50%	20%	30%

Table. 1 Number and percentage of fish caught by each fisher.

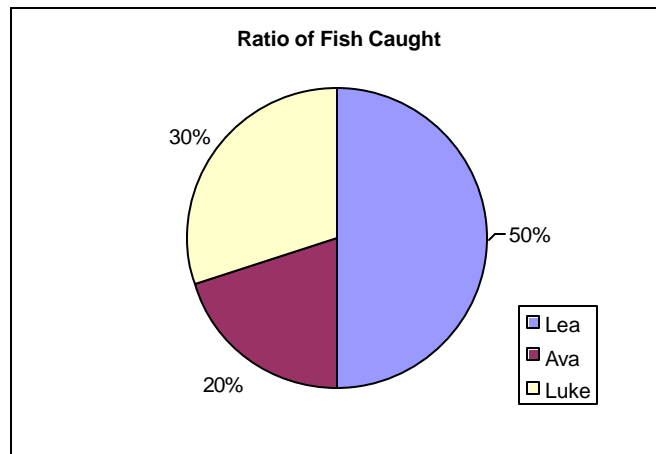


Figure 1. Ratio of fish caught by each fisher.

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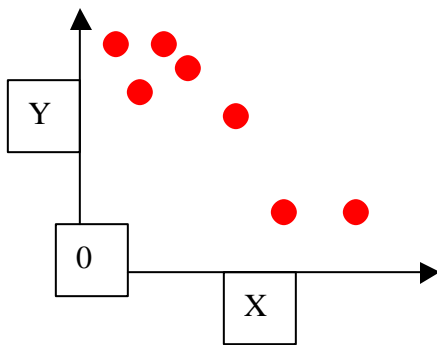


Part 3. Understanding Distribution Graphs

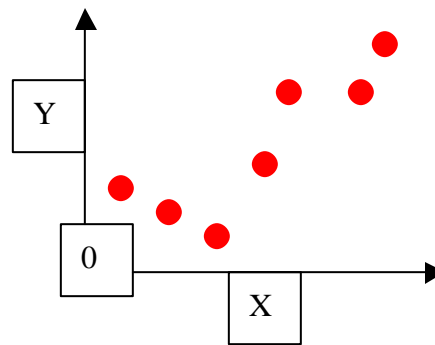
Distribution graphs are scatter plots (*Review Unit 1: Section 2. Understanding Scatter Plots and Trend Lines*) using distance as the independent variable. The plot displays the amount of garbage (Y) found over a distance (X).

The points of the plot display the **density** of garbage.

If large amounts of garbage are found in short distances and over large distances less garbage is found, the garbage is densely distributed in one location.



If little garbage is found at a short distance, but more garbage collected with distance, then the garbage is widely distributed.



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Section 2 – In Class Demonstration: Part 1: Applying a Pie Chart to Garbology Data



(Using datasets from www.4empowerment.com as an example)

Step 1 – Transfer the Data from the Computer to the Calculator

A. Gather the Data

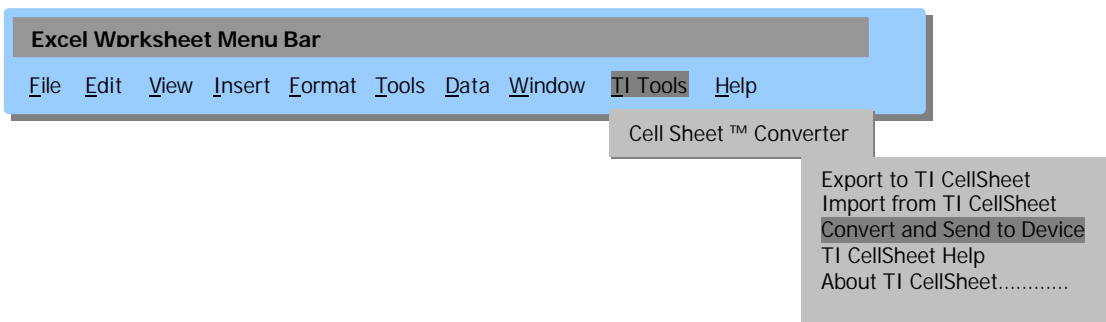
- 1) Using a web browser, go to <http://www.4empowerment.com/en/dataprojects/> and enter the Site Data page
- 2) Select the Site Brownwood HS:Ten Mile
- 3) Click View Data Options
- 4) Select Garbology data sets
- 5) Select Tables: Garbology Summary
- 6) Click on Retrieve as Excel Spreadsheet
- 7) **Save** the spreadsheet on your computer, giving it a file name easy to recognize. Then, **Open** the spreadsheet.
- 8) **Organize the data.** Check the data to be sure it is organized in a manner that is easy to navigate and understand. Each entry should be organized by column.
- 9) **Add Formulas** At the end of each column, add the total number of each item collected. Below the totals, calculate the percentage of each item out of total number of items.

	A	B	C	ETC.....
1	<i>Items Collected</i>	<i>Cloth</i>	<i>Glass</i>	
2	133	1	31	
3	152	5	22	
4	=sum(A2:A3)	=sum(B2:B3)	=sum(C2:C3)	
5		=(B4/A4)*100	=(C4/A4)*100	

- 10) **Rename** Sheet 1 to a name that will be easy to recognize when transferred to the calculator. (In this example the file will be named "Ten Mile").

B. Convert and Transfer the Data to the Graphing Calculator

- 1) Make sure the calculator is connected to the computer (via the USB port) and is turned on.
- 2) Display the Excel spreadsheet with the data to be exported
- 3) On the menu bar, click *TI Tools*
- 4) Under *TI CellSheet Converter*, scroll down to *Convert and Send to Device*
- 5) A box will appear indicating the data is exported to the calculator under a file with the same name as the Excel sheet name.



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C. Locate the Data in the Calculator

<u>Steps</u>	<u>Corresponding Keys</u>	<u>Resulting Screen View</u>
1) Open the applications menu on the calculator by pressing APPS .		
2) Scroll down to the CellSheet application and press Enter		
3) Press Enter . The CellSheet Help menu will appear.		
4) Press Enter . (The most recent dataset used will be displayed.) The Menu box will appear in the lower right corner.		
5) Press the Graph button located just under the Menu tab. The CellSheet Menu will appear.		
6) With 1: File highlighted, press Enter .		
7) With 1: Open highlighted, press Enter .		

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C. Locate the Data in the Calculator (Cont.)

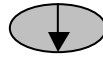


Steps

Corresponding Keys

Resulting Screen View

- 8) Scroll until the arrow points to the file name of the desired data set. Press **Enter**.

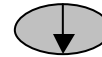


AND



TECH	A	B	C
1	MEASUR	MEASUR	DISTA
2	10/20/10:45 A		100
3	04/18/10:15 A		200
4	03/05/09:45 A		200
5	01/11/10:00 A		800
6	12/14/10:15 A		800
A1: "MEASUREMENT [→] Menu"			

Scroll through the cell sheet and check that all of the information is transferred successfully.



You are now ready to create a pie chart!

Note: If at any point you get lost, press the **2nd Function** and **Mode** to return to the beginning.



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Step 2. Create a Pie Chart



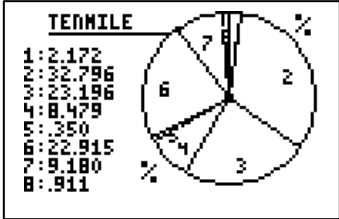


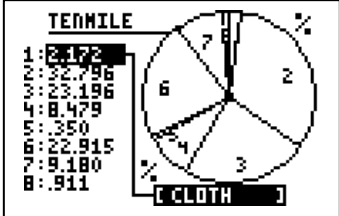
<u>Steps</u>	<u>Corresponding Keys</u>	<u>Resulting Screen View</u>
1. With the data displayed in the CellSheet application, press the GRAPH button located just under the Menu tab. The CellSheet Menu will appear.		<pre>CELLSHEET MENU 1:File... 2:Edit... 3:Options... 4:Charts... 5:Help 6:Quit CellSheet</pre>
2. Select 4: Charts		<pre>CHARTS 1:Scatter... 2:Scatter Window 3:Line... 4:Line Window... 5:Bar... 6:Bar Window... 7:Pie...</pre>
3. Select 7:Pie		
4. Enter the data range. The Categories are the item names. Enter F1:M1		<pre>PIE CHART Categories: :M1 Series:F13:M13 Number: Percent Title: Draw</pre>
The Series are the percentages. Enter F13:M13		
5. Scroll to highlight Percent		
6. Scroll Down to Title and enter "Ten Mile". Note: Press 2nd ALPHA to lock the ALPHA . After entering "TenMile" press ALPHA to release.		<pre>PIE CHART Categories: :M1 Series:F13:M13 Number: Percent Title:TENMILE Draw</pre>

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Step 2. Create a Pie Chart (cont.)

<u>Steps</u>	<u>Corresponding Keys</u>	<u>Resulting Screen View</u>
7. Scroll Down to Draw and press ENTER .	 	
8. To view the Categories press TRACE and Scroll .	 	

Step 3. Capture the Chart

Using the **TI Connect** software, you can capture the calculator display and store it as a file to the computer. This allows you to copy and paste the graphs you create into documents and report.

- In the **TI Connect** window, click on the **camera**. A window will appear displaying the image from the calculator.
- Under **File**, click on **Copy**.

In the **Word** document, create a text box and **paste** the image into the box.

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Section 2 – In Class Demonstration: Part 2: Applying a Distribution Graph Chart to Garbology Data



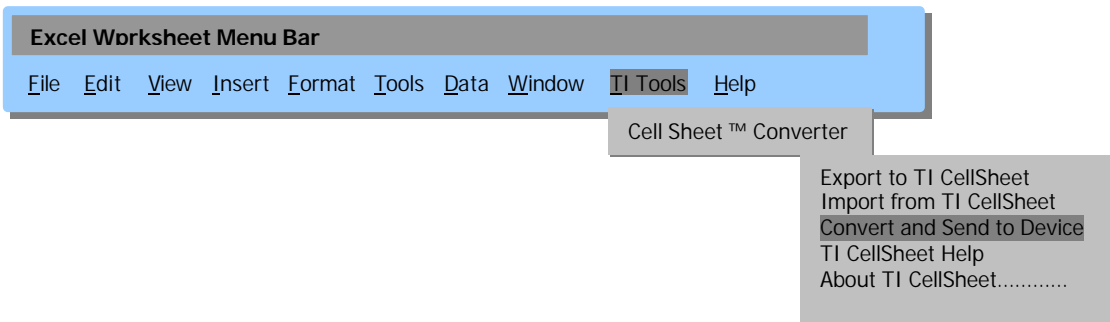
Step 1 – Transfer the Data from the Computer to the Calculator

A. Gather the Data

- 1) On the internet, go to <http://www.4empowerment.com/en/dataprojects/> and enter the Site Data page
- 2) Select the Site Brownwood HS:Ten Mile
- 3) Click View Data Options
- 4) Select Garbology data sets
- 5) Select Tables: Garbology Summary
- 6) Click on Retrieve as Excel Spreadsheet
- 7) **Save** the spreadsheet on your computer, giving it a file name easy to recognize. Then, **Open** the spreadsheet. **Close** the internet.
- 8) **Organize the data.** Select only the parameters you will need: distance and number of items. Check the data to be sure it is organized in a manner that is easy to navigate and understand. Each entry should be organized by column.
- 9) **Rename** Sheet 1 to a name that will be easy to recognize when transferred to the calculator.

B. Convert and Transfer the Data to the Graphing Calculator

- 1) Make sure the calculator is connected to the computer (via the USB port) and is turned on.
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C. Locate the Data in the Calculator (Cont.)

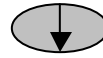


Steps

Corresponding Keys

Resulting Screen View

16) Scroll until the arrow points to the file name of the desired data set. Press **Enter**.

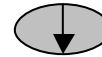


AND



TECH	A	B	C
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A1: "MEASUREMENT [→] Menu"			

Scroll through the cell sheet and check that all of the information is transferred successfully.



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Step 2. Create a Distribution Graph

<u>Steps</u>	<u>Corresponding Keys</u>	<u>Resulting Screen View</u>
1. With the data displayed in the CellSheet application, press the GRAPH button located just under the Menu tab. The CellSheet Menu will appear.		<pre>CELLSHEET MENU 1:File... 2:Edit... 3:Options... 4:Charts... 5:Help 6:Quit CellSheet</pre>
2. Select 4: Charts		<pre>CHARTS 1:Scatter... 2:Scatter Window 3:Line... 4:Line Window... 5:Bar... 6:Bar Window... 7:Pie...</pre>
3. Select 1:Scatter		
4. Enter the data range . The distance data is in cells C2 thru C11; thus, the XRange: is C2:C11 Scroll Down	 	
The items data is in cells D2 thru D11; thus, the YRange: is D2:D11	 	
5. Scroll Down to Title and enter the "TenMile". Note: Press 2nd ALPHA to lock the ALPHA . After entering "TenMile", press ALPHA to release	 	<pre>SCATTER CHART XRange:C2:C11 YRange1:D2:D11 YRange2: YRange3: Title:TENMILE AxesOn AxesOff DrawFit Draw</pre>
5. Scroll Down and Right to Draw and press ENTER .	 	
6. Enlarge the graph window to show the points	 	

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- In the **TI Connect** window, click on the **camera**. A window will appear displaying the image from the calculator.
- Under **File**, click on **Copy**.

In the **Word** document, create a text box and **paste** the image into the box.

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Section 3: Student Exercises

Part 1: Percentage of Types of Garbage Found in Garbology Understanding the Function of a Pie Chart

- **Find the data:** Search through various field sites to find data sets that provide at least one collection date of garbology data.
- **Organize the data:**
 - Download the data as an Excel spreadsheet
 - Create a table with the garbology data. Think about how to best organize the data to make it easy to search and understand.
 - Use formulas to determine the total number of items for each type of garbage.
 - Use formulas to determine the percentage of each type of garbage out of total number of items collected.
 - Print out the table of the data.
- **Hand draw a pie chart!**
 - Using the worksheet, create a pie chart of the data. Determine the area to be shaded based on the percentages for each type of garbage.
 - Use different colors to shade each area. Label the garbage type and include the percentage as text.
 - Label the table and chart and give a brief explanation of the information each presents.
- **Create a pie chart using the graphing calculator.**
 - Using the Excel spreadsheet with garbology sums and percentages, enter the data into the calculator.
 - Follow the steps to create a pie chart.
- **“Capture” your chart and add it to a report of your findings.**
- **“Think About It”: What does the pie chart tell us?**
 - What garbage type(s) makes up the greatest percentage of all items?
 - What type of garbage contributes to the greatest percentage of the data? Is it smaller trash and litter or larger items that have been dumped?
 - Is the type easily carried by water downstream? Or is the type heavy enough to stay in place?
 - Based in the trash type, can you determine the source of the trash?

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Section 3: Student Exercises

Part 2: Distribution of Garbage over Distance ***Understanding the Function of a Distribution Chart***

- **Find the data:** Search through various sites to find data sets with multiple collection dates.
- **Organize the data:**
 - Download the data as an Excel spreadsheet
 - Create a table with the garbology data to be used in the distribution graph. Think about how to best organize the data to make it easy to search and understand.
- **Input the data into the graphing calculator:** Using the steps outlined, input the Excel file with the data to be used in the distribution graph. Be sure to correctly label each table as the file is transferred to the calculator!
- **Graph the data.**
 - In the calculator check the table to ensure all the data transferred correctly.
 - Determine the data range and axis for each category.
 - Using the directions provided, create a scatter plot of the data on the graphing calculator.
- **“Think About It”: What does the graph tell about the data?**
 - Is the garbage strewn over a large area? Or does it seem to gather in one spot?
 - Does the garbage seem to be carried by the stream over a large area or are there stream characteristics that cause the garbage to collect in one area?
 - Does the garbage seem to be scattered by human activities over a large area, or are the human activities central to a certain spot?
- **Display your graph and write up your findings.**
 - Display the graph on the computer screen and “capture it”
 - Insert your graph into a Word document and add a brief explanation of your findings.

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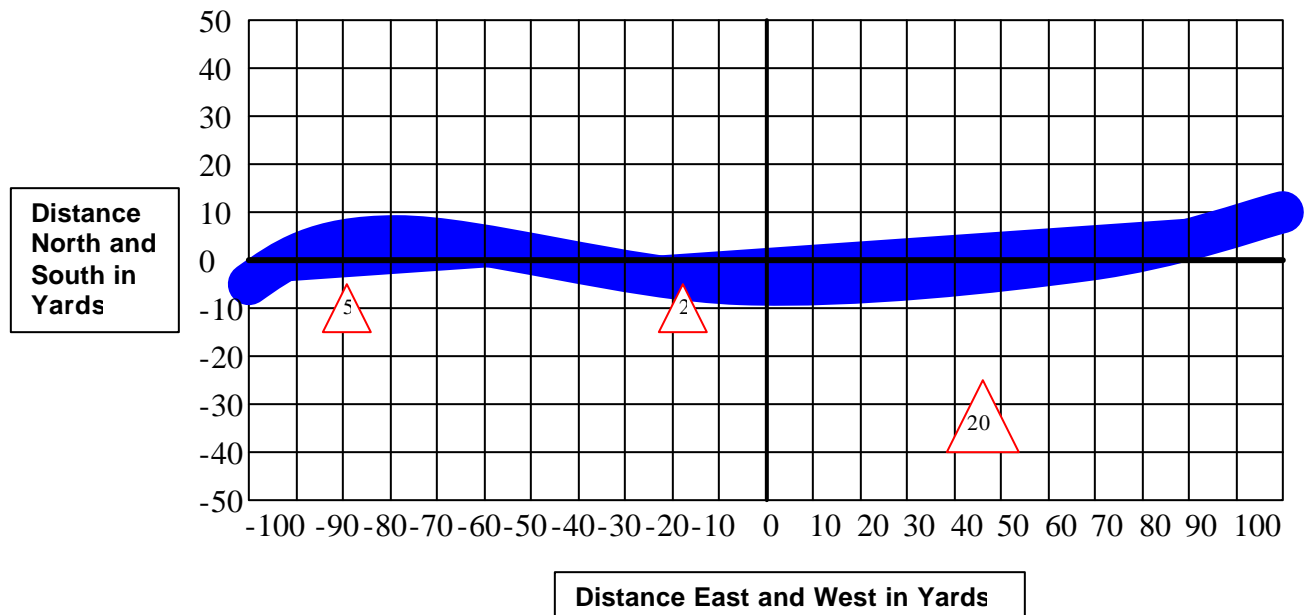
Section 4: Long Term Projects

Other Exercises

- Combine the information from the pie chart and the distribution graphs to answer more questions.
 - Look at the all the types of garbage collected and the distribution of the garbage?
 - What types are easily carried over distance by wind or stormwater?
 - What types are less likely to be carried?
 - What are the land use activities at and around the site? Do the garbage types reflect these activities? Or do they indicate that garbage from land use activities far upstream is being carried downstream?
- Create a distribution chart that can be used in the field.

Use the example below to document the distribution and type of garbage as you collect it in the field.

- Use a landmark to determine the 0 centerpoint.
- Plot the distances using a grid and use the x and y axis labels as coordinates.
- Indicate the number and type of garbage found at grid points. Use different symbols for each garbage type.
- Make the symbol larger incrementally; ie. a smaller symbol represents up to ten items, a medium symbol represents up to twenty.



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“Take Action” Activities

Use what you have learned to graph data collected from your site. Using what the graph tells you:

- Start a litter program – target the place and type of litter based on the information provided in the graphs.
 - Determine if there are specific locations garbage originates or collects.
 - Is the garbage carried downstream or is it deposited on land?
 - Is it concentrated in one location?
 - What type of garbage is it?

Place signs in locations where garbage is deposited before it is washed downstream. Based on the type of garbage, the sign may say “No Littering” (glass, paper) or “No Dumping” (rubber, wood). If possible, have your city place garbage cans, recycling cans, or dumpsters at these locations. Using your field graph, you may be able to show exact locations to effectively place the receptacles.

- Organize a river clean-up – use your graphs to effectively focus the project and organize the volunteers.
 - How much and what types of garbage are usually found at your site?
 - What is the distribution of the garbage?

With this information, decide:

- Approximately how many people will you need to recruit? If the garbage is distributed widely you may need more people to participate. Your volunteer recruitment techniques for volunteers will need to reach many people. Will it need to be city-wide or school-wide? Or can a couple of classes cover the distribution area?
- What types of garbage will be collected? If larger, heavier types of garbage are present, you need more or stronger people to collect the garbage. Will you need to recruit adults as well as students?
- Using the historic data in your field distribution graphs, divide the area into quadrants and decide the appropriate number of people needed to collect garbage in each. This will provide an idea of how many volunteers to recruit and allow you to organize the volunteers effectively during the clean-up.

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