The Garbage Problem

About the Lesson

In this activity, students will examine data about garbage production, observe comparisons in the data, make predictions based on the data, sketch a graph based on their predictions and design a plan to help deal with potential garbage problems. As a result, students will:

- graphically represent data from a data table in

  a scatter plot
- extrapolate from a given set of data, to develop an understanding of the amount of trash generated per person in the U.S.
- design a plan to address the garbage problem

Vocabulary

- dependent variable
- independent variable

Teacher Preparation and Notes

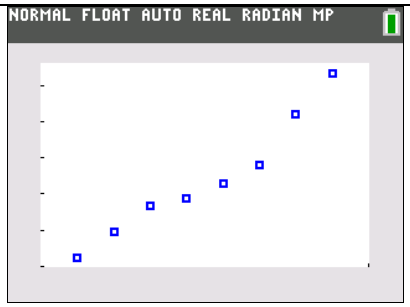
- Students should know how to input data into lists and graph scatter plots.

Activity Materials

- Compatible TI Technologies:

TI-84 Plus*
TI-84 Plus Silver Edition*
TI-84 Plus C Silver Edition
TI-84 Plus CE

** with the latest operating system (2.55MP) featuring MathPrint™ functionality.*



Tech Tips:

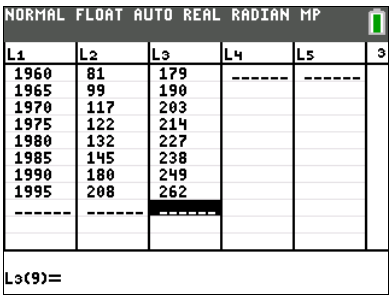
- This activity includes screen captures taken from the TI-84 Plus CE. It is also appropriate for use with the rest of the TI-84 Plus family. Slight variations to these directions may be required if using other calculator models.
- Watch for additional Tech Tips throughout the activity for the specific technology you are using.
- Access free tutorials at http://education.ti.com/calculators/pd/US/Online-Learning/Tutorials
- Any required calculator files can be distributed to students via handheld-to-handheld transfer.

Lesson Files:

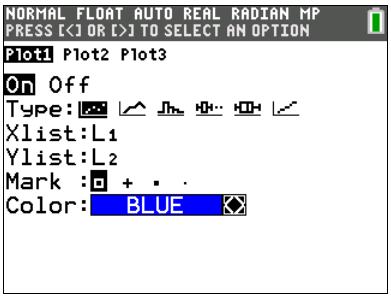
- The_Garbage_Problem_Student.pdf
- The_Garbage_Problem_Student.doc

Entering the Data

1. Before entering data in the lists, clear any existing data from the lists.
   a. Press 2nd [mem].
   b. Highlight **4:ClrAllLists**, and then press enter.
   c. This takes you to the Home screen, and you will see **4:ClrAllLists** with a blinking cursor following it. Press enter, and the TI-84 PLUS CE displays **Done**. Your lists are now cleared.
2. Press stat then press enter to choose **1:Edit**.
3. Enter the **Years** from the data table in **L1,** starting with 1960 and ending with 1995.
   a. Your cursor should be highlighting the first row in **L1**. Press **1 9 6 0** and then press enter. Notice the cursor is now in the second row of **L1**.
   b. Enter the next number, and then press enter. Repeat this process until you have entered all of the data from the Year column.
4. Press ▶. The cursor should now be highlighting the first row in **L2**. Enter the data from the **Garbage** column in **L2**.
5. Press ▶ to move to **L3**. Enter the data from the Population column in **L3**.
6. Make sure you have the same number of entries in all three lists, and that they all align as they do in the data table on page 1.



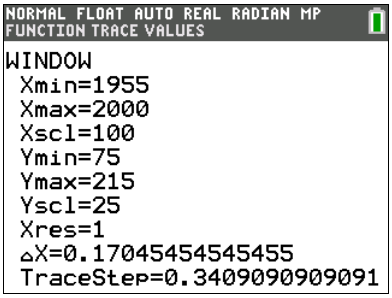
7. Make a numerical comparison between the data in **L1** and the data in **L2**.
   - Answer question 1 on the **Data Analysis** page.
8. Make a graph of garbage production versus year.
   a. Press 2nd [stat plot], to access the **STAT PLOTS** menu. (**STAT PLOT** is above the y= key on the TI-84). The **STAT PLOTS** menu allows you to choose what type of graph is best for your data.
   b. Press enter to select **1:Plot1**. Set your TI-84 PLUS CE as shown at the right. Follow the steps below for more help in setting the calculator up:



- The cursor will be flashing on the word **On**. To turn this plot on, press enter.
- Press ▼ to move to Type. The cursor will be flashing on the first option. This is a scatter plot. A scatter plot allows you to plot the independent variable versus the dependent variable. To choose this option, press enter.
- Press ▼ to move to **Xlist**. The **Xlist** can also be referred to as the independent variable. If **L1** is not in your **Xlist**, enter **L1** by pressing 2nd [L1]. ([L1]is above the 1 key on the TI-84 PLUS CE).
- Press ▼ to move to **Ylist**. The **Ylist** can also be referred to as the dependent variable. Enter **L2** for the **Ylist** by pressing 2nd [L2].
- Press ▼ to move to **Mark**. The mark is the type of mark you want to represent each data point on your graph. There are not many data points for this graph, so choose the first option, since it is larger. Your cursor should be blinking on this option. To choose it, press enter.
- Press ▼ to move to **Color** and select the color of your marks by pressing ▶or ◀.

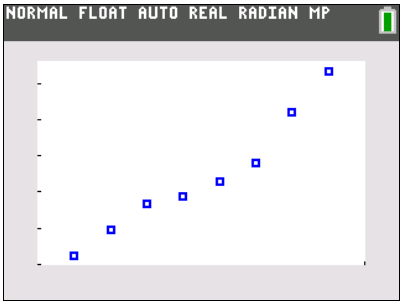
9. Answer question 2 on the **Data Analysis** page.

10. Set the **WINDOW** appropriate for your data. You are telling the TI-84 Plus CE how you want the graph scaled so that you can best view the data.
    a. Press window. (window is along the top row of keys on the TI-84).



11. Press ▼ to select the settings, and set the window as shown at the right. These settings are appropriate for the garbage collection data.

12. Press graph to see how your data is plotted. Label the axes on the graph at the right.



13. Press trace. Using ◀ and ▶, move the cursor from point to point. Notice that the ordered pairs (data points) are shown at the bottom of the screen. Find the two consecutive points where there was the least increase in garbage production. Find the two consecutive points where there was the greatest increase in garbage production.
    - Answer question 3 on the **Data Analysis** page.

14. Graph garbage production versus population. Before you do this, decide which will be your independent variable, and which will be your dependent variable.
    - Answer question 4 on the **Data Analysis** page.

15. Press 2nd [stat plot], to access the **STAT PLOTS** menu. Make the necessary changes, keeping in mind your choices for independent and dependent variables.

16. Reset your window to make it appropriate for your new data.
    - Complete the table under question 5 on the **Data Analysis** page, indicating what you chose for your window settings.

17. Press graph.
    - Complete the graph in question 6 on **the Data Analysis** page.

18. Press trace. Press ▶ a few times to move the cursor to the last plotted point on your graph. Make note of the ordered pair.
    - Answer question 7 on the **Data Analysis** page.

19. Using this final data point, calculate the amount of garbage generated per person during that year.
    - Answer question 8 on the **Data Analysis** page.

20. Assume the rate of garbage production is the same today as it was in 1995.
    - Answer question 9 on the **Data Analysis** page.

Data Analysis

1. a. What number pattern do you observe in L1? Explain.

   Answer: The numbers (years) increase by five each time.

   b. What number pattern do you observe in L2? Explain.

   Answer: The numbers increase, but not by a constant number

2. a. Why are you using the years as the independent variable (Xlist)?

   Answer: You are using the years as the **Xlist** because time is independent of garbage production.

   b. Why are you using the garbage production as the dependent variable (Ylist)?

   Answer: You are using the garbage production as the **Ylist** because the amount of garbage produced depends on the time.

3. a. Between which years did the rate of garbage production slow down?

   Answer: The rate of garbage production slowed down between 1970 and 1975.

   b. Between which years did the rate of garbage production speed up the most?

   Answer: Garbage production sped up the most between 1985 and 1990.

   c. From your graph, predict what the garbage production would be in the years 2000 and 2005. Be sure to indicate the units of production.

   Answer: The garbage production in the year 2000 is predicted to be about 220-225 billion kg. The garbage production in the year 2005 is predicted to be about 240 billion kg.

4. What is the:

- Independent variable: **The independent variable is the population.**

- Dependent variable: **The dependent variable is the garbage production.**

Explain your reasoning.

Answer: This is because the garbage production depends on the population, not the other way around.

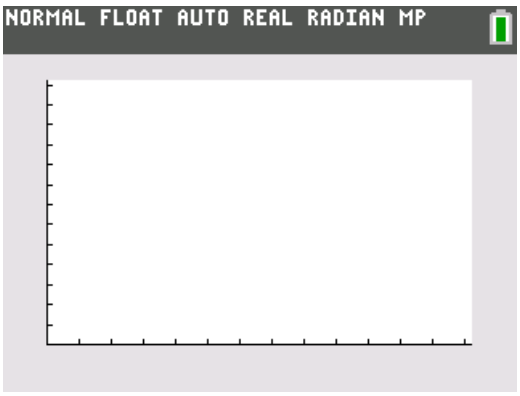
5. Complete the table.

Student Answers will vary.

Xmin	**~170**	**Ymin**	**~75**
Xmax	**~265**	**Ymax**	**~210**
Xscl	**~10**	**Yscl**	**~10**
Xres	**1**		

6. Sketch your graph in the grid below.

Student Answers will vary.



7. What is the ordered pair?

X: **262** Y: **208**

What labels should be applied to each of these numbers?

X: **millions of people** Y: **billions of kg of garbage**

8. What is the amount of garbage generated per person during the year?

Answer: 794 kg of garbage per person.

9. How much garbage does your family generate in a day?

   A week?

   A month?

   A year?

   How much garbage would your class produce in a year?

   How much garbage would your school produce in a year?

   Student Answers will vary.

Additional Questions for Discussion and Writing

1. What are some potential problems we may be facing now and in the future if the current trend in garbage production continues?

   Student Answers will vary.

   Possible answers include: running out of landfill space, running out of raw materials for packaging, and so on.

2. Design a plan to help deal with these potential problems.

   Student Answers will vary.

   Possible answers include: recycling, less packaging of materials, and so on.

3. What economic, ecological, and social factors could have attributed to a slowing in the rate of garbage production between 1970 and 1975?

   Student Answers will vary.

   This is a good problem to have the students research by going to the library, using the Internet, or asking their parents. Possible factors were the environmental movement and awareness, recycling, couples having fewer children, and so on.