

### About the Lesson

In this activity, students are introduced to modeling linear data through an investigation of comparing grams of fat and Calories in fast food hamburgers. Students will use multiple representations – numeric, graphical, algebraic, and verbal – to explore aspects of the linear equation that models the data. As a result, students will:

- Represent and interpret data displayed in line graphs and scatter plots.
- Analyze statistics to draw conclusions and test the validity of stated inferences.
- Model with mathematics and use appropriate tools strategically.

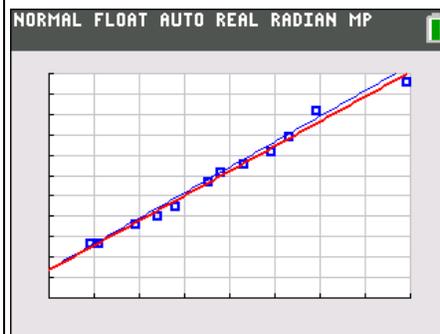
### Vocabulary

- scatter plot
- line of best fit
- slope
- y-intercept

### Teacher Preparation and Notes

This activity can serve to consolidate earlier work on graphing data, finding line of best fit, and modeling data with linear functions. It offers an introduction to exploring linear data, model fitting using transformation of linear functions, and interpreting graphs.

- Begin by reviewing with students the slope-intercept form of a linear equation and a line of best fit.
- You may want to bring in a box of instant oatmeal as a visual aid to help students with an understanding of question 7.
- For the extension you may want to have the packaging for candy or other foods. Get packaging from other countries for energy units of kilojoules as students will see in science classes.



### Tech Tips:

- This activity includes screen captures taken from the TI-84 Plus C Silver Edition. It is also appropriate for use with the TI-84 Plus family with the latest TI-84 Plus operating system (2.55MP) featuring MathPrint™ functionality. Slight variations to these directions given within may be required if using other calculator models.
- 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.

### Compatible Devices:

- TI-84 Plus Family
- TI-84 Plus C Silver Edition

### Associated Materials:

- YouAreWhatYouEat\_Student.pdf
- YouAreWhatYouEat\_Student.doc

**Problem 1 – Fast Food Hamburgers**

Calories are a unit of energy. You may burn around 70 Calories just sitting at your desk and over 100 Calories while you sleep. The energy required to lift a book from the floor to the table is only about 0.003 Calories.

The table to the right shows the grams of fat and Calories for 11 hamburgers from three different fast food places. How many fast food hamburgers do you eat in a week?

Fat (g)	Calories
11	270
9	270
19	360
24	400
28	450
35	570
38	620
43	660
49	720
53	790
79	1060

1. Look at the data. What do you think is the relationship between the grams of fat and the Calories in a hamburger? Is it a positive or negative association?

**Sample Answer:** As the grams of fat increase, the number of Calories increase. A relationship where one variable is increasing while the other variable increases is called a positive association. A relationship where one variable is increasing while the other variable is decreasing is called a negative association.

2. In order to graph the data and set up an appropriate viewing window, consider the following.

- a. What is the independent variable? What is the domain?

**Answer:** The independent variable, grams of fat, is from 9 g to 79 grams. An appropriate Xmin and Xmax is from 0 to 80 so students can see the y-axis.

- b. What is the dependent variable? What is the range of the data?

**Answer:** The Calories depend upon the fat grams and range from 270 to 1060 Calories. As shown to the right, a Ymin and Ymax of 0 to 1100 will allow the students to see the x-axis and can be helpful for seeing the y-intercept.

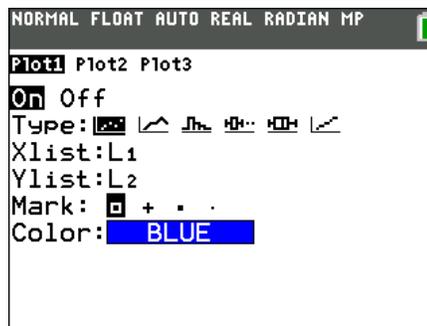
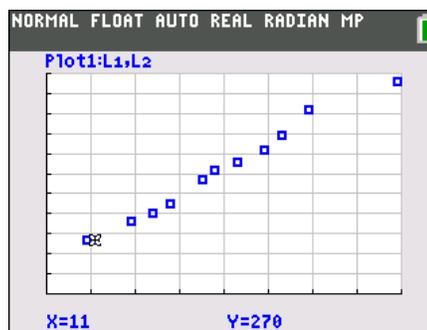
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NORMAL FLOAT AUTO REAL Radian MP
WINDOW
Xmin=0
Xmax=80
Xscl=10
Ymin=0
Ymax=1100
Yscl=100
Xres=1
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TraceStep=.606060606060606
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3. Estimate about how much the Calories increase for every increase of 1 gram of fat.

**Sample Answer:** An increase of about 800 Calories results from an increase in 70 grams of fat. So an estimate should be greater than 10 Calories/gram of fat.

Plot the Calories vs. grams of fat as a scatter plot, and then find the line of best fit. Enter the data into your calculator by pressing **[STAT]** **[ENTER]** to open the ListEditor. Enter the grams of fat in L<sub>1</sub> and the Calories in L<sub>2</sub>.

Plot the data as a scatter plot as shown to the right by pressing **[2nd]** **[Y=]** for **[STAT PLOT]**. Then press **[WINDOW]** and set up the window you decided upon in questions 2. The Xscl and Yscl sets up the tick marks. Press **[GRAPH]**.



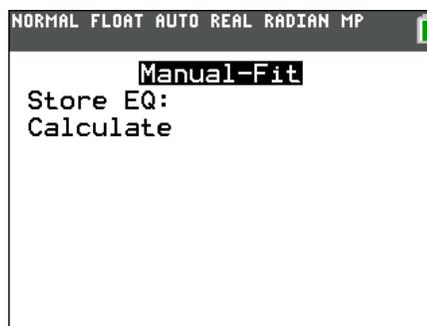
4. How does your answer for question 3 relate to the graph?

**Answer:** The Calories/gram of fat is the slope of the graph

**Tech Tip:** Turn on the GridLine by pressing **[2nd]** **[ZOOM]** to change the **[FORMAT]** settings. Note the GridLine feature is unique to the TI-84 Plus C.

To create your own line of best fit press **[STAT]**, arrow over to choose **CALC**, and up arrow to select **Manuel-Fit**. Arrow down to and select **Calculate**. Your equation will automatically be stored in Y<sub>1</sub>. With the TI-84 Plus C you can press the soft key **[GRAPH]** to change the **STYLE**.

Move the cursor along to where the line of best fit appears to be and press **[ENTER]**. Move the cursor again to pick another point further away. Think of it as lining up your ruler along the data points. Press **[ENTER]** again. Use the arrows and type in a value to change the slope and y-intercept until you are satisfied with your line. To quit press **[2nd]** **[MODE]**.



Move the cursor along to where the line of best fit appears to be and press **ENTER**. Move the cursor again to pick another point further away. Think of it as lining up your ruler along the data points. Press **ENTER** again. Use the arrows and type in a value to change the slope and y-intercept until you are satisfied with your line.

5. What is the equation of your line? Explain the meaning of your slope. Include units.

**Sample Answer:** The equation may be around  $Y_1 = 12.2x + 140$ , where the slope means that there is an increase of 12.2 Calories for every 1 gram of fat.

6. How does your equation compare with the linear regression? View the data and the two linear equations together. **STAT**, **CALC**, **LinReg (ax+b)**. Use **ALPHA****[F4]** to select  $Y_2$  to store the regression equation in  $Y_2$  as shown to the right and select Calculate.

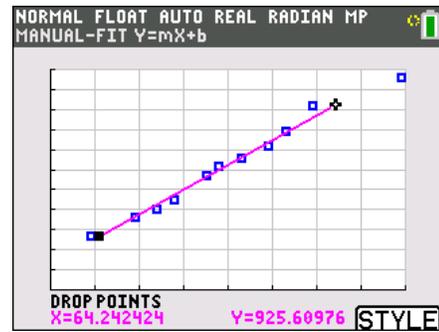
**Answer:**  $Y_2 = 11.79x + 145.07$  is linear regression for the data. Students should discuss how their slope and y-intercept compare.

Students should use the regression equation to answer the following questions:

7. What does the y-intercept mean in terms of the number of hamburgers?

**Answer:** If there are zero hamburgers, then the equation says there will be about 145 Calories. Since the equation shows the relationship between the fat grams and Calories, it is reasonable that there are some Calories that come from other sources than fat.

**Teacher Tip:** If you bring a box of instant oatmeal, it can serve as a visual aid that there are approximately 140 calories and 0 grams of fat.



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NORMAL FLOAT AUTO REAL RADIAN MP
LinReg(ax+b)
Xlist:L1
Ylist:L2
FreqList:
Store RegEQ:Y2
Calculate
    
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NORMAL FLOAT AUTO REAL RADIAN MP
Plot1 Plot2 Plot3
Y1=12.2X+140
Y2=11.789141523299X+145.07
Y3=
Y4=
Y5=
Y6=
Y7=
Y8=
Y9=
    
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8. How many calories are in a hamburger with 22 grams of fat?

**Answer:** 404.45 Calories. If students use  $\boxed{\text{ALPHA}}$  [F4], or  $\boxed{\text{VARS}}$ , Y-VARS to select  $Y_2$ , on the Home screen they could enter  $Y_2(22)$  to get 404.45.

9. If one of the fast food places created a triple burger with 1243 calories, approximately how many grams of fat would it have?

**Answer:** 93.12 grams of fat. Students should solve  $Y_2(x) = 1243$  for  $x$ .

### Extension

Students can also research and explore their own data.

10. Find nutritional data on other fast food hamburgers and compare them to your results.
11. Find nutritional data on various other types of food (ice cream, candy, chips, pop, etc.) and explore the relationship between sugar grams and Calories.

**Teacher Tip:** Bring in or have students bring in packages of candy or other foods and compare the grams and Calories. A search for “calorie counter candy” on the Internet may help provide a list.