



About the Lesson

In this activity, students explore a geometric sequence related to an outbreak of the flu and extrapolate to make predictions based on given data. As a result, students will:

- Develop the geometric model for the outbreak.
- Write summation notation to calculate total number of individuals infected.

Vocabulary

- geometric sequence
- summation notation
- exponential functions
- growth rate

Teacher Preparation and Notes

- Before beginning this activity, students should clear out lists L1 and L2 and turn off all functions and plots

Activity Materials

- Compatible TI Technologies:

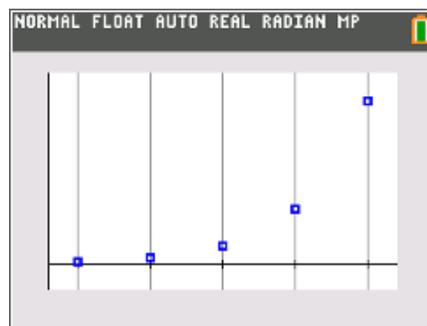
TI-84 Plus*

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:

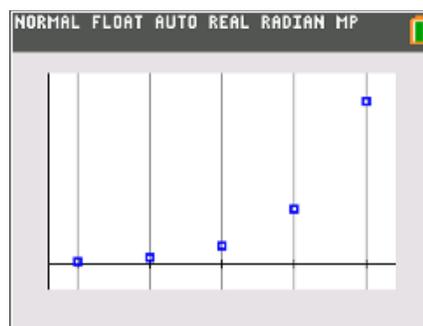
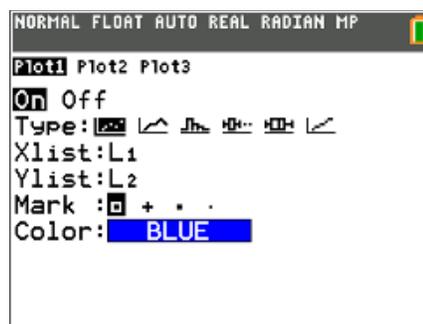
- This activity includes screen captures taken from the TI-84 Plus CE. It is also appropriate for use with the rest of the TI-84 Plus family. Slight variations to these directions may be required if using other calculator models.
- Watch for additional Tech Tips throughout the activity for the specific 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:

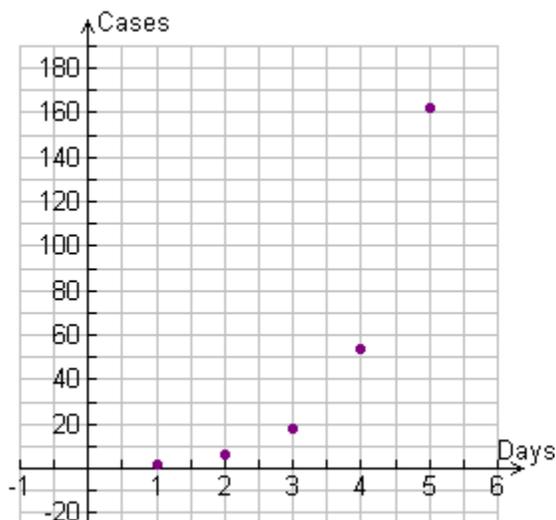
- Outbreak_Student.pdf
- Outbreak_Student.doc

Students are given data for a flu epidemic and use the data to create a scatter plot and answer questions about the data and associated graph.

Students begin by constructing a scatter plot and drawing their graph on their worksheet. To create a scatter plot, students first enter the data into their lists by pressing $\boxed{\text{stat}}$ and selecting **1:Edit....** Once the data is entered, students should press $\boxed{2\text{nd}}\boxed{\text{stat plot}}$ and select **1:Plot1**. The settings should be set the same as those to the right. Students should press $\boxed{\text{zoom}}$ and select **9:ZoomFit** for a window that displays all of the data.



1. Press $\boxed{2\text{nd}}\boxed{y=}$ and construct a scatter plot using the data you placed in L1 and L2. Sketch the graph displayed on your calculator below.



Answer:



2. Describe the rate of change observed in the data and corresponding graph.

Answer: increasing

3. What term describes the type of sequence displayed in the “students” data column?

Sample Answer: Geometric because the number of new cases is increasing by a factor of 3 everyday.

4. Identify a term other than scatter plot that describes the type of graph.

Answer: exponential

5. How many students would you expect to come down with the illness on day 6?

Answer: (number of cases)(growth rate) = $(162)(3) = 486$

6. Assuming that this pattern will continue, develop an equation that will relate the number of students, y , to any day, k .

Answer: Substitute the initial condition $\left(0, \frac{2}{3}\right)$ found by dividing the number of cases on day 1 by the growth rate of 3.

$$y = a(b)^k$$

$$\frac{2}{3} = a(b)^0$$

$$\frac{2}{3} = a$$

$$y = \frac{2}{3}(3)^k$$

$$y = 2(3^{-1})(3)^k$$

$$y = 3(3)^{k-1}$$



7. How many students total will have been affected by day 5?

Answer: 242 students will have been affected by day 5.

Summation (sigma) notation may be used to make the previous calculation easier to perform. An example is:

$$\sum_{k=1}^5 2^k = 2^1 + 2^2 + 2^3 + 2^4 + 2^5$$

The expression 2^k is evaluated for each integer from 1 to 5 and the results are added.

8. Using summation notation, write and evaluate an expression that may be used to determine the total number of students affected in 5 days.

$$\sum_{k=1}^5 (2g(3)^{k-1}) = 2g(3)^{1-1} + 2g(3)^{2-1} + 2g(3)^{3-1} + 2g(3)^{4-1} + 2g(3)^{5-1}$$

Answer:

$$\begin{aligned} &= 2 + 2g(3)^1 + 2g(3)^2 + 2g(3)^3 + 2g(3)^4 \\ &= 2 + 6 + 18 + 54 + 162 \\ &= 242 \end{aligned}$$

9. Develop a generalized summation notation expression that can be used to determine the number of students affected after any number of days, n , assuming that this pattern will continue.

Answer: As seen in question 8, the upper limit of the summation notation lets us know how many terms to add. In this case, it is how many days of outbreak. Changing the upper limit to n results in

$$\sum_{k=1}^n (2g(3)^{k-1}).$$