



### About the Lesson

In this activity, students will simulate the spread of a virus, produce a graph of the virus data and analyze the data.



### Vocabulary

- virus
- infection
- scatter plot

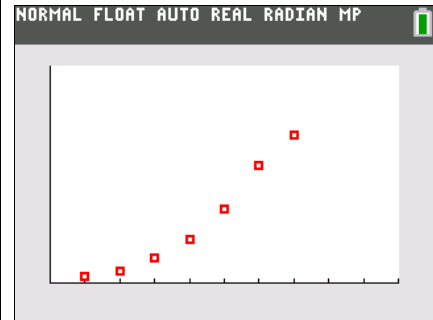
### Teacher Preparation and Notes

- 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:

- Outbreak\_Student.pdf
- Outbreak\_Student.doc



### Introduction

One problem that has always confronted society is the spread of disease. Viruses cause some of the deadliest diseases we know of. When you think of diseases that are easily spread from person to person, you probably think of the common cold, influenza, and chicken pox, along with one of the most dreaded diseases of our time: AIDS. Viruses cause all of these diseases, and the members of a population can very quickly share them.

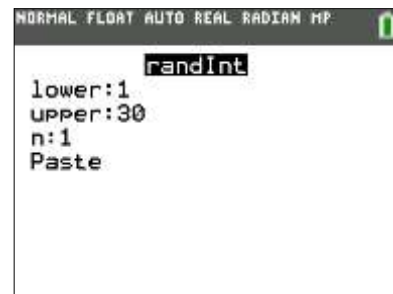
### Teaching Notes:

- This is a teacher-led activity. You will be generating the numbers that represent students who have been infected.
- Each student in the class should be assigned a consecutive integer starting with the number 1. This number will identify the individuals who will become infected with the virus that will be introduced to this healthy population.
- Each infected person may spread the virus when they come into contact with another individual, although you will not simulate the contact.
- During the simulation, a student's number may appear more than once. This simply means that you did not have contact with another person during that trial.

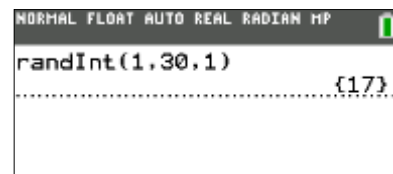
**Tech Tip:** If collecting data on multiple calculators you may have to “seed” the random number generator to ensure all calculators display unique numbers. Do this by storing a unique number on each calculator before calculating random numbers. The key press sequence is input a unique number on the **Home** Screen then `sto→` `math` `◀` `◀` `1:rand` `enter`. You can also avoid repeating numbers by using the **randIntNoRep** command in the **Math PROB** menu.

### Teacher Set-Up for the simulation using the TI-84 CE Plus

1. `clear` the Home screen. Calculate a random integer by pressing `math` `◀` `◀` `5:randInt(`. Count the number of students in class and enter the following data: `1` `,` (number of students) `)`. For example, if there are 30 students in your class, you would enter `1` `▾` `30` `▾`. To generate the first number that will identify the infected person, press `enter` to Paste the correct syntax to the Home screen.



2. Your TI-84 Plus CE screen should look something like this, but you may have a different number. The 17 means that the student that was assigned #17 before the simulation began, is now infected with the virus and may pass the disease on to someone else. This student should sit down.





- Now, there is one infected person, and this person may spread the virus to the next person whom they come in contact with. To determine the next person infected, press `[enter]` again. Now you may have two individuals infected, and each may spread the virus, so you need to change the number of random integers that will be generated to two.
- To reset the command on the TI-84 screen, press `[2nd][enter]`. This will recall the last command on the home screen. Press `[↓]` to move the cursor just after the **30** and enter `[↓] 2 [↓]`. Now when you press `[enter]` you will produce two random integers, which will indicate the individuals newly infected with the virus. Remember to count and record the number of individuals infected after each trial.
- After each trial, continue to change the third argument as described above to reflect the number of individuals who are now infected (students sitting down).
- Continue pressing `[enter]` and changing the number infected until the entire population in your classroom is infected (sitting down).

### Recording the Data

As you generate the random numbers to represent those who are infected by the virus, the students should record the data on the printed *Data Table*. Following the activity, the students will then enter the data from the Data Table for the entire class, into their calculators for analysis, using the directions that follow.

### Data Analysis

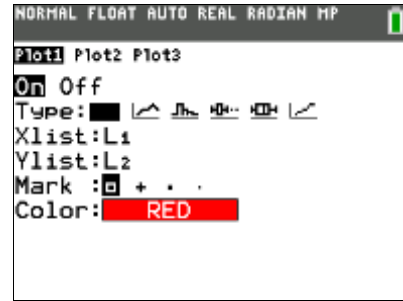
- Press `[stat][enter]` to return to the List Editor. Clear all lists of data. Enter the number for each trial in L1 and the class data, those infected, in L2. The screen at the right represents sample data for this simulation. Your results in L2 may be different.

| NORMAL FLOAT AUTO REAL RADIAN MP |    |       |       |       |   |
|----------------------------------|----|-------|-------|-------|---|
| L1                               | L2 | L3    | L4    | L5    | 2 |
| 1                                | 1  | ----- | ----- | ----- |   |
| 2                                | 2  |       |       |       |   |
| 3                                | 4  |       |       |       |   |
| 4                                | 7  |       |       |       |   |
| 5                                | 12 |       |       |       |   |
| 6                                | 19 |       |       |       |   |
| 7                                | 24 |       |       |       |   |
| -----                            |    |       |       |       |   |
|                                  |    |       |       |       |   |
|                                  |    |       |       |       |   |
|                                  |    |       |       |       |   |
|                                  |    |       |       |       |   |
|                                  |    |       |       |       |   |

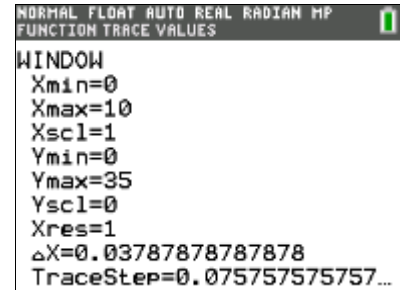
L2(8)=



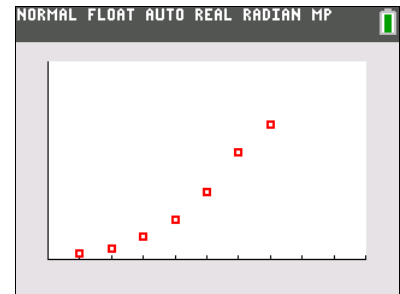
2. Press **2nd** [stat plot]. Press **enter** to select 1:Plot1. Set your TI-84 Plus CE as shown at the right.



3. Press **window** and set your window to reflect the number of trials. In the screen at the right, there were 10 trials, so 10 was entered for Xmax. If your simulation took more than 10 trials, enter that number for Xmax. The Ymax value is the maximum number of students in the class. In this case the setting is bigger so we will be able to see the graph of all data points.



4. Press **graph**. You have a graphical representation of the spread of the virus in your classroom. This common type of graph is called a scatter plot. You told the TI-84 Plus CE to produce one of these when you set up STAT PLOT for your data. (See step 2.)





Data Collection- *Data will vary.*

**Data Table**

| <b>Trial Number</b> | <b>Individuals Infected</b> | <b>Change in Individuals Infected</b> |
|---------------------|-----------------------------|---------------------------------------|
| 1                   | 1                           | 1                                     |
| 2                   | 2                           | 2                                     |
| 3                   | 3                           | 4                                     |
| 4                   | 4                           | 7                                     |
| 5                   | 5                           | 12                                    |
| 6                   | 6                           | 19                                    |
| 7                   | 7                           | 24                                    |
| 8                   |                             |                                       |
| 9                   |                             |                                       |
| 10                  |                             |                                       |
| 11                  |                             |                                       |
| 12                  |                             |                                       |
| 13                  |                             |                                       |
| 14                  |                             |                                       |
| 15                  |                             |                                       |
| 16                  |                             |                                       |
| 17                  |                             |                                       |
| 18                  |                             |                                       |
| 19                  |                             |                                       |
| 20                  |                             |                                       |



### Data Analysis

1. Looking at your graph, how would you describe the spread of the virus from start to end?

**Student answers will vary.**

Sample Response: The disease spreads slowly at the beginning, increases in the middle, and then starts to slow down again at the end.

2. Using the  $\square$  key, move along your scatter plot and estimate when the virus is spreading fastest. Between what two consecutive trials did this happen?

**Student answers will vary.**

Sample Response: Answers will vary depending on the size of your class. In the sample data, it was between the 5th and 6th trial.

3. Looking at your data table, you can see that there is a constant change of 1 in the first column. Is there a constant change in the number of infected in the second column? Complete the data table to determine the rate of change of those infected between consecutive trials. What is the label that needs to be applied to these values?

**Student answers will vary.**

Sample Response: There is not a constant change in the number of infected in the second column. Answers will vary when determining the rate of change of those infected between consecutive trials. The label that needs to be applied to these values is Number Infected per Trial.

4. The ratio of Change in Number Infected to Change in Trial Number gives a numerical representation of the rate of the spread of the virus. Does the greatest rate of change in the data table match the value you found in the previous question? Explain why or why not. What does this mean about the spread of the virus?

**Student answers will vary.**

Sample Response: The greatest range of data in the table is when the spread of the virus is the greatest, and then it slows down.

5. Why does your graph level off toward the end?

**Student answers will vary.**

Sample Response: The number of individuals has been reduced and there are fewer people to become infected.

6. Use the information you learned in this activity to describe the spread of the virus causing the common cold.

**Student answers will vary.**

Sample Response: At the beginning, there are more people without a cold. The spread of the common cold will increase rapidly and then taper off as the number of people without a cold becomes fewer and fewer.



### Going Further

1. In colder climates, what are some possible reasons that more people seem to become infected with the cold or flu virus in the winter more often? .

***Student answers will vary.***

Sample Response: More people seem to become infected with the cold or flu virus more often in the winter because they are inside more, and are in contact with more people in a confined environment.

2. In general, why are diseases that are caused by bacteria more easily treated than viral diseases?

***Student answers will vary.***

Sample Response: Bacterial diseases are commonly brought under control with antibiotics, whereas viral diseases are not.