



About the Lesson

In this activity, students will play a “Drop-Catch” game with a partner and collect data on their reaction time. Students will then use the **Data/Graphs Wizard** tool in the **SciTools App** to compare the averages of four sets of data. As a result, students will:

- graph and compare measures of reaction time with their writing and their non-writing hands, illustrating variances in data collection.

Vocabulary

- reaction time
- one variable statistics
- average
- standard deviation

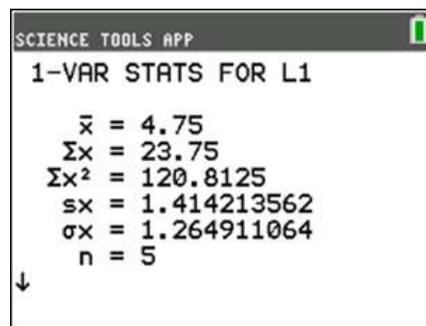
Teacher Preparation and Notes

- Students work in pairs to graph and compare measures of reaction time with their writing and their non-writing hands, illustrating variances in data collection.
- Students should know how to collect data and input data into lists.
- You may want to further explain the term standard deviation.
- Students will be using the DATA/GRAPHS WIZARD in the **Sci Tools App**

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:

- Watch for 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.

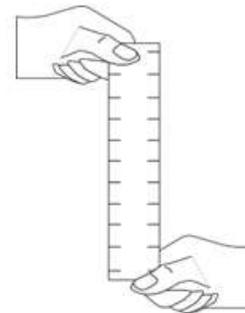
Lesson Files:

- How_Fast_Are_You_Student.pdf
- How_Fast_Are_You_Student.doc



Introduction

How fast are you? How do you compare to your classmates? Human reaction time can be measured using a ruler and the “Drop-Catch” method with a partner.

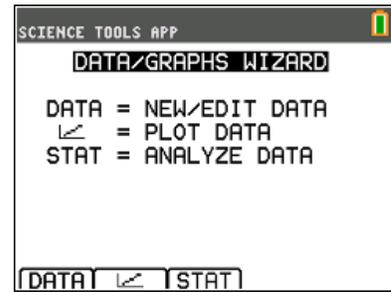


Collecting the Data

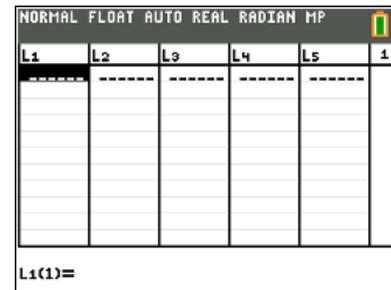
1. Have your partner brace his or her writing hand on the edge of a desk or table, with the fingers and thumb extending over the edge. Hold the ruler above your partner's hand so that the “0” line is level with the top of the thumb, as shown in the figure. The ruler should be able to slide easily between your partner's thumb and index finger.
2. Drop the ruler so that it falls straight down between your partner's thumb and index finger. Your partner should grab the ruler as quickly as possible. Read the number on the ruler just above your partner's thumb and index finger. This is the distance the ruler fell before your partner caught it. Record this number in your data table.
3. Repeat steps 1 and 2 four more times. You should have a total of five measurements in your data table.
4. Repeat steps 1 and 2 four more times. You should have a total of five measurements in your data table.
5. Have your partner switch hands so that he or she is catching the ruler with the non-writing hand. Repeat steps 1 through 3. You should now have a total of 10 measurements for your partner: 5 for the writing hand and 5 for the non-writing hand. Don't forget to record them in the data table.
6. Switch places with your partner. Repeat steps 1 through 4. You should now have a total of 20 measurements: 10 for you and 10 for your partner.
7. Use your calculator to determine the average distance the ruler fell for each of the four conditions. Turn the calculator on, and press `[apps]` to bring up the applications menu. Scroll down to **Sci Tools** and press `[enter]`. Press `[enter]` again to load the SciTools **SELECT A TOOL** menu.



8. Press **3** to select the **DATA/GRAPHS WIZARD**.



9. Press **[y=]** to select **DATA**. This will open the list editor. Three lists—**L1**, **L2**, and **L3**—will be displayed on your screen. Use the arrow keys to select list **L1**. If there are already data in **L1**, use the up arrow to highlight **L1**, and press **[clear]**, **[enter]**. Enter the drop distances for the first condition (your partner’s writing hand) into list **L1**. To enter a drop distance, type in the distance and press **[enter]**. The cursor should move down to the next line, where you can enter the next distance.



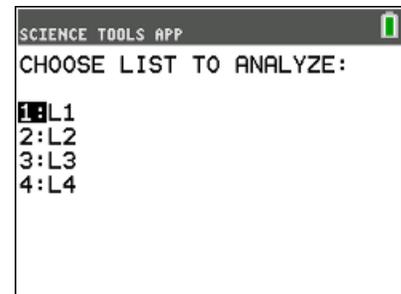
10. Use the arrow keys to move to list **L2**. Enter the drop distances for the second condition (your partner’s non-writing hand) into list **L2**.

11. Use the arrow keys to move to list **L3**. Enter the drop distances for the third condition (your writing hand) into list **L3**.

12. Use the arrow keys to move to list **L4**. Enter the drop distances for the fourth condition (your non-writing hand) into list **L4**.

13. When you have entered all of your data, press **[2nd]**, **[mode]** to return to the **DATA/GRAPHS WIZARD** menu. Press **[zoom]** to select **STAT**.

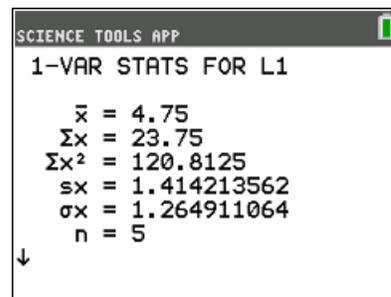
14. Press **[enter]** to choose list **L1** to analyze. This will tell the calculator to determine the average and other statistical information about the data in list **L1**.



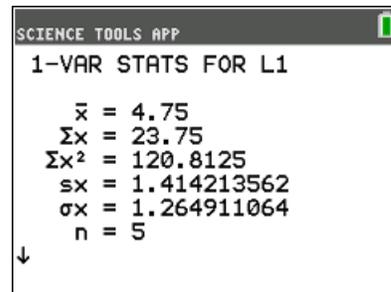


15. In your data table (last page), record the average drop distance for the first condition. The **average drop** distance is shown on the screen, to the right of $\bar{x} =$. For example, in this screen, the average drop distance is 4.75 cm.

Note: Your data will vary from the sample screenshot shown, as the data you entered for the drop times were unique to the student(s).



16. Record the standard deviation (the average amount that your measurements vary from the average) for these data in your data table. The **standard deviation** is shown on the screen shot in the second line, next to $\Sigma x =$.



17. Press $\boxed{2nd}$, \boxed{mode} to return to the **DATA/GRAPHS WIZARD** menu. Press \boxed{zoom} to select **STAT**. Use the arrow keys to select list **L2**, and press \boxed{enter} . Record the average drop distance and the standard deviation for the second condition in your data table.
18. Repeat step 16 for lists **L3** and **L4**.
19. When you have determined the average drop distance and standard deviations for all four conditions, press $\boxed{2nd}$, \boxed{mode} to return to the **DATA/GRAPHS WIZARD** menu. Press $\boxed{2nd}$, \boxed{mode} again to return to the **SELECT A TOOL** menu. Press $\boxed{y=}$ to select **EXIT** to exit the **SciTools** App.



Data Analysis

1. Which person had a faster reaction time with the writing hand, you or your partner?

Student Answers will vary.

Sample Response: For the sample data, the partner caught the ruler after less of it dropped, so the partner's reaction time was faster.

2. Was your average reaction time when you used your writing hand different from when you used your non-writing hand? Was your partner's?

Student Answers will vary.

Sample Response: Reaction times were different for the two hands for both people.

3. The standard deviation is a measure of how widely scattered your measurements are. It is often reported as a percentage called the relative standard deviation, or RSD. A large RSD indicates that your data are very variable. To calculate the RSD, divide the standard deviation by the average and multiply by 100:

$$RSD = \frac{\text{standard deviation}}{\text{average}} \times 100$$

Calculate the RSD for each of the four conditions and record in the last line of the data table below.

Which condition had the most-variable data (the highest RSD)? Which condition had the least-variable data (the lowest RSD)?

Student Answers will vary.

Sample Response:

$$RSD1 = 3.9 \div 12.4 \times 100 = 31.5$$

$$RSD2 = 39.2$$

$$RSD3 = 45.1$$

$$RSD4 = 25.0$$

The most variable of these data were for the non-writing hand of the student reporting, and the least var data were for that student's writing hand.

4. Compare your results with other pairs of students. What can you conclude from the class results?

Student Answers will vary.

Sample Response: Reaction time varies greatly. In general, the results are least variable for writing hands.



Sample Data	Your partner		You	
	Writing hand	Non-writing hand	Writing hand	Non-writing hand
Drop 1 distance	17	11	14	8
Drop 2 distance	11	13	9	24
Drop 3 distance	8	21	11	9
Drop 4 distance	16	13	11	16
Drop 5 distance	10	7	7	14
Average drop distance	12.4	13	10.4	14.2
Standard deviation	3.9	5.1	2.6	6.4
RSD	31.5	39.2	25	45.1