

Running Circles Around the Diameter

ID: 12355

Time required
45 minutes

Activity Overview

This activity provides students an opportunity to explore the relationship between the diameter of a circle and its circumference.

Topic: Measurement and Geometry

- *Apply appropriate techniques, tools, and formulas to determine measurements*
- *Solve problems involving scale factors, using ratio and proportion*

Teacher Preparation and Notes

- *TI-Navigator is not required for this activity, but an extension is given for those teachers that would like to use it.*
- *The following materials are needed: measuring tapes (customary and metric units), string (optional), variety of objects with a circular section (soda can, garbage can, top of stool, etc.), access to at least one object that it is difficult to measure either the circumference or diameter (such as a round building column or center circle on a basketball court)*
- *Students should be familiar with entering lists, setting up a Stat Plot, and determining an appropriate Window for the scatter plot.*
- *Before beginning the activity, have students clear all lists by pressing $\boxed{2nd}$ [MEM] and select **ClrAllLists**.*
- ***To download the student worksheet and TI-Navigator file, go to education.ti.com/exchange and enter "12355" in the quick search box.***

Associated Materials

- *MGAct18_Circles_worksheet_TI73.doc*
- *MGAct18_Circles_Nav_TI73.act*

Suggested Related Activities

To download the activity listed, go to education.ti.com/exchange and enter the number in the quick search box.

- *Circles All Around (TI-73 Explorer with TI-Navigator) — 6691*
- *Diameter and Circumference of a Circle (TI-84 Plus family and Cabri Jr.) — 9844*
- *3.14159265... (TI-73 Explorer) — 4663*

Problem 1 – Gathering the Data

First, have students record measurements for the circumference and diameter (in customary and metric units) for the round objects provided. Students can work in groups of 2 or 3.

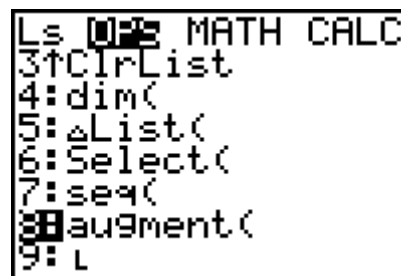
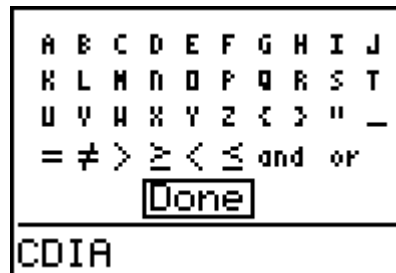
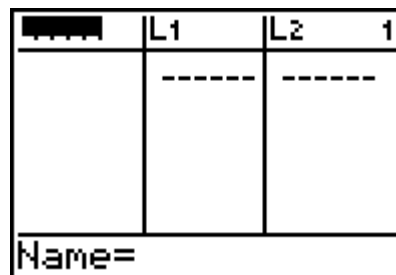
Have the students name the lists **CCIR**, **CDIA**, **MCIR**, and **MDIA**. To enter the lists, they will need to create new lists. Press **LIST** and move the cursor to the top of list **L1**. Press **2nd DEL** to insert a new, blank list. To name the list press **2nd MATH**. Spell the name of the list, move the cursor to **Done** and press **ENTER**.

Repeat for the other three lists. After the lists have been named, press **LIST** and input the data for each list. Note that unlike the screenshot, there does not need to be data in lists **L1** to **L6**.

If you wish to share the whole set of data with the class, and use the overhead calculator, students will need to enter their data in your calculator as well. Have one person from each group enter their data.

Students can also send the overhead calculator (using a link cable) each list. You can use the **augment(** command to add the new list to the end of the original list and resave the list. The **augment(** command is found

by pressing **2nd LIST** **▸** **8** and the command on the home screen should look like **augment(MDIA, MDIAT)→MDIAT**. **MDIAT** is used as the example list name for the teacher calculator because you cannot have two lists with the same name.



Problem 2 – Customary Measurements

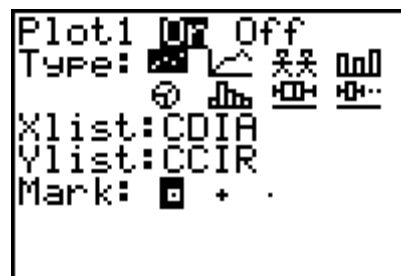
Questions 3–4

Students may need help setting up the stat plots. Press **2nd Y=** **ENTER** to access Stat Plot 1. Press **ENTER** to turn Stat Plot 1 on. To enter **CDIA**, move the cursor to Xlist and press **2nd LIST**, scroll to **CDIA** and press **ENTER**. Repeat for **CCIR**.

To set up the window, press **WINDOW** and change Xmin and Ymin and Xmax and Ymax to appropriate values. Then press **GRAPH** to display the stat plot.

Ask students a variety of questions such as:

- Why doesn't the plot make a perfectly straight line?
- If you were to apply a rule to the diameter to find the circumference, what would it be?

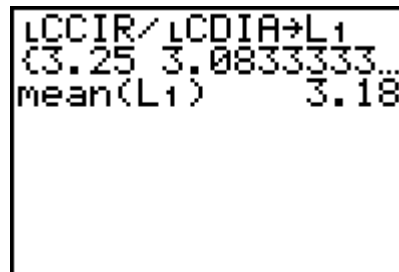


Questions 5–8

Help students realize that **CCIR** is about 3 times **CDIA**. Some students may be familiar with pi and may realize the relationship. Have students use the graph or the lists to estimate any unknown items.

After students divide **CCIR** by **CDIA**, they can store the results to L1. Then they can find the mean of L1 using the **mean(** command under the List/Math menu.

Press the following to duplicate the division command and mean calculation at the right. Press **2nd** **LIST** and select **CCIR**, press **ENTER**, then press **2nd** **LIST** again to select **CDIA**, and press **ENTER**. Then press **STO** **2nd** **LIST** **1** **ENTER** to store the list to L1. To calculate the mean, press **2nd** **LIST** **3** **2nd** **LIST** **1** **ENTER**.



Discussion Questions:

- Why are we taking the average of the results?
- Does the result look familiar?
- How does this change your rule for finding the circumference when you know the diameter?

Problem 3 – Metric Measurements

Questions 9–10

Have students either set up Stat Plot 2 with the metric data or update Stat Plot 1 with the new list names. Having both stat plots set up could allow students to move between the data for comparison.

Questions 11–13

Again, students should see that the relationship is about 3 times.

See the steps for dividing and finding the mean in Question 7 above.

Solutions – student worksheetProblem 1

1. See students' work. Answers will vary depending on the objects measured.
2. Answers will vary. Students should have at least one of their objects that has missing data.

Problem 2

3. Answers will vary. Ensure students have set up the stat plot correctly with an acceptable window.
4. Sample answers could include: as diameter increases, the circumference increases; the circumference seems to be about 3 times the diameter.
5. Multiply the diameter values by a little over 3 to get the circumference values. Some students may be familiar with pi and try substituting it here.
6. Answers will vary. Students should have been given at least one item that has a missing measurement.
7. Answers will vary. Results should be close to pi, 3.14.
8. Taking the mean finds the average of each of the division problems done between the two lists.

Problem 3

9. Answers will vary. Ensure students have set up the stat plot correctly with an acceptable window.
10. Sample answers could include: as diameter increases, the circumference increases; the circumference seems to be about 3 times the diameter. Students should see that this graph looks very similar to the graph in Exercise 3.
11. Multiply the diameter values by a little over 3 to get the circumference values. Some students may be familiar with pi and try substituting it here.
12. Answers will vary. Results should be close to pi, 3.14. The results are the same.
13. The relationship is the same.

Extension – TI-Navigator™

1. Throughout the lesson, use **Screen Capture** to check student work.
2. Load the ***MGAct18_Circles_Nav_T173.act*** activity settings file. This will set up 4 lists for students to use for inputting data. (CDIA, CCIR, MDIA, and MCIR) Once students have input the data, have them **SEND** it back.

After all of the students have turned in their data, send it back to them by clicking on Configure and Existing activity lists. By starting the activity again, students will receive the aggregated lists that were just created.

Proceed with the activity as originally given. This just uses TI-Navigator to aggregate the data instead of each student needing to input all the data.

3. Loading ***MGAct18_Circles_Nav_T173.act*** above also set up 2 stat plots in Activity Center. You can use these stat plots instead of having students create stat plots on their calculators.

Exploring the Ratio Pi

Plot 1: Customary Diameter vs. Customary Circumference

Plot 2: Metric Diameter vs. Metric Circumference

Turn on **Plot 1** by clicking on Configure Plots and checking “On” for Plot 1. Talk about the graph. Display the graph and talk about what can mathematically be done to get from diameter to circumference.

Ask questions from Questions 3 & 4 in the activity.

4. Use ***MGWeek18_Circles_Nav_T173.act*** and repeat the procedure from Step 3 above for metric measurements. Students should see the similarity between the relationship of **CIR** to **DIA** regardless of the units of measurement.



Problem 1 – Gathering the Data

In this activity, you will measure the circumference and diameter of various round objects in both metric and customary units. This data will then be used to investigate relationships.

1. Measure the circumference and diameter of the items available. Store the metric measurements of diameter and circumference to **MDIA** and **MCIR**. Store the customary measurements to **CDIA** and **CCIR**.

To name a list, press **[LIST]**, then arrow to move to the top of L1, **[2nd] [DEL]** to insert a new list, and then **[2nd] [MATH]** to input letters for the list name. Once you have input the list name, move down to **DONE** and press **[ENTER]** to return to the List screen. Press **[ENTER]** again to save the name.

Repeat for each list. Record your lists below.

MDIA: _____

MCIR: _____

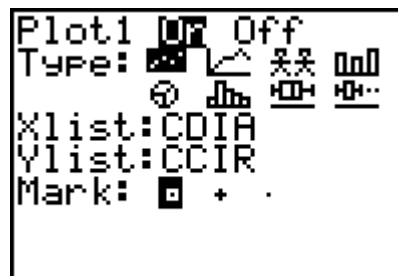
CDIA: _____

CCIR: _____

2. If there were any objects that you could not measure for the circumference and diameter, list the item and known measurements here. _____

Problem 2 – Customary Measurements

3. Set up a Stat Plot for **CDIA** vs. **CCIR**. Press **[2nd] [Y=]** **[ENTER]** and match the settings at the right. Then press **[ZOOM]** and select **ZoomStat**.



4. Describe the relationship you see in the stat plot.



Running Circles Around the Diameter

5. What could be done, mathematically, to get from a diameter measurement to a circumference measurement? Use either the graph or the lists to help.

6. Estimate the unknown measurements for any items listed in Exercise 2.

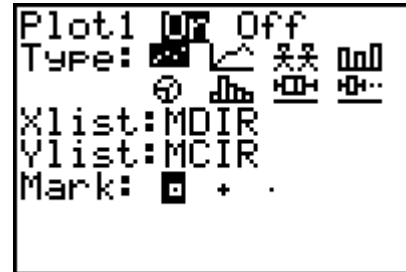
7. On the home screen, divide **CCIR** by **CDIA**. Press $\boxed{2\text{nd}} \boxed{\text{LIST}}$ to find the list names. The home screen should read **LCCIR/ LCDIA**. What is the relationship of the elements in **CDIA** to the elements in **CCIR**? _____

8. Find the mean of the data. Press $\boxed{2\text{nd}} \boxed{\text{LIST}} \boxed{\blacktriangleright} \boxed{\blacktriangleright}$ and select **mean**(. _____

Problem 3 – Metric Measurements

Now look at the relationship between the metric measurements you recorded.

9. Set up a Stat Plot for **MDIA** vs. **MCIR**. Press $\boxed{2\text{nd}} \boxed{\text{Y=}} \boxed{\text{ENTER}}$ and match the settings at the right. Then press $\boxed{\text{ZOOM}}$ and select **ZoomStat**.



10. Describe the relationship in the stat plot.

11. What could be done to the diameter measurement to get the circumference measurement? Use either the graph or the lists to help.

12. Divide **MCIR** by **MDIA**. How does this relate to your answer in Exercise 7?

13. Is the relationship between **MDIA** and **MCIR** the same or different than **CDIA** and **CCIR**? _____
