

Objectives

- Students will develop the equation for a circle centered at $(0, 0)$ from the Pythagorean Theorem.
- Students will write equations of circles given a radius and center at $(0, 0)$
- Students will solve equations of circles for y in terms of x .


Vocabulary

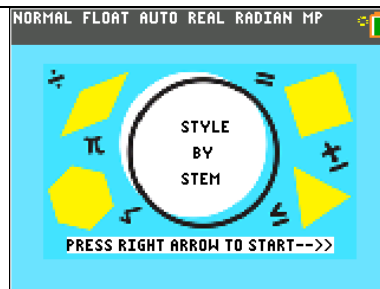
- Radius
- Center
- Pythagorean Theorem

About the Lesson

- In this activity students will explore the creation of a circle skirt
- Students will need familiarity with Pythagorean Theorem.
- Students will need to be able to solve equations involving squares and square roots.
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Activity Materials

- Compatible TI Technologies:
 -  TI-84 Plus CE *with the latest operating system.*



Tech Tips:




- This activity includes screen captures taken from the TI-84 Plus CE.
- 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.

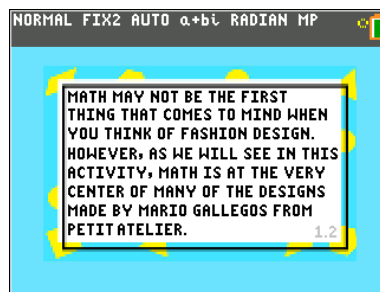
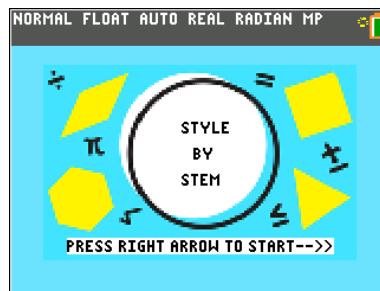
Lesson Files:


- Image0.8ca
- Image9.8ca
- Image8.8ca
- Style_By_STEM.8xp

Tech Tip: Make sure when sending the program file Style_By_STEM.8xp to your TI-84 Plus CE calculators that the program, and image0, image9, and image8 are also sent.

Integration of Algebra, Geometry and Fashion

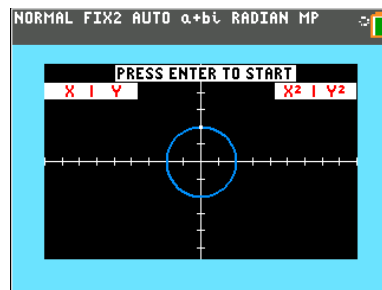
1. Run (execute) the program “STLBYSTM”.
2. Read the opening screen. Press  to proceed to the next screen.
3. Read pages 1.2 to 1.4 and make notes as needed. Use  and  to navigate between pages.



4. Navigate to page 1.5. Press  to start the simulation and use the right and left arrow keys to move the red point around the circle. Right moves clockwise and left moves counter clockwise.

As you move the point around the circle what patterns do you notice? What values are X and Y always between?

Answer: Answers may vary, but lead students to a discussion of how X and Y are always between -2 and 2. Also how X^2 and Y^2 are always positive.





5. For the original circle, move the point to nine different positions and fill out the table below.

Note that students' values may differ. Also note that the values are rounded to the nearest 100th.

X	Y	X^2	Y^2	$X^2 + Y^2$
0.00	2.00	0.00	4.00	4.00
0.39	1.96	0.15	3.85	4.00
0.77	1.85	0.59	3.41	4.00
1.11	1.66	1.23	2.77	4.00
1.41	1.41	2.00	2.00	4.00
1.66	1.11	2.77	1.33	4.00
1.85	0.77	3.41	0.59	4.00
1.96	0.39	3.85	0.15	4.00
2.00	0.00	4.00	0.00	4.00

Use your work in the table to answer the questions below.

- a. Between what two values is X^2 always between?

Answer: 0 and 4.

- b. What is the maximum value for Y^2 ?

Answer: 4

- c. What do you notice about the sum of X^2 and Y^2 ?

Answer: It has a constant value. 4. Some students should comment that this is the radius squared.

- d. Why do you suppose this happens?

Answer: Answers will vary, but students should talk about the constraint of the (x, y) pair lying on the circle.

6. Press the $\boxed{+}$ key to show a right triangle.

- a. As you move the point around now, what coordinate value corresponds to the length of the horizontal leg of the triangle? What coordinate value corresponds to the length of the vertical leg?

Answer: The X coordinate goes with the horizontal leg and the Y coordinate goes with the vertical leg.

- b. What part of the triangle represents the radius of the circle?

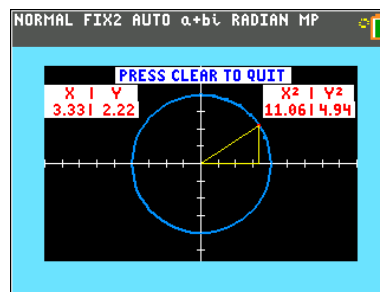
Answer: The hypotenuse.

- c. Write an equation showing how the legs are related to the hypotenuse of the triangle.

Answer: $X^2 + Y^2 = 4$ or $X^2 + Y^2 = R^2$

7. Press the \uparrow or \downarrow key or type a number 1 – 4 to change the radius. Does the pattern you noticed in part 6 hold true for any circle centered at (0, 0)? Explain

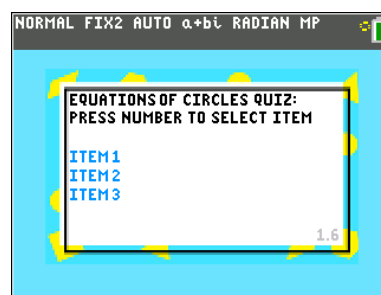
Answer: Yes. For each radius chosen, the sum of X^2 and Y^2 remains constant, equivalent to the radius squared.



8. Based on your exploration, what is the equation of a circle centered at (0, 0) with radius r ?

Answer: $X^2 + Y^2 = R^2$

9. Now that you've generalized the equation for a circle at (0, 0), we are ready to get back to designing the circle skirt with Mario. Press \square to quit the simulation and then press \rightarrow to proceed to page 1.6.



10. Use the number keys to select an item for the Equations of a Circle Quiz. Write your answers to all three questions below. Show the necessary work. (Hint: the equal sign is under the test menu on your calculator)

- a. Question 1: What is the equation of a circle with radius 5, centered at (0, 0)?

Answer: $X^2 + Y^2 = 25$

- b. Question 2: What is the radius of a circle that is defined by the equation, $X^2 + Y^2 = 144$?

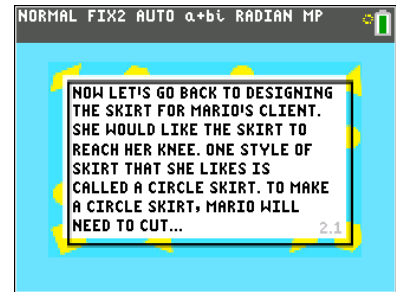
Answer: 12

- c. Question 3: What is the equation of the circle with radius $\sqrt{24}$, centered at (0, 0)?

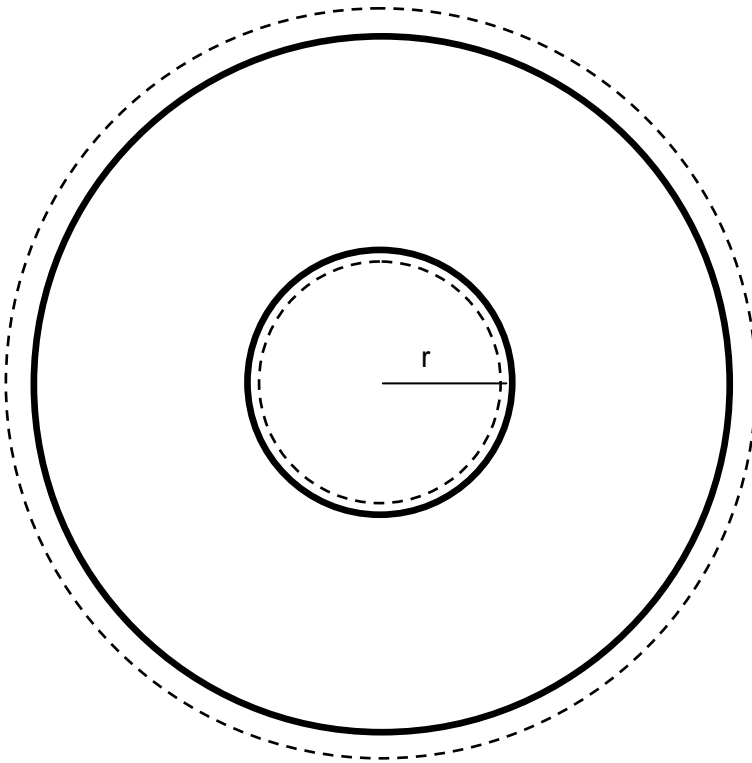
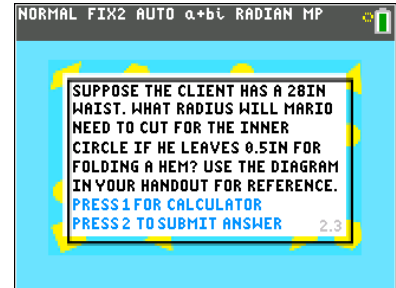
Answer: $X^2 + Y^2 = 24$



11. Press to proceed to page 2.1. Read pages 2.1 and 2.2 making notes if necessary.



12. Answer the question on page 2.3 using the diagram of the pattern below. The dashed lines are the cuts and the solid lines represent where the hems will be folded.

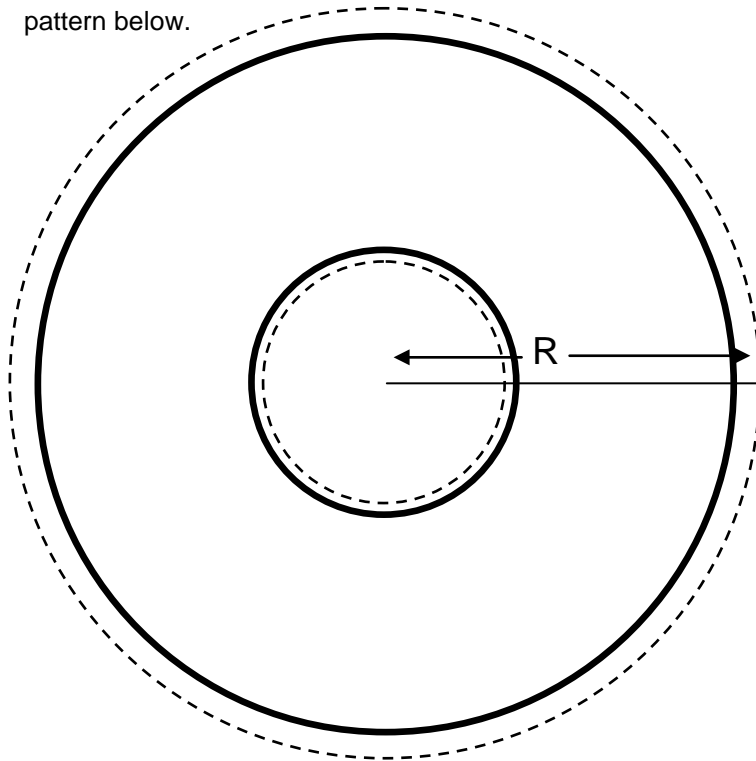


Round your answer to the nearest half inch.

Answer: $\frac{28}{2\pi} \approx 4.5$ so the cut radius should be 4 inches.



13. Answer the question on page 2.4 using the diagram of the pattern below.



Round your answer to the nearest half inch.

Answer: $19 + 4 + 1 = 24$ inches.

14. Press to and read page 2.5. Write the equations for the circles of each cut Mario will have to make. Assume that the center of the skirt is at (0, 0).

Answer: $X^2 + Y^2 = 24^2$ for the large radius and $X^2 + Y^2 = 4^2$ for the small radius

15. On page 2.6, press to start the interactive question. Make sure to solve your equations from part 14 for Y in terms of X, then enter the positive portion of the equations into the appropriate prompts.

Answer: $Y = \sqrt{576 - X^2}$ for the hem and $Y = \sqrt{16 - X^2}$ for the waist equation.

