



CINDY D. KROON

# Playing around with “Mono-pi-ly”

ACCORDING TO THE GEOMETRY STANDARD in *Principles and Standards for School Mathematics*, “In grades 6–8, all students should precisely describe, classify, and understand relationships among types of two- and three-dimensional objects” (NCTM 2000, p. 232). The Measurement Standard goes on to state, “In grades 6–8, all students should develop and use formulas to determine the circumference of circles” (NCTM 2000, p. 240). In addition, South Dakota’s Measurement Standard for Grade 7 delineates what mathematics students should know, such as “Given the formulas, find the circumference, perimeter, and area of circles” (South Dakota Department of Education 2004).

This article describes how to play “mono-pi-ly,” a mathematical game for two to five players that furthers the intent of both NCTM’s and South Dakota’s Standards. It was created as part of a Pi Day activity for use with a mixed-level geometry class. While playing, students review their understanding of mathematics vocabulary involving circles and practice area and circumference calculations. The playing time is approximately forty to fifty minutes.

The game generated a great deal of student enthusiasm and was also a good review of circle properties. Students were by turns competitive and sup-

portive as they played the game. All students were engaged, whether completing calculations as part of their own turns or checking the accuracy of answers calculated by others.

Although created for Pi Day, this game would serve as a good class activity whenever circle concepts are taught or reviewed. Making the game’s questions either easier or more difficult can vary the level of difficulty. The game board is shown in **figure 1**, and the questions are shown in **figure 2**.

These materials are needed for play:

- Game board (see **fig. 1**)
- Questions (see **fig. 2**) (Note: Question cards will be more durable and easier to use if printed on heavy paper or card stock.)
- Two dice
- Playing pieces (buttons, coins, and so on; one per player)
- Calculator
- Scratch paper

The following information is important to note before playing:

- The official rules are in **figure 3**.
- Use 3.14 as an approximation for pi in calculations.
- The student whose birthday is closest to Pi Day (3/14) plays first. After that, play passes to the left.
- When a student lands on a “?” symbol, he or she will answer a question for a bonus roll. Someone else should read the question, since the answer appears at the bottom of the card.



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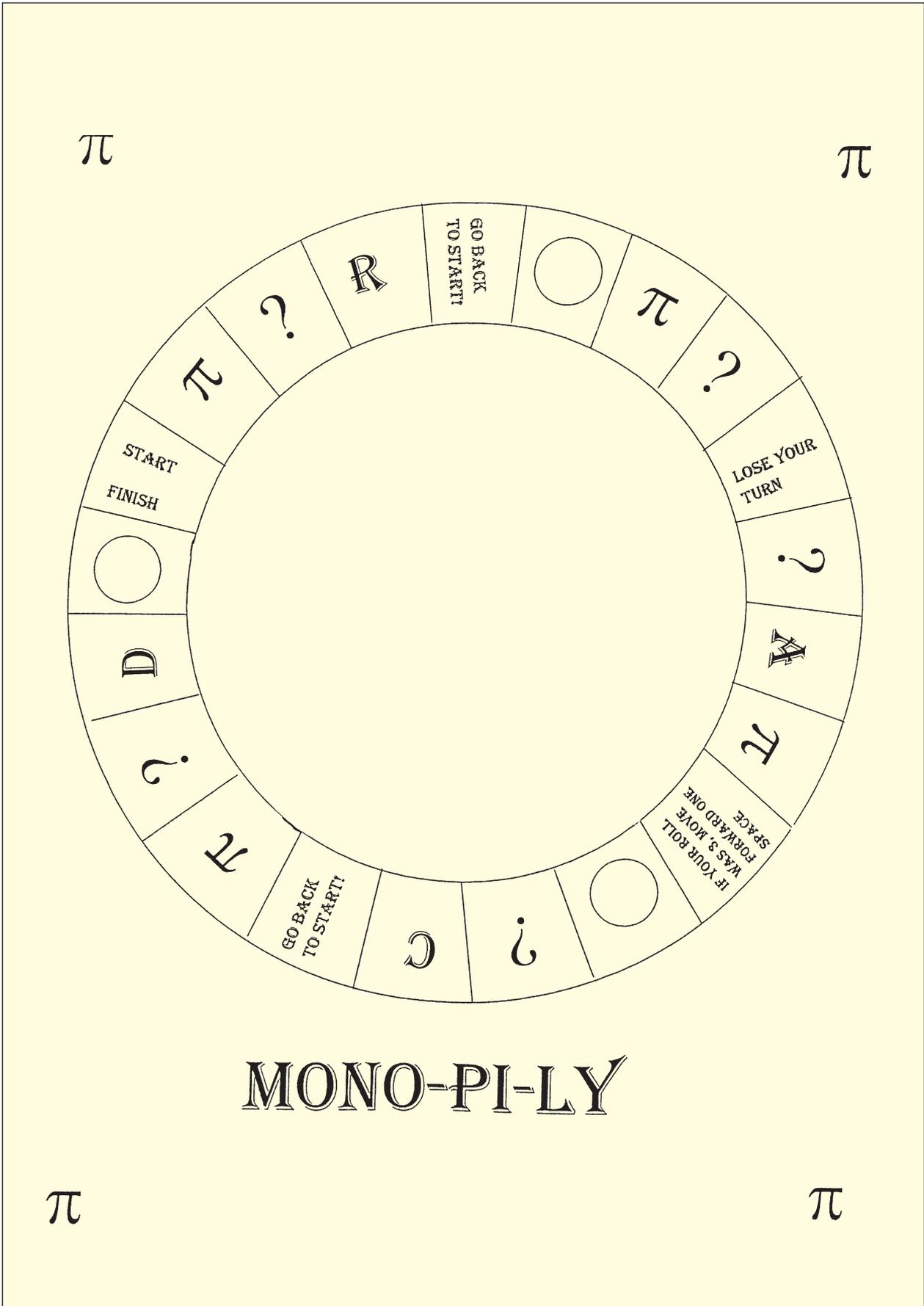


Fig. 1 The "mono-pi-ly" game board

<p><b>Find the area of a circle with a radius of 8 meters.</b> 200.96 m<sup>2</sup></p>	<p><b>The radius of a circle is 13 inches. What is its circumference?</b> 81.64 inches</p>	<p><b>The diameter of a circle is 10 cm. What is its area?</b> 78.5 cm<sup>2</sup></p>
<p><b>True or false: A circle is a polygon.</b> False</p>	<p><b>What is the formula for circumference?</b> <math>C = 2\pi r</math>, or <math>\pi d</math></p>	<p><b>The radius of a circle is 10 m. What is its area?</b> 314 m<sup>2</sup></p>
<p><b>The diameter of a circle is 8 cm. What is its circumference?</b> 25.12 cm</p>	<p><b>What is the decimal approximation for <math>\pi</math> to 5 decimal places?</b> 3.14159</p>	<p><b>What do you get when you divide the circumference of a pumpkin by its diameter?</b> Pumpkin pi!</p>
<p><b>The area of a circle is 78.5 ft.<sup>2</sup>. Find its circumference.</b> 31.4 ft.</p>	<p><b>Circle A has a diameter of 24 mm. What is its radius?</b> 12 mm</p>	<p><b>How many degrees are in a semicircle?</b> 180</p>
<p><b>The area of a circle is 100 cm<sup>2</sup>. What is the radius of the circle?</b> 5.64 cm</p>	<p><b>How many degrees are in a circle?</b> 360°</p>	<p><b>Have the person to your left make up the radius of a circle. Calculate its area.</b></p>
<p><b>What is the area of a circle with a diameter of 12 cm?</b> 113.04 cm<sup>2</sup></p>	<p><b>What does circumference divided by diameter equal?</b> <math>\pi</math></p>	<p><b>Find the area of a circle with a diameter of 26 cm.</b> 530.66 cm<sup>2</sup></p>
<p><b>Find the area of a circle with a circumference of 18.84 cm.</b> 28.26 cm<sup>2</sup></p>	<p><b>Have the person to your left make up the radius of a circle. Calculate its circumference.</b></p>	<p><b>Find the area of the 68 degree sector of a circle with a radius of 4 cm.</b> 9.49 cm<sup>2</sup></p>
<p><b>The area of a circle is 28.26 m<sup>2</sup>. What is the circumference?</b> 18.84 m</p>	<p><b>The circumference of a circle is 6.28 m. What is its diameter?</b> 2 m</p>	<p><b>The radius of a circle is 2.5 in. What is its diameter?</b> 5 in.</p>
<p><b>Define radius.</b> The distance from the center of a circle to any point on the circle.</p>	<p><b>Have the person to your left make up the diameter of a circle. Compute its area.</b></p>	<p><b>What is the area of a circle with a diameter of 12 cm?</b> 113.04 cm<sup>2</sup></p>
<p><b>What is the circumference of a circle with a radius of 9 cm?</b> 56.52 cm</p>	<p><b>What is the equation for finding the area of a circle?</b> <math>A = \pi r^2</math></p>	<p><b>What is the circumference of a circle with 24 m as the radius?</b> 150.72 m</p>

**Fig. 2** The game's questions, divided into individual cards

## How to Play

The student whose birthday is closest to Pi Day (3/14) plays first. After that, play passes to the left.

1. Roll two dice. The sum of these two numbers is the circumference of a circle. Calculate the diameter of the circle. (Use 3.14 as an approximation for pi.)

2. If you answer correctly, round to the nearest unit and move that many spaces. If the answer given is incorrect, you lose your turn.

3. Follow the directions on the space that you land on. More than one player can be on the same space at one time.

4. If you land on a space with a ?, you must answer a question card. If the answer is correct, roll one die and advance that many spaces. Your turn ends. If the answer is incorrect, stay on the ? space. Your turn is over.

5. To win the game, you must be the first player to go around the game board twice and correctly answer a question at the finish line.

**Fig. 3** The rules of “mono-pi-ly”

- Other spaces on the game board—decorated with circles and letters representing circumference, area, radius, diameter, and so on—are decoration only and do not affect game play.
- Cards should be shuffled and placed facedown at the start of the game.

As a follow-up writing assignment, students critiqued the game and made suggestions for improvement (see **fig. 4**). Each student also submitted three problems with solutions, suitable for inclusion in a subsequent question set.

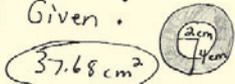
It is hoped that others will echo Pat, who wrote this comment after playing the game, “It makes it very easy to remember all the formulas involved with circles.”

## References

- National Council of Teachers of Mathematics (NCTM). *Principles and Standards for School Mathematics*. Reston, VA: NCTM, 2000.
- South Dakota Department of Education. “Measurement Standard 6–8.” Office of Curriculum, Technology, and Assessment. [doe.sd.gov/contentstandards/math/new/standards](http://doe.sd.gov/contentstandards/math/new/standards). 2004. □

Pat

Mono-Pi-Ly is a very fun game. It makes it very easy to remember all the formulas involved with circles. The game is very easy to learn and play. The game would be more fun if calculators were not allowed. Also, it is most likely that a two or three will be rolled. If the rolling scheme was different, and there was more variance in the rolls, the game would probably be more interesting.

1) Given:  What is the area of the shaded region?

2) What is the sum of the first 6 digits (1st number and 5 decimal places) of pi? 23

Eric

The educational game of Mono-pi-ly was interesting and allowed me to learn more about the calculation of the areas and diameters of circles. Before this activity, I was not totally clear on how to calculate the areas of circles with selected given information. This information allowed me to clarify my knowledge on circles.

P: Calculate the area of a circle with a diameter of 10 cm?

A: 78.5 cm<sup>2</sup>

P: What is the area of a circle with a radius of 3 m?

A: 31 m<sup>2</sup>

Alex

Mono-pi-ly is still fun. It is a very good game and has a lot to do with math. It really helps you learn to do circles in your head. If the game board were bigger it might be a little more fun.

What are the first seven digits of pi? 3.141592

What is the formula for the area of a circle?  $\pi r^2$

**Fig. 4** Student questions and opinions about the game