Open-Ended Template

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Grade Level: 3 – 5 **Content Area**: Geometry and Trigonometry

PA Standard(s) addressed:

2.9.5.H Describe the relationship between the perimeter and areas of triangles, quadrilaterals, and circles.

2.9.5.C Identify and measure circles, their diameters, and their radii.

2.5.5.D Connect, extend, and generalize problem solutions to other concepts, problems, and circumstances in mathematics.

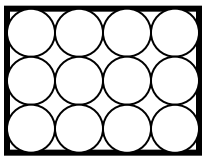
NCTM Standard(s) addressed:
Analyze characteristics and properties of two- and three- dimensional geometric shapes and develop mathematical arguments about geometric relationships.

Use visualization, spatial reasoning, and geometric modeling to solve problems.

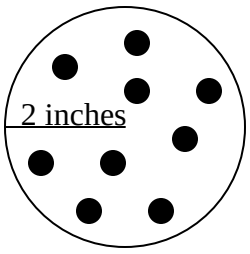
Problem Name: Cookies on a Tray

Directions: WRITE each step of your math work.
EXPLAIN **why** you did each step.
WRITE your answer in the space below each question.
LABEL your answers.

Problem: As shown below, twelve cookies are arranged side-by-side, with edges touching either another cookie or the edge of the tray.



- Each cookie has a **radius** of 2 inches.



- To find the area of a circle, multiply 3.14 times the **radius** times the **radius**.

A. What are the **dimensions** of the tray?

B. What is the **area** of the tray?

C. What is the **area** of one cookie?

D. What is the **total area** of all the cookies?

E. What is the **area** of the tray **not covered** by the cookies?

Problem Solution(s):

A. The dimensions of the cookie tray are 16 inches x 12 inches.

2 inches + 2 inches = 4 inches or 2 inches x 2 inches = 4 inches
4 inches x 4 cookies = 16 inches
4 inches x 3 cookies = 12 inches

Because the diameter of a circle is two times the radius, and the radius given is 2 inches, the diameter of each cookie is 4 inches. Because there are 4 cookies across the length of the tray, therefore, 4 inches x 4 cookies = 16 inches. Because there are 3 cookies across the width of the tray, therefore, 4 inches x 3 cookies = 12 inches.

B. The area of the tray is 192 square inches.

A = L x W A = 16 inches x 12 inches A = 192 square inches

In problem A, I discovered the dimensions of the rectangular tray. The formula for the area of a rectangle is Area = Length x Width. Therefore, I multiplied the length of 16 inches times the width of 12 inches to arrive at the area of the tray equaling 192 square inches.

C. The area of each cookie is 12.56 square inches.

3.14 x 2 inches x 2 inches = 12.56 square inches

I used the given formula for the area of a circle (3.14 x R x R). Therefore I multiplied 3.14 times 2 times 2 and arrived at the answer of 12.56 square inches.

D. The total area of all the cookies is 150.72 square inches.

12 cookies x 12.56 square inches = 150.72 square inches

I know that the area of one cookie is 12.56 square inches and that there are 12 cookies on the tray. To find the total area, I needed to multiply 12 cookies times 12.56 square inches arriving at the total area of 150.72 square inches.

E. The area of the tray not covered by the cookies is 41.28 square inches.

Area of tray = 192 square inches
\- Area of cookies = 150.72 square inches
Area of tray not covered = 41.28 square inches

The area of the tray is 192 square inches. The total area of all twelve cookies is 150.72 square inches. To find the area of the tray not covered by the cookies, you need to subtract the area of the cookies from the area of the tray.

Scoring the Rubric

Part A 5 points

1 point – Formula knowledge of radius to diameter
1 point – Compute diameter
1 point – Compute length and width
1 point – Correct label of inches
1 point – Correct explanation

Part B 4 points

1 point – Correct formula used
1 point – Correct computation
1 point – Correct label of square inches
1 point – Correct explanation

Part C 3 points

1 point – Correct application of formula
1 point – Correct label of square inches
1 **point** – Correct explanation

Part D 3 points

1 point – Correct computation
1 point – Correct label of square inches
1 point – Correct explanation

Part E 5 points

1 point – Applying the correct numbers to arrive at the answer
1 **point** – Use of proper operation
1 point – Correct computation
1 point – Correct label of square inches
1 point – Correct explanation

Specific Rubric:

5. Advanced Understanding:

- **Attains 18 to 20 points**

4. Satisfactory Understanding:

- **Attains 14 to 17 points**

3. Almost Satisfactory Understanding:

- **Attains 9 to 13 points**

2. Partial Understanding:

- **Attains 5 to 8 points**

1. Minimal Understanding:

- **Attains 1 to 4 points**

0. No Understanding:

- **Attains 0 points**