

Grade 5 Mathematics Instruction Plan

Instructor: Yasuhiro Hosomizu, University of Tsukuba Elementary School

Research Theme	How to develop lessons designed to foster students' secure academic ability through relishing the joy of thinking
----------------	---

1. The topic of the lesson: Area of the circle

2. Relationship between the research theme and the lesson

Through teaching mathematics, I would like my students to develop 'secure ability' for finding problems on their own, studying by themselves, thinking, making decisions, and executing those decisions. Moreover, I would like to help my students like mathematics as well as enjoy thinking.

I chose this theme so that I can find a way to design lessons that help my students to cultivate these feelings.

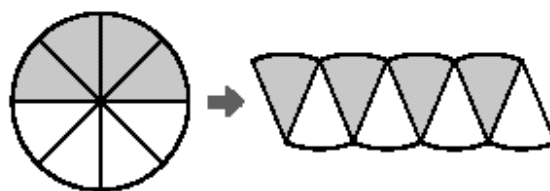
Specifically, the following are my ideas to pursue the theme.

(1) Think about multiple ways to find the area of a circle

When finding the area of a circle, I would like my students to experience multiple approaches to do so. These approaches include ways such as counting the number of the unit squares with the area of 1 cm^2 on grid paper (idea of the unit square), approximating the area of the circle by using an inscribed regular polygon and a circumscribed regular polygon (successive approximation), and segmenting a circle into basic shapes so the area can be found using the previously learned formulas for finding the area of shapes (composing and decomposing, idea of limit).

This lesson is designed for students to develop the formula for finding the area of a circle by using the approach of segmenting a circle into basic shapes. Prior to this lesson, the students already experienced the two other approaches to finding the area of a circle: approximating from the number of 1 cm^2 unit squares in the circle; and from the area of an inscribed square and a circumscribed square.

The students' textbook shows the diagram of segmenting a circle into sectors and rearranging them to make a parallelogram in order to use the formula for finding the area of parallelogram. It also shows the diagrams of the circle segmented by 16 congruent sectors, 32 congruent sectors, and 64 congruent sectors. By showing that the rearranged shape

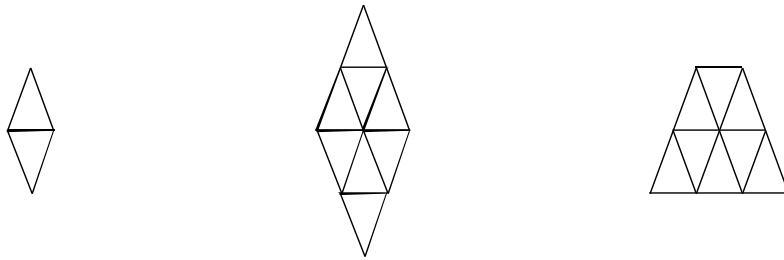


almost becomes a parallelogram, the textbook shows that the area of circle can be found by using the formula for finding the area of the parallelogram and deriving the following

formula, Area of circle = $Radius \times Radius \times \pi$.

(2) Deriving the formula for finding the area of a circle through activities such as expressing and interpreting ideas by using mathematical expressions

In this lesson, students will have the opportunity to find the area of a circle by rearranging the sectors. These sectors are made from a circle by segmenting it into 8 congruent parts, so that the previously learned formula for finding the area can be used. Then, the students will derive the formula for finding the area of the circle from them. Because manipulating a mathematical expression is very useful during this process, I will emphasize the activities of expressing and interpreting mathematical expressions.



$$\frac{1}{8} \text{ of circumference} \times (\text{radius} \times 2) \div 2 \times 4$$

$$\left(\frac{1}{8} \text{ of circumference} + \frac{3}{8} \text{ of circumference} \right) \times (\text{radius} \times 2) \div 2$$

$$\frac{1}{4} \text{ of circumference} \times (\text{radius} \times 4) \div 2$$

3. Unit plan (Circle, total 10 lesson periods)

1st section Circle and regular polygons (2 lesson periods)

2nd section Length of circumference (3 lesson periods)

3rd section Area of circle (3 lesson periods) today's lesson 2/3

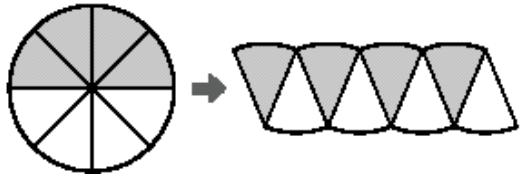
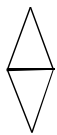
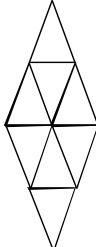
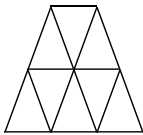
4th section Summary and application (2 lesson periods)

4. Goal of the lesson

1) Goal

Students will be able to come up with ways to find the area of a circle by rearranging the shape of the circle so that they can use previously learned formulas, and be able to derive the formula for finding the area of a circle.

2) Process of the lesson

Learning activities	Points of Consideration
<p>1. Present the problem</p> <div style="border: 1px solid black; padding: 5px; margin-bottom: 10px;"> <p>Come up with ways to find the area of the circle by using the sectors that are made by segmenting the circle into eight equal parts.</p> </div> <div style="border: 1px solid black; padding: 10px; margin-bottom: 10px;">  <p>The area of parallelogram = base \times height = a half of the circumference \times radius</p> </div> <p>2. Think about different ways to rearrange the shape so that other formulas for finding the areas of basic shapes can be used</p> <div style="border: 1px solid black; padding: 5px;"> <p>Rearrange the shape and find different formulas to find the area of the circle.</p> </div>	<ul style="list-style-type: none"> ○ Make sure that the students are aware that the area of a circle can be found by rearranging the shapes using the eight sectors. ○ First, by find the way to rearrange the shape into parallelogram. Next, find the area of the circle through a whole class discussion. Then derive the formula for finding the area of a circle, $Radius \times Radius \times \pi$ from them. ○ Set up the situation for thinking of other methods that use other previously learned formulas for finding the areas of basic shapes. ○ Once each student comes up with a way, facilitate opportunities to exchange their ideas. ○ Using colored chalk to emphasize which sides need to find the area ○ Derive the formula for finding the area of a circle by manipulating mathematical expressions.
<div style="border: 1px solid black; padding: 10px;"> <p>$1/8$ of circumference \times (radius $\times 2$) $\div 2 \times 4$ $(1/8$ of circanference + $3/8$ of circumference) \times (radius $\times 2$) $\div 2$</p> <div style="display: flex; justify-content: space-around; align-items: center; text-align: center;">    </div> <p>$1/4$ of circumference \times (radius $\times 4$) $\div 2$</p> </div>	
<p>3. Derive the formula for finding the area of a circle</p> <p style="text-align: center;">Area of a circle = $Radius \times Radius \times \pi$</p>	<p>Summarize that the area of a circle is π of the area of a square that has sides with the same length as the circle.</p>