Title: Discovering Perimeter And Area

Brief Overview:

The focus of this unit is helping students develop a conceptual understanding of the formulas used to calculate perimeter and area. Before beginning, students should have prior knowledge of the characteristics and properties of two-dimensional geometric shapes. In this unit, students will use a class-generated definition for perimeter and area and data derived from hands on activities to "discover" the formulas for perimeter and area.

NCTM Content Standard/National Science Education Standard:

- Understand measurable attributes of objects and the units, systems, and processes of measurement.
- Explore what happens to measurements of a two-dimensional shape such as perimeter and area when the shape is changed in some way.
- Apply appropriate techniques, tools, and formulas to determine measurements.
- Develop, understand and use formulas to find the area of a rectangle.

Grade/Level:

5^{th}

Duration/Length:

3-4 days; 60 minutes per day

Student Outcomes:

Students will:

- Develop a definition for perimeter.
- Develop a definition for area.
- Explore what happens to the perimeter of a two-dimensional figure when its area remains constant, but its dimensions are changed.
- Construct the formulas for perimeter and area.
- Calculate perimeter and area when given specific dimensions.

Materials and Resources:

Lesson 1

- Markers
- Pencils
- Multilink blocks/Snap cubes

- Overhead projector and screen
- Overhead markers
- Chart paper
- Student Resource 6 grid paper
- Crayons or coloring pencils
- Student Resource 1 KWL chart
- Teacher Resource 1 Twelve Figure Answer Key

Lesson 2

- 4x6 index cards
- Pencils
- Overhead projector and screen
- Overhead markers
- Transparency of grid paper
- Student Resource 6 grid paper
- Multilink blocks/Snap cubes
- Student Resource 2 Data Table
- Teacher Resource 2 Data Table Answer Key
- Whole class KWL Chart from Lesson 1

Lesson 3

- Crayons or coloring pencils
- Pencils
- Tape
- Student Resource 3 Lesson 3 "Pre-assessment"
- Student Resource 4 "Design a Bedroom"
- Student Resource 5 "Summative Assessment"
- Student Resource 6 grid paper
- Teacher Resource 3 Pre-assessment Answer Key
- Teacher Resource 5 Summative Assessment Answer Key

Development/Procedures:

Lesson 1

Pre-assessment

- Tell the students that they will be preparing a KWL chart about area and perimeter.
- Divide students into groups of 4. Within each group assign a Recorder, Reporter, Materials Manager, and a Task Manager.
- Materials Manager will get a marker and Student Resource 1.
- Allow the students 5 minutes to complete the K and W columns of Student Resource 1. (At this time, you may need to briefly review KWL charts with your students.)

- Remind the class that ALL ideas are written down.)
- Circulate taking particular note of any misconceptions that need to be corrected.

Launch

- After 5 minutes, students should put down all materials and prepare for a group discussion. Allow 10 minutes.
- Each group will take turns sharing what they recorded in the K section of their chart. Record and compile groups' ideas on a large class chart.
- Repeat the same procedure for the W section of their chart.
- The whole purpose of the KWL chart is to come to a class consensus of a definition for area and perimeter. (*Perimeter is the distance around any closed geometric figure; Area is the number of square units needed to cover the surface enclosed by a geometric figure)*
- Teacher may need to guide students in developing these definitions. No reference should be made to the formulas for these measurements at this time.

Teacher Facilitation

- Tell students that today they will be constructing 12 different figures using 5 multilink blocks.
- Using the overhead, construct a rectangle using your 5 multi-link blocks.
- Discuss the rules for building the regular and irregular figures. Students are watching at this point in the lesson as you model. (*Background information: A figure/polygon is regular when all sides and angles are congruent. An irregular figure/polygon is any figure with angles and/or sides that are not congruent)*
  Rules: Each cube must touch the complete edge of another cube;
  - You must use all 5 cubes
  - You can't repeat any figure- it is the same if the figure can be slid, flipped, or turned
  - There are 12 different figures.
- *Ask: Based on our KWL chart, can anyone tell me how we can determine the perimeter or area of this shape using the definitions we developed earlier?* (*perimeter= distance around; area= surface covered)* (For perimeter, we can count the number of spaces around the figure. For area, we can count the units inside/enclosed.)
- Using an overhead and a transparency of a grid, demonstrate how to transfer the constructed figure on grid paper. One multilink block equals one block on the grid paper. Shade in your transferred figure.
- Model finding the perimeter using tick marks. (P=12)
- Model finding the area using X's. (A=5)
- Then *ask: How did you know this?*

- Model noting area and perimeter for each figure using P=perimeter and A= area. (Remind students to use tick marks for perimeter and X's for area.)
- Repeat this process modeling/recording with an irregular shape.

Student Application

- Divide students into pairs. Distribute 5 multi-link blocks/snap cubes/centimeter cubes to each student.
- Students will construct 10 different irregular shapes following the procedure modeled on the overhead.
- You will want to remind students the figures must be different and shouldn't be the same if they are slid, flipped, or turned.
- Allow 15 minutes for exploration and recording their data.
- After 15 minutes, STOP, whether finished or not.
- Have the students put down their cubes and pencils.

Embedded Assessment

- *Say: Let's look at your shapes on your grid paper.* Have one group come to the overhead and share an irregular shape they found. *Say: if you and your partner have this shape, circle it. If not, draw and shade in the shape. Ask: What is the area and perimeter of this shape?* (The area for ALL shapes will be 5 because we used 5 blocks for each figure. The perimeter for all figures except the "p" figure will be 12. The perimeter for the "p" figure is 10. Other groups can agree/disagree by putting their thumbs up or down. The group that shared the shape and gave their answers will now justify their answers using the overhead. They will use tick marks to count the perimeter and X's to shade in the area.
  Continue the above process, guiding the students to find all 12 figures. (Remember, we found 2 as a class.)
  Refer to Teacher Resource 1 (Twelve Figure Answer Key).

Reteaching

- Through teacher observation, identify the students who need further assistance.
- In small groups, further develop area and perimeter by drawing several figures on grid paper.
- Model determining perimeter using tick marks and area using X's.

Extension

- In student response journals, students will explain in writing why 1 of the 12 figures had P=10 and all others had a P=12. (The more compact the figure, the smaller the perimeter.)
- Explain in writing "Why do all figures have the same area? (All areas have the same area because all are built with 5 cubes.)

Lesson 2

Pre-assessment

- Distribute 4x6 index cards.
  Using the overhead and grid paper, show students a rectangle with dimensions of 4x2.
  Ask students, *What is the perimeter for this rectangle?* (P=12) Students will record their answer on their index card. (Answers will be shared with the teacher and class, so their writing should be large enough for everyone to see.)
- Students will all respond by holding up their index card. Choose a few students to justify their responses.
- Repeat the above procedure for area.

Launch

- Tell students today they will explore what happens to the perimeter of a two- dimensional figure when its area remains constant, but its dimensions are changed.
- Tell them that they will use this information to develop a method for calculating perimeter and area mathematically.
- Ask: *Why do you think that it is important to know how to calculate perimeter and area*? Allow several student responses. (So I can put a new rug in my bedroom; to be able to fit all my new posters up on the wall; etc…)
- Guide students to see that it is important by giving some real world applications. (You would need to calculate the area of the walls in your room to determine how much paint to buy.)
- Ask: *What would happen if we wanted to find the perimeter or area of the parking lot at the local mall? Would we be able to use grid paper or multilink blocks?* (No, because the area is too large).
- Explain that this is why it's important to have alternate ways to determine perimeter and area.

Teacher Facilitation

- Students will explore all the ways to make a rectangle with an area of 16 square units.
- Distribute Student Resource 2 (Data Table) and grid paper.

- Using the grid paper transparency, show students a 4x4 square/rectangle. (Remind students that a square is just a special type of rectangle)
- Ask: *"What is the perimeter of this rectangle?* (P=16 units) Remind students to draw their rectangles and prove their answers on their grid paper using tick marks. Tell students to record the dimensions and the perimeter on their worksheet.
- Model student answers on the overhead using tick marks.
- Ask: *How can you change the dimensions of this rectangle while keeping an area of 16 square units?* (two other ways: 2x8, 1x16)
- For each different rectangle, ask, *"What is the perimeter of this rectangle?" Prove with tick marks and record dimensions and perimeter on their worksheet.* (P=34 for 1x16; P=20 for the 2x8)
- Model each rectangle and perimeter on the overhead.

Student Application

- Tell students that now they will repeat this procedure for rectangles with areas of 18 and 24 square units.
- Students will work with a partner and use grid paper or multilink blocks to model each rectangle. They will to record the dimensions and perimeters of each figure on Student Resource 2.
- Give students 10 minutes to complete the worksheet.
- Circulate to observe while students complete their worksheet.
- After 10 minutes, pairs will share their findings with the class. Verify that all partners have the correct data. (Refer to Teacher Resource 2 Data Table Answer Key).
- Tell student pairs to look for patterns in their data. Ask: *"Do you see any connections between the dimensions and the area for each figure?"* To help students see the connection between the dimensions and area, have them cover the perimeter column of their worksheet. (The correct response is we can always multiply dimension 1 by dimension 2, and the result will be the area. If they don't see this connection, guide the students to look for patterns in their data.) Introduce the formula, A = l X w.
- Now Ask: "*Do you see any connections between the dimensions and perimeter?"* To help students see the connection, have students cover the area column of their worksheet. (The correct response is if I add 2 of dimension 1 and 2 of dimension 2, the result will be the perimeter.)
- Guide students to see that since perimeter is the distance around a figure and our figure has 4 sides, the "formula" should have 4 numbers. This 4-sided figure has 2 pair of parallel sides with each pair having a different dimension (The exception is the square, which is a special type of rectangle). P = s + s + s + s or P = 2 (s) + 2 (s)
- Ask: "*How can we get 4 numbers from our dimensions so that we can calculate perimeter?"* (If students can't see that they need to double each dimension, you can use the overhead and label a rectangle showing the pairs of parallel sides as dimension 1 and dimension 2.

Embedded Assessment

- The class will complete the "L" column of the whole class KWL chart started in Lesson 1.
- Students will complete a journal entry answering the following: Explain how we developed the formulas for perimeter and area.
- Circulate and observe as students complete the journal entries. Based on observation, separate those who need reteaching.

Reteaching

- While the teacher observes, students will use their worksheet (Student Resource 2) and a new sheet of grid paper to draw the figure that they will get using just the data on the worksheet. This should help students discover that this will give them only ½ of the rectangle. Ask: *"What do we need to do to complete our rectangle?"* (We need to draw the other half.) Have students draw several more rectangles from their sheet.

Extension

- Introduce the following scenario to the class: *"You received a puppy for your birthday. Your parents said you could have 30 square feet in the backyard to create an outside play area for the puppy. You will need to pay for the fencing of this play area from your allowance."* Ask: "*What dimensions will you use for the play area if the cost of the fencing is your primary concern?"* Explain your answer. (6x5 enclosure. I chose the 6x5 because it has the smallest perimeter and it will cost me less.)
- What dimension will you use if cost isn't your primary concern? Explain your thinking. (Answers will vary. I would choose the 15x2 because my puppy likes to run. This enclosure will allow him to run and have a little extra width than if I chose the 30x1.)

Lesson 3

Pre-assessment

- Distribute Student Resource 3 (Pre-assessment). Students will work in pairs to calculate perimeter and area for each figure using the formulas. (If students are having difficulty remembering the formulas, they can transfer the figures onto grid paper.
- Circulate and observe as students complete this worksheet.
- Refer to Teacher Resource 3 (Pre-assessment Answer Key).

Launch

- Have a few students share their answers and explain how they calculated the perimeter and area.
- Review the formulas for perimeter and area. Write formulas on the board.
- Tell students that today they will be designing a bedroom. Ask: "*Who would like to share with the class some of the items in your bedroom?" (*TV, desk, bed, lamps, etc)
- After a brief discussion, tell the students that they will be designing a virtual bedroom.

Teacher Facilitation

- Distribute Student Resource 4 (Designing a Bedroom).
- Discuss the directions and answer any questions that they may have before they begin.

Student Application

- Students will work individually to calculate the perimeter and area of the given items.
- Students will be allowed to add no more than 2 items to personalize their bedroom. They must provide the dimensions and calculate the perimeter and area of each item added. (All items must fit in the 18x16 cm rectangle)
- Students will "decorate" their rooms by adding color, patterns, designs, etc.

Embedded Assessment

- Circulate and monitor students' progress.
- After all students have completed their bedroom, number their pictures and post their creations around the room.
- Divide students into pairs. Students will be assigned two numbers that will correspond to pictures in the gallery.
- With their journal and ruler in hand, students will check the calculations and measurements on the two pictures they have been assigned as they walk through the "gallery" of bedrooms.
- After the walk is complete, the whole class will discuss their findings and any discrepancies in measurements and calculations. .
- If time permits, students can choose a "favorite" bedroom.

Reteaching

- Based on discrepancies found in the gallery walk, assign a peer tutor to assist students to correct their errors.

Extension

- Have students calculate dimension 2 of a rectangle given the perimeter and dimension 1 (Ex: P=30, dimension 1=12, what is dimension 2?) (dimension 2=3)

- Have students calculate dimension 2 of a rectangle given the area and dimension 1. (Ex: A=30, dimension 1=6, what is dimension 2?) (dimension 2= 5)

Summative Assessment:

Students will demonstrate an understanding of perimeter and area and the formulas used to calculate these measurements by completing Student Resource 5 (Summative Assessment).

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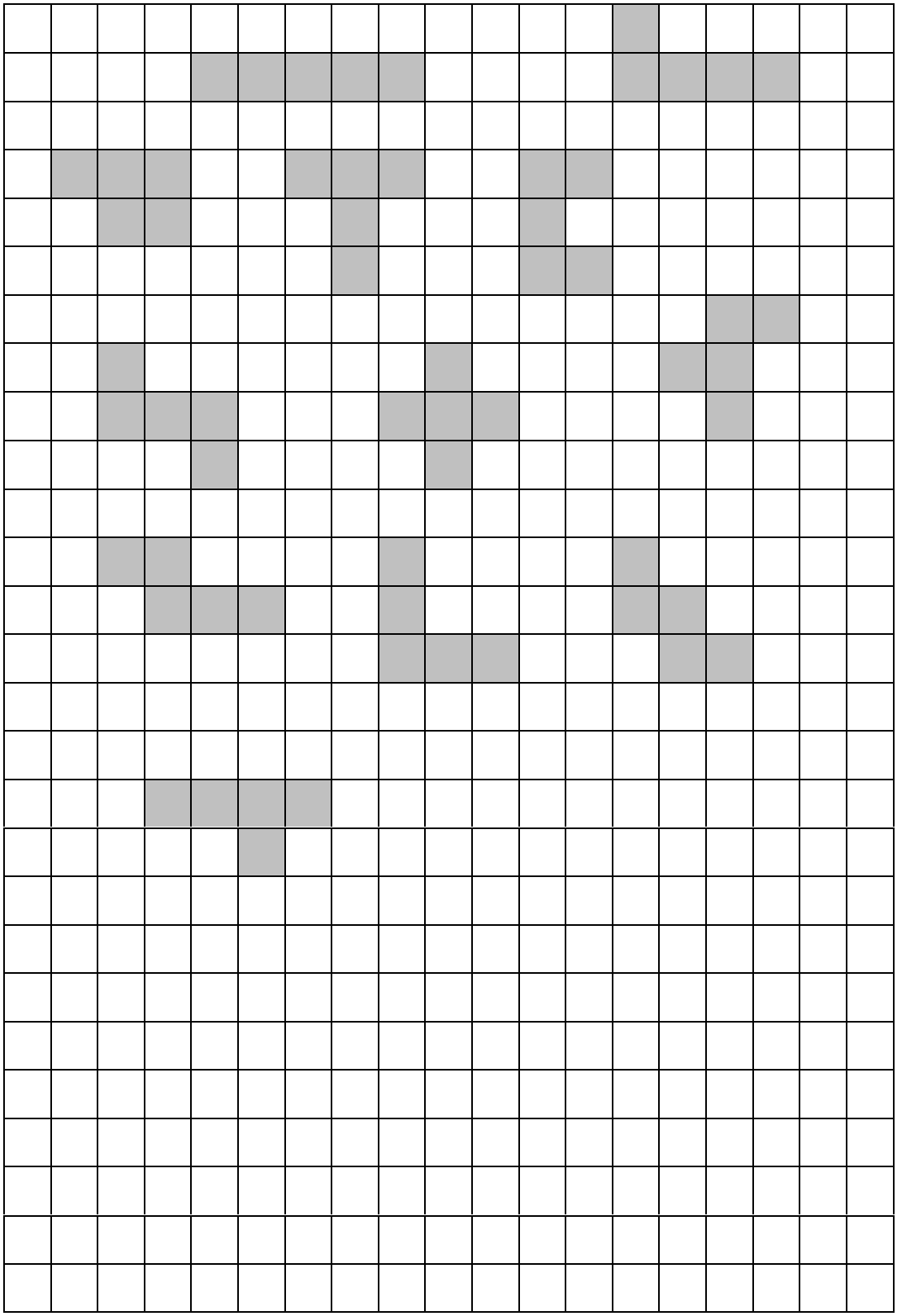
Appendix A: Teacher Resources Teacher Resource 1



Area (sq.)	Dimension 1	Dimension 2	Perimeter
16	1	16	34
16	2	8	20
16	4	4	16
18	1	18	38
18	2	9	22
18	3	6	18
24	1	24	50
24	2	12	28
24	3	8	22
24	4	6	20

Lesson 03 Pre-assessment

Find the AREA and PERIMETER of the following figures:

1. Dimension 1- 6 cm Dimension 2- 19 cm

P= 50 cm A= 114 cm sq.

2. Dimension 1- 7 inches Dimension 2- 25 inches

P= 64 inches A= 175 inches sq.

3. Dimension 1- 15 mm Dimension 2- 7 mm

P= 44 mm A= 105 mm sq

4. Dimension 1- 9 cm Dimension 2- 14 cm

P= 46 cm A= 126 cm sq

5. Dimension 1- 4 inches Dimension 2- 17 inches

P= 42 inches A= 68 inches sq.

Answer Key for Summative Assessment

1. What is the definition for perimeter? What is the formula for calculating perimeter?
   Perimeter is the distance around any closed geometric figure.
   P= dimension 1 + dimension 2 + dimension 3 + dimension 4

2. What is the definition for area? What is the formula for calculating area?
   Area is the number of square units needed to cover the surface enclosed by a geometric figure

Find the Perimeter of the following rectangles:

3. Dimension 1 = 5 inches and Dimension 2 = 3 inches

P = 16 inches

4. Dimension 1 = 13 cm and Dimension 2 = 11 cm

P = 48 cm .

Find the Area of the following rectangles:

5. Dimension 1 = 9cm and Dimension 2 = 10 cm

A = 90 cm sq.

6. Dimension 1 = 14 ft and Dimension 2 = 6ft

A = 84 ft sq.

7. Give the dimensions of two different rectangles with the same area.

Possible answer:

Rectangle 1	Dimension 1 = 2	Dimension 2 = 12
Rectangle 2	Dimension 1 = 4	Dimension 2 = 6

Appendix B: Student Resources Student Resource 1

Know	**W**ant to know	**L**earned

Student Resource 2

AREA	Dimension 1	Dimension 2	Perimeter
16			
16			
18			
18			
18			
24			
24			
24			
24			

Student Resource 3

Lesson 03 Pre-assessment

Find the AREA and PERIMETER of the following figures:

1. Dimension 1- 6 cm Dimension 2- 19 cm

P=_____ A=_____

2. Dimension 1- 7 inches Dimension 2- 25 inches

P=_____ A= _____

3. Dimension 1- 15 mm Dimension 2- 7 mm

P=_____ A=_____

4. Dimension 1- 9 cm Dimension 2- 14 cm

P= _____ A=_____

5. Dimension 1- 4 inches Dimension 2- 17 inches

P= _____ A= _____

Student Resource 4

Designing a Bedroom

You have been chosen by a design firm to create a "Virtual Bedroom". Your task is to use the following specifications to create this room. The room must contain a bed, desk, dresser, and a TV stand. All of these objects must be placed in the bedroom. You need to calculate the area and perimeter of each object in your bedroom. Record these measurements on this page.

- The measurement of the entire room (rectangle) is 18x16 centimeters.
- The measurement of the dresser is 8x4 centimeters. A= _____ P=_____
- The measurement of the bed is 10x5 centimeters. A= _____ P= _____
- The measurement of the TV stand is 3x4 centimeters. A= _____ P=_____
- The measurement of the desk is 5x4 centimeters. A= _____ P=_____
- Item 1 A=_____ P=_____ Item 2 A=_____ P=_____

You may add up to 2 items to personalize your bedroom. After all calculations are complete, you may decorate your room by adding color, patterns, or designs.

Summative Assessment

1. What is the definition for perimeter? What is the formula for calculating perimeter?

2. What is the definition for area? What is the formula for calculating area?

Find the Perimeter of the following rectangles:

3. Dimension 1 = 5 inches and Dimension 2 = 3 inches

P = _____

4. Dimension 1 = 13 cm and Dimension 2 = 11 cm

P = _____

Find the Area of the following rectangles:

5. Dimension 1 = 9cm and Dimension 2 = 10 cm

A = _____

6. Dimension 1 = 14 ft and Dimension 2 = 6ft

A = _____

7. Give the dimensions of two different rectangles with the same area.

Possible answer:

Rectangle 1 Dimension 1 = Dimension 2 =
Rectangle 2 Dimension 1 = Dimension 2 =

Student Resource 6