

The learner will understand and use perimeter and area.

2

2.01 Develop strategies to determine the area of rectangles and the perimeter of plane figures.

Notes and textbook references

A. Use the Block Boy and Block Girl sheets (Blackline Masters II - 10 and II - 11) for practice in measuring. Students can figure perimeters of pants, volume of heads, area of shirt, etc.

B. Make a square foot (or a square yard) by using square-inch paper glued in sheets on a poster or a bulletin board.

C. Define a unit of measure such as a specific pattern block. Use pattern blocks to find the area of a design or picture. Students can record the number of triangles, hexagons, parallelograms, or trapezoids needed to cover a design. Discuss why there are different answers for each unit of measure.

D. Using the square from pattern blocks, color tiles, or 1 inch paper squares, have students cover index cards to find the area. What is the area of your math book cover? Use this strategy to find the area of different items.

E. Students bring in boxes (cereal boxes, cracker boxes, etc.). Have students discuss the number of faces they think are the same size on their boxes. Students measure and record the dimensions of each side. Then they use the measurements to draw the faces on different colored pieces of paper. Cut pieces and glue to the box.

F. Students will use the tools (meter ribbon and yard ribbon) while participating in a measurement Olympics competition where the goal is to estimate as close as possible. The AIMS (Activities to Integrate Math & Science) Project includes a MINI-METRIC OLYMPICS which is the basis for this task. Lead a brief discussion about the events in the summer Olympics. Hopefully, students will be familiar with events such as the shot put, javelin, and discus throw. Ask everyone to estimate how far they might be able to shot put a cotton ball and record the estimates on a chart. This might be an opportune time to discuss the appropriate unit of measurement for such a distance. Then, give everyone a cotton ball, have them shot put the cotton ball, and have their partner measure the distance. Record the actual distances beside the estimates on the chart. Each student's "score" for this event is the difference between the estimate and the actual distance of the shot put.

G. The class can organize and implement their own mini Olympics. Lead a brainstorming session to create a list of possible events. Some of the events on the list might be held outside while others will be inside. Emphasize that the events must include estimates and actual distances, and the focus is on making the closest estimate - not the longest actual measurement. Divide students into pairs or small groups. Each group selects an event to plan. This planning should include a list of needed materials and clear rules for judging the event. Each group might also be responsible for designing a "medal" for the event. Students will be using their own handmade tools for measuring during this Olympic event. After holding the measurement Olympics for their own class, students might repeat this for other classes.

H. As students are creating events for the Olympics, encourage them to include events that require estimating and "measuring" areas with concrete objects. These events might include some of the following: How many lima beans will cover an outline of your "mitten hand" or stocking foot. Using these same outlines of your own mitten hand and foot, how many of the square blocks from the pattern block set will cover each area? How many triangles? How many trapezoids? Draw a rectangle and estimate the number of paper square units it will take to cover the rectangle. What about an outline of a student's entire body? How many index cards would cover this area? Be sure to keep this at an exploration level.

I. Extend the mini Olympics idea with a focus on weight events. Use the same procedure by beginning with brainstorming a list of events. Then have small groups of students plan and implement the Olympics. Some ideas for events include:

- object snatch (estimating the weight of a handful of various kinds of objects like a handful of marbles or popcorn),
- barges (estimate the maximum weight that various floating objects will hold, or the “sinking weight” ... some of these might be commercial toy boats, and some might be boats created by students from clay, aluminum foil, etc.),
- dry sponge and wet sponge (estimate the weight of sponges before and after they are soaked in water),
- magnetic lift (estimate the weight of the paper clips that a small magnet will lift when “dunked” into a pile of paper clips), and,
- your pick (pick an object to estimate), etc.

J. What is the perimeter of North Carolina? Estimate. In groups have students use a North Carolina road map and string to measure the perimeter of the state. Use a calculator, and the scale of 1” equals 13 miles. Compare the results from each group and as a class agree upon an approximate number of miles for North Carolina’s perimeter. Save the data for other activities.



K. Give each student 20 squares. Have them arrange the squares in the shape of a rectangle. Record on chalkboard or chart all the dimensions exhibited. Discuss the relationship of the dimensions to the perimeter and area. Do this activity with other numbers of squares.

L = length, W = width, P = perimeter, A = area.

L	W	P	A
1	20	42 units	20 sq. units
2	10	24 units	20 sq. units
4	5	18 units	20 sq. units

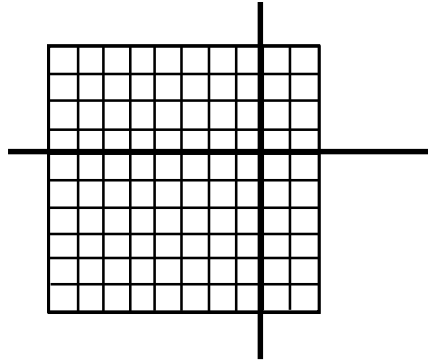
Notes and textbook references

An array is a rectangular arrangement of objects in rows and columns.

L. Using Arrays

Model with students:

Divide a 100 grid into 4 sections by drawing one horizontal line and one vertical line. The lines will divide the 100 grid into 4 arrays.



With students, elicit the dimensions of each array. Record. Through questioning, lead students to see that multiplying the dimensions of an array gives the number of square units in the array.

$$8 \times 4 = 32 \quad 2 \times 4 = 8 \quad 8 \times 6 = 48 \quad 2 \times 6 = 12$$

Find the sum of the dimensions of the four arrays.

$$(8 \times 4) + (2 \times 4) + (8 \times 6) + (2 \times 6) = \\ 32 + 8 + 48 + 12 = 100 \text{ square units}$$

Write the dimensions of the two arrays located below the horizontal line.

$$8 \times 6 = 48 \quad 2 \times 6 = 12$$

How might you use the small arrays to find the large array above the horizontal line? Write these equations on the board or overhead.

$$(8 \times 4) + (2 \times 4) = 10 \times 4 \\ 32 + 8 = 40$$

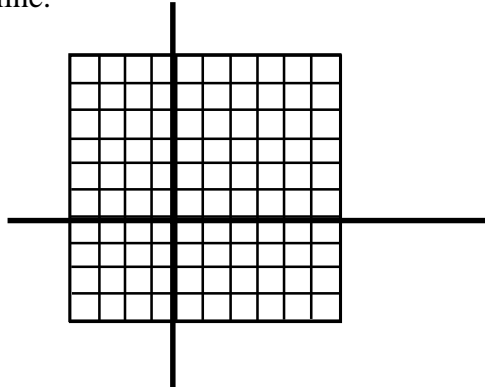
Ask students to find the 10 x 6 array. Use overhead or other methods to be sure students can locate arrays.

The dimensions of the array above the horizontal line are 4 x 10. What do the numbers stand for? (4 rows with 10 squares in each row)

What are the dimensions of the larger arrays below the horizontal line?
Ask students to complete this equation.
 $6 \times 10 = (\underline{\quad} \times \underline{\quad}) + (\underline{\quad} \times \underline{\quad})$

Continue by writing the dimensions of each array located to the left of the vertical line.

Present students with a 100 grid divided into 4 arrays using one horizontal line and 1 vertical line.



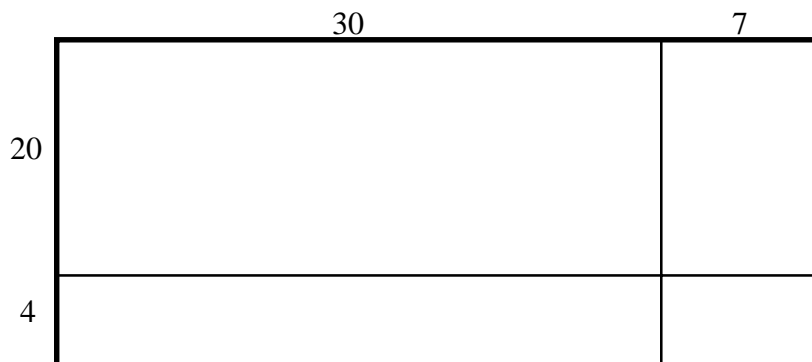
Challenge students to write all the possible multiplication facts using the dimensions of arrays found in the 100 grid.

4×6 6×6 4×4 6×4 10×6 10×4 4×10 6×10

Present students with a 200 grid divided into 4 arrays using one horizontal line and 1 vertical line. Challenge students to write all the possible arrays.

Drawing Arrays:

Lead students to draw their own representations without grids. For example: 24×37



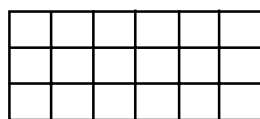
M. Have students draw a rectangle on paper, then estimate how many color tiles (or 1" paper squares) it would take to cover the rectangle. When students have covered part of their rectangle, they should stop and adjust their estimate before finishing.

N. Color in centimeter or inch squares on grid paper to make polygons or pictures of a specified area.

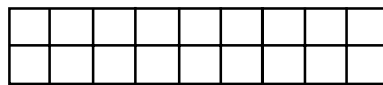
O. Measure the perimeter of the classroom by children holding hands (non-standard). Have students decide what to do if the room is too big for the children to completely encircle it.

P. Use non-standard units such as children's shoes to measure the distance around the classroom, the gym, and playground. What do you do if you do not have enough units to measure all the way around?

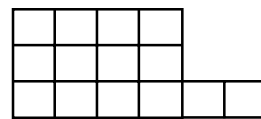
Q. Draw a shape on centimeter graph paper (Blackline Master I - 25) with a perimeter of 18 centimeters. Find its area. Draw a different shape with the same perimeter. Must it have the same area? What shapes with a perimeter of fourteen have the largest area? How many different shapes can you make with 18 as the perimeter.



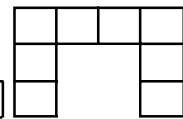
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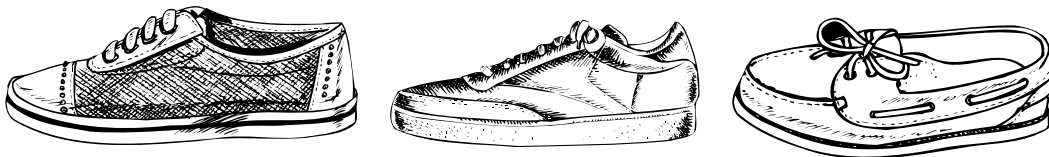


perimeter 18

R. Using centimeter grid paper with wax paper on top, have students estimate the largest bubble they can blow on the wax paper with a straw. Students then blow their bubbles using the straw and a mixture of Dawn detergent and water. (Two parts water to one part detergent.) Apply the soap solution to a section of the wax paper. Hold the straw at a 45 degree angle and blow into the solution to form a bubble. This would also be a good opportunity to measure using time: How long will the bubble stay without popping? See Blackline Master I - 25.

S. Each student needs a partner and 10 blank tiles or squares of paper. Working together, have students make rectangles using 12, 13, 14, or 15 tiles. Discuss possible answers, showing on board or overhead. Next, ask students to create a rectangle whose perimeter is between 13 and 19. Discuss the possibilities. What figures other than rectangles could you make (no donut holes allowed!) using the tiles. Use rectangles and irregular shapes as well to find perimeters.

T. Include perimeter events in the Olympics described for 2.01 - F, G, and H. This might include events like estimating the number of students needed to measure the perimeter of the classroom when holding outstretched hands, or standing shoulder to shoulder. How about the perimeter of other spaces like the principal's office, lunchroom, library, softball field? How many toothpicks would you need to measure the perimeter of your desk, your foot, or your mitten hand? How many children's shoes to measure the perimeter of the gym?



U. Have students measure the same rectangular region, such as the blackboard or a bulletin board in both feet and meters. Using the idea in 2.01 - K, have them draw the array on graph paper (Blackline Master II - 8) representing square meters. Later draw in the array for square feet. Discuss the relationship. Measure a smaller area like a desk top in inches and centimeters. Figure the area and discuss the relationship.

V. Provide students with 1" tiles or squares. Have them form rectangles, keeping a record of the width, length, and area of each rectangle. Encourage them to look for patterns and relationships.

W. Write the numbers from 1 through 50 on small pieces of scrap paper and drop them into a paper bag. Have each student draw two or three pieces of paper. Then have students work with a partner to complete the following task:

- Read the number on one of the papers.
- Take out that number of square-inch tiles from the ones available in the room.
- Build as many different rectangles as possible with that number of tiles.
- Record each rectangle on grid paper.
- Also record the following information about each rectangle: total number of square units, length, width, and perimeter.
- Repeat this process for each number drawn from the bag.

It might be necessary to lead a discussion about how to define “different” before students begin working. How will students know when they have found all the different rectangles? When students have completed gathering all the data for the numbers one through one hundred, ask them to discuss how all of these data might be represented or displayed. Then ask them what patterns they can find. Can they make any generalizations?

X. I have a rectangle made of 12 squares. There are four squares on one side. How many squares are on the other three sides? (Show model with only four squares marked on a side. Provide students with 8 squares to model and check their responses.)

Y. Students use connecting cubes or pattern blocks to create designs. They then discuss how many blocks they used (area) and the distance around their design (perimeter).

Z. Find the perimeter and area of a given rectangle, drawn and shaded on graph paper. See Blackline Masters I - 25 and II - 1.

AA. Students use square, triangular, and hexagonal grid paper to create colorful designs. Estimate and then measure accordingly to find perimeters and areas of parts or all of the designs. Use pattern blocks as measuring units. See Blackline Masters II - 7, II - 8 and II - 12.

BB. On grid paper, trace the following: bottom of your shoe, your hand, cover of a book, etc. Shade areas that are completely covered or at least half covered. Estimate the area in square units.

CC. Give students a ball of “play-dough” approximately 2” in diameter. Have them spread the dough on wax paper as thinly as possible. Trace around the dough shape with a marker. Remove the dough shape from the wax paper. Then put the wax paper over grid paper and count the area of the outlined shape.

DD. Cut out the outline of your county from a North Carolina map. Place your county’s outline on grid paper and find the area. Compare the size of your county with the size of other counties. Find other counties that are approximately the same size as your county.

EE. Divide and cut out the three regions from a North Carolina map. Using multiple sheets of grid paper taped together, trace the outline of each region. Are all regions of equal size? Find the area of each and compare.

FF. Puzzling Perimeters: Have groups of students build rectangles with 1” tiles or squares with whole sides touching. How many shapes with different perimeters can you make for these areas? Look for patterns:

Area - 8 squares; 9 squares; 10 squares; 12 squares

Count the perimeter of the shape. Record the shape on graph paper.

GG. Give each child a chocolate chip cookie. Before eating the cookie, determine:

- cookie weight in grams
- area of one surface
- diameter
- perimeter
- the number of chips in each cookie
- the median number of chips per cookie for the class
- the total of chocolate chips in the class's cookies

How many cookies would it take to fill up one cup? (The children will need to crush their cookies to find out this information.) In order to use the crushed cookies in a yummy way, make a dirt pie. Alternate layers of crushed chocolate chips with Cool Whip. If you really want to give an authentic look, make the dessert in a (clean) clay or plastic flower pot.

HH. Ask the children to determine in how many different shapes a house could be built if it had an area of 1000 square feet. (A scale of one grid square could equal ten feet.) Have the children illustrate their findings.

II. Using hexagons, blue parallelograms, and triangles, create a design with a perimeter of 24 units (the length of one side of the pattern blocks is your unit of measure). Trace design onto triangular grid paper (Blackline Master II - 7). Explore the area of the different designs. Are they the same? different?

JJ. Using a North Carolina map, students will practice using grid coordinates by locating Stokes, Rockingham, and Caswell counties. Next, using geoboards, the students will create the shape of each county with the following perimeters:

Stokes	P= 16
Rockingham	P= 20
Caswell	P= 12

Then, using grid paper, cut out the shapes of the counties. Record the areas of the counties.

KK. A collage is a composition created with fragments from a variety of sources that have been glued into one picture. Have students bring in a variety of discarded magazines from home. Be sure to stress that they need to check with their parents before bringing the magazine to school. Show a few examples of collages and explain the process. Brainstorm a list of possible themes for collages. These might include ideas like favorite things, food, sports, math in the environment, etc. Each small group of students then decides upon a theme. They search through the magazines and cut out pictures demonstrating the theme. Using centimeter graph paper (Blackline Master I - 25), they trace around the perimeter of each picture separately. They then find and record the approximate area of each part of the collage. After adding all the areas of these collage parts, the group chooses a size for the final picture and cuts a rectangular piece of paper with this area. Very often in a collage, the parts that are glued down will overlap. How will students adjust the area of the rectangle to account for this overlapping? After completing a group collage, students may want to create one of their own. These second collages might be “self portraits.”

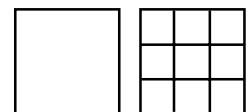
LL. Mr. Jones has a rectangular garden. He used 5,276 meters of fencing to go around his garden. If he used his fencing to change the shape of his garden to a square garden, how long will each side of his garden be?

MM. Using square-inch graph paper, have teams of students construct a square foot. Then, using these square feet to cover various rectangular areas in the room, have the students discuss how to find the area without covering the space. These square feet can also be used to create a square yard. Equivalencies can also be discussed from these visuals. e.g.,

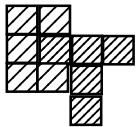
$$1 \text{ sq. ft.} = 144 \text{ sq. in.}; 1 \text{ sq. yd.} = 1,296 \text{ sq. in.}$$

A similar activity can be done with cm graph paper to create square decimeters and a square meter. See Blackline Master II - 8.

NN. Have teams of students find the area of a room in your school, such as the cafeteria. Have one team find the area in square feet and another team find the area in square yards. (Do the same for centimeters and meters.)



1 square yard = 9 square feet



$P = 16 \text{ in.}$
 $A = 10 \text{ sq. in.}$

Open response: The measure of each side of a rectangle is an even number. The perimeter of this rectangle cannot be

- (a) 16 (b) 136
(c) 180 (d) 246

Explain how you figured this out.

OO. Cut lengths of string 50 cm in length and tied to form a loop. Give every pair of students a loop and a sheet of cm graph paper. First, ask students to lay out the loop so that you can fill it with dimes (or some other desirable item.). Count the squares enclosed. Which shape gives the largest possible area? (A circle) Now ask students to use the loop to enclose the space that determines a dose of castor oil (or some other undesirable, and distasteful substance). How does the string look now? (A very skinny loop) Observe, the perimeter never changed but the area varied greatly. Students need to see this concrete demonstration to help distinguish between constant perimeter and varying area. A companion exercise involves the pentominoes created in 2.05 D. Each has an area of five square units. What about their perimeters? Ten of the shapes have perimeters of 12 units, but two have perimeters of ten units. Now we have equal areas but unequal perimeters.

PP. Have students cut out a set of pentominoes by putting five squares together on one-inch grid paper. See Blackline Masters II - 3 and II - 4. They should previously have discovered that there will be 12 pentominoes in a complete set. Examine the perimeter and area of each. Put two pentominoes together and record perimeter and area. Ask students to look for combinations with the least perimeter and the combinations with the greatest perimeter. Also, explore perimeters with 3 pentominoes, 4 pentominoes, etc.

QQ. Using geoboards and rubber bands, have students construct a figure with the area of one square unit. Following this, have students construct a figure with an area of 2, 3, 4, and 5 units. Extend to areas of $2\frac{1}{2}$, $5\frac{1}{2}$ square units, etc. Have them try to make regions that are not always quadrilaterals.

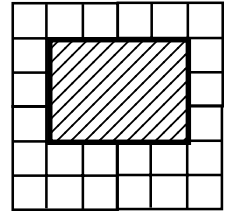
RR. Using a rectangular prism such as a cereal box, have students find and record the perimeter of each face. Students then should find the area of each face and explain the method they used. Is it possible to have different-shaped boxes that have the same surface area (the sum of all the faces)?

SS. A room is 10 feet by 12 feet. What is its perimeter? How many students (standing shoulder to shoulder) would it take to outline the room?

TT. Have students, in pairs, measure the length and width of various rectangular areas in the room (desk top, window, book, etc.) in appropriate units, rounding off to whole units. Have them draw a picture of the region on cm graph paper with one cm = 1 unit, and write the multiplication fact that describes the array. See Blackline Master I - 25.

UU. Using a geoboard, find and record all of the possible rectangles. Find the area and perimeter of each. See Blackline Master III - 4.

Notes and textbook references



*window 4 ft by 3 ft
1 square = 1 square foot*

$1 a = 100 m^2$
 $1 ha = 100 a$ or
 $10,000 m^2$
 $1 km^2 = 1,000,000 m^2$
 $1 acre = 4,840 yd^2$
 $1 mi^2 = 640 acres$

2.02 *Solve problems involving perimeter of plane figures and areas of rectangles.*

A. Make two tubes of 9 x 12 paper, rolling one by width, then one by length. Fasten edges to make cylinders. Estimate which will hold more. Fill with popcorn, discuss outcome, then eat popcorn.

Extension: If you made containers which were rectangular prisms out of the same size sheets (9 x 12), would they hold more, less, or the same amounts of popcorn as the cylinders? (See Blackline Master II - 9.)

B. Each student needs a partner and 12 blank tiles or squares of paper. Working together, have students make rectangles using all 24 tiles. How many different rectangles are possible? Color the rectangles on grid paper. Ask students to find the perimeter of each of these figures. Are any of the perimeters the same? If one square is removed from a rectangle, does the perimeter change? Does it matter which square is removed? What shape rectangle has the largest perimeter? the smallest? Can you make any statements about the shape of the rectangles and the perimeter that you could investigate with 18 squares?

C. Have students work in groups of 2 to 5. Each person selects three pattern blocks and forms a shape with the smallest possible perimeter. The shape with the smallest perimeter wins a point. (The length of the side of the green triangle is defined as one unit.) Use the blocks to search for the largest possible perimeter.

D. Using a grid, compare the area of your hand with the area of Michael Jordan's hand (see Blackline Master II - 6). What investigations could this spark?

E. Give each student a 9 x 12 piece of paper. Tell the students this is the floor of a room and it needs to be tiled. Have them choose one pattern block as a template and trace it to cover the floor. Predict how many tiles will be needed before actually determining the number. Share as a larger group the pattern created. Try this activity with 2 or 3 pattern blocks. Try to find a pattern for which every vertex has exactly the same combination of shapes in the same order around the point.