

Grade 8 Mathematics

Measurement: Lesson 2

Read aloud to the students the material that is printed in **boldface type** inside the boxes. Information in regular type inside the boxes and all information outside the boxes should **not** be read to students. Possible student responses are included in parentheses after the questions.

NOTE: The directions read to students may depend on the available materials. Read only those parts of the lesson that apply to the materials you are using.

Any directions that ask you to do something, such as to turn to a page or to hand out materials to students, will have an arrow symbol (\Rightarrow) by them.

Purpose of Lesson 2:

- In this lesson, the tutor and the students will
 - ✓ find the perimeter of an illustrated or described figure;
 - ✓ find the area of a square, rectangle, triangle, or figures formed from these shapes;
 - ✓ estimate the perimeter and area of figures; and
 - ✓ find the squares and square roots of numbers.

Equipment/Materials Needed:

- About 2 pieces of grid paper (Student Sheet 21)
- Copies of Student Sheets 22 and 23
- Calculators (optional)
- Paper and pencils

Preparations before beginning Lesson 2:

- Run off 2 sheets of the grid paper (Student Sheet 21) for each student.
- Run off one (1) copy of Student Sheets 22 and 23 for each student.
- Gather paper and pencils.
- Have calculators available if you choose to use them.

Lesson 2: Measurement

Say:

Do you know what the word *perimeter* means? (the distance around a figure—any figure. It can be a square, a triangle, a figure with 20 sides, etc.)
Note: When we find the distance around a circle, we give the distance the special name of circumference.

⇒ Write the word *perimeter* on a piece of paper or on the board. Underline *rim* in the word. A *rim* is an edge or border around an object. Think of the rim on a jar or the rim of the Grand Canyon. This explanation may give the students a visual clue about perimeter.

Say:

Look around the classroom. What might we find the perimeter of? (distance around the classroom, around your waist, around the bulletin board, etc.) **Why would you want to find these perimeters?** (to measure for baseboards, to buy a belt, to put a border around the bulletin board)

Say:

I want you to use your ruler (or tape) to measure the perimeter of an item in the classroom. Write on your paper the item you chose and what you found the perimeter to be. Remember to write the units. Have each student share the item that was measured. **How did you find the perimeter?** (They probably measured all sides and added them together. If an item was a rectangle, ask the students whether they had to measure all four sides. They could measure the length and double it, measure the width, double it, and add the two measurements. This process is the basis for the formula for the perimeter of a rectangle: $P = 2L + 2W$. If the item was a square, the students could have simply measured one side and multiplied by 4. This fact is why the formula for a square is $P = 4s$.)

⇒ Pass out sheets of the grid paper (Student Sheet 21) to the students and give them this problem.

Say:

Mr. Warren is building a pen for his dog, Jake. The pen will be in the shape of a rectangle that is 9 ft. by 4 ft. Draw the rectangle on grid paper that represents the pen. How much fencing material will he need to buy? (26 feet of fencing)

How did you find this answer? (I counted the blocks around the rectangle. I added $9 + 4$ and multiplied by 2. I doubled 9, doubled 4, and added them together.)

⇒ Give the students Student Sheet 22. Emphasize that, when finding the perimeter, they have to find the distance around the entire figure, so they need to add all of the sides. (If they are going to use calculators on the test, I would allow them to do so now.)

Answers:

- 1) 16 units
- 2) 12 units
- 3) 198 inches
- 4) 25.6 meters
- 5) 5.1 feet
- 6) 49 inches
- 7) 6 cm
- 8) C
- 9) C
- 10) 11 yards
- 11) 236.8 cm
- 12) Both are correct. They are the same formula.

Say:

Let's go back to the problem about Mr. Warren's dog pen. Look at your 9×4 rectangle. What was the perimeter? (26 ft.) Suppose Mr. Warren wanted to make a cover for the pen for very hot or cold days. How much material would he need to buy? This time you are looking to see what it would take to cover the pen. Count the number of squares that it would take to cover the pen. (36 squares) You have now found the area of the pen. *Area* is the number of square units that it takes to cover a figure. I will give you some dimensions, and I want you to draw the rectangles. Find the perimeter and the area of each.

- A. 4×6 (P = 20 units, A = 24 square units)
- B. 4×4 (P = 16 units, A = 16 square units)
- C. 8×2 (P = 20 units, A = 16 square units)

Say:

Did you notice anything about the areas of the rectangles? (B and C have the same areas, but different perimeters.) **Did you notice anything about the perimeters of the rectangles?** (A and C have the same perimeters, but different areas.)

Say:

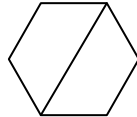
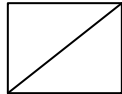
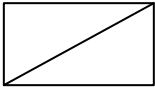
I will give you some dimensions of rectangles. I want you to draw the rectangles. This time I want you to find only the area of each.

- A. 2×6 (A = 12 square units)
- B. 3×3 (A = 9 square units)
- C. 10×2 (A = 20 square units)

Did you have to count the squares each time? You want the students to see that, to find the area of a rectangle, they can simply multiply the length times the width. **So the formula for the area of a rectangle is $A = L \times w$.** Sometimes you will see the formula for the area a rectangle as $A = \text{base} \times \text{height}$. What do these terms mean? (They are simply calling the length, the base, and the width, the height.) **To find the area of a square, you multiply side \times side, so the formula for the area of a square is $A = s \times s$ or $A = s^2$.**

Say:

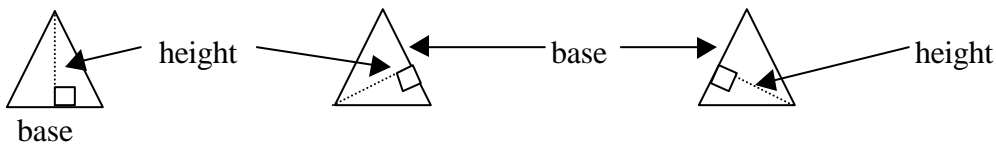
On the grid paper, draw a rectangle that has dimensions of 4 x 6. What is the area of the rectangle? (24 sq. units) A *diagonal line* is a line that connects two vertices that do not share an endpoint, for example, these lines are diagonals of the figures.



On the 4 x 6 rectangle that you drew on the grid paper, draw a diagonal line. What figures are formed? (triangles) What should the area of the each of 2 triangles formed be? (12 square units) Why? (Each triangle covers 1/2 of the area of the rectangle. Since the area of the original rectangle was 24 square units, each triangle should cover 12 square units.)

The formula for the area of a triangle is $\frac{1}{2}(\text{base} \times \text{height})$ or $A = \frac{1}{2}bh$.

Does this formula make sense? (Yes.) Why? (The area of a rectangle is length x width or base x height. The triangle is one-half of that area.) Any side of a triangle can be the *base*. The *height* of a triangle is a line that starts at a vertex and is perpendicular to the base.

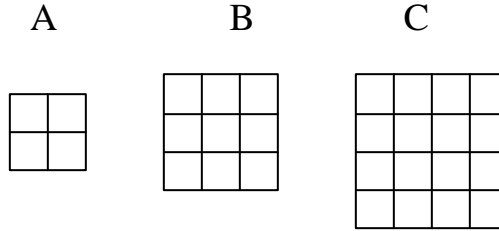


⇒ Give Student Sheet 23. Emphasize that *area* is the number of square units needed to cover a figure.

Answers:

- 1) 12 square units 2) 9 square units 3) 20.25 sq. cm 4) 216 sq. miles
 5) 1.95 sq. m 6) 154 sq. in. 7) B 8) B 9) B

⇒ Draw the following squares on the board.



Say:

What kind of figures did I draw? (Squares) What is the length of the sides in each square? (A, 2 units; B, 3 units; C, 4 units) What is the area of each square? (A, 4 units; B, 9 units; C, 16 units) When a number is multiplied by itself, the product is the *square* of the number.

Four is a square number. It is 2×2 . Nine is a square number. It is 3×3 . Sixteen is a square number. It is 4×4 .

Name some other square numbers. (25, 36, 49, 64, 81, 100, etc.) We can write $2^2 = 4$; $3^2 = 9$; $4^2 = 16$. The small raised 2 means to square the number or to multiply the number by itself. What is 10^2 ?

(10×10 or 100)

What was the length of the side of the square with an area of 4? (2)

What was the length of the side of the square with an area of 9? (3)

What was the length of the side of the square with an area of 16? (4)

How did you find each area? (I multiplied side \times side or 2×2 ; 3×3 ; and 4×4 .) The *square root* of a number is the factor of a number which, when multiplied by itself, gives the original number. The square root of 4 is 2, because $2 \times 2 = 4$. The square root of 9 is 3, because $3 \times 3 = 9$. What is the square root of 16? (4) You can think of the square root as the length of a side of a square. The symbol for square root is ($\sqrt{\quad}$). Find the $\sqrt{100}$.

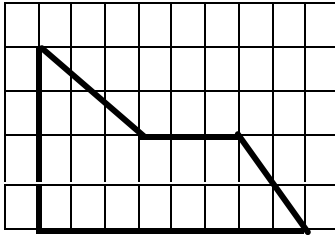
(10) Find the $\sqrt{81}$. (9)

Extension:

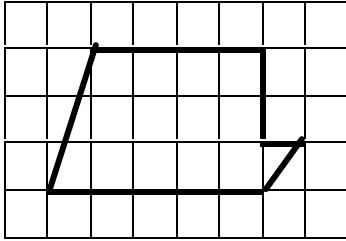
Say:

Not all figures are in the shapes of rectangles or squares. Sometimes you need to find the area of a figure that is different, or *irregular*. Counting squares on grid paper will give you an approximate area.

Here are 2 examples.



There are 13 or 14 whole squares. If I put the others together to make whole squares, I get about 3 more; so the answer is about 17 or 18 whole units.

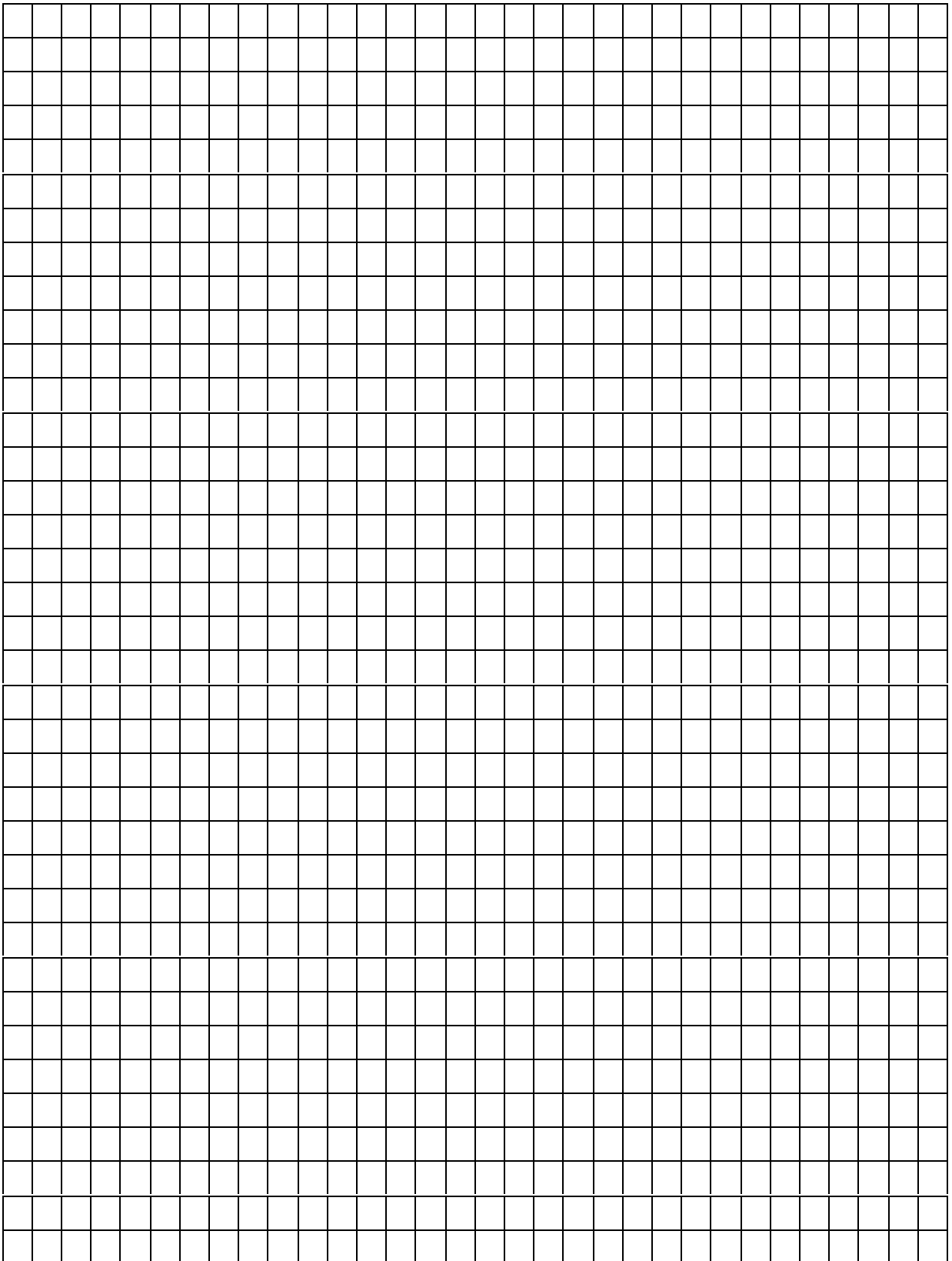


There are 12 whole squares and about 2 others, so the area is about 14 square units.

Trace a figure on grid paper. (a coke can, their hands, a box, etc.) Count the squares that are covered. Most will realize that it is easier to count the whole squares first and then to estimate the others. **How did you estimate the area?** (Answers will vary, but let them talk about their methods.)

⇒ Have one student summarize today's lesson. The students should understand when to find perimeter and when to find area.

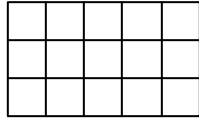
Student Sheet 21 (Measurement: Lesson 2)



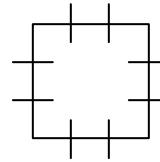
Student Sheet 22 (Measurement: Lesson 2)

Find the perimeter of the following figures.

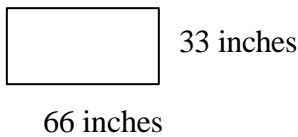
1. $P = \underline{\hspace{2cm}}$ units



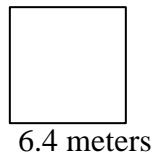
2. $P = \underline{\hspace{2cm}}$ units



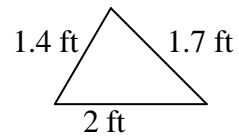
3. $P = \underline{\hspace{2cm}}$



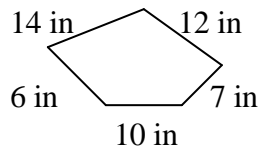
4. $P = \underline{\hspace{2cm}}$



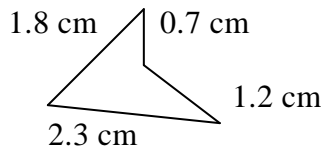
5. $P = \underline{\hspace{2cm}}$



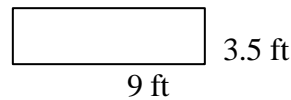
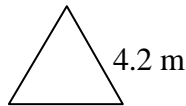
6. $P = \underline{\hspace{2cm}}$



7. $P = \underline{\hspace{2cm}}$



In problems 8 and 9, choose the best estimate of the perimeter of each figure.



8. A. 4 m

B. 8 m

C. 12 m

D. 16 m

9. A. 10 ft

B. 20 ft

C. 25 ft

D. 30 ft

10. Heather wants to fence in her vegetable garden to keep out animals. The garden is in the shape of a hexagon with sides of these lengths: 8ft, 7ft, 8ft, 6ft, and 4ft. How many **yards** of fencing material does she need to buy?

11. Mr. Burns is making a rectangular bulletin board display. He wants to put a border around it. If the bulletin board measures 92.6 cm by 25.8 cm, how much border material should he buy?

12. Jose says that the formula for the perimeter of a rectangle is $P = 2(L + W)$. Jimmy says that it is $P = 2L + 2W$. Who is correct? Why?

Student Sheet 23 (Measurement: Lesson 2)

Use the figures below to answer the following questions.

Figure A

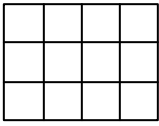
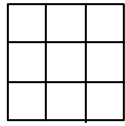


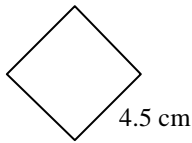
Figure B



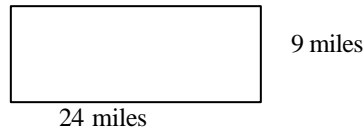
1. What is the area of figure A? _____ sq. units
2. What is the area of figure B? _____ sq. units

Find the area (A) of each of the following figures.

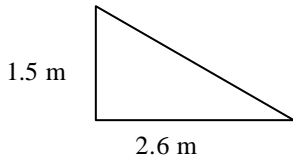
3. $A =$ _____



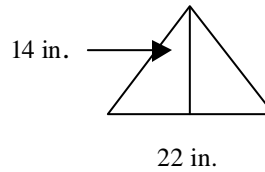
4. $A =$ _____



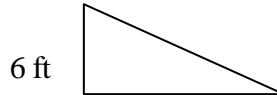
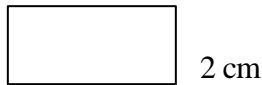
5. $A =$ _____



6. $A =$ _____



In problems 7 and 8, choose the best estimate of the area of each figure.



- | | |
|----------------|-----------------|
| 7. A. 4 sq. cm | 8. A. 20 sq. ft |
| B. 8 sq. cm | B. 35 sq. ft |
| C. 15 sq. cm | C. 60 sq. ft |
| D. 24 sq. cm | D. 75 sq. ft |

9. Jonie wants to cover the bulletin board with bright paper. The bulletin board measures 4 ft by 3 ft. What is the area of the bulletin board?
- | | |
|----------|--------------|
| A. 7 ft | B. 12 sq. ft |
| C. 22 ft | D. 24 sq. ft |