M2T2

Perimeter, Area & Mass

Measurement

STATE GOAL 6:

Estimate, make and use measurement of objects, quantities and relationships and determine acceptable levels of accuracy..

Statement of Purpose

The Illinois Learning Standards state that measurement provides a way to answer questions about "how many", "how much", and "how far." During the late elementary years, it is important that we help students to make connections between different systems of measurement (metric and customary), different units of measurement (feet vs. inches, cm vs. m), and different methods of measurement (direct measurement, comparison, estimation, use of appropriate instrument). It is during this time that students should also begin to understand the relationships between measurements in one, two, and three dimensions (length, area, and volume). As the NCTM Principles and Standards points out, measurement skills and concepts can be developed across the curriculum and throughout the year. With the hands-on activities in this unit we strive to build the students' understanding of the concepts of perimeter, area, and mass and have them apply these understandings.

Highlights

This unit addresses a number of measurement concepts that prove difficult for late elementary students. The students will participate in several activities where they will explore the concepts of perimeter, area, and mass.

Connections to the Illinois Learning Standards.

Standard 7.A. -- Measure and compare quantities using appropriate units, instruments, and methods. Participants develop the concepts of perimeter and area by measuring objects with both non-standard and standard units, working with geoboards and constructing rectangles with colored tiles and straws.

Standard 7.A. -- Estimate measurements and determine acceptable levels of accuracy. Participants will estimate mass, area and perimeter and select the appropriate units in both the customary and metric systems.

Standard 7.C. -- Select and use appropriate technology, instruments, and formulas to solve problems, interpret results, and communicate findings. Students will construct and draw figures with given perimeters and area. Students will work together in groups to design a scale drawing of their classroom.

M2T2

Table of Contents **Page Number**

Note: Appendices are printed only on the odd pages. This is done to make photocopying easier. That is, each participant should have a copy of all the odd numbered pages. While the instructors should have a copy of all the pages.

M2T2

Materials

MATERIALS LIST

Minimal:

- "Mathfiti Boards"
- Tape
- Magic markers, box of regular paper clips, box of large paper clips
- Oranges, bananas, grapefruit, tangerine
- Scales
- Calculators
- Rulers, yardsticks, measuring tapes, meter stick
- Ball of heavy string
- One-inch tiles
- Paper towels
- Geoboards
- Overhead geoboard

What is Perimeter?

Instructor Page

The distance around a figure is called the perimeter.

To find the perimeter of any figure, add the lengths of its sides.

A pace is the length of a single step.

Summarize the discussion non-standard and standard units. Even though a pace is a non-standard unit it is frequently used for estimating.

Activity Instructions:

The class will measure to find perimeter. To assess prior knowledge of perimeter do the following activity.

Activity 1: What is Perimeter?

- The teacher divides the class into groups of 5 or 6 students and then introduces the "Mathfiti" Boards (see Appendix A) that are hanging on the classroom walls. The student groups will use markers and write words, drawings, symbols etc on the Mathfiti Boards to demonstrate their ideas of the concept of perimeter.
- Each group then shares and explains what they have on their Mathfiti Board and the class comes to consensus on the meaning of perimeter.

Activity 2: Finding Perimeter Using Non-standard Units

- Each student receives a large index card (4x6) and an envelope containing 25 paper clips. Some students should receive large paper clips and the others should get regular size.
- Teacher instructs students measure the perimeter of the index card using a paper clip as the unit of measure and record their measurement.
- Students share their findings with the class. Did everyone have the same results? Why or why not?
- Have students estimate the perimeter in inches and then measure the index card again using rulers and record the perimeter in inches. Does everyone have the same results now? Why or why not?

Materials:

- "Mathfiti" Boards
- 4"x6" index cards
- small paper clips
- large paper clips
- small envelopes
- 8 yds. of string
- rulers
- yardsticks
- measuring tapes
- meter sticks

Related Activity:

Students find the perimeter of the classroom by walking around the room and determining the perimeter in paces. Record and compare data. Why are the measurements different? Is there a need for a standard unit of measure? Use yardsticks, meter sticks or measuring tapes to find actual perimeter and record information.

M2T2

Participant Page

Journal Activity:
Explain how to find the perimeter of a figure.

When might it be ok to use non-standard units?

What is Perimeter?

Finding Perimeter Using Non-standard Units

- ▷ Measure the perimeter of the index card with the paper clips in the envelope and record the perimeter.
- ▷ Estimate the perimeter in inches and record below.
- ▷ Then, using a ruler, measure the index card and record.

Perimeter in paper clips	Estimate of perimeter in inches	Perimeter in inches
_____ paper clips	_____ inches	_____ inches

▷ Does everyone have the same perimeter in paper clips? _____ Why or why not? _____

_____

▷ Does everyone have the same perimeter in inches? _____ Why or why not? _____

_____

How Big is Your Pace?

Estimate the number of paces around the perimeter of the room and record. Then walk around the room and determine the perimeter in paces and record.

- ▷ Do you agree with your classmates' number of paces? _____
- ▷ Why are the measurements different? _____

  _____
- ▷ Is there a need for a standard unit of measure? _____

Estimate the perimeter of the classroom in feet and record. Using a yardstick or measuring tape, work with a partner and measure the actual perimeter of the classroom in feet and record.

Perimeter of Our Classroom

Estimated number of paces	Actual number of paces	Estimated number of feet	Actual number of feet

Extension activity:

In your classroom, find items that have an approximate perimeter of:

_____20 in. _____40 in. _____30 cm

_____ 4 ft. _____12 ft. _____10m

What is Area?

Instructor Page

Area is a measure of covering. It is the number of square units needed to cover a figure.

Area is reported in square units.

Activity Instructions

Brainstorm the meaning of area using the "Mathfiti" Boards. Ask students to explain the difference between perimeter and area.

Activity 1: What's My Area?
Students find the area of their math book (and/or desktop) using index cards as the unit of measurement and record their data . Make sure that some students receive 3" x 5" index cards and others 4" x 6" index cards to use for this activity. Student share their findings.
Discuss:

- Did everyone have the same number of index cards for area?
- How did you find the area when the index cards didn't fit exactly?
- Did anyone need to use parts of units (e.g. 12 1/4 units)?

Using the index cards, work in groups of 3 or 4 and find the area of three more items in the room.

- Did any of the items have the same area as the math book or desktop? If so, were they the same shape?
- Which of the items had the largest area, the smallest area?

Materials:

- "Mathfiti" Boards
- Markers
- Square tiles
- 3"x5" index cards
- 4"x6" index cards
- rulers & measuring tapes
- inch graph paper
- crayons or markers

Constructing Areas
Give students 1-inch square tiles and sheets of inch graph paper

Students use the tiles to make figures with the specified area and color the same figure on the 1-inch grid paper. There should be a variety of shapes all having the same area.

As they experiment the students should be making generalizations about area and trying to find methods for finding the areas of various shapes.

Participant Page

Journal Activity:

Explain how to find the area of a figure. What is the difference between area nd perimeter?

When do we need to know the area of something?

Can different shapes have the same area?

What is Area?

Finding Area Using Non-standard Units

- ☐ Estimate the number of index cards it will take to cover your math book.
- ☐ Measure the area of your math book by covering it with index cards.
- ☐ Record your estimates and actual area of your math book and desktop using an index card as the unit of measure.

Estimated area of book in index	Area of book in index cards	Estimated area of desk in index	Area of desk in index cards

Using the index cards, work with your group and find the area of three more items in the room and record their area below.

Item measured	Area (in index cards)
1.	
2.	
3.	

Constructing Areas:

Using 1 inch tiles:

1. Make a figure with an area of 4 square inches. Copy this figure on the 1-inch graph paper by coloring in the squares to show area of 4 square inches .
2. Make a different figure with an area of 4 square inches and copy on the graph paper.
3. Make a figure with an area of 5 square inches and copy on the graph. Make as many different figures with area of 5 square inches as you can.
4. Make a rectangle with an area of 8 square inches.
5. Make as many different rectangles as you can with an area of 12 square inches. Use another sheet of inch graph paper if you need it.
6. Make a figure with an area of 7. Draw a line that separates it into two equal parts.

Area By Design

Instructor Page

This activity asks students to use a scale of one unit square on the grid for one square foot in the actual pizza parlor. To help visualize one square foot, each student makes a life size square foot out of construction paper. The students in the class put their squares on the floor and arrange them into rectangles or squares. This gives us a benchmark for the actual size of the kitchen or the counter

Context:

Students will design a floor plan for a new pizza parlor.

Activity Instructions:

- The students design a floor plan using all the items listed in the chart.
- The dimensions of the items must be as listed.
- Color code the items.
- Draw each item on grid paper using a scale of one square unit for each square foot. Color the item according to your color code.
- Arrange the cutouts into a pizza parlor floor plan.
- Tape or glue the cutouts on the large grid.
- Find the requested areas in square feet.

Questions for Discussion

- Are all of the proposed pizza parlors the same size and shape?
- Which have the smallest area?
- Which shape uses the space more effectively?

Discussion of Math Content and Related Questions:

At first students find area by counting the unit squares. As they gain experience they develop more efficient methods for counting. Discuss the students' methods for finding the area of a rectangle. Someone may suggest counting the number of unit squares in one row and counting the number of rows. In the rectangle at the right there are 7 unit squares in each row and 5 rows. The students may count by seven's to get the area of 35 square units. Through discussion formalize the rule for finding the area of a rectangle:

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35

Area of a rectangle = length times width
A = l x w

Display the floor plans on the bulletin board.

Discuss what makes a good restaurant design. Where do customers like to sit? What arrangements are convenient for the workers? Where are good places for the restrooms?

Extensions:

The pizza parlor has to pay rent based on the area of the space. If the rent is $.75 per square foot per month, how much is the monthly rent payment?

If a large pizza sells for $14.50 and costs $10.00 to make, how many pizzas have to be sold just to pay the rent?

The floor tile for the dining area costs $2.25 per square foot. How much will it cost to cover the dining area floor?

Participant Page

Area By Design

You have been hired to design a floor plan for a new pizza parlor. It needs to include all of the items listed below. The size of each item has also been listed. To help you organize all the items that need to be included, you should color code them. Select a different color for each item and color the box in the chart. Draw each item on grid paper using a scale of one square unit for each square foot. Color the item according to your color code and cut it out. Arrange the cut outs into a good floor plan for a pizza parlor. Combine the three counter cut outs to form a U-shaped counter. Tape or glue your cut outs to the large grid. Express your areas in square feet.

Color	Item	Size (ft)
☐	kitchen	15 x 20
☐	counter	2 x 8
☐	counter	2 x 8
☐	counter	2 x 12
☐	8 large tables	4 x 8 each
☐	4 medium tables	4 x 6 each
☐	6 small tables	4 x 4 each
☐	salad bar	4 x 10
☐	ladies' room	8 x 12
☐	mens' room	8 x 12
☐	soda fountain	2 x 4
☐	condiment counter	2 x 6
☐	4 trash cans	2 x 2 each

What is the area of the salad bar?

_____

What is the total area of the counter?

_____

What is the total area of the small tables? _____

What is the total area of the large tables? _____

What is the total area of the trash cans? _____

What are the dimensions of your pizza parlor? _____

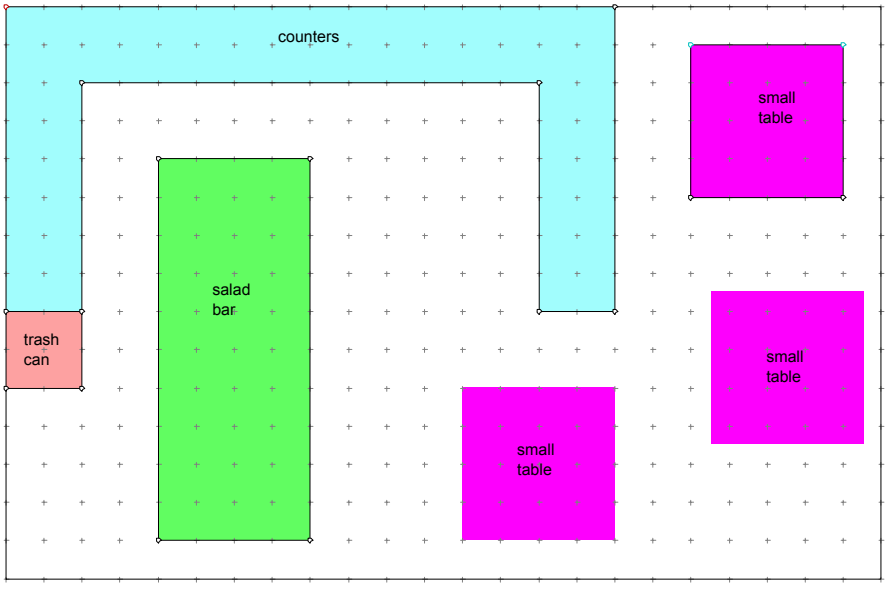
What is the area of the dining area?

_____

How many people could be eating here?

____

At the left is an example of a partially completed floor plan. It includes only a few of the required items.



M2T2

Instructor Page

The teacher should circulate around the room to make sure that students are following directions and address any questions/ problems that occur.

Area of a square may be found by squaring the length of one side of the square. If one side equals 6 in., then the area is equal to: 6x6=36 sq.in.

.

Squares on the Geoboard

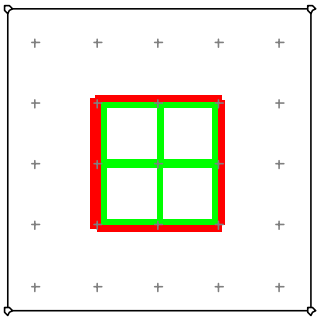
The teacher demonstrates placing the rubber bands on the geoboard and shows what one unit square on the geoboard looks like. (A geoboard for the overhead projector is especially helpful but the teacher may also demonstrate by holding up a regular geoboard.) Depending on the quantity of available geoboards, students may work independently or in pairs.

Teacher directs the students to:

1. Use a rubber band to make a square.
2. Each of the sides of the square must be parallel with an edge of the geoboard.
3. On the geoboard grid (more grids in Appendix D), sketch the square that you made.
4. Record the length of each side.
5. On the sketch draw the outlines of the unit squares that are inside the square made by your rubber band.
6. Count the number of unit squares in each row and record.
7. Count the number of rows of unit squares and record.
8. The total number of unit squares is the area. Record this.

Materials:

- geoboards
- rubber bands
- geoboard paper
- crayons or markers



The red rubber band outlines a square that has a side length of 2 units. There are two green unit squares in each row and two rows for a total area of 4 unit squares.

Side length = _____2___ units
__2___ row(s) of __2___ unit square(s)
Area = ___4_____ unit squares

Discussion of Math Content and Related Questions:

- Develop the formula for finding area of a square and a rectangle.
- Do you see a pattern?
- Do you notice anything about the length of each side?

Literature Connections:

How Big Is A Foot? By Rolf Myllar

Spaghetti & Meatballs for All: A Math Story, Scholastic Books

M2T2

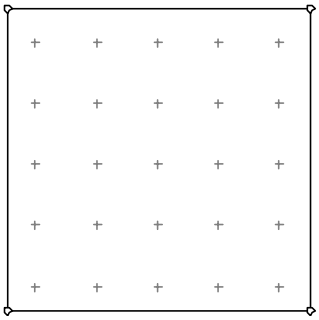
Participant Page

Journal activity:
Tell three things that you have learned about area. How is area different from perimeter?

Extension
What other squares can be made on the geoboard? Try to enclose a square that has edges that are not parallel to the edges of the geoboard

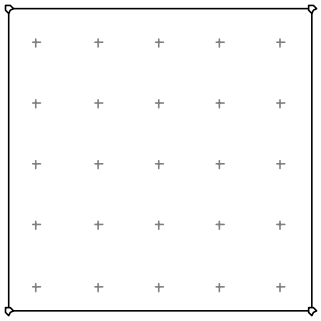
Squares on the Geoboard

Use the rubber band to make a square on your geoboard. Each of the sides of the square must be parallel with an edge of the geoboard. Sketch the square and record its side length and area.



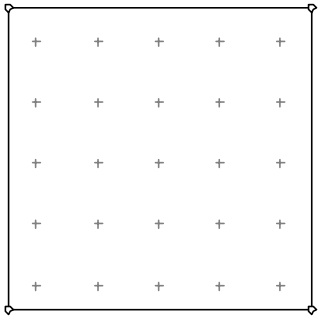
Side length = _____ units
_____ row(s) of _____ unit square(s)
Area = _____ square units

Use the rubber band to make a different size square on your geoboard. Each of the sides of the square must be parallel with an edge of the geoboard. Sketch the square and record its side length and area.



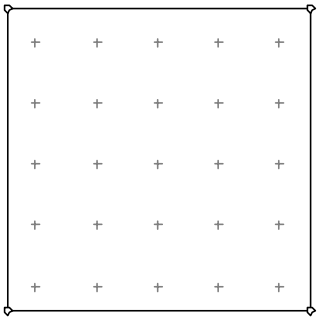
Side length = _____ units
Area = _____ square units

Use the rubber band to make another size square on your geoboard. Each of the sides of the square must be parallel with an edge of the geoboard. Sketch the square and record its side length and area.



Side length = _____ units
Area = _____ square units

Use the rubber band to make a fourth different size square on your geoboard. Each of the sides of the square must be parallel with an edge of the geoboard. Sketch the square and record its side length and area.



Side length = _____ units
Area = _____ square units

M2T2

More Geoboard Area Activities

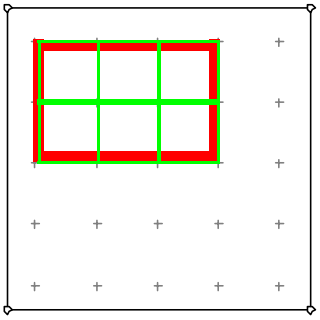
Instructor Page

Rectangles may have same area but different length and width.

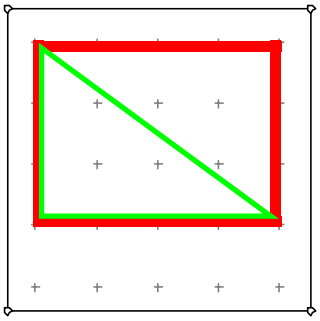
The diagonal of a unit square separates it into two congruent triangles. Each one has an area of one-half square unit. This idea can be extended to other squares and rectangles.

There are many possible correct responses for these exercises. Encourage students to use small rubber bands to outline the unit squares of each the figure and experiment until they are able to generalize a method for finding the area of a rectangle.

The figure at the right shows how small rubber bands can be used to outline the unit squares



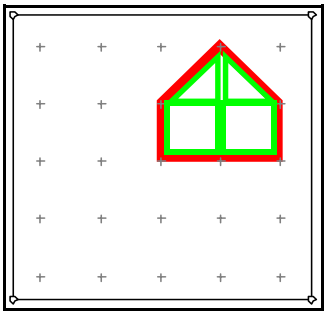
Length = ___3____ units
Width = ___2___ units
__2__ row(s) of ___3__ unit square(s)
Area = ___6____ square units

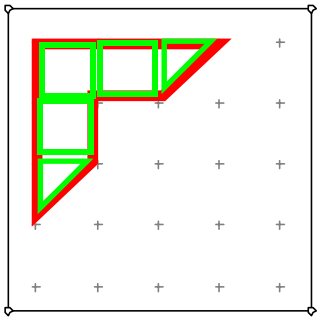


The rectangle outlined by the red rubber band has an area of 12 square units. The green rubber band separates it into two congruent trianges. Each triangle has an area of 6 square units,

In the figure there are three whole unit squares and two half squares. The total area of the figure is 4 square units.

Students may also experiment with figures that are not rectangles. In the figure at the right, there are two unit squares and two triangles that can be put together to make one more unit square for a total area of three unit squares.





Online Resources:

- Virtual geoboard

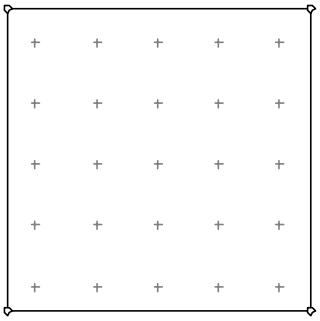
M2T2

Participant Page

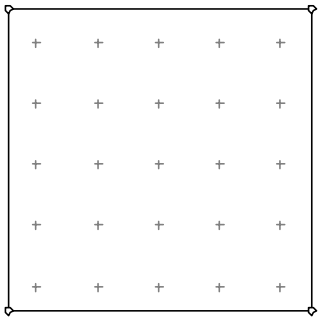
Remember that area is a measure of the number of unit squares inside a figure.

More Geoboard Area Activities

1. Make two different rectangles on your geoboard. Sketch each and record the width, length and area.

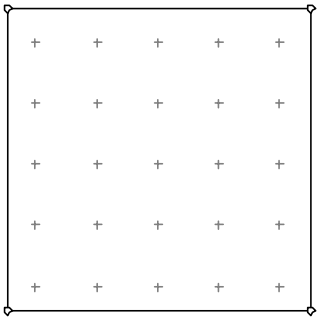


Length = _____ units
Width = _____ units
_____ row(s) of _____ unit square(s)
Area = _____ square units



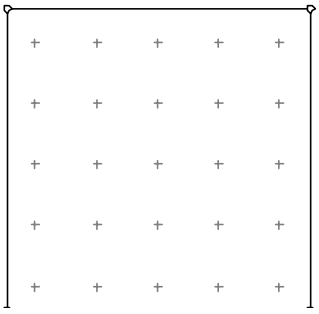
Length = _____ units
Width = _____ units
_____ row(s) of _____ unit square(s)
Area = _____ square units

2. Make a figure with an area of 8 square units.



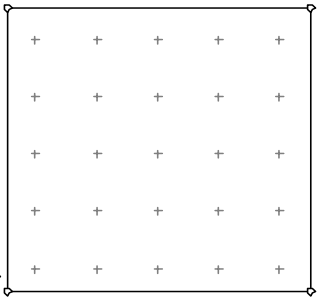
Length = _____ units
Width = _____ units
_____ row(s) of _____ unit square(s)
Area = _____ square units

3. Make a 2 x 5 rectangle.

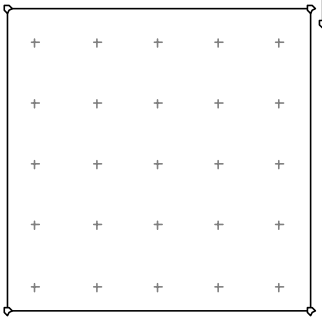


Length = _____ units
Width = _____ units
_____ row(s) of _____ unit square(s)
Area = _____ square units

4. Make two different figures on the geoboard that have the same area, (They don't have to be rectangles.)

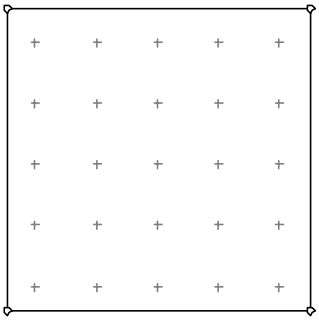


Length = _____ units
Width = _____ units
_____ row(s) of _____ unit square(s)
Area = _____ square units



Length = _____ units
Width = _____ units
_____ row(s) of _____ unit square(s)
Area = _____ square units

5. Make a figure on the geoboard with the largest possible area.



Length = _____ units
Width = _____ units
_____ row(s) of _____ unit square(s)
Area = _____ square units

M2T2

Instructor Page

One way to find the area of irregular shapes is to partition the figure into squares, rectangles and triangles and find the area of each. Then add to find the area of the larger irregular figure.

To find the area of curved shapes, use a square unit grid overlay. Count the covered squares and estimate partially covered squares. Combine the covered areas. Another method is to find the area of the overlay rectangle. Then count the squares that are not covered and subtract.

Area of Irregular Shapes

Even after students have learned to find the area of regular shapes by multiplying the length times the width, they often have difficulty finding the area of irregular shapes.

See the appendix for a transparency master for the L-shape figure. Discuss the steps for partitioning the irregular figure into squares and rectangles to find the area.

- Use a dotted line to divide the figure into a square and a rectangle.
- Find the area of the square. Remind students that area is always expressed in square units.
- Find the area of the rectangle.
- Add the area of the square and the rectangle together to find the area of the irregular figure.

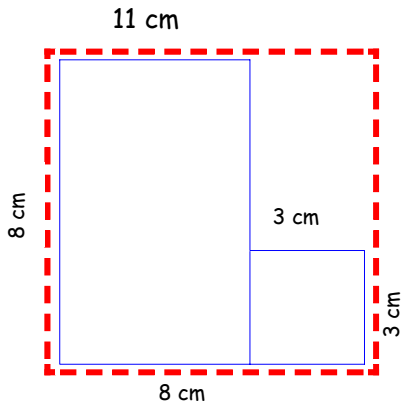
It would also be helpful to demonstrate another method for finding the area of irregular figures.

- Using the same figure, demonstrate that you can draw a dotted rectangle around the irregular figure.
- Find the area of the large rectangle.
- Count the unit squares outside the irregular figure and inside the dotted rectangle.
- Subtract to find the area of the irregular shape. (Appendix F)

Area of the dotted rectangle: 11 x 8 = 88 square cm.

5 rows of 3 unit squares outside the L-shaped figure: 5 x 3 = 15 square cm.

88 — 15 = 73 square centimeters in side the L-shape.



Materials:

Transparency master of irregular figure from the appendix

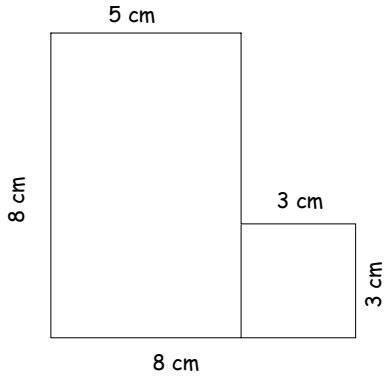
Participant Page

Area of Irregular Shapes

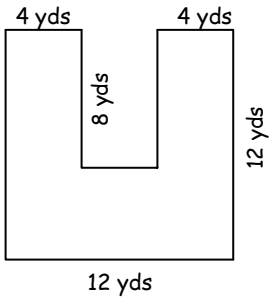
One way to find the area of irregular shapes is to partition the figure into squares, rectangles and triangles and find the area of each. Then add to find the area of the larger irregular figure.

- Use a dotted line to divide the figure into a square and a rectangle.
-
- Find the area of the square._____sq. cm
- Find the area of the rectangle._____sq. cm
- Add the area of the square and the rectangle together.

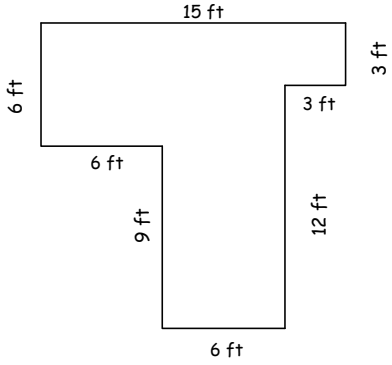
_____ sq.cm



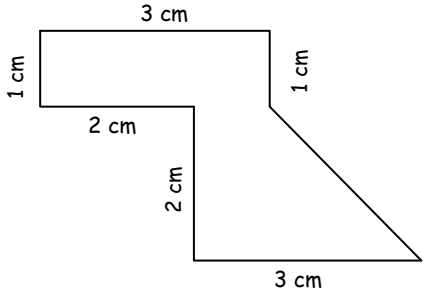
Find the areas of these irregular shapes.



Area =_____

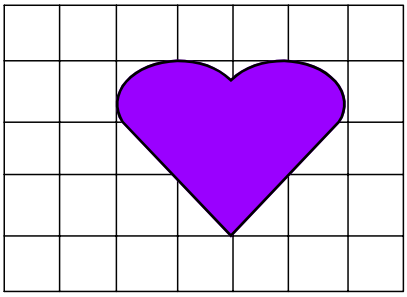


Area =_____

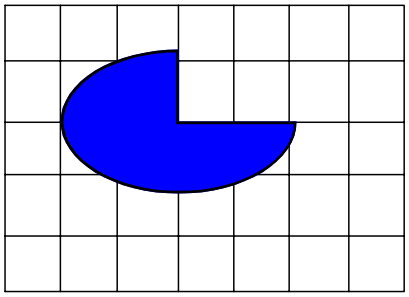


Area =_____

To find the area of curved shapes, count the squares and combine the areas that are partially covered **or** find the area of the background rectangle and count and subtract the squares that are not covered. Find the area of the following shapes:



Area =_____



Area =_____

M2T2

Constant Perimeter Different Area

Instructor Page

Objects can have the same perimeter but different areas.

In this string activity, the students will discover that the string will be in the shape of a square when the largest number of students will fit inside.

Activity 1: Area Inside the String

- Using a piece of string approximately 9 yards long, have four students hold it to make the 4 corners of a very long narrow rectangle
- Ask how many students could stand inside this rectangle. The answer of course will be zero.
- Have students gradually enlarge the area of the rectangle and continue to ask how many students can stand inside. Allow students to do so as there is room.
- Have the 4 students continue to enlarge the area until the largest number of students can stand inside the rectangle.
- The students should see that the area increases as the rectangle becomes more and more like a square.

Activity 2: Area & Perimeter with Geoboards

Depending on the quantity of available geoboards, student may work independently or in twos. Teacher directs the students to:

1. Make a figure with a perimeter of 8 units. Draw it on your geoboard paper. What is the area of this figure?_____
2. Can you make another figure with a perimeter of 8 units that has a larger area?_____, or a smaller area? _____
3. Make a figure with a perimeter of 10 units and draw it on your geoboard paper. Can you make another figure with a perimeter of 10 units? Which figure has the larger area?

Materials:

9 yards of heavy string

geoboards

Rubber bands for geoboards

dot paper or geoboard paper

Discussion of Math Content and Related Questions:

Discussion questions:

- Explain how it is possible for figures/objects to have the same perimeter and different areas.
- Is it also possible for figures/objects to have the same area and different perimeters. Have students use their geoboards or dot paper and see if they can prove that this is possible or impossible.

M2T2

Participant Page

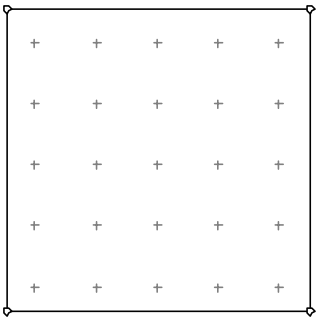
Constant Perimeter/Different Area

Make each of these figures on your geoboard. Sketch your figure on the geo-grid.

Journal Activities:
Explain what happens to the shape of the string rectangle as the area increases.

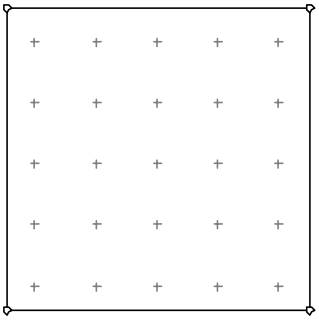
Is it possible for two rectangles to have the same area but different perimeters? Make a sketch.

1. Make a rectangle with a **perimeter of 16** units



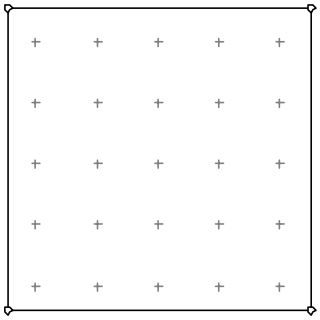
Length _____ units
Width _____ units

2. Make another rectangle with **perimeter of 16** units that has a larger area.



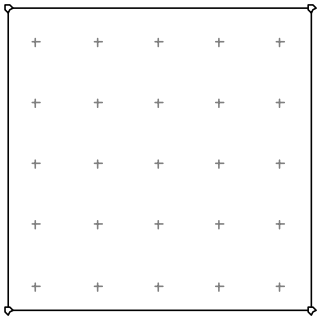
Length _____ units
Width _____ units
Area _____ square units

3. Make one more rectangle with a **perimeter of 16** units that has a smaller area.

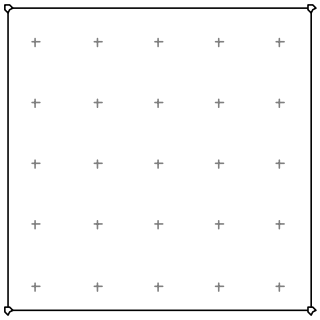


Length _____ units
Width _____ units
Area _____ square units

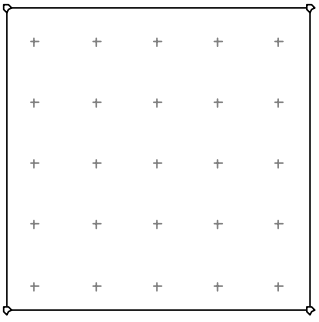
4. Make three different rectangles that each have a **perimeter of 24** units



Length _____ units
Width _____ units
Area _____ square units



Length _____ units
Width _____ units
Area _____ square units



Length _____ units
Width _____ units
Area _____ square units

Constant Perimeter / Changing Area Graph

Instructor Page

Grid paper with axes available in the appendix

It is possible to draw a rectangle with width of 1cm, length of 11.1cm and area 5H. The number of possible rectangles is infinite. This data results from measures and the relationship is continuous.

One rectangle with perimeter of 24 has an area of 36. This rectangle is a square and is the largest possible (maximum) area for this perimeter.

Context: Students use grid paper to draw rectangles with perimeter 24 cm. They are looking for as many different areas as possible.

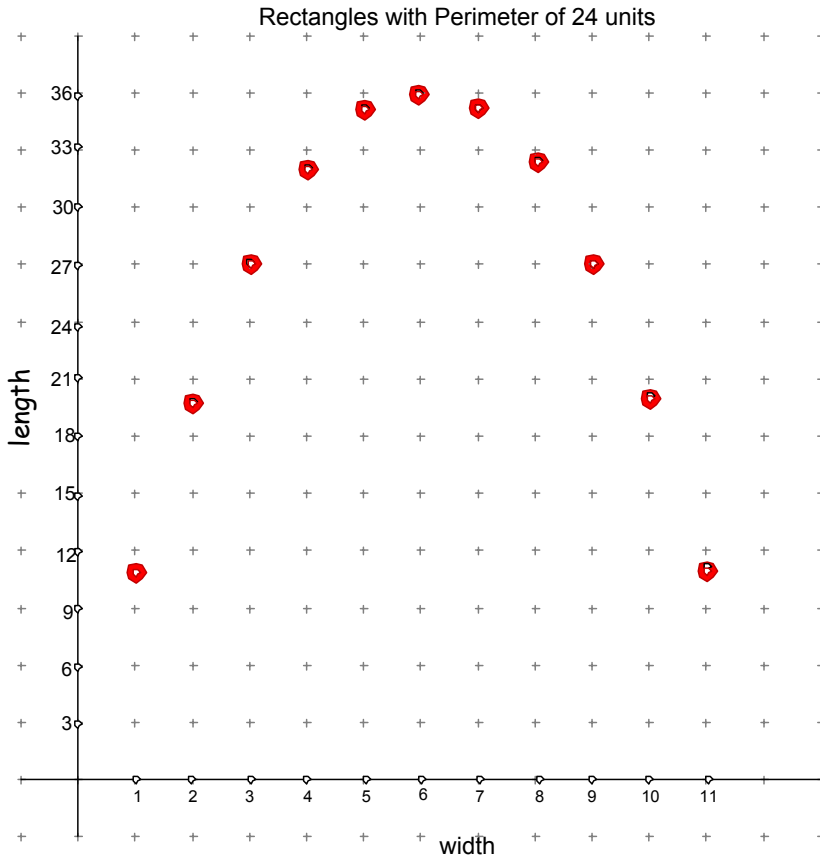
Activity Instructions:

⇒ Discuss the rectangle drawn on the grid. It is 11 cm long and 1 cm wide. Its perimeter is 24 cm and its area is 11 square cm.
⇒ Working individually, students draw several more rectangles that also have perimeters of 24 cm. and find the area of each.
⇒ Each student uses his/her drawings to complete the information in the chart at the bottom of the page.
⇒ Discuss the information in the charts. Are there rectangles on the grid paper that are not shown in the chart? Could we include more widths than are listed on the page?
⇒ Working together complete the scatter graph of the rectangle width and the area.
⇒ Do the points suggest a relationship? Is it possible to connect the points with a line or curve? Discuss the shape of the curve that fits this data.
⇒ Discuss the rectangle with the largest possible area.
⇒ Draw the rectangle with the largest area.
⇒ Repeat this activity with rectangles with perimeter of 36 cm or 60 cm. See appendix

Discussion of Math Content and Related Questions:

Points plotted from data may suggest a relationship. If the points can be lined up with a ruler or the edge of an index card (or any straight edge), the relationship is **linear**. The relationship may be almost linear or it may be **nonlinear**.
A nonlinear relationship may curve **upward** or **downward**.
We may also describe a relationship as **increasing** or **decreasing**. We might be interested highpoints (**maximums**) or lows (**minimums**).
The graph may increase or decrease at a **constant rate**. It may be **symmetrical**.

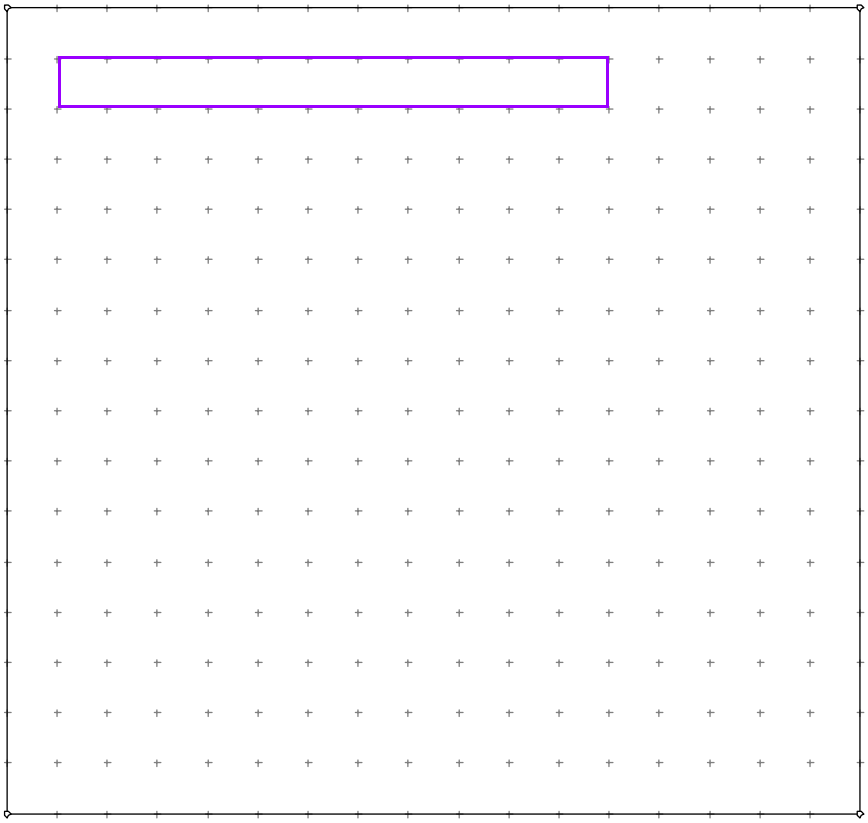
This graph is nonlinear. It curves downward. It is symmetrical. It is increasing, reaches a maximum, and then is decreasing. The relationship is quadratic and the graph is a parabola. The value of the maximum is 6 x 6 or 36, a square number.



M2T2

Participant Page

Constant Perimeter / Changing Area Graph

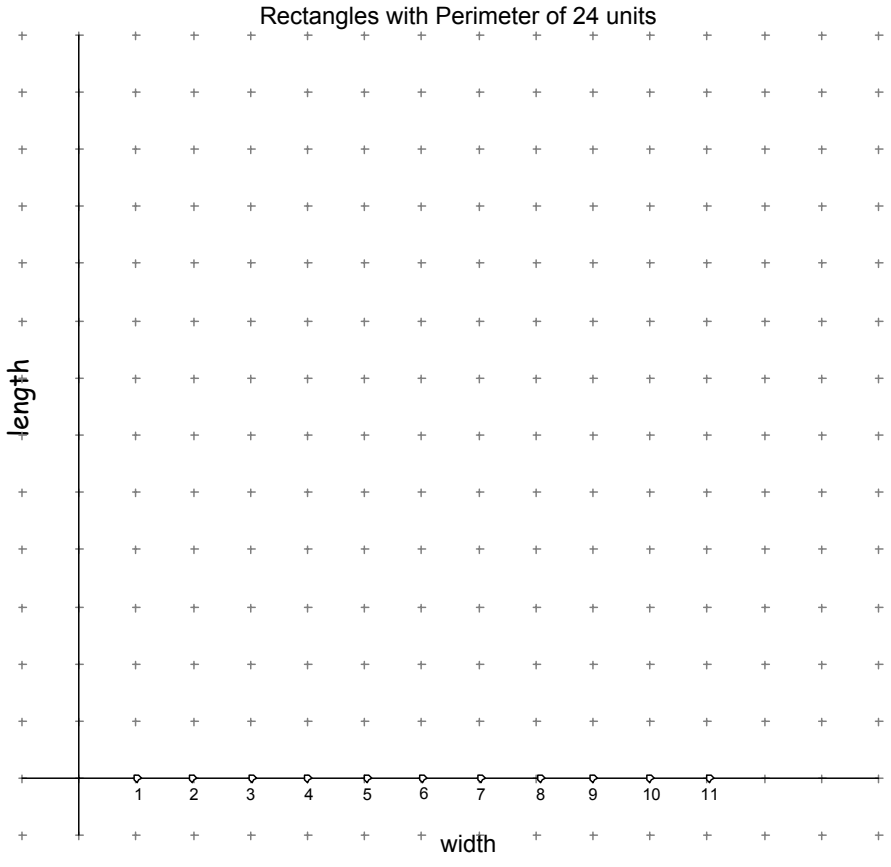


Use the grid to draw rectangles with a perimeter of 24 units. Record the width, length and area in the chart.

Journal Activity:

What does the graph show? Include answers to these questions in your description. Is it linear or nonlinear? Is it increasing or decreasing? Is there a maximum or minimum?

Rectangles with Perimeter of 24		
width	length	area
1	11	11
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		



M2T2

Instructor Page

Mass is most often measured in grams and kilograms

1 large paper clip or 2 small paper clips weigh approximately 1 gram

A nickel weighs 5 grams

1000 grams equals 1 kilogram

Estimating and Measuring Mass

To begin this activity, the teacher announces that the class will be measuring the mass of pieces of fruit. It is necessary to find out what the students know about the concept of mass.

Step-by-step guide

Activity 1: Mass/Weight

- The teacher divides the class into groups of 5 or 6 students. Groups go to their designated "Mathfiti" Board (Appendix A) and brainstorm their ideas of the meaning of mass. Using words, drawings, symbols etc, the students each put their ideas/understandings of mass on the Mathfiti Boards that are hanging on the classroom walls.
- Each group then shares and explains what they have on their Mathfiti Board. Teacher will need to facilitate and guide this discussion so that the class will come to an agreement on the meaning of mass.
- If the subject didn't come up earlier, the teacher should initiate the discussion of mass and weight. Are they the same or different?

Discussion of Math Content and Related Questions:

Mass and weight are similar but they are not the same. Mass is the amount of matter in an object. It is usually measured by comparing with an object of known mass. Weight is a measure of how heavy an object is. While gravity influences weight, it does not affect mass. On Earth, your mass and your weight are the same but out in space and on other planets your weight would be different. There is still the same amount of you no matter where you are so your mass remains the same.

Materials:

- "Mathfiti" Boards (8 1/2 x 11 or poster sized laminated)
- tape
- colored markers

Literature Connections:

Why Doesn't The Earth Fall Up? by Vicki Cobb

Zero Gravity by Gloria Skurzynski

M2T2

Participant Page

Estimating and Measuring Mass

First, estimate and then measure and record the mass of each of these objects in grams and in ounces.

OBJECT	ESTIMATE (gm)	MASS (gm)	ESTIMATE (oz)	MASS (oz)
pen				
comb				
chalk eraser				
box of crayons				
key				
apple				
nickel				

Journal Activity:

After listening to the group discussion, write what you know about mass. Describe a situation where the difference between mass and weight becomes important.

Find 5 more objects in your classroom with mass less than 20 grams.

OBJECT	ESTIMATE (gm)	MASS (gm)

Find 5 more objects in your classroom whose weight is less than 16 oz.

OBJECT	ESTIMATE (oz)	MASS (oz)

Fruit Basket

Instructor Page

If gram weights or paper clips aren't available, 1 penny or 1 cm cube also equal approximately 1 gram.

Materials

oranges, bananas, grapefruit & tangerines

paper towels

Balances & gram weights or paper clips

calculators

Class Data Sheet (Appendix)

- Teacher asks each student to choose a piece of fruit from the basket and directs the students to estimate the mass. Use a balance to find the mass of their piece of fruit in grams. Remind students that 1 paper clip is approximately equal to 1 gram.
- Ask students to record their estimates on the Student Data Sheet.
- Teacher demonstrates how to use balance.
  1. Use gram weights or paper clips as weights.
  2. Put the piece of fruit in container on one side of the container on the other side until the containers are even with each other.
  3. Count the weights or paper clips in the container to find the mass
- Using balances and gram weights or paper clips, each student should find the mass of his/her piece of fruit and record it on the data sheet.
- Teacher directs students to peel their piece of fruit and then estimate the mass of the fruit that is not edible. Record estimate on data sheet.
- Using the balances and weights, students determine the mass of the peel and seeds (if any) and record this. ***(Remind students not to throw the peel away because it will be used in Activity 3.)***
- Students record data as a fraction using the edible or inedible part as the numerator and the total mass as the denominator.
- Students can then use calculators to compute the percent of the piece of fruit that was edible and the part that was inedible.
- Ask students to explain what they did to find the percent and why they did what they did.

Discussion of Math Content and Related Questions:

- Discuss the mass of the edible and inedible portions of each type of fruit. Since most pieces of each type of fruit will have a different mass, compute the average mass of each fruit and record on the Class Data Sheet transparency.
- Ask students which fruit would be the best buy based on the data. Further exploration of this idea could be done if students were provided with the cost of the fruit.
- Discuss the relationship between the mass and the weight of the fruit.

Ecology Extension:

Repeat this activity for a prepackaged snack lunch (Lunchable or similar product. Calculate the percent that is inedible (packaging that is thrown away) and the percent that is edible (food they actually eat). Make a plan for a better way to package the snack lunch with ecology and conservation in mind.

M2T2

Participant Page

Don't throw away any of your fruit. You will need it for the next activity.

Fruit Basket

Choose an orange, grapefruit or banana to eat. Estimate in grams the mass of your piece of fruit. Record on the data sheet. Measure the mass of your piece of fruit and record. Peel the fruit. Eat and enjoy! Keep the peel and other parts that you cannot eat and estimate the mass. Weigh and record. (Don't throw the peel away yet.) What fractional part of your piece of fruit is not edible? What part is edible? What percent of your piece of fruit is not edible? What percent is edible?

Student Data Sheet

Type of fruit	Estimated total mass	Actual total mass	Estimated mass of what you cannot eat	Actual mass of what you cannot eat	Fractional part that you cannot eat	Fractional part that you can eat	Percent that you can not eat	Percent that you can eat

What does your data tell you about your piece of fruit?

_____

_____

_____

Record your data on the Class Data Sheet.

HOW DID YOU DO?

- How close were your estimates?
- Look at the data on the Class Data Sheet. Which fruit has the smallest percent of inedible mass?

M2T2

Instructor Page

These activities are good opportunities to review area of irregular shapes.

The name activity is a good review of area & perimeter and the difference between the two.

Area of Fruit Peels

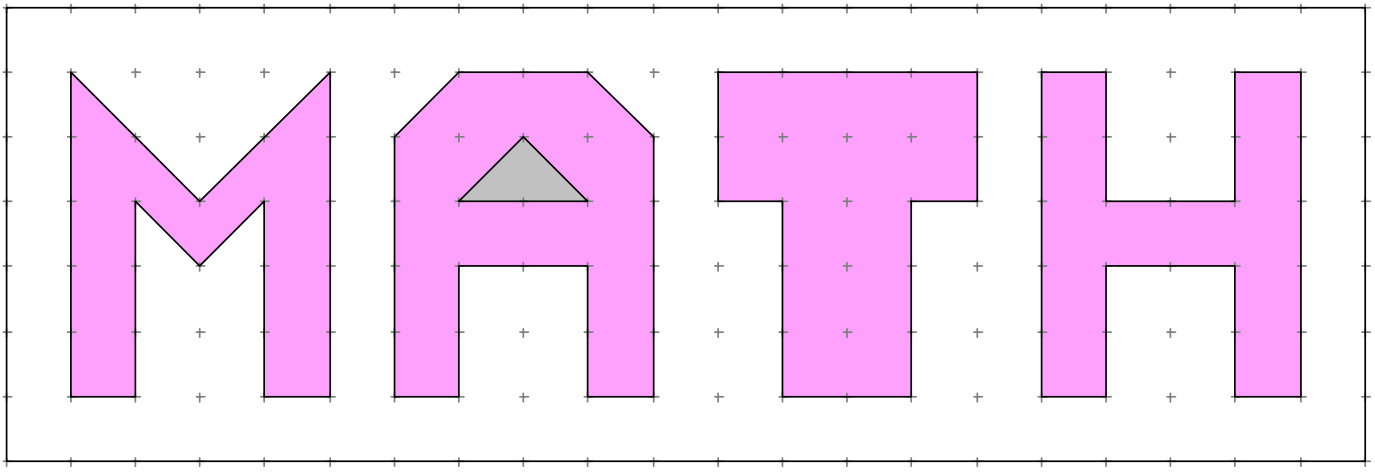
Step by Step Instructions:

- Teacher poses the following question: Is It possible to find the area of the fruit peel? How could you do this?
- Teacher lists suggestions/ideas on overhead projector or chalkboard. Hopefully from the previous lessons on area, someone will suggest flattening the fruit peel on cm graph paper (Appendix C), tracing it and counting the square units. If necessary, discuss again what to do with partially covered squares.
- Ask students to record the area on their worksheet. Check to see if they recorded the area in square units

Area of Student Names

On centimeter graph paper, print your first and last name in block letters 5 cm high. After you have finished, find the area of your first and last name.

- Area of first letter of first name_____
- Area of first name_____
- Area of first letter of last name_____
- Area of last name_____
- Total area of your name_____



Area of the letter "**M**" is 11 square cm,
Area of the letter "**A**" is 14 square cm.
Area of the letter "**T**" is 14 square cm.
Area of the letter "**H**" is 12 square cm.
Area of the word "**MATH**" is 51 square cm.

M2T2

Participant Page

Journal Activity:

Describe how you found the area of the fruit peel. Tell what you did and why you did it.

Which fruit has peel with the greatest area? Were any about the same? Why?

Area of Fruit Peels

Find the area of the fruit peel. Use grid paper to help. Record the area here and on the class data sheet. Be sure to label the area in square units.

Type of fruit	Estimated total area	Actual total area

Area of Student Names

On centimeter graph paper, print your first and last name in block letters 5 cm high. Then find the area of your first and last name.

Area of first letter of first name_____

Area of first name_____

Area of first letter of last name_____

Area of last name_____

Total area of your name_____

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Appendix A

Additional Activities

Straw Perimeter Journal Activity

Each student measures and cuts three pieces of string. Each piece is 30 inches long.

Figure One
- Measure and cut drinking straws into four 6-inch lengths.
- Thread one of the string pieces through all four straws and tie the string ends to form a quadrilateral.
- Describe the figure that is constructed.

Figure Two
- Measure and cut drinking straws into three pieces of different lengths.
- Thread one of the string pieces through all three straws and tie the string ends to form a triangle.
- Describe the figure that is constructed.

Figure Three
- Measure and cut drinking straws into two 6-inch lengths and two 4-inch lengths.
- Thread one of the string pieces through all four straws and tie the string ends to form a quadrilateral.
- Describe the figure that is constructed.

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Appendix B

Fruit Basket
Class Data Sheet for Mass

Type of fruit	Estimated total mass	Actual total mass	Estimated mass of what you cannot eat	Actual mass of what you cannot eat	Fractional part that you cannot eat	Fractional part that you can eat	Percent that you can not eat	Percent that you can eat
Orange								
Banana								
Grapefruit								
Tangerine								

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Appendix C

Area of Fruit Peels
Class Data Sheet

Type of fruit	Estimated total area	Actual total area
Orange		
Banana		
Grapefruit		
Tangerine		

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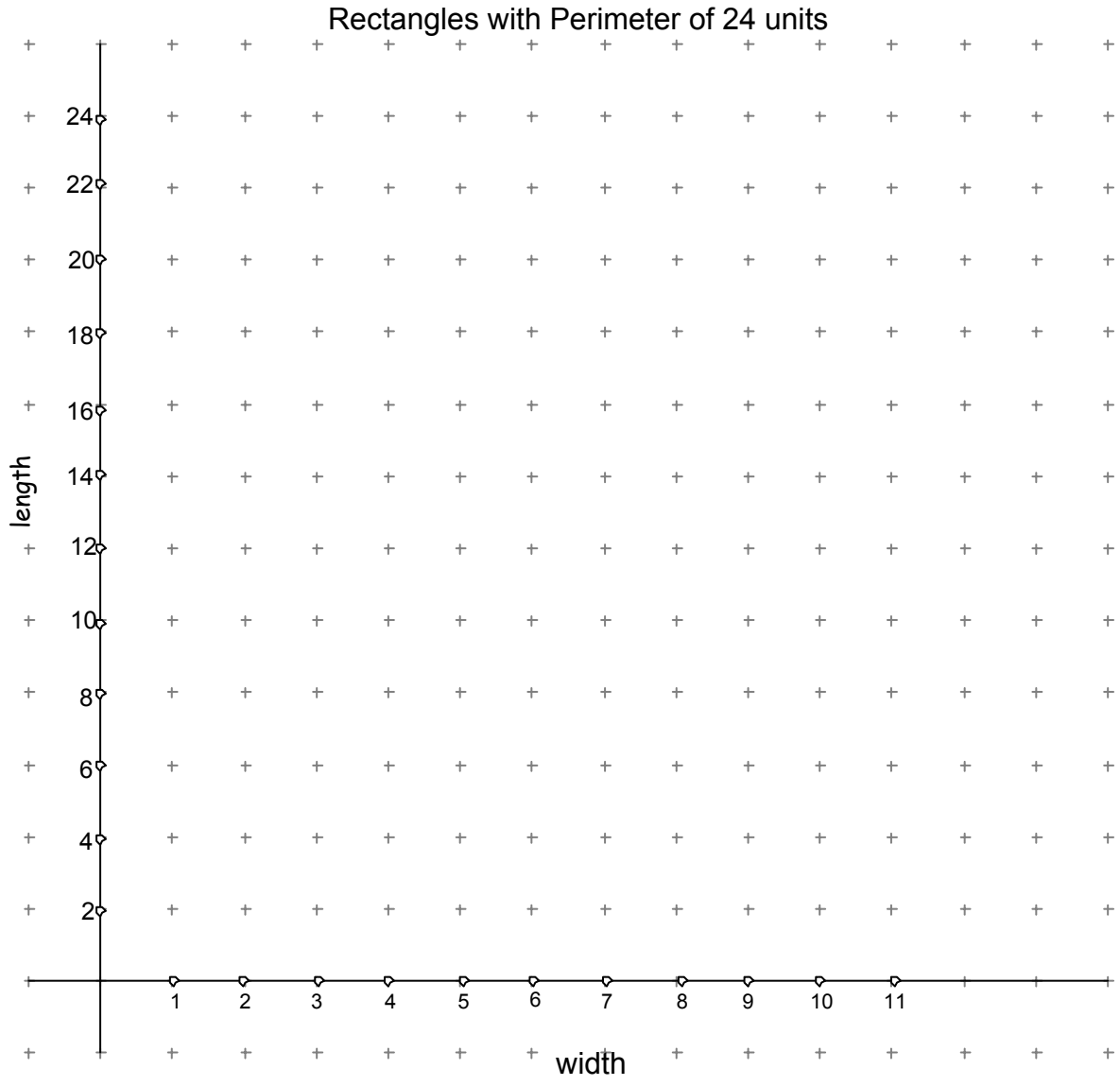
Appendix D


Rectangles with Perimeter of 24 units
length
24
22
20
18
16
14
12
10
8
6
4
2
1
2
3
4
5
6
7
8
9
10
11
width

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Appendix E

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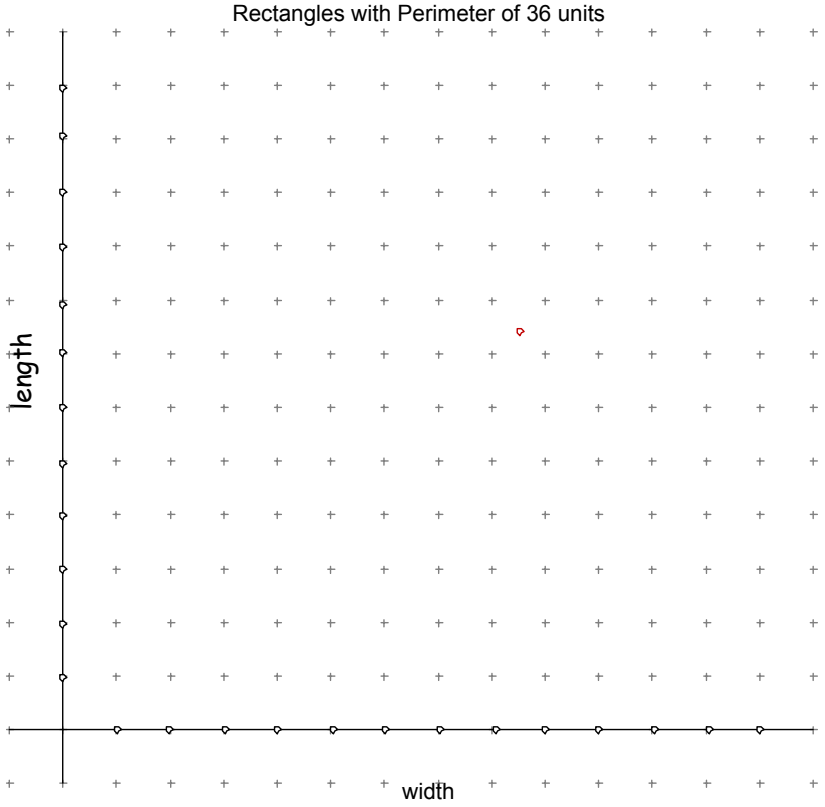
Appendix F

Use grid paper to draw rectangles with perimeters of 36 or 60 units. Record the width, length and area in the appropriate charts.

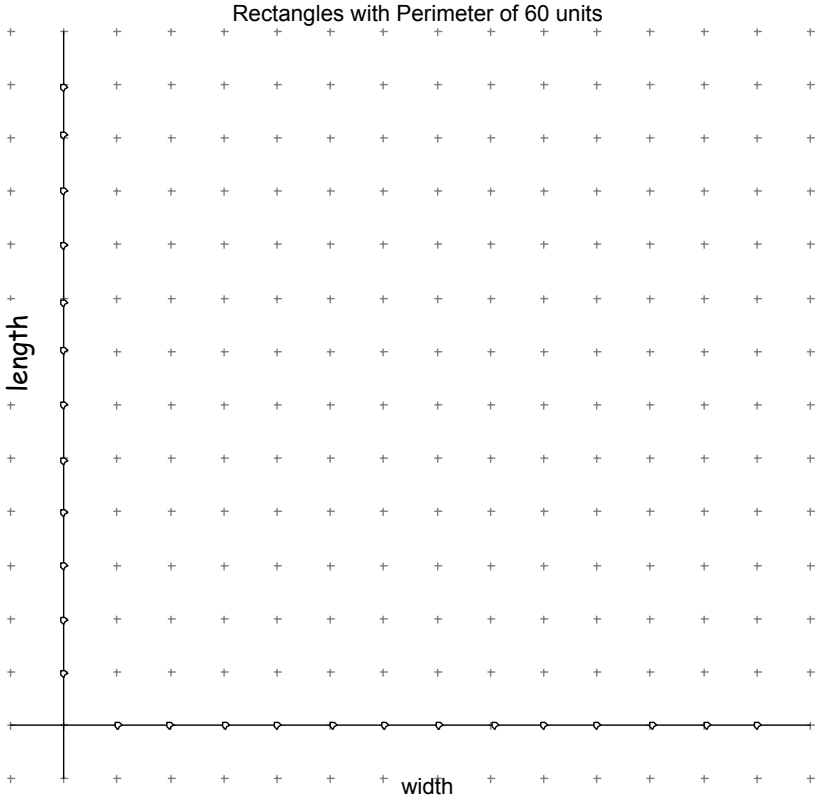
More Constant Perimeter / Changing Area

Rectangles with Perimeter of 36 units



Rectangles with Perimeter of 36		
width	length	area
1		
6		
8		
12		
16		

Rectangles with Perimeter of 60 units



Rectangles with Perimeter of 60		
width	length	area

Email questions and comments to
m2t2@mail.mste.uiuc.edu

Number Sense