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Introduction
sections

General Instructions for Activity

1. Read the activity completely before starting.

2. Collect the supplies. You will have less frustration and more success if you have all the necessary materials for the activity are ready in all the necessary materials for the activity are ready.

3. Do the same thing for the exercises. Following the steps twice, then follow the steps described in the answers.

Through and Exercise Sections

General Instructions for Let's Think It Through

1. Study each section carefully by reading through it once or twice.

4. What you need to know: Background information and an explanation of terms.

The formal for each chapter is:

The formal for each chapter is:

4. Do the work again if any of your answers are incorrect.

3. Check your answers in the solutions to Exercises to evaluate.

2. Do the same thing for the exercises. Following the steps twice, then follow the steps described in the answers.

1. Study each section carefully by reading through it once or twice.


5. Activity: A project to allow you to apply the skill to a problem-solving situation in the real world.

The formal for each chapter is:

1. What is the main objective of the problem or the exercise? Write the main objectives to be pursued.
A line segment is a part of a line. It follows a straight path between two points, called endpoints. A line segment is named \( \overline{AB} \) or \( \overline{BA} \), where \( A \) and \( B \) are the endpoints.

If it is written as \( TA \) or \( TA \), it is read: line segment \( TA \) or line segment \( AT \). The name of the line segment in the example is \( \overline{AT} \) (which can also be read as \( TA \) or \( AT \)). Any line segment can be identified by naming any two points on the line, such as \( T \) and \( A \). Here, the combination is indicated by an arrow at each end of the line segment, \( TA \) or \( AT \), or \( \overline{TA} \) or \( \overline{AT} \).

The geometric definition of a line is a straight path that has no endpoints or curves, such as a straight line made by a pen or pencil, or the edge of your hand. A straight line can be of any shape and length. It can be as straight or curved as you like.

What you need to know:

- Line segments, and rays
- Identifying lines
- Lineup
Exercises

1. Study the diagram and name the line segments.

2. Identify the example that shows a line and give its name.

3. Identify the example that shows a line segment and give its name.

2. Think!

The name of the ray is Ray OP (OP).

The points on the ray, beginning with the endpoint, are O and P.

The line that includes a point is one endpoint. Example: B.

A ray is a part of a line with one endpoint. Which example?

1. Think!

The name of the segment NL (NL).

The endpoints on the line segment are L and N.

A shows a straight path. Example: A.

Do both examples show a straight path? No. Only example M.

Answers

Let’s Think It Through

Read: Ray HL. It is written as HL.

Starts with its endpoint. The name of the ray in the example is H. The ray goes on forever in only one direction. A ray’s name follows a straight path.

A ray is a part of a line with one endpoint. It follows a straight path.

Lineup 13

Geometry for Every Kid
1. **Think!**

**Solutions to Exercises**

* * *

where the paper

- Use the ruler to draw a 6-inch (15-cm) line segment any-

1. Draw a point in the center. Draw the line I-I. I-1 I-1

2. Mark a point in the exact center of the line. I-

Procedure

Materials

Special Illusion To use lines and line segments to demonstrate an

(Activity) SIDE BY SIDE

Why?

length

then IM even though we know that both lines are the same

Results 1. With the Y's pointing inward appears to be longer

4. Compare the visual appearance of KL with that of IM.

**Diagram**

I. Draw A point outward from point M as shown in the

3. Draw two Y's pointing toward each other from points K and

1a. Geometry for Every Kid
The unit used in measuring an angle is the degree. One degree

$\text{Vertex} - E$

is $\angle\text{BEN}$ or $\angle\text{NEB}$. It is written in the example is read: angle BEN or angle NEB. It is written as $\angle$, the symbol $\angle$. The name of the angle can be replaced by its symbol. $\angle$. The word $\text{angle}$ is used to name an angle, with the center letter being the vertex. The word $\text{angles}$ is used to name the sides of the angle. alternate letters are used to name the sides of the angle, and the endpoint where they meet is the vertex of the angle, and the endpoint where they meet is the endpoint of two straight lines that meet. The rays or lines are some endpoints of two straight lines that meet. The rays or lines are some endpoints of two straight lines that meet. The rays or lines are some endpoints of two straight lines that meet. The rays or lines are some endpoints of two straight lines that meet. The rays or lines are some endpoints of two straight lines that meet.

What You Need to Know

Measuring Angles of Straight-sided Figures

What’s the Angle?

1. Geometry for Every Kid

2. Think

3. Think

4. Think

The name of the line is line BC (BC) or line CB (CB).

The name can start with either of the two points.

A line is identified by naming two points on the line.

A ray’s name starts with its endpoint.

C. Yes

B. No

A. No

For each example, ask yourself: Does this show a straight line?

The statement is false.
Angle is obtuse. So CAF is 130 degrees. The larger number in the example, 130, crosses the scale at 130 degrees. If the angle is acute, use the smaller number. If it is obtuse, use the larger number. The protractor will show two numbers on the curved edge. The protractor will show two numbers on the curved edge. The sum of the vertices of the angle and the straight edge on one side of the angle is then placed on the center mark of the protractor on the edge of the angle. The measure of an obtuse angle is greater than 90 degrees. The measure of an acute angle is less than 90 degrees. The measure of a right angle is 90 degrees.
What's the angle?

Acute angle:
The measure of an acute angle is less than 90 degrees.

Right angle:
The measure of a right angle is 90 degrees. The corner of a square or rectangle is a right angle.

Obtuse angle:
The measure of an obtuse angle is greater than 90 degrees.

An instrument used to measure angles in degrees is the protractor.
1. What is the name of the angle in example A?

2. Write the name of the angle in example B.

**Exercises**

The angle is written as: \( \angle WXY \) or \( \angle YXW \).

How is the angle read? Angle \( \angle WXY \) or angle \( \angle YXW \).

What is the middle? \( \angle WXY \).

What are the angle's three letters? With the vertex letter.

**Think**

The angle is 140 degrees.

The angle is obtuse. Which of the angle choices, 40 degrees or 160 degrees, is acute?

The angle is acute. Which of the angle choices, 20 degrees or 160 degrees, is acute?

2. Use a protractor to measure the angles in examples A and B.

Let's think it through.

Geometry for Every Kid
Activity: Paper Art

Materials:
Blue crayon
Typing paper
Scissors

Procedure:
1. Measure and cut an 8-by-8-inch (20-by-20 cm) square from the paper.
2. Measure the angle of the bottom chord.
3. Lay the paper on a table, with the side up.
4. Fold the paper in half diagonally from point A to point B.
5. Unfold the paper and cut about 2 inches (5 cm) down the center fold line.
6. Fold the paper so that points C and D meet at the center.
7. Fold the paper again, so that points E and F meet at the center fold line.
8. To fold a sheet of paper into the shape of a whale.
1. **Think**

   The bottom left corner of the frame is 90 degrees.
   - How many degrees are in a right angle?
   - Right angles.
   - The frame is a rectangle. Rectangles have what type of angles?
   - Right angles.

2. **Think**

   The angle of the bottom chart is 90 degrees.
   - How many degrees are in a right angle?
   - Right angles.
   - The angle is obtuse. Which of the angle choices, 35 degrees or 145 degrees, is acute?
   - The angle is acute. Which of the angle choices, 35 degrees or 145 degrees, is acute?

3. **Think**

   The angle of the bottom chart is 160 degrees.
   - Draw an eye and a mouth on the fish face, as in the diagram.
   - Turn the paper over and draw an eye and a mouth on either side of the face.
   - Fold the two cut ends outward.
   - Fold along the fold line from point A to point B.

---

**Solutions to Exercises**

For the art of paper folding.

Forms and designs are like puzzles, simple folds, and other paper crafts introduced to Europe in the 18th century. The art form was brought to Japan, where Japan- and was influenced by the Chinese about 2,000 years ago. In the years ago, the art of folding paper into shapes that look like objects is called origami. Each fold in the paper is made at a new angle. The art of paper folding.

**Results**

You have made a paper whale.
What You Need to Know

Parallel and Perpendicular Lines

Identifying Intersecting, Parallel, and Crossover
Let's think it through.

- They are written as: \( \overline{KB} \parallel \overline{FN} \).
- Line \( \overline{KB} \) is parallel to line \( \overline{FN} \).

LINES that do not intersect and are always the same distance apart are called **parallel lines**. Lines \( \overline{KB} \) and \( \overline{FN} \) are examples of parallel lines.

\[ H \]

They are written as: \( \overline{CH} \).

Think Answer

A is an example of parallel lines.

The lines in example A do not meet or cross and are the same distance apart.

The lines in example B do not meet or cross and are the same.

Intersecting Lines.

The lines in example C cross.

The three examples identify the intersecting and parallel lines of line segments in segments.
Procedure

1. Ask your helper to hammer the tip of one of the nails into adult header. If you have a wooden block, you can use a small block of wood instead of a header.

Materials: Hammer, wooden block, nails (2-4 by 6 inches or larger), 7 nails. Check balance on the head of a seventh vertical nail.

Purpose: Study the two drawings and identify the following:

Exercise: Geometry for Every Kid

Activity: Balancing Nails

1. Lay nail 2, 3, 4, and 5 over nail 1 so that they are parallel. Lay nail 1 parallel with the edge of the table.

2. Arrange the nails so that they work as a single unit by following these steps. The numbers refer to the nails as shown in the drawings.

3. To show how six intersecting and parallel nails can...
18. Think

Solution to Exercise

Connect the balance of weights allows six nails to balance on the
opposite side of the weights of the two horizontal parallel nails. Thus
the weight of each nail is the same. Thus, the weights

Why?

Results. The arrangement of nails balances.

4. Place the center of nail 1 on the head of the vertical nail that

under the nail.

3. Gently and very carefully pick up the group of nails by

the lip of nail 1. Lay nail 6 on top of the arrangement so that it is parallel

Do any of the lines meet or intersect at 90 degrees? No.

Think:

这对都处于垂直方向上吗？

There are no perpendicular lines in either diagram.

32 Geometry for Every Kid
a polygon.

What you need to know:

Identifying Figures

Triangles

Three-Sided

4
Geometry for Every Kid

Three-Sided Figures

Look at the diagram in the chapter and answer the following:

1. Let's Think It Through

Obtuse Triangle

Angle measures greater than 90 degrees.

Right Triangle

One angle measures exactly 90 degrees.

Acute Triangle

All angle measures less than 90 degrees.

In an equilateral triangle, all three sides are congruent.

In an isosceles triangle, two sides are congruent.

In a scalene triangle, no sides are congruent.

Triangles can be identified in two different ways. One way always measures 180 degrees.

The sum of the angles created by the three sides is their sides. A polygon made up of three sides is called a triangle.
Materials: Scissors

Purpose: To construct models of acute triangles.

Activity: STRAW TRIANGLES

1. What are all the possible names for the boat's triangular sail?

Exercises

The possible names for the triangle are isosceles triangle and acute triangle.

- What is the name given to a triangle in which all angles measure less than 90 degrees?
- All the angles measure less than 90 degrees.
- What is the name given to a triangle with two congruent sides?
- Isosceles triangle.
- Two of the sides are congruent.

Think!

The measure of the missing angle is 71 degrees.

\[
\begin{align*}
180^\circ - (109^\circ + 71^\circ) &= 0^\circ \\
&= 180^\circ - 180^\circ \\
&= 0^\circ
\end{align*}
\]

Gives the amount of the missing angle.

The sum of the two angles shown subtracted from 180

triangle is 180 degrees.

The sum of the three angles formed by the sides of a

Think!

Answers

1. What are all the possible names for the triangle?

2. What is the measure of the missing angle?

3. What is the measure of the missing angle?
The procedure for making the triangle involves the following steps:

1. Cut the strips into six pieces: make one 2-inch (5-cm) piece.
2. Open the paper clips as shown in the diagram.
3. Form the triangle by using the clips. Place and fix the 4-inch (10-cm) pieces.

Why?

The lengths of the strips determine the angles.

Two acute triangles are formed. One of the angles is congruent and the other isosceles.

Results

• Three 4-inch (10-cm) pieces.
• Two 4-inch (10-cm) and one 2-inch (5-cm) piece.
What you need to know

Identifying Quadrilaterals

What is a quadrilateral? A quadrilateral is a four-sided polygon formed by four line segments that are not parallel to each other.

Four-Sided Figures

- Parallelogram
- Square
- Rectangle
- Rhombus
- Trapezoid

Identifying Parallelograms

A parallelogram is a quadrilateral with opposite sides that are parallel and equal in length. Opposite angles are also equal. The diagonals of a parallelogram bisect each other. If one diagonal bisects the other, then it is a rhombus. If all sides are equal, then it is a square.

2. Think

The possible names for the triangle are obtuse triangle and isosceles triangle.

- A triangle with one obtuse angle.
- Two sides of equal length.

Solutions to Exercises

Geometry for Every Kid
3. Think

Two of the figures are parallelograms: A and C. How many of these figures have two pairs of parallel sides?

2. Think

There are three quadrilaterals: figures A, B, and C. Which figures have four sides?

1. Think

Answers

3. Identify each of the quadrilaterals. How many of the quadrilaterals are parallelograms?

2. How many quadrilaterals are labeled in the diagram?
Form a rectangle of equal size.

Results

The rhomboid is taken apart and rearranged to

![Diagram of rearranged shapes]

Procedure

1. Lay the yellow plastic folder over the rectangle pattern
2. Cut off the blue triangle and place it on the yellow
   triangle and place it on the yellow
3. Place the edge of the ruler on the right side of the blue
   triangle and place it on the yellow
4. Lay the blue plastic folder over the rhomboid pattern and
   trace the rhomboid figure onto the plastic. Use the edge of
   the ruler to make the edges of the rectangle straight.
5. Cut out the rhomboid
6. Lay the rhomboid on top of the rectangle as shown.

Materials
- 1 yellow plastic folder
- 1 blue transparent plastic report folder
- Marker pen
- Scissors
- Ruler
- Notebook

Activity: Rearrangement

Exercise

Identify the four labeled quadrilaterals in the diagram.
What You Need to Know

Polygons Can Fit Together

Determining Different Ways That Figures Figures

Hidden Figures

Solutions to Exercise

This makes a green rectangle. 

one side and placing it over the yellow triangle on the opposite edge. By changing the blue triangle, it can form a rhombus. The shape of the rhombus can be drawn into that of an equal-length side. The rhombus is like a diamond.
Exercise

The total number of squares is five.
- The figure shows one large square made up of four smaller squares.
- A square has four congruent sides and all its angles are right

Think
Answer

How many squares are hidden in the figure?

Let's think it through.

Activity: Cutaway

1. Measure and cut an 8-by-8-inch (20-by-20-cm) square from the paper.
2. Follow these steps to divide the square into seven pieces.

Procedure

Stopwatch
Sheets of construction paper
Scissors

Materials

Purpose
To make a lantern

Drawn diagram of a cutaway figure with labeled parts for cutting.
Try making different shaped polygons with the pieces.

3. Without looking at the diagrams in this book, name how

4. Fold the isosceles (piece 2) in half so that the shorter

Label the triangular piece „4„ and set it aside.

Fold the isosceles (piece 2) and set it aside.

Label the isosceles (piece 2) in half and along the fold line. Label the longer side touches the center of the longest side, label the opposite side.

Fold piece 1 in half as shown and label the second half.

Square piece „6„. Set pieces 7 and 5 aside.

Set pieces 7 and 5 aside.

Fold piece 2 so that the pointed end touches the opposite side.

Go to the back of the book and refer to the instructions.
The total number of squares in the figure is 14.

1. How many pairs of triangles make up the figure?
   - Equal-size triangles.
   - A diamond shape can be formed by combining two.

2. Think
   - The total number of triangles in the figure is five.
     - Hidden triangles inside.
     - The figure shows a large triangle with four smaller triangles inside.
     - Which smaller sides?
     - What is the shape of a triangle? A closed figure with three.

Solutions to Exercises

Various of other polygons can be arranged to form the original square as well as a great square into five triangles. A square, a triangle, and a rhombus. The pieces are made by cutting a square into seven pieces: five triangles —

Why

Results
What You Need To Know

Identifying Congruent Polygons

Overlay

7
Exercise

Polygons E and C are congruent.
- Do the sides and vertices of the two polygons match? Yes.
- If so, then A over Polygon C.
- Flip the image of Polygon B, over, then slide and rotate.

1. Think

Polygons E and F are congruent.
- Vertices and sides matching? Yes.
- Do the figures exactly fit on top of each other with their
  figure E Slide and rotate the image to fit over Polygon
  to compare the figures, use tracing paper to neatly make

2. Think

Polygons E and F are congruent.
- Vertices and sides matching? Yes.
- Do the figures exactly fit on top of each other with their
  figure E Slide and rotate the image to fit over Polygon
  to compare the figures, use tracing paper to neatly make

Answer

Figure C and D are not congruent polygons. They have the
same shape, but C is smaller than D. If C were placed on top
of D, their sides and vertices would not match.
Trace Figure A on the tracing paper.

Cut Figure A from the yellow paper.

Cut two polygons congruent to Figure A from the folded paper.

Place the traced pattern of Figure A on the folded paper.

Fold the yellow construction paper in half.

Purpose
To construct a design with congruent polygons.

Activity: MATCHUP

Materials
Pencil
Tracing paper
Yellow, red, green, and white construction paper
Scissors
Glue
Polynomials A, B, C, D, E, and F are congruent with polygon A.

When polynomials do not polygon A exactly at one point or so that their vertices and sides match:

1. Place one of the six green pentagons on the right side of the design.
2. Flip one of the yellow hexagons upside down and place together in the shape of flower petals.
3. Overlap the short ends of the six red congruent pentagons.
4. Repeat Step 1 to color in the indicated number and color of the remainder of the flower petals. Flip a second pentagon left over and place it on the left side of the stem opposite the first leaf. Arrange the petals. Flip a second pentagon left over and place it on the stem to make a leaf that angles upward toward the flower.

To compare the figures, use tracing paper to nearly face the copies.

**Solution to Exercise**

Why? Cutting out the polygons by cutting through the white space of size Tissue, they remain congruent polygons. The congruency of size Tissue can change their arrangement, if does not change their size. The congruency of size Tissue does not change their arrangement. Although cutting or flipping the two congruent polygons one from the tracing paper and one from the paper and the folded congruency paper produces the same result, the paper and the colored congruency paper produces the same result.

Where is created.

A colored flower design
There are only five arrangements that are not pentominoes. The diagram shows figures made with five squares and their arrangements that are not pentominoes. The squares must be arranged so that the entire side of a figure made from five congruent squares is called a pentominoes.

Making Pentominoes

Five-Square Figures
Activity: Square Dance

Materials
- 6 sheets of typing paper
- 1 sheet of construction paper
- Scissors
- Ruler

Purpose
To determine if 12 different possible pentominoes

Procedure
1. Measure and cut five 1-by-1-inch (2.5-by-2.5-cm) squares
2. Place the five colored squares on one sheet of typing paper
3. Arrange the squares into a pentomino
4. Trace around the outside of each square

Exercise
Figure B is a pentomino?
- In which figure do the entire sides of touching squares line up?
- In which figures have we squares, yes, B and C?

Pentominoes are made up of five squares. Do any of the figures above square B? Yes, B and C.

Think

Answer

Which one of the figures is an example of a pentomino?

Let's Think It Through
Only one of the figures is a pentomino.

Why?

Think

Solution to Exercise

Up to five of the possible pentominoes are drawn, two on each sheet of paper.

Results

5. Rearrange the five squares on the same paper to form a second pentomino.

6. Again, place the outside of each square.

7. Repeat the procedure of arranging the squares into other pentominoes and placing around them until 12 different pentominoes are drawn. Two on each sheet of paper.

In which figure do the entire sides of touching squares line up?

How many figures are made with five squares? Three.
Learning about Curved Figures

What You Need to Know

Geometric Figures

Curved Figures

Closed Curve

Open Curve

The ends of the lines forming open curves do not meet, but form the perimeter of a plane figure. Curved figures can be closed or open. Curved figures that do not have straight sides are called geometric figures.
Figure A is an open curve. Which curved figure is formed by a line that has ends that do not meet?

2. Think!

Figure B is a simple closed curve. Is it self-intersecting and is continuous?
Which curved figure has a perimeter that does not intersect?

1. Think!

Answers

3. A curve whose perimeter intersects itself
2. An open curve
1. A simple closed curve

Match the picture with the correct description.

Let's think it through, complex curve...
1. Measure and cut two separate 2-by-36-inch (5-cm-by-1-m) strips from the butcher paper.

2. Label the strips 1 and 2.

Procedure

Materials
- transparent tape
- pencil
- butcher paper
- scissors
- ruler

Different closed-curved paper strips down their centers.

Purpose
To predict and compare the results of cutting two curved lines open, closed, simple, complex.

Choose two of the following items to describe each curved line:

Exercise

1. Figure C is a curve whose perimeter intersects itself.
2. Which curve is formed by a line that crosses itself?
5. Lay strip 1 over the corner of a table. Shrink where the edges are lapped together. Draw a straight line back and forth down the strip until you return to the starting point.

4. Prepare strip 2 by holding the ends, add a twist to the closed curve.

3. Prepare strip 1 by lapping the ends together to make a simple closed curve.

2. Cutting strip 1 along the edges, cut along the center of each strip.

1. Without removing the tape, cut along the center of each strip.

6. Repeat step 4, using strip 2.

7. Strip parallel with the edges.

The strange marking appears only on one side of each strip.
The figure is a closed complex curve.

Does the line forming the figure intersect itself? Yes.

Is there a break in the perimeter of the figure? No.

1. Think!

Solutions to Exercises:

The figure is a closed complex curve.

Does the line forming the figure intersect itself? No.

Is there a break in the perimeter of the figure? Yes.

2. Think!

The figure is a simple closed curve.

Does the line forming the figure intersect itself? No.

Is there a break in the perimeter of the figure? No.

3. Think!

The figure is a simple open curve.

Does the line forming the figure intersect itself? No.

Is there a break in the perimeter of the figure? Yes.

Why?

The Mobius strip does not separate into two loops when it is cut in half as wide and twice as long as the original, then is also equally as long as the original. Cutting strip 2 creates one large

side—the inside is also the outside.
A line passes through the center of a circle is called the diameter. A chord is a line segment whose endpoints lie on the circle. The radius is a line segment from the center of the circle to its circumference. Any point on the circumference of a circle is the same distance from the center of the circle. A circle is a simple closed curve. Any point on the circumference of a circle is a line. What you need to know about the parts of a circle is never-ending. 10
Exercises

1. The diagram shows that Holly and Andrew have worked together to draw a circle in the sand. If the length of rope between the two children is 6 feet (72 in), what is the diameter of the circle?

b. Diameter of the circle?

2. Use a ruler to draw a line the length of the radius, which is

\[ \text{radius (10 cm)} + 2 = \text{diameter (10 cm)} \]

The radius of the circle is half as long as the diameter. When

Think

Answer

Let’s Think It Through

circle. Every circle has an unending number of radius and diameters.
The diameter of any circle is twice as long as the radius of the circle.
Materials
- 10-inch (25-cm) coffee filter
- 8-inch (20-cm) coffee filter (basket type)
- Black water-soluble marker
- Drinking glass
- Round bottom
- Pipette
- Evaporation dish
- Beaker
- Water

Procedure

1. Stretch the coffee filter over the mouth of the glass.
2. Use the rubber band to hold the filter tightly against the glass.
3. Use the black marker to draw a circle with a diameter of about ¾ inch (1.9 cm) around the first circle.
4. Draw a second circle with a diameter of about ¼ inch (0.6 cm) in the center of the first circle.
5. Use the eyedropper to add one drop of water to the center of the outer circle produced by the spreading of the ink.
6. Wait about 10 seconds and add a second drop of water.
7. Continue waiting about 10 seconds and adding one drop.
8. Allow the paper to dry. This should take 5 to 10 minutes.
9. Draw a second circle with a diameter of about ¾ inch (1.9 cm) in the center of the third paper.
10. Use the black marker to draw a circle with a diameter of about ¼ inch (0.6 cm) in the center of the other paper.

Follow-up:
- How many different diameters are shown?
- What is the diameter of the pie?

Activity: SPREADERS
The diameter is 8 inches (20 cm).

Thus, the circumference of the circular pipe is 2 x 4.14 inches (10 cm).

2a. Think!

The diameter is 12 feet (4 m).

Thus, the circumference of the circle is 2 x 6 feet.

b. Think!

The radius is 6 feet (2 m).

Thus, the length of the rope is equal to the circumference.

The rope is situated from the center to the circumference.

Think!

Solutions to Exercises

Once the shape of a circle with an irregular form has been determined, a multicolored figure that is the general weight of the chemicals and their attraction to the area into the different primary colors of yellow, red, and blue. The result is a mixture of different colors. In water, most black water-soluble ink appears. The black ink is made from a combination of ink dissolved in water that is absorbed by the paper. The black ink is produced. A multicolored, jagged-edged, circular figure with an average diameter of 3.75 inches (9.4 cm) is produced.

Results

- 15 inches (37.5 cm) + 4.5 inches (9.4 cm)
- 15.00 inches (37.6 cm)
- 0.00 inches (1.0 cm)
- 3.75 inches (9.5 cm)
- 3.75 inches (9.5 cm)
- 3.5 inches (8.8 cm)

For each of the example that follows:

- Calculate the average diameter of the outer circle by adding
- the four diameter measurements together and dividing.
- By feet in the example that follows:

11. Calculate the average diameter of the outer circle by adding...
What You Need to Know

Central Angles

Drawing and Measuring Around

Central Angles

There are four congruent diameters. When it is divided into eight equal pieces, how many separate 8-inch (20-cm) lines cross the pie?

Think
Diagram with the string protractor:

1. Measure and cut a 12-inch (30-cm) piece of string.
2. Thread one end of the string through the hole in the center.
3. Tape about 1 inch (2.5 cm) of this end of the string to the back of the protractor.

Procedure:

Following these steps:

Construct a string protractor and use it to measure angles by

Materials:

- protractor
- string
- scissors
- ruler
- mathematics toolbox: string

The angle between the hands on the larger clock is the same as the angle between the hands on the small clock. The size of the circle does not affect the size of the angle.

1. Is ZSEA acute or obtuse? Oblique.
2. Pull the string so that it lines up with EA.
3. ZSEA and the edge of the 0-degrees line on ES.
4. Place the center mark of the protractor on the vertex of the angle.

THINK

ANSWER

Diagram is 70 degrees.

Let's Think It Through.

Use your string protractor to measure the central angle, angle, and wheel.

SE A between the second and sixth spokes on the ship's wheel.
Materials

- adult helper
- paper plate
- paper plate
- scissors
- pencil
- triangle paper

Purpose
To use the hands of a clock to estimate direction.

Activity: 12 O'Clock High

Heads directly toward the island.

How many degrees must the ship turn to be on a course toward the island?

Exercise

Which of the angle choices under the ship is obtuse?
Procedure

1. Lay the tracing paper over the pattern of the clock hands and trace them with the pencil.

2. Cut out the traced clock hands.

3. Place a hole in the center of the paper plate and draw through the circle.

4. Use the paper as a stencils to punch the hands in the center of the plate.

5. Write the number 1 through 12 around the edge of the clock.

6. Imagine that you and your friend are standing side by side, looking up at the stars in the sky. Your friend places the following:

7. Find the approximate location of the stars in the sky.

8. Draw 2 is in the night at 2 o'clock.

9. Place 1 as at 12 o'clock.

10. Hold the paper plate vertically in front of you.

11. Observe the direction of the hands and note the size of the angle.

12. If any between the hands, move the hands of the clock to 12 o'clock.

13. At 12 o'clock, the hands point straight up with no angle between the hands.

Results

Why?

Imagine any stars and you'll see the same thing your friend sees.

60 degrees apart. Follow the short hand as you look up at the sky.

At 2 o'clock, the hands should be no angle between the hands.

At 12 o'clock, the hands point straight up with no angle between the hands.

Hand at 2 o'clock and again note the size of the angle.

Leaving the shorter hand at 12 o'clock, place the shorter
Solution to Exercise

The clock would have to turn 60 degrees. Which of the angle choices under the string is acute? 60 degrees.

Is the angle acute or obtuse? Acute.

Measure 45° with your protractor.

Think
What You Need to Know

Tracing Plane Geometric Figures

Odd

2

12
Figure D can be drawn with one continuous stroke of the pencil.

1. Which figure can be drawn with one continuous stroke of the pencil?
   - Figure D

2. Draw a sheet of paper the figures (that can be traced) are printed on.

3. Draw a sheet of paper the figures over the same line twice.

4. How many odd vertices do the figures D have? Two.

Let's Think It Through:

4. Figure C cannot be drawn without lifting the pencil.
   - Yes, Figure C has four odd vertices. All vertices 1, 2, 4, and 5 are odd. There are more than two odd vertices in either figure.

1. Think! Answers

Some figures have vertices in which an odd number of lines meet. When a line meets an odd number of vertices, it cannot be drawn without lifting the pencil. If the figure has more than two vertices where a line meets an odd number of vertices, the figure cannot be drawn in one continuous stroke. If the figure has only two vertices where a line meets an odd number of vertices, the figure can be drawn in one continuous stroke.
1. Challenge 1: Draw a circle within a circle without lifting the pencil from the paper.

Procedure:

- Paper
- Pencil
- Marker

Stroke of a pencil. To draw a circle within a circle in one continuous line.

Activity: Impossible Challenge

1. Determine which figures can be traced with one continuous line.

   - Figure A
   - Figure B

Study Figures A and B to answer the following:

   - Figure A: Can be traced with one continuous line?
   - Figure B: Can be traced with one continuous line?

Exercises:

1. Determine which figures can be traced with one continuous line:

   - Figure C
   - Figure D

2. Draw on a sheet of paper the figure(s) that can be traced with one continuous line without lifting the pencil from the paper.

   - Figure E
   - Figure F

Here: Each point on the path has an odd number of endpoints, and the path can be traced without lifting the pencil from the paper.
Solutions to Exercises

1. THINK

**How many odd vertices does each figure have?**

**Figure E can be traced with one continuous stroke.**

- Figures with two odd vertices can be traced with one continuous stroke.
- Figures with two or fewer vertices can be traced with one continuous stroke.
- Figures with eight vertices can be traced with one continuous stroke.

2. When your helper has given up, follow these steps below to fold the corner:

1. Fold the paper, stopping when you reach the outer edge of the paper. Draw a large circle on the front of the paper. Where is the folded corner?
2. Draw a small circle on the front of the paper. Beginning at the tip of the folded corner, open the paper so that the tip is straight line above two inches (5 cm) from the circle. Draw a straight line. From this circle, draw a straight line down through the center. Draw a line from this circle, draw a straight line down through the center. Draw a line from this circle, draw a straight line down through the center. Fold the paper so that the tip is at the folded corner. Impossible challenge:

Show that you can successfully perform this step.
What You Need to Know

Determining Lines of Symmetry in Geometric Figures

Possible Solutions

Because it has two odd vertices, figure B can be traced in two continuous strokes if the starting point S is at one of the odd vertices, or at Z, and the endpoint E is at one of the odd vertices. The following is one of the two halves of the figure. If the figure is folded along the line of symmetry, the two halves will exactly match.
Determine if the dotted lines are lines of symmetry for the figures on the next page.

Let's Think It Through

- Figures on pages 103 and 104.

2. Figures have more than one line of symmetry, as indicated by the dotted lines. Some symmetric figures have one line of symmetry, while figures with two lines of symmetry are called symmetric figures.
Exercises

1. Determine if the dotted lines are lines of symmetry for the figures.

2. Think

CD is a line of symmetry

Which line exactly matches?

On which line(s) can the figure be folded to form two halves that exactly match?

AB, CD, and EF are all lines of symmetry

On which line(s) can the figure be folded to form two halves that exactly match?

Answers
1. Use the compass to draw a 4-inch (10-cm) diameter circle on the paper. (See Chapter 10 for information about diameters.)

2. Trace the equilateral triangle on paper and cut it out. Fold the circle in half twice to form a semicircle. Then unfold it.

3. Hold the circle in half twice until...

4. Cut four triangular notches in each side and one at the pointed end of the folded paper.

Procedure

Materials

- scissors
- graph paper
- compass

Purpose

To create a symmetrical figure.

Activity: LACV
The equilateral triangle has three lines of symmetry.

On how many lines can the paper be folded to form

2. Think!

None of the lines are lines of symmetry.

b. Think!

AB is a line of symmetry.

On which line(s) can the figure be folded in two

D. Think!

CD is a line of symmetry.

On which line(s) can the figure be folded in two

Solutions to Exercises

1. Think!

5. Unfold the paper.
Chapter 14

What You Need to Know

Make Artistic Designs Using Plane Geometry to

Plane Art

Let's Think It Through

1. Use a metric ruler and a protractor to draw two 6-cm lines.

2. Use the following steps to draw a curved design by connecting the points on an angle:
1. Draw a 140°-degree (obtuse) angle, each ray of which is 6 cm long. Divide the rays into six equal parts as shown in the diagram, then create the curve.

2. Draw a right angle measuring 3 cm along one ray and 6 cm along the other. Divide both rays into six equal parts as shown in the diagram, then create the curve. Note: The curve created by connecting the points on adjacent rays is also symmetrical.

**Exercise**

Let's think through the steps to draw the curved line.

**Answer**

Way: 1 to 6, 2 to 5, 3 to 4, and so on.

Points on adjacent (adjacent or neighbor) rays in this line create the curve. Connect the points on one ray to points on the other ray. Connect the points on adjacent rays. Draw a line segment to connect points on adjacent rays.

Use the steps in the exercise. Think through the steps to draw the curve.
Procedure

1. Use the ruler and protractor to measure and cut a 15-cm-
wide piece from the paper.

2. With the pen, draw a 10-cm-by-10-cm square in the center of
the paper.

3. Use a divisor to divide each side into 20, 2-cm parts and
number each dot with the pen, as shown in the diagram.

4. With a pencil, lightly mark and number each dot.

5. Thread the needle with about 2 feet (60 cm) of thread. Pull
the thread through the eye of the needle so that the two
ends meet. Tie a knot in the two ends.

6. Starting on the back side of the paper, begin working in
even numbers of the square. Insert the needle through one of
the points numbered 1.

Materials
- Transparent tape
- Sewing needle
- Colored sewing thread
- Pencil with eraser
- Ruler
- Marking pen
- Lining paper
- Scissors
- Protractor
- Metric ruler

Purpose
To construct a geometric string design.

Activity: String Theory

1. Draw a 30-degree (acute) angle, each ray of which is 6 cm
long. Divide the rays into six equal parts as shown in the
diagram. Then create the curve.
What You Need to Know

Geometric Patterns

Extending and Relating

What's Next?

15

This figure has the smallest angle and the most pointed.

As angles get smaller, the curves become more pointed.

Both rays are the same length, so the curve is symmetric.

Think:

The right angle produces a greater curve than the obtuse.

Symmetrical.

2. Think.
Exercises

1. What would be the next figure in each pattern?

2. Think

Answers

1. Think

2. Think

Let's think it through.

* What is the pattern? The flavor of the ice cream in the cone alternates.
* How do the figures differ? There are two different flavors with one scoop of ice cream.
* The next ice cream cone would be:

The next figure would be:

The sizes of the faces alternate.

Small faces have legs and feet and the large faces wear smiles. They vary in size also.


1. Measure and cut two strips of paper that are 2 x 4 inches.

2. Draw a line across the shorter side of the paper strips (5 x 10 cm).

3. Tape the top and bottom of one strip to a table.

4. Starting on the bottom line of the taped strips, draw a stick figure about 1 inch (2.5 cm) tall that has both arms down.

5. Place the second paper strip on top of the drawing with the edges of the strips lined up and tape the top of this strip to the table.

6. Trace the figure onto the top paper, but raise one arm and slip it to the table.

Procedure

Materials

- Transparent tape
- Marking pen
- Tracing paper
- Scissors
- Ruler

Purpose

To demonstrate a repeated pattern.

Activity: BOUNCER
The next figure would be:
- Heads
- What is the pattern? The direction of the heads after.
- Can directions.
- How do the figures differ? The heads are facing different.
- When figures are showing? Crowns heads.

1. Think!

Solutions to Exercises

The next figure creates the illusion that the ball is bouncing up and down. The next figure shows how to follow the object so quickly that persistence of vision is achieved. When the images are in motion, the eyes and brain combine the images and perceive them as real. When the two retinal images are quickly flashed on and off, the brain perceives an image that persists for a second after the object is out of view. This phenomenon is called persistence of vision. Why?

Results

The ball appears to bounce up and down.

Hints on the paper's several lines.

Quickly roll the pencil back and forth between the two shown edges of the top edge of the paper as

8. Place your hands on the ends of the pencil and roll the pencil up to the top line drawn on the paper.

9. Quickly roll the pencil back and forth between the two pencil lines on the paper.
Let's think it through.

What is the area of the rectangle shown?

Calculate the area of a rectangle, use the formula $A = l \times w$.

What You Need to Know

Calculating the Area of a Rectangle

CoverUp 16

Think! 2

The next figure would be:

- The next fish in line has one extra bubble.
- The next figures are flying.
- The number and size of the bubbles are different.
- How do the figures differ? The number and size of the bubbles are different.
- What is the pattern? The next fish in line has one extra bubble.
- The next figure would be:

Think! 3

must describe as a motion image of the third dinosaur.

position, but the position of the second dinosaur is a different position. Each dinosaur is in a different position.

How do the figures differ? The dinosaur's body is in different positions.

What figures are shown? Cartoon dinosaurs.
1. What is the area of Katherine's scar?

2. Martin mows his lawn twice a month. What is the total area that he mows each month?

Exercises

The area of the rectangle is 8 in.$^2$ (50 cm.$^2$)

$A = 50$ cm.$^2$

$A = 10$ cm $\times 5$ cm

$A = 4$ in.$^2$ $\times 2$ in.

or

$A = 50$ cm.$^2$

$A = 5$ cm $\times 10$ cm

$A = 2$ in.$^2$ $\times 4$ in.

or

$A = 1$ in.$^2$ $\times 1$ in.

Answer

English

The area of the rectangle is:

- inches (cm) x cm = cm$^2$ and is read: square centimeters)
- inches (cm) x cm = cm$^2$ and is read: square centimeters)

placed in the upper right of the unit $^2$. This is read: square

When two units are multiplied, such as in x in, a small 2 is

Length or the width without changing the result.

Sides a and b of the diagram may be labeled as either the

The formula for calculating the area of a rectangle is

$A = l \times w$
3. Rub the round pen back and forth across the nozzle while holding your index finger against the side of the pencil.

2. Hold the tweeter stick in one hand and the round pen in the other hand, with your index finger on the nozzle and end of the pen.

Procedure

1. Ask your adult helper to make a tweeter stick by following these steps:

   a. Measure and cut off the index and two rectangular pieces one 1/2 x 2 inches (1.25 x 5 cm) and 1 inch (2.5 cm) (10 cm).
   b. Push the tweeter through the center of the small propeller.
   c. Repeat the previous step to prepare the hole in the large propeller, and add the propeller in the tweeter stick by sticking the small propeller inside the large.
   d. Place the tweeter around the hole in the small propeller.
   e. Push the tweeter through the hole in the large propeller.
   f. Place the tweeter around the hole in the small propeller to prepare the hole in the large propeller.

Purpose

1. To determine if surface area affects the movement of air.
2. To determine if surface area affects the colour of the air.

Material

- Round pen
- Tweeter stick
- Index card
- Small propeller
- New pencil with eraser
- Adult helper
English

The area of each of the

3. Think

Martin moves 3,000 ft (914 m) each month.

If x = 2 ft, x

covers two times the surface area of the lawn x 2 x 1,500

Moving the lawn twice a month means that Martin

A = 1,500 ft²

Metric

The formula for calculating the area of the lawn is:

2. Think

The area of Katherine's scant is 1.5 ft² (150 cm²).

A = 1.5 ft²

A = 1 ft x 1.5 ft

A = 150 cm²

Metric

The formula for calculating the area of the scant is:

1. Think

Solutions to Exercises

Why?

Why is it easier to get started

Results

Both propellers turn, but the smaller one is usually

5. Repeat steps 2 and 3.

on the large propeller

4. Ask your adult helper to take off the small propeller and pu
The terms base and height are used when measuring triangles.

### Rhombus

Four sides are congruent. The opposite sides of a rhombus are parallel, and only its opposite sides are equal. A rhombus (also called a parallelogram) is explained in Chapter 5.

#### Calculating the Area of a Rhombus or Rhomboid

**Same Size**

<table>
<thead>
<tr>
<th>Units</th>
<th>English</th>
<th>Metric</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 in.</td>
<td>2.5 cm</td>
<td>1 cm</td>
</tr>
<tr>
<td>4 in.</td>
<td>10 cm</td>
<td>2.5 cm</td>
</tr>
</tbody>
</table>

The area inside the picture frame is:

$A = w \times h$
The area of the trapezoid is 8 in.² (50 cm²).

\[ A = \frac{1}{2} (b + a) \times h \]
\[ A = 8 \text{ in.}^2 = 4 \text{ in.} \times 2 \text{ in.} \]
\[ A = \frac{1}{2} (b + a) \times h \]

**Metric**

- Parallel side (2 1/2 in.)
- The height (the line drawn between the base and the opposite base) is 2 1/2 in.
- The formula for calculating the area of a trapezoid is:

\[ A = \frac{1}{2} (b + a) \times h \]

**Think**

- The height of a trapezoid is measured by drawing a perpendicular line between the base and its opposite parallel side.
- The mean of a 90-degree angle.
- The base (the bottom horizontal line) measures 2 1/2 in.
- Any side of the trapezoid may be labeled as the base.

**Answer**

Find the area of the trapezoid shown.

**Let's Think It through**

In this chapter, as we base as shown in the diagram. This method will be used.
Procedure

1. Use the pencil and ruler to mark two dots on the index card.

2. Calculate the area of the missing trapezoid-shaped puzzle piece in the illustration on the next page.

Materials

- Pencil
- Index card
- Ruler
- Scissors

Purpose

To demonstrate how the height of a trapezoid is determined.

Activity: How High?

Exercises

1. Calculate the area of the table leg.
The sides are congruent.
Perpendicular lines drawn between the base and its parallel side and height.

**Question:** Why the height is the perpendicular distance between the base and its parallel side?

**Results:** The length of both lines is equal.

6. Measure and compare the length of each of the two dashed lines.

5. Draw a dashed line on the trapezoid along both sides of the edge of the trapezoid.

4. Lay the ruler on top of the trapezoid in the left corner and along the lines.

3. Cut along the dashed lines. Keep the trapezoid but discard the triangle.

Diagram:
Drawing the dots in the corners on the card as shown on the diagram. With a ruler, draw two dashed lines across the card, one

Lower right corner
of the card, and the second dot 1/4 inches (3.8 cm) from the
What You Need to Know

Calculating the Area of a Circle

The area of the missing puzzle piece is 2 in.² (12.5 cm²).

\[
\text{Area} = \pi \times r^2
\]

In the formula, \( \pi \) is used more simply as 3.14. The number that is used in this book, like 3.14, is the value for \( \pi \) and is the most common value used and is known as \( \pi \) or \( \pi \). There is no exact number equal to this ratio. Calculators give the most accurate value of this ratio. The value of \( \pi \) is about 3.14, but there is no exact number equal to this ratio.

The radius of a circle is the length from the center of the circle to its edge. The formula is: \( A = \pi r^2 \). To find the area of a circle, use the formula for calculating the area of a circle. The radius of the circle is the length from the center of the circle to its edge. The area of the missing puzzle piece is 2 in.² (12.5 cm²).

1. Think:

The formula for calculating the area of the table leg is:

\[
A = \pi \times r^2
\]

2. Think:

The formula for calculating the area of the table leg is:

\[
A = \pi \times r^2
\]
Exercises

1. Determine the area of the lid on the jam jar.

The area of the lid is $113.04 \text{ in}^2$ ($706.5 \text{ cm}^2$).

Area of the lid = $\pi \times 4.5 \text{ cm} \times 15 \text{ cm}$

Area of the lid = $3.14 \times 4.5 \text{ cm} \times 15 \text{ cm}$

Area of the lid = $3.14 \times 67.5 \text{ cm}^2$ = $212.025 \text{ cm}^2$

English

The formula for calculating the area of the pizza is

$A = \pi r^2$

Think

Let's Think It Through

What is the surface area of the pizza?

The area of the pizza is $113.04 \text{ in}^2$ ($706.5 \text{ cm}^2$).

Area of the pizza = $\pi \times 6 \text{ in} \times 6 \text{ in}$

Area of the pizza = $3.14 \times 6 \text{ in} \times 6 \text{ in}$

Area of the pizza = $3.14 \times 36 \text{ in}^2$ = $113.04 \text{ in}^2$
Activity: Round off rectangles

2. The length of each fan blade from the center of the fan is 4 inches (10 cm). Calculate the area of the circle that the blades sweep with each complete turn.

3. Each small square in the diagram has a measurement of 2 inches (5 cm). What is the area of the circle?

Materials
- Compass
- Transparent paper
- Scissors
- Pencils
- Typing paper

Purpose
To compare the area of a rectangle made from parts of a circle with the area of the original circle.

Procedure
1. Use the compass to draw a circle with a 4-inch (10-cm) radius on the paper.
2. Lay the paper over the diagram with the center of the circle over the vertex of the rays.

Over the vertex of the rays. Over the vertex of the rays.
6. Cut two pieces of string equal to the radius of the circle.

7. Cut two additional pieces of string equal to one-half the distance around the circle. To do this, cut a piece of string to one-half the circumference, which is equal to π x r.

8. Place the ends of the strings to a table so that they form a rectangle.

9. Can you pie-shaped pieces from the circle and arrange them inside the rectangle made by the string, as shown in the diagram.

10. Use the pencil to shade the bottom half of the circle.

11. Trace each ray extending to the circumference of the circle.

12. Number each section in the circle as shown.
The area of the circle that the fan blades sweep with each complete turn is 50.24 in² (314.0 cm²).

The area of the circle is

\[
A = \pi r^2 \text{ in}^2
\]

\[
A = 3.14 \times 4 \times 4 \text{ in}^2
\]

\[
A = 50.24 \text{ in}^2
\]

English

The formula for calculating the area of the lid is

\[
A = \pi r^2
\]

\[
A = 3.14 \times 2 \times 2
\]

\[
A = 12.56 \text{ in}^2
\]

The area of the lid on the jam jar is 12.56 in² (78.5 cm²).

\[
A = \frac{1}{2} \pi (10 \text{ cm})^2 = 78.5 \text{ cm}^2
\]

\[
3.14 \times 5 \times 5 \text{ cm}
\]

\[
A = 3.14 \times 5 \times 5 \text{ cm}
\]

\[
A = 78.5 \text{ cm}^2
\]

Metric

The area of the lid on the jam jar is 12.56 in² (78.5 cm²).

The area of the lid on the jam jar is 12.56 in² (78.5 cm²).

### Think

- English
  - \( A = \pi r^2 \) in\(^2\)
  - \( A = 3.14 \times 2 \times 2 \)
  - \( A = 12.56 \text{ in}^2 \)

- Metric
  - \( A = \pi r^2 \text{ cm}^2 \)
  - \( A = 3.14 \times 5 \times 5 \text{ cm} \)
  - \( A = 78.5 \text{ cm}^2 \)

### The Formula for Calculating the Area of the Circle

\[
A = \pi r^2
\]

\[
A = 3.14 \times 2 \times 2
\]

\[
A = 12.56 \text{ in}^2
\]

The area of the lid on the jam jar is 12.56 in² (78.5 cm²).

\[
A = \frac{1}{2} \pi (10 \text{ cm})^2 = 78.5 \text{ cm}^2
\]

\[
3.14 \times 5 \times 5 \text{ cm}
\]

\[
A = 3.14 \times 5 \times 5 \text{ cm}
\]

\[
A = 78.5 \text{ cm}^2
\]

### Think

- English
  - \( A = \pi r^2 \) in\(^2\)
  - \( A = 3.14 \times 2 \times 2 \)
  - \( A = 12.56 \text{ in}^2 \)

- Metric
  - \( A = \pi r^2 \text{ cm}^2 \)
  - \( A = 3.14 \times 5 \times 5 \text{ cm} \)
  - \( A = 78.5 \text{ cm}^2 \)

### Solutions to Exercises

1. **Think**:  
   \[
   A = \pi r^2
   \]
   \[
   A = 3.14 \times 1 \times 1
   \]
   \[
   A = 3.14 \times 1
   \]
   \[
   A = 3.14 \text{ in}^2
   \]

2. **Think**:  
   \[
   A = \pi r^2
   \]
   \[
   A = 3.14 \times 1
   \]
   \[
   A = 3.14 \text{ cm}^2
   \]

### Why

The pieces from the circle fit almost exactly into a rectangular shape.

### Results

The pieces from the circle fit almost exactly into a rectangular shape.
The area of the circle is 28.26 in² (76.63 cm²).

Metric

\[
\begin{align*}
A &= \pi \times 7.5 \text{ cm} \\
A &= 3.14 \times 7.5 \times 7.5 \\
A &= 176.63 \text{ cm}^2
\end{align*}
\]

English

\[
\begin{align*}
A &= 3.14 \times 7.5 \times 7.5 \\
A &= 176.63 \text{ cm}^2
\end{align*}
\]

What You Need to Know

- The area of a circle is \( \pi \times r^2 \).
- The area of a trapezoid is \( \frac{1}{2} \times (b_1 + b_2) \times h \).
- The area of a parallelogram is \( b \times h \).

If the area of a circle is \( A \text{ cm}^2 \), then the radius is \( \sqrt{\frac{A}{\pi}} \text{ cm} \).

The diameter of the circle is equal to twice the radius.

The diameter of one small square is 3 in. (7.5 cm) = 6 in. (15 cm).

Think!

3. The diameter of the circle is ______ cm.
Exercises

1. Multiply these two numbers. \( \frac{1}{2} \times 8 = 4 \)

2. Add 0 to the product. \( 4 + 1 = 5 \)

The steps in solving this problem are:

- Formula: \( A = \frac{1}{2} b \times h + \frac{1}{2} b \times l - \frac{1}{2} h \times l \)

Let's think it through.

- The area of figure C is a square units.
- The area of figure D is 2 square units.
- Subtract 1 from the sum: \( 5 - 1 = 4 \)

Answers

1. Think

2. Think
Activity: GEOBOARD

Purpose  To build and use a geoboard to determine areas of plane geometric figures.

Materials  hammer
25 3d finishing nails
block of wood at least 5 x 5 inches (12.5 x 12.5 cm) square
short rubber bands
adult helper

Procedure
1. Ask your adult helper to hammer the nails halfway into the wooden block. The nails should be driven straight, and about half their length should stick out of the wood. Position the nails so that they are 1 inch (2.5 cm) apart in the pattern shown in the diagram.

2. Stretch rubber bands around the nails to create geometric figures.
The area of figure $A$ is $9$ square units.

1. Add $4$ to the product $6 + 4 = 10$
2. Multiply the first two numbers, $\frac{1}{2} \times 12 = 6$
3. Subtract $1$ from the sum, $10 - 1 = 9$

The steps in solving this problem are:

\[ A = \frac{1}{2} \times (b + \frac{1}{2}) \]

\[ b = 8 \]

Formula: $A = \frac{1}{2} \times (b + \frac{1}{2})$

Think:

The area of figure $B$ is $3$ square units.

1. Multiply the first two numbers, $\frac{1}{2} \times 6 = 3$
2. Add $1$ to the product $3 + 1 = 4$
3. Subtract $1$ from the sum, $4 - 1 = 3$

The steps in solving this problem are:

\[ A = \frac{1}{2} \times (b + \frac{1}{2}) \]

\[ b = 6 \]

Formula: $A = \frac{1}{2} \times (b + \frac{1}{2})$

Think:

The area of figure $C$ is $6$ square units.

1. Multiply the first two numbers, $\frac{1}{2} \times 9 = 4.5$
2. Subtract $1$ from the sum, $9 - 1 = 8$
3. Add $4$ to the product $8 + 4 = 12$

The steps in solving this problem are:

\[ A = \frac{1}{2} \times (b + \frac{1}{2}) \]

\[ b = 6 \]

Formula: $A = \frac{1}{2} \times (b + \frac{1}{2})$

Think:

The area of figure $D$ is $12$ square units.

1. Multiply the first two numbers, $\frac{1}{2} \times 12 = 6$
2. Subtract $1$ from the sum, $12 - 1 = 11$
3. Add $4$ to the product $11 + 4 = 15$

The steps in solving this problem are:

\[ A = \frac{1}{2} \times (b + \frac{1}{2}) \]

\[ b = 12 \]

Formula: $A = \frac{1}{2} \times (b + \frac{1}{2})$

Think:

The area of figure $E$ is $15$ square units.

1. Multiply the first two numbers, $\frac{1}{2} \times 15 = 7.5$
2. Subtract $1$ from the sum, $15 - 1 = 14$
3. Add $4$ to the product $14 + 4 = 18$

The steps in solving this problem are:

\[ A = \frac{1}{2} \times (b + \frac{1}{2}) \]

\[ b = 15 \]

Formula: $A = \frac{1}{2} \times (b + \frac{1}{2})$
From the center, a sphere is shaped like a ball. All points on its surface are an equal distance from the center. A cylinder has two congruent circular bases (top and bottom) and is shaped like a can. A cone has one circular base and is shaped like an ice cream cone without the scoop of ice cream. A pyramid has a base that is a polygon and faces that are triangles. A prism has two congruent bases that are polygons and rectangular faces. A cube has six congruent square faces. A sphere has no edges or vertices. A cylinder has no vertices.

What You Need to Know

Identifying Space Figures

Spacey

20
A **pyramid** has triangular sides and a single polygonal base.

- **Rectangular pyramid**
- **Square pyramid**
- **Triangular prism**
- **Cylinder**
- **Hexagonal prism**

Identify each numbered space figure in the drawing.

**Let's think it through:**

- Prisms and pyramids are made up of polygons. In a **prism**, the sides are parallelograms and the **two parallel bases** are congruent.
- The **base** of a prism is a **polygon** and the lateral faces are parallelograms.
- A **pyramid** has **triangular sides** and a **single polygonal base**.
- **Rectangular pyramids** and **square pyramids** are among others.
- In a **cylinder**, the ** bases** are congruent circles and the **lateral surface** is a **cylinder**.
Materials
- Transparencies
- Ruler
- Scissors
- Marking pen
- Writing paper

**Exercise**: Match the patterns with the figures.

<table>
<thead>
<tr>
<th>Space Figure</th>
<th>Name</th>
<th>Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triangular prism</td>
<td>Figure 1 is a cone.</td>
<td>1. Think</td>
</tr>
<tr>
<td>Square pyramid</td>
<td>Figure 2 is a sphere.</td>
<td>2. Think</td>
</tr>
<tr>
<td>Cube</td>
<td>Figure 3 is a cylinder.</td>
<td>3. Think</td>
</tr>
</tbody>
</table>

**Activity**: 3-D

**Purpose**: To construct a model of a triangular prism.

- What is the name given to space figures with this shape?
- What are all rectangles?
- What is the shape of the box of cookies? The sides, top.

**Think**

- Figure 1 is a cone.
- Figure 2 is a sphere.
- Figure 3 is a cylinder.
- What name is given to space figures with this shape?
- What is the shape of the base of each cylinder?
- What is the shape of the base of a cone?
- What is the shape of the base of a sphere?
- Does this shape have one or two curved sides?
Pattern A matches figure 3.
Which pattern has these shapes in these numbers?
and base. Three rectangles and two triangles.

Describe the number and shapes of the figure's sides

3. Think!
Pattern C matches figure 2.
Which pattern has these shapes in these numbers?
and base. Four rectangles and one square.

Describe the number and shapes of the figure's sides

2. Think!
Pattern D matches figure 1.
Which pattern has six squares?
base. Six squares.

Describe the number and shape of the figure's sides and

1. Think!

Solutions to Exercises

8. Distinguish the model from other pyramids.
Identify the triangle as a pyramid. The triangular base differs
The base of the pyramid as well as the sides are all

Why?
Results A model of a triangular pyramid is constructed.

Tab C over side C.
Tab B over side B.
Tab A over side A.

Procedure
1. Lay the paper over the pattern of the model.

6. Tape the tabs sections, matching tabs to sides as follows

5. Fold along each dashed line.
Repeat the procedure for each dashed line.

4. Make the dashed lines easier to fold by following these steps:
Cut out the traced pattern along the solid lines.
2. Trace the pattern onto the paper with the pen.
What You Need to Know

Edges, and Vertices of a Polyhedron

Determining the Number of Faces,

Faces

21
The number of faces for the box is six.

- The box has a top, bottom, left side, right side, front, and back.

Each face is a surface of a polyhedron. A face is a polygon.

1. Think

The number of vertices for the box is eight.

- The number of vertices in a polyhedron is equal to the number of corners.

2. Think

The number of edges on the box is twelve.

- An edge is a line segment where two faces of a polyhedron meet.

1. Faces
2. Edges
3. Vertices

3. Think

Let's think it through.

- The box shown in the diagram is a polyhedron. Examine the diagram to determine the number of its:

- Faces
- Edges
- Vertices
Activity: Face Prints

Purpose:

Materials:

- 2 sheets of white construction paper
- 3 small bowls
- 3 different colors of poster paint
- Scissors
- Rectangular dishwashing sponge
- Marking pen
- Water

Polyhedrons:

To make prints of the faces of different shaped polyhedrons. 1. Square Pyramid

Procedure:

1. Use the pen and ruler to draw a rectangle and a triangle on one of the largest faces of the sponge.

2. Pour about 1/2 inch (1.25 cm) of paint into each bowl. One rectangular prism will form a triangular prism and the rectangle will form a

3. Point bowl 1/2 inch (1.25 cm) of paint into each bowl. One

4. Look at the faces. Dip one of the triangle rectangular faces of the rectangular prism into one of the bowls of paint and make a print of this face on the paper.
<table>
<thead>
<tr>
<th>Polyhedron</th>
<th>Vertices</th>
<th>Faces</th>
<th>Edges</th>
<th>Total Number of</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Square Pyramid</td>
<td>5</td>
<td>8</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>2. Triangular Prism</td>
<td>6</td>
<td>9</td>
<td>9</td>
<td>6</td>
</tr>
</tbody>
</table>

Solution to Exercise

"The cuts made in the sponge may not produce pieces identical to the triangular prism. Five prisms with two different kinds of shapes are made by the triangular prism. Two prisms with one kind of shape are made by the rectangular prism. Six prisms are made by the triangular prism. Again, use a different color of paint for each shape of each face of the triangular prism. Again, use a different color of paint for each shape of each face of the rectangular prism. Use a different color of paint for each shape of each face of the remaining prisms. Turn the sponge over and make a print of the opposite face."

Results

7. Repeat steps 4 and 5 to make prints of each face of the triangular prism.
6. Repeat steps 4 and 5 to make prints of the remaining faces.
5. Turn the sponge over and make a print of the opposite face.
Let's Think It Through

Given 1 inch (2.5 cm) on the box.

Chapter 11: Surface Area of a Cube

The total surface area of the box can be found by adding the areas of the six faces that make up the box. Each face of the box is a square and can be used to draw the shape of the box and calculate its area. The surface area of a rectangular box is equal to the sum of all its faces. The surface area of a solid is the sum of the areas of all its faces.

What You Need to Know

Calculating the Surface Area of Rectangular Boxes

On the Surface

22
The surface area of the gift box is 128 in.\(^2\) (800 cm\(^2\)).

Metric

Surface area = 128 squares \(\times 6.25\) cm\(^2\)

English

Surface area = 128 in.\(^2\)

Ask: What is the area of each square on the graph paper and what does each square represent?

Squares multiplied by the area represented by one square:

The surface area of the box equals the total number of squares.

<table>
<thead>
<tr>
<th>Right-side area</th>
<th>Top area</th>
<th>Bottom area</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 squares</td>
<td>24 squares</td>
<td>24 squares</td>
</tr>
<tr>
<td>Front area</td>
<td>Back area</td>
<td></td>
</tr>
<tr>
<td>24 squares</td>
<td>16 squares</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To calculate the surface area of the box, determine the total number of squares in the diagram and multiply by the number of squares per cm. 2.5 cm \(\times 2.5\) cm = 6.25 cm\(^2\).

Think

Answer
Purpose: To demonstrate how surface area can be decreased.

Activity: More Space

Exercise

On the Surface 188

Geometry for Every Kid
The surface area of the open shoe box is 188 in.² (1.175 cm²).

Surface area = 188 squares x 1 in.² (6.25 cm²)

The surface area of the box equals the total number of squares multiplied by the area represented by one square.

- Front
- Side
- Right
- Left
- Back
- Bottom

<table>
<thead>
<tr>
<th>Square</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 \ 24 squares</td>
<td>24 squares</td>
</tr>
<tr>
<td>6 \ 24 squares</td>
<td>24 squares</td>
</tr>
<tr>
<td>3 \ 60 squares</td>
<td>60 squares</td>
</tr>
<tr>
<td>3 \ 40 squares</td>
<td>40 squares</td>
</tr>
</tbody>
</table>

The boxes are rectangular prisms, and the figure made up of the boxes are rectangular prisms, and the figure made up of the boxes is a rectangular prism.

The surface area does change, but the shape created by combining the boxes does not change.

- Right: neither the shape nor the size of the four-inch
drawn on the graph paper is.
- Front and Back
- Side and Bottom
- Right and Left
- Front and Back

The boxes are positioned in a straight line have 18 visible faces. The boxes positioned in a straight line have 18 visible faces. The boxes positioned in a straight line have 18 visible faces. The boxes positioned in a straight line have 18 visible faces.

The boxes are positioned in a straight line have 18 visible faces. The boxes positioned in a straight line have 18 visible faces. The boxes positioned in a straight line have 18 visible faces. The boxes positioned in a straight line have 18 visible faces.

Solution to Exercise

1. Lay the boxes end to end in a straight line on a table.
2. Count the visible faces of the boxes and those touch-
3. Two boxes.
4. Take two of the boxes and stack them on top of the other
5. Place.
6. Find the visible faces of the boxes and those touching the
7. Two boxes.
8. Take two of the boxes and stack them on top of the other
Let's think it through.

What you need to know:

- Through analysis and reasoning
- Changing geometric figures

Toothpick Magic

23
Exercises

1. Change the nine congruent squares into two congruent squares by removing four loothpicks.

For each exercise use the specified number of loothpicks to make the figure.

Remain will leave two squares?

Which your loothpicks when removed from the original figure.

Must remain unchanged.

To make the three specified squares, two original squares removed loothpicks can be arranged to make one square.

If takes your loothpicks to make a square. Thus, the four

Think

Answer
Procedure

1. Bend each toothpick into a V shape without breaking it.

2. Place the bent toothpicks on the sheet of wax paper in a star burst pattern as shown in the diagram. Put the bent parts as close together as possible in the center.

Materials
- 1/2-inch (3.0-cm) square wax paper
- 5 round wooden toothpicks

A Star Burst

To watch the toothpicks move by themselves into a six-pointed star pattern.

Activity: Star Burst

1. Bend each toothpick into a V shape without breaking it.

2. Place the bent toothpicks on the sheet of wax paper in a star burst pattern as shown in the diagram. Put the bent parts as close together as possible in the center.

Materials
- 5 round wooden toothpicks

A Star Burst

To watch the toothpicks move by themselves into a six-pointed star pattern.
1. Think

Solutions to Exercises

In an ever-widening star, the center of the figure, six congruent quadrilaterals are created. Their ends touch in the center of the figure. Six congruent quadrilaterals are created.

Remove the middle toothpick from each outside edge of the figure. Five congruent squares are left.

Why? What is the wooden where the toothpick is?
The diagram shows the steps for graphing coordinates (2, 5).

A. Start at the zero corner of the grid.
B. Move to the right the number of spaces equal to the first coordinate number.
C. Move up the number of spaces equal to the second coordinate number.
D. Mark a dot.
E. Move 2 spaces to the right.

These steps:

location of a point on a grid. To graph a coordinate, follow the points in order. Coordinates are number pairs that tell the figures. Can be created on a grid by connecting coordinates.

What you need to know

Using Coordinates to Graph Figures

Over and Up

24
Exercises

1. Graph a figure using these coordinates: (1, 4), (2, 4), (3, 4).

2. Graph a similar figure, but make it twice the size as large.

(6, 4) = (12, 8)
(9, 5) = (18, 10)
(8, 2) = (16, 4)
(4, 2) = (8, 4)
(3, 5) = (6, 10)

Which each line is drawn.

Draw a line to connect each point in the order given.

Close the figure by drawing a line from the last to the first.

Let's Think It Through

1. Think

Answers

2. Think

L= 4.

Under given to create a figure: (3, 5), (4, 2), (8, 2), (9, 5).

The coordinates of a figure twice as large as the previous.

The vertices of the previous figure are:

(6, 4)
An enlarged version of the original boat

Larger squares allow you to use the same coordinates to draw
the bigger than those in the smaller grid. Unless the grid with
cent squares, the figure you made also has 25 squares, but they
are bigger than those in the smaller grid. Unless the grid with
cent squares. The figure you made also has 25 squares, but they

The original figure is on a grid made of 25 cent-

Why

is produced.

Results

An enlarged, colored picture of a boat on the water

Procedure

1. Use the measuring stick and pencil to draw a 15-inch (37.5-

2. Draw the more lines parallel with the

3. Draw six vertical lines intersecting the horizontal lines. 3

4. Number the lines in pencil across the bottom and up the left

5. Graph the coordinates of the figure of the boat shown on the

6. Trace over the pencil lines of the drawing with the pen.

7. Erase the grid lines and numbers.

8. Use the crayons to color the figure and add water waves and

Crayons

Pencil with eraser

Marking pen

18-inch (45-cm) square poster board

Materials

Yardstick (meterstick)

Purpose

To use a grid to make an enlargement of a figure.
See diagram to compare the figures:

- \( (x, y) = (6, 12) \)
- \( (1, 12) \)
- \( (1, 6) \)
- \( (2, 6) \)
- \( (2, 12) \)
- \( (4, 12) \)
- \( (4, 6) \)
- \( (6, 6) \)
- \( (6, 12) \)
- \( (12, 12) \)
- \( (12, 6) \)

The coordinates of a figure twice as large as the previous one are determined by multiplying each of the
coordinates of the previous figure by 2.

1. Think

Solutions to Exercises

Connect the points in the order given.

- Use the coordinates provided to place points on the grid.

2. Think
1. Draw a rectangular prism by following these steps:

2. A rectangular prism

1. A cylinder

2. A cylinder

Use a pencil, ruler, and graph paper to draw the following:

Let's think it through.

First rectangle, as shown in the diagram.

Draw two squares in the right and one square up from the line.

Draw a second overlapping rectangle of equal size, but

NOTE: The measurements are not significant.

Draw an oval nine squares wide and two squares long.

Draw the cylinder by following these steps:

NOTE: The measurements are not significant.

Draw a rectangle on graph paper with a width of five

Draw four squares and a length of three squares. (NOTE: The mea

two rectangles.

Draw lines to connect the corresponding vertices of the
1. Lay the paper over the diagram of the fish in the bowl.

Procedure

Materials
- Typewriter paper
- Blue and pink highlighter marker
- Red and blue transparent plastic report folder

Purpose
To show how colors can be used to create a three-dimensional drawing that seems to rise off the page.

Activity: SWIMMING FISH

1. Draw an open box.
2. Draw a cookie jar.

Exercises

Draw an identical oval in squares below the first oval.
Solutions to Exercises

1. Think

2. Draw a rectangular prism with a width of five squares.

3. What shape is in an open box? A rectangular prism.

4. Given counter (Note: The rectangle can be any size.)

5. And a length of six squares. Following the instructions:

   - Draw a rectangular prism with a width of five squares.

   - What shape is in an open box? A rectangular prism.

6. With your left eye, look at the face of a pink fish in a blue bowl.

7. Close your right eye and use your left eye to look through the plastic.

8. With the plastic over your right eye and the blue plastic.

   - The blue plastic is reflected in the face of the fish. You see only the fish.

   - The fish is not visible when viewed only through the red plastic. The fish is darker and the pink fish disappears.

9. Cut one 2-by-2-inch (5-by-5-cm) square from each of the folders.

10. Place the plastic on a table.

   - The fish is blue with the pink marker.

   - Trace the fish with the pink marker.
Erase the lines indicated in the diagram.

Trace the drawing onto a sheet of typing paper and add the label "Toys" and a toy plus shading to complete the drawing. Be sure to erase any lines of the box that pass through the height of the toy.

Draw a cylinder with a width of eight squares and a length of two squares. Following the instructions given earlier (NOTES: the cylinder can be any size)

What shape is a cookie jar? A cylinder.
**Glossary**

**Closed curve**: A curved figure formed by a continuous line.

**Boundary**: The perimeter of a circle: the length of this circumference.

**Circumference**: The perimeter of a circle: the length of the curved line called the circumference: every point on the curved line is an equal distance from the center point of the circle: a simple closed curve: a plane figure bounded by a circumference of a circle.

**Chord**: Any line segment that begins and ends on the circumference of a circle.

**Central angle**: An angle that has its vertex at the center of a circle: the sector of a plane figure.

**Area**: The measure of the number of square units needed to cover the surface of a plane figure.

**Angle**: The figure formed when two rays have the same endpoint or two straight lines meet.

**Angle**: An angle greater than 90° and less than 180°.

**Adjacent angles**: Two angles in which all angles measure less than 90°.

**Adjacent angles**: Neighboring angles.

**Acute angles**: An angle that measures less than 90°.

**Trace the drawing onto a sheet of typing paper to make cookies.**
of the square if its corners.

Pythagorean Theorem: A triangle with two congruent sides.

Isosceles Triangle: A triangle with two congruent sides.

Right Triangle: A triangle with one right angle.

Equilateral Triangle: A triangle with three congruent sides.

Scalene Triangle: A triangle with no congruent sides.

Parallelogram: A quadrilateral with two pairs of parallel sides.

Rectangular Parallelogram: A quadrilateral that has two pairs of perpendicular sides.

Opposite sides: Common names for a parallelogram.

Parallelogram: Any two or more lines that do not intersect and are always the same distance apart.

Intersection: The set of points common to two or more figures.

Point of intersection: The point where two or more figures meet.

Parallelogram: A quadrilateral with two pairs of parallel sides.

Parallel Lines: Any two or more lines that do not intersect and move in opposite directions.

Reflections: A transformation of a figure that gets mirrored about a line.

Reflections: A transformation of a figure that gets mirrored.

Open curve: A curved figure formed by a noncontinuous curve.

Greater than 0°. Open curve: A curved figure formed by a noncontinuous curve.

Obtuse Triangle: A triangle with one angle that measures greater than 90°.

Obtuse Angle: An angle that measures greater than 90°.


Perpendicular Bisector: A line that divides a plane into two identical parts.

Line Segment: A part of a line, which follows a straight line.

Line of Symmetry: A mirror divides a figure into two identical halves.

Line: The geometric definition of a line is a straight path that extended infinitely in both directions.

Line Segment: A part of a line, which follows a straight path.

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Trapezoid: A quadrilateral that has one pair of parallel sides.

Trapezium: A quadrilateral that has no parallel sides.

Length, width, and height refer to the length of the figure.

Three-Dimensional: Having three measurements—length, width, and height.

Tetragon: A Chinese puzzle made by cutting a square into five pieces with three cuts.

Symmetry: Figures with lines of symmetry.

Surface Area: The sum of the areas of all the faces of a solid.

Square: A rectangle that has four congruent sides.

Sphere: A space figure that has no bases and all points on its curved surface are an equal distance from its center.

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Solid: Another name for space figure.

Solid geometry: The study of three-dimensional figures.

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Simple curve: A curved figure, such as a circle, formed by a single line segment.

Semicircle: A segment with one endpoint on a curved sides.

Right triangle: A triangle that has one 90-degree angle.

Right angle: An angle that measures 90 degrees.

Regular polygon: A polygon with all sides and angles congruent.

Rhombus: A parallelogram that has no right angles and four parallel sides are congruent commonly called a square.

Kite: A parallelogram that has no right angles and only opposite sides are congruent.

Rectangle: A parallelogram that has four right angles and only opposite sides are congruent.

Perimeter: The distance around a plane figure.

Perimeter of a plane figure: The length of the boundary.

Perpendicular Lines: Two lines that intersect forming a right angle.