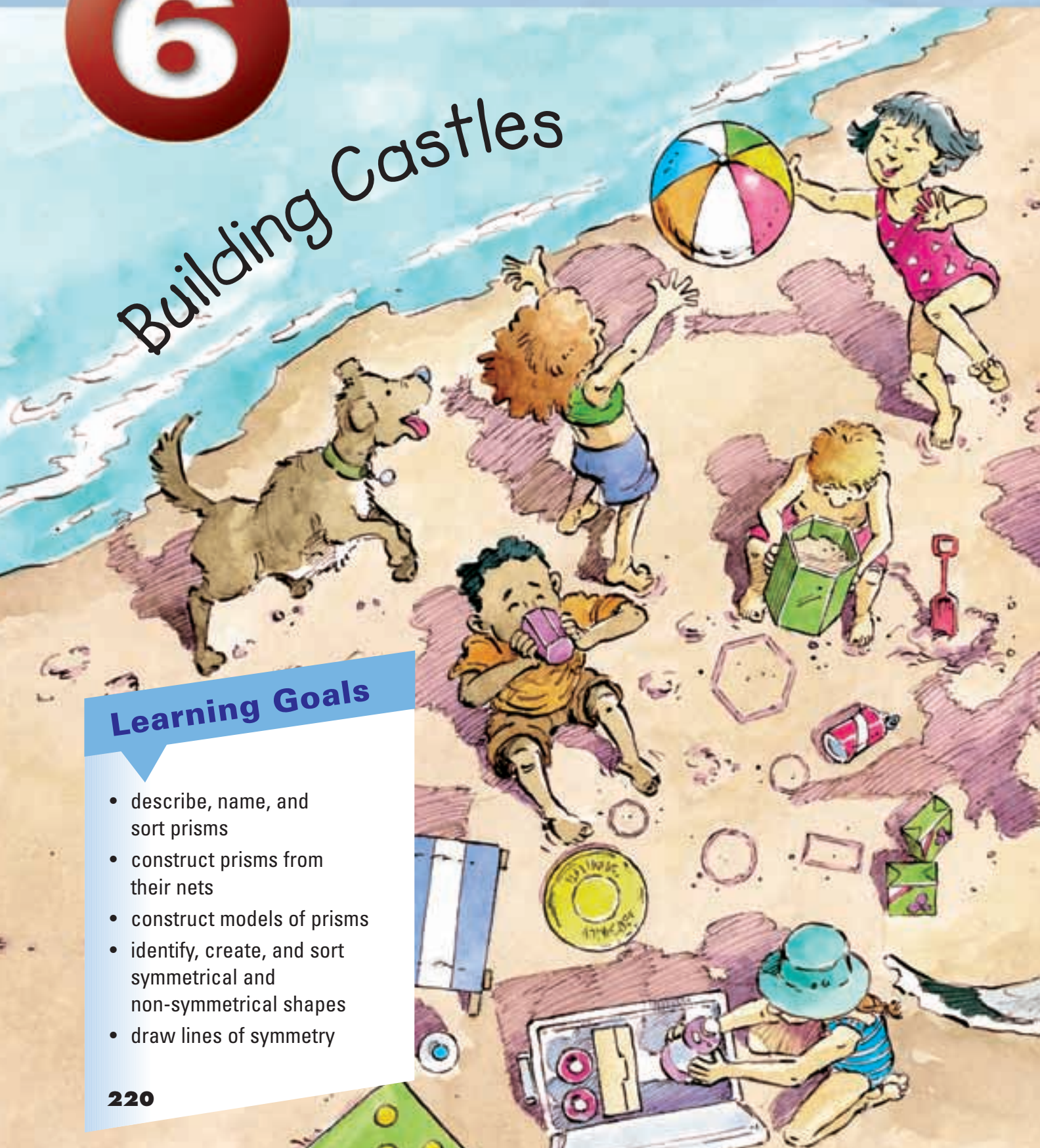
UNIT 6

Geometry

Building Castles



Learning Goals

- describe, name, and sort prisms
- construct prisms from their nets
- construct models of prisms
- identify, create, and sort symmetrical and non-symmetrical shapes
- draw lines of symmetry

Key Words

- triangular prism
- rectangular prism
- net
- symmetrical
- line of symmetry

Look at the picture.

- Name the shapes and objects you see.
- How are some of the objects the same? Different?
- Where else might you find these shapes and objects?

LESSON 1

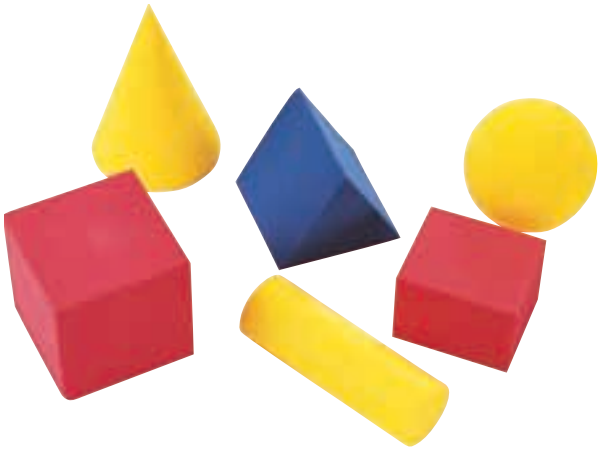
Objects in Our World

Think about some of the objects you see around you.

What makes one object different from another?

Explore

➤ Go on a scavenger hunt.
Find as many classroom items as you can that match each object below.
Explain why each item matches an object.



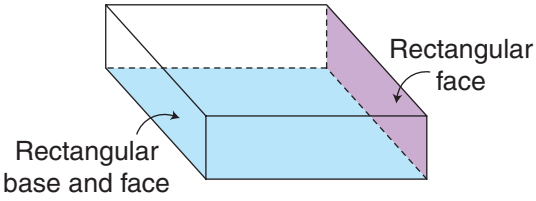
➤ Sort the items and objects. Record your sorting.

Show *and* Share

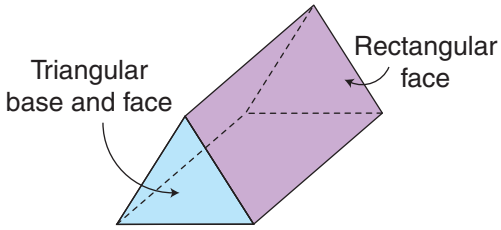
Share your sorting with another pair of students.
Discuss the ways you sorted the objects and items.
Find other ways to sort them.

Connect

Rectangular prism

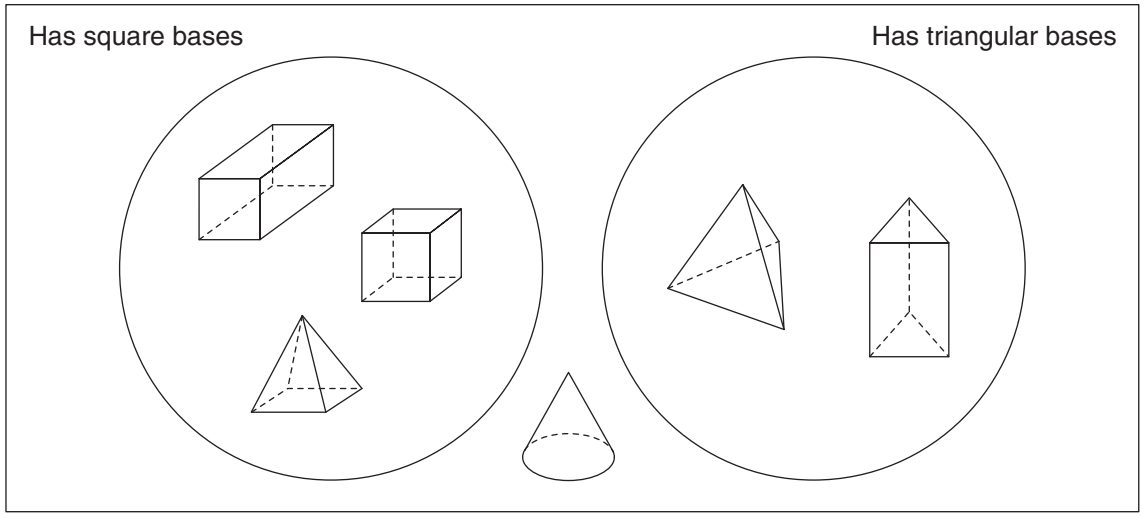


Triangular prism



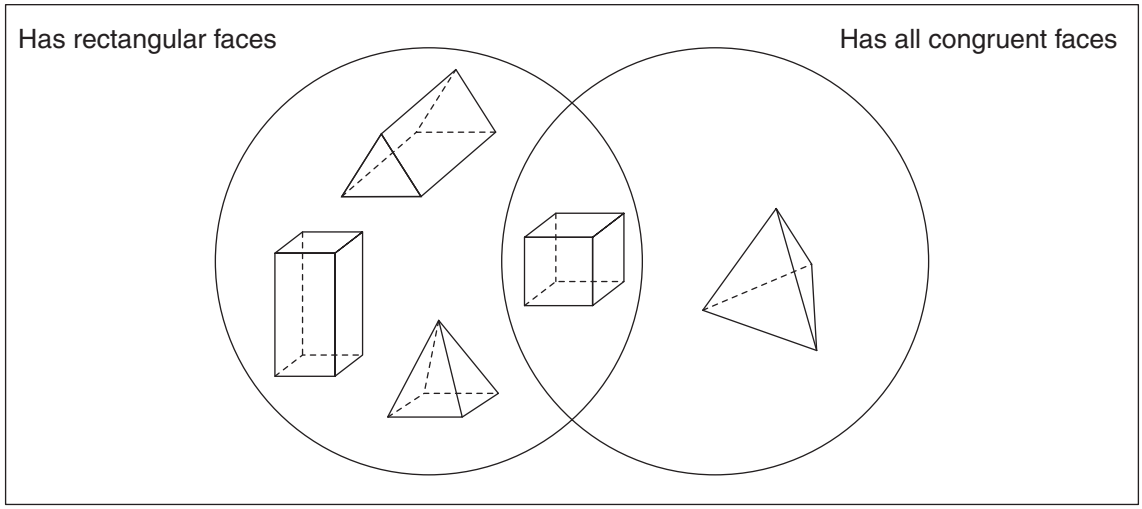
Here are some ways to sort objects.

➤ You can sort by the shapes of the bases. Use these attributes.



➤ You can sort by the shapes of the faces. Use these attributes.

Recall that "congruent" shapes match exactly.



Practice

1. Name the prism that best represents each item.

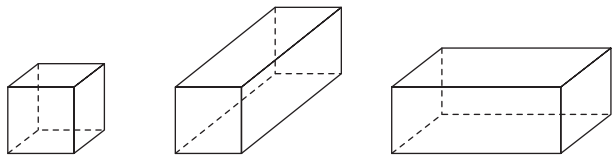
a)

b)

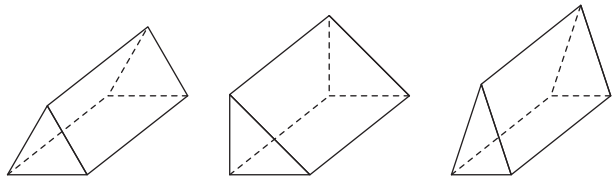
c)

d)

2. Which attributes do all rectangular prisms have? Use these pictures to help you find out.

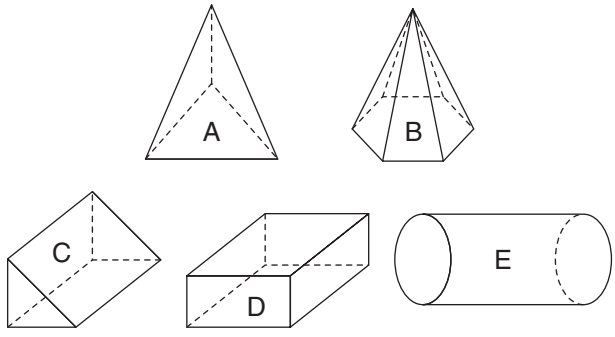


3. Which attributes do all triangular prisms have? Use these pictures to help you find out.

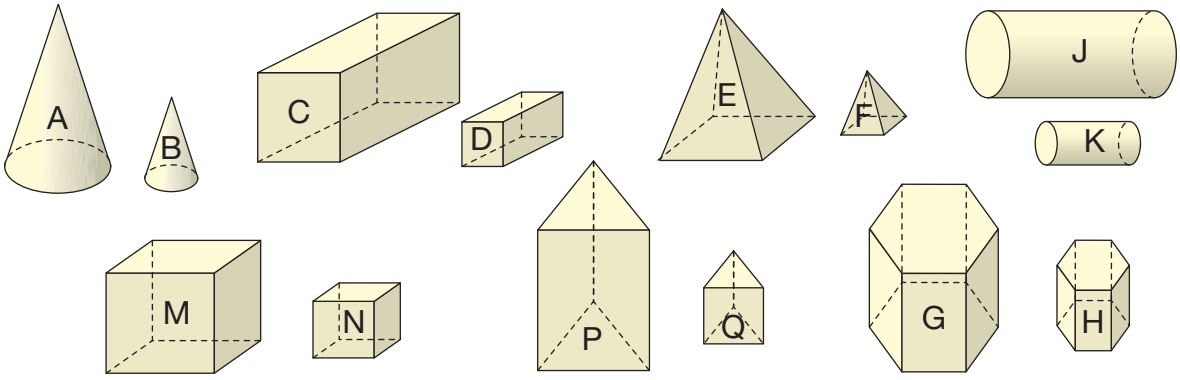


4. **a)** Sort these objects. Use these attributes: "Has triangular faces" and "Has two congruent faces" Record your sorting.

b) Sort the objects again. Choose 2 different attributes to sort them by. Record your sorting.



5. Look at the objects below.
Find 2 attributes.
Sort the objects.
Use the letters to help record your sorting.
Write your sorting rule.



6. Use one of the words "all," "some," or "no" in place of ☐.
Copy and complete each sentence.
How do you know each sentence is true?

a) ☐ prisms have congruent bases.

b) ☐ rectangular prisms are cubes.

c) ☐ cubes are rectangular prisms.

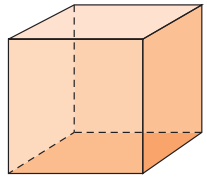
d) ☐ prisms have all rectangular faces.

Show your work.

Math Link

Patterning

There is a pattern in the numbers of edges, faces, and vertices of an object.
When you add the numbers of vertices and faces, the sum is 2 more than the number of edges.



8 vertices
6 faces
12 edges

8 + 6 = 12 + 2

Reflect

How are a rectangular prism and a triangular prism alike?
How are they different?

LESSON 2

Constructing Prisms

Explore

You will need Pattern Blocks.

➤ Use the orange square as the base of a prism.
Stack orange squares. Can you make a cube? Explain.
Continue to stack orange squares to make rectangular prisms.
Describe the prisms. How are they alike? How are they different?

➤ Use the green triangle as the base of a prism.
Make some different triangular prisms.
Describe the prisms. How are they alike? How are they different?

➤ Compare your rectangular prisms and your triangular prisms.
Describe how they are alike and how they are different.

Show *and* Share

Work with another group of students. Combine your Pattern Blocks.
Make a rectangular prism with a different size base.
How many different prisms can you make?
Make a triangular prism with a different size base.
How many different prisms can you make?

Connect

Sarah used modelling clay.
She began with a square base.
Sarah made each other face of her prism a square.
She made a cube.

Sarah added more clay to make her prism taller.
She made a square prism.

Sarah then started with a rectangular base.
She made a rectangular prism.

Sarah started with a triangular base.
She made a triangular prism.

Practice

1. Use modelling clay.
Make 3 different objects.
Each object should have at least one rectangular face.

2. Use modelling clay. Make an object that has each set of faces.

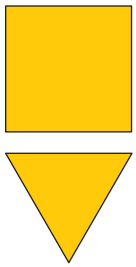
a)

b)

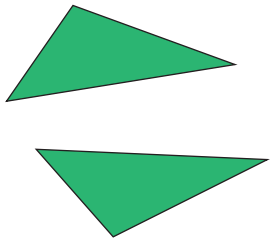
c)

3. Two faces of a prism are shown.
What could the prism be?
How do you know?
Which different prisms can you name each time?

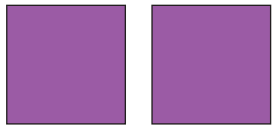
a)



b)



c)



4. Use modelling clay.
Identify and make 2 different prisms for each description.

a) It has 6 congruent square faces.

b) It has 2 congruent triangle faces and 3 congruent rectangle faces.

c) It has 3 pairs of congruent rectangle faces.

Reflect

With which tool: modelling clay or Pattern Blocks can you make more prisms that are all different? Explain your choice.

LESSON 3

Exploring Nets

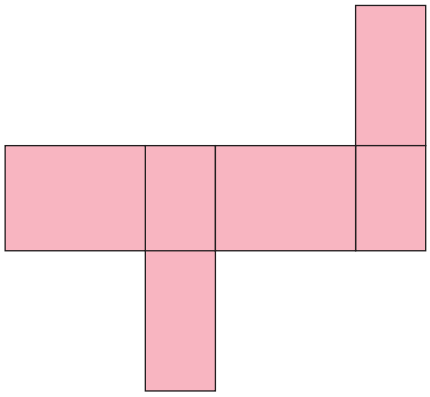
Explore

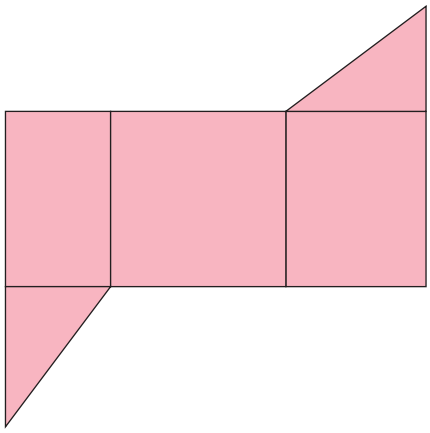
Look at the two patterns below.

➤ Predict which pattern you think would fold to make a triangular prism.
Give reasons for your prediction.

➤ Which prism do you think the other pattern would make when it is folded?
How do you know?

Use the patterns provided by your teacher.
Cut out each pattern.
Fold it to make a prism.



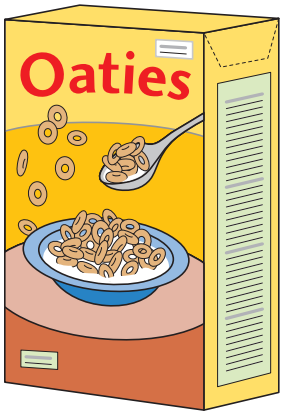


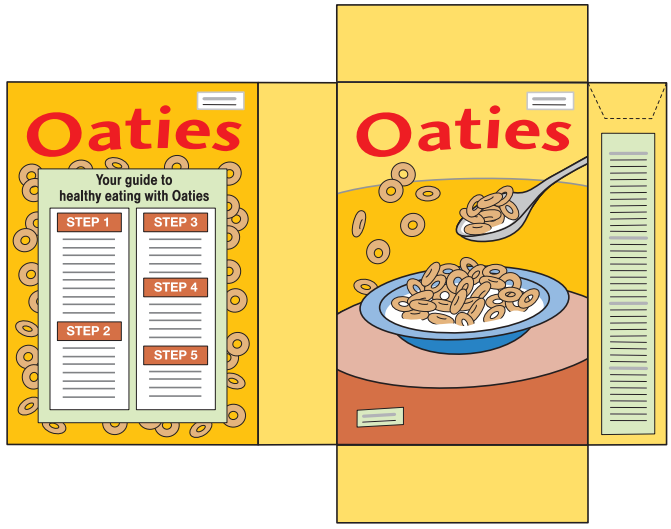
Show *and* Share

Compare your prisms with those of other students.
Were your predictions correct? Explain.
Explain to each other how you folded your pattern.

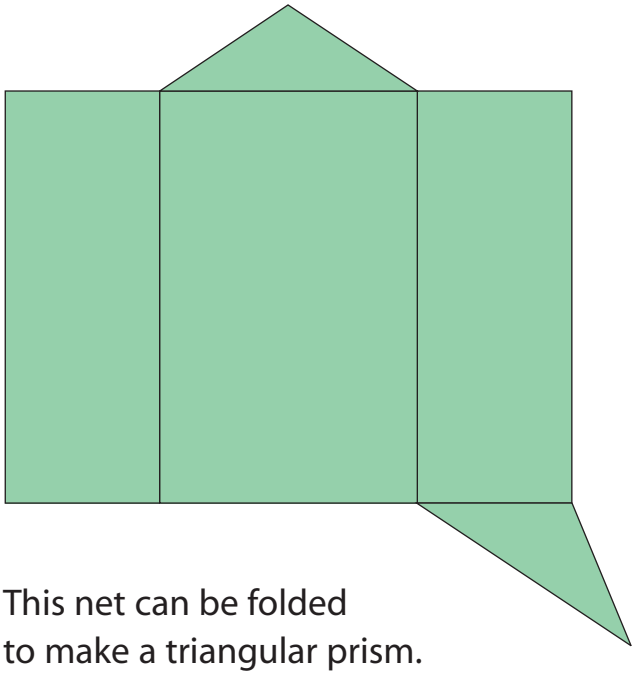
Connect

A pattern that can be folded to form an object is called a **net**.
A cereal box is a rectangular prism.
It can be made from a net.

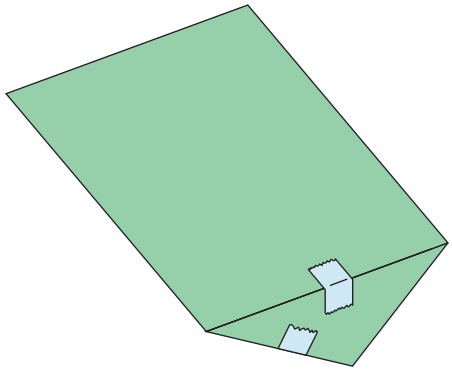




A triangular prism can also be made from a net.

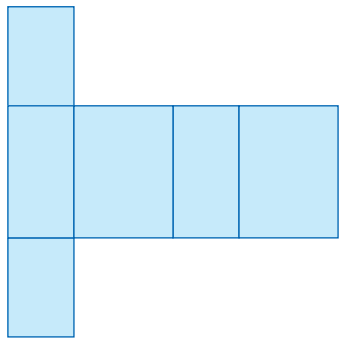


This net can be folded
to make a triangular prism.



Practice

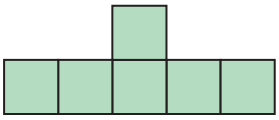
Your teacher will give you copies of the nets.



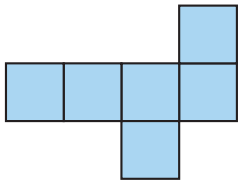
1. Use a large copy of this net.
Colour the congruent faces the same colour.
Fold the net to make an object.
Where are the congruent faces on your object?

2. Which of these pictures are nets of a cube?
How do you know?

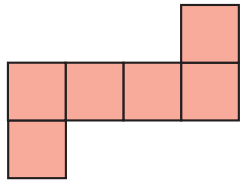
a)



b)



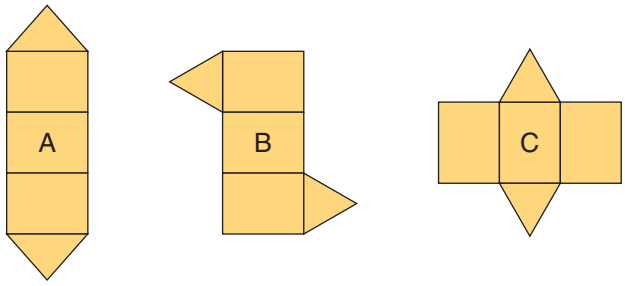
c)



3. **a)** Which of the pictures below are nets of a triangular prism?
How do you know?

b) Predict which sides will meet when you fold the net.
Cut out and fold each net to check.

c) What do you notice about the lengths of the sides that join?



4. The net for a prism has 3 pairs of congruent rectangles.
What kind of prism is it? How do you know?

Reflect

Suppose you see 6 rectangles in a picture.
How can you tell if it is a net of a rectangular prism?
Use words and pictures to explain.

LESSON 4

Strategies Toolkit

Explore

Liam and Sophie have 36 Snap Cubes.
They use all the cubes to build a rectangular prism.
How many different rectangular prisms can they build?

Show *and* Share

Explain how you solved this problem.

Connect

Here is a similar problem.
How many different rectangular prisms can you build with 24 Snap Cubes?

What do you know?

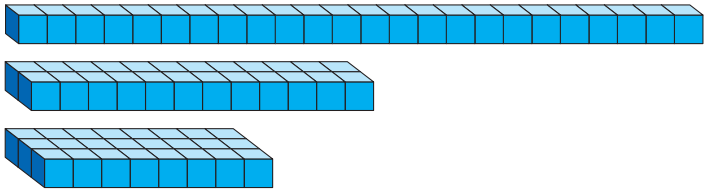
- There are 24 cubes.
- The cubes are used to build a rectangular prism.

Think of a strategy to help you solve the problem.

- You can **work backward**.
- You know how many cubes you need. Use the cubes to make different rectangular prisms.

Strategies

- Make a table.
- Use a model.
- Draw a picture.
- Solve a simpler problem.
- Work backward.
- Guess and test.
- Make an organized list.
- Use a pattern.



Start with a prism that is 1 cube high.
How many different prisms can you build?
Then try to build different prisms that are 2 cubes high, 3 cubes high, and so on.
How many different rectangular prisms did you make?
Record each prism that you made.

How do you know you have found all possible rectangular prisms?
Think of another way you could have solved this problem.

Practice

Choose one of the **Strategies**

1. You have 100 Snap Cubes. How many larger cubes can you make using any number of the Snap Cubes? Record your work. What patterns do you see?

2. A rectangular prism is made with 9 Snap Cubes.
How many different prisms can be made with these cubes?
Suppose the number of cubes were doubled.
How many different prisms can be made now?

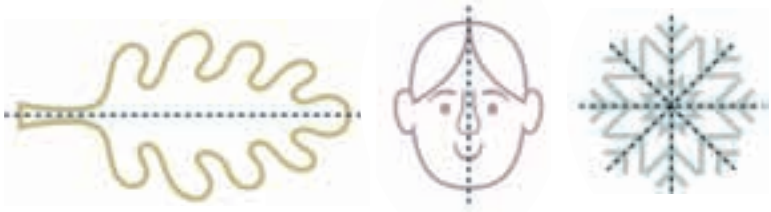
Reflect

How can working backward help you solve a problem?
Use examples to explain.

LESSON 5

Symmetrical Shapes

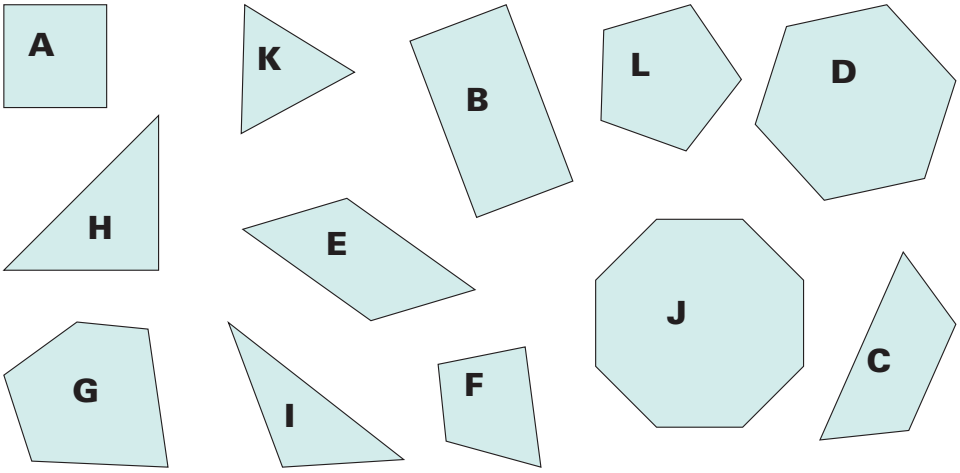
Each picture is **symmetrical**.



What do you think "symmetrical" means?
How can you find out if a shape is symmetrical?

Explore

You need a copy of these shapes.
Use a Venn diagram with headings "Symmetrical" and "Non-symmetrical."
Sort the shapes.
Share the work.

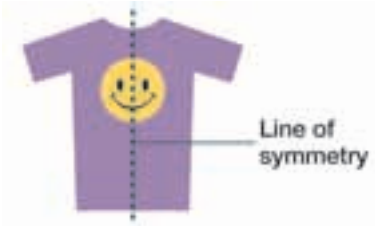


Show *and* Share

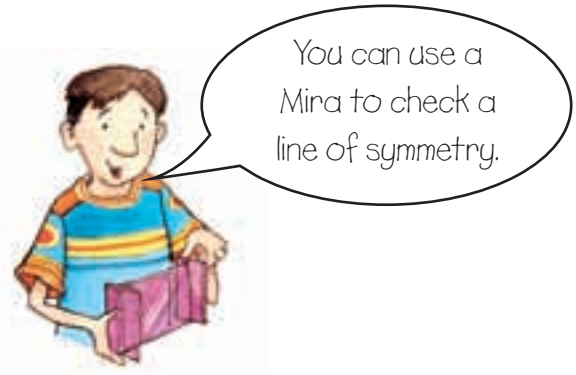
How did you identify symmetrical shapes? Non-symmetrical shapes?
What do all symmetrical shapes have?

Connect

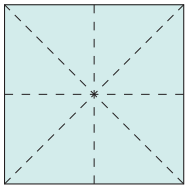
A **line of symmetry** divides a symmetrical shape into 2 congruent parts.



You can fold along the line and the 2 parts match.

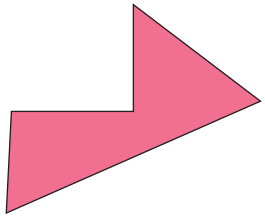


Some shapes have more than 1 line of symmetry.



A square has
4 lines of symmetry.

Some shapes are non-symmetrical. They have no line of symmetry.



Practice

1. Which pictures are symmetrical? Non-symmetrical? How do you know?

a) 

b) 

c) 

d) 

2. Write your name in capital letters.

a) How many letters have 1 line of symmetry?

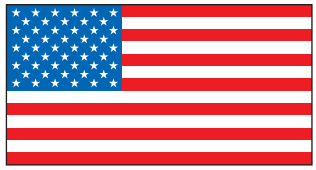
b) Are these letters more than one-half of your name? Less than one-half?

3. Which flags below have each symmetry? How do you know?

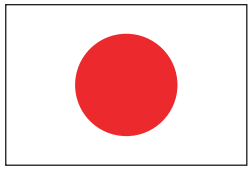
- a vertical line of symmetry
- a horizontal line of symmetry
- more than 1 line of symmetry
- no lines of symmetry

a) Canada

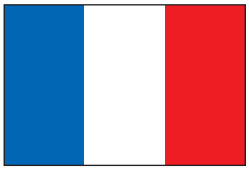
b) The United States of America



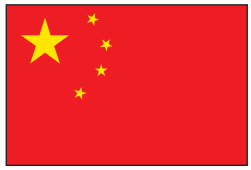
c) Japan



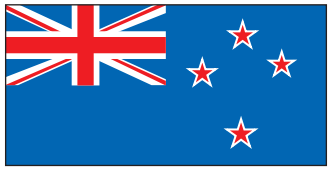
d) France



e) China



f) New Zealand



4. On grid paper, draw a symmetrical picture.
Tell how you know it is symmetrical.
Draw a non-symmetrical picture.
Tell how you know it is not symmetrical.

Reflect

When you see a picture, how can you tell if it is symmetrical?

LESSON 6

Line Symmetry

The Lakota Morning Star quilt represents the planet Venus in the sky.
Lakota women began making quilts in the late 19th century.
Buffalo were scarce and quilts replaced buffalo robes.
A star quilt is given as a gift on important occasions.

Explore

You will need grid paper, Pattern Blocks, and a Mira.

- Fold the grid paper in half.
  Use Pattern Blocks.
  Make a design on one side of the fold line.
  Your design must touch the fold line.
  Trace around your design.
  Do not draw on the fold line.

- Open the paper.
  Use the Mira.
  Make a mirror image of the design on the other side of the fold line.
  Trace around the mirror image.
  Remove the Pattern Blocks.

- Find any lines of symmetry on the picture.

Show *and* Share

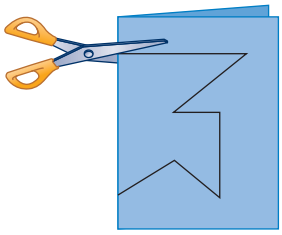
Show your work to another pair of students.
How did you find the lines of symmetry?
What did you notice about the fold lines?

Connect

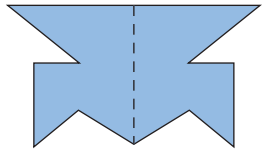
Here is one way to make a symmetrical shape.

Recall that a symmetrical shape has one or more lines of symmetry.

➤ Fold a piece of paper.
Draw a shape.
Use the fold line as one side of the shape.
Cut out the shape.



➤ Unfold the paper.
The fold line is a line of symmetry.



Practice

1. How many lines of symmetry does each Pattern Block have?
Trace each block and draw the lines of symmetry.

a) 

b) 

c) 

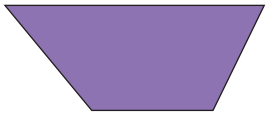
d) 

e) 

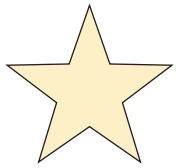
f) 

2. Trace the shapes that have line symmetry.
Draw the lines of symmetry.

a)

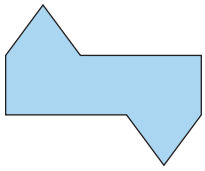


b)

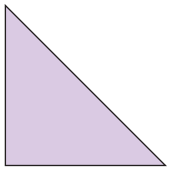


c)

d)

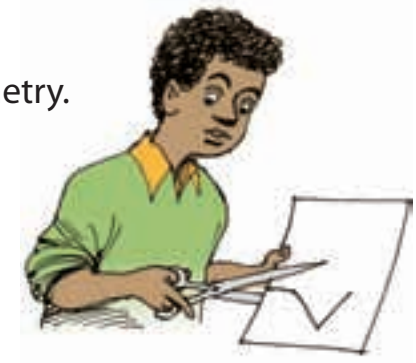


e)



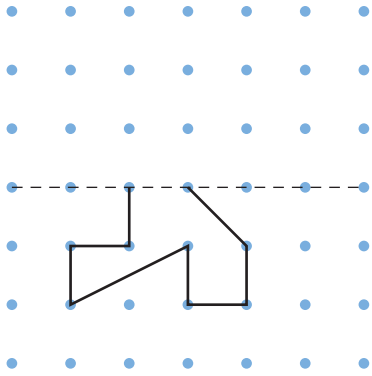
f)

3. Choose a shape in question 2 that has line symmetry.
Fold a piece of paper in half.
Use scissors.
Cut out a shape so that
when the paper is unfolded, it matches
the shape you chose in question 2.

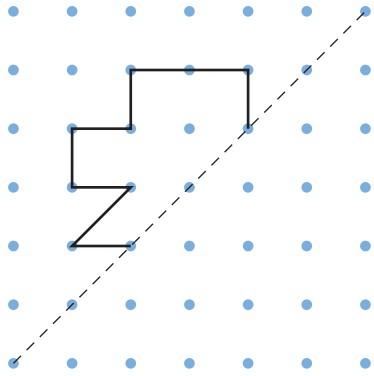


4. One-half of a symmetrical shape is shown.
The broken line is a line of symmetry.
Copy the shape and the line of symmetry on dot paper.
Complete the shape.

a)



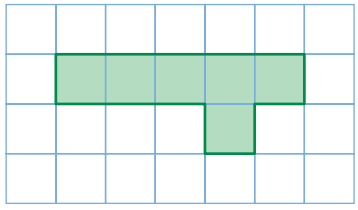
b)



5. Work with a partner.
Use dot paper.
Take turns to draw a symmetrical shape.
Explain how you know your partner's shape is symmetrical.
Draw the lines of symmetry on your partner's shape.

6. Work with a partner.
Use a geoboard and geobands.
Divide the geoboard in half.
The dividing line is a line of symmetry.
Make one-half of a shape on the geoboard.
Trade geoboards.
Make the other half of your partner's shape.
Trade geoboards again to check that
the shapes are symmetrical.

7. This shape does not have a line of symmetry.
Copy the shape on grid paper.
Add one or more squares so it has
a line of symmetry.
How many different ways can you do this?
Record each way on grid paper.



8. Use Pattern Blocks to make a star quilt design.
Try making three different star designs.
How many lines of symmetry does each design have?

9. Fold a piece of paper in half.
Cut the paper to make each shape below,
when the paper is unfolded.
a) a triangle
b) a quadrilateral
c) a pentagon
d) a hexagon
Tell about the shapes you created.

Reflect

How well do you think you understand symmetry?
Explain how to construct a shape that has line symmetry.

LESSON 7

Sorting by Lines of Symmetry

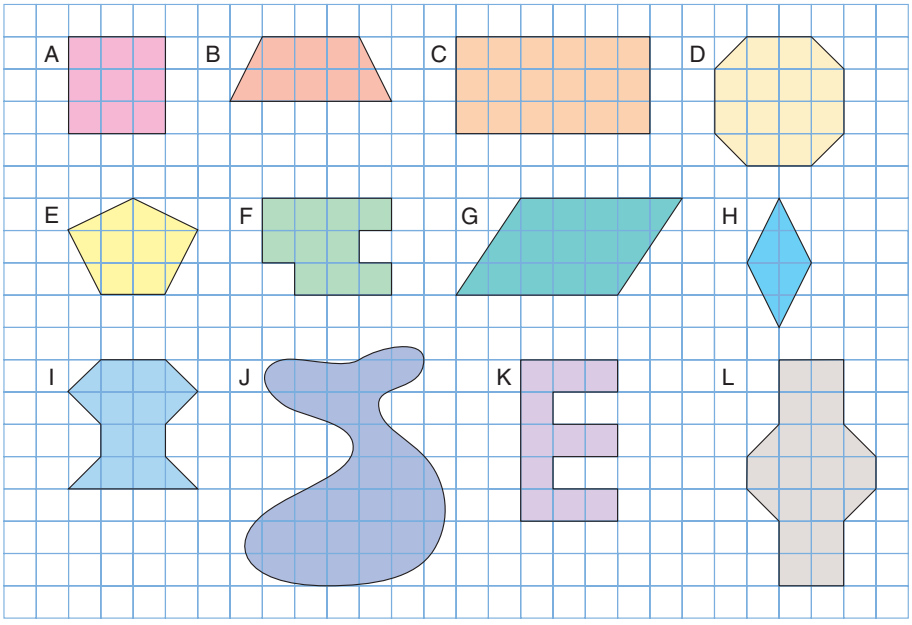
A line of symmetry divides a shape into two congruent parts. When the shape is folded along its line of symmetry, the parts match exactly.

How can you tell that the two parts are congruent?

Explore

You will need a copy of the shapes below and a Mira.

➤ Draw as many lines of symmetry on each shape as you can find.



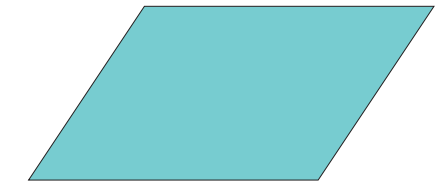
➤ Draw a Venn diagram.
Label the circles: "0 lines of symmetry;" "1 line of symmetry;" and "More than 1 line of symmetry."
Sort the shapes.

Show *and* Share

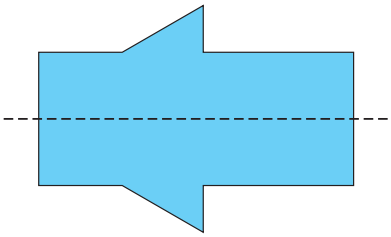
Share your sorting with a classmate.
Explain how you know which shapes are symmetrical.

Connect

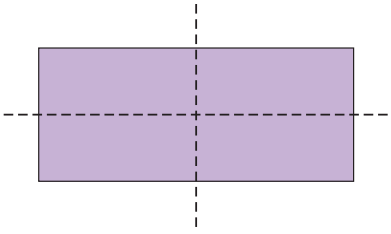
A shape has symmetry when a line of symmetry can be drawn on it.
Some shapes have no lines of symmetry.
Some shapes have more than one line of symmetry.



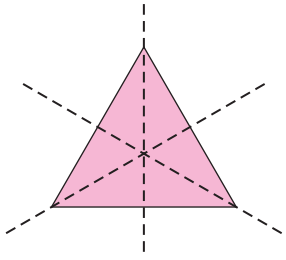
0 lines of symmetry



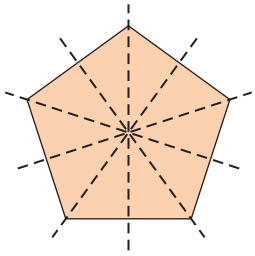
1 line of symmetry



2 lines of symmetry



3 lines of symmetry



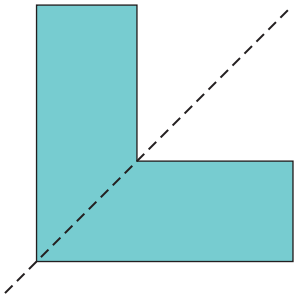
5 lines of symmetry

Practice

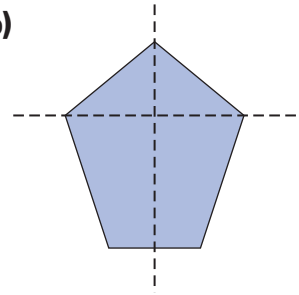
Use a Mira when it helps.

1. Is each broken line a line of symmetry? How do you know?

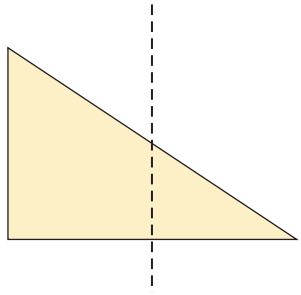
a)



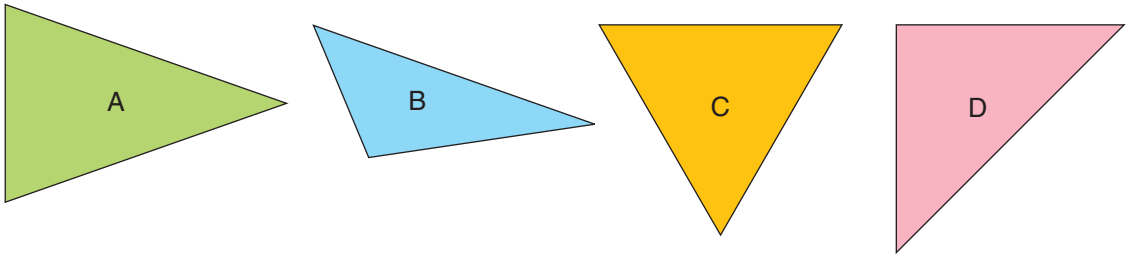
b)



c)

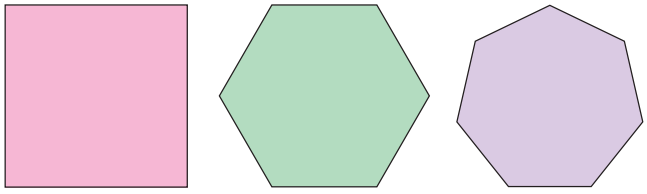


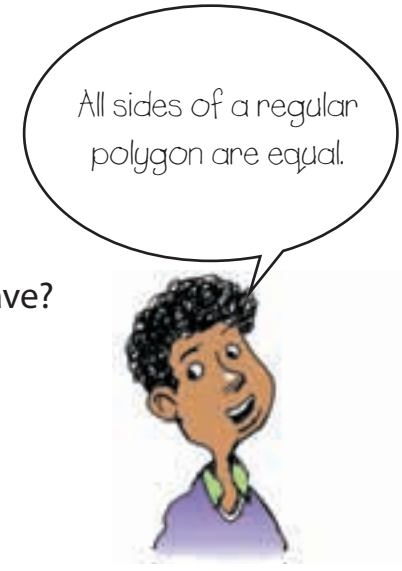
2. a) How many lines of symmetry does each triangle have?



b) Which triangle has the most lines of symmetry? Describe the triangle.

3. a) How many lines of symmetry does each regular polygon have?





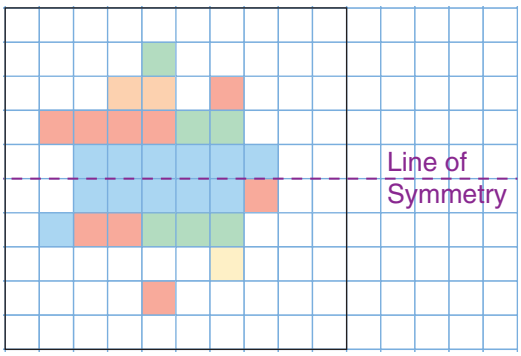
b) How many sides does each regular polygon have?

c) Predict the number of lines of symmetry for a regular polygon with 10 sides, a *decagon*. Explain your thinking.

4. Use a copy of this diagram. Sketch a shape in each cell.

Shape has …	0 lines of symmetry	1 line of symmetry	More than 1 line of symmetry
3 sides			
4 sides			
5 sides			
6 sides			

5. a) How would you change this design to make it symmetrical about the line of symmetry shown?



b) How many different ways could you change this design but still make it symmetrical?
Use grid paper to show the different ways.

Reflect

When you see a shape, how can you identify how many lines of symmetry it has? How do you know you have found all the lines of symmetry?

At Home

Look through magazines to find pictures with symmetry. Cut out the pictures. Use a ruler to draw each line of symmetry.

What's My Rule?

You will need a set of *What's My Rule?* game cards, scissors, 2 labels, and two 1-m lengths of string.

Cut out the game cards.
Spread them out, face up.
Use the string to make 2 loops.
Label one loop "Matches" and one loop "Discards."

➤ Player A thinks of a secret rule that describes some of the shapes on the cards.
The rule could be:
- it has more than 1 line of symmetry; or
- it has all sides equal; or
- it is a square

➤ Player A chooses 2 game cards. One card must fit the rule.
He places it face up inside the "Matches" loop.
The other card must not fit the rule.
He places it face up in the "Discards" loop.

➤ Player B chooses a game card.
If she thinks the card fits the rule, she places it inside the "Matches" loop. Otherwise, she places it in the "Discards" loop.

➤ Player A tells Player B whether she is correct.
If she is correct, she can guess the rule.
If she is not correct, she cannot make a guess.

➤ Players C and D continue until someone guesses the secret rule.

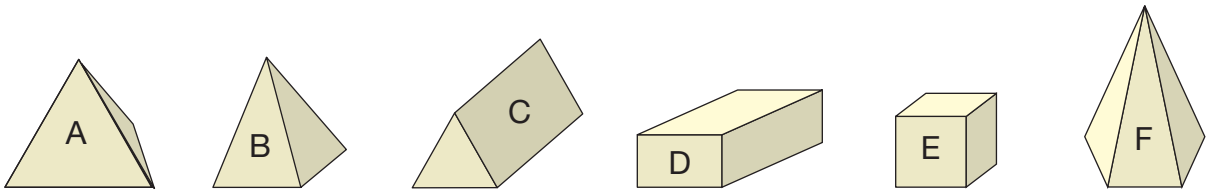
➤ Switch roles. Another player thinks of a secret rule.
The other players take turns trying to guess the new rule.
The winner takes the fewest turns to guess the rule.

Unit 6 Show What You Know

LESSON

1 2

1. Look at the objects below.
Choose 2 attributes.
Draw a Venn diagram.
Sort the objects.
Record your sorting.



2. Use the pictures above.

a) Identify a triangular prism.
Write all that you know about it.

b) Identify a rectangular prism.
Write all that you know about it.

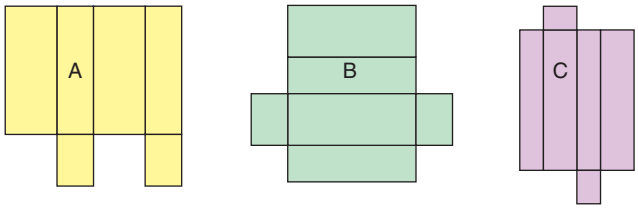
2

3. Use modelling clay.
Make two different triangular prisms.
How are the prisms alike? How are they different?

4. Use 12 orange Pattern Blocks.
How many different rectangular prisms can you make?
How are the prisms alike? How are they different?

3

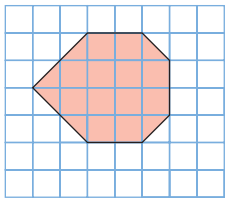
5. Which pictures below show a net for a rectangular prism?
How could you check?

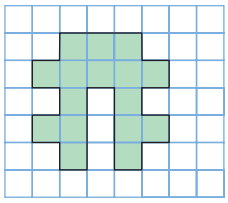


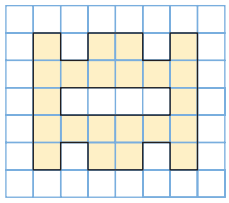
LESSON

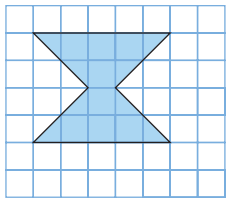
5

6. Is each shape symmetrical?
How do you know?

a) 

b) 

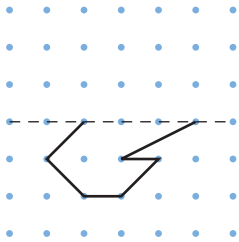
c) 

d) 

6

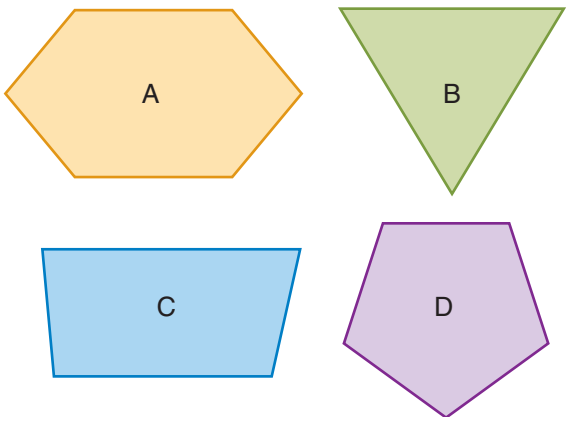
7. Copy each shape in question 6 on grid paper.
Draw all the lines of symmetry.

8. One-half of a symmetrical shape is shown.
The broken line is a line of symmetry.
Copy the shape and line of symmetry on dot paper.
Complete the shape.



7

9. Sketch each shape. Draw its lines of symmetry.



10. Draw a Venn diagram.
Sort the shapes in question 9.
Use these attributes:
"Has 0 lines of symmetry;"
"Has 1 line of symmetry;"
"Has more than 1 line of symmetry"

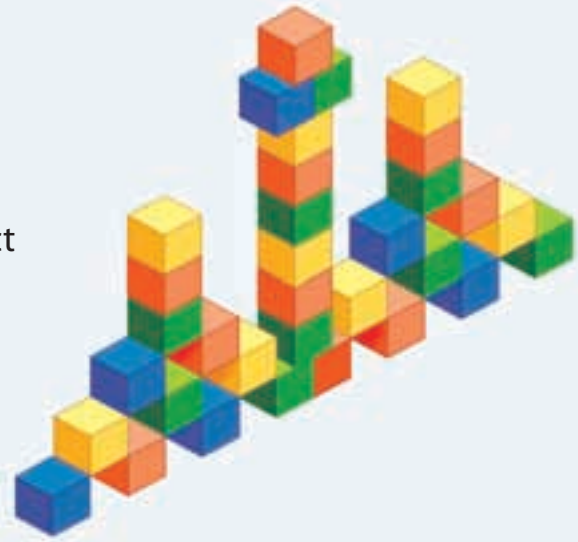
UNIT 6 **Learning Goals**

- ☑ describe, name, and sort prisms
- ☑ construct prisms from their nets
- ☑ construct models of prisms
- ☑ identify, create, and sort symmetrical and non-symmetrical shapes
- ☑ draw lines of symmetry

Unit Problem

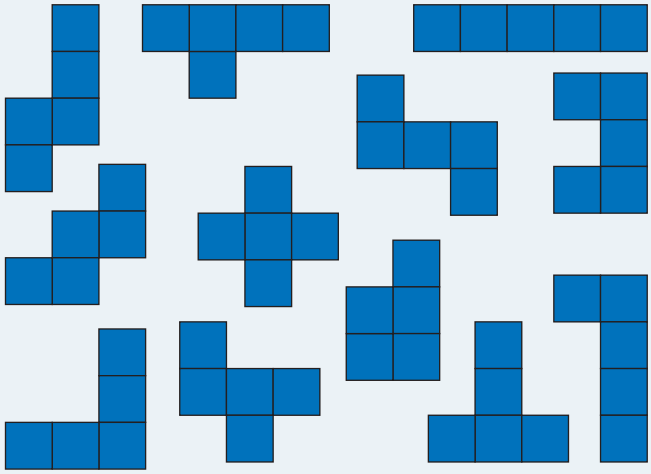
Building Castles

Stefanie wants to make a castle with cubes. First she has to construct the cubes.



Part 1

Stephanie has this set of pentominoes.



A *pentomino* is an arrangement of 5 congruent squares.

Which pentominoes are symmetrical?
Your teacher will give you a copy of the pentominoes.
Draw the lines of symmetry.

Stefanie knows that some of these pentominoes will fold to make an open cube.
Which pentominoes above can be folded to make an open cube?

Part 2

Stefanie will use the pentominoes that fold to make open cubes.
She will draw a square on each pentomino so when it folds, it makes a closed cube.
Draw a square on each pentomino so it is a net of a cube.

Each net is a hexomino because it has 6 squares.
Draw the hexominoes on grid paper.
Which hexominoes are symmetrical?
Draw the lines of symmetry.

Part 3

A *hexomino* is an arrangement of 6 congruent squares.

Combine any pentomino and hexonimo to make a new shape that is symmetrical.
Sketch this new shape.
Draw the line of symmetry.
Is it possible to combine two shapes to make a new shape with more than one line of symmetry?
Investigate to find out.

Reflect on Your Learning

Which learning goals have you met?
Find examples of your work that show how you met these goals.

Units 1–6 Cumulative Review

UNIT 1

1. a) Use Colour Tiles to build this pattern.

Figure	Tiles in a Figure
1	2
2	5
3	8
4	11
5	14
6	17

b) Draw the pattern on grid paper.
c) Write a pattern rule.
d) How many tiles would be in the 8th figure? How did you find out?

2. Add or subtract. How do you know each answer is reasonable?

a) $3057 - 1999$ **b)** $3210 + 5909$ **c)** $6666 - 3777$ **d)** $8376 + 1234$

3. a) What is the product when you multiply a number by 0? Draw a diagram to explain your answer.
b) What is the product when you multiply a number by 1? Explain how you know.

4. Show each time on a digital clock and an analog clock.
a) five forty-five
b) ten thirty
c) 3 minutes after 7

5. Show each time on a 24-hour digital clock.
a) six thirty-two in the afternoon
b) eleven thirteen at night

6. Use 1-cm grid paper. Draw a large shape.
Find the area of your shape.
Explain how you did this.

7. Use 1-cm grid paper.
Draw as many rectangles as you can that have area 24 cm^2.

5

8. Fold a paper strip to show fifths.
Colour $\frac{3}{5}$ of the strip.
What fraction of the strip is not coloured?

9. Use 18 counters.
a) What fraction of the set is 9 counters?
b) How many counters are in $\frac{5}{6}$ of the set?
c) What other fractions can you show with 18 counters?

10. Order each set of fractions from least to greatest.
a) $\frac{1}{5}, \frac{1}{3}, \frac{1}{7}$ **b)** $\frac{6}{8}, \frac{3}{8}, \frac{1}{8}$ **c)** $\frac{4}{9}, \frac{4}{7}, \frac{4}{12}$

11. Use a hundredths grid to represent 1.
Colour a grid to show each fraction.
a) $\frac{11}{100}$ **b)** $\frac{4}{10}$ **c)** $\frac{8}{10}$ **d)** $\frac{73}{100}$

12. Write an equivalent decimal for each number.
Use a hundredths grid to show how you know the decimals are equivalent.
a) 0.40 **b)** 0.2 **c)** 0.9 **d)** 0.70

6

13. Look around your classroom.
Find 4 rectangular prisms.
What is the same about all the prisms?

14. Use grid paper.
Draw a symmetrical shape.
a) How do you know the shape is symmetrical?
b) How many lines of symmetry does it have?