Be CALM

Geometry

Beginning Curriculum for Adults Learning Math Curriculum

STUDENT PACKET

Public Adult Education of MA
LIVE TO LEARN

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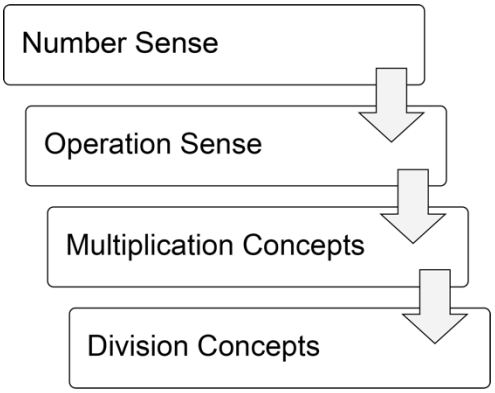
Because math and science build futures

Created with funding from Public Adult Education of Massachusetts by the SABES Mathematics and Adult Numeracy Curriculum & Instruction PD Team, which is managed by TERC, Inc.

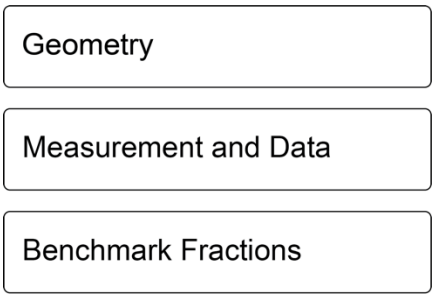
Acknowledgements

The titles in the BeCALM series were developed and piloted in the classroom by Melissa Braaten for the SABES Mathematics and Adult Numeracy Curriculum & Instruction PD Team, with contributions from Yvonne Readdy, Emily Rudd, and Sherry Soares.

The BeCALM series includes four sequential packets:



and three non-sequential packets:



Activities from the EMPower™ series title *Over, Around, and Within: Geometry and Measurement* are used and/or adapted with permission from the author, TERC, Inc.

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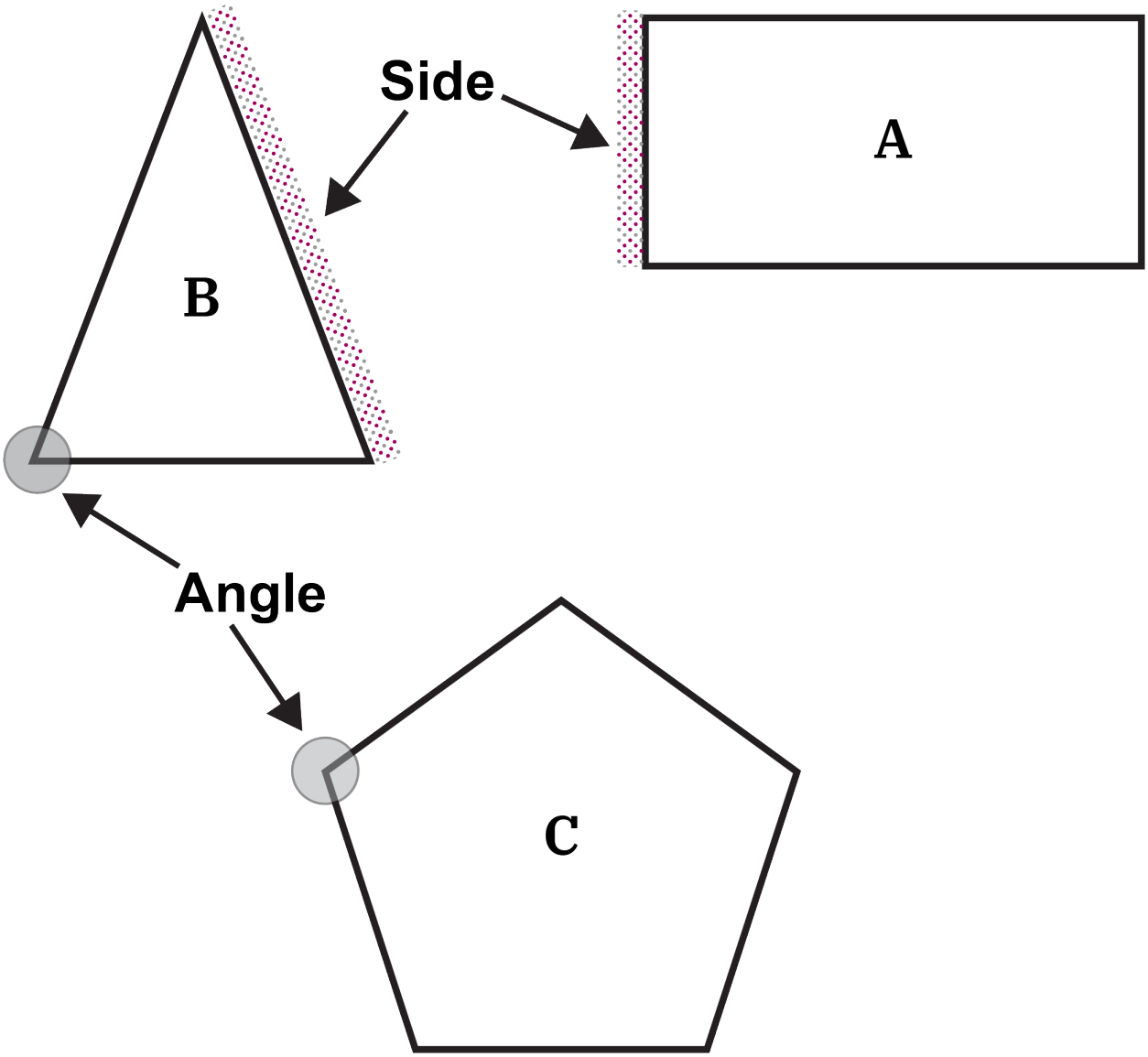
Geometry is the part of math where we study shapes, sizes, and positions.

Shapes

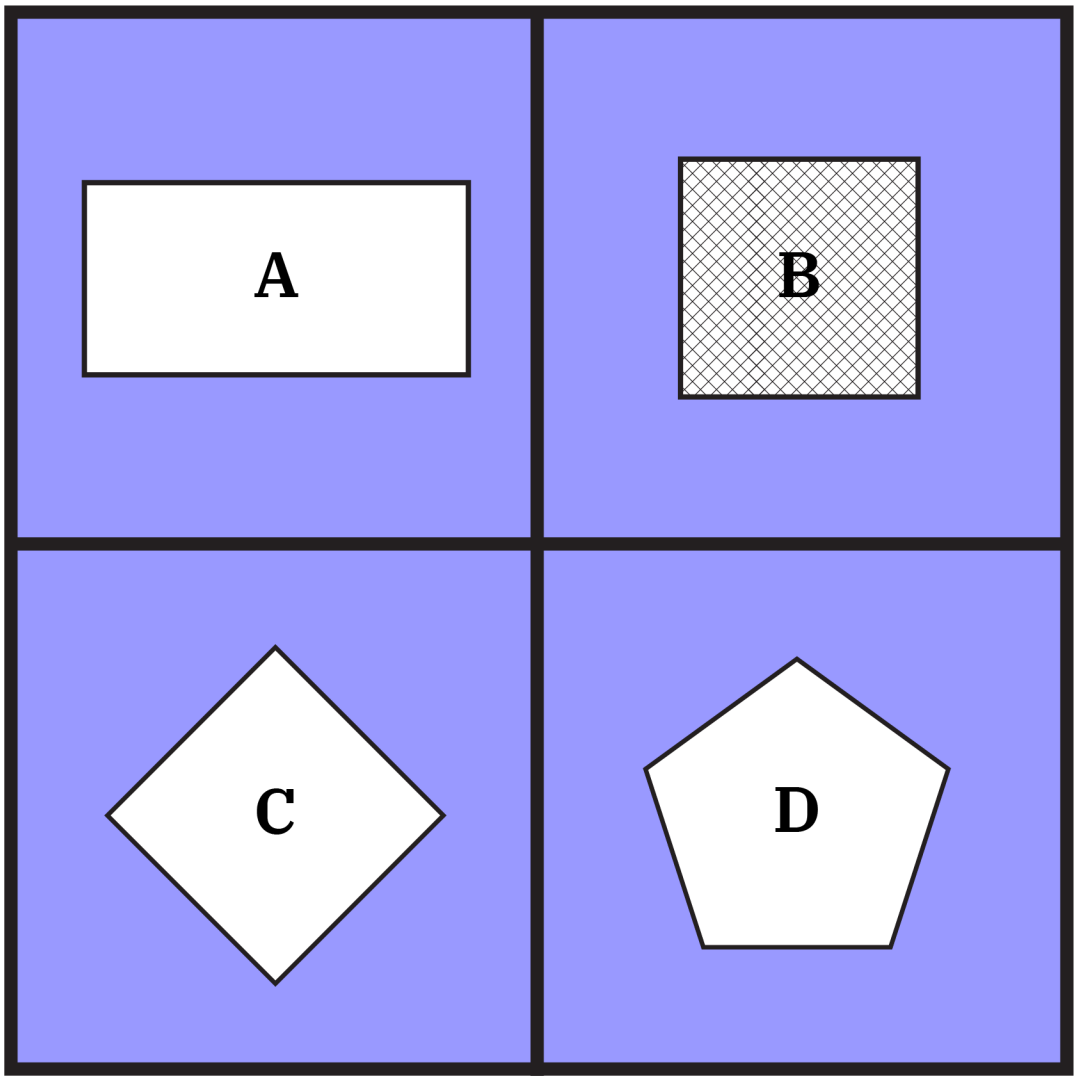


UNIT 1: Putting Together and Taking Apart Shapes

Which One Doesn't Belong?

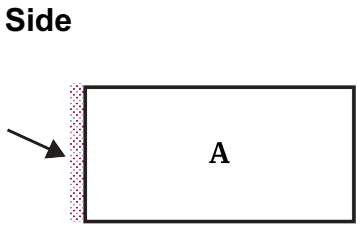
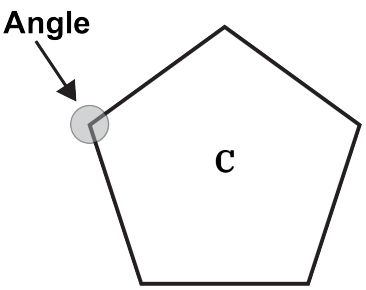
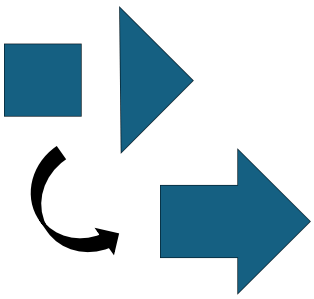
Choose one shape in this picture that you don't think belongs with the others. Explain why.

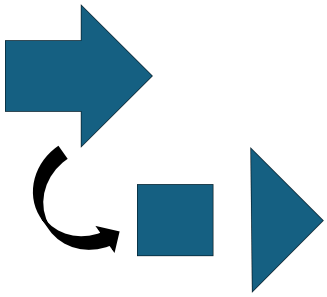
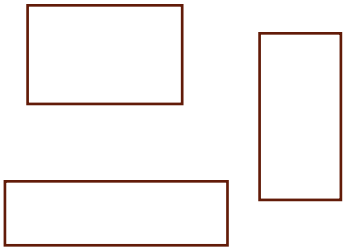
Can you pick another shape and give a different reason?



Source: wodb.ca

Vocabulary List for This Unit

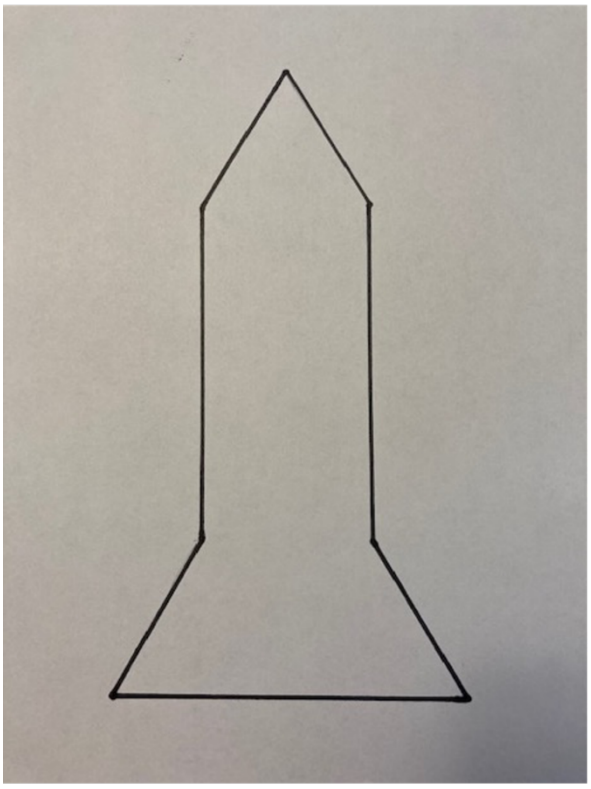
Word	Definition	Example
geometry	the study of _____, sizes, and positions	
sides	the straight _____ that make a shape	
angles	the _____ of a shape	
compose	to put _____. We can compose shapes to make new shapes.	

Word	Definition	Example
decompose	to break _____. We can decompose shapes into smaller shapes.	
rectangle	a shape with four _____ and four _____ angles.	

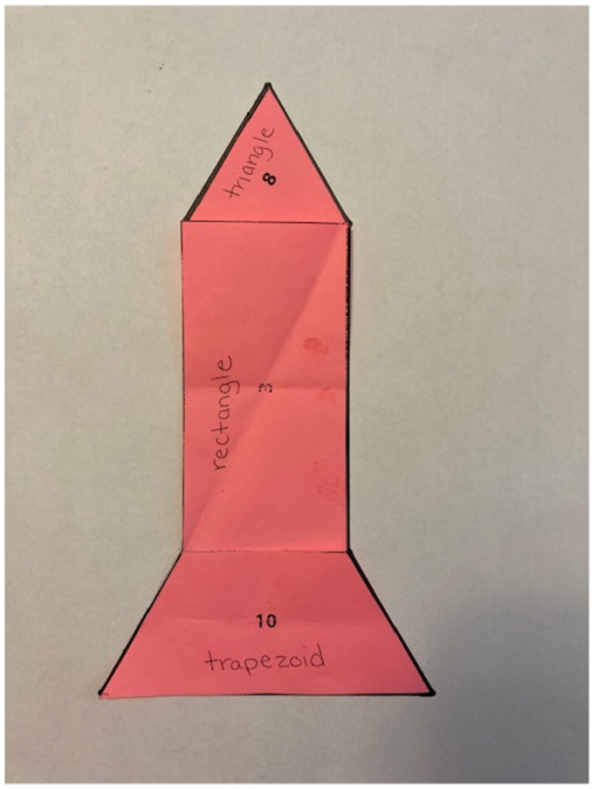
Shape Puzzles

Build the outlined shape using the shapes in your Shape Set. You can turn and flip over the shapes if you need to.

Here is an example:

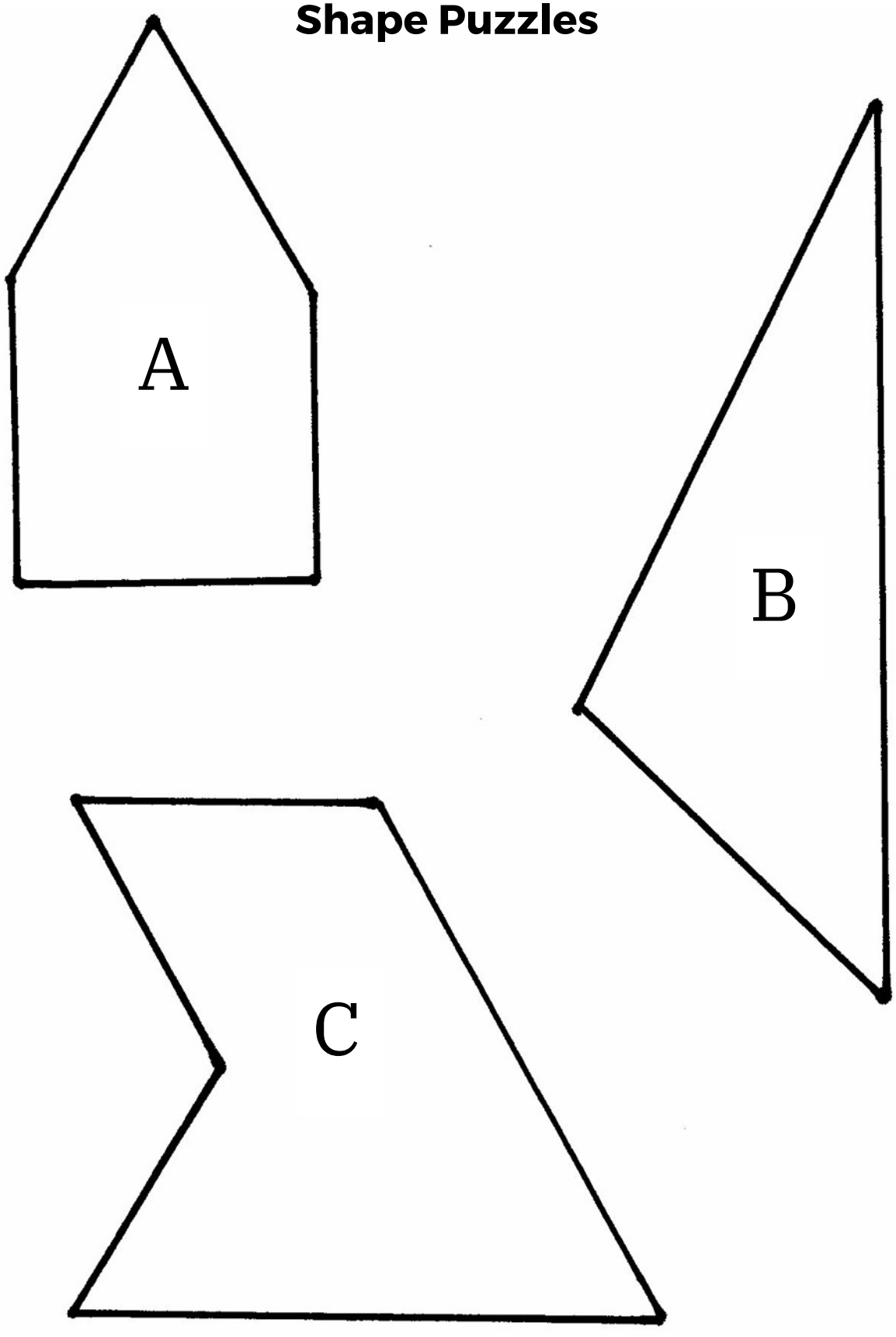


Shape Puzzle

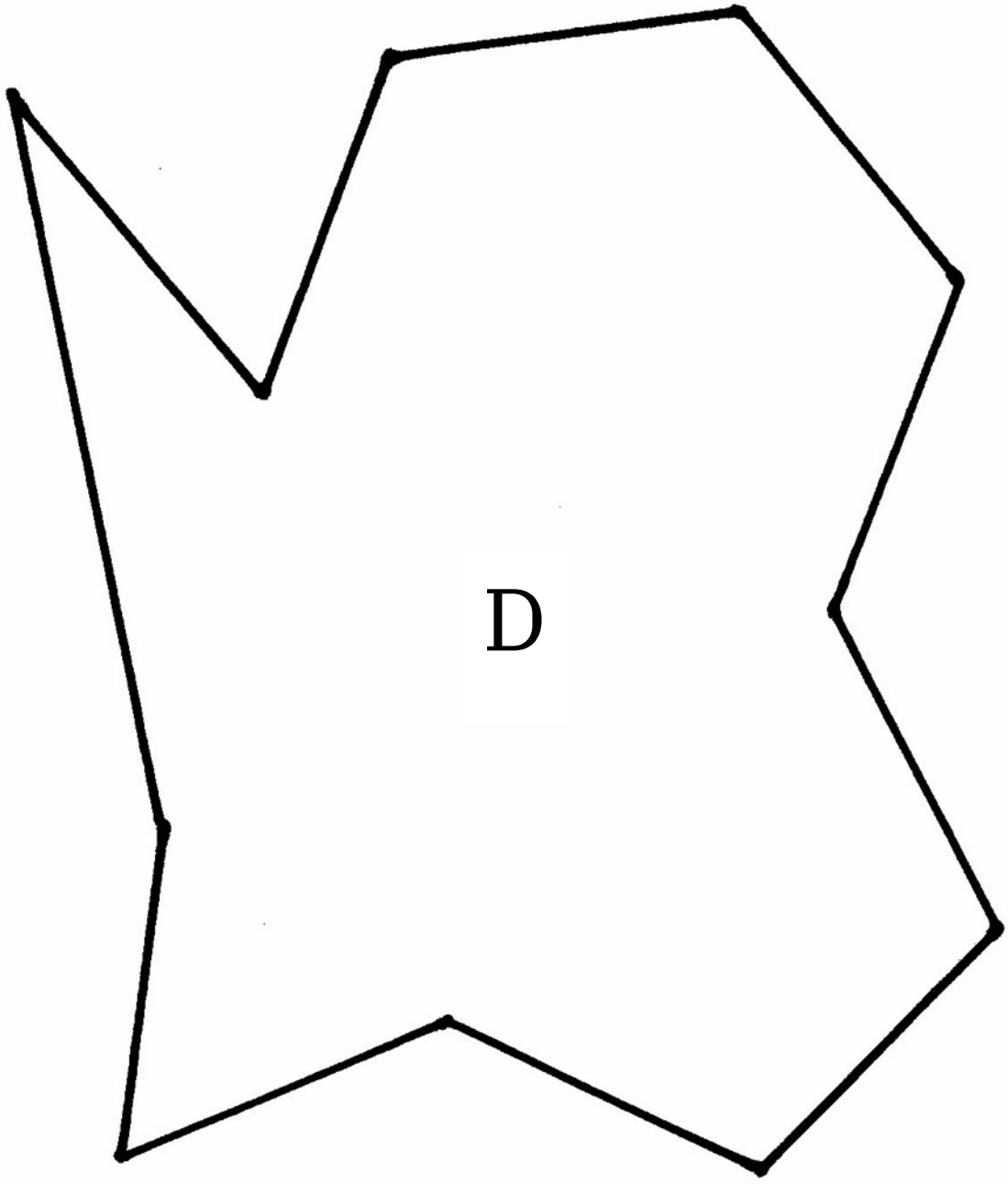


Possible Solution

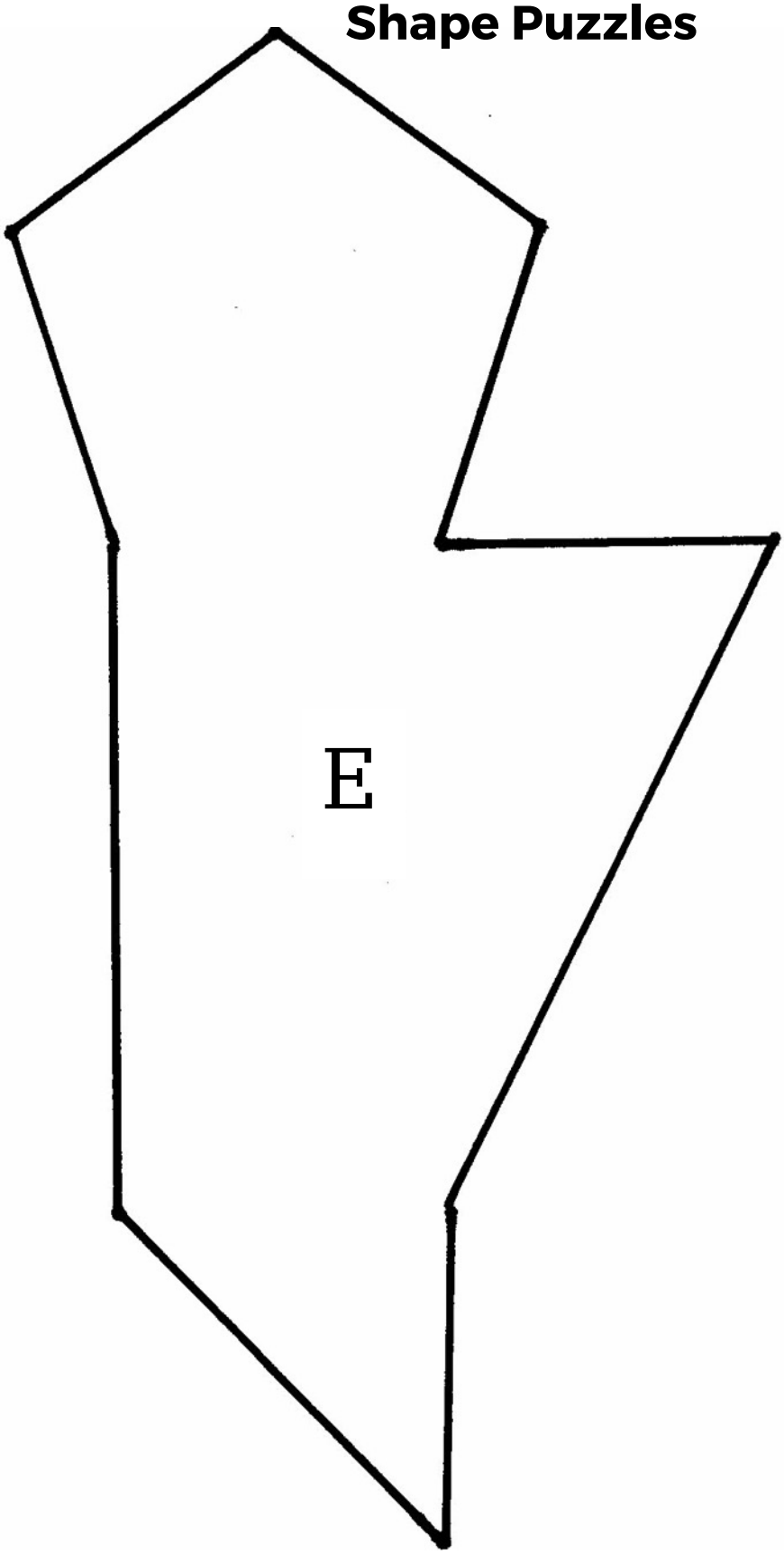
Shape Puzzles



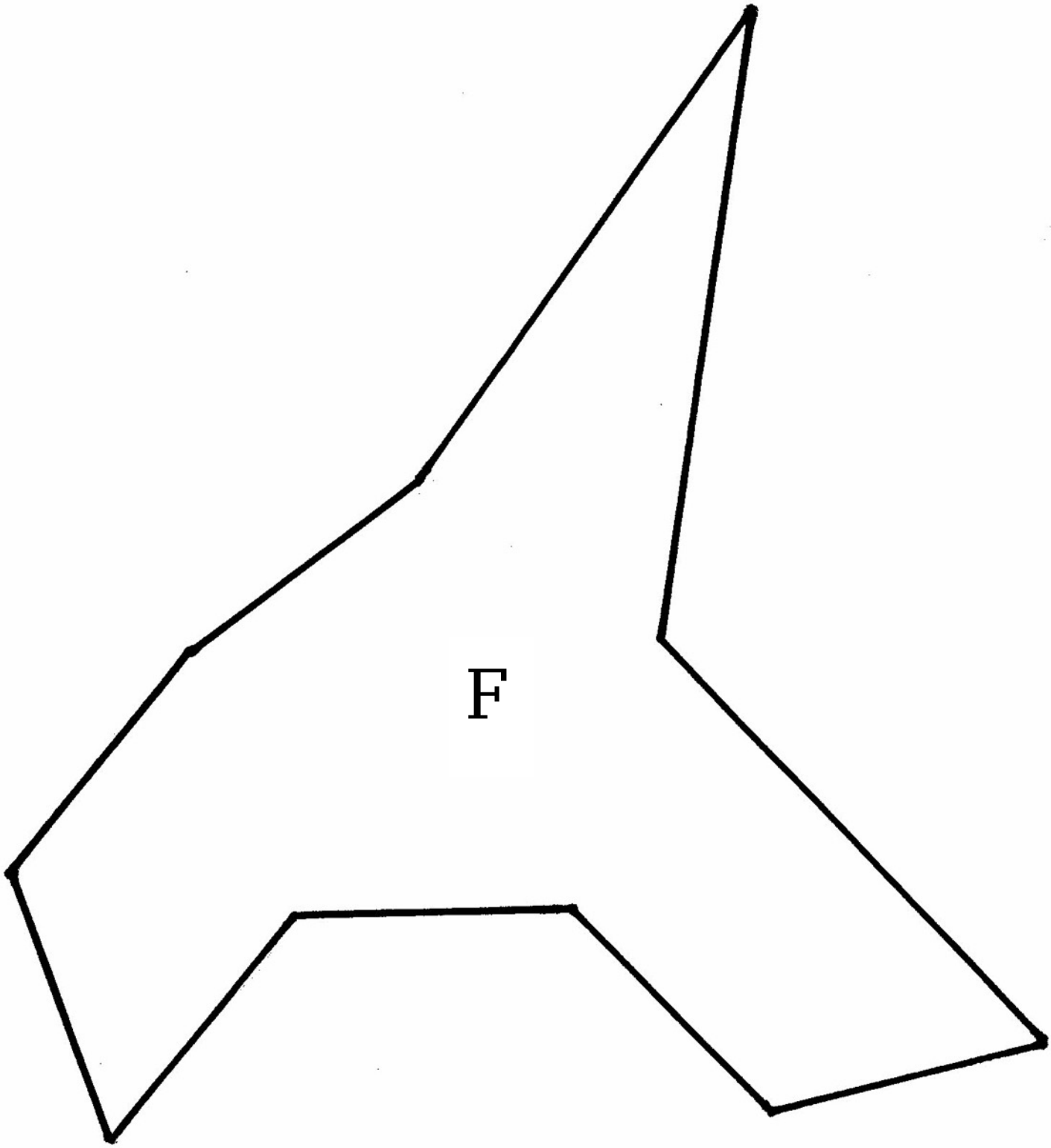
Shape Puzzles



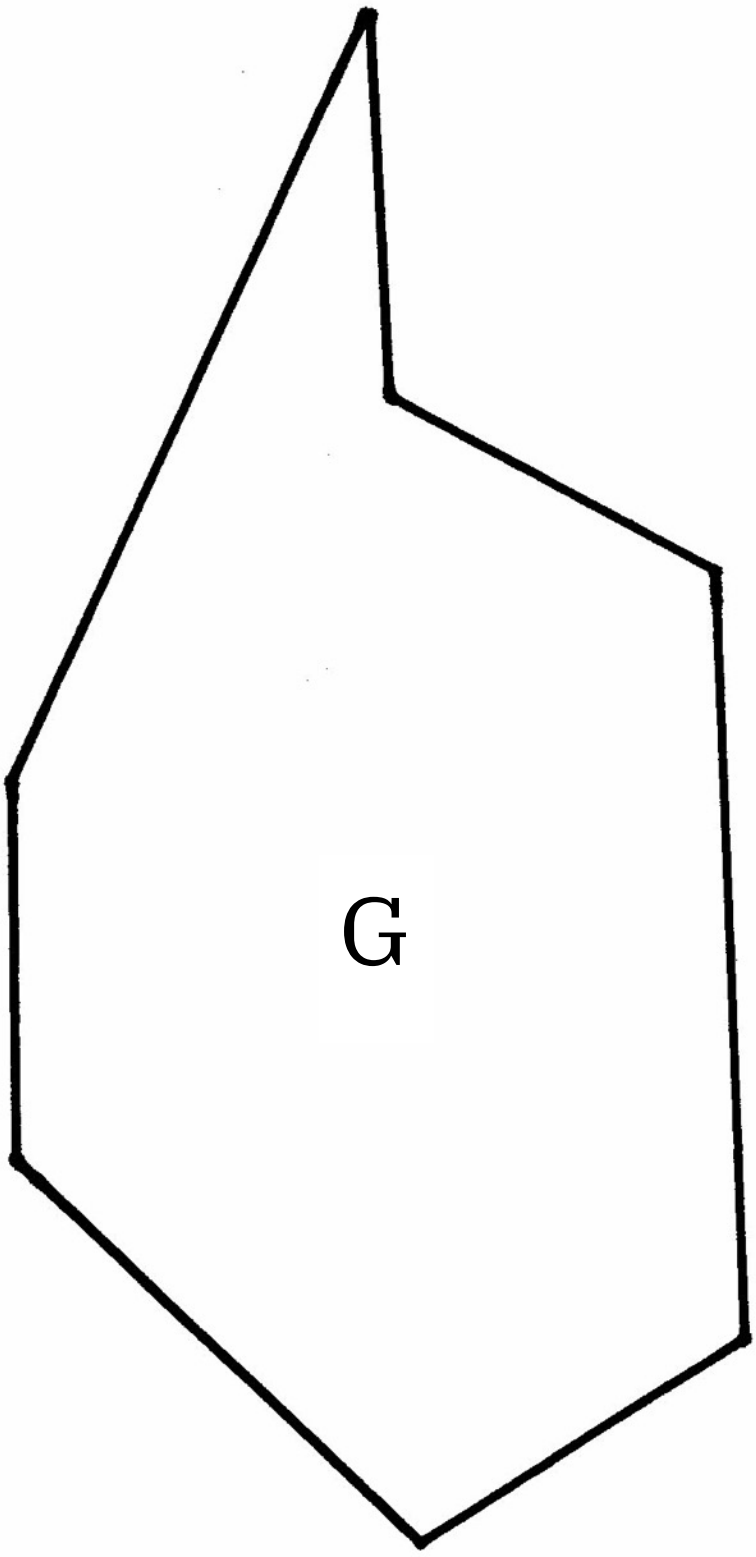
Shape Puzzles



Shape Puzzles

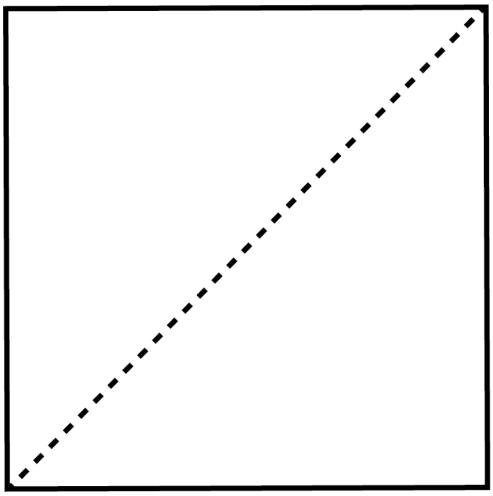


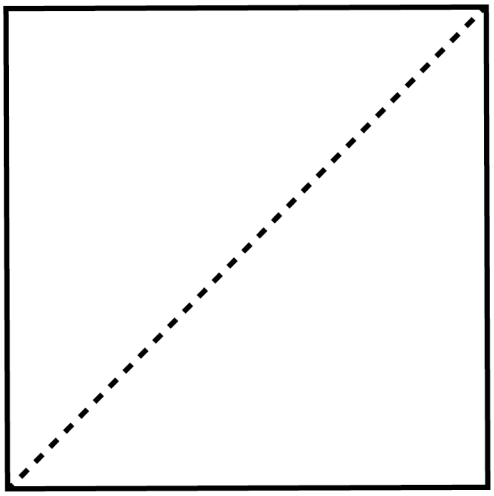
Shape Puzzles

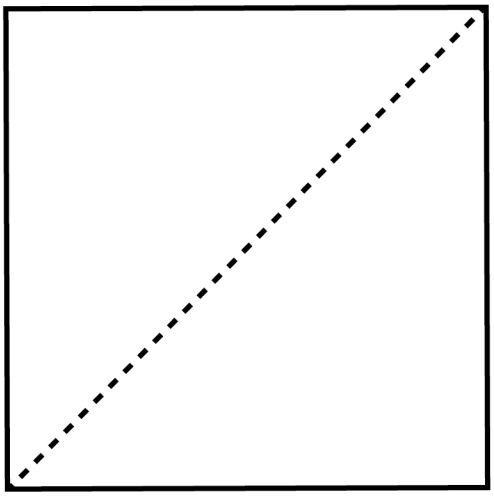


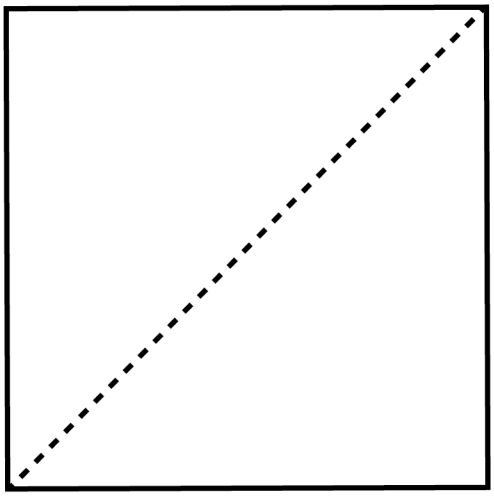
Squares from Investigations

Cut out the squares. Cut each square in half along the dotted line.

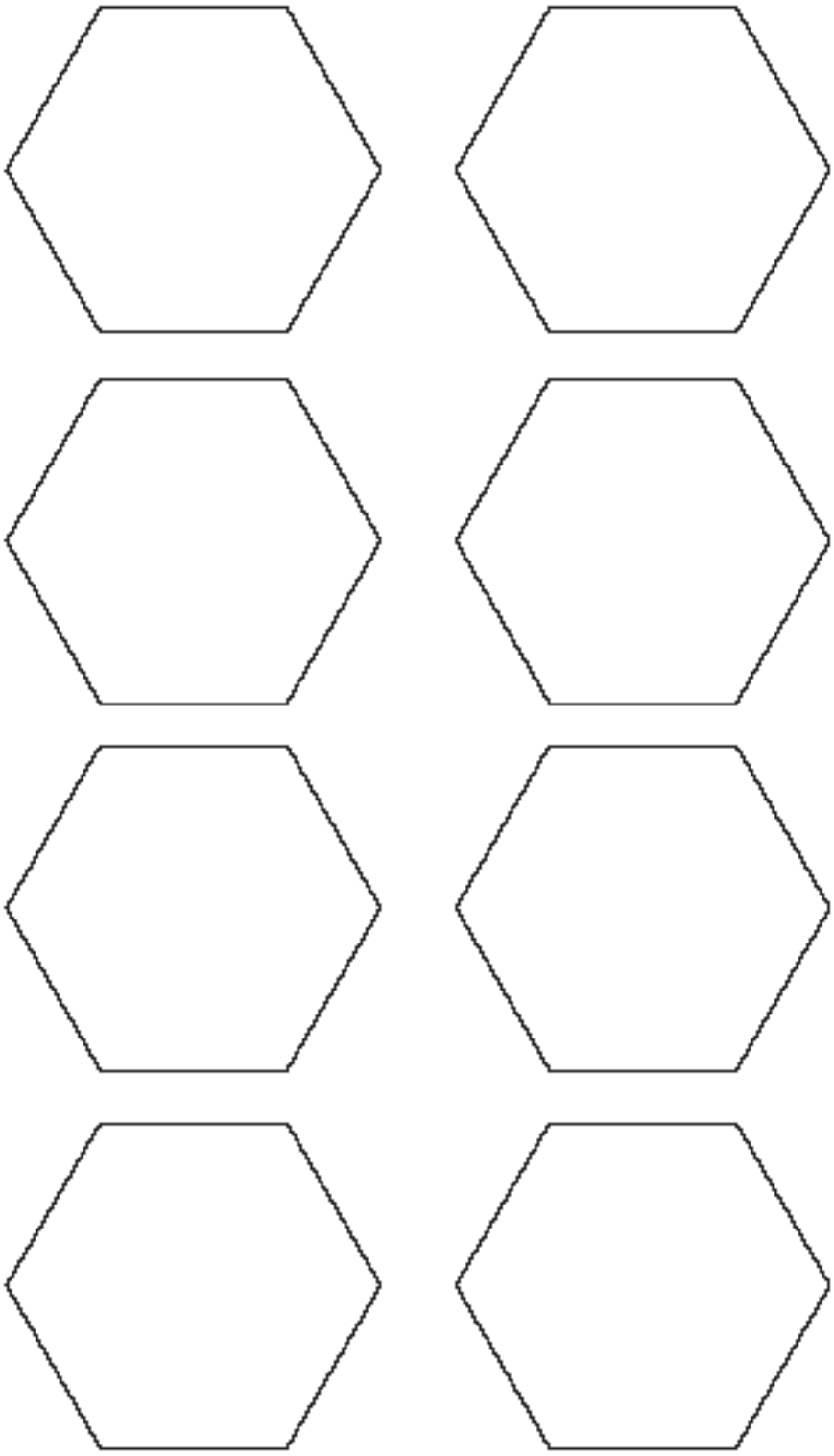








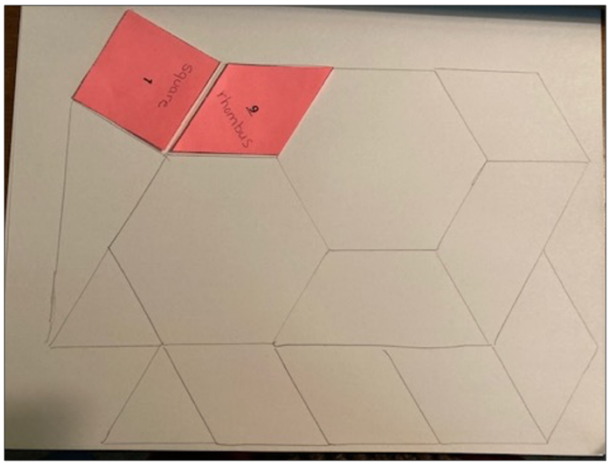
Creating Shapes

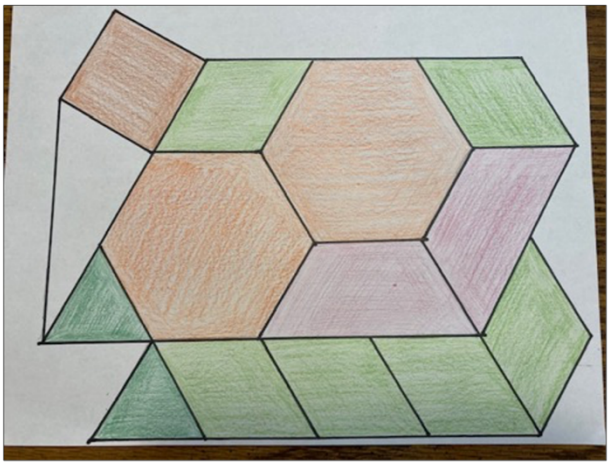


Create a Design

Use the shapes in your Shape Set. Trace the shapes on a blank piece of paper to create a design. Try to cover as much of the paper as possible.

Here is an example:



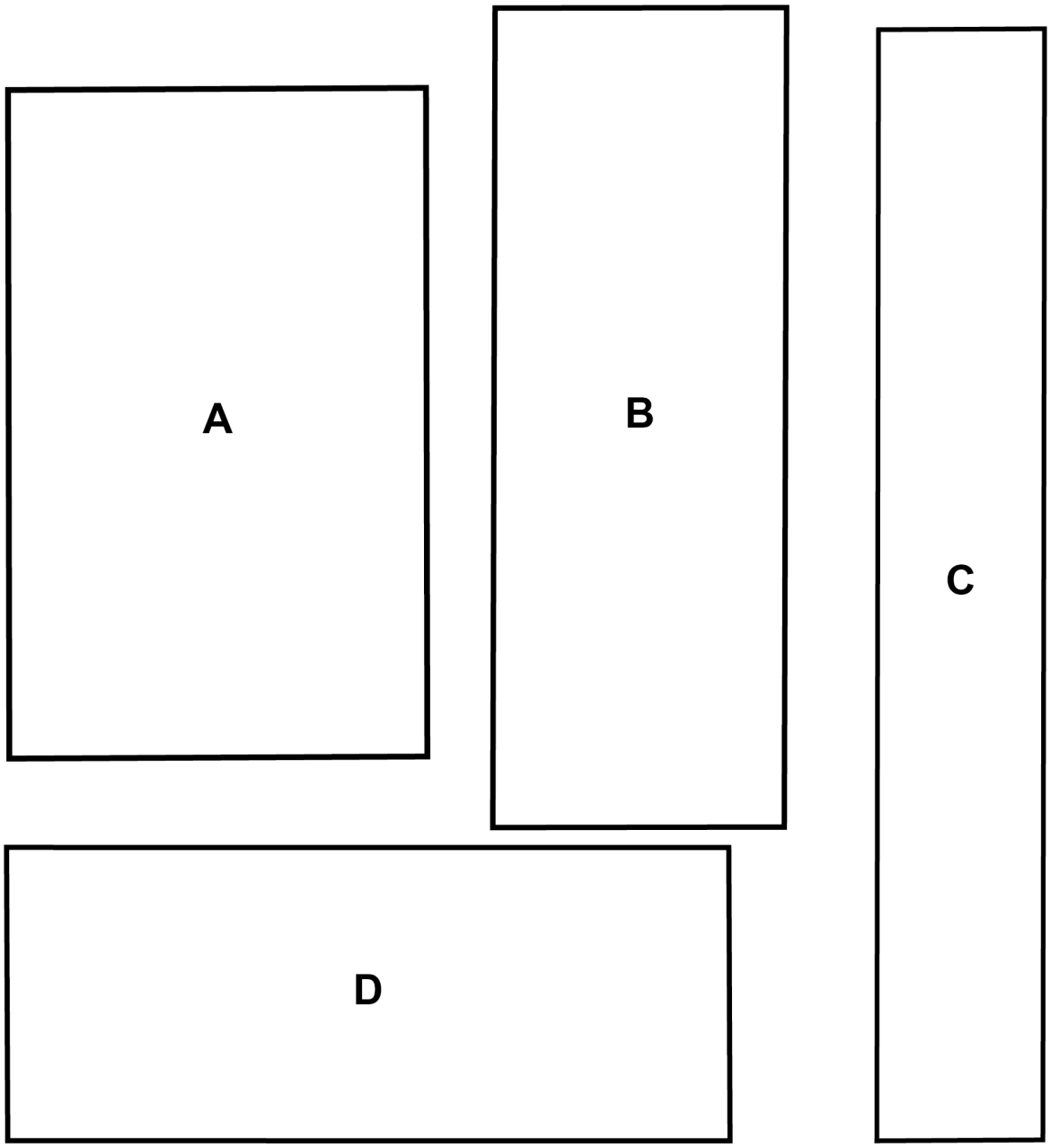


Which shapes were the easiest to fit together?

Which shapes were the hardest to fit? Why?

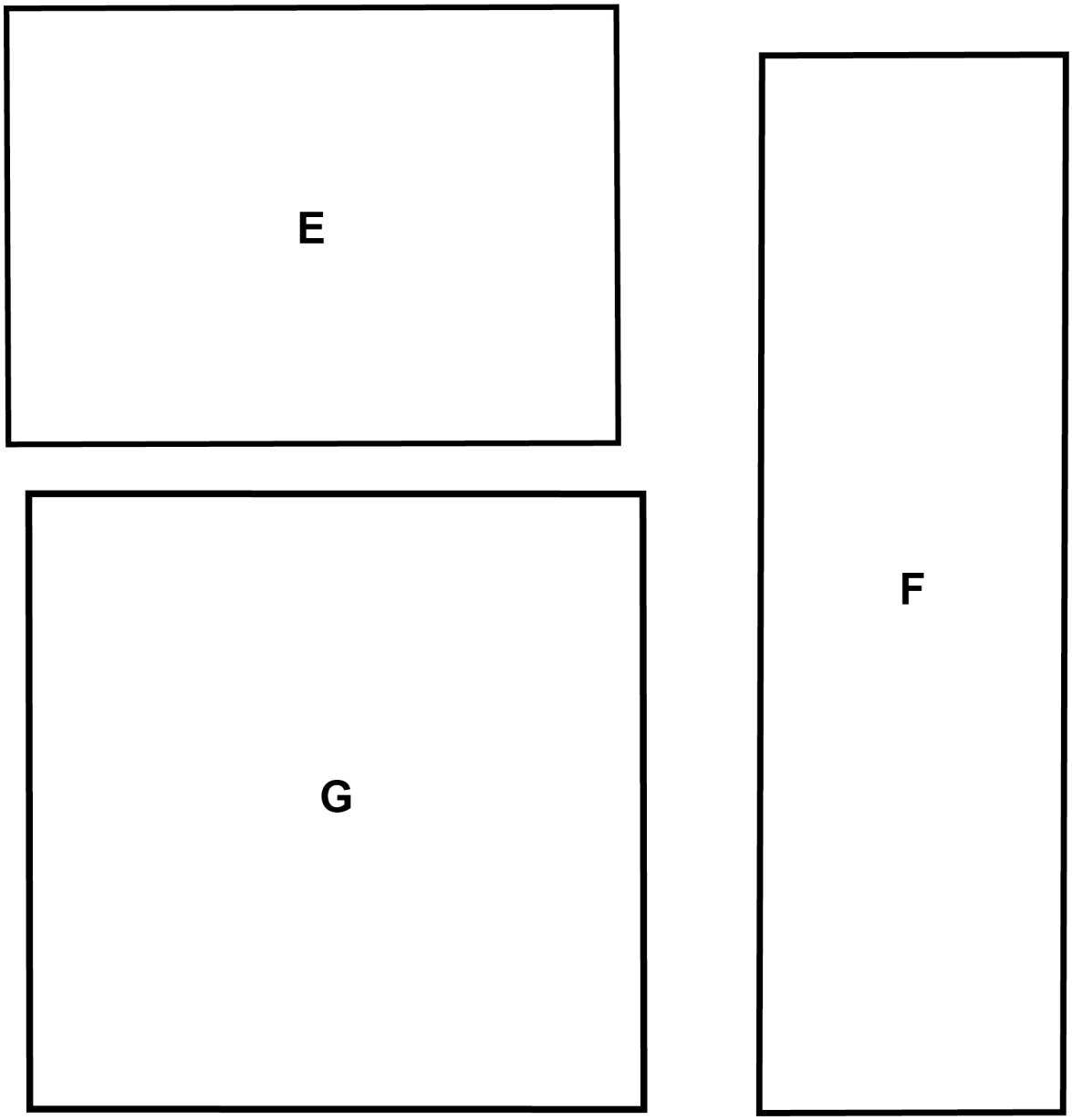
Rectangle Activity from Investigations 1

Cut out the rectangles. Which is the smallest? Which is the biggest? Put them in order.

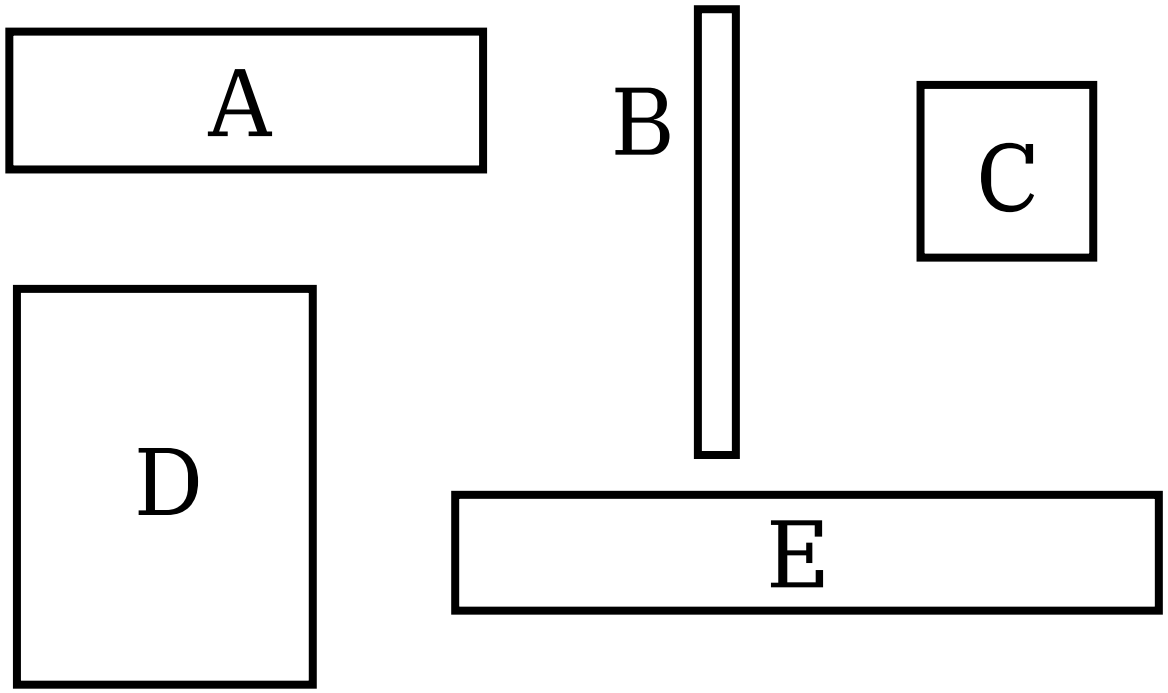


Rectangle Activity from Investigations 2

Cut out the rectangles. Which is the smallest? Which is the biggest? Put them in order.



Rectangles



What do these shapes have in common?	What has this shape in real life?
Draw two more rectangles.	Draw two shapes that are NOT rectangles.

Find the Rectangles

UNIT 2: Finding Half and Understanding Symmetry

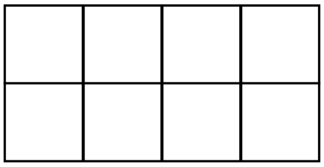
Halves and Not Halves

Use 2 colors. Color each rectangle to show halves and not halves.

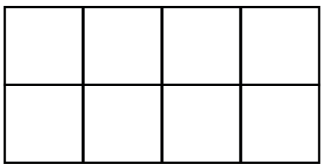
1. Half-and-Half

Not Half-and-Half

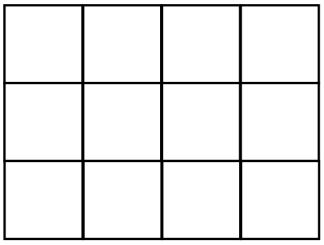
2. Half-and-Half



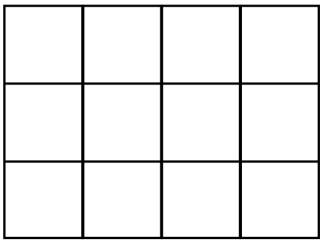
Not Half-and-Half



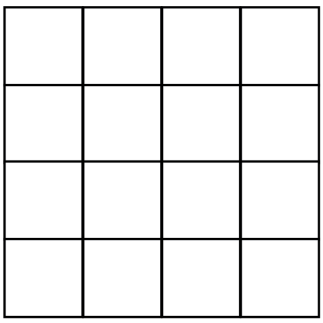
3. Half-and-Half



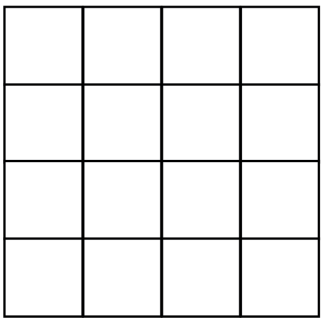
Not Half-and-Half



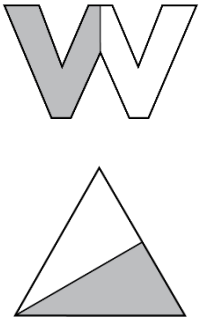
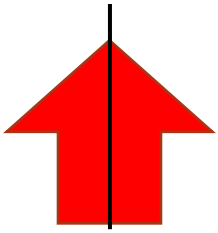
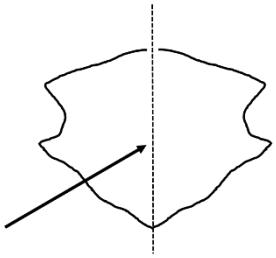
4. Half-and-Half



Not Half-and-Half

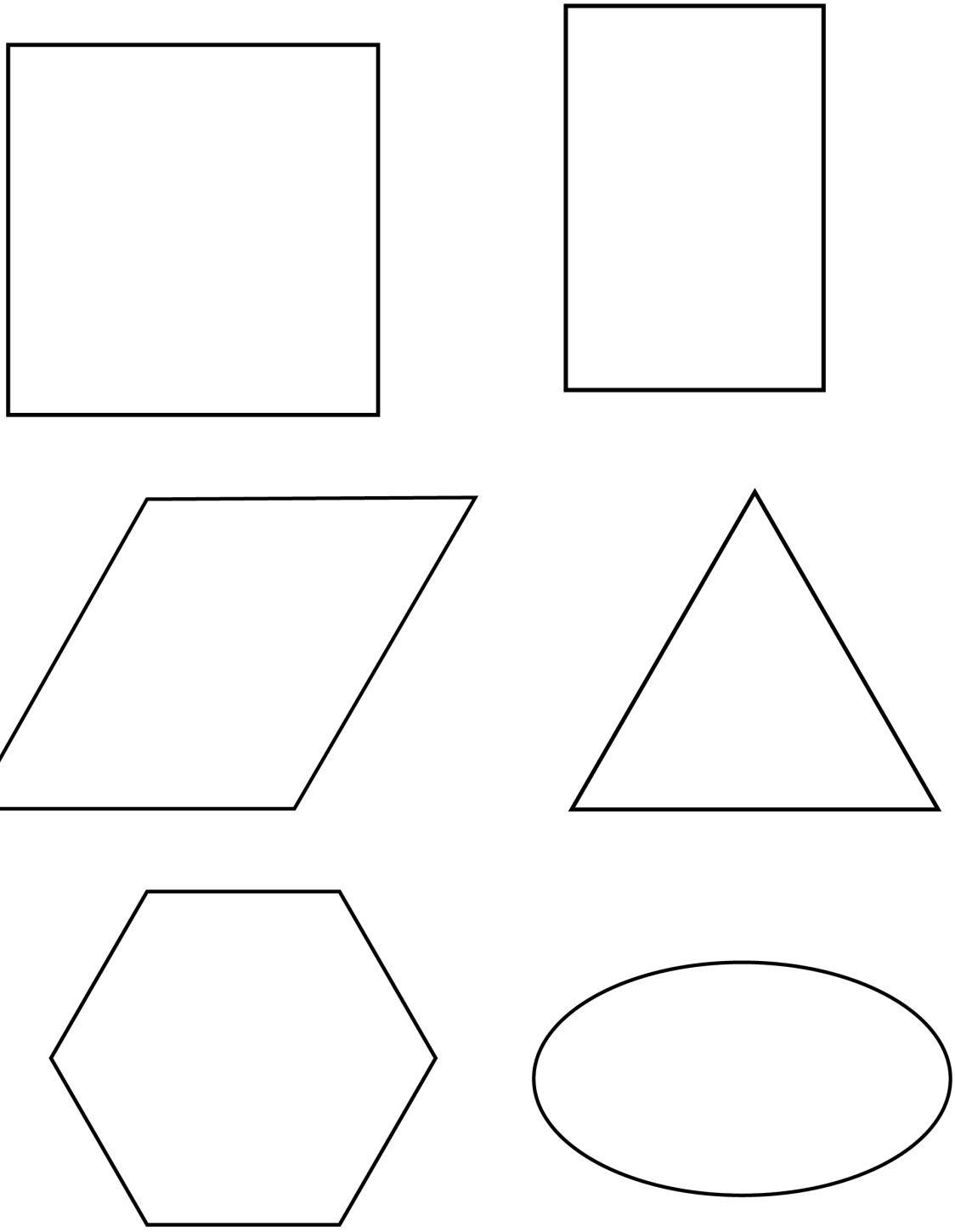


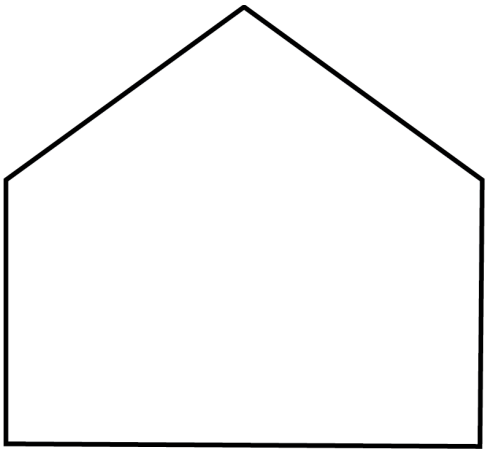
Vocabulary List for This Unit

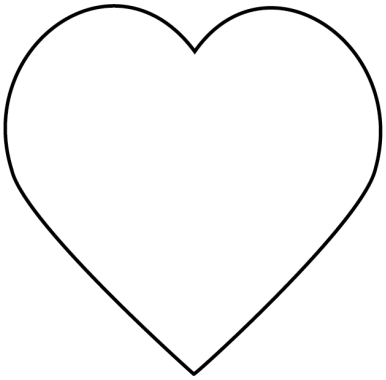
Word	Definition	Example
half halves	one of two _____ parts or portions	
(line) symmetry symmetrical	when a shape or image is the _____ when folded or reflected over a line	
line of symmetry	the line in a symmetrical shape where the shape can be “folded”	

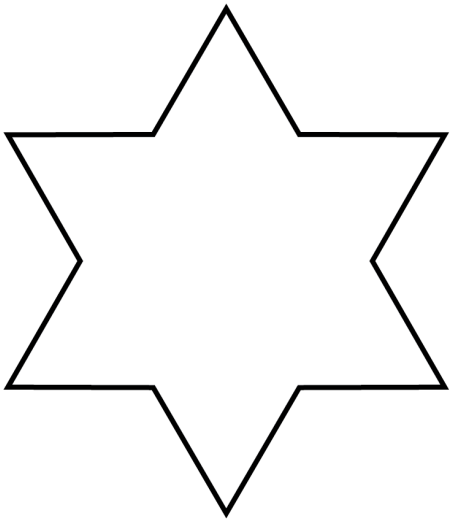
Word	Definition	Example

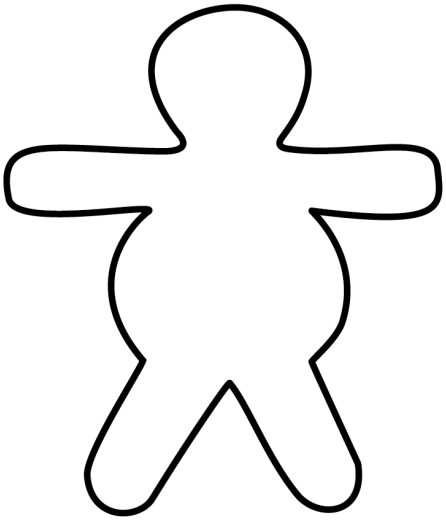
Shape Halves

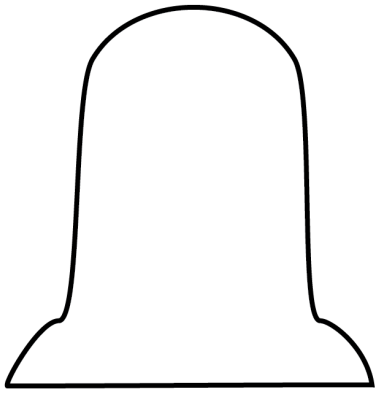


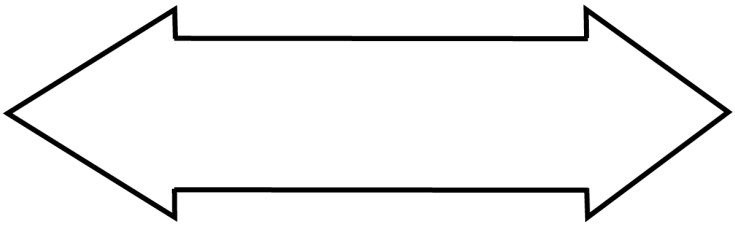






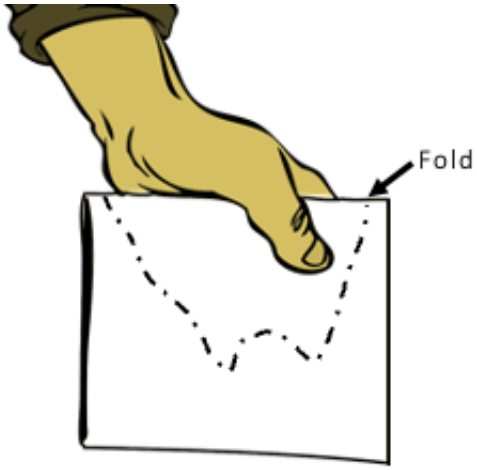






Making Symmetrical Shapes

Fold a piece of paper. Hold the paper on the folded side.

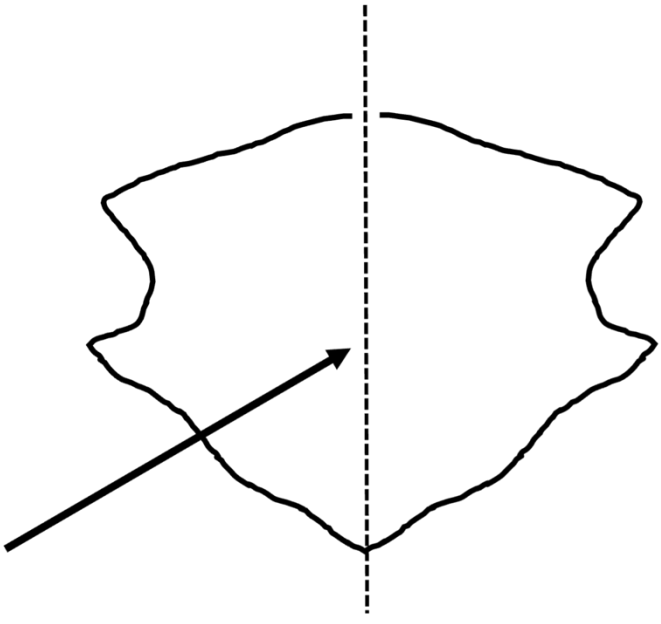


Use scissors to cut the paper around your hand.

Unfold the shape that you cut out.

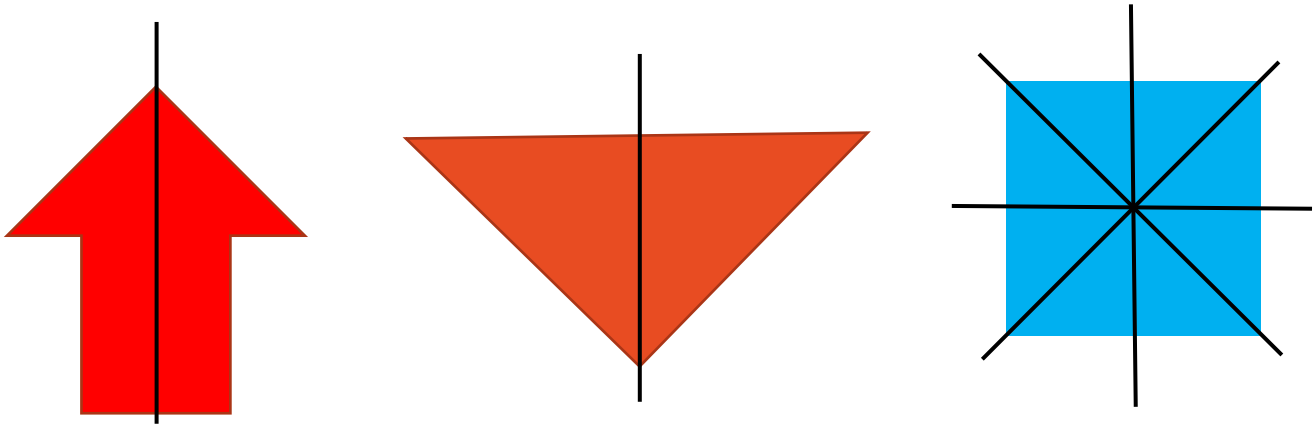
You have a symmetrical shape.

The fold is the line of symmetry.



Symmetry

Symmetry is when a shape or image is the same when folded over a line. The line is called a **line of symmetry**. The shape is said to be **symmetrical**.

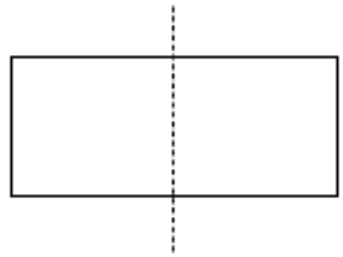


Are the dashed lines below lines of symmetry?

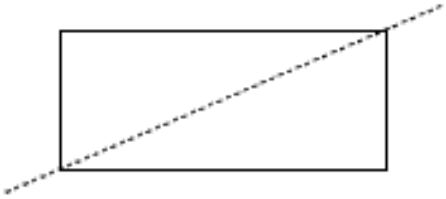
Lines of Symmetry

Is the dashed line a line of symmetry?

1)



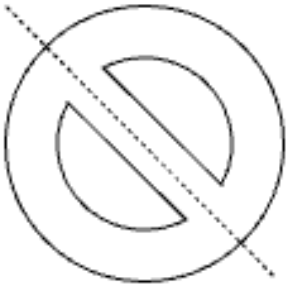
2)



3)

4)

5)



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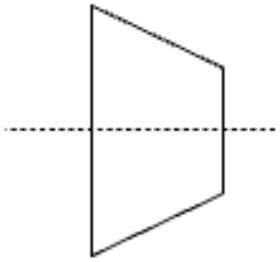

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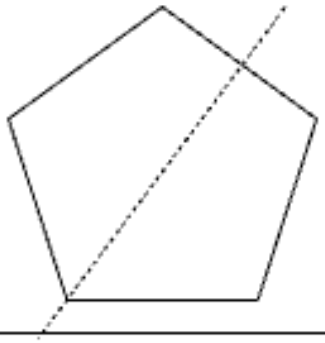

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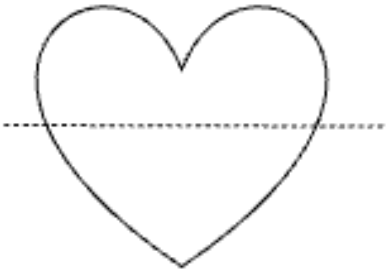
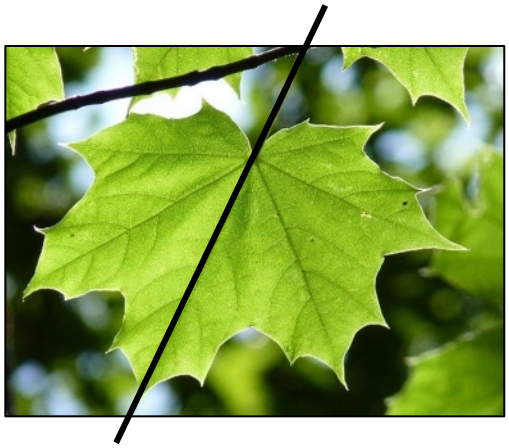
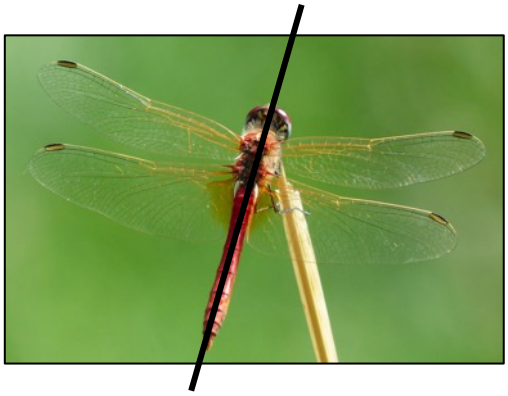


Symmetrical or Not?

Symmetry in Nature



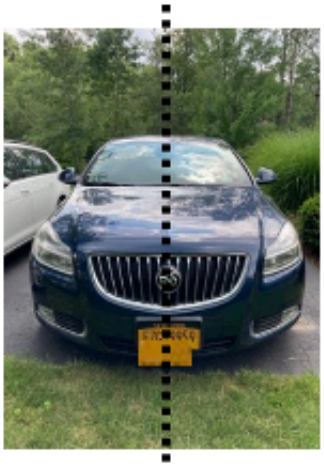


Where else do you see symmetry in nature?

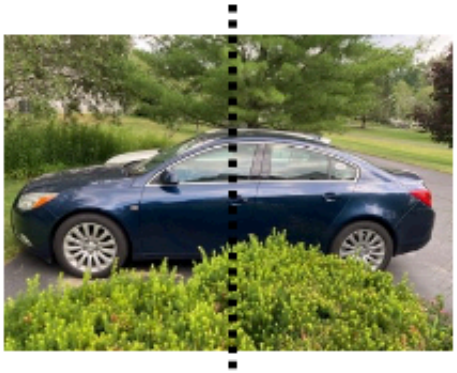
Explain and draw a picture.

Front and Side Views

Is it a line of symmetry? Write **yes** or **no**.



Car



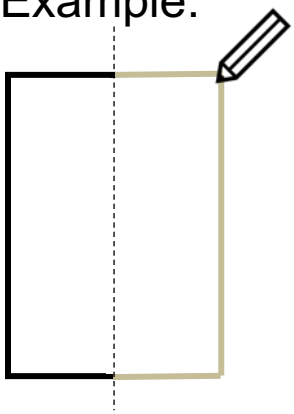
Chair

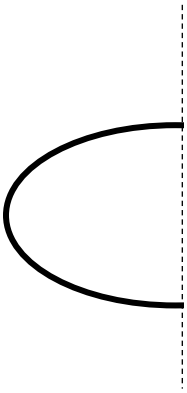
Bird Feeder

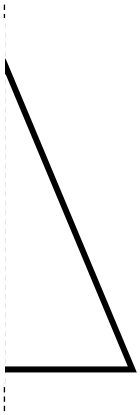
Finish the Shape

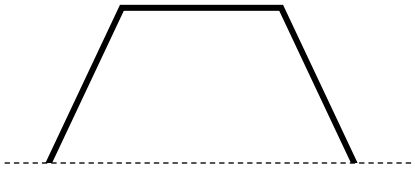
Draw the other side of each symmetrical shape.

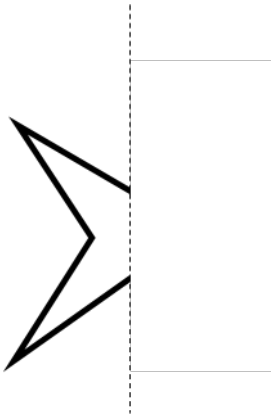
Example:

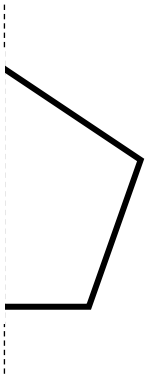












Draw two of your own symmetrical shapes below.

Adinkra Symbols

Adinkra symbols are common in Ghana. They are traditional symbols of the Asante culture. Each symbol represents an ideal or belief. There is often a proverb that goes with the symbol. For example, Akokonan ("the leg of the hen") represents mercy and nurturing. This comes from the proverb, "The hen steps on her chicks but does not hurt them."

Adinkra symbols are most commonly used in textiles (cloth). The cloth is worn to ceremonies and special events, like funerals. Today, Adinkra symbols are also used in architecture, sculptures, pottery, and even in company logos.

Calabash Adinkra stamps. Photo by Dr. Carol Ventura

To stamp the cloth, artists carve the symbols into a calabash (a type of gourd that can become very hard). They attach bamboo sticks for grip. The ink is made from the bark of a Badie tree. The cloth is laid out on a table, the stamps are pressed in ink and stamped on the cloth equal distances apart.

The above text is adapted from Barta, J., Eglash, R., & Barkley, C. (2014).Adinkra Symbols. In Math is a Verb: Activities and Lessons from Cultures Around the World (pp. 61-62). Reston, VA: National Council of Teachers of Mathematics.

Adinkra Stamped Cloth

Anthony Boakye prints an adinkra cloth with a calabash stamp in Ntonso, Ghana. Photo by Dr. Carol Ventura.

What do you notice? What do you wonder?

Symmetry in Adinkra Symbols

These are some Adinkra symbols. Which symbols have a line of symmetry? Which do not?

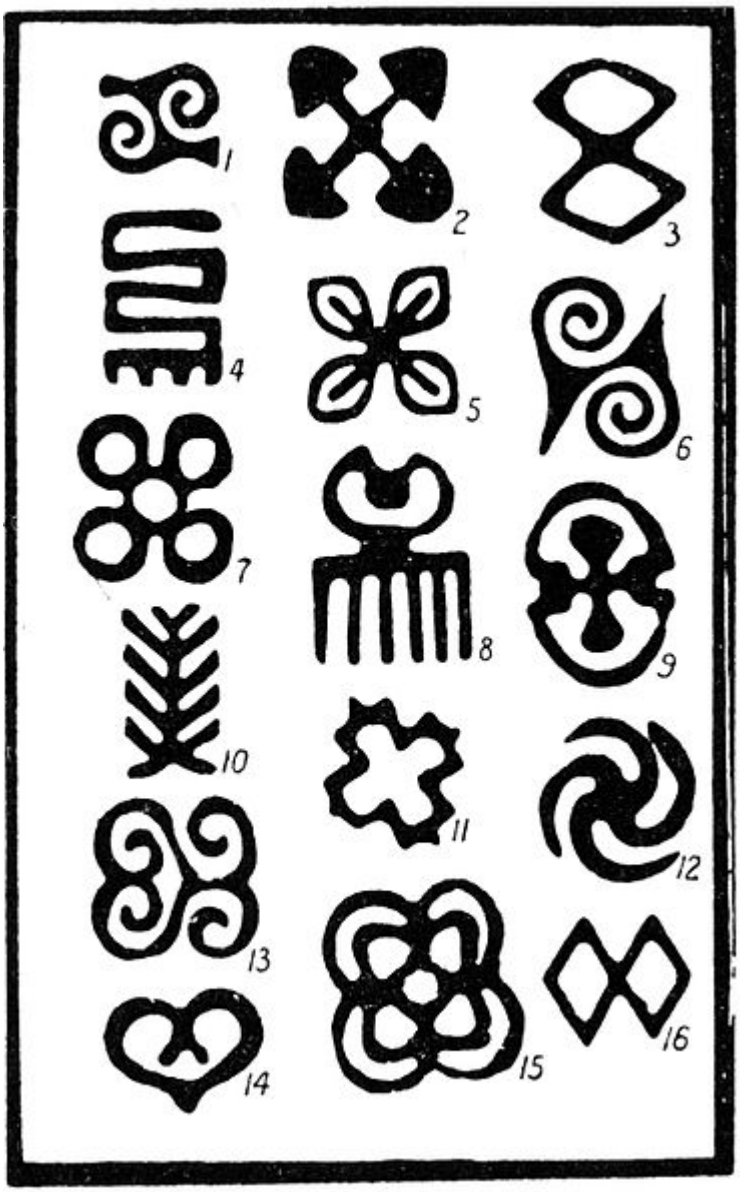


Image by Robert Sutherland Rattray

If you are curious, the next page lists the names and meanings of the symbols above.

1. Gyawu Atiko, lit. the back of Gyawu's head. Gyawu was a sub-chief of Bantama who at the annual Odwira ceremony is said to have had his hair shaved in this fashion.

2. Akoma ntoaso, “the joined hearts.”

3. Epa, handcuffs. See also No. 16.

4. Nkyimkyim, the twisted pattern.

5. Nsirewa, cowries (a type of shell)

6. Nsa, from a design of this name found on nsa cloths.

7. Mpuannum, “five tufts (of hair)”

8. Duafe. the wooden comb.

9. Nkuruma kese, lit. dried okros.

10. Aya, the fern; the word also means ' I am not afraid of you ', ' I am independent of you' and the wearer may imply this by wearing it.

11. Aban, a two-storied house, a castle; this design was formerly worn by the King of Asante alone.

12. Nkotimsefuopua, certain attendants on the Queen Mother who dressed their hair in this fashion. It is really a variation of the swastika. (Note: The swastika symbol has been used for thousands of years as a spiritual or religious symbol in cultures all over the world, usually meaning good luck or well-being. In Western cultures, it became a symbol of hate after the Nazis used it in the 1930’s. It does not have this connection in other parts of the world.)

13 and 14 Both called Sankofa, lit. turn back and fetch it.

15. Kuntinkantan, lit. bent and spread out ; nkuntinkantan is used in the sense of ' do not boast, do not be arrogant '.

16. Epa, handcuffs, same as No. 3.

The above text is from R.S. Rattray. (1927). Religion and Art in Ashanti. Oxford: Clarendon Press.

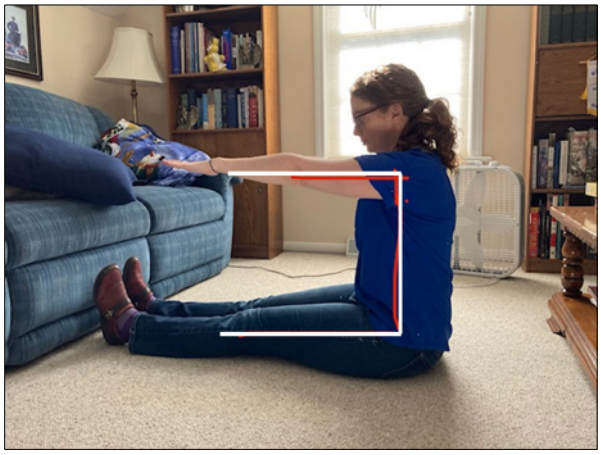
UNIT 3: Right Angles and Parallel Lines

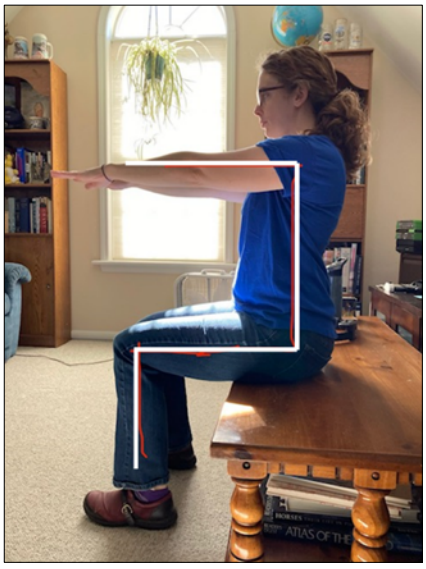
Angles in the Body

Small

Right

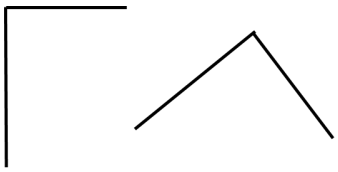
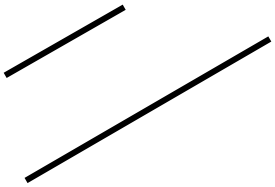
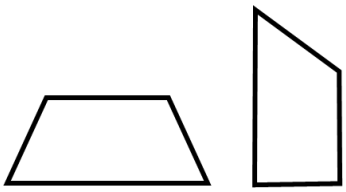
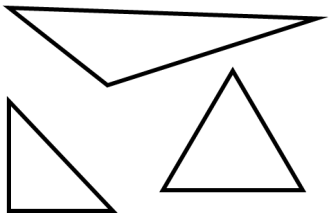
Large





Which joints are making right angles?

Vocabulary List for This Unit

Word	Definition	Example
right angle	a “_____.” The corner of a piece of paper will fit into it perfectly.	
parallel	Parallel lines go in the same _____, stay the same _____ apart, and never _____.	
trapezoid	a four-sided shape with exactly one pair of _____ sides	
triangle	any _____-sided shape	

Word	Definition	Example

Right Angles: Paper Test

A **right angle** looks like the corner of a square.

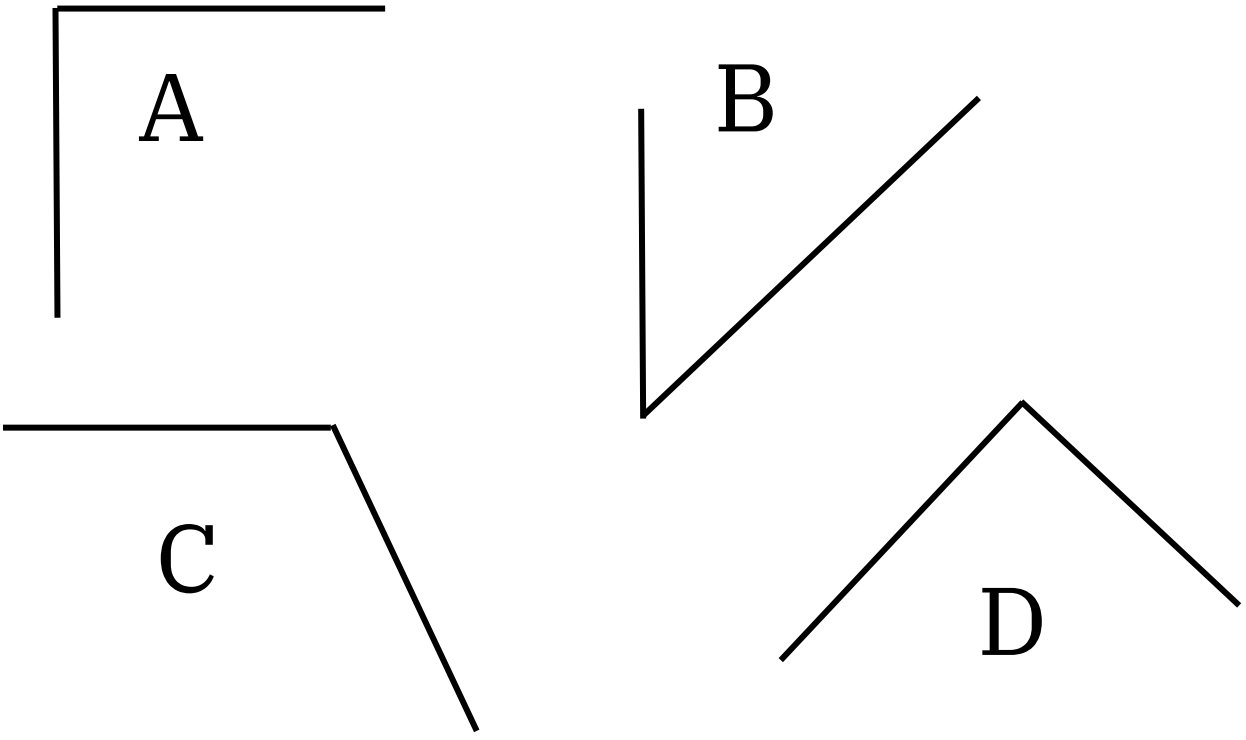
You can check for a right angle because the corner of a piece of paper will fit into it perfectly.

Paper test:

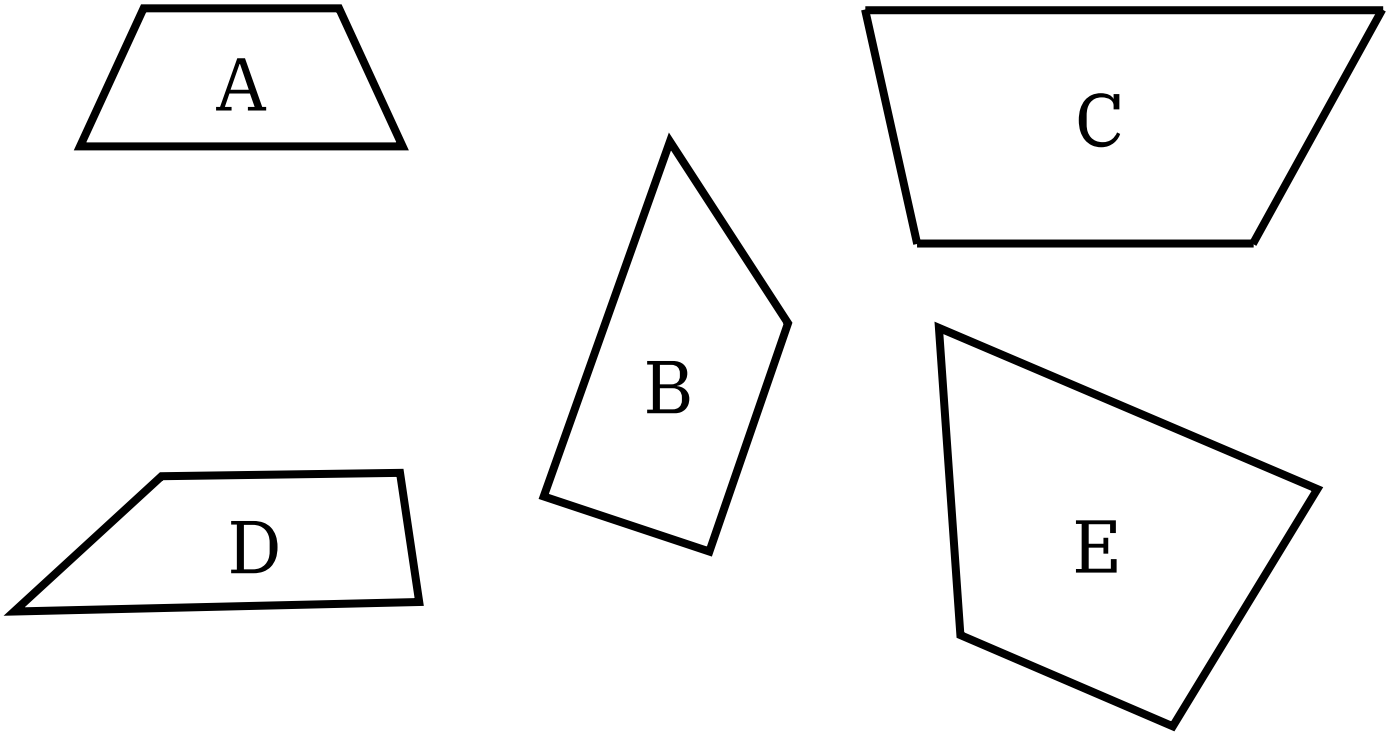
Does the corner of a paper fit?

Yes? It's a right angle!

Use the paper test to see if the angles below are right angles.



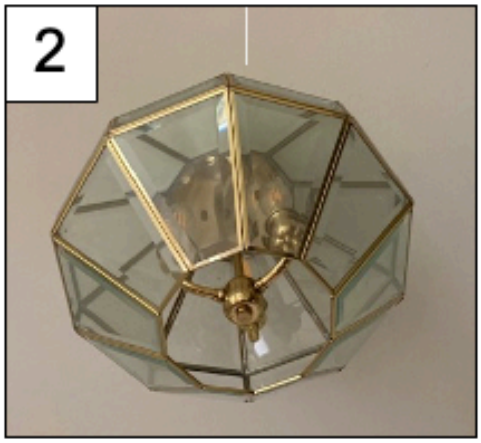
Trapezoids

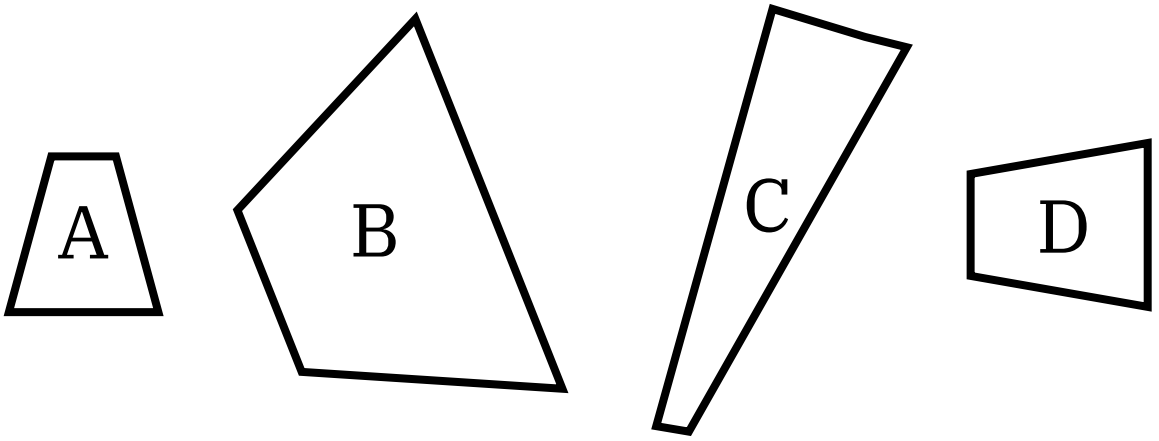


What do these shapes have in common?	What has this shape in real life?
Draw two more trapezoids.	Draw two shapes that are NOT trapezoids.

Trapezoids

Match each photo to the trapezoid shape seen in the photo.

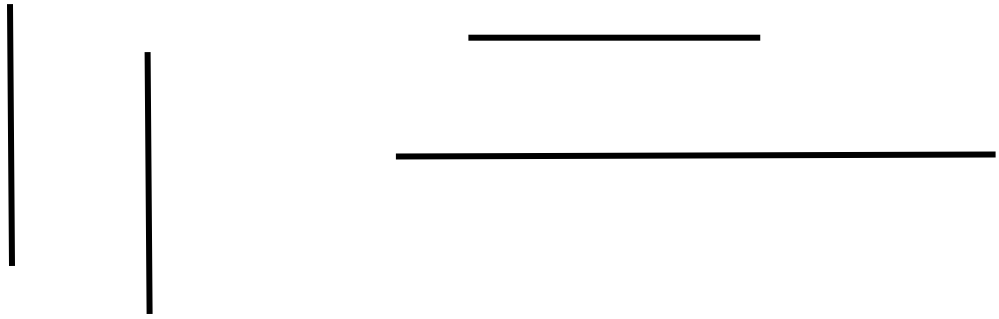




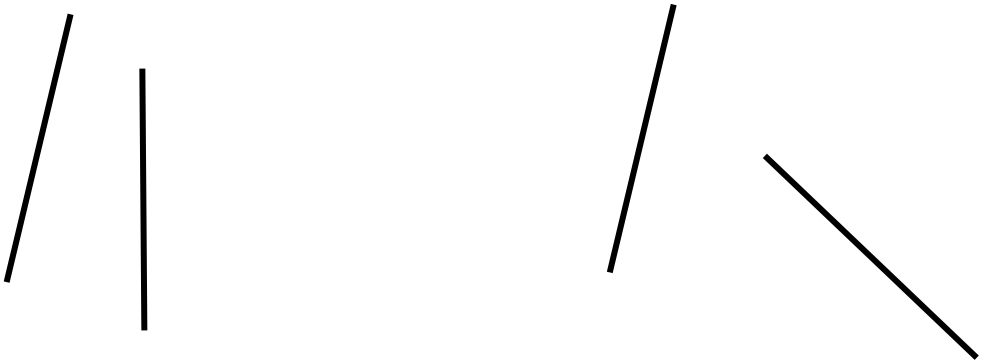
Parallel or Not?

Parallel lines go the same direction. They are always the same distance apart. They will never meet.

These are examples of parallel lines.

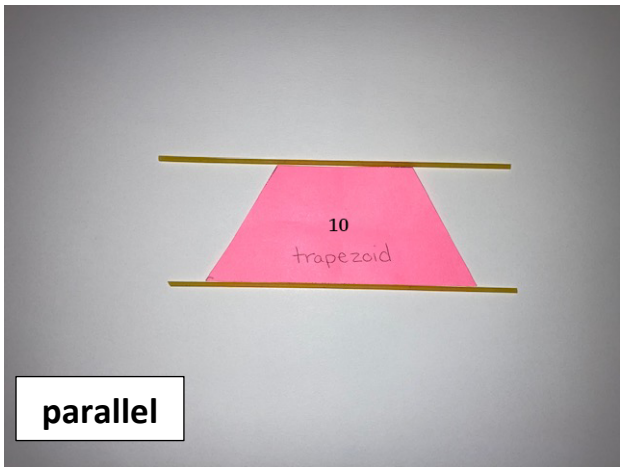


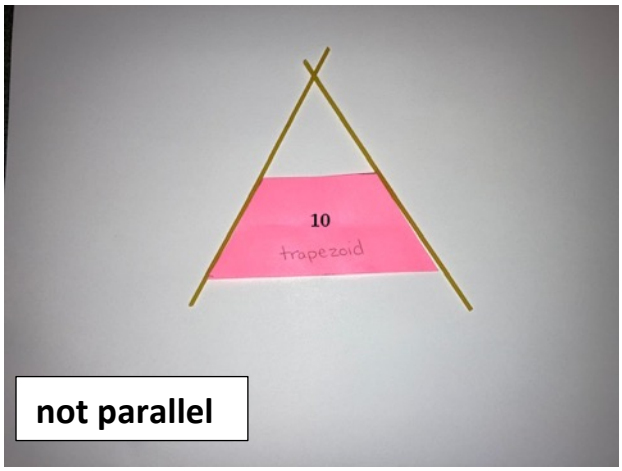
These are examples of lines that are not parallel. If you continued the lines, they would cross.

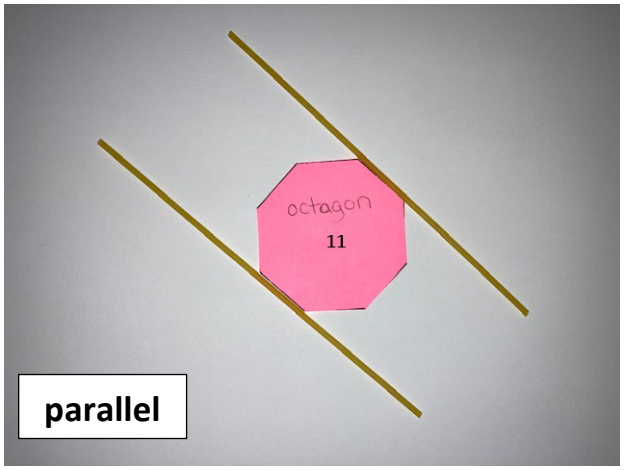


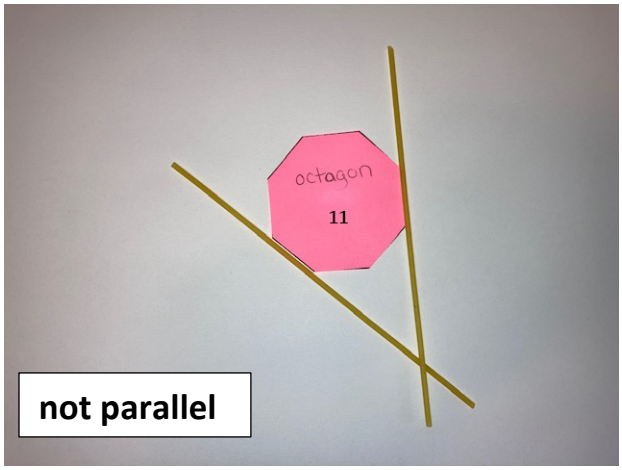
Checking for Parallel Lines

You can use spaghetti, or something else long and skinny, to check if two sides of a shape are parallel.









Parallel

These are pairs of sides that are parallel.

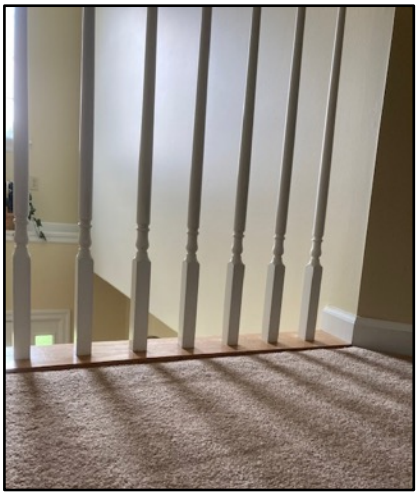
The lines will never cross.

Not Parallel

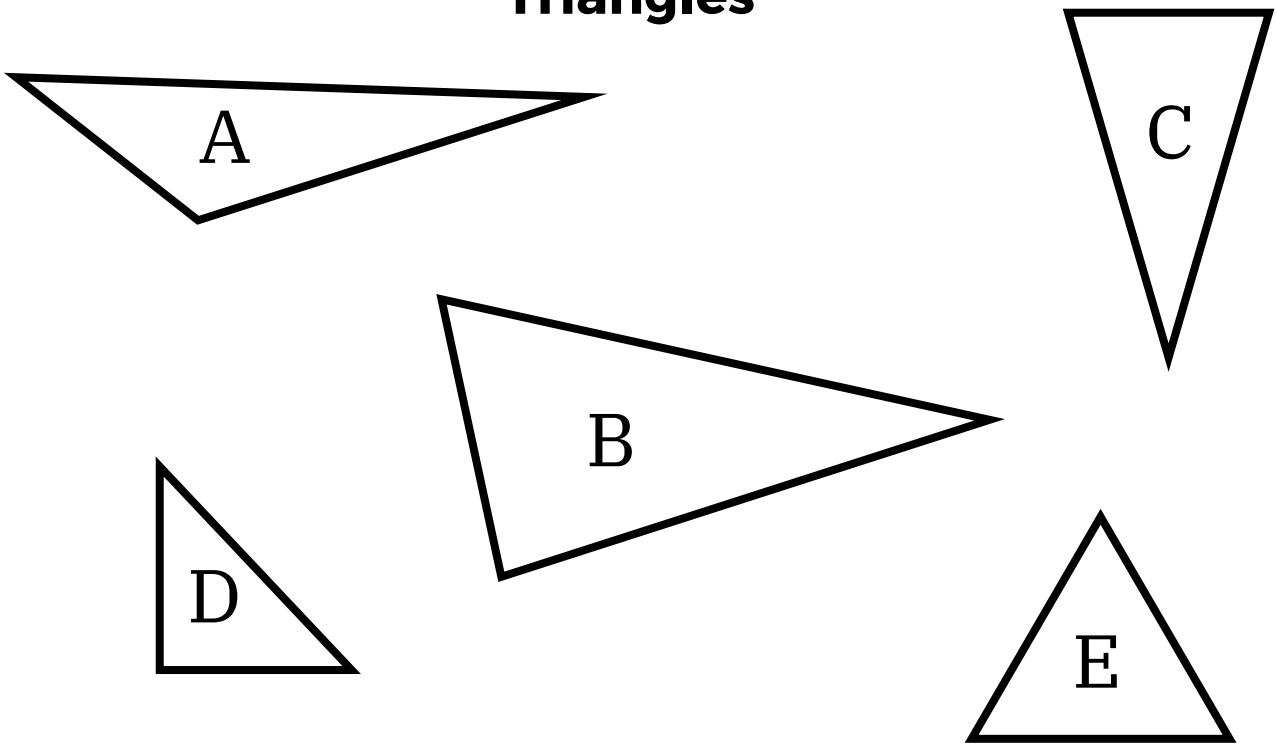
These are pairs of sides that are not parallel.

The spaghetti shows that the lines, if they continue, will cross.

Parallel Lines



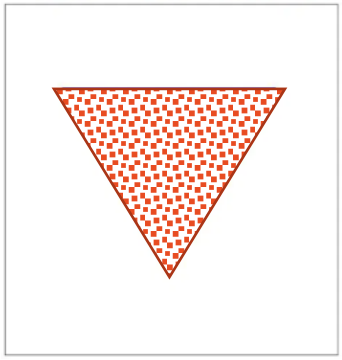
Triangles

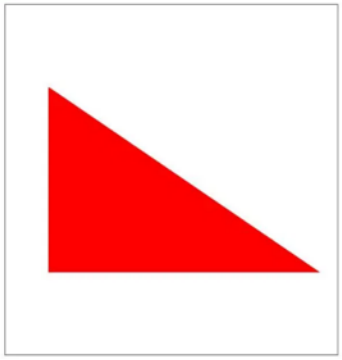


What do these shapes have in common?	What has this shape in real life?
Draw two more triangles.	Draw two shapes that are NOT triangles.

Triangles: Same and Different

On a piece of paper, make two columns. In one column, list the things that are the same in this picture. In the other column, list the things that are different.





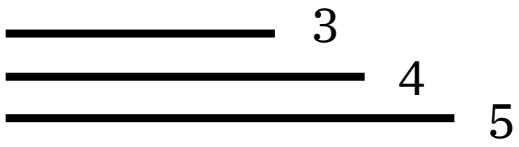
Things that are the same	Things that are different

Credit: Brian Bushart, https://samedifferentimages.wordpress.com

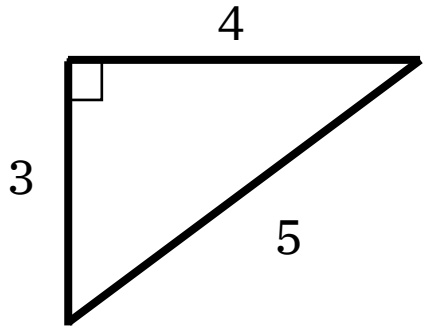
How Do You Make Sure the Corners Are Square?

You will need three lengths: one 3 inches long, one 4 inches long, and one 5 inches long (you can also use lengths of 3, 4, and 5 centimeters).

Put them together to make a triangle.



Did you notice something about your triangle? It has a right angle! The lengths 3, 4, and 5 will always create a triangle with a right angle (also called a right triangle).



Making a 3-4-5 triangle is a method for making a right angle that has been used for thousands of years. We know it was used by the Babylonians, an ancient

civilization in the Middle East, and by the Egyptians in Northern Africa, before it was brought to Greece (and Europe) by Pythagoras around 500 BCE.

Source: https://www.livescience.com/earliest-form-of-pythagorean-triplet

This method is still commonly used by carpenters and construction workers today to check that the angles on a building are right angles.

U.S. Navy photo by Mass Communication Specialist 2nd Class Kenneth W. Robinson

UNIT 4: Review and Extension

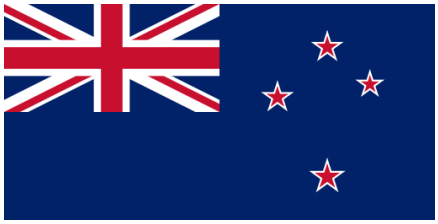
Flags: Did You Know?

Flags were originally used on the battlefield. They could be used to identify an army and to signal across a distance. Later, flags became common on ships. A ship's flag would show which country the ship was from. Like on the battlefield, flags were also used to signal and communicate between ships.

Now flags have become national symbols. Cloth flags like we have today were first used in India and China more than 2000 years ago. A country's flag often uses colors or designs to show its cultural, religious, or political connections to other countries. For example, the flag of Ethiopia uses green, yellow, and red. Since Ethiopia was one of the oldest independent states in Africa, these colors were adopted by many other African countries and became associated with Pan-Africanism.

Some flags of former British colonies still have the British "Union Jack" as part of their flag. Not everyone likes having the Union Jack on their flag because of its connections to colonialism. New Zealand actually had a

national vote in 2016 to decide if they should keep their current flag or switch to a new flag. Just over half of the voters chose to keep the current flag.



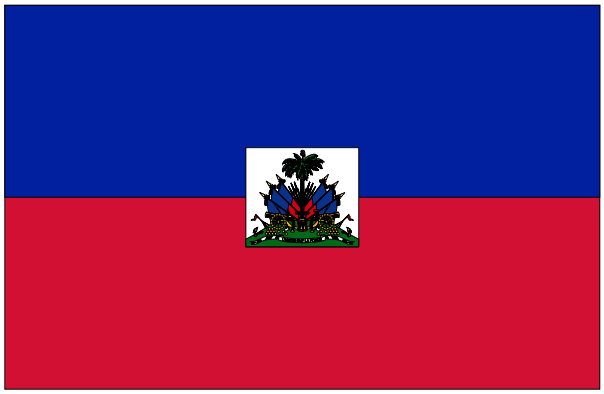
Sources: New World Encyclopedia https://www.newworldencyclopedia.org/entry/flag, Wikipedia https://en.wikipedia.org/wiki/Flag, and New Zealand History https://nzhistory.govt.nz/politics/flags-of-new-zealand)

Choose one of the following questions to discuss with your group:

1. Do you think countries should change their flags if the design has connections to colonialism or other historical oppression? Why or why not?

2. Do you think a vote is a good way to decide on a flag? Why or why not?

Flags

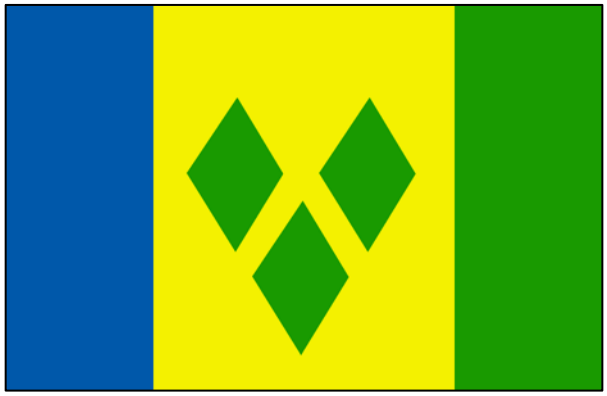


Haiti

Jamaica

Antigua

Dominican Republic



St. Vincent

Suriname

U.S. Flag Review

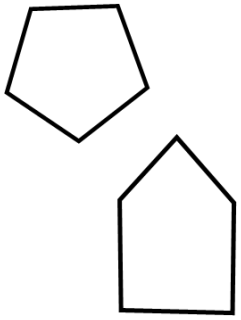
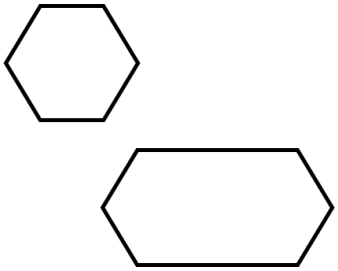
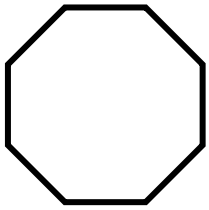
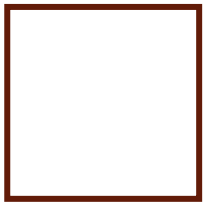
What shapes do you see in this flag?

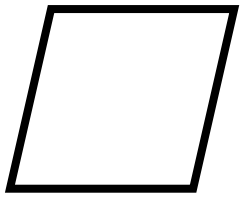
What types of angles do you see?

Do you see any parallel lines?

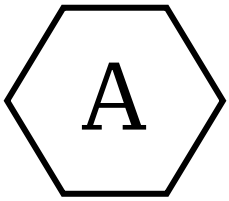
Are there any lines of symmetry?

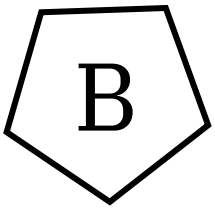
Vocabulary List for This Unit

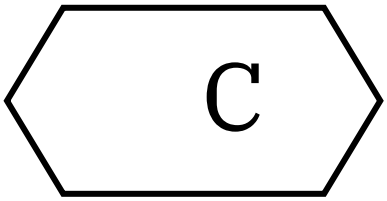
Word	Definition	Example
pentagon	a _____-sided shape	
hexagon	a _____-sided shape	
octagon	an _____-sided shape	
square	a shape with four _____ sides and four _____ angles. A special rectangle and a special rhombus.	

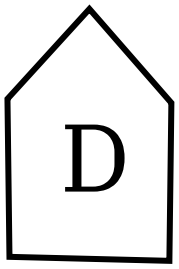
Word	Definition	Example
rhombus	a shape with four _____ sides	

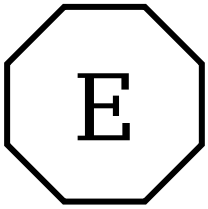
Shapes with More Sides

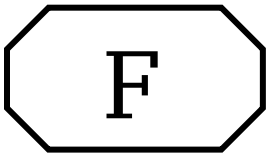








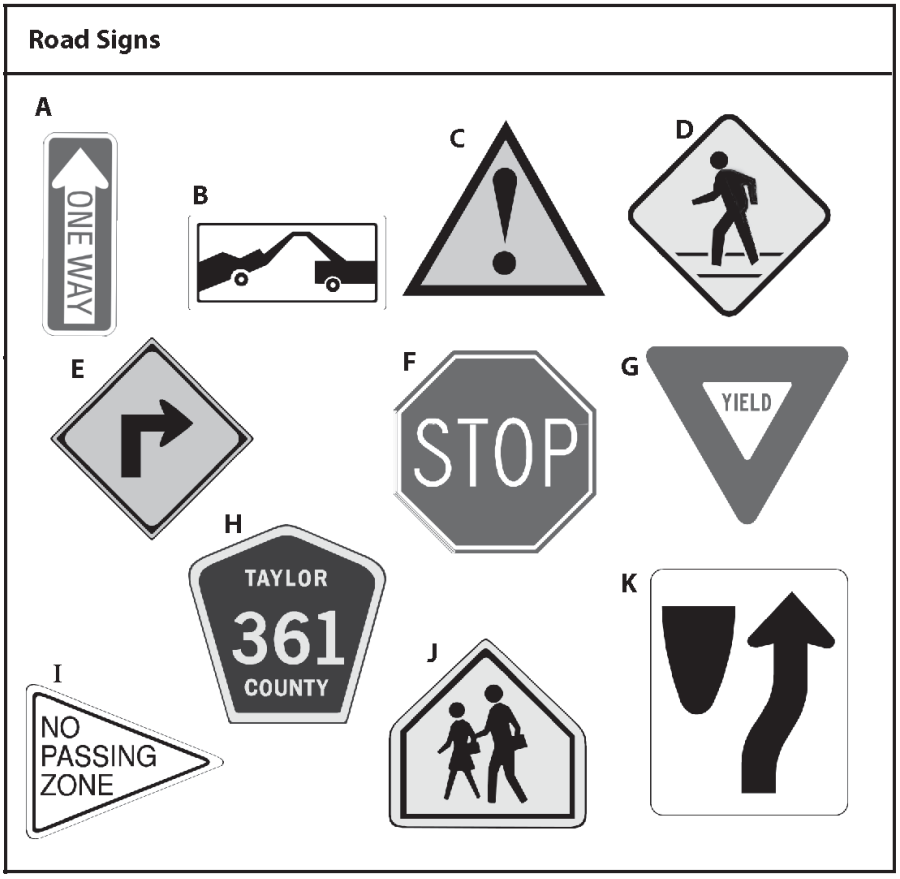




A <u>pentagon</u> has 5 sides and 5 angles. Which of the shapes above are pentagons?	A <u>hexagon</u> has 6 sides and 6 angles. Which of the shapes above are hexagons?	An <u>octagon</u> has 8 sides and 8 angles. Which of the shapes above are octagons?
Where have you seen a pentagon in real life?	Where have you seen a hexagon in real life?	Where have you seen an octagon in real life?

Shapes with More Sides: Examples

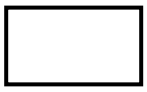
Road Signs



Next to each shape below, write the letters of the road signs that have the same shape.

Square

Rectangle



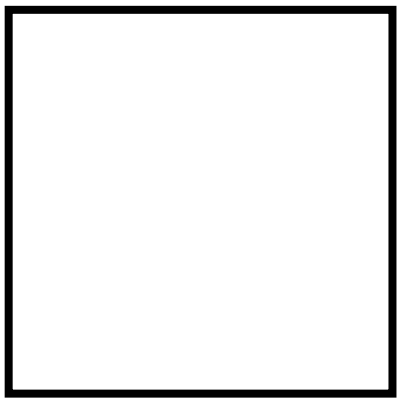
Triangle

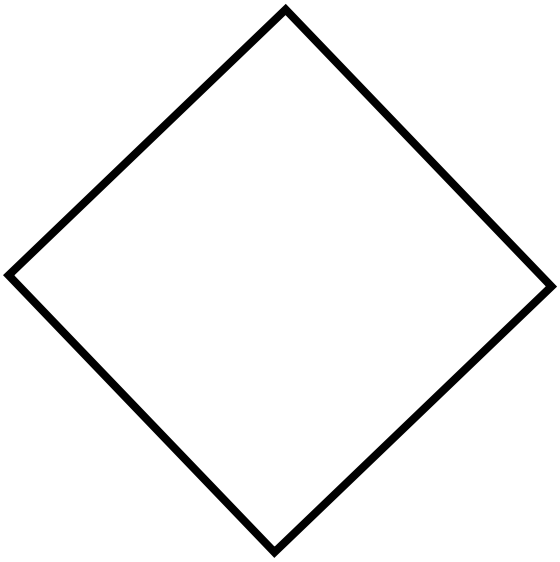
Octagon

Pentagon

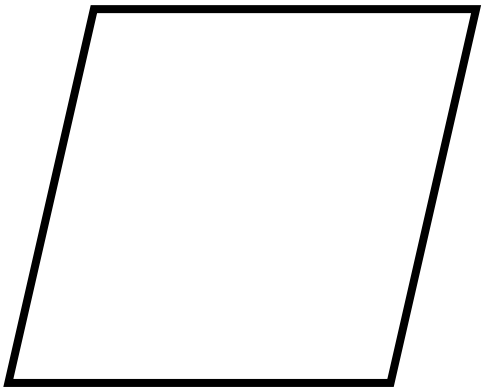
Source: EMPower™ book Over, Around, and Within: Geometry and Measurement

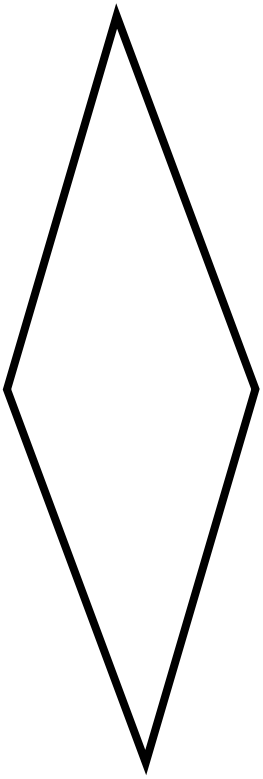
Square



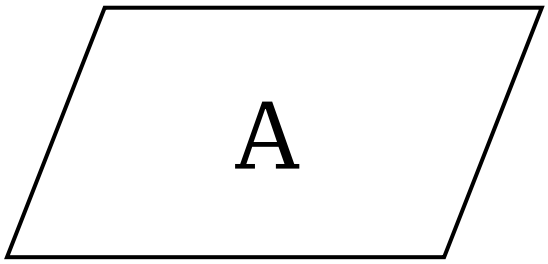


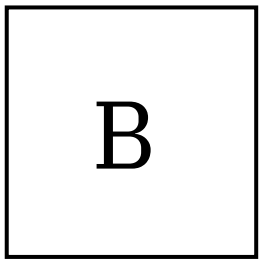
Rhombus





Compare Shapes





How are these two shapes alike?

How are they different?

How would you describe the angles in each shape?

Source: EMPower™ book Over, Around, and Within: Geometry and Measurement

Shape Scavenger Hunt

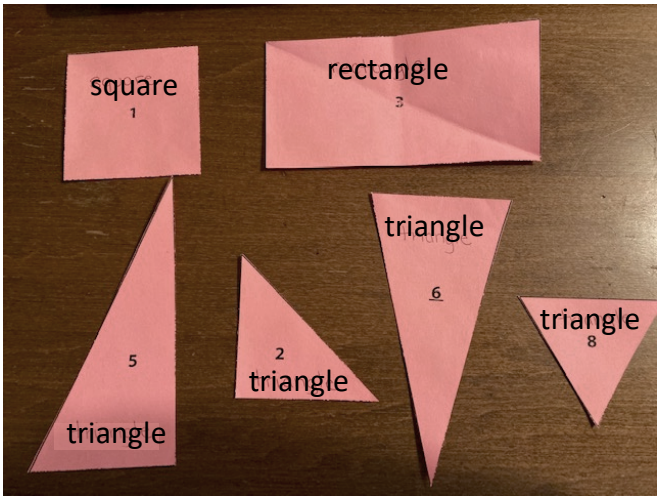
Look around your home. Where do you see…

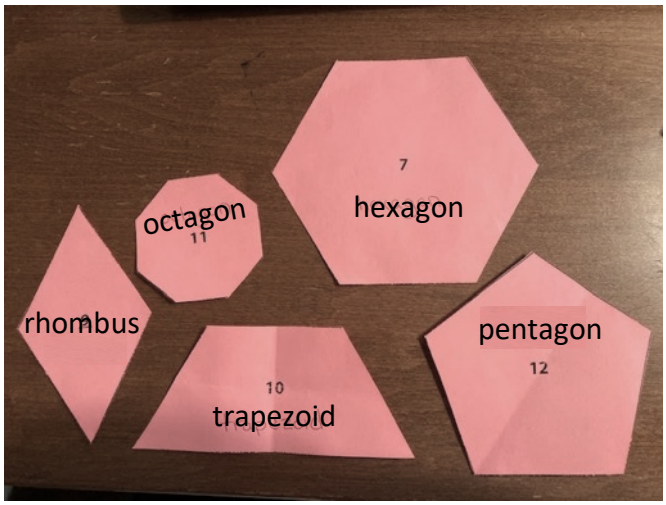
Squares	Rectangles
Triangles	Right angles
Parallel Lines	Symmetry

Sort Shapes

Study Strategy

1. Label the shapes in your Shape Set with the name of each shape.

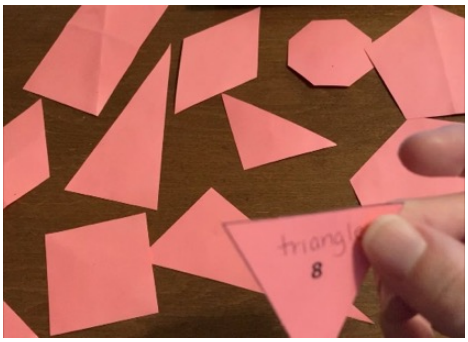




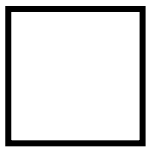
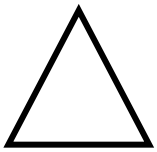
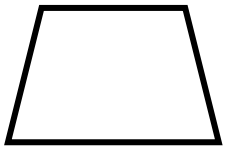
2. Turn the shapes over so that the names are facing down. Can you find the

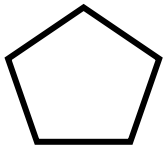
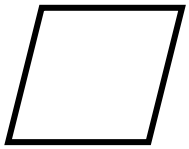
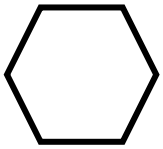
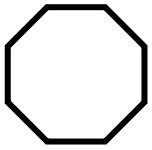
   - triangles?
   - square?
   - rectangles?
   - trapezoid?
   - rhombus?

3. Check each one by flipping it over to see if you are correct.



Common Shapes Review

	Name of shape	Describe it	Where do you see this shape?
A	Square 		
B	Rectangle 		
C	Triangle 		
D	Trapezoid 		

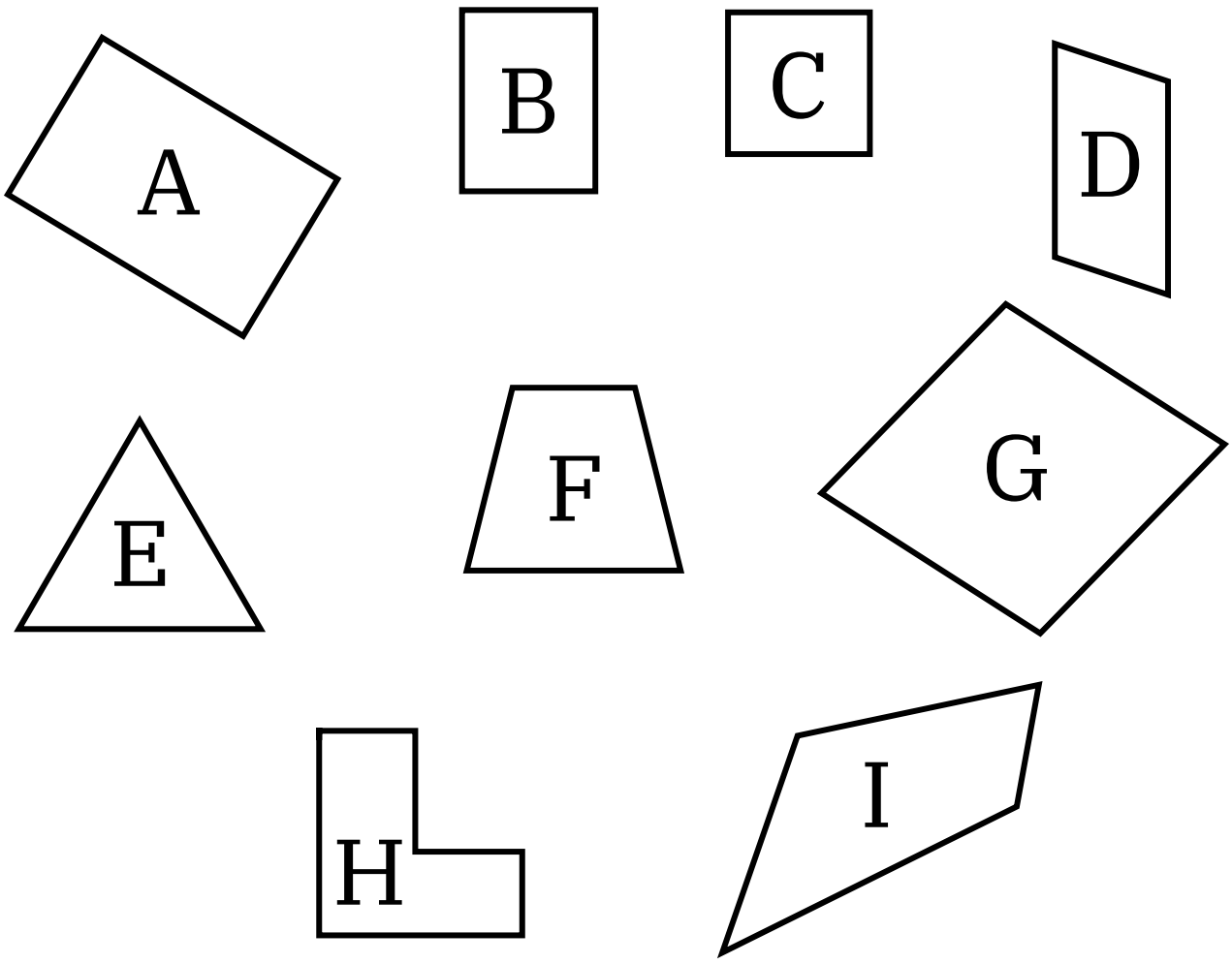
	Name of Shape	Describe it	Where do you see this shape?
E	Pentagon 		
F	Rhombus 		
G	Hexagon 		
H	Octagon 		

Is It a Rectangle?

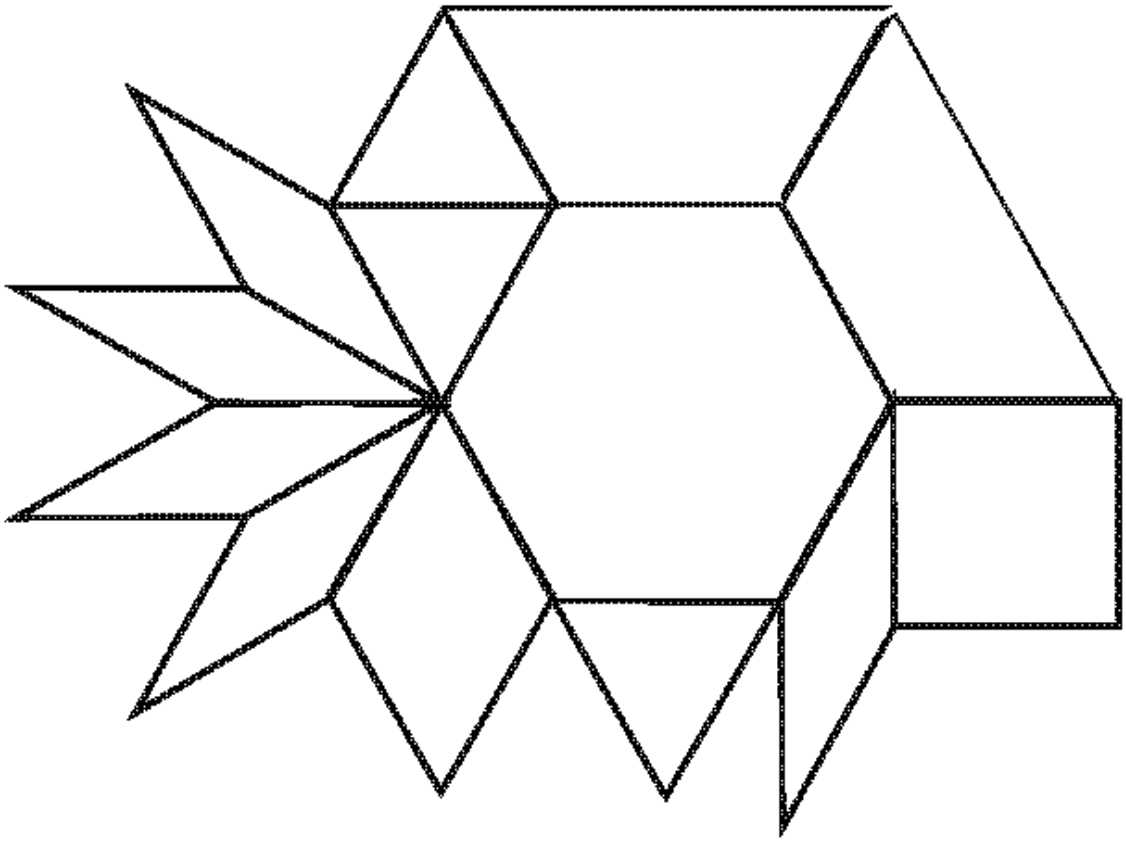
A rectangle is a shape with four sides and four right angles. The opposite sides are equal length.

For each shape, decide if it is a rectangle. Check three things:

1. Does it have four sides?
2. Does it have four right angles?
3. Are the opposite sides equal length?

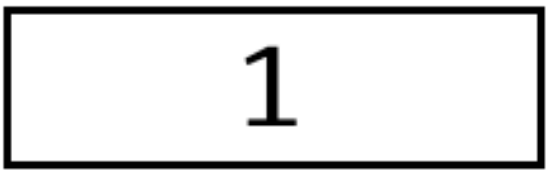


Design Challenge



Source: EMPower™ book Over, Around, and Within: Geometry and Measurement

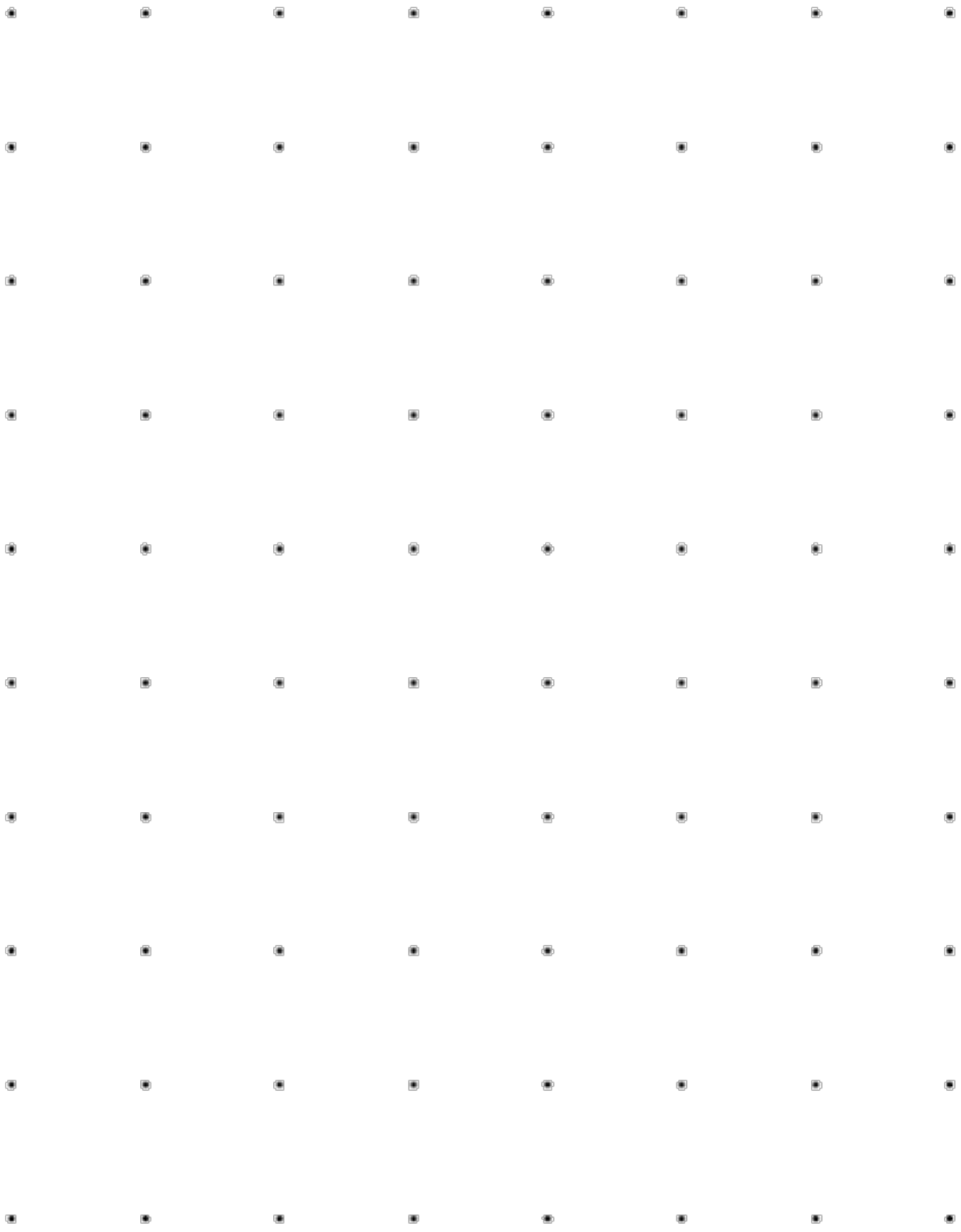
Geometry Quiz



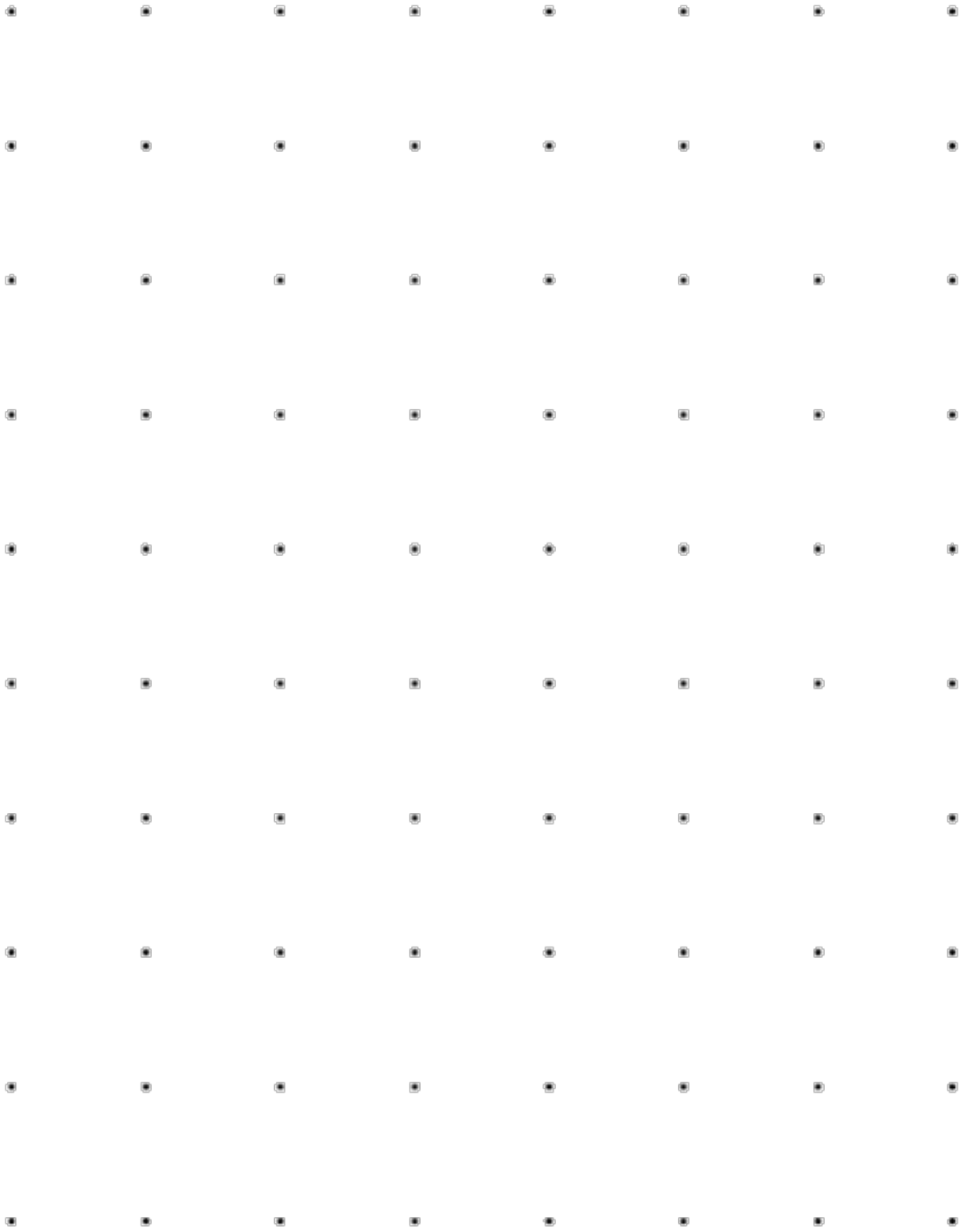
Square Dot Paper – Large

Square Dot Paper – Large

Square Dot Paper – Small



Square Dot Paper – Small



Triangle Dot Paper – Large

Triangle Dot Paper – Large

Triangle Dot Paper – Small

Triangle Dot Paper – Small