Half the Rectangle to Tile the Hall

Teacher		**Class**	Grade 6
Subject	Math	**Topic**	Area of triangles
Date		**Room**	
Lesson length	60 minutes	**Country**	United States

Students learn triangle and polygon area by composing and decomposing. They design a polygon tile and calculate its total area.

Curriculum links

- Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems. [1]

Learning objectives

- Students will find area of right and other triangles using half base times height.
- Students will find area of quadrilaterals and polygons by composing and decomposing shapes.
- Students will solve real-world problems using triangle and polygon area.

Success criteria

- I can find triangle area with 1/2 x base x height.
- I can split polygons into triangles and rectangles and add areas.
- I can use area to decide tile and paint amounts.

What students already know

Ask: What is area of a 4 in. by 3 in. rectangle? Listen for 12 square inches, length times width.

Key words

base	the side you choose to start measuring from [5]
perpendicular height	the straight distance from the opposite corner to the starting side, meeting at 90 degrees [5]
area	the amount of flat space covering a shape [3]
compose	to put two or more shapes together to make a new shape [1]
decompose	to cut or split a shape into smaller parts to measure them [1]

Materials

- inch grid paper
- rulers
- colored pencils
- pre-split polygon outlines with labeled base and height for support
- Slides 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12
- Video clip 1 (0:00–4:50) on slide 6

Before the lesson

- Print inch grid paper, one sheet per student plus spares, and pre-split polygon outlines for support
- Test Slide 6 Video clip 1 (0:00–4:50) with sound and captions
- Set up rulers, colored pencils, and right-angle corners in table baskets

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- mini whiteboards and markers
- plastic right-angle corners

- Load Slides 1-12 and make exit ticket copies from Slide 12

Lesson outline

0–5 min **Starter** 5 min · Whole class

Activate rectangle area and hook students with the tile design challenge.

YOU DO

1. Show Slide 1 and read the Polygon Tile Design hook about hallway floor tiles.
2. Show Slide 5 rectangle 8 in by 5 in. and ask students to predict each triangle area after a corner-to-corner cut.
3. Record 2-3 predictions on the board without confirming.
4. Confirm by rectangle halving and link to today's tile job.

STUDENTS DO

1. Think for 30 seconds about the rectangle and triangle areas.
2. Pair-share prediction and reason with a neighbor.
3. Show prediction on mini whiteboard on teacher cue.

Say: Our hallway needs new floor tiles. Your weird polygon design wins if you can tell us exactly how much tile to order. First, if I cut this rectangle from corner to corner, did both pieces get a fair share?

Worked example: Rectangle = 8 x 5 = 40 sq in. Cut corner to corner makes 2 equal right triangles [8]. Each triangle = 40 / 2 = 20 sq in. Both get a fair share.

Ask: What is the area of the 8 in. by 5 in. rectangle? (40 square inches, length times width.) · After one diagonal cut, what is each triangle area and why? (20 square inches, because the diagonal splits the rectangle in half.)

Check understanding: All whiteboards show 40 and 20. If not, quickly count grid squares and re-halve before moving on.

Support: Let students count squares on inch grid to see 40 whole squares split into two 20s [3]. **Stretch:** Ask for prediction for a 6.5 in. by 4 in. rectangle before cutting, then check.

Use: Slides 1, 5

5–17 min **Teaching** 12 min · Whole class

Teach base, perpendicular height, and composing and decomposing for triangles and polygons.

YOU DO

1. Show Slides 2-4 and state steps: pick a side, find height at 90 degrees, multiply then divide by 2 [6].
2. Model a right triangle as half a rectangle, since two copies of a right triangle make a rectangle [5].
3. Model an acute and an obtuse triangle, showing height inside and height outside the shape [5].
4. Model decomposing a pentagon into a rectangle plus two triangles and adding parts [1].

STUDENTS DO

1. Choral-repeat steps and point to base and 90-degree height on teacher triangles.
2. Use right-angle corners to check which dashed line is square to the base.
3. Copy the two worked examples into notebooks.

Say: Any side can be the starting side. Height is the straight line from the opposite corner that hits that side squarely at 90 degrees. Triangle area is base times height divided by 2.

Worked example: Right triangle legs 6 in. and 4 in.: rectangle = 6 x 4 = 24 sq in., triangle = 1/2 x 6 x 4 = 12 sq in. Acute triangle base 6 in., height 4 in.: A = 1/2 x 6 x 4 = 12 sq in. Same base, same height, same area.

Ask: Can any side be the base? What changes if we pick a different side? (Yes, any side can be the base; the matching height changes to stay at 90 degrees to it.) · Why do we divide by 2? (Because a triangle is half the area of the parallelogram formed by two of those triangles [11].) · Can we use the slanted side as height? (No, height must hit the base at 90 degrees; slanted length is not height.)

Check understanding: Thumbs up if height must be at 90 degrees to base. Reteach with color-coded base and height if mixed.

Support: Highlight base in one color and matching height in another and check squareness with the corner tool. **Stretch:** Ask which side could be a new base on the obtuse triangle and where the new height would go.

Use: Slides 2–4

17–27 min **Video and guided practice** 10 min · Whole class

See two copies making a rectangle and practice spotting the correct height.

YOU DO

1. Play Slide 6 Video clip 1 (0:00–4:50) and ask students to listen for base times height divided by 2.
2. Pause twice to ask what rectangle is being halved.
3. Show Slide 7 bullets and sort three large triangles into height-inside, leg-as-height, and height-outside.
4. Guide whole-class calculation for one acute and one obtuse triangle in inches.

STUDENTS DO

1. Watch, then call out the base, height, and rectangle double for each example.
2. Vote with fingers which dashed line is the true height and justify squareness.
3. Solve the two guided problems on whiteboards with units in square inches.

Say: Watch how two copies make a rectangle. Notice where height falls for leaning triangles. Height must hit the base at 90 degrees, inside or outside the shape.

Worked example: Obtuse triangle: base = 10 in., height outside = 3 in. A = 1/2 x 10 x 3 = 15 sq in. Slanted side 5 in. is not used because it is not at 90 degrees.

Ask: Where does height fall for an obtuse leaning triangle? (Outside the triangle, still at 90 degrees to the base line.) · A triangle has base 8 in. and height 5 in. What is its area? (A = 1/2 x 8 x 5 = 20 square inches.)

Check understanding: Whiteboard check for 15 sq in. and 20 sq in. with correct units; re-model 90-degree mark if errors.

Support: Keep a small grid background so students can estimate by counting squares to cover the region [3].
Stretch: Give base 4.5 in., height 6 in. and ask for area: 13.5 square inches.

Use: Slides 6–7; Video clip 1 (0:00–4:50)

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27–50 min **Main activity** 23 min · Pairs

Calculate polygon area by decomposing into triangles and rectangles for a tile order.

YOU DO

1. Show Slide 9 task and Slide 10 words and hand out inch grid paper, rulers, and colored pencils.
2. Model a sample irregular pentagon split with dotted lines into two triangles and a rectangle, measuring in inches.
3. Release pairs to design their own pentagon or hexagon, split it, measure each base and perpendicular height, and calculate each part [4].
4. Circulate to check 90-degree heights, halving, and addition to total tile area.

STUDENTS DO

1. Draw a pentagon or hexagon, split it with dotted lines, and color each part a different color.
2. Measure base and perpendicular height in inches and write A = 1/2 x base x height with square inches for each triangle.
3. Label each part area and total area underneath and write tile order sentence.

Say: Design your weird polygon on grid paper. Cut it with dotted lines into two triangles and a rectangle. Measure each part in inches, find each area, then add for the total tile to order.

Worked example: Rectangle 6 x 3 = 18 sq in. Triangle 1: 1/2 x 6 x 2 = 6 sq in. Triangle 2: 1/2 x 4 x 3 = 6 sq in. Total polygon = 18 + 6 + 6 = 30 sq in. by decomposing into triangles and other shapes [1].

Ask: What did you decompose your polygon into? (Two triangles and a rectangle, then added the parts.) · How do you know you used the right height? (It meets the base at 90 degrees, checked with the corner tool.)

Check understanding: Collect color-coded designs and check that part areas add to total; pull a small group to re-measure if heights are slanted.

Support: Provide a polygon outline already split with dotted lines and labeled base and height for the first shape. **Stretch:** Have students redesign the same total area with a different set of triangles and compare totals.

Use: Slides 9–10

50–60 min **Plenary** 10 min · Whole class

Apply composing and decomposing to a real wall and check the success criteria.

YOU DO

1. Show Slide 11 vote: best first move for a polygon wall mural is to cut it into triangles and add or surround with a rectangle and subtract.
2. Discuss when to compose into rectangles versus decompose into triangles [1].
3. Show Slide 12 exit ticket and have students write answers on paper.
4. Close by restating that triangle area is half base times height for right and other triangles [6].

STUDENTS DO

1. Vote, then defend choice with a partner using compose or decompose language.
2. Complete exit ticket with area calculation and reflection.
3. Share one thing learned about height with the class.

Say: You must find paint needed for a polygon wall mural. Do you surround it with a rectangle and subtract, or cut it into triangles and add? Both work if you add or subtract parts correctly.

Ask: When would you surround with a rectangle and subtract extra triangles? (When the polygon almost fills a rectangle and the extra corners are easy right triangles.) · Triangle base 10 in., height 6 in.: area? (30 square inches, 1/2 x 10 x 6.)

Check understanding: Read exit tickets for 30 sq in. and correct first-move reasoning; reteach halving tomorrow if needed.

Support: Show the decomposition line already drawn and label which numbers are base, height, length, and width. **Stretch:** Add a rectangular door cut-out that must be subtracted from the total paint area.

Use: Slides 11–12

Common mistakes

Mistake	How to spot it	How to fix it
Using slanted side length as height	Student multiplies two sides with no right-angle mark	Place right-angle corner at base and show height must meet at 90 degrees to the opposite vertex [3][5].
Forgetting to halve base times height	Triangle area is double, equal to full rectangle	Recall each triangle is half the rectangle or half the parallelogram formed by two copies [11][8].
Labeling area in inches instead of square inches	Answer writes in. for area	Sort units: lengths in inches, covering counts in square inches, and always label sq in. [3].

Support

- Provide a polygon outline already split with dotted lines and labeled base and height for the first shape.
- Give pre-drawn rectangles on grid to count whole and part squares and confirm halves match [3].

Stretch

- Have students redesign the same total area with a different set of triangles and compare totals.
- Include decimal and fractional puzzles like base 4.5 in. with height 6 in. and area 17.5 sq in. with height 7 in.

For the LSE or teaching assistant

Sit near pairs using pre-split sheets; prompt base in one color and height in another, check corner is square, and confirm halving.

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Check for understanding

Question	Answer
Triangle base 10 in, height 6 in: area = __ sq in.	30 sq in. (1/2 x 10 x 6)
Right triangle legs 8 in. and 5 in.: area = __ sq in. How do you know?	20 sq in.; two copies make an 8 by 5 rectangle of 40, half is 20.
A polygon is split into rectangle 18 sq in. and triangles 6 sq in. and 6 sq in. Total area?	30 sq in. (18 + 6 + 6)

Homework

Measure a triangle at home in inches and find its area with 1/2 x base x height in square inches.

Sources

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