LESSON TITLE: CALCULATING THE AREA OF IRREGULAR SHAPES (PART 1)

TOTAL TIME: TWO 45-MINUTE PERIODS

BRIEF DESCRIPTION

In the first part of this *The House That STEM Built* lesson plan, students are going to explore calculating the area of irregular shapes on the construction site as well as in their own lives. Students will break down irregular shapes into shapes they are more familiar with and calculate their area by following along with *The House That STEM Built: Calculating the Area of Irregular Shapes* video.

CURRICULUM OUTCOMES

Taken from the New Brunswick Grade 7 Math curriculum.

GENERAL CURRICULUM OUTCOMES

GCO Shape and Space (SS): Use direct and indirect measurement to solve problems.

SPECIFIC CURRICULUM OUTCOMES

SCO SS2: Develop and apply a formula for determining the area of

→ triangles,

→ parallelograms, and

→ circles.

NEW BRUNSWICK GLOBAL COMPETENCIES ACHIEVED[1]

- Critical Thinking and Problem-Solving
    - Learners engage in an inquiry process to solve problems, as well as acquire, process, interpret, synthesize, and critically analyze information to make informed decisions.
    - Learners construct, relate and apply knowledge to all domains of life, such as school, home, work, friends, and community.
    - Learners formulate and express questions to further their understanding, thinking, and problem-solving.
- Collaboration
    - Learners participate in teams by establishing positive and respectful relationships, developing trust, and acting interdependently and with integrity.
    - Learners learn from and contribute to the learning of others by co-constructing knowledge, meaning, and content.

LEARNING OBJECTIVES

Learners will

- calculate the area of a rectangle,
- calculate the area of a triangle,
- calculate the area of an irregular shape, and
- identify where the use of area calculations are used on the construction site as well as in their own lives.

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1 https://www2.gnb.ca/content/dam/gnb/Departments/ed/pdf/K12/curric/competencies/NBCompetencies.pdf?fbclid=IwAR1ldrZs1gFgiNm8rC4oz7Fmx6mSn-6t_QJkenev0eD33rZ-foYYn6bmdmc *also available at* https://tinyurl.com/nb-competencies

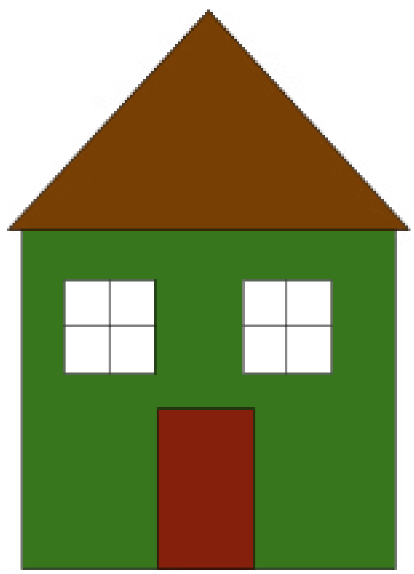
MATERIALS

→ Video: *The House That STEM Built: Calculating the Area of Irregular Shapes*

MINDS ON: 10 MINUTES

GROUPING: INDIVIDUAL

Today we are going to be talking about area calculation. Before we get started, ask students to take a minute to look around the class and see how many rectangles they can count. How many triangles are there around the classroom? On the board, draw an irregular shape that includes a rectangle and a triangle, like the house below. Ask students to pick out how many of each shape they see.



ACTIVITY: 30 MINUTES

GROUPING: ENTIRE CLASS

Watch *The House That STEM Built: Calculating the Area of Irregular Shapes* video. Included in this video are many opportunities to stop and solve practice problems together. Feel free to pause the video and ask some or all of the following questions to prompt discussions.

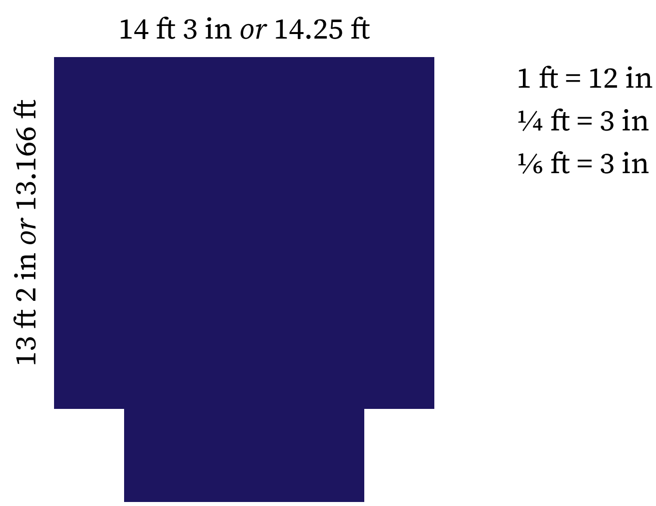
- 1:17 – As a reminder, it might be valuable to jot down the equations for rectangles ($Area = l \times w$) and triangles ($Area = \frac{1}{2}(b \times h)$) somewhere where students can reference them.

- 1:29 – Where in the building process would you need to know how to calculate irregular shapes—shapes that aren't our typical rectangles, triangles, and circles? Can you think of any examples?

- 3:30 – Example 1: Let's try and figure out how much flooring we need to cover the floor of the home theatre/games room. This room is made up of 2 separate rectangles. So how do you think we should go about calculating the total area of this space? Let's walk through it together.

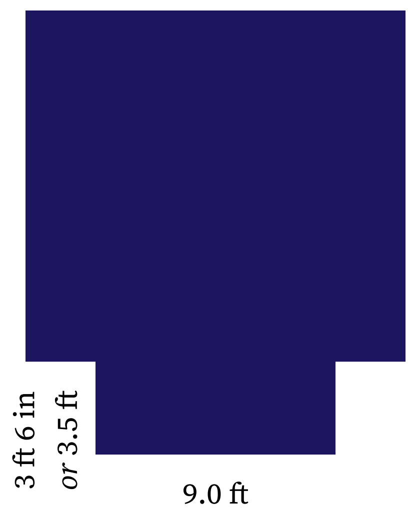
    - First, let's calculate the area of the larger rectangle. The long side of the rectangle is 14 feet and 3 inches. Does anyone know how many inches are in a foot? If there are 12 inches in a foot, 3 inches would equal ¼ of a foot or 0.25 feet. The long side is 14.25 feet. The short side of the rectangle is 13 feet 2 inches or 13 ⅙ feet which equals 13.166 feet. The area of the larger rectangle is

$$Area = l \times w$$
$$Area = 14.25 \text{ ft} \times 13.166 \text{ ft}$$
$$Area = 187.6 \text{ ft}^2$$



→ Now that we have the area of the larger rectangle, let's find the area of the smaller one.

$$Area = l \times w$$
$$Area = 9.0 \text{ ft} \times 3.5 \text{ ft}$$
$$Area = 31.5 \text{ ft}^2$$



1 ft = 12 in
½ ft = 6 in

→ To figure out the total area of the room we will add the two areas together.

$$187.6 \text{ ft}^2 + 31.5 \text{ ft}^2 = 219.1 \text{ ft}^2$$

→ 5:27 – Why would a contractor want to have extra materials on hand? Would this add to the total cost of the build? Can anyone explain why we multiply 219.1 ft^2 by 1.1 in order to add 10% to our total area?

→ 5:37 – Now that we have figured out what the total area of the floor is, how do we figure out how many pieces of flooring we need?

→ 6:12 – How many pieces of flooring would we need? First, we will need to find the area of each of the boards. Take note that the units are different and will need to be converted into feet before we can find the area. Follow the video for instructions on how to do that.

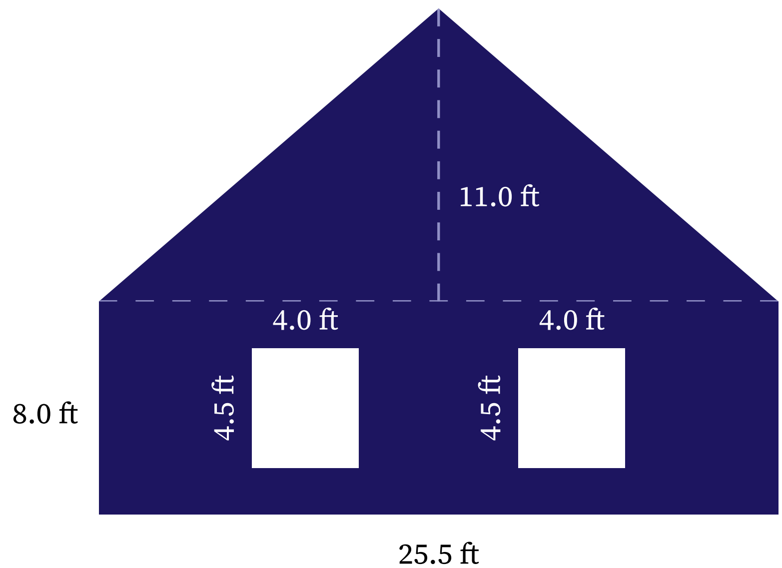
→ To find the area of the board we will use the following equation.

$$Area = l \times w$$
$$Area = 4.0 \text{ ft} \times 0.6 \text{ ft}$$
$$Area = 2.4 \text{ ft}^2$$

→ 8:40 – Now that we know the area of each board, we can divide the total area (amount of flooring needed) by the area of 1 board.

$$241 \text{ ft}^2 \div 2.4 \text{ ft}^2\text{/piece} = 100.4 \text{ pieces}$$

→ 9:22 – Example 2: Feel free to watch and walk through or do this next example as a class.



$$Area\ of\ a\ rectangle = l \times w$$
$$Area\ of\ a\ triangle = ½(b \times h)$$

$$Area\ of\ the\ large\ rectangle = 25.5 \text{ ft} \times 8.0 \text{ ft}$$
$$Area\ of\ the\ large\ rectangle = 204 \text{ ft}^2$$

$$Area\ of\ the\ triangle = ½(25.5 \text{ ft} \times 11.0 \text{ ft})$$
$$Area\ of\ the\ triangle = 140.25 \text{ ft}^2$$

Total area of the side of the house (without windows)
= 204 ft^2 + 140.25 ft^2
= 344.25 ft^2

Area of 1 window = 4.0 ft × 4.5 ft
Area of 1 window = 18.0 ft^2

Area of both windows = 18.0 ft^2 × 2
Area of both windows = 36.0 ft^2

Total area of siding required = 344.25 ft^2 – 36.0 ft^2
Total area of siding required = 308.25 ft^2

Area of siding required + 10% = 308.25 ft^2 × 1.1
Area of siding required + 10% ≈ 339 ft^2

1 ft = 12 in
⅔ ft or 0.66 ft = 8 in

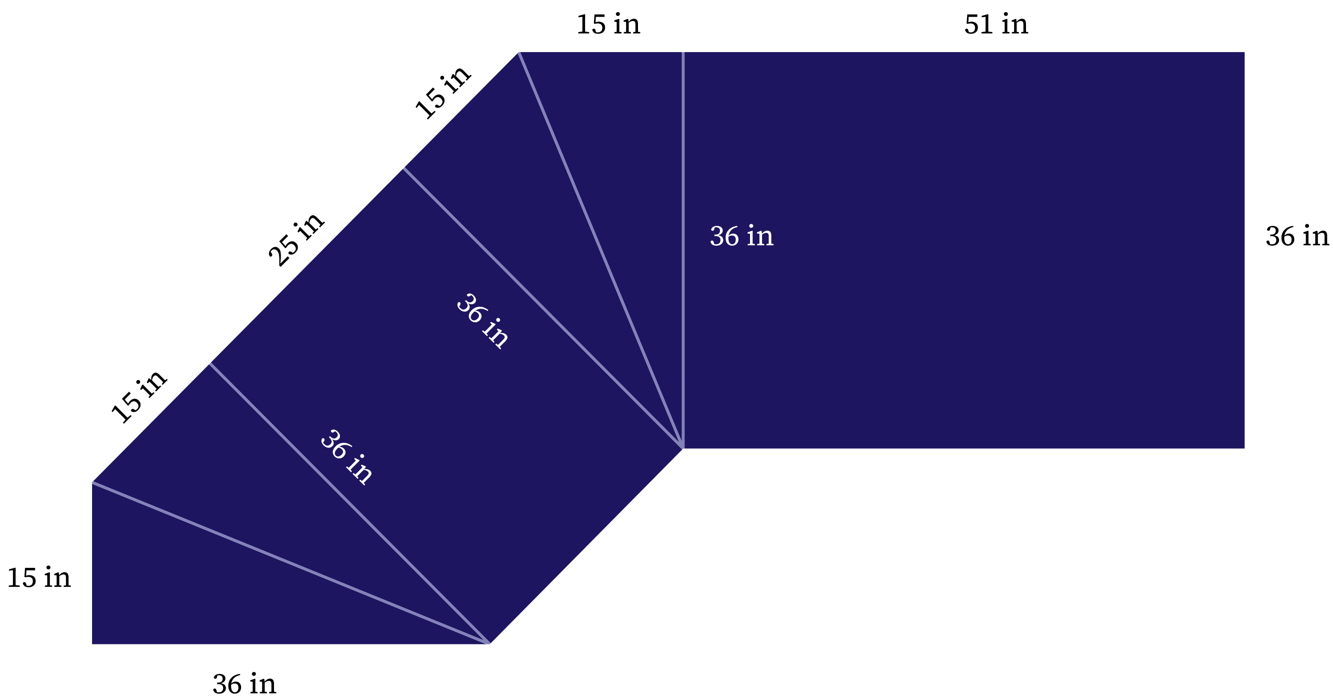
Area of a piece of siding = 12.0 ft × 0.66 ft
Area of a piece of siding = 7.92 ft^2
Area of a piece of siding ≈ 8ft^2

Number of siding pieces needed
= 339 ft^2 ÷ 8 ft^2/piece
= 42.40 pieces

→ 14:12 – Throughout this video, we have been doing all of our calculations in feet and inches. Here in Canada we often use centimetres and metres to measure things. Why do you think they use the imperial system in the construction industry? Would it be easier or harder to use the metric system?

→ 14:50 – Example 3: Let’s break the shape of the kitchen island countertop into smaller pieces together and then take some time on our own to calculate the amount of quartz needed to cover it.

Area of a rectangle = $l \times w$
Area of a triangle = ½($b \times h$)



Area of R1 = 25 in × 36 in
Area of R1 = 900 in^2

Area of R2 = 51 in × 36 in
Area of R2 = 1836 in^2

Area of T1 = ½(36 in × 15 in)
Area of T1 = 270 in^2

T1 = *T2* = *T3* = *T4*
Area of all triangles = 270 in^2 × 4
Area of all triangles = 1080 in^2

$$\textit{Total Area} = 900\ \text{in}^2 + 1836\ \text{in}^2 + 1080\ \text{in}^2$$
$$\textit{Total Area} = 3816\ \text{in}^2$$

$$1\ \text{ft}^2 = 1\ \text{ft} \times 1\ \text{ft}$$
$$1\ \text{ft}^2 = 12\ \text{in} \times 12\ \text{in}$$
$$1\ \text{ft}^2 = 144\ \text{in}^2$$

$$\textit{Total Area in ft}^2 = \textit{Total Area} \div 144\ \text{in}^2/\text{ft}^2$$
$$\textit{Total Area in ft}^2 = 3816\ \text{in}^2 \div 144\ \text{in}^2/\text{ft}^2$$
$$\textit{Total Area in ft}^2 = 26.5\ \text{ft}^2$$

CONCLUSION: 5 MINUTES

GROUPING: ENTIRE CLASS

If you have a word wall feel free to add the equations from today to the wall.

Let students know that tomorrow we are going to practice measuring skills and the equations we have been working on as well as creating our own shapes.

DIFFERENTIATION

CONTENT

Use *The House That STEM Built* video to spark a conversation about careers other than construction that would require knowledge of area equations (e.g., farming, fashion design, urban planning, land surveying, etc.).

Do your students take a shop/building technology class? Are there any opportunities for a cross-subject project?

How are irregular shapes used in art? Take a look at some examples of modern art to see how different shapes are used.

Host a debate in your classroom about the benefits and downfalls of using the imperial measuring system in construction.

PRACTICE

Take the class outside and ask students to do an area scavenger hunt on the playground. Playgrounds are made up of many geometric shapes that can be measured and that students can calculate the area of.

What is the area of certain parts of your school or classroom? In teams, ask students to calculate the area of the windows and doors of one side of your school building or the walls inside of your classroom. It might be difficult to measure the exact height of the building, so, using metre sticks or measuring tapes, make an estimate of how tall it is. After you have got the height of the building, the length can be measured and the area of the wall calculated. With all of this information together (area of the wall and area of the doors and windows), as a class, you can calculate the total area of the wall.

How much money would it cost to re-tile your classroom floor? Get students to calculate the area, figure out how many tiles they would need, and then find out how much money it would take to buy the new tiles.

PRODUCT

Ask students to create a blueprint of their dream house. What is the total area of each of the rooms? What about the roof? Deck? Blueprints can be created on graph paper or by using programs like Minecraft Education (https://education.minecraft.net/en-us/homepage) or RoomSketcher (https://www.roomsketcher.com/) which allow students to create their visions digitally.

Ask students to create a how-to manual about how to calculate the area of irregular shapes. Make sure they include all of the steps required as well as explanations and drawings to help clarify.

Using graph paper and tape, construct a 3D irregular shape and calculate the surface area.

EXTENSION

If you have already covered circles in class, feel free to use examples that include circles.

Board games can be a great way to learn. In teams, students can physically or digitally create a board game that involves calculating area. Once teams finish they can swap with another team. Multiple game templates can be found at https://flippity.net/. Students can create breakout rooms, bingos, board games and more by editing the template details in Google Spreadsheets.

LESSON TITLE: CALCULATING THE AREA OF IRREGULAR SHAPES (PART 2)

TOTAL TIME: TWO 45-MINUTE PERIODS

BRIEF DESCRIPTION

In the second part of this *The House That STEM Built* lesson, students are going to get the chance to practice calculating the area of irregular shapes by measuring and calculating the area of shapes around the classroom before they create their own irregular shapes in "The Irregular Area Challenge".

CURRICULUM OUTCOMES

Taken from the New Brunswick Grade 7 Math curriculum.

GENERAL CURRICULUM OUTCOMES

GCO Shape and Space (SS): Use direct and indirect measurement to solve problems.

SPECIFIC CURRICULUM OUTCOMES

SCO SS2: Develop and apply a formula for determining the area of

- triangles,
- parallelograms, and
- circles.

NEW BRUNSWICK GLOBAL COMPETENCIES ACHIEVED[2]

- Critical Thinking and Problem-Solving
    - Learners engage in an inquiry process to solve problems, as

2 https://www2.gnb.ca/content/dam/gnb/Departments/ed/pdf/K12/curric/competencies/NBCompetencies.pdf?fbclid=IwAR1ldrZs1gFgiNm8rC4oz7Fmx6mSn-6t_QJkenev0eD33rZ-foYYn6bmdmc *also available at* https://tinyurl.com/nb-competencies

    well as acquire, process, interpret, synthesize, and critically analyze information to make informed decisions.

    - → Learners construct, relate and apply knowledge to all domains of life, such as school, home, work, friends, and community
    - → Learners formulate and express questions to further their understanding, thinking, and problem-solving

- → Collaboration
    - → Learners participate in teams by establishing positive and respectful relationships, developing trust, and acting interdependently and with integrity.
    - → Learners learn from and contribute to the learning of others by co-constructing knowledge, meaning, and content.

LEARNING OBJECTIVES

Learners will

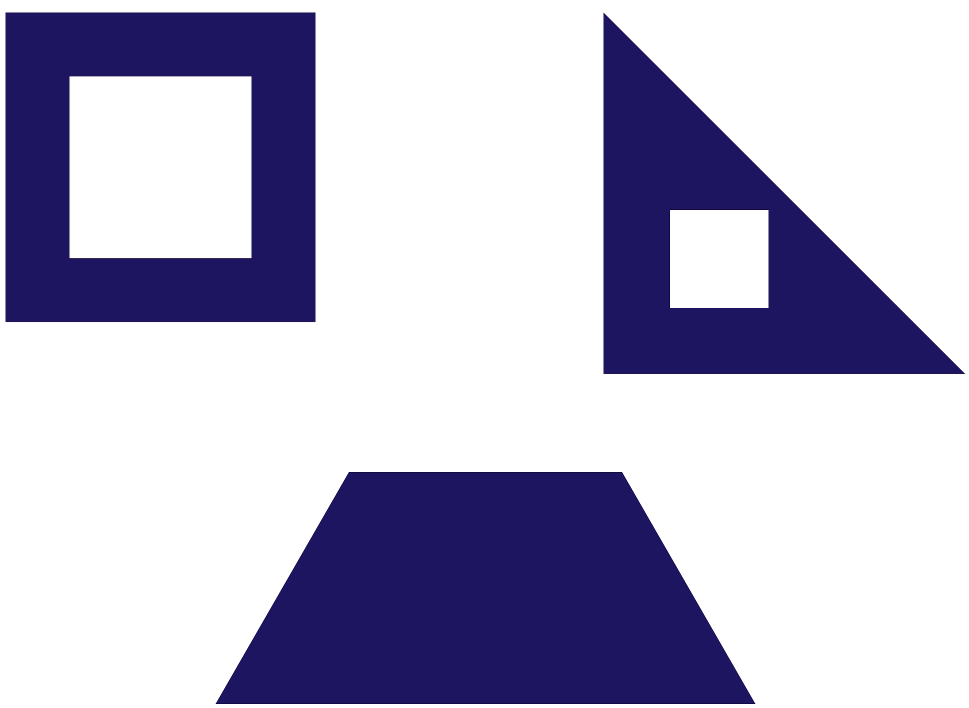
- → calculate the area of a rectangle,
- → calculate the area of a triangle,
- → calculate the area of an irregular shape, and
- → create unique irregular shapes for others.

MATERIALS

- → Painter's tape.
- → Measuring utensils (rulers, yardsticks, measuring tapes).
- → Copies of "Area Classroom Search" (1 per student).
- → Pieces of white paper (1 per student).
- → Copies of "The Irregular Area Challenge" (1 per student).

BEFORE CLASS

Using painter's tape, arrange 10 or more irregular shapes on the floor, walls, or windows for students to find. Examples may include the shapes below.



MINDS ON: 5 MINUTES

GROUPING: ENTIRE CLASS

To get the ball rolling today ask students what was covered yesterday. What were the steps that we learned about when it comes to calculating the area of a shape that isn't a typical rectangle or triangle?

- First, we need to cut up the complex shape into simpler shapes whose areas we can easily calculate.
- Once the larger shape is cut up into squares, rectangles, and triangles, we can measure the sides.
- Next, we calculate the area of each of the pieces and add or subtract them depending on the shape.

ACTIVITY: 15 MINUTES

GROUPING: INDIVIDUAL

Students will have noticed that there are many different shapes marked out on the floor with painter's tape. Hand out copies of "Area Classroom Search" and different measuring instruments. Explain that they will be required to choose 4 of the shapes, sketch them, measure them, and calculate the area. Remind students that they need to show all of their work, including equations.

ACTIVITY: 20 MINUTES

GROUPING: GROUPS OF 4

Once students have measured and calculated the area for their 4 shapes on the floor or walls, give each student a piece of white paper. Ask them to fold the paper in half once and then half again. Students can then open the paper and write their names at the top.

The fold lines will create 4 boxes. In each box ask students to design an irregular shape of their own. It can be as complex as they like, but it must fit in the box and it must be made of rectangles, triangles, and squares. These shapes must be large enough to measure with a ruler.

Once students have created their 4 unique shapes, hand out copies of

"The Irregular Area Challenge". On this sheet, they will get the chance to choose one shape from each of their group members to sketch and calculate. They will also choose one of their own to complete the sheet.

CONCLUSION: 5 MINUTES

GROUPING: INDIVIDUAL

After students have had the opportunity to wrap up their sheets, ask them to complete a 3–2–1 exit slip. On a piece of paper ask them to write down 3 things that they have learned, 2 questions they have, and 1 way they could use their new knowledge.

DIFFERENTIATION

CONTENT

Use *The House That STEM Built* video to spark a conversation about careers other than construction that would require knowledge of area equations (e.g., farming, fashion design, urban planning, land surveying, etc.).

Do your students take a shop/building technology class? Are there any opportunities for a cross-subject project?

Are there any quilters in the community? As a class project, put together a quilt made up of geometric shapes. How many irregular shapes can you make?

PRACTICE

Take the class outside and ask students to do an area scavenger hunt on the playground. Playgrounds are made up of many geometric shapes that can be measured and that students can calculate the area of.

How much money would it cost to re-tile your classroom? Get students to calculate the area, figure out how many tiles they would need, and then find out how much money it would take to buy the new tiles, does the answer change if the type of tile changes?

Create a tower out of a deck of cards or other objects. What is the surface area?

PRODUCT

Ask students to create a blueprint of their dream house. What is the total area of each of the rooms? What about the roof? The deck? Blueprints can be created on graph paper or by using programs like Minecraft Education (https://education.minecraft.net/en-us/homepage) or RoomSketcher (https://www.roomsketcher.com/) which allow students to create their visions digitally.

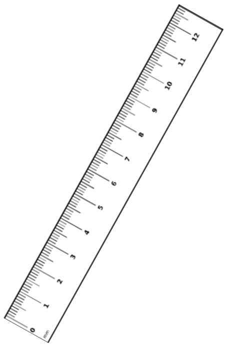
Using geometric shapes, create a pop-up book explaining how to calculate the area of irregular shapes.

Create a music video explaining how to calculate area. Use previously used tunes to make a parody or create something unique.

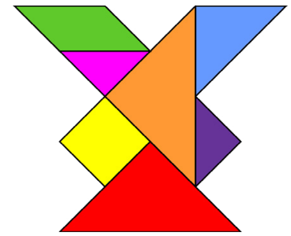
EXTENSION

If you have already covered circles in class, feel free to use examples that include circles.

Using small pieces of paper of multiple colours and shapes, ask students to create a pixelated self-portrait of themselves on a piece of chart paper. Once they have done a self-portrait, ask them to calculate their total area. Create a class gallery of their works of art.



CLASSROOM AREA SEARCH



You might have noticed that there are some irregular shapes scattered around the classroom. It is your task to pick 4 different shapes, sketch them in the boxes below, and calculate their area. Remember that when you are finding the area of irregular shapes you must first break the shapes into smaller more familiar shapes. Show all of your work! Good luck!

Area of a rectangle = $l \times w$

Area of a triangle = $\frac{1}{2}(b \times h)$

Shape 1:	Shape 2:
Shape 3:	Shape 4:

THE IRREGULAR AREA CHALLENGE

It is your turn! On a separate piece of paper, create 4 unique irregular shapes. It can be as complex as you like, but it must be made up of familiar shapes (rectangles and triangles). In a group of 4, trade your shapes with another classmate. Choose one of their shapes, sketch it below, and calculate the area. Repeat with the rest of your group and then choose one of your own shapes to do.

Area of a rectangle $= l \times w$

Area of a triangle $= \frac{1}{2}(b \times h)$

Original shape created by: Sketch: Work:	Original shape created by: Sketch: Work:
Original shape created by: Sketch: Work:	Original shape created by: Me Sketch: Work: