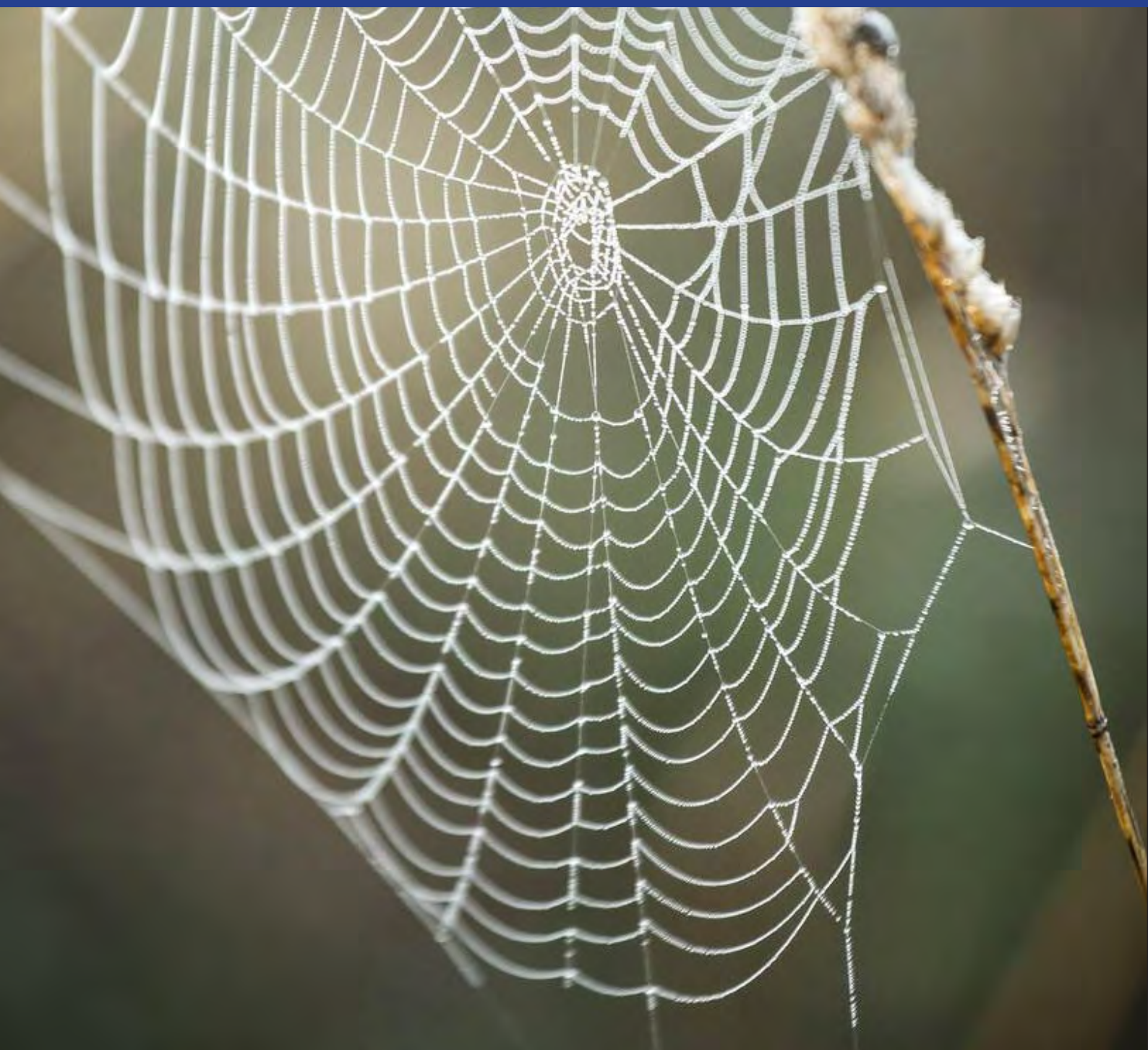
SECTION

4

GEOMETRICAL REASONING AND MEASUREMENT



GEOMETRY AND MEASUREMENT

Shape and Space/Measurement

INTRODUCTION

In this section, you will learn to recognise and sort 2D shapes based on their attributes, such as the number of sides, angles and symmetry. You'll also identify and describe prisms and pyramids found in your environment, like boxes, buildings and rooftops, connecting mathematics with the real world. Additionally, you will construct nets of prisms and pyramids, which are flat shapes that can be folded into 3D objects, giving you a hands-on understanding of how these shapes are formed. Finally, you'll measure and record the perimeters of regular and irregular shapes using centimetres and metres, helping you grasp the concept of perimeter in practical, everyday situations.

In this section, you will learn to;

Identify and sort 2D shapes according to their attributes

1. Identify and describe prisms and pyramids in the environment
2. Construct the nets of prisms and pyramids.
3. Measure and record perimeters for regular and irregular shapes in centimetres and metres.
4. Develop and apply a formula for determining perimeters of given shapes in centimetres and metres.
5. Construct different rectangles for a given perimeter (cm, m) to demonstrate that many shapes are possible for a perimeter

2D AND 3D SHAPES

Focal Area 1: Identify and Sort 2D Shapes According to their Attributes

Imagine you're at a toy store, and you're helping a friend pick out building blocks for a baby. The blocks come in different shapes—triangles, squares, circles and rectangles. To find the right set, you need to sort them by shape, size, or even colour. But what if you don't know how to tell these shapes apart? Understanding the attributes of shapes becomes crucial in this situation.

In everyday life, whether you're arranging tiles in a pattern, designing a piece of art, or simply organising objects, being able to identify and sort shapes based on their attributes is essential. Attributes like the number of sides, the length of sides, and the angles they form help us categorise and make decisions. Learning to identify and sort 2D shapes helps us make sense of the world around us and is a key skill in many practical situations.

Reinforcement Activities

Shape Hunt

Purpose: To help recall and recognise basic 2D shapes in your environment before identifying and sorting them according to their attributes.

Materials Needed:

- Blank paper or a shape chart (with pictures of basic 2D shapes like squares, circles, triangles, and rectangles)
- Pencils or crayons
- A clipboard (optional, for holding paper while writing)

Activity Instructions:

1. **Introduction:**
   - Can you name some 2D shapes you already know (e.g., square, circle, triangle, rectangle).
   - Have look at the shape chart and examine the basic shapes.

2. **Shape Hunt:**
   - In small groups, go on a "Shape Hunt" around the classroom or schoolyard to find real-life objects that match the shapes on their chart.
   - Have a blank piece paper or shape chart and a pencil or crayon to record your findings.
   - Walk around and look for objects that match the shapes they know (e.g., the clock is a circle, the window is a rectangle).
3. **Recording Findings:**
   - As you find each shape, draw or write the name of the object next to the corresponding shape on your paper.
   - Try and find at least one object for each shape.
4. **Group Discussion:**
   - After 10-15 minutes, gather back together.
   - Share what objects you found for each shape.
   - Discuss how these objects have specific attributes (e.g., a square has four equal sides, a rectangle has two pairs of equal sides) that make them that shape.

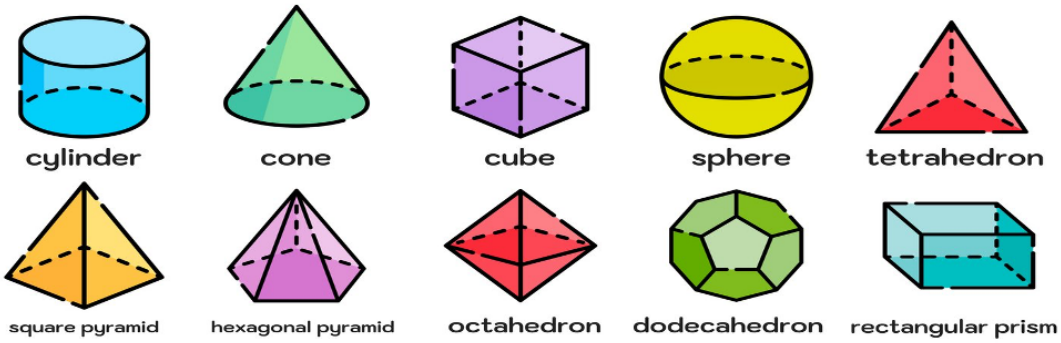
Identify common 2D shapes from real-life 3D shapes

All around us, we find various shapes in the objects that we come into contact with. When we look around us, we find circles, squares, rectangles, triangles, pentagons and many other shapes. In this lesson, we will take a look at some of these everyday life items that have these shapes and understanding their unique properties and characteristics.

All these real life objects are made up of shapes that we know. Let's us also take a look at these 3D shapes and the 2D shapes that are found within them and their properties.

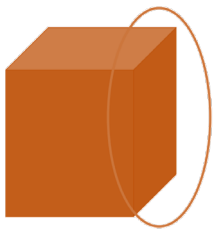
Three-dimensional Shapes (3D)

These shapes are solid or hollow. They have three dimensions – length, width and height. There are many 3D shapes. Examples are shown in the picture below



There are some attributes of 3D shapes that you need to know. They include the faces, edges and vertices (vertex = singular).

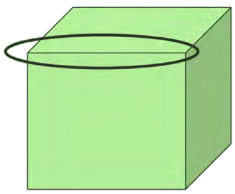
Face



The face is the part of a shape that is flat. (Or curved)

E.g. A cube has 6 faces.

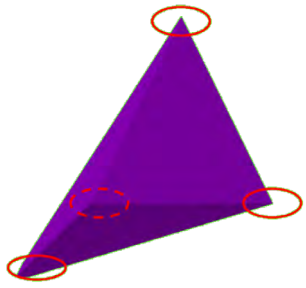
Edge



The edge is the line where two faces meet.

E.g. A cube has 12 edges.

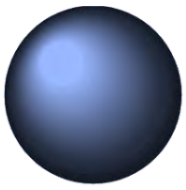
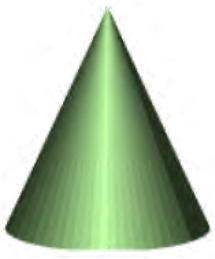
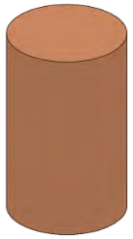
Vertex (Vertices)



A vertex is the place where three or more edges meet.

E.g. This pyramid has 4 vertices.

Let's take a look at these 3D shapes and their attributes.

Cube	Cuboid	Sphere	Cone	Cylinder
				
• 6 square faces all the same size. • 12 Edges all the same length. • 8 Vertices. • It's 2D shape is a **square**	• 6 rectangular faces. • 12 Edges. • 8 Vertices. • It's 2D shape is a **rectangle**.	• A perfectly round 3D shape, like a ball. • It has only one curved face. • It's 2D shape is a **circle**.	• A circle at its base and a pointed vertex. • 2 faces.	• Circular ends of equal size. • 2 Edges. • 3 Faces. • 0 Vertices

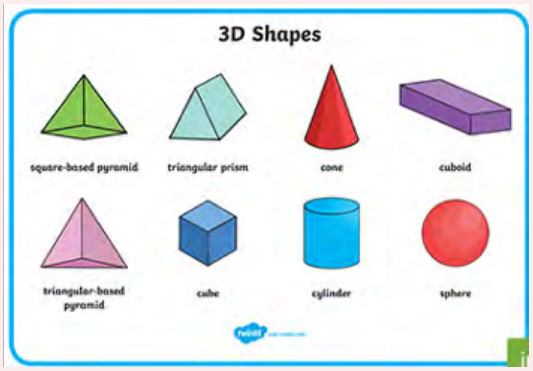
Activity 4.1: Individual/Pair/Group Work

3D Shape Scavenger Hunt

Purpose:image To reinforce understanding of common 3D shapes by identifying and describing their attributes through real-life examples found in the environment.

Materials Needed:

- A checklist with pictures and names of the 3D shapes (Cube, Cuboid, Sphere, Cone, Cylinder)
- Clipboards (optional)
- Pencils or crayons
- Measuring tape or ruler (optional, for checking attributes like edges and faces)



Activity Instructions:

1. **Introduction:**
   - Remember the different 3D shapes you have learned (Cube, Cuboid, Sphere, Cone, Cylinder) and their attributes (e.g., number of faces, edges, and vertices).
   - You will be going on a scavenger hunt to find real-life objects that match these 3D shapes.
2. **Scavenger Hunt:**
   - In small groups, each group will have a checklist with pictures and names of the 3D shapes.
   - In your groups explore the classroom, schoolyard or another designated area to find objects that correspond to each 3D shape on your checklist.
   - For each shape you find, write down the name of the object (e.g., "water bottle" for a cylinder) and note its attributes (e.g., "The water bottle has 2 circular faces and 1 curved surface").
   - Try and find at least one object for each 3D shape.
3. **Measuring and Describing:**
   - If available, use measuring tapes or rulers to measure the dimensions of some objects to better understand the shape's attributes (e.g., the height and diameter of a cylindrical can).
4. **Group Presentation:**
   - After 15-20 minutes, gather back together.
   - Each group will present the objects they found for each 3D shape and describe the attributes of these objects.
   - Discuss how these attributes (e.g., the number of faces, the shape of the faces) define the 3D shapes.
5. **Reflection:**
   - Conclude the activity by reflecting on how recognising 3D shapes and their attributes can help you in real-life situations (e.g., identifying shapes in packaging, building structures, etc.).

Two-dimensional Shapes (2D)

These shapes are flat and can only be drawn on paper. They have two dimensions – length and width. They are sometimes called plane shapes.

2D shapes

<table>
<tr>
<td>  </td>
<td>  </td>
<td>  </td>
</tr>
<tr>
<td>Rectangle
A 2D shape.
• 4 straight sides
• 2 pairs of parallel sides that meet at right angles.
• 2 sides are usually longer and 2 are shorter.
• 2 Lines of symmetry.</td>
<td>Square (a special type of rectangle)
A 2D shape.
• 4 sides of the same length.
• 2 pairs of parallel sides.
• 4 right angles.
• 4 corners/vertices.
• 4 Lines of symmetry.</td>
<td>Triangle
A 2D Shape.
• 3 straight sides.
• 3 Corners/Vertices.
• A regular triangle (equilateral) has 3 lines of symmetry.
• Can you name 4 different kinds of triangles?</td>
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<td>  </td>
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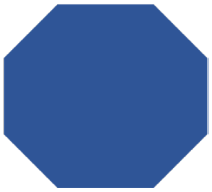
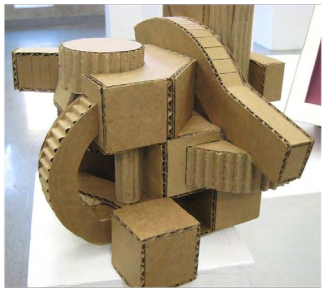
<td>  </td>
</tr>
<tr>
<td>Circle
A round flat 2D shape.
• No Straight sides, only one curved side.
• No corners.
• Infinitive lines of symmetry.</td>
<td>Pentagon
A 2D shape
• 5 straight sides
• 5 Corners/Vertices
• A regular pentagon has 5 Lines of Symmetry</td>
<td>Octagon
A 2D shape.
• 8 straight sides
• 8 Corners/Vertices.
• A regular octagon has 8 Lines of Symmetry</td>
</tr>
<tr>
<td>  </td>
<td colspan="2">Hexagon
A 2D shape.
• 6 straight sides
• 6 Corners/Vertices.
• A regular hexagon has 6 Lines of symmetry.</td>
</tr>
</table>

Importance of 2Ds and 3Ds in Real-Life Scenarios:

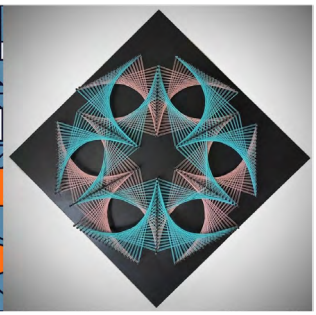
Understanding 2D shapes and their attributes is not just a mathematical exercise; it has real-life applications. For example:

- **Architecture and Engineering:** Identifying shapes helps in the design and construction of buildings and structures.

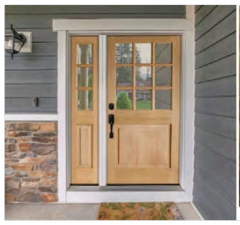



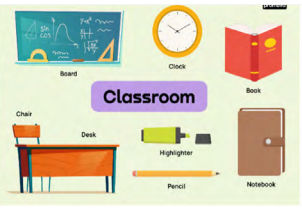

- **Art and Design:** Artists and designers use geometric shapes to create patterns, designs, and artworks.



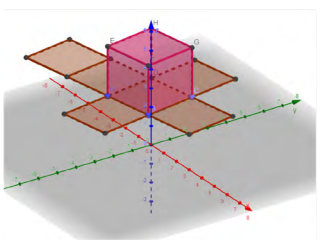
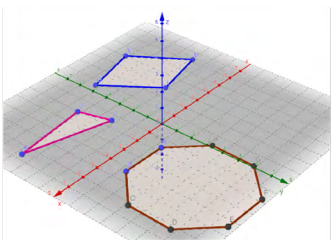


- **Everyday Objects:** Recognising shapes helps in identifying and categorising objects in daily life, such as signs, tools, and devices.





- **Interactive Technology:** You can use computer application software like geogebra to explore shapes.

Activity 4.2: Individual/Pair/Group Work

Exploring 2D Shapes in Real-Life Objects and Using GeoGebra

Purpose: To reinforce understanding of 2D shapes by identifying them in real-life objects and using GeoGebra to explore their properties.

Materials Needed:

- A checklist with pictures and names of common 2D shapes (Circle, Square, Rectangle, Triangle, Hexagon, etc.)
- Pencils or crayons
- Tablets or computers with GeoGebra software installed (if available)
- Measuring tools (optional, for checking dimensions)

Activity Instructions:

1. **Introduction:**
   - Revise the different 2D shapes you have learnt (Circle, Square, Rectangle, Triangle, Hexagon, etc.) and their attributes (e.g., number of sides, angles).
   - Note that you will explore both the physical environment and digital tools to identify and analyse these shapes.
2. **Real-Life Shape Hunt:**
   - Be in small groups. Each group will have a checklist of common 2D shapes.
   - The groups are to explore the classroom, schoolyard, or any area to find objects that contain 2D shapes (e.g., a book cover as a rectangle, a clock face as a circle).
   - For each shape you identify, write down the name of the object and the 2D shape you found within it (e.g., "The whiteboard is a rectangle").
   - Please note the attributes of these shapes (e.g., "The table top is a rectangle with opposite sides equal in length").
3. **GeoGebra Exploration:**
   - After the real-life shape hunt, come back to the classroom and open GeoGebra and use it to create and explore the 2D shapes that you found during the shape hunt.
   - Perform the following:

- Draw the shapes (e.g., circles, rectangles, triangles) using the tools in GeoGebra.
- Measure and explore the attributes of these shapes (e.g., measuring the angles of a triangle or the lengths of sides of a rectangle).
- Compare your digital shapes with the ones you found in the real world.

4. **Group Presentation:**
   - After the exploration, each group should present their findings:
     - Discuss the real-life objects you found and the 2D shapes within them.
     - Share what you learnt about the shapes using GeoGebra (e.g., how changing the lengths of sides in a rectangle affects its shape).
   - Please talk about any patterns or interesting observations you made during the activity.
5. **Reflection:**
   - Reflect on how recognising 2D shapes in the environment and understanding their attributes can be useful in everyday life (e.g., designing, building, art).
   - Discuss how digital tools like GeoGebra can enhance your understanding of geometry.

Focal Area 2: Identify and Describe Prisms and Pyramids in the Environment

Identifying common prisms in the environment (square, rectangular, triangular)

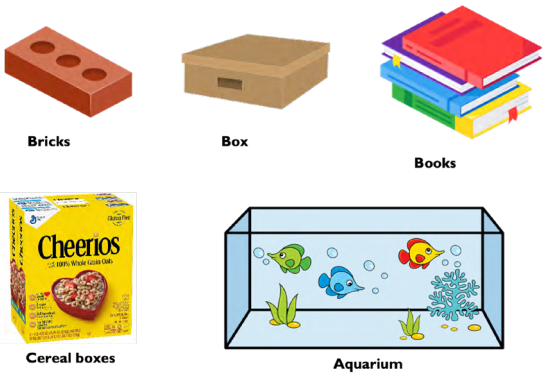
Prisms are three-dimensional solids with two parallel and congruent (identical) bases, and their sides are parallelograms. Among the most common prisms we encounter are square prisms, rectangular prisms, and triangular prisms. Let's explore these shapes, their properties, and where we might find them in our environment.

Rectangular Prism

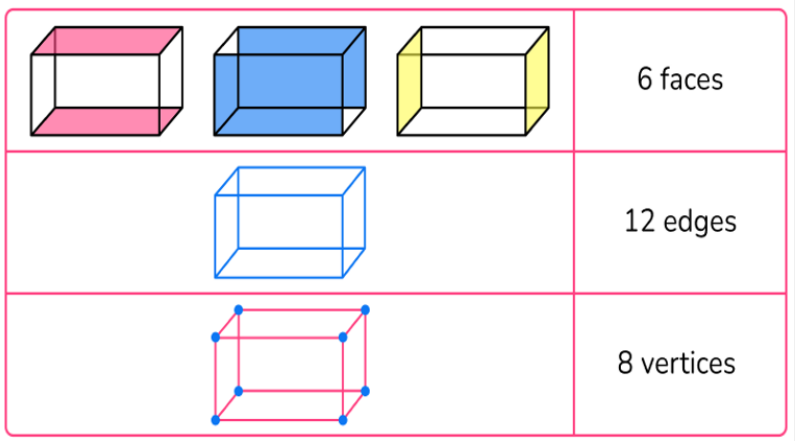
A rectangular prism is a three-dimensional shape with **6 rectangular** faces that meet at right angles. They are also known as cuboids.

Cubes are a special type of rectangular prism where the length, width and height are all equal.

- **Examples in the Environment**:
  11 Fun 3D Shapes Real Life Examples with Worksheets (youvegotthismath.com)
  - Books
  - Bricks used in buildings
  - Cereal boxes



- **Properties/attributes**
  - 6 faces, all rectangles, with opposite faces equal in size
  - 12 edges, with opposite edges equal in length
  - 8 vertices
  - All interior angles are right angles



Square Prism

A square prism, also known as a cube, has all sides equal and all faces are squares. This shape is characterised by all edges being of equal length and right angles. A square prism (= cube) is a special type of a rectangular prism (= cuboid).

- **Examples in the Environment**:
  - Dice used in games
  - Sugar cubes
  - Building blocks in construction

Rubik cube

Sugar cube

Choco milo

- **Properties/attributes**:
  - 6 faces, all squares
  - 12 edges of equal length
  - 8 vertices
  - All interior angles are right angles

Triangular Prisms

Triangular prisms have bases that are triangles. These shapes are characterised by their triangular bases and three rectangular faces.

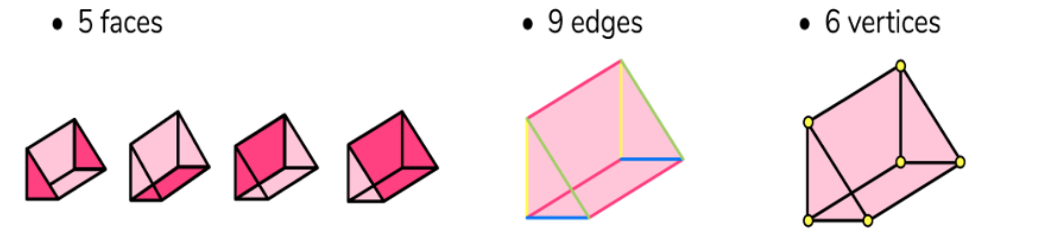
- **Examples in the Environment**:
  - Roofs of houses (often in the shape of triangular prisms)
  - Toblerone chocolate bars
  - Tents

Tents

Tents

Chocolate

- **Properties**:
  - 2 triangular bases
  - 3 rectangular faces
  - 9 edges
  - 6 vertices



Identifying common pyramids in the environment (square, rectangular, triangular)

Pyramids are very interesting three-dimensional shapes that we often see in our environments, both in nature and in human-made structures. These shapes consist of a polygonal bases and triangular faces that converge at a single point called the apex. Three types of pyramids are: square pyramids, rectangular pyramids, and triangular pyramids.

Square Pyramids

A square pyramid has a square base and four triangular faces that meet at the apex.

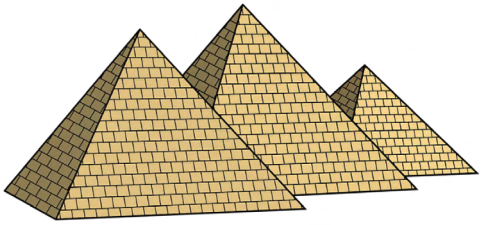
- **Examples in the Environment**:
  - The Great Pyramid of Giza
  - Tetrahedra in crystal structures
  - Certain roof designs in architecture

- **Properties/attributes**:
  - 1 square base
  - 4 triangular faces
  - 5 vertices (including the apex)
  - 8 edges

Rectangular Pyramids

A rectangular pyramid has a rectangular base and four triangular faces that converge at the apex.

- **Examples in the Environment**:
  - Pyramidal tents
  - Some modern architectural structures
  - Certain packaging designs

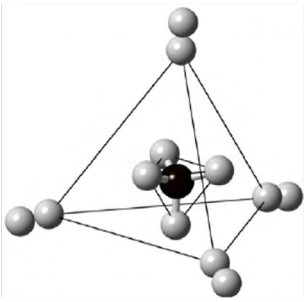


- **Properties/attributes**:
  - 1 rectangular base
  - 4 triangular faces
  - 5 vertices (including the apex)
  - 8 edges

Triangular Pyramids (Tetrahedrons)

A triangular pyramid, or tetrahedron, has a triangular base and three triangular faces that meet at the apex.

- **Examples in the Environment**:
  - Molecules in chemistry, such as methane (CH_4)
  - Certain types of dice
  - Structural elements in geodesic domes



- **Properties/attributes**:
  - 1 triangular base
  - 3 triangular faces
  - 4 vertices (including the apex)
  - 6 edges

Activity 4.3: Individual/Pair/Group Work

Investigating and Presenting on Prisms and Pyramids

Purpose: Explore the environment to find real-life examples of prisms and pyramids, investigate their properties, and present your findings to the class.

Materials Needed:

- Measuring tools (rulers, measuring tapes)
- Construction paper, scissors, glue, and markers
- Tablets or smartphones with camera function
- Presentation materials (poster boards, digital presentation tools like PowerPoint)
- Pre-made models of prisms and pyramids (optional for demonstration)

Part 1: Investigating Prisms and Pyramids in Your Environment

1. **Get Ready to Explore:**
   - Think about the different types of prisms and pyramids you've learnt about (square, rectangular, triangular).
   - In groups, you'll explore different areas of the school or nearby places to find objects that look like these shapes.
2. **Group Investigation:**
   - You will be assigned to a specific area to investigate (e.g., the classroom, playground, or school building).

- Look carefully for objects that resemble prisms or pyramids. For example:
  - A classroom door or window frame might look like a rectangular prism.
  - The roof of a shed or a monument might resemble a triangular pyramid.
- When you find an object, take notes about it, including:
  - What shape it is (prism or pyramid).
  - The specific type (e.g., square prism, triangular pyramid).
  - Any interesting features you notice (like the number of faces, edges, or vertices).

3. Take Photos and Sketch:

- Use a tablet or smartphone to take pictures of the objects you find.
- Make quick sketches of the shapes and try to measure some parts, like the height or the length of the edges if you can. Otherwise estimate these dimensions by using some appropriate referents.

Part 2: Exploring Properties and Preparing Presentations

1. Explore the Properties:

- Back in the classroom, use the materials provided to explore the properties of the prisms and pyramids you found.
- Build simple models of the shapes you identified using paper, glue and other materials.
- Count and record the number of faces, edges and vertices on your models.
- Compare what you discovered about these properties with the real-life objects you found.

2. Create Your Presentation:

- Work together to create a presentation that includes:
  - Photos and sketches of the objects you found.
  - Descriptions of the shapes, types and properties of these objects.
  - Any interesting things you noticed or challenges you faced during your investigation.
- Be creative! You can make posters, digital slideshows, or even 3D models to show the class.

3. **Present Your Findings:**
   - Each group will share their findings with the class.
   - During your presentation, make sure to:
     - Show your photos and sketches.
     - Use your models to explain the properties of the prisms and pyramids you found.
     - Discuss how these shapes are used in real life and why they are important to understand.

Part 3: Reflection and Discussion

1. **Join the Class Discussion:**
   - After all the presentations, we will have a class discussion about why it's important to recognise prisms and pyramids in the environment.
   - Think about how understanding these shapes could help in jobs like architecture, engineering, or design.
   - Reflect on how you can use what you've learnt in future projects or in everyday situations.
2. **Write Your Reflection:**
   - Write a short reflection about what you learnt during this activity. Focus on the properties of prisms and pyramids and how you might see them in the world around you.

Exploring Nets of 3D Objects

What Are Nets?

- A **net** is a two-dimensional (2D) shape that can be folded to form a three-dimensional (3D) shape. It's like a **blueprint** that shows all the faces of the 3D shape laid out flat.
- Imagine cutting along the edges of a 3D shape and unfolding it to lay it out flat; the resulting shape is called a net.

Nets of Common 3D Shapes:

1. **Cube:** A net for a cube consists of six squares arranged in a cross pattern. When folded along the edges, the squares come together to form the six faces of the cube.

2. **Cuboid (Rectangular Prism):** A cuboid's net is made up of six rectangles (or four rectangles and two squares) that can be arranged in various patterns. These rectangles fold up to form the faces of the cuboid.
3. **Triangular Prism:** The net of a triangular prism includes two triangles and three rectangles. The triangles form the two ends of the prism, and the rectangles connect the corresponding sides of the triangles.
4. **Square Pyramid:** A square pyramid's net has one square and four triangles. The square is the base, and the triangles fold up to form the sides of the pyramid.

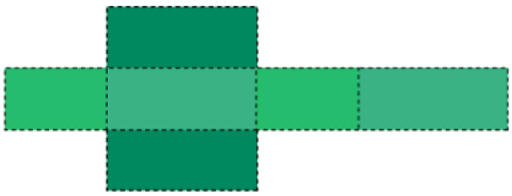
Why Are Nets Important?

- Understanding nets helps in visualising and constructing 3D shapes from flat materials like paper or cardboard.
- Nets are used in various real-life applications, such as packaging design (where a net is folded to form a box) and in architecture (where complex shapes are often created by folding materials).
- They also help in calculating the surface area of 3D shapes, as you can find the area of each face in the net and add them together.

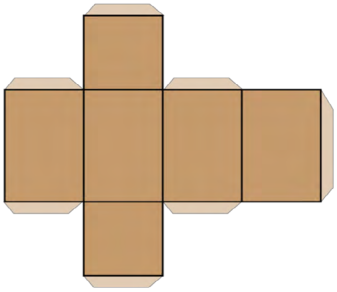
Nets of Prisms

Net of Rectangular Prism

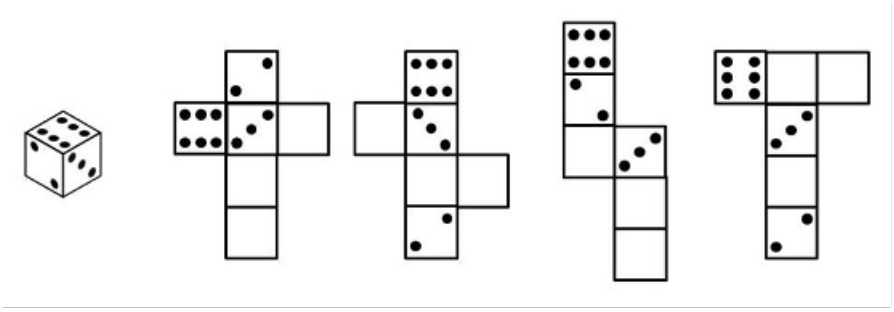
Rectangular Prism



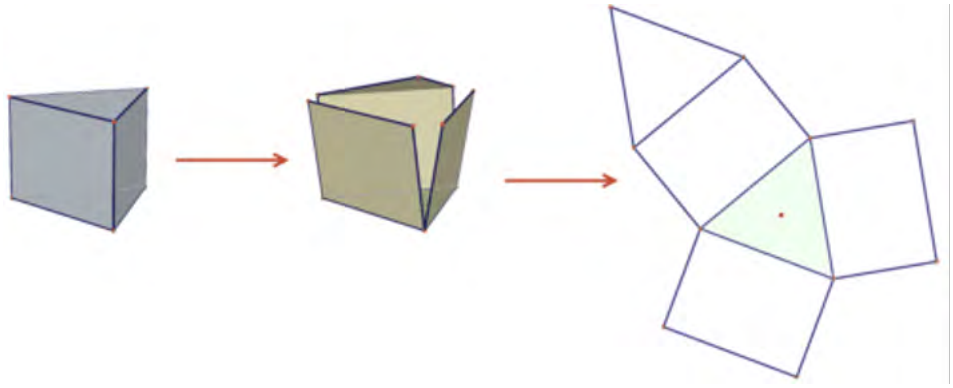
Net of Rectangular Prism



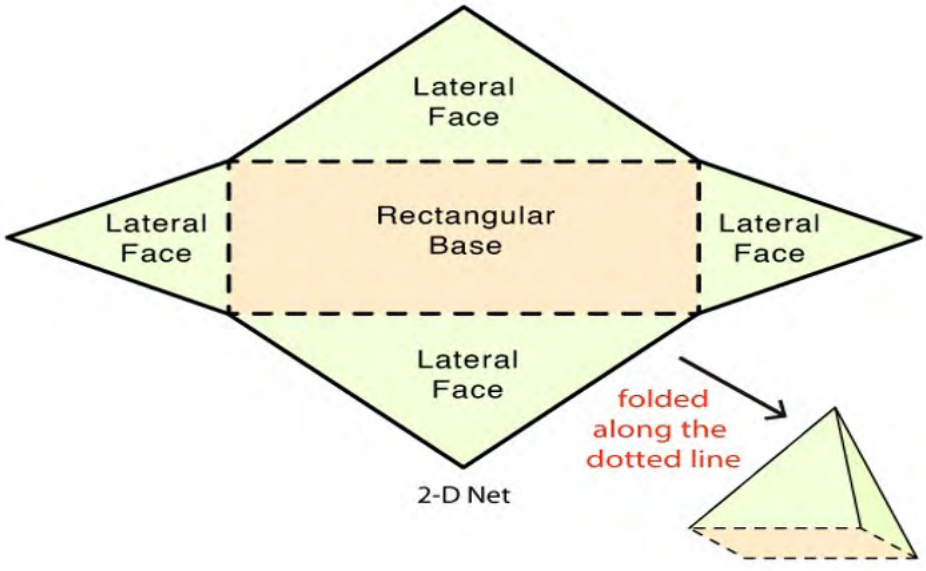
Net of Square Prism (cube)



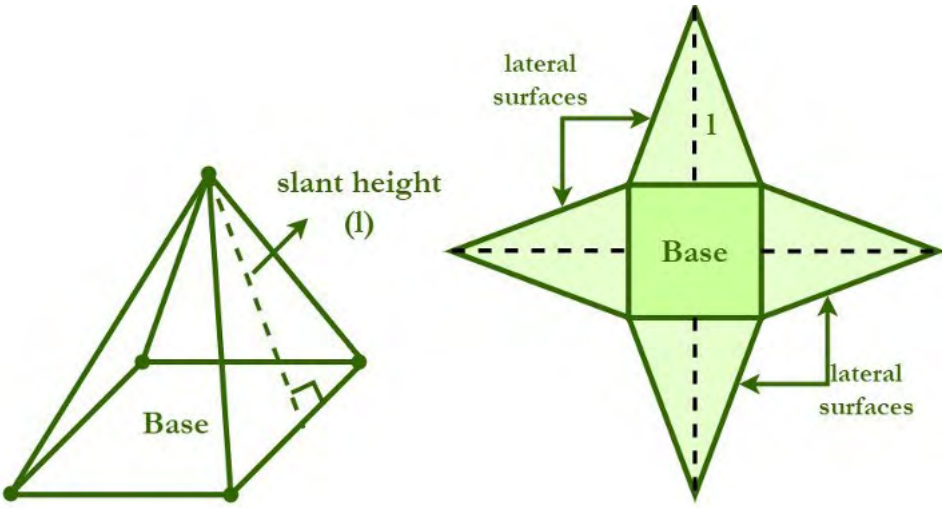
Net of a Triangular Prism



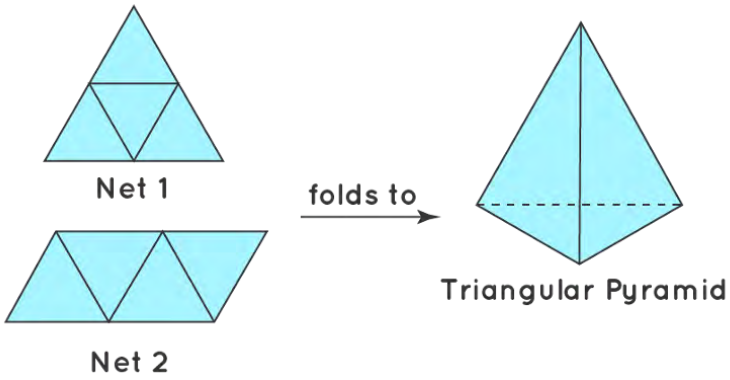
Net of Rectangular Pyramid



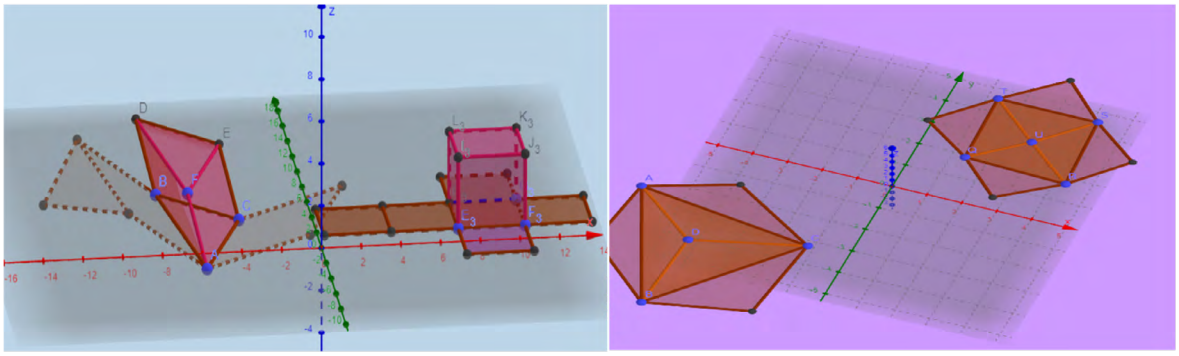
Net of Square Pyramid



Net of Triangular Pyramid



Explore the nets of prisms and pyramids using applicable computer applications



Activity 4.4: Individual/Pair/Group Work

Exploring Nets of 3D Shapes

Purpose: To understand how 2D nets fold into 3D shapes by creating and assembling nets for a cube, cuboid, triangular prism and square pyramid.

Materials Needed:

- Construction paper or cardstock
- Scissors
- Rulers
- Pencils
- Glue sticks or tape
- Markers or crayons (optional, for decoration)

Steps:

1. **Introduction to Nets:**
   - Begin by discussing in groups what a net is and how it can be used to form a 3D shape.
2. **Drawing the Nets:**
   - **Cube:**
     - Draw a cross-shaped net consisting of six equal squares on construction paper. Each square should be connected to at least one other square.
   - **Cuboid:**
     - Draw a net consisting of three pairs of rectangles. The rectangles can be arranged in different patterns, but they should all connect to form the faces of the cuboid.
   - **Triangular Prism:**
     - Draw a net with two equilateral triangles and three rectangles. The rectangles should be long enough to connect the sides of the triangles.
   - **Square Pyramid:**
     - Draw a net with one square and four triangles attached to each side of the square.
3. **Cutting Out the Nets:**
   - Carefully cut along the outer edges of each net using scissors. Be precise to ensure that all edges will match when folded.
4. **Folding the Nets:**
   - Fold along all the lines of the nets to prepare for assembly. Remember that these folds represent the edges of the 3D shape.

- Fold the net for the cube along each edge to form the cube. Do the same for the cuboid, triangular prism, and square pyramid.

5. Assembling the 3D Shapes:

- Apply glue or tape along the edges of the nets and carefully fold them into their corresponding 3D shapes.
- Press firmly to ensure all edges are secure.

6. Observing and Analysing:

- Once the shapes are assembled, observe the 3D shapes and compare them to the original nets.
- Discuss how each face of the net corresponds to a face of the 3D shape.

7. Challenge Activity:

- Make prediction of the net of a given 3D shape and then draw and assemble it to see if their prediction was correct.

8. Creative Decoration (Optional):

- Decorate your 3D shapes using markers or crayons to make them more visually appealing.

Reflection:

- Reflect on how the nets helped you understand the structure of 3D shapes.
- Discuss the importance of nets in real-life applications such as packaging and architecture.

Extension:

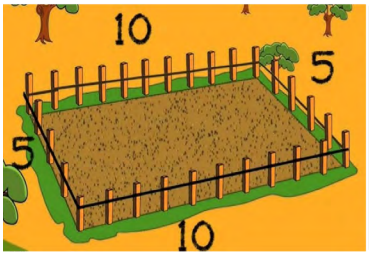
- Design your own 3D shapes and create corresponding nets.
- You may explore complex shapes like pentagonal prisms or hexagonal pyramids if you are interested to explore further.

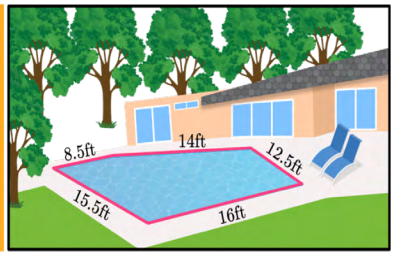
MEASUREMENT OF PERIMETER

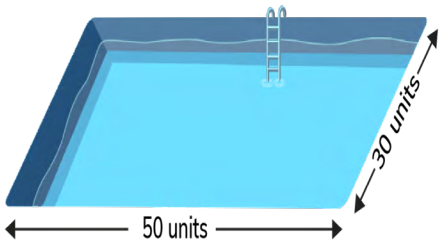
Focal Area: Measuring Perimeter of Regular and Irregular 2D Shapes

Understanding how to measure the perimeter of both regular and irregular 2D shapes is a fundamental concept in geometry that you will encounter frequently in both academic and real-life situations. The perimeter is the total distance around the boundary of a shape, and it is important for tasks such as determining the amount of material needed for a fence, the length of trim for a picture frame, or the border of a garden.

For example, to find the perimeter of the fence or the swimming pools in the picture, you need to measure all the sides and add the results.







The perimeter of large objects like the fence above is measured in metres (m) and kilometres (km). The perimeter of small objects like your exercise book or the top of your table can be measured in millimetres (mm) and centimetres (cm).

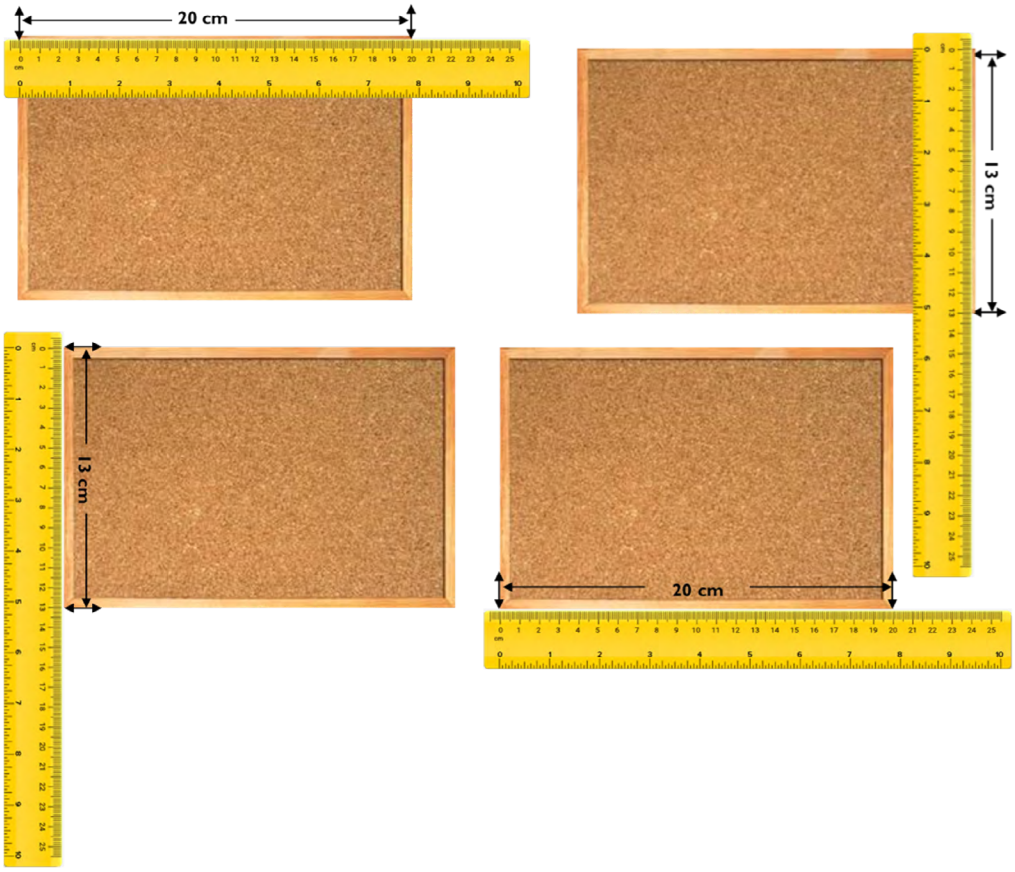
Measure and record perimeter for real life regular shapes in cm and m

Take a look at the following objects as we find them in our various communities. We will measure and determine the perimeter of these objects.

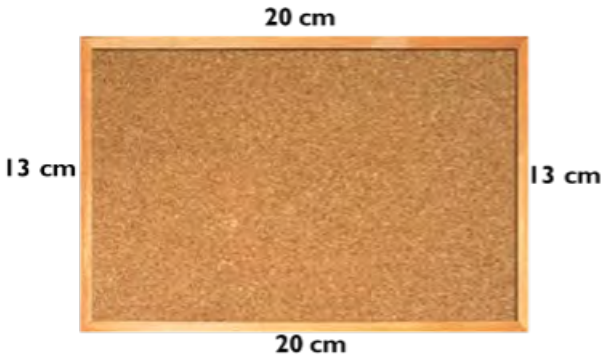
To find the perimeter of each of these objects, we will use our ruler to measure all the sides of the object and add the results.

For example; Determine the perimeter of the object below

Step 1: Measure the sides of the object



So, these are the measurements of all the sides of our object.

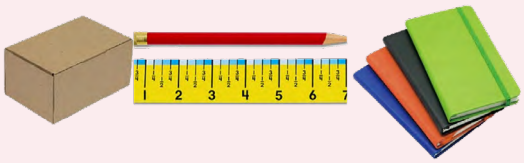


To find the perimeter, we add all the sides. Thus, 20 *cm* + 20 *cm* + 13 *cm* + 13 *cm* = 66 *cm*.

Activity 4.5: Individual/Pair/Group Work

Measuring and Calculating Perimeter

Purpose: To measure the sides of various objects and calculate their perimeters.



Materials Needed:

- Rulers or measuring tapes
- Objects with clear, straight edges (e.g., books, notebooks, tables, boxes)
- Pencil and paper for recording measurements
- Calculator (optional)

Instructions:

1. **Select Your Object:**
   - Choose an object from the classroom or home that has clear, straight edges, like a book, table, or box. Make sure the object is easy to measure using a ruler or measuring tape.
2. **Measure the Sides:**
   - Using your ruler or measuring tape, carefully measure the length of each side of the object. Be as accurate as possible.
   - Write down each measurement on your paper. Label each side (e.g., Side A, Side B).
3. **Calculate the Perimeter:**
   - Add up the lengths of all the sides you measured to find the perimeter of the object. Remember, the perimeter is the total distance around the object.
   - Use a calculator if needed to ensure your addition is correct.

   For example:
   - If you measured a rectangular book and found that Side A is 15 cm, Side B is 10 cm, the perimeter would be calculated as:
     - Perimeter = Side A + Side B + Side A + Side B
     - Perimeter = 15 cm + 10 cm + 15 cm + 10 cm = 50 cm

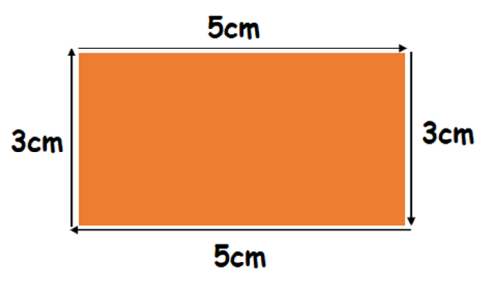
4. **Repeat with Different Objects:**
   - Repeat the measuring and calculating process with at least two more objects. Try to choose objects of different shapes and sizes to practise measuring and calculating perimeter.
5. **Compare and Discuss:**
   - Once you have calculated the perimeters of all your objects, compare your results with your classmates or discuss them with a partner.
   - Talk about which objects had the largest and smallest perimeters and why that might be the case.
6. **Reflection:**
   - Write a short paragraph about what you learned from this activity. Did anything surprise you? How do you think knowing how to calculate perimeter could be useful in real life?

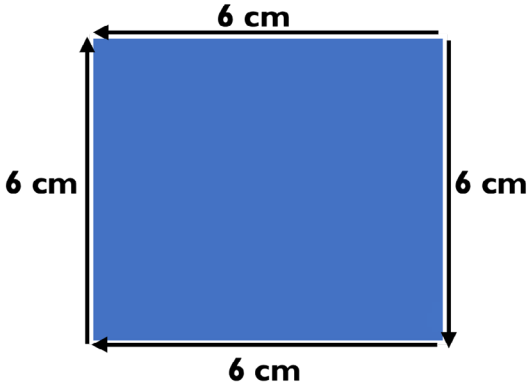
Extension:

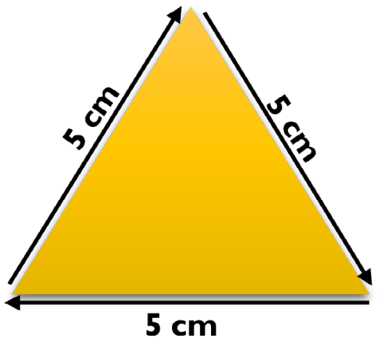
- If you want a challenge, try to find the perimeter of a more complex shape, such as an irregular polygon, by measuring all its sides.

Determine the perimeter of squares, rectangles and triangles

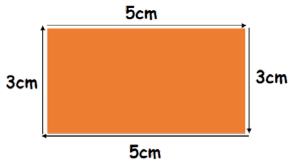
Let's solve these examples;





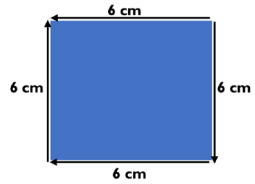


Solutions



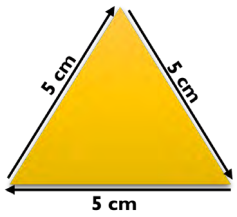
Perimeter = 5 *cm* + 3 *cm* + 5 *cm* + 3 *cm*

Perimeter = 16 *cm*



Perimeter = 6 *cm* + 6 *cm* + 6 *cm* + 6 *cm*

Perimeter = 24 *cm*



Perimeter = 5 *cm* + 5 *cm* + 5 *cm*

Perimeter = 15 *cm*

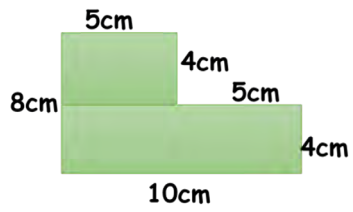
Measure and record perimeters for irregular shapes in cm and m

Sometimes, we are given shapes that are not the three common shapes (square, rectangles and triangles that we know).

For such shapes, we will still add the lengths of all the sides to determine the perimeter of the shapes.

Example 1:

This shape is not one of the common shapes that we know, but to find the perimeter we just add all the sides.

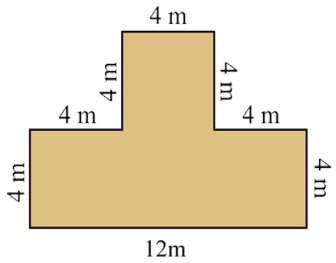


5 + 4 + 5 + 4 + 10 + 8 = 36 *cm*

Perimeter of the shape = 36 *cm*

Example 2:

Find the perimeter of the shape below



Solution

Perimeter = 4m + 4m + 4m + 4m + 4m + 4m + 4m + 12m

= 40 m

Activity 4.6: Individual/Pair/Group Work

Calculating the Perimeter of Regular and Irregular 2D Shapes

Purpose: To practise calculating the perimeter of both regular and irregular 2D shapes.

Materials Needed:

- Rulers
- Pre-drawn 2D shapes on paper (both regular and irregular)
- Pencil and paper for calculations
- Scissors (optional, if learners want to cut out shapes)

Instructions:

1. **Introduction:**
   - Revise what a perimeter is—the total distance around the edge of a shape.
2. **Shape Exploration:**
   - In small groups, or pairs, you will have pre-drawn 2D shapes. The shapes will include a mix of regular shapes (e.g., squares, rectangles, equilateral triangles) and irregular shapes (e.g., polygons with sides of different lengths).

3. **Measure the Sides:**
   - Using a ruler, measure the length of each side of the shapes. Write down the measurements on the paper next to the corresponding sides.
   - For regular shapes, be reminded that all sides are of equal length (e.g., all sides of a square are the same).

4. **Calculate the Perimeter:**
   - Add up the lengths of all the sides to find the perimeter of each shape.
   - For regular shapes, multiply the length of one side by the number of sides (e.g., for a square, Perimeter = 4 × side length).
   - For irregular shapes, add each side length together (e.g., Perimeter = Side A + Side B + Side C + ...).

   Example for a Regular Shape:
   - **Shape:** Square with each side = 5 cm
   - **Calculation:** Perimeter = 4 × 5 cm = 20 cm

   Example for an Irregular Shape:
   - **Shape:** Irregular pentagon with sides 3 cm, 4 cm, 5 cm, 6 cm, and 7 cm
   - **Calculation:** Perimeter = 3 cm + 4 cm + 5 cm + 6 cm + 7 cm = 25 cm

5. **Compare Results:**
   - Compare the calculated perimeters with the rest of the class. Discuss why regular shapes have simpler perimeter calculations and how irregular shapes require more careful measurement.

6. **Discussion:**
   - Reflect on which shapes were easier to calculate and why. Discuss any challenges you faced while measuring or calculating.

7. **Extension Activity:**
   - If you want to challenge yourself, have a complex irregular shape or a combination of regular shapes joined together. Then find the perimeter of the combined shape by calculating each part separately and then adding the results.

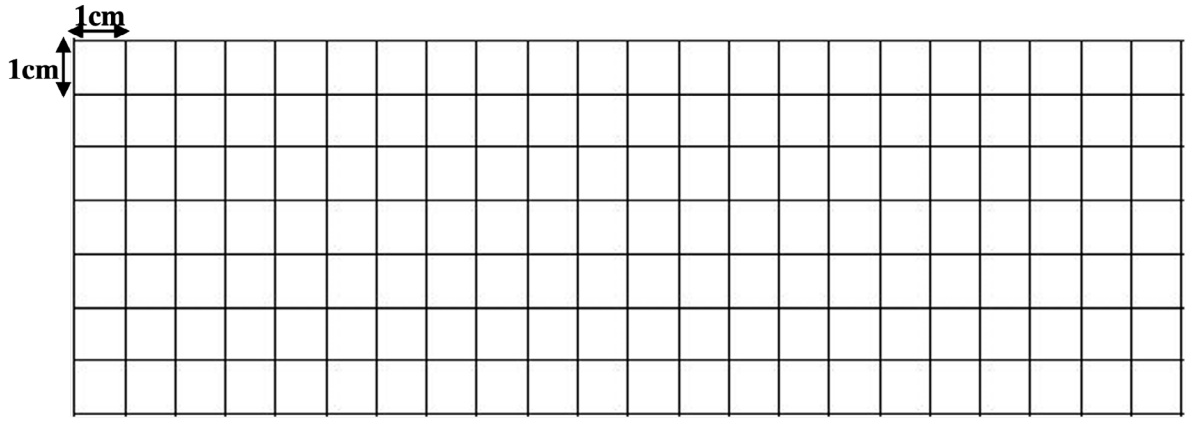
8. Reflection:

- Write a brief summary of what you have learnt about calculating perimeters and how you can apply this knowledge in real-life situations, such as fencing a garden or framing a picture.

Use grids to determine the perimeter of regular and irregular shapes

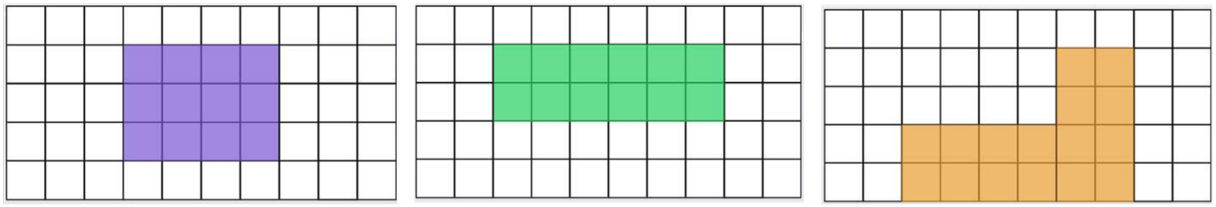
We can also use graph sheets and paper grids to determine the perimeter of 2D shapes.

An example of a grid is show below. Usually, a square on a grid is 1 cm by 1 cm.

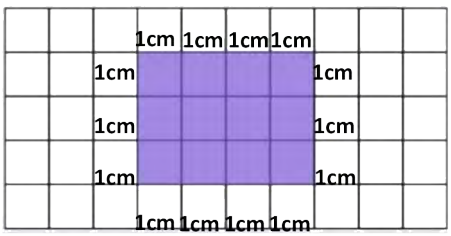


Example

Determine the perimeter of the shapes on the grid.



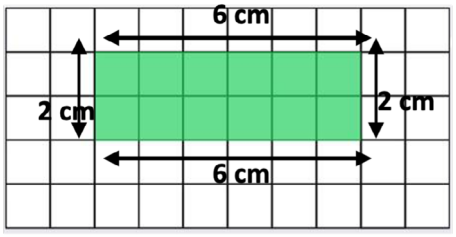
Solution



Since each side of the grid is 1cm, we will count around the shape drawn on the grid.

Perimeter = 4cm + 3 *cm* + 4cm + 3 *cm*

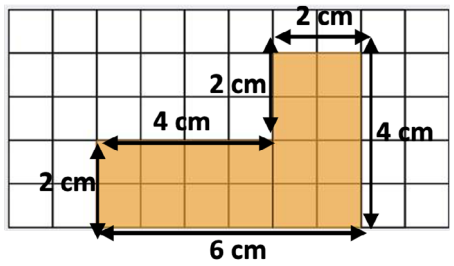
Perimeter = 14 *cm*



Since each side of the grid is 1cm, we will count around the shape drawn on the grid.

Perimeter = 6 *cm* + 2 *cm* + 6 *cm* + 2 *cm*

Perimeter = 16 *cm*



Since each side of the grid is 1cm, we will count around the shape drawn on the grid.

Perimeter = 6 *cm* + 4 *cm* + 2 *cm* + 4 *cm* + 2 *cm*

Perimeter = 20 *cm*

Activity 4.7: Individual/Pair/Group Work

1. Individually, draw at least five different shapes on grid paper and determine the perimeter.
2. Discuss your work with a partner and share areas where you found challenges and how you intend to overcome them next time.

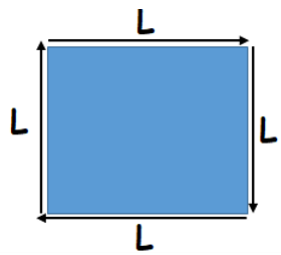
MEASUREMENT OF PERIMETER II

Focal Area 1: Develop and Apply a Formula for Determining Perimeter of Squares and Rectangles

We can use formula to calculate the perimeter of squares and rectangles. Formulas make our calculations easier and faster.

Square

A square has all four sides equal. Therefore, when adding the sides to find the perimeter, you add the same number four times.



So, for any square, you add the four lengths.

Thus, L + L + L + L

This give 4L

Worked Example 1:

Find the perimeter of the square below.

Formula = L + L + L + L = 4L

Since all the sides of a square are the same, we add the 7 cm four times.

Perimeter = 7 cm + 7 cm + 7 cm + 7 cm = **28 cm**

Or 4L = 4(7cm) = **28 cm**.

Worked Example 2:

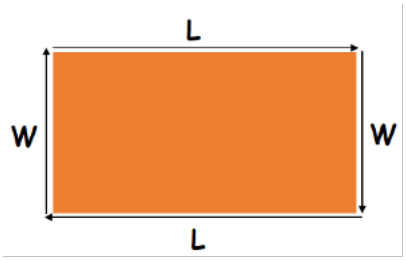
Find the perimeter of the square below.

Perimeter = 5 cm + 5 cm + 5 cm + 5 cm = **20 cm**

Or 4L = 4(5 cm) = **20 cm**.

Rectangle

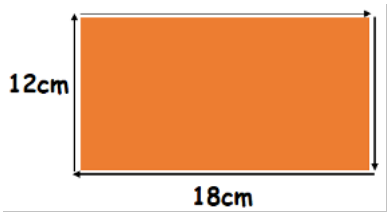
A rectangle has its two opposite sides equal.



Formula = L + W + L + W = 2L + 2W

Worked Example 1

Find the perimeter of the rectangle below.



Formula = 2L + 2W

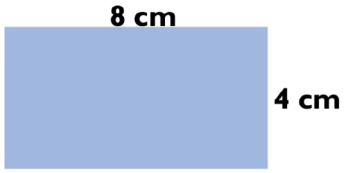
2(18 cm) + 2(12 cm)

36 cm + 24 cm

60 cm

Worked Example 2

Find the perimeter of the rectangle below.



Formula = 2L + 2W

2(8 cm) + 2(4 cm)

16 cm + 8 cm

24 cm

Activity 4.8: Individual/Pair/Group Work

Developing the Formula for Calculating the Perimeter of Squares and Rectangles

Purpose:

- To discover and develop the formulas for calculating the perimeter of squares and rectangles.
- To apply the formulas to solve problems.

Materials Needed:

- Graph paper or plain paper
- Rulers
- Pencils
- Pre-cut square and rectangular shapes (optional)

Instructions:

1. **Introduction:**
   - Remind yourselves that perimeters are the total distance around the edge of a shape.
   - You will explore and develop formulas for calculating the perimeter of squares and rectangles.
2. **Exploring the Perimeter of Squares:**
   - Draw squares on graph paper.
   - Measure the length of one side of the square and write it down.
   - Physically trace around the edges of the square with your fingers or pencils to reinforce the idea that the perimeter is the sum of all the sides.

- **Question:** "If each side of the square is 4 cm, what would be the total distance around the square?"
- Calculate the perimeter by adding all four sides: $P = 4 + 4 + 4 + 4 = 16\ cm$.
- **Observation:** Note that since all sides of a square are equal, the perimeter can be calculated by multiplying the length of one side by 4: $P = 4 \times side\ length$.

3. Exploring the Perimeter of Rectangles:

- Draw rectangles on graph paper.
- Measure the length and width of the rectangle and write these down.
- Trace around the edges of the rectangle, noting that opposite sides are equal.
- **Question:** "If the length of the rectangle is 6 cm and the width is 3 cm, what is the total distance around the rectangle?"
- Calculate the perimeter by adding the lengths and widths: $P = 6 + 3 + 6 + 3 = 18\ cm$.
- **Observation:** Note that the perimeter can be calculated by adding the lengths of two sides and two widths:
  $P = 2 \times (length + width)$.

4. Developing the Formulas:

- Summarise the patterns you have noticed:
  - **Square:** The perimeter is 4 times the side length: $P = 4 \times side\ length$.
  - **Rectangle:** The perimeter is twice the sum of the length and width: $P = 2 \times (length + width)$.

5. Applying the Formulas:

- Work on several examples of squares and rectangles with given side lengths and use the formulas you have developed to calculate the perimeters. ***Refer to review questions for the examples.***

Example Problems:

Square: If a square has a side length of 7 cm, find its perimeter.

Solution $P = 4 \times 7 = 28\ cm$.

Rectangle: If a rectangle has a length of 8 cm and a width of 5 cm, find its perimeter.

Solution: $P = 2 \times (8 + 5) = 26\ cm$.

6. **Problem-Solving Challenge:**
   - Solve real-life problems using the formulas. For example:
     - "A garden is shaped like a rectangle with a length of 10 metres and a width of 6 metres. How much fencing is needed to surround the garden?"
     - **Solution:** $P = 2 \times (10 + 6) = 32\ metres$.
7. **Reflection:**
   - Reflect on how you developed the formulas and how you can use these formulas in everyday situations.

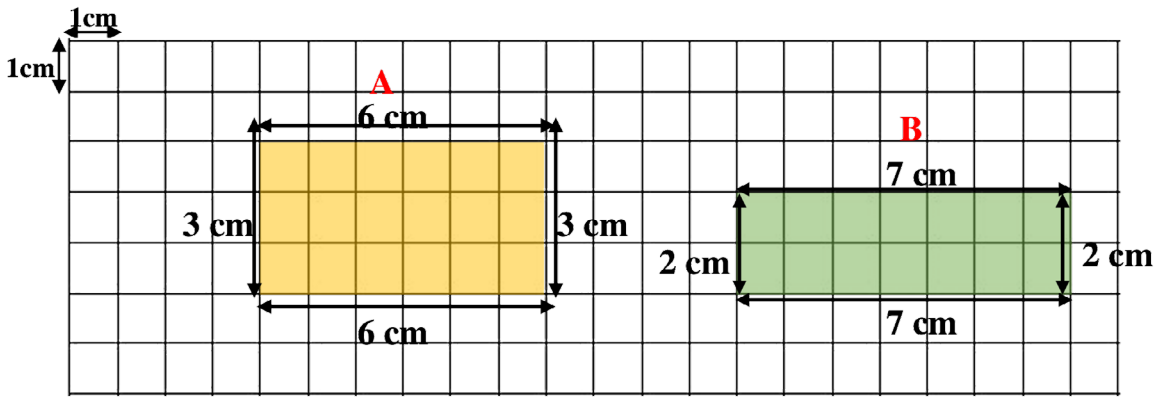
Focal Area 2: Construct Different Shapes for the Same Perimeter

We can draw different shapes for the same perimeter using the grid paper. Let's take a look at some examples.

Example 1

Given the perimeter is 18 cm, draw two different shapes with different side lengths for the same perimeter.

Solution

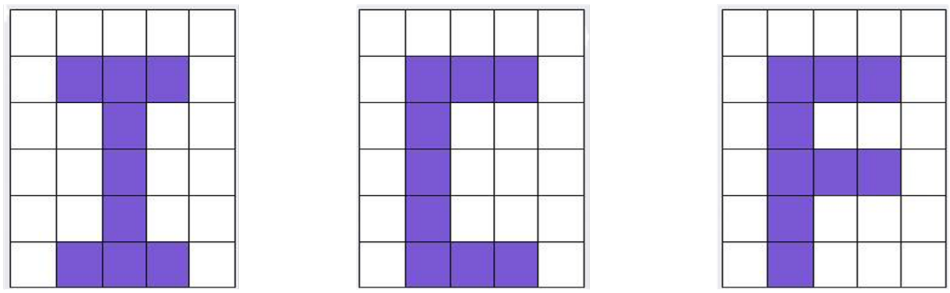


Now, comparing the two shapes (Shape A and B), we see that they both have different length sides and are obviously different shapes but they both have the same perimeter, 18 cm.

Example 2

Given the perimeter 20 cm, draw three different shapes with different sides for the same perimeter.

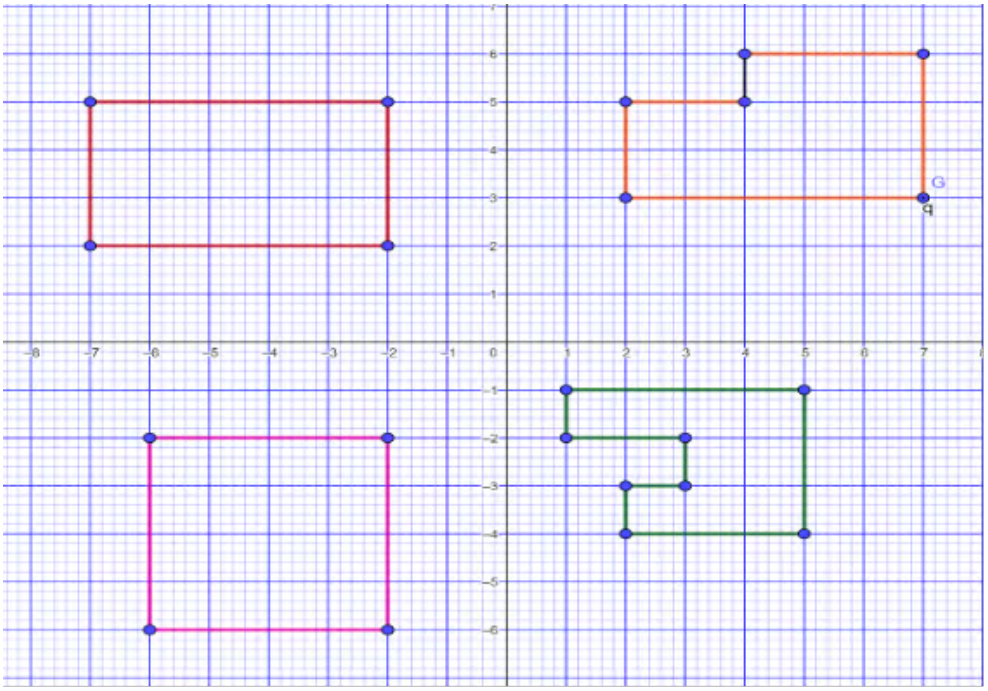
Solution



We can also draw different shapes for the same perimeter using the geogebra. Let's take a look at some examples.

Example 3:

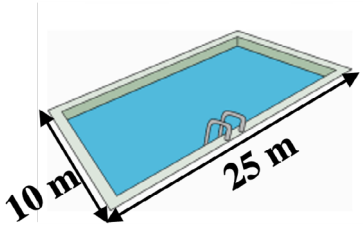
Use geogebra to draw four different shapes, each with a perimeter of 16 cm.



FOCAL AREA 3: SOLVE WORD PROBLEMS INVOLVING PERIMETER

Worked Example 1

The rectangular swimming pool in this house has sides of 25m and 10m. What is the perimeter?



Solution

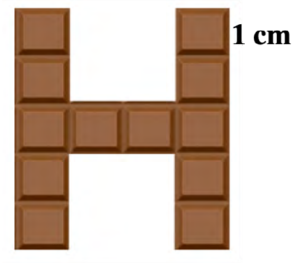
Formula = L + W + L + W = 2L + 2W

Perimeter = 2(25m) + 2(10m)

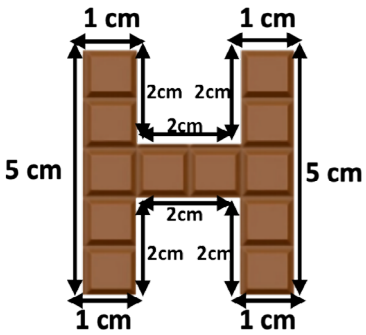
= 70m

Worked Example 2

Okrakua has a chocolate bar in the shape of a letter H. What is the perimeter of a chocolate bar if the length of one piece of chocolate is 1 cm?



Solution



Perimeter = 5cm + 5cm + 1cm + 1cm + 1cm + 1cm + 2cm + 2cm + 2cm + 2cm + 2cm + 2cm

= 26 cm

Worked Example 3

Akua wants to decorate her birthday card in the shape of a rectangle. She wants to put tape around the card. The card has sides 13cm long and 9cm wide. How many centimetres of tape does Akua need?

Solution

Formula = L + W + L + W = 2L + 2W

Perimeter = 2(13cm) + 2(9cm)

= 44cm

Therefore, Akua needs 44cm of tape.

Activity 4.9: Individual/Pair/Group Work

Drawing Different Shapes with the Same Perimeter Using Grid Paper

Purpose:

- To explore how different shapes can have the same perimeter.
- To apply the concept of perimeter to solve real-life problems.

Materials Needed:

- Grid paper
- Rulers
- Pencils
- Erasers

Instructions:

1. **Introduction to Perimeter:**
   - Remember that the perimeter is the total distance around the edge of a shape.
   - Today we will explore how different shapes can have the same perimeter.
2. **Drawing Shapes with the Same Perimeter:**

- Choose a perimeter length to work with, such as 12 units.
- Working individually, or in pairs, on grid paper.
- **Challenge:** "Draw at least three different shapes on the grid paper, each with a perimeter of your chosen length."

- Example, for 12 units:
  - A square with sides of 3 units by 3 units.
  - An L-shaped figure with a combination of lengths totaling 12 units.
  - A T-shaped figure with a combination of lengths adding up to 12 units.
- Don't forget to measure and count the units along each side carefully to match your chosen perimeter.

3. Discussion:

- Once you have completed your shapes, compare them with your classmates.
- Discuss how the shapes are different in appearance but share the same perimeter.
- Why do different shapes have the same perimeter and how might this concept be useful in real life?

4. Real-Life Problems on Perimeter:

Problem 1:

- **Scenario:** A farmer wants to fence a rectangular plot of land that has a perimeter of 40 metres. If the length of the plot is 12 metres, what is the width?
- **Solution:** Use the perimeter formula for a rectangle, $P = 2 \times (\textit{length} + \textit{width})$, and solve for the width.
- **Calculation:**
  - $40 = 2 \times (12 + \textit{width})$
  - $20 = 12 + \textit{width}$
  - Width = 8 metres

Problem 2:

- **Scenario:** A school is planning to create a running track that is shaped like a triangle. The perimeter of the track is 50 metres. If one side of the triangle is 20 metres and another side is 15 metres, how long is the remaining side?
- **Solution:** Add the given sides and subtract from the total perimeter.
- **Calculation:**
  - Remaining side=50−(20+15) metres

- Remaining side=50−35=15 metres.

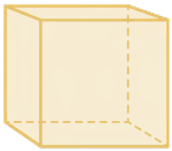
5. Reflection and Application:

- Discuss how understanding perimeter helps in real-life situations, such as planning fencing, designing layouts, and more.
- Think about other situations where knowing the perimeter is essential.

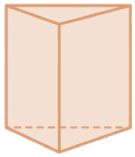
REVIEW QUESTIONS

Review Questions 4.1

1. Identify and name the following 3D shapes.

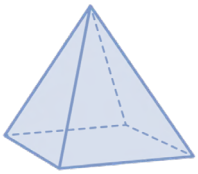


A



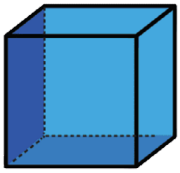
B

C



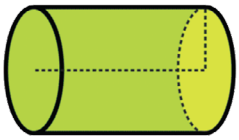
D

2. Identify the 3D shape in the following objects.

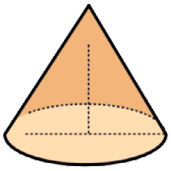


A

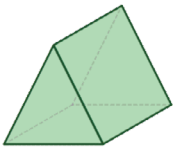
B



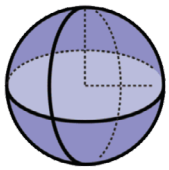
C



D



E



F

G

H

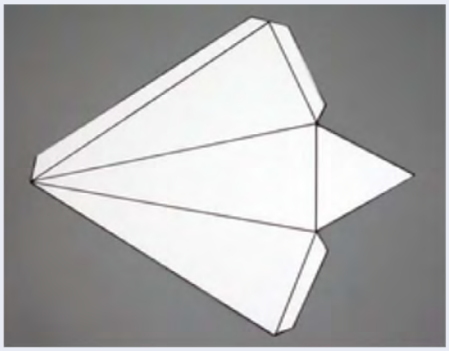
I

J

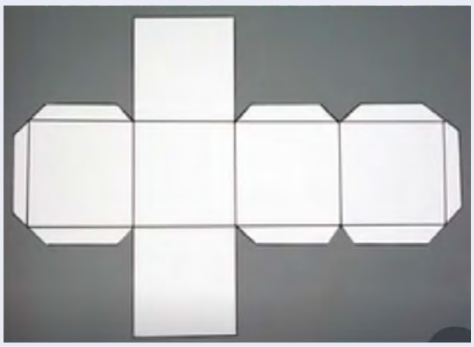
K

L

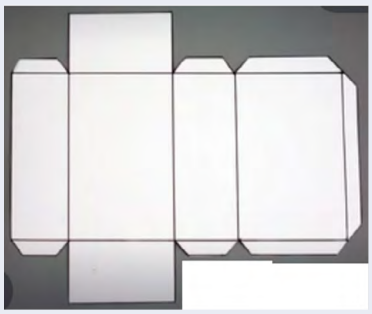
3. Identify the 3D shapes that have these nets.



A



B

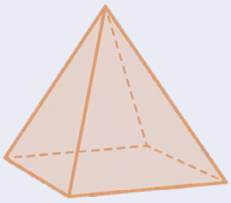


C

D

4. For each of the following 3D shapes, identify the faces, edges and vertices where applicable.

A



B

C

5. Complete the table below by filling in the number of sides, angles, and lines of symmetry for each shape.

Shape	Sides	Angles	Lines of Symmetry
Square			
Rectangle			
Equilateral Triangle			
Circle			

Shape	Sides	Angles	Lines of Symmetry
Regular Pentagon			
Regular Octagon			
Regular Nonagon			

Hints:

- **Sides**: Line segments forming the boundary of the shape.
- **Angles**: The corners where sides meet.
- **Lines of Symmetry**: Imaginary lines that divide the shape into two identical parts.

6. Complete the table below by filling in the number of vertices, edges, faces and base shapes for each shape.

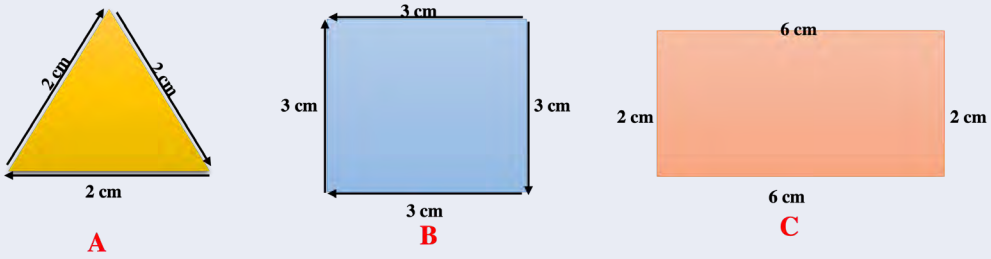
Shape	Vertices	Edges	Faces	Base Shape
Triangular Prism				
Square Prism				
Rectangular Prism				
Triangular Pyramid				
Square Pyramid				
Rectangular Pyramid				

Hints:

- **Vertices**: Points where edges meet.
- **Edges**: Line segments between vertices.
- **Faces**: Flat surfaces of the shape.
- **Base Shape**: The shape of the base of the prism or pyramid.

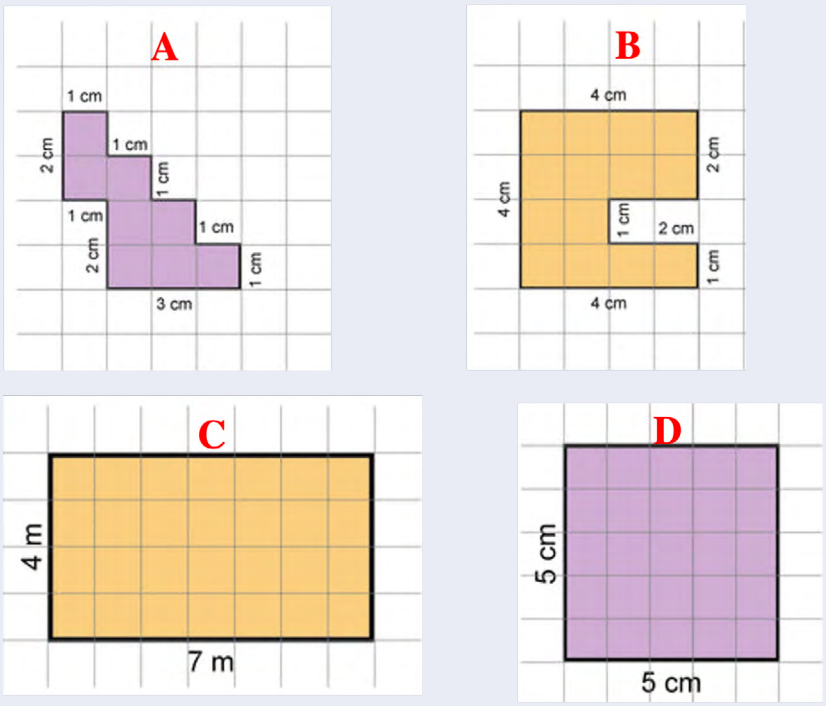
Review Questions 4.2

1. Determine the perimeter of the following shapes.

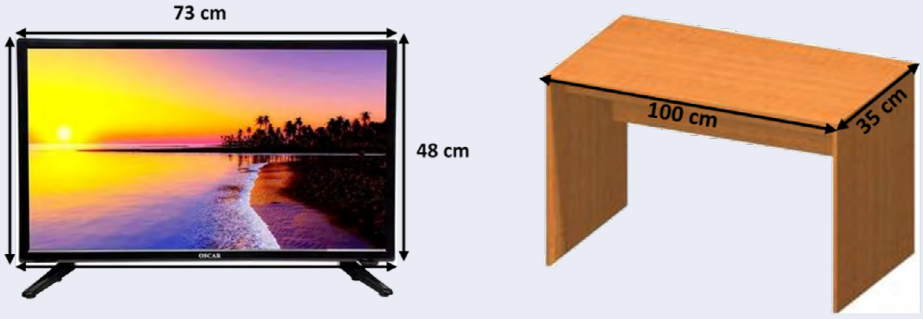


A B C

2. Determine the perimeter of the following shapes drawn of the grid.



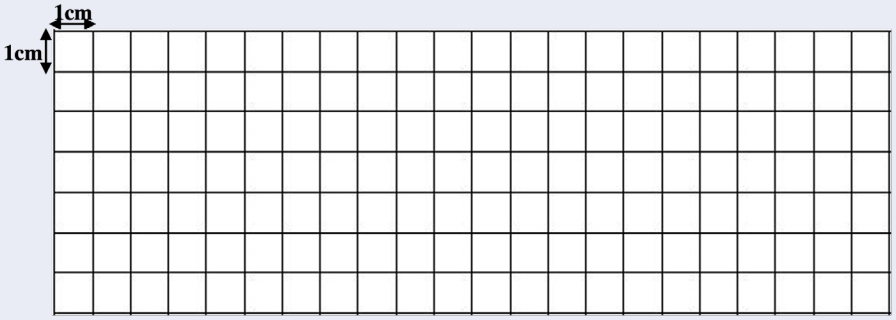
3. Determine the perimeter of the following objects.



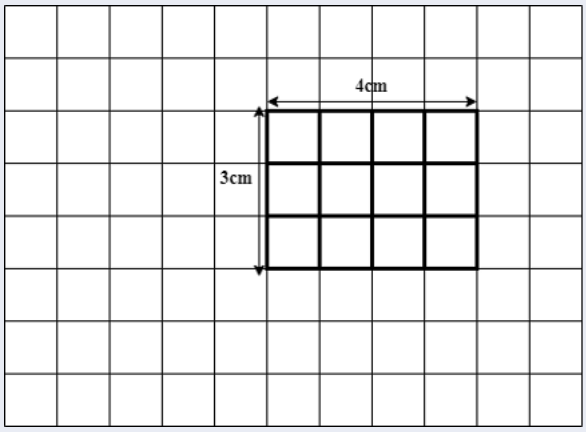
A B

Review Questions 4.3

1. Draw three different shapes each with the same perimeter of 22 cm.



2. Carefully observe the rectangle on the square grid. Draw another rectangle that has the same perimeter but with different side lengths.



3. Find the perimeter of the following shapes.

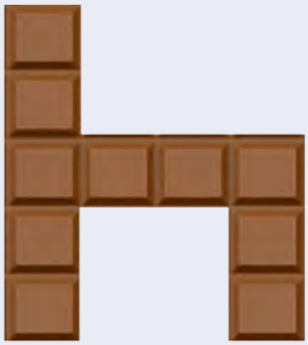
A

B (a square)

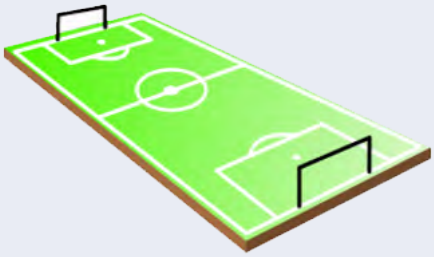
C (a square)

D

4. Mark has a chocolate bar in the shape of a letter h. What is the perimeter of the chocolate bar if the length of one piece of chocolate is 1cm?



5. A school built a football field with length of 70 m and a width of 35 m. They will need to draw the boundaries of the field and centre line. What length of line they will need to paint?



6. It is a festive holiday and Larley wants to put lights around her TV. Look at the measurements of the TV.

What length of lights does she need?

ANSWERS TO REVIEW QUESTIONS

Review Answers 4.1

1.

3D shape	Identified	Name
A	Prism	Cube (Square Prism)
B	Prism	Triangular Prism
C	Prism	Cylinder (Circular Prism)
D	Pyramid	Rectangular Pyramid

2.

Objects	3D shapes
A	Square prism (cube)
B	Rectangular prism (cuboid)
C	Cylinder
D	Cone
E	Triangular prism
F	Sphere
G	Rectangular prism
H	Square prism (cube)
I	sphere
J	Cylinder
K	Cone
L	Triangular pyramid

3.

Net	3D shape
A	Triangular pyramid
B	Cube (Square Prism)
C	Cuboid (Rectangular Prism)
D	Square Pyramid

4.

Shape	Edges	Faces	Vertices
Cuboid	12	6	8
Square based pyramid	8	5	5
Cylinder	2	3	0

5.

Shape	Sides	Angles	Lines of Symmetry
Square	4	4	4
Rectangle	4	4	2
Equilateral Triangle	3	3	3
Circle	0	Indefinite (Many)	Indefinite (Many)
Regular Pentagon	5	5	5
Regular Octagon	8	8	8
Regular Nonagon	9	9	9

6.

Shape	Vertices	Edges	Faces	Base Shape
Triangular Prism	6	9	5	Triangle
Square Prism (= Cube)	8	12	6	Square
Rectangular Prism (= Cuboid)	8	12	6	Rectangle
Triangular Pyramid	4	6	4	Triangle
Square Pyramid	5	8	5	Square
Rectangular Pyramid	5	8	5	Rectangle

Answers to Review Questions 4.2

1. **a.** 6cm

b. 12cm

c. 16cm

2. **a.** 16cm

b. 20cm

c. 22m

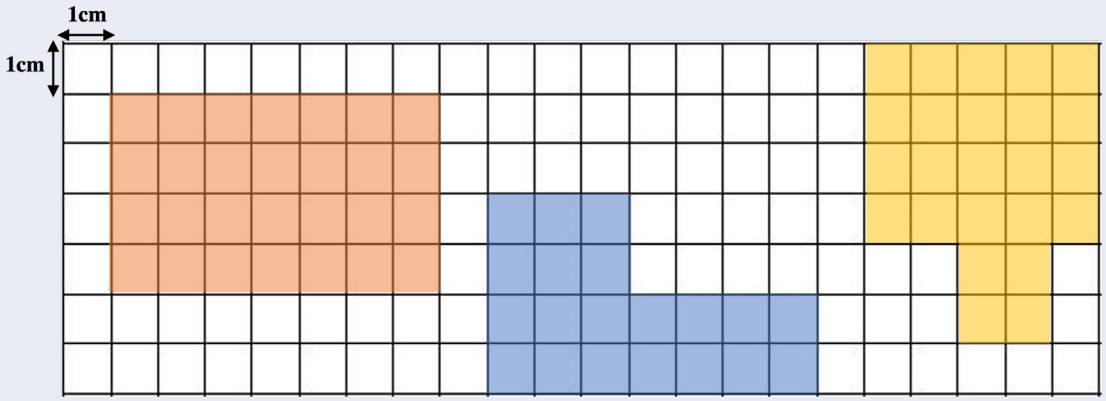
d. 20cm

3. **a.** 242cm

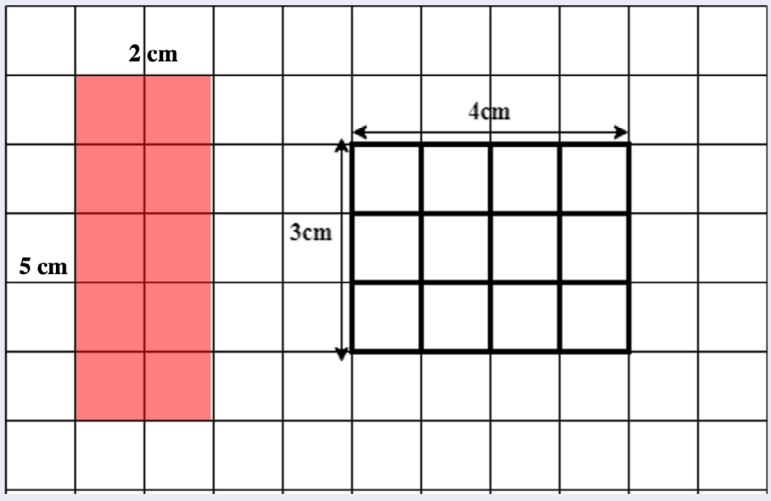
b. 270cm

Answers to Review Questions 4.3

1. For example:



2. For example:



3. **a.** 22 cm

b. 20 cm

c. 36cm

d. 40 cm

4. 22 cm

5. 210 m round the edge, + 35 m for the centre line = 245m

6. 1600 cm

ACKNOWLEDGEMENTS

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