

DESIGN YOUR OWN FURNITURE (LEVEL 3)

Description	Learners will create models of furniture items that their home needs. They will do so using the concepts of 2D and 3D shapes, measurements, and scaling.
Leading question	How can I design the furniture that my home needs?
Subjects covered	Math, Art, English
Total time required	40-60 min a day for 4 days
Resources required	Paper, ruler, pencils, glue/ tape, colours, cardboard (<i>optional</i>)
Learning outcomes:	<p>By the end of this project, learners will be able to:</p> <p>Knowledge-Based Outcomes:</p> <ol style="list-style-type: none"> 1. Identify common 2D shapes (square, rectangle, circle, triangle) 2. Describe objects in the environment using names of shapes. 3. Identify common 3D shapes (cube, cuboid, cylinder, cone, prism, pyramid) 4. Compare 2D and 3D shapes. <p>21st Century Skill Outcomes:</p> <ol style="list-style-type: none"> 1. Think creatively while drawing the furniture design and making the model. 2. Communicate effectively while presenting your furniture model to your family. 3. Think critically while calculating the required dimensions of the furniture.
Previous Learning	Adding whole numbers Multiplying fractions
Supervision required	Medium

Day 1 -

Today, you will find out the furniture requirements for your home and use 2D shapes to think about your design.

Time	Activity and Description
5 minutes	<p>Introduction</p> <ul style="list-style-type: none"> - Does your home have enough furniture (tables/ chairs/ cupboards etc)? - What problems do you notice at your home that can be solved using furniture?


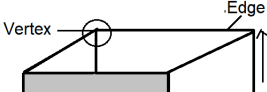


	<p>The leading question we will answer in this project is: How can I design furniture that my school needs? To answer this question:</p> <ul style="list-style-type: none"> - We will choose an area in our home and design a furniture item that it needs. - We will then make models of these furniture items!
10 minutes	<p>Deciding the Furniture Item Think about one area at your home.</p> <ul style="list-style-type: none"> - Identify one need or problem that you can take care of by adding a furniture item to the space. - Decide what furniture item you will design to solve the problem.
10 minutes	<p>Introduction to 2D Shapes <i>Note: Show learners a furniture item and photographs of some other furniture items (Appendix 1). For each item, ask them to think about:</i></p> <ul style="list-style-type: none"> - What material it is made of. - How they think the material looked before it became furniture. - How they think the material was changed into furniture. <p>To build furniture, material such as wood, plastic or metal, is first made into various shapes. These shapes are then fixed together to make furniture.</p> <div data-bbox="418 911 1419 1129" data-label="Image"> </div> <p>To make models of our own furniture, we need to first learn about the different shapes into which we can cut the material.</p> <p>Let us start with flat shapes!</p> <p>Flat shapes can be drawn on paper.</p> <ul style="list-style-type: none"> - They have two dimensions, which is why they are also called 2D shapes: <ul style="list-style-type: none"> - Length, which shows how long it is. - Breadth, which shows how wide or broad. - 2D shapes may have <ul style="list-style-type: none"> - sides, which are flat lines; and - vertices (singular: vertex), which are points at which two sides meet and form an angle. <div data-bbox="954 1184 1455 1390" data-label="Image"> </div>
10 minutes	<p>Types of 2D Shapes <i>Note: Ask learners to observe the furniture item again and draw all the flat shapes that they can notice in it. Add shapes from the shown image (printable format to record features in Appendix 2).</i></p> <div data-bbox="1263 1717 1451 1835" data-label="Image"> </div>

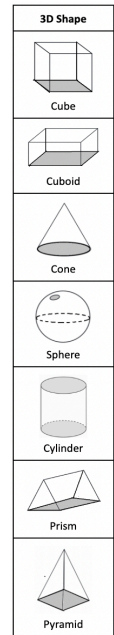
	<p>For each 2D shape,</p> <ul style="list-style-type: none"> - mark the sides and vertices. - write any 1 feature that they notice. <p>Let us summarise the features of these shapes:</p> <ul style="list-style-type: none"> - A square is a four-sided shape with all sides of equal length and four right angles. - A rectangle is a four-sided shape with opposite sides of equal length and four right angles. - A triangle is a three-sided shape with three angles. - A circle is a shape with no sides or angles; it's a round, curved shape. - A pentagon is a shape with five sides ('penta' means five). Pentagons with equal sides are called regular pentagons. - A hexagon is a shape with six sides ('hexa' means six). Hexagons with equal sides are called regular hexagons. - An octagon is a shape with eight sides ('octa' means eight). Octagons with equal sides are called regular octagons. <p><i>Tip: To challenge learners, ask them to draw a 2D shape with (a) 5 and 6 sides each, and (b) 1 side but no vertices.</i></p>
At-home activities	Use 2D shapes to draw the furniture item you decided to design.

Day 2

Today, you will use 3D shapes to finish designing your furniture.

Time	Activity and Description
10 minutes	<p>Finalising 2D Designs</p> <p>In your 2D designs include these aspects:</p> <ul style="list-style-type: none"> - the dimensions of the furniture (length and width). - the measure of angles used in the design. 
15 minutes	<p>Introduction to 3D Shapes</p> <p>How would you change your designs into real furniture?</p> <p>Our furniture designs are two-dimensional. However, the furniture model that we will make will be three-dimensional.</p> <ul style="list-style-type: none"> - This means that it will have one more dimension - depth or thickness. - Shapes that have three dimensions are called solid or 3D shapes. Let us learn about such shapes so that we can use them to make our designs more accurate! <p>Note: As shown, using the example of a cube, explain that:</p> <ul style="list-style-type: none"> - 3D or solid shapes have three dimensions: <ul style="list-style-type: none"> - Length, which shows how long it is. 

	<ul style="list-style-type: none"> - Breadth, which shows how broad or wide it is. - Height or Depth, which shows how tall or thick it is. - 3D shapes may have <ul style="list-style-type: none"> - Faces, which are flat surfaces; - Edges, which are lines at which 2 faces meet; and - Vertices, which are points at which 3 edges meet.
15 minutes	<p>Types of 3D Shapes</p> <p>Now that you know what 3D shapes are:</p> <ul style="list-style-type: none"> - Draw at least 3 3D shapes that they will need to make their models. - Label the vertices, faces and edges on it. - Write 1-2 features of each shape. <p>Note: Once done, the teacher introduces the names of different 3D shapes and summarises their descriptions:</p> <ul style="list-style-type: none"> - A cuboid has 6 faces, 12 edges, and 8 vertices. All the faces are rectangles. The opposite faces are always the same size. - A cone has 1 face, 1 edge, and 0 vertices. The face is a circle and it also has a curved surface. - A sphere has 0 faces, 0 edges, and 0 vertices. It has a curved surface. All points on its surface are the same length from the centre. - A cylinder has 2 faces, 2 edges, and 0 vertices. The faces are circles and it also has a curved surface. - A prism has 5 faces, 9 edges and 6 vertices. 2 of its faces are triangles and 3 are rectangles. - A pyramid has 5 faces, 8 edges, and 5 vertices. One face is a square and the others are triangles. <p>Tip: To challenge learners, ask them to answer these questions:</p> <ul style="list-style-type: none"> - Is paper rectangular or actually cuboidal? Why? - Is a pizza circular or actually cylindrical? Why? - Can you think of any objects that are purely rectangular or circular?
At-home activities	<ul style="list-style-type: none"> - Sketch 3D versions of your 2D designs and list what shapes you will put together to make your models. - Measure the dimensions of the space (length, breadth and height) in which you will keep the furniture.



Day 3 –

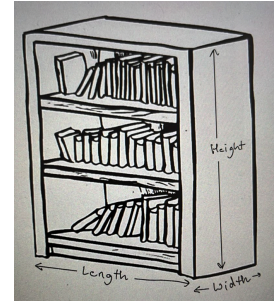
Today, you will calculate the dimensions of your furniture items.

Time	Activity and Description
20 minutes	<p>External Dimensions</p> <p>What should be the length, width and height of your furniture? How will you decide this?</p>

The furniture must fit within the space where it will be kept. Therefore, the available space will decide how big or small the furniture will be.

Note: If needed, explain to the learners how to calculate the external dimensions of a bookshelf using the example shown below.

Length	Breadth	Height
Space available along the wall = 4 m	Space available between the wall and the door = 1 m	Space available between the floor and the ceiling = 3 m
Maximum Length = 2 m = 200 cm (to allow space to walk)	Maximum Breadth = 1 m = 100 cm	Maximum Height = 1.5 m = 150 cm (to reach books easily)



20 minutes

Calculating Dimensions of Individual Parts

Is knowing the length, width and height of your furniture model enough to start making the model?
What other measurements do you need?

To make furniture, the material is first cut into parts and then put together. Therefore, the dimensions of each part need to be calculated.

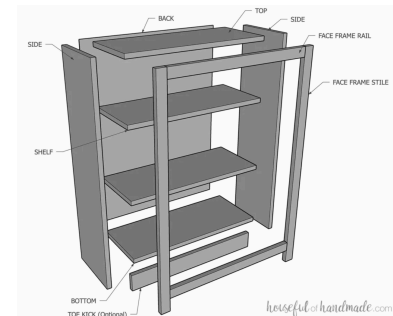
List all the parts that you will need to make for your models.

Tip: If needed, use the shown example of the bookshelf to explain how to identify individual parts.

Now that you have identified each part of your furniture item, how will you calculate their dimensions?

Note: Encourage learners to try and calculate the dimensions of 1 or 2 parts first. Ask them to take the thickness of wood as 5 cm.

- Use the example of a bookshelf to explain how to calculate the dimension of each part, as shown below.
- Once done, remind learners to keep in mind the dimensions of the space in which they will store the furniture. The length, width and height of the furniture should be less than or equal to it.



Part	Length	Width	Height
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	Back	200 cm (= length of furniture)	5 cm (= thickness of wood)	150 cm (= height of furniture)
	Side	150 cm (= height of furniture)	5 cm (= thickness of wood)	100 cm (= width of furniture)
	Top	200 cm - 2 x 5 cm (= length of furniture - 2 x thickness of wood) = 190 cm	100 cm (= width of furniture)	5 cm (= thickness of wood)
	Bottom	200 cm - 2 x 5 cm (= length of furniture - 2 x thickness of wood) = 190 cm	100 cm (= width of furniture)	5 cm (= thickness of wood)
	Shelf	200 cm - 2 x 5 cm (= length of furniture - 2 x thickness of wood) = 190 cm	100 cm (= width of furniture)	5 cm (= thickness of wood)
At-home activities	<ul style="list-style-type: none"> - If possible, visit a carpenter, show them your calculations, and ask for any feedback that they may have. - Invite your family to participate in your presentation in the next class! 			

Day 4 –

Today, you will make your models and present them to your family.

Time	Activity and Description
25 minutes	<p>Making Furniture Models</p> <p>Today we will make small models of our furniture item and present them to our family! Your model should be small enough to sit on the top of a textbook.</p> <p>To do this:</p> <ul style="list-style-type: none"> - First, assemble the 3D shapes you created on Day 2. - Then, make any additional 3D shapes that you may have missed making on Day 2. <p>Note: Encourage learners to think and do this on their own, but if needed, use Appendix 3 to explain to learners how to make any 3D shapes they may struggle with.</p> <ul style="list-style-type: none"> - After that, stick them with glue/ tape to finalise the models. - Finally, if time permits, decorate your models using colours, and add more details such as doorknobs etc.



10 minutes	<p>Presentation</p> <p>Present your furniture models to your family! As you do that, cover the following pointers:</p> <ul style="list-style-type: none"> - What is the purpose of the furniture? - What need or problem will the furniture item take care of? - How did they calculate the dimensions? - Why they have designed it this way? - What material will be used to design the furniture? Why have they chosen this material?
5 minutes	<p>Reflection</p> <p>Now that we have completed the project, let us think about our experience. Think and share:</p> <ul style="list-style-type: none"> -

Additional enrichment activities:	<ul style="list-style-type: none"> - Learners can calculate the cost of constructing their furniture item based on the cost of raw materials (for example, wood at \$25 for a 1m x 1m plank) - Learners can scale down the dimensions of individual parts to calculate the dimensions of each part for their model, ensuring it fits length-wise on an A4-sized sheet of paper. For example, in the case of the example of a bookshelf used in the plan: <ul style="list-style-type: none"> - Original length of bookshelf = 200 cm - Scaled down the length of bookshelf = 30 cm (length of A4-sized sheet) - Fraction of the original length = $30/200 = 3/20$ - Scaled down width of bookshelf = $100 \times 3/20 = 15$ cm - Scaled down the height of bookshelf = $150 \times 3/20 = 22.5$ cm - Learners can optimise the design of the furniture to increase its capacity. <ul style="list-style-type: none"> - They can first calculate its current capacity. For reference: In case of the example of a bookshelf used in the plan: <table border="1" style="margin-left: auto; margin-right: auto; text-align: center;"> <thead> <tr> <th>Length of Each Shelf</th> <th>Width of Each Book</th> <th>Total Books Per Shelf</th> </tr> </thead> <tbody> <tr> <td>190 cm</td> <td>10 cm</td> <td>$190/10 = 19$ books</td> </tr> </tbody> </table> <ul style="list-style-type: none"> - Total books = Total Books Per Shelf x No. of Shelves = $19 \times 3 = 51$ - They can then think of ways to increase its capacity and calculate the revised capacity. For reference: In the case of the example of a bookshelf used in the plan, making vertical sections, and arranging books on top of each other may increase the capacity of the furniture. 	Length of Each Shelf	Width of Each Book	Total Books Per Shelf	190 cm	10 cm	$190/10 = 19$ books
Length of Each Shelf	Width of Each Book	Total Books Per Shelf					
190 cm	10 cm	$190/10 = 19$ books					
Modifications for simplification	<p>Calculating dimensions of individual parts can be skipped, and learners can directly make small models of the furniture item they design.</p>						

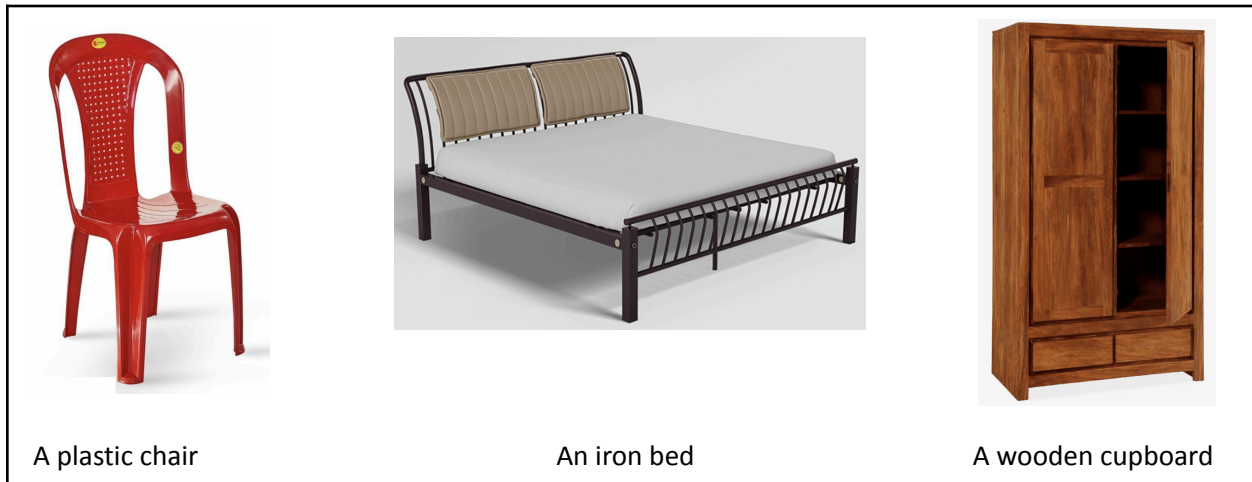
ASSESSMENT CRITERIA

A majority of my learners were able to:

- Use at least 2 2D and 3D shapes to design a furniture item.
- Add lengths to calculate the dimensions of the furniture item and its parts.
- Make 1 furniture model based on their designs and scaled-down dimensions.

APPENDIX 1

Examples of Furniture Items




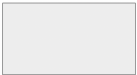

A plastic chair


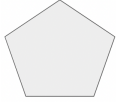
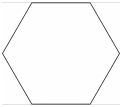
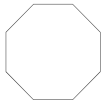
An iron bed

A wooden cupboard

APPENDIX 2

Describing 2D Shapes

2D Shape	No. of Sides	No. of Vertices	Features
 Square			
 Rectangle			
 Triangle			

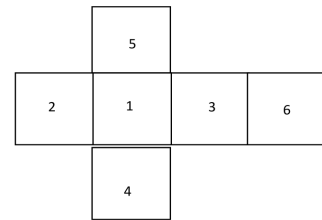
 Circle			
 Pentagon			
 Hexagon			
 Octagon			

APPENDIX 3

Making 3D Shapes

- **Cube:** First, draw six squares in this shape on a piece of paper then cut out the entire shape.

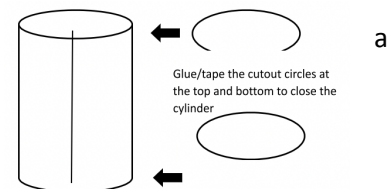
- Keep Square 1 down and fold up squares 2, 3, 4, and 5.
- Bring up Square 6 to close the cube.



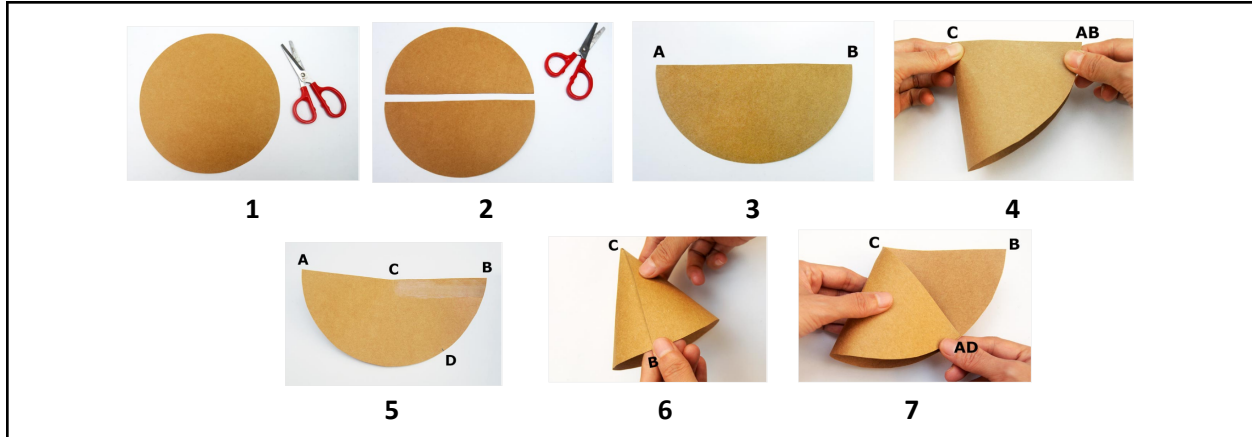
- **Cuboid:** First, draw six rectangles in the same shape as for the cube, and cut out the entire shape. Then repeat the instructions from the cube.

- **Cylinder:**

- Cut out the piece of paper you want to use to make cylinder for your furniture.
- Roll the paper so both ends meet.
- Cut out the circles and tape or glue them onto the top and bottom parts of the cylinder.

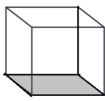
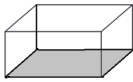

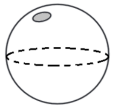
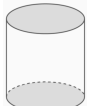


- **Cone:** Draw a circle on a piece of paper, then follow the instructions below:



APPENDIX 4

Describing 3D Shapes

3D Shape	No. of Faces	No. of Edges	No. of Vertices	Features
 Cube				
 Cuboid				
 Cone				
 Sphere				
 Cylinder				

 Prism				
 Pyramid				