<div align="center">**Vision Empower & XRCVC**

Teacher Instruction KIT

Visualizing Solid Shapes</div>

Syllabus: Karnataka State Board
Subject: Mathematics
Grade: 7
Textbook Name: Text cum Workbook (Revised) – Seventh standard
Chapter Number & Name: 15.Visualising Solid Shapes

1. OVERVIEW

1.1 OBJECTIVE & PREREQUISITES

Objective
- Will be able to classify figures into plane and solid figures in terms of its dimension.

Prerequisite Concept
- Solid shapes

  TIK_MATH_G4 _CH18_Solids
  TIK_MATH_G5 _CH19_Three dimensional figures

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*Kindly Note: Activities marked with * are mandatory*

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2. LEARN

2.1 KEY POINTS
- o   Dimensions
- o   Planes
- o   Solids
- o   Edges
- o   Vertices
- o   Faces

2.2 LEARN MORE

3. ENGAGE

3.1 INTEREST GENERATION ACTIVITY

2 dimensional figure for 3dimensional objects
Activity 1: To draw 2 dimensional figure (2D) for 3dimensional objects (3D)
Materials required: Geometry kit, parchment paper, push pins, clay, book, bottle, geometry box, ball, plate
Prerequisites: Construction of basic shapes

Activity Flow

i. Hand the students the following objects one after another. And ask them to name and describe them; book, bottle, geometry box, ball, plate.
ii. Place these 3D shapes on the table and then ask the students to use their index finger to trace the outline of the top view.
iii. Ask them if they had to draw it on parchment paper, what shapes would they draw.
iv. Repeat the steps 2 and 3 for side view
iii. Ask them to create solid shapes using clay.

3.2 CONCEPT INTRODUCTION ACTIVITIES

Plane figures and Solid shapes
Activity 2: Introduction - Plane figures and Solid shapes
Materials required: Circular bindi, tactile diagram of front view of cone, tactile diagram of rectangle and tactile diagram of cylinder. Ball, ice cream cone, empty bottle and match box, empty match box/lunch box/cardboard box/birthday cap and solid cube, cuboids, cone
Prerequisites: Construction of plane figures

Activity Flow

Give the students the following and let them explore the pairs. And then,
a)ball and circular bindi,
b)ice cream cone and tactile diagram of front view of cone,
c)matchbox and tactile diagram of rectangle,
d)empty water bottle and tactile diagram of cylinder.
Ask the students the difference between the paired objects.
Give them the clue for the first one.

After the activity, explain to them that the circular bindi and tactile diagrams of the cone, rectangle and cylinder have only length and width and are called two dimensional shapes. But the ball, ice cream cone, empty bottle and match box also has height along with length and width. Therefore these are called 3 dimensional figures or solid figures.
Explain to them that figures drawn on paper which have only length and breadth are called two dimensional or plane figures.
Ask the student to list a few examples of 3D shapes and to draw 2D shapes of them.
Demonstrate solid 3D objects as well as hollow 3D objects with lids. Explain to the student the difference between solid and hollow objects.
Example:
Hollow (empty) objects, match box/lunch box/cardboard box/birthday cap.
solid objects, cube, cuboids, cone

Faces, Edges and Vertices
Activity 3: Faces, Edges and Vertices
Materials required: Cube, cone, cylinder, sphere, pyramid, building blocks/clay, geometry kit, parchment paper, push pins
Prerequisites: Construct square

Activity Flow

Hand the 3D cube shape to everyone and ask them the number of corners, surfaces and line segments it has.

I.e., the 8 corners of the cube are its vertices. The 12 line segments that form the skeleton of the cube are its edges. The 6 flat square surfaces that are the skin of the cube are its faces. Also discuss what will disappear if they draw a 2D cube which is square on parchment paper. Make sure the student is holding the correct shape when you are explaining it. Guide them to the correct part, like edge or vertex or face when you are talking about that.

Similarly, give them a cone, cylinder, sphere, pyramid and ask for the number of vertices, faces and edges.

If needed, make the student build the shapes using clay/playdough/sticks.

Nets for building 3D shapes

Activity 4: Nets for building 3D shapes

Materials required: Nets of cube, cylinder, cone, pyramid and cuboid
Prerequisites: To fold the cut outs

Activity Flow

A net is a sort of skeleton-outline in 2-D,which, when folded, results in a 3-D shape.

First give them a solid shape for every net of its respective shapes. Let them explore the solid shape then hand over its net. Ask the students to make a fold such that it should form the respective solid shape.

In the beginning the teacher can help with one as an example.

When folding paper cut outs, orient the student to the cut out before you start folding. And use hand over hand technique to guide and assist the student while they are folding. Do not fold the net and give a final object to the student. Make sure the student is also folding so as to enhance the understanding of 3D geometry and how shapes can be formed. If you make some tactile markings on the lines on the paper cutout that align to form edges on the 3D object, then you can describe this to the student, thus giving them an idea of what is about to happen before you start folding. This will make the understanding of the concept more holistic.

Oblique sketches

Activity 5: Oblique sketches

Materials required: 4 tactile diagrams of oblique sketch of a cube in steps on a plane paper.
Prerequisites: Construct shapes, lines

Activity Flow

In this sketch we will see that in the drawn picture, the lengths are not equal, as they should be in a cube. Still, we are able to recognize it as a cube. Such a sketch of a solid is called an oblique sketch.

Show them the tactile diagram of the square with an oblique sketch in steps to be followed to draw the square. Later ask them to draw it on parchment paper step by step.

Step 1: Draw the front face
Step 2: Draw the opposite face. Sizes of the faces have to be the same, but the sketch is somewhat off- set from step 1.
Step 3: Join the corresponding corners
Step 4: Redraw for hidden edges

In the oblique sketch,
  (i)   The sizes of the front faces and its opposite are same; and
  (ii)   The edges, which are all equal in a cube, appear so in the sketch, though the actual measures of edges are not taken so. We could now try to make an oblique sketch of a cuboid (remember the faces in this case are rectangles)

Isometric sketches
Activity 6: Isometric sketches
Materials required: 4 tactile diagrams of isometric sketch of a cuboid in steps on a plain paper, geometry kit, parchment paper, push pins
Prerequisites: Construct shape

Activity Flow

In this type of sketch we can draw sketches in which measurements also agree with those of a given solid.
For isometric sketches we need to use isometric dot sheets. It would be difficult to draw lines of dots on a dot sheet. Hence we will use the parchment paper to draw sketches in which measurements also agree with those of the solid.
Let us look at the steps to draw an isometric sketch of a cuboid of dimensions $4 \times 3 \times 3$ (which means the edges forming length, breadth and height are 4, 3, 3 units respectively). And simultaneously show them the respective tactile diagram of isometric sketch of cuboid on a plain paper with its respective steps. Later ask them to draw it on parchment paper.
Step 1: Draw a rectangle of length 4 cm and height 3cm to show this as the front face.
Step 2: Draw four line segments of length 3cm down from each vertex starting from the four corners of the rectangle.
Step 3: Connect the corners with appropriate line segments.
Step 4: This is an isometric sketch of the cuboid.

Visualizing solid objects
Activity 7: Visualizing solid objects
Materials required: 3D prints of combined cubes, combined cuboids, Lego blocks
Prerequisites: To arrange to form random solid shape

Activity Flow

Give them the different 3D prints of combined cubes, combined cuboids to figure out the number of cubes, cuboids.
This can also be done through Lego blocks. Take a few Lego blocks and arrange them one over the other and next to each other such that it forms some random solid shape in which they need to find the number of cubes or cuboids.
This can be played between two groups in a class. Where both the groups will get their alternative turns to make a solid shape using Lego blocks so that the other group should guess the number of cubes in it after looking at it and vice versa. Whichever group gets the more guesses right wins.

Example: If two cubes of dimensions 2 cm by 2cm by 2cm are placed side by side, what would the dimensions of the resulting cuboids be?
Solution: When kept side by side, the length is the only measurement which increases; it becomes 2 + 2 = 4 cm. The breadth = 2 cm and the height = 2 cm

Viewing different sections of a solid
Activity 8: One way to view an object is by cutting or slicing
Materials required: Clay, a butter knife/ paper cutter
Prerequisites: None

Activity Flow

Start with the following examples
1. *Slicing a loaf of bread. It is like a cuboid with a square face. When we give a vertical cut. We get several pieces. Each face of the piece is a square. We call this face a cross section of the whole bread.*
2. *Slicing a spherical tomato, onion and potato we get a circular slice*
3. *A cube of cheese gives us a square or rectangular slice*

Also ask the students to give examples for slicing and discuss the difference of solid shape before slicing and after slicing the shape of slice.
As we saw in the first example, the loaf of bread was in cuboid shape but each slice looked square.

Also make the student make some clay models of 3D shapes (cube, cuboid, cone, pyramid, sphere) using a butter knife/ paper cutter then cut along an axis then ask the student to describe the resultant cross sectional shape.

Using this as an example, define and describe a cross section and then proceed to giving examples as well as posing some questions to encourage the child to build their own mental image of cross sections.

Another way is by shadow play
Activity 9: Another way is by shadow play
Materials required: Torch, 3D shapes (sphere, cube, pyramid, cuboid and cone)
Prerequisites: 2D shapes

Activity Flow

Explain to the students that another way of looking at solids is by shadow play. When we keep torchlight, right in front of any cone will get a shadow of a triangle which is 2D of cone. Similarly, ask the students for a sphere, cube, cuboid. I.e., the shadow of the sphere will be circle, square for cube, rectangle for cuboid.

A third way is by looking at it from certain angles to get different views
Activity 10: A third way is by looking at it from certain angles to get different views
Materials required: Model of house, car and geometry box
Prerequisites: Construct shapes

Activity Flow

One can look at an object standing in front of it or by the side of it or from above. Each time one will get a different view.
Example: Give them the model of house and ask them to draw its front view, side view and top view on parchment paper.
Similarly, do it for car, geometry boxes.
Also, ask them to make a 3D model using clay and draw its front view, side view and top view on a parchment paper.

3.3 LET'S DISCUSS: RELATE TO DAILY LIFE*
Any object that occupies space is called a solid shape or 3-dimensional object. The phrase 3-dimensional is justified by each object having 3 dimensions: length, width, and height. Some examples of solid shapes are:
- Cone
- Pyramid
- Cube
- Cuboid
- Sphere
- Hemisphere

- Cylinder
- Prism

Cones in Real Life

Here are some examples of cones in daily life:
- Ice cream cone
- Funnel
- Christmas tree
- Traffic cone
- Waffle cone
- Megaphone
- Party hat
- Volcano

Pyramid in Real Life

Here are some examples of pyramids in daily life:
- Pyramids of Giza
- In Architecture, on top of clock towers.
- Roofs of houses
- On acupressure objects

Cuboid in Real Life

Here are some examples of cuboids in daily life:
- The lunch box
- Cubicles
- Shoebox
- Book
- Carton boxes
- Bricks
- Mattresses
- Cabinet
- Microwave or Oven
- Fridge
- Mobile Phone
- Washing machine

Sphere in Real Life

Here are some examples of spheres in daily life:
- Ball
- Planets
- Sun

- Moon
- Stars
- Orange
- Marbles
- Eyeball

Hemisphere in Real Life

Here are some examples of spheres in daily life:
- Bowls
- Human brain
- Headphones
- Igloo - a type of dome-shaped shelter built from blocks of solid snow
- Domes in architecture

Cylinder in Real Life

Here are some examples of cylinders in daily life:
- Pipes
- Beaker
- Cold drink cans
- Battery
- Water tanks
- Gas cylinder
- Candle
- Fire extinguisher
- Test tube

4. EXERCISES & REINFORCEMENT
4.1 EXERCISES & REINFORCEMENT

Practice and Recall
Activity 11: Exercise problems
Materials required: Geometry kit, parchment paper, push pins
Prerequisites: Construct shapes

Activity Flow

Help the students to solve the following problems in the class itself.
1. The dimensions of a cuboid are 5 cm, 3 cm and 2 cm. Draw three different isometric sketches of this cuboid.

2. Three cubes each with 2 cm edge are placed side by side to form a cuboid. Sketch an oblique or isometric sketch of this cuboid.

3. Give (i) an oblique sketch and (ii) an isometric sketch for each of the following: (a) A cuboid of dimensions 5 cm, 3 cm and 2 cm. (Is your sketch unique?) (b) A cube with an edge 4 cm long

4. What cross-sections do you get when you give a (i) vertical cut (ii) horizontal cut to the following solids?

(a) A brick

(b) A round apple

(c) A dice

(d) A circular pipe

(e) An ice cream cone

5. Examine if the following are true statements:

(i) The cube can cast a shadow in the shape of a rectangle.

(ii) The cube can cast a shadow in the shape of a hexagon.

4.2 IMPORTANT GUIDELINES*

Exercise Reading

It is very important that the children practice their learnings as well as their reading. Hence have the children read out the newly learned concepts from their textbooks or other available resources.

Perform Textbook Activity

It is good practice to have the children perform the textbook activities. Your textbook activities might not be accessible hence go through this resource to learn how to make textbook content accessible

Provide Homework

To evaluate their understanding and to help the student revise and implement the new learnt concept ensure to provide them with homework. Students should perform one or two of the questions mentioned above or from the textbook exercises with the teacher in Class and the remaining may be given for homework. Also, ensure that the student knows their special skills linked to independently using their accessible books as it will be critical to doing homework independently

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