

# TearOut

## Sketches and Views: Mapping 3D to 2D and vice versa

*In this 5th TearOut, we will use the isometric and the rectangular dot sheets to visualize various solid shapes. As before, pages 1 and 2 are a worksheet for students while pages 3 and 4 give guidelines to the facilitator. Since we will be exploring solids, it is a good idea to have some interlocking cubes<sup>1</sup> handy to make some of those solids.*

The first part involves matching the isometric sketches with the oblique ones and then drawing the front, top and side views of each solid. The second part does the reverse. You start with the views and make the solids and then draw the sketches for each one. You can refer to NCERT mathematics textbooks for Class 7, chapter 15<sup>2</sup>, for isometric and oblique sketches. Isometric sketches are made on isometric dot sheets while the oblique sketches are made on rectangular dot sheets.

### Part A

1. **Isometric and Oblique Sketches**
  - a. Match the isometric sketches with the oblique ones
  - b. Mention the side lengths in the oblique sketches
  - c. Draw the top, front and side view of each solid – the front is according to the oblique sketch
2. **(Optional) Make a solid with interlocking cubes**
  - a. Make the isometric sketch
  - b. Make the oblique sketch using the isometric sketch without looking at the solid
3. **(Optional) Make another solid with interlocking cubes**

	Isometric sketches	Oblique sketches
I		
II		
III		
IV		

<sup>2</sup> NCERT textbooks: <https://ncert.nic.in/textbook.php>

- a. Make the oblique sketch
- b. Make the isometric sketch using the oblique sketch without looking at the solid

**Part B**

4. Views and Sketches

- a. Make each of the following solids
- b. Draw the isometric sketch of each
- c. Draw the oblique sketch of each mentioning the side lengths

	Top view	Front view	Side view
I			
II			
III			
IV			

5. (Optional) Views to solids

- a. Take three  $3 \times 3$  spaces on a rectangular dot sheet (i.e. each space is a square of side 3 units) and shade at least 5 unit squares in each. Consider these shaded parts as the top, front and side views respectively.
- b. Using these views, make the solid with interlocking cubes.

*This TearOut can be considered a continuation of the last one since the focus is on developing spatial sense and visualising solid shapes. This worksheet combines oblique sketches of solids. These sketches maintain some of the side proportions and some of the angles but distorts the rest. In addition, front, top and side views of the solids are also explored. While top view is clear from both isometric and obliques sketches, the latter is better at defining the front view – the part without any distortion, where rectangular faces are preserved. Side and front views are interchangeable for isometric sketches.*

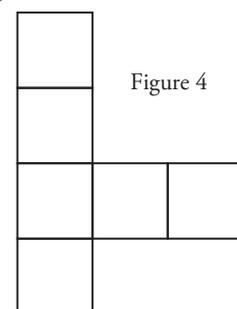
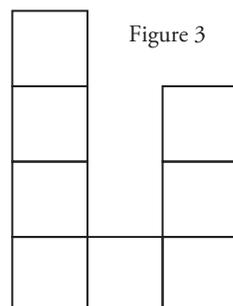
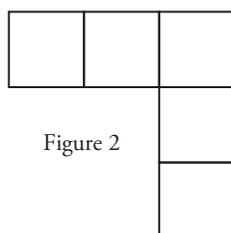
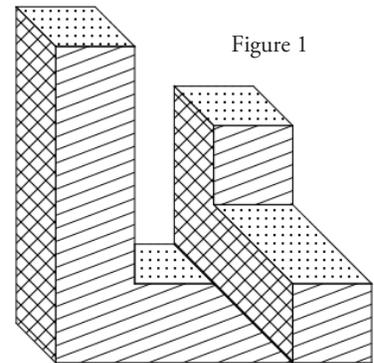
*(published in the Nov 2019 <https://azimpremjiuniversity.edu.in/SitePages/resources-ara-vol-8-no-5-november-2019-isometric-sketches-and-more.aspx>)*

## Part A

This part focuses on the sketches. The first question uses the sketches as the starting point while the remaining two use the solids to start off.

### 1. Isometric and Oblique Sketches:

- This is a simple matching task to assess understanding of the sketches.
- This task is to deepen the understanding of oblique sketches by focussing on the side-lengths. The horizontal and vertical lines are stretched by a factor of 2. So, a vertical or horizontal line that is 6 units long actually represents a length of 3 units for the solid. All oblique lines are at  $45^\circ$  angle with horizontal and vertical lines. These lines are stretched by a factor of  $\sqrt{2}$ . So, the smallest possible oblique line segment represents unit length for the solid.
- The last task requires focussing on different views. It may require imagining and rotating the solid. It can help to imagine a lamp above the solid and colouring/shading the parts that will be lit. These will form the top view. Similarly, the non-distorted parts enclosed by horizontal and vertical lines in the oblique sketch can be coloured/shaded differently. These form the front view. The remaining sides generate the side view. It may help to colour/shade them in another way. For example, in Figure 1,
  - The dotted parts correspond to the top view (Figure 2)
  - The hatched parts are without distortion and they correspond to the front view (Figure 3)
  - The remaining cross-hatched parts correspond to the side view (Figure 4)



Similar colouring/shading can be done with the isometric sketch also.

It is easier to figure out the views from the solid. But it is a good idea to ask children to figure it out just from the sketch or sketches. This will help them visualize the solid being considered and develop stronger spatial sense.

The remaining two problems can be done as group activities with minimum three children sitting in a circle or in groups of three each. Each child can have, say, 10 interlocking cubes. They can create a solid using these cubes (not necessarily all) and draw the isometric sketch of their solid. Then they pass this sketch (and not the solid) to the child on their right. Now each child has just the isometric sketch of a solid. They draw the oblique sketch of the solid based on its isometric sketch. Then both sketches are passed to next child on the right. Now, each child makes the solid with the help of the sketches. Finally, this solid is passed again to the right and it goes to the child who made the original solid. The two solids are compared to see if the task was completed successfully. The sequence of isometric sketch followed by oblique can be changed. Also, children can be asked to make the solid based on only one of the sketches.

We encourage the teacher to collect the sketches generated by the above activity since they can be used to create similar worksheets in future.

## Part B

### 4. Views and Sketches

- a. The first part is the most challenging where the solid has to be made based on the views. Each of the solids can be made with 10-12 cubes only.
  - b. Once the solids are made, the isometric sketches will follow. It is important to note that the top view should be considered for the correct orientation of the isometric sketch. There should be more than one correct possibility.
  - c. On the other hand the top and the front view fix the oblique sketch to a great extent. The only possible variation remains in choosing the oblique lines – they can be on the right or on the left of the non-distorted faces of the solid.
5. This last question allows children to try out a range of possibilities. Essentially, they create the views. Incidentally, these views will be independent of each other. Then, the solid is made based on them. Note that it is possible that some combination of views may not generate any solid. In such cases, one of the views can be modified so that a solid can be made. In some cases, a solid can be formed in theory e.g. if each view consists of 5 alternate squares including the corners and the centre. The solid in question is a collection of 9 unit cubes filling a space of a  $3 \times 3 \times 3$  cube with 8 cubes at the 8 corners and the remaining one at the centre. But this solid can't be made with interlocking cubes. So, this activity can provide the opportunity to explore various possibilities.

The restriction of making the views on  $3 \times 3$  squares can be relaxed. Same goes for how many squares should be shaded to generate each view.

We encourage the teacher to collect the sets of top, front and side views that do generate solids which can be made with interlocking cubes. These can be useful to create similar worksheets and do various similar activities.

Understanding solids is challenging since textbooks, notebooks, board and screens are all 2D and therefore can't provide the full flavour of 3D. The sketches and views are ways to map solids within 2D. This is crucial for designing and manufacturing 3D objects. These activities can provide some opportunity to engage with various solids, map them to 2D as well as create them based on the 2D representations – the sketches and the views. The optional tasks allow a wide range of possibilities to create solids and engage with them.