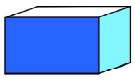
Chapter-10

Visualization of Solid Figures

In class VII, you were familiar with some plane figures and some solid figures. Triangle, Circle, Square, Rectangle, Quadrilateral etc. are examples of plane figures. Similarly, Cube, Rectangular parallelopiped, Cylinder, Cone, Pyramid, Prism etc. are examples of solid figures. Plane figures are two Dimensional (2D) and solid figures are three Dimensional (3D).

You are aware that three dimensional figures occupy space and they are seen differently from different positions.

Activity Match the dimension with the figures of the following shapes.

Figure of the shape	Name of the shape	Dimension of the shape
	Square	Three dimensional
	Cone	Three dimensional
	Cylinder	Two dimensional
	Rectangular parallelopiped →	Three dimensional
	Quadrilateral	Two dimensional
	Sphere	Three dimensional

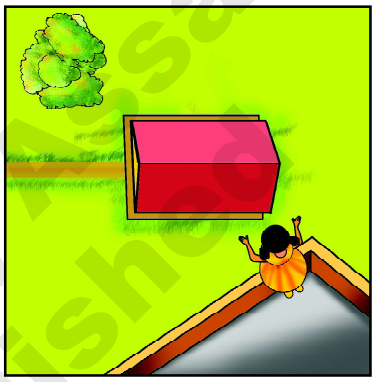
From the above table, you are able to understand that some shapes are two dimensional and some three dimensional.

10.1 View of three dimensional figures from different positions

From your previous class, you are already familiar that three dimensional figures are viewed differently from different positions. For example, you have learnt that a cube can be viewed differently as it is viewed from top or one side. We can draw figures of these three dimensional objects as viewed from different angles. For example, look at the diagrams 1, 2 and 3. Diagram-1 is the front view, diagram-2 is the side view and diagram-3 is the view from top of the house. In each case, the observer views differently from different positions. Isn't it?

Front view
Picture-1

Side view
Picture-2

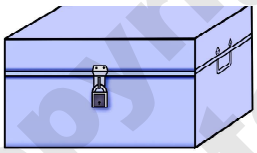


Top wiew
Picture-3

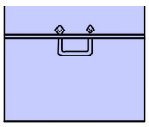
Exercise 10.1

1. Some three dimensional figures are given below. Front view, side view and top view of the figures are given. Identify each view of each figure.

(a) Box



(i)



(ii)

(iii)

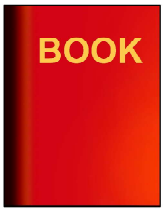
(b) Almirah

(i)

(ii)

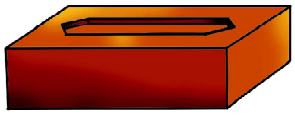
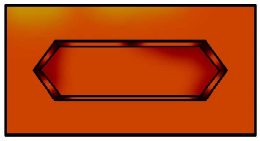
(iii)

(c) Book


(i) (ii) (iii)

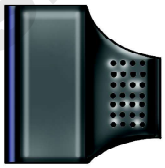
(d) Brick

(i) (ii) (iii)

(e) TV





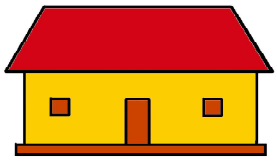
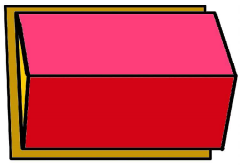
(i) (ii) (iii)

(f) Weight


(i) (ii) (iii)

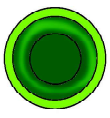
(g) House



(i) (ii) (iii) (iv)

(h) Dustbin

(i) (ii)

Activity Draw figures of front view, side view and top view from above of the following solid objects by discussing in a group.

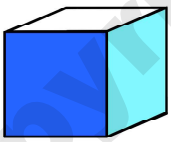
(i) A chalk pencil box
(ii) Almirah in your school
(iii) School building
(iv) Table, desk-bench in class room

10.2 Faces, Edges and Vertices

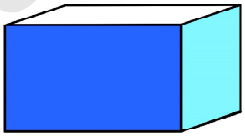
In our surrounding, we see so many solid objects. Some of the objects like bottle of soft drinks, dice, brick, glass etc. have length, breadth and height. Every solid object occupies space.

Activity Observe three dimensional things like cube, rectangular parallelopiped, cylinder, sphere etc. Investigate and count their faces, edges and vertices and match the numbers you obtain with those given in the following table.

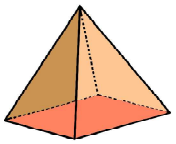
Solid objects	Vertex	Face	Edge
Cube	8	6	12
Rectangular Parallelopiped	8	6	12
Cylinder	0	2 plane faces 1 curved faces	2
Sphere	0	1 curved face	0
Cone	1	1 plane faces 1 curved face	1



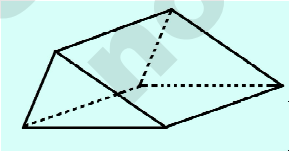
Cube



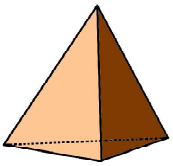
Rectangular Parallelopiped



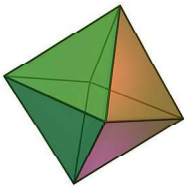
Pyramid with square base



Triangular Prism



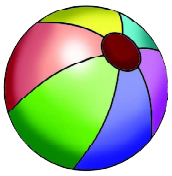
Pyramid with triangular base



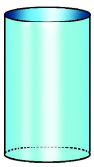
Octahedron

Look at the solid objects given in the previous page. These special solid objects are made of some flat polygonal faces. Such solid objects are called polyhedrons. Polyhedron is a Greek letter 'Poly' means **many** and' Hedron' means **base or sitting place**. A polyhedron may have 3 or more straight edges and the meeting point of these edges is called vertex.

Now, question arises. Are all solid objects polyhedrons? Look at the following diagrams of solid objects.



Sphere
Figure (1)



Cylinder
Figure(2)

Cone
Figure (3)

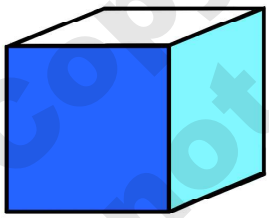
Figure (1) Sphere has one curved surface. It has no edge and vertex.

Figure (2) Cylinder has one curved surface in its side. It has no straight edge.

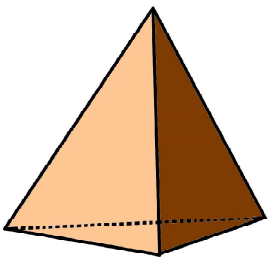
Figure (3) Cone has one curved surface in its side. It has no straight edge. It has one vertex and one circular face.

What have you noticed? These are not polyhedrons. Why? Because, the faces they have are not all plane, base is not a polygon and they don't have any straight edge.

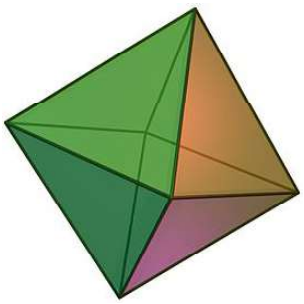
These polyhedrons may be regular or irregular. Regular polyhedrons have faces consisting of regular polygons and the vertices are formed by same number of faces. Again look at the following three figures



Cube
Figure (A)



Regular tetrahedron
Figure (B)

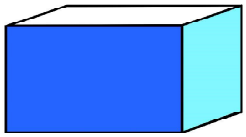


Regular octahedron
Figure (C)

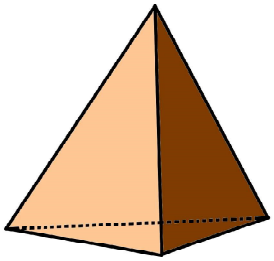
Figure (A) Cube - Each vertex of the cube is formed by three congruent faces.
Figure (B) Tetrahedron - Each vertex is formed by four congrunent faces.
Figure (C) Octahedron - Each vertex is formed by eight congruent faces.

On the other hand, faces of irregular polyhedrons are not congruent.

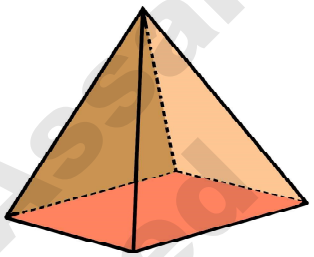
For example, rectangular parallelopiped is an example of irregular polyhedron because, its faces are not congruent. Some figures of irregular polyhedrons are given below-



Rectangular parallelopiped



Pyramid with triangular base



Pyramid with square base

Prisms and Pyramids are important members of polyhedron family.

There are many types of prisms, like prisms with square bases, prisms with triangular bases, prisms with pentagonal bases etc.

Similarly, there are many types of pyramids like pyramids with square bases, pyramids with triangular bases etc. Write the number of faces, edges and vertices of the polyhedrons mentioned in the following table F, V and E respresent face, vertex and edge respectively. (First one is worked out)

Polyhedron	**F**	**V**	**E**	**F+V**	**E +2**
Cube	6	8	12	14	14
Rectangular Parallelopiped					
Pyramid with square base					
Prism with square base					
Prism with triangular base					
Pyramid with triangular base					

What do you get by filling the table?

For each polyhedron of the table in the last two column, the values of F+V and E+2 are same.

The relation could be written as

$$F + V = E + 2$$

or $\boxed{F + V - E = 2}$

This relation was invented by the great mathematician Euler which is known as **Eular's formula for Polyhedra**. This formula is true for any polyhedron.

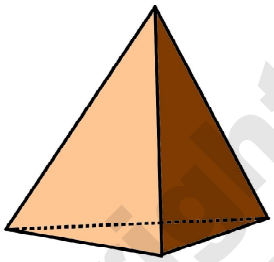
Leonhard Euler
(1707-1783)

Try yourself

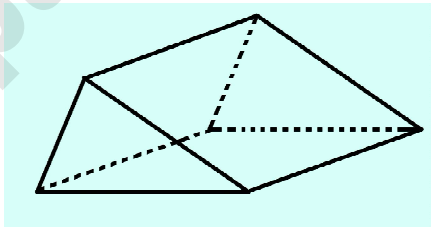
- Take a cube, cutting a corner of it, you will get a shape. Count F, V and E of this shape by group discussion. Then, verify Euler's formula.
- Is there any similarity between a prism with square base and a cube? Discuss this in your group by activity.

Exercise 10.2

1. For a polyhedron, number of vertices and faces are 12 and 20 respectively. Find the number of edges.
2. For a polyhedron, number of edges and vertices are 12 and 6 respectively. Find the number of faces.
3. Verify Euler's formula for the two polyhedrons given below.



Pyramid with triangular base



Prism with square base

10.3 Drawing map of our surrounding places

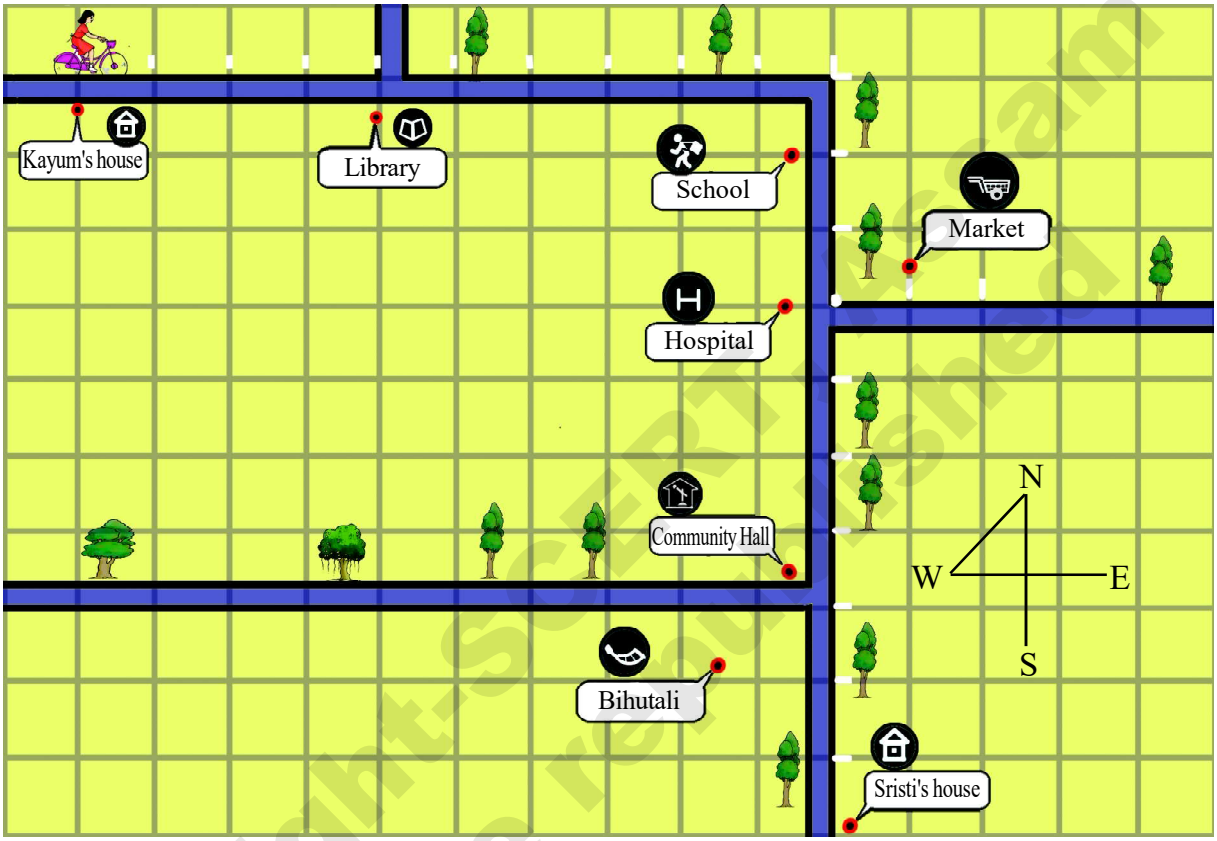
Already you have known how to locate a special place, river, forest in the map. A map gives information about how to travel from one place to another, its distance from one place etc. Different symbols and colours are used to represent places, rivers, hills, waterways, roadways in a map. For example, green for forests, blue for rivers etc. are used. To draw a map, proper scale should be used. Distances shown in a map must be proportional to the actual distances.

From the above discussion, can we say that drawing a map and the drawing a picture are same? In drawing a picture, we try to draw as we see in reality. We know that a picture can be viewed differently with respect to the position of the observer. It depends on how the

observer views the picture - whether from top or from front or from one side. For example picture of a house as discussed earlier.

But it is not valid in case of a map. Rather, the map will be same whatever the position of the observer may be.

Observe the following map. Kayum draws the way from her house to her friend Sristi's house on the map. She has used different symbol for different places on the way.



Use of symbols and mention of distances make the study of map easier. When Kayum draws the map, she used scale. By knowing actual distances she draws the map as she used the scale and estimated distances proportionately to the actual distances. In her map, she used 1 cm = 100 m actual distance.

This measurment may be different for different maps.

Note that although two maps may be of same size, but, their scale and distance may be different. For e.g., the maps of Assam & India may be of same size. But, the ratio of the scales may be different. Actual distance shown by 1 cm in the map of Assam must be less than that of the distance shown by 1 cm in the map of India.

Activity

Draw a map of the road from your house to your school like Kayum did. Use symbols and scale for the places on the road.

1. A three dimensional object is seen differently if it is viewed from different position.
2. A map shows a definite object or place relative to other object or place.
3. Different symbols are used in a map to represent different places.
4. To draw a map, different scales may be used according to necessity.
5. For any polyhedron

   $F+V-E=2$

   where, F represents face, V represents vertex and E represents edge of the polyhedron. This relation is known as Euler's formula for polyhedra.

❑❑❑