3D Projections

Take a look at the solid structure built by putting two identical cubes next to each other. The diagram on the left shows 2D projections (top, front and the right side projection). The diagram on the right side is an isometric view. The isometric projection is a method of drawing a 3D shape on the plane in such a way that the angles between the three main directions (front ↔ back, left ↔ right, up ↔ down) are all equal to 120°.

The 3D image shows an isometric view. Take your time looking at the isometric view, and try to understand how it works.

1. Draw a third cube attached to the back of the 3D figure above. Please change the projections accordingly.

2. We will use the right side projections. Note that right and left side projections are usually not the same. Suppose you are given the top, front and right side projections, and you build a solid using these projections. However, you mistakenly use the right side projection as the left side projection. What would be the difference between the solid you built and the solid you were supposed to build? Draw an example of this phenomenon.
3. Draw the front, side and top views of the given solids. Remember that the 3D solids are drawn on isometric paper, while the 2-D projections are drawn on orthographic paper.
4. Given the following 2D projections, draw the solid structures on isometric paper.
5. The following cubes represent aquariums. Imagine that the darkened line shows the path that a fish takes. Draw what you think the top, front and right-side projections for each path is.
6. If three people look at the aquarium from the top, the front and the right-side, respectively, they see that the fish take takes the following paths. Draw the path that the fish actually takes in the tank on the isometric paper given below. (Hint: First, draw a $3 \times 3 \times 3$ cube.)
Solid structures

1. Look at the drawing of the cube shown below. If you were to cover the surface with paper, you would create a "jacket." For example, figure Y is the jacket for figure X.

(a) Match the following solid structures to their corresponding jackets.
(b) Draw the jackets for the corresponding solids. (Hint: Given below are the “footprints.” First, draw the front, right, left and back faces attached to the bottom. Then, draw the top surface.)
2. Given below are top views with the heights of each section. Some problems also include the side view and front view of the solid. Draw all possible solid structures which have the given projections on isometric paper. Note that not every block needs a supporting block below it).

(a) Top view with heights

(b) Top view with heights

Figure 1: Possible solid structures.
3. Three solid structures are given below. For each, draw on isometric paper the complimentary solid structure that can be joined with the given structure to form a cube. (Hint: First, figure out the dimensions of the smallest cube that works.)