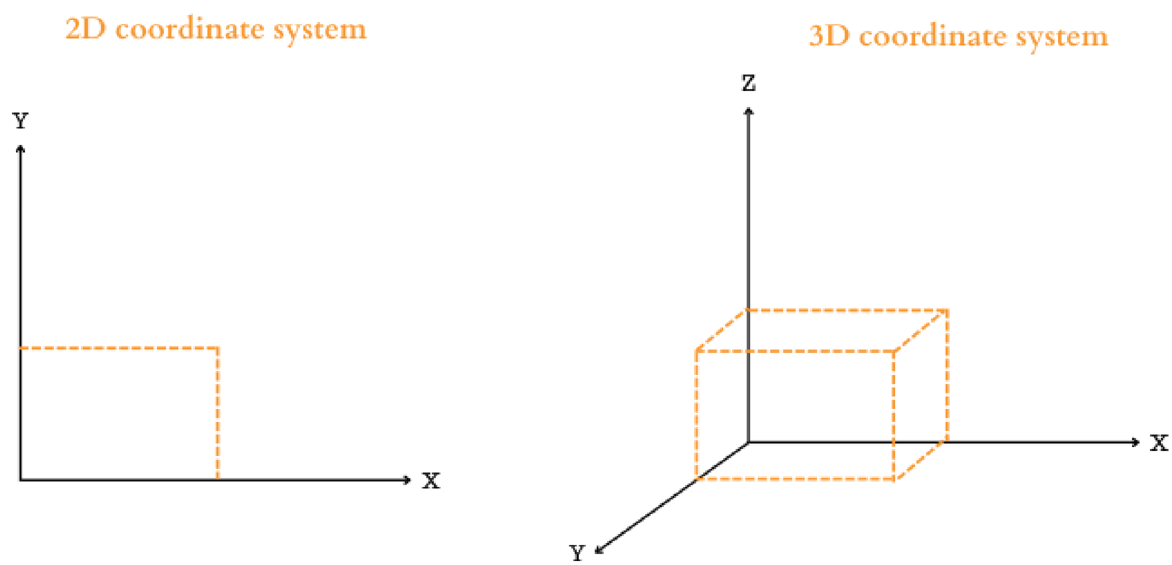
Lesson 4: Working in 3D planes

Objectives:

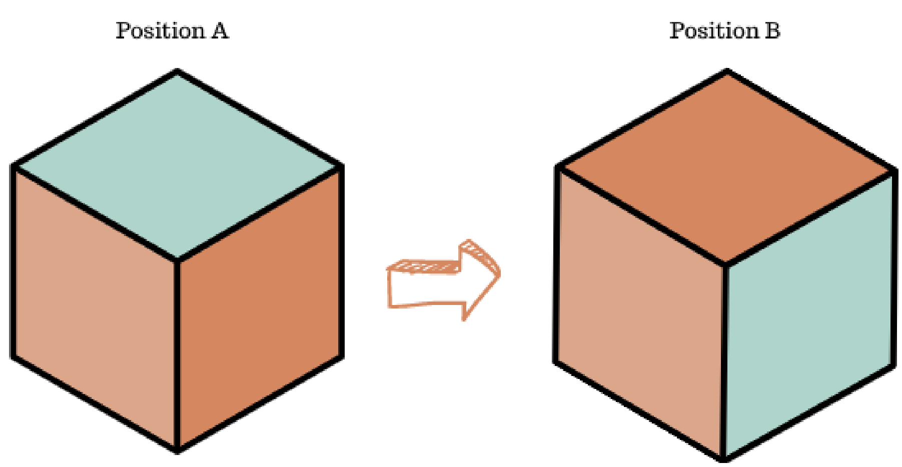
1. Communicate motion within the 3D coordinate system using X, Y and Z axes.
2. Create a 3D isometric sketch to communicate a design idea.

Warm Up:

1. What observations can you make about these two coordinate systems?



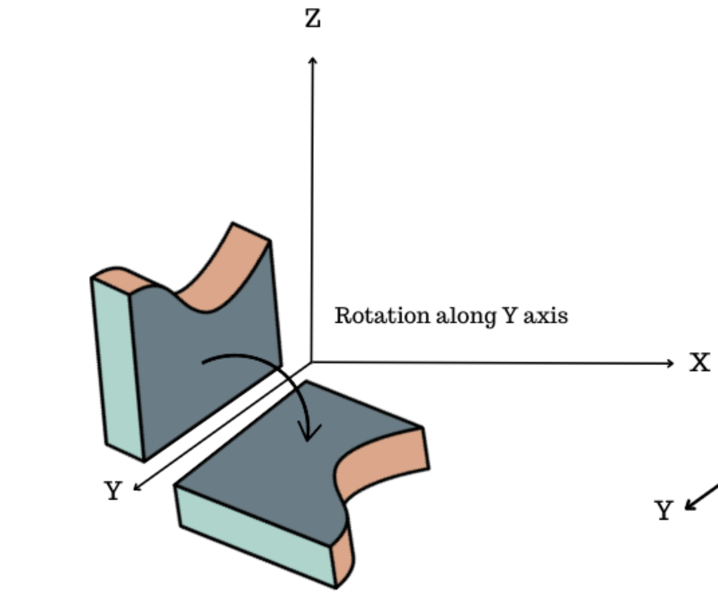
2. How can you explain verbally the change in orientation of the cube from Position A to B? Try it out!

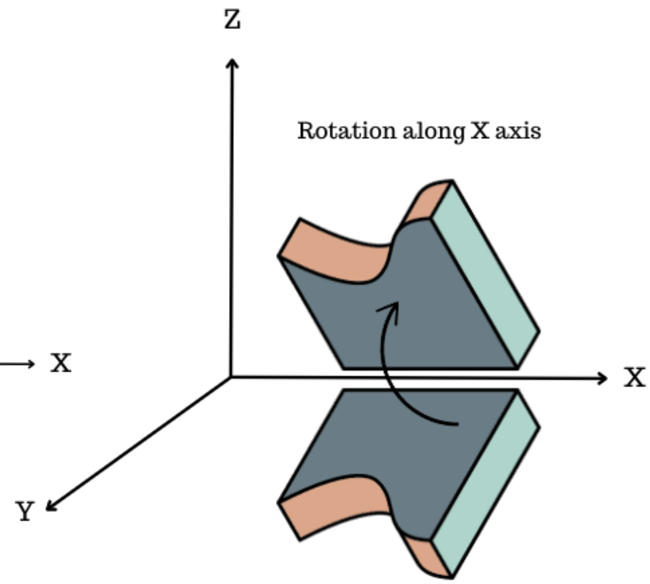


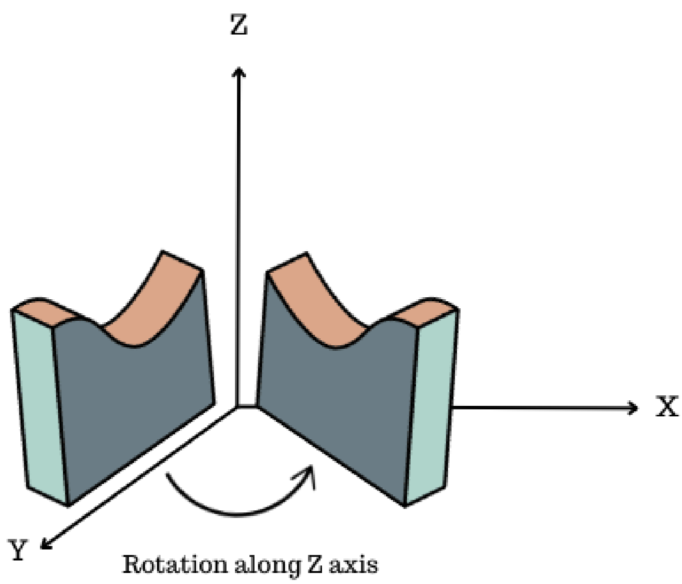
It's difficult to do, right? How do you describe where the different faces of the cube are in space? Below you will learn some tools to do just this.

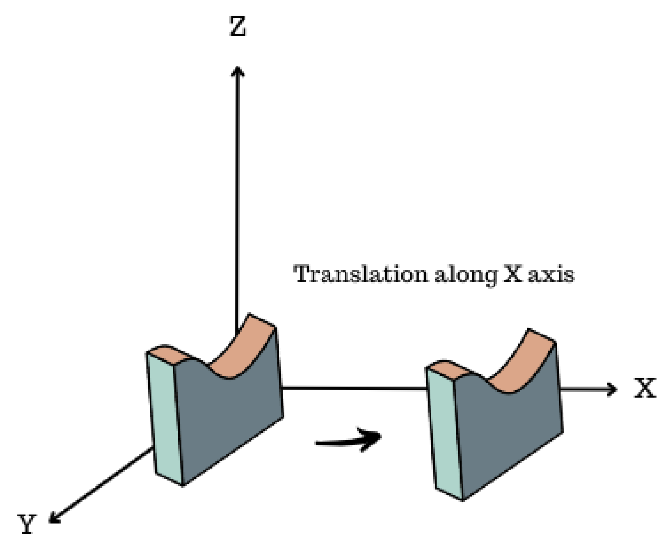
Introduction

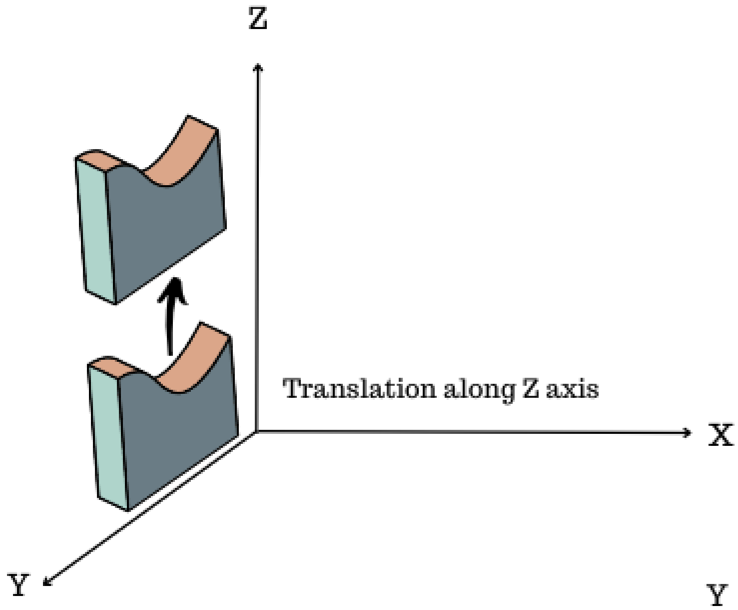
The x y z coordinate system, also known as the Cartesian coordinate system, is a system used to represent points in three-dimensional space. It is named after the mathematician René Descartes, who developed it in the 17th century. A point is a location that has no size or dimensions, but can be represented by a set of coordinates. You can view a point along three different planes: XY, XZ, or YZ planes. This will determine where in three-dimensional space this point exists.

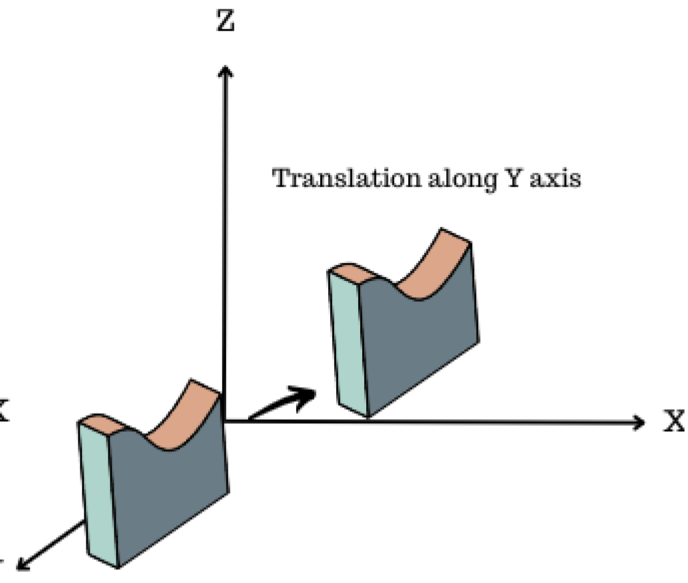












You can describe the movement of objects in 3D space using the terms ‘translation’ and ‘rotation’. When the points that make up an object are changing position in a linear fashion along the same plane, is it undergoing translation. When the points that make up an object are changing position concentrically around an axis, this is rotational motion.

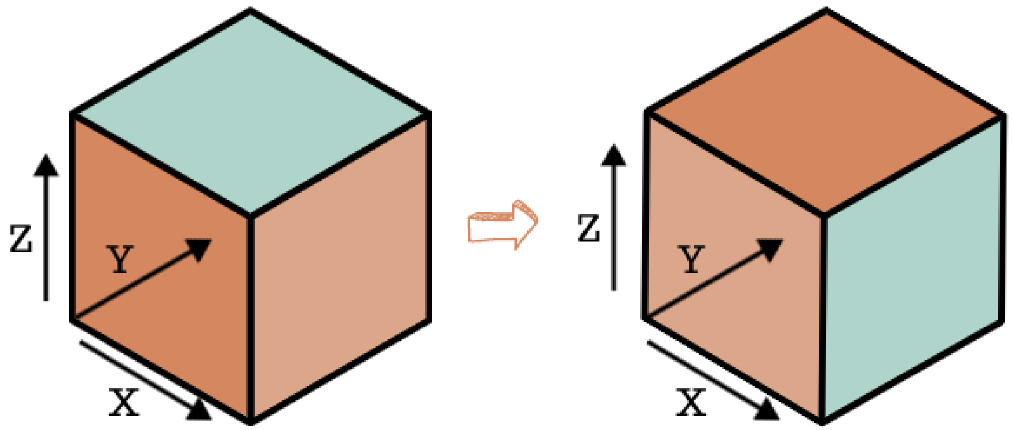
Practice

Practice articulating translational and rotational motion by hot gluing 3 bamboo skewers together to create the 3D axis. (If you’re short on time, you could also just hold them in place with your hand carefully).

Find an object in the classroom that is small enough to move along these small planes you have created. An eraser, computer mouse or card would all work.

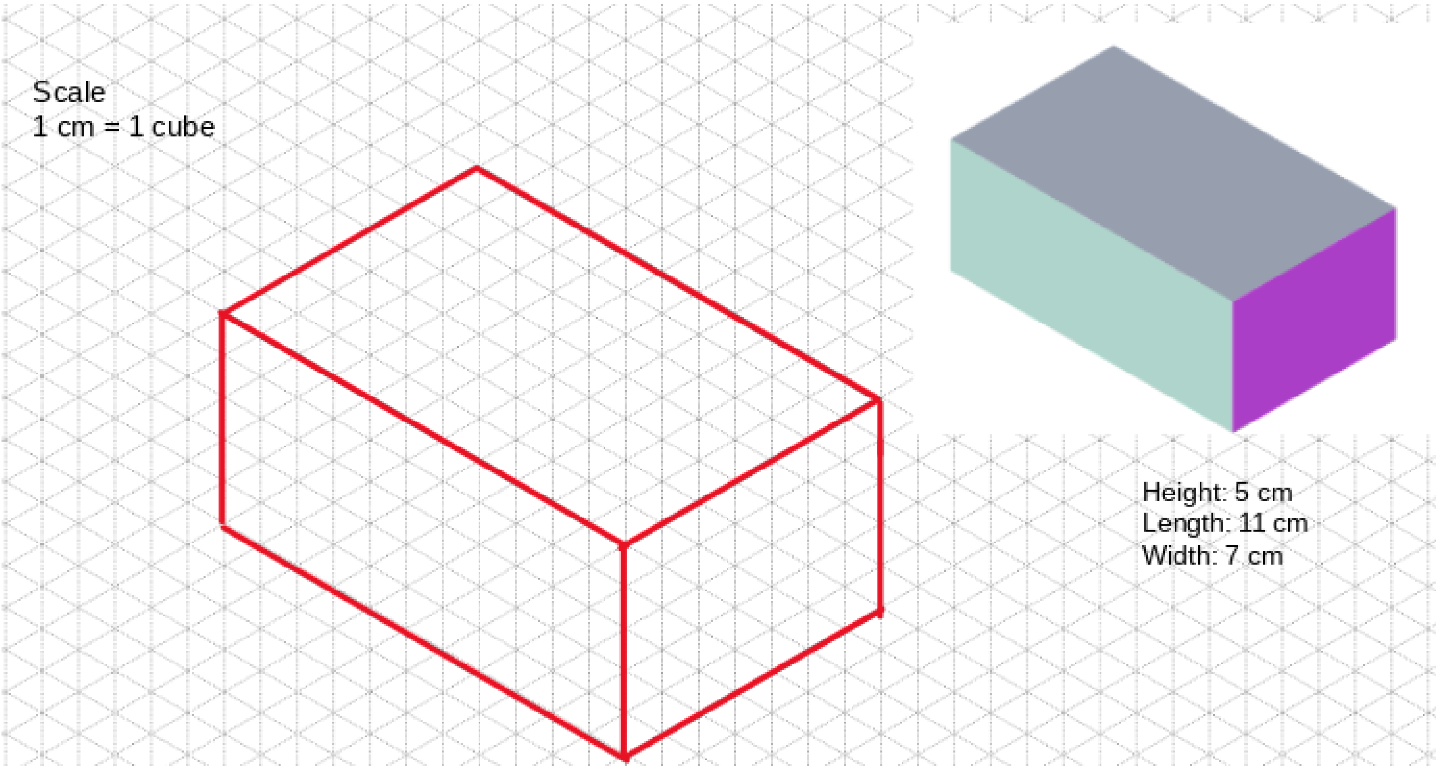
1. Identify the Z, Y, and X planes. You could label them if you like.
2. Demonstrate with your object the following types of motion:
    a. Rotate the object around the X axis.
    b. Translate the object across the Y axis.
    c. Rotate the object around the Z axis.
    d. Translate the object across the X axis.

3. Now that you have practiced the terms rotational and translational motion, try once more to articulate the changes in orientation of the cube from Position A to B.



What is a 3 dimensional sketch?
Drawing 3 dimensional sketches can help communicate design ideas because you can view the height, width and depth of an object all at once. One way you can draw 3 dimensional sketches is through isometric sketching. An isometric sketch example is below:

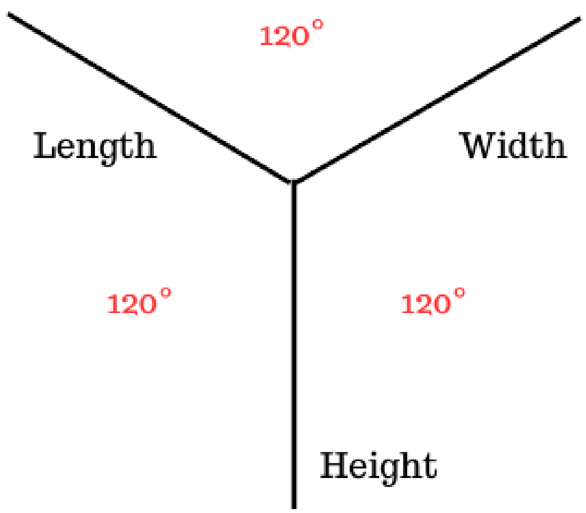
Learn how to draw an isometric sketch of a rectangle:



1. Start by using isometric paper or grid paper. You can find isometric drawing paper for free to print online. This is shown in the above image.

2. Record the longest height, length and width of the object. Create a scale on your isometric paper so that 1 cube is equal to a predetermined unit. [For example: 1 cm = 1 cube].

3. Draw a Y shape to outline the height, width and length. Isometric sketches should show all 3 faces at equal angles, as seen below. This is what produced the three dimensional view.



4. Using the measurements recorded, draw straight lines along the isometric paper according to the maximum length, width and height of the object.

5. Try it out for yourself in the two shapes on the following page.

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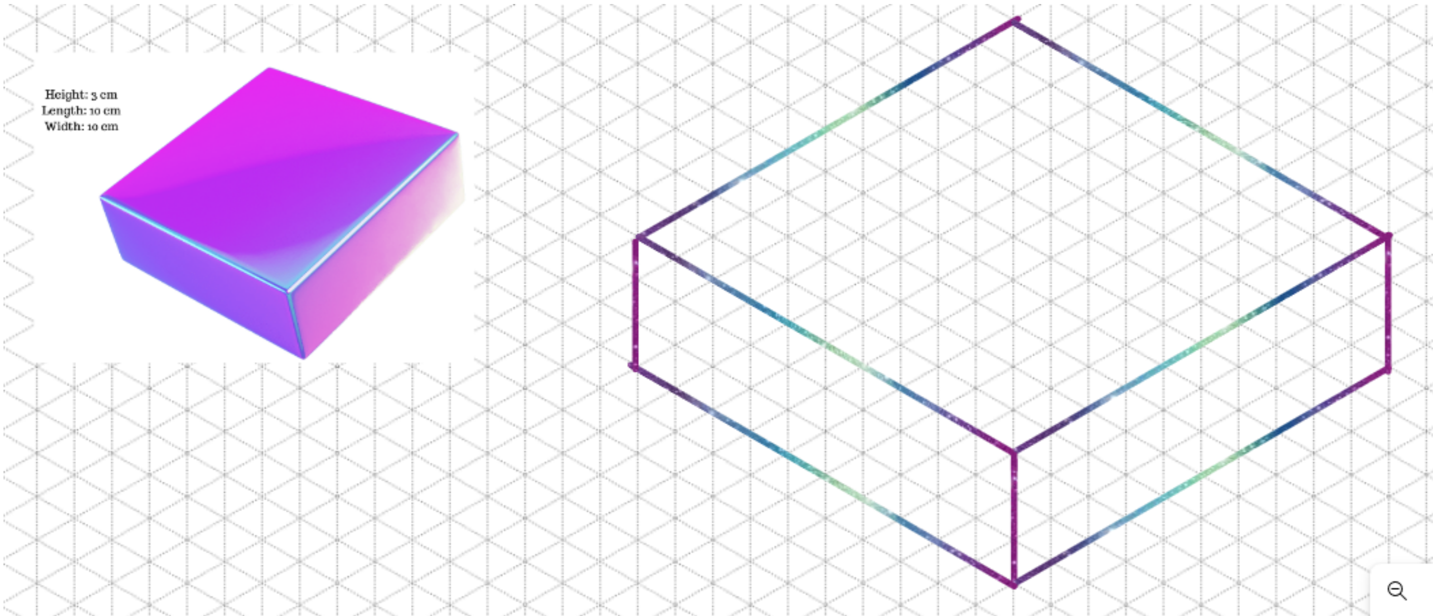
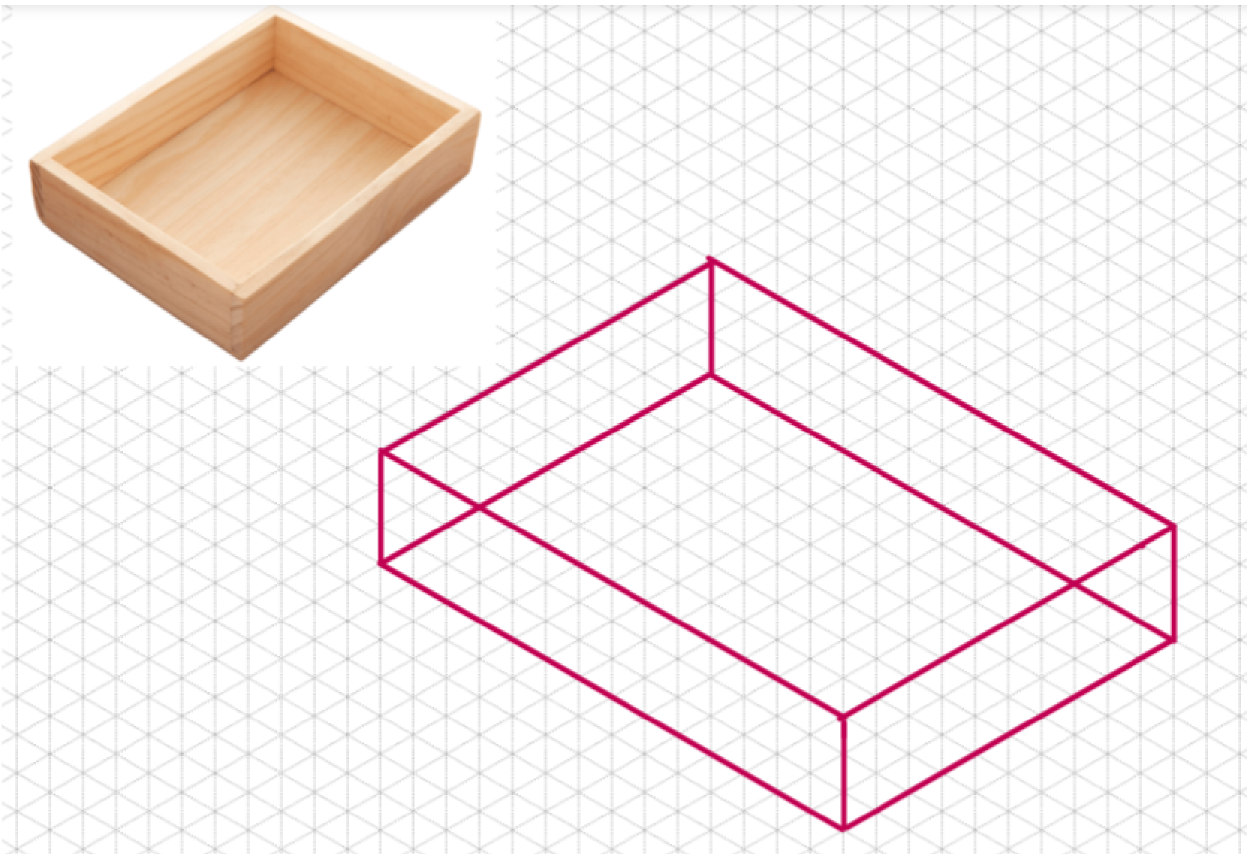
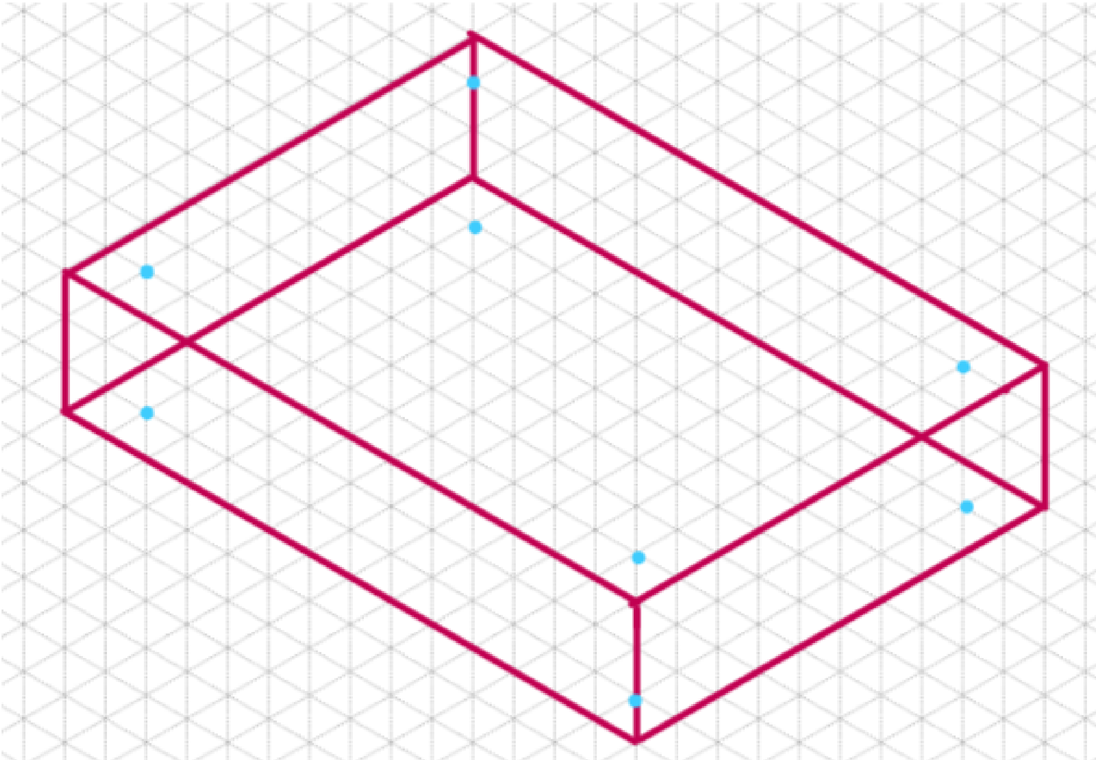


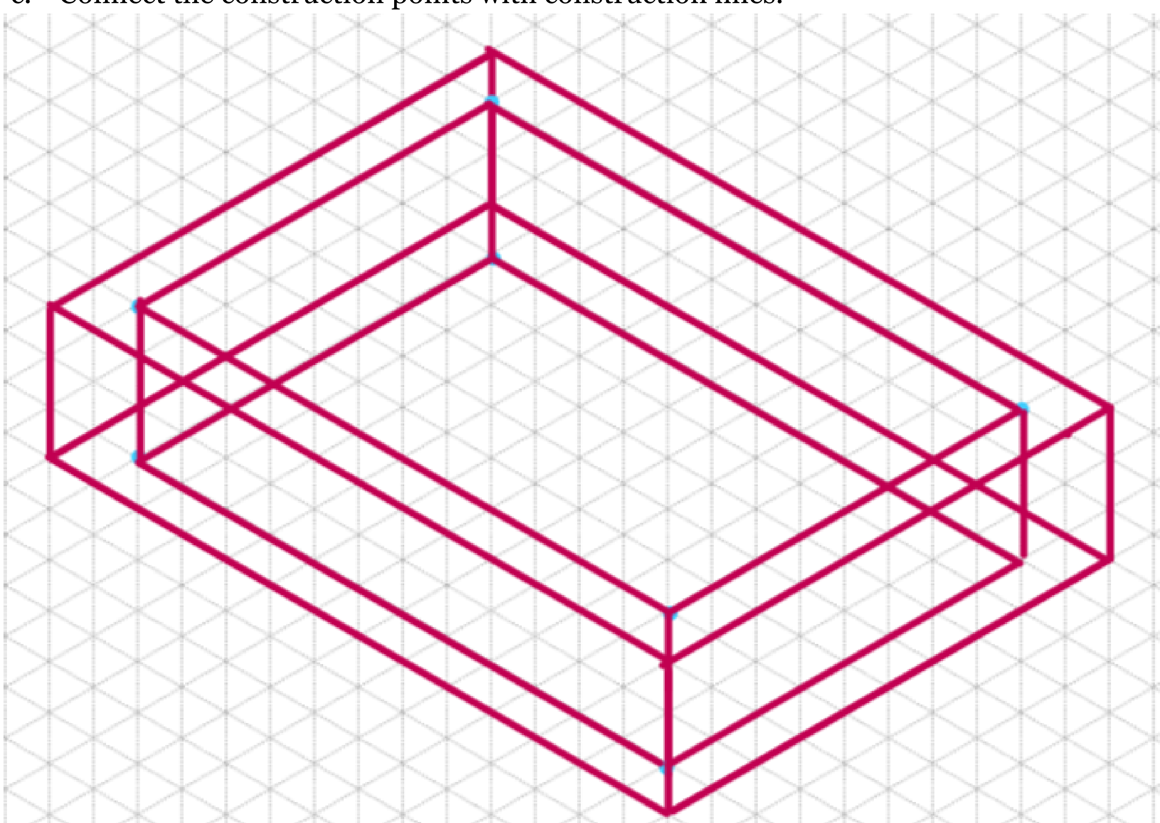
6. For the shapes in the next section, first draw a box on the isometric paper. The box should be the size of the maximum dimensions of the object.
    a. Record the maximum dimensions of the object. Using the height, length and width, create the outer shape.



    b. Notice that the box has a hollow interior. Place construction points on the limits of the inner faces to demarcate the interior shape.



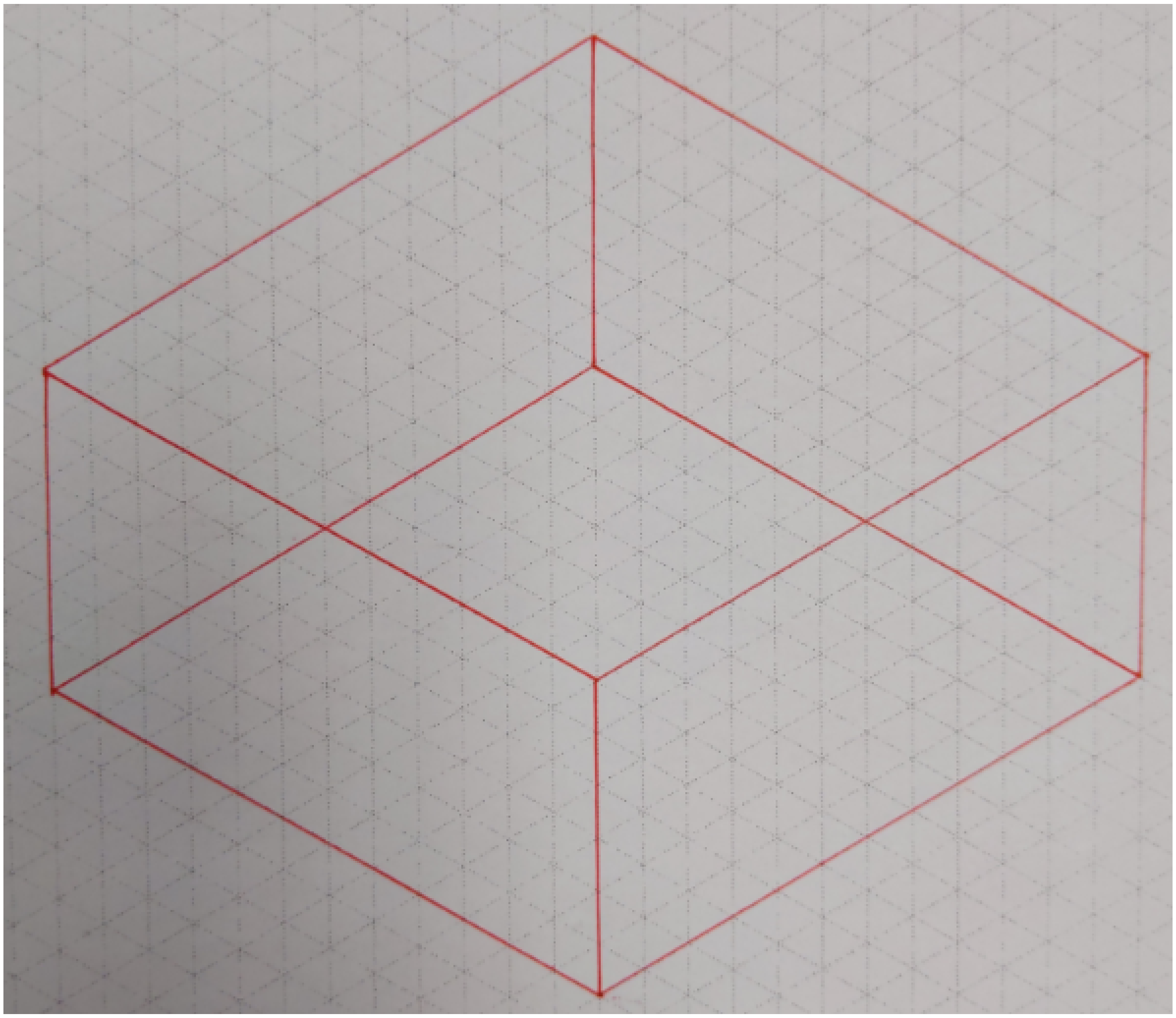
c. Connect the construction points with construction lines.



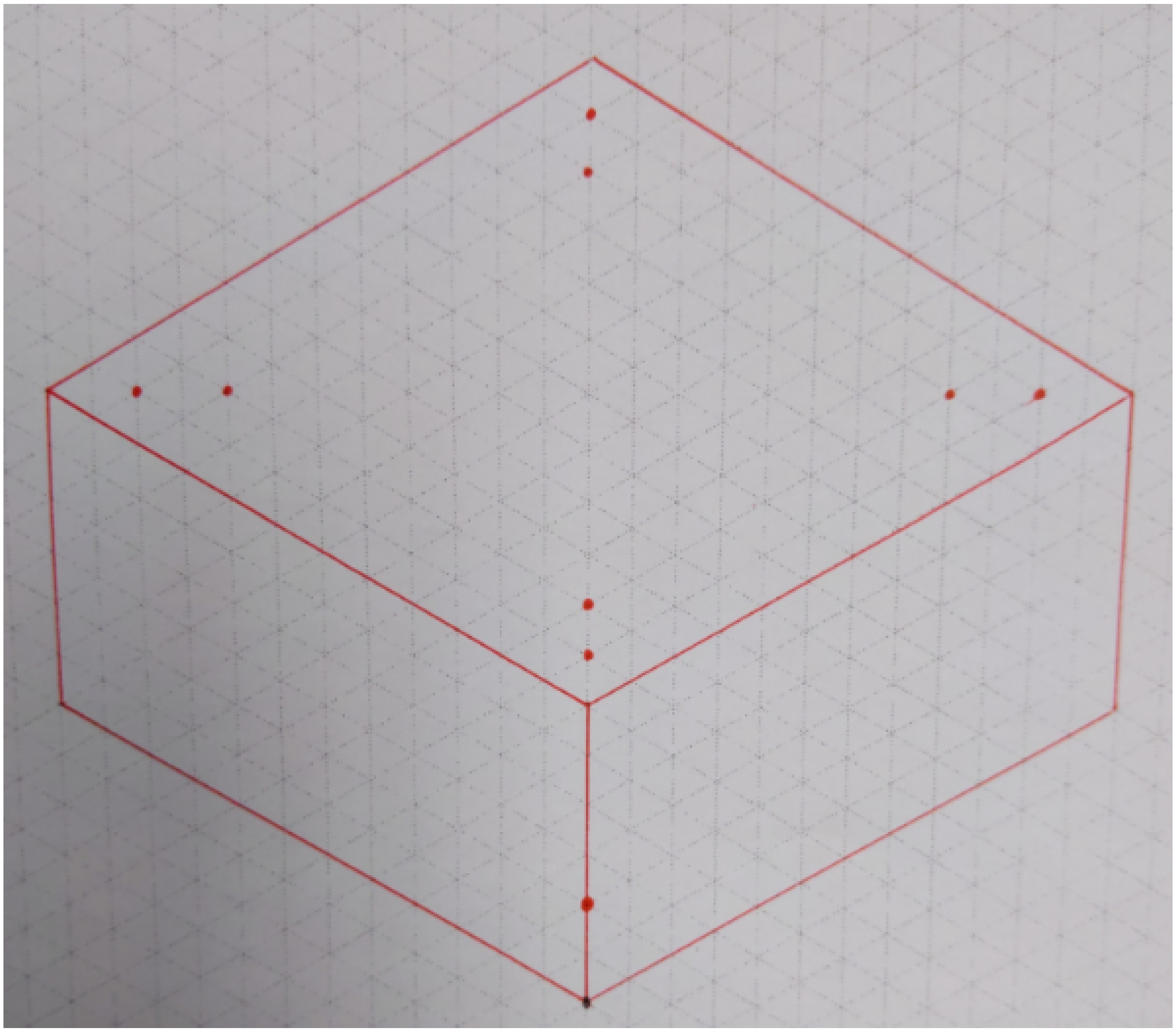
d. Find a rectangular shaped object in the classroom to practice with. This might be an eraser, remote, speaker, cell phone, etc.

7. **Learn how to draw an isometric sketch of a curved object:**

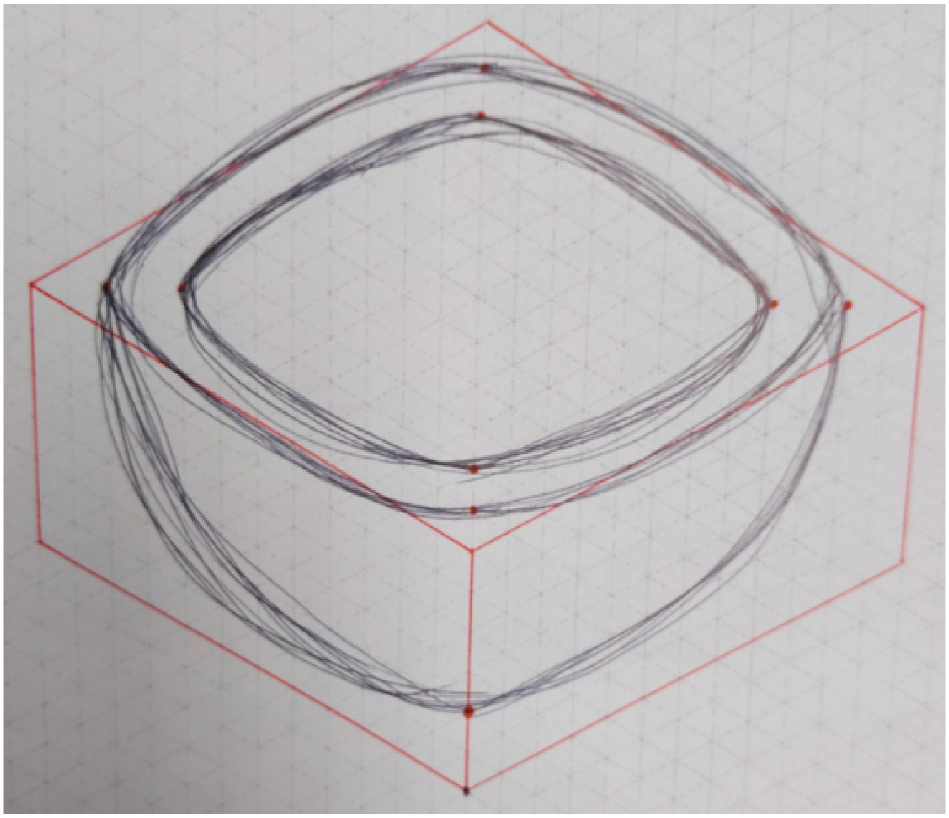
a. Using the steps learned above, create the outer rectangle that the object can fit in.



b. Plot construction points in the corners to indicate the limits of the circular aspects.



c. Using a pencil (and a protractor if available), connect the points with curves. You may need to go over the line a few times to get the right curvature.
Note: this is a SIMPLIFIED way to draw isometric curves! For higher quality isometric circles, there are a greater number of steps that one can explore online.



d. Try it yourself below: