**Extruding**

*Extrusion* is a powerful method for adding geometry to a mesh. Extrusion duplicates one or more geometry elements (vertices, edges, or faces), with the duplicate attached to the original mesh with more new edges or faces. The easiest way to do this is with "quick extrude" (although it doesn't offer the most control). To use it, put the object into edit mode and select the geometry elements that you want to duplicate. Mostly commonly, that will mean one of the faces of a mesh, although you can also do multiple faces or single edges. Selecting a face means selecting all the vertices of that face. Then all you have to do is CONTROL-left-click at some point, and the selected face will be duplicated at that point. (Note that this is the same way that you would extend a curve.) The original face is now de-selected, and the new duplicate face is selected instead, making it easy to move, scale, or rotate the new face and to add more faces at other locations.

For more control, select the geometry that you want to duplicate and press the "e" key. When you extrude using the "e" key, the duplicated geometry is in the same location as the original and will not be visible, but it is selected and in grab mode so that you can easily move it away from that location.

As an example, I started with a mesh cube and extruded various faces, applying various scaling factors along the way. Here is what it looked like in the Blender 3D window in edit mode:

![Image of extruded mesh](image)

**Subdivision Surface Modifier**

*Modifiers* are a powerful feature that can affect the rendered view of a mesh object, without actually modifying the underlying geometry. To apply a modifier to an object, first select the object. Then go to the "Object Modifiers" controls in the properties editor panel (monkey-wrench icon). Click the "Add Modifier" button to choose from a large selection of modifiers. I only understand a few of them. At the bottom of the list, you will see the "Subdivision Surface" modifier.

The "Subdivision Surface" modifier is useful for modeling shapes, particularly when used with extrusion. It makes a smoother shape that uses the original shape as an outline, sort of like the control points of a NURBS curve. Try adding a "Subdivision Surface" modifier to a cube that you have extruded a few times. A small panel will appear under the "Add Modifier" button with controls for the modifier, as shown at the right. The "View" and "Render" buttons, under "Subdivisions," are important controls for sub-surfaces. Increasing the level increases the number of polygons on the sub-surface, and hence its smoothness. The "Render" control selects the number of levels that will be used when an image of object is
rendered. The "View" control selects how many levels you see in the 3D window (which you might want to make smaller than the render level to speed up drawing of the window). You should also note the "Apply" button, which will discard the original surface and replace it with the sub-surface. You might do this if you want to start editing the sub-surface itself—but you won't be able to get the original back (except with Undo). The "X" can be used to remove the modifier from the object. Here is a rendered image produced when the a Subdivision Surface modifier was applied to the extruded cube shown above:

![Rendered image](image.png)

**Hint:** I was going after a fish shape, but I should probably have used Curve objects for fins and attached them to a fishy body!

**Array Modifier**

Another modifier, the "Array" modifier, can make duplicates of an object and arrange them in a line. Just add the modifier to an object, adjust the distance between objects in the X, Y, and Z directions, and use the "Count" control to specify how many objects you want. (There are more advanced ways of arranging the duplicates, but I won't cover them here.)

In the picture shown at the right, I started with a single sphere and applied **three** Array modifiers to it. (You can add multiple operators to an object, and they will be applied in sequence.) The first modifier turned the sphere into a line of spheres in the X direction. The second modifier duplicated the line in the Y direction to give a grid of spheres. The third duplicated the grid in the Z direction to give 3D formation of spheres. In the image, I placed the camera in the grid, looking along a line of spheres, with a Sun shining in the same direction that the camera is looking. I added some Mist (in the World controls) to make the spheres fade a bit in the distance. (I had to set a fairly large "Dist" value for the mist, or else I didn't see anything at all.)