So far, we see that Blender has many features that are found in almost all 3D computer programs like the ability to extrude along paths, subtract and add meshes through Boolean expressions and now we will examine **revolving-type, or spinning** commands. The commands used for these effects are found in the **Tool Shelf** and are visible when in **Edit Mode**. The Spin and Screw commands can be used to revolve around a center point with duplicate objects or smooth spinning. You can also provide an offset that will create a spiral. The process to get them to work can be confusing to beginners so we'll create some basic shapes.

### Creating Screws and Gears

There are actually mesh add-on tools that can create both of these items easily that will be discussed later in the chapter, but for now, we will look at the traditional way to create these items.

**Screws and Springs:**

In order to make these items, you need a closed shape for the profile (ex. circle or triangle) and a 2-vertex line that controls the spacing from one coil to the next. We'll make a screw form for our first example. Start by adding a **Plane**. In **Edit mode**, select the 2 right side vertices and scale them down to make a triangle form that will represent the triangle thread. Move the 3D cursor to the left side and place it where you want the center of the screw to be.

Now add another plane (**while still in edit mode**), delete the 2 right side vertices so that all you have is a line, and place those 2 vertices on the 3D cursor. These 2 vertices control the distance between the coils and must be part of the 1st mesh. If they are not joined together, use “**Ctrl-J**” to join them. My example has the line the same size as the edge of the triangle. This means that the threads created will be tight together. If you want space between the threads, make the line longer. I place these 2 point on the 3D cursor so it is easier to delete them later. Stay in **Edit mode**.

Now, use the “**A**” key to select **All** vertices. The line and triangle vertices should all be selected. Make sure you are in a principle view since the spinning will occur related to your view. Select the **Screw** command.
When you select the Screw command, additional options will display below the Tool Shelf. Steps will control the quality of the circular curve (I used 32). Turns is the number of coils. Center and Axis will do some fine-tuning for you.

By spinning the mesh, you will be able to select the string of vertices created from the line down the center.

In order to make a spring, you do the exact same thing as the screw, except you use a circle instead of a plane. I will create 2 examples using a short line for close coils and a longer line for wider coils.
Gears:
Since a gear uses a 3D shape for the tooth and not just a 2D profile like screws and springs, we need to use the Spin command for that and duplicate the object as it is revolved. To start, add a cube, switch to a front view and shape the one edge to look like a wedge. I selected the 4 right edge vertices and hit “S” to scale and “Z” to scale on the Z axis only. This is a pretty simple gear tooth, but good for discussion.

Now move the 3D Cursor to a location where you would like the center to be. (still in the front view). Enter Edit Mode and select all vertices. In the Tool Shelf, select the “Spin” command. You will need to adjust:

- **Steps** to match the number of teeth.
- **Angle** to 360 (full circle).
- **Dupli** may need to be checked to duplicate vertices rather than spin them.

To finish off the gear, add a cylinder to the center and shape/scale it to fit the teeth. You could also use Boolean modifiers to cut holes for more detail. Join the meshes together when finished.
Creating Revolved Shapes

If you wanted to make a revolved shape, like a goblet or an alien flying saucer, you could start with a circle and extrude it to make the shape, but you could also use the Spin command.

For this example, I started with a plane, deleted one vertex, and shaped/extruded the mesh into the profile of a goblet. Make sure the 3D Cursor is somewhere on the center axis line of the mesh.

Switch to a front view (or whichever view you need) so you are looking down at the shape and displays as a line. Spinning is related to the view you are working with.

Just like we did for the gear, make sure all vertices are selected and hit the “Spin” command. You will need to change the “Steps” (I used 32), and the “Angle” to 360 for a full circle. You will also want to select all vertices and “Remove Doubles”.

To the left is a profile extruded in the top view. The examples show spinning that shape in a front view and a side view. The active view at the time does make a difference!

Don’t forget- there are Modifiers listed that can do some of these features, only a bit differently. You can actually specify an object for an axis and a few other things. Feel free to experiment with them now that you have a better understanding of how to do revolves.
Blender Add-On Meshes

Using the above techniques have always been in Blender and can work well for making mechanical parts like screws, bolts and gears, but with newer versions, there are now easier ways to do these things. For the past several releases, there has been a script included with Blender called Bolt Factory. It worked great for making bolts and nuts, but many users didn’t know it existed. Now, you can have that feature and others appear in the “Shift-A” add menu by enabling the “Add-Ons” in the User Preferences menu. This has been discussed earlier in the book, but here are the details again.

Go to the “File” pull-down menu and select “User Preferences”. In there, you will see a tab called “Add-Ons”. There are a lot of nice features you may want to use in there and by checking the box, the script will be enabled. For now, we are checking “Add Mesh-Bolt Factory” and “Add Mesh-Gears”. If you want these enabled at all times, save the defaults. There are also many other mesh types that could be useful in the Add-Ons. There are now architectural elements available as well. These features are pretty simple and easy to figure out, but here are the basics:

Bolt Factory:

When you hit “Shift-A” now, you will see the 2 new options in the mesh menu. By selecting “Bolt”, you will see a list of options in the Tool Shelf area. You can select bolt or nut, a preset metric size, head shape and type, lengths, etc. Almost everything you need for quick hardware.

Gears:

There are 2 different types of gears you can add. A worm gear and a gear (spur gear). You have many setting options that can be changed with terminology related to real gear development.
Create a worm gear and a spur gear to mesh with each other using the information discussed in this chapter. You can use the “Spin” and “Screw” Tool Shelf commands or use the Gears Add-On in the User Preferences. Either method, try to keep the gear teeth equal on each part. Try using the copy command for the basic tooth shape. Add materials, textures and appropriate lighting. Make a 200 frame animation of the gears turning. Try to make them mesh perfectly! Remember the Linear Extrapolation options available in the Graph Editor Window. All you need to do is create a small section of the animation and let the computer do the rest! If you need a refresher, review the animation chapter and page 10-9 for animating the light in the lighthouse.

**Call the instructor when finished**
Challenge Task: An Animated Spring

Scenario:
You have been asked to develop an animation for a new automotive suspension system. You can add as much detail as you wish, but need to demonstrate a coil spring in motion.

Research the internet to find a suspension system you would like to duplicate. Create as much detail as possible with a spring in the system and animate the system. Animate the spring using shape keys or armatures as discussed in previous chapters. Here is a refresher:

Shape Keys:
After creating the spring, go to the Object Data buttons and create a Shape Key slider. Enter edit mode, select the top vertices and turn on Proportional Editing. Scale the selection area to effect all but the bottom of the spring. Stretch or compress the spring and exit edit mode. Move the slider and animate to change the spring. Refer back to previous chapters if you need assistance.

Armature:
After creating the spring, add an Armature-Single Bone. Scale the bone so it matches the length of the spring. Go into Pose Mode for the bone. Child-parent the Spring to the Bone and choose the parent to Bone option. Now when you scale the spring on the Z-axis, you will stretch and compress the spring.

Create a short animation of your scene when finished.

** Call the instructor when finished**
Chapter 20 Reflection

Chapter 20 Reflection and Wrap-up:

Mesh Features and Mesh Add-ons

Mesh spin and screw features and modifiers can save you a lot of time when trying to model spun shapes. So can the mesh add-ons. Take a few minutes to reflect on your experiences.

1. If you have not done so already, go into Preferences and enable all of the mesh add-ons. Take a look at all of the different mesh shapes you can add. You have everything from geometric shapes to pipe joints to torus knots. Which shapes do you find the most interesting? Which can be the most useful? Why? Explain.

2. Review the architectural meshes that have been recently added to Blender. Find a YouTube video that demonstrates their use. What could be a good possible use for these tools for a personal project? Explain.

3. If you were to make gears of different sizes that needed to mesh together perfectly, how could you do it? If gears are different diameters, are the gear teeth the same size? Should diameters and number of teeth be proportional? Research these questions and explain your answers.