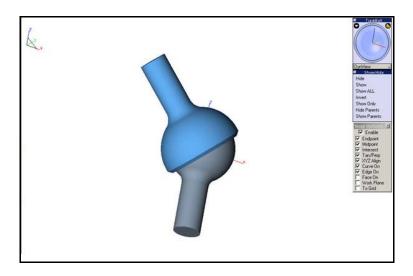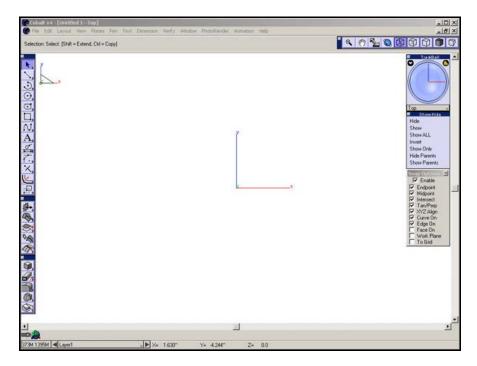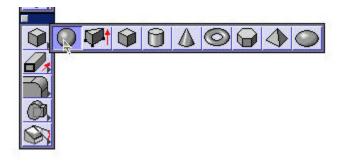# Modeling a Ball Joint

This is a quick, simple tutorial on how to make a ball joint. It utilizes primitive solid modeling and Boolean operations. The modeling was done in Standard Units. To begin, I have arranged the screen as shown below. I have the **Tools, Surface Tools,** and **Solid Tools** palettes on the left side of the screen. I have the **View, Trackball, Show-Hide, a**nd **Snaps** palettes along the right side. All of these windows are accessible from the *Window* menu. The view is in the Top View.

The ball joint we will create is made from two spheres and two cylinders. After we create them, we will union them together and do a little trimming to create a ball joint.
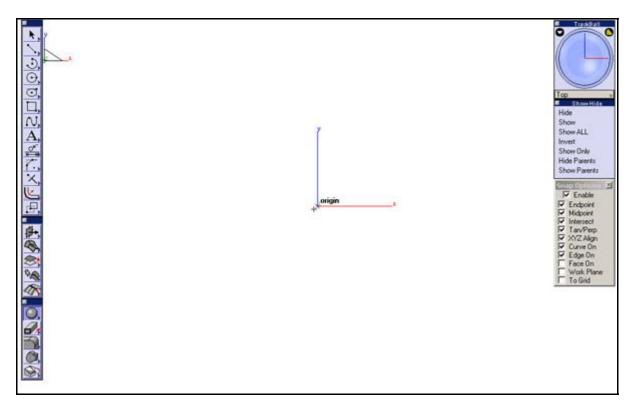
First, select the **Sphere Tool** from the Solids Tool Palette.

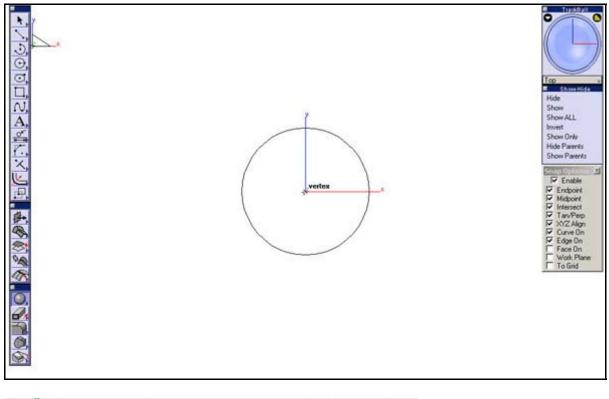Check the Message Line and make sure that you have the **1 Point Sphere** selected.

Place a sphere at the **origin** of the drawing area.

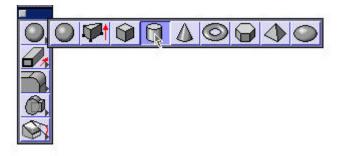Type in **3** in the **D (Diameter)** field as shown below and press **Enter**.

✍✈	X	0.0	Y	0.0	Z	0.0	D	3.0
389M 1409M ◀ Layer1						▼ ▶ X= -0.779"		

Create another sphere in the same place with a **Diameter** of **2.5 inches**.

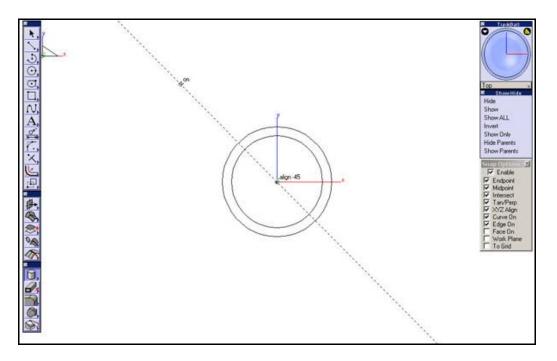| ✍✈	X	0.0	Y	0.0	Z	0.0	D	2.50
391M 1411M ◀ Layer1						▼ ▶ X= -0.198"		

Select the **Cylinder Tool**.

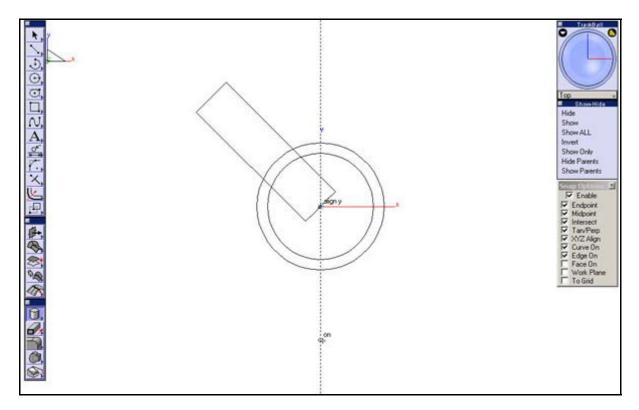For the first cylinder, place the first point at the **origin** of the drawing area.

Place the second point up and to the left of the spheres.

Type **1** into the **Diameter** field of the cylinder and press **Enter**.

Put the first point of the second cylinder at the **origin** as well. Place the second point below the spheres along the **Y-axis**.

Now that we have all the primitives created, we can use Boolean operations to create the part we want.
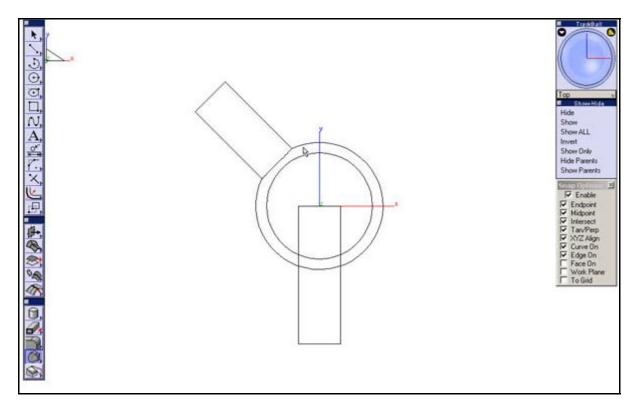
Save your file.

Combining the Primitives

We are now going to combine the primitives together using Boolean operations. As fancy as that sounds, all we are really doing is adding to objects together to make one object or subtracting an object from another.
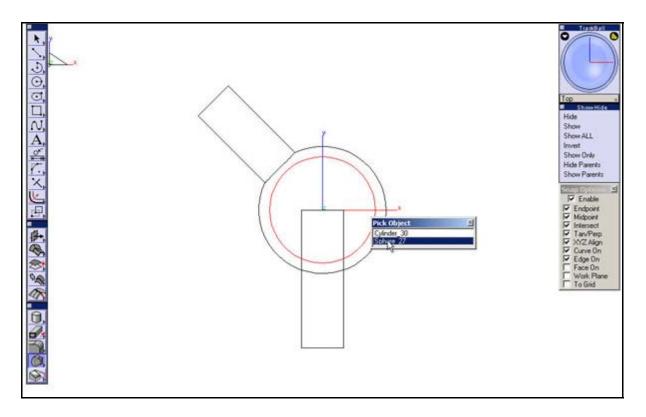
Select the **Union tool** from the solids tool palette.

Select the upper cylinder and then the outer sphere. We have just joined the two parts into one; not so hard is it?

Now Union the other two together in the same fashion.

We now have two parts instead of four in our model. Now we are going to subtract the smaller one from the larger one. This will leave the larger piece empty inside (not emotionally empty, just physically).

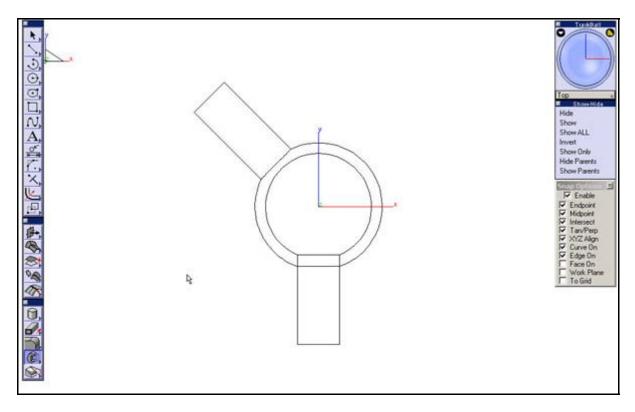Select the **Subtract Solid Tool** from the solids tool palette.

In the Message Line, it first asks for the solid to be subtracted from. That's the big one so select that one first.

Even though we want the larger piece to be empty for our ball joint, we do not want to lose the smaller piece. In order to keep the smaller piece, hold down the **CTRL** key on a **Windows** machine or the **Option** key on a **Mac** while doing this subtraction.

Subtract Solid: Pick solid(s) or surface to subtract:[Ctrl = Keep subtracted][Shift = Extend]
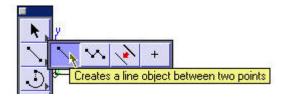
Select the smaller piece.

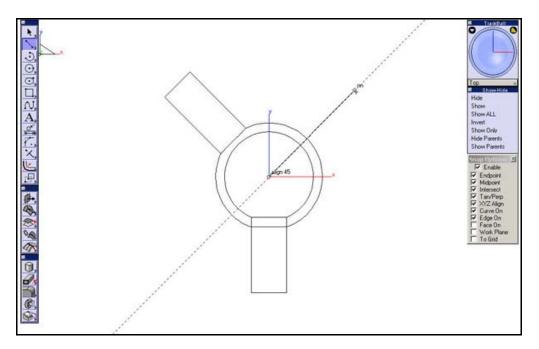The model should now look like what you see below.

Now we need to trim a little bit of the larger piece away, to show the smaller part of the ball joint inside. To do this we will trim the larger piece with the Trim Solid Tool.
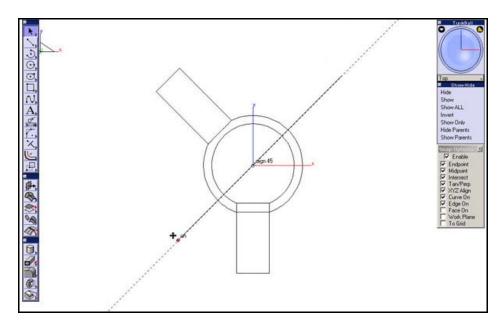
Select the **Line Tool** from the tools palette.

Create a line that starts at the **origin** and goes to the right at **45 degrees**. Use the drafting assistant to help you place the line accurately.
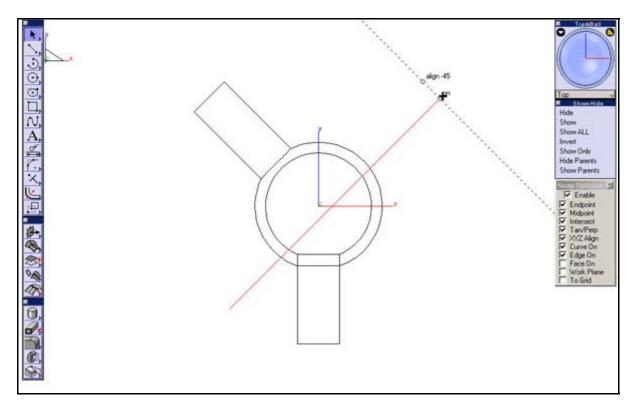

Next, use the **Select Tool** to drag a window and select just the first endpoint of the line and drag it the other way a little bit as shown below.
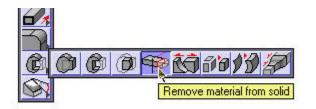
We are going to use this line we just created to trim the larger piece. If this were a real ball joint it wouldn't work because if we trimmed it like it is the smaller piece would just fall out. So what we need to do is move the line a little bit so that the sphere section of the upper piece wraps around the lower piece a little bit.

With the **Select Tool**, select the whole line and move it down a little bit so that the larger sphere section covers more than half the lower sphere section.

Now that we have done that, we can trim the solid.

Select the **Trim Solid Tool** from the solids tool palette.

Make sure that the **Perpendicular to View** option is selected in the message line and pick the line we created.

The select the larger part of the ball joint. The lower half should be removed by the line. If the larger half gets removed you can hit the **CTRL** key on **Windows** or the **Option** key on a **Mac** to flip the section that gets removed.

With the **Select Tool**, select the line and select **Hide** from the **Hide-Show** palette.

Go to the **Trimetric** view by selecting it from the drop down menu at the bottom of the **Trackball**.

Select the **shaded mode** from the **View** palette so that you can see what you've made.
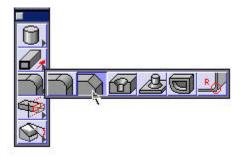

Now that we have are parts all combined and trimmed up, we can add some details.

Save your file.

Adding the Details

To add a little bit of detail to the model we will add a chamfer to the edge of the larger part.
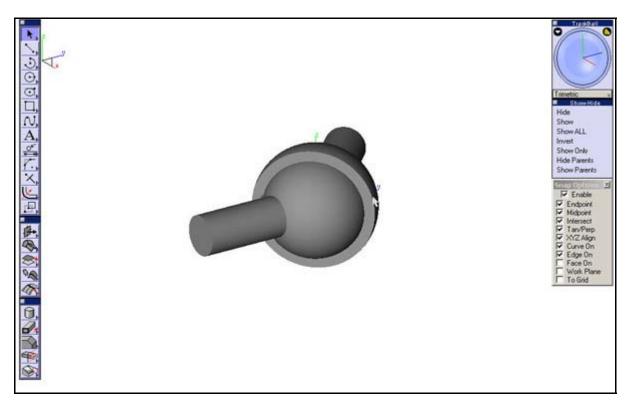
Select the **Chamfer a Solid Edge** from the solids tool palette.

Type **.125** inches for the Length as shown below.

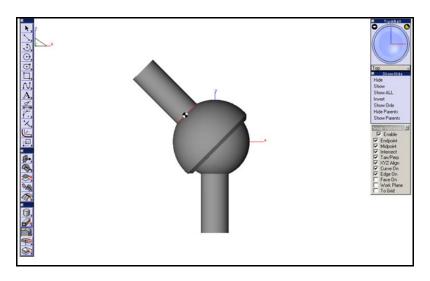Select the **outside** edge of the larger piece to put a chamfer on it.

Return to the **Top view**.

Select the **Blend a Solid Edge** tool.

Select the edge where the cylinder meets the sphere for the larger section as shown below.

Then select the same edge on the smaller piece. That's all there is to it.

This is what you model should look like when you are finished.

I've changed the colors of the parts by selecting the part and going to **Pen>Color.**

Save your file.