So today we're going to be using SketchUp to create some simple 3D drawings. To start off, click on the Choose Template button here. And we're going to be working in meters. So select Simple Template and Meters and then click Start Using SketchUp.

So before we get started, I'm going to turn on some toolbars that we're going to want to see. So go to View Toolbars. And I'm going to add the Large Tool Set and the Views. That's going to make navigation work in SketchUp a lot easier.

So first-- this guy here is for scale in the drawing. I'm just going to get rid of him. He's a little distracting. I'm going to make some simple blocks just to show you how SketchUp really works. So I just selected the Rectangle tool over here. I'm going to bring it into the View area. I'm going to start from the center of the universe here, and sketch up the origin, and draw a rectangle.

And if I want to make it an exact size, I can type in the dimensions of it. So I'm going to make this one meter by one meter. And so these dimensions will pop up in the bottom right corner of the screen in the small box down here. So just type in 1, comma, 1. We'll click Enter. And that gives me my rectangle.

To add thickness to the part, I use the Push/Pull tool. Hover over a face, and notice that it highlights blue as that happens. You can just click and start moving that. And you can either just sort of eyeball it like this, or type in an exact dimension. And it'll give you that.

So we now have what looks like a cube. Now one thing to realize with SketchUp is that it's not actually making a solid part, like most CAD modeling programs do. So I'm going to turn on the Select tool-- just the regular mouse. Select this top face. And then just click Delete. And we see that we really just have a hollow box.

So all SketchUp is doing is creating planar faces. And that's pretty much the basis of the entire program. So often, if a model's doing something unexpected, you'll wind up with a hole in it. What that's usually caused by is from a face not being planar. And often you can just fix that by drawing a line across it. And it'll close the face. Erase the line with the Erase tool. And your face is closed.

So to navigate around your model the three main tools you're going to use are the Rotate tool, the Zoom tool, and the Pan tool. So turn to rotate, click your scroll wheel and move the mouse around. To

zoom, you can just scroll on that with your scroll wheel. And to pan, select the hand tool from the Navigate tools over in the toolbar, and left click and drag. And that's going to slide your model back and forth. So that's the basics of getting started with SketchUp.

So we're going to start drawing the chair. So to start, we're going to go to the Right view. So go up to the Center Views toolbar. Click on Right. And that gets us close to the orthogonal plane that we want to be in for drawing from the side. Then we click on the Rectangle tool.

Come back over to center of the screen. Click on the origin. You notice the little yellow inference point appears. And then click and start dragging out the direction you want your rectangle to go. And then type the dimensions. In this case, 0.5 meters by 0.5 meters. So I type in 0.5, comma, 0.5. Click Enter. And the rectangle is created. We can zoom in for a closer look on that.

So now we're going to add a back to the chair. So I'm going to go over and click on the Line tool. And start from this corner point. Notice it highlights the endpoint to show that it's inferencing off of that.

Draw up vertically 0.5 meters. So draw in the direction you want to go. Type 0.5 and click Enter. And then from the end here, we're going to go over 0.1 meters. And then straight back down to the base.

So next we're going to add an offset from the outer edge of the chair that we're going to use to create the truss structure. So we go over to the Offset tool on the Large Tool Set. And then as you hover over the face, it'll highlight blue. And then click and start dragging inwards in the direction you want to go. And we're going to make this offset 0.1 meters. So I type 0.1 click Enter. And that's created.

So next we're going to add a diagonal brace across the middle of the chair. So I'm going to start by drawing a line between the two corners. And this geometry-- I'm just going to use to sort of set up what we're creating.

From this point I'm going to draw up a small perpendicular line. So notice how it highlights pink. That shows that it's perpendicular to the line I just drew. I'm going to make this 0.05 meters. And then draw along. It's going to highlight pink perpendicular to the line I just drew, again. And I can end it right at this edge here.

And then do the same thing on the other side. Highlights pink.

So to draw the other line, I'm going to go over here to this corner point. And it'll usually just highlight pink, based on the line it thinks you want it to be perpendicular to. But if it doesn't, all you need to do is hover over the line you want. Just have it snap on to it for awhile. And then move back over. And you'll get that perpendicular.

So 0.05. Draw down the edge here.

And so now I'm just going to erase everything that I don't want here. So I'm going to go over to the Erase tool on the Large Tool Set. And then to use this, you can click on the lines you want. Or you can just click and drag through your lines you want to delete. And when they're selected, they'll highlight blue and then disappear.

So now everything is deleted here that I don't need. And I'm also going to delete the two faces in here that aren't really going to become anything in the model. So I'm going to use the Select tool and select those. And then click Delete. And they're going to go away.

So now I'm ready to give the chair some thickness. Before that, we've got to delete one more little line here-- this one back. And then we have one clean face to use.

And so now I'm going to rotate it just a little bit, so we can get a better view of the extrude when we do that. And then go over and select from the Large Tool Set the Push/Pull tool. And then hover over the whole face of the chair. It'll highlight blue. And then click and drag the direction we want to go.

And we only want to make this 0.02 meters thick. So we type in 0.02 and then Enter.

So now our chair has thickness. So we can rotate around, see what's going on. And to rotate we use the scroll wheel, click, and then drag your mouse. And you'll get navigation of your model.

So the next step is to make this part a component. So components are one of the most important things to use in SketchUp. Without them you get what's called sticky geometry, which I'll talk about in a sec.

So here I have a block and a cylinder that I made. They're not components. They're just individual faces. So I'm going to triple click and select this whole cylinder. And then move it, using the Move tool, so that it intersects with the block here. And then I'm going to try to move it back out.

And there's a lot of weird stuff going on. What happens is the bottom edge of the cylinder has stuck to

all the geometry of the block and has dragged it with it. So we can rotate around and see that some craziness is happening down here. Without making components, this is what's going to happen every time you move things together.

So if I have a set of components-- which I have over here. The same two parts, just made into components. If I click one, use the Move tool, I can move it till it intersects and move it back out. Nothing happens.

So to make the chair component, double click on it until the whole thing is selected blue. So you usually have to click several times until everything is highlighted. And then right click anywhere in the model. And select Make Component.

And one of the key things here on this screen is to make sure this box is checked. Sometimes it's not. And this replaces the selection you just have with the component. Otherwise it'll create a component, but not actually change the part that you have. So then click Create.

So now the chair piece is highlighted all in blue. It looks just like the normal model. But to edit it, you have to double click. And then you get this little gray box around the part. And now you can work with it just like it's a normal SketchUp part. Except it's going to behave a lot nicer and not stick to your geometry.

All right. So once one side of this has made a component, we're going to copy it so we have two pieces of the chair. So just click on the component. And then use the Move tool over here on the Large Tool Set. And then you can just click anywhere on the model, and it'll start moving.

But we wanted a copy. So just go to your keyboard and click the Control key. Now SketchUp knows that we're trying to make a copy. If you're on a Mac, use the Option key.

So moving this part around is a little tricky. We're trying to get it to slide orthogonally to it. And so now I've got that. You can see it's moving along the red axis, because we have the red inference line going along.

We want the chair to be 0.5 meters away. So I type in 0.5 and click Enter. And now we have two sides that are each a component.

So next we're going to add some guidelines to the side of the chair, to add the cross braces. So I'm

going to switch to the right view, so we can see the side nicely. And then start drawing these guidelines. So there's a lot of little lines here. Dimensions are in the handout. But I'm going to go over here-- 0.025 meters, and then down 0.1 meters.

If you're in the Line tool and you want to start drawing lines again, but you don't want to start from this endpoint, you can just click Escape on the keyboard. And you'll stay in the tool. But it will sort of forget about that last point you were on.

The next spot we're going to go from is down here. We're going to go up 0.025 and over 0.25. And then Escape. And then same on the bottom corner.

And so now we have these three guide points that we're going to use to place the rectangular cross pieces. So I'm going to zoom in up at the top where our first one is going to be, select the Rectangle tool from the Large Tool Set. I'm going to start drawing from this corner of the line and draw down. And we're going to type in 0.1, comma, 0.05. That's going to make the correct size rectangle here.

So next we're going to offset it from the inside. First I'm going to erase this line here. Just delete that. And then go over to the Offset tool in the Large Tool Set. Hover over the edge. Start moving in. And we're going to make this 0.01 thick.

And then I'm going to rotate so we can see the Push/Pull that we're going to do next. So first I'm going to delete this middle face of the rectangle here. And then select the Push/Pull tool. Hover the section that we want to push. And then start moving that.

And what I want to do-- I want to make it stick to this opposite side of the chair piece. We don't need to go all the way through. So we just click, and it's there.

So just as with the size of the chair, we want to make this a component. So I can just click on it several times-- like a triple click, basically. You know your component will be selected when it turns blue-- the whole thing turns blue-- after click. Right click and select Make Component. And Create.

So next we're going to copy this rectangular tube down the model into a couple of places. So just like we did before with the chair, go over and click the Move tool. And in this case, we've got to be careful with what we're selecting when we go to move.

So I want to move this bottom left corner of the rectangle to this point down here. So I'm going to click on the bottom left corner of the rectangular tube, click Control, and then start moving down, and snap it to the endpoint that I already created down here.

Next we need to rotate this whole component 90 degrees so that it'll line up correctly. So to do that, I go over and click on the Rotate tool. And because we want to rotate it around this endpoint, I click on the endpoint first. Then you can click anywhere out in space next to start the rotation, and then move in the direction you want to go.

And SketchUp will automatically snap at 90 degree increments to make this easier. You can also, as with all the other dimensioning tools, just start moving in a direction and type the angle you want. In this case, I'm just going to snap to 90, and it's made.

To make more copies of this, I'm going to go back and click on the Move tool. First I'm going to pan the model down so we can actually see the bottom of it here. And then reselect the Move tool.

So we want to make another copy of this rectangular tube at the bottom. So I click and then Control. And snap it to this bottom line.

So next we want to make several copies of these rectangular tubes moving forward. So we're still in the Move tool. But I'm going to go to the Select tool and select both of them, just with a click, and then Control click. So now you can see that both the rectangular tubes are selected.

Go back over to the Move tool. Click anywhere on them. Control click. You can slide it over, making sure that we're staying flat along this face. And I'm going to move it 0.15 meters. So I type in 0.15 and Enter. And I actually want to make not just one copy, but two copies.

So then next you can just type in 2x and Enter. And it'll double that.

So next we're going to make some file tweaks to the chair. Let's just zoom out and look at the whole thing as it is. So one thing you'll notice is that when I created the rectangular tubes, when I pushed them to the opposite side, I made them just attach to this face-- the inside face here-- and not go all the way through. And I'd like to get that nice clean look on the other side as well. And this is a great opportunity to see how powerful using Components is.

So I'm going to go to the Select tool. We're going to click on any of the components here. I'm selecting

the top one. And to edit it, we double click. And everything else gets grayed. And we get this little gray box around this component. So I'm going to zoom in at the area of interest here.

So this is the face that I want to move a little bit. So I'm going to select the Push/Pull tool, hover over the face, and then slide it in. So I could rotate around and see the other side. But what it is easy to do is just inference off of the edge here.

So notice the little red dot that appears. And SketchUp is telling me that I'm on an edge. And so I'm going to select that. We can rotate around to confirm that we are in fact on that edge.

And so to exit this Edit component mode, just click anywhere outside the component we're in. And then we can zoom out. And you'll see that the chair has the nice clean sides on both of the edges. So the key with components is that by editing one of them, you've edited all of the copies you've made of it. So since we edited one of the top tubes here, all the ones below it that we copied were edited as well.

For final tweaks, I could go in and delete the little lines that I've used as guidelines here. Other than that, the chair's complete.