Going Beyond Buildings

IN THIS CHAPTER

>> **Extruding around circles and along paths with Follow Me**

>> **Mastering the Scale tool**

>> **Creating 3D terrain with the Sandbox tools**

>> **Using the Solid Tools for additive and subtractive modeling**

Here's something you already know: There's more to life than modeling buildings. Even though SketchUp is *really good* at letting you make models of built structures, you can use SketchUp to build just about anything you can imagine. All you need is time, ingenuity, and the ability to step back and break down things into their basic parts. SketchUp provides fantastic tools for creating forms that aren't the least bit boxy, but those tools aren't as obvious as Push/Pull and Rectangle, so most people never find them. This chapter is devoted to helping you discover SketchUp's "rounder" side.

Another reason for pushing past basic boxes? Many people see 3D printing (sound of futuristic music and warp drives engaging) as the next vanguard of human innovation, and 3D modeling — like you do with SketchUp — is half of that equation. If you're going to be printing your own bike helmets and vacuum cleaners in the next decade, you'd better get good at modeling organic shapes. (Chapter 9 offers an introduction to 3D printing with SketchUp.)

In this chapter, you discover tools, techniques, and other tips for creating forms that are distinctly unbuilding-like. Our hope is that you'll use them to push the limits of what you think SketchUp can do.

Extruding with Purpose: Follow Me

Follow Me is probably the best example of a powerful SketchUp tool with kind of an underwhelming name. When the software designers were trying to figure out what to call their new baby, the problem that they faced was this: This tool does what other 3D modeling programs dedicate two or three other tools to doing. The designers chose an unconventional name because Follow Me is a wholly unconventional tool.

As shown in Figure 6-1, you can use Follow Me to create all sorts of shapes:

» **Bottles, spindles, and spheres:** These are all examples of *lathed* forms. You can create these by spinning a 2D *profile* (shape) around a central axis to create a 3D model.

» **Pipes, gutters, and moldings:** If you look closely, all three of these things are basically created by extruding a 2D face along a 3D path; the result is a complex 3D form.

» **Chamfers, fillets, and dados:** Without explaining what all these things are (that's what Internet search engines are for), know this: You can use Follow Me to *cut away* profiles, too.
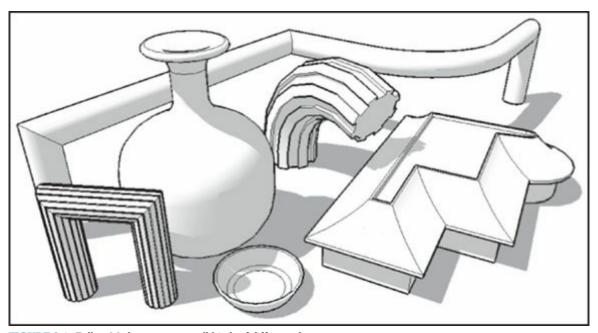

FIGURE 6-1: Follow Me lets you create all kinds of different shapes.

Using Follow Me

At its core, Follow Me lets you create forms that are extrusions. It's a little bit like Push/Pull, except that it doesn't just work in one direction. You tell Follow Me to follow a path, and it extrudes a face all along that path. So, you need three things to use Follow Me:

» **A path:** In SketchUp, you can use any edge, or series of edges, as a path. All you have to do is

make sure that they're drawn before you use Follow Me.

>> **A face:** Just like with Push/Pull, Follow Me needs a face to extrude. You can use any face in your model, but the face needs to be created before you start using Follow Me.

>> **Undo:** Imagining what a 2D face will look like as a 3D shape isn't easy. Getting a Follow Me operation right usually takes a couple tries. That's what Undo is for, after all.

Follow these steps to use Follow Me; Figure 6-2 shows a basic example of how it works:

1. **Draw a face to use as an extrusion profile.**

   In this example, you create a pipe, so the extrusion profile is a circular face.

2. **Draw an edge (or edges) to use as an extrusion path.**

   Although the edge (or edges) is touching the face in this case, it doesn't have to for Follow Me to work.

3. **Select the complete extrusion path you want to use.**

   Check out the section on making selections in Chapter 3 for pointers on using the Select tool to best advantage.
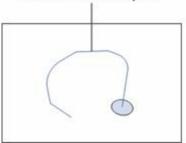
4. **Activate the Follow Me tool by choosing Tools ⇒ Follow Me.**

   To see Follow Me on your toolbar, select the Large Tool Set. On Windows, choose View ⇒ Toolbars, select the Large Tool Set check box in the dialog box that appears, and click Close. On a Mac, choose View ⇒ Tool Palettes ⇒ Large Tool Set.

5. **Click the face you want to extrude.**

   Magic! Your face (extrusion profile) is extruded along the path you chose in Step 3, creating a 3D form (in this case, a section of pipe).
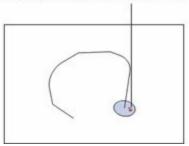
FIGURE 6-2: Using Follow Me to create a simple extruded shape.

TIP If you want to use Follow Me all the way around the perimeter of a face, you don't need to

spend time selecting all the individual edges. Just select the face and then use Follow Me; the tool automatically runs all the way around any selected face.

TECHNICAL STUFF You can use Follow Me another way, too: Instead of preselecting a path (as in Step 3 of the preceding list), you can click any face with Follow Me and attempt to drag it along the edges in your model. Although this dragging method works on simple things, preselecting a path works a lot better — it's really the only option for using Follow Me in a predictable way.

Making lathed forms like spheres and bottles

And nuclear power plant chimneys. A surprising number of things can be modeled by using Follow Me to perform a lathe operation. A *lathe* is a tool that carpenters (and machinists) use to spin a block of raw material while they carve into it — that's how baseball bats are made (the good ones, anyway).

A simple example of a lathed object is a sphere. Here's how you might make one with Follow Me:

1. **Draw a circle on the ground.**

2. **Rotate a copy of your circle by 90 degrees, as shown in Figure 6-3.**

   If you're wondering how to do this, follow these steps:

   a. *Select the face of your circle with the Select tool and then choose Tools ⇒ Rotate to activate the Rotate tool.*

   b. *Press the Ctrl key (Option on a Mac) to tell SketchUp you want to make a copy.*

   c. *Click a green endpoint inference along the edge of your circle and hold down your mouse button to drag. Don't let go just yet.*

   d. *Still dragging, move your cursor to the endpoint on the exact opposite side of your circle; then release your mouse button.*
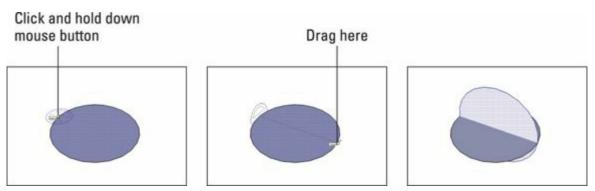
      Your *axis of rotation* is a line right through the center of your circle.

   e. *Click anywhere on the edge of your circle and then move your mouse over a little bit.*

   f. *Type **90** and press Enter.*

   TIP You can read all about the Rotate tool in Chapter 3.

3. **Make sure that one of your circles is selected.**

4. **With the Follow Me tool (choose Tools ⇒ Follow Me), click the circle that's not selected, as shown in Figure 6-4.**

Now you have a sphere. The Follow Me tool lathed your circular face around the path you selected — the other circle.

Click and hold down mouse button

Drag here

Using the Rotate tool to make a rotated copy of a circle.
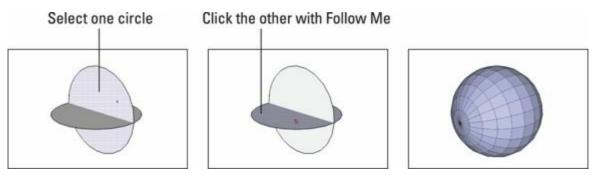
Select one circle

Click the other with Follow Me

Clicking one circle with Follow Me while the other one is selected produces a sphere.

TIP If you really need a sphere, the easiest way to get one is in the Components panel. Type **sphere** into the 3D Warehouse search box, and then press Enter on your keyboard. Something useful should appear.

If you want to make your curved surfaces look *smooth* (hiding the edges between them), check out the sidebar "Smoothing those unsightly edges," later in this chapter.

Under typical circumstances, you only have to model half a profile to use Follow Me to make it three-dimensional. Figure 6-5 shows a few examples of 3D objects created by using Follow Me.
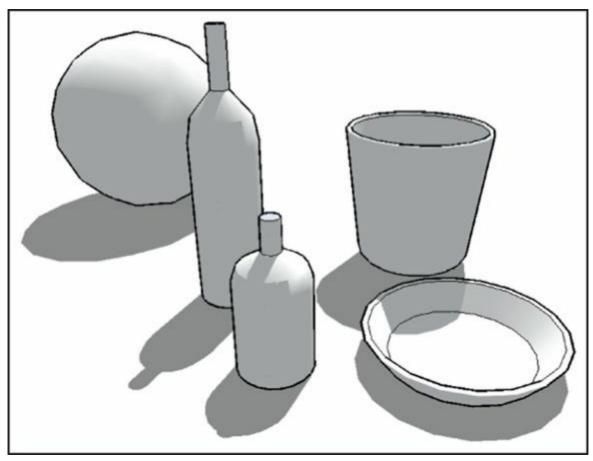
Creating extruded shapes like gutters and handrails

A lot of the time, you want to use Follow Me to create geometry (edges and faces) that's attached to another part of your model. An example of this may be modeling a gutter that runs all the way around the roof of your house. In this case, you already have the path along which you want to extrude a profile (the edge of the roof).

When you use Follow Me to extrude a face along a path that consists of edges that already exist as part of your model, *always* do two things:

>> WARNING **Before using Follow Me, make the rest of your model a separate group.** Take our word for it — Follow Me can sometimes mess up your model, so keep the geometry Follow Me creates separate, just in case.

>> REMEMBER Make a copy of your extrusion path outside your group. There's a consequence to working with Follow Me on top of a group: The edge (or edges) you want to use as an extrusion path aren't available because you can't use Follow Me with a path that's in a separate group or component.

What to do? You need to make a copy of the path *outside* the group and then use the *copy* to do the Follow Me operation. Here's the best way to make a copy of the path:

a. *With the Select tool, double-click your group to edit it.*

b. *Select the path you want to use for Follow Me and then choose Edit ⇒ Copy.*

c. *Exit (stop editing) your group by clicking somewhere else in your modeling window.*

d. *Choose Edit ⇒ Paste in Place.*

You have a copy of the path you want to use, and it's outside your group.

TECHNICAL STUFF The Weld Ruby script is a SketchUp extension that's super-useful for creating extrusion paths for Follow Me. Chapter 16 introduces the Extension Warehouse, where you find SketchUp extensions.

When you use an existing edge (or series of edges) as an extrusion path, the hard part is getting your profile in the right place. You can proceed in two ways; which one you choose depends on what you need to model:

>> Draw the profile in place. Do this only if the extrusion path is parallel to one of the colored drawing axes.

>> Draw the profile on the ground and then move it into position. If your extrusion path doesn't start out parallel to a colored drawing axis, you should probably draw your profile somewhere else and move it into place later.

WHY YOUR COMPUTER IS SO SLOW

When you use Follow Me with an extrusion profile that's a circle or an arc, you create a piece of 3D geometry that's very big. In this case, *big,* means that the geometry has lots of faces, and faces are what slow down your computer. Without going into detail about how SketchUp works (we don't really know that anyway), keep this in mind: The more faces you have in your model, the worse your computer's performance will be. At a certain point, you'll stop being able to orbit, your scenes (introduced in Chapter 11) will stutter, and you'll be tempted to do something terrible out of frustration.

The first pipe in the figure that follows has been extruded using Follow Me; it was made with a 24-sided circle as an extrusion profile, and it has 338 faces. Hidden Geometry is turned on (in the View menu) so that you can see how many faces you have.
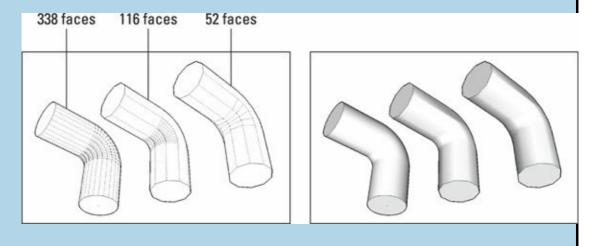
The second pipe uses a 10-sided circle as an extrusion profile. As a result, it has only 116 faces. What an improvement!

The third pipe also uses a 10-sided circle as an extrusion profile, but the arc in its extrusion path is made up of only 4 segments, instead of the usual 12. This pipe has a total of 52 faces. Even better.

The second image in the figure shows all three pipes with Hidden Geometry turned off. Is the difference in detail worth the exponential increase in the number of faces? Most of the time, the answer is no.

To change the number of sides in a circle or an arc, just before or just after you create it, follow these steps:

1. **Type the number of sides you want to have.**

2. **Type an** s **to tell SketchUp that you mean "sides."**

3. **Press Enter.**

Drawing your profile in place

Consider that you have a model of a house. You want to use Follow Me to add a gutter that goes all the way around the perimeter of the roof. You decide to draw the profile in place (right on the roof itself) because the edges of the roof are drawn parallel to the colored drawing axes. This means that you'll have an easier time using the Line tool to draw in midair.

The trick to drawing an extrusion profile that isn't on the ground is to start by drawing a rectangular face. You then draw the profile on the face and erase the rest of the rectangle. Figure 6-6 shows how you'd draw the profile of a gutter directly on the corner of a roof; the steps that follow explain the same things in words:

1. **Zoom in on what you're doing.**

   Many people try to work without filling their modeling windows with the subject at hand. Not doing so is like trying to do a crossword puzzle while looking the wrong way through a pair of binoculars. Get close — SketchUp models don't bite!

2. ✏️ **Using the Line tool, draw a rectangle whose face is perpendicular to the edge you want to use for Follow Me.**
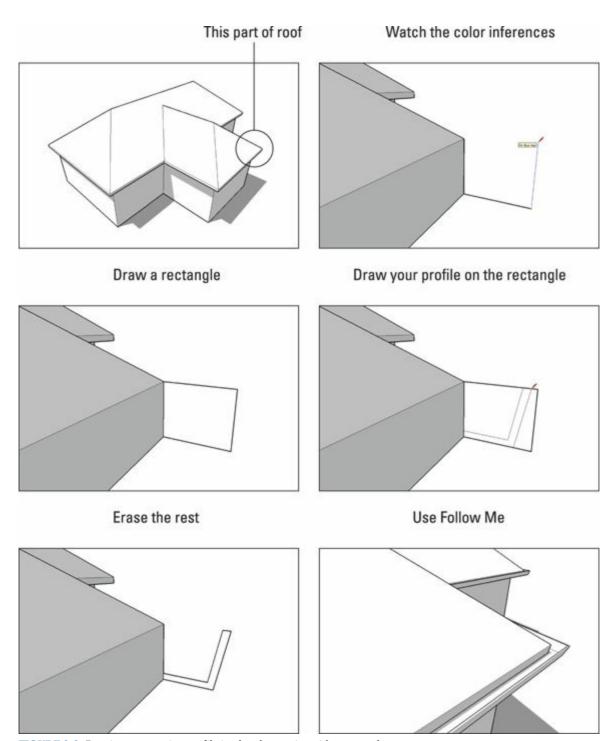
   Pay careful attention to SketchUp's inference engine, introduced in Chapter 3. Watch the colors to make sure that you're drawing in the right direction.

3. **Use the Line tool (and SketchUp's other drawing tools) to draw your profile directly on the rectangle you just drew.**

   TIP The important thing here is to make sure that your extrusion profile is a single face; if it's not, Follow Me won't work the way you want it to.

4. **Erase the rest of your rectangle, leaving only the profile.**

This part of roof

Watch the color inferences

Draw a rectangle

Draw your profile on the rectangle

Erase the rest

Use Follow Me

FIGURE 6-6: Drawing an extrusion profile in place by starting with a rectangle.

Drawing your profile somewhere else

The awful thing about handrails is that they're almost always at funny angles, not parallel to a colored axis. When drawing your extrusion profile in place isn't convenient, draw it on the ground and move it into position after.

Here's the trick: Draw a *tail* — a short edge — perpendicular to your extrusion profile. This tail helps you line up your profile with the edge that you want to use as an extrusion path for Follow Me. The following steps and Figure 6-7 describe how you'd draw and position a profile for a handrail:

1. **Draw your extrusion profile flat on the ground.**

2. **Draw a short edge perpendicular to the face you just drew.**

   This tail should come from the point where you want your profile to attach to the extrusion path.

3. **Make your profile and its tail into a group.**

   This makes it easier to move and rotate around all at once. See Chapter 5 for information on creating and using groups.
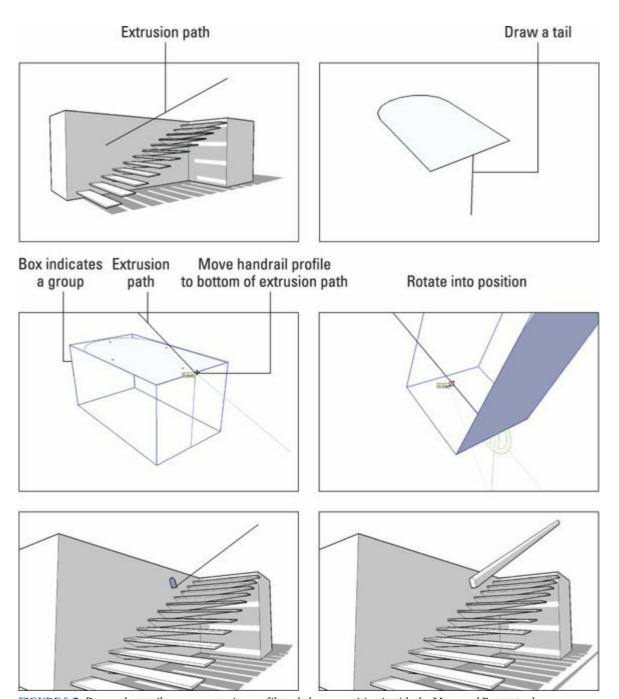
4. **Using the Move tool, place your profile at the end of the extrusion path.**

   To make sure that you position your profile accurately, pick it up by clicking the point where the tail meets the face and then drop it by clicking the end of the extrusion path.

5. **With the Rotate tool, rotate your profile into position.**

   Here's where you need to use a bit of skill. (See Chapter 3 for guidance.) The Rotate tool is easy to use — after you get the hang of it.

6. **Context-click the group you made in Step 3 and choose Explode; delete your tail.**

Extrusion path

Draw a tail

Box indicates a group **Extrusion path** **Move handrail profile to bottom of extrusion path**

Rotate into position

FIGURE 6-7: Draw a short tail on your extrusion profile to help you position it with the Move and Rotate tools.

Subtracting from a model with Follow Me

What if you want to model a bar of soap? Or a sofa cushion? Or anything that doesn't have a sharp edge? The best way to round off edges in SketchUp is to use Follow Me. In addition to using Follow Me to *add* to your model, you can also *subtract* from your model.

Here's how it works: If you draw an extrusion profile on the end face of a longish form, you can use

Follow Me to remove a strip of material along whatever path you specify. Figure 6-8 demonstrates the concept on the top of a box.
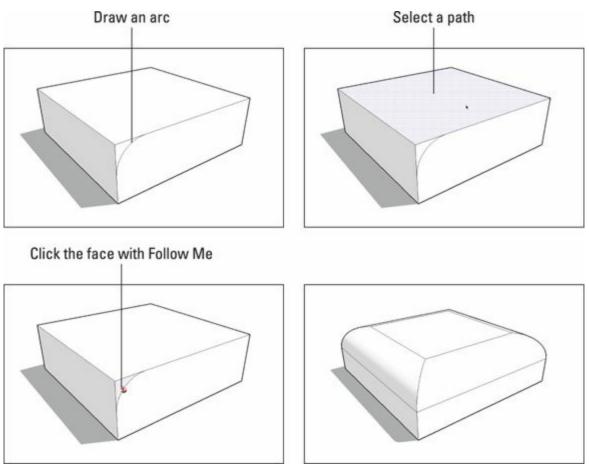
Draw an arc

Select a path

Click the face with Follow Me

FIGURE 6-8: Creating a rounded edge with Follow Me.

TIP If the extrusion path you want to use for a Follow Me operation consists of the entire perimeter of a face (as is the case in Figure 6-8), you can save time by just selecting the face instead of all the edges that define it.

But what if you want to create a corner that's rounded in *both* directions, as so many corners are? That one's a little trickier to do. The basic technique involves using Follow Me on a corner you've already rounded with the Push/Pull tool. After you round a corner with an arc of the correct radius, you can use copies (or component instances, if you're clever) of that corner several times, wherever you need them. Although we wouldn't call this solution elegant, it works.

Figure 6-9 gives a step-by-step, visual account of the process, while the following steps explain it in words, as follows:

1. **Draw a box.**

   The box should be big enough for the round you want to apply.

2. ⬦ **With the 2 Point Arc tool, draw an arc on the corner of the box.**

   When you're drawing an arc on a corner, keep an eye out for the inferences that help you draw properly:

   - After clicking to place one endpoint of your arc, as you cut across the corner, the point at which your line turns magenta is where your endpoints are *equidistant* (the same distance) from the corner across which you're cutting.

   - After clicking to place your second endpoint, you see a point at which the arc you're drawing turns magenta — this means your arc is *tangent to* (continuous with) both edges it's connected to. You want this to be the case, so you should click when you see magenta.

   REMEMBER Reduce the number of sides on your arc before you start rounding away. See the sidebar "Why your computer is so slow," earlier in this chapter, to find out why.

3. **Push/pull down the new face to round off the corner.**

4. **Draw another *identical* arc on one of the corners directly adjacent to the corner you just rounded.**

   This is where you refer to Figure 6-9. Pictures are better than words when explaining things like adjacent corners.

5. **Select the edges shown in Figure 6-9.**

6. **Choose Tools ⇒ Follow Me.**

7. **Click the arc corner face to extrude it along the path you selected in Step 5.**

8. **Hide or smooth any edges that need it.**

   For information about hiding edges, see Chapter 5. Check out this chapter's "Smoothing those unsightly edges" sidebar for the whole scoop on how to smooth edges.
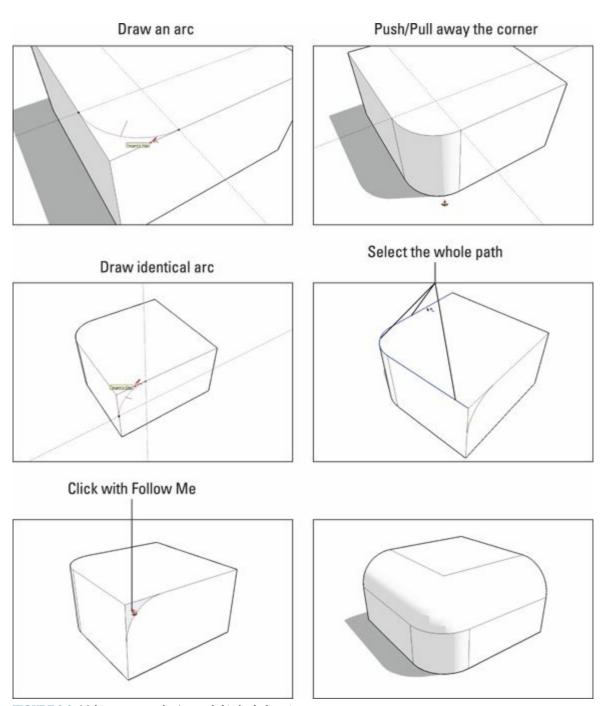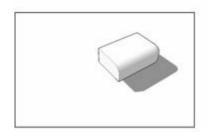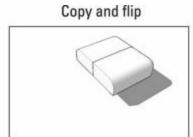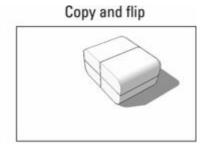
Draw an arc

Push/Pull away the corner

Draw identical arc

Select the whole path

Click with Follow Me

FIGURE 6-9: Making a corner that's rounded in both directions.

After you have a fully rounded corner, you can use a bunch of them to make anything you want; it just takes a little planning. Figure 6-10 shows a simple bar of soap created out of eight rounded corners, copied, and flipped accordingly. The text (in case you're wondering) was created with SketchUp's 3D Text tool, which you can find on the Tools menu.

Copy and flip

Copy and flip

Copy and flip

Hide and smooth edges; then add text

FIGURE 6-10: Assembling a bunch of rounded corners to make objects is relatively easy.

SMOOTHING THOSE UNSIGHTLY EDGES

If you're wondering how to get rid of all the ugly lines that appear when you use Follow Me, the answer is pretty simple: You can *smooth* edges, just like you can hide them. (See Chapter 5 for more information about hiding edges.) The difference between hiding and smoothing is illustrated by the images of the cylinders in the figure that follows:
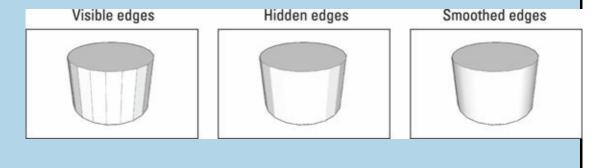
- **When you *hide* an edge between two faces,** SketchUp treats those faces as though your edge is still there — it just doesn't show the edge. Materials you've applied to each face stay separate, and each face is lit separately by SketchUp's sun. The latter fact is the reason why simply hiding the edges between faces that are supposed to represent a smooth curve doesn't make things look smooth — you still end up with a faceted look, as you can see in the second cylinder.

- **When you *smooth* an edge between two faces,** you're telling SketchUp to treat them as a single face — with a single material and smooth-looking shading. The difference is pretty huge, as you can see in the third cylinder in the figure.

You can smooth edges in two ways:

- **Use the Eraser.** To smooth edges with the Eraser tool, hold down the Ctrl key (Option on the Mac) while you click or drag over the edges you want to smooth.

- **Use the Soften Edges panel.** Located on the Window menu, this panel lets you smooth a bunch of selected edges all at once, according to the angle of their adjacent faces. To get started: Select the edges you want to smooth and then move the slider to the right until you like the way your model looks.

To unsmooth edges, follow these steps:

1. **Choose View ⇒ Hidden Geometry so that the Hidden Geometry menu option is selected.**
   This makes hidden edges visible.

2. **Select the edges you want to unsmooth.**

3. **In the Soften Edges panel, move the slider all the way to the left.**

Visible edges   Hidden edges   Smoothed edges

Modeling with the Scale Tool

Real heroes are rarely obvious. The Scale tool is the single most misunderstood member of SketchUp's mercifully limited toolkit. New modelers assume that Scale is for resizing things in your model. That's technically true, but most folks only use it to resize *whole* objects; the real power of Scale happens when you use it on *parts* of objects to change their shape. Figure 6-11 illustrates how Scale can distort basic shapes into more complex ones.
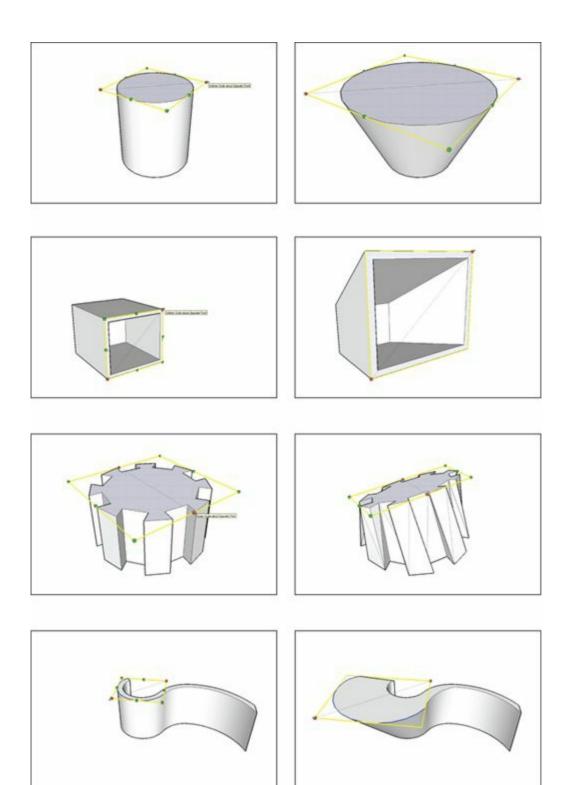
FIGURE 6-11: Using the Scale tool on parts of objects changes their shape.

Getting the hang of Scale

The basic principle of this technique is pretty simple: You select the geometry (edges and faces) in your model that you want to resize, activate the Scale tool, and go to town.

Here's a list of steps, just so it's crystal clear. Figure 6-12 tells the story in pictures:

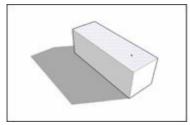1. **Select the part of your model that you want to scale.**

   Use the Select tool to do this; check out Chapter 3 for details about making selections.
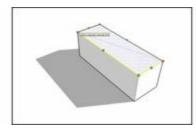
2. **Activate the Scale tool by choosing Tools ⇒ Scale.**

   You can also make Scale active by clicking its button on the toolbar or by pressing the S key on your keyboard. After you activate Scale, the geometry you selected in Step 1 should be enclosed in a box of little green cubes, or *grips*.

3. **Click a grip and then move your mouse to start scaling your selected geometry.**

   Keep reading for the lowdown on the different grips.

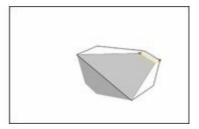4. **When you're finished scaling, click again to stop.**

FIGURE 6-12: The Scale tool is a cinch to use.

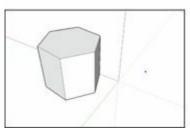While we're on the subject of Scale, here are a few more things you should know:

>> **Use different grips to scale different ways.** Which grip (the little green boxes that appear when you activate the Scale tool) you use determines how your geometry scales:

- *Corner* grips scale proportionally — nothing gets distorted when you use them.

- *Edge* and *side* grips distort your geometry as you scale — use them to squeeze what you're scaling.

>> **Hold down the Shift key to scale proportionally.** This happens automatically if you're using one of the corner grips, but not if you're using any others. If you don't want to distort what you're scaling, hold down Shift.

>> **Hold down the Ctrl key (Option on a Mac) to scale about the center of your selection.** You might find yourself doing this more often than not.

>> **Type a scaling factor to scale accurately.** To scale by 50 percent, type **0.5**. Typing **3.57** scales your geometry by 357 percent, and typing **1.0** doesn't scale it at all. Take a look at Chapter 3 to read more about using the Measurements box while you work.

>> **Type a specific measurement.** If you know the final dimension you're trying to achieve with
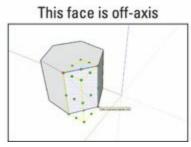
the Scale tool, you can type it in, followed by the units. To scale a 4-foot box until it's 10 feet wide, type **10'**.

>> **Which grips appear depend on what you're scaling.** Have a look at the differences in Figure 6-13.

- Most of the time, you see a scaling box enclosed by 26 green grips.

- If you're scaling flat, *coplanar* geometry (faces and edges that all lie on the same plane) and that plane is perfectly aligned with one of the major planes in your model, you see a rectangle consisting of 8 grips instead of a box with 26.

- If what you're scaling is a Dynamic Component, you may see anywhere from 0 to all 26 grips, depending on how the builder set up the component. Chapter 5 introduces Dynamic Components.

>> TIP   **You can't make a copy while you scale.** Both the Move and Rotate tools let you make copies by holding down a button on your keyboard while you're using them, but Scale doesn't work this way. If you need to make a scaled copy, try this instead:

a. *Select the geometry that you want to scale and copy, and then make it into a group.*

See Chapter 5 for more information on making groups.

b. *Choose Edit ⇒ Copy from the menu bar and then choose Edit ⇒ Paste in Place from the menu bar.*

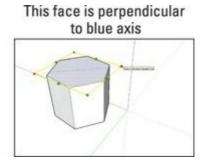c. *Scale the copied group as you would anything else.*

FIGURE 6-13: Grips depend on what you're trying to scale.

Scaling profiles to make organic forms

Here's where it gets really interesting. We need to thank über-SketchUpper Justin Chin (who goes by the handle monsterzero online) for demonstrating the power of scaling profiles to make organic forms. The method is great because it's easy to understand *and* powerful enough to be applied all over the place.

So what is this method? You use the Scale tool in combination with a series of 2D profiles to create curvy, lumpy, distinctly un-boxy 3D shapes. An awful lot of the stuff in the universe fits squarely in this category: us, you, slugs, intergalactic alien fighter vessels, bananas — just about everything that wasn't made by a machine can be modeled using the scaled profiles method of 3D modeling.

TECHNICAL STUFF On the Extension Warehouse, you find the FredoScale SketchUp extension, which is hyper-relevant to the material in this section. After you're comfortable with the techniques we describe in this section, check out the extension. We introduce the Extension Warehouse in Chapter 16.

Combining Scale and Push/Pull

The simplest way to use this method is in association with Push/Pull. Here's a very simple example of how it works. Check out Figure 6-14 for an illustrated view:

1. **Create a 2D shape.**

   TIP This shape may be something simple (such as a circle) or something more complex; it all depends on what you're trying to model. The shape may also be a half-shape if what you're trying to make exhibits bilateral symmetry. Take a look at the last section in Chapter 5 for more information on using components to build symmetrical models.

2. **Push/pull your 2D shape into a 3D form.**

3. **Scale the new face you created so it's slightly bigger (or slightly smaller) than the original 2D shape from Step 1.**

   See the previous section in this chapter for more specifics about using the Scale tool. Pay special attention to the points about using *modifier keys,* or keyboard buttons, to scale proportionally or about the center of what you're working on.

4. **Push/pull the face you scaled in the preceding step.**

   Try to make this extrusion about the same as the one you made in Step 2.

   TIP You can usually double-click a face with the Push/Pull tool to repeat the last Push/Pull operation you did.

5. **Repeat Steps 3 and 4 until you're done.**

   You can add skillful use of the Rotate tool into the mix if you like; doing so allows you to curve
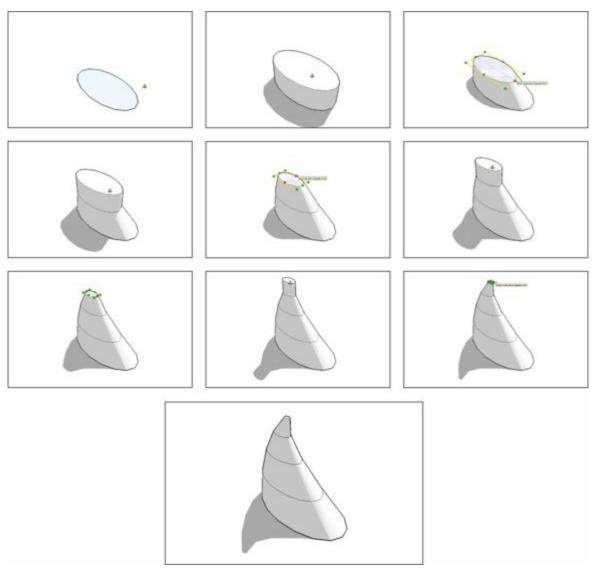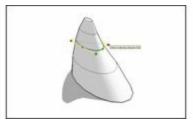
and bend your form as you shape it.

FIGURE 6-14: Using Scale and Push/Pull together is a simple way to make organic forms.

Keep the following tidbits in mind as you explore this technique:

» **Watch your polygon count.** *Polygons* are faces, basically — the more you have, the "heavier" your model becomes, and the worse it performs on your computer. Try to minimize the number of faces you're working with by reducing the number of edges in your original 2D shape. Have a look at the sidebar "Why your computer is so slow," earlier in this chapter, for the whole scoop.

» **Don't be afraid to go back and tweak.** The beauty of this method is its flexibility. While you're working, you can select any of the 2D *profiles* (shapes) in your model and use the Scale tool to tweak them. Just select the loop of edges along the perimeter of the profile you want to scale and take it from there. Figure 6-15 illustrates an example of how you can tweak a shape by scaling.
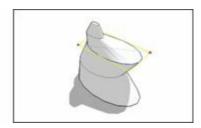
FIGURE 6-15: You can go back and scale any profile at any time while you work.

Combining Scale and Follow Me

Another way to create extruded forms is to use Follow Me. (See the first part of this chapter if you need a refresher.) This technique is ideally suited to making long, curvy, tapered things like tentacles and antlers; it's a little time-consuming but works like a charm.

Modeling a simplified bull's horn is a good, straightforward illustration of how the Follow Me variation of this method works. Here's how to go about it; take a look at Figure 6-16 to see the story in pictures:

1. **Draw a circle.**

   This is the extrusion *profile* for Follow Me. Strongly consider reducing the number of sides in your circle from the standard 24 to something more like 10 or 12. See the sidebar "Why your computer is so slow" (earlier in this chapter) to find out how and why you should do this.

2. **Draw a 10-sided arc that starts perpendicular to the center of the circle you drew in Step 1.**

   Type **10s** and press Enter right after you click to finish drawing your arc.

   This tells SketchUp to make sure your arc has 10 sides (instead of the default 12). Why 10 sides? It makes the math easier a few steps from now.

   TIP The easiest way to create a halfway-accurate arc in 3D space is to start by drawing a rectangle. When you're sure this rectangle is properly situated, use one of the arc tools to draw on top of the rectangle and then delete everything but the arc.

3. **Select the arc you just drew.**

   This is the extrusion *path* for Follow Me.

4. **Activate the Follow Me tool by choosing Tools ⇒ Follow Me from the menu bar.**

5. **Click the circle you drew in Step 1 to extrude it along the path you drew in Step 2.**

6. **Choose View ⇒ Hidden Geometry from the menu bar.**

   Showing the hidden geometry in your model lets you select the edges that were automatically *smoothed* (made hidden) when you used Follow Me in Step 4.

7. **Scale the face at the end of your new extrusion by a factor of 0.1.**

   See "Getting the hang of Scale," earlier in this chapter, for instructions on how to do this. Use

any of the four corner grips on the scaling box, and don't forget to hold down the Ctrl key (Option on a Mac) while you're scaling — this forces SketchUp to scale about the center of the face you're resizing.

8. **Select the edges that define the next-to-last profile in your extruded form.**
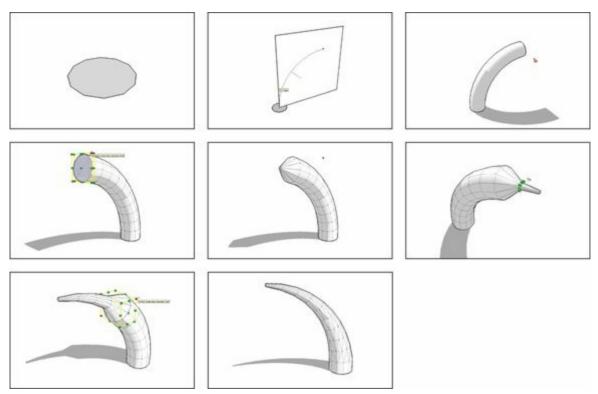
TIP   Depending on the angle of your arc, making this selection can get tricky. Here are some tips that may help:

- See Chapter 3 for tips on making selections.

- Choose View ⇒ Face Style ⇒ X-Ray or View ⇒ Edge Style ⇒ Back Edges from the menu bar to make it easier to see what you've selected.

- Hold down the Ctrl key (Option on a Mac) while you orbit to turn off SketchUp's "blue is up/down gravity bias." While orbiting this way, try drawing lots of tight, little circles with your mouse to get your view to tilt in the direction your want. This is by no means simple stuff, but getting the hang of temporarily disabling the Orbit tool's tendency to keep the blue axis straight up and down is a very nifty way to work. Doing so makes it infinitely easier to get just the right angle for making a window selection. This in turn makes selecting the edges that define profiles a whole lot easier, and that's what becoming a Zen master of the Orbit tool is all about.

9. **Scale the edges you selected in the preceding step by a factor of 0.2.**

Starting to see what's happening?

10. **Repeat Steps 8 and 9 for each of the remaining profiles in your form, increasing the scaling factor by 0.1 each time.**

Of course, you can absolutely choose to sculpt your form however you like, but this method (counting up by tenths) yields a smooth taper.

The Santa-Claus-and-reindeer project illustrates the kind of fancy, not-a-box models you can build after you master the Scale tool. It's not beginner-level material, but it's worth the time when you're ready.

FIGURE 6-16: Use Scale with Follow Me to create long, tapered forms like this bull's horn.

Push/Pull and Scale for the hat

Follow Me for the hat trim

Modified sphere for the head

Push/Pull and Scale for the body and arms

3D Text for the buckle

Follow Me for the coat trim and legs

Push/Pull and Scale for the boots

Follow Me for the antlers

Sphere for the nose

Push/Pull and Scale to make the head, body, and legs

Spheres for the kneecaps