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Beginning Google SketchUp for 3D Printing

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Sandeep Singh

Apress®

Beginning Google SketchUp for 3D Printing

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To my parents, Baldev and Harjit; my wife, Khuspreet;
and my sister, Balveen, for their love and support.

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About the Author

Sandeep Singh is 27 years old and lives in Sacramento, California, with his wife. He currently works as a project engineer providing technical support for Energy Management Software (EMS). He has a bachelor's degree in electrical and electronics engineering from California State University, Sacramento and a master's degree in biomedical engineering from Cal Poly, San Luis Obispo. Sandeep started using SketchUp in 2007 after taking a class in product design and development where he learned how CAD software can be used to prototype models for biomedical prostheses and artificial organs. He found SketchUp to be the simplest modeling software to use and yet advanced enough to design complicated models for his own projects.

When not working on his projects, he enjoys reading how-to books, building things, running, hiking, watching movies, and spending time with his wife.

About the Technical Reviewer

Steve Nieman is a systems administrator/teacher's assistant for a private school in Munising, Michigan. He has earned degrees in accounting and information systems and has completed a course in PC repair. Prior to his current job, Steve enjoyed the privilege of being a stay-at-home dad and raising his three kids.

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Lastly, I would like to thank my parents, Baldev Singh and Harjit K. Singh; my wife, Khuspreet Singh; and sister, Balveen K. Singh, for their love and support while I was writing this book.

Introduction

Welcome to *Beginning Google SketchUp for 3D Printing*. I'm pleased that you chose this book as a companion to guide you in your 3D printing and SketchUp modeling adventures. Whether you're an experienced pro or a seasoned 3D designer, hobbyist, craftsperson, or artist who is new to Google SketchUp and Shapeways, you will find valuable information and step-by-step instructions to help you develop your SketchUp expertise for 3D printing.

The book is divided into three sections. If you are a Google SketchUp and Shapeways beginner, I recommend you start with a close reading of Part I, because it lays out some of the basics of modeling in SketchUp and 3D printing in Shapeways. Those of you who are intermediate to advanced users can skim through the chapters to find what most appeals to you. Part II of the book focuses on developing models in Google SketchUp for 3D printing in Shapeways. Part III is all about presenting and sharing your models. The book concludes with future developments in 3D printing. To set the stage for you to start thinking about 3D printing, I'll introduce the different printing methods for some historical perspective.

Background

Advanced printing technology has been around for many decades now and has become highly advanced since the first printing presses were invented in the 15th century. As the years have progressed, we have seen changes in printing technology, and it's now available in various forms. Table 1 lists the five printing methods that are being used today.

Table 1. *Five Common Printing Methods*

Methods	Descriptions
Screen printing	This form of printing is commonly used to create designs on fabric. Screen printing involves a screen or wire mesh that paint seeps through to create a design. Most designs on T-shirts are screen printed.
Dot-matrix printing	This form of printing was commonly used before the invention of laser or inkjet printers. This printer is slower and nosier than an inkjet or laser printer. The printouts are created from dots. The print head strikes an ink ribbon that transfers a dot of ink onto paper. The alignment of these dots creates the characters on paper.
Inkjet printing	This is the type of printing most commonly used with at-home desktop printers. Desktop printers are relatively inexpensive and can be bought at your local electronics store. Expect to spend anywhere between $30 and $100 for an inkjet printer.

Methods	Descriptions
Laser printing	Laser printers are commonly found in a business setting. The benefits of laser printers are less noise and quick printing, but they are more expensive than the inkjet printer. Expect to spend between $150 and $400 for a desktop laser printer.
3D printing	One of the most advanced printing technologies involves 3D printing. There are several types of 3D printers, including nano printers for printing on the nano scale. There are 3D printers that print various types of materials. You will find 3D printers that use plastic, powder, and paper—and even chocolate and sugar. The possibilities are endless when you think about the types of materials you can use for 3D printing. 3D printers are available in all shapes and sizes. Some take up an entire room, and some can be easily placed on your desktop.

I hope that after reading this book you are encouraged to dive into your own fabricating adventures and try the many new ways of using SketchUp and Shapeways in your daily life.

Who This Book Is For

This book is for anyone interested in learning about 3D modeling and 3D printing. If you're a hobbyist, engineer, architect, or someone who enjoys building things, there are some great things you will learn from this book. If you have never modeled before, you should start with the very basics in Chapter 1 and work your way through more advanced examples in every chapter. If you're coming in with some experience developing designs using CAD software, then you will find this book a great review. You will learn about developing models and preparing them for 3D printing on Shapeways.

What's Covered

In Part I, you'll take a look at Shapeways, where you will learn how to set up an account, order a model, and see the various materials used for 3D printing. You also are introduced to SketchUp and its tools.

Part II is where all the fun begins. Here you learn how to come up with ideas to model in SketchUp and use SketchUp to design models for 3D printing on Shapeways. You learn what types of models are acceptable for 3D printing.

In Part III, you'll see how to share and sell all the models you have designed in SketchUp throughout this book. You'll also learn how they can be animated and how they can be presented using LayOut. The last chapter concludes the book by exploring other ways you can 3D print your models and you are introduced to Ponoko for laser-cutting your models.

Getting the Most Out of This Book

Learning to model in 3D can be difficult, especially if you haven't had any prior experience sketching or modeling. For a blacksmith, it takes many years of practice to design that perfect tool. Now, I don't expect it will take you years to master SketchUp, but there is a slight learning curve. To assist you along the way, I recommend the following:

- Reading this book is the easy part, but applying what you learn is another thing. So, remember to download Google SketchUp and apply all the examples in this book.
- If you are stuck, refer to the example files for each chapter. You can download example files for this book from the Apress web site. Look at *Beginning Google SketchUp for 3D Printing*'s catalog page in the Book Resources section under the cover image. Click the Source Code link in that section to download the example files.
- Although this book tries to cover all the details you will need to design models for 3D printing in SketchUp, there still may be some things you're probably curious about. If you want to learn more about a particular topic, refer to the appendix, where we take a look at online communities you can join to get your questions answered.

PART 1

Getting Your Feet Wet

CHAPTER 1

The Ins and Outs of Google SketchUp and Shapeways

Before you jump in and start the 3D printing process, it's important you learn about the tools used in the development process. With the numerous modeling programs available today, you might ask, "Why should I use Google SketchUp?" I recommend Google SketchUp for two reasons. First, it has an easy learning curve that allows even beginners to create models effortlessly. Second, for such a simple tool, SketchUp offers the user the ability to draw highly complex models. Software such as AutoCAD, SolidWorks, and Blender are also great, but the downside of those modeling packages is the steep learning curve. A beginner might find those software programs intimidating compared to the ease of using Google SketchUp. In the first half of this chapter, I will go through the steps of installing Google SketchUp and introduce you to the SketchUp toolbars.

The second half of the chapter explores the online 3D printing service Shapeways. Shapeways is an online platform for uploading models for 3D printing. By using Shapeways, you avoid having to purchase expensive equipment. The equipment is operated by Shapeways, and all it does is charge you for the cost of the material and service.

Let's not waste any time; by the end of this chapter, the goal is to provide you with enough information to construct a simple model in Google SketchUp and to navigate your way through the maze of options in Shapeways.

Google SketchUp

Google SketchUp is 3D modeling software downloadable from Google. In 1999, @Last Software in Boulder, Colorado, developed SketchUp and then introduced it into the market in 2000, before being acquired by Google. Since then, Google SketchUp has become popular among 3D modelers. What individuals love about this software is its easy learning curve. An individual with no experience in computer 3D modeling could easily learn SketchUp within a few hours of starting the program. With this advantage over other software packages, such as SolidWorks and AutoCAD, individuals with little to no experience can produce designs of immense complexity.

The interface is very simple—a common trait among many of Google's products. This is what especially makes the software package so attractive. The look and feel of the software is what sparked its popularity. It incorporates most of the tools used by software packages such as Microsoft Paint and Photoshop, including Line, Arc, Freehand, Rectangle, Polygon, and 3D Text, which are all common but also powerful tools for modeling 3D structures.

Installing Google SketchUp

You can download either a free or professional version of Google SketchUp online. If you are a beginner or intermediate user of SketchUp, I highly recommend you download the free version, because there is a lot you can do with it without having to pay anything. Most of this book is set up to use the free version of Google SketchUp, but in Chapter 11 we use LayOut, which is a separate software package that comes with the Pro version. I recommend that you wait, read the entire book, and use the free version before investing money in buying the Pro version—unless you are planning to do some serious 3D modeling. The Pro version of Google SketchUp has additional features that allow you to create documents and presentations and comes with an additional tool set called Solid Tools. It also imports and exports a variety of file formats and allows you to create your own custom styles. Now let's get started on our 3D modeling and printing journey.

Downloading Google SketchUp

The free version of Google SketchUp is available for download on the SketchUp home page at `http://sketchup.google.com`. In the upper-right corner of the page, click Download Google SketchUp, as shown in Figure 1–1.

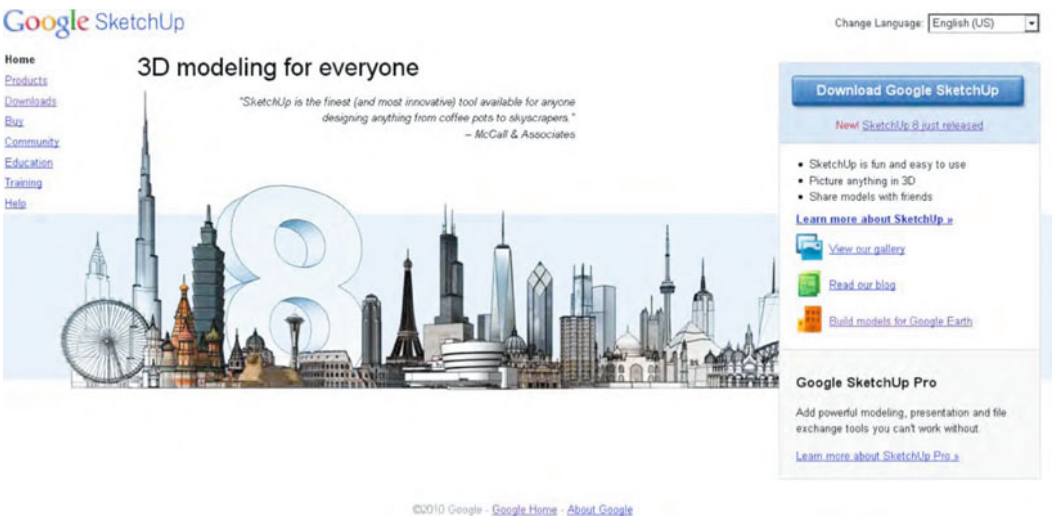


Figure 1–1. *Google SketchUp home page*

You will be directed to a second page to select between two links (Figure 1–2). You can download Google SketchUp Pro or Google SketchUp 8. For now we will be using the free Google SketchUp 8. Click the Download Google SketchUp 8 link to continue the download process.

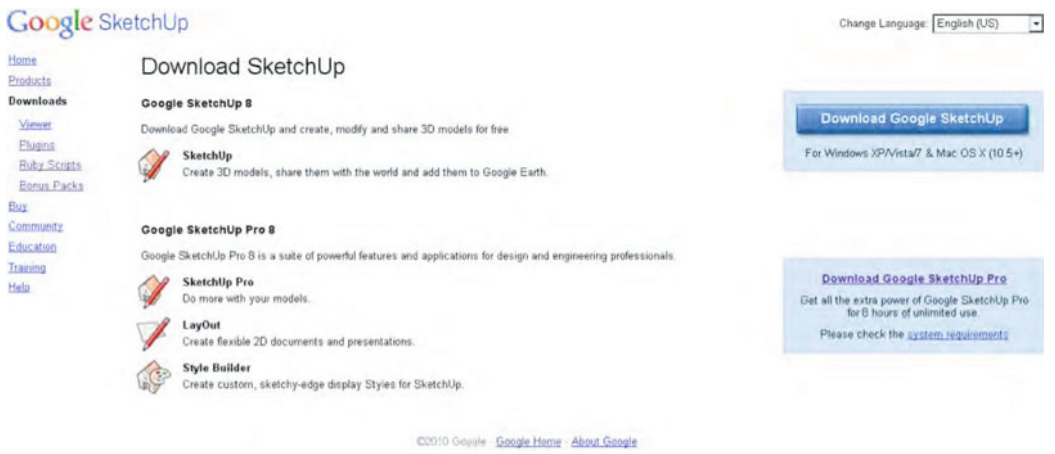


Figure 1–2. *Google SketchUp free and professional version download page*

You are redirected to the agreement page (Figure 1–3). Select the platform you are using, Windows or Mac OS. Then click Agree and Download.

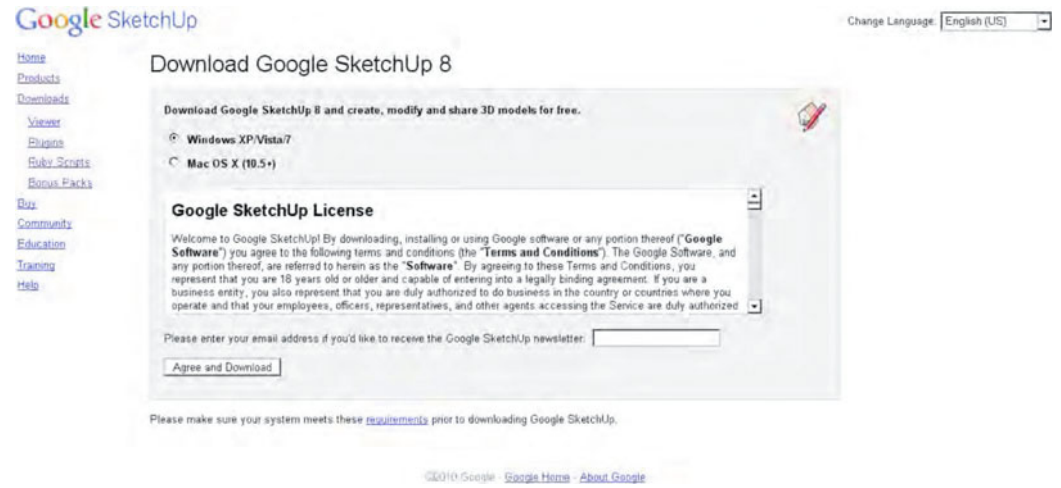


Figure 1–3. *Google SketchUp download agreement page*

Installing Google SketchUp

For Windows users, a download dialog box will appear; click Save File. Remember to save the file in a location you can easily access. The downloaded file is approximately 40MB, so with a DSL connection, the download will take only a few minutes. After the download completes, double-click the executable file. The Google SketchUp 8 Setup dialog box will appear (Figure 1–4). Click Next to continue the installation.

Figure 1–4. *Google SketchUp 8 Setup dialog box*

Select the "I accept the terms in the License Agreement" check box, and then click Next (Figure 1–5).

Figure 1–5. *End-User License Agreement screen*

By default Google SketchUp will be installed automatically into your programs folder. I recommend you stay with the default options at this time unless you have a good idea of where you want to save the file beforehand. Click Next to continue the installation of Google SketchUp (Figure 1–6).

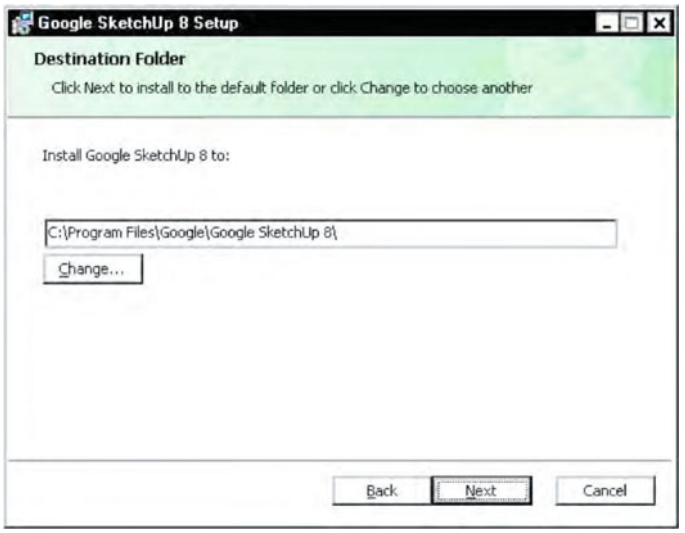


Figure 1–6. *Destination Folder screen*

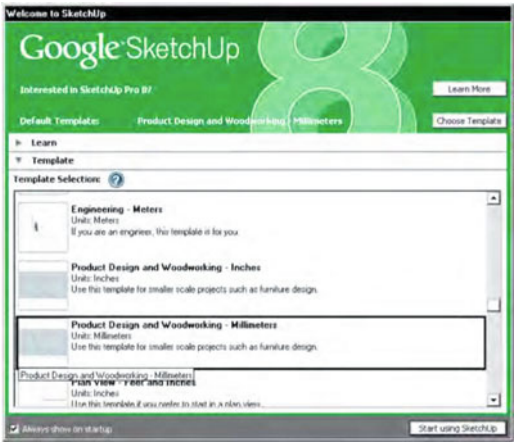
Finally, click Install (Figure 1–7). Google SketchUp will take a couple of seconds to install on your computer. After installation is complete, click Finish.

Figure 1–7. *Ready to install Google SketchUp 8 screen*

User Interface

Once installation is complete, double-click the Google SketchUp icon on your desktop, or select it from your programs menu. When SketchUp opens, you are presented with the Welcome to SketchUp dialog box (Figure 1–8a). On the bottom of the menu, select the Template tab. You are then asked to select a units template (Figure 1–8b). This will be the default template used when drawing models. Since we will be working with small-scale 3D printed models in this book, select the Product Design and Woodworking–Millimeters template. If you do not want the Welcome to SketchUp dialog box to appear again, uncheck the "Always show on startup" box in the bottom-left corner of the window. Then click Start using SketchUp in the bottom-right corner of the dialog box.

a.



b.

Figure 1–8. *(a.) Welcome to SketchUp dialog box; (b.) selecting a units template*

When SketchUp opens for the first time after the Welcome to SketchUp menu, the Instructor dialog box will appear. This dialog box gives you an introduction to the Line tool. You will be using the Line tool to construct a lot of the models throughout this book. For now, you can close the dialog box. On first use of SketchUp, you are presented with only the bare minimum needed to start modeling (Figure 1–9). This allows you to begin using SketchUp and avoid being overwhelmed by too many tools, especially if you're a beginner to 3D modeling. As you gradually get comfortable using the basic tool sets, you can easily activate the advanced tools in SketchUp.

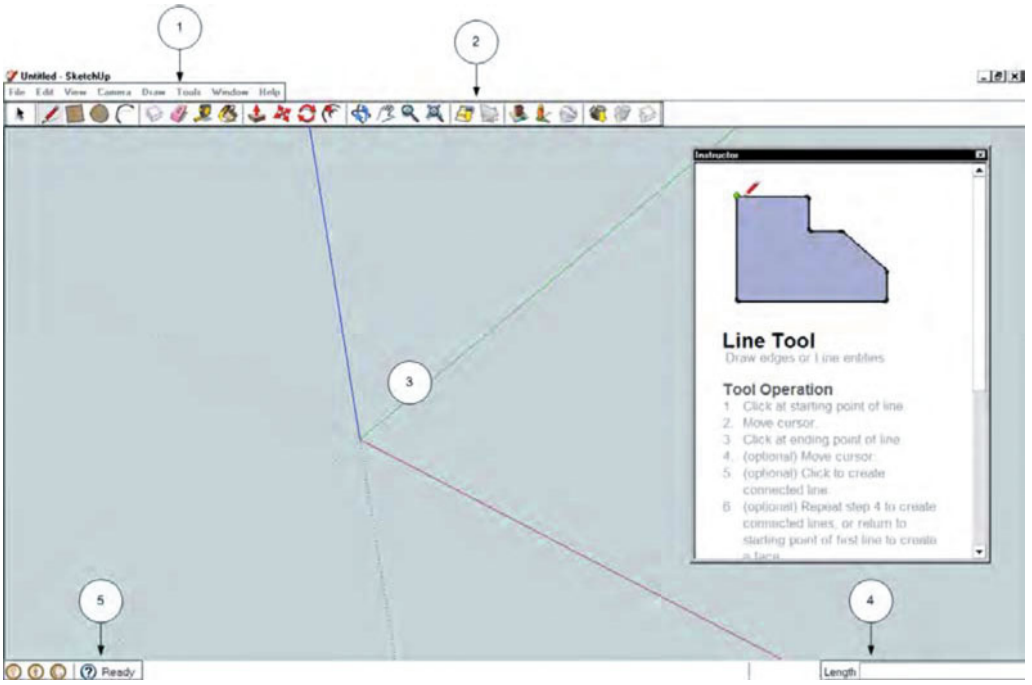


Figure 1–9. *Google SketchUp user interface*

The Google SketchUp user interface is divided into five sections. These are numbered in Figure 1–9 and described in the following list. You will be using each part of the user interface throughout this book, so don't worry about how they work. For now, browse through each menu option and get familiar with their locations in SketchUp. In later sections and chapters, you'll explore each tool's functionality while you develop models for 3D printing.

1. The menu bar is divided into eight menu options. These are File, Edit, View, Camera, Draw, Tools, Window, and Help.
2. The Getting Started toolbar, located below the menu bar, contains the tools you will be using to construct models.
3. The modeling window is where you will spend the majority of your time constructing your 3D models using the tools from the Getting Started toolbar and the Large Toolset. We will be discussing the Large Toolset later in this chapter (see the "Large Toolset" section).
4. The Measurement toolbar is in the bottom-right corner of Google SketchUp. It displays dimensional information about each model and allows you to enter information to adjust model features.
5. The status bar, located on the bottom left of the screen, provides tips on each tool you select while modeling. Keep an eye on the status bar when you are not sure how to use a particular tool while modeling.

Let's continue and learn about the Getting Started tools available in Google SketchUp.

The Getting Started Toolbar

The Getting Started toolbar contains 25 tools, including all the basic tools you will need to start modeling, as shown in Figure 1–10. From the name of the tool, you can probably understand exactly what each does. Table 1–1 explains in more detail each tool's function, based on the numbers in Figure 1–10. In the "Learning by Example" section, you will be applying some of these tools to construct models, and you will get a hands-on feel of how the tools operate.

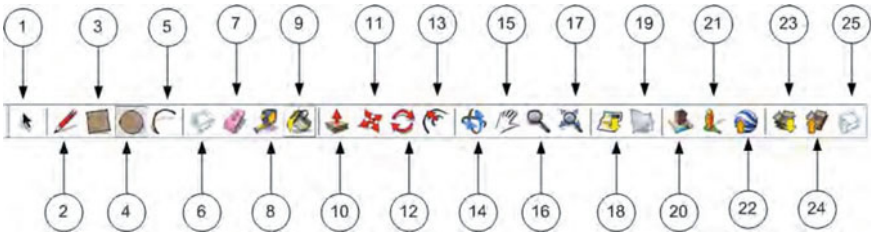


Figure 1–10. *Getting Started toolbar*

Table 1–1. *Getting Started Tools*

Tool	Number	Description
Select	1	Selects objects in the modeling window to be modified with other tools
Line	2	Draws lines forming edges and faces
Rectangle	3	Draws a rectangle or square made of four edges
Circle	4	Draws a circle by defining the number of sides
Arc	5	Draws multiple connected line segments
Make Component	6	Creates a component of selected edges and surfaces
Eraser	7	Erases objects from the modeling window
Tape Measure	8	Measures distance, creates guidelines, or resizes models
Paint Bucket	9	Paints objects in the modeling window
Push/Pull	10	Converts 2D surfaces into 3D models
Move/Copy	11	Rotates components and groups and moves and copies objects
Rotate	12	Rotates and stretches objects in a circular path

Tool	Number	Description
Offset	13	Copies lines and surfaces in line with the first model
Orbit	14	Rotates camera around the object
Pan	15	Moves camera horizontally and vertically
Zoom	16	Moves the camera position in or out
Zoom Extents	17	Zooms to the entire model
Add Location	18	Captures site location where the model will appear
Toggle Terrain	19	Toggles between 2D and 3D while in SketchUp
Add New Building	20	Launches the Google Building Maker
Photo Textures	21	Adds photo textures to buildings
Preview Model in Google Earth	22	Places the model in Google Earth
Get Models	23	Downloads models from the 3D Warehouse
Share Model	24	Uploads models to the 3D Warehouse
Upload Component	25	Uploads components to the 3D Warehouse

Large Toolset

When you open Google SketchUp for the first time, you are presented only with the Getting Started toolbar. To activate the Large Toolset, select View ➤ Toolbars ➤ Large Toolset from the menu bar. You will then be presented with 32 additional tools. Hold the cursor over each tool to display its name (Figure 1–11). Some of the tools displayed are similar to those shown in the Getting Started toolbar. Table 1–2 describes the ones that are not present in the Getting Started toolbar, based on the numbers in Figure 1–11.

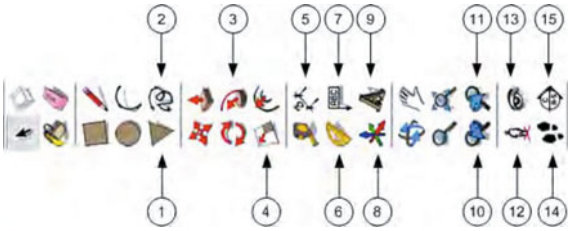


Figure 1–11. *Google SketchUp Large Toolset*

Table 1–2. *Large Toolset*

Tool	Number	Description
Polygon	1	Creates polygonal objects
Freehand	2	Draws hand-drawn lines
Follow Me	3	Extrudes a face along a path
Scale	4	Resizes a model
Dimension	5	Places dimensions in the model
Protractor	6	Measures angles and creates guidelines
Text	7	Adds text to the modeling window
Axes	8	Moves the axes in the modeling window
3D Text	9	Creates 3D text on objects
Previous	10	Goes to previous zoom location
Next	11	Goes to the next zoom location
Position Camera	12	Places the camera at the desired eye height
Look Around	13	Pivots the camera at a single point
Walk	14	Walks within the modeling window
Section Plane	15	Creates cuts to view within your model

The feel of Google SketchUp is very similar to Microsoft Paint. The most common tools you will be using in SketchUp are Move/Copy, Push/Pull, Rotate, Scale, Tape Measure, and Offset. You will be using these tools in most, if not all, of your modeling work throughout the book. With the Move/Copy tool, you

can select an object and move it. By pressing the Ctrl key on your keyboard and then selecting the object, you can create a copy of the object. With the Push/Pull tool, you can extrude any surface of the model. The Scale tool resizes the selected surface or the entire model. Use the Tape Measure tool to draw in guidelines to assist you in modeling, or use it to automatically adjust the dimensions of your model. The Offset tool will create a copy of the surface, which you can shrink or enlarge on top of the surface being offset.

We have just gone over some of the common tools you will be using in SketchUp. In the next section, I will demonstrate how to use some of the tools to draw simple objects. I also recommend you take a leap of faith and let your imagination run wild. Select any tool and simply start drawing.

Learning by Example

Let's start modeling by using the tools in the Getting Started toolbar. For our first tutorial, you'll draw simple shapes in the modeling window, which you will then convert into 3D shapes using the Push/Pull tool.

Modeling a Cube

Open SketchUp, and in the Getting Started toolbar, select the Rectangle tool. The cursor turns into a pencil.

1. Take the pencil, click the center axes, and drag the mouse outward.

   As you are doing this, take a look at the Measurement toolbar. The dimensions of the model change as you drag the cursor outward while drawing the rectangle. As you drag the cursor outward, you will see the rectangle get bigger.

2. Click your mouse once more to lock the rectangle in place.

   You can also add a specific dimension rather than dragging the cursor and trying to estimate the size of your rectangle. Instead of locking the rectangle in place, type the value **500, 500**, and hit Enter on your keyboard. This will create a 500mm × 500mm square instead of a rectangle (Figure 1–12). You will recall that a few sections back we set the default unit as millimeters. If you want to work with inches, meters, or feet, type in the desired unit after each number (500", 500", 500m, 500m, or 500', 500').

   After drawing the rectangle or square, if you are unable to see the model, select the Zoom Extents tool from the Getting Started toolbar. This will readjust the modeling window so that the entire model is visible. To show the size of the square in Figure 1–12, I added dimensions to the sides. Dimensions are not placed automatically when you draw a model in SketchUp.

3. To place a dimension, select the Dimension tool from the Large Toolset, and select the edge of the square.

4. Drag the cursor outward, and click your mouse once to lock the dimensions in place.