

LEARNING MADE EASY



Tinkercad™

for
dummies®
A Wiley Brand



Use the drag-and-drop tools to build 3D designs

Export your designs to have them 3D printed

Share designs with the Tinkercad community

Shaun C. Bryant

Autodesk Certified Professional

Tinkercad™

for
dummies®
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by Shaun C. Bryant
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Tinkercad™ For Dummies®

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Introduction

Welcome to *Tinkercad For Dummies!*

This book has been written for you to get a head start with Autodesk's amazing entry-level 3D modeling app called Tinkercad. Tinkercad is cloud-based, so you don't need any expensive 3D modeling software to get started — just an Internet connection and a computer, such as a desktop PC or a suitable laptop.

You find out about basic 3D modeling concepts and how to use Tinkercad to model simple 3D designs, which in turn you can then 3D print, using the information and lessons provided.

Tinkercad is a great way to get started in the world of 3D modeling and 3D design, regardless of age, experience, and expertise, and this book is a perfect way to get your first step into that 3D world. Enjoy!

About This Book

So why do you need *Tinkercad For Dummies*? Well, this book gives you a great insight in to Tinkercad, world-class instruction that you find in *For Dummies* books, and easy-access organization.

Throughout this book, I follow several conventions:

- » **Bold text** means that you're meant to type the text just as it appears in the book. The exception is when you're working through a steps list: Because each step is bold, the text to type is not bold.
- » If you're reading a digital version of this book on a device connected to the Internet, note that you can click the web address to visit that website, like this: www.dummies.com.
- » Tinkercad is a browser-based app. Therefore, you may find that some of your regular keyboard shortcuts and the right-hand mouse button menu

are not available. You can, however, find a great list of keyboard shortcuts and commands on the Tinkercad blog at <https://blog.tinkercad.com/keyboard-shortcuts/>.

Foolish Assumptions

This book is aimed at the Tinkercad beginner who has general computer knowledge, such as the ability to use a PC/laptop/MacBook, a mouse, and a keyboard. I also use the Microsoft Windows operating system throughout this book, so you may see subtle differences when using Tinkercad on a browser when using a Mac with the Mac OSX operating system.

I also assume that you know how to use an Internet browser. (I use Google Chrome throughout this book as the host browser for Tinkercad).

As Tinkercad is browser-based, you can find a plethora of assistance available on the Tinkercad website at <https://blog.tinkercad.com/>, with numerous help screens and the Tinkercad blog.

Icons Used in This Book

Throughout the margins in this book are little pictures. Here's what those icons mean:



TIP

The Tip icon marks tips (duh!) and shortcuts that you can use to make using Tinkercad easier.



REMEMBER

The Remember icon marks the information that's especially important to know. To siphon off the most important information in each chapter, just skim through these icons.



TECHNICAL
STUFF

The Technical Stuff icon marks information of a highly technical nature that you can normally skip over.



WARNING

The Warning icon tells you to watch out! It marks important information that may save you headaches when using Tinkercad.

Beyond the Book

Extra content is available beyond this book. If you go online, you can find the following:

- » **Sample 3D output files that you can use in conjunction with this book:** Output STL, OBJ, and SVG files from Chapters 17, 18, and 19 are available at www.dummies.com/go/tinkercadfd.
- » **The Tinkercad blog and gallery:** You can find a huge amount of useful information in the pages of the Tinkercad blog at <https://blog.tinkercad.com/>. Here, you find many uses of Tinkercad and user designs. You're also able to converse about Tinkercad with other users. Check out numerous user designs in the Tinkercad gallery as well at www.tinkercad.com/things.
- » **The Cheat Sheet for this book:** At www.dummies.com/cheatsheet/tinkercad, you'll find a roadmap to setting up your drawings and keyboard shortcuts.
- » **Updates to this book:** If we have any, you can find them at www.dummies.com/go/tinkercadfdupdates.

Where to Go from Here

So where do you go from here? Well, if you're like me, you'll follow this book all the way through from start to finish. But that's just how I roll. You may not want to work like that. That's the benefits of a *For Dummies* title, though. The book is not linear. You can start anywhere and then get going, using the book as a reference.

Here are a few suggestions if you want to get straight into designing with Tinkercad:

- » **Part 2, Chapter 6** gets you going with the beginnings of a 3D nameplate to design.
- » **Part 3, Chapter 10** gets you straight into designing a simple skyscraper, with its own helicopter landing pad.

Also, make sure to check out the Part of Tens. These chapters offer some great background information that will stand you in good stead as you start to involve yourself more deeply in 3D modeling.

1

Getting Started with Tinkercad

IN THIS PART . . .

Learn about 3D modeling, the modeling process, and various modeling techniques.

Get started with Tinkercad by creating a Tinkercad account, logging in and out of Tinkercad, and creating a Tinkercad design.

View recent designs, choose options and settings, find the help screens, and visit the Tinkercad Twitter page, gallery, and blog.

Explore the Tinkercad user interface and use the ViewCube, viewing tools, the Tinkercad grid, and keyboard shortcuts.

Explore the 3D tools in Tinkercad, including Copy and Paste, Duplicate, Hide, Show All, Group and Ungroup, Align, Flip, Workplane, Ruler, the Tinkercad Basic Shapes menu, and the Featured Shape Generators and Community Shape Generators.

- » Discovering basic concepts of 3D design
- » Understanding 3D models
- » Looking at the 3D modeling process
- » Comparing 3D and 2D methods

Chapter 1

Exploring 3D Design

In this chapter, you discover all things 3D so that you can understand the basic terminology and concepts of the 3D universe before you go rushing off to the world of Tinkercad.

What Is 3D Modeling?

3D is the abbreviation for 3-dimensional. In the world of *Computer Aided Design* (CAD), *3D modeling* (also known as three-dimensional modeling) is the process or workflow of developing a computer-based (mathematical) model of any surface of an object, regardless of whether it's inanimate (such as a gear wheel) or living (such as an animal or a human being).

3D modeling is done in three dimensions via specialized software and, in your case, Tinkercad. The end product is normally called a *3D model*. Someone who works with 3D models may often be referred to as a *3D artist*.

The 3D model has the advantage that it can be displayed on the computer screen as a two-dimensional image through a process called *3D rendering*. For example, these images are often the uber-cool pictures you see in an architect's slideshow of a new building or house he designed. They also may be used in a computer

simulation of physical phenomena, such as virtual prototype testing to see whether the lighting makes a new product desirable to a given market.

The iPhone is a typical example where lighting is an important facet of the design to highlight all the lovely curves and bevels on the iPhone case. (Can you tell I'm an Apple fan?) The model can also be physically created using 3D printing devices, which is where Tinkercad comes into its own, with the ability to export 3D model files for 3D printing.

3D models may be created automatically or manually. The manual modeling process of preparing geometric data for 3D computer graphics is similar to plastic arts, such as sculpting. Now that does sound complicated, right? It's not. The Tinkercad interface simplifies the manual 3D workflow, allowing you, the Tinkercad user, to manually create your 3D designs and take them all the way to 3D printing.



Tinkercad is classed as *3D modeling software*, which is a class of 3D computer graphics software used to produce 3D models. Individual programs of this class are called *modeling applications* or *modelers*. Tinkercad is one of several 3D modeling applications or modelers that are provided by the San Francisco-based software company, Autodesk.

Figure 1-1 shows a typical example of 3D design.

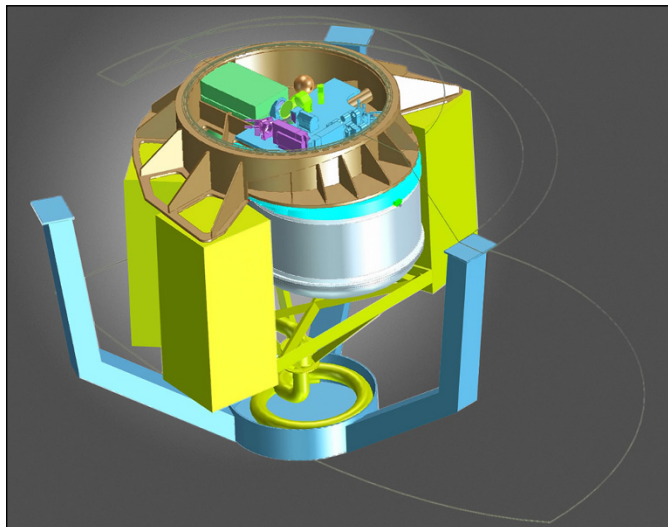


FIGURE 1-1:
The ERS
high-resolution
camera and
spectrograph
concept design
for ESO's Very
Large Telescope.

Credit: ESO/ERIS Phase A Team

3D MODELING IN THE REAL WORLD

As technology and computer hardware have moved forward and become much faster and much more capable, 3D models are now widely used anywhere in 3D graphics and CAD. Their use predates the widespread use of 3D graphics on personal computers nowadays, and many computer games used prerendered images of 3D models as sprites (not the soft drink) before computers could render them in real-time.

Today, 3D models are used in a diverse variety of fields:

- The **medical industry** uses detailed models of organs, which are created with multiple two-dimensional (2D) image slices from an MRI or CT scan.
- The **movie and television industry** uses them as characters and objects for animated and real-life motion pictures in film and television (think *Avatar*, *Star Wars*, and *Game of Thrones*).
- The **video game industry** uses them as assets for computer and video games. If you've used an Xbox, a PlayStation 4, or a Nintendo, you've used 3D assets in the games you've played, regardless of how cartoony or real-life they are.
- The **science industry sector** uses them as highly detailed models of chemical compounds, such as the human genome project.
- The **architecture and construction industry** uses them instead of traditional, physical architectural models to demonstrate proposed buildings and landscapes. However, some of those 3D models then become 3D printed models to show the new building or landscape in place in a city environment, for example.
- The **engineering community** uses them for the design of new devices, vehicles, and structures, as well as a host of other uses, such as nondestructive prototyping.
- In recent decades, the **earth science community** has started to construct 3D geological models as a standard practice. City modeling is now common practice within government departments in an effort to become more environmentally sustainable with the study of light and wind to create a more "green" world in which to live.

3D models can also be the basis for physical devices that are built with 3D printers or CNC machines.

Comparing 3D to 2D Methods

3D photorealistic effects achieved without wireframe modeling can be hard to distinguish when in their final form. Some of the software available has incredibly sophisticated filters that you can apply to 2D vector graphics or 2D raster graphics on transparent layers, making the finished image look remarkably realistic.

However, wireframe 3D modeling has several advantages over the 2D method:

- » **Flexibility:** The ability to change angles or animate images with quicker rendering, because a realistic 3D model is already there to be used.
- » **Easy rendering:** The automatic calculation and rendering is easier as the 3D modeler has built-in algorithms to render realistically rather than mentally visualizing or estimating the rendered image.
- » **Accurate photorealism:** You have less chance of overdoing, misplacing, or forgetting to include any visual effects.

So, what disadvantages are there to 3D?

- » **Software learning curve:** Learning 3D software can take longer as 3D modelers tend to be more sophisticated and have more “under the hood.”
- » **Difficulty achieving certain photorealistic effects:** You can achieve some photorealistic effects with special rendering filters included in the modeling software and specific to a 3D modeler. 3D artists sometimes use a combination of 3D modelers, following that up with 2D editing of the 2D computer-rendered images from the 3D model.

3D modeling makes sense if you’re going to fabricate or manufacture your design. It provides a real-world model that can be viewed from any angle, 3D printed in order for it to be visualized for real, and even submitted for nondestructive testing (such as the outer casing for a cell phone such as the iPhone, for example).

2D, on the other hand, is great for conceptual work. There is no need for full visualization because 2D is great for approximating what a model might look like with no need for a full 3D model to be created, thus saving on time, training, and costs.

Discovering Model Representation

A 3D model is represented either as a full solid or a shell of a solid. Imagine an old-fashioned wooden toy block as compared to a hollow Lego™ brick. Pretty much all 3D models fall into one of two categories:

- » **Solid:** These models define the volume of the object or entity they represent (like a cube, for example). Solid models are often used for engineering and medical applications and are usually built with constructive solid geometry.

In this book, I show you how Tinkercad utilizes solids to make your life easier as you design.

- » **Shell/boundary:** These models represent the surface of an object or entity. The boundary of the object is a bit like an eggshell and forms the object's shell, which is infinitesimally thin. Almost all visual models used in games and film are shell models, with surface properties applied.

Solid and shell modeling can create functionally identical objects, such as the Utah teapot, which is one of the most common models used in 3D graphics education (see Figure 1-2).

The differences between solid and shell modeling are the different methods in which they're created and edited in the various 3D modelers that are used, along with differing conventions of use in various fields.

Another difference is in the types of approximations between the model and reality, such as units of measurement and how the solids, shells, and boundaries are represented.



FIGURE 1-2:
A modern rendering of the iconic Utah teapot model developed by Martin Newell (1975).

Credit: Dhatfield/CC BY-SA 3.0.

Looking at the Modeling Process

Imagine a big, infinite space, such as a galaxy in *Star Wars*. Your 3D models represent a physical object, such as a building, a gear cog, or even a nut or a bolt, by using a collection of points in that infinite 3D space (galaxy). You can connect these points using various geometric entities, such as triangles, lines, and curved surfaces.

Because the 3D model is formed by a collection of data (points and other information), you can create these 3D models by hand (manually), algorithmically (procedural modeling), or scanned (using 3D scanning methods).

You can further define their surfaces with *texture mapping*, which adds physical material attributes, such as brick, metal, or glass.

Creation of a 3D model

You can create a 3D model in one of three popular ways:

- » Polygonal modeling
- » Curve modeling
- » Digital sculpting

These methods, which are described in the following sections, allow for very artistic exploration of the model with topology created over it after the models form and details have been sculpted. The new mesh will usually have the original high-res mesh information transferred into displacement data or normal map data if it's for a game engine. *Meshes* are nets of interconnected triangles.

Due to the accuracy and artistry digital sculpting provides, the 3D modelers used are often installed on tablets using highly accurate styli. Check out the 3D fantasy fish in Figure 1-3 for a typical example of a 3D model. It was modeled using organic surfaces.



FIGURE 1-3:
A 3D fantasy fish
composed of
organic surfaces
generated using
LAI4D.

Credit: Jahurtado/CC BY-SA 4.0.

Polygonal modeling

The points used to create a 3D model are called *vertices* and are connected by line segments to form a polygon mesh. (Imagine a 3D spider web, where it forms a 3D shape, and each line from each interconnecting point forms a 3D edge, and each of these edges forms the 3D model.)

Many 3D models created are developed as textured polygonal models because they're flexible and can be rendered extremely quickly.

The downside, however, is that polygons are planar and can only approximate curved surfaces using many polygons.

Figure 1-4 gives you a good idea of how polygonal modeling breaks down an object — in this case, a human head — into polygons to allow it to be modeled and rendered quickly.

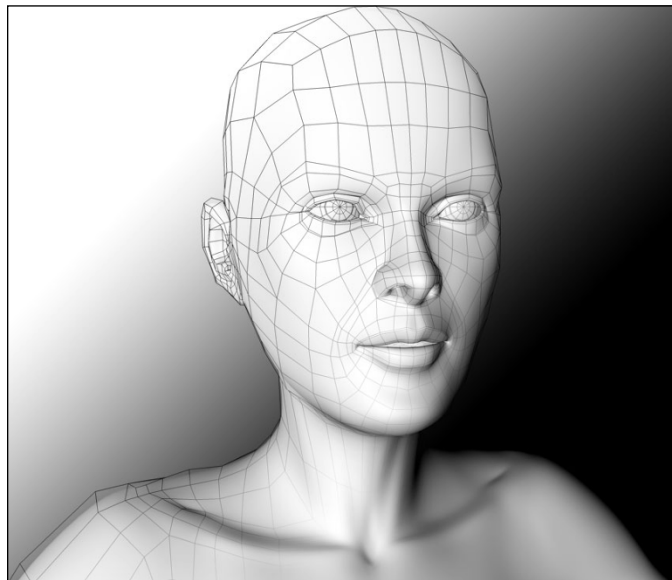


FIGURE 1-4:
Polygonal modeling.

Credit: CC BY-SA 3.0.

Curve modeling

Using curve modeling, the 3D surfaces are defined by curves, influenced by weighted control points, which pull the curves in the appropriate direction.

The curve then follows the points (but sometimes will not interpolate them). If the weighting for a point is increased, it will pull the curve closer to that point.