



ELLERY CONNELL

3D for Graphic Designers

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3D for Graphic Designers

ELLERY CONNELL



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Best regards,

A handwritten signature in black ink, appearing to read 'Neil Edde', with a stylized, cursive script.

Neil Edde

Vice President and Publisher
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To Monica, Kyrstin, Zoe, and Gwendolyn

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About the Author

Ellery Connell is a seasoned professional with well over a decade of experience in interactive media, film, television, web, print, and game design. His personal clients cover the United States, the United Kingdom, and Europe. Some of his notable credits include work for CBS Broadcasting, Inc., Simon & Schuster, *Star Trek Magazine*, the Utah Jazz, Caesars Palace, the Bellagio, and CGChannel.com. Ellery has created numerous professional training series and taught seminars (both live and web-based) covering a wide variety of subjects related to motion graphics, visual effects, 3D modeling, animation, and postproduction.

Ellery spent six years as a bilingual (English/Spanish) graphic designer for Dex Media, now known as Dex One. During his time at Dex, Ellery fulfilled his regular duties and added his expertise to the company by creating training materials, writing Photoshop scripts to enhance and speed artist workflow, and completing various special projects that utilized his unique skill set.

Ellery has a passion for teaching. He has often sought opportunities to work in instructional design. Since 2009, he has been employed as a full-time assistant professor of multimedia at the University of Wisconsin-Stout. During his tenure at Stout, he has helped to develop, update, and enhance courses in 3D modeling and animation, motion graphics, digital narrative, and game design. Ellery has spent years improving his skills in all aspects of his field. He holds an MFA from the Academy of Art University in San Francisco with an emphasis in animation and visual effects.

Introduction

Over the years working as a 3D artist, I have noticed that many of my best clients have been competent (even fantastic) artists. They have had a wonderful grasp of design principles and produce excellent work for clients large and small. The time that I have spent working as both a 3D artist and a graphic designer have lead me to the realization that one key element is missing in the workflow of the modern graphic designer: 3D skills. Clearly, the needs of a graphic designer do not include the depth of knowledge needed by a production 3D artist for film, television, or game design, but a basic understanding can set an artist apart in the field. These skills will open doors for both artists and their employers or clients. This can also save money by dispensing with the need to outsource simple to moderate 3D sections of larger projects. When more-complex needs arise, a solid foundation of 3D design techniques will allow you to interface more easily with 3D artists and streamline the collaborative process.

As an educator, I have found this same lack of 3D instruction within digital foundation courses. In fine arts course layouts, 3D skills are usually included for all artists regardless of their target medium and area of study. The addition of sculpting, pottery, or metalwork classes helps to add breadth to the education of a painter, but that same breadth is rarely offered as an option to artists in graphic design, multimedia design, or other digital mediums. This book is intended to fill that crucial gap as a text for related courses in a digital media curriculum.

This book uses Luxology modo as the software for demonstration purposes. If you are completely new to 3D, I highly recommend modo for its power, modern user interface, ease of use, and high-quality rendering. If you are already using another 3D software package with a moderate level of fluency, most of the skills will transfer to any modern application. If the features demonstrated in the sections of this book are not available in your 3D program, a demo of modo is available for you to use as you work through the exercises in the book. You can download it at www.Luxology.com/trymodo.

Who Should Read This Book

Graphic designers are the main audience for this book. Any artist who may use 3D for visualization or illustration purposes will find the information they need to create great 3D art to support or augment their current workflow. Designers who are outsourcing portions of their current projects, looking to expand their current capabilities, or wanting an advantage in the current job market will benefit greatly from this book. In addition to graphic designers, industrial designers and interior designers can use this book to help increase their capabilities for creating advanced visualization of their designs.

With the increase of 3D usage in marketing, photography, and visualization, the skills taught in this book will be of use to beginning 3D artists who are looking to improve the quality of their output and find new venues for their work. Just as graphic designers can use the lessons to add 3D workflow, 3D artists can use this as a guide to find new clients among graphic designers and businesses looking for these services. In addition, novice 3D users will find that this book is useful for more-concrete training in this subject. Anyone interested in learning 3D modeling, texturing, lighting, rendering, and animation with practical and marketable outcomes should study

the projects in this book.

What You Will Learn

3D for Graphic Designers covers many of the basic principles of 3D design. In this book, you will learn to create many types of 3D models for use in illustration, product visualization, and architectural visualization. The techniques used to add textures to 3D models are also covered for various applications as well as advanced texturing beyond the basics. Scene setup and lighting as well as final render settings will be covered to make high-quality finished works. Even though animation is not a key topic in this book, at times it is useful for graphic designers to know, so a chapter has been dedicated to the basics of setting up simple animation. Upon completing the exercises and reading the chapters in this book, you will be able to create professional-quality works for various purposes.

Hardware and Software Requirements

Hardware requirements for 3D modeling, rendering, and animation are some of the most demanding for any type of computer usage. As a general rule, the best system for your budget is what you should use. Special emphasis should be given to three areas: CPU, RAM, and GPU (graphics card). A fast processor will allow you to make your finished rendered images more quickly and also let you work more smoothly in general. The amount of RAM you have will determine the size and complexity of scenes that you can work with and will also affect the resolution of the final images you can produce. The GPU determines the interactive abilities of your system, so a faster GPU will allow you to model more-complex objects, sculpt with higher-resolution models, and paint 3D textures with greater fluidity and resolution. Since RAM is usually the easiest thing to upgrade, I highly recommend adding as much as your system can handle to make your work more productive and enjoyable. For minimum requirements, see the website of your 3D program. If you are new to 3D and using modo (or trying modo as a new 3D solution), visit the Luxology website at www.Luxology.com.

Most modern computer systems will run modo and other 3D applications for at least basic functions relatively well. So as you begin to work in 3D modeling, rendering, and animation, no major purchases are required to get started!

How to Use This Book

The first section of this book, comprising Chapters 1–4, covers the basics of 3D scene creation. The first two chapters act as an introduction to 3D space, creating and moving objects, and the 3D viewports. Chapter 3 continues to cover basic texture and material creation as well as the creation and implementation of simple UV maps. Chapter 4 finishes this section with a basic look at lighting and rendering a simple but complete 3D scene.

Product visualization is the topic for the second section (Chapters 5–7). In the modeling process, subdivision surface modeling is covered in depth. Chapter 5 covers the processes of object creation and modification, including falloffs, action centers, and edge weighting. In Chapter 6, more-complex texture creation is discussed, including opaque, reflective, and transparent materials. Chapter 7 focuses on lighting appropriate to each type of material in a manner similar to real-world photographic lighting.

The third section (Chapters 8–11) covers modeling, texture creation, lighting, and rendering for architectural visualization. The projects in this section include workflows for both interior and exterior scenes. The modeling in this section is mainly polygonal but also includes the use of subdivision surfaces where appropriate. Efficient use of materials is covered to allow you to make and modify complex material settings quickly. Lighting and rendering appropriate to both interior and exterior scenes completes each of the projects in this section. Chapter 8 details the modeling process for an interior space. Chapter 9 adds texture and lighting to complete the interior visualization. In Chapter 10, the focus is the creation of a building exterior. This includes using reference images, blocking in basic geometry, and using the base geometry to create a complete and detailed model. Chapter 11 continues with the model created in Chapter 10 to add texture, lights, and scenery appropriate to this type of visualization.

The fourth section (Chapters 12 and 13) is aimed at helping you move beyond the basics covered in the first part of the book. Chapter 12 presents advanced material creation to allow you to improve and add complexity to the techniques covered in previous chapters. Post-processing is an important part of any 3D workflow. Efficient postproduction allows a 3D artist to make changes and adjustments in seconds that would take many minutes or even hours if another finished render had to be made. These skills will allow artists to adapt to client needs in a timely manner. Basic animation can be helpful for many graphic design projects, so Chapter 13 covers the basics of adding motion to the work from previous chapters.

How to Contact the Author

You can contact the author at www.sm-graphics.com. You may also go to the book's website at www.sybex.com/go/3dforgraphicdesigners.

Working in 3D

The initial impulse for someone interested in learning 3D graphics is to immediately jump in and start building—trust me, I have been there! While there is definitely something good to be said about diving right in, if you spend a little time creating a foundation of skills, you will have less need to break bad habits later. Before you start creating anything, you need to understand the canvas you will be working with and the elements that will be used in the creative process.

This chapter covers the following:

- Understanding 3D space
- Exploring a 3D scene
- Navigating the modo user interface and its viewports
- Maneuvering views and objects in space

Understanding 3D Space

Maneuvering in 3D space can seem easy at first glance. After all, only one dimension has been added to the standard page layout, and that dimension is what we experience as we move around every day. However, believe it or not, the addition of this dimension can make navigation harder to get used to for the novice 3D artist. If you don't grasp some foundational principles from the outset, you can become disoriented and lose track of your model and scene. The addition of a third dimension adds much more than just another arrow on the monitor.

A standard page layout has two axes: *x* and *y*. If these equate to the horizontal and vertical directions, respectively, then the third axis (*z*) extends off the screen, toward the viewer (see [Figure 1-1](#)).

This works well for starters, but let's take it a step further and look at space in terms of a map or other top-down design. In this case, the plane defined by the *x* and *z* axes makes up the Cartesian plane. More specifically, the negative *z*-axis is north, and the negative *x*-axis is west, in relation to the middle of our workspace (see [Figure 1-2](#)).

The center of space (called the *origin*) will be the starting point for all of our design work unless we specifically need to work in a different area of the scene. Even in this case, it is often best to create an object at the origin and then move it to the desired location, because this will enable you to work with symmetry, easily locate objects, and move the mesh layer, which can then be reset or animated much more easily.

Figure 1-1: Three dimensions from a screen perspective

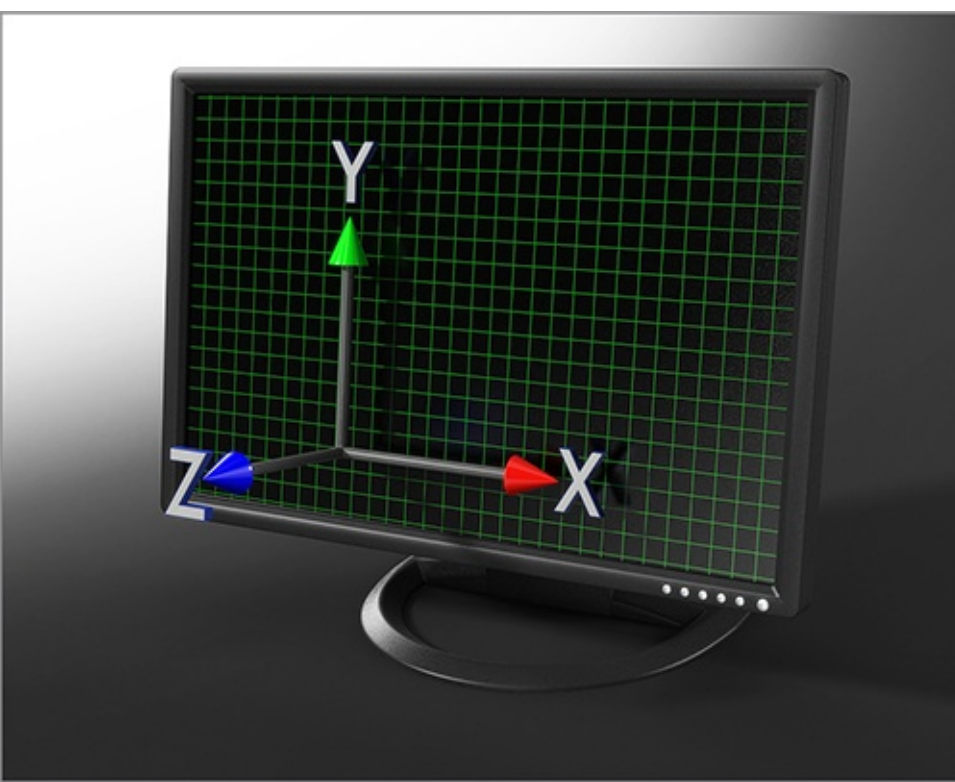
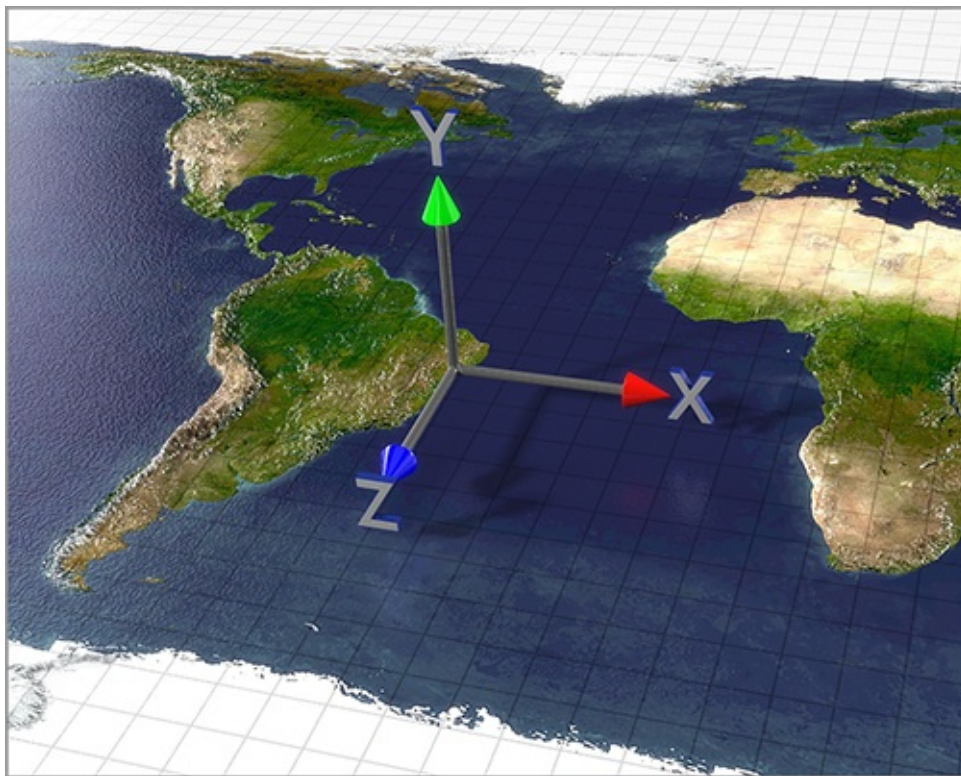


Figure 1-2: Three dimensions from a map perspective



Luxology's modo and many other common 3D applications work by default with the y-axis pointing up. Some applications, however, use z as the up-axis. The modo program allows you to customize this aspect in its preferences. Choose System ⇒ Preferences ⇒ Input ⇒ Accuracy And Units. From the heading marked Coordinate System, you can change the up-axis to z, y, or even x to suit your needs.

You can view a 3D scene through either an orthographic or a perspective view. An *orthographic view* offers a completely flat vantage point of objects, and placement without perspective of any kind. This means that objects located farther from the viewer will not appear smaller as the distance increases. An orthographic view is similar to a floor plan or elevation in architecture. Because it lacks the distortion associated with perspective, this type of view is ideal for creating

and aligning objects.

Modo offers different interface layouts under its viewport tabs. Model Quad gives us three orthographic views and one perspective view. Although these two-dimensional views are initially set to Top, Front, and Right views, they can be changed to any other angle (Bottom, Left, or Back) and to views that include three-dimensional perspective.

Perspective views enable you to see objects and scenes with real depth. There are options to use an arbitrary perspective (the default in the Model Quad layout), camera perspective (based on the default scene camera or any additional cameras that have been added in the creative process), or light perspective. You can completely adjust the first option without changing the scene in any way, but it is important to note that both camera and light perspectives are tied to actual objects in 3D space. Thus, if you move these views, you will actually be moving (or rotating) objects and changing the makeup of the scene. Movement in camera and light perspectives can be reversed with the Undo command, but movement in the generic perspective view cannot be undone.

A common analogy is that if an Adobe Photoshop (or other 2D graphic) image is like a painting, a 3D document is like a sculpture. Two-dimensional art forms (digital and analog) use space, form, and color to create the finished image. Depth and dimension are created through color variation for simulation of light and shadow. Three-dimensional art adds volume to the mix, which offers more-concrete simulation of real light and shadow. Because 3D provides added levels of realism, you need to consider additional parts of the creative process in order to create compelling 3D art.

Exploring a 3D Scene

The next things to consider when beginning to work in 3D are the individual pieces of a 3D scene and the steps in the creative process that will result in a finished project (a model, still image, animation, and so forth). This space is filled with points, edges, and polygons that create the objects. Materials and textures control the appearance of objects. Lights add shading and highlights to the scene. The camera provides the vantage point for the finished scene. Let's look at each of these in more depth.

Points, Edges, and Polygons

At the heart of any model that you will create are three basic elements: points (also called *vertices*), edges, and polygons. **Points** represent a single location in space. The initial impulse is often to think of these as being analogous to pixels in a raster image, but this is not the case. Because a vertex represents a single point in space, it is infinitesimally small and therefore does not appear in a finished 3D render. The fact that the vertex is the basic building block of the 3D creative process means that it is visible only when several are combined to create edges and polygons.

Edges make up the next level in the 3D food chain. When two points are joined together, an *edge* is created. This edge now exists in one dimension and is still invisible to the finished rendering. Once again, this should not be confused with a line in a 2D image file. For both edges and points, it is better to consider a vector illustration without any line weight assigned. Individual points and lines may appear on the page, but they will not print unless some thickness is attached to these elements. To see these elements, you must have a combination of at least three

of them (points and edges), which creates a polygon.

A simple triangle represents the *polygon* at its most basic level. Three points (with three edges connecting them) creates a defined surface. For the most part, four-sided polygons, also known as **quads**, will be the basis for your models. The reason for this will become clear when modeling is discussed in the coming chapters, but suffice it to say that many forms can be more easily defined by quads than by triangles. By combining and blending together multiple polygons, objects take form.

Single-Sided Polygons

Polygons exist as two-dimensional elements within the three dimensions of a scene. The flat surfaces of polygons face in a single direction. Just as the points are infinitesimally small, so polygons are infinitely thin. This means that they are invisible when viewed from the back. Some thickness must be added in order to make the geometry appear from all angles.

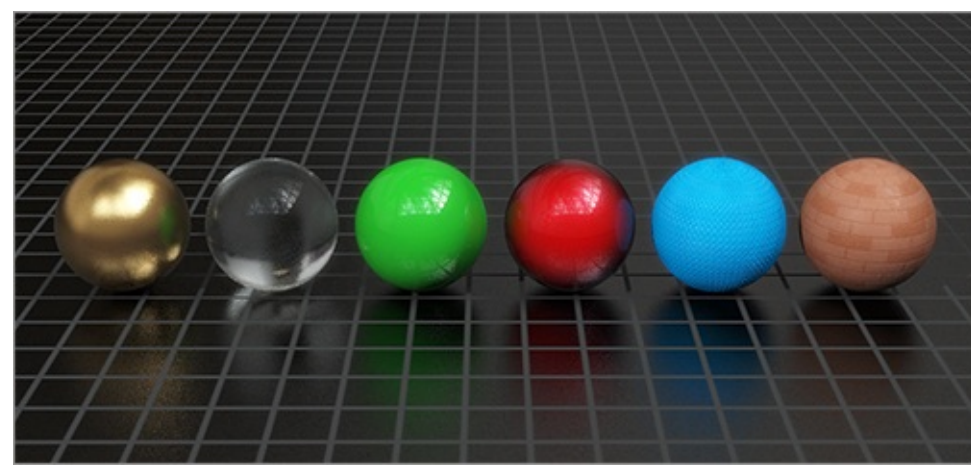
Materials and Textures

After polygons are created, they must be assigned surface attributes to define their appearance. A *material* contains the basic description of how light interacts with a surface. The key components of a material are color, reflection, transparency, refraction, absorption, and emission of light. A material creates these attributes at a very basic level that is defined by either a color or a percentage (depending on the attribute). Proper combination of these properties can create a wide variety of looks and styles. To achieve something beyond the evenly distributed appearance of a basic material, additional layers must be added.

Textures add additional detail to surfaces. Textures are made from either rasterized 2D images or mathematical functions that display colors based on various inputs. Images can be placed on the surface of 3D models and offer a high degree of customization. You can place details exactly where you want them and edit them either by using an application such as Photoshop or by using texture painting inside of modo. The downside of image textures is that they can become pixilated if they are not of a high-enough resolution. Mathematical textures (known as **procedural textures**) are free from resolution and have a fairly wide range of styles, from simple grids and gradients to complex fractal algorithms. These textures, however, cannot be edited directly, so placement of detail is random.

These textures can be used to modulate any aspect of a material. Color can be applied to add variation as well as to colorize reflections or transparent tints. Other possibilities include changing the amount of reflection or transparency, the shininess, the translucency, or even adding the appearance of depth on a surface (see [Figure 1-3](#)).

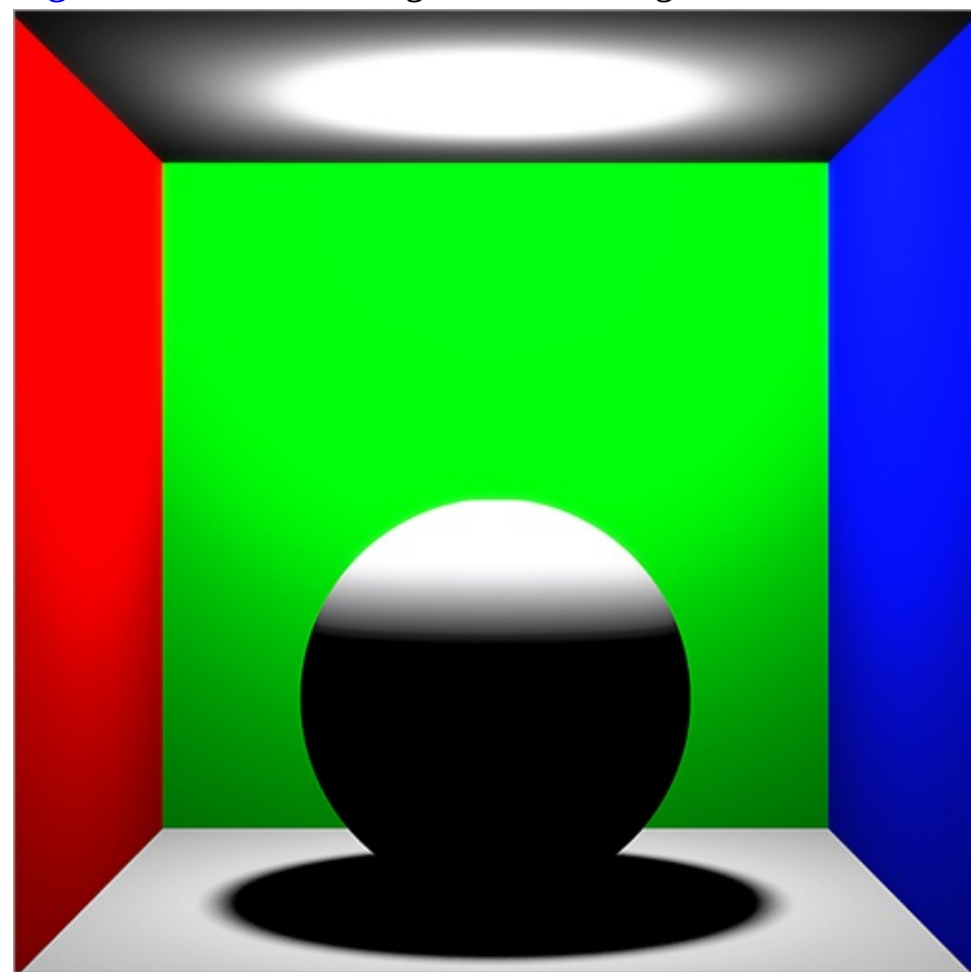
[Figure 1-3](#): A few examples of possible textures



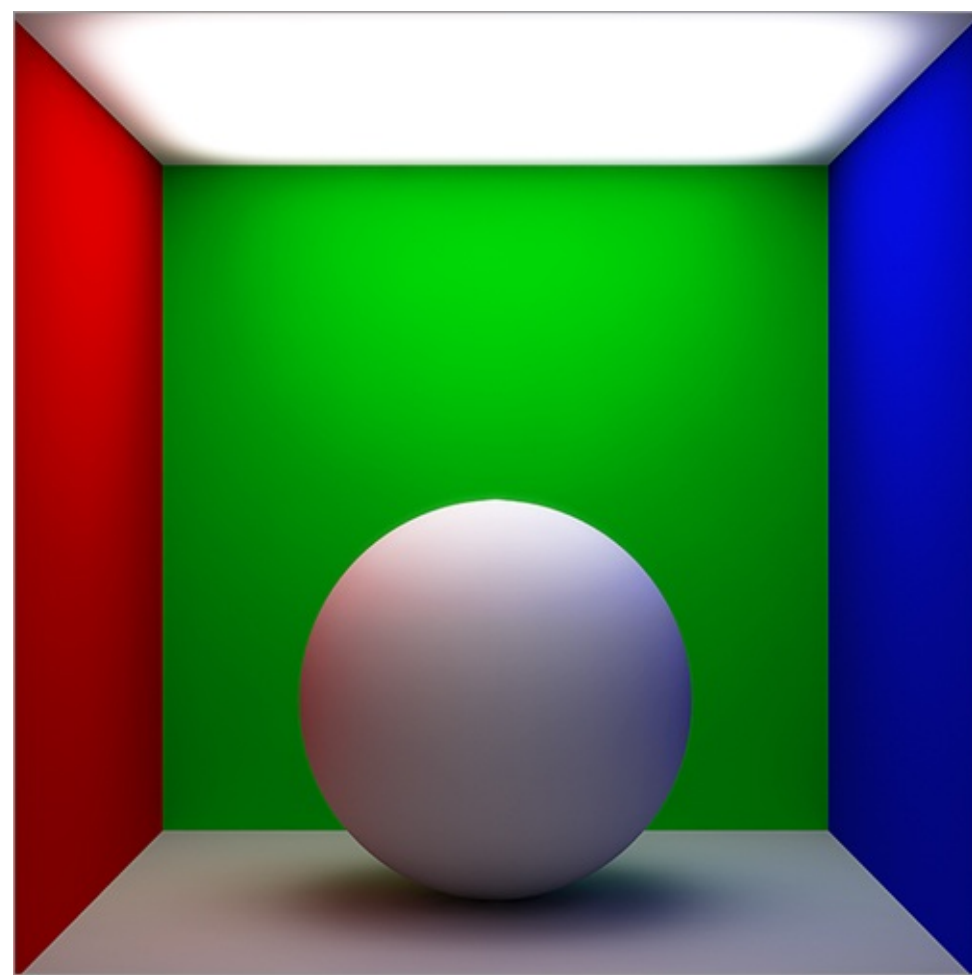
Lights

There are two methods of adding light to your 3D scenes: using computer representations of real lights (*standard lighting*) or casting light from the environment and textures in the scene (**radiosity**). The former is relatively easy to compute and delivers results more quickly. The latter uses more-complex computation and slows the finished image but results in lighting with more subtlety, nuance, and realism. [Figure 1-4](#) shows a simple scene with standard lighting, and [Figure 1-5](#) shows that same scene using radiosity.

[Figure 1-4](#): A scene using standard 3D lights



[Figure 1-5](#): A scene using radiosity for lighting



Traditional lights in 3D space use simple math to add brightness based on an area of influence, light color, and intensity. These lights come in common variations that are seen in most 3D applications. *Distant lights* (sometimes called **directional lights**) are similar to the sun. The actual light comes from infinitely far away and is adjusted by the angle it enters the scene. *Spotlights* simulate their real-world namesake. **Point lights** are similar to lightbulbs and cast light outward from a single point, in all directions evenly. *Area lights* are similar to soft boxes used in studios. Other lights are more situational and are covered in depth (along with the other lights mentioned here) in the following chapters.

Radiosity is also known as **global illumination**, because illumination comes from other angles than just the direct light source. In this lighting model, light is based on light particles (known as *samples*), which project into a scene much like real-world light. As with light particles in the real world, these samples can bounce off surfaces to provide illumination in areas where a light does not have a direct effect. Each bounce of light adds an order of complexity to the calculation and, as a result, causes a slower render time. Because light samples are blended together for the final result, using more of them creates a smoother finished look and (like other quality-improving options) slows the final image production.

In general, a combination of both lighting types gives the best quality and control. However, there are times when using just one or the other can deliver excellent results.

The Camera

The camera in a 3D scene gives the viewpoint for finished images. Cameras appear only as representations in the scene and will not appear when a finished image is rendered (so you don't have to worry about them showing up in reflections). Cameras offer control over many of the

options that physical cameras have. You can control focal length, lens distortion, f-stop, film back, and shutter speed. Although they are simple, cameras are the window into a scene, so using them properly will improve your art and add impact to your designs.

Navigating the modo User Interface

Modo offers visual cues that enable us to keep things straight from an orientation standpoint. In the bottom-left corner of each viewport window, a small axis indicator shows, in the orthographic view, the two axes making up the plane of view. The colored lines point in the positive direction, and the colors always correspond to a particular direction (red for x, green for y, and blue for z). These same colors will appear in tool handles after modeling begins. In the perspective view, indicators are displayed for all three axes. As in the orthographic view, each line indicates the positive direction. In the perspective view, there is also a light gray square that aligns itself to the two axes that are most perpendicular to the current view. This square indicates the orientation of the work plane, which is presented in more depth in Chapter 2, “Creating Objects.” By staying aware of these markers, we can more easily keep the scene aligned.

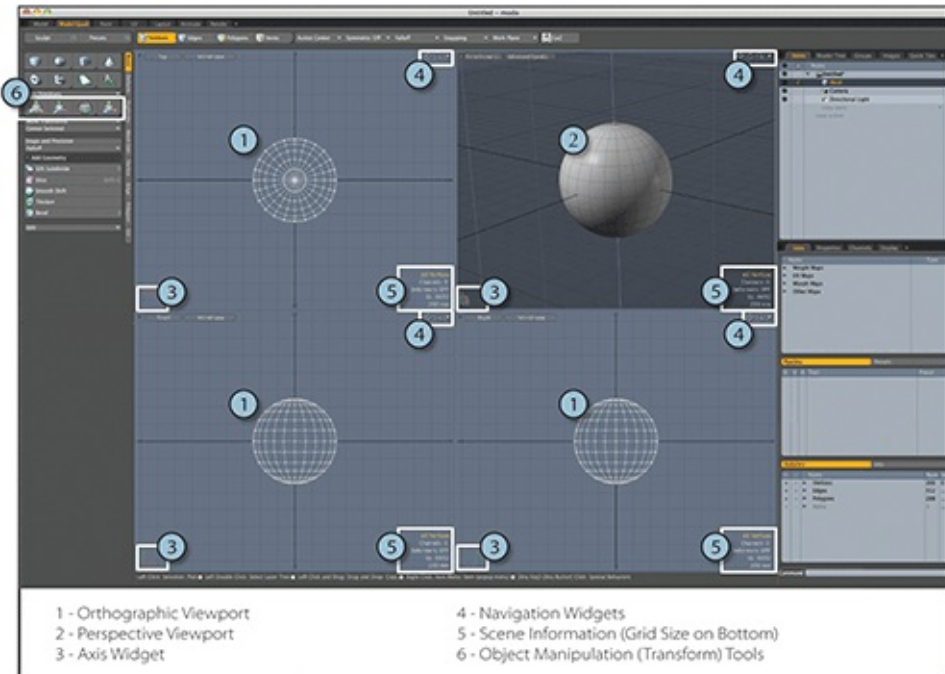
In addition to the axis widget, the perspective view offers a gradient background that helps to keep us from looking at our scene upside-down (or enables us to more easily get there if that is our desire). The background consists of a two-color gradient: a light blue-gray color indicates up, in the positive y direction (think of the sky); and a darker shade of the bluish color fills the negative y direction (indicating the ground). Because we spend a lot of time rotating around our objects to get the best view, staying aware of this gradient ensures that we keep our feet on the ground, so to speak.

Before you move on to navigating this space, you need to know about scale. You may notice that there are no document boundaries in 3D space as there are in a page layout document, at least not visible ones. What we do have to consider is the depth that the computer is able to re-create. This is called *draw distance*. A good example of a short draw distance can be seen in older racing video games. As you drive along a course and look into the distance, objects (such as buildings, trees, and mountains) will appear rather suddenly instead of growing from small points on the horizon. Although modern 3D applications are much more capable of handling distance than those games were, we want to keep draw distance in mind and create our scenes at (or near) actual scale.

In the bottom-right corner of each modo viewport, a display shows the scale of the small grid boxes. By default, the three orthographic views are linked together, but the perspective view is independent. Because modo uses physical scale for many aspects of lighting and texturing, it is important to check your scale as you begin to create models in 3D space. I have seen many students (and, regrettably, myself) create large sections of scenes only to realize that the pencil onscreen is as large as an oak tree—or bigger! In the 3D view, you will also see a light-colored grid that changes position and orientation based on your perspective. This is the Work Plane, and it is a huge help when you begin modeling objects.

[Figure 1-6](#) is a breakdown of the modo user interface (UI) with labels for the features that are pertinent to this section.

Figure 1-6: The modo user interface



Maneuvering in 3D Space

Now that you have a basic understanding of our canvas, you are ready to start maneuvering the viewports to get the best view for any part of the creative process. In a 2D application, the view controls are simple and are limited to panning, zooming, and rotating the canvas. Interestingly, the addition of just one more navigational feature significantly complicates the way that we interact with the environment.

Panning and zooming are relative to the perspective of the user, so they do not change much. There are two ways to pan in 3D space: by clicking and dragging on the pan icon in the upper-right corner of the view or by holding Alt (Windows) or Option (Mac) while clicking and dragging.

Zooming can be achieved via one of three methods. As with the pan tools, there is a zoom widget in the upper-right corner (this one zooms directly toward the center of the view). Holding Alt+Ctrl (Windows) or Option+Control (Mac) while clicking and dragging zooms based on the position of the cursor. By using this method with the right mouse button, a zoom area can be selected. This creates a box, and the area inside will zoom to fill the view after the mouse button is released. Finally, you can zoom with the scroll wheel. This last option is also context sensitive and will zoom toward the cursor position.

While in the camera view, using the Alt+Ctrl / Option+Control key combo with the right mouse button adjusts the focal length of the camera and enables you to zoom in and out, as opposed to actually moving the camera in and out in space.

The real complication comes with rotation. Rotation works based on the combination of two axes. Consider the way we rotate in two dimensions. With the x and y axes covering the screen horizontally and vertically, we can rotate along the perpendicular axis (in this case, z). Because only two axes are present, we can rotate in only one dimension. The addition of the third axis adds two more possible rotation options, as we now have three planes to consider (xy, xz, and yz). As if this did not complicate things enough, there is one more point to consider: the center of rotation.

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