3ds Max Basics

for Modeling Video Game Assets

VOLUME TWO

Model, Rig and Animate Characters for Export to Unity or Other Game Engines

Bill Culbertson

CRC Press
Taylor & Francis Group

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Contents

Acknowledgments

Writing this book was an adventure in finding ways to create characters that would be basic in their construction, yet be appropriate for meeting the project goals. Thanks go to my colleagues for their feedback and reviews. Special thanks to Jordan Dubreuil for his help with creating the Unity Environment Package and the ThirdPersonCharacter Package with scripts for importing the characters into Unity.

Thanks again to Autodesk for creating some amazing software. Thanks to New England Tech for the opportunity to teach and work with their students and the Video Game Department faculty.

Thanks to Focal Press and Sean Connelly for this opportunity.

A special thanks to my amazing wife and family for putting up with and allowing me to go on a bizarre and wild career path, from sculpting toys to monumental public art, from designing theme park amusement rides to creating video games. Somehow it all fits together, a truly great adventure.

Author

Bill Culbertson, Creative Director/Owner Whooplah LLC, has traveled along several diverse paths that crisscrossed, overlapped and eventually merged together. He is a Fine Artist, Commercial Artist, Corporate Director, Freelancer, Entertainment Media Producer and Professor.

A graduate in Fine Art at Towson University in Maryland, Culbertson earned a Master of Arts degree from the Rhode Island School of Design, Providence, RI, USA. Commercially, he began his career at Hasbro, Inc., as an industrial designer in Research & Design. Within a short time, he was the Director of the Sculpture Department, guiding the sculpting of the company's popular toy lines such as G.I. Joe and My Little Pony. Moving into the freelance community, he developed an international clientele including manufacturers, theme parks and cruise lines. Specializing in licensed characters, he worked extensively with The Walt Disney Company, Jim Henson Company, Sesame Street Workshop, Nickelodeon and others. As an inventor, Culbertson is responsible for a number of manufactured toy concepts. Additionally, he created and produced the award-winning puppet show, "Li'l Rhody!" for Rhode Island PBS.

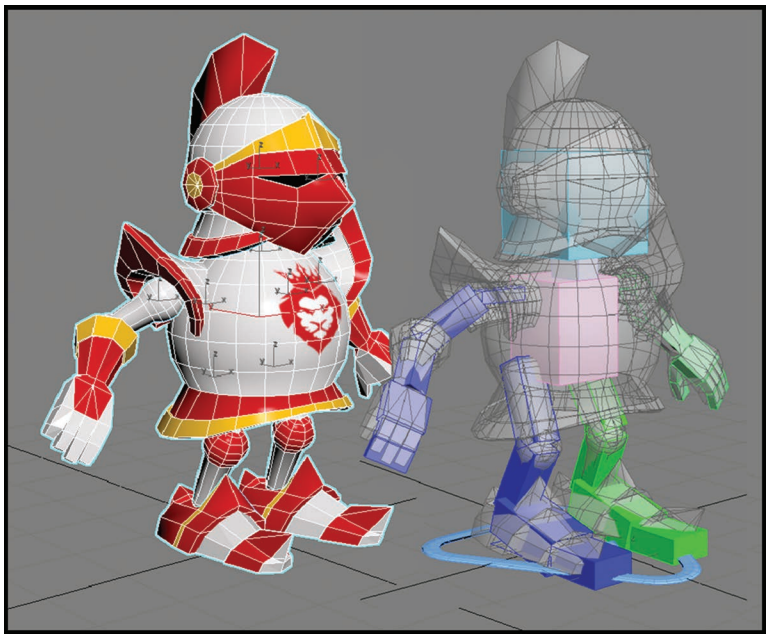
As a fine artist, Culbertson has been recognized nationally and internationally for his work through numerous large-scale public art works. He has been distinguished as a Copley Master by the Copley Society of Boston.

As the founder of Whooplah LLC, Culbertson is committed to creating family-fun entertainment that helps parents meet and exceed their parenting goals. The company's first game released, "Pollywog Pond," is an early learner portal to reading, music, videos, games and more. In 2019, Pollywog Pond was nominated for a Kidscreen Award for Best Video Game – Original. In 2021, Pollywog Pond is scheduled to be released as a children's television series co-production between Whooplah and RI PBS for national distribution.

As a Professor at the New England Institute of Technology in Rhode Island, Culbertson is a member of the nationally ranked Video Game Development and Design Department. With over 18 years of post-secondary teaching experience, his teaching emphasis is in 3D modeling, animation and game development.

For more information, please visit: Whooplah.com and PollywogPond.com

Introduction



Welcome to Volume II of this book series. In volume I, we covered the basic workflow pipeline for modeling and the basic tools in 3ds Max. In doing so, we modeled and textured modules to assemble a castle. The modules were all based on geometric forms. We created the models for the environment using "hard modeling." We then exported the completed the castle to the Unity game engine and moved around our creation.

In Volume II, we will be modeling some basic characters for our medieval castle environment using "soft modeling" techniques, models that are more organic in construction. We will use a couple of different types of bone rigging methods to allow us to animate the characters. When the characters are complete, we will import them into our Unity Castle scene from Volume I. Completing these projects in the order they are presented is recommended, as the concepts and techniques are organized in a progressive order, building your skills and knowledge in a step-by-step lesson format. As in Volume I, during the process of creating these objects, you will repeatedly use the tools and techniques to reinforce and gain mastery of them.

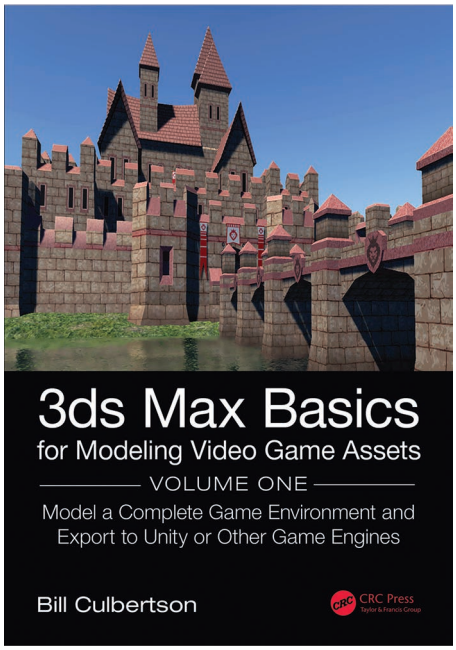
Please remember that, while using 3ds Max, you will find that there are typically two or three different ways to do the same or similar procedure that yield the same result. Some procedures may be easier or more efficient to use than others. Personal preference can come into play. For example, some people prefer hotkeys, some people prefer floating menus, some like using the toolbar menus. 3ds Max is a flexible software in that almost everything in 3ds Max is customizable. We will use certain methods, so you will be familiar with them.

Note:

> If you have not completed the project chapters in Volume I of this series, I would recommend you stop here and complete the lessons in that book. We will not be covering many of the tool basics that were covered in Volume I in this text. The projects in this book were created assuming you have completed those projects and are ready to build on your acquired skills. If you find yourself getting lost or confused while working on the projects presented here, that may be the cause of the problem.

The main target audience for this book is the potential modeler for video game assets. In the current state of the hardware available, video game assets need to be on the low end of the Polygon count spectrum to keep the game running with a minimum of lag. We will be striving to keep the models low poly: using as few polygons is necessary to create the assets. Although the text targets video games, the same principles of modeling will apply for other industries: simulation, film, animation, architecture and others.

Another goal of both volumes of this series is to give the reader a taste of what it might be like to work in a game studio as a modeler. In Volume I, we worked with our imaginary video game company's Game Design Document (GDD) to guide our design decisions for the castle modules. In this volume, we will return to the GDD as a guide for modeling our characters.



Character Design

Topics in This Chapter

- Game Design Document
- Sourcing Reference Materials
- Developmental Sketches

Concepts/Skills/Tools Introduced in This Chapter

- Character Sheet – Turnaround
- Scene Set-Up with Templates

Where to Start?

There have been tons of references written on character design and development. They all start with an idea that establishes the direction the character development will take. As designers at our fictitious game company, we too need a starting point for creating characters for our game. In most cases, there is

a definite starting point for our process. That would be the Game Design Document (GDD). We referenced it in the creation of our castle modules in Volume I. From it, we gleaned the parameters that the game designers for our game defined. The GDD gave us the style, tone, size and look desired for the modules as well as the polygon and other limiting parameter required.

For our characters, we will also need to first reference our game's GDD. In our role in the company as modelers it is typically not our responsibility to define the character for the game, our role is to translate the character's defined characteristics provided in the GDD into a visual model. In some books, chapters similar to this one might discuss character development: what makes the character "tick," their wants and desires, etc. As modelers, we are interpreting an already defined character description. Sometimes reference to work from will be provided, sometimes not.

Referring to our company's GDD information about characters, I have summarized the following as a refresher of our game and what we modeled in Volume I:

Game Name: Castle Keep: Red vs. Blue	
• General Features	3D Medieval Environment, Multiplayer, FPS
• Gameplay	"Capture the Flag," Two Kingdoms, the Red and the Blue
• Game Engine/Editor	Unity 3d
• Player Characters	King, Queen, Knight on Horseback, Knight, Dragon
• Environment	Hand-painted, medieval fantasy
• Castle Modules	Curtain Wall, Fixed Bridge, Gate House, Turrets, Keep
• Castle Accessories	Wooden Table and Chair, Wall Torch, Wine Barrel, etc.

Look specifically at the character information. The GDD lists five characters: The King, the Queen, the Knight on Horseback, the Knight and the Dragon. We will be modeling and rigging the Knight on Horseback, the Knight and the Dragon together in this book. The King and Queen will be assignment exercises you can complete on your own.

Let's use the Knight as our first figure to design, model and rig. Referring to the GDD for character parameters for this character, we find the following:

Game Castle Keep, Blue vs. Red	
• Who	Character: Knight In the game, the male Knight serves as the main infantry soldier. The Knight has the ability to attack other characters and objects by swinging/slashing a hand-held sword. His movement is strong, skilled and confident. He's not hesitant, ready to fight on command.
• What	The Knight is a biped figure. The character has a cartoonish look. For his proportions, he stands three "heads" high. He wears a stylized suit of armor (creating an air of confidence/tough guy) that allows free movement for running, jumping and swinging his sword for attack. The character has markings that can be used to assign the character to either the Blue or Red team (one character used for both teams with different skins).

• When	The character is middle to late medieval time period, refined armor and weapons, appropriate to the modeled environmental castle modules.
• Where	The Knight will fight at the ground or surface level (regular gravity). • Movement: WASD movement with jump, arm sword swing • Animations: Idle, walk, run, jump, attack (sword swing), die
• Model	
	Poly limit: 4000 poly limit (low poly)
	Height limit: 1.5 m (scaled to castle environment: fits through doorways)
	Complexity: Can be simple, non-deformation

There is some key information in the above character description. We have been given the impression the character is a short, feisty guy who is comfortable in his armor. He will be a low poly character of 4000 polygons. His proportions of three heads high give him a cartoony look. Because he can be a non-deformable character, we can design him with multiple parts that can be rigged using just linking. I will be creating our design based on this information.

References

Our next step would be to start gathering some references for the character design. We want to be sure our reference includes some actual armor, so we are not just working from someone's interpretation of armor, like a 3d model. The following are some of the images I found.

IMAGE 1.1 © Shutterstock. Used with Permission.

IMAGE 1.2 © Shutterstock. Used with Permission.

The images above show typical medieval armor construction. The torso and waist areas are covered with armor pieces. The helmet visors on these two samples are different styles: one opens in the up direction and one in the downward. The elbow and knee areas are covered with separate, spherical cover pieces. The leg pieces shown in Image 1.3 of reproduction armor shows similar knee shapes. Note the separate toe covering pieces that allow foot movement.

IMAGE 1.3 © Shutterstock. Used with Permission.

The armor image to the right shows the shoulder flairs for jousting. The shapes echo the shapes used on the helmet. The pointed shapes add a sense of flair to the image, adding some visual flair and movement.

These are just a few images of the several dozen I collected as reference for designing this character. The ones here appealed to me as a collection that I could envision coming together to form our Knight. The next step is to start sketching to explore some possibilities. As you can see, I started with some loose sketching, exploring different possible directions to go. I am working on both three-quarter views and orthographic views (front and side), exploring different proportions and looks.

IMAGE 1.4 © Shutterstock. Used with Permission.

Design

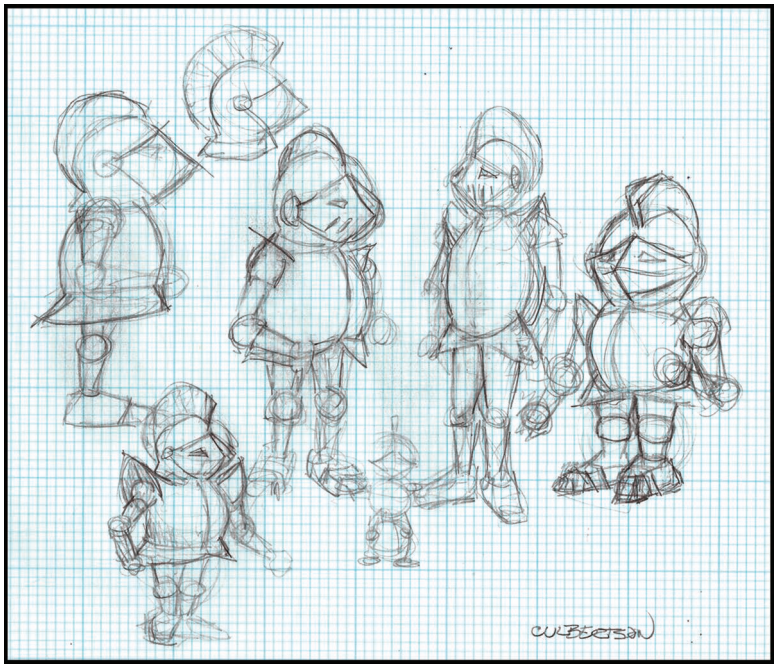


IMAGE 1.5

Reviewing initial sketches, I then start refining the design in a single direction. Tightening up to a true three head height (using three stacked circles) helps to ensure the design will be within the specs of the GDD.

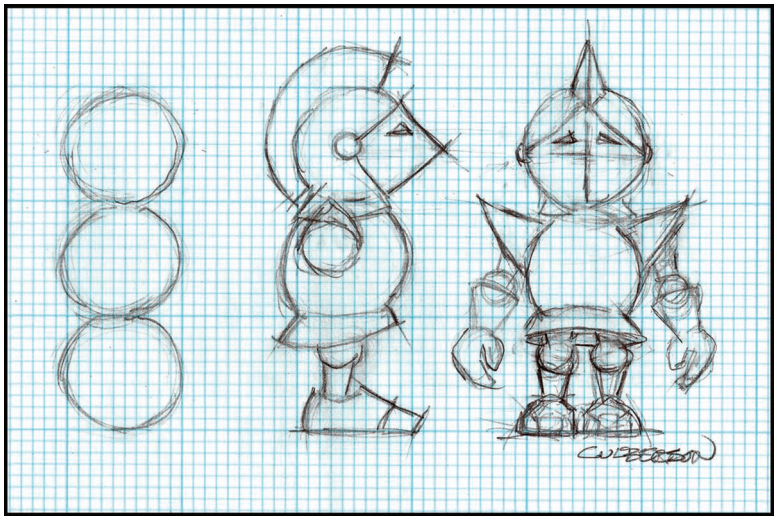


IMAGE 1.6

Further refinement brings us closer to a finished design. Note how the features of the reference were incorporated into the design. Our character looks like it could be a real armored soldier because it has the features of real armor. It is really important that designs be based on real-world features that the player can relate to. At this point, I have transitioned from paper sketching to drawing in the computer (Photoshop) using a drawing tablet (Wacom Cintiq). The reason for switching is, in the end of this process, I will need digital images to import into 3ds Max as template guides. Notice that I purposely aligned the features in the front and side views, so they align horizontally. At this point, you would want to check with our supervisor and other designers in our company for suggestions and comments on our design to make sure we are heading in a good direction.

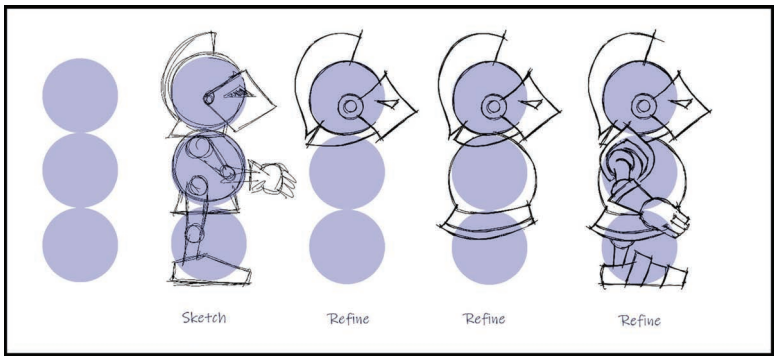


IMAGE 1.7

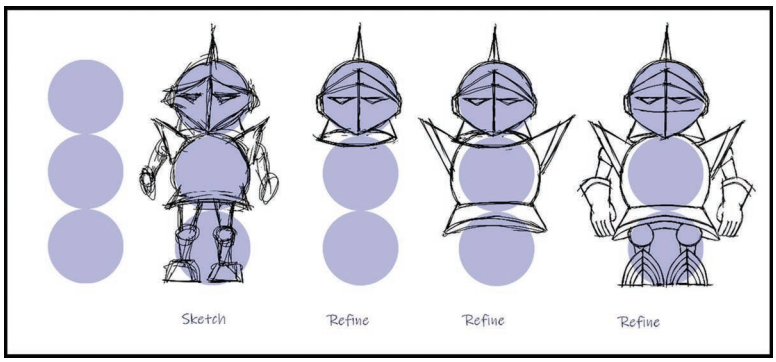


IMAGE 1.8

We are effectively creating a Character Model Sheet. Companies that license their characters usually create Character Model Sheets for their characters. The Model Sheet ensures that their characters will have a consistent look across the marketplace. Notice that I purposely aligned the features in the front and

side views, so they align horizontally. This is very important. When we are modeling the mesh using these drawings as templates, the features must align or there will be problems.

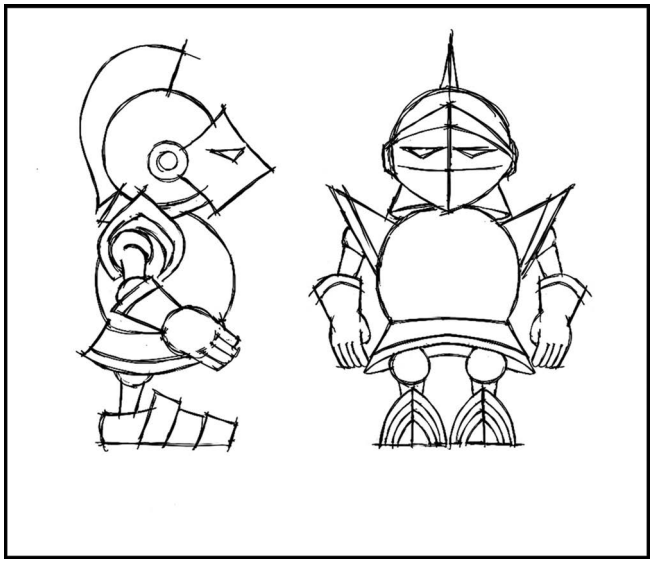


IMAGE 1.9

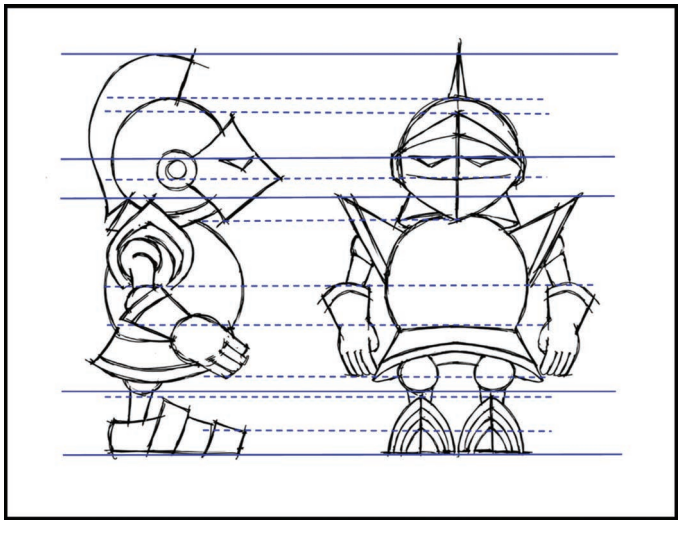


IMAGE 1.10

We are at the stage where we would seek out approvals at our company to proceed to the modeling stage. Once everyone has had the opportunity to add their comment, we would make the necessary tweaks to reach the approved stage. Next, we would break the single image we have created (Image 1.8) into separate front and side views in Photoshop or another image editing software. The two images would be used as textures on planes in 3ds Max to serve as modeling guides.

Image 1.12 shows the front and side images applied to planes in the Perspective Viewport in 3ds Max. Note where they are positioned, away from the X, Y, and Z-axis intersection at 0,0,0. The side view plane is parallel to the X-axis, and the front is parallel to the Y-axis.

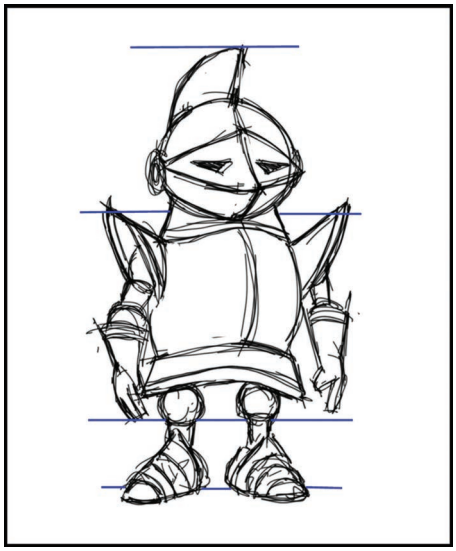


IMAGE 1.11

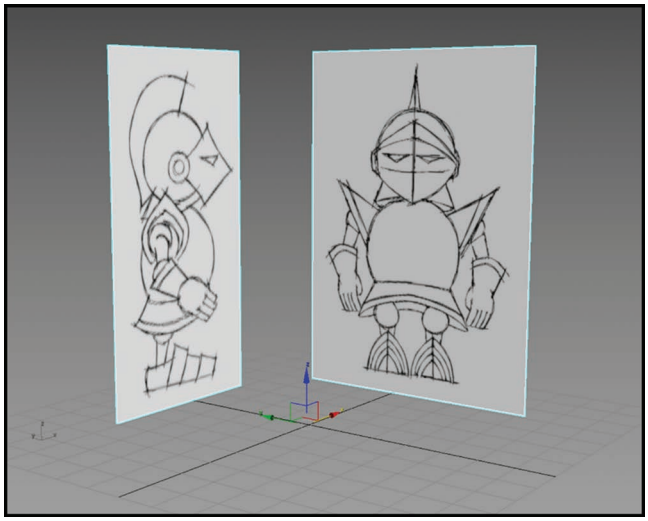


IMAGE 1.12

Image 1.13 shows a blue cylinder to represent the area where we would create the model. Setting the mesh to "see-through" in the Object Properties we can adjust the vertices to match the images on the planes. In the next chapter, we will start to model the Knight character.

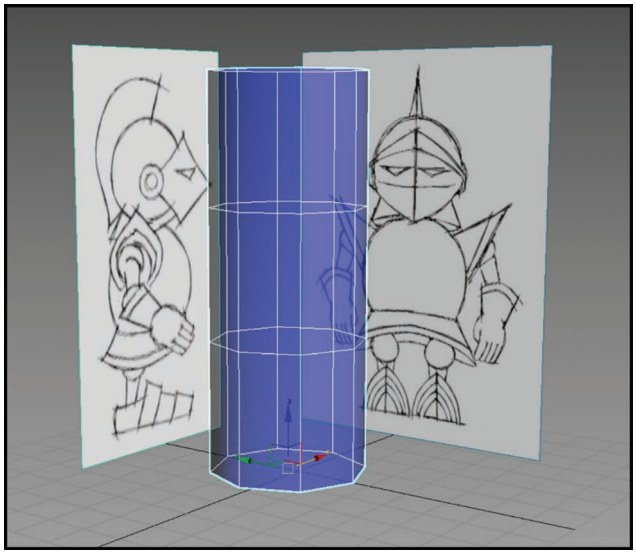


IMAGE 1.13

Chapter 1 Exercise: Design a King or Queen

In this chapter, the design for the Knight was developed through a process of researching medieval knights, gathering imagery and developing design concepts based on the reference. For this exercise, you need to design a King or Queen for the game.

The character styling should complement the Knight character, utilizing similar styling. Follow the same process as used for the Knight. You do not need to model the character; you need to just design the character and create a turnaround drawing (see Image 1.10) that can be used to make the front and side view templates for modeling as in Image 1.12.

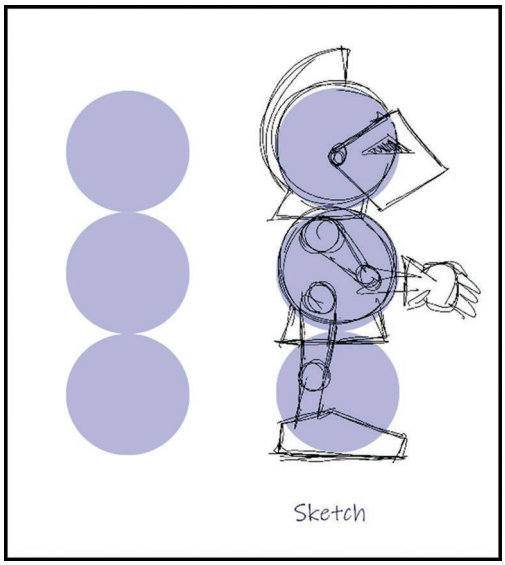
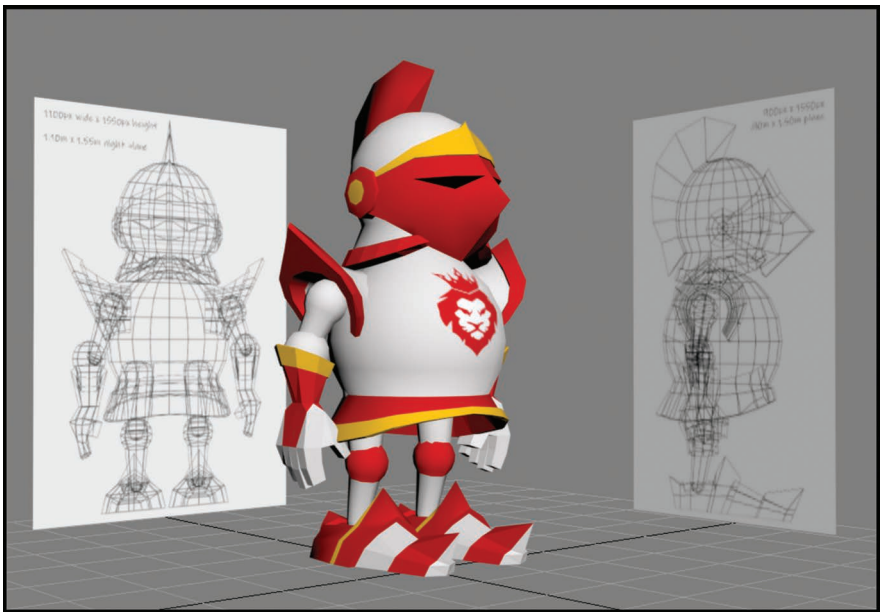


IMAGE 1.14



Character Modeling: The Knight

Topics in This Chapter

- Preparing the scene: Template planes
- Template images
- The Slate Editor

Concepts/Skills/Tools Introduced in This Chapter

- Creating and assigning materials with the Slate Editor
- Review of using the basic tools from Volume I

Preparing the Scene in 3ds Max

Now that our character model sheet with front and side views is complete, we can start modeling the character. Our first step would be to create individual images of the front and the side views to be used as templates in the scene as shown in Image 1.12

In preparing to write this chapter of the book, I went ahead and modeled the character using the two hand-drawn templates in the scene. I made some slight design changes along the way, refining the process and

making better design decisions. Having completed the character model, I was able to create new template images using wireframe screenshots of the completed model. The advantage in this case, you will be able to more accurately model the character with less "guessing" as to the correct positioning of vertices.

Additionally, I created a number of templates to isolate the mesh parts as we model them. All you will need to do is swap out the texture images. The first two images we will use are shown in Images 2.1 and 2.2.

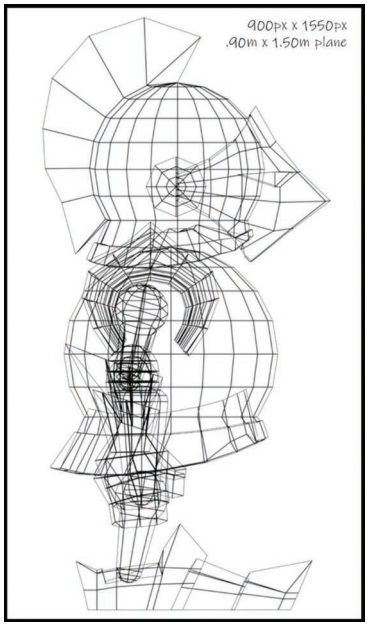


IMAGE 2.1

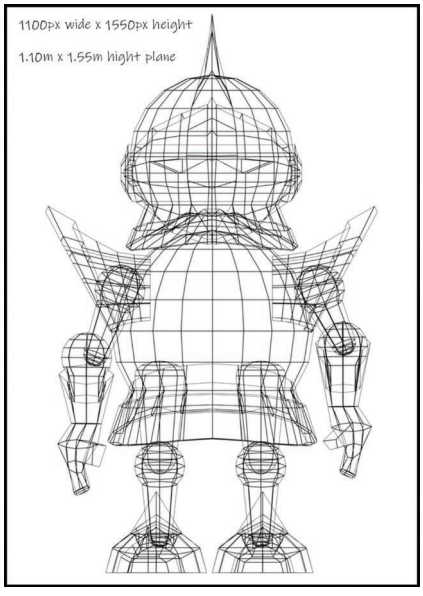


IMAGE 2.2

To start, open 3ds Max to a new scene. As in the previous book volume, we need to provide our programmers with a place holder to use in the game program as they develop the game on their end. First, we will set up the scene.

Setting Up the Scene

Begin by saving the scene. Using the Save As, save the file to a location of your choosing using the same naming convention as we used when modeling the castle environment, *lastname_knight_01*. As before, let's create a folder using the Scene Explorer for the objects we will be creating. Select the Toggle Scene Explorer Button if the Scene Explorer is not open already. Make sure the "Sort by Layer" button at the bottom of the window is active, not the "Sort by Hierarchy" one.

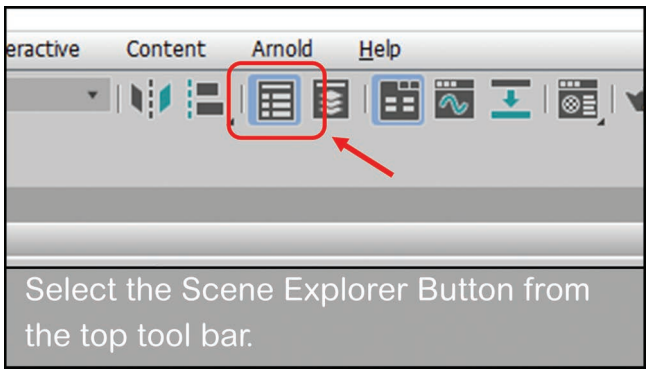


IMAGE 2.3

When the Sort by Hierarchy button is active, the window does not allow layers to be added. Add a new layer to the list by selecting the "add a New Layer" icon. Name the new layer "knight." Add three layers within the knight layer: templates, placeholder and knight model.

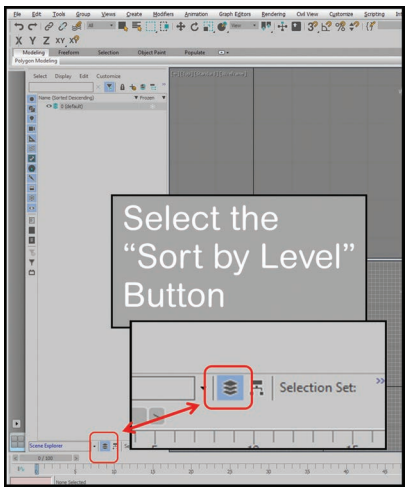


IMAGE 2.4

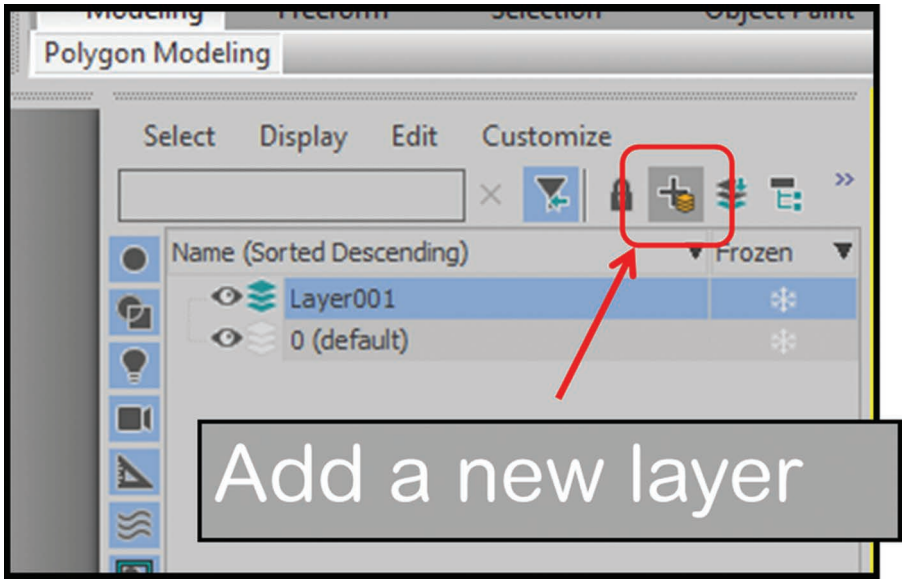


IMAGE 2.5

Select the "templates" layer. We will bring in our two image templates into this layer. This will allow us to turn the images on and off easily to review the modeling progress.

Check to make sure we are using the metric units of measure by selecting "Units Setup" in the drop-down menu of the "Customize" tab on the top toolbar. Select the Metric radio button and Meters and the units of measure.

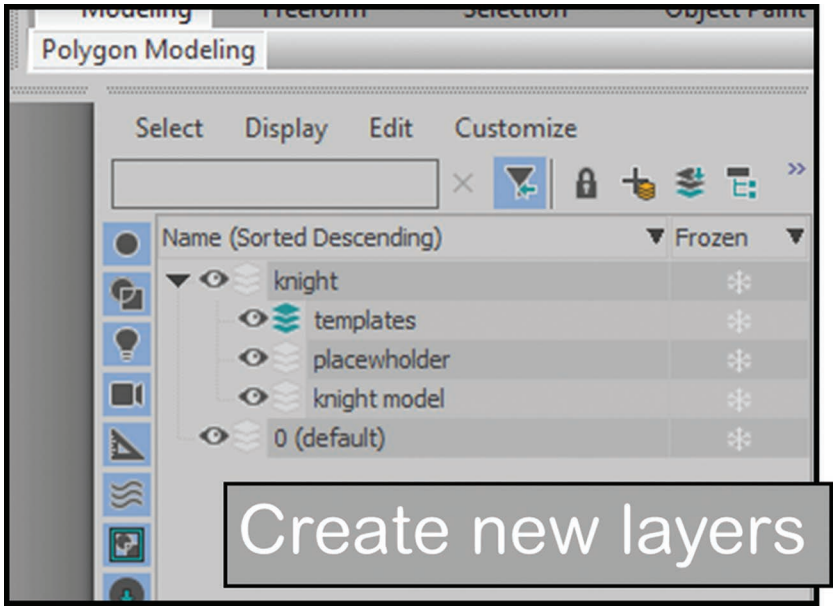


IMAGE 2.6

Check to make sure we are using the metric units of measure by selecting "Units Setup" in the drop-down menu of the "Customize" tab on the top toolbar. Select the Metric radio button and Meters and the units of measure.

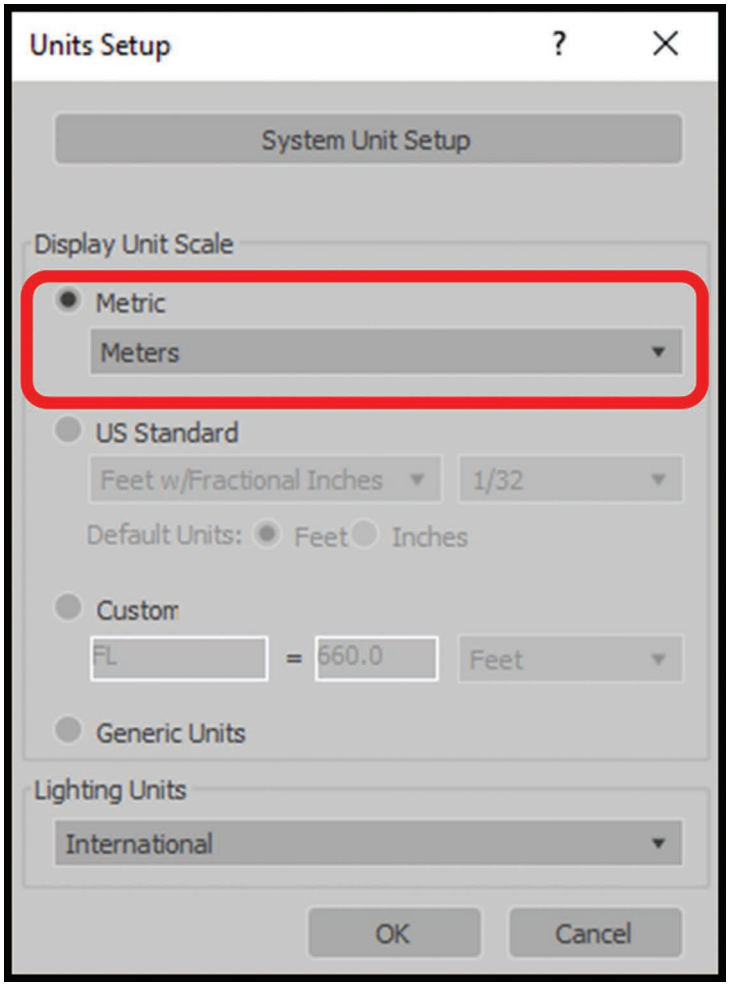


IMAGE 2.7

Creating the Template Planes

Next, create a plane in the Front Viewport with a size of 1.55 m height and 1.10 m width, length Segs and Height Segs set to 1. If you are not sure how to create a plane using the 3ds Max interface tools, it probably means you have not completed the tutorials in Volume I of this book series. Please step back to complete these tutorials. Successfully completing this volume of tutorials is dependent on having learned the skills taught in Volume I. All the front view images we will be using as templates for this model will fit this plane and register in alignment with each other. Change the X-, Y-, and Z-axis settings on the bottom tool bar to X=0.0, Y=0.0, and Z=0.785. Rename the plane "front_template."

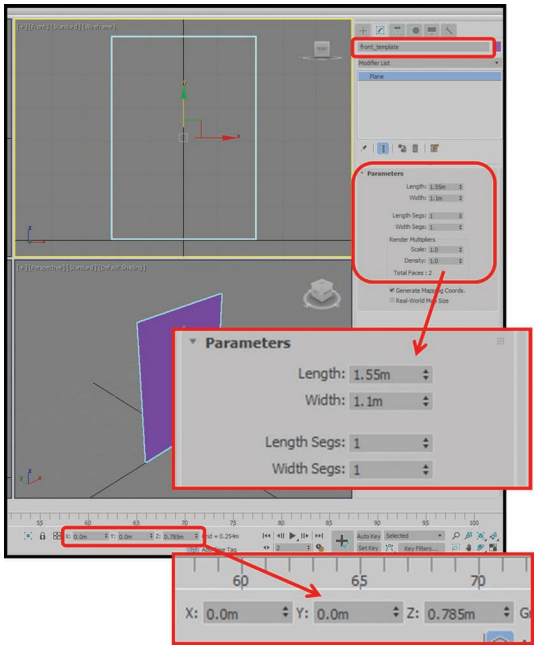


IMAGE 2.8

Now create another plane for the side view by cloning the first plane you just created. With the Select and Move Tool selected on the top toolbar, hold the Shift key down and then drag the plane to the right about 1.55 m. Change the width parameter in the new plane to 0.90 m to match the size of the side view images we will be using. When the Clone Options window pops up, select "Copy." Rename the new plane "side_template." Please note that the image size is shown on the image as pixels (px). The image will scale to fit a plane in 3ds Max shown in meters (m).

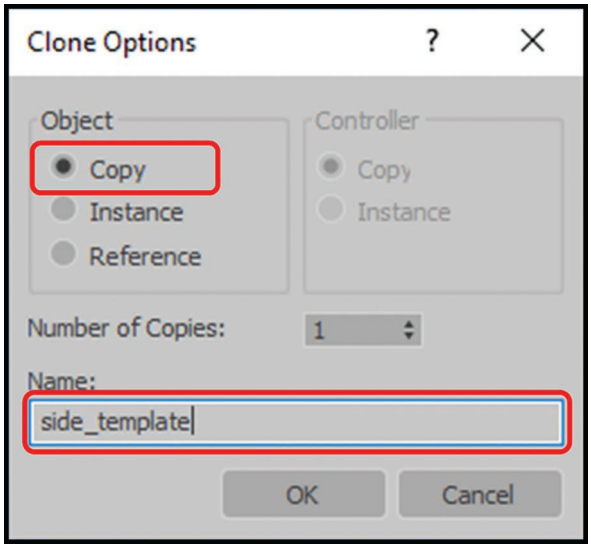


IMAGE 2.9

This plane needs to be rotated 90 degrees to orient it for the side view. Switch to the Select and Rotate tool. In the Coordinate Display boxes on the lower tool bar, change the Z-axis setting to –90 degrees.

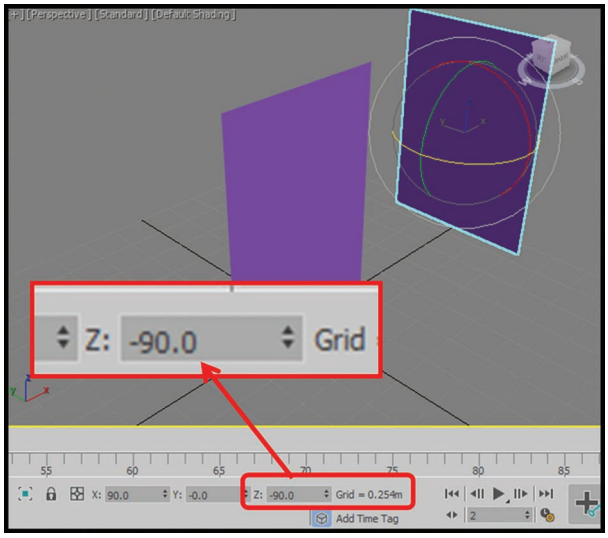


IMAGE 2.10

Next, move to the front_template plane back from the Y-axis line. Select the front template again and change the Z coordinate value in the Coordinate Display to 1.50 m. Now we will be able to create our model at the 0, 0, 0 coordinates, away from our two template planes.

Setting up the template planes in this orientation is a fairly standard practice for modeling objects. This orientation allows us to model, move vertices, so they follow the template reference image without the template intersecting the model, causing problems.

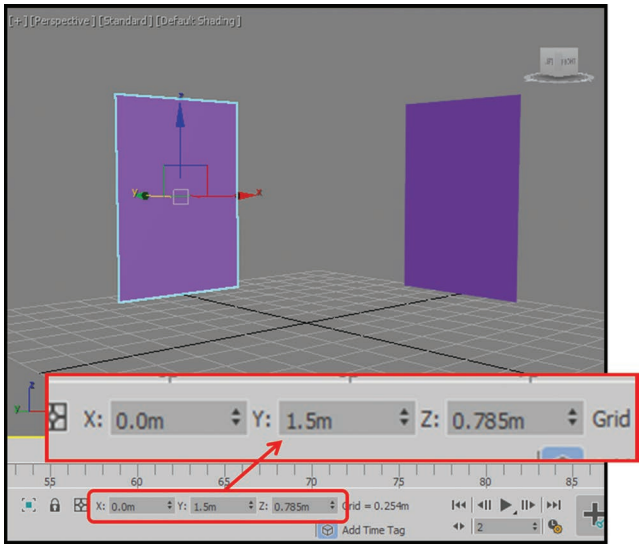


IMAGE 2.11

Next, assign the "knight wireframe-00-front" image from the companion files (located on the companion web site page, www.3dsMaxBasics.com) to the front_template plane and the "knight wireframe -00 side" to the "side_template."

We are ready to assign texture maps to the two planes. In Volume I, we created materials in the Material Editor using the Compact Editor mode. In this volume, we will use the Slate Editor mode to expand your skill set.

The Slate Editor

To open the Slate Editor, either hover the mouse over the Material Editor icon on the Top Tool Bar to expose the drop-down button for the Slate Editor and select it or click on the Material Editor icon to open the editor.

In the window that opened is in Compact Editor mode, click on the "Modes" tab on the tool bar and select the Slate Editor. The Slate Editor has the same functions as the Compact Editor but has some enhanced tools for creating and tweaking more complex material textures. Using the Compact Editor is more convenient when using existing materials, the Slate Editor more practical for creating new materials.

If we take a quick look at the two editors, we will find a lot of similarities and tools in common. In fact, the tools with similar names have the same functions for both. On the left side of the Slate Editor is the same menu list that appears when you select the "Get Material" icon button on the Compact Editor. To create a new material, we go through the same process as with the Compact Editor, just a little differently procedurally.

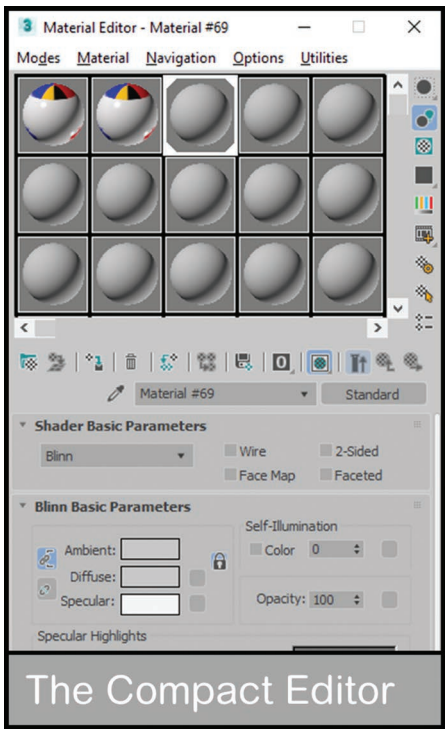


IMAGE 2.12

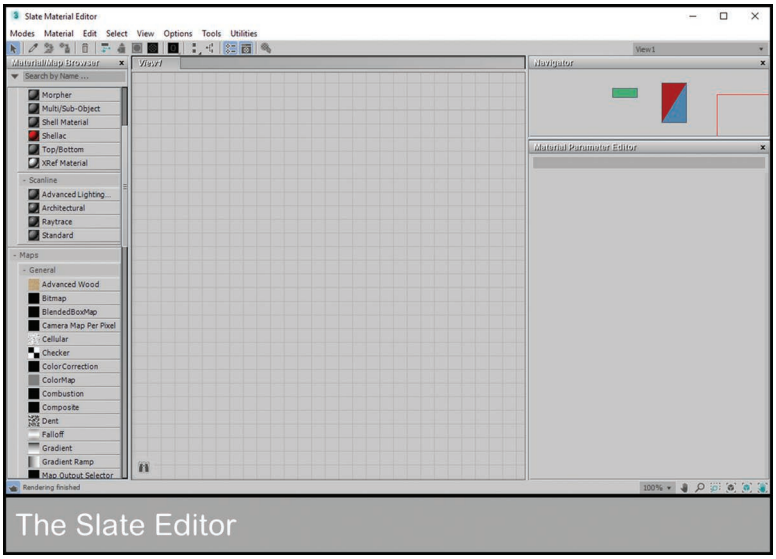


IMAGE 2.13

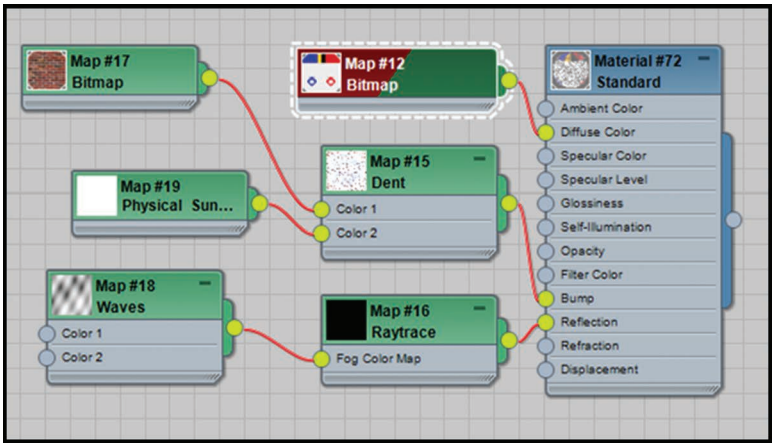


IMAGE 2.14

If we take a quick look at the two editors, we will find a lot of similarities and tools in common. In fact, the tools with similar names have the same functions for both. On the left side of the Slate Editor is the same menu list that appears when you select the "Get Material" icon button on the Compact Editor. To create a new material, we go through the same process as with the Compact Editor, just a little differently procedurally. The Slate Editor create material, map, and shader tree hierarchies by wiring together material, map or shader, and controller nodes. To create the tree hierarchies, you connect the object nodes with wires, like spaghetti connecting meatballs.

Step 1) Select a Standard material in the Scanline material section by double-clicking on "Standard" or by right-clicking anywhere in the View 1 window area to open a flyout menu. Navigate to "standard" and select it.

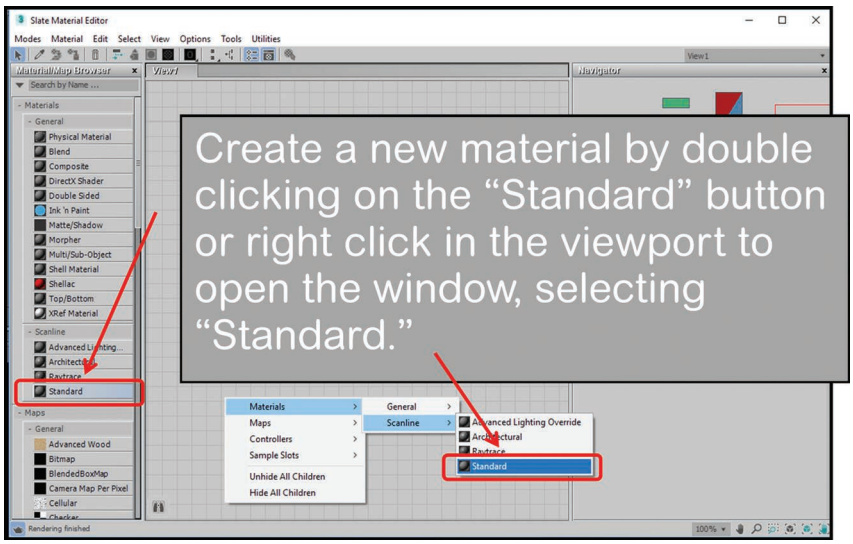


IMAGE 2.15

Step 2) A material slot will be created in the active View window. There are a number of node endings available along the left side of the material. Left-click the mouse icon on the node ending (the circle) next to the "Diffuse" option. Drag the depressed mouse icon to the side, away from the material. A red "wire" will stretch from the node ending to your mouse icon. When you release the mouse button, an option rollout menu will appear. Navigate through the options: General > Bitmap. Select Bitmap. In the Select Bitmap Image file window that pops open, find and select the "knight_wireframe-frontview_01.png" image in the companion files you downloaded to your computer. Note: your material names will be different, that's OK.

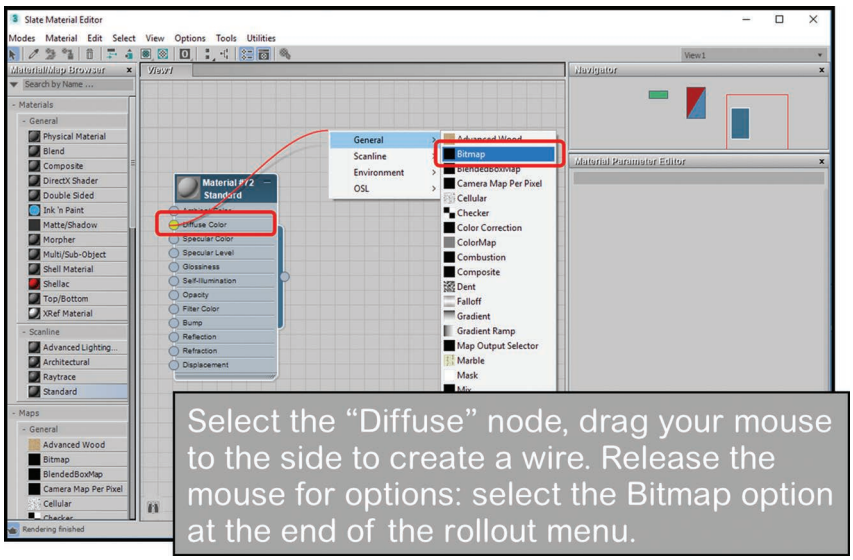


IMAGE 2.16

In the next image, note that I rearranged the elements orientation in the active view to make a clearer view of the relationships of the connected nodes.

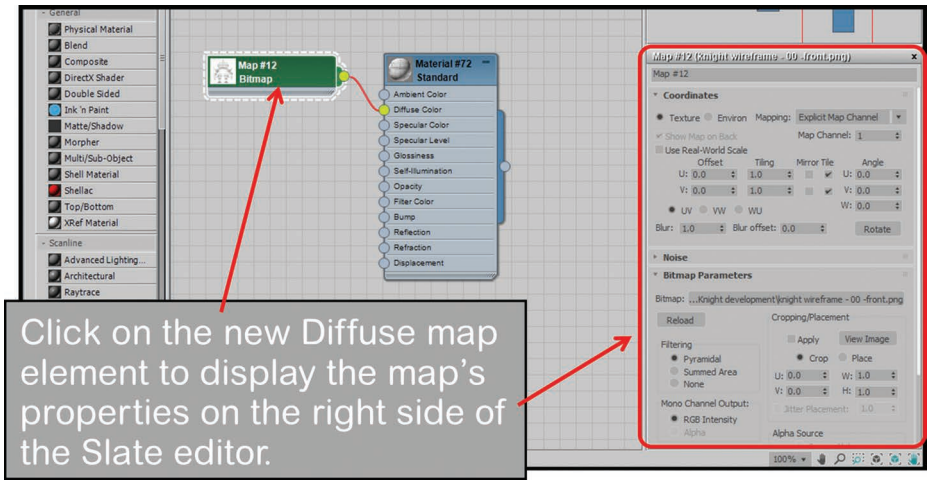


IMAGE 2.17

If you double-click on the map, the map's properties will appear in the Parameter Editor on the right-side column of the editor. These properties appear in the same orientation as they do in the Compact Editor. All that is left to do is to assign the material to the front template. You will find the same icon buttons we used in the Compact Editor on the Top Tool Bar of the Slate Editor. First, select the object you want to have the material, in this case the front template, then left-click on the "Assign Material to Selection" button and then left-click on the "Show Material in Viewport" button. The knight wireframe image should appear on the front template plane. Make sure the Right, Left and Perspective Viewports are set to "Default Shading" so you can see the images (in the upper Left Viewport corner menus).

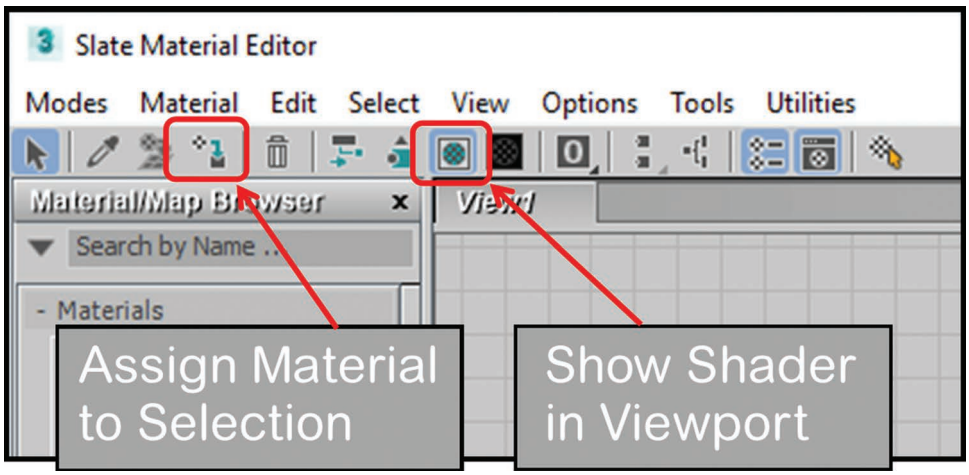


IMAGE 2.18

We are ready to begin modeling the character. We have our template images in place, and they are aligned vertically so the features on both images are aligned horizontally.

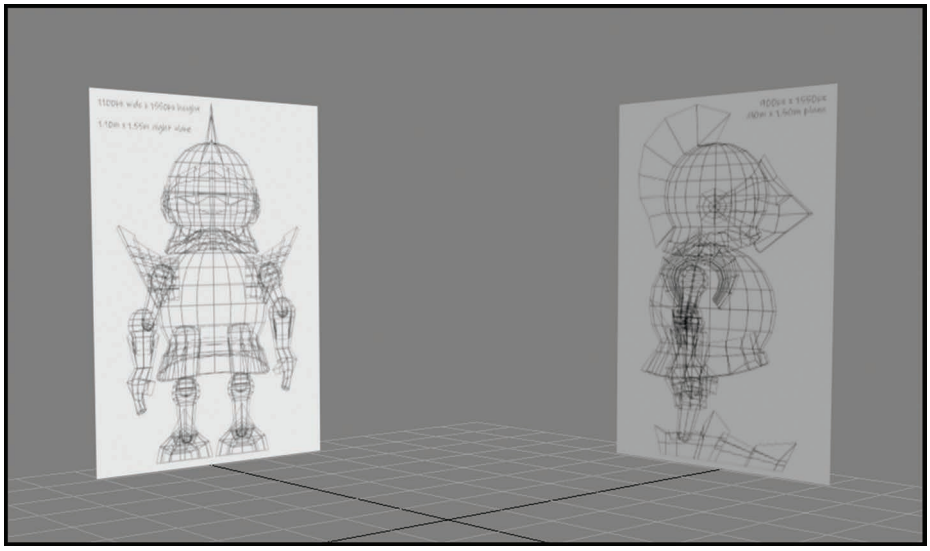


IMAGE 2.19 (Max File Save 2.1)

Making a Place Holder

As explained in the previous volume, it is our responsibility as modelers to provide the programmers with placeholder models they can use until the finished models are completed. This way they can keep working without needing to wait for us. For this character placeholder, we can use basic shapes to make a facsimile of the completed model. We could add some basic animations but will hold off this time as that is what we will be learning to do once we complete this model. By adding the basic animations, the placeholder could be used in the game in a more developed way.

With your current modeling skill set, model a quick placeholder mesh using Standard Primitives and the two template images. Be sure to select the "Placeholder" layer in the Scene Explorer, so your model is in the correct layer.

The next image shows the placeholder I quickly made in a few minutes. It is composed of ten spheres, nine cylinders, two boxes and a cone. I added a Taper modifier to the boxes used for the feet. I also added a taper to the cone used for the helmet visor. The comb on top of the helmet is a short cylinder with the Slice parameters adjusted to make a pie shape with a piece cut out. It looks more like a chicken than a knight, but it is all that is needed for our placeholder. It's the right size and has joints where the final one will have them.

Note too I added a "dummy object" at the bottom of the fire. A dummy object is a non-rendering object that is often used as an animation helper. To access it, go to: Create panel > (Helpers) > Standard > Object Type rollout > Dummy. All the objects in this placeholder are linked to the center sphere. It then is linked to the dummy object. If you move the dummy object, the whole placeholder will move with it as one object. The programmers can move the placeholder using just the dummy object, making their job easier to manage the model.

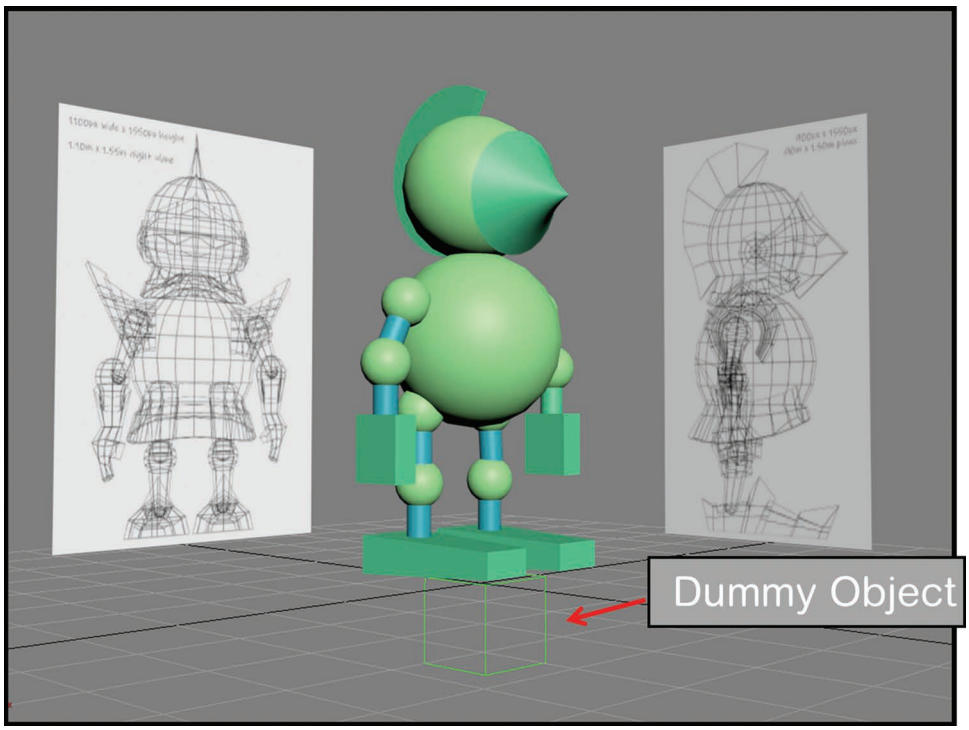


IMAGE 2.20 (Max File Save 2.2)

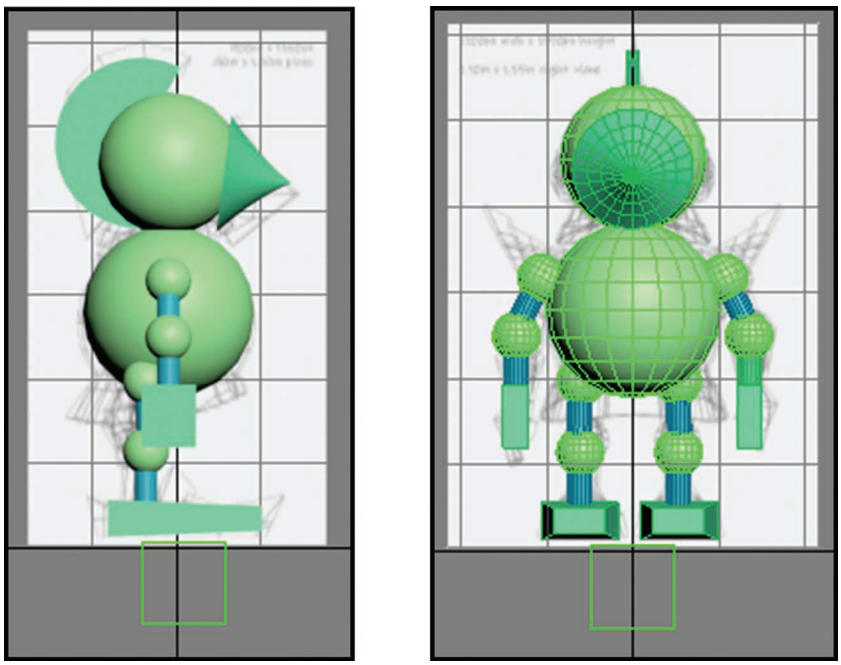


IMAGE 2.21

Modeling the Helmet

The first part of the knight we will model will be the helmet. Remember, we are modeling all the parts of the knight character separately as opposed to one single mesh for the model.

Looking at the images on our templates, you will notice that there are overlapping wireframes from the different parts of the model. As this is your first time working with templates in this orientation, I have made multiple images for you to use as templates on the planes. The images isolate the different parts of the model that you will be modeling so you will not have the overlapping wireframe issues creating confusion. It will be a little inconvenient to keep switching the images as you work, but it will make the modeling more manageable. Typically, you would not have this opportunity; you would be working from a single image that would not be a pre-done mesh wireframe. This is setup as a learning experience.

In the Scene Explorer, change the active layer to the "knight model." Create a sphere in the Front Viewport. It should be visible in the scene explorer inside the knight model layer. Position the sphere, so it is centered over the image of the helmet, the circular part of the image. Adjust the size to get close to the image size.

The sphere I created has a radius of .215, with 20 segments. Remember, you do not need to have exactly the same number values as I do. Close is good.

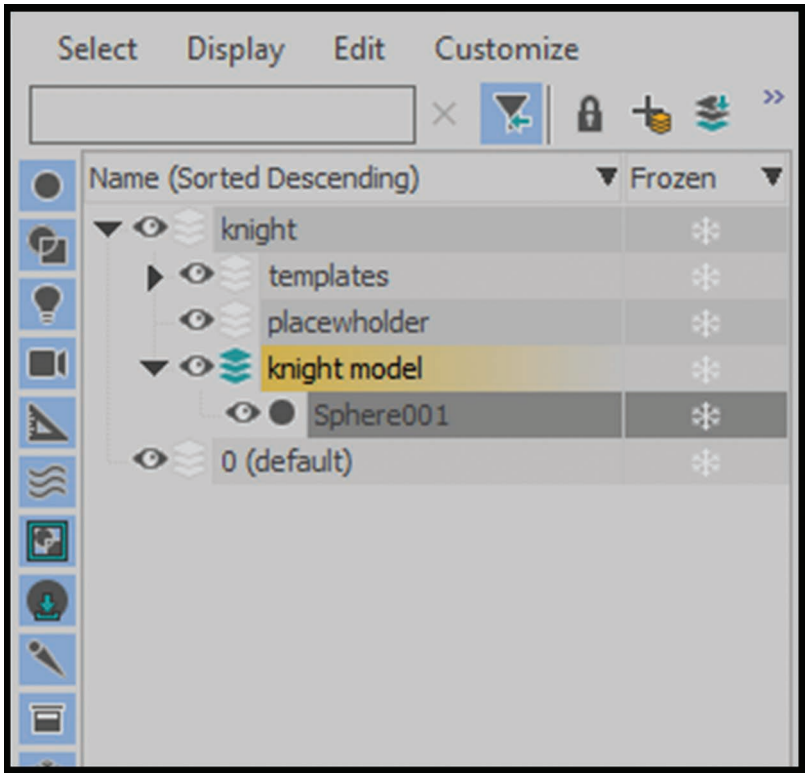


IMAGE 2.22

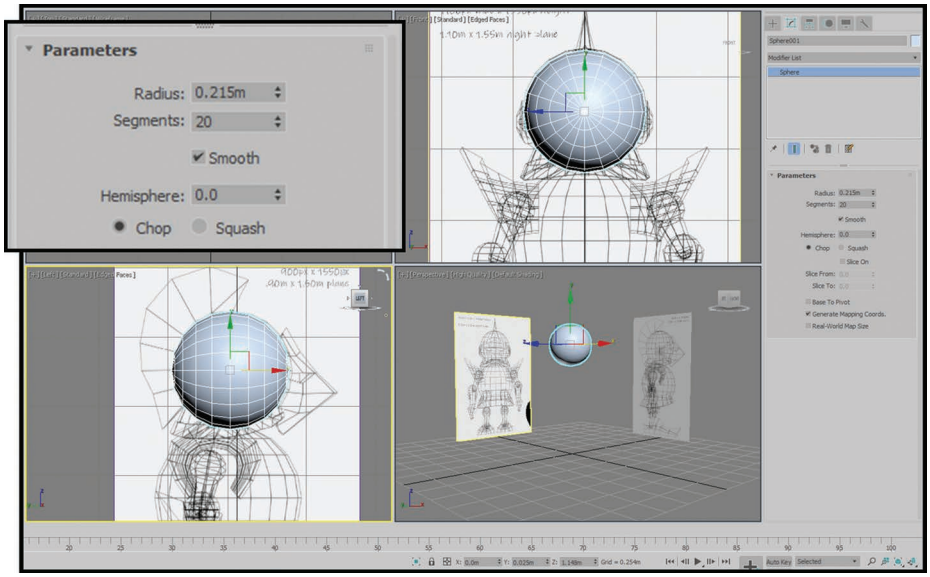


IMAGE 2.23

Next, rotate the sphere 90-degrees, so the two pole vertices are vertically aligned. Left-click on the Select and Rotate tool on the top toolbar to get into the rotation mode. In the Coordinate Display, change the X-axis value to 0.0, which will rotate the sphere.

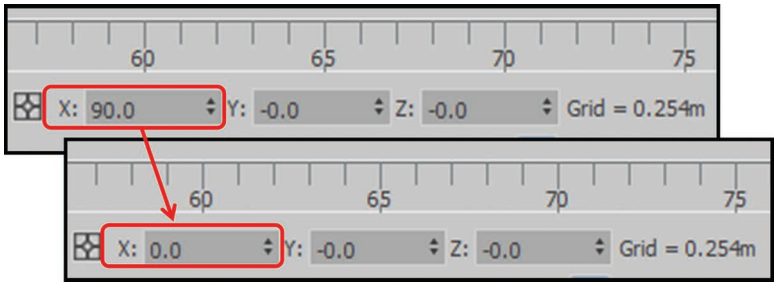


IMAGE 2.24

Note the position of the sphere and the two template planes in the Perspective Viewport. In the Front and Left viewports, it appears that the sphere is right on top of the template image. Remember, in all but the Perspective Viewport, every point in the viewport is seen from 90 degrees to the viewport plane. In the Perspective Viewport, we see the true orientation. Image 2.24 demonstrates this.

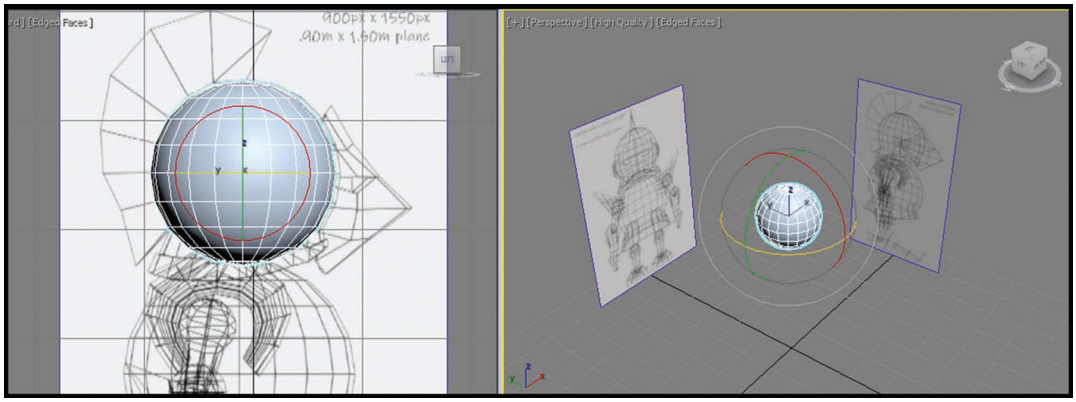


IMAGE 2.25 (Max File Save 2.4)

Convert the sphere to an Editable Poly, and rename it "helmet." First, we will add the comb to the helmet, the raised fin along the top and back side. In polygon mode, select the 14 polygons along the back of the mesh as shown in Image 2.26.

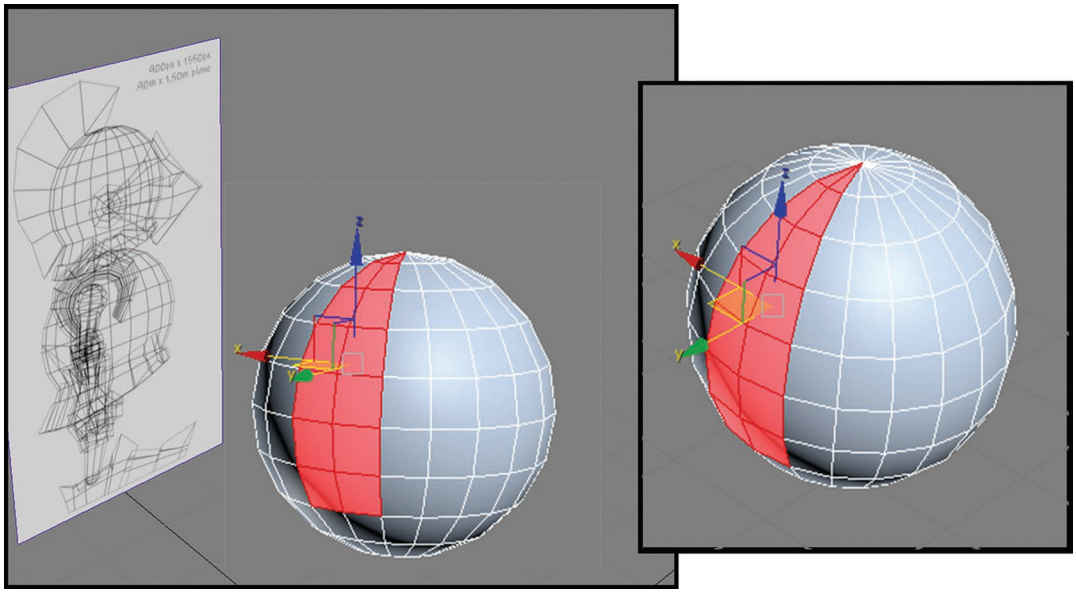


IMAGE 2.26

Use the Extrude Caddy to extrude the selected polygons 0.05 m. It is a small extrusion, but it will help to define the change of direction in the mesh construction.

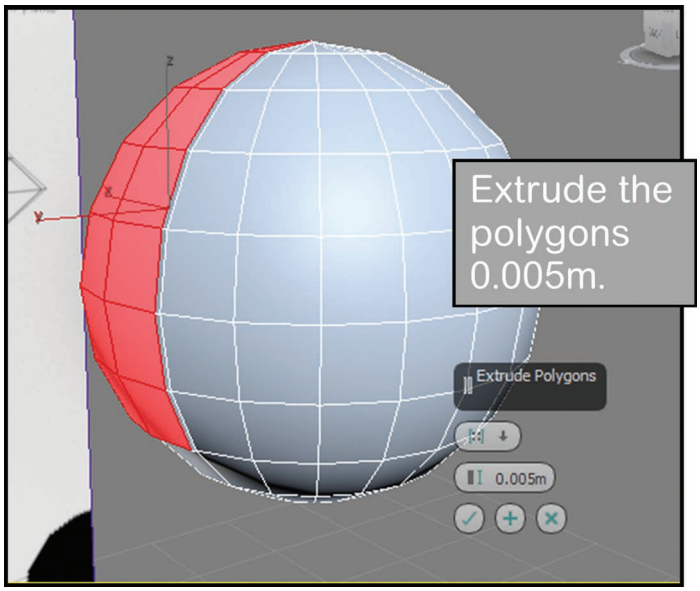


IMAGE 2.27 (Max File Save 2.5)

Select the center row of vertices along the center row of the polygons we just raised.

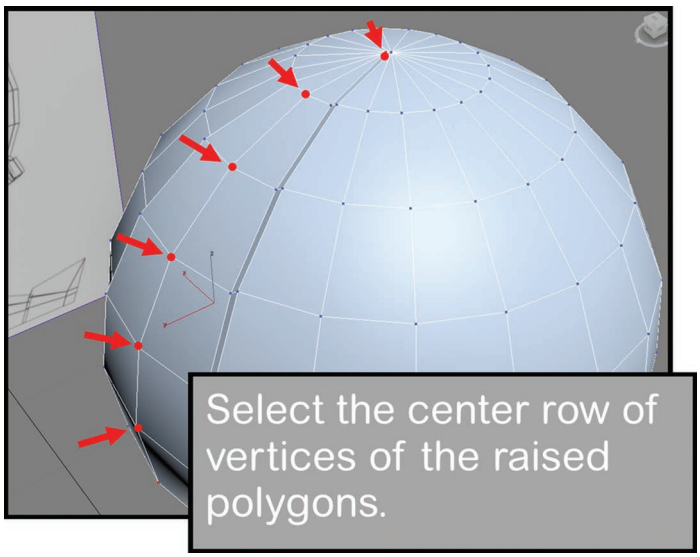


IMAGE 2.28

Using the Select and Move toll in the Left Viewport, move the vertices up and to the left as shown. This will roughly create the comb shape. Using the Select and Move toll in the Left Viewport, move the vertices up and to the left as shown. This will roughly create the comb shape.

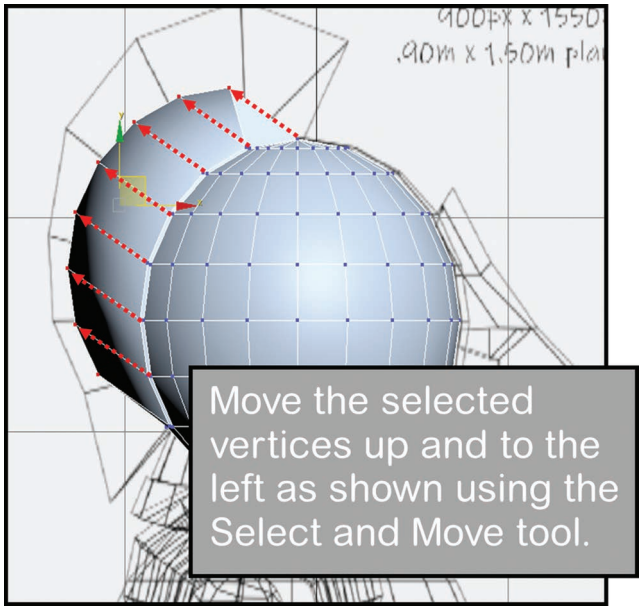


IMAGE 2.29

To complete the comb, move the selected vertices individually to the corresponding vertices on the template image. Remember, your mesh might not match the image exactly.

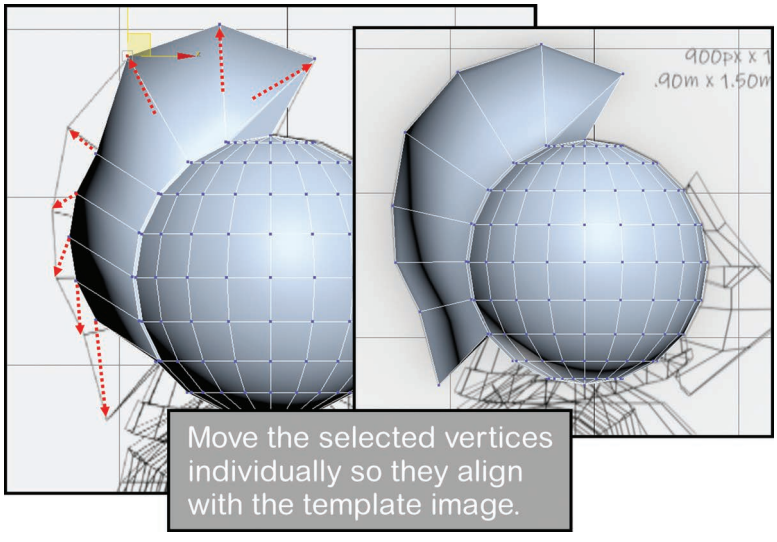


IMAGE 2.30 (Max File Save 2.6)

Next, we will model the bottom flared neck guard. In Vertex mode, select the bottom row of vertices on the sphere and the bottom vertex. Delete the selected vertices to create an opening.

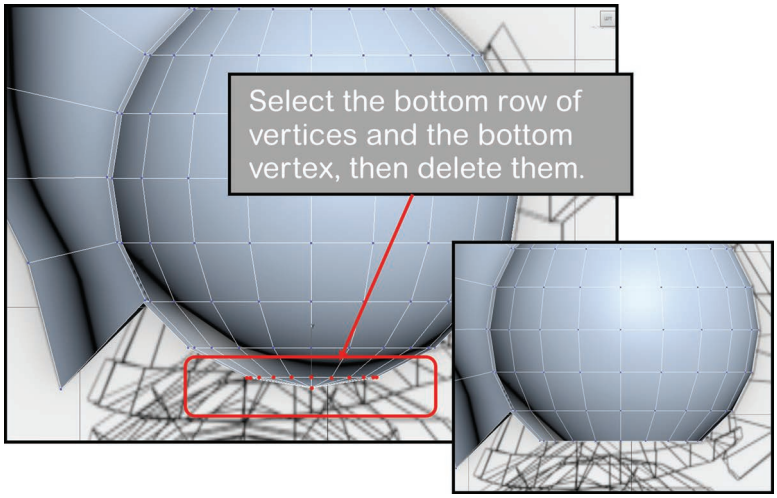


IMAGE 2.31

Create the curving bottom edge of the helmet by moving the individual vertices of the sphere to match the template image vertices, as you did to create the comb on top of the helmet. We are moving the vertices to the row mid-way to the bottom of the helmet. The vertices might be difficult to discern. Remember, they do not need to be exactly like in the images here. Look at the overall shape and work to create a nice smooth curve with the vertices.

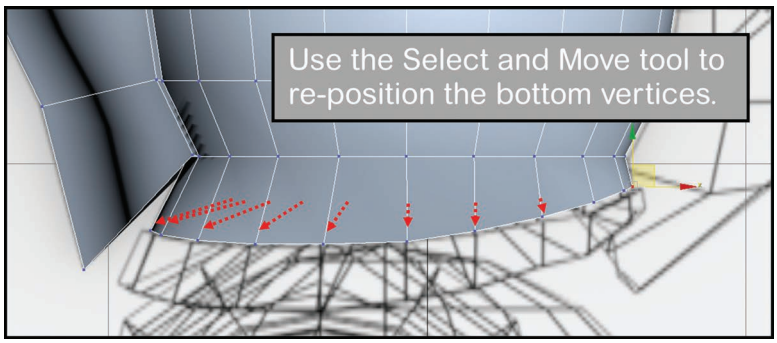


IMAGE 2.32

Switch to the Border tool again and select the bottom edge. We will be creating a small lip/shelf to create a raised border around the bottom of the helmet as trim. We will be recreating this Border trim on other parts of the character model as a unifying design element. With the Border selected, click on the Extrude Caddy to open it. Enter an extrusion setting of 0.01 m, and accept it by clicking the green check mark.

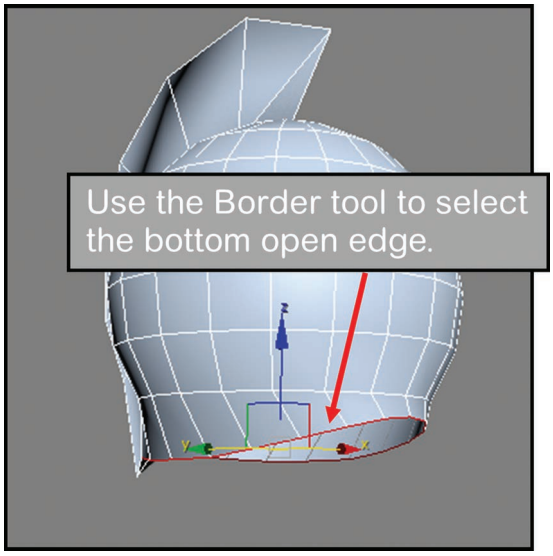


IMAGE 2.33

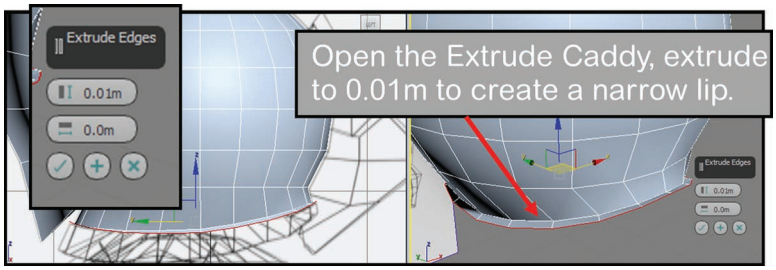


IMAGE 2.34

The edges are extruder at 90-degrees to the original Edge's plane, so the lip around the bottom of the helmet has some interesting angles as it goes around the perimeter.

Next, we need to create the vertical wall of the trim section. If you use the Extrude Caddy again, the edge will be extruded in a direction we do not want. Instead, using the Select and Move tool with the Border still selected, hold down the Shift key and click on the Z-axis of the gizmo. Drag it down a short distance as shown to establish the extrusion.

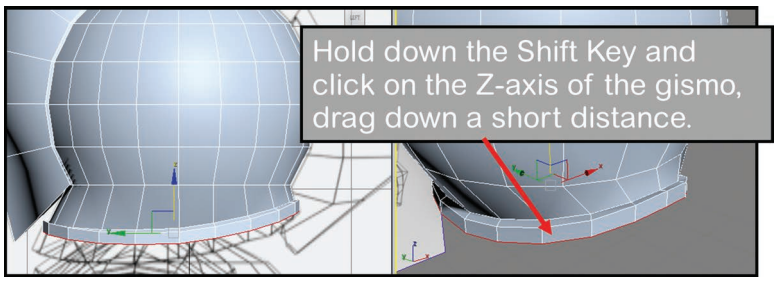


IMAGE 2.35

Now, switch to Vertex mode and move the vertices again to approximately match the vertices in the template image, creating the bottom edge of the helmet.

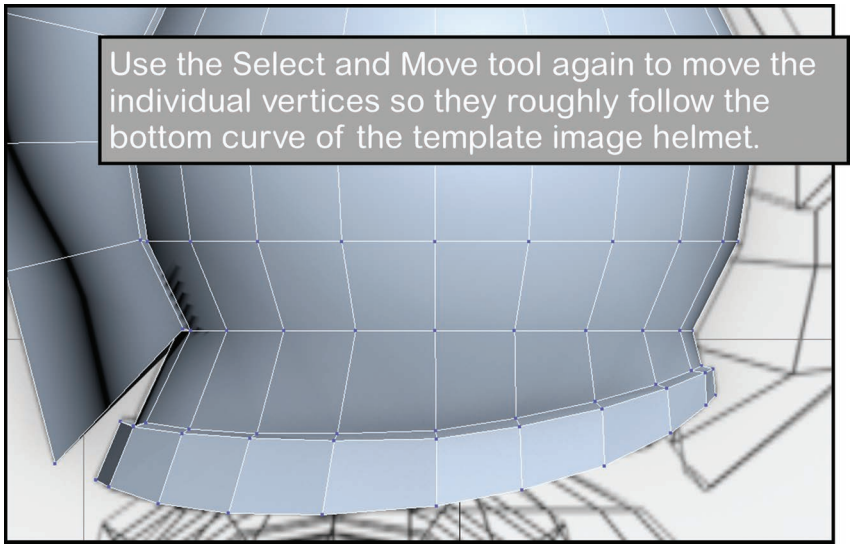


IMAGE 2.36 (Max File Save 2.7)

Use the Border mode to select the bottom row of vertices. Looking at the Front view of the model, the new trim section at the bottom of the helmet that we just created is too narrow compared to the template image. Switch to Vertex mode and select the vertices as shown. Using the X-axis of the Select and Uniform Scale tool gismo, click and drag it to angle the vertical walls closely matching the template image.

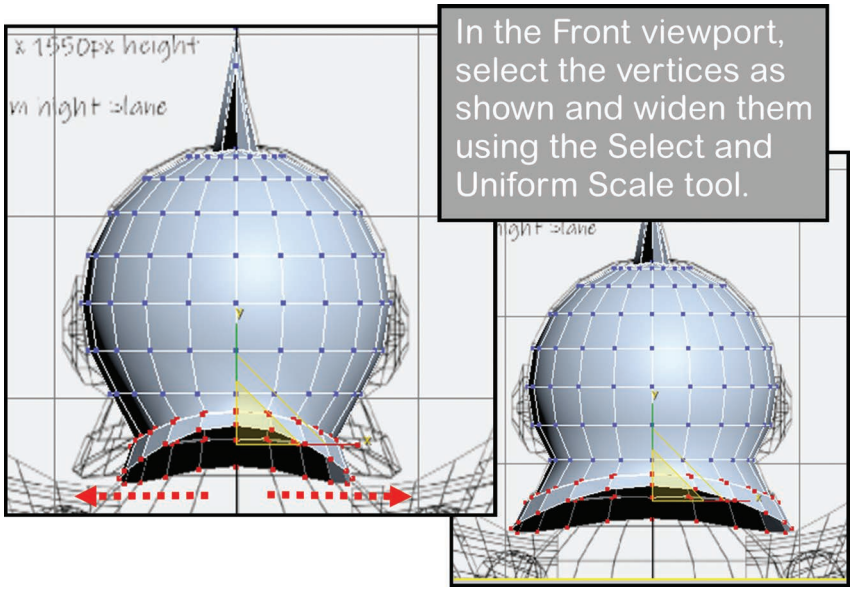


IMAGE 2.37

Next, we need to finish the underside of the helmet. We can complete this in a few steps. Rotate the view of the helmet in the Perspective Viewport using the View Cube so you can see the underside of the model.

With the Border edge still selected, use the Extrude caddy to extrude the edge –0.03 m to create a bottom edge.

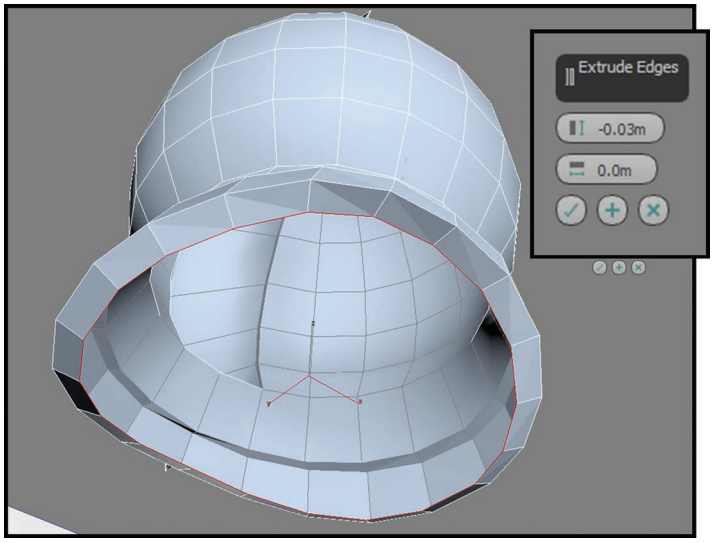


IMAGE 2.38

Create the inner wall of the helmet holding down the Shift key and dragging the Z-axis of the Select and Move gizmo in the positive direction as shown.

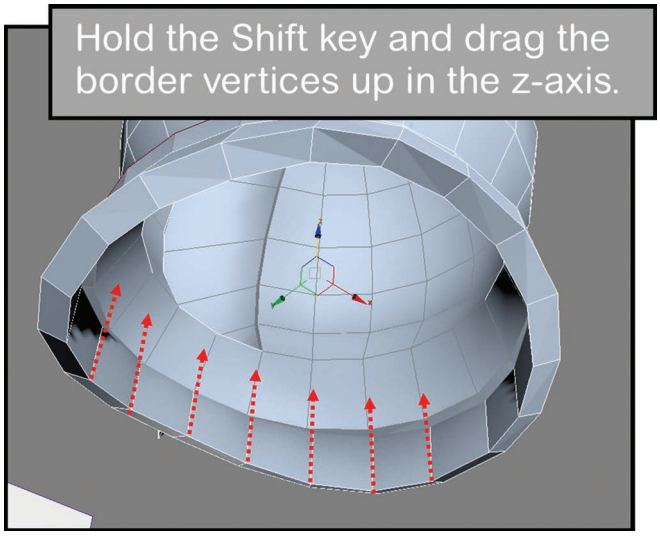


IMAGE 2.39