THE ART OF

Martin Hash's

ANIMATION MASTER

Animation:Master
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"Tin Woodman of Oz" Images by Hash, Inc.

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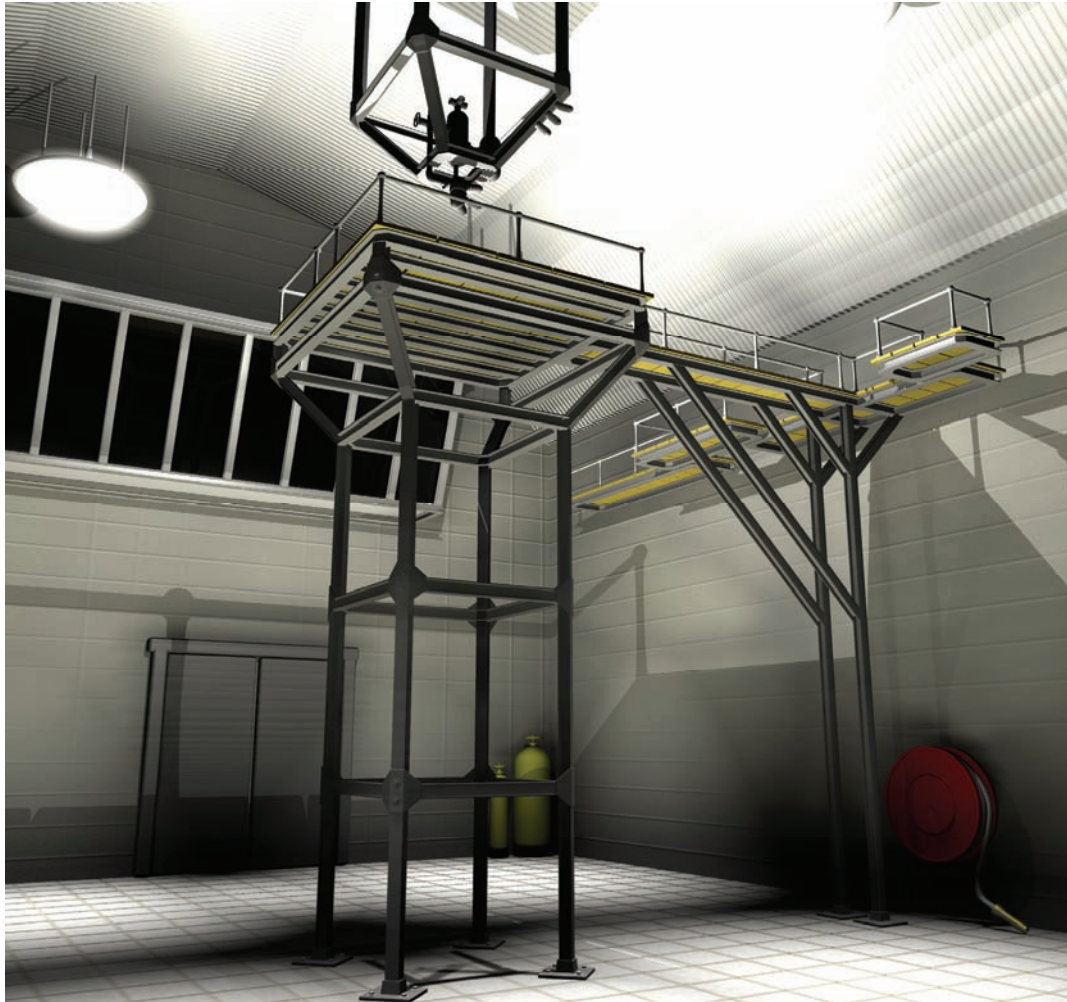
Created By John Henderson

COMPUTERS AND ANIMATION

We were all raised on Saturday morning cartoons and Disney movies. Who can say how many imaginations were sparked to life or how many personalities have been formed by simple line drawings on paper. Everyone carries some vestige of fond remembrance of lazy mornings awaiting the adventures and the humor. Some people choose to make it their career; others want to visit the Magic Castle at Disneyland and maybe even have a creation of their own.

Because of the difficulty and skill required, there has never really been a place for dilettantes before the advent of the personal computer. Never before has there been such a massive upheaval of the animation industry. The computer makes possible projects that were never financially viable before.

The biggest change is subtler. Because computer models are reusable, the richness and scope of design within a continuing series will improve with each episode. Soon, even the most rudimentary projects will provide visual complexity not possible in the laborious hand-drawn days. The mechanics of storytelling finally becomes more difficult than the mechanics of animation, as it should be; for animation is only a means to tell stories, and telling stories is the goal of every animator.

A:M COMMUNITY, ONLINE FORUM

The A:M Community is right inside Animation:Master! The Community window is open by default, but if you've closed it, you can get it back by choosing "community" from the view menu inside Animation:Master. Community includes tabs for real-time chat with other users, What's New, and Support. It's a great place to look for news and current events related to A:M!

The Hash Online Forum is a great place to network with other users to obtain tips, tricks and tech support; find out about new revisions of the software, discuss and use beta versions or ask specific questions related to Animation:Master. To join, visit our web site, choose the **Online Forum** topic in the support menu. There you will find specific instructions on how to apply for membership and rules of conduct. The forum has become an incredible resource with thousands of users ready to assist you any time of day or night!

MARTIN'S MINUTES

There is a weekly Internet column available on our web page in the bulletins area. These columns are primarily for entertainment but may offer insight into the programming of Animation:Master.

PRODUCT SUPPORT

In the event that you are experiencing problems or have questions about the software, Hash Inc. can be reached in a number of ways:

Address:

Hash, Inc.
400 W. Evergreen Blvd.
Vancouver, WA. USA 98660

Technical Support:

(360) 750-0042

Fax:

(360) 750-0451

e-mail:

support@hash.com

ftp:

ftp://ftp.hash.com

web:

http://www.hash.com

HELP FILES

In the event that you experience difficulty while working in Animation:Master, in Windows simply press the <F1> key to bring up the online reference help. From there you can search for the topic you need more details on. If you are running the software on a Mac, the help files are in HTML format and can be opened from the Technical Reference folder on the CD-ROM with a web browser.

MACINTOSH AND NO RIGHT-MOUSE BUTTON

The only significant difference between the Windows and Macintosh versions of Animation:Master involves the right-mouse button. Obviously, the Macintosh has only one button rather than two like Windows. Unfortunately, using the right-mouse button has become a standard interface tool and is used throughout Animation:Master. Therefore, on a Mac, whenever the manual asks you to "right-click," you will click the mouse button while holding down the <Control> key, with the exception of joining control points or attaching hooks, when you will use the <~> key located above the left <Tab> key on the keyboard.
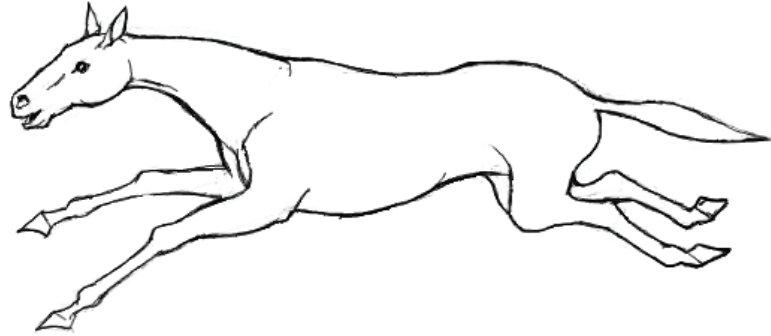
HISTORY OF ANIMATION

The development of the motion picture projector was the result of a bet on whether a horse could fly. In 1872, a racehorse owner insisted that there were times when all four hooves of trotters were in the air at the same time. This was sacrilegious to trotter racers who take pride in how fast their horses can "walk," rather than gallop. Eadweard Muybridge, a talented photographer known for his motion studies of human athletes, was brought in to confirm or deny the claim of the owner, who had shown faith in his hypothesis with a sizable bet among his peers. Muybridge placed dozens of trigger wires along the racetrack connected to evenly spaced cameras so as to snap a photograph whenever they were tripped. The horse trotted through the myriad of wires, snapping photograph after photograph in equal increments of time between them. When the photographic series was played back, the audience of bettors was surprised and aghast. The first motion picture film ever shown exhilarated them, and they were at a loss of their money because the horse did indeed "fly."

In 1914, Winsor McCay, a cartoonist and vaudevillian performer became the first animator, laboriously drawing frame after frame of the animation, "Gertie the Dinosaur", to show to paying audiences. Surprisingly enough, Winsor McCay

was also the first to combine live action with animation when he interacted with Gertie in each choreographed performance, to the audience's great approval.

Ub Iwerks, the artist for the early Mickey Mouse, was prodigious in his animation output, averaging a finished film a month. William Hanna and Joseph Barbera brought animation to the infant and risky field of television just when the major motion picture studios were closing down their own animation departments due to animation's great expense. Though many point to Disney as the progenitor of modern day animation, it was the Hanna-Barbera style and cost containment factors that really influenced the field and led to modern day look and story content.

Though new techniques have brought animation to the masses, normal people could only be viewers, not creators; it was still too difficult for aspiring storytellers to do on their own. Only the personal computer could break the barriers of talent, money, and time. You won't be disappointed by what Animation:Master can do. It competes feature-wise with the most expensive and complex movie special effects 3D computer programs but it is designed and written for you, someone who wants to get started right away and move onto more difficult things as you are ready.

The animation training you learn here can be used anywhere – whether in traditional drawing or dazzling movie special effects. We always say, "We don't care what 3D software you use as long as you recommend Animation:Master to your nephew."

This manual is divided into three parts:

"Anyone can Animate" is for those of you who want to animate but have little interest in learning the insides of 3D computer programs.

"Modeling takes Talent" is an entirely different set of instructions and tools that help you create computer models of people and things.
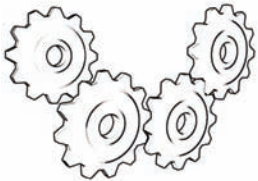
"Technical Directors Training" appeals to specialists who want and need to know how things work.

You might be all three!

Created by Stian Ervik Wahlvag

INSTALLATION

Animation:Master software is delivered on a hybrid CD-ROM that is compatible with both the PC using a Microsoft Windows operating system and the Apple Macintosh.

WINDOWS

To install the Windows version of Animation:Master on your PC, simply insert the Animation:Master CD-ROM into your CD-ROM drive and the Setup program will automatic launch. The Setup program will walk you through the steps to complete the installation process.

If the Setup program fails to launch when you insert the CD-ROM into the CD-ROM drive, you can manually launch it by picking [Start][Run]. Click the "Browse" button and select your CD-ROM drive then select the file "Setup\Windows\Setup.exe". Click "OK" to launch the installation program.
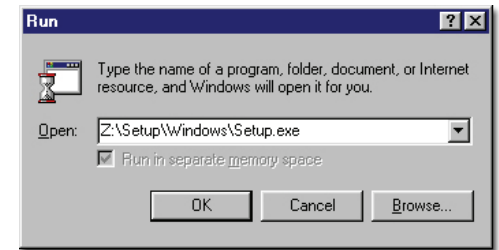
When the installation is complete, a shortcut to Animation:Master will be installed on the desktop. Double-click this icon to launch Animation:Master. Animation:Master may also be launched by choosing the icon in [Start][Programs][Hash Inc].

MACINTOSH

To install Animation:Master, you will need to run the installer program from the CD-ROM. Insert the CD-ROM in your computer. Open the CD-ROM's volume folder, open the "Setup" folder and finally, the "Mac" folder. Double-click the "AM Full Installer" icon. This will launch the installer application. The installer copies both the Animation:Master software, and the HTML help files to a folder named "Animation Master" plus the version number in the "Applications" folder on your Hard Drive.

Double-click the Animation:Master icon on your desktop, or in the AM folder to launch Animation:Master.
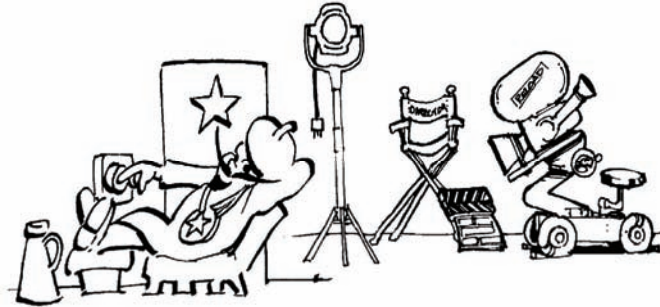
IT'S EASY

The vocabulary of Animation:Master should be familiar: there are models, actions, lights, cameras, and choreographies. Animation requires a sequence of pictures that are automatically created, one after another. How easy is it?

1. Pick an actor.
2. Add some action.
3. Pictures are created!

Finish the lessons fast or take your time. Go at your own pace. Let the computer be your assistant in bringing your ideas out for everyone to see. You'll find talent you never knew you had.
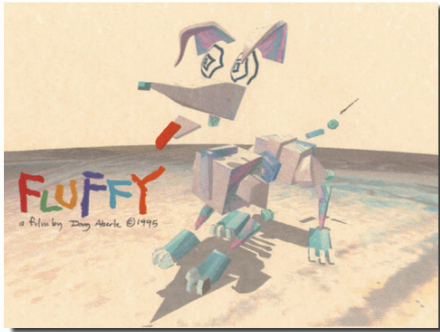
Fluffy
© Doug Aberle

Alien Song
© Victor Navone
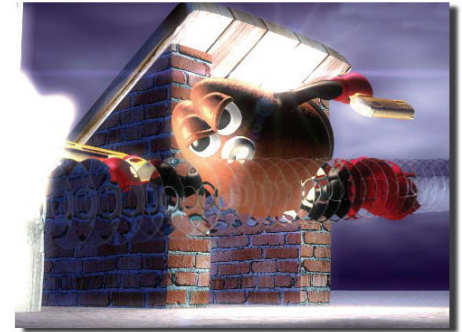
Killer Bean 2
© Jeffrey Lew

These award winning, internationally famous shorts are examples of what you can do in your spare time.

To see what other just like you have been doing since they've learned to animate, visit www.hash.com and go to the "contests" section. There are regular themed art and animation contests sponsored by Hash Inc. and offering prizes to the winners but just looking at the entries should be inspiration enough.

ANYONE CAN ANIMATE

Would you love to be able to animate? This section takes you step-by-step through all of the things you need to know to make your own animations.

CLASSROOMS

Listen teachers, if there is one thing your students should take away from this class, it's animation technique. Not only is it the most important storytelling aspect of computer graphics but it's also the easiest to learn, and provides the fastest positive reinforcement. Also, the animation skills learned here are not program specific; in fact they're not computer specific.
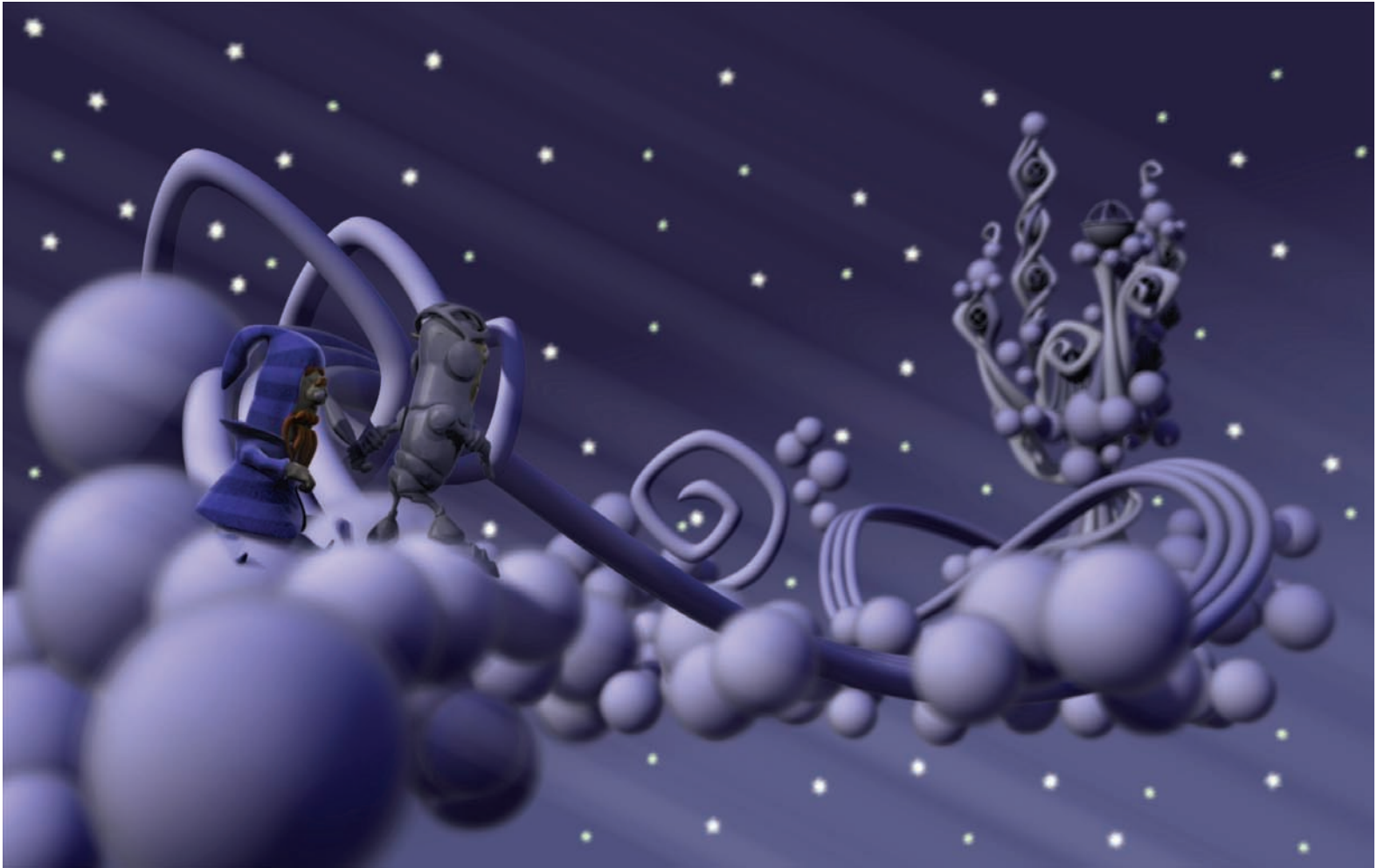
Created by John Henderson
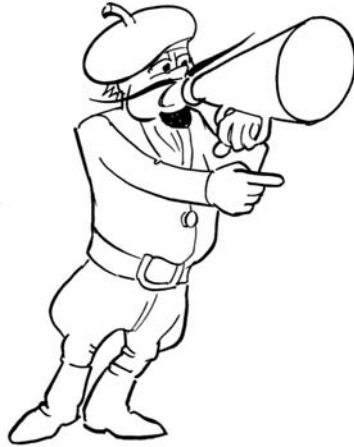
EXERCISE 1: YOU'RE THE DIRECTOR

Completion time: 20 minutes

CHOREOGRAPHY WINDOW

Once the software has been launched, a new Project with a Choreography window opened will appear. It is in a Choreography window that you assemble your cast of characters and tell them what to do. Think of it as the stage where you are telling your story.
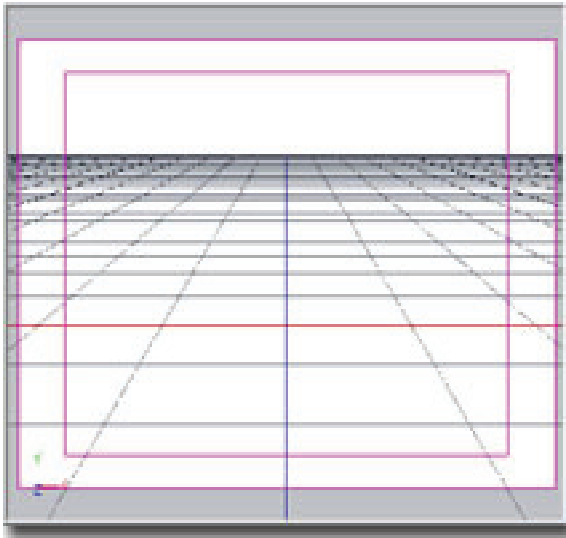
Camera View

You will be looking from the Camera view.
Cameras, lights and any other object in the Choreography window can be positioned and animated any way you wish.

LIBRARY

Libraries provide a simple way to organize models, actions, materials and other objects you will use in an animation. You can add your own objects to the library. You can also create folders for anything, like "Silly Actors" or "Landscapes."

In the Library, click the "Models" tab, double-click the "Actors" folder, then drag-and-drop "KeeKat" into the Choreography window. KeeKat's feet will be placed at the point where the mouse pointer was located when the mouse button was released. A manipulator surrounds KeeKat. When you move the mouse pointer over the manipulator, you can click and drag KeeKat anywhere in the window
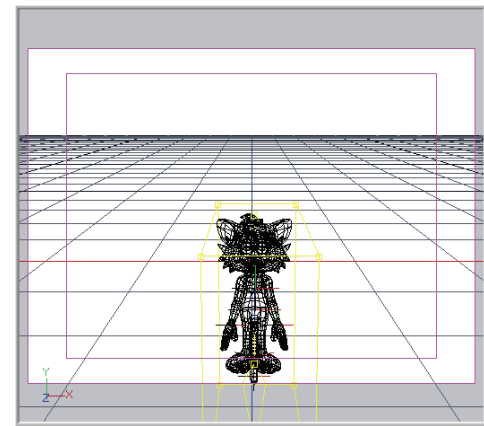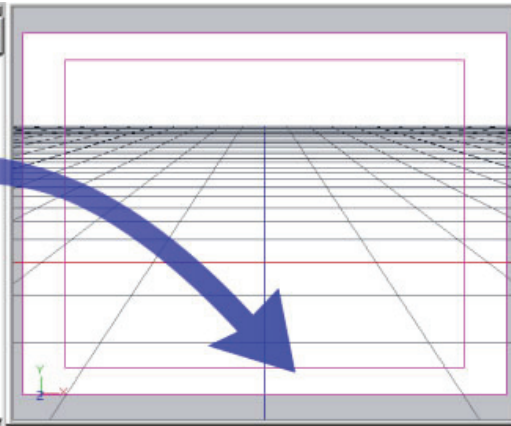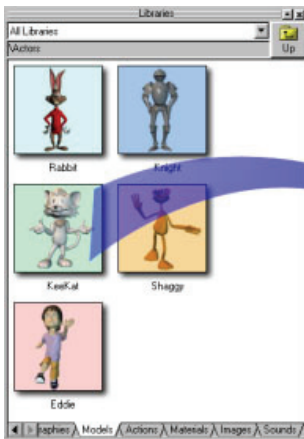
NAVIGATION

The navigation tool-bar is located just below the menu bar.

Move slides the part of the window you see. Click the Move button on the Navigation toolbar, then click-and-drag in the window. (Click-and-drag means to hold down the mouse button while moving the mouse pointer around the window).

Zoom changes the window's magnification. Click the Zoom button, then click-and-drag to the right to make things bigger, or click-and-drag to the left to make things smaller.

Bound Zoom is very useful: click the Zoom button then right-click (press the right mouse button) or <Control> click on a Mac (hold down the <Control> key while pressing the mouse button) and drag a box around the part of the window you want to see magnified.

Zoom To Fit to see everything in the window.

Turn changes the viewing angle in 3D space. Click the Turn button, then click and drag in the window to circle around the selected object.

CAMERA

To change the window's view to look down from the top, right-click (<Control> click on a Mac) over the window and pick [View][Top] from the many view options. To switch back to the camera view, pick [View][Shortcut to Camera1].
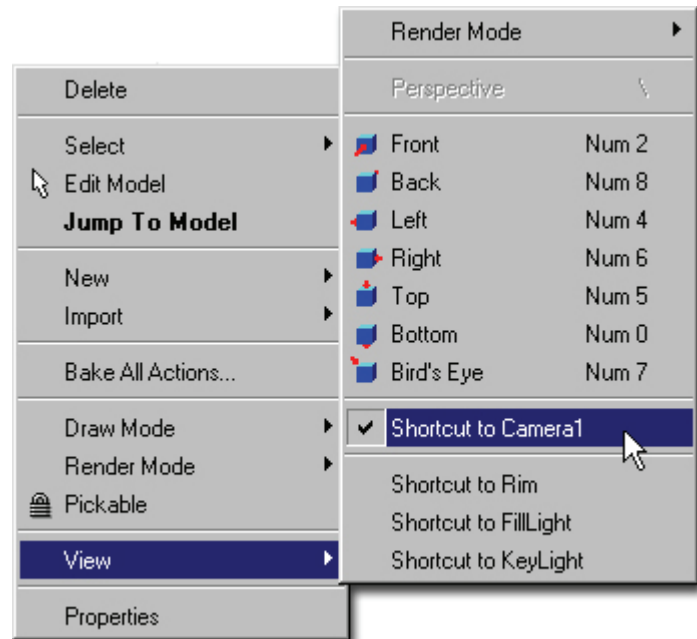
Filmmaking is an art form with over a century of history. Even though you will be using a modern computer to create films, you can still learn from historical cinematic examples. Here are some camera techniques you may find useful in making your films.

SHOT VOLUME

The camera cone contains the shot volume, a term used by filmmakers to describe the emotional breadth of a camera composition. If a nearby wall closes off the camera cone, the shot volume is very small and the audience's attention is limited to a very small space. If the camera can see all the way to the horizon, the shot volume is very large and the audience perceives a great deal of openness and space. Controlling shot volume for specific storytelling effects is part of being a good director.

REVEAL

A common camera move is a reveal, where the camera begins with a mostly empty view, and moves to show the rest of the scene. This enables the director to focus the audience's attention on one item at a time, instead of dividing their attention among all the items in a scene.

DOLLY

A straight move of the camera with no rotation or zoom changes is called a dolly.

PAN

A simple rotate of the camera.

INERTIA

A real camera is heavy; it does not snap instantly from moving quickly to becoming perfectly still. Animation:Master creates this effect automatically. However, the computer camera is not limited by weight, size or inertia, and can easily do things that would be very difficult, even impossible, for a real-world camera.

POINT OF VIEW (POV)

One of the most useful storytelling techniques of camera movement is to animate the Camera as if it were an actor's eye. This creates animations from the actor's point of view, or POV, and is a very effective way of showing your audience what the actor sees. Used well, this cinematic technique can also encourage your audience to identify with the POV actor, or at least to better understand the actor's motivation.

Your ability to direct the camera enables you to make better pictures and to tell your animated stories more effectively. The quality of all your images and animations depends on how well you direct the camera. If you can do this well, there are many opportunities for you to make a living, or just have fun, creating animation with Animation:Master.

POSE
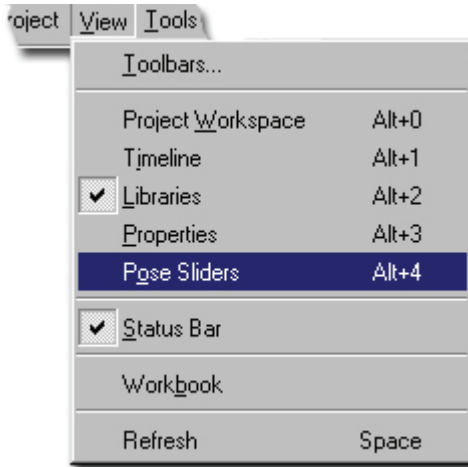
A complete actor has a variety of built-in poses.   Pick [View][Pose Sliders].
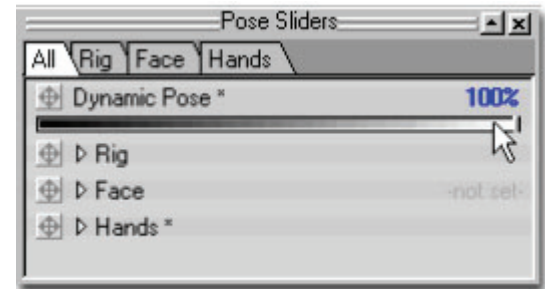
Click and drag the "Dynamic Pose" slider to "100%." And watch KeeKat change.

RENDER

If you are not viewing the scene from the "Shortcut to Camera1" view, change back to it.

Click the Render button on the Render toolbar and click anywhere in the Choreography window. In a short time, a fully shaded picture of KeeKat will appear. We'll cover saving your image or animation in the next exercise.

KeeKat © Paw Island Entertainment

Notes:

Using shortcut keys can make life easier when frequently using the same tools. The shortcut key will be displayed in the tool tip when you hold the mouse pointer over a button. The shortcut for a menu item is displayed to the right of the menu item name.

Common navigation shortcut keys:

Z:	*Zoom*	*Num pad 0:*	*Bottom view*
Shift + Z:	*Zoom fit*	*Num pad 1:*	*Camera view*
M:	*Move*	*Num pad 2:*	*Front view*
T:	*Turn*	*Num pad 4:*	*Left view*
7:	*Default render mode*	*Num pad 5:*	*Top view*
8:	*Wireframe render mode*	*Num pad 6:*	*Right view*
9:	*Shaded render mode*	*Num pad 7:*	*Bird's eye view*
0:	*Shaded and Wireframe render mode*	*Num pad 8:*	*Back view*
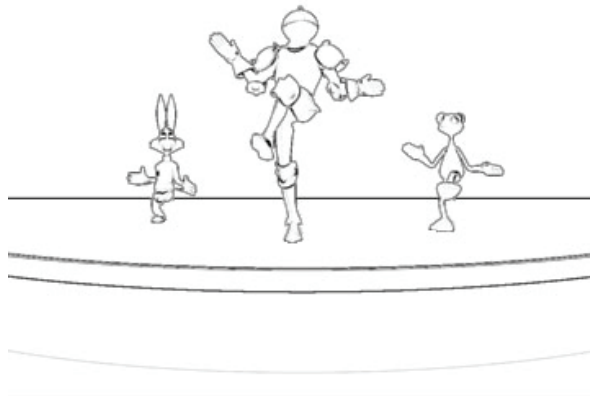
EXERCISE 2: CHORUS LINE

Completion time: 20 minutes

Pick [Project][New] to start a new, empty project.

Pick [File][New][Choreography].
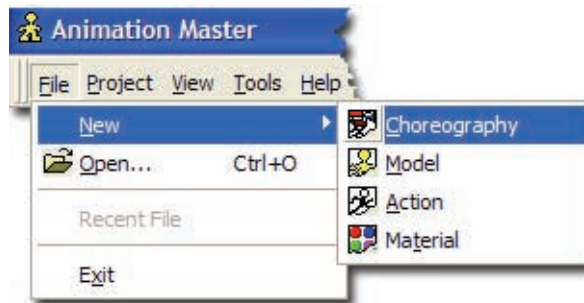
POPULATING

In the Library, click the "Models" tab, double-click the "Props" folder, then drag-and-drop "Stage" into the Choreography window. Position the stage so that it is near the camera.

Press the "Up" button on the Library then double-click the "Actors" folder and drag-and-drop "Knight," "Rabbit," and "Shaggy" into the Choreography window.
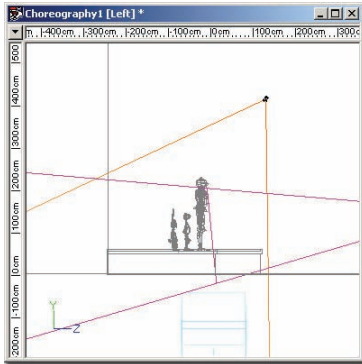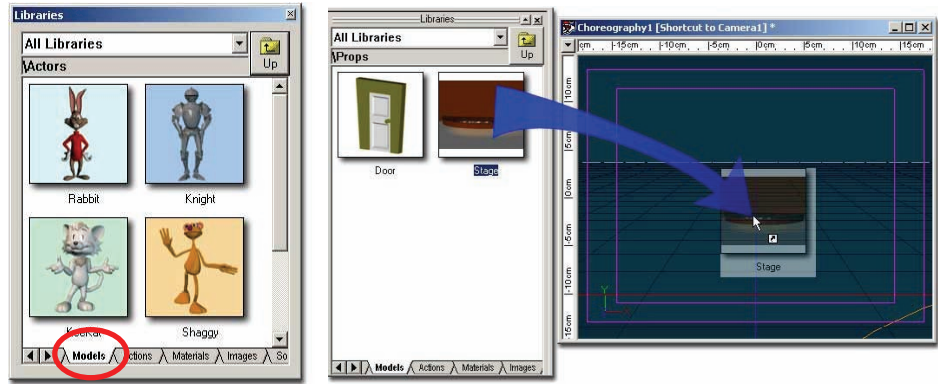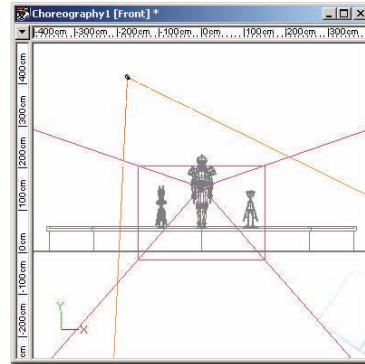
Left view	Front view	Left view after camera positioned	Camera view
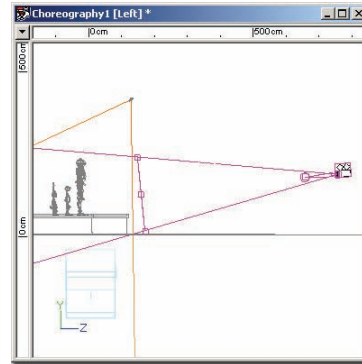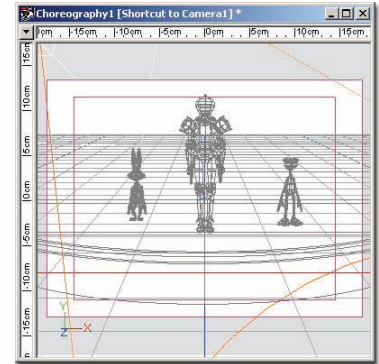
Move the actors into position on the stage, as shown. If you accidentally select the stage rather than an actor, pick [Edit][Deselect All]. Position and aim the camera from the left, then switch to the camera view. Right-click (<Control> click on the Mac) in the choreography window and pick [View][Shortcut to Camera1].

LIGHTING

Lighting plays an important part in storytelling; from the most obvious day verses night differences to the more esoteric mood indicators. (In fact, indoor light is different than outdoor light). Attractive lighting usually consists of many individual lights, strategically placed and colored to achieve the desired effect. Some lights cast shadows, while others are there only for highlights. Be comforted to know that even though technical directors can spend their entire careers becoming lighting specialists, you are provided with the basic 3-point light setup in a new choreography.

ACTIONS

In the Library, click the "Actions" tab, then drag-and-drop the "CanCan" action onto each actor in the choreography.

RENDERING

Click the Render to File button on the Render toolbar, (the "Render to File" dialog will appear). Technical directors will love all of the render options, like "Toon," "Stereo," and "Film," but concentrate on the basics for now.
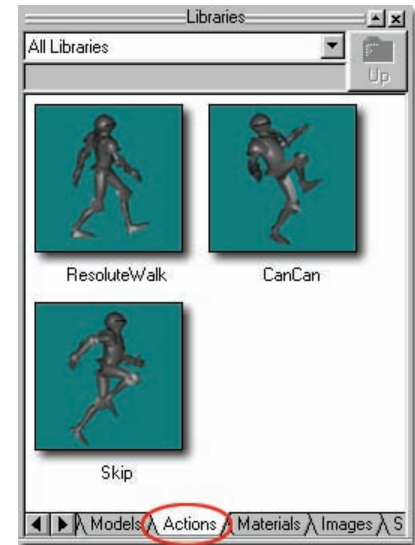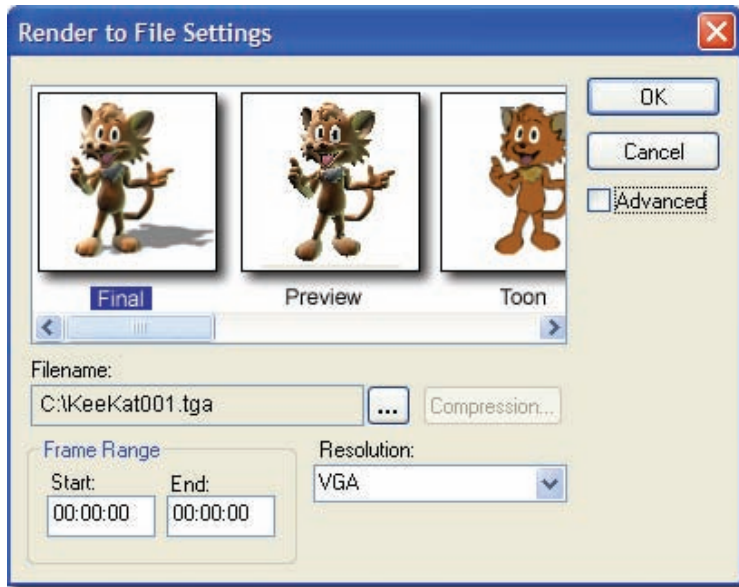
Select "Final", then click the "…" to the right of the Filename property. A file dialog will appear, choose a location to save, and a file type (Tga for still images QuickTime or AVI for animations) and then type "CanCan" in the file name box. Next, click the "Save" button. Set the "Range" property, "Start" value to 00:00:00, and the "End" value to 00:02:00. On the "Resolution" property, change VGA to Low.

Click "OK" to begin rendering.

When the Render has finished, play your movie!

Congratulations, you're a director!

Created by Torsten Thuenen
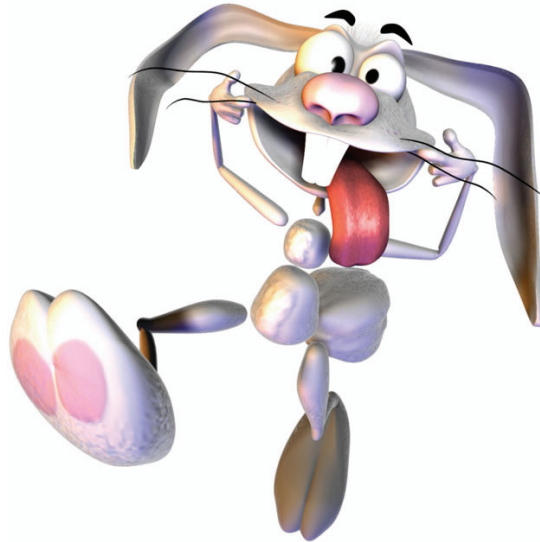
© Gary C Martin

ANIMATION

Animation:Master is a character animation tool, so it seems likely that you should spend the majority of your time animating characters. Considering that traditional animators must be extremely talented, drawing and painting every single frame, computer animators have it easy. In most cases, a talented animator using a computer can tell more stories with better draftsmanship during their careers. Luckily, all of the animation philosophies developed over the years are still applicable to computer tools. The concepts of follow through, anticipation, and exaggeration apply equally well to what you will be doing here. In fact, traditional character animation books make great references, both for modeling and animation.

TALENT POOL

Animation:Master embraces the concept of a talent pool. The computer can't supply the talent for you but it can allow you to use the talent that is already in the pool, or more importantly, put your talent into a library for later use. As you work on an animation, you will recognize a lot of repetition in your character's facial expressions, gestures, locomotion, and a thousand other activities, just like we do in real-life. By using reusable actions from the talent pool, you can get a great head start, speeding the animation process and increasing the number of stories you can tell during your career.
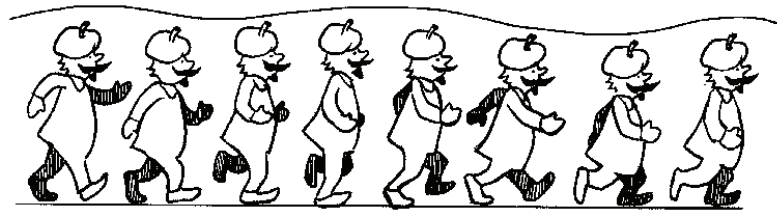
KEYS TO ANIMATING

Early in animation's history, when superhuman animators first proved that a single person could produce the thousands of drawings necessary to make a cartoon, they used a technique now called "straight ahead animation," where every frame was drawn as a minor adjustment on the previous frame. Though the process is simple to comprehend, it had no timing – it was difficult to know how much time a move would take, and every move flowed evenly into the next. Watch some early (pre 1930) cartoons to see examples.

Modern "keyframe" animation instead requires the animator to time the movement first, draw the frames that are the extremes of the motion, then fill in the in-between frames that make the movement smooth. As keyframe animation developed, master animators adjusted the in-between frames to produce a visual impression of acceleration and deceleration simply by changing the spacing. Other master animators created distinctive styles by exaggerating the acceleration and deceleration and carrying the exaggeration into the keyframes. For example, a character's head may turn so quickly that it snaps back, and probably even distorts the shape.

As you develop as an animator, your own style will emerge. You will become very proficient at certain moves and find yourself adding nuances that make your "look" different and recognizable. However, this is many thousands of frames in your future. For now, learn the basics.

THE 10 ANIMATION INGREDIENTS (UPDATED FOR COMPUTERS)

In animator terms, a talented pencil sketcher is understandably called a good draftsman. The "Nine Old Men" of Disney fame were all good draftsman but they were canonized because they identified the ingredients of animation.

1. Pose to Pose
2. Anticipation and Overshoot
3. Follow Through
4. Exaggeration
5. Timing
6. Balance and Weight
7. Secondary Action
8. Attitude
9. Staging
10. Squash & Stretch

Pose To Pose

This term is taken from a traditional animator's technique of drawing key poses for the action, each morphing into the next. Computer animation is a little different in that every part of the body can have its own keys on different frames but the concept is the same. For example, an actor is posed holding a ball on the first keyframe, he lifts the ball on the subsequent key, reaches back on the next, and steps forward with his arm ahead throwing the ball on the last keyframe.

Anticipation And Overshoot

If the viewer is watching another part of the screen, it takes about a fifth of a second (6 frames) after a new object moves before the viewer can refocus on that movement. Essentially, the viewer misses the beginning of the movement, so you, as the animator, should make a preliminary movement before the main movement to attract the viewer's attention, called anticipation. These are the clues your character gives the viewer that something is about to happen. An example of anticipation is drawing back a character's foot before a big kick; by the time the viewer is watching, the leg will begin its swing. Other Examples:

- The character's eyes may follow a pestering bee before a swat.
- The camera pans to a flower the character is going to sniff.
- A baseball player winds up for a hit.

Movement that is important to the narrative especially requires anticipation, and for emphasis, the movement should overshoot. An example of overshoot is an arm stretching too far while pointing a finger, then snapping back.

Follow Through

We see the results of follow through all around us in our everyday life. These are the subtle movements caused by the physics of nature. Examples are:
- A character's hair waving after turning his head.
- A rabbit's ears bouncing.
- Coat tails swinging.
- Bug antennas bobbing.
- Cigarette smoke swirling.
- The rebound of a baseball player's bat after the hit.
- Jiggling of a fat belly.

Exaggeration

When clueing the audience that an actor is heavy, it always pays to overdo it. Not meeting the viewer's expectation of weight hurts the story but exaggerating only makes it funny. Most characters are not supposed to be real – that's their charm. Everything about them is meant to entertain the viewer. Exaggerating the character's movements, expressions, and reactions is funny, and a proven device that keeps the audience entertained. For example, a happy character's smile is much too big for their head, and silly characters bob high in the air when they walk. Also, when characters tumble, their arms flail wildly. In a sense, character animation is the art of exaggeration.

Timing

The spacing of key poses determines the amount of time the action will take. Varying the spacing varies the speed, which in turn signals emotion: lethargic, excited, nervous, relaxed, etc.

Animation movement is divided into tenths of seconds. Most natural movement occurs over two tenths of a second (which is 6 frames at 30 frames per second). Computer animation is described by keyframes. The animator establishes the keyframes and the computer calculates and performs the in-between frames.

Keyframe Spacing	Impression
1	tremendous force
2	hit by a frying pan
3	twitch
4	dodging the frying pan
5	crisp order "Move it!"
6	friendly request "Hurry"
7	caught attention
8	casual look
9	close scrutiny
10	thoughtful consideration
11	stretching

EASE

Ease is an animator's term for simulating acceleration and deceleration of movement. It is enough for beginners to know that the computer automatically supplies its own ease to most movement. However, knowledgeable animators can control just how much ease they want by adding extra keyframes.

HOLDS

Often a character is not moving at all, called a hold. Holds are an important part of timing, so-much-so that they have evolved their own rules.

- The character must be balanced before holding.
- A look off-screen needs a half-second of hold (15 frames) before cutting to what the character sees.
- Allow two thirds of a second (20 frames) for each word of a title card for reading time.
- The freeze position at the end of a fast throw is held for half a second (15 frames).
- After a character stands up quickly, the pose is held for a third of a second (10 frames) before the next movement.
- A note about setting up for holds; avoid having all parts of a character start or stop at the same time.

Balance and Weight

Balanced   **Unbalanced**
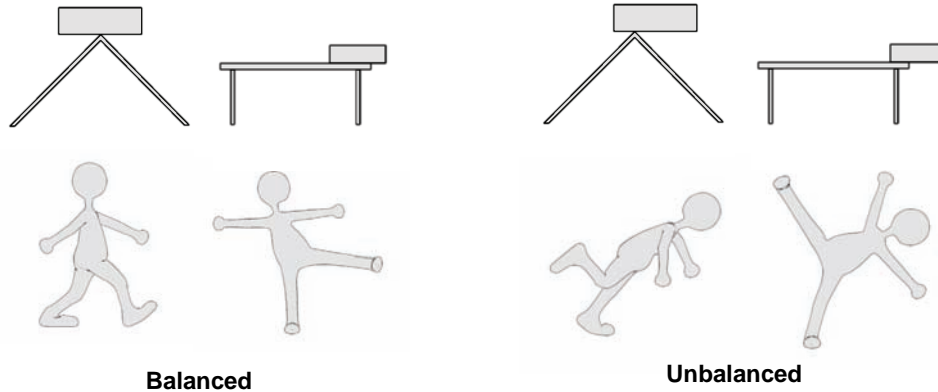
As humans, we immediately recognize if someone loses their balance and is about to fall over. We intuitively know what is balanced. One of the things that makes animation funny is when it violates these balance expectations BUT, other than a storyline gag, characters MUST remain balanced! If a character appears off-balance, yet never falls down, the narrative is ruined because you have confused the viewer's senses. Because of our expectations of what happens when something is out of balance, balance hints of upcoming action. If a character's pelvis is shifted to the right, then his shoulders surely must shift to the left to maintain balance. If the character leans forward and points, he certainly should stretch his other arm behind him to even things up. You should exaggerate weight shifts to accentuate it.
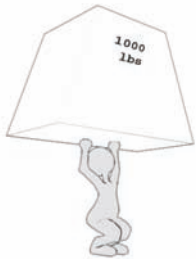
Weight is related to balance. Traditional animators stress weight above all other technical concerns. How much an object weighs is dictated by how much effort is required to move, stop, push, pull, or change its direction. Heavy characters should show a distinct shifting of balance and squashing of their legs as they step, moving slow and deliberately. Also, importantly, thrown objects need to travel along a realistic arc.

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Secondary Action

Secondary action supports the main action. These are the little details that show personality. For example, an evil-doer twirling his mustache, or a bookworm taking off her glasses and rubbing her eyes. These little mannerisms add personality to a character. As you become more experienced, the level of secondary action you add to a character will increase. Secondary action is a good way of measuring an animator's skill, so you will want to show off as you improve.

Attitude

Characters express their feelings and emotion through body language: quizzical characters shrug their shoulders; angry characters thrust out their chest; surprised characters throw up their hands. But these obvious examples are not nearly as important as the natural positions a character assumes while listening to a conversation, or the heroic stance of a leader. Every character in a scene needs an appropriate pose or they will appear out-of-place.

Staging

Staging includes photography direction, choreography, and set dressing. Staging should convey the mood even before the characters arrive. There are many staging artifices already built up in moviemaking iconology.

SCENE

Staging includes the scene's ingredients. For example, something scary should be filled with symbols of a spooky situation: an old house, bones, the wind howling.

DEPTH

The subject of any camera shot should stand out from the background, otherwise the audience suffers a glitch in story continuity while they decide what in the scene is important. Centering the shot on the subject is the most important visual clue, including centering of the subject's depth in the scene. Traditional animation has a lack of depth clues so gimmicks such as blurred backgrounds, isolation, and color desaturation were used to provide emphasis. Computer rendering has the advantage that shading and perspective show depth to the audience.

However, if a shot becomes jumbled, use depth-of-field (blurring of objects in front of and behind the subject) and lighting to emphasize depth.

ASYMMETRY
When you animate, make sure both arms or legs are not doing exactly the same thing (or the mirror of the same thing). Also, make all movement in flowing arcs – this makes the character appear natural rather than robotic.

EMOTION
There are several established symbols of emotion in the scene.
- Rear views for dreaming.
- Center on the shadows for suspense.
- Shadows fall onto main character during drama.
- A desperately searching character frequently has his face obscured as he looks around.
- Support the staging. For example, leaf bare trees at night signal terror.
- Painted backgrounds can be used as establishing shots, such as a castle in the distance.
- Effects, such as rain, fire, and fog convey strong preconceived feelings.
- Instead of animating a character, prolong a feeling of activity by moving the camera.
- Off-screen sound effects are the easiest scene builder.
- Sad or quiet scenes are long, with slow camera pans and trucks, and slow moving characters.
- Happy or excited scenes are short with fast cuts and quicker moves of the camera and characters.
- A down shot should be used when there are interesting or important things to identify.

"Even sugar bowls have feelings in the world of fantasy." Ollie Johnston

EXPRESSION
Rules of thumb
- Change the expression before a fast move
- A character looks down when frowning, up when smiling
- When the character is talking, minimize other facial expressions before or after the dialog.

GROUP MOVEMENT

When more than one character is walking together, modify each ones pace slightly. Also have the spacing between characters change slightly – pull apart, close in again, pass another, or fall behind. This gives life to the group.

ANIMALS

Animals are common in animation and they have their own secrets. Hair clues the audience to an animal's personality: smooth fur is feminine, mussed hair gives an irritable look. Tails show mood: happy dogs wag their tails; scared dogs put their tails between their legs. Ears show an animals attitude: quizzical, angry, alert. Neck and chest also show attitude – from belligerent chest jutting to friendly leg rubbing.
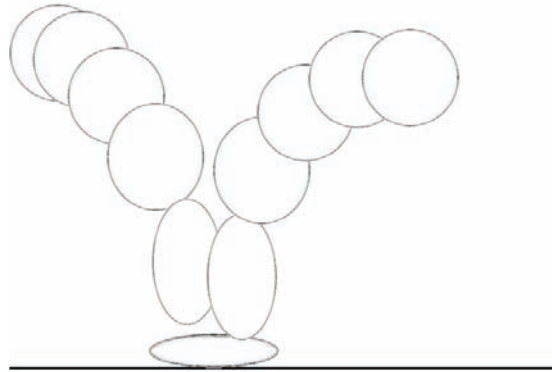
Squash and Stretch

Actors in real life do not really squash or stretch when they move but it has become a staple in traditional animation because it exaggerates weight, which is considered the most important aspect of realistic movement. Balls squash as they hit the ground, stretch as they rebound: rubber balls squash more than cannonballs. The fact that you can tell if a ball is a rubber ball or a cannonball by a simple animated bounce, demonstrates how influential squash and stretch can be. However, a little bit goes a long way; unless your goal is to animate like the great Tex Avery, don't overdo squash and stretch.
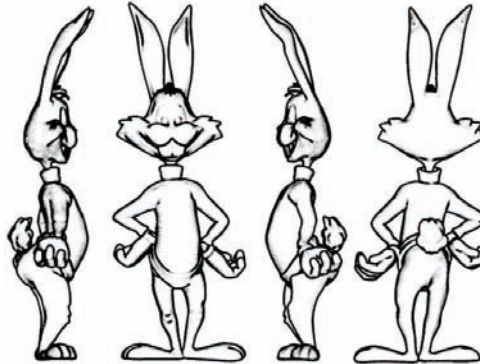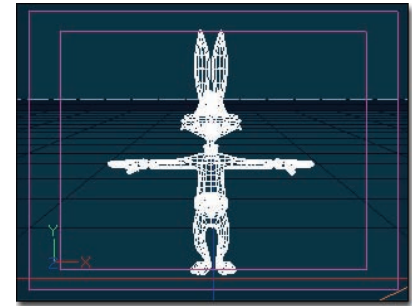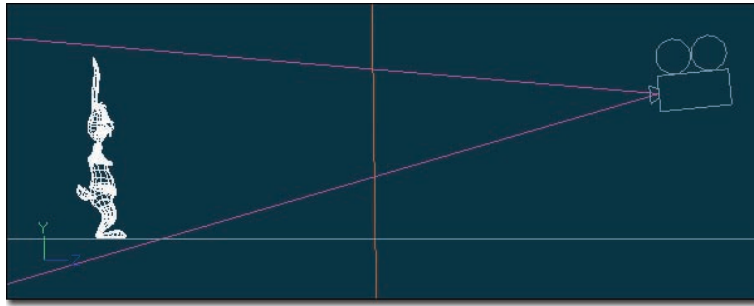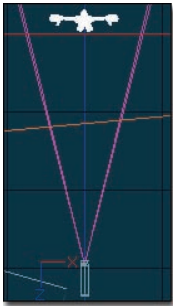
EXERCISE 3: MOVE IT

**Completion time: One Hour**

Pick [Project][New] to start a new, empty project.

Pick [File][[New][Choreography].

In the Library, click the "Models" tab, double-click the "Actors" folder, then drag-and-drop "Rabbit" into the Choreography window.

Right-click (<Control> click on a Mac) over the Choreography window and pick [View][Render Mode] [Shaded]. Every model in this Choreography window will now be displayed solid shaded rather than in wireframe.
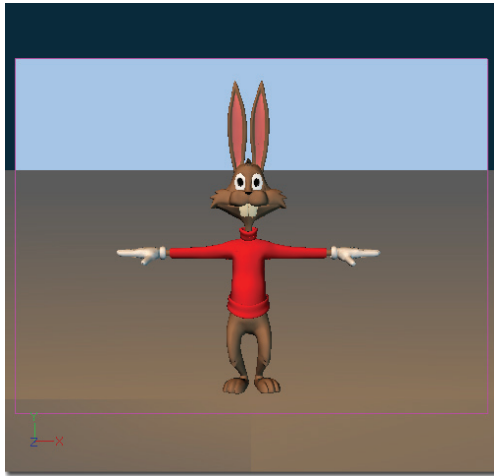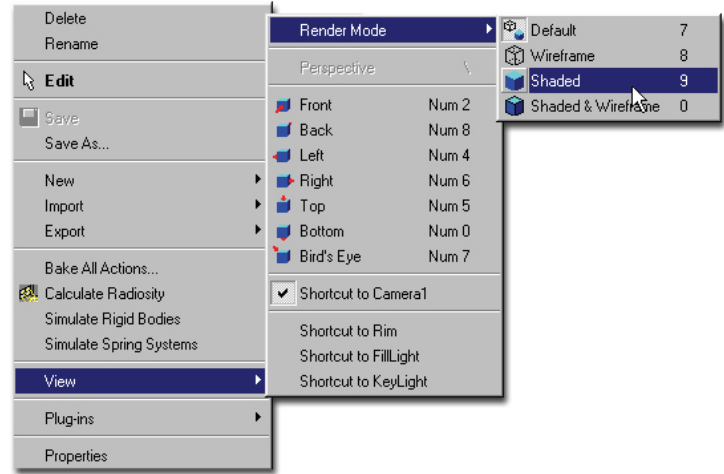
Click Rabbit to select him, and then click the Skeletal button on the Mode toolbar. (Rabbit's bones will now be displayed). If you hold your mouse over a bone for a short moment the bone's name will appear. This is helpful when trying to pick bones.
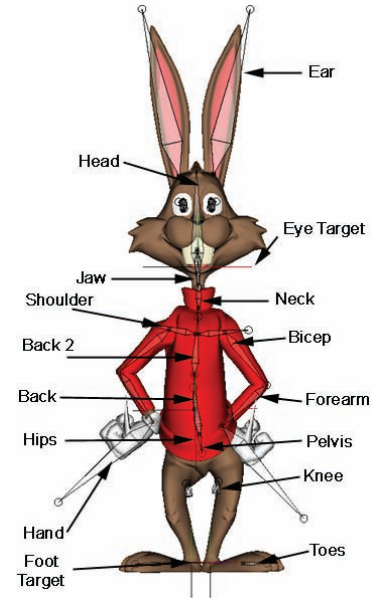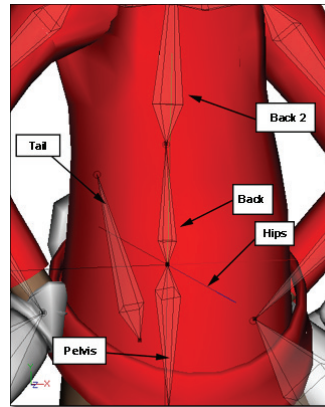
HIPS

To select the hips, click on the null (3D cross) that is centered in Rabbit's waist. The Standard manipulator will surround the hips when it has been successfully selected.
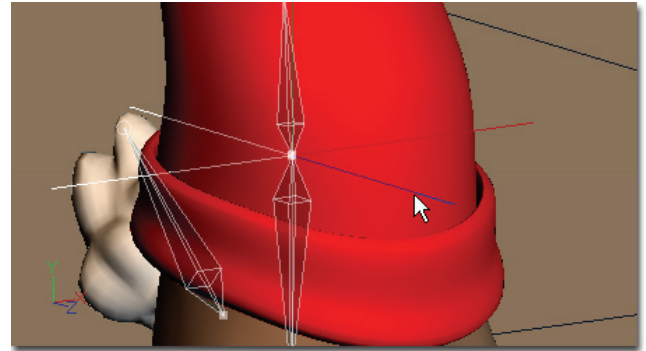
You can translate the hips by dragging the manipulator. Notice the mouse pointer changes to a Translate cursor when it is over the manipulator box.

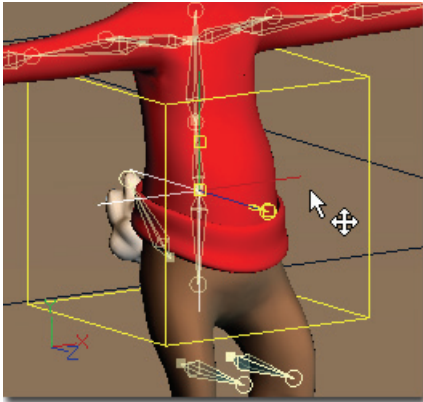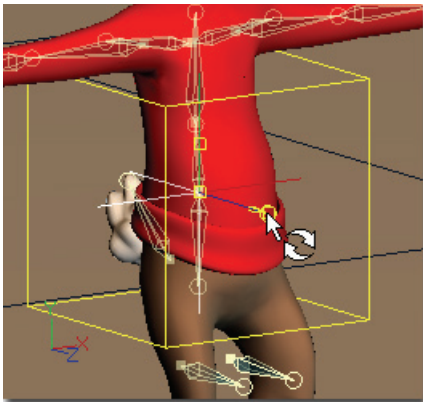To rotate the hips, drag the end of the bone, or click the Rotate Manipulator button on the Manipulator toolbar. (The Rotate manipulator will surround the hips). Click anywhere on the sphere, and drag the mouse to rotate the hips, (or click on one of the colored Axis circles to rotate the hip only on one axis).
It may be helpful to change to other views when rotating to better see Rabbit's movement.
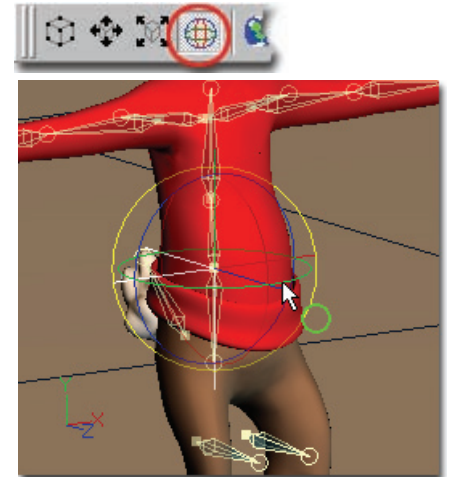
An imaginary line extending through the main action of the rabbit is called the "Line of Action." Pose the rabbit and his limbs to emphasize this line. By doing this you will strengthen the dramatic effect of the pose.

From a side view, rotate the hips downward so that they match the line of action. Also translate the hips a bit downward so that the rabbit's knees bend slightly.

Now position the Head, Back2, Back, and Pelvis bones to match the line of action.
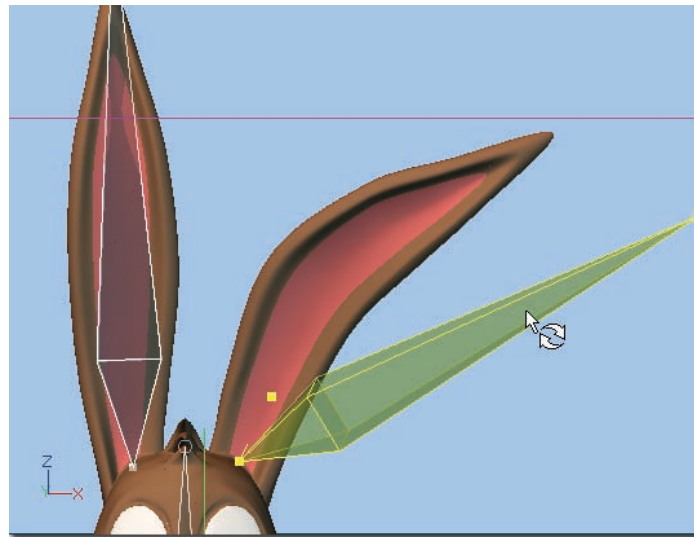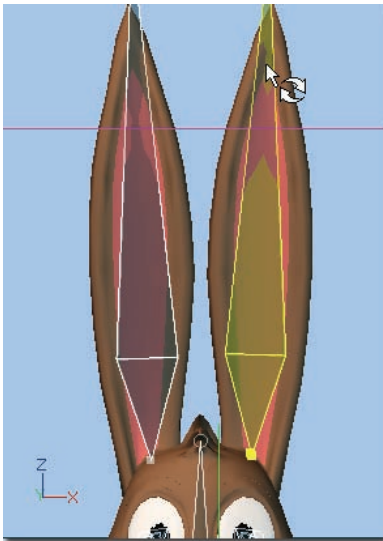
EARS

To position the ears simply drag the end of the ear bone. The ears will bend smoothly in the same direction that the ear bone is positioned.
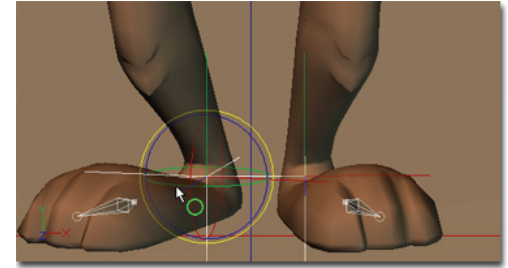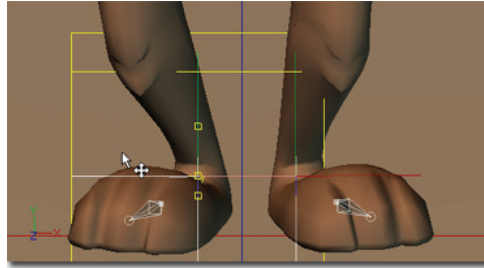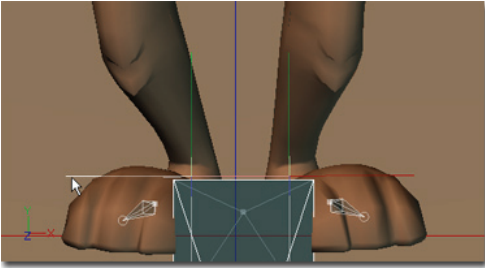
FEET

To position the feet, click the null centered in the heel. Move the mouse pointer over the manipulator until it turns into a Translate cursor. Click and drag the mouse to translate the foot. Notice that when you move the foot, the hips automatically keep centered and translate up and down. Bring the heels close together. Rotate the feet to turn outward using the Rotate manipulator.
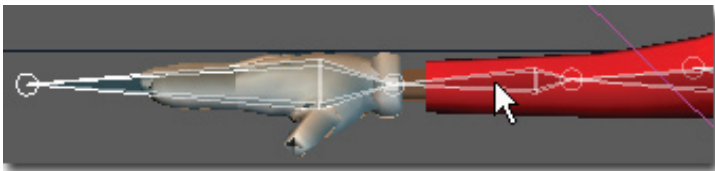
ARMS

To position the arms, use the Forearm bone. As you rotate the forearm, the bicep will also rotate, as you would expect. This automation is called inverse kinematics. To bend the elbow, rotate the bicep bone.

HANDS

To roll the hands, first click Rabbit's "Hand" bone, then click-and-drag the bone's Roll Handle. To rotate the hand, simply drag the end of the Hand bone. (The mouse pointer will change to represent what operation will happen if you click and drag.)
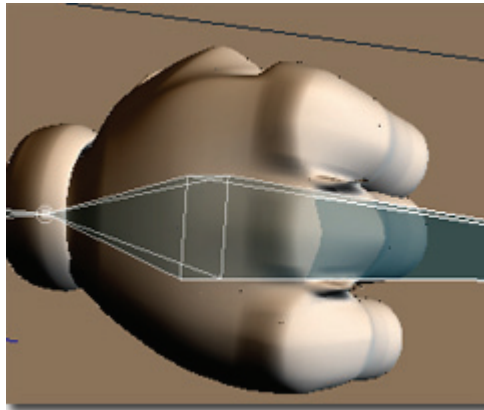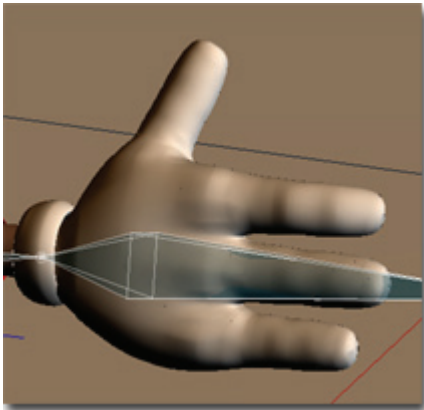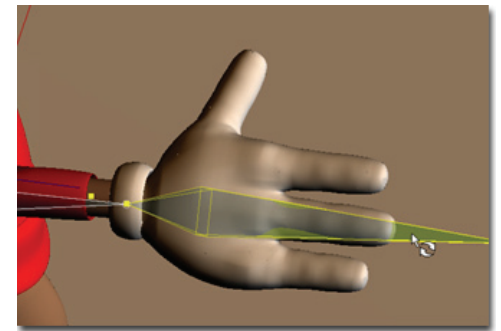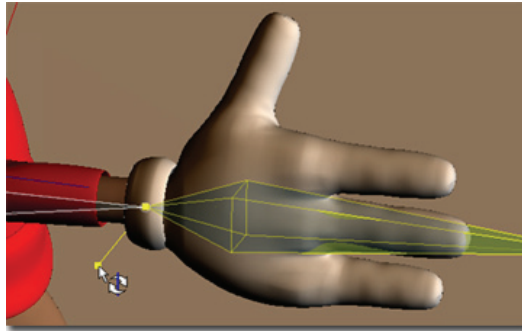
FINGERS

To clench all Rabbit's fingers simultaneously, pick [View][Pose Sliders]. Click the "Hands" tab, then click and drag the slider for the Left or Right Hand Clench pose.
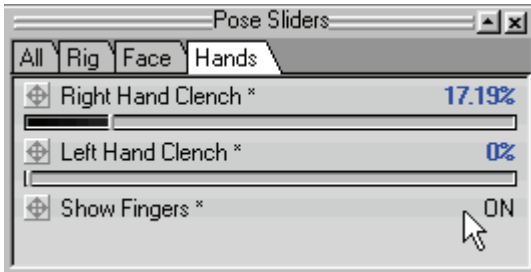
By default, Rabbit's finger bones are hidden to simplify the hand. To move the fingers individually, unhide the finger bones by clicking on "Show Fingers" so it is set to "ON"

To bend a whole finger, click a finger bone to select it, then move the end of the bone. To bend a finger at the knuckles, rotate the bone's Roll Handle. The finger will then bend inward or outward depending on which direction you turned the Roll Handle.
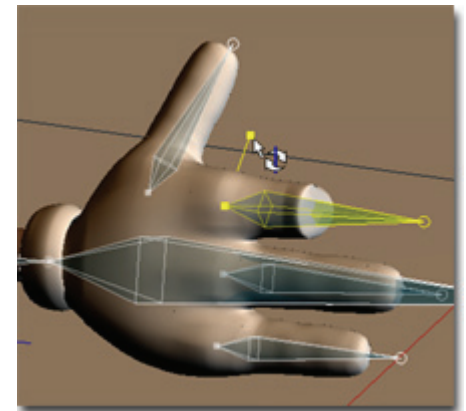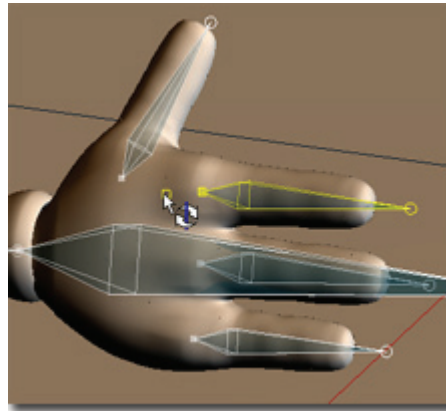
Position Rabbit to match the picture at the beginning of this exercise. When you are finished, you might want to try the poses on page 34 as well. It may take a little practice to become efficient at posing a character, but once you have, you will be ready to start animating.

Created by Stian Ervik Wahlvag
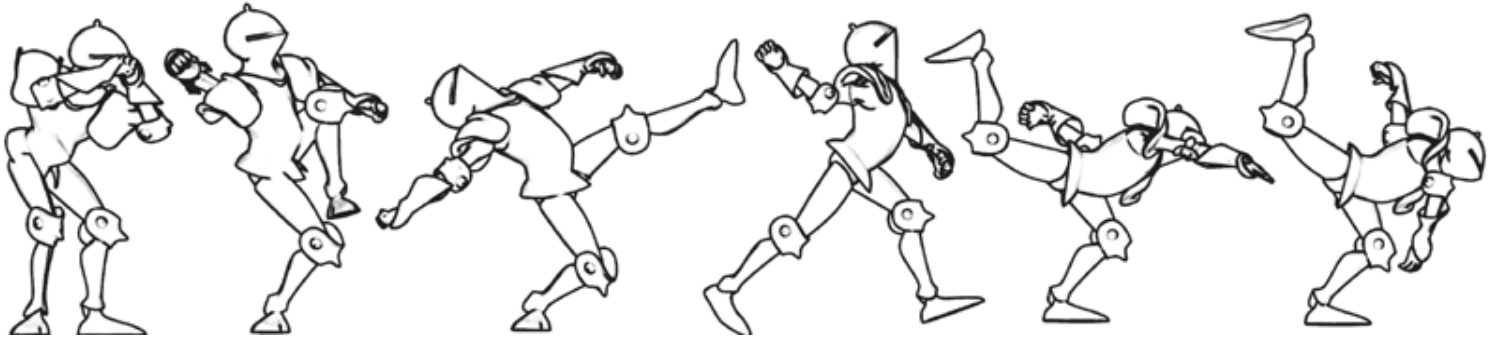
EXERCISE 4: IT'S A PITCH
Completion time: One Hour

There's no better example of all the animation fundamentals than throwing a ball. A baseball pitcher exhibits three major components of good animation: anticipation, balance and weight, and follow through.

Pick [Project][New] to start a new, empty project.

Pick [File][New][Choreography]
In the Library, click the "Models" tab, double-click the "Actors" folder, then drag-and-drop "Knight" into the Choreography window

Right-click (<Control> click on the Mac) over the Choreography window and pick [View][Render Mode][Shaded]. Every model in this Choreography window will now be displayed in shaded rather than in wireframe.

 Click the Skeletal button on the Mode toolbar. (Knight's bones should appear).
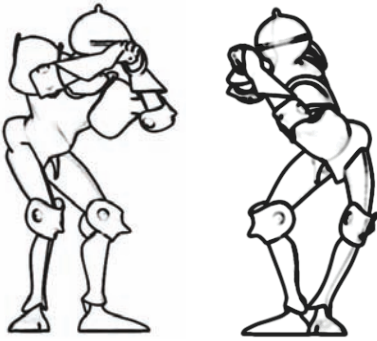
Left   **Front**

On frame "00:00:00," put Knight into the initial pose, as shown. It's easiest to start by positioning the feet, followed by the hips, back, head, and then arms. Use the Pose sliders to clench the hands.
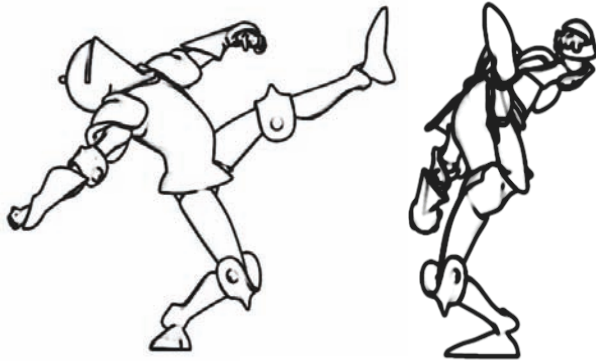
At frame "00:00:10," Knight cocks his throwing arm back and shifts his upper body behind his planted right foot. His left foot reacts by rising as a counter balance.

Balance

Change the frame by clicking in the frame edit box at the bottom of the screen and change the "00:00:00" to "00:00:10" then press the **<enter>** key (**<Return>** key on the Mac.) Simply typing in "10" will also work. Or alternatively, you can press the '+' key 10 times or click the Next Frame button 10 times until the edit box displays frame "00:00:10".

Left　　　**Front**　　　**Top with swing**
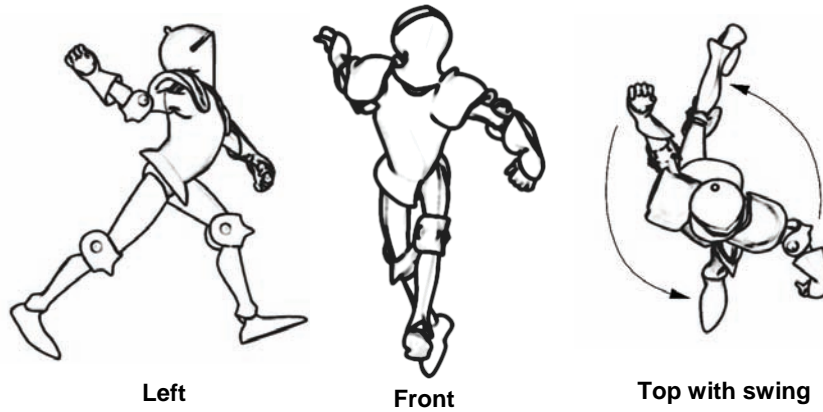
At frame "00:00:13," Knight begins his forward motion and starts to take a step. A circular swing by his right hand triggers a corresponding reaction swing by his left hand.
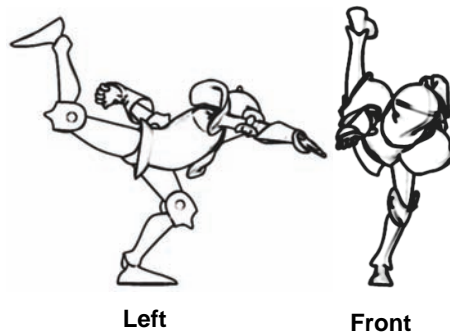
Left　　　**Front**

At frame "00:00:18," Knight opens his hand. His right leg rises above his head to balance his throwing arm.

Left

Front

At frame "00:00:20," create follow through by continuing the throwing arm's motion while his back leg continues rising, and his left arm and head continues forward. The length of the action, in this case 20 frames, determines how much weight Knight appears to have.
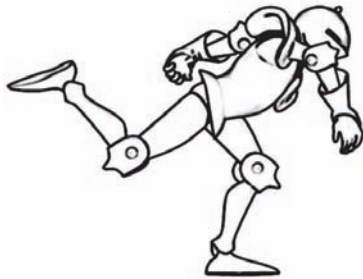
Left view
Frame "00:00:24"

Left view
Frame "00:01:06"

Finally, during frames "00:00:24" through "00:01:06," Knights returns to a relaxed pose. Use the frame toolbar to step through your completed animation. Make any necessary changes, and then render the animation.

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REUSABLE ACTIONS

Reusability is the foundation of Animation:Master. You might animate a walk on one character and apply it to a different character, or animate a character singing a song and use that lip-sync with other characters so they can sing in a chorus. Anytime the animation you are creating has repetition, or multiple actors are to act out the same action, or you will use the same action in multiple scenes, then a reusable action should be created. Here is a list of some examples that would make good reusable actions.

Any action that can cycle:
- **Walking**
- **Running**
- **Skipping**
- **A bird flapping its wings to fly.**
- **The wheels turning on a car.**

Any action that multiple models will be acting out:
- **Dancing**
- **Waving**
- **Cheering**
- **Clapping**

Any action that a model might use in multiple scenes, or multiple times in a scene:
- **Standing up**
- **Sitting down**
- **Laying down**
- **Punching**
- **Kicking**

TECHNICALITIES

ACTION WINDOW
Cycled actions like walks are specially made in an Action window, which contains only the model and the action you are working on. Actions in the Action window are in their pure reusable form while actions in a Choreography window can have all kinds of custom modifications. Action windows have different tools and redraw faster because they are simpler.

FRAME RATE
There are a few technicalities that you don't have to do but you have to know. First, in America and Japan the video format is 30 frames per second, so one second of animation is 30 frames. Second, due to the nature of computers, the first frame is 0, so frame 29 would be the last frame of a complete second, and frame 30 would be the beginning of the next second.

SMPTE
Video uses time to determine what frame you are on, called SMPTE time-code. The format is 00:00:00, for minutes, seconds, and frames. 00:03:15 would represent 3 seconds, frame 15. Animation:Master uses this frame representation method throughout.

SKELETON
Animation:Master has a suggested hierarchical layout and bone naming convention. Currently we recommend one called the "2001 skeleton", but others, like the "Raf" or "Taylor" skeletons exist and more will evolve. It is very important to know the skeleton of your character because that determines what existing actions can be used with it.

CONSTRAINTS
Constraints are a common tool you use to computer animate. Constraints are so named because they "constrain" something: feet are constrained to the floor; eyes are constrained where to look; knees are constrained to point forward. Constraints often use invisible reference objects, called "nulls," to target to, but constraints also use bones, lights, cameras, splines, etc.
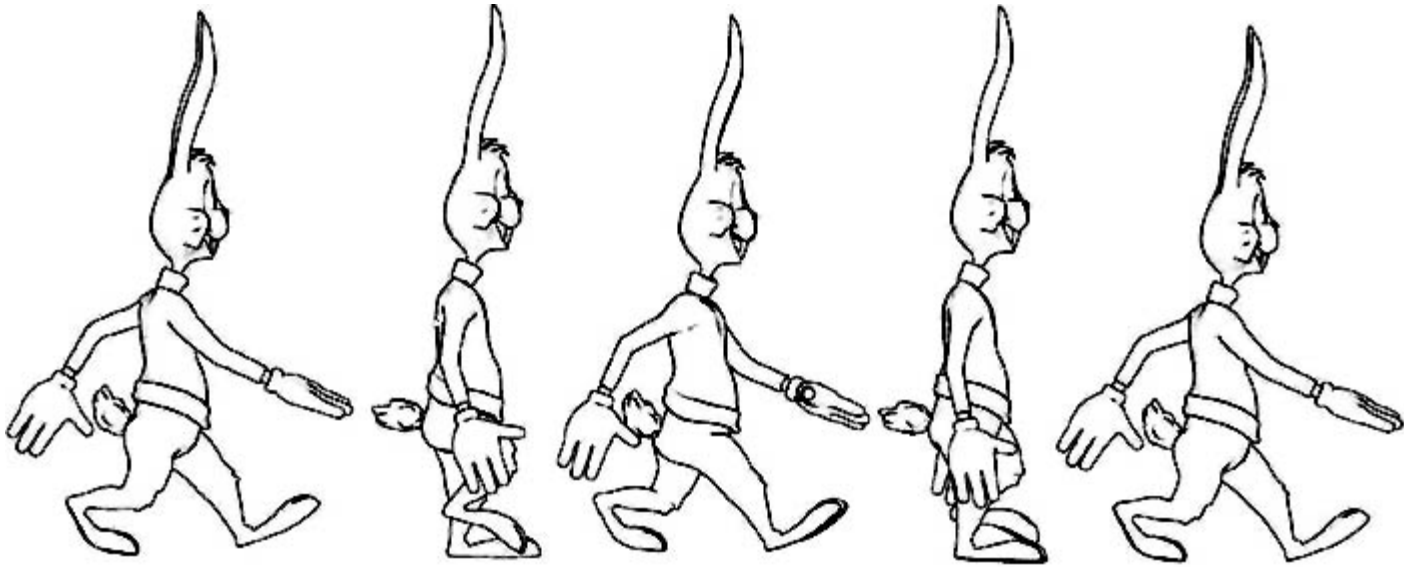
EXERCISE 5: TAKE A WALK

Completion time: One Hour

Walks do a lot to communicate a character's personality: from short and long strides, waddling, bouncing, swaggering, and other easily distinguishable traits. Walks exhibit balance and weight, follow through, secondary action, and they are special because they cycle. This means each step is repeated many times, so only one step needs to be animated, then the character is given a path to follow and off they go. Other cycled "walk" actions include a wide assortment of runs, crawls, sneaks, etc.

Pick [Project][New] to start a new, empty project

In the Library, click the "Models" tab, double-click the "Actors" folder, then double-click "Rabbit" to add him to the project, (a Model window will open, close it).

Pick [File][[New][Action], (a new Action window will open).

Since this is a cycling action the rabbit should be walking in place as if he were on a treadmill. Turn OFF "auto balance" by turning the "Balance" and "Balance Rigid" sliders to "0%" on the "Rig" tab of the Pose Sliders panel. Another time you would turn off these control is when you want to position the feet above the pelvis, like in the "Pitch" or "Stuck Door" exercises.

Keyframe "00:00:00"

Pose Rabbit in his starting keyframe. Use the vertical and horizontal guides in the pictures as reference points. You can add your own reference points (called Markers) in the Action window by clicking and dragging in the ruler margins. If rulers are not visible already, choose [Tools] [Options] and on the "Action" Tab and select "Display Rulers". To remove a Marker, Right-click (<Control> click on the Mac) on the arrow in the rulers margin and pick [Clear]. Be sure to pay attention to the feet in relation to the Marker.
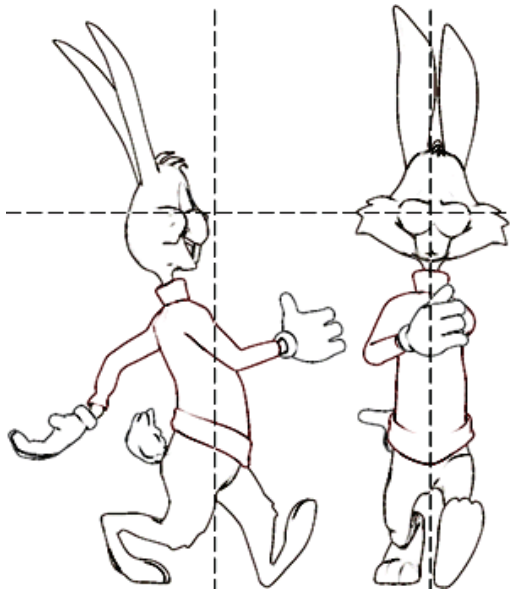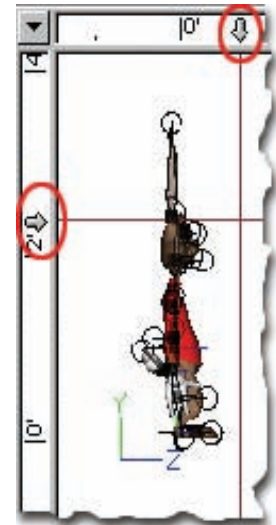
`00:00:05`

Change the time by clicking in the frame edit box at the bottom of the screen and change to 00:00:05. Or alternatively you could press the '+' key 5 times, or click the Next Frame button 5 times. (Typing "5" rather than "00:00:05" will also work.)
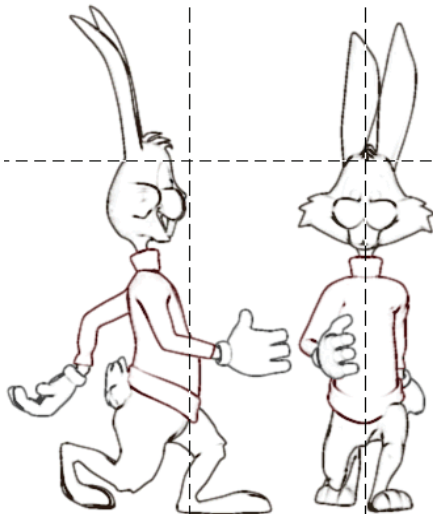
Rabbit is anticipating lifting his right leg, so he prepares to transfer all of his weight to his left foot. Lower his hips and translate the chest forward over the left leg. Translate Rabbit up with his Hip null.

Use the rotate manipulator on the foot target when pointing the foot straight down to prevent it from rolling.
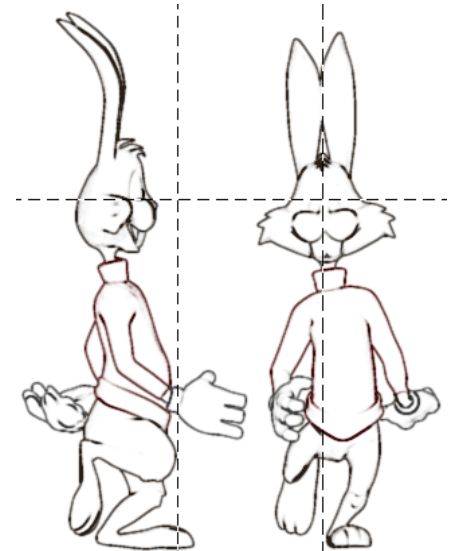
Keyframe "00:00:05"

Keyframe "00:00:10"

EXAGGERATE

At frame "00:00:10," Rabbit's right foot lifts up and starts coming forward for the step. Exaggerate the lift to give him some personality, (the higher the leg lifts, the lighter on his feet Rabbit will seem). From the Front view, you can see his back has rotated slightly to the right. Also rotate Rabbit's neck.
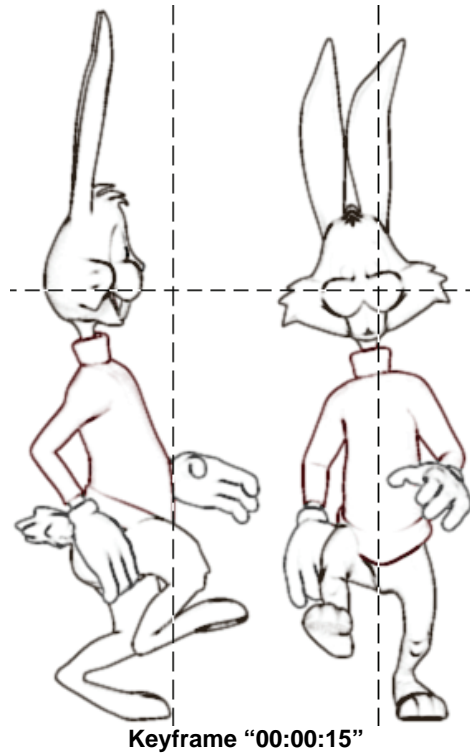
Keyframe "00:00:15"

On frame "00:00:15," Rabbit is at his high point. The right foot is raised high in the air anticipating his next step.

Click the Looping button next to the Play button on the Frame toolbar, and then click the Play button to watch what you have created so far. Re-click the Play button to stop the action playing.

FOLLOW THROUGH

Follow through is action resulting from another action, so if your character has any appendages or loose parts, such as the ears and tail of Rabbit, these parts will move at a slower speed, trailing behind. When Rabbit strides forward, his ears should lag behind, and then he hesit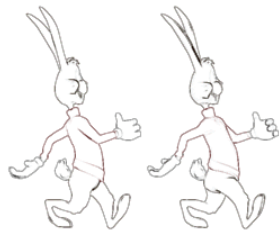ates at a step, his ears should continue to move forward. The same holds true for the side to side motion of the head: the ears should lag behind the rest of the motion, sort of flopping back and forth depending on how exaggerated his motion is. His tail should exhibit similar follow through. Add your own follow through to the rabbit.

00:00:0 and 00:00:20   **00:00:05 and 00:00:25**   **00:00:10 and 00:01:00**   **00:00:15 and 00:01:05**

So far you have created the first four keyframes. The rest of the keyframes are simply mirror images of these keys, thus keyframe 00:00:20 is the mirror image of keyframe 00:00:00, and likewise keyframe 00:00:25 is the mirror image of keyframe 00:00:05. There is a special animation tool called "Paste Mirrored" to accomplish this.

Go to frame "00:00:00." Pick [Edit][Copy Keyframe]. At frame "00:00:20," pick [Edit][Paste Mirrored]. Repeat for frame 00:00:05 to 00:00:25, 00:00:10 to 00:01:00, and 00:00:15 to 00:01:05. Lastly copy frame "00:00:00" and do a normal paste [Edit][Paste Keyframe] at frame "00:01:10" to complete the walk cycle.

STRIDE LENGTH

It is important to keep a character's feet from slipping while traveling along a path. Setting the character's stride length determines just how far the character needs to move each fram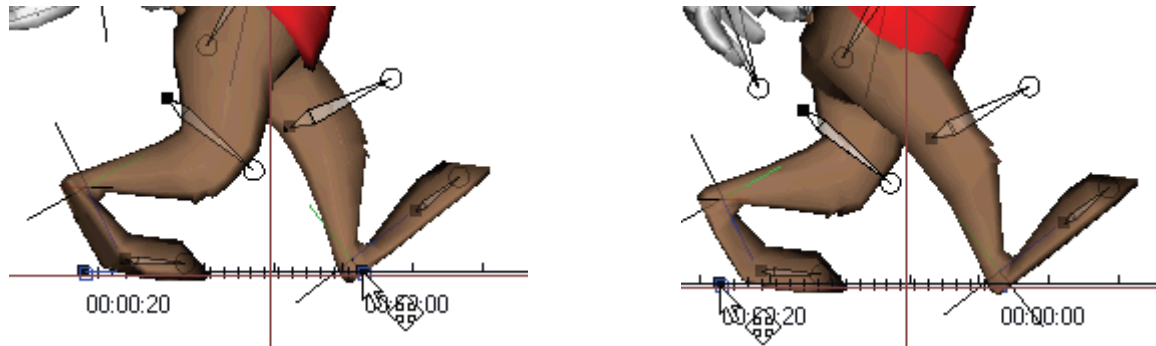e to make its feet appear solidly anchored to the ground. To complete the next step you will need to use the Properties. Pick the [View][Properties] menu to open the panel.
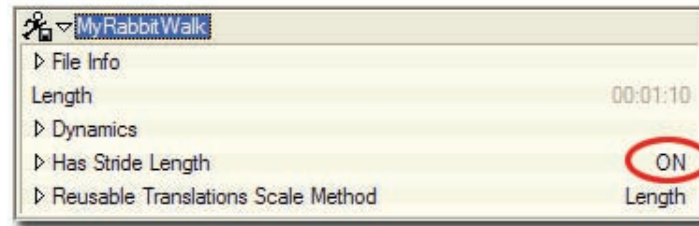
Click in an empty area in the Action window to select the Action and have its properties appear. Change the "Has Stride Length" from
OFF to ON.

On frame "00:00:00," slide the Start Stride Length manipulator under Rabbit's forward foot using the heel as a reference point. Advance frames until the same foot reaches the back of a step (just before it comes off the ground): this should be on frame "00:00:20." To finish, zoom out to find the End Stride Length manipulator and slide it beneath the foot until it lines up with the same reference point you used for the Start.
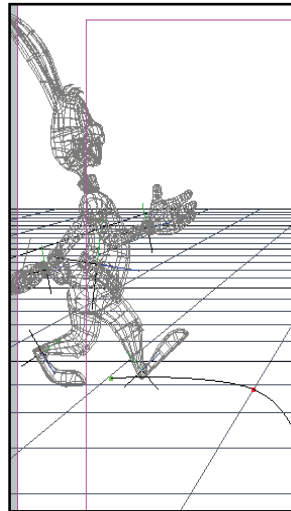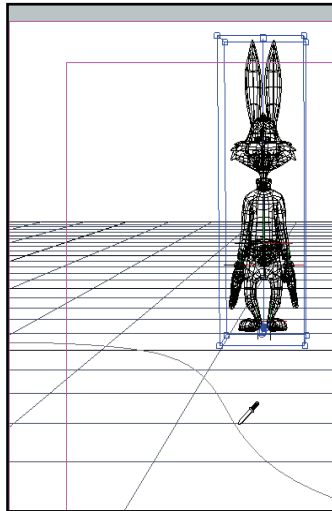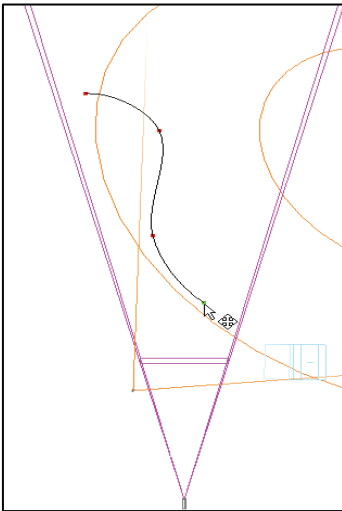
Right-click (<Control> click on the Mac) over the window and pick [Create Shortcut in Library]. This will prompt you to save your action and then add it to the active folder under the "Action" tab in the Library. (Since you are done editing the action, you can close the window.)

PATH
Before Rabbit can walk, you must give him a path to follow. Pick [File][New][Choreography] to open a new Choreography window.

To create a path, first change views to the top then click the Add button on the Choreography toolbar. (Located on the right.) Click inside the Choreography window and drag, click again to add a second point, repeat until your path looks similar to the image below. To end your path, right-click (<Control> click on the Mac) or use the <esc> key.

In the Library, click the "Models" tab, double-click the "Actors" folder, then drag-and-drop "Rabbit" into the Choreography window

Select Rabbit, then right-click (<Control> click on the Mac) on him and pick [New][Constraint][Path]. The mouse pointer will change to a picker with which you can click on the path.

Now, drag-and-drop the "Walk" action you just created from the "Action" tab of the Library onto "Rabbit" in the Choreography window.
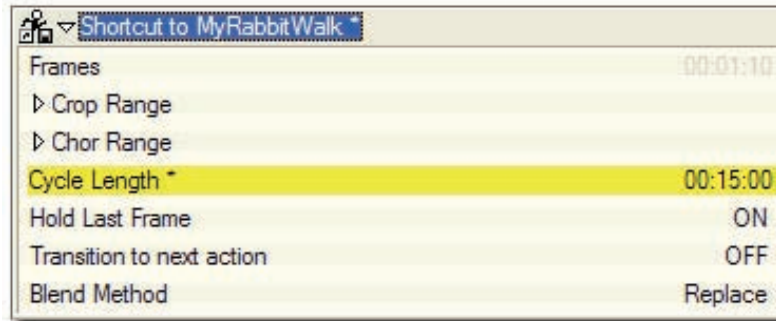
On the "Walk" action properties, set the "Cycle Length" to "00:15:00." (Rabbit will now walk along the path for 15 seconds).

Next, change the view to "Shortcut to Camera1", and then render the animation.

PRODUCTION

Any animation project is divided into three parts: pre-production, production, and post-production.

Character design, script writing, storyboards, and dialog recording are defined as pre-production. What is the story all about and what will it look like when it is done? What does the character look like? What will the character act out? Will there be interaction with other characters? Is the skeleton capable of the animation that you have planned? All of these things are important questions that must be answered before you begin your animation. Story sequences can usually be described in a dozen or so numbered sentences.

1. Character walks up to door.
2. Character tries to pull door open but it won't budge.
3. Character exerts outrageous force to open door but it still won't open.
4. Character discovers door opens inwards.
5. Character walks through open door.

Animating is production.

Lighting and rendering are post-production. Recombining the dialog track, credits, and adding sound effects and music finish the process.
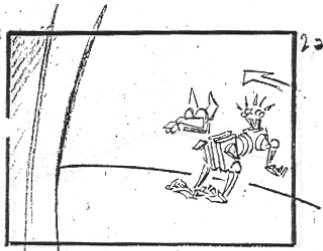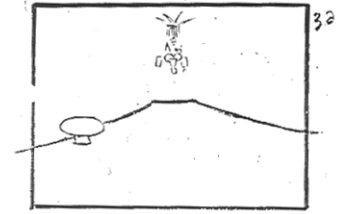
Camera moves out from behind door as we see Fluffy enter frame and approaches the door, tail still wagging.
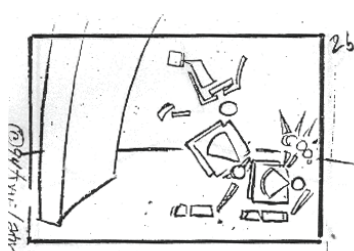
Camera continues move as Fluffy comes right up to door & looks up.
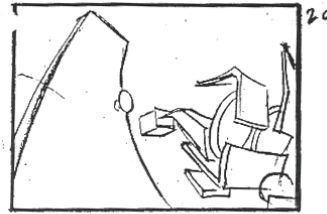
Camera stops behind Fluffy, and we see the door from his perspective.

Cut to reverse angle, with the door handle in the foreground.

STORYBOARDING

Most often, you will be involved in small productions that might involve just yourself or maybe another animator. As is often the case, there are no drawn storyboards available, other than maybe an overall idea of what it is about. Somebody is going to have to at least block the camera shots: what's visible and for how long. You don't have to hand draw anything, Animation:Master is an excellent tool to create the storyboards using stand-in characters. First, to get a quick idea how long your animation is going to be: position the lights, camera, and characters for the first frame, then guess how long the animation will be. (Music or sound tracks are excellent indicators of how long the shot is). Go to that frame and reposition everything. Guess where the intermediate poses are and make further refinements every second or so. Watch the rough animation and make further adjustments until everything is close to what you want. Your storyboards should answer the questions:

1. Which character receives the most camera time?
2. When are close-ups used? Long shots?
3. Which scenes show perspective?
4. Where do the camera angles change?
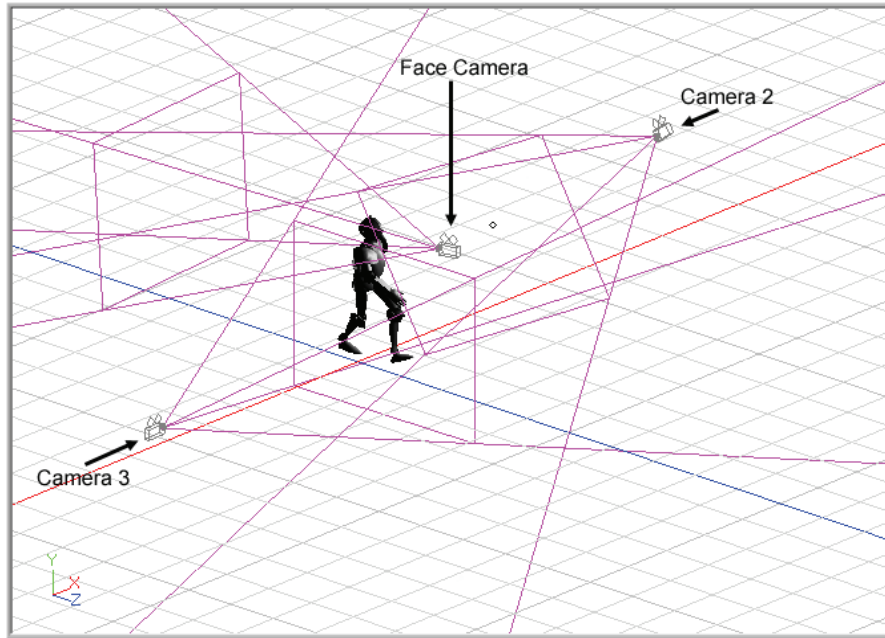
MULTIPLE CAMERAS

You are encouraged to have several cameras in the scene, capturing different angles, aspects, and shot volumes. Cutting liberally between them makes the storytelling more compelling to the audience. Cameras can be constrained to track an objects movement automatically.

FACE CAMERAS

A particularly useful suggestion is to constrain a camera to always point at a character's face. Have a separate window containing the Face Camera's view, and then no matter what the character is doing, you can easily animate the face.

VIDEO REFERENCE

For a good source reference, videotape a friend doing the proposed action. There are some inherent shortcomings in using video: actors simply cannot emulate a cartoon character. Consequently, a literal translation of the action from the video must be tempered by the nature of the character and the difference between the real world and the animation world that the character lives in. Obviously, the video actor cannot float, exaggerate movement, stretch and squeeze, or even achieve some of the anatomical positions of a cartoon character; therefore, the animator must be the liaison between the real world and the cartoon world.
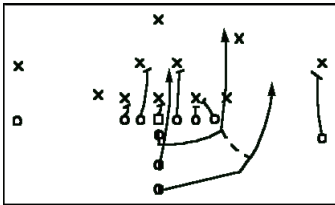
ANIMATING STRATEGY

All animation is actually small bites from a much bigger project. Concentrate on short, one or two second vignettes at a time. Some animators start at the beginning of the story and continue through shot-by-shot to the end. Other animators like to pick and choose parts of the story in order of importance. Whatever your preference, do the pose-to-pose keyframes, then other keyframes until the animation is roughed out. Once you are satisfied that the keyframes are complete, then you can go back and finish the eye blinks, lip-sync, hand gestures, and other ancillary movement required to bring the character to life. This is where you can add your own flourishes as your skills increase

Angry	Cheeky	Sleepy	Enraged	Happy	Quizzical

| Incredulous	Laughing	Surprised	Suspicious	Worried	Impish

EYES

Eyes give life even if no other part of the character moves. Eyes are the single most important focus point for the audience because we all know and understand eye nuances. For example, you easily recognize angry eyes, or surprised eyes. When you listen to another person speak, you usually look into their eyes, and they look into yours. Whenever two characters converse in an animation, they must appear to be looking into each other's eyes. When the camera cuts to a close-up, you are assuming the role of listener, so the character's eyes should stare straight out of the screen as if they were looking at you. If you violate this simple rule of eye contact, your animation's narrative will break down.

The reason we as humans look into another person's eyes when we speak derives from long ago survival tactics. A speaker's internal feelings are usually expressed in raised eyebrows for surprise, or lowered eyebrows for anger. Quizzical speakers have one eyebrow raised with the other lowered, while suspicion causes the eyelids to half close. These simple eye formulas are required for successful storytelling.

PUPILS

Look to the side　　　**Excitement/Intensity**　　　**Vague Expression**　　　**Dazed**

Pupils move simultaneously, and point in the same general direction. Pupils should always shift first, anticipating a head turn.
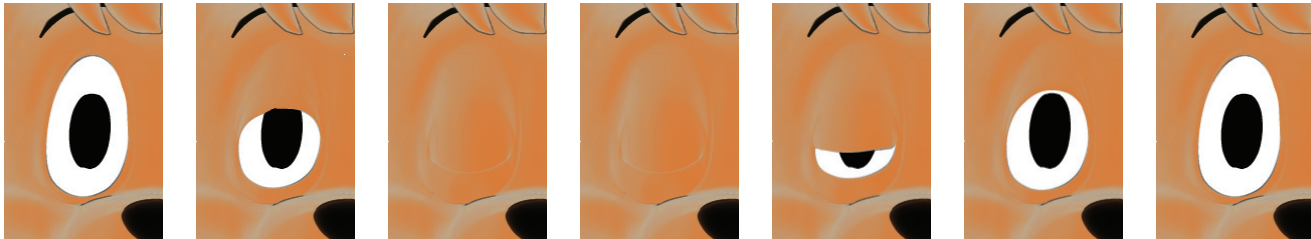
BLINKS

Blinks bring motionless eyes alive. Characters blink at least once every two seconds, sometimes more if they are moving. So, if a character turns his head – blink. If a character bends over – blink. Even if a character is looking intently through a close-up, blink randomly every second or so. Sometimes the blinks are fast but every time the character is supposed to be thinking, the eyelids stay in the halfway position for several frames. Surprised characters initially flutter their eyelids. Sleepy characters have half-closed eyelids until they abruptly awaken. Blinks are also good anticipation for any eye shift, to call attention to the eyes

In a classroom setting, the next exercise is used as a "practical mid-term". If you aren't very comfortable with the exercises up to this point, now would be a good time to do them again! After all, repetition is the key to learning!

EXERCISE 6: THE DOOR'S STUCK
Completion time: Six Hours

Animation is interaction: with the audience, with the surroundings, with other characters, and with pesky stuck doors. You start with a simple premise from the script: "Shaggy attempts to turn the door knob and open the door but it won't open. He resorts to tremendous exertions trying to pull open the door, little knowing that the door must be pushed to open."

In the Library, click the "Projects" tab, double-click the "Tutorials" folder, then double-click "The Door's Stuck". Since this project was loaded from the CD-ROM, save it to our own hard drive so you can keep any changes. Pick [Project][Save as] and choose a filename and location on your local hard drive.
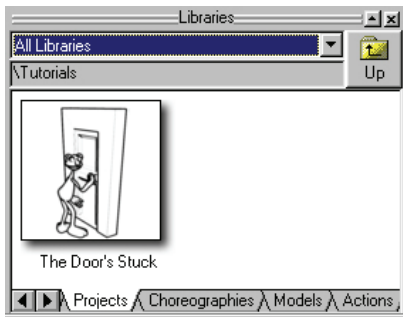
Click on Shaggy then click the "Skeletal" button on the Mode toolbar. Pose Shaggy with his hands gripping the doorknob. Remember, you will probably need to position Shaggy from multiple views so that you can make sure that he is lined up with the doorknob. Use the "Right Hand Clench" and "Left Hand Clench" Pose Sliders to close his hands.
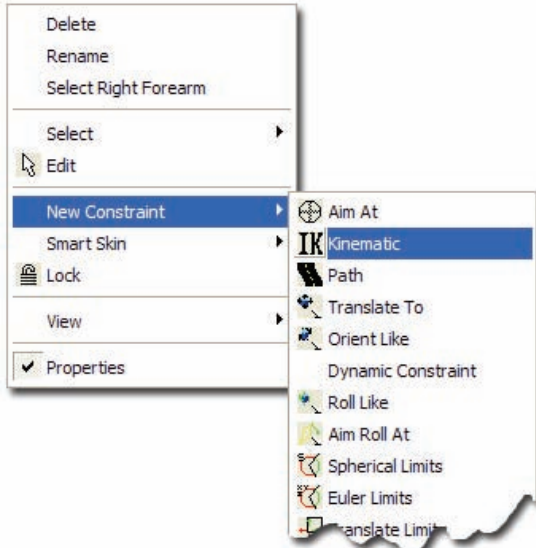
KINEMATIC CONSTRAINT

Common constraints are used to attach Shaggy's hands to the doorknob so that whenever the doorknob or Shaggy moves, his hands stay attached. Attaching his hands to the doorknob requires two constraints: "Kinematic" and "Orient Like." Switch to the Top view and zoom in to make it easier to select the forearm and knob. (Be sure to switch back when you are done.) Click the "Right Forearm" bone, then right-click (<Control> click on a Mac) and pick [NewConstraint][Kinematic].

The pointer will change to a picker:

Before picking the knob, there is one more step to do, you must turn on "Compensate Mode"

Compensate Button

COMPENSATE MODE

When a constraint such as "Kinematic" is applied to a bone, the bone will attempt to move to the pivot of the target bone, which is the doorknob in our case. To keep the forearm where you originally positioned it, click the *Compensate button* on the Manipulator toolbar then click the "Knob" bone on the door. Now, wherever the doorknob goes, the right forearm will try to follow it. (The *Compensate button* is turned off automatically after you make your selection.) Since the *Compensate button* was on, offsets were built for the constraint to keep the forearm from jumping to the knob bone's pivot position. Repeat this step for the "Left Forearm" bone

Note: If you hold the mouse pointer over a bone for a moment, the bones name will appear. This will help you find the bone you are looking for and assure you pick the right one.

(If you clicked the wrong target bone, or had a hard time finding the "Knob" bone, you can instead choose it from the "Kinematic Chain To" Target property.) To test the constraint you may move Shaggy around to see if his arm stays attached to the doorknob.
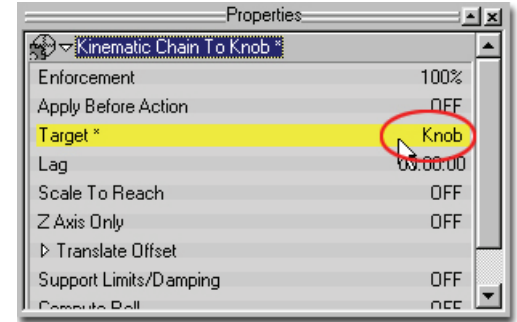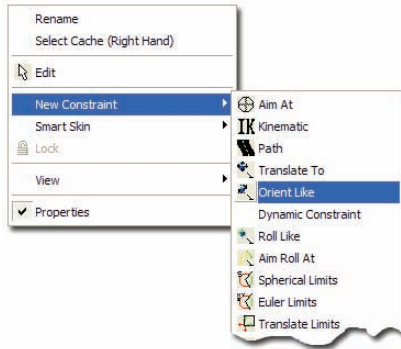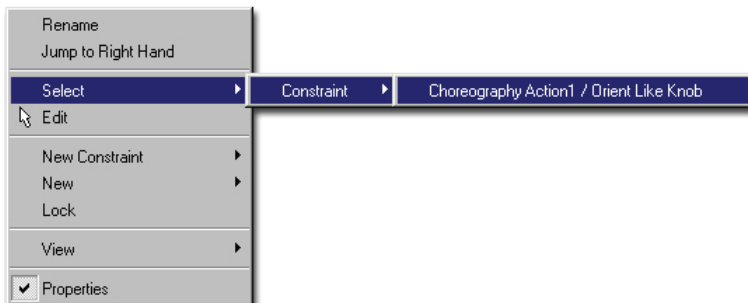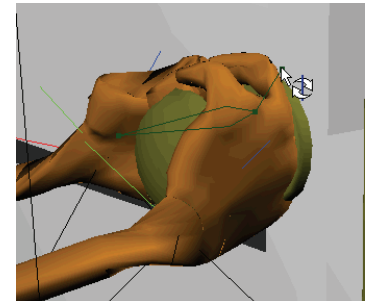

ORIENT LIKE CONSTRAINT
Right-click (<Control> click on a Mac) the "Right Hand" bone and pick [New Constraint] [Orient Like]. Again use the Compensate mode before clicking the "Knob" bone.

Repeat this step for the "Left Hand" bone.
To rotate the doorknob, and hands, use the Roll handle of the Knob bone. If his hands slip off the doorknob you will need to move him closer so he can reach.

If you ever need to reselect a constraint you added to a bone to make changes to its properties or delete it, simply Right-click (<Control> click on a Mac) the bone and pick [Select][Constraint]["Constraint Name"].

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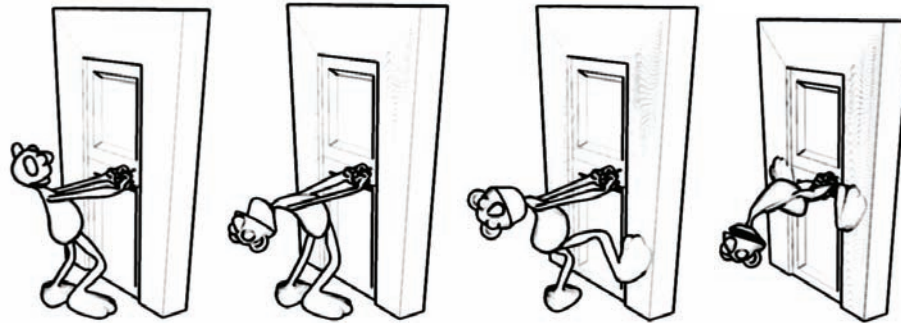
If the animation sequence is part of a larger story, you will need to know how long to make it. Animate the "stuck door" sequence for five seconds. This is a how real animation project runs. You are given a script and a time (and maybe a few storyboards) and are expected to use your creativity and everyday experience to determine exactly what happens. There are many possible ways to animate this sequence. Shaggy might try to pull the door open in one exaggerated yank, or he may pause between each attempt, perplexed, and then exert even greater effort on the next one. During the action, keep his arms taut, his knees locked, and his back arched.

Once Shaggy figures out that the door opens inwards, open the door by using the roll handle of the "Hinge" bone.
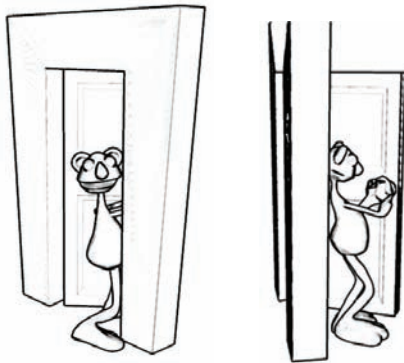
When Shaggy has passed through the door, he needs to let go of the knob. First, you must create keyframes for his hands so that once the constraints are turned off his hands will remain where they are.
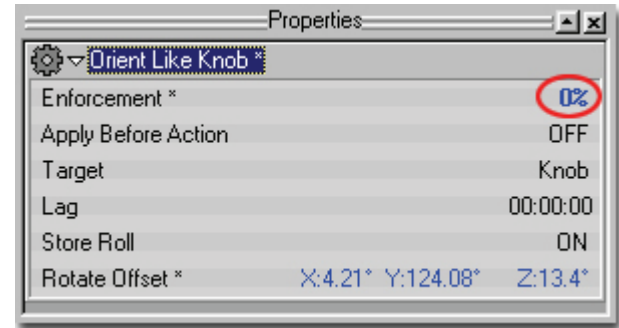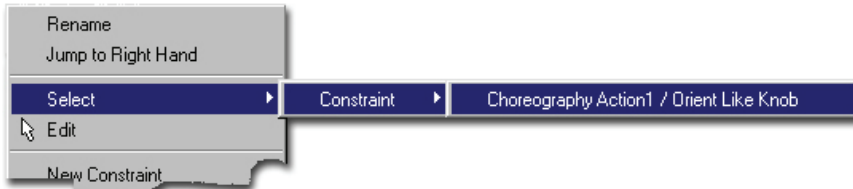
Click the "Right Bicep" bone, and then click the Key Branch button on the Frame toolbar. (Make sure the other buttons are pressed down as shown above, these are the software, defaults, so unless you've changed them, they should already be set.)
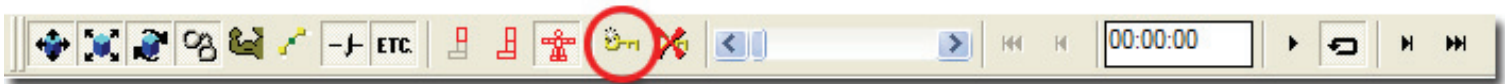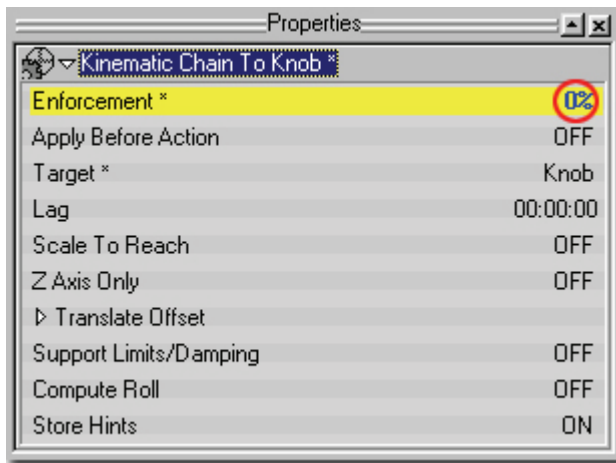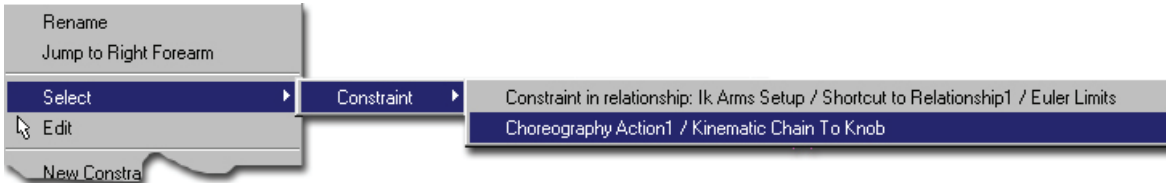

Click the Force Keyframe button on the Frame toolbar.

Repeat these steps for the Left Bicep.

Right-click on the right hand and pick [Select][Constraint]
[Choreography Action1/Orient Like Knob]. Change its
"Enforcement" to "0" on the constraint's Properties. The "Orient
Like" constraint for the right hand is now turned off. Repeat for the left hand.

Right-click on the right forearm and pick
[Select][Constraint][Choreography
Action1/Kinematic Chain To Knob].
Change its "Enforcement" to "0" on the
constraint's Properties. The "Kinematic"
constraint for the right forearm is now
turned off. Repeat for the left forearm.

Shaggy is now unstuck. Pose Shaggy
with his hands away from the knob, and then render your animation.

Success!

SOUND

Dialog and lip-sync are of paramount importance to character animation. Your characters need to be able to talk, yell, sing, laugh, and cry. With sound editing software it is possible for you to create soundtracks and sound effects for your own stories. Animation:Master allows you to import your sound files and sync them with actions for your characters: from the sound of a bouncing rubber ball, to the burning of a Dragon breathing fire, or a line of dialog for one of your actors.

SOUND EFFECTS

It is easy to make your own sound effects and put them in the "Sounds" tab in the Library (Be sure to post your homemade sound effects to the Hash website for others to use).

MUSIC

Rules of thumb:

- Since characters naturally step every half second, pick music that beats twice a second.
- Music has a beat: fast, slow. Pick music with a beat that matches your action.
- A character walks in rhythm.
- Surprise movements occur off beat.
- The action should lead up to and match the music's crescendo.
- Music sets the mood. It can express inner emotions that are hard to visualize with animation, such as isolation, rejection, hope, and devotion.
- Music can determine how far a character has to travel in a given time.

ACCENTS

Movement should be accented on the beat, so first determine the accents.

1. Going through the door.
2. Slamming the door.
3. Opening the door.
4. Pulling the mat in.
5. Slamming the door again.

Created by David Higgins

EXERCISE 7: CAN YOU SAY THAT?

Completion time: Two Hours

In animation, dialog is recorded first so that the animator can match the animation to it. (Recording dialog is considered part of pre-production). Each word must be divided into phonemes, called the "phoneme breakdown," which the computer can do for you. Each phoneme has a matching lip pose, which makes the process of lip-syncing almost mechanical, however, even the simplest words can be expressed in a multitude of ways.

Pick [Project][New] to start a new, empty project.

In the Library, click the "Models" tab, double-click the "Actors" folder, then double-click "KeeKat" to add him to the project. (Close the Model window).

Pick [File][New][Action].

From the Front view, Bound Zoom KeeKat's face, and change the Render Mode to "Shaded"

In the Library, click the "Sounds" tab, then drag-and-drop "secret" onto KeeKat.

Pick [View][Timeline].
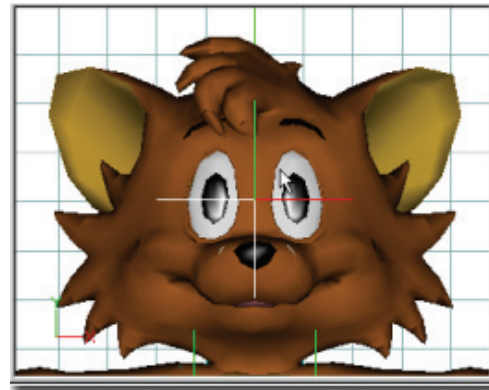
KeeKat © Paw Island Entertainment

Before creating the lip motion, you should position the current frame to the beginning of the sound. Many times a sound sample has a pause before the actual dialog actually starts, so you don't want to start at the beginning of the sample, but at the beginning of the sound. It's easy to find where that is since you can see the sound's waveform in the Timeline window. Drag the Current Frame Marker, located at the top of the timeline, (circled in red below) until you hear the sound start. This should be at frame "00:01:00".

Timeline window with current frame set to the beginning of the sound "00:01:00"

DOPESHEETS

Right-click (<Control> click on a Mac) in the Action window and pick [New][Dope Sheet]. Type: "I've got a secret. Can you keep a secret? Didn't think so" in the text box.

Click "OK." You will have to adjust the size and position of the words to fit with the actual sound, (look at the sound waveform for clues of where each word starts and ends). You can click on any word in the Timeline to hear it. (Words that have a red box were words not found in the phoneme dictionary.)

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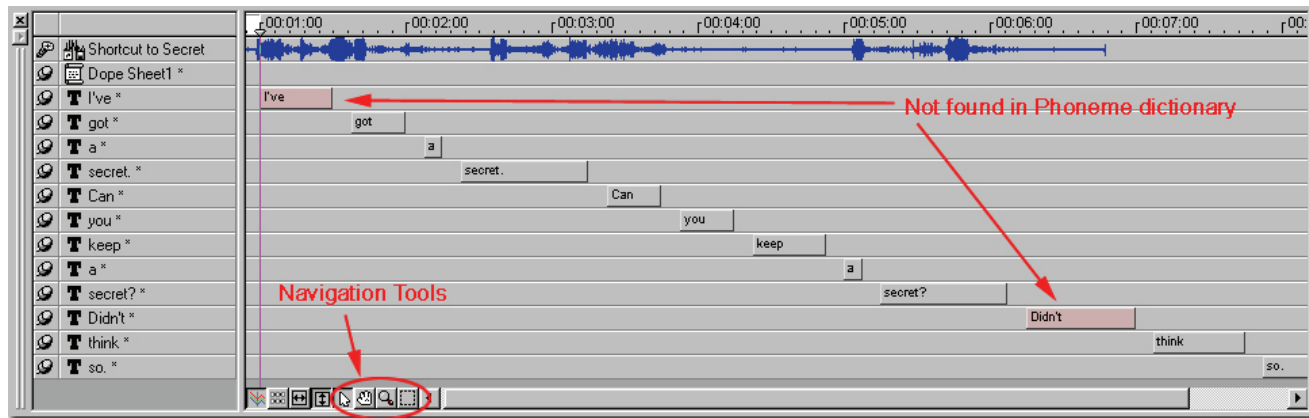
Timeline with the words aligned to the sound sample.

Move the mouse pointer to the right edge of the word (the pointer will change to a Stretch cursor) and drag the edge to line up with the end of the word in the wave sample. Move to the next word and line up the beginning of its box with the beginning of the next word in the sample. Sometimes this will be up against the last word, or perhaps there is a gap because there's a pause. Repeat this procedure until all of the words line up properly with the words in the sound sample.

For words starting with vowels, the lips need to start two or three frames before the actual sound for that word. Use the same tools to navigate in the Timeline window as you use to navigate in the Modeling, Action and Choreography windows. The edit, zoom, and move buttons are duplicated in the bottom of the Timeline window for your convenience.

ADDING CUSTOM PHONEMES

Next you need to add phonemes for the "I've" and "Didn't" words since they were not found in our dictionary. Drag the "current frame marker" to the start of the word "I've", then right-click (<Control> click on a Mac) on "I've" in the left pane of the Timeline window and pick [Add Single Phoneme].
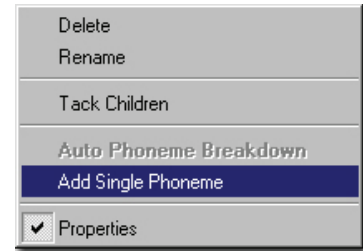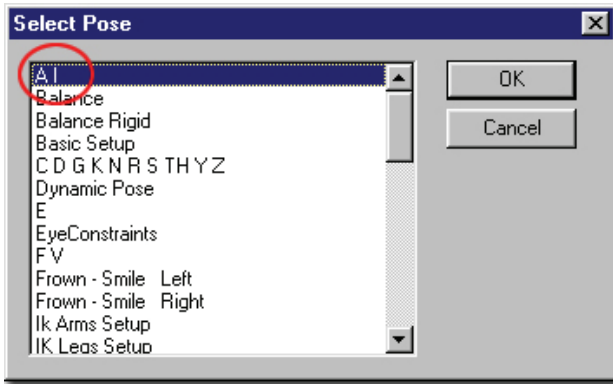
From the list of Poses, choose the "AI" pose and then click "OK". Repeat the above step but this time, place the Current Frame Marker at the end of "AI", then add the "FV" pose. The "AI" and "FV" phonemes will appear under the "I've" word in the Timeline. Adjust the bars to match the sound sample.

Repeat this procedure for the "Didn't" word. Be sure to pay attention to the position of the "current frame marker" while adding the phonemes. Add the following phonemes:

1. "C D G K N R S T H Y Z"
2. "AI"
3. "C D G K N R S T H Y Z"
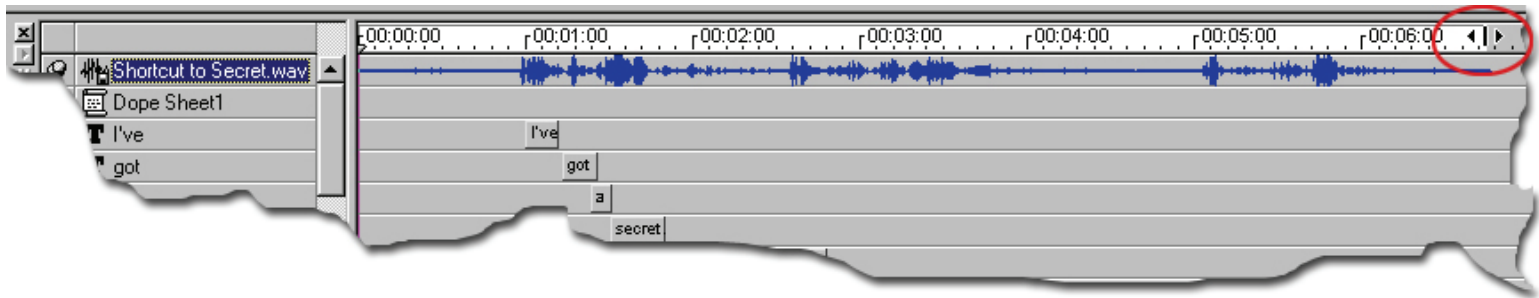
Set the playback range in the timeline (the white part of the ruler) to include the entire sound sample, approximately frame "00:06:24," by clicking and dragging the bar. Go back to frame 00:00:00 and click the Play button. You should see KeeKat's lips moving and hear the dialog. If some of the words don't seem synched yet, you can still move and adjust them. If the computer generated phoneme spacing doesn't match the sound waveform, they can be fine tuned as well.

Right-click over any word that doesn't match in the left pane of the Timeline window and pick [Tack Children].

You can now adjust the individual phoneme spacing with the same methods used above to adjust the word spacing.

Note:
> *Sometimes slower computers have trouble playing back the sound and real-time 3D at the right speed but the sync will be correct when you render to a file.*

SECONDARY ACTIONS

Of course, lip-sync alone is not a performance: you should include the whole face and body for personality and story continuity. Consider what the character is thinking while he's talking. His expression should anticipate what he's thinking before he says it.

KeeKat should wink when saying "secret" for the first time.

At frame "00:01:10," click the slider below the "Right Eye Open – Close" to activate it and make sure it is set to 0%, so that the wink action starts on this frame.
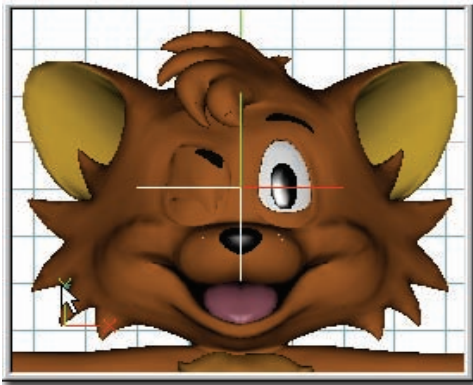
Wink
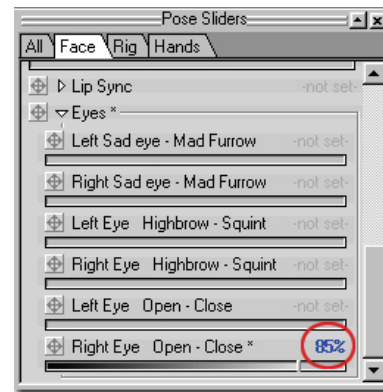
At frame "00:01:14," start the wink by setting "Right Eye Open-Close" pose (found under the Eyes on the Face tab in the Pose Sliders) to "85%."

On frame "00:01:18," close the eye all the way. On frame "00:01:24," move the slider away from 100%, then back to 100%, this will keep the eye closed for 6 frames, then open it in 2 frames at frame "00:01:26." During these frames, you also use the "Right Sad eye – Mad Furrow" to lower the right eyebrow to emphasize the blink. Raise the left eyebrow a little too.
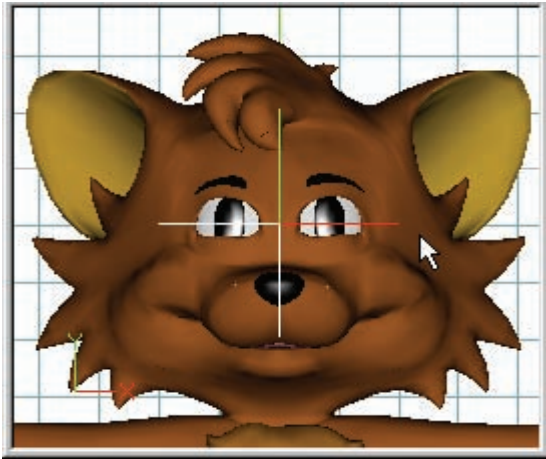
Suspicious

Make KeeKat look suspicious before asking, "Can you keep a secret?". On frame "00:02:01," set the Right and "Left Eye Highbrow –Squint" and "lower eyelids" to 0% so they are neutral, then on frame "00:02:05," using these sliders, make his eyes narrow so he is squinting.

Click and drag the "Eye Constraint" Null Object to aim the eyes.(The Eye Constraint Null is the large cross directly in front of the eyes, illustrated in the picture above) Use the "Up/Down" arrow keys on your keyboard to slightly move or "tweak" the Null on frame "00:02:05" where the action will start. Advance four frames and make the eyes look to the right. Advance eight more frames and "tweak" the Null again, and then advance four frames and re-center the eyes. Advance four more frames and make the eyes look to the left. Advance eight frames "tweak" the Null again using the arrow keys, then finally advance 4 frames and re-center the eyes.
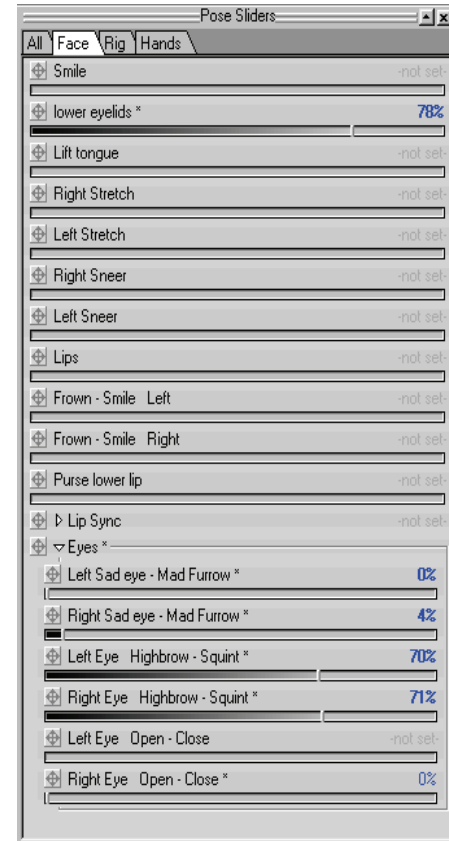
As KeeKat reaches the end of the question, he will relax his eyes with a questioning look. At frame "00:04:13," set the "lower eyelids" pose to 39% and the Right and "Left Eye Highbrow – Squint" pose to 42 and 33%. Advance 15 frames until he's about to say "Didn't think so?" then move the "lower eyelids" and the Right and "Left Eye Highbrow – Squint" sliders slightly, then return them to the same values (39, 42 and 33%).

Questioning
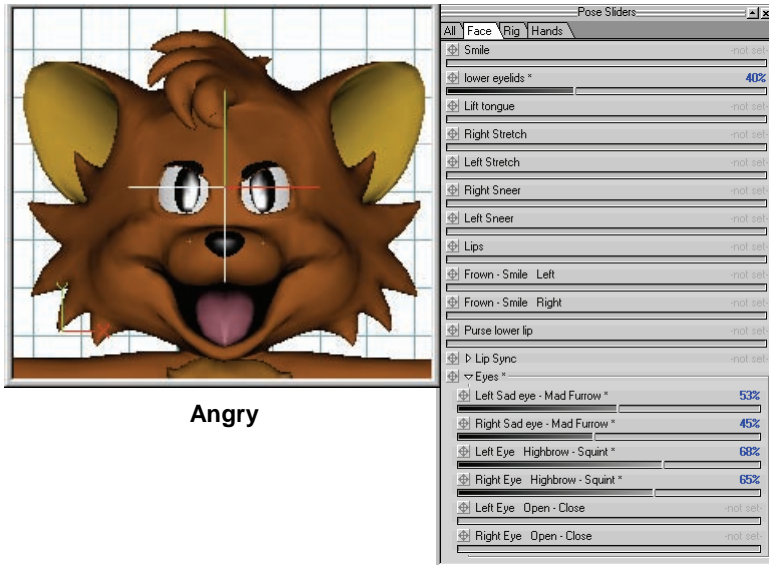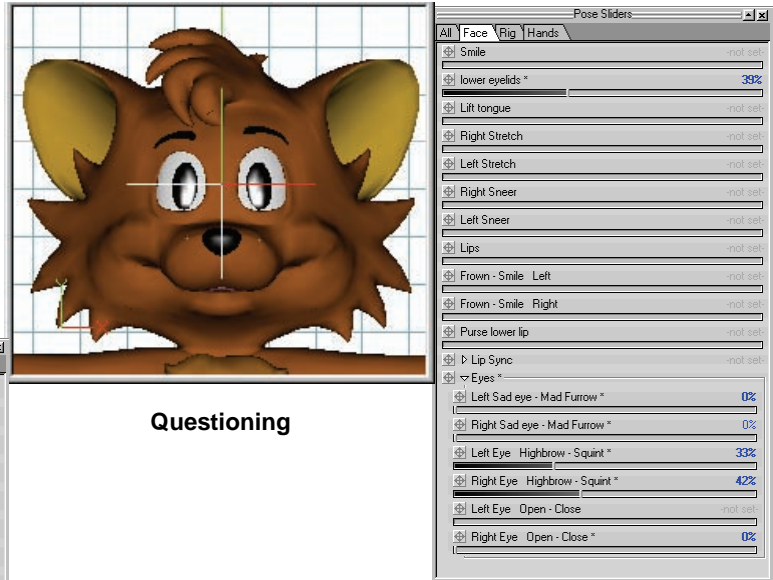
Angry

Now, let's make KeeKat look **angry**. Advance five frames, then set the "Right and Left Eye Highbrow – Squint" and "Right and Left Sad-eye – Mad Furrow" poses as shown.

Finally, add body language to this action. You could turn the head slightly when he looks around and lean his head toward you as he whispers, and make his head nod when he winks. Think about what the hands are doing when he talks. The motions will probably be subtle rather than exaggerated since he's whispering and doesn't want to draw too much attention. Don't be afraid to act out the motions in a mirror. Render your animation!

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Modeling Takes Talent

The process of creating an object such as a cup, a person, or a tree, is called modeling. Modeling can sometimes be time consuming, but the objects you make are durable and can be reused. Many people are attracted to modeling because you truly create something that is your own. We encourage you to think this way but start out easy. Modeling requires talent, skill, and some technical knowledge. How and where splines are located for animation as well as shape is vitally important. There is no better way to learn than to examine existing models. Find a model similar to what you want and modify it. You will gain an understanding of where things go and how they connect, and then use this knowledge when you start your own models.

Modeling is composed of two parts: the artistic part is shape, and the technical part is technique. There is also a lot of knowledge needed to turn the wireframe into an animatable character, including: adding materials, applying decals, inserting a skeleton, adjusting smart skin, and creating poses. However, all of these tasks can and should be done by the artist.

Created by Cindy Groves and Yves Poissant

EXERCISE 8: CUSTOMIZED CAR
Completion time: 10 minutes

Often, modifying an existing model is the fastest and easiest way to get started.

You will be opening a model from your CD-ROM. Pick [File][Open]. Find "Data\Models\Vehicles\Automobiles\Cars\Sedan\Sedan.mdl" then click "OK."
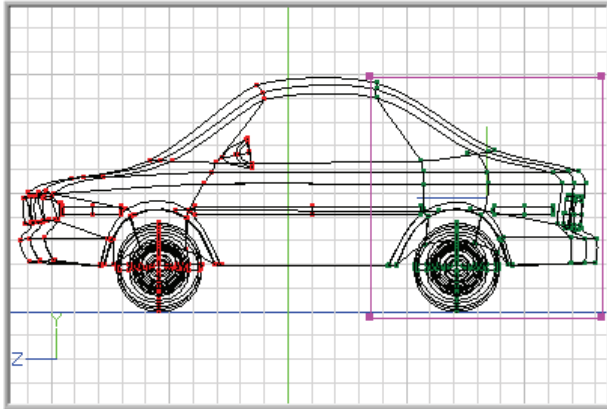
From the Right view, Bound Group (click and drag a bounding box) the back half of the sedan. A Group manipulator box will surround the selected CP's.

Move the mouse pointer over the lower right corner of the Group manipulator until it changes to a Scale cursor.

Scale control point(s).		↔ -45	↕ -83	⊕ 0	⊘ -90	∅ 0	⤢ 97

(The status message at the bottom of the screen will read "Scale control point(s)"). Click and drag the back end and rear wheels of the car larger. Then click and drag anywhere in the middle of the Group manipulator to move the CP's so that the bottoms of the back wheels line up with the front wheels.
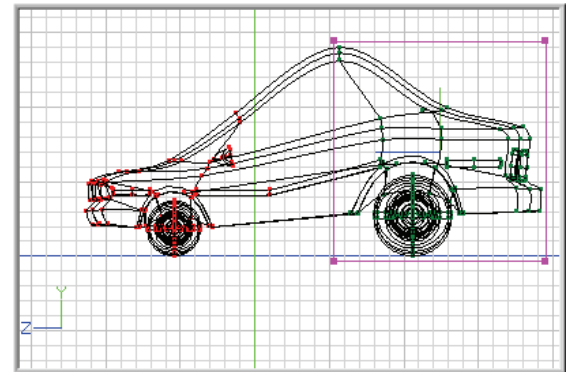
PROJECT WORKSPACE

Pick [View][Project Workspace]. The Project Workspace shows detailed information about each part of your project.

Right-click in the model window and pick [View][Render Mode][Shaded] to see the car in shaded mode.

> *Use the shortcut keys "Page Up" and "Page Down" to adjust the quality of the model when being displayed in shaded mode. The higher quality the car is, the slower it will draw so be careful not to display it in too high of quality. This is only for interface display, the car will always render in its highest quality when you use the Render and Render To File buttons.*
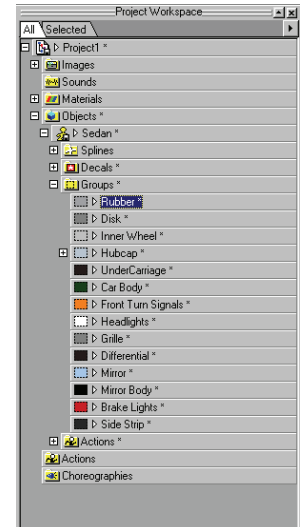
Group Color
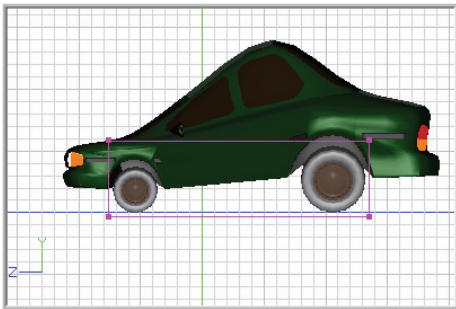
Select the "Rubber" group under the "Groups" folder in the Project Workspace. Expand the "Rubber" item, then its "Surface" properties by clicking on the white triangle to the left of "Rubber", then "Surface" name. (Make sure "show properties triangles" is checked ON in the Tools/Options/Global menu.) Expanding an item will display all the properties available for it. Clicking the triangle again will collapse its properties. Click on the black color chip to the right of the "Diffuse Color" name and select a gray color from the color palette, and click "OK" to exit the color picker. Click the "Car Body" group and change its diffuse color to red using the same steps you used to change the tire color. You will be saving these changes to your hard drive. Right-click on the "Sedan" icon in the Project Workspace and pick [Save As]. Save it to your hard disk as "Customcar.mdl."
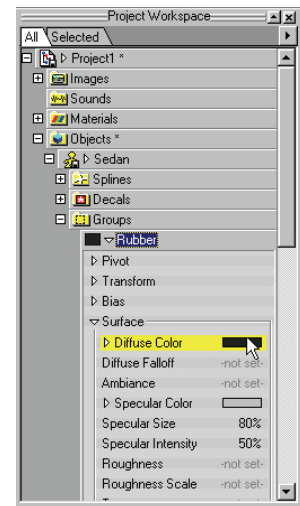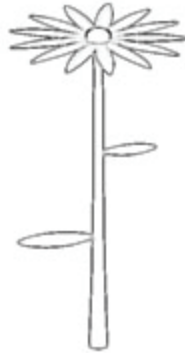
EXERCISE 9: FLOWER POWER

Completion time: Two Hours

Modeling in Animation:Master can be relatively simple and uncomplicated, whether you are an accomplished artist or just starting out. Whoever you are, you will learn to fully appreciate the modeling features, even though you may not be a gifted draftsman. All of the basic aspects of design and art-layout apply directly to the process of building a fully functional character that can be animated to perform whatever you, as the director, desire. Traditional approaches to drawing a person or animal apply to computer modeling. Start with an idea of what it is that you want to build and what it will look like when it is finished, then you can rely on your own sketches or actual photographs for reference. The tools that you are going to use are as valuable to the artist as the brush and palette knife.

Pick [File][New][Model]

An empty modeling window will open in Front view.
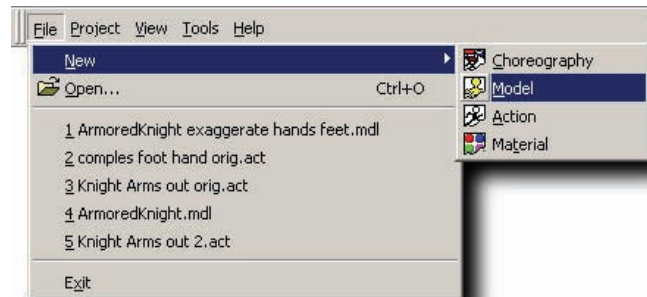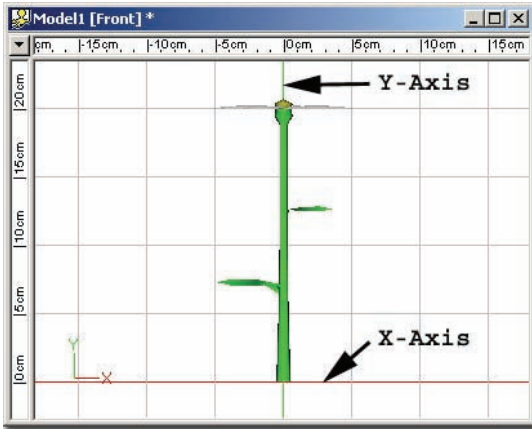
There is a vertical line (usually green) that runs through the zero mark of the top ruler: center your models on it. The horizontal line (usually red) that runs through the zero mark of the side ruler represents the ground, and is what your model's feet should rest on. Have your model face you.

Zoom and move the window so that you can see 20cm vertically, and so that the X-axis is along the bottom of the window.

STEM
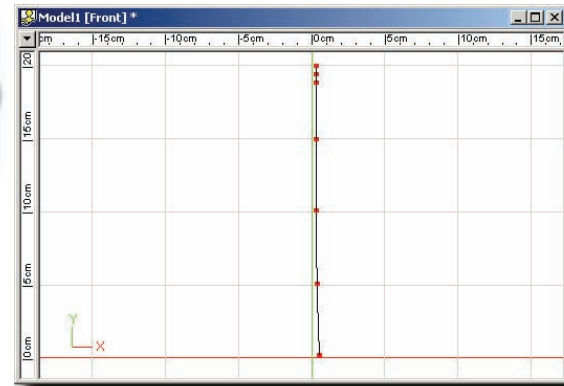
Add Mode
Click the Add button on the Modeling toolbar.

Add seven control points, as shown, then right-click (Press the <Esc> key on the keyboard on a Mac).
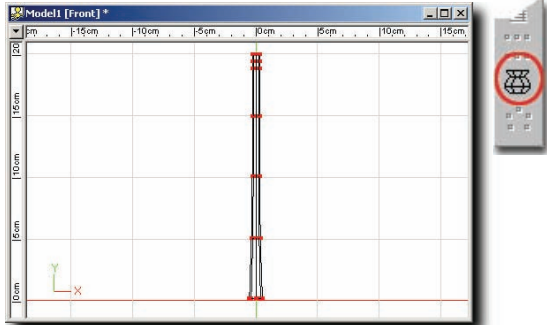
Lathe
Click one of the new control points (this will select the spline), and then click the Lathe button on the Modeling toolbar.
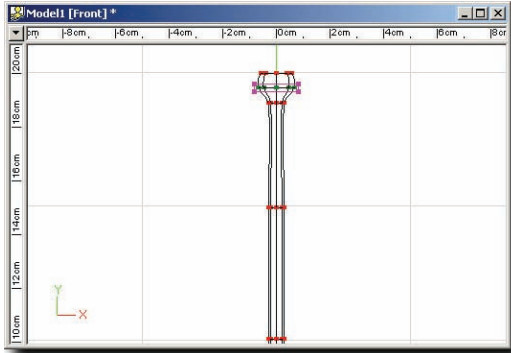
To form the bud, Bound Group and scale the top two rings of the stem one after the other.

LEAF
Click the Add button again and add seven control points as shown.
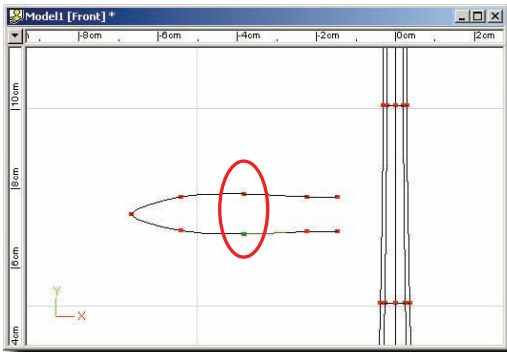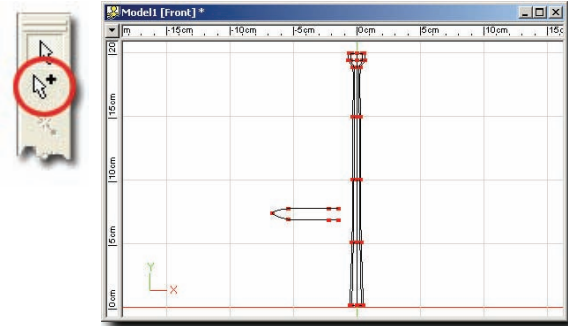
The easiest way to add a control point to an existing spline is to click the Add tool, then click on the control point where you want to add the spline. Add a spline to the two control points as shown.
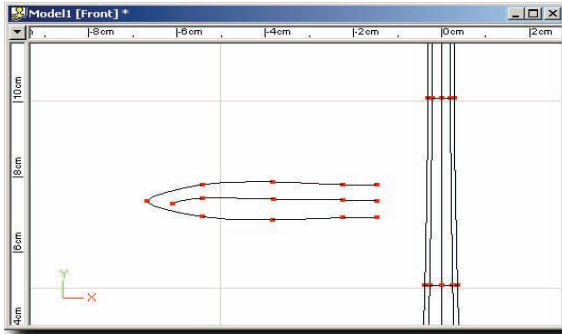
Before Attach
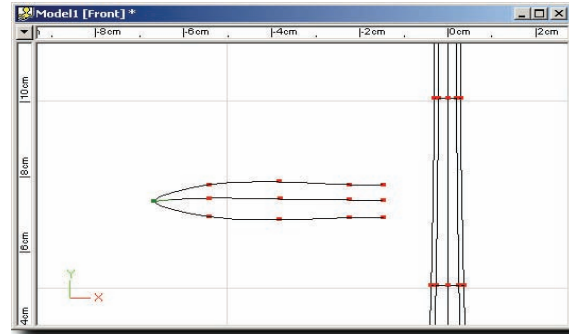
After Attach

Attaching Control Points

Add a new spline along the center of the leaf with five control points. Remember click once for each control point, , then right-click (press the <Esc> key on the keyboard on a Mac). To attach two splines, drag the end of the new spline over the leaf's tip, and while still pressing the mouse button, right-click (press the <~> key on the keyboard on a Mac).

Note:

Attach Control Points on non-US keyboards (Macintosh Only)

> *Attaching two control points on a Macintosh is normally done using the < ~> key. However, on keyboards outside of the United States this key may not be available. You can assign the Attach-Control-Point to any available key by using the Customize dialog.*

- *Pick [Tools][Customize] and click the "Keyboard" tab.*
- *Click "Attach Control Point" in "Commands."*
- *The current key assignment will appear in "Current Keys." It should appear as a backwards apostrophe (`) since that's the key that <~> is on.*
- *Click the Create Shortcut button. Type the key you would like to assign Attach-Control-Point to, and click the OK button.*

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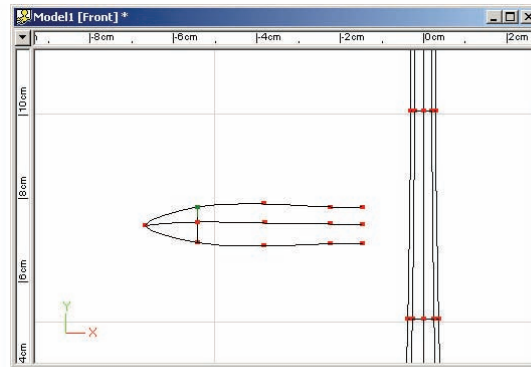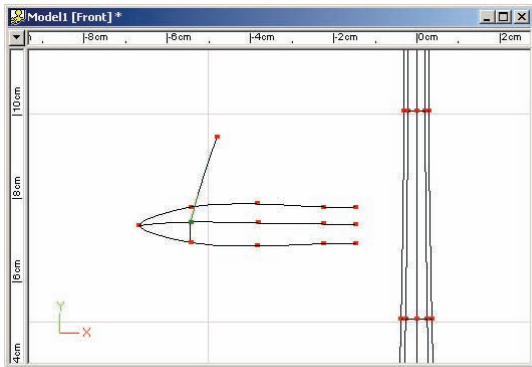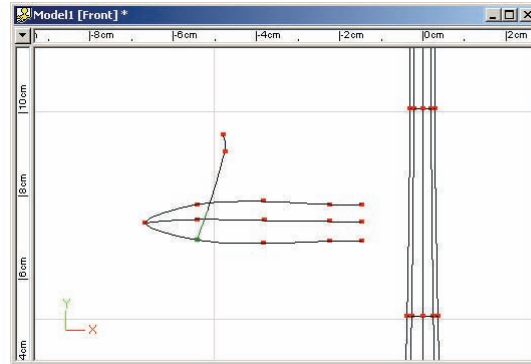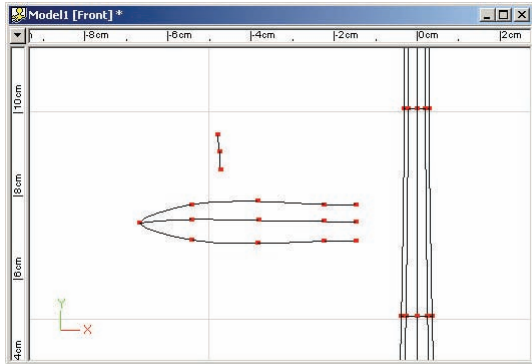
Add a three-control point spline and attach each control point across the tip of the leaf.

Repeat for the next two leaf crossing splines. Don't do the last one yet.
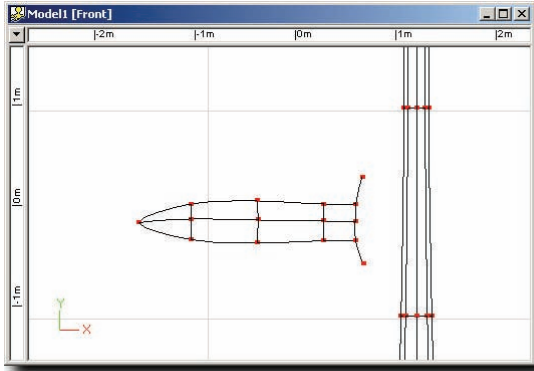
The end of the leaf needs special attaching. Add a five-control point spline and attach it across the end of the leaf, leaving the extra control points hanging as shown.

Deleting Control Points

Then click each hanging control point to select it and click the Delete button on the Standard toolbar or use the Delete key on your keyboard. (This hanging spline technique keeps the new spine and the existing leaf spines from forming an unwanted loop).
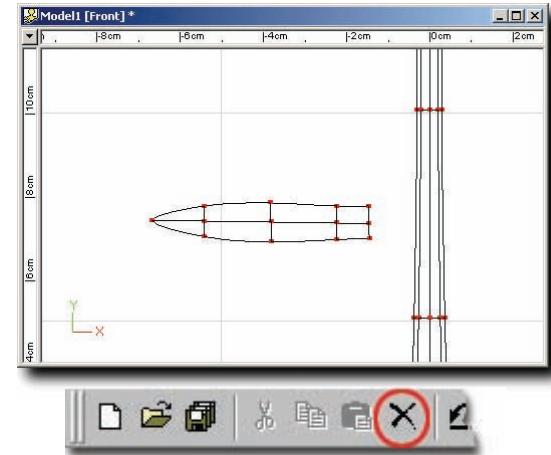
Peaking Control Points

To make the leaf's tip pointy, click on the outer spline of the leaf next to the tip then click the Peak button on the Modeling toolbar.

Bias Manipulators

Click the Bias button on the Manipulator toolbar to turn on Bias Handles. While keeping the <Shift> key on the keyboard pressed, click and drag the end of the Bias handle to fatten the petal's tip. Do the same on the tip's other spline. Turn off the bias handles by clicking the Bias button again.
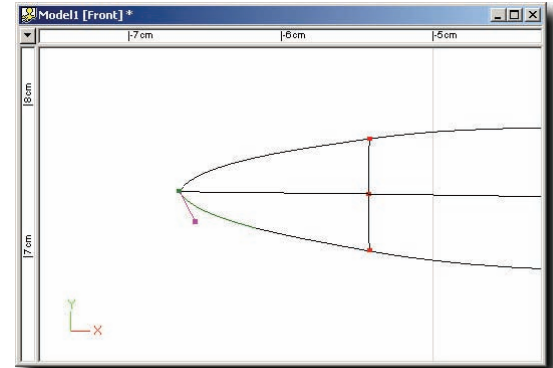
Copy and Paste

Group the leaf. The leaf and petals of this flower have almost the same shape, so pick [Edit][Copy], and then pick [Edit][Paste]. Click on the "Untitled" group in the Project Workspace and rename it "Petal". (you can rename any item by right-clicking (<Control> click on a Mac) the item in the Project Workspace, and choosing "rename" from the menu, then typing the new name.) Translate the "Petal" to the top of the stem.
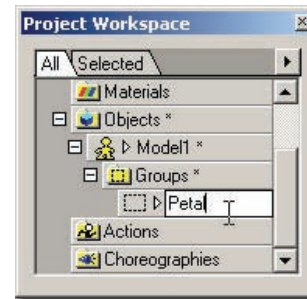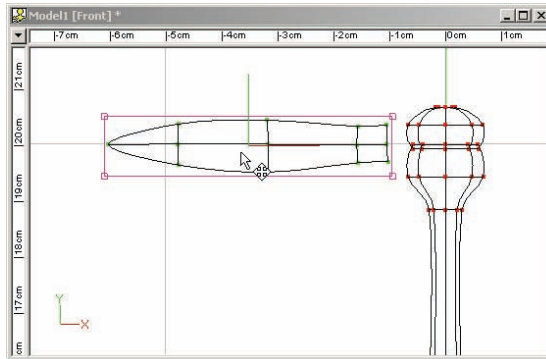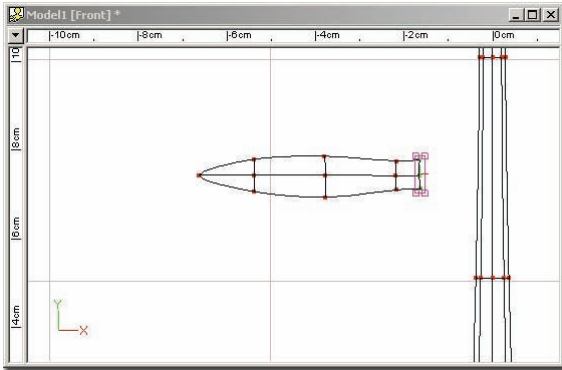
Copy and Paste allows the reuse of similar parts of your model. In this case, the leaves and petals. Now that the petal is pasted, it is time to finish the leaf. First select the base of the leaf from the Front view.

Then translate it to the right in the Left view to push it in to the stem. Check the position from the Top view as well.
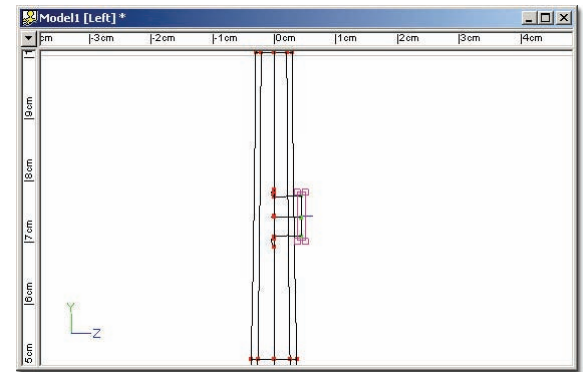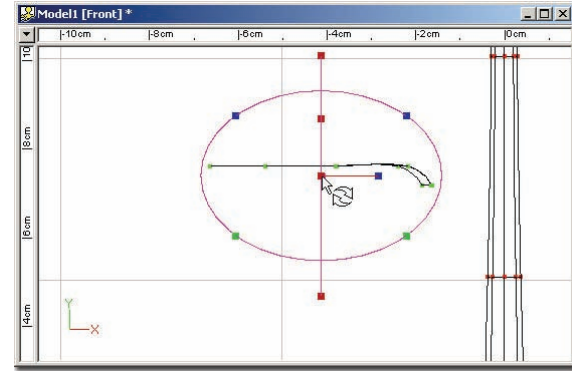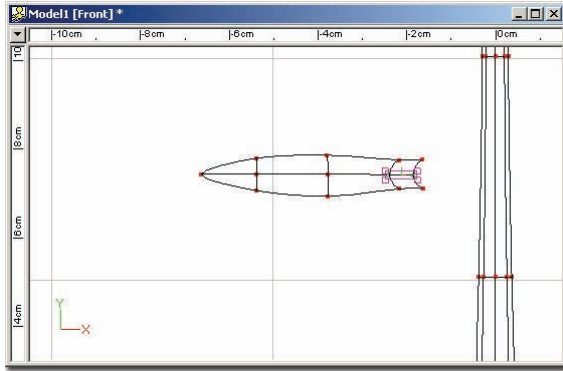
Also from the Front view, translate the two center control points of the base away from the stem so it will fit the stem. Group the whole leaf, and use the Rotate Manipulator's X-axis to rotate the leaf flat.
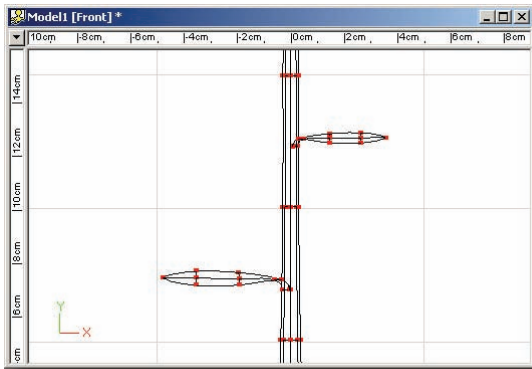
Group the leaf and pick [Edit][Copy], [Edit][Paste], and then translate the new copy of the leaf half way up the stem.

Flip Control Points

Right-click (<Control> click on a Mac) over the new copy and pick [Flip][X-Axis]. Scale the new leaf smaller. Next translate the leaves so that they touch the stem.

Rotate the tips of the leaves some using the Rotate Manipulator so that they look more natural.

HEAD
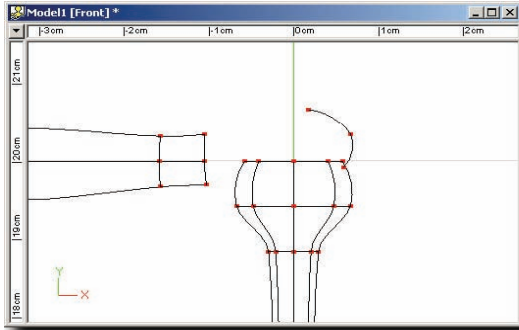
Front view
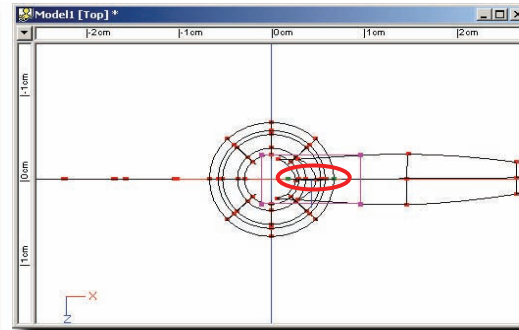
Top view

Add a spline near the top of the stem, as shown. Group the spline and center it on the stem in the Top view.
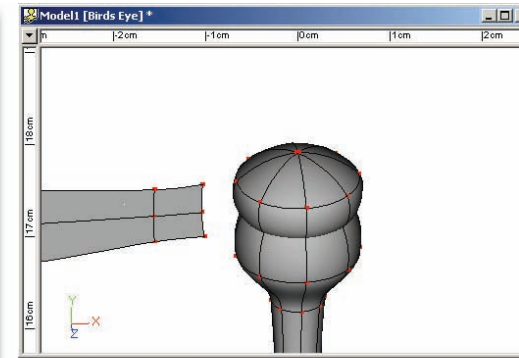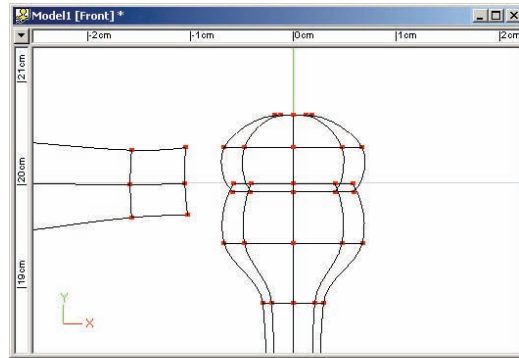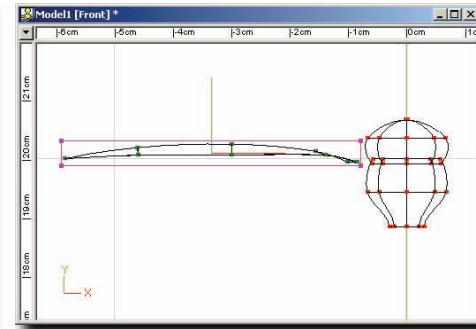

Deselecting a group
To deselect the group, click away from any control point, and then click one of the new control points to select it so that you can click the Lathe button. Group the top ring of the head and scale it down to close off the top of the head

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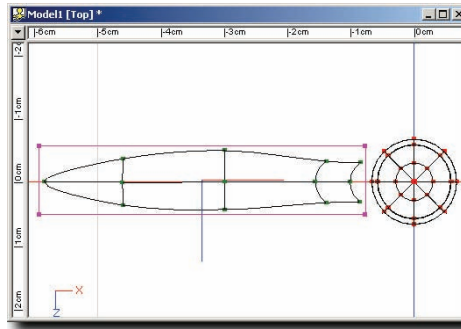
PETAL

Top

Front

Rotating a group

Click the "Petal" group in the Project Workspace then translate and rotate the petal to line up with the top of the bud, as shown. To rotate the group, click the Rotate manipulator button on the Manipulator toolbar and then click and drag the manipulator ball.

(Another method to rotate the petal is to turn on the Manipulator Properties on the Manipulator toolbar, then click the Rotate button on the Manipulator toolbar. This time instead of rotating the group using the manipulator ball, you can type in 90 into X-Rotate.).

X-Rotate: 90
Y-Rotate: 0
Z-Rotate: 0
X-Pivot: -4.45cm
Y-Pivot: 22.75cm
Z-Pivot: 0cm
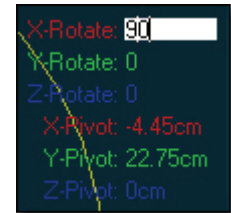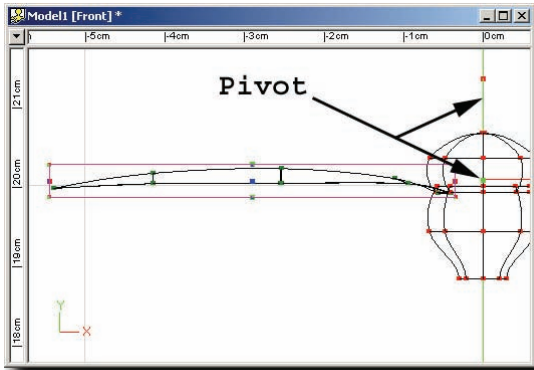
Shape the petal by lifting the center spline giving the petal some curvature.


Moving the pivot of a group

Click on the petal group in the Project Workspace, and then click the Translate Manipulator button on the Manipulator toolbar to make the group's pivot visible. Move the pivot to the center of the bud by dragging its corner.

Duplicator Wizard

Right-click over the grouped petal and pick [Plug-ins][Wizards] [Duplicator]

Change the wizard's settings as shown, and then click the "OK" button.
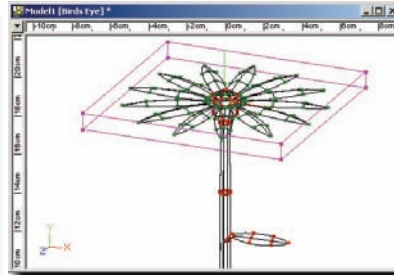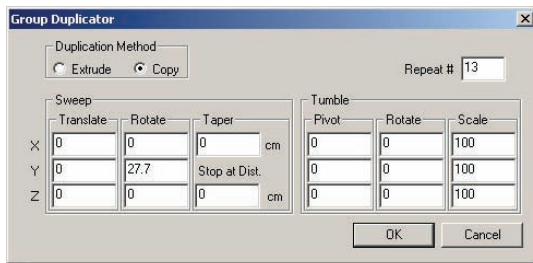
Make groups and name them for the leaves, bud, stem and petals. Set their colors as you like. The petal group will now include all of the petals. Click a control point on the stem and pick [Edit][Group Connected] to group all of its control points. This will work well for the leaves as well

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BONES

Click the Bones button on the Mode toolbar.

Click the Add button, then click and drag from the base of the stem to just slightly above the first spline ring up the stem. Name this bone "Stem" in the Project Workspace. Rename the bone the same way you renamed the petal group earlier. (Or click the name and press the F2 key.) Type in the bones new name, and then press the <Enter> key.

Add another bone starting at the end of the "Stem" bone, and ending just above the next spline ring. Name this bone, "Stem 2". (Bones that are part of a chain are usually named with numbers from the second bone on).
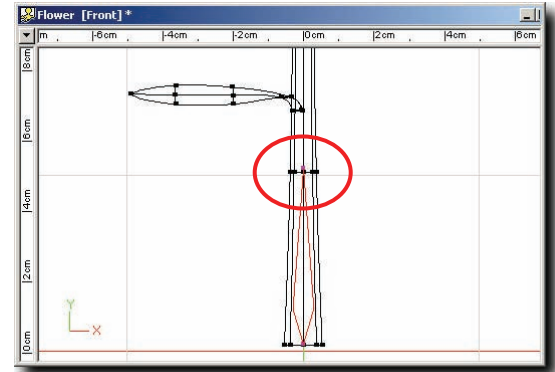
Note: When you add a bone starting at the end of the selected bone, it attaches the two bones together. Bones that are attached together form a chain. If bones are chained together, you can pull one bone causing the second bone to be pulled also.

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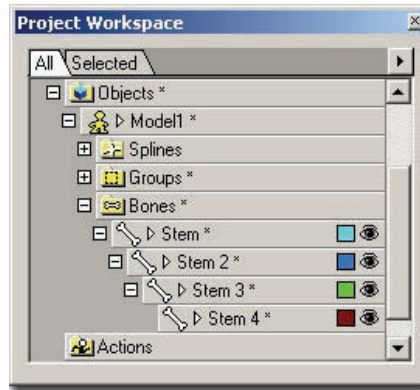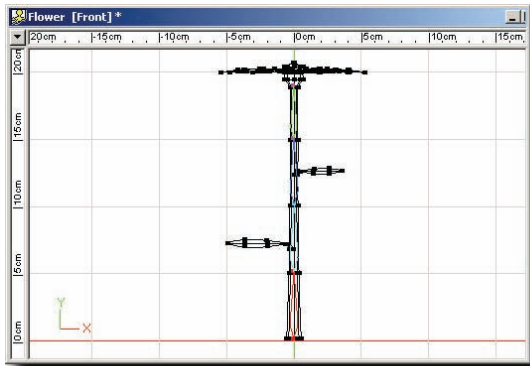
Continue adding bones until you have four bones for the stem. Remember to name and number them. (Notice in the Project Workspace that "Stem 2" is under "Stem"; this is called a hierarchy).

Change to the Left view and then pick [Edit][Deselect All]. If no bone is selected when you add a bone then the bone will be added to the root of the hierarchy rather than a child of the selected bone. Add a bone named "Root" that lies as shown. (This keeps the base of the stem level when the flower bends, and allows you to move the whole flower easily in an action). Drag the "Stem" bone onto the "Root" bone in the Project Workspace. Your hierarchy should match the illustration.
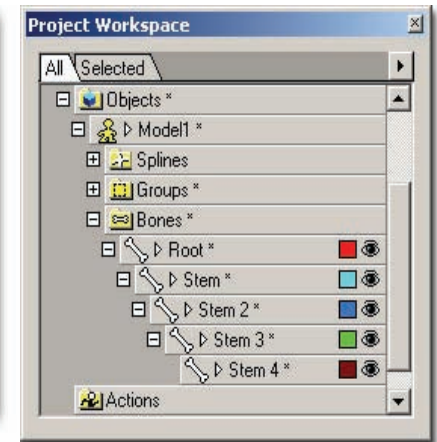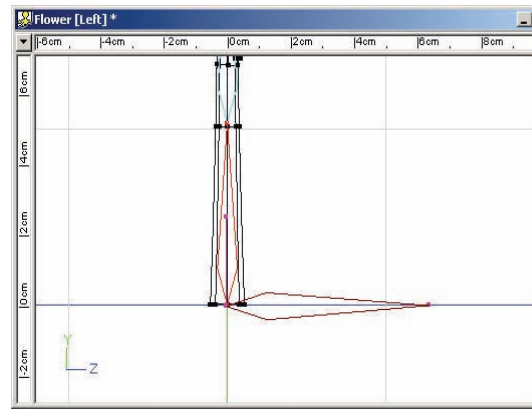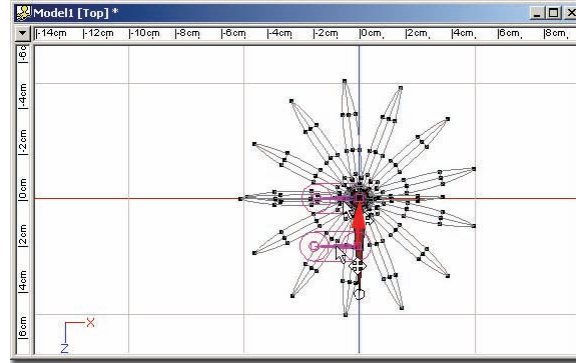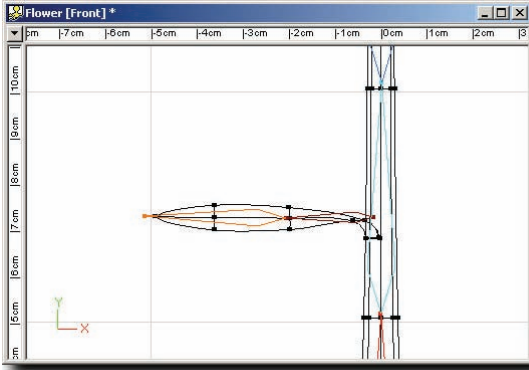
Click the bone in the stem nearest the lowest leaf. From the Front view, add a new bone from the stem to the middle of the leaf. Name this bone "Leaf A". From the Top view select "Leaf A" by clicking it in the Project Workspace, and drag its center so its base lines up with the center of the stem. Add another bone from the end of "Leaf A" to the leaf's tip. Name it "Leaf A 2".
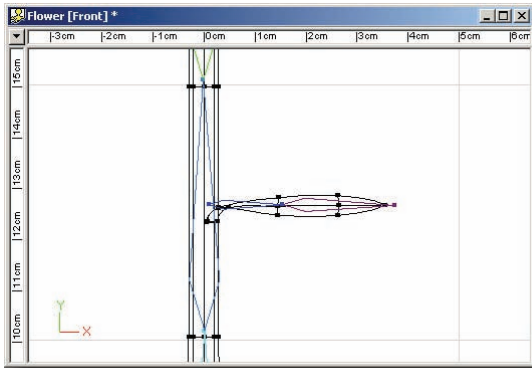

Select the stem bone nearest the next leaf up and add bones for this leaf like you did for the first. Name the second leaf bones "Leaf B" and "Leaf B 2". (Remember to check the leaf bones position from the Top view to make sure you inserted them inside the leaf.).
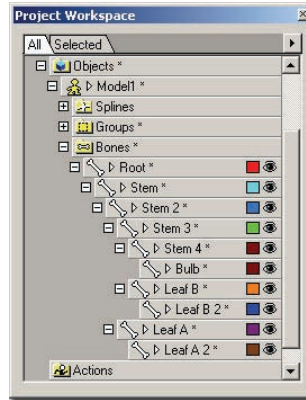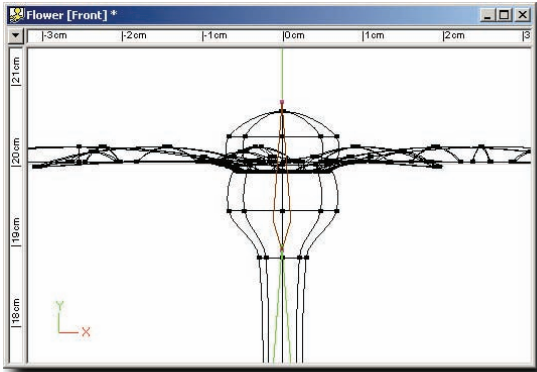
Click the last stem bone (Stem 4), and then add a "Bulb" bone.

From the Front view, add a bone for a petal and position it from the Top view. Click the "Bulb" bone

again before adding each petal, naming them "Petal A," "Petal B," "Petal C," etc. (Once you add the first petal bone you can add the rest from the top view).
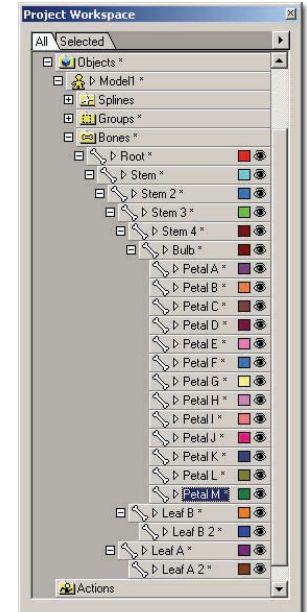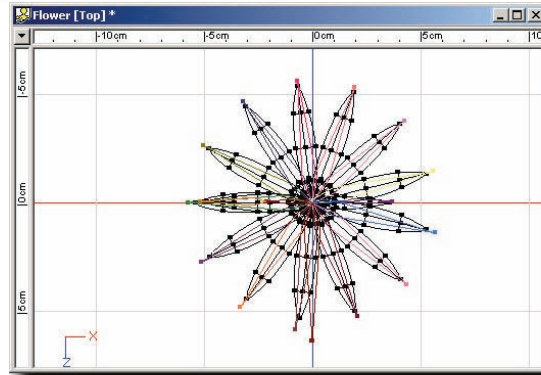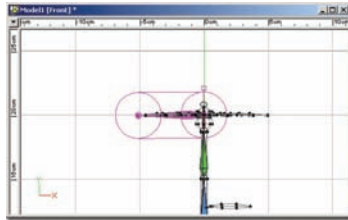
Note: The hierarchy of the bones not only controls how bones may be chained together, it also controls how bones move in relation to one another. As you would expect, if you move the "Stem" bone, all of the bones under it move too. (To change the hierarchy, it is a simple matter of drag-and-drop in the Project Workspace to rearrange).

ASSIGNING CONTROL POINTS TO BONES

Bones control groups of control points. There is a handy tool to simplify this process that automatically chooses the nearest bone for each control point. Right-click over the Bones window and pick [Auto Assign Bones].

"Auto-Assign" works well to get started, but when control points are near two bones, you must manually assign the control point to the bone you want. For example, click the "Root" bone, and then group the bottom ring of the stem. (This prevents the base of the stem from coming out of the ground when the flower bends).

Note: The control points will display in the same color of the bone that owns them while in bones mode. When a bone is selected, the control points it has assigned to it will blink to help identify them.
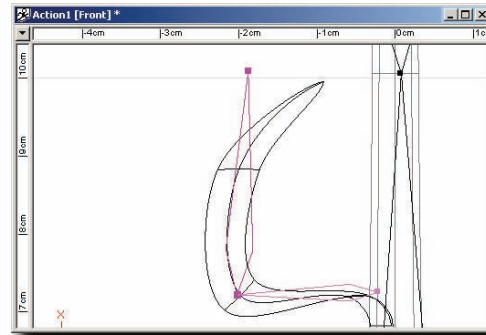
Click on the stem bone nearest each leaf and group the base of the leaf. (This keeps the leaf connected to the stem when it bends).

To test bones, close the modeling window then pick [File][New][Action]. Move the bones around a bit, and when you have finished testing the bones, close the Action window.
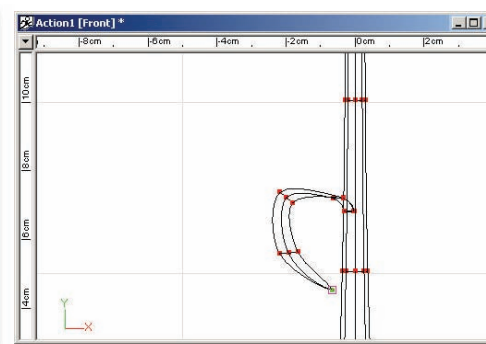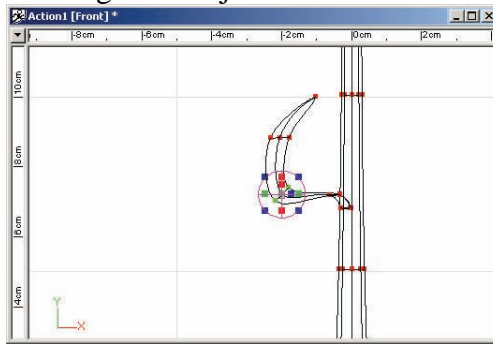
Smartskin
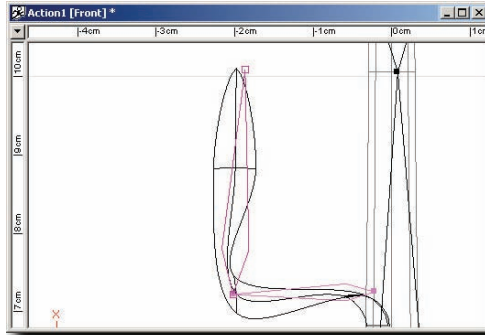
**Before SmartSkin**   **After SmartSkin**

Sometimes the splines at joints don't bend quite right. To fix this problem, right-click on the "Leaf A 2" bone in the Project Workspace and pick [New][SmartSkin]. This opens a new window that allows you to control the shape of the spline in relation to the angle at the joint.

Click the Muscle mode button on the Mode toolbar, and then group the spline at the joint between "Leaf A" and "Leaf A 2." Click the Rotate Manipulator button then rotate the group until the bend looks smooth. Change back to Skeletal mode and rotate the "Leaf A 2" bone so it points down, and then reshape the leaf back in Muscle mode to look smooth from this angle. Repeat for "Leaf B 2."

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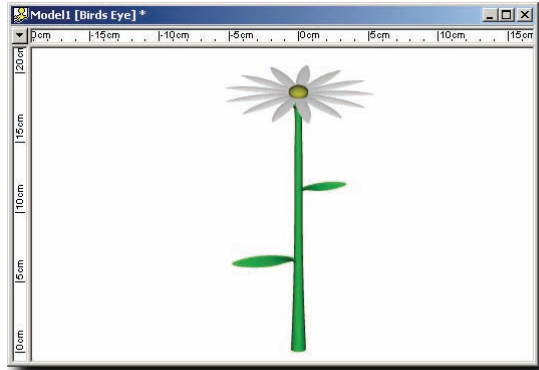
The finished flower

You can apply smartskin to any joint you wish so that you can depict exactly how the geometry of the model will look when the joints bend. This is extremely useful for shoulders or biceps of humans. When the elbow bends the bicep will bulge. Double-click on "Action1" in the Project Workspace to test the bones and to see the joints with smartskin added.

Created by Maki Yoshida
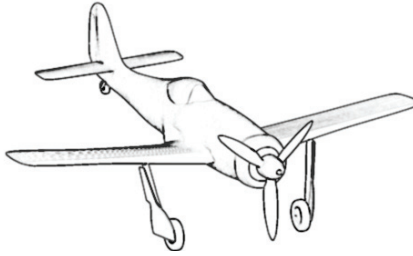
EXERCISE 10: FW-190 FIGHTER

Completion time: Two Hours

With mechanical objects such as automobiles, planes, and space ships, there are lots of straight lines and geometric conformity. Use your local hobby store for finding good reference pictures or actual models of your favorite airplanes or automobiles. Having an actual plastic model can help you when building your own 3D version, and also it is a great source for decals to scan in and use on your 3D version of the model. In this tutorial we will be building a famous German fighter, the FW-190 (Focke-Wulf). The design of the Focke-Wulf 190 began in 1937 as a backup to the Messerschmitt 109 that had been selected as the standard German fighter. The design concept was entirely different and featured an air-cooled BMW radial engine and a wide-track, inward-retracting landing gear. The first flight of the FW 190V-1 prototype was on June 1, 1939, but production models weren't in combat until September 1941. Now that we know a little about the fighter lets build a replica in 3 dimensions!

Pick [File][New][Model].

Right-click (<Control> click on a Mac) in the Model window and pick [New][Rotoscope]. Select the decal "\Data\Tutorials\FW-190 Fighter\Maps\Front.TGA" from the CD-ROM.


Focke-Wulf Fw 190A-8
Drawing by Lloyd Jones
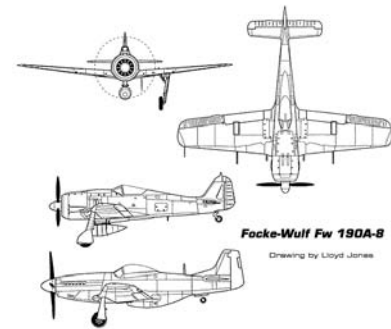
| Focke-Wulf Fw 190A-8	
Wingspan:	34ft., 5 1/2 in.
Length:	29 ft.
Powerplant:	one 2,100hp BMW 801D-2 14-cylinder radial engine
Max Speed:	408 mph
Range:	500 miles
Service Ceiling:	37,400 ft.
Armament:	two .31 in. MG-17 machine guns, four 20mm MG-151 cannon, one 1,100-lb. bomb and two 500-lb. bombs
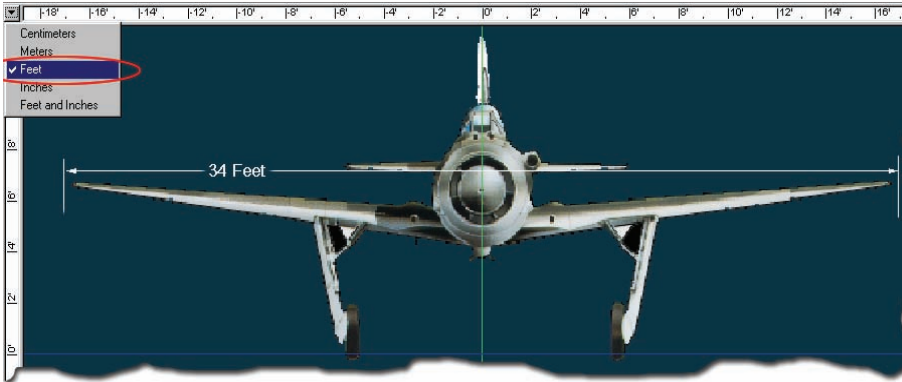
It is important to build the model to scale. To do this, first change the ruler units to Feet rather than Centimeters. Click the arrow in the upper left hand corner of the Modeling window and select "Feet". Then zoom the window out and size the rotoscope so that the wingspan is 34 feet in length. Always scale the rotoscopes in this tutorial from the corner with the <shift> key held down, so the proportions are kept correct. Center the rotoscope so that the nose is centered on the green y-axis and the wheel of the plane are resting on the red x-axis.
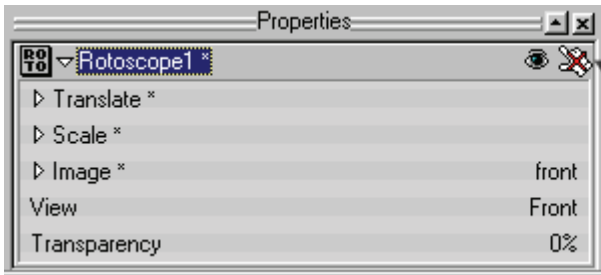
Click the "Rotoscope1" icon in the Project Workspace to see the rotoscope's properties. Turn off the "Pickable" option to prevent inadvertently moving the rotoscope.
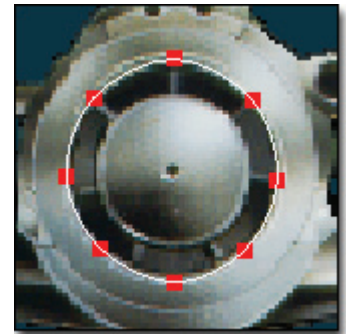
FUSELAGE

Bound Zoom the fuselage so that it is easier to trace. Add a nine-point spline that matches its shape. Drag the last control point over the first control point of the spline and click to attach – this creates an eight-point looped spline.
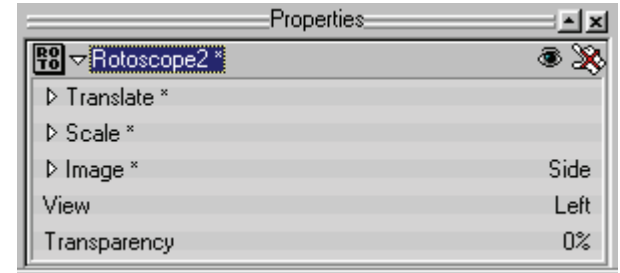
From the Left view, right click and pick [New][Rotoscope][Other…]. Browse for and open "\Data\Tutorials\FW-190 Fighter\Maps\Side.TGA" from the CD-ROM. Scale and position it so that it is 29 feet long, the wheels are on the blue z-axis line and the beginnings of the fuselage are lined up with the image in the correct location. On Rotoscope2's Properties, turn off pickable.
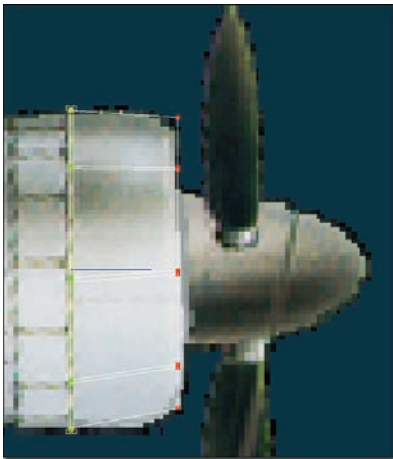
Extrude

Next, from the Left view, Bound Group the spline and click the Extrude button on the Modeling toolbar. Drag the newly extruded spines back. Click and drag the corner of the manipulator to scale it to fit the rotoscope. Translate the group down slightly to follow the profile of the rotoscope.

Continue to extrude, translate, and scale until you have matched the profile of the fuselage.
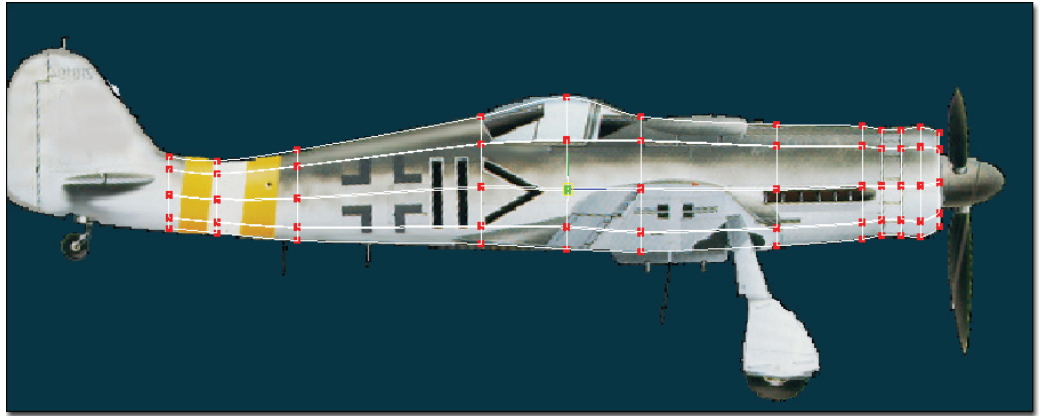

From the Top view, open "Top.TGA" as a rotoscope. Resize the rotoscope to fit the model and then turn off pickable.
From the Top view, you need to scale the individual spline rings to match the rotoscope. Bound Group each ring.

Click the Scale Manipulator button on the Manipulator toolbar. Move the mouse pointer over the sides of the manipulator until you see "Scale in X-Axis only" in the status bar at the bottom of the window. Click and drag to fit the rotoscope.

WINGS
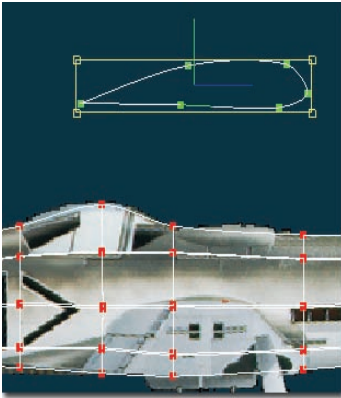
From the Left view, use Add Lock mode to add a six-point looped spline above the plane. Shape it to match the edges of the wings where they attach to the fuselage. Then use Attach to connect the two loose ends together. (These steps have already been covered earlier when building the spline used to create the fuselage.)

Use the Peak button to sharpen the rear control point. Bound Group the wing edge you just created and press the Lock button on the Modeling toolbar. (Lock allows you to see the fuselage but not move or select parts of it while you adjust the wings.)
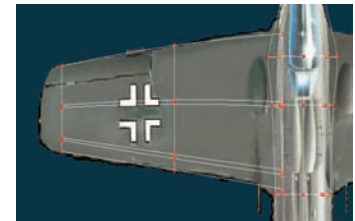

**Figure 1**

Figure 2

Figure 3

Position the wing to match the rotoscope from Left view. Change to Top view and drag the wing edge to where the wing will touch the fuselage. Extrude twice, translate and scale each new extrude to match the rotoscope. Move the entire wing so the first spline ring is just inside the fuselage. Add a four-point spline for the wing tip as shown in Figure 1.

Turn on the Bias manipulators and adjust the curve, with the <shift> key held down, to match the rotoscope. Next you will need to extend the four middle splines that make up the wing as shown in Figure 2. (Turn to match Figure 2 so you can see the loop of the wing). Click the Add Mode button on the Modeling toolbar then click near the control point you wish to add a spline to and drag the newly attached spline out. (You must click close enough to the control point so the software doesn't start a new spline, but far enough away that it knows which direction the spline should come out.) Now attach the tip spline and wing splines, as shown in Figure 3.
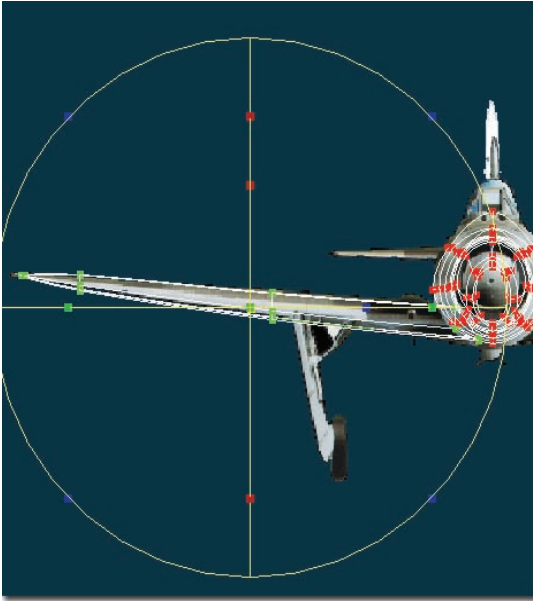
Bound Group the entire wing, or click on any point on the wing and pick [Edit][Group Connected]. Click the Rotate Manipulator button on the Manipulator bar. Rotate the wing until the wing's angle matches the rotoscope. Also translate the wing to lie on the rotoscope.

Press the <Esc> key on the keyboard to return to the Standard manipulator. Pick [Edit][Copy] then [Edit][Paste] to make a duplicate wing. (The copied wing will lie near the original wing).
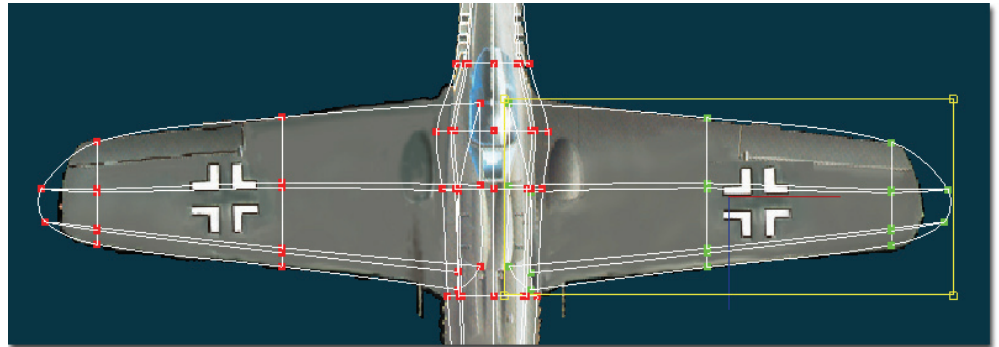
Click the Translate Manipulator button and then move the group's pivot from the center of the group to the center of the fuselage. With the mouse pointer over the manipulator, right-click (<Control> click on the Mac) and pick [Flip][X-Axis] to invert the wing. Finish fine tuning the position of the copied wing to match the rotoscopes from Top, Left, and Front views.
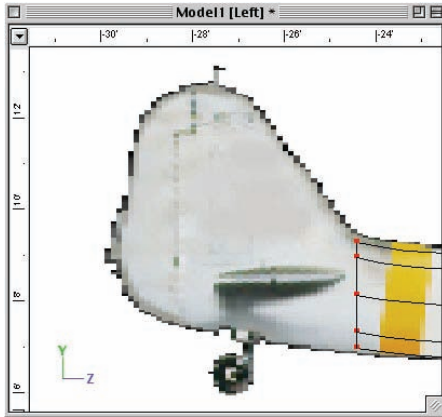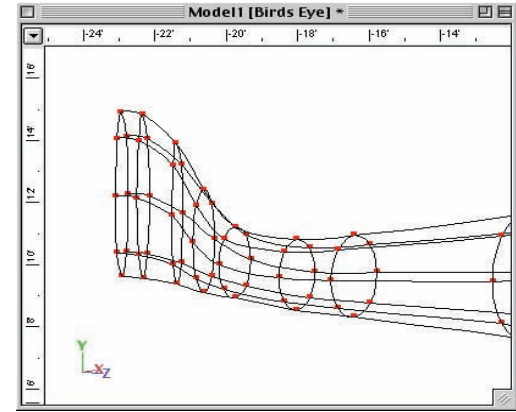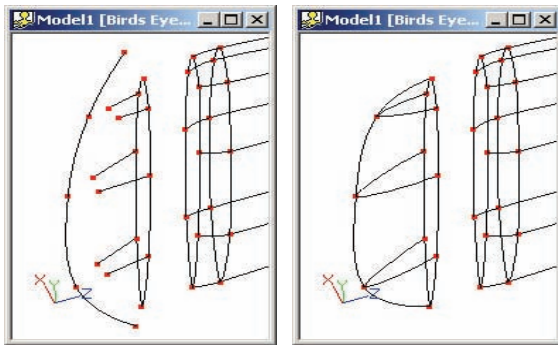
TAIL

To build the tail, first press the Lock button again to unlock the fuselage. Select any point on the fuselage and pick [Edit] [Group Connected]. Then click the hide button on the Modeling toolbar. This will hide everything but the fuselage. The vertical stabilizer consists of two parts: the tail and the rudder. To build the tail, group the last looped spline, and extrude four times. Bound Group, translate and scale each spline ring to fit the rotoscope. Remember to scale the tail with the X-axis of the Scale manipulator from the top view like you did for the fuselage.


To make the rudder, click on the part of the last spline ring. It will change color to show it is selected, then pick [Edit][Select Spline]. Pick [Edit][Copy] then [Edit][Paste] and move the new spline ring away from the tail to give yourself room to work.

Make a five-point spline in the shape of the vertical edge of the rudder. Turn to see the loop, and make six two-point splines and attach them to the center three control points in the loop. Attach the loose ends of the new splines to the middle three control points in the edge spline and the ends of the edge spline to the top and bottom of the looped spline, as shown, then move the rudder piece into position at the end of the tail.

The horizontal stabilizer (rear wing) is modeled the same way as the wing; it is just a miniaturized version. Click the Hide button again to unhide the wings. From the Top view copy and paste one of the wings (use Group Connected to select it). Position and scale it to match a horizontal stabilizer, then copy paste and flip it like you did for the wing.

CANOPY
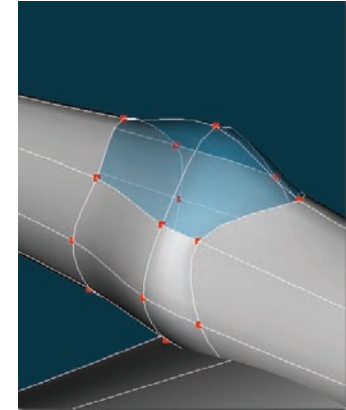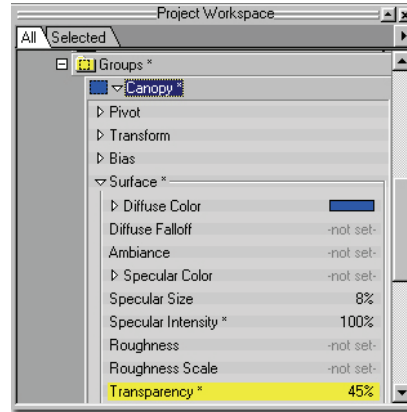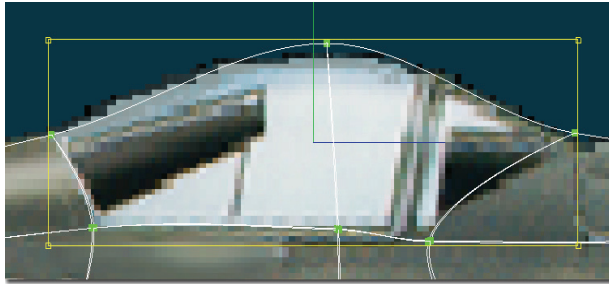
From the Left view, Bound Zoom the canopy section of the rotoscope. Shape the Fuselage to match the canopy in the rotoscope. Bound Group the entire canopy section and rename the "Untitled" group in the Project Workspace to "Canopy". Set its Diffuse Color to blue, its Transparency to "45%" and its Specular Intensity to "100%".

TIRES

The Lathe tool provides a simple way of making a quick circle. From the Front view, draw a two-point spline along the edge of a tire. Pick [Tools][Options], click the "Modeling" tab, and change "Lathe Cross Sections" to "4."

Lathing occurs around the pivot, which can be moved using one of the enhanced manipulators, (Translate, Scale, or Rotate): click the Translate Manipulator button on the Manipulator toolbar. Click on the pivot in the middle of the manipulator and drag it to the outside left of the manipulator to where the tire's center would be. <Shift>-click one of the points in the group to select it. (This enables the Lathe button.) Click the Lathe button on the Modeling toolbar.
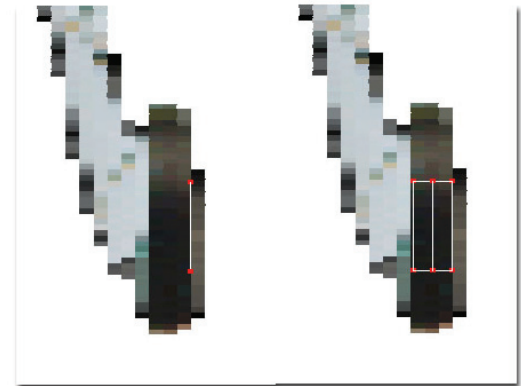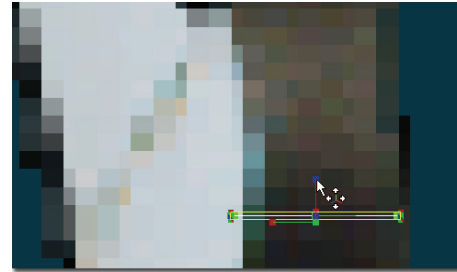
**Figure 1**   **Figure 2**   **Figure 3**

Since the lathe actually makes a cylinder and you just need the top circle ring, Bound Group and delete the bottom ring. Group the remaining circle. Position the ring so that it lies on the tire in the rotoscopes of the Left and Front views. <Shift>-click any point in the remaining ring. Drag the pivot to where the center of the tire will be (Figure 1). When you lathe, it always spins the selected group around the Y-axis (green). From the Front view, click the top of blue knob on the pivot (Figure 2) and rotate it upwards until the green axis is horizontal (Figure 3).
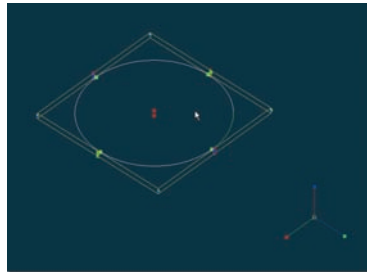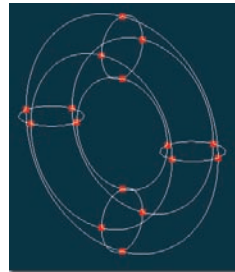

Figure 4   **Figure 5**   **Figure 6**

Again notice in Figure 4 how the pivot is positioned and rotated. When you click the Lathe button the software will spin the grouped control points around the green axis on the pivot. Click the Lathe button now. Your result should resemble Figure 5. From Left and Front view, position the tire to fit the rotoscope as shown in Figure 6.

To make the wheel covers, in the Top view, make a looped four-point spline that is large enough to enclose the wheel. Click the four points while holding down the Shift key to select them and press the Lock button on the Modeling toolbar. Then from the Left view, extrude the loop along the length of the skirt several times. Use the Group tool to shape the extruded control points to match the skirt in the rotoscope.
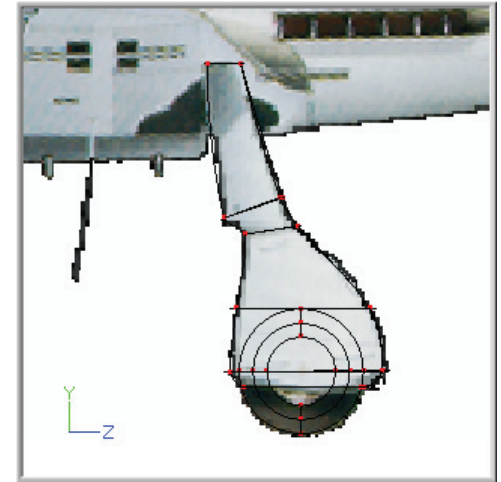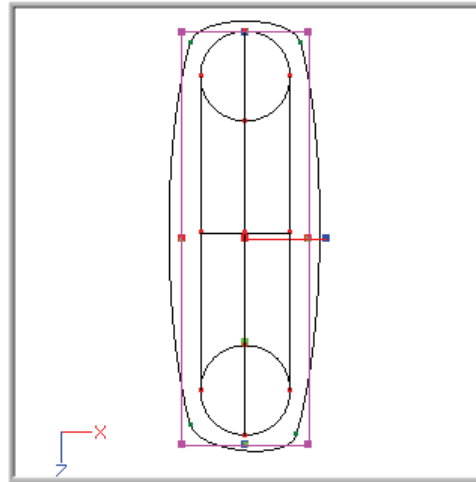
From the Front view the skirt is turned slightly inward, so you must group the complete skirt, then click the Rotate Manipulator button on the Manipulator toolbar, then rotate the skirt so that it matches the angle of the rotoscope.

Press the Lock button again to unlock the tires. Pick [Edit][Deselect All], or click away from any point or group to deselect. Then click a point of the tire and a point of the skirt with the Shift key held down. Finally pick [Edit][Group Connected] to select the tire and skirt without any of the wing or fuselage.

Pick [Edit][Copy] then [Edit][Paste]. Next, right-click over the group and pick [Flip][X-axis]. Position this new tire and skirt on the other side of the plane in the Front view. Check it from the Left view also.

Pick [Edit][Paste] again and drag this new third tire and wheel to the rear of the fuselage directly under the horizontal stabilizer for a tail wheel. Scale this tail wheel smaller and flip it on the Z-axis to match the Left view rotoscope.

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PROPELLER

Making the propeller is a combination of everything you have done so far. In the Top view, make a looped four-point spline the size of the base of your propeller blade. From the Right view, Extrude, Translate, Extrude again and scale to match the

rotoscope. Click the Manipulator Properties button then click the Rotate manipulator button and rotate that spline 30 degrees around the Y-axis. Extrude again and rotate 20 degrees around the Y-axis. Extrude and rotate the ring 10 degrees along the Z-axis (the last two extruded splines will not be rotated at all, just scaled). Model the tip of the propeller blade by adding a three point spline, extending the middle vertical splines of the propeller, and attaching to the middle control point of the new spline, and attaching the ends (similar to the tips of the wings).
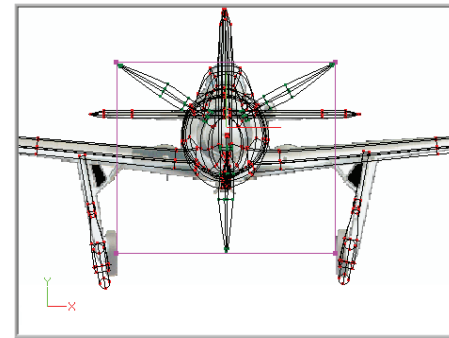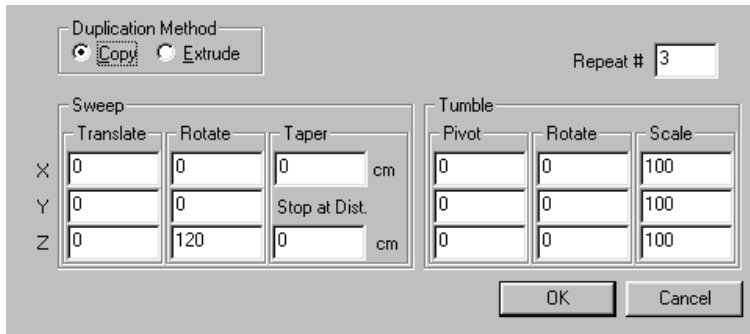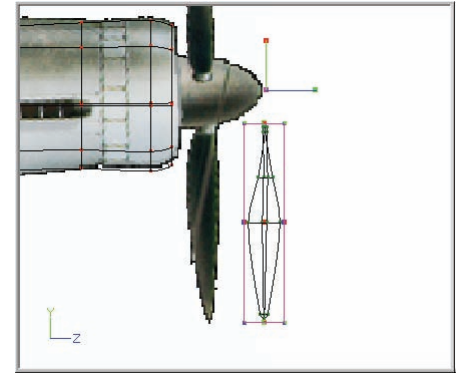
To make the other two propeller blades, you will use the Duplicator wizard on the propeller blade you just created. First group the blade and move the pivot to the front center of the plane. Right-click the group and pick [Plugins][Wizards][Duplicator]. When the Duplicator dialog appears, set the Duplication method to "Copy," the "Repeat #" to "3" and the "Sweep Rotate Z" value to "120" and click the "OK" button. When the group is duplicated, drag it to the correct position in the Front view.
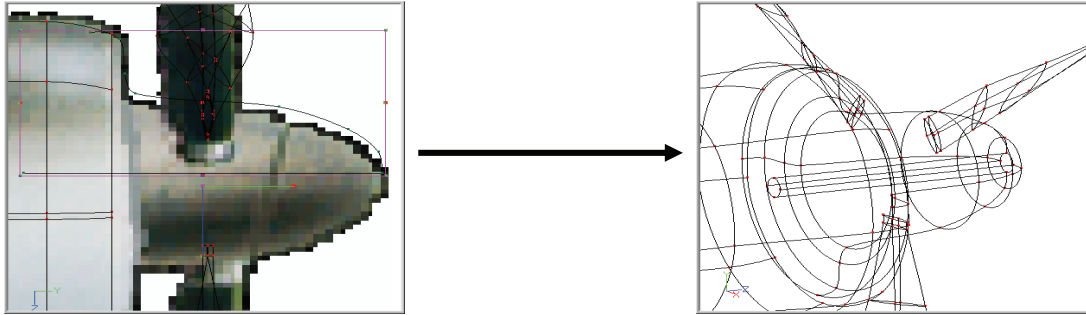
SPINNER

Lathe a spinner using your previous experience, and move it into position. Remember to rotate the pivot like you did with the tire.

DECALING

Next we need to stick the images on to the surface of our model. (Decaling). Using decals is one of the most effective ways to give a model instant recognizability, and increased photo-realism. Decaling is the practice of applying images to models to add detail. When Decaling, it is important to hide the parts of your model you do not want the decals to be applied to. For example, when decaling the body of your plane, hide everything but one side of the body. When decaling the wings, hide everything but the top or bottom of the wings. Also, make sure when sizing your decal that it covers all the patches you want the decal to "stick" to completely.

Click a point in the fuselage and tail with the Shift key held down and pick [Edit][Group Connected]. Click the Hide button on the Modeling toolbar. In the Left view window, right-click (<Control> click on the Mac), and pick [New][Decal][Side]. Name it "Side". The decal needs to be resized to fit the model. Move the mouse pointer over the corner of the manipulator until it changes to a Scale cursor, (press and hold the <Shift> key on the keyboard to maintain proportion), click and drag the decal to fit the model. Right-click inside the manipulator and pick [Apply]. The decal will stick.

The same decal can be used for both sides. Switch to the Right view. Double click the "Side" decal in the Project Workspace. The decal will reappear. Right-click (<Control> click on the Mac) over the decal and pick [Flip][Horizontally]. Resize the decal if needed, and apply. Click the Hide button again to unhide.

From the Top view, apply the "Top" image as a decal with only the wings and horizontal stabilizer visible. Remember, when decaling, apply the images in multiple steps. For instance it may be easier to decal the wings and horizontal stabilizer separately. You might want to touch up the images you used as rotoscopes and paint out the wings from the side.tga file so they don't show up on the side of your fuselage. Or extract only the symbols from the rotoscopes and use materials to make the metal color of the fuselage. If you want, try making a cockpit for inside the plane.

Created by Eduardo Gutiérrez
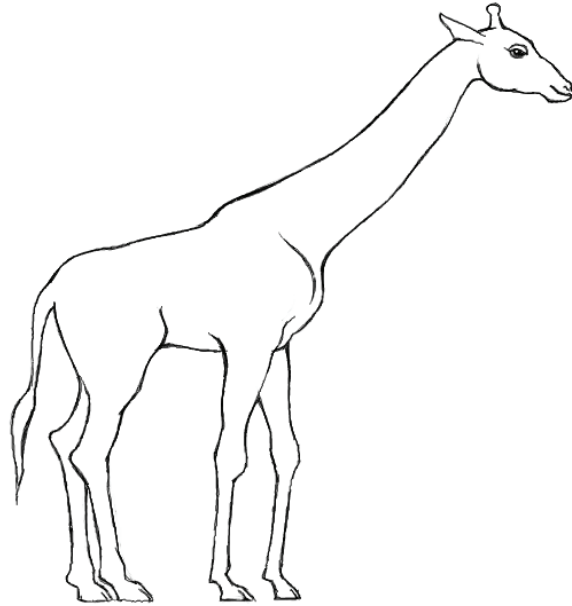
EXERCISE 11: GIRAFFE

Completion time: Five Hours

Animation:Master emphasizes animation, therefore its modeling philosophy is totally driven by the needs of a moving character. Hash patch models have the unique advantage of being able to put a control point just about anywhere. Naturally, you would put control points at the corners of a character's eyes (to blink), and at the corners of the mouth (to talk). With a little more thought you can minimize patch intersection as splines change during an animation; this is called "modeling for animation." Any model can look good as a still image, but can the mouth open and the legs bend without weird artifacts? Did you even leave a hole for the mouth? Is there an extra patch for the eyelids to blink with? It only takes a few awkward learning experiences to understand what "modeling for animation" means.

Pick [Project][New] to start a new, empty project

Pick [File][New][Model] to open a new Model window.
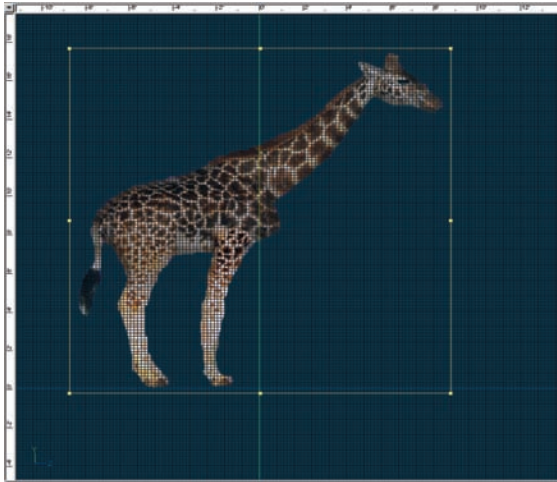
Figure 1

Change to the "Left View" and then right-click (<Control> click on a Mac) the Model icon in the Project Workspace and pick [New][Rotoscope]. Open "\Data\Tutorials\Giraffe\Maps\Side.TGA" from the CD. Position and size the giraffe rotoscope so that its feet reside on the blue z-axis line and its horns are about 18 feet off the ground using the rulers in the margin of the window. See Figure 1. Remember to hold down the <shift> key to keep the rotoscope proportional. Turn off "Pickable" on the rotoscopes properties by clicking on the hand icon.

HEAD
To get a general head shape, draw a profile with six control points just to the right of the green "Y" axis line as shown in Figure 1. By default the Lathe tool will rotate around the y-axis of the view. Pick [Tools][Options] "Modeling" tab, and make sure that "Lathe cross sections" is set to 8. Then click OK to exit the Options dialog. Click the Lathe button.

Figure 2

120
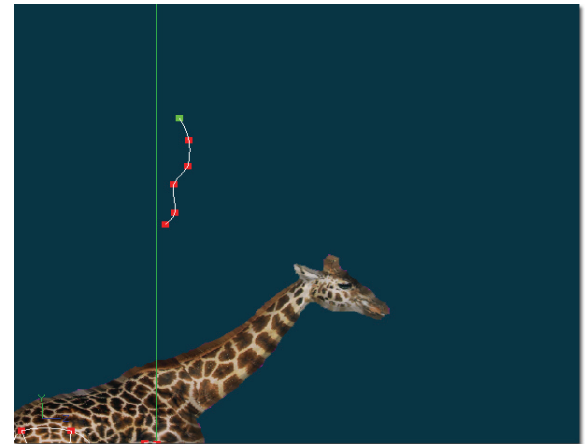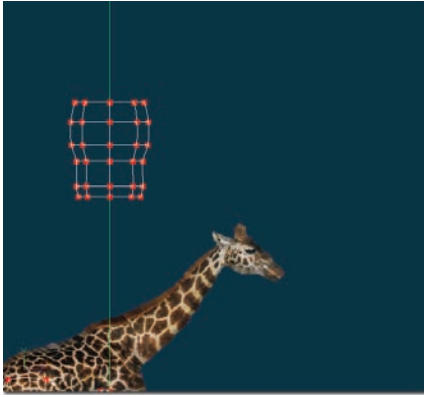
Figure 1 **Figure 2** **Figure 3**
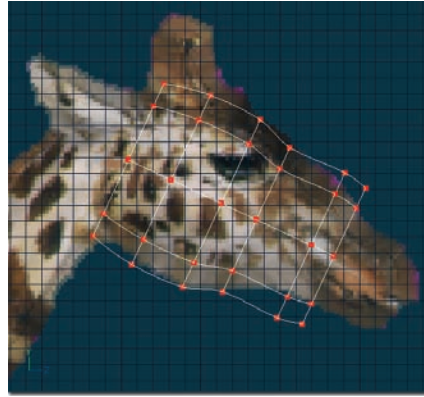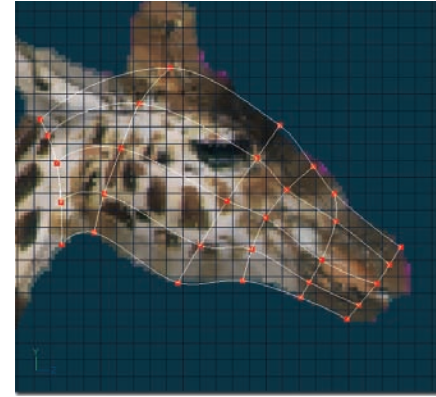
The lathe produces an initial shape for the head. See Figure 1.

Pick [Edit][Select All]. Drag the selected control points over the giraffe's head in the rotoscope. Click the Rotate Manipulator button. Rotate the control points so that they are the same angle as the giraffe's head, as shown in Figure 2

Click any blank space in the window to deselect all.

> *Note: To deselect all, you may also pick [Edit][Deselect All], or simply press the <Enter Key>*

Move the control points to match the rotoscope as shown in figure 3. (If you Bound Group over the control points you will select the same control point on each side of the head. This is useful so when you move the group, both sides are moved at once.)
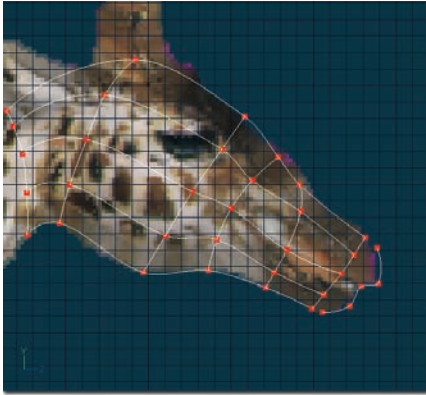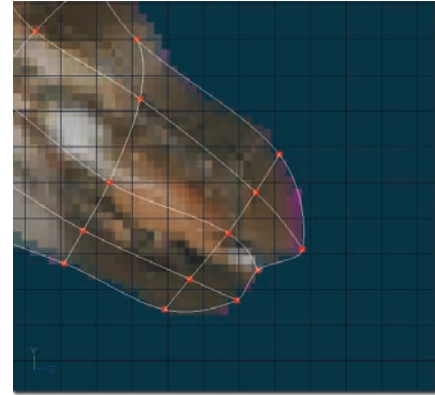
Figure 1   Figure 2   Figure 3

To complete the nose, create a 5-point spline that matches the giraffe's rotoscope, as shown in Figure 1. Next, extend the splines of the head by clicking the Add Mode button on the Modeling toolbar then click and drag on each of the end control points, see Figure 2. Next attach the nose to the head, see Figure 3. You may need to look at the model from different views while attaching. Check the giraffe's head and nose from Front and Top view. Make any necessary changes.

NECK
From the Left view, click a control point on the back ring of the head. Pick [Edit][Select Spline] to group just the back spline ring.

Click the Extrude button on the Modeling toolbar. Drag the new group down the neck. Extrude again and again until you have reached the base of the neck, as shown in Figure 4. Shape the neck to match the rotoscope from the Left view. Also shape the neck from the Top and Front views.
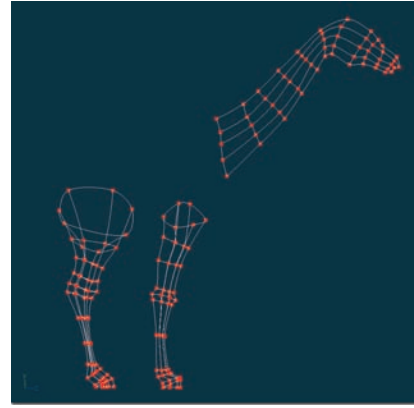

Figure 4

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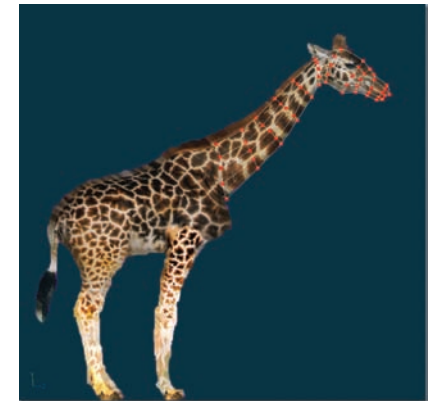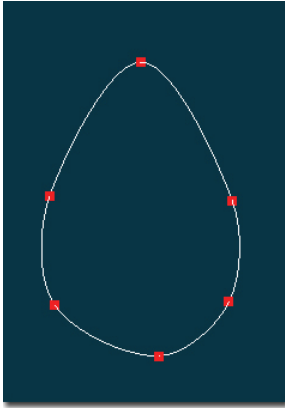
| Figure 1 | Figure 2 | Figure 3 | Figure 4 |

LEG

From the Top view, draw a looped spline of six-control points, as shown in Figure 1. From the Left view, extrude along the leg all the way to the hoof. From the Front view, group the whole leg and drag it into position on the left side of where the giraffe's body will be. Repeat this process for the rear leg.

BODY

When building the body it is very important where you place the extruded rings, and how many rings you create. This is because you will be attaching the legs seamlessly to the body, and it is crucial you have proper splines in place to attach to. Group the last spline ring of the neck and extrude twice. (Sometimes it is difficult to bound group the desired control points. In these cases try using the Lasso Draw Mode or Lasso Line Mode grouping tools on the Modeling Toolbar. Simply click and drag to draw a circle around all control points you wish to select in Lasso Draw Mode, or click multiple times to form lines around the control points you wish to select in Lasso Line Mode. To complete the selection in Lasso Line mode, simply click on the origin of the first line you added.) Shape these two rings to match the rotoscope, as shown in Figure 5.
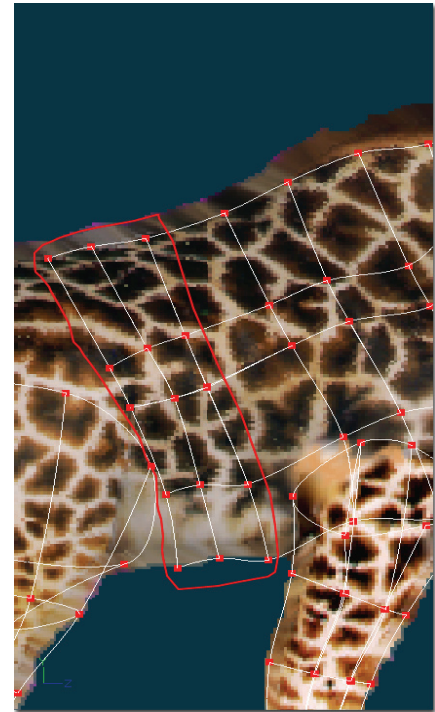

Figure 5

Figure 1

Figure 2

Figure 3

The two body rings just added (Figure 1) will tie into the middle splines running down the front leg (shown in purple and green in Figure 2). The yellow spline shows the connection to the front of the leg. Finish laying out the body extrusions then come back and connect the legs.

Extrude the last ring three more times to form the belly of the giraffe (Figure 3). Again shape these splines to match the rotoscope from Left view. Also shape the newly added rings from Front and Top view.

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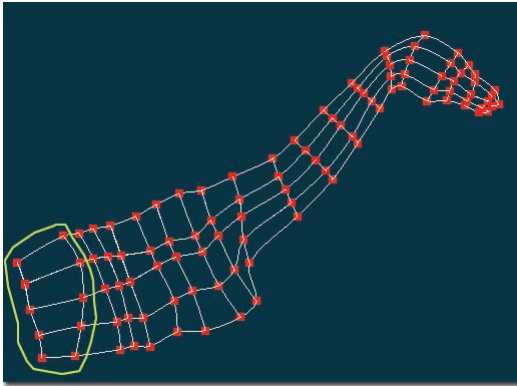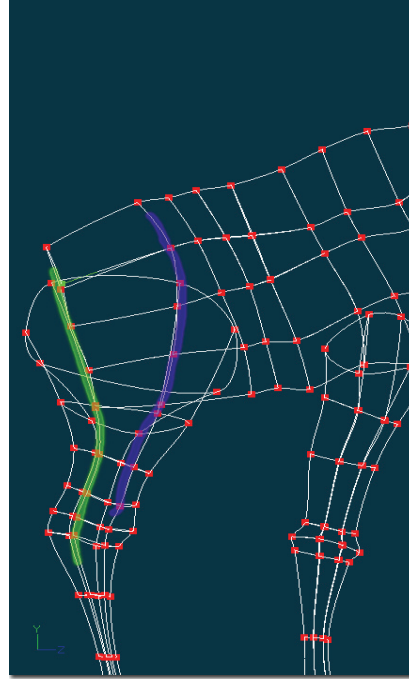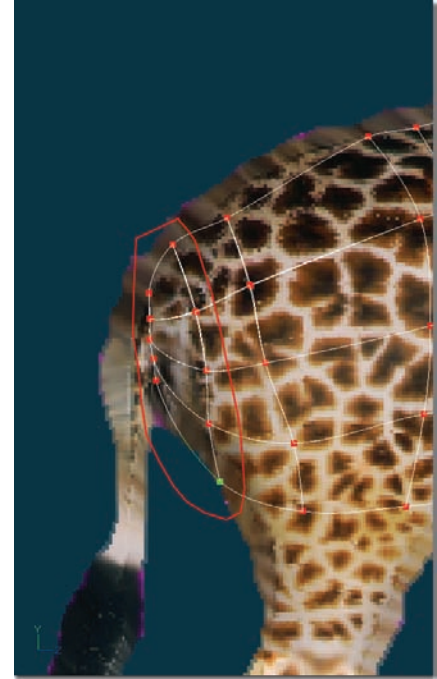
Figure 1

Figure 2

Figure 3

Extrude the last belly ring twice more (Figure 1) to form the splines that will tie into the middle of the back legs (Figure 2). Shape the splines to match the rotoscope. Notice how the splines are also positioned so that they will smoothly connect to the legs splines. The splines should follow the same curvature and arc. These arcs are green and purple in Figure 2.

Finally, extrude the last ring twice more to form the rear of the giraffe (Figure 3). This will complete the body of the giraffe.
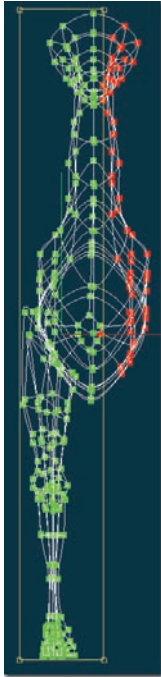
Figure 1
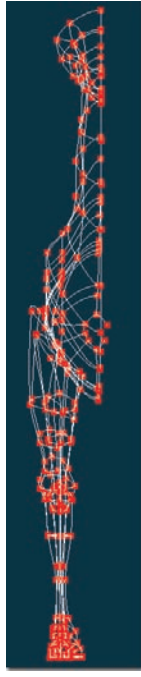
Figure 2

Figure 3

CONNECTING FRONT LEG TO BODY

From Front view, group the right half of the giraffe and then click the hide button (Figure 1).

Break

From Left view, zoom in on the front leg. Select the control point and spline highlighted in green in Figure 2. Make sure that the green highlighting spline coming out of the selected control point is to the right of the control point. Next click the "Break" button on the Modeling toolbar. The highlighted green spline should be removed as shown in Figure 3.
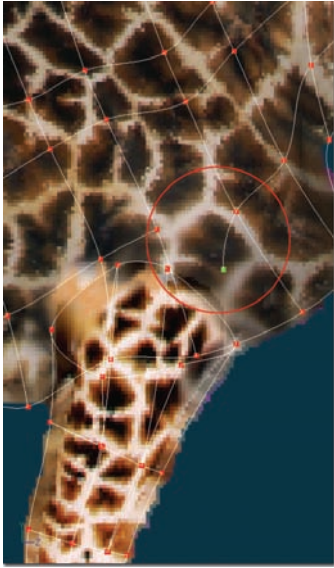
Figure 1
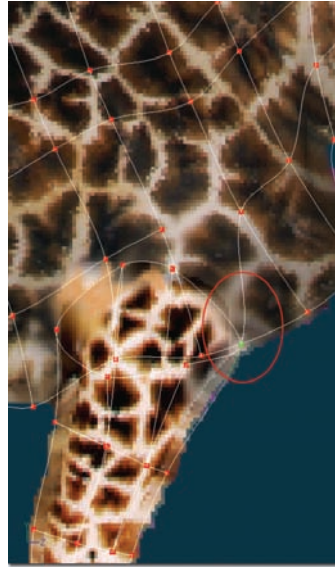
Figure 2

Next, attach a spline from the opposite side of the spline you just broke (Figure 1) to the front control point of the leg (Figure 2). This will create a smooth spline that runs from the neck all the way down the front of the leg.

Patches

At this point it is necessary to explain valid and invalid patches. Connecting splines together create surfaces called patches. These patches can only be rendered if they are valid. 3 or 4 control points outline a valid patch. (For special junctions, 5 control points can be used.) See Figure 3 for sample valid patches. Also to be valid, the patch must consist of at least two splines, thus one looped circle spline with 3 or 4 control points will not render (See Figure 4). This is intentional to prevent internal patches in objects. For instance consider the tube in Figure 5. It would be undesirable for the internal ring to be a valid, renderable patch
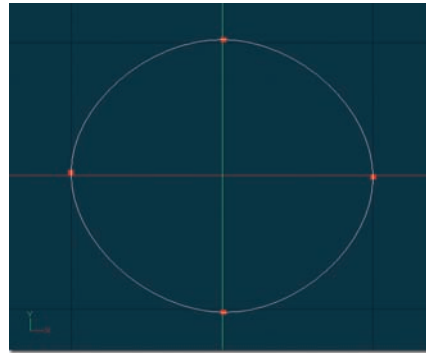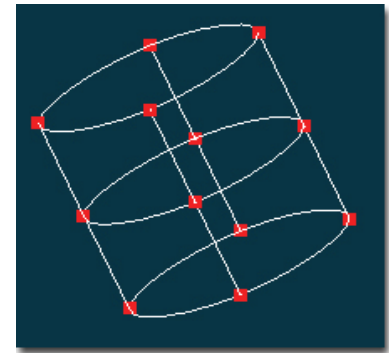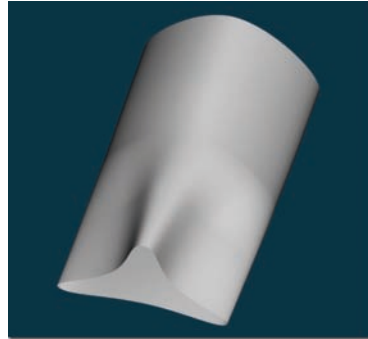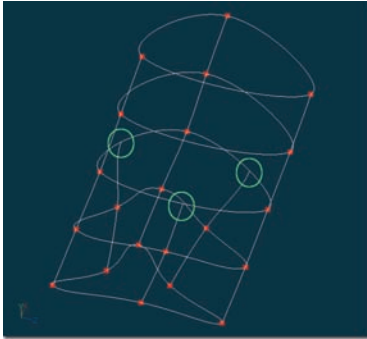

Figure 3

Figure 4

Figure 5

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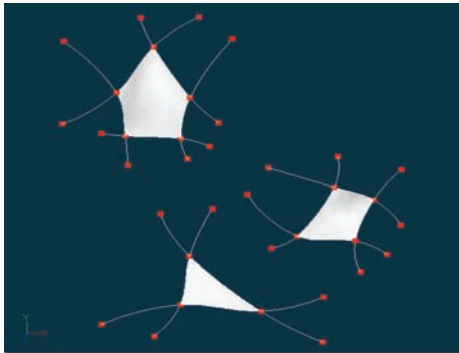
Figure 1

Hooks

Hooks allow us to obtain more resolution in a model where it is needed, yet keeping parts of the model simple that don't need the added detail. In Figure 1 we show how the tube is composed of a ring of 4 points. Yet the other end of the tube has 6 points. The key is the hooks added in in the middle ring. A hook is simply a way of ending a spline into another spline. The hook can be attached to another spline at the 25%, 50%, 75% positions.
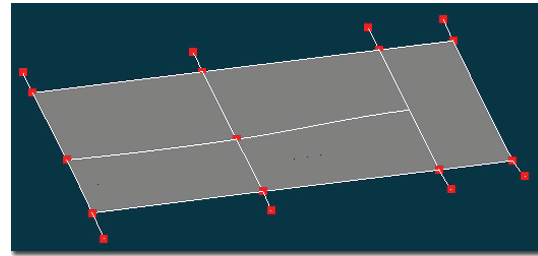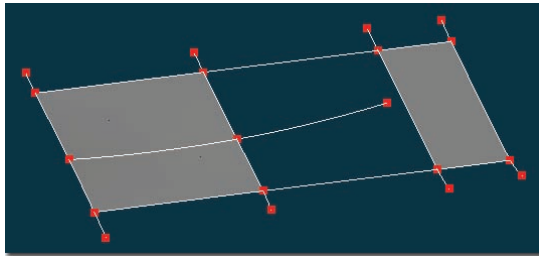

To create a hook, simply drag the control point you wish to hook over the spline you wish to hook to, and click the right-mouse button (<~>key on the Mac) while the left mouse button is still down.

Avoid attaching hooks to a spline that makes up a 5-point patch! Or multiple 5-point patches next to each other!

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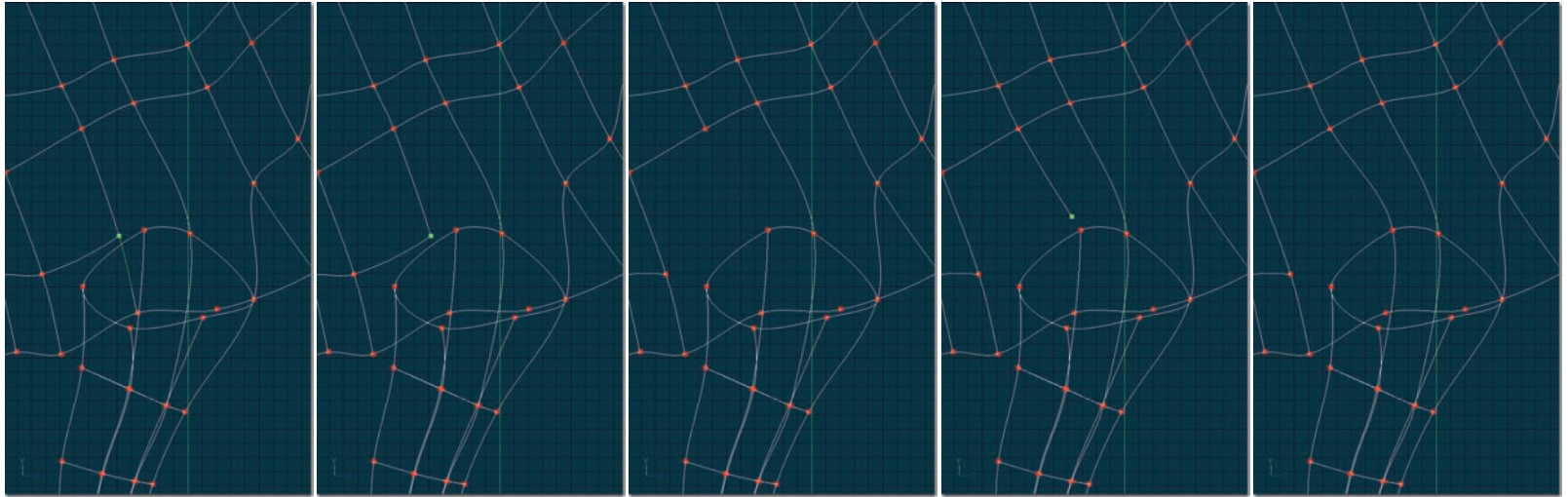| Select Point | Break Spline | Delete Point | Add New Spline | Attach Point and Make 5 Point Patch |
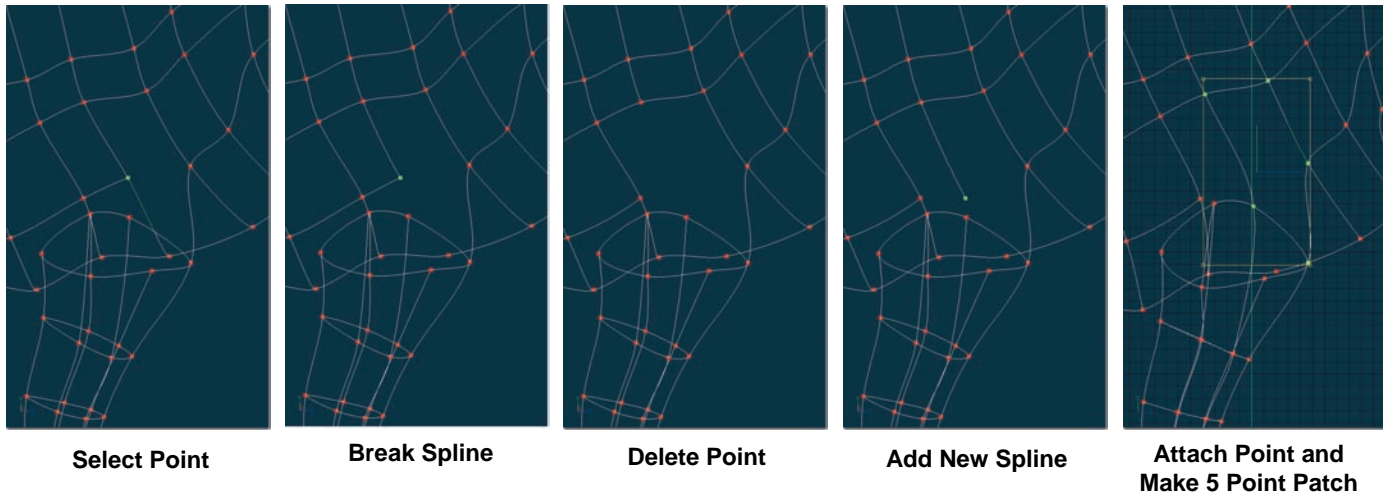
Finish attaching the legs to the body. Select the control point shown above. Make sure the highlighted spline points downwards. Click the Break button on the Modeling toolbar to break the spline.

Note: The <Tab> key will cycle through splines that are all conntected to the selected control point.

Next bound group and delete the same control point you selected when you clicked the Break button. Now add a new spline from the top mesh and connect it to the leg as shown above. This is the perfect case for a 5-point patch. 5-point patches are usually used at junctions connecting arms, legs, or the nose to the face. To create a 5-point patch, you must select the five corners of the patch. Use the Lasso group tool, or simply click each control point while holding down the <Shift> key. The "Make 5-Point Patch" button on the Modeling toolbar will become active when all five points have been selected. Simply click the button to make the five points become a valid patch.
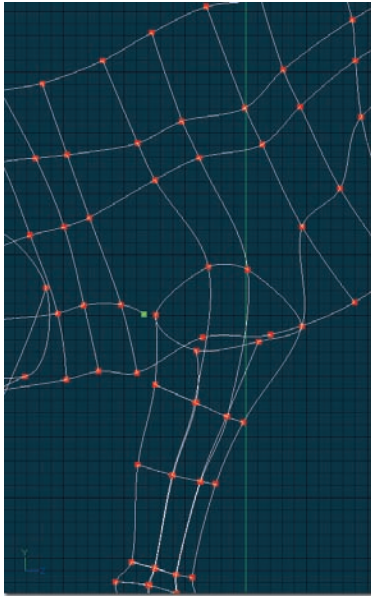
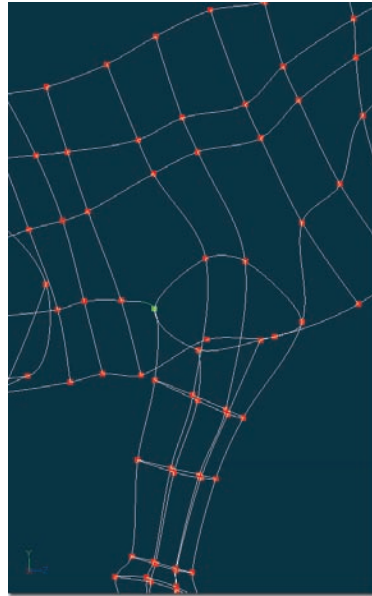| Select Point | Break Spline | Delete Point | Add New Spline | Attach Point |

Repeat the previous proceedures for the next spline tying into the leg.
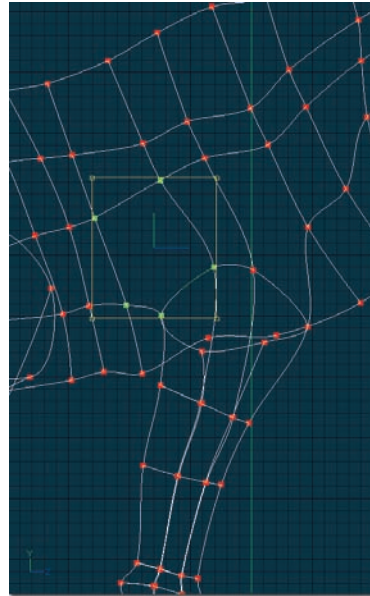
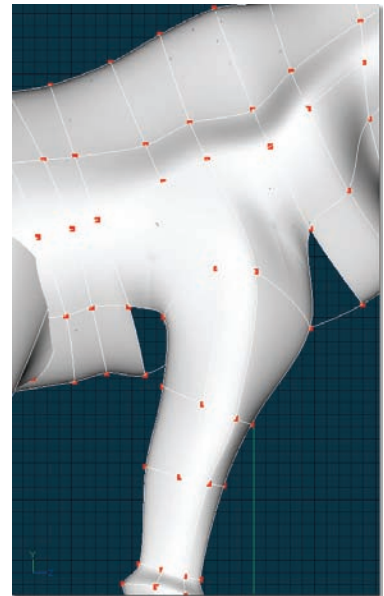Follow the steps in the sequence of images above.

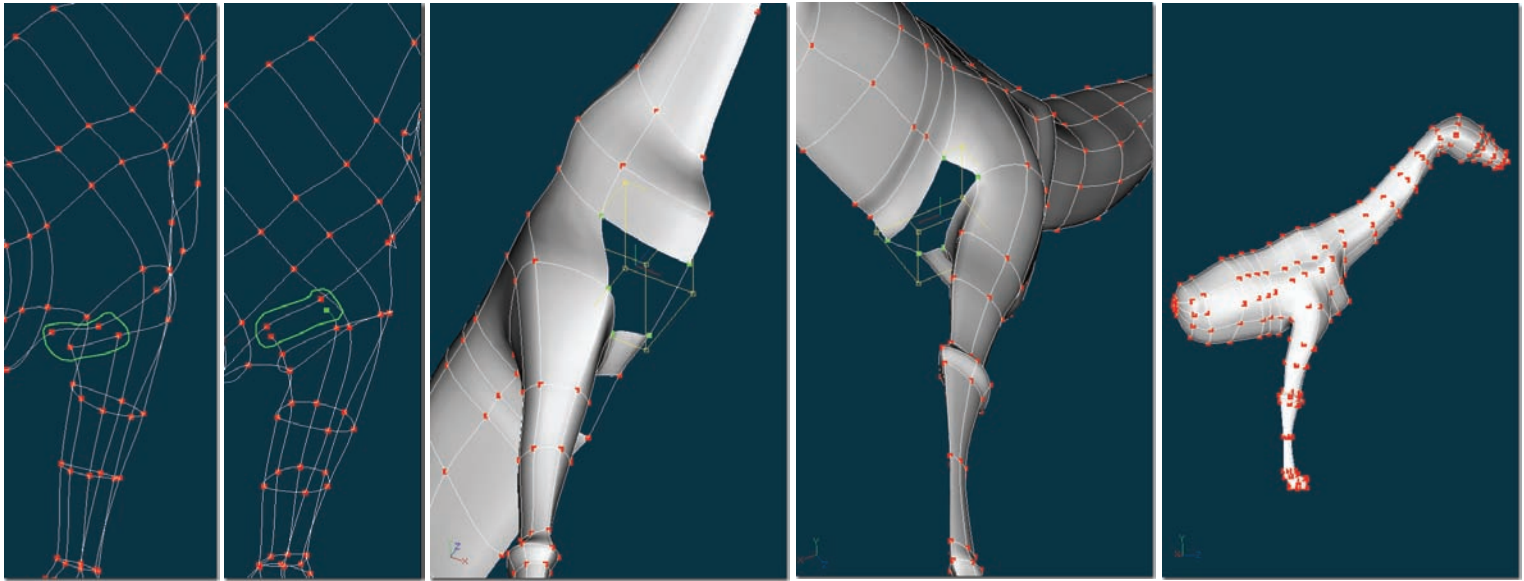**Add New Spline**   **Attach Spline**   **Make 5 Point Patch**   **Shaded Mode**

Finish the back of the leg by adding and attaching a spline as shown above. This will form another 5 point patch. Select the five points of the patch and click the "Make 5-Point Patch" button on the Modeling toolbar.

Right-click (<Control> click on the Mac) and pick [View][Render Mode][Shaded & Wireframe]. You can see what you accomplished so far. (The under side of the leg still needs attached to the body of the giraffe.)

Right-click (<Control> click on the Mac) and pick [View][Render Mode][Default] to change back to wireframe mode again.

Note: Use the 7, 8, 9, 0 keys to quickly change the Render Mode to "default", "wireframe", "shaded", and "wireframe & shaded", respectively.

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Figure 1

**Make 5-Point Patch in Front and Back
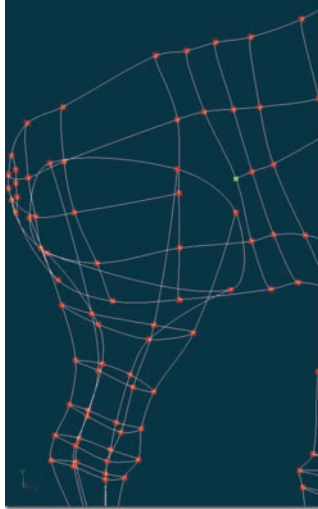of the Leg**

**Front Leg Fully
Attached**

To finish underneath the leg, attach splines from the middle two splines running up the inside of the leg to those adjacent on the belly as shown in Figure 1.

After the two splines have been attached, you will have created two 5-point patches; one in front and one behind the leg. Select the control points that make up each of the 5-point patches and click the "Make 5-Point Patch" button on the Modeling toolbar.
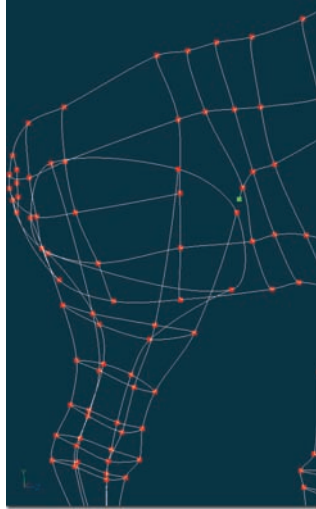
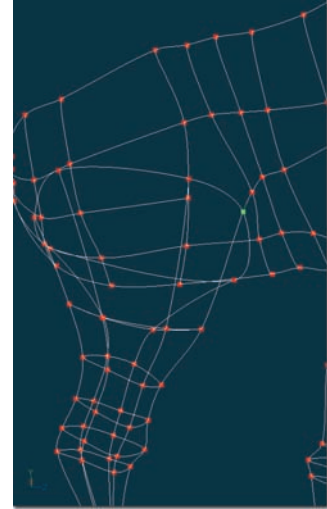The front leg should be fully attached.
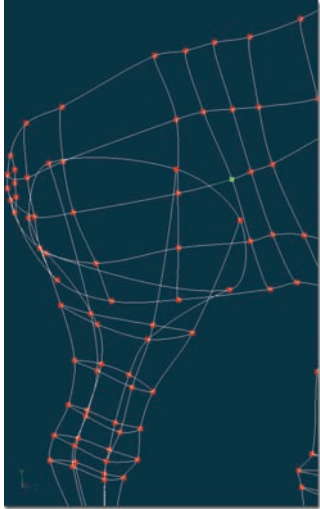
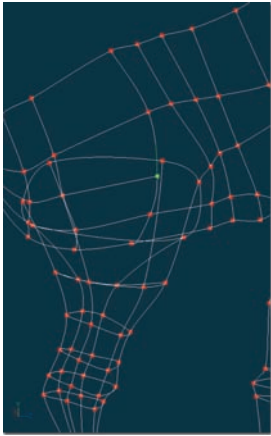**Select Point**   **Break Spline**   **Add New Spline**   **Attach Spline**
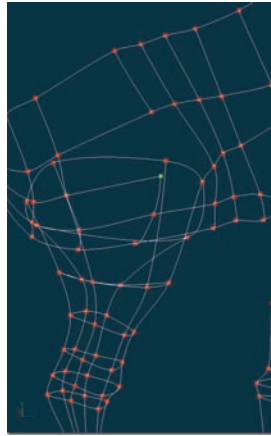
CONNECTING BACK LEG TO BODY

To connect the back leg to the body, perform tasks similar to attaching the front leg. The primary difference is that you will be attaching the leg higher on the body.
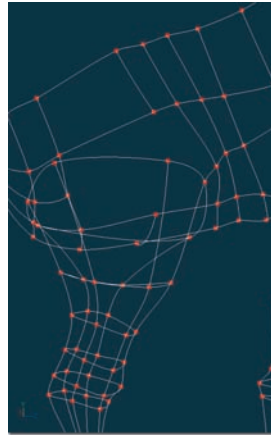
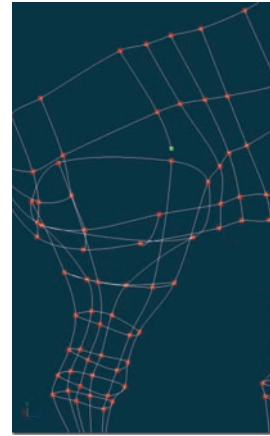Follow the steps in the sequence of images above and on the following pages.

Select Point

Break Point

Delete Point

Add New Spline

Attach Spline
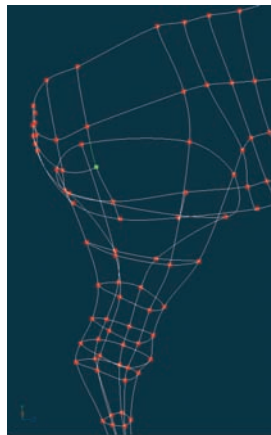
Make 5-Point Patch

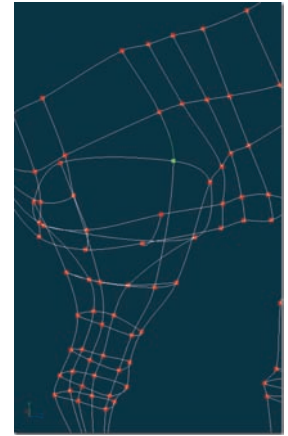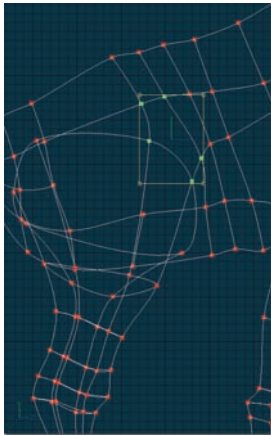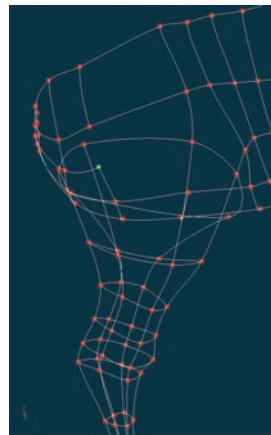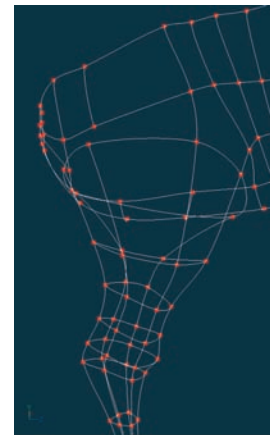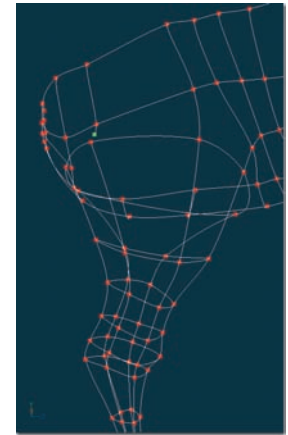**Select Point With Highlighted Spline Running Upwards**

Break Spline

Delete Point

Add New Spline

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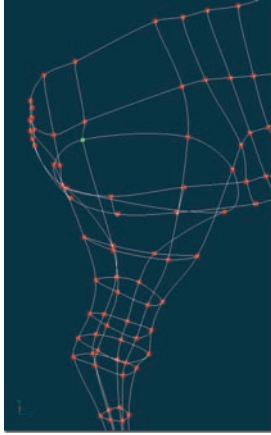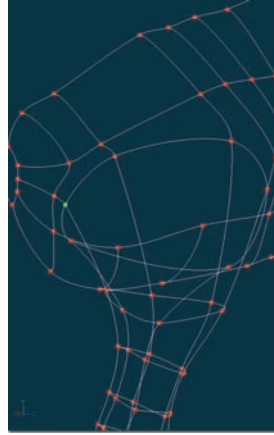
Attach Spline

Add and Attach Spline to Spline Running Down Back of Leg
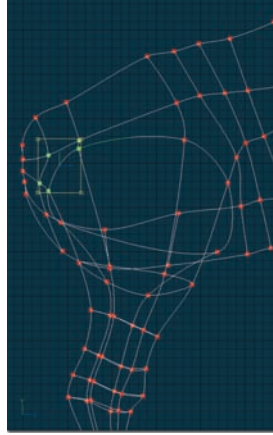
Make 5-Point Patch
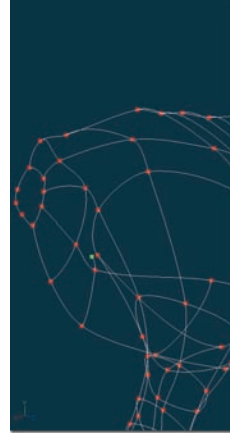
Add New Spline
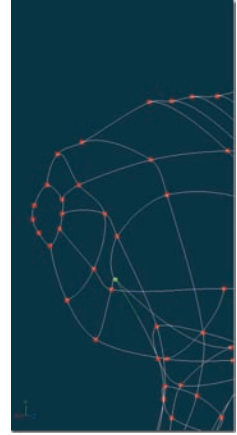
Attach Spline
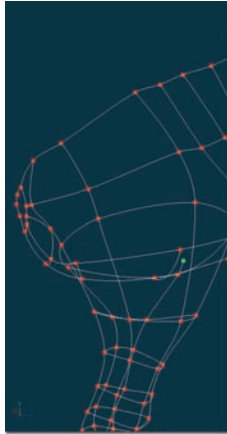
Add and Attach Spline on Inside of Leg
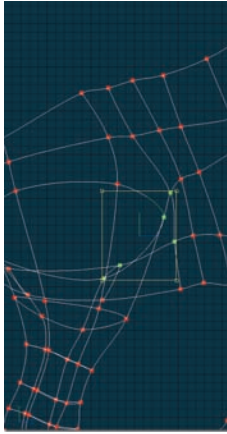
Make 5-Point Patch

Legs Completely Attached to Body
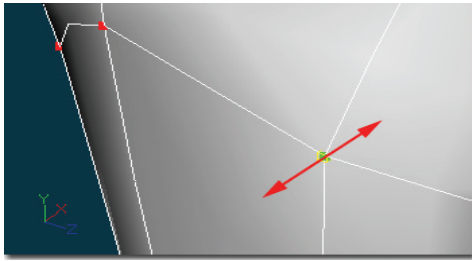
1 Key
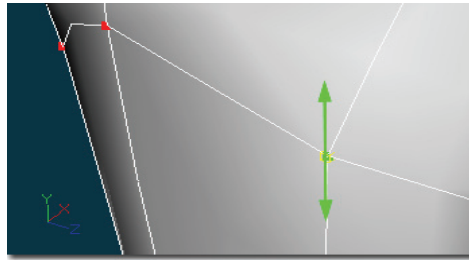
2 Key
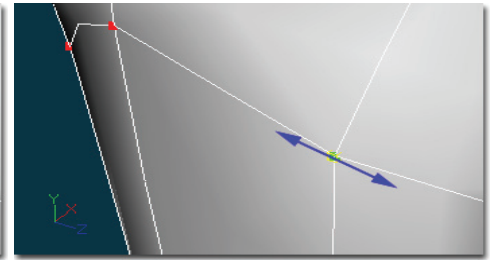
3 Key
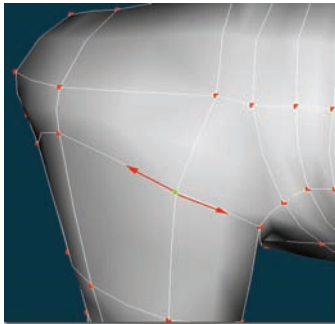
4 Key
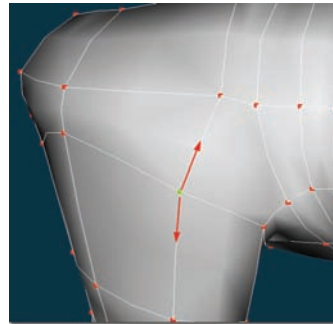
5 Key
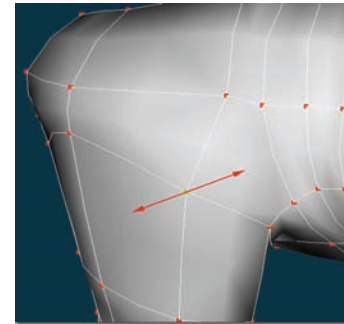
6 Key

After both the front and back legs have been attached, you should spend some time cleaning up and smoothing the shape of the giraffe from all views.

Translate Constraint Keys

A useful tool when positioning control points is to hold down the "1", "2", "3", "4", "5" or "6" key to constrain the movement of the control point to a specific axis or direction.

- Hold down the "1", "2", or "3" key while dragging a control point to constrain it to the x, y, or z-axis.
- Hold down the "4" key while dragging a control point to constrain in to one of the splines that intersects it.
- Hold down the "5" key while dragging a control point to constrain it to the other spline that intersects it.
- Hold down the "6" key while dragging a control point to move it perpendicular to the surface.

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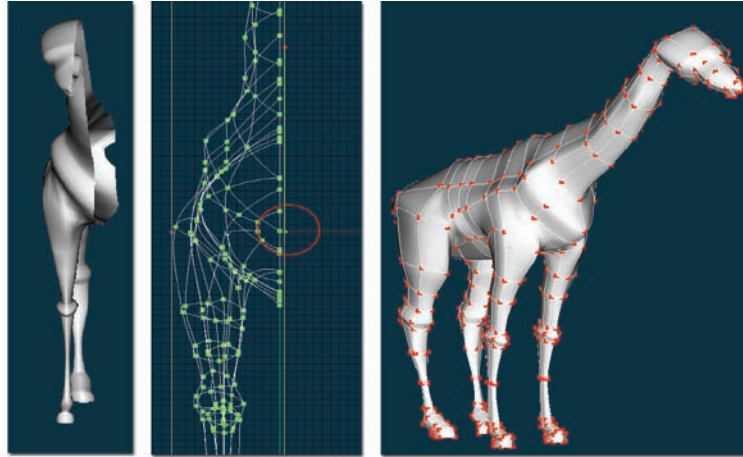
If your Hide button is still down, click it now to unhide anything that might be hidden. Next group half of the giraffe, including the center spline. Pick [Edit][Copy]. Now select the entire model and delete it. Finally, pick [Edit][Paste]. You should be left with the completed half of your model aligned on the y-axis.

COPY/FLIP/ATTACH

Next pick [Edit][Select All]. Then <shift> click one of the control points that make up the center spline. Click the Translate manipulator button so that the pivot of the group become visible. Position the pivot just to the right of the group as shown above, and then right click (<Control> click on the Mac) and pick[Copy/Flip/Attach]. You should now have both sides of your giraffe. Look over the model in shaded mode to see if all is well. (You might have to define some 5 point patches on the newly created side that bordered the center spline.)
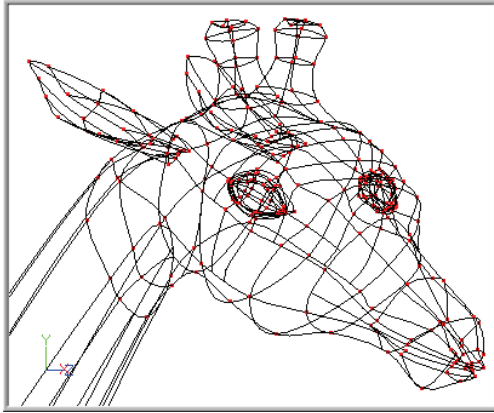
EARS/HORNS/TAIL

Using your modeling knowledge, add ears, horns and tail.

Now apply the rotoscope images as decals. Hide so only the left half of the model is visible before applying the "Side.TGA" image, then hide so only the right half of the model is visible and apply the same decal to the inside.

Apply the "TopSeam.TGA" image on the top of the model.
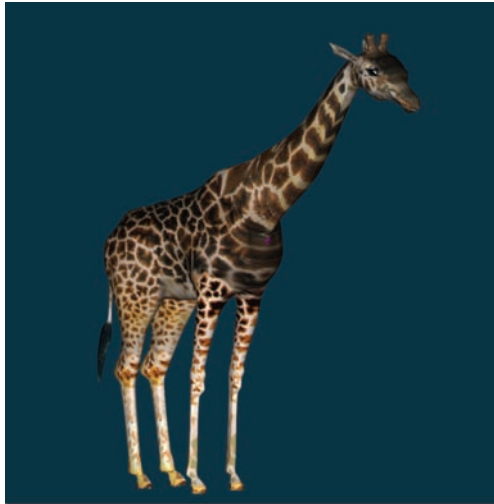
Set the model color and the roughness, as shown.
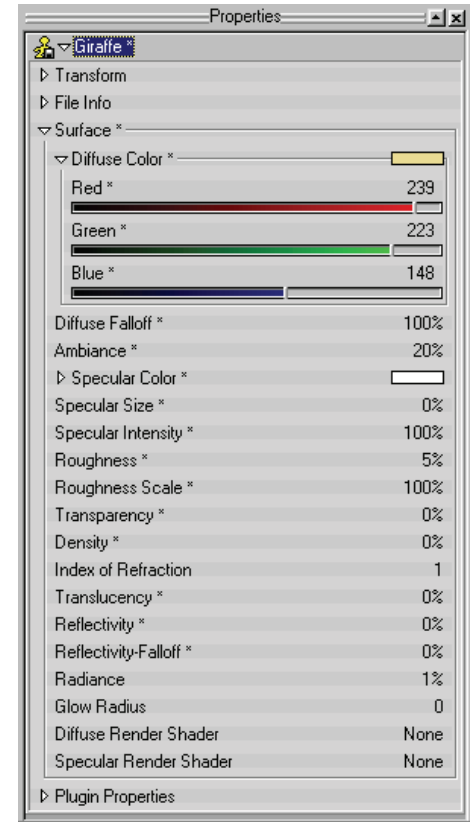
EXERCISE 11.5: MAKE A FACE
Completion time: Two Hours

Everyone wants to see themselves on the computer: why not you?

Start by having someone take digital pictures of your head; front and left side views, (the more megapixels your camera has, the better). Step back as far as you can get to take the picture, (as far away as possible then zoom onto the person's face to minimize perspective distortion). Transfer those pictures to your computer.

For this exercise, we'll be using pictures of a little boy named Cooper.

Pick [File][New][Model] from the Menu bar.

If the Project Workspace is not visible, pick [View][Project Workspace] from the Menu bar.

Right-click (<Control> click on the Mac) the model name in the Project Workspace and pick [Rename], then type the name of the person you are modeling. In this example, type "Cooper."

If you are not in the Front view, right-click in the Model window and pick [View][Front].

Are you in Shaded & Wireframe mode? If not, right-click in the Model window and pick [View][Render Mode][Shaded & Wireframe].

Right-click in the same window and pick [New][Rotoscope], then use the "Open Image/Animation" dialog to find the front view of the person. In this example, open "\Data\Tutorials\MakeFace\maps\CoopFront.jpg."

If the Properties dialog is not visible, pick [View][Properties] from the Menu bar.

If the ruler is not visible, click the Ruler button on the Modeling toolbar. If it is not set to centimeters, click the menu triangle in the upper-left corner of the top ruler and pick [Centimeters].

Click the image in the Front window and drag the lower-right corner of the image (while holding the <shift> key to keep the proportions the same) until the chin sits on the 'x' axis. And the top is at 22 centimeters. Now drag the image so that it is centered on "0" horizontally. Remember to measure the person's head you are modeling, and use their measurements.

You are going to model using two windows:

Pick [Window][New Window] from the Standard toolbar, then pick [Window][Tile Vertically]. If there more than two windows, close all but two Modeling windows and pick [Window][Tile Vertically] again.

Right-click in the window on the right and pick [View][Left].

Right-click in the same window and pick [New][Rotoscope], then find the side view of the person. In this example, open "\Data\Tutorials\MakeFace\maps\CoopLeft.jpg."

You will need to move and scale the "CoopLeft" image so that the head and mouth line up with the "CoopFront" image in the window next to it. To make this easier, you can mark the height with a marker by clicking and dragging in the ruler until the ruler lines up with the eyes.

Now that the images are positioned correctly, you want to make them un-pickable so that you do not accidentally move them. Click the "CoopFront" Rotoscope icon in the Project Workspace to see the image's properties. Turn off the Pickable option by clicking the little pointing hand icon, (a red cross should overlay the hand). Turn off the Pickable option for "CoopLeft" also.
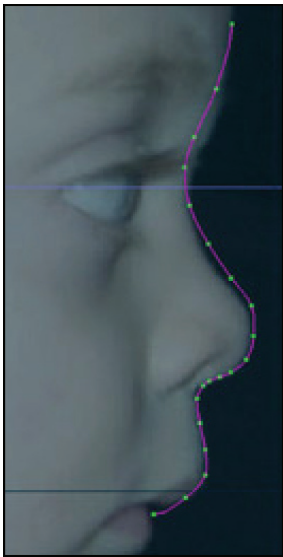
Click the Add button on the Modeling toolbar. In the Left window, make a spline following the profile as shown in Figure 1. (Right-click to stop adding).

With one of the control points selected, pick [Edit][Group Connected] from the Menu bar.

Figure 1

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Click the Extrude button on the Modeling toolbar.
In the Front window, move the grouped control points.
Repeat three more times.

Go back and forth between the two windows moving control
points to match the Front and Left images, as shown in Figure 2.

Figure 2
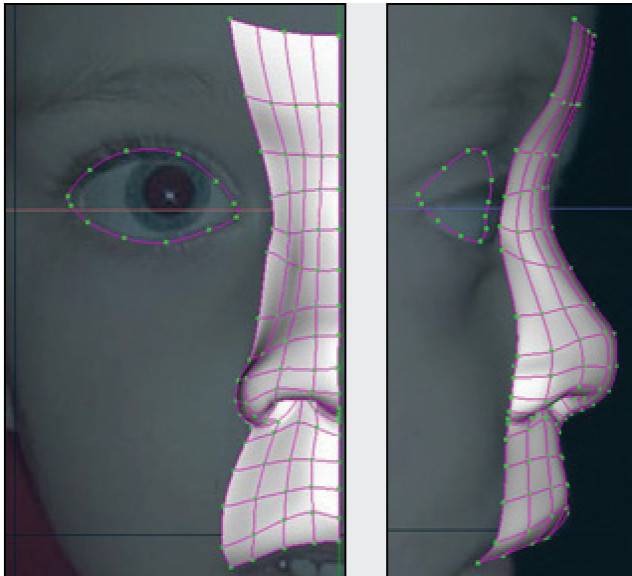
Create a spline ring around the eye, as shown in Figure 3.

Group the ring, extrude and scale three times.

Click the upper spline nearest the nose then click the Break
button on the Modeling toolbar. Similarly, break the lower
spline nearest the nose.

To connect new splines across to the nose, click the Add button
on the Modeling toolbar then click from one control point to
the other.

Figure 3

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Figure 4

Notice the 5-point areas near the nose, as shown in Figure 4. For the top area, press <shift> while clicking on each of the five points until the 5-Point Patch button on the Modeling toolbar highlights (indicating a valid 5-point patch), then click that button to create the 5-point patch. Similarly, create the bottom 5-point patch.

Add a spline for the bottom of the mouth then extrude it once to create a lower lip.

Continue to add splines around the brow and cheeks. Notice in Figure 5 how to use 5-point patches to tie the corner of the eye to the cheeks.
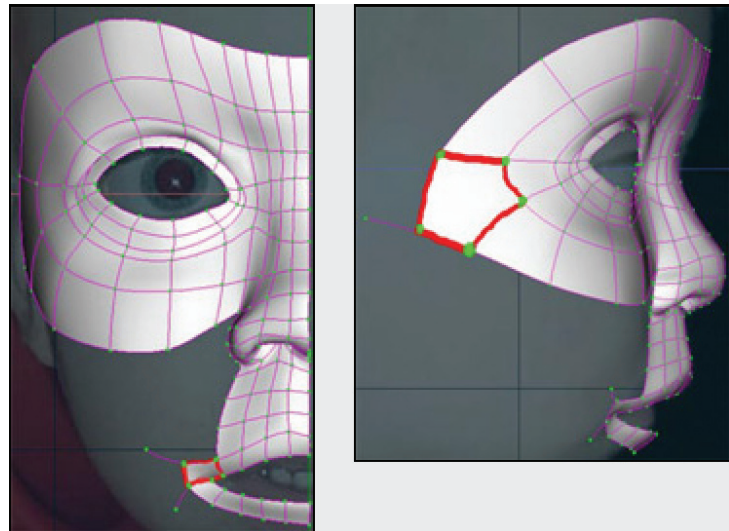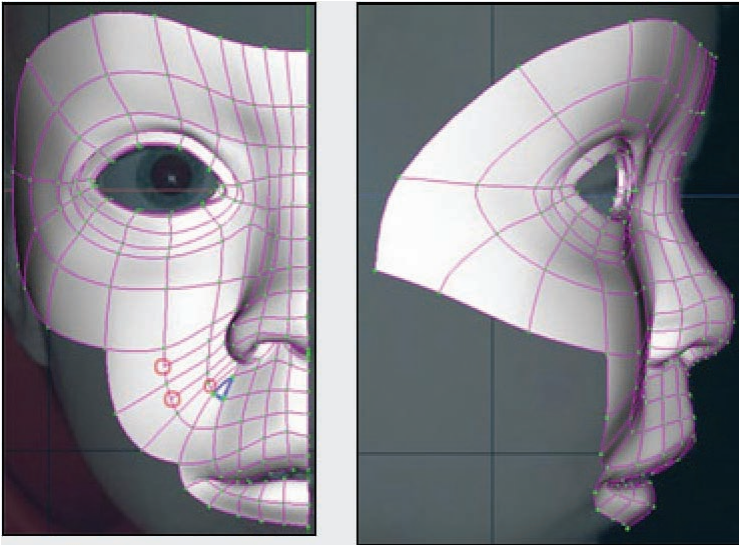
Figure 5

Figure 6

Add Hook splines as shown in Figure 6. To 'hook', add a dangling spline then drag the last control point over the spline you wish to hook to, then, while keeping the mouse button pressed, right-click.
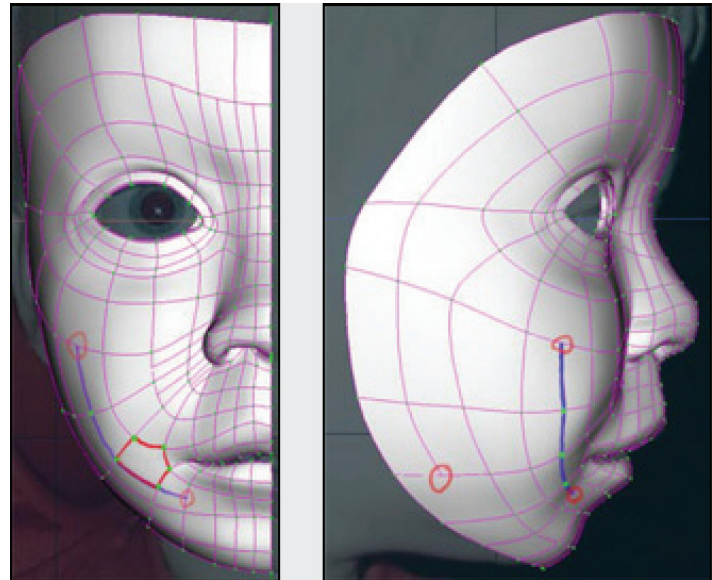
Add another 5-point patch and hook, as shown in Figure 7, and you are half way there because one side of the face can be copied, flipped and attached to create the other side.

Figure 7

To use the Copy/Flip/Attach tool, you must straighten the right edge of the existing model. To do this, first Bound Group the rightmost vertical spline. Click the Translate button on the Manipulator toolbar. Click on the center of the Pivot and drag it to line up vertically with the rightmost edge spline. Expand the "Scale" item in the Properties dialog (which will be showing the group's properties). Type "0" into the "X" axis. (The edge should become perfectly straight but not move).

Pick [Edit][Select All] from the Menu bar. All of the control points in the model will be grouped. Click the Translate button on the Manipulator toolbar, and again move the Pivot to line up vertically with the rightmost edge spline.

While pressing the <shift> key on the keyboard, click on any control point near the center of the straightened edge (this will select the direction of the flip). Right-click over the grouped selection then pick [Copy/Flip/Attach]. A full face should appear as in Figure 8.
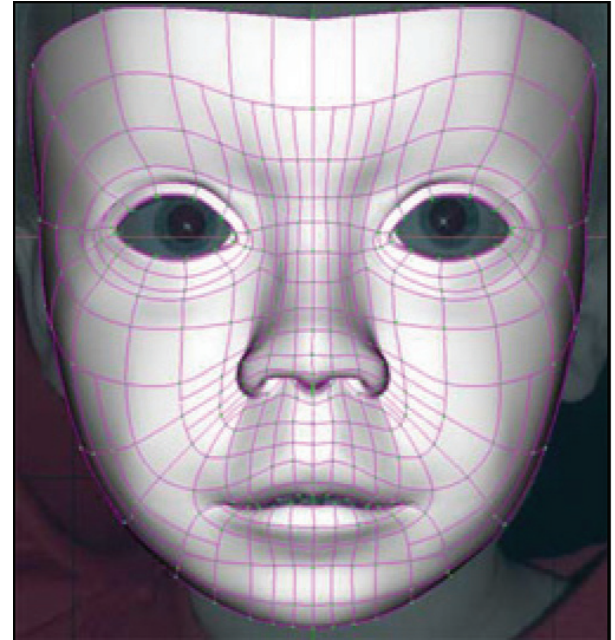
Figure 8

Right-click over the Front window and pick [New][Decal][CoopFront]. Move the image around and resize it to best cover the face model then right-click with the pointer over the image and pick [Apply].

For the additional tutorials on how to build your whole body, eyes, teeth, and skeleton, visit the Animation:Master forum at **http://www.hash.com/forums**

Special Thanks to Colin Freeman, and his son Cooper!

Created by Kevin Waldron

A and I   CDGKNRS TH Y and Z   F and V

E   W and Q

O   M B and P

U   L (sometimes like D or TH)
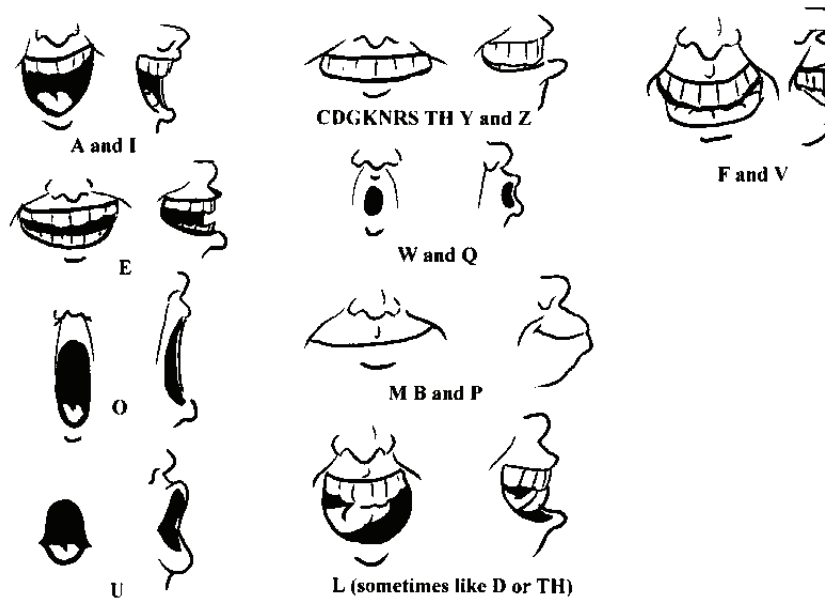
EXERCISE 12: LIP POSES
Completion time: One Hour

Poses are movements so common that they have a name, such as "smile" or "blink," and are the building blocks of animation. For example, there is a single adjustment for how much a character smiles even though many control points and bones need to move to make the lips curl correctly. Poses are ideal for creating mouth shapes for lip-syncing. Many characters use the "Preston" mouth poses because there are fewer phonemes, which make them easy. Animation done with mouth poses is reusable, so you can use it on all characters that have standard mouth poses.

| A I |
| E |
| O |
| U |
| M B P |
| F V |
| W Q |
| C D G K N R S TH Y Z |
| L |

The "Preston Set," named after the famous animator Preston Blair.

Pick [Project][New] to start a new, empty project.

In the Library, click the "Models" tab, double-click the "Actors" folder, then double-click on "Eddie". (A Modeling window will open. Close it.)

In the Project Workspace, under the "Objects" folder, right-click (<Control> click on a Mac) "Eddie", and pick [New][Pose][Percentage]. (A new Relationship window will open).
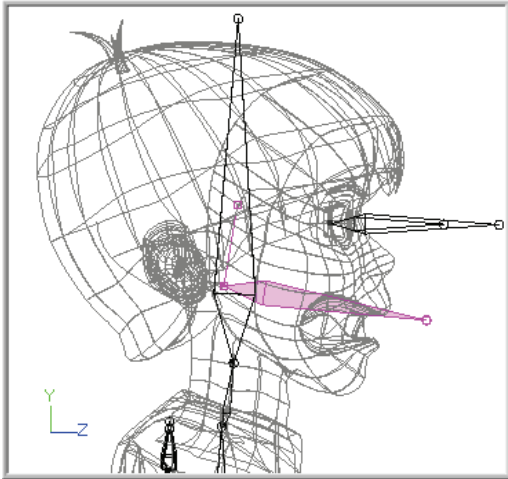
Figure 1

Switch to the Left view and bound Zoom his face.

Rotate the "Jaw" bone so that the mouth is open as shown in Figure 1.

Click the Muscle button on the Mode toolbar.

Group the mouth and jaw area, and click the Hide button.
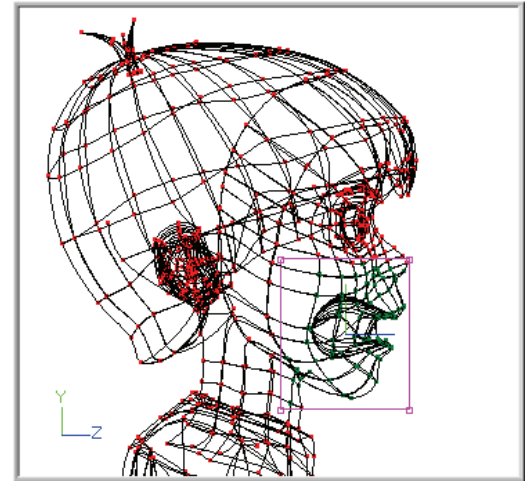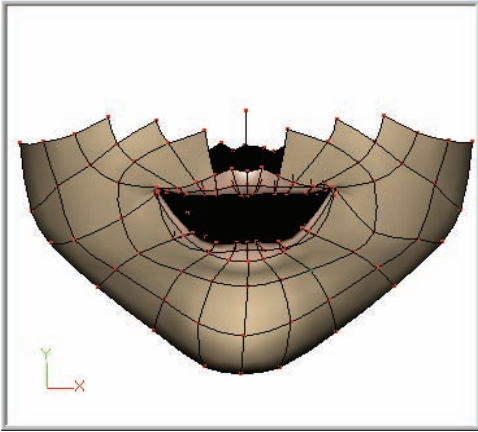
A I Lip Pose

Switch to the Front view and Bound zoom the mouth area. Change the drawing mode to "Shaded with Wireframe" so you can see the model's surface more clearly. Move the control points at the sides of the mouth to make the "A I" shape.

Right-click (<Control> click on the Mac) on "Pose" in the Pose Sliders and pick [Rename]. Change "Pose" to "A I." (It is important to use the standard phoneme pose names so that the Dopesheet phoneme lookup works correctly, so don't forget the space between "A" and "I").
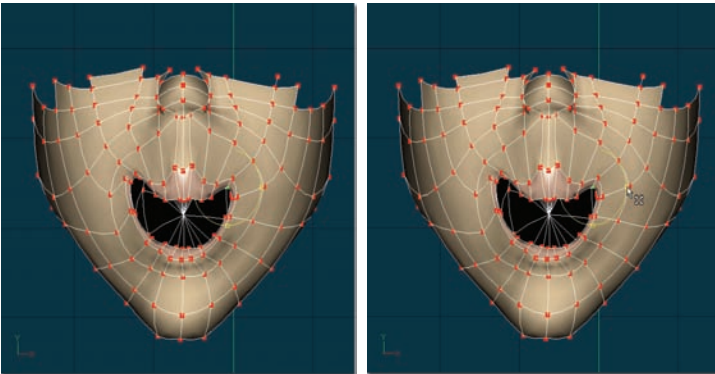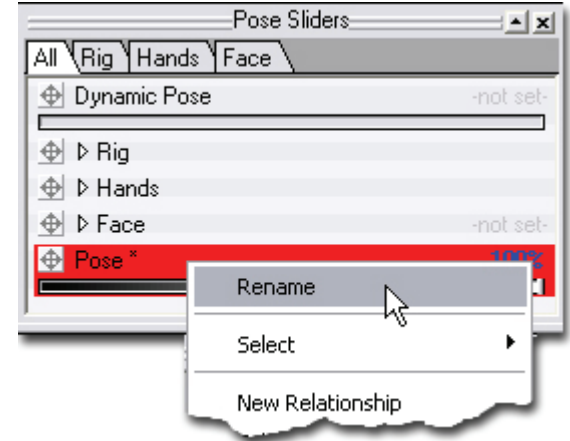
MAGNET MODE

When creating lip shapes it is useful to use the Magnet Mode on the Manipulator toolbar. When a control point is selected a round influence circle will appear. Clicking and dragging one of the knobs on the circle will change the influence region. When a control point is moved, any point within this circle will move also, but the amount it moves is determined by how far away it is from the selected control point. The influence circle actually represents a 3D sphere, so all points in any direction within the sphere will get effected.

Notice that the Pose Slider percentage indicates 100%. This is the percentage of the pose you are defining. You can make other keyframes at different percentages by moving the slider to the desired percentage and then adjusting the model in the Relationship window.

When you have finished editing the pose, close the Relationship window.
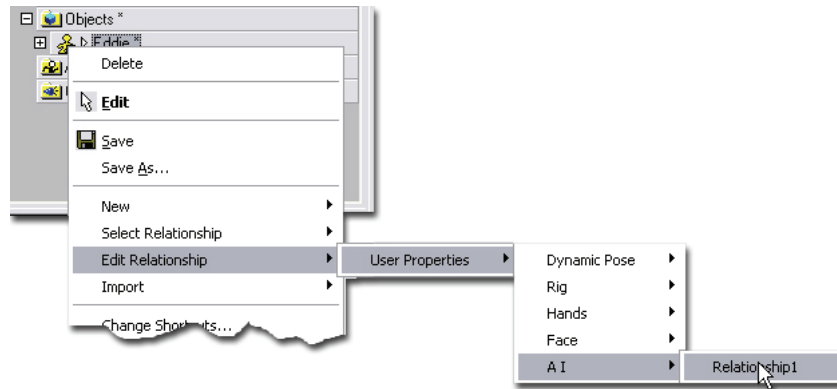
Hints: To edit the pose you created, right-click (<Control> click on the Mac) on Eddie in the Project Workspace and pick [Edit Relationship] [User Properties] [A I] [Relationship 1].
All poses are saved with the model, so in order to save the pose you just made, you would need to save the model to your hard drive, (not the CD-ROM), but in this case, since the poses already exist for Eddie, this is not necessary.

Created by Eugene Liscio

EXERCISE 13: SHOW SOME BACKBONE (ADDING A SKELETON)
Completion time: Two Hours

To take full advantage of Animation:Master, your characters should use a standard skeleton. This will allow you to use the libraries of reusable motion, and add to it as you create more animation.

In the Library, click the "Models" tab, double-click the "Tutorials" folder, then double-click "BonelessThom". Next click the "Up" button in the Library, double click the "Skeletal Rigs" folder, then double-click the "2001 Skeleton". Close the "2001 Skeleton.mdl" window.

Since you will be modifying BonelessThom from the CD-ROM, save him to your hard-drive first. Right-click (<Control> click on the Mac) on BonelessThom in the Project Workspace and pick [Save As…]. Choose a location on your hard-drive and click "Save". (If the Project Workspace is not visible, pick [View][Project Workspace].)

Click the "+" next to the "2001 Skeleton" icon in the Project Workspace to expand the model, then expand "Bones" so that the "Root" is visible.
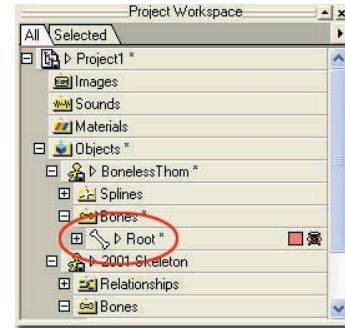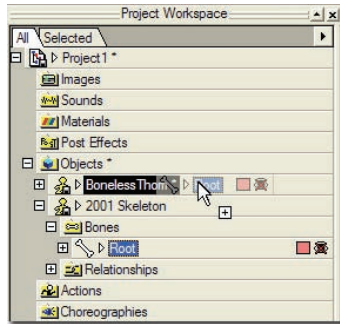
Click-and-Drag the "Root" bone from the "2001 Skeleton" model to the "BonelessThom" model in the Project Workspace as shown above. After completing this step you can crack open the BonelessThom model and notice that it now has the "Root" bone and all of its children bones.
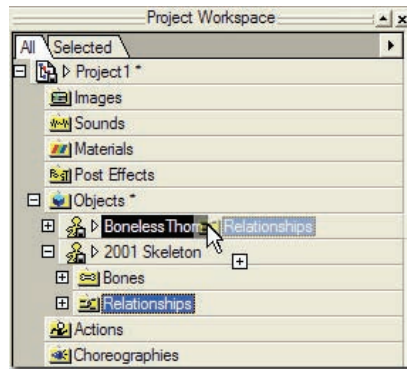
Click-and-Drag the "Relationships" folder under the "2001 Skeleton", and drop in on the "BonelessThom" model. Now, "BonelessThom" should also have a Relationships Folder.

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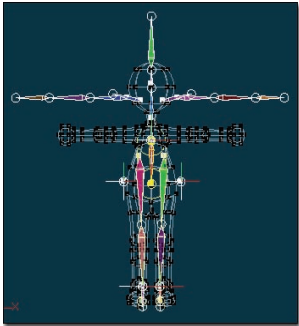
 Click the Bones mode button on the Mode toolbar.

Click on the "Root" bone in the Project Workspace.

 Click the Scale Manipulator button on the Manipulator toolbar.
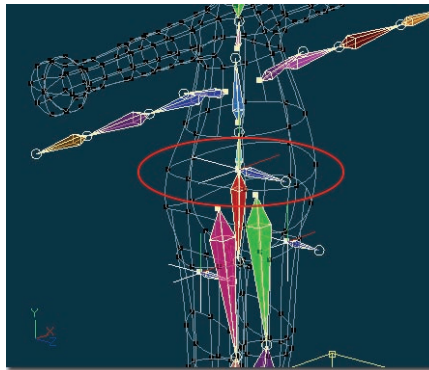
Figure 1
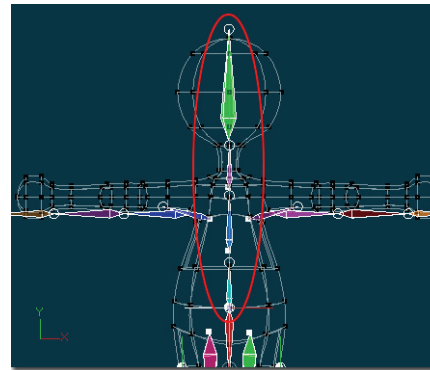
Figure 2

Scale using the corner of the manipulator to scale the whole skeleton in the X, Y and Z-axis until the "Hips" null matches Figure 1 (center of first ring above where leg hooks end). This is important because it scales many hidden bones that make up how the skeleton behaves when you animate.

Using the Scale manipulator again, scale the "Back" bone, (this will scale Back2, Neck, Head and Arm bones as well) to match Figure 2. Whenever you move a bone to match the skeleton to your model, be sure and use the Translate, Scale, or Rotate manipulators so it and its children are moved also.
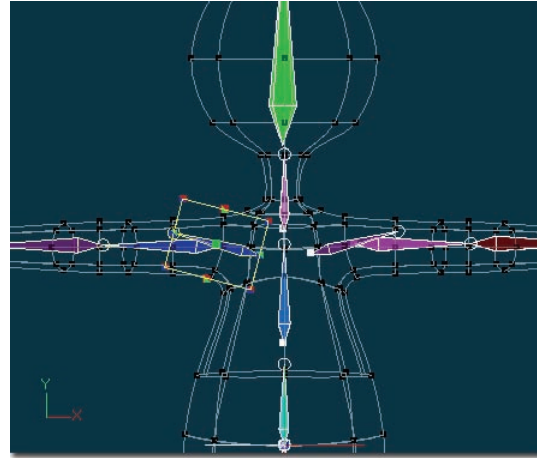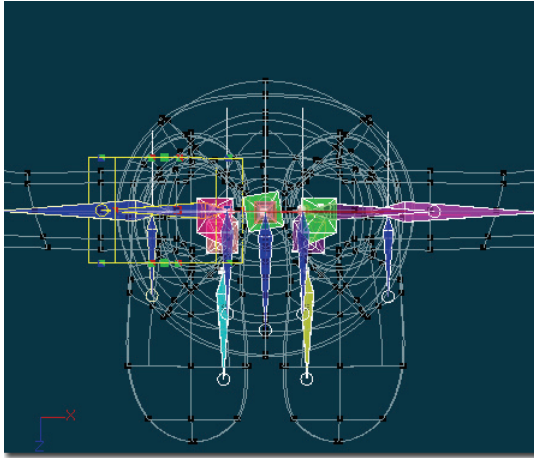
With the Translate Manipulator, translate the shoulder bones so the bicep is at the center of the arm, and the base of the Shoulder bone is at a valid spot for the shoulder to rotate around. (Make sure that the Shoulder bone is in the center of the arm from the top view also.)
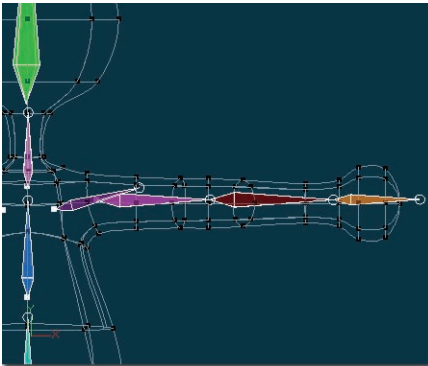
Again, using the Translate manipulator, translate the Bicep bones to a valid spot for the arm to rotate around. With the Scale manipulator, scale the bicep bones so they end at the elbow. Use the Scale manipulator on the forearm bones so they end at the wrist. If you need to, scale the hand bones so they end just past the end of the hand.
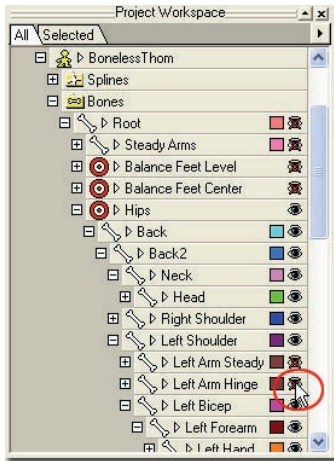
Figure 1
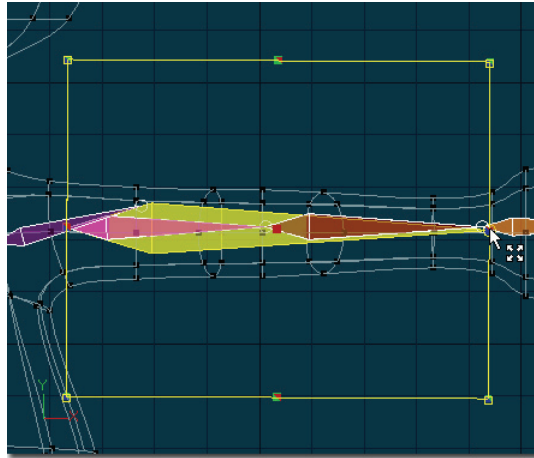
In the Project Workspace, expand the necessary items as indicated in Figure 1, select the "Arm Hinge" bones and make them visible. Using the Translate manipulator, translate it to start at the same place as the Bicep. Using the Scale manipulator, scale it so that it ends on the wrist. Hide them again.

With the Translate manipulator, move the Thigh bones to a valid spot for them to rotate. Sometimes you'll have to scale the thigh and calf bones to match the geometry. Translate the toes to where they should rotate.
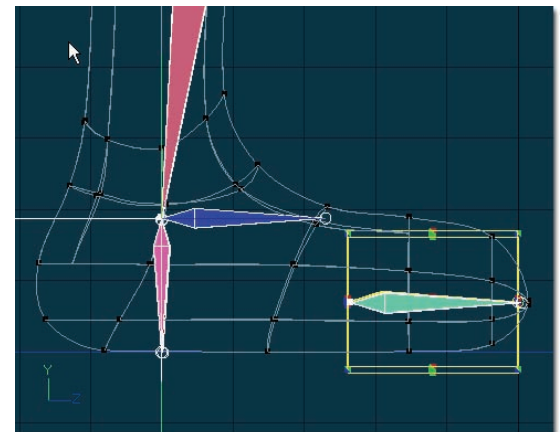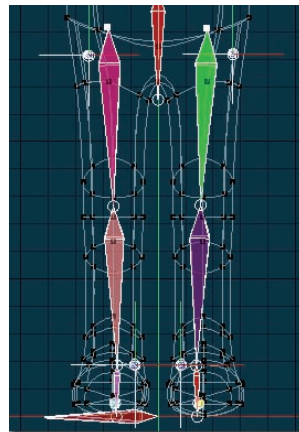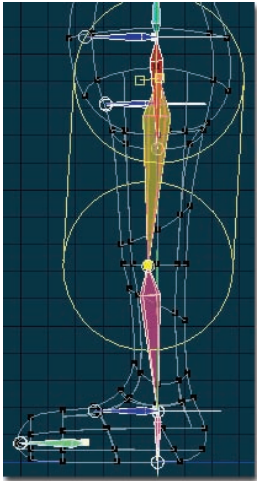
Figure 1
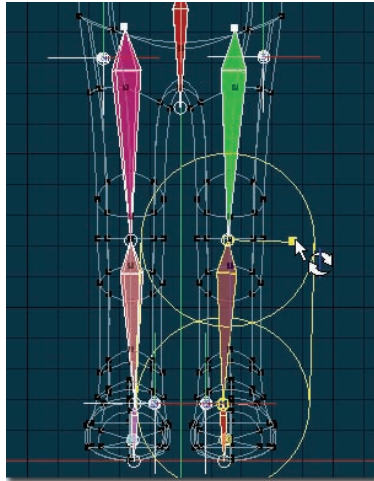
Figure 2

Ensure that from the side view the leg bones are in the center of the knee as shown in Figure 1. From the Front view, rotate the Thigh, Calf, and Foot bones roll handles so that they are pointing straight out to the side as shown in Figure 2. The easiest way to ensure this is to just click and drag the roll handle out to the side as far as it will go.

Unhide the Left and Right Leg Hinge bones as shown in Figure 1. Translate and Scale the Leg Hinge bones to match the legs from the start of the thigh to the ankle as shown in Figure 2. Hide the bones again after you finished positioning them.
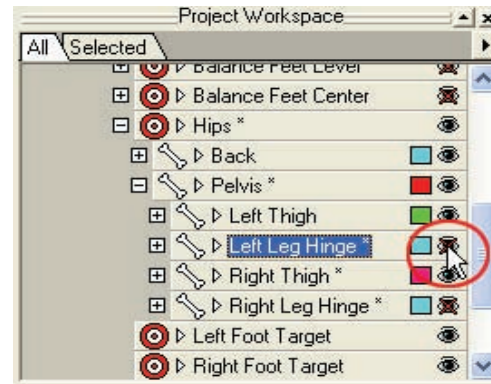
Figure 1
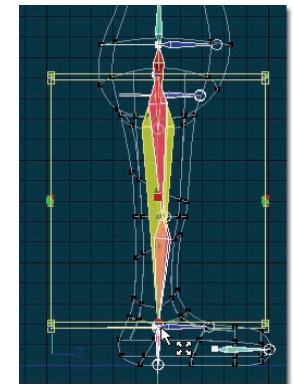
Figure 2
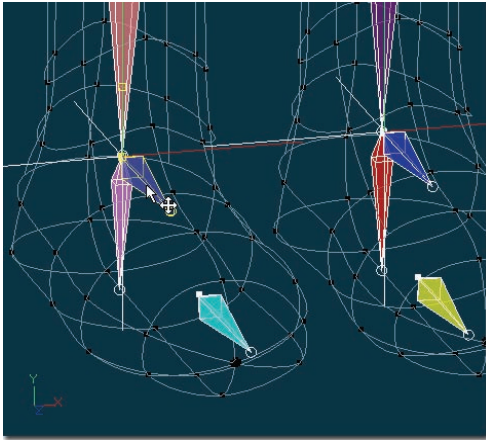
Figure 1

Figure 2

Figure 3

Translate Feet Targets to the ankles as shown in Figure 1.
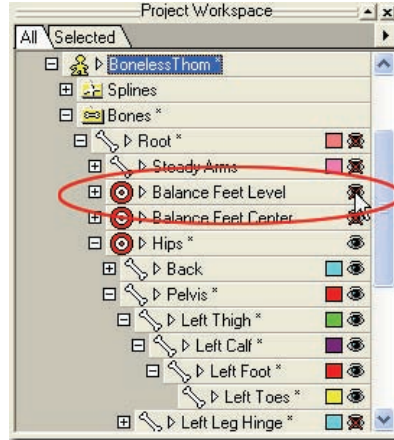
Select the "Balance Feet Level" Null in the Project Workspace and <shift> click the visible icon to show it and its children; see Figure 2.

Move the Balance Feet, Balance Base, Balance Point, Balance Base Rigid, and Balance Point Rigid bones (Figure 3 & Figure 4) to line up with the ankles and hips from the Front view only; see Figure 5.
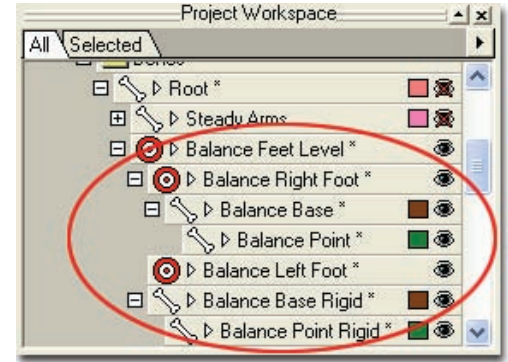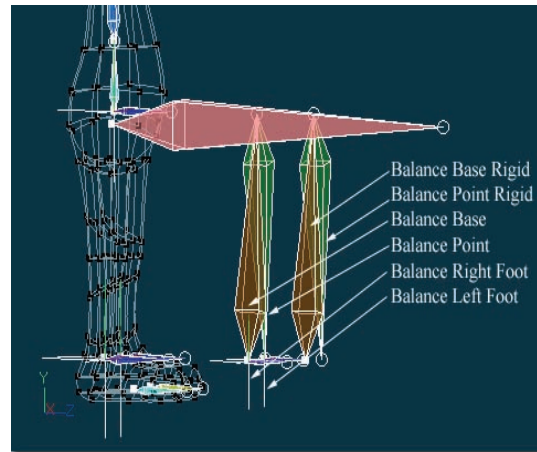
Figure 4
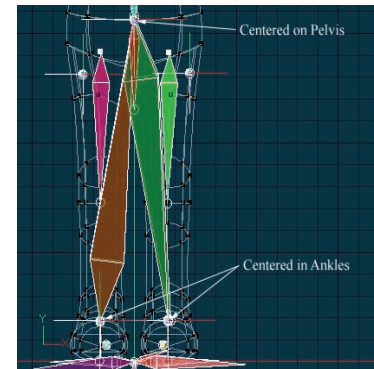
Figure 5

<Shift>click the "Balance Feet Level" visible icon again to re-hide these bones.

At this point, only the following bones should be visible:

-Hips	**-Right and Left Shoulder**	**-Right and Left Toes**
-Back	**-Right and Left Hand Target**	**-Right and Left Foot Target**
-Back2	**-Right and Left Bicep**	**-Right and Left Knee**
-Neck	**-Right and Left Forearm**	
-Head	**-Right and Left Hand**	
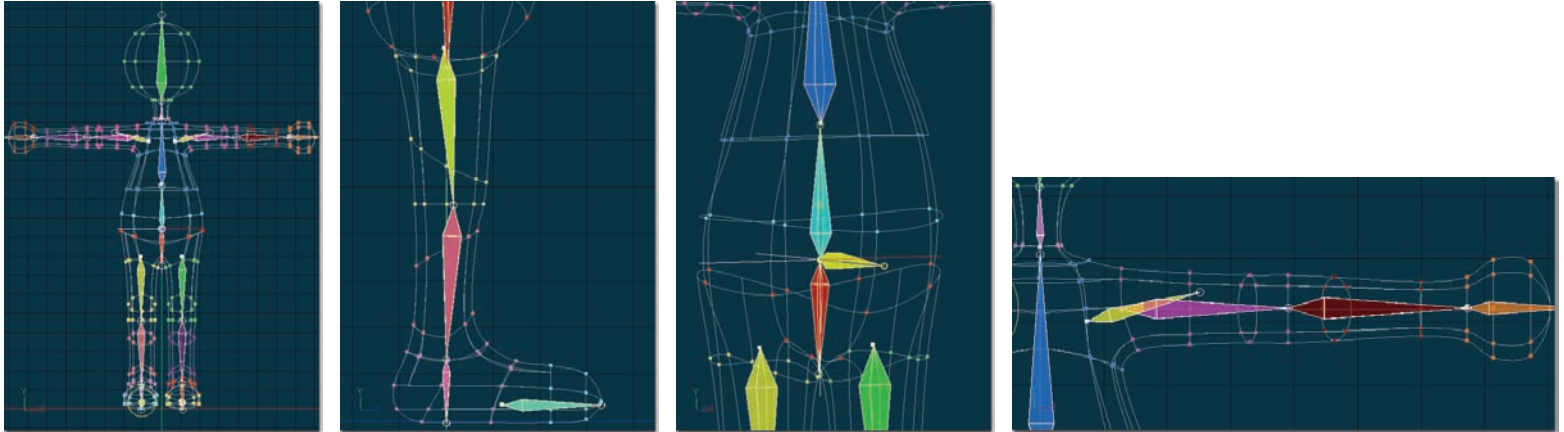
Assign the control points to the visible bones as shown above. Note that the Shoulder bones do NOT have any control points assigned to them. (Most characters will also need to have the finger bones assigned as well). To assign control points to bones, simply select the bone then group the control points you wish to assign. The control points will change to the color of the bone they are assigned to.

After all control points have been assigned to their respective bones, right-click (<Control> click on the Mac) and pick [View] [Render Mode] [Shaded] to see a shaded representation on how the bones will effect the model, as seen in Figure 1.
Create smartskin for all of the joints, especially for the armpits and knees.
(You learned this in the "Flower Power" tutorial.)

Note: Change mode to Modeling mode and hide control points to make it easier to assign control points to bones. Change back to Bones mode after the desired control points are hidden.
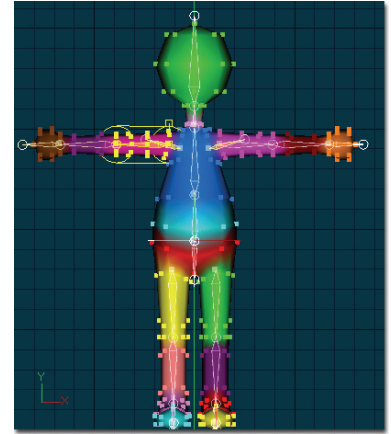
Pick [File][New][Action]. Choose "BonelessThom" from the "Choose A Model To Use" dialog. Pick [Window] [Tile Vertically] to position the two windows side by side.

Click in the Action window to make it active.

Pick [View][Pose Sliders] if it is not already visible.

Turn "ON" the "IK Arms Setup" in the "Rig\Setup" property in the Pose Sliders.

In the Bones window move the Hand Targets until the arms are naturally at Thom's side in the Action window. (Press <Shift>+<Space> to see the Action window update without switching to it.)
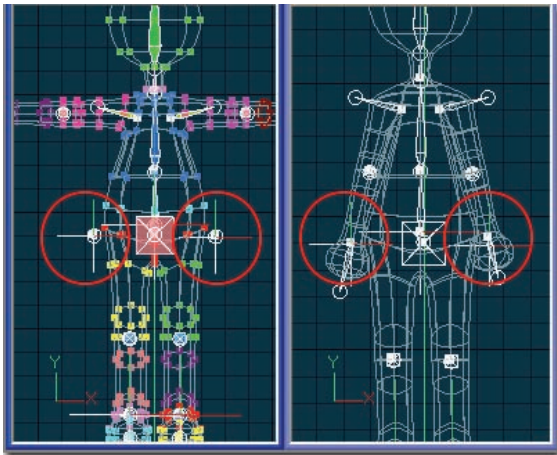
Bone Window   **Action Window**

Thom's hands should be almost touching his hips and his elbows should be just slightly bent to the rear.

This should finish putting the 2001 Skeleton Rig into Thom. From the Library, click the "Action" tab, double-click the "Walk Cycles" folder, then double-click "Resolute Walk" to test your work.
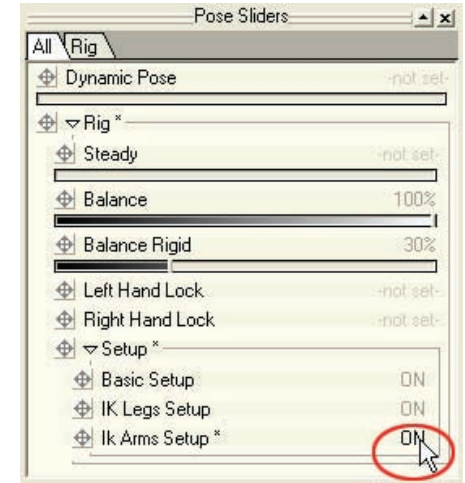
Technical Directors Training

WHAT IS A TD?
Computers and 3D programs in particular, have added a level of arcanery to the artistic process. The need to know about "megabytes," and "preferences," and "naming conventions" can easily overwhelm a storyteller's creative urge. At first, those hardy few who could wear both hats – artists and technical savants drove the 3D industry, and it is their work that is most prevalent. Large studio facilities that could afford to have two people working together – an artist and a software technician called a "Technical Director," were the most successful at minimizing the stifling effect of computers on great art. As the 3D market matures, software usability must be improved by 3D programmers focusing more on the artist and less on the feature set, but skeletal setups, particle systems, and material combiners still need to be understood, so the ambitious artist needs to learn these things.

Just as all artists are not technicians, all technicians are not artists, but they both have the same goal – to tell stories. Find out which you can be strongest in, then specialize. Artists, you study lip-syncing and animation timing. Budding technical directors should know all of Animation:Master's features, the advantages of the different skeletons, and how to input and record audio and video. Eventually, each camp will inherit from the other through osmosis, and the symbiosis will be stronger for it.

Created by Reiko Weidtland
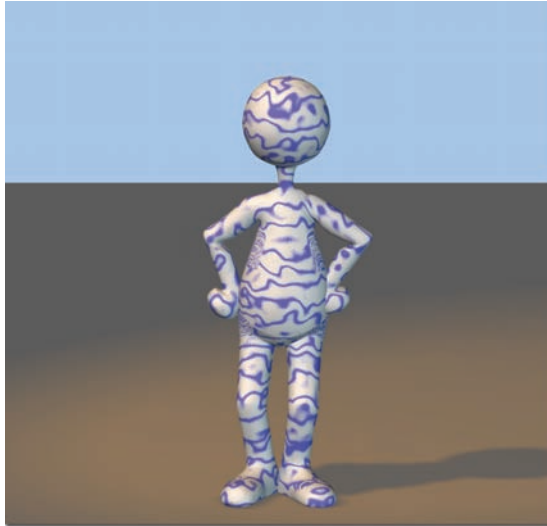
EXERCISE 14: PLAYING MARBLE (MATERIALS)
Completion time: 20 Minutes

Pick [Project][New] to start a new, empty project.

Pick [File][New][Material]. A material will appear in the "Materials" folder of the Project Workspace, and a Material window will open.

Rename "Material1" to "Marble" in the Project Workspace.

Right-click (<Control> click on a Mac) on "Attribute" under the Marble material in the Project Workspace. Pick [Change Type To][Combiner][Spherical].
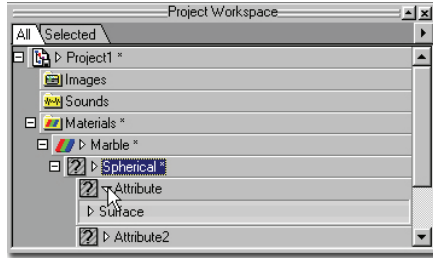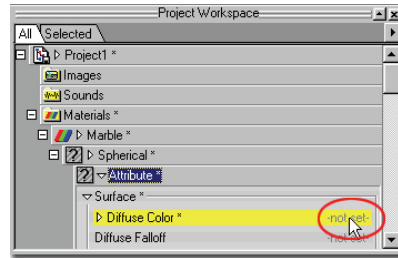
Figure 1   **Figure 2**

Click the "+" next to "Spherical" to see its children. Expand the properties of the first "Attribute" under the spherical combiner by clicking the white triangle to the left of its name as shown in Figure 1. (Remember to check on "show properties triangles" in the Tools/Options Menu, global tab.)

Expand "Surface" from the "Attribute Properties." Click the"-not set-" on the Diffuse Color property as shown in Figure 2. A color palette will open. Select white and then click OK.

Click "Attribute2." Change its surface's Diffuse Color property to blue.

The Material window will display what your current marble material looks like (See Figure 3.)
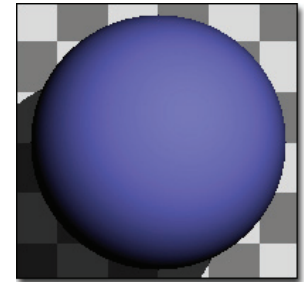
Figure 3

A spherical combiner works on alternating shells of color, starting with Attribute for the first layer, then Attribute2 for the second layer, then back to the first Attribute again for the third layer and so on.
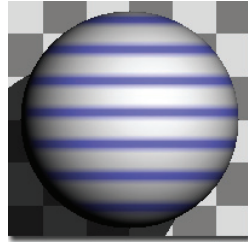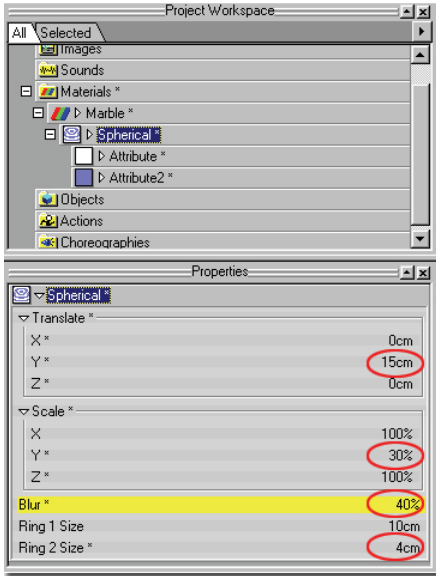
Click the "Spherical" icon in the Project Workspace.

On the "Spherical Properties", set the "Translate Y" values to "15." This will move the starting point of the rings away from the center of the sphere on the y-axis by 15 centimeters.

To make the rings mimic non-uniform layers of rock, set the Y "Scale" component to "30%."
To make the dark layer thinner, set "Ring 2 Size" to "4."
Set "Blur" to "40," which blends the edges between the blue and white layers.

To mix the layers together, right-click on the "Spherical" icon and pick [Add Turbulence][Fractal Sum]
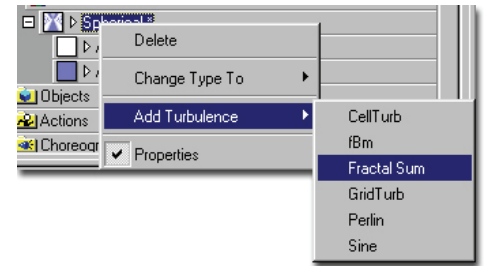
Set the three "Scale" values to "300," and Amplitude to "300."
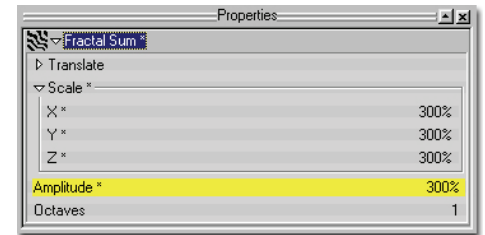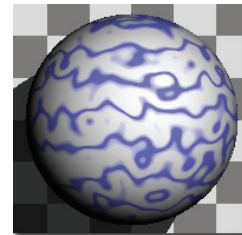
You can now drag-and-drop the "Marble" material onto any model or group you want.

In the Library, click the "Models" tab, double-click the "Props" folder, double-click the "Bottles and Vases" folder, then double-click the "Wine Bottle".

Drag the Marble material into the Wine Bottle window from the Project Workspace.
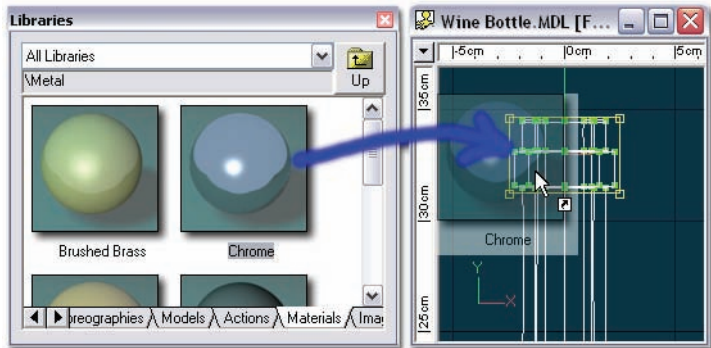
Group the top of the bottle. In the Library, click the "Materials" tab, then double-click the "Metal" folder, then drag the "Chrome" material onto the group on the top of the bottle as shown.

Render the bottle in the window to see the Marble and Chrome material.

EXERCISE 15: EAT MY DUST (VOLUMETRICS)
Completion time: 45 Minutes

Volumetric Dust effects can be used to simulate anything from morning mist rising from a hillside to puffs of dust caused by a character's footfall.

Pick [Project][New] to start a new, empty project.

In the Library, click the "Models" tab, double-click the "Actors" folder, then double-click "Knight" to add him to the project. Close the modeling window.

In the Library, click the "Actions" tab, double-click the "Walk Cycles" folder, then double-click "Resolute Walk".

Right-click (<Control> click on a Mac) in an empty part of the Action window and pick [New][Volumetric Effect][Dust].

Since you are changing the "Resolute Walk" action, which resides on your CD-ROM, you should save it to your local hard drive first. Right-click (<Control> click on the Mac) the "Resolute Walk" action in the Project Workspace and pick [Save As…]. Pick a location and filename, and then click the Save button.
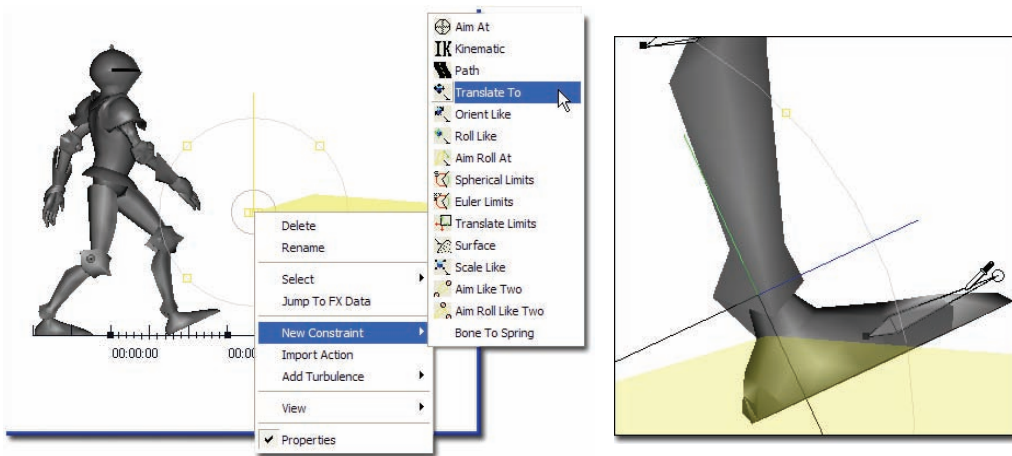
Switch to the Left view. Right-click the circle of the volumetric effect and pick [New Constraint][Translate To].

The picker cursor will be active.

Move the cursor over the "Left Toes" bone and select it. You will see it set the target in the "Translate To Left Toes" properties.

The objective is to have the dust appear when a foot hits the ground, then dissipate before the next foot hits. Using the Next Frame button on the Frame toolbar, click through the frames. Notice on what frame each foot touches the ground, in this case frame "00:00:00" for the left foot and frame "00:00:15" for the right foot.

Go to frame "00:00:00." If the "Translate To Left Toes" is not already selected, right-click (<Control> click on the Mac), the "Dust1" sphere and pick [Select][Constraint][Driver / Translate To Left Toes] to see the constraint's properties.
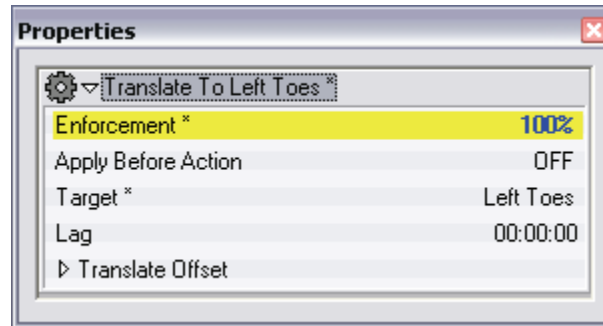
In the "Translate To Left Toes" constraint Properties, set "Enforcement" to "100." It is important to actually type in 100% and press <enter>, even though it might already say 100%. This will cause a keyframe to be inserted at frame "00:00:00."

Go to frame "00:00:15" and set "Enforcement" to "0."

Select the "Dust1" sphere in the Action window and add another "Translate To" constraint and pick the "Right Toes."

On frame "00:00:00," set "Enforcement" to "0," on "Translate To Right Toes" and on frame "00:00:15" set "Enforcement" to "100." The dust will now travel first with the left foot then the right foot.

If the Timeline is not already open, pick the [View][Timeline] menu.
If you select the Enforcement property for either the "Translate To Left Toes" or the "Translate To Right Toes" constraint, you will see the keyframes you just added. If you have forgotten how to select the Enforcement property, right-click (<Control> click on the Mac), the "Dust1" sphere and pick [Select][Constraint][Driver / Translate To Left Toes] to bring up the constraint's properties in the Properties.

Pick [Tools][Options]. Make sure that the "Unit of measurement" is set to Centimeters on the Units tab. Click OK.

Click the "Dust1" sphere in the Action window or in the Project Workspace.

Go back to frame "00:00:00." Set "Fall-Off" to "0cm" in the Properties.
On frame "00:00:02," set "Fall-Off" to "30cm."
On frame "00:00:10," set "Fall-Off" to "0cm."
On frame "00:00:15," set "Fall-Off" to "0cm," (even though it is already 0, "0" must be typed in to set a keyframe).
On frame "00:00:17," set "Fall-Off" to "30cm."
On frame "00:00:25," set "Fall-Off" to "0cm."
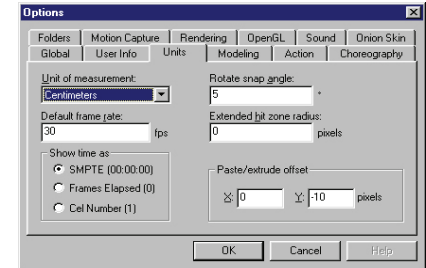
Render your animation to see the dust when the knight's foot strikes the ground!

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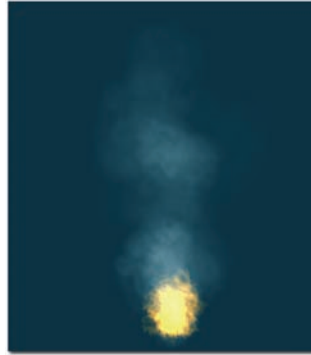
EXERCISE 16: SMOKE, WIND AND FIRE (PARTICLE SPRITES)
Completion time: 30 minutes

Everyone wants to make burning fire, bellowing smoke, sparkling twinkles, and massive explosions. The simplest and best solution is to use a particle system that emits thousands of little pictures that by following the laws of physics look like fire, smoke, or the like. What really makes this process powerful is that once you have made a fire, you can use it many times, and in other animations as well, simply by drag-and-dropping it into your scene.
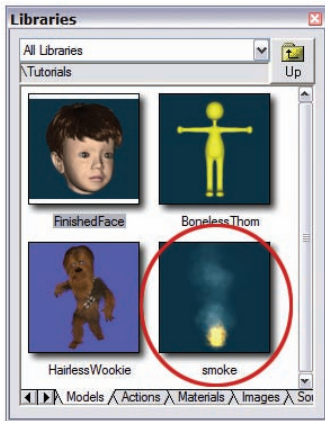
Pick [Project][New] from the Menu bar to start with a new, empty project.
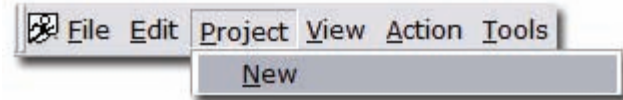
In the Library, click the "Models" tab, double-click the "Tutorials" folder, double-click on "smoke" Close the model window.

You will be creating a particle system material that consists of three images called sprites.

If the Project Workspace window is not already visible, pick [View][Project Workspace] from the Menu bar.

Pick [File][New][Material] from the Menu bar. Close the Material window.

Right-click (Control-click on the Mac) on the new material and pick [Rename]. Type 'Fire'
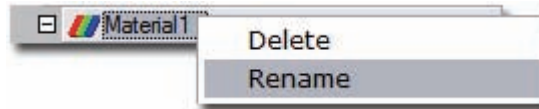
Drag-and-drop the "Fire" Material onto the smoke model in the Project Workspace.
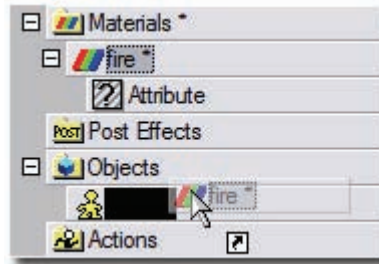
Pick [File][New][Action] from the Menu bar.
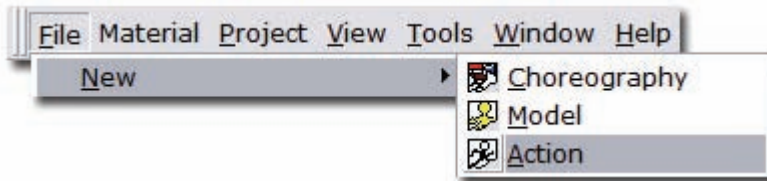
An Action Window will appear. Resize the window, and zoom out, so the emitter is positioned in the window like Figure 1.

Figure 1

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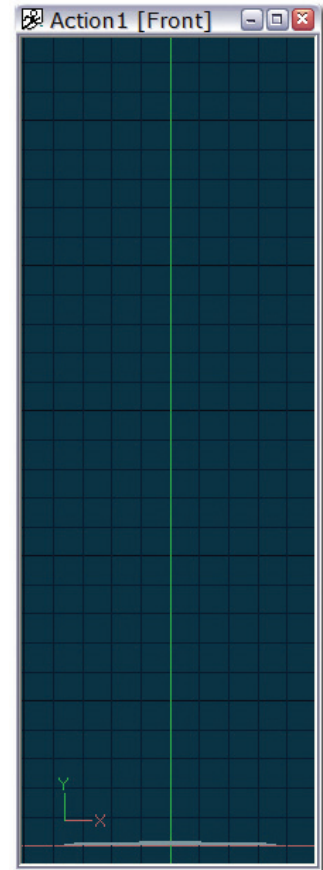
Pick [Tools][Options][Rendering] from the Menu bar.
Turn on "Advanced". Make sure "Draw Particles/Fur" is "ON".
Turn off "Advanced", close the dialog.

Right-click on the "Attribute"
under the "Fire" Material in the Project Workspace,
and pick [Change Type To][Particle System][Sprites].
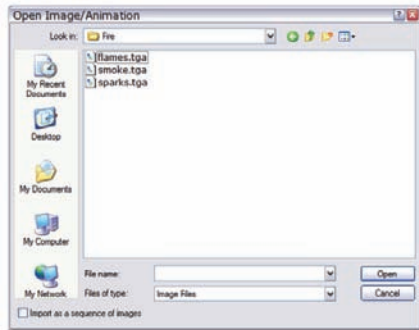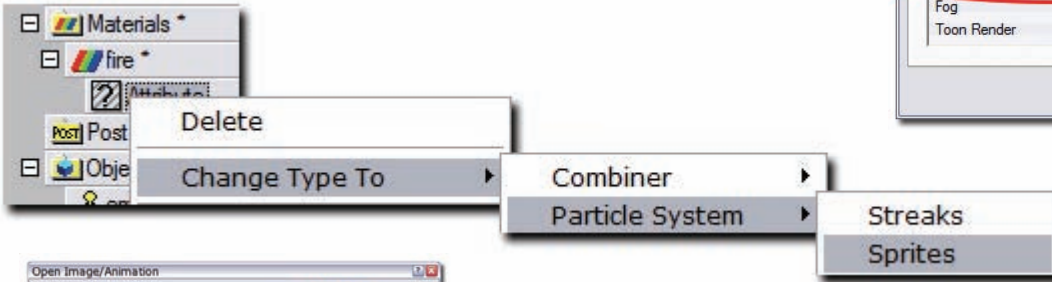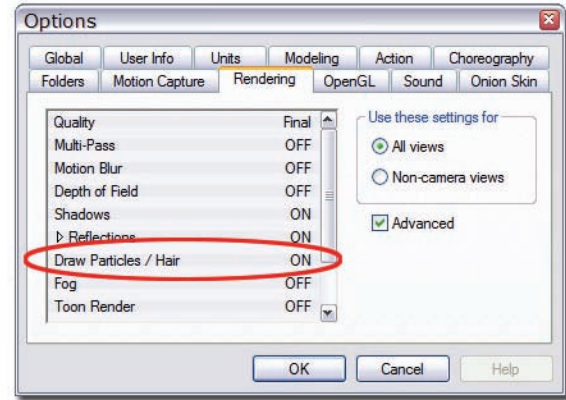
The 'Open Image/Animation' dialog will appear.
Browse to \Data\Tutorials\Fire\ and choose "smoke.tga".
Rename the "Sprite Emitter" to "smoke".

Right-click on the "Sprite System" and pick [Insert Sprite Emitter][Other]. Browse to \Data\Tutorials\Fire\ and pick "flames.tga". Repeat and pick "sparks.tga".
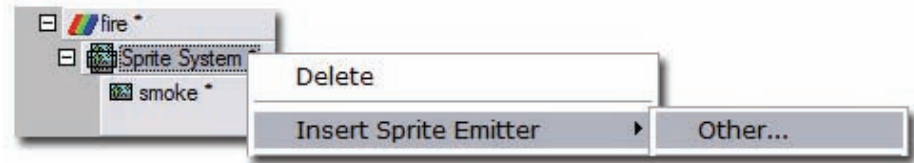
Pick [View][Properties] from the Menu bar. You may want to drag the Properties Window next to the Project Workspace instead of beneath it, and resize it so it is long and narrow.
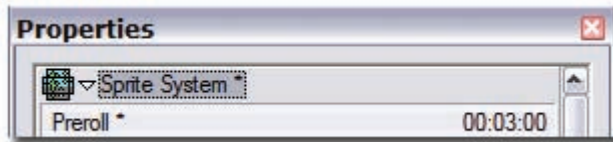
Click on the 'Sprite System' to select it. On the properties panel, set 'Preroll' to "00:03:00". This will make the particles show up immediately.

Right-click in the Action window and pick [View][RenderMode][Shaded]. Your window should look like Figure 2. The emitter is 100% transparent, so you will not see it, only the particle sprites that are being emitted from it. At the moment, all the sprite images are stacked on top of each other.

Figure 2

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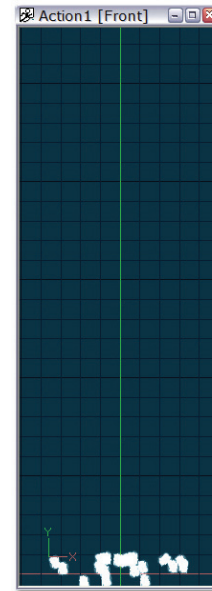
Set each emitter's properties:

Properties	smoke
Image *	smoke
Random Seed	0
▽ Life *	00:03:00
Variation *	80%
▽ Rate of Emission *	15
Variation *	40%
Max Distance Per Emit	-not set-
▽ Initial Velocity *	100
Variation *	25%
▽ Drag *	0%
Variation	0%
Over Life	100%
▽ Color Method	Over Life
▷ Color	
Additive Color	ON
▽ Opacity *	20%
Variation *	30%
Over Life	100%
▽ Size *	40cm
Variation *	30%
Over Life	100%
▽ Gravitational Affect *	0%
Variation	0%
Over Life	100%
▽ Angle Method *	Align To Motion
Angle	0°
Variation	0°
▽ Spin *	15°
Variation *	50°
Over Life	100%

Properties	flames
▷ Image *	flames
Random Seed	0
▽ Life *	00:00:10
Variation *	90%
▽ Rate of Emission *	600
Variation	0%
Max Distance Per Emit	-not set-
▽ Initial Velocity *	100
Variation *	60%
▽ Drag *	0%
Variation	0%
Over Life	100%
▽ Color Method *	Over Life
▷ Color *	
Additive Color *	ON
▽ Opacity *	40%
Variation *	50%
Over Life	100%
▽ Size *	20cm
Variation *	90%
Over Life	100%
▽ Gravitational Affect *	0%
Variation	0%
Over Life	100%
▽ Angle Method *	Align To Motion
Angle *	20°
Variation *	50°
▽ Spin *	15°
Variation *	80°
Over Life	100%

Properties	sparks
▷ Image *	sparks
Random Seed	0
▽ Life *	00:02:00
Variation	0%
▽ Rate of Emission *	10
Variation	0%
Max Distance Per Emit	-not set-
▽ Initial Velocity	100
Variation	0%
▽ Drag *	0%
Variation	0%
Over Life	100%
▽ Color Method *	Over Life
▷ Color *	
Additive Color	ON
▽ Opacity *	100%
Variation *	0%
Over Life	100%
▽ Size *	2cm
Variation *	50%
Over Life	100%
▽ Gravitational Affect *	0%
Variation	0%
Over Life	100%
▽ Angle Method *	Align To Motion
Angle *	30°
Variation *	60°
▽ Spin *	200°
Variation *	90°
Over Life	100%

To make the smoke and fire appear more natural, you will animate the "Over Life" values.

Pick the "**smoke**" emitter in the Project Workspace. Cick on the Opacity Over Life property and set it to 0%. This will create a channel. Expand the '+' sign and select:
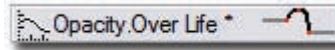
Pick [View][Timeline] from the Menu bar. Click the "tack" icon in the upper-left corner of the Timeline. This keeps the timeline from changing if you click anything else. Zoom and Move so you can see 100% both horizontally and vertically. Horizontal represents Over Life with 0% being birth and 100% being death, and vertical is the property itself, in this case, percentage of original Opacity.

Hover the mouse over the dotted line and it will change to an 'Add' cursor. Click and you will add a control point to the channel. Do this at 20% and 100% horizontally. Now, click and drag the control point at 20% up to 65% vertically. Your end result should look like this:
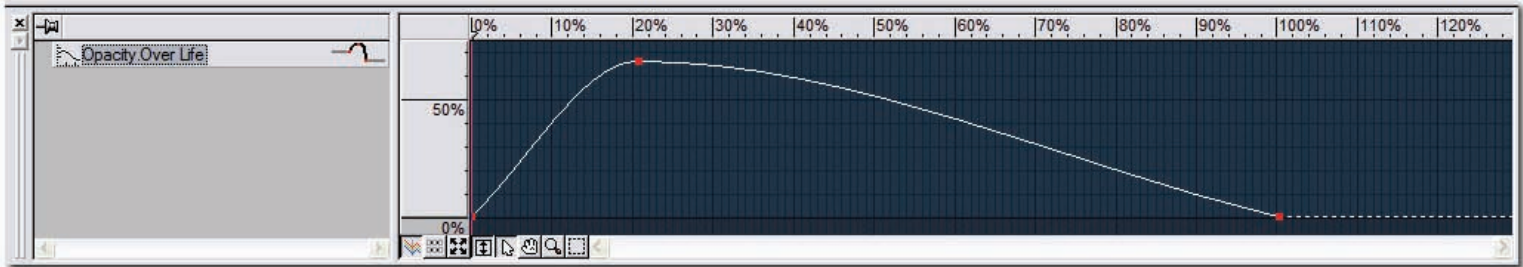
This makes the smoke "particles" opacity 0% to 65% and back to 0% over its life. When you are finished, be sure to move the position indicator back to 0, and un-tack the Opacity Over life channel before moving on to the next one. The position indicator is the purple line; to move it, simply click and drag.

Next, pick Size Over Life property and set it to 45%. Using the same process, add a control point to the channel at 100% horizontally, then drag it to 300% vertically. The end result should look like this:
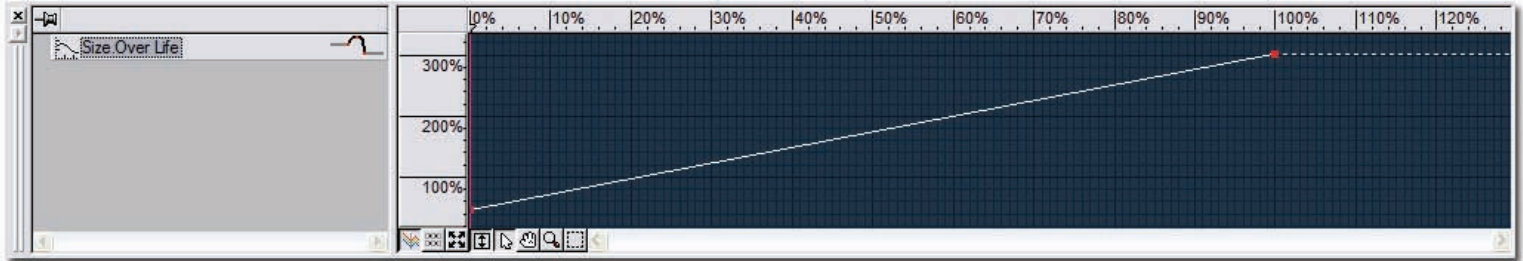
Be sure to move the position indicator back to 0, and un-tack.

Pick the "**flames**" emitter. Select the Opacity Over Life property and set it to 0%. Also, set the Size Over Life property to 0%.

Select the Opacity Over Life channel, and add a control point at 50% and 100% horizontally. Click and drag the control point at 50% to 100% vertically. Your end result should look similar to this:
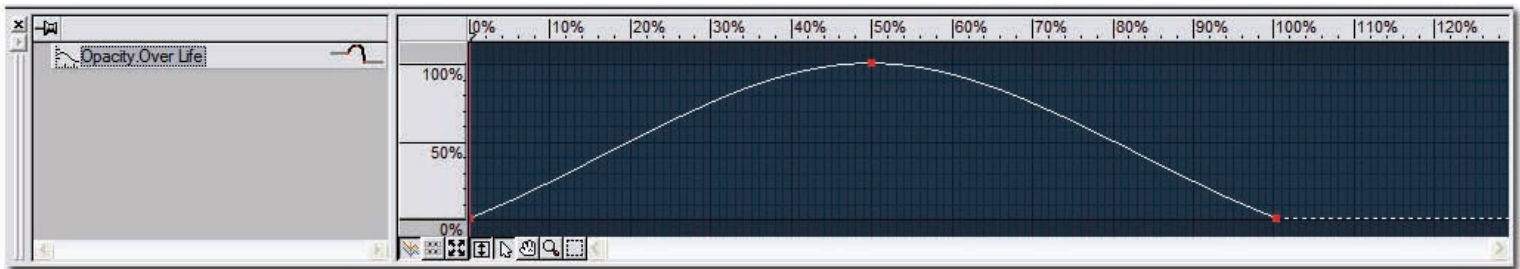
Be sure to move the position indicator back to 0 and un-tack.

Select the Size Over Life channel. Add contol points at 40% and 100% horizontally, drag them to 70% and 100% vertically. Your end result should look like this:
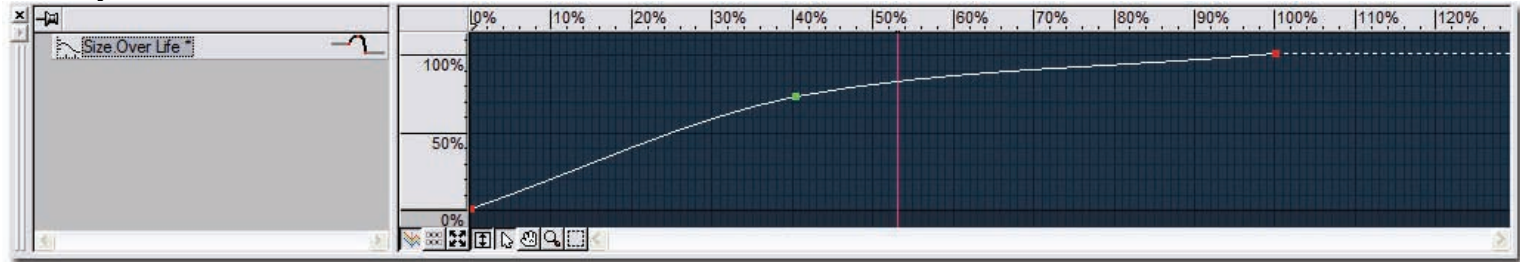
Be sure to move the position indicator back to 0 and un-tack.

Pick the "**sparks"** emitter. Select the Opacity Over Life property and set it to 0%.
Select the Opacity Over Life channel and add a control point at 50% and 100% horizontally. Click and drag the control point at 50% to 100% vertically. Your end result should look like this:
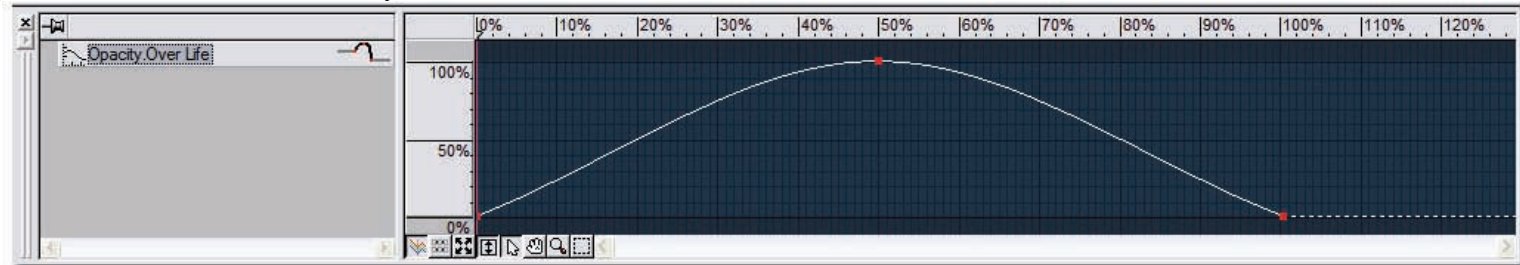
To animate the color value of the sparks, click the Color chip on the properties for the sparks emitter in the Project Workspace. Tack the timeline. With the color property selected, click and drag the Position Indicator to 100%. (The position indicator is the purple line) Click on the color chip and pick light yellow.

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The Timeline should now look like this:
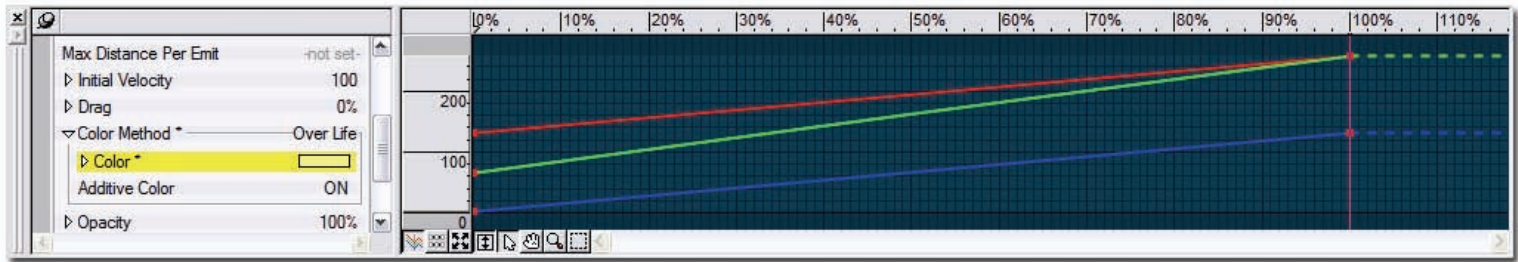
You can see a visual representation of the animated color shift you just created in keyframe mode by clicking the circled button:

Fire is now complete! Remember, Sprite Emitter materials, are completely reusable! Try applying it to your favorite character.

A material can be dropped on either an entire model, or on a group in a model. Also, sprites emit in the direction of the surface normals, so make sure the normals are point out (<Shift+1> to show normals, and <F> to flip.)

WIND

Pick [File][New][Choreography] from the Menu bar. Drag and Drop the smoke model from the Project Workspace to the Choreography Window.
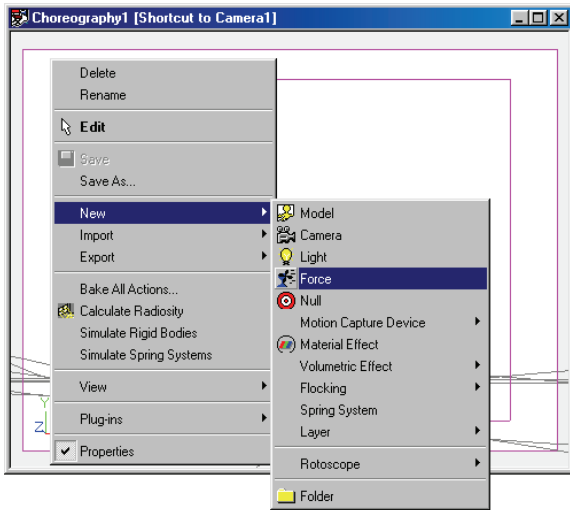
Right-click in the Choreography window and pick [New][Force]. Right-click the force object in the window and pick [Select Cache (Force 1)]. (This will select the actual force under the Objects folder, rather than the shortcut you added in the choreography.)
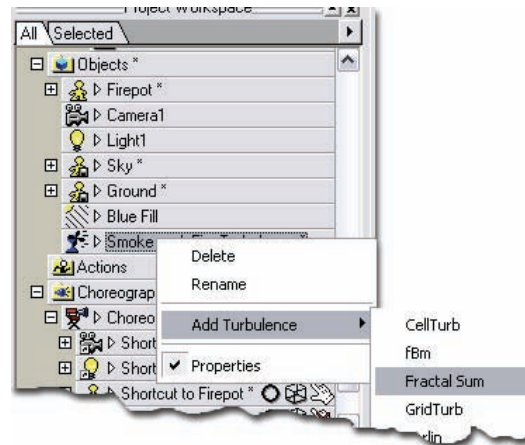
Right-click the Force icon in the "Objects" folder and pick [Add Turbulence] [Fractal Sum].
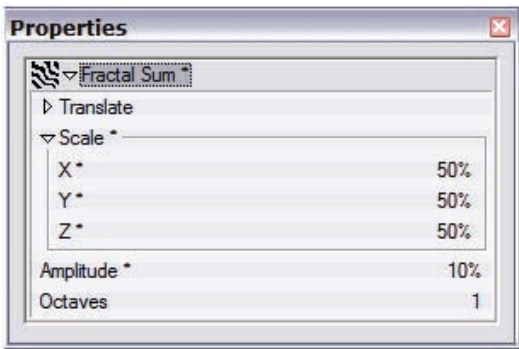
Set the X, Y, and Z Scale all to "50%." Set "Amplitude" to "10%."
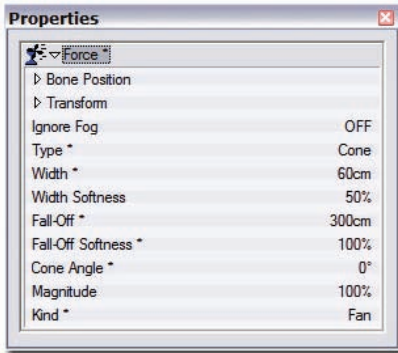
Set the following properties for the Force Object:

- "Type" to "Cone"
- "Width" to 60
- "Width Softness" to 50%
- "Fall-Off" to 300
- "Fall-Off Softness" to 100%
- "Cone Angle" to 0

Position the Force and the emitter as shown in the Choreography Window. You may need to select it in the Project Workspace, under the choreography, and change to a different view to accomplish this. Remember, the Force objects have a bone that behaves just like other bones that you can use to rotate and position it.
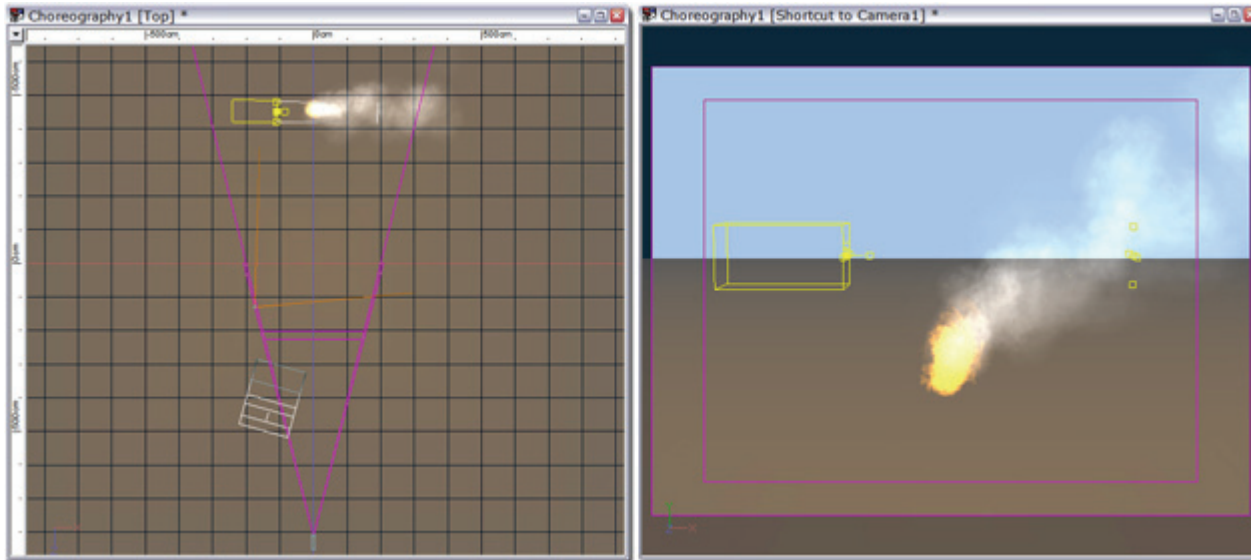
Instead of drifting straight up, the smoke now drifts to the right.

Special thanks to Shaun Freeman.

Created by Frank Hegemann

PHYSICAL SIMULATION

An animator welcomes any tool available that helps them tell stories. Physical simulation, the inclusion of physics in an animation, can have a profound effect on how you work (or it can be totally ignored). Physics is all about masses, forces, collisions, and responses – called "dynamics." An explanation of dynamics is easy enough to understand when you compare it to everyday life: take a rubber ball (mass), throw it (force), eventually it hits something (collides), and bounces (response). But using dynamics in a practical way can be challenging. It is hard enough for a real person to hit a ping-pong ball over the net and have it land where they want it – letting the computer do it is a haphazard chore. However, the computer can perform some simulations rich in dynamics, such as tumbling dice, faster and better than any human could animate. So, if you choose the simulations wisely, dynamics can speed up some laborious but important animating tasks.

Created by Joel Steudler
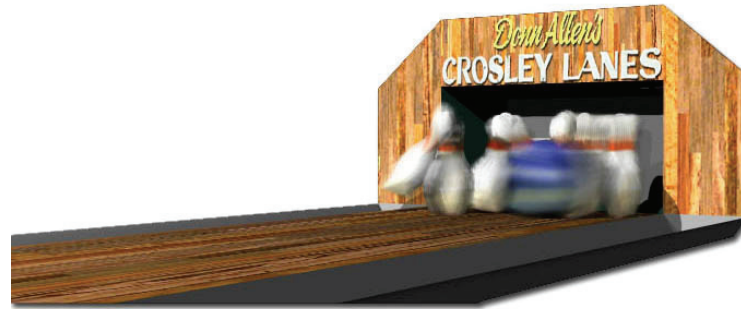
EXERCISE 17: COSMIC BOWLING (DYNAMICS)

Completion time: One Hour

In the Library, click the "Projects" tab, double-click the "Tutorials folder, then double-click "Cosmic Bowling".

The bowling project is set up where the first 5 frames of the animation are complete. If you advance through the frames you will notice that the ball moves for the first 5 frames only. This movement will allow the physical simulation to know what the balls initial direction is so it can animate all the rest of the frames.

Right-click (<Control> click on the Mac) on the bowling ball in the Choreography window and pick [New] [Constraint][Rigid Body].
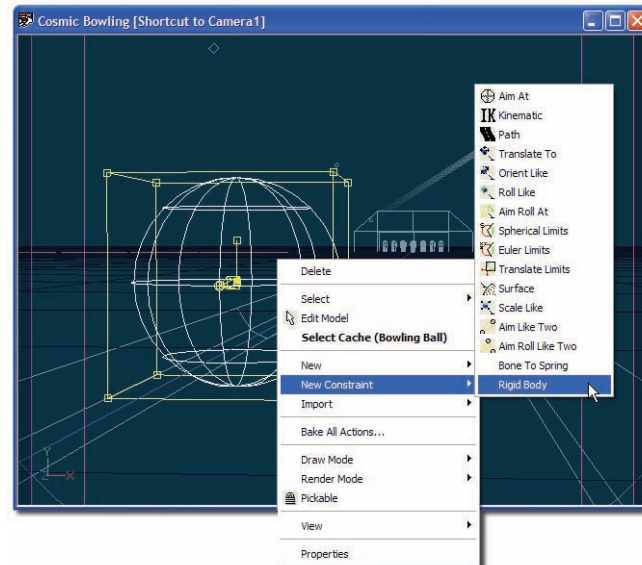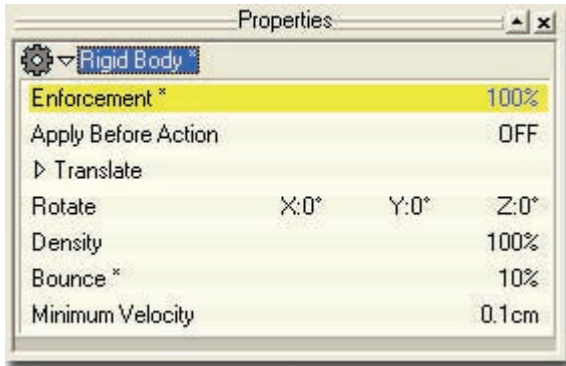
On frame "00:00:00" using the "Rigid Body" Properties, set "Bounce" to "10%," and "Enforcement" to "0."

On frame "00:00:05" set "Enforcement" to "100."

Right-click (<Control> click on the Mac) on the "Cosmic Bowling" choreography icon in the Project Workspace and pick [Simulate Rigid Bodies].

Once the ball simulation is complete, advance through the frames and notice that the bowling ball should collide with the pins just after frame "00:02:14."

From the Top view zoom in on the bowling pins. Right-click (<Control> click on the Mac) on each pin and pick [New] [Constraint][Rigid Body].
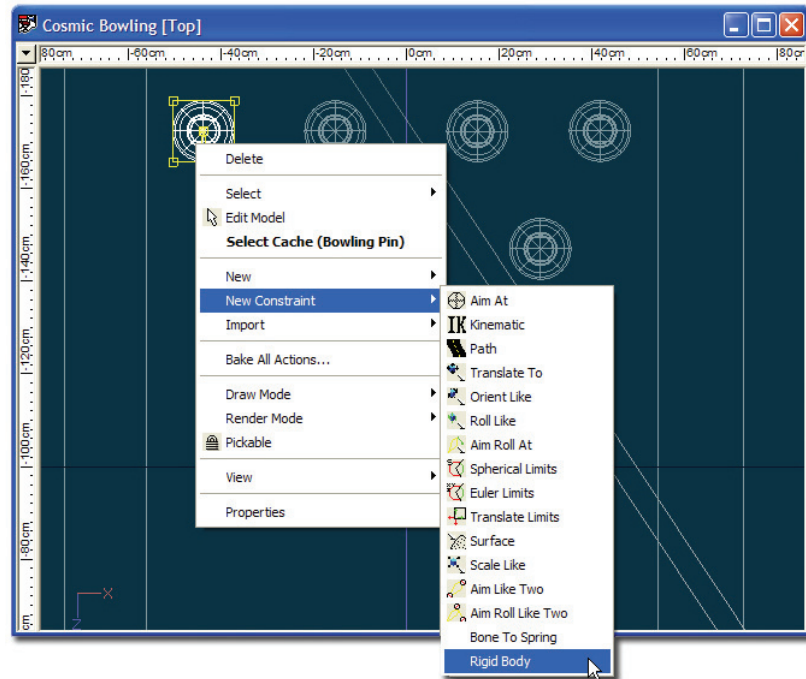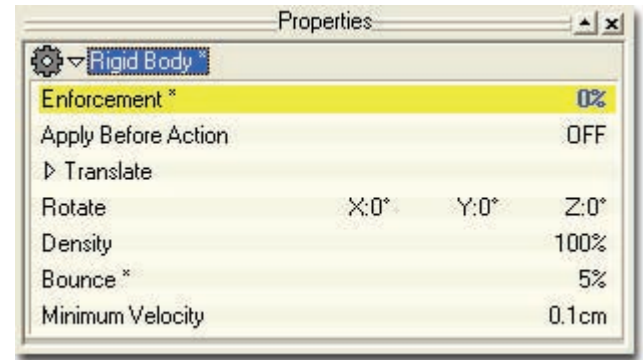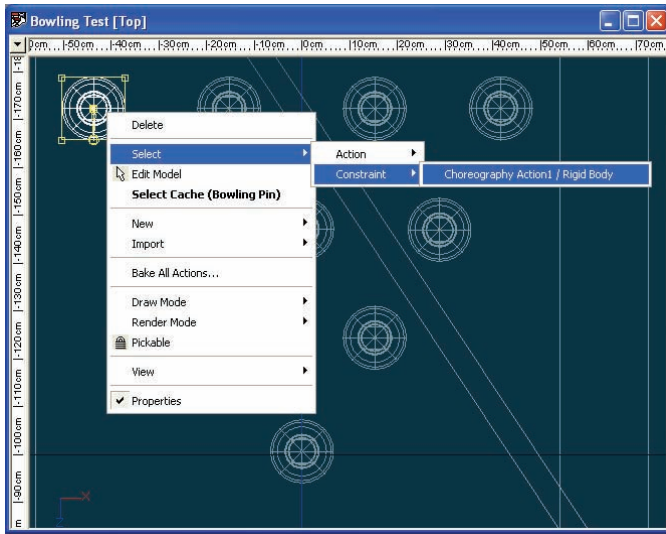
After the Rigid Body constraint has been added to each pin, you need to set the enforcement value for each pin.

Right-click (<Control> click on the Mac) on each pin and pick [Select][Constraint][Choreography Action1 / Rigid Body].

On frame "00:00:00," set "Bounce" to "5%," and "Enforcement" to "0."
On frame "00:02:14," set "Enforcement" to "100%."

On frame "00:00:00," go to the Camera view. Right-click on the "Cosmic Bowling" choreography icon and pick [Simulate Rigid Bodies]. Again you will be able to see the simulation take place.

When the simulation is done, render the animation

Created by Rijk Lau Ying Kit

EXERCISE 18: WAVING THE FLAG (CLOTH)

Completion time: 30 Minutes

In the Library, click the "Projects" tab, double-click the "Tutorials" folder, double-click on "Flag".

If the Project Workspace window is not already visible, pick [View][Project Workspace] from the Menu bar.

Pick [File][New][Material] from the Menu bar. Close the Material window.

Right-click (Control-click on the Mac) on the new material and pick [Rename]. Type "cloth".

Right-click on the "Attribute" under the "cloth" Material in the Project Workspace, and pick [Change Type To][Plugin][Hash, Inc.][SimCloth]
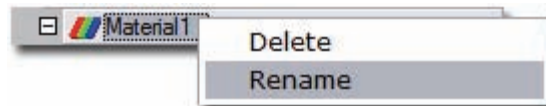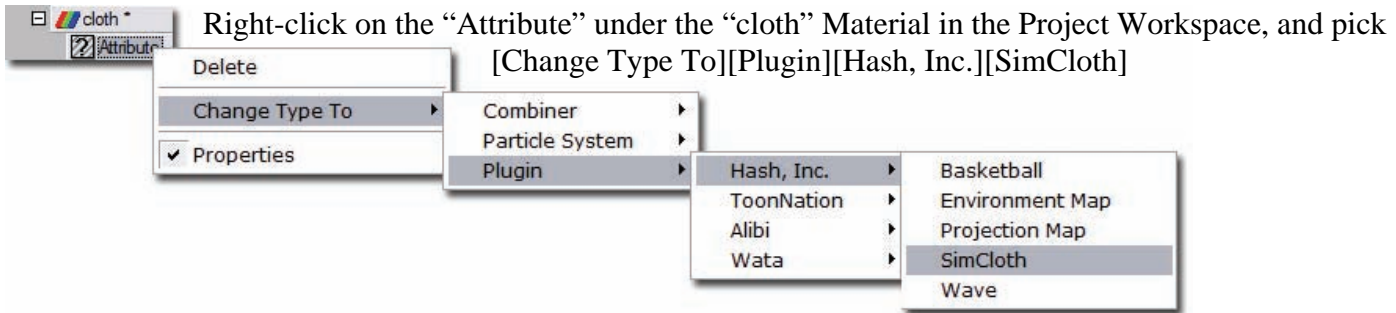
If the Properties dialog is not visible,

pick [View][Properties] from the Menu bar.
Click on the "SimCloth" object under the "cloth" material.

Change the Object Type property to "Cloth".
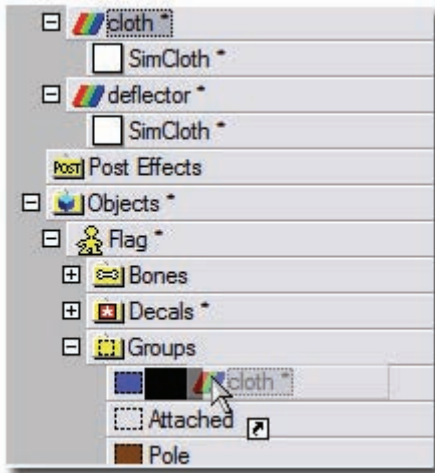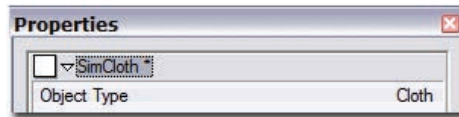
Using the same procedure, create a second material called "deflector". The Object Type for this material will be set to "Deflector"

In the Project Workspace, expand the Objects folder by clicking the "+" sign.
Expand the "Flag" object, and then expand the "Groups" Folder.

Drag and drop the "cloth" material onto the "Cloth" group.

Drag and drop the "deflector" material onto the "Pole" group.
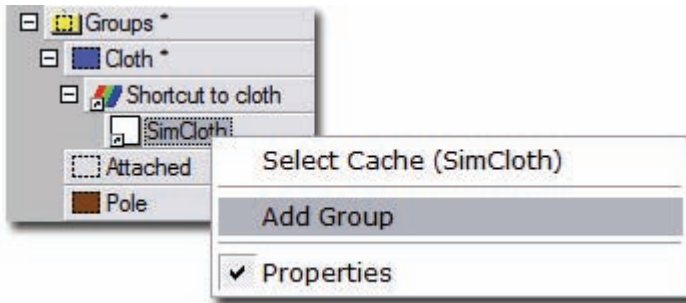
Right-click on the "SimCloth" object under the "Shortcut to cloth" on the Cloth group and pick [Add Group]. In the Properties dialog, pick the "Attached" group from the dropdown menu.
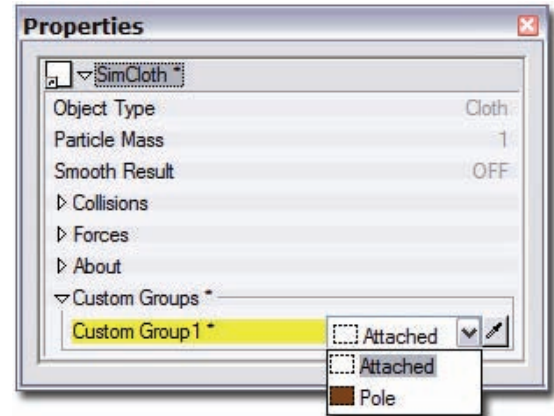
Pick the "Attached" group in the Project Workspace. Change the Attached property to ON.
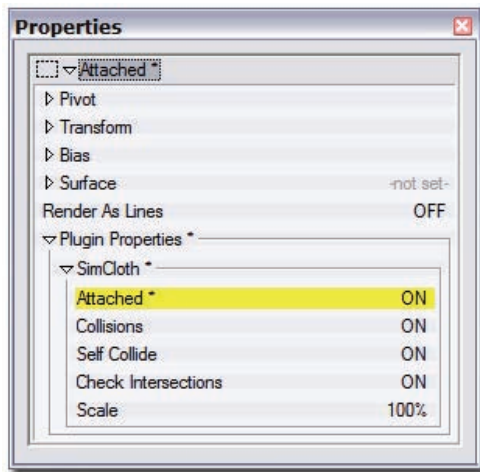
Finally, right-click in the choreography and pick [Plug-ins][SimCloth Simulate].

In a few minutes the simulation will finish. Scrub back through the frames to see your results!

Created by Avalanche Software

EXERCISE 19: FLYING SOUTH (FLOCKS)
Completion time: 30 Minutes

Animating a single bumblebee flying towards a flower is fun but animating a dozen bumblebees zigzagging in and out around each other is laborious. Animating a hundred bumblebees will make you crazy. Animating a large, randomly interacting group is common enough that it gets its own name; flocking. There are different kinds of flocking: "birds" flock, bees "swarm," and people "crowd," ("crowds" are also used to populate a landscape with bushes and trees). Also, every member of a flock can be performing a specified action while interacting with other flock members.
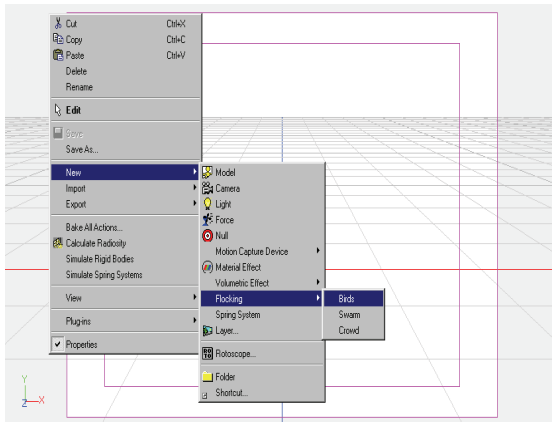
Pick [Project][New] to start a new, empty project.

Pick [File][New][Choreography].

Right-click (<Control> click on a Mac) in the Choreography window and pick [New][Flocking][Birds]. The spherical flocking influence region appears in the window, which the birds try to stay within.
In the Library, click the "Models" tab, double-click the "Animals" folder, double-click the "Birds" folder, then drag-and-drop "Goose" onto the "Shortcut to Birds1" icon in the Project Workspace.

On frame "00:00:00," from the Camera view, To select the Influence region, click on the circle, then click-and-drag the middle yellow manipulator square to move the sphere as shown in Figure 1. Also go to a Left view and move it so all the birds are above the ground.

On frame "00:01:00, drag the Influence region to the middle of the view.

On frame "00:02:00," drag the Influence region forward and to the right. (As you advance through the frames you will see the birds orient themselves to the direction of motion).

In the Library, click the "Actions" tab, then drag-and-drop "fly" onto the "shortcut to Goose" icon in the Project Workspace.
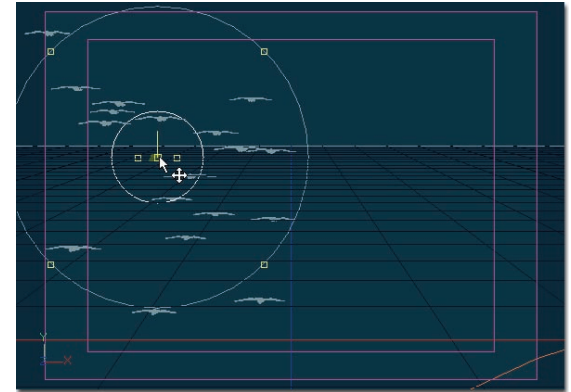
Figure 1
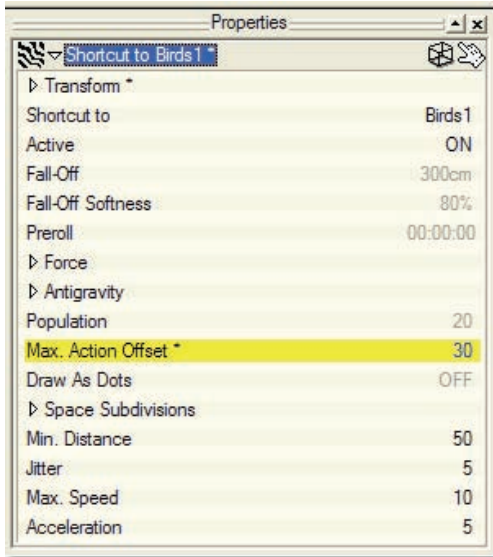
Go back to frame "00:00:00".

Click the flock Influence region in the Choreography window so that it is selected. To prevent the geese from flapping in unison, set "Max. Action Offset" to "30" in "Shortcut to Bird1" properties. Select "Shortcut to fly" in the "Actions" folder under "Shortcut to Goose" and change its "Repeat" property to "30", change the cycle length to 00:00:10, and set "Hold Last Frame" to OFF. This will cycle the action on the geese.

Finish the camera movement and lighting.

Render the animation!

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EXERCISE 20: IT'S GETTING A BIT HAIRY (HAIR)
Completion time: One Hour

Many of the characters you want to design and use will need hair. There are several ways to do hair: transparency mapped, modeled, and as a particle system. Each has its advantages, but the particle system hair you will be creating next is especially satisfying. Hair based on a particle system will display real-world dynamics, which for animators means it has automatic follow-through for that added bit of personality or realism.   The particle system can simulate short hair, long hair, grass, feathers, tree leaves and many other possibilities.

Pick [Project][New] from the Menu bar to start with a new, empty project.

In the Library, click the "Models" tab, double-click the "Tutorials" folder then double-click on "HairlessWookie."

You will be creating two hair systems: one for the head and one for the fur on the rest of the body. If the Project Workspace window is not visible, pick [View][Project Workspace] from the Menu bar.

Pick [Tools][Options][Rendering] from the Menu bar. Make sure "Draw Particles/Fur" is "ON". (The default hotkey for Draw Particles/Fur is [Shift+8]. Close the dialog.

First, create a hair material for the head:

Pick [File][New][Material] from the Menu bar. Close the material window. Right-click (Control-click on the Mac) on the new material and choose 'Rename'. Name it 'Hair'

Right-click on the "Attribute" under the new material in the Project Workspace, and pick [Change Type To][Particle System][Hair].
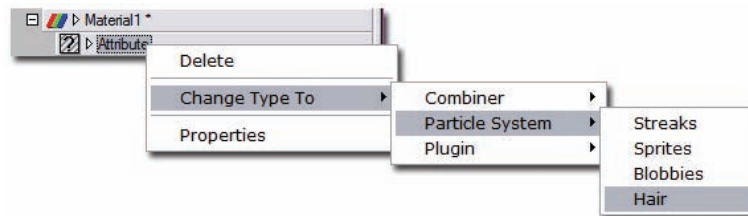
If the Properties dialog is not visible, pick [View][Properties] from the Menu bar. Select the Hair System.
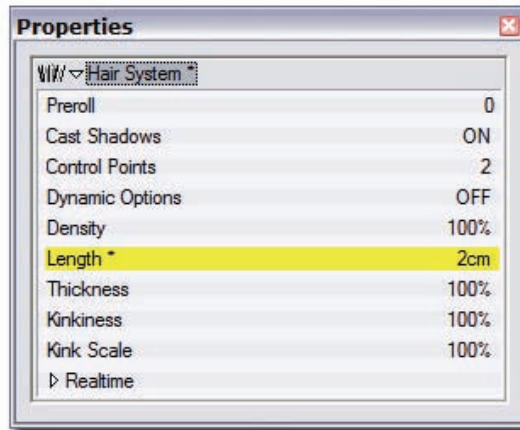
On the "Hair System" Properties, change "Control Points" to "1" and "Length" to "2" (centimeters). This is only temporary: we will be making the hair on Wookie's face longer later, but short hair is much easier to groom.

Click the "+" sign next to the "Hairless Wookie" model in the Project Workspace to show more information. Expand the groups folder the same way. Drag-and-drop the new hair material onto the Group named "face fur."

Click on the "face fur" group to select it then press the Hide button on the Modeling toolbar. For faster interactive drawing response, right-click in the Modeling window and pick [View][Render Mode][Wireframe].

Click the Grooming button on the Mode toolbar. This allows you to shape the appearance of the hair by brushing it.

Click the brush button on the Grooming toolbar.
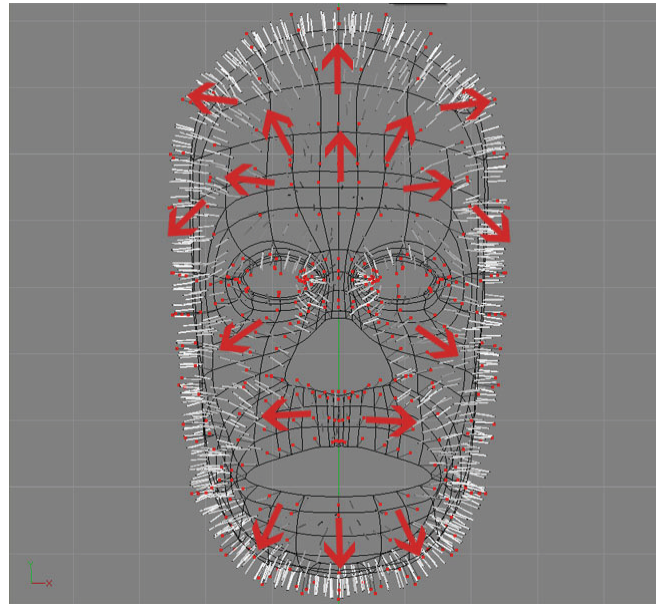
Click the mouse button and drag the Brush cursor over the hair control points. The guide hairs will move in the direction of your movement. Groom the guide hairs as shown.

On the Hair System Properties dialog, change Length to "6," Control Points to "3."

To improve the interactivity, click the display triangle next to the word "Realtime" on the Hair Systems Properties dialog to see more information. Change Density Factor to "20." You will want to do this with all Hair Systems you create.

Go back to brushing until you are satisfied with the grooming of the hair.

Sometimes it is necessary to switch to 'Edit' mode to properly shape the hair when brushing is not enough. Editing lets you move a single hair guide control point to precisely position it. (Switch back and forth between Shaded and Wireframe display to more clearly see which hairs you are working on).

The length of the hair around Wookie's eyes, nose, forehead, and moustache can be controlled with a Hair Length Map. A grey scale Hair Length Map uses white 100% of the hair length and black for 0% of the original hair length.

Click the "+" next to Wookie's "Decals" folder to expand it, then do the same thing for the "face"decal. Right-click (Command-click on Mac) the "Images" folder and pick [Add Image], choose "other", then browse to the 'images' folder in the same location as the HairlessWookie model and pick the "face_length" image in the Open Image dialog. (You can hover over the model's icon in the library to see its path)

In the "face_length" Properties dialog, change Type to "Other." A new option will appear called Properties Driven. Right-click on 'Properties Driven' and pick 'Add Property', then switch 'None' to 'Length'. The hair guides should change to use this new mapped length information.
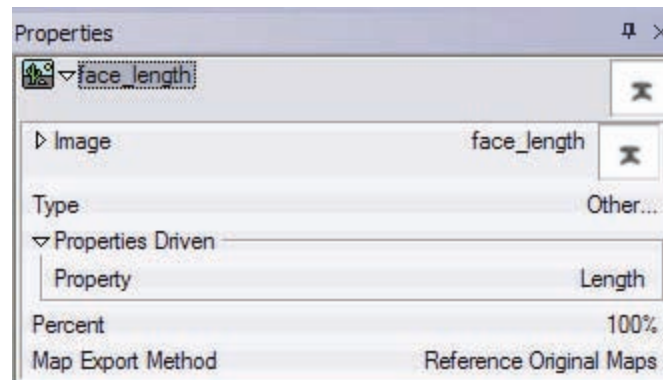
You are going to use another technique lengthen to the hair on his beard and on his forehead. Click the Length tool from the Grooming toolbar

Lengthen mode allows you to increase the length of the hair guides by clicking on a control point and dragging the mouse to shorten or lengthen the guide depending on which way you move. Increase the length of the hair guides on Wookie's beard. (Do more combing as needed).

As a last step using this technique of hair control, change the control points to "4" and length to "8" (Your own hair systems will have differing number of control points and lengths).
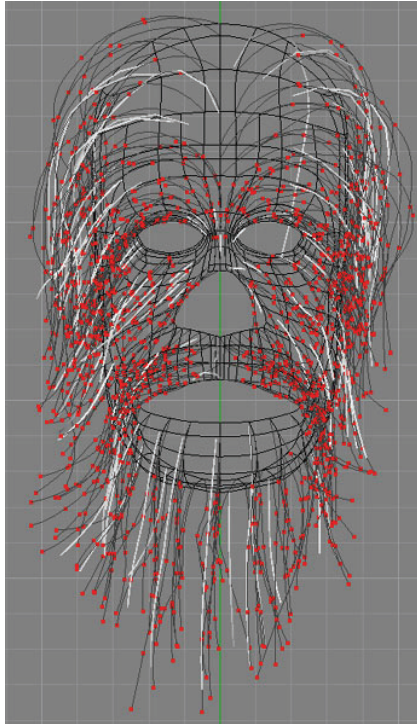
To control hair color, click Wookie's "face" decal in the "Decals" folder. Right-click the "Images" folder and pick [Add Image]. Pick the "face_color" image from the menu.

In the "face_color" Properties dialog, change "Type" to "Other." Right-click on Properties Driven, and pick [Add Property][DiffuseColor]. The hair guides should change color according to the map. Switch back to Modeling Mode by clicking the Modeling mode button.

Unhide the rest of the model by clicking the Hide button off.

Perform similar steps to apply hair on the back of Wookie's head using the 'head_back' group.

A different hair material will be used for the rest of Wookie's body. Create a new material and name it "Fur." Change the attribute to a Hairs System like you did in the previous example. "Fur" will use two hair emitters to improve the appearance: one for short hair and one for long. Add another hair emitter by right-clicking on the Fur Hair System and pick [Insert Hair Emitter].

Name the first Hair Emitter to "Long" and the second one to "Short".

Click the "Short" emitter to select it, and change Length to "25%."

Click the "Fur" Hair System to select it, and change Length to "6"

Bound-group Wookie's body and press the Hide button on the Modeling toolbar.
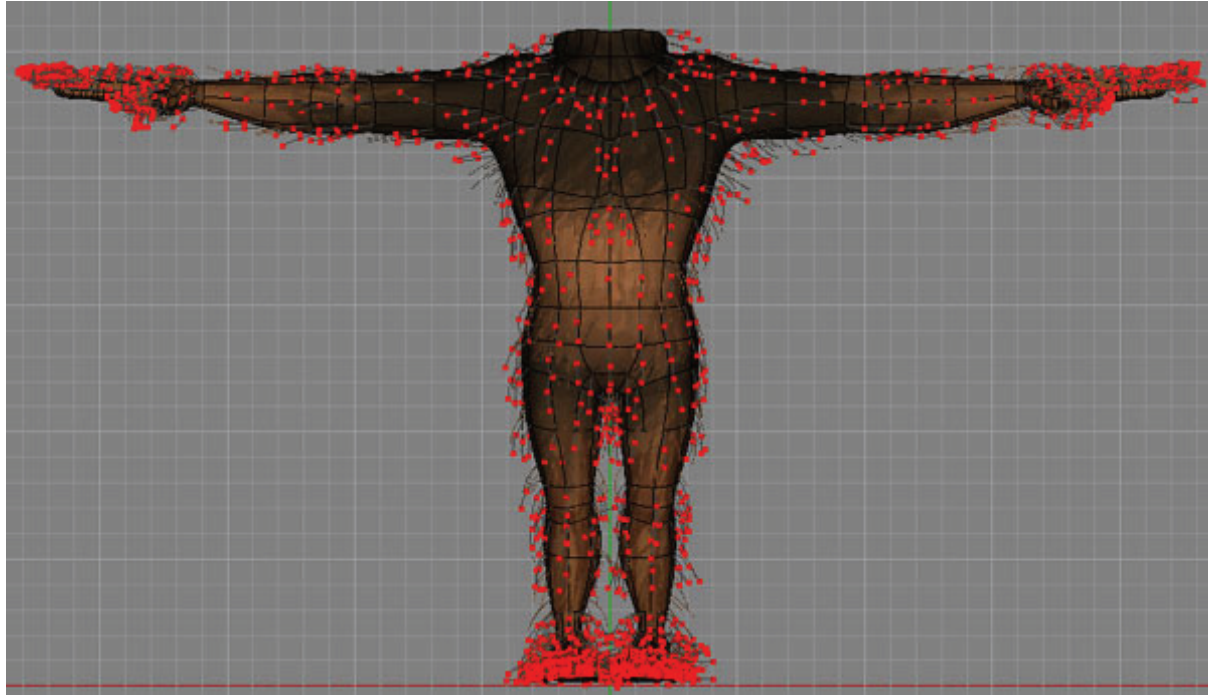
Drag-and-drop "Fur" on to the following groups: "body_front" "body_back," "arms_top," "arms_bottom," "hands_top," "legs_rear," "legs_front," and "feet_top." You will need to add two new images to control color for each decal corresponding to the group, one for each hair emitter. Also add images to control the length on the Hands and Feet Comb the hair to flow down over the body. You may also want to lengthen some random hair guides to add more variety.

The final step will be to add more realism by varying the thickness of the hair over its length.

To vary the thickness of the hair over its length, start by setting the Thickness property for the Hair Emitter to "0.3," Make sure thickness is still selected.

If the Timeline is not visible, pick [View][Timeline] from the Menu bar. Zoom and move so that you can see 0-100%: this represents 0% of the length up to 100% of the length.

Click on the Channel at 100% to add a control point, Drag the new control point down to a thickness of .01 (making the hair taper towards its end). Do the same thing for the other Fur emitters, after moving the position indicator (the purple line) back to 0%.
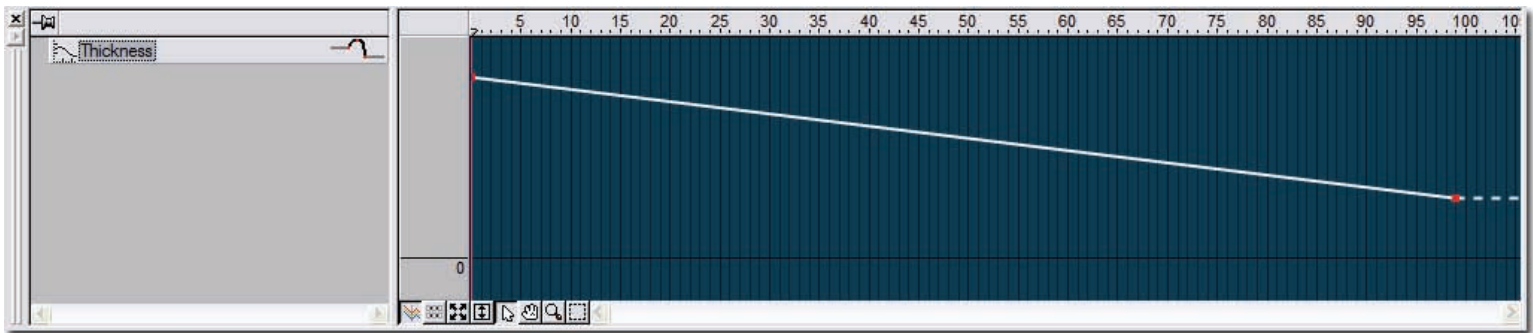
Make the following changes to the emitter Properties settings of the "Hair" material:

- Density: 10
- Length Variation: 100%
- Direction Variation: 10%
- Surface
    - Specular Color: white
    - Specular Size: 80%
    - Specular Intensity: 35%
- Thickness Variation: 20%
- Bow: 80%
- Bow Variation: 20%,
- Kinkiness: 20%
- Kinkiness Variation: 50%

Make the following changes to both emitters Properties settings of the "Fur"material:

- Density: 10
- Length Variation: 100%
- Direction Variation: 50%
- Surface
    - Specular Color: white
    - Specular Size: 80%
    - Specular Intensity: 35%
- Thickness Variation: 50%
- Bow: 80%
- Bow Variation: 20%
- Kinkiness: 45%
- Kinkiness Variation: 30%

The 'Hairless Wookie' should now have hair similar to that pictured at the beginning of the exercise. Congratulations!

Special Thanks to Kevin Waldron.

Created By Eric Webster