LOST MARBLE

MOHO®
ANIMATION SOFTWARE

TUTORIAL MANUAL

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Moho Tutorials

In this manual, we will walk you through various aspects of using Moho. This is the perfect place to start if you've never used Moho before. Even if you're an experienced Moho user, this version of Moho has some big changes, so we recommend reading through the tutorials again.

The best way to get started is to read all the tutorials in the Basics section in order. Each of these tutorials builds on skills learned in the earlier ones, and one-by-one will get you up to speed with Moho's basic drawing and animation techniques. Once you're comfortable working in Moho, then you can move on to the other tutorial sections. You don't have to read them all (although that probably wouldn't hurt), but choose the ones that address the specific techniques you want to learn about.

When you first start Moho, you will be prompted to create a Custom Content folder in a location that you specify. The tutorial files that are used in this tutorial manual will get installed in that Custom Content folder. You can find them by going to your Content folder, and looking for the Tutorials sub-folder. If you're having trouble with a tutorial, try opening the corresponding Moho file to see what it should look like.

If you did not create a custom content folder at startup, you can create one any time by choosing **Help > Set Custom Content Folder***.*

Once you've finished the tutorials, you should be comfortable enough to continue on your own. However, the tutorials won't teach you how to use every feature of Moho - the rest of this manual is a reference that covers Moho's features in detail, and is recommended reading to be able to use the full power of Moho.

Quick Start

Tutorial 1.1: A Quick Run-through

This tutorial quickly runs through the major features of Moho, without going into too much detail. The purpose here is more to give an overview of how Moho works, rather than to teach you how to use any specific features. In this tutorial, we will draw and animate a very simple object.

Moho has several groups of tools, used for different types of tasks. Some of these tools are used to create new objects, and others are used to modify and animate existing objects. The basic Moho tool groups are: Draw, Fill, Bone, Layer, Camera, and Workspace.

This tutorial introduces a few of the Draw, Fill, and Layer tools, while the following tutorials focus specifically on each of the tool groups.

Drawing a Simple Shape

Launch Moho by double-clicking the Moho icon, or selecting the Moho shortcut in the Start menu (Windows). When you create a new Moho project, the application starts off looking something like this:
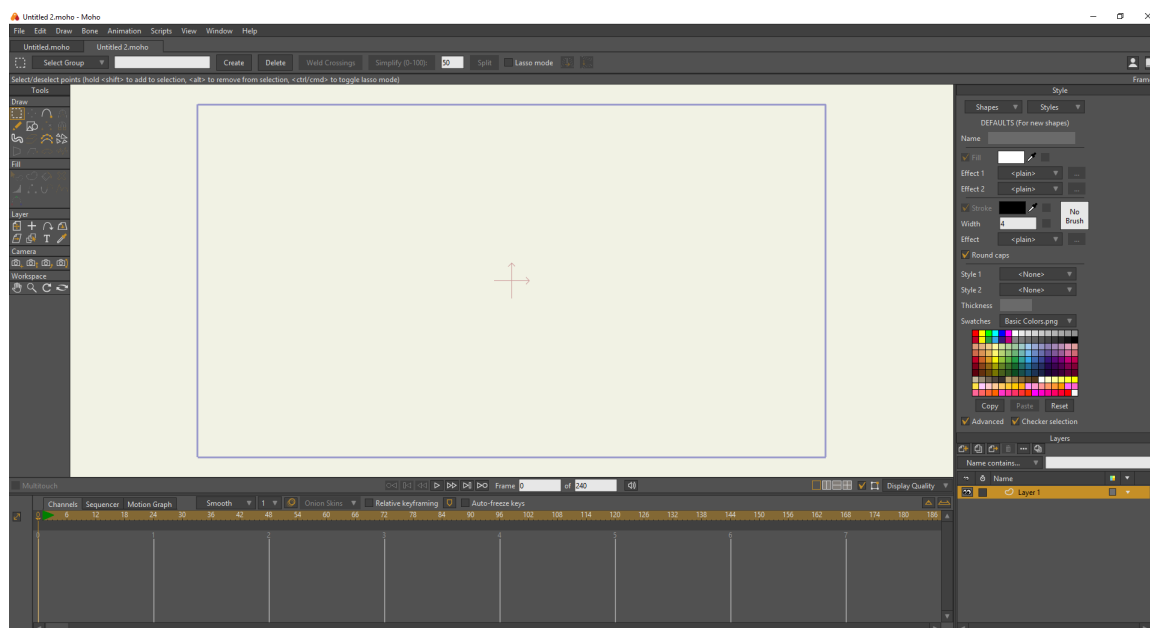
The Moho Interface

Choose **File > New** to create a new project, and then click the current tool icon (just beneath the File menu), to select **Reset All Tools**. This puts all tools at their default settings so that you can follow along with this tutorial.
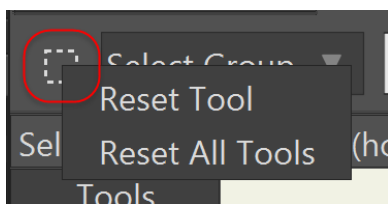
Reset all tools.

  Select the **Draw Shape** tool by clicking on it in the toolbar.

Select the Oval shape from the Draw Shape tool options.

The Style panel on the right side of the Moho interface allows you to select fill and stroke colors for the shapes you draw. To select a fill color, click the Fill color square to open a color palette, or click one of the color squares in the Swatches palette. Alternatively you can click one of the colors in the Color Swatch palette. Select the fill color you want to use, and click OK.
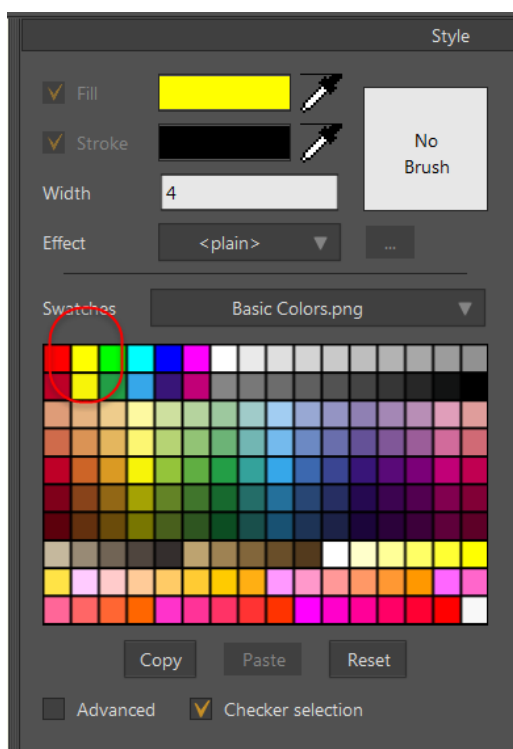
Changing the fill color

Press the **Shift** and **Alt** keys while you drag from the center of the workspace to create a circle shape. The **Shift** key forces the shape to be a circle, rather than an oval; and the **Alt** key centers the circle around the point that you first clicked. Try to keep the circle within the blue rectangle (this rectangle represents the visible area of your project). Note that the circle will automatically fill with color when the **Auto Fill** option is checked as shown in the previous figure.

If you're not happy with your circle, just select the **Edit > Undo** command from the menu bar. Your circle should look something like this:

Quick Start
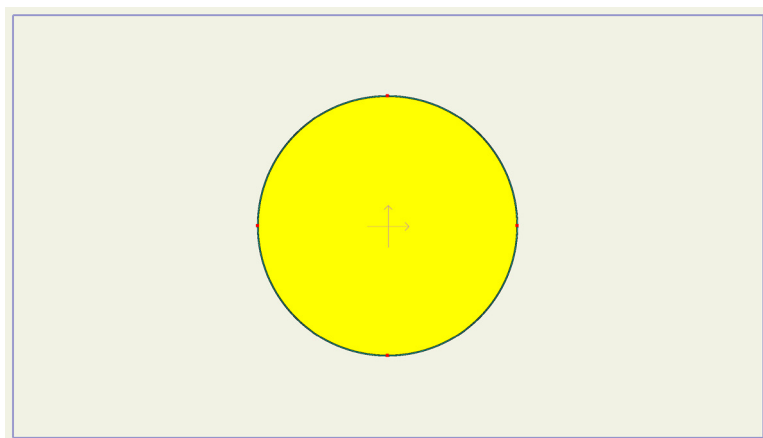
Your first Moho drawing

Changing the Color of Your Shape

 If you want to change the fill color, choose the **Paint Bucket** tool from the Fill toolbar. The **Fill** option changes only the Fill color; the **Stroke** option changes only the Stroke color; and the **Both** option changes both the Fill and the Stroke color to those that you have selected in the Style window.
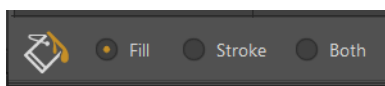
Paint Bucket options

Select a new color from the Style panel, similar to the way that you selected the color in the previous steps. Then click inside the shape to change the color(s).
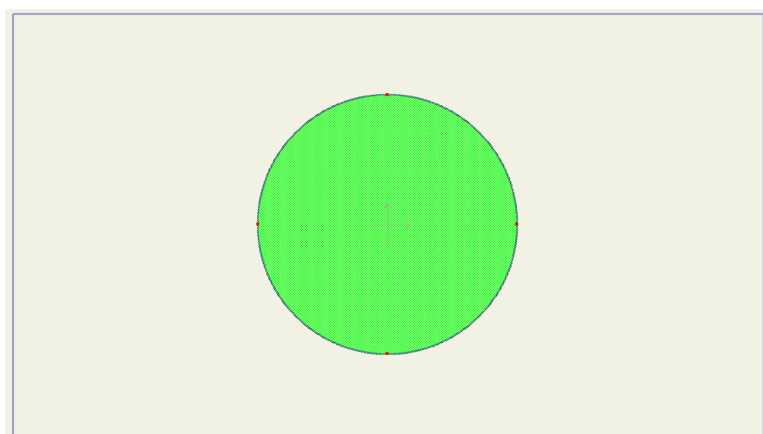
The Fill color is changed with the Paint Bucket.

Simple Animation

When you animate in Moho, you move objects around and set up keyframes - points in time at which an object has a certain position. At points in time between keyframes, Moho automatically computes the position of all objects.

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Near the top of the Timeline window is a ruler that displays frame numbers in the animation. Click the number 36 to set the current time to frame 36.
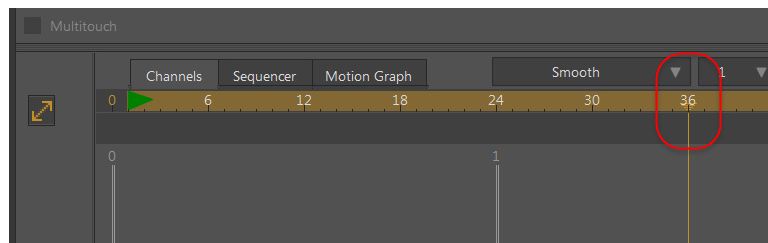
The Timeline

Next, choose **Edit > Select None** from the menu bar.

Pick the **Transform Points** tool from the Draw toolbar. Click and drag the bottom point of the circle upward to distort the circle into a shape that looks like this:
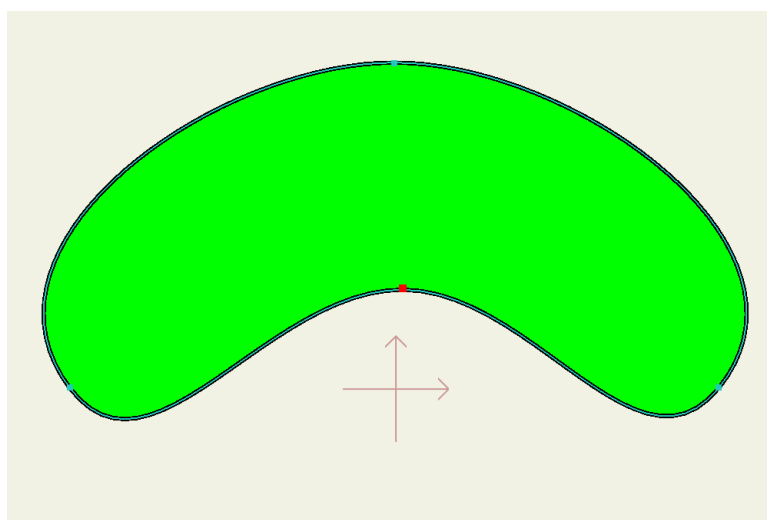
Moving a single point

Now use the **Transform Layer** tool from the Layer section of the Tools panel to rotate the layer.

To rotate the object with the Transform Layer tool, click and drag in the area between the two bounding boxes that surround your object. Rotate the object into a position similar to the one below:
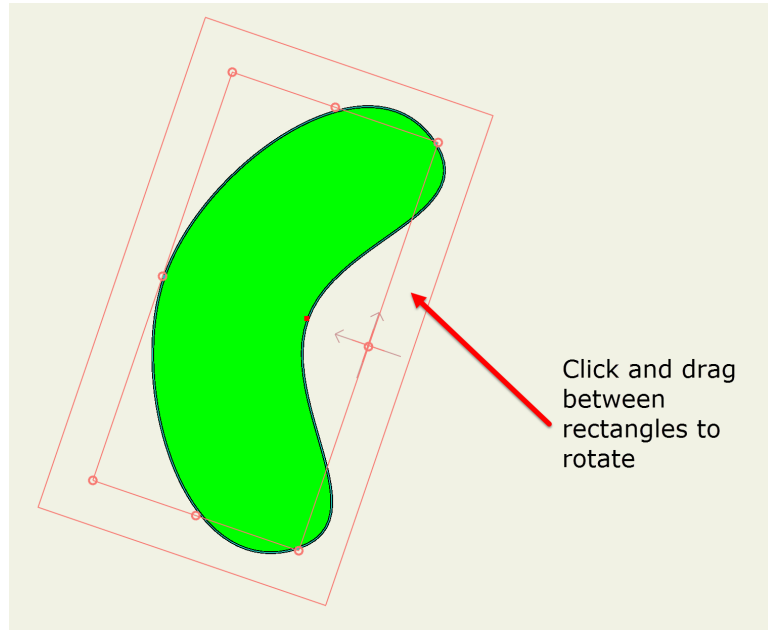
Rotating an entire layer

Back in the timeline, click frame number 72 in the ruler to change the current time. Next, select **Draw > Reset All Points** from the menu bar to move all points back to their original positions. In the tool options area at the top of the main window, press the **Reset** button to reset the rotation of the entire layer.
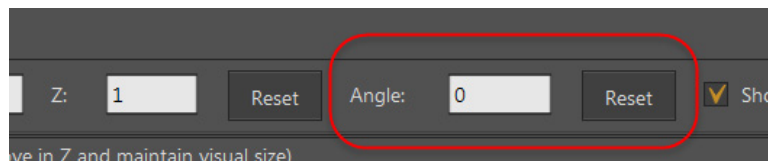
Click the Reset button to reset the rotation of the layer.

Finally, we'll shorten the length of the animation from its default length of 240 frames. In the Timeline window, enter 80 in the second number field. This will shorten the length of the animation to 80 frames.
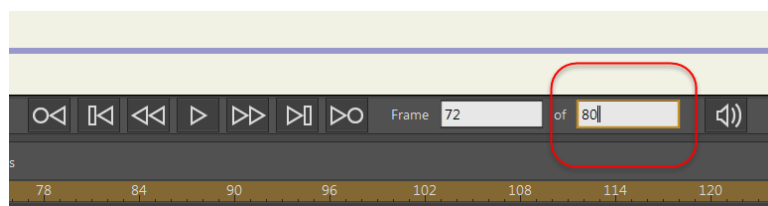
Shorten the animation to 80 frames.

Congratulations, you've made an animation! Press the play button near the bottom of the main window to watch it go. When you're done, press stop. OK, so it probably won't win any film awards, but you're off to a good start learning Moho.

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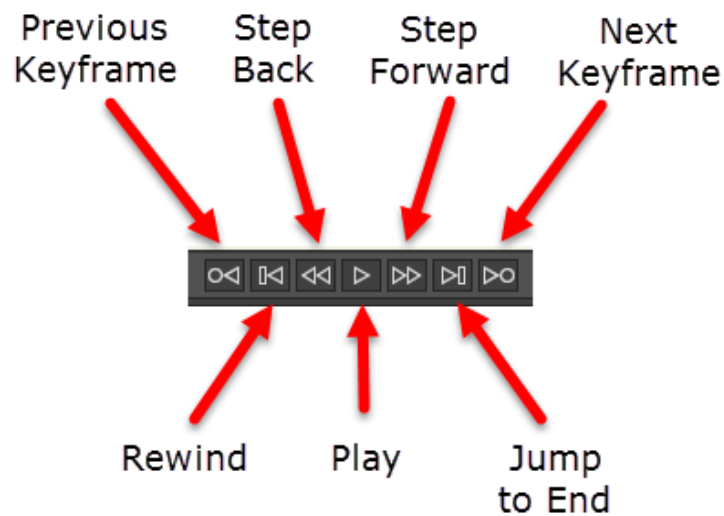
Playback controls.

Here's what your finished animation should look like (approximately). Press the **Play** button below to see the result.

 Click this link to view a brief video of the finished results of your project.

You've learned how Moho has different groups of tools for different operations, and even how to use a few of those tools. You can experiment more on your own, maybe adding more keyframes. When you're ready to learn more, move on to "Tutorial 1.2: Drawing Simple Shapes" on page 7.

Tutorial 1.2: Drawing Simple Shapes

In this tutorial you will learn how to draw simple shapes in Moho. The following tutorials will build on what you start drawing in this tutorial.

Creating a Background

Launch Moho by double-clicking its icon. Or, if Moho is already running, choose **File > New** to create a new project, which opens in a new document tab.

Click the current tool icon (just beneath the File menu), to select **Reset All Tools**. This puts all tools at their default settings.
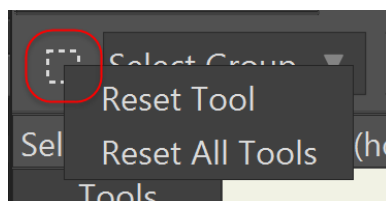
Reset all tools.

In the Tools window, click the **Draw Shape** tool to activate it. Then select the Rectangle option.

From the Style window, select a brown color for the Fill color as shown below.
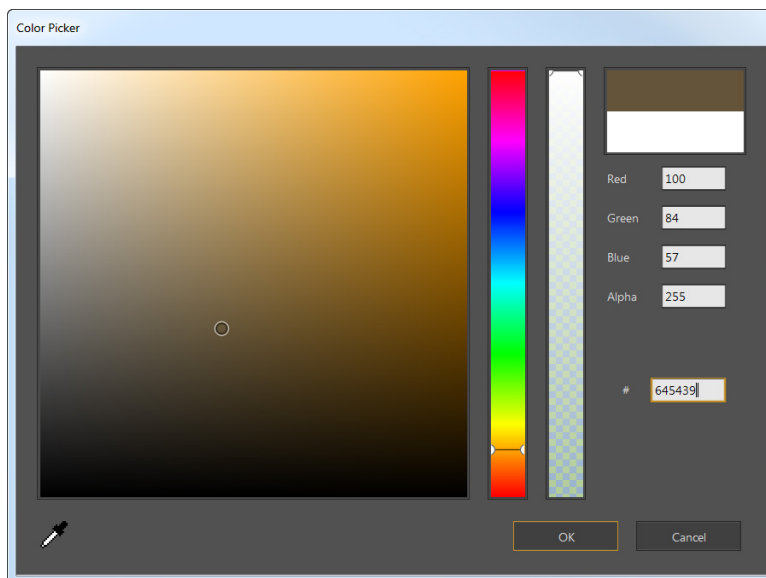
Select a brown fill color.

Click and drag in the working area to create the rectangle shown below:
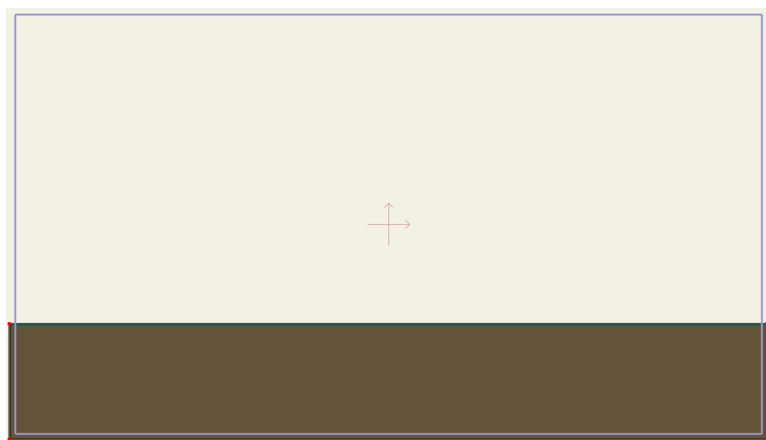
Draw a simple rectangle.

This shape is going to be the start of some rolling hills. So far, these hills look kind of flat, so let's fix that. Pick the **Add Point** tool from the toolbar.

Click on the top edge of the rectangle and drag the mouse upwards:
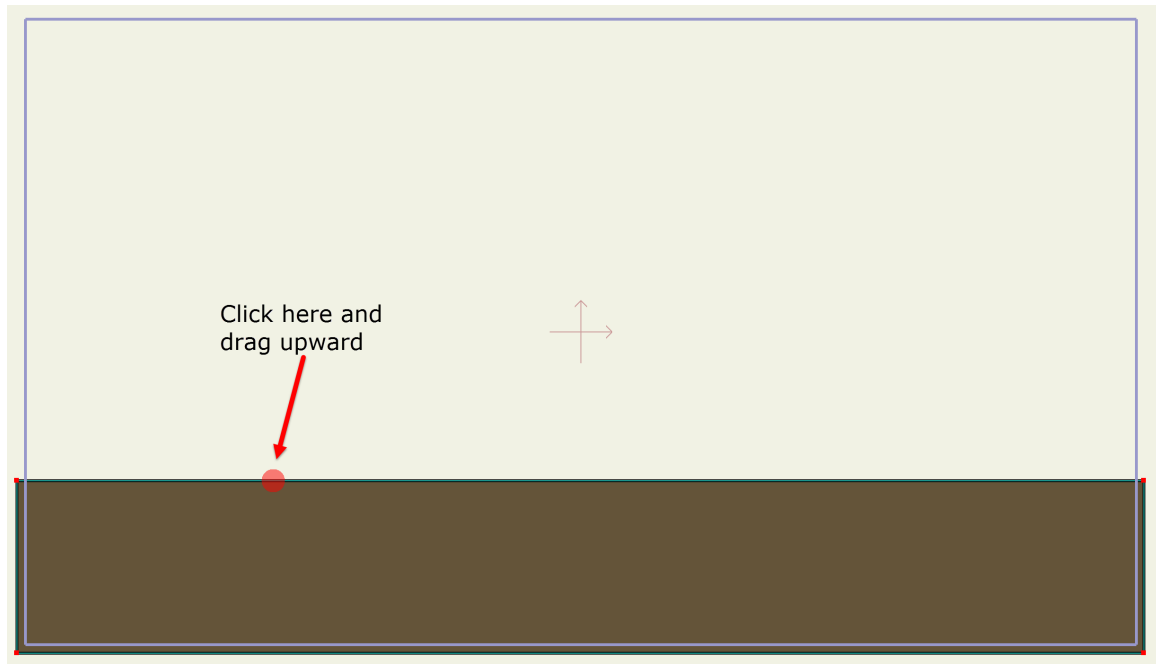
How to add a point to an existing shape.

You should have something now that looks like the picture below. If this isn't what you got, select the **Edit > Undo** menu item and try again. Be sure to click on the line that forms the top of the rectangle and drag upwards from there.
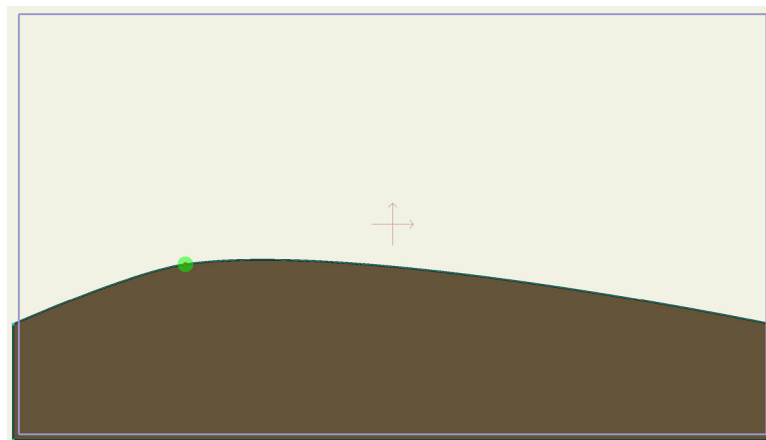
Drag the new point upward.

Let's add another curve to the hills by clicking a little more to the right and dragging downwards:
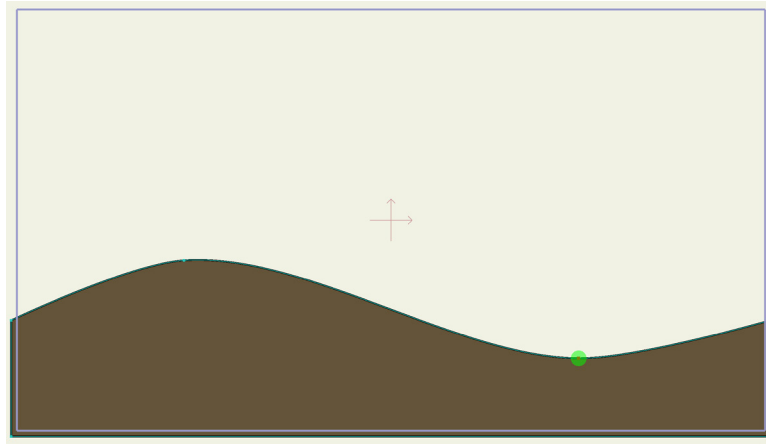
Add a second point and drag it downward.

To keep things organized, it's a good idea to name the layers in a Moho project. Double-click this layer (the only one so far) in the Layers window.
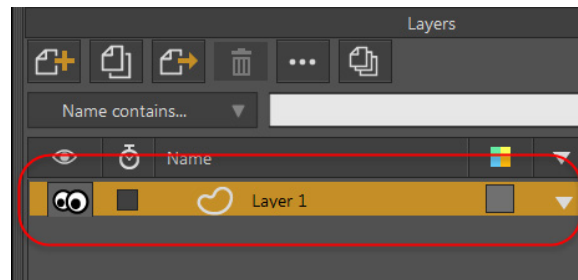
Accessing a layer's properties.

In the dialog that appears, type in "Hills" for the layer name and click the OK button.
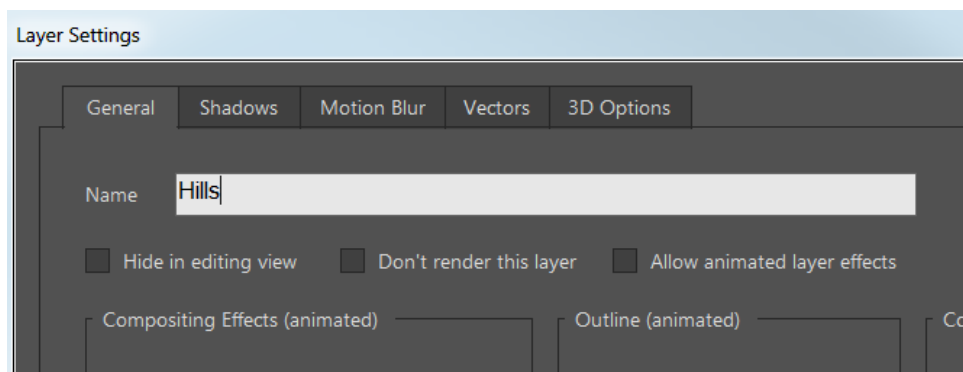
Rename the layer.

After creating the hills, choose **Edit > Select None** to deselect any selected points. Then click the Select Shape tool in the Fill section of the Tools panel, and click the fill on your hills.

The Style window will display the settings for the fill: its color, its line width and color, and the styles used to display it. To remove settings that you have used in previous projects, click the **Reset** button to reset the fill colors to their default settings.

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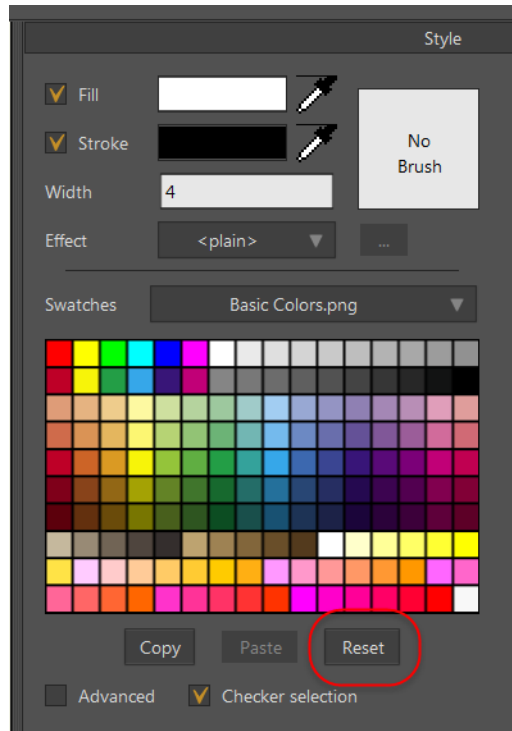
Click the Reset button.

Set the line width to 1. Then choose Gradient from the Effect menu to open the Gradient dialog.

If you want to change the gradient settings later, click the details button (...) to the right of the Effect pop-up menu.

The Style Window

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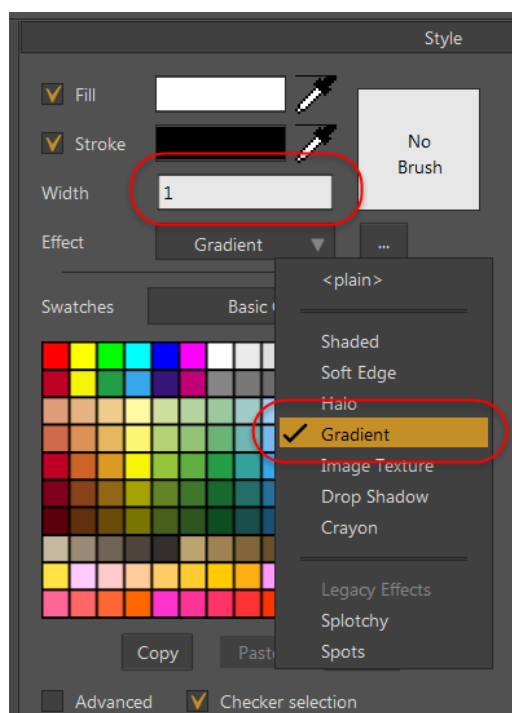
When you select the Gradient fill style, Moho automatically opens up the gradient settings dialog. The Linear gradient type is automatically selected for you.
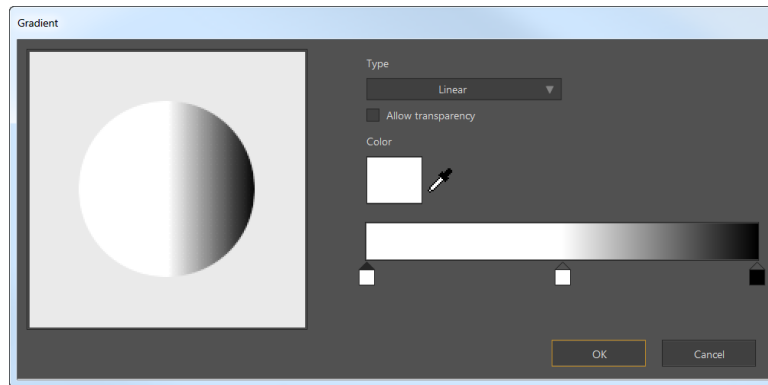
Linear gradient.

- To set the left gradient color, double-click the left square at the bottom of the gradient bar to open the Color Picker. Select a green color and click OK to return to the Gradient dialog.

- To set the center gradient color, double-click the middle square at the bottom of the gradient bar to open the Color Picker. Select a darker green color and click OK to return to the Gradient dialog.

- To set the right gradient color, double-click the right square at the bottom of the gradient bar to open the Color Picker. Select a brown color and click OK to return to the Gradient dialog.

When your colors are selected, the Gradient settings should appear as shown below. Click OK to return to the scene.

Green   Dark   Dark
             Green   Brown
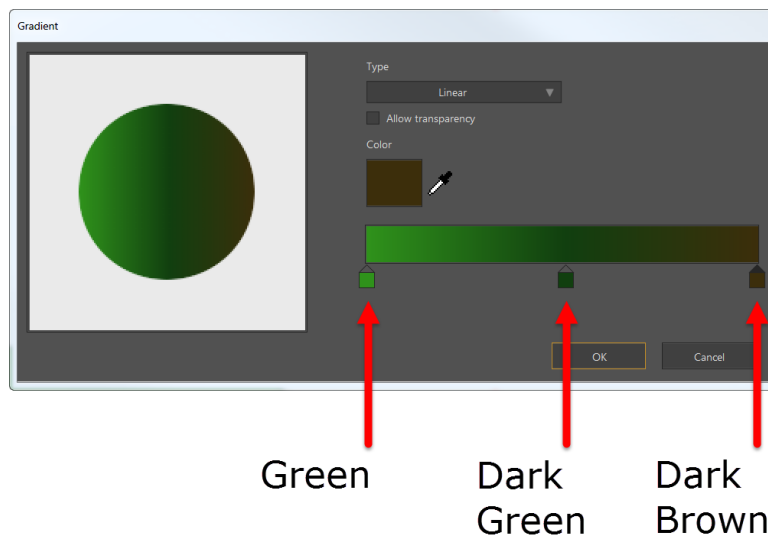
Gradient settings.

To see the gradient preview more easily, click outside the hill to deselect the fill. You'll notice a line with a filled circle at one end, which represents the start color of the gradient (green in our example). The empty circle at the other end represents

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the end color of the gradient (brown in our example). You can adjust the position of these indicators to control the blending and direction of the gradient.
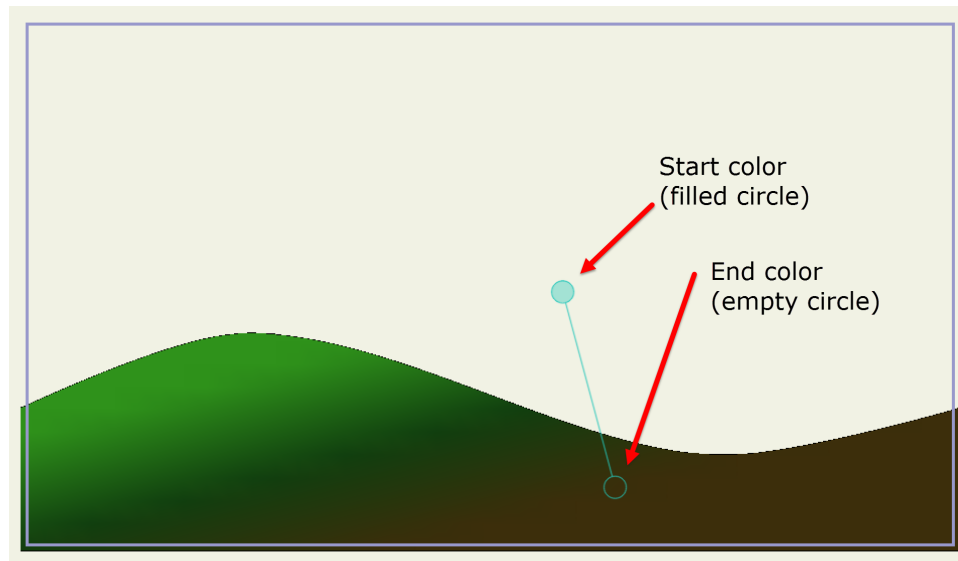
Final result.

In our example, the gradient starts with brown on the bottom (empty circle) and ends with green on the top of the hill (filled circle). The angle tilts slightly toward the left as shown below.

Choose the **File > Save As...** command from the menu and save the project under the name "Tutorial 1.2".

In "Tutorial 1.3: Drawing Complex Shapes" on page 13 we'll continue working on this scene by adding more complex shapes.

Tutorial 1.3: Drawing Complex Shapes

This tutorial follows on the previous one, and teaches you how to draw more complex shapes. You can either continue with the project you created in Tutorial 1.2, or you can open a file provided for you named "Tutorial 1.2". This file can be found in the "Tutorials/1 - Basics" subfolder within your custom content folder. The file you're starting this tutorial with should look something like the following:
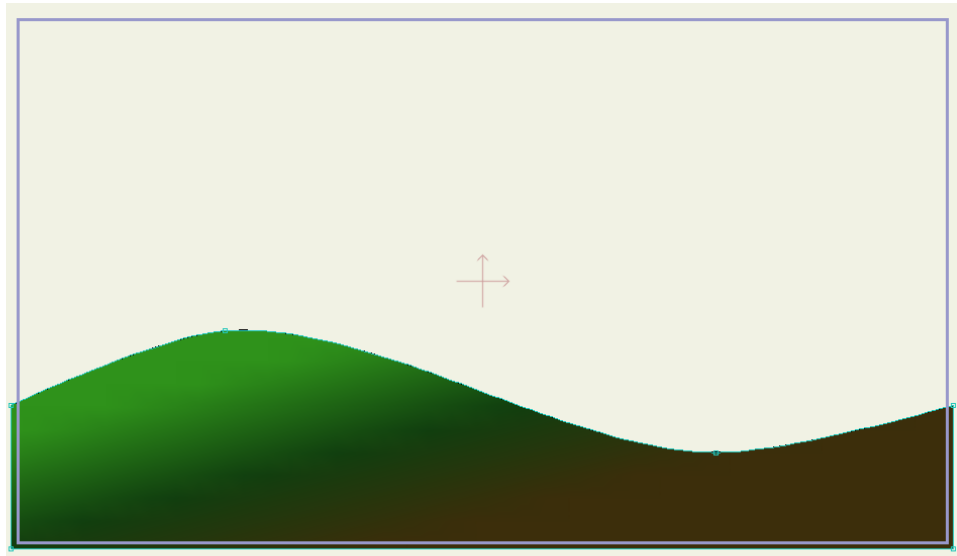
Starting point.

Creating a New Layer

Click the New Layer button in the Layer window to create a new layer. In the popup menu that appears, choose "Vector".
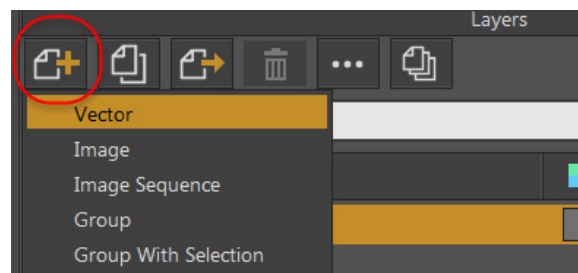
Create a Vector layer.

You can assign the name "Clouds" to the new layer when you create it, or double-click this new layer and rename it "Clouds" in the Layer Settings dialog.
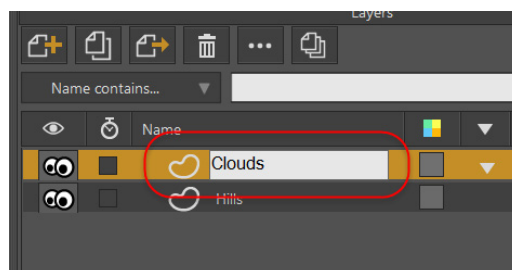
Rename the layer Clouds.

 Now select the **Add Point** tool.

Click the **Reset** button in the Style panel to reset the colors to their default. Set the line width to 1.
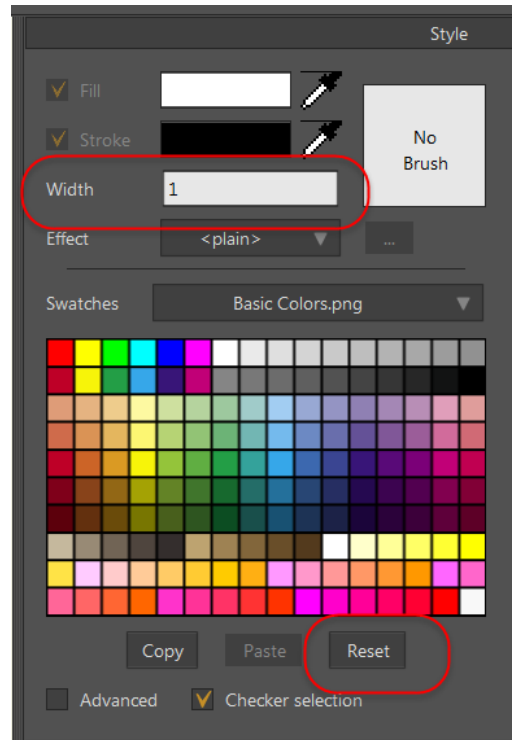
Reset colors and set line width to 1.

Click to set the start point for a new line segment. Without releasing the mouse, drag the cursor and release the mouse to create the end of the segment. The finished segment is shown below.
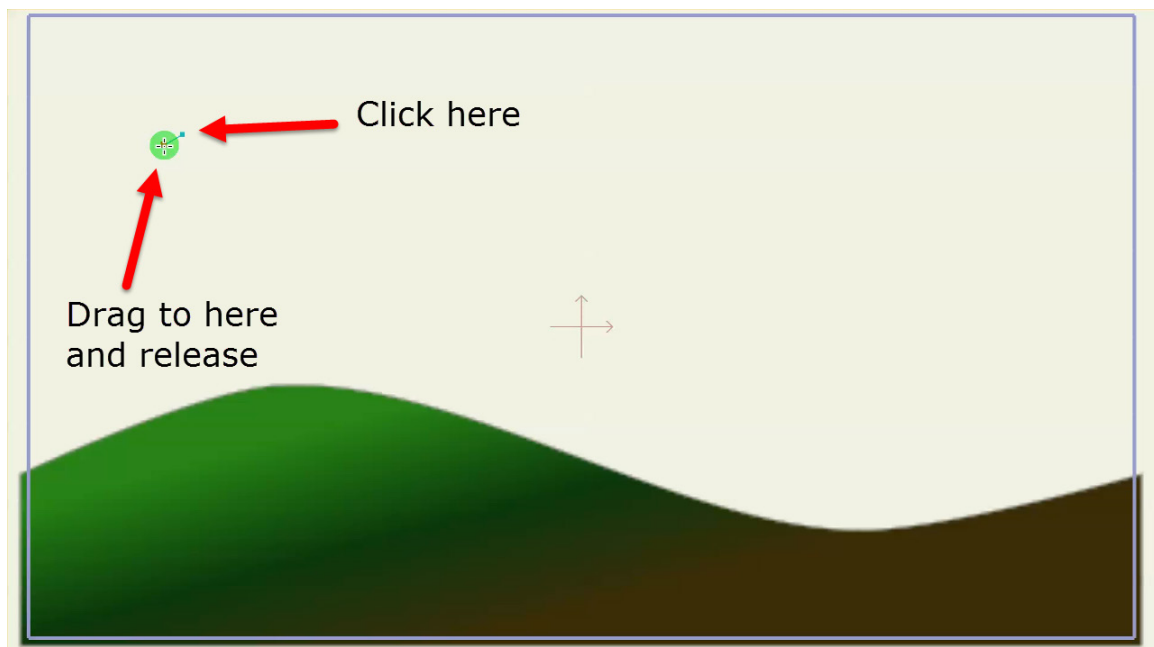
Add a line segment.

Next, click on the end of the new line segment and drag to stretch the curve out like this:

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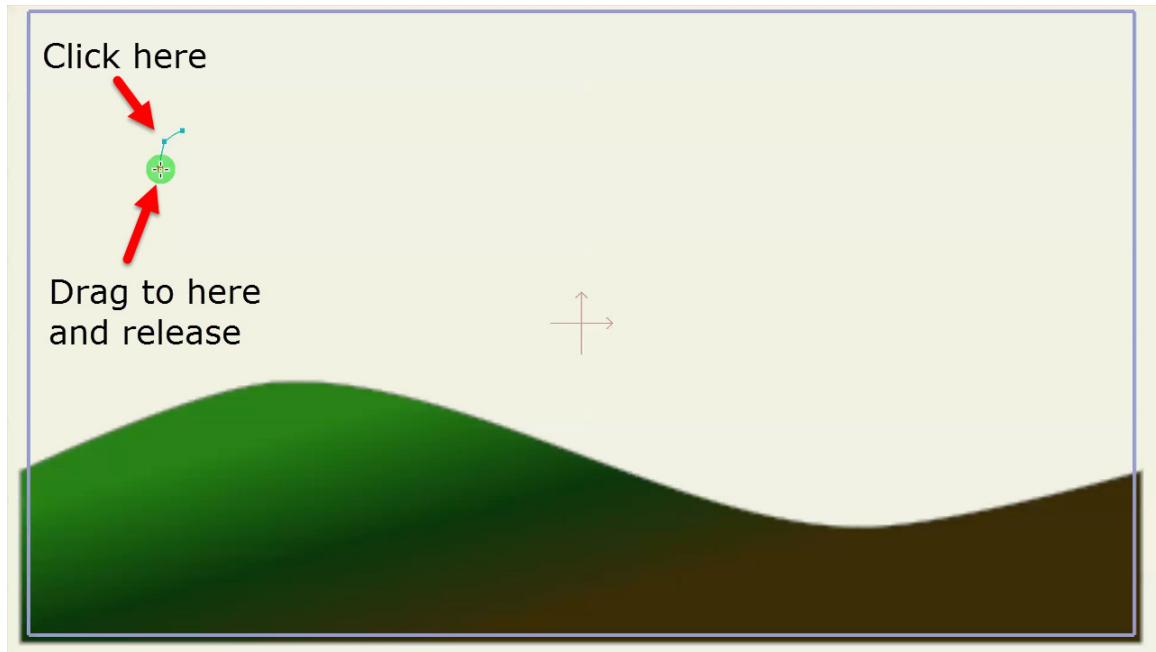
Add another segment to the end of the curve.

Do this a few more times until you have the curve below:
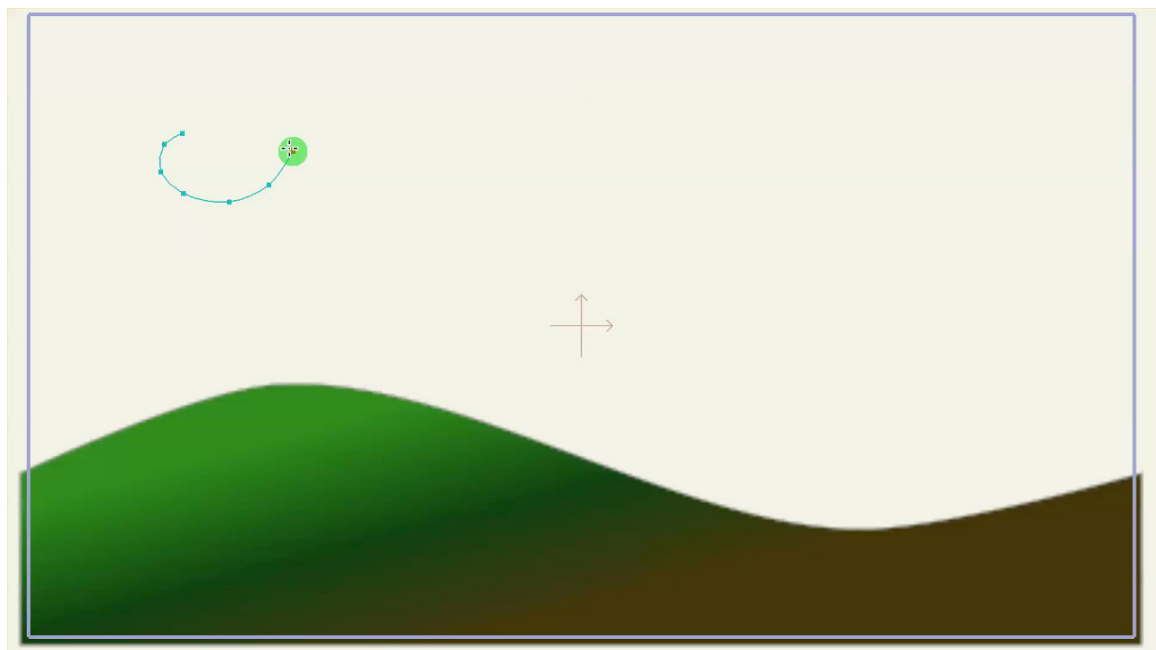
Several more segments added.

The key point to remember is in order to extend a curve, you need to click on one of its endpoints and then drag the mouse to where you want the new point to be. Remember, if you make a mistake at any time, just choose the **Edit > Undo** menu command.

Now we're going to add a second puff to the cloud. Move your mouse to the point just before the end of the previous segment. The "Auto Weld" option for the Add Point tool should be turned on by default. When turned on, the node will turn green

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when you can automatically weld the new segment to the existing one. When Auto Fill is turned on, the cloud will automatically fill with color when the shape is closed.
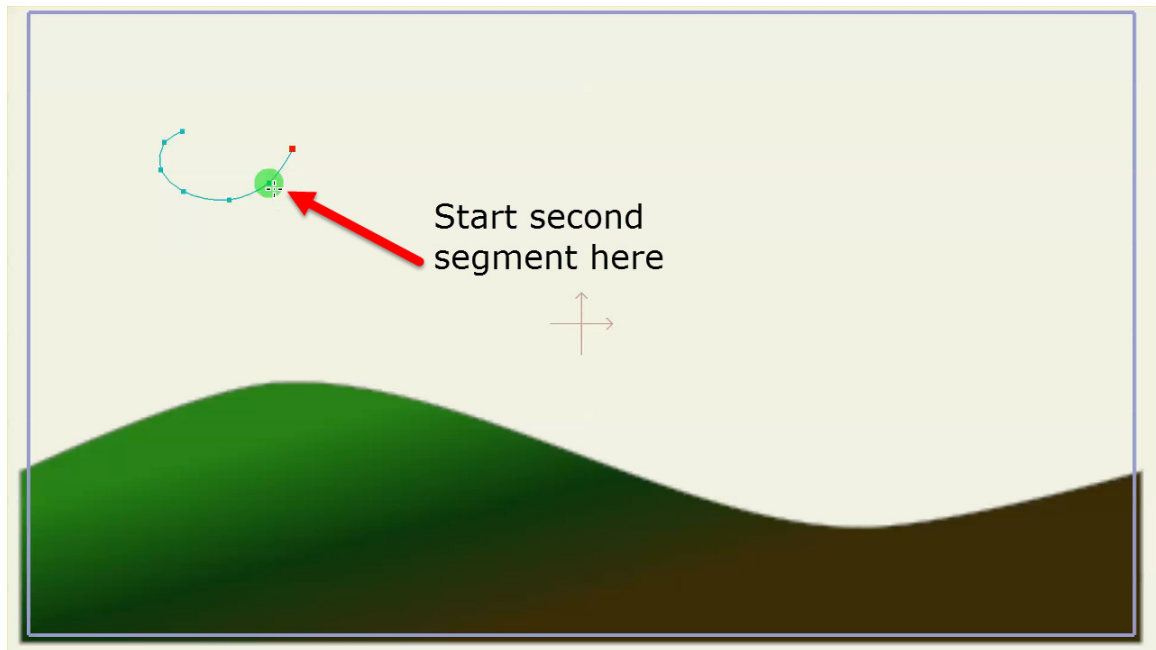
Add a new curve at this point.

Click on the second to last point in the curve, and drag down and to the right, as shown below. When you use the **Add Point** tool on a point that is in the middle of a curve, what happens is that you start a new curve that is automatically welded to that point in the first curve. These two curves are permanently joined at that point, which becomes important when we get to filling the shape with color. Here's what your project should look like after adding the new curve segment:
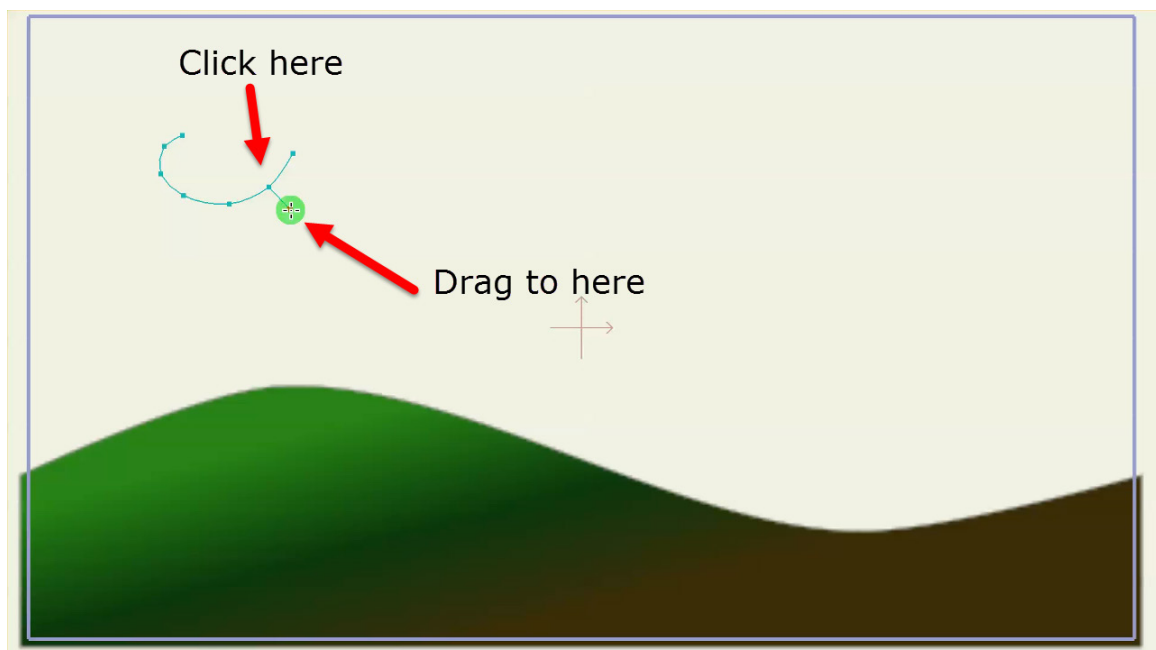
A new segment welded to an existing curve.

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Add some points to the end of this new curve to get the shape below. Remember, to add a point to the end of a curve, click just on the last point of that curve.
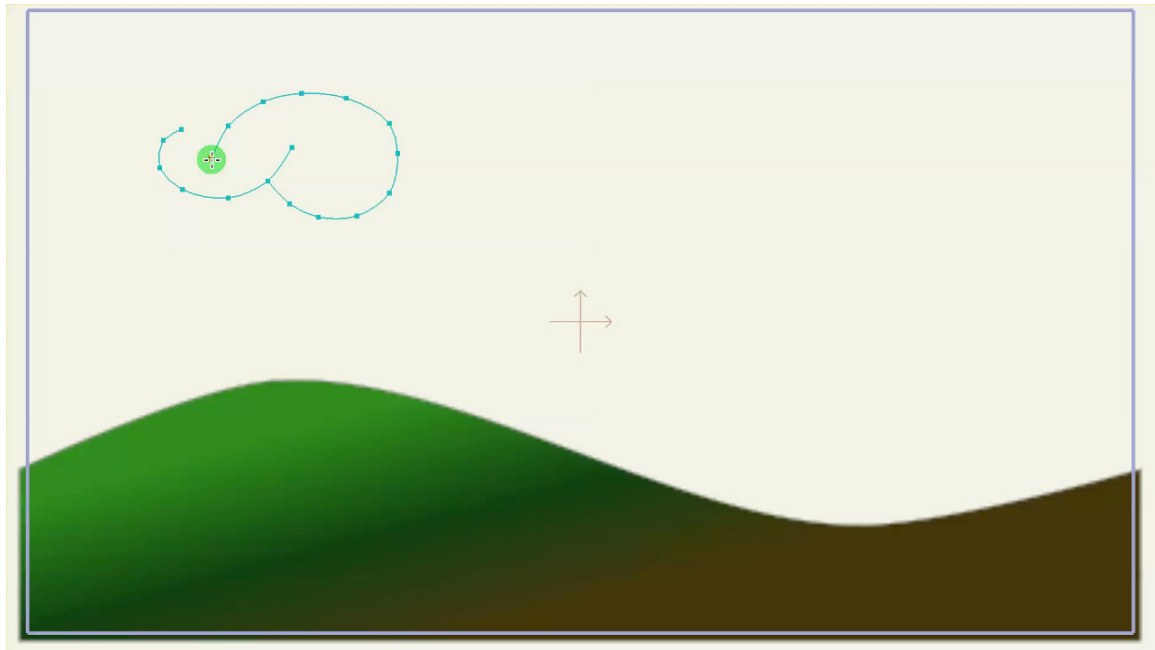
More new points.

Finally, add two or three more points at the beginning of the original curve. When you add the last point, drag it over to the right and line it up with the next to last point of the second curve before letting go of the mouse. Moho will automatically weld those points together and fill the cloud with color to get the final shape below:
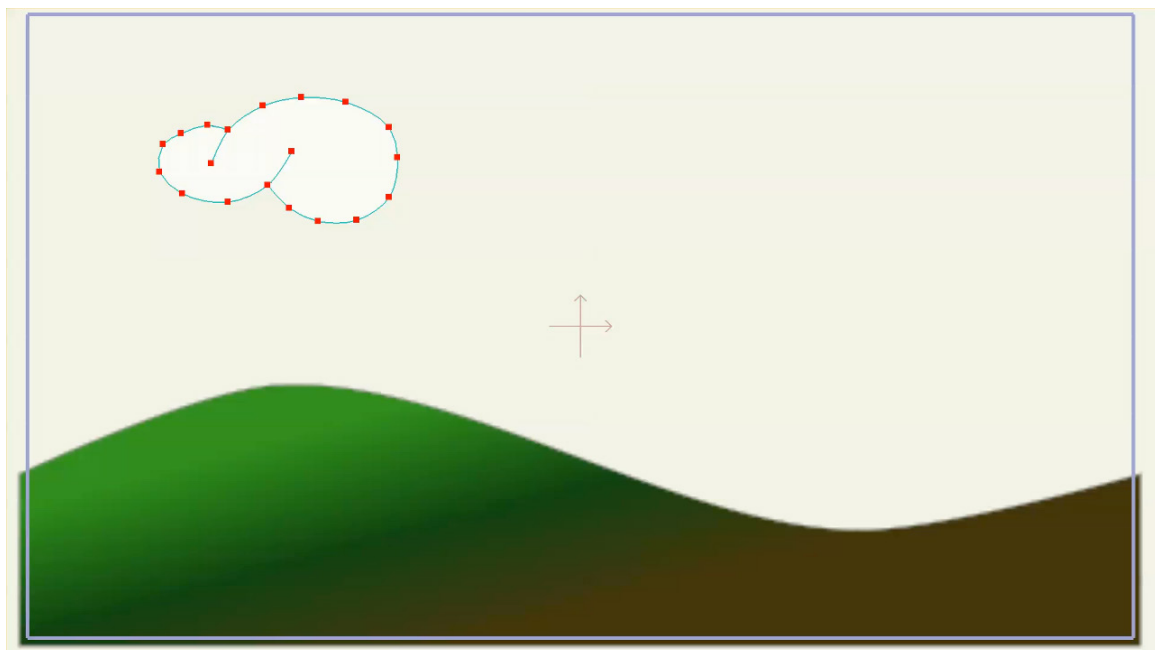
Finished cloud.

Sometimes it can be hard to follow this sequence of steps - let's take a moment to watch a movie of the cloud being created in Moho. Pay special attention to where the mouse is clicked in order to weld the two curves together.

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Click this link to view a brief video of how to draw the clouds..

We will add a line effect to make the cloud a bit softer. In the Style window, check the Advanced button to display the advanced style options. Select 'Soft Edge' from the Stroke Effect pop-up menu. Accept the default settings and click OK.
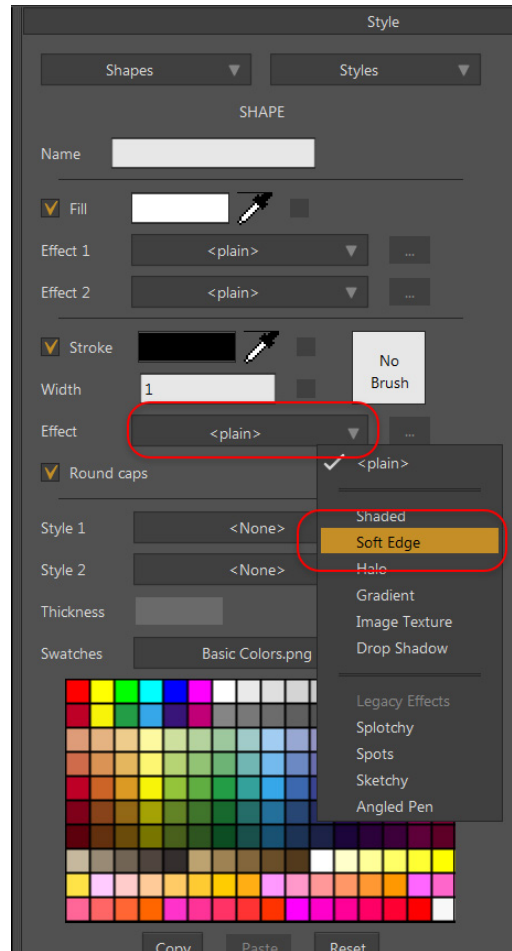
Soft Edge effect.

Now would be a good time to select the **File > Preview** command to see what your final result looks like:

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The rendered cloud.

A Second Cloud

Let's make another cloud. With the Clouds layer selected, choose **Edit > Select All** from the menu. Now choose **Edit > Copy**, followed by **Edit > Paste**. Next, pick the **Transform Points** tool from the toolbar.

In the working area, click and drag to the right to move the new cloud away from the original. (When you paste an object from the clipboard, it is positioned directly on top of the original.)
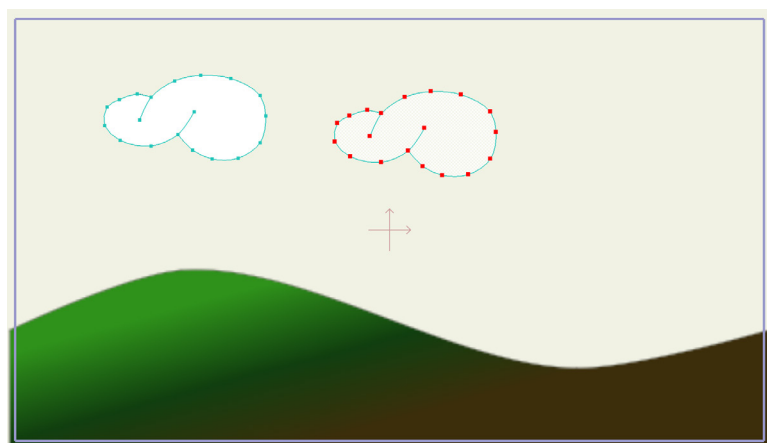
Duplicated cloud.

Use the **Transform Points** tool to resize this new cloud, making it larger or smaller than the original, as preferred (here we make ours larger).

The Transform Points tool can resize an object both vertically and horizontally, and will scale whether or not the object is selected beforehand. In this case, we don't really want to change the cloud's shape like that. With the Transform Points tool active, click and drag one of the corner handles that appears around the cloud, thus making it smaller or larger without changing its overall shape. Continue using the Transform Points tool until you get the new cloud in a position you like.

Drag a corner handle to scale
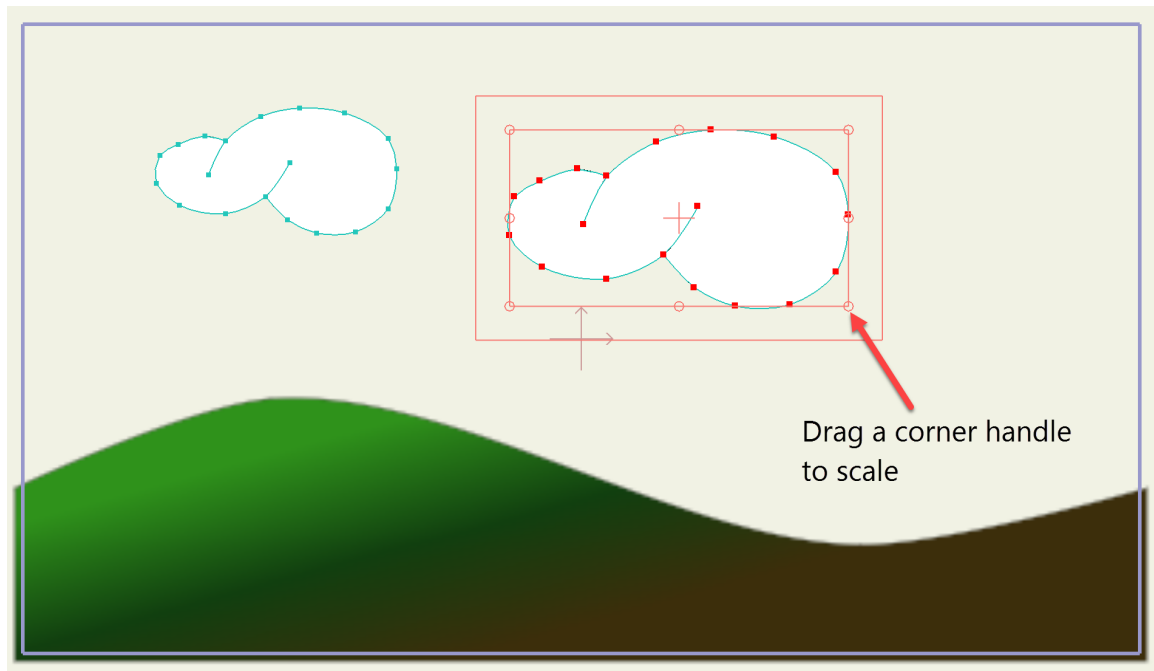
Second cloud scaled and positioned.

To deselect all of the points in the cloud, use the **Edit > Select None** command, or press the Enter key, or click outside the cloud to de-select the points.

Now you can use the Transform Points tool to click and drag individual points to reshape the second cloud.

In this case, since only one point is selected at a time, the Transform Points tool is used to re-shape the cloud, not move the entire object. Just re-shape a few points here and there so that the two clouds don't look exactly the same.

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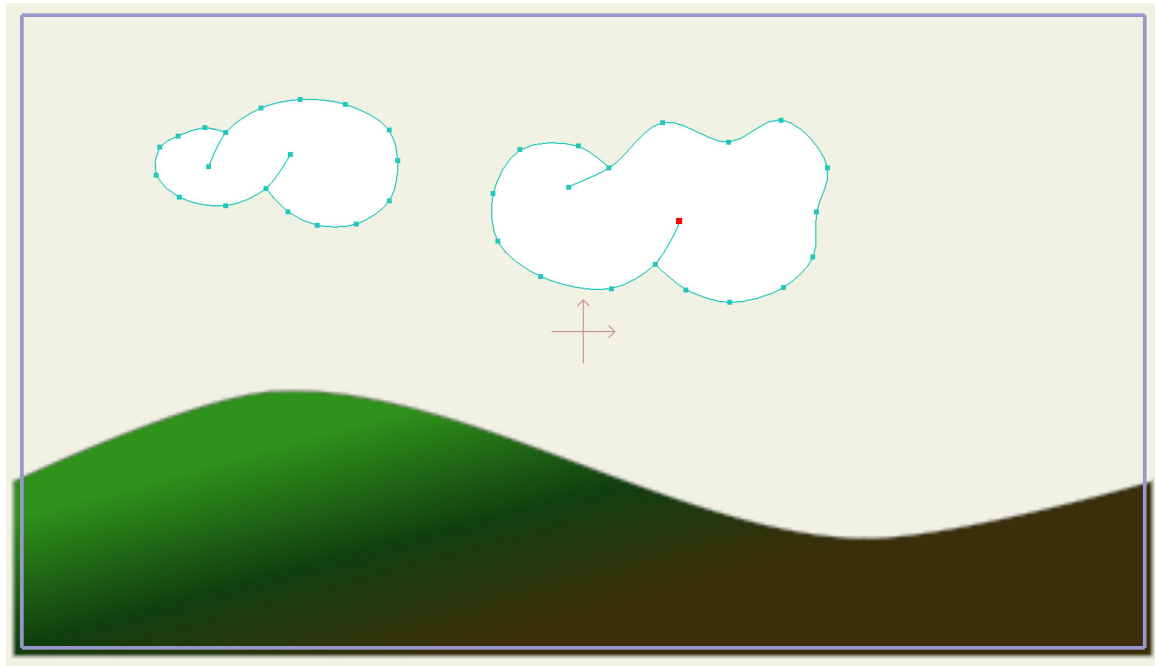
Modify some points.

Plant a Tree

Good - we're moving right along, but this scene needs some plant life. Add a new layer to the project by clicking the new layer button in the Layer window. Again, choose "Vector" from the popup menu. Name it "Tree".
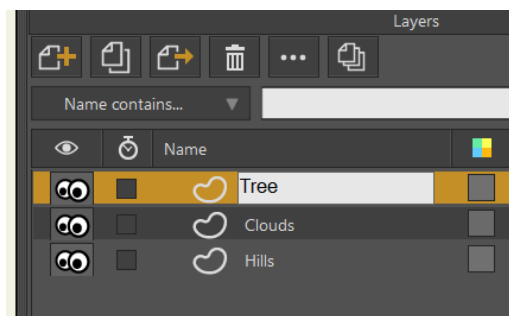
Rename the layer to Tree

Select a brown fill color from the Style panel. Set Stroke Width to 4, and set the effect to <plain>.
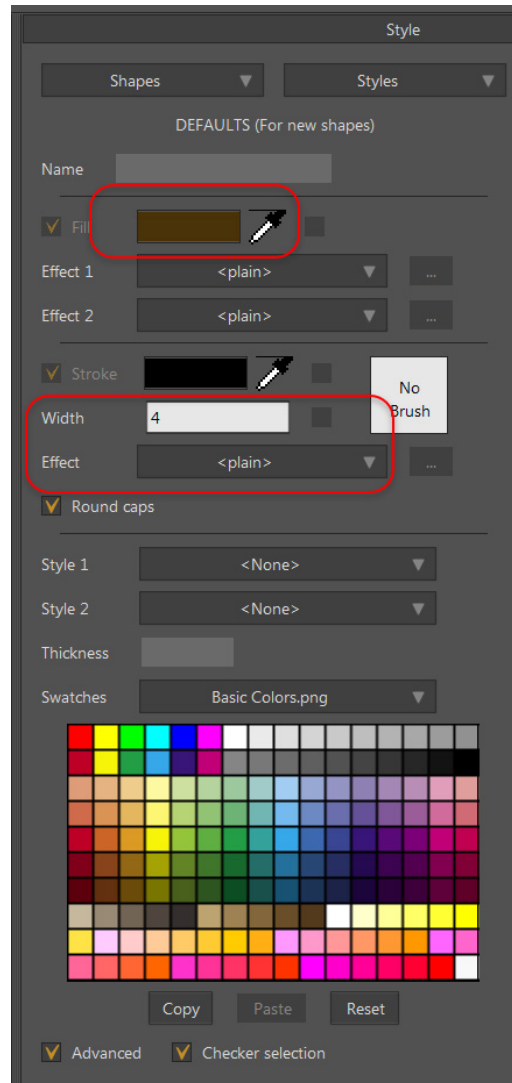
Select a brown fill color.

Using the **Add Point** tool, along with the welding feature, draw a shape that resembles the trunk of a tree.

Here are a few things to remember as you go: First, you can always use the **Edit > Undo** command to back up if you make a mistake.

Second, you can switch to using the **Transform Points** tool to reshape part of the object, even if you haven't finished drawing the whole thing yet.

Third, the Transform Points tool lets you pick individual points by clicking on them - if you want to get rid of a point, but it's too far back to use undo, select it with the Transform Points tool and press the backspace or delete key on your keyboard.

Feel free to be creative with your tree trunk, you don't really have to stick to the sample below.

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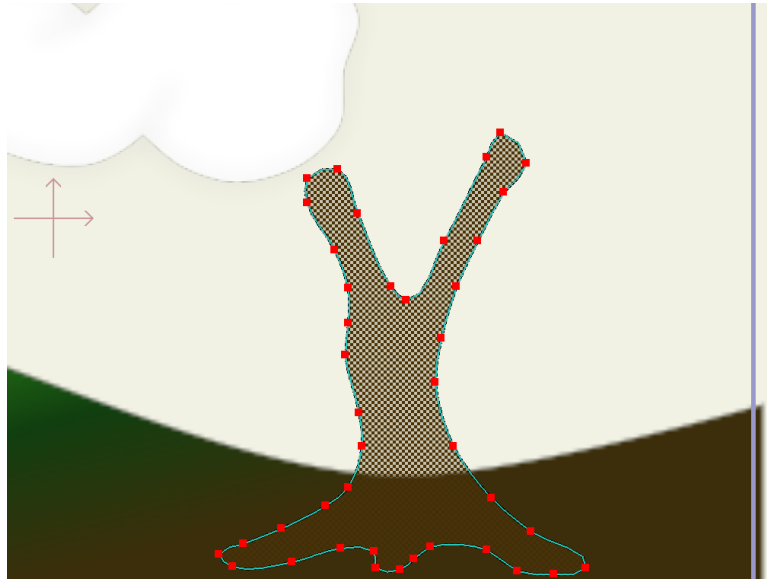
Draw a tree trunk

There are a few tools that may be useful when building your tree that haven't been introduced yet. The **Pan Workspace** and **Zoom Workspace** tools can be used to move around the workspace.

Note that these tools are not used to manipulate your drawing - they just let you move your view so that you can focus in on a particular area of interest. To reset your view to its original position, select the **View > Reset** command from the menu bar.

Another useful tool is the **Curvature** tool. Using this tool, you can click and drag on a point to adjust how round or pointy the curve is as it passes through that point.
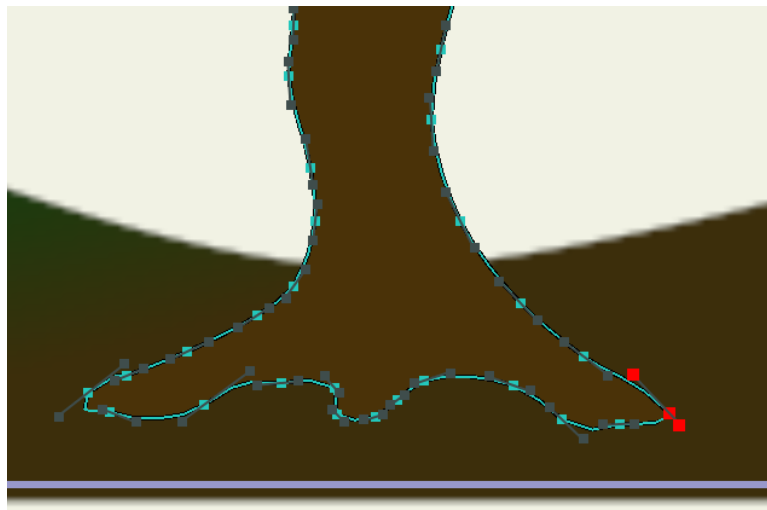
Use the Curvature tool to adjust the curves.

The last thing we'll add in this tutorial is some greenery to the top of the tree. The shape for the treetop will be similar to the clouds, so follow similar steps to create it, but there is one tricky part. Because the treetop overlaps the trunk of the tree, it can

be easy to click on the wrong part and add a new point to the trunk instead of the treetop.

There are two ways to avoid this problem.

- One, use the Pan and Zoom tools to move in close to the top of the tree so that it's easier to avoid clicking on the wrong thing.

- The second approach is to draw the treetop off to the side where there's plenty of empty space. Then, when the treetop is finished, drag it back into position at the top of the tree.

- For the second approach, when you're ready to move it back into position, use the Transform Points tool and click to select one point on the treetop. Then use the **Edit > Select Connected** command to select the rest of the treetop. Finally, drag the treetop into place, and use the Transform Points tool to resize it if necessary.

Select a nice leafy green fill color in the Style panel. Set the line width to 4, you'll see why later.

Quick Start
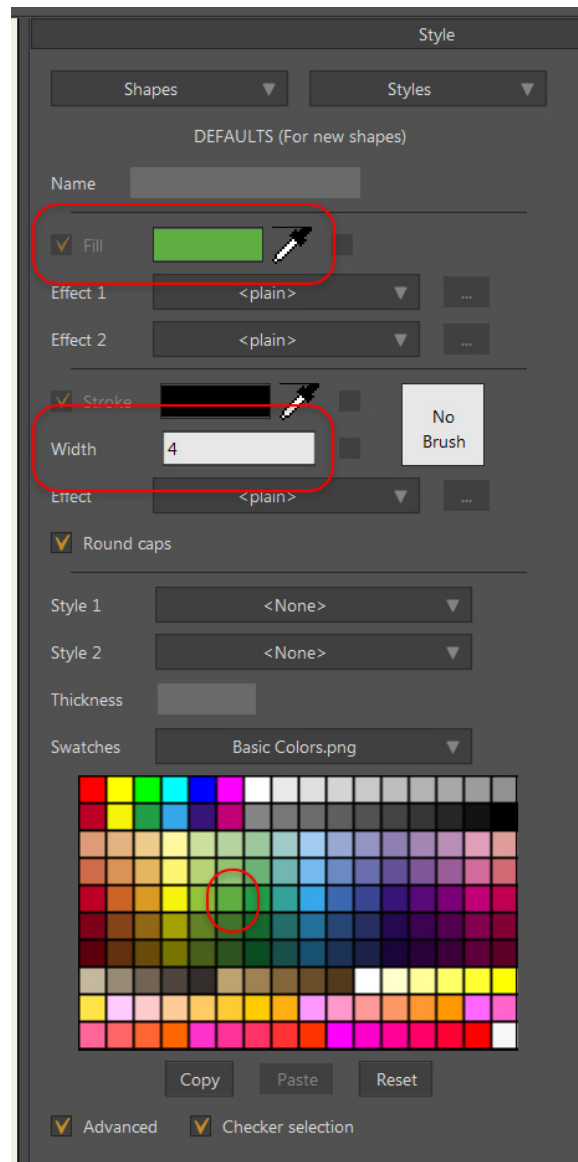
Select a green fill color and set line width to 4.

Use the Add Point tool to draw your treetop. Here's the kind of look we're going for:
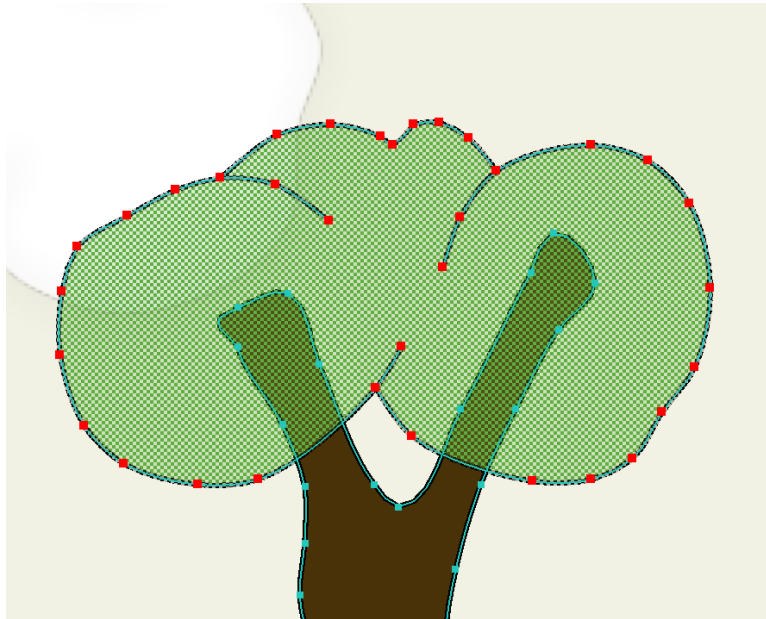
The treetop.

Choose **File > Preview** to see how the treetop looks. Notice how the ends of line segments look kind of squared off and blocky. We'll fix that using Moho's variable line width feature.

Exit the render window and press Enter to de-select all points in the treetop.

Now, using the **Line Width** tool, click on each of the points in the treetop that is at the end of a line segment. The area that the Line Width tool affects is indicated by a semi-transparent red circle. The default width is .5, which is quite large. Decrease the width to around .1 or less to obtain finer control over the area that you want to affect.
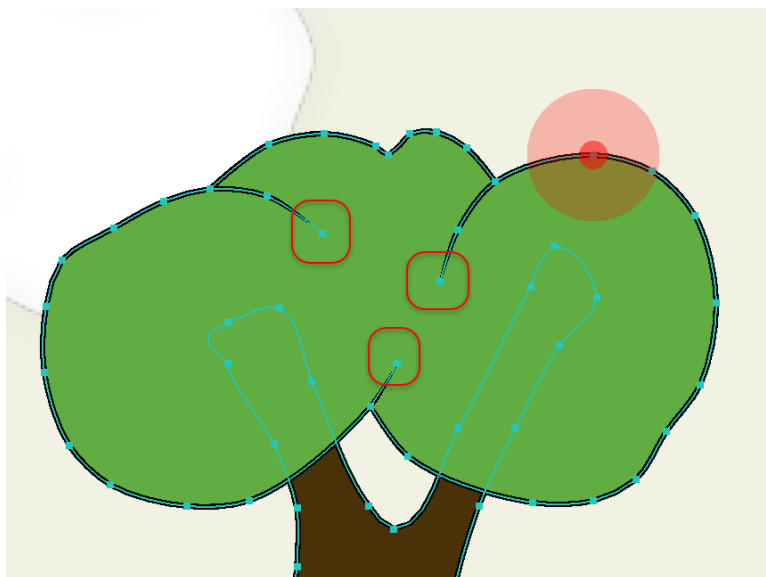
Changing line width.

Choose **File > Preview** again, and notice how the endpoints are now nicely tapered. This feature isn't limited to endpoints - experiment with using it on other points along

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a curve. Also, try dragging the Line Width tool back and forth to make lines thinner or thicker.
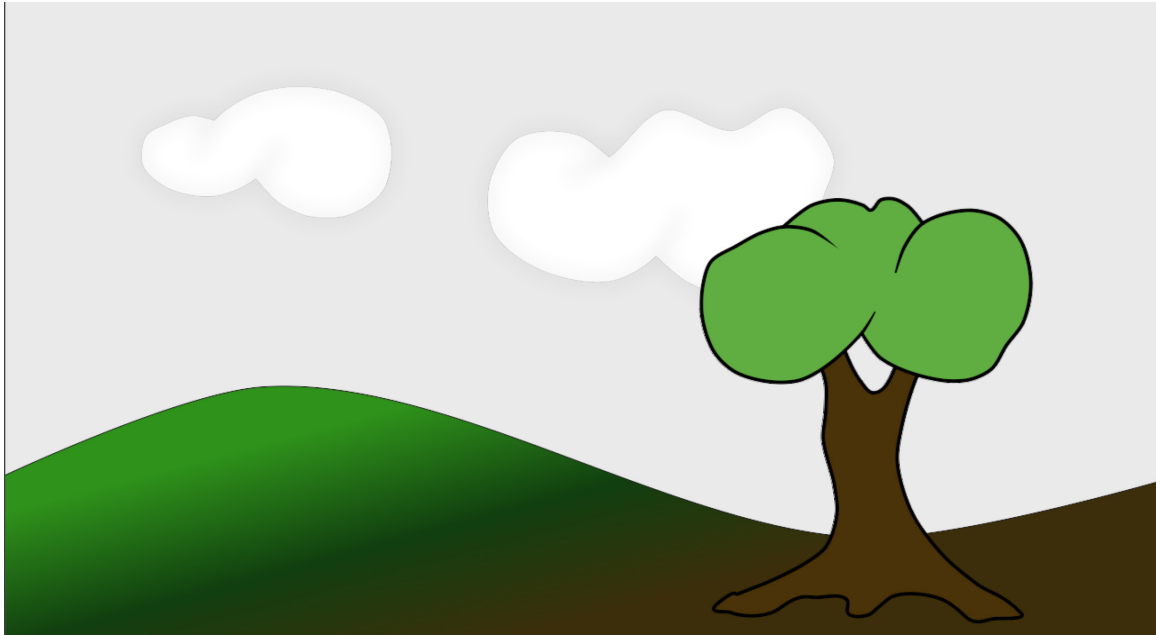
The completed background.

"Tutorial 1.4: Bone Setup" on page 28 *will move into using bones to control a character, and you'll learn how to set up some animation controls to make things move.*

Tutorial 1.4: Bone Setup

This tutorial builds on the results of the previous two, teaching you how to add bones to a character. You can either continue with the project you created in Tutorial 1.3, or you can open a file provided for you named "Tutorial 1.3". This file can be found in the "Tutorials/1 - Basics" subfolder within your custom content folder.

Bones are an important tool you can use in Moho to help make animation easier. If you think of drawings in Moho (like the ones you made in previous tutorials) as soft rubber, then bones can be thought of as stiff wires inside the rubber that help you move and position objects. Bones are never displayed in a final rendering, they're just used as tools during the animation process.

Bones are not absolutely necessary for animation. They are very helpful for animating certain types of motion as we'll show in this and the next tutorial, but there are other ways to animate in Moho as well. As you gain experience using Moho, you'll learn when bones are appropriate and when they're not.

Importing an Object

Launch Moho and open the project from the last tutorial.
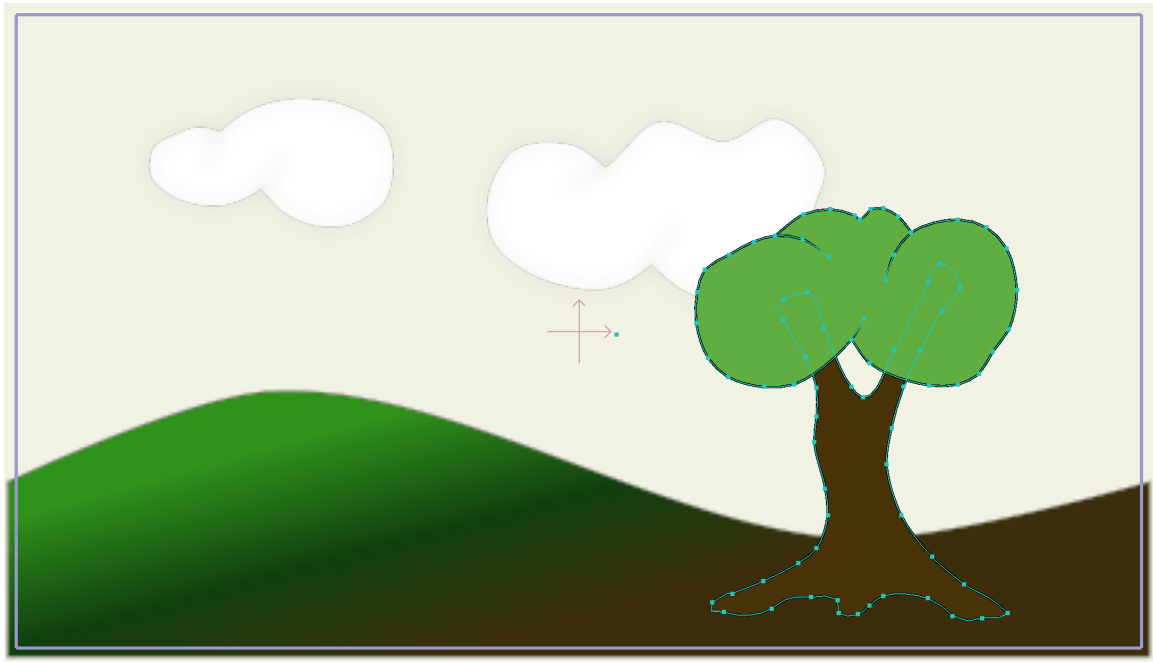
Starting point for this tutorial.

As you build a Moho project, there are times you may want to re-use objects you created before. There's an easy way to do this, and we'll use it now to add a character to the project.

Select the **File > Import > Moho Object**... command. In the file dialog that appears, navigate to your Moho custom content folder. From your custom content folder, locate the Tutorials/1 – Basics folder and open the file "Tutorial Extras." A dialog will open asking you which object you want to use from this project:

> *If you have not yet created a custom content folder, choose*
> **Help > Set Custom Content Folder** *to create one. See* **"Creating**
> **a Content Folder" on page 16 in your Moho Users Manual** *in your*
> *Moho Users Manual).*
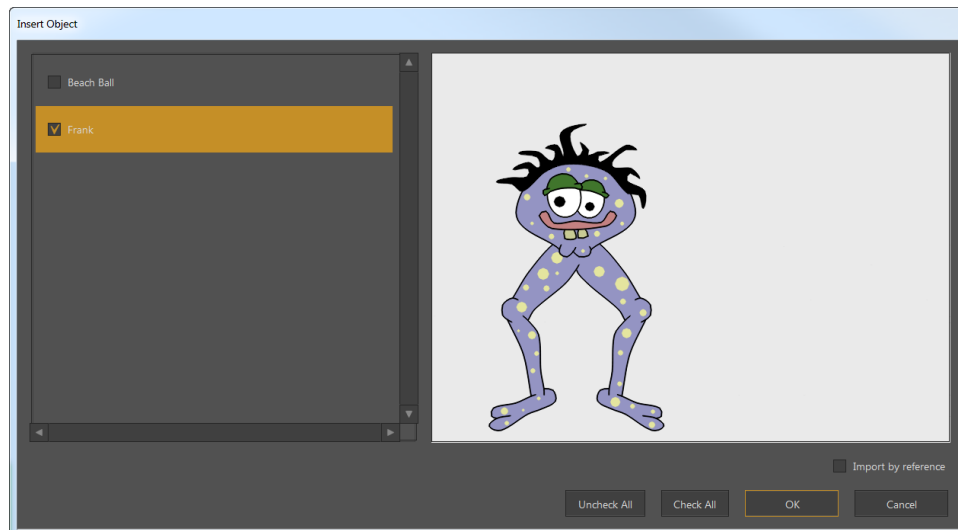
Insert Object dialog.

Select the layer named "Frank" on the left side of the dialog. On the right side, you'll see a preview of Frank. Click OK. A new layer will be added to your project. This layer is a copy of the layer Frank from the "Tutorial Extras" project. Frank is fully drawn and filled in - you can see what the scene really looks like now by selecting **File > Preview**.
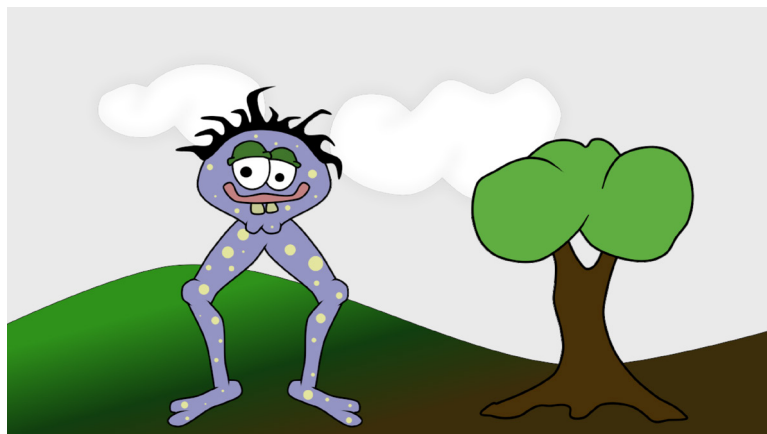
Frank added to the project.

Adding Bones

Lets give Frank some bones to make him easier to animate. In the Layers window, click the new layer button. In the popup menu that appears, choose "Bone". Rename this new layer "Skeleton."

Drag the Frank layer upwards "into" the Skeleton layer. **This step is very important - you will know that you're dragging the Frank layer to the correct place when the Skeleton layer becomes highlighted.** Finally, click the Skeleton layer to make sure it's active. When this is done, the Layer panel should look like this:
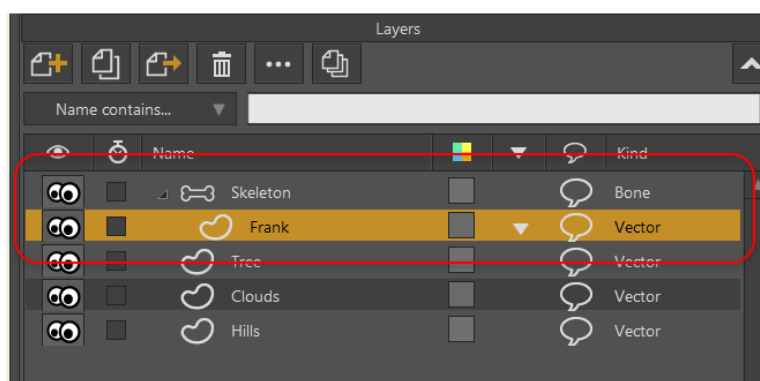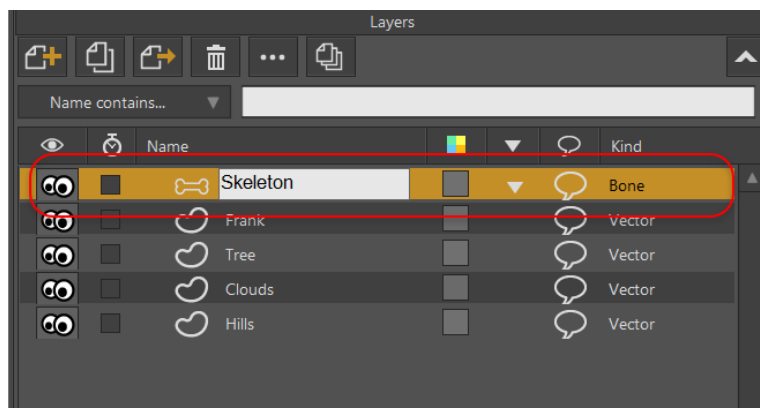
Add a bone layer named Skeleton (top) and drop Frank inside the layer (bottom).

Make sure the layer "Skeleton" is selected in the Layer panel. Click the eyeballs icon on the left side of the Tree, Clouds, and Hills layers to temporarily hide them.
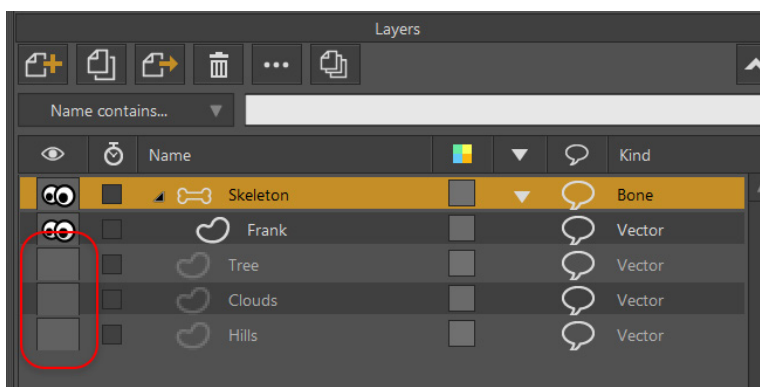
Hide the Tree, Clouds, and Hills layers.

Finally, use the Pan and Zoom tools to zoom in on the contents of this layer. Your window should now show something like this:

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Zoomed in on Frank.

With the Skeleton layer selected, add a bone to Frank by selecting the **Add Bone** tool and clicking and dragging upwards as shown below:

This will be the main control bone - you could think of it as Frank's spine. It should look like this:
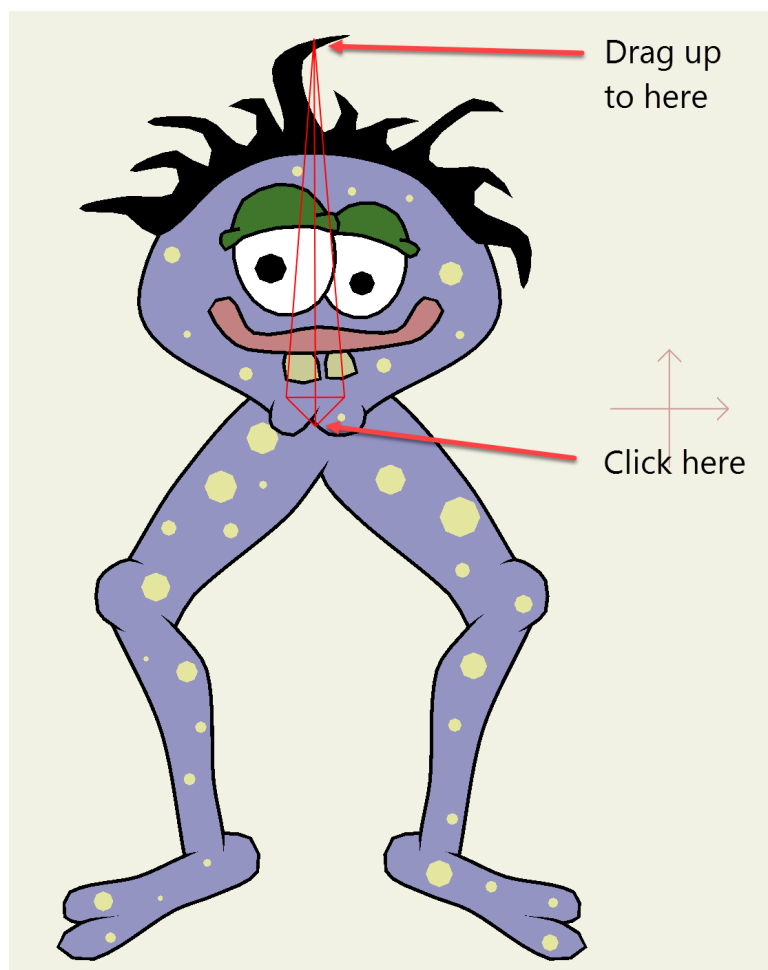
First bone added.

Click and drag out three more bones as shown below. It's important that you draw these three bones in order from top to bottom: thigh, shin, and foot.

Right leg bones.

When a bone is selected, it is drawn in the highlighted color, red.

When you add a new bone, it becomes the "child" of the currently selected bone. The parent-child relationship for bones means that the child can move around without affecting the parent, but if the parent moves, the child will move with it. This is why it was important to draw the previous three bones in order: the thigh bone's connected to the spine bone, the shin bone's connected to the thigh bone, and the foot bone's connected to the shin bone (at least in Frank's body).

When a bone is selected, it's displayed in red. Its parent also gets displayed differently: in blue. The parent is highlighted like this for your information - sometimes you may connect bones in the wrong order and looking for the blue parent bone can help determine where things went wrong.
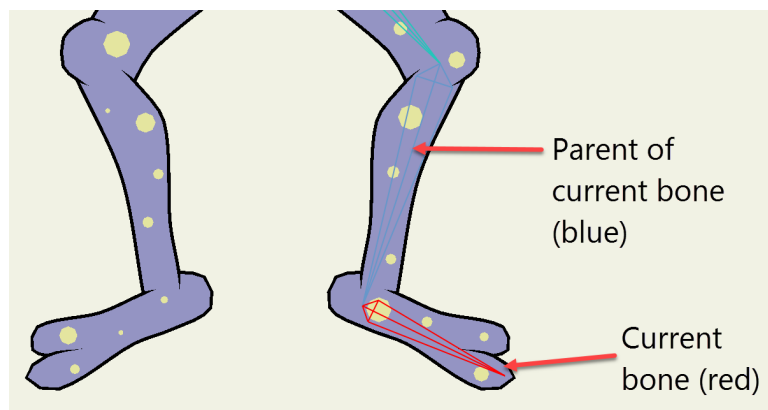
A current bone and its parent.

OK, let's add bones to the other leg. But first, we need to select the spine again so that the second leg will also be attached to it. Use the **Select Bone** tool and click on the spine to select it.

Next, use the **Add Bone** tool to add three bones to the other leg as shown below:

Select the spine bone

Then add three bones for the other leg.
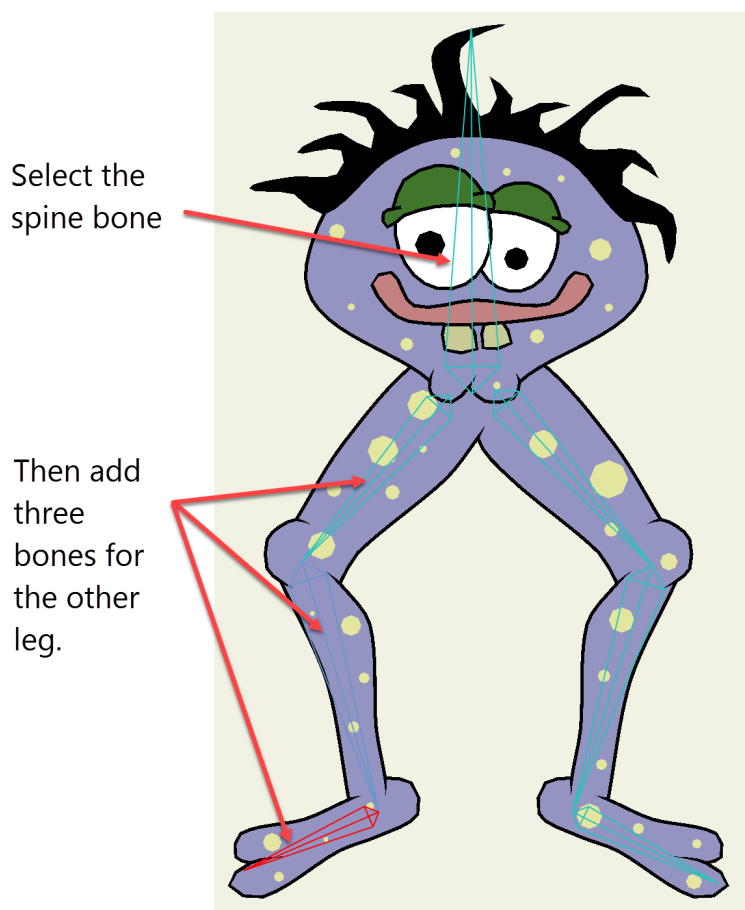
Left leg bones.

Testing Bones

There's a bone tool that lets you test how your skeleton structure is working. Let's try that now. Select the **Manipulate Bones** tool and click and drag any of the bones you created. Try dragging several of the bones around to see what happens.

Moving Frank's legs.

Notice that Frank automatically moves with the bones. You may have also noticed that Franks looks quite "squishy" - when you move either of his legs, his head changes shape as well. The next step is to clean this up a bit by telling Moho which parts of Frank should move with which bones.

When you are on Frame 0, the Manipulate Bones tool doesn't permanently move the bones. Click the **Select Bone** tool and all the bones will snap back into their original places.

Adjusting Bone Strength

When you use a bone layer to control a character, every bone in the skeleton has some influence on every part of the character. We saw that in Frank - when you

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move one of the legs, even the head moves a bit. This influence is strongest closest to each bone, so the head only moves a little bit, not as much as the leg itself.

We don't really want to see Frank's head move much at all when his legs move. Luckily, there's a way to control this: bone strength. Each bone has a "strength" value that controls how large its region of influence is. What we'll do next is adjust the strength of the bones that control Frank.

Select the **Bone Strength** tool and take a look at the bones.

Each bone has a semi-transparent region highlighted around it. (You also saw these regions when using the Manipulate Bones tool.) These regions show you the influence of each bone in the skeleton. A bone has the most influence inside its shaded region.

Regions of influence.

With the Bone Strength tool active, click and drag side-to-side on each of the bones in Frank's skeleton to adjust its strength. The goal here is to adjust the region of each bone so that it just encloses the corresponding section of Frank's body. For example, the region around the shin bone should just enclose the shin, and not much more. Don't worry about being too precise - pretty close is good enough. For Frank's head, don't make the bone region enclose the entire head - that would make the

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bone too strong. Adjust the bone strengths so that they look approximately like the following:

Adjusted bone strengths.

Testing Bones (Again)

Once you adjust bone strengths, it's a good idea to test the skeleton again to make sure everything works correctly. Pick the **Manipulate Bones** tool from the toolbar and click and drag on Frank's shin bones just above the ankle.

If everything was set up correctly, Frank should be able to move like this:

Bones in action.

Play around - move Frank's bones around into various positions and get a feel for manipulating the skeleton. will cover animation, and you'll learn how to make objects move around over time.

Tutorial 1.5: Animation

This tutorial continues on from the previous three, moving into the animation features of Moho. You can either continue on with your project from the previous tutorial, or you can use a file that has been created for you - it's named "Tutorial 1.4" and it's located in the "Tutorials/1 - Basics" subfolder within your custom content folder.

There are three basic ways to animate objects in Moho:

• animating an entire layer,

• using bones to animate parts of an object,

• animating the individual points on an object

These three types can be combined to make very complex animations. This tutorial will walk you through all three types of animation.

Open your previous project (or the "Tutorial 1.4" file) in Moho. Make sure all the layers are visible by clicking to turn on each layer in the Layers window.
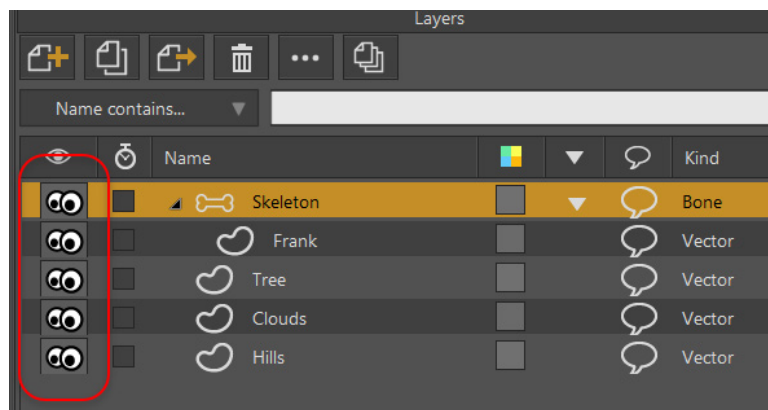
Turn on all layers.

Your window should look something like this:
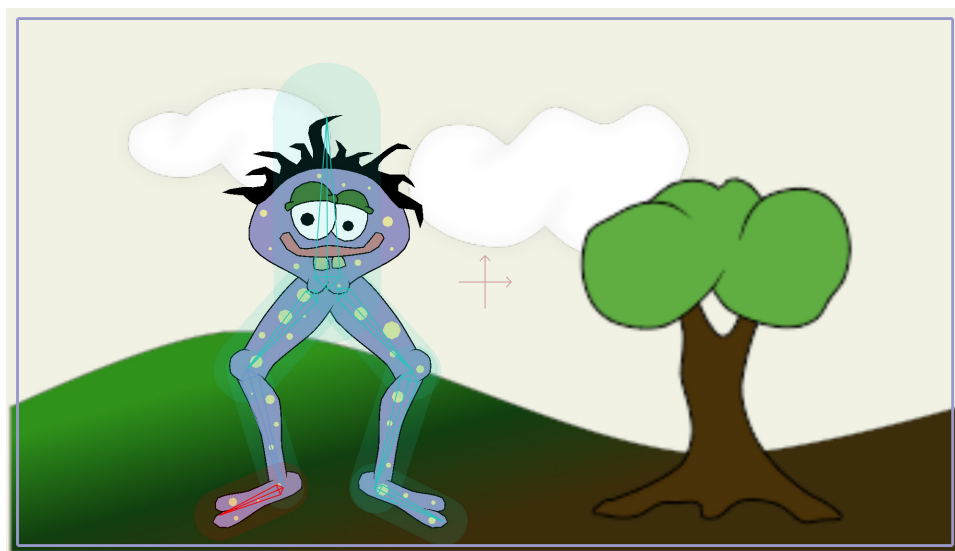
Starting point for this tutorial.

Layer Animation

Layer animation is the most simple way to make objects move around in a Moho animation. It's limited in the way you can move the objects, but in some cases it's all you need. Layer animation moves an entire layer around as if it were painted on a pane of glass.

Click the Clouds layer in the Layers window to activate it. Next, set the current time to frame 72. This is done in the Timeline window. To set the time, scroll the timeline panel sideways (if necessary) until you see the number 72 in the ruler at the top. Click on the number 72 and the time marker will jump to that frame, as shown below:
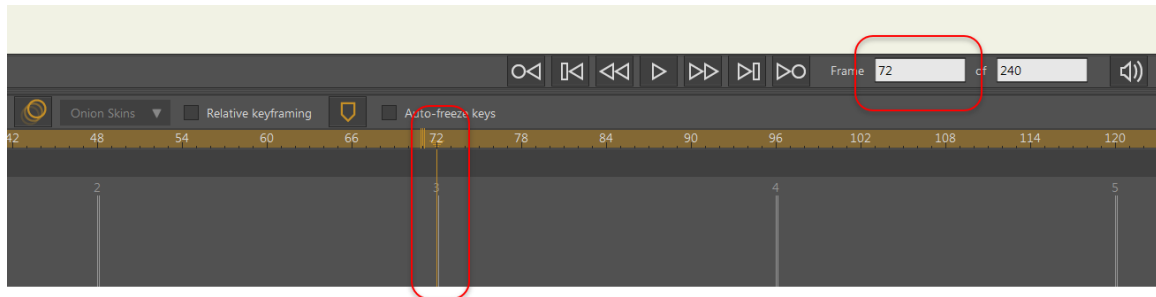
Time set to frame 72.

🔴 *If you do not see multiple channels in the timeline, you may have Moho set to collapse them. Choose* **Edit > Preferences,** *and uncheck the "***Consolidate timeline channels***" option in the Options tab. This displays all animation channels in the timeline.*

🔴 *In Moho, an important concept is to learn the importance of frame zero. At the far left end of the timeline is a frame marked zero. When the time is set to zero, you are in Moho's creation mode. For now, you should only draw, add bones, or create other objects at frame zero. When Moho is at any other frame, you are animating the objects you have created. As you get more comfortable with Moho, you can choose to draw objects at other frames, but for now it's best only to create new objects when the time is set to frame zero. You can switch back to frame zero at any time by pressing the rewind button, or by clicking on the number 0 in the timeline. For now, leave the time at frame 72.*

Select the **Transform Layer** tool from the toolbar.

Click and drag to the right in the working area to move the cloud layer to the right. You can press the Shift key, if desired, to constrain the movement to a straight line.:
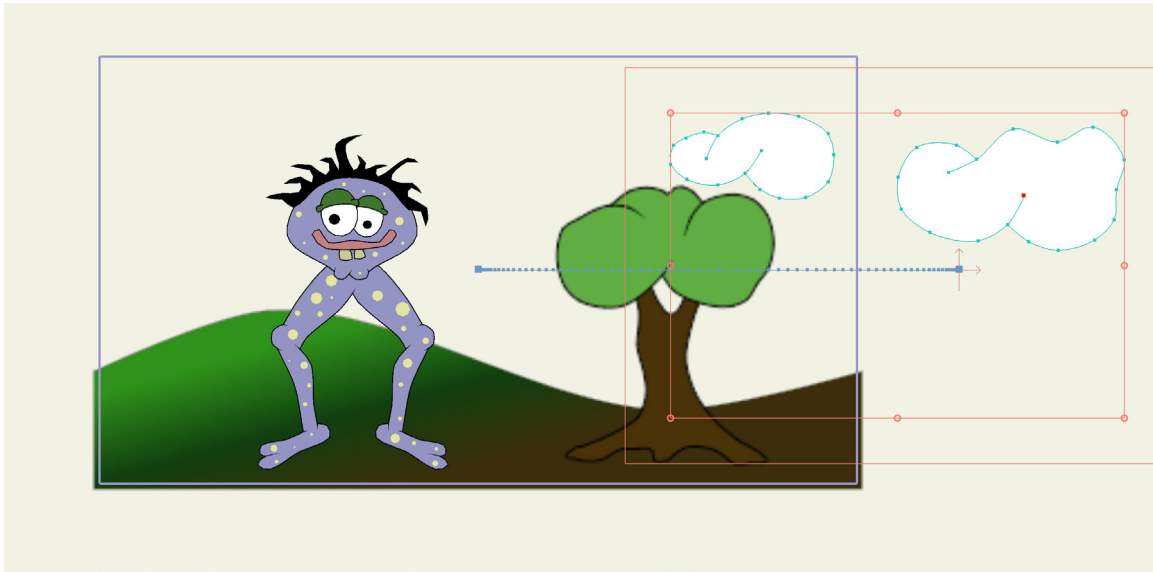
Moving the cloud layer.

Notice that a marker appeared in the timeline at frame 72. (You may have to scroll downwards to see the marker.) This marker represents a keyframe - a point in time at which the layer has been given a position. There are several animation channels displayed in the Timeline panel. This keyframe appeared in the Layer Translation channel, because that's what type of action you just performed - you translated (moved) a layer.
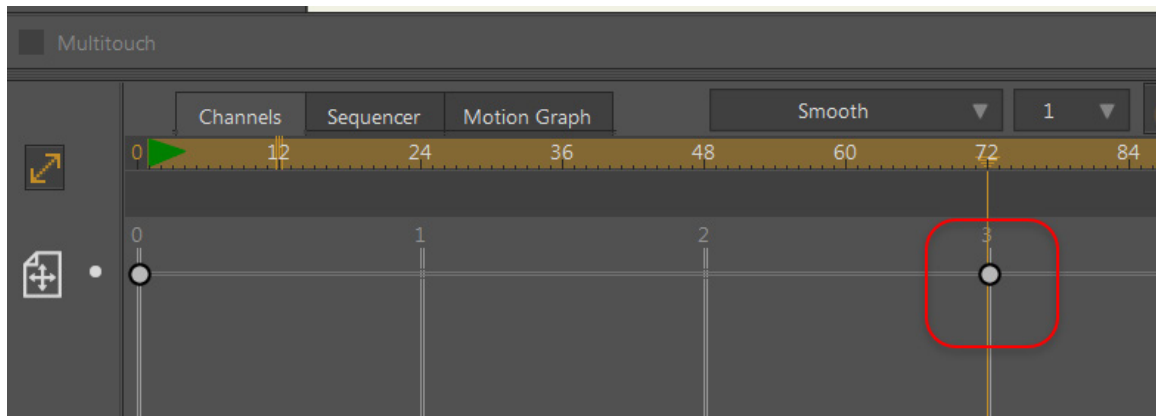
The new keyframe.

Try out the animation so far: press the play button at the bottom-left of the main window. The animation loops when it reaches the end (in this case frame 240). When you've seen enough, press the stop button.

If you prefer, you can shorten the length of the animation to 72 frames, so that it will loop back to the beginning once it reaches the last keyframe. Simply change the total number of frames to 72 as shown below.

Quick Start
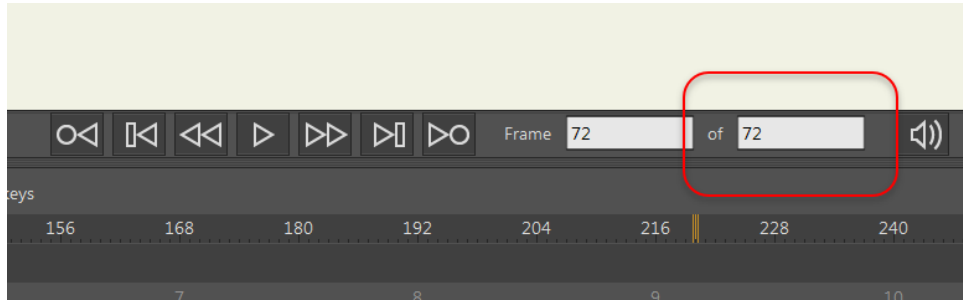
Shorten the length of the animation to 72 frames, if desired.

Bone Animation

Bone animation uses skeleton structures to move an object around. You got a good feel for how bones work in the previous tutorial when you used the Manipulate Bones tool. When animating bones you use very similar tools.

Activate the Skeleton layer by clicking its entry in the Layer panel.
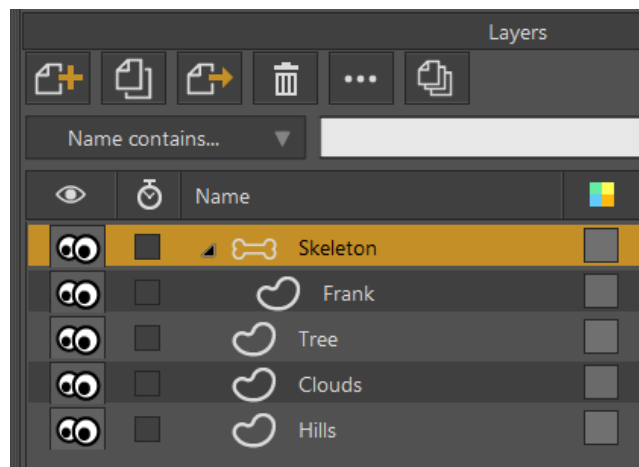
Activate the Skeleton layer.

Set the time to frame 12 by clicking the number 12 in the Timeline window. (You may have to scroll the Timeline window before you can see the number 12.)

Now, pick the **Manipulate Bones** tool in the toolbar. Click and drag the bones in Frank's legs until they are positioned as shown below:
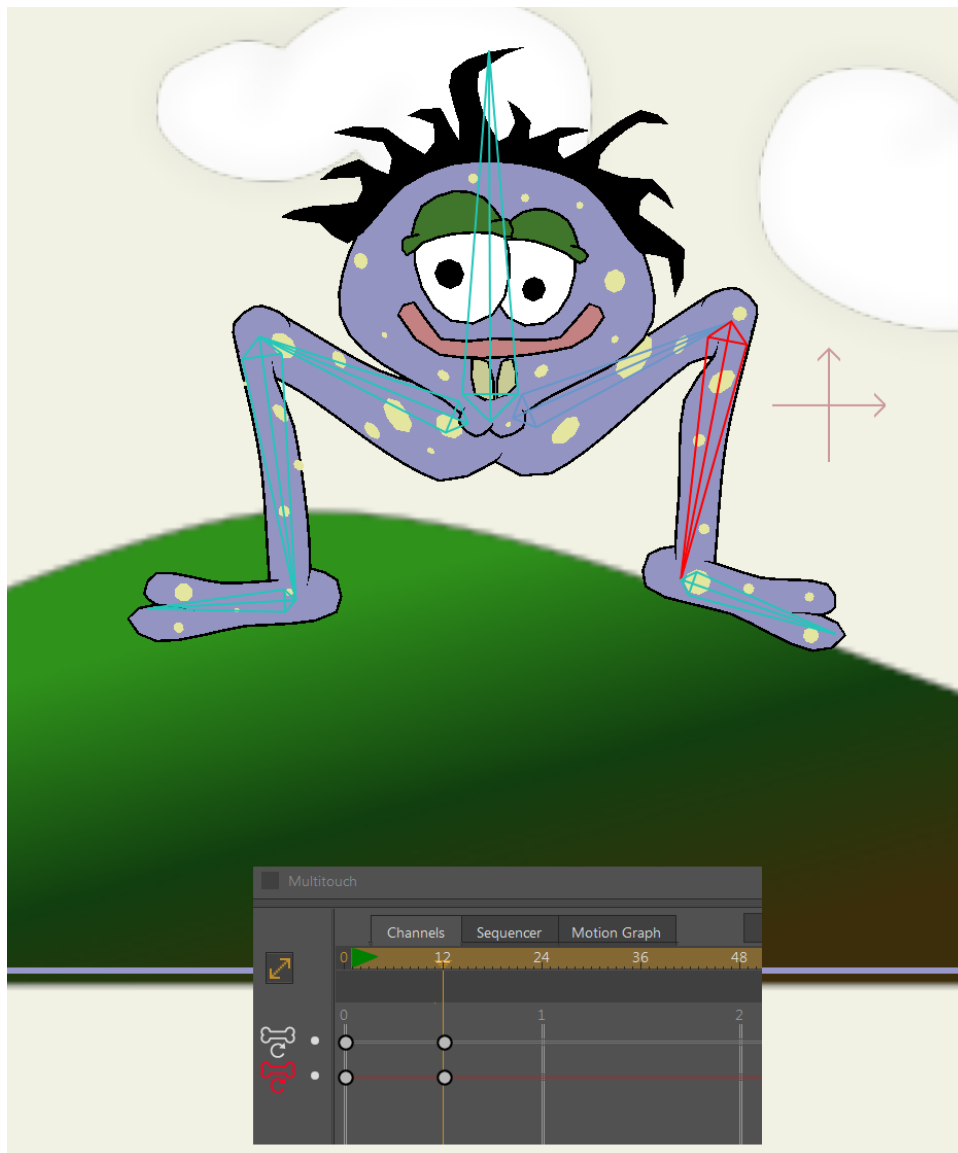
Move Frank's legs up at Frame 12

Note that the Manipulate Bones tool works differently at frame 12 than it did at frame 0 in the previous tutorial. At frame 0, this tool is used to test a bone system, and doesn't permanently modify the bones. However, when you are animating bones (at any frame other than 0), the bones do hold their new position.

Next, pick the **Transform Bone** tool. Click on Frank's spine bone and drag it downwards a bit:

To transform the bone, drag from the bottom control point on the bone. For more information about the control points in the Transform Bone tool, see **"Transform Bone" on page 92 in your Moho Users Manual.**
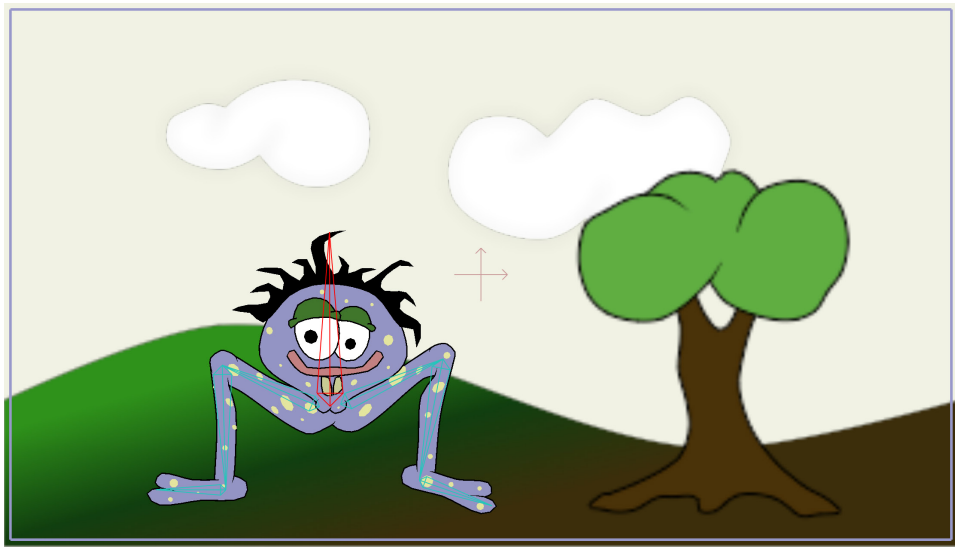
Lower Frank's entire body.

Next, set the time to frame 24 and choose the **Bone > Reset All Bones** menu command. Press the play button to watch your animation, and press stop when you're done.
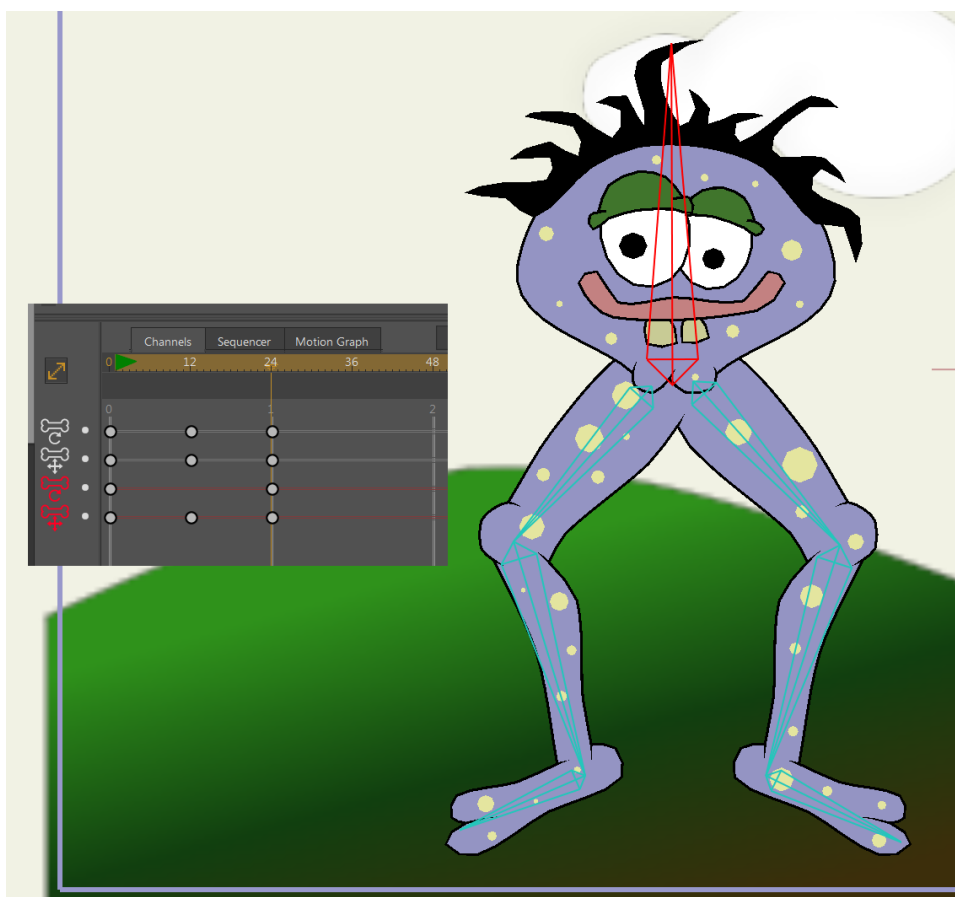
Reset all bones at Frame 24.

When you played back the animation, you probably noticed that after frame 24, Frank doesn't move any more. You could add more keyframes by setting the time

to some later frame and moving Frank's bones some more, but let's try out Moho's animation looping feature.

In the timeline, you should see a group of keyframes at frame 24. These keys represent bone movement (the spine bone moving up and down) and bone rotation (the bending legs). Drag a rectangle around these keyframes to select them:
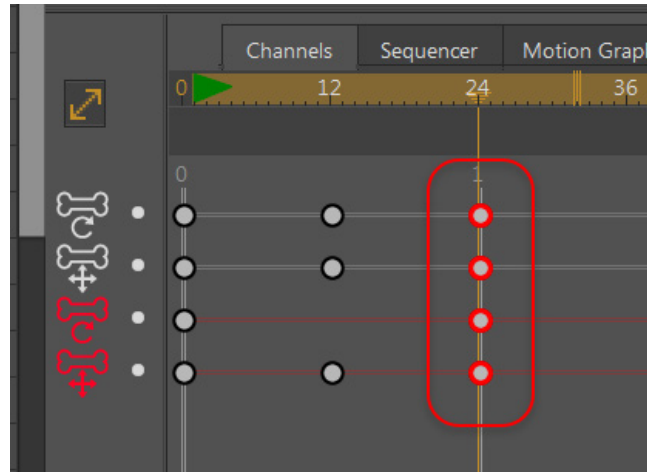
Select bone keyframes at frame 24.

Next, right-click on one of these selected keys. A popup menu will appear. Select "Cycle..." from the popup menu.
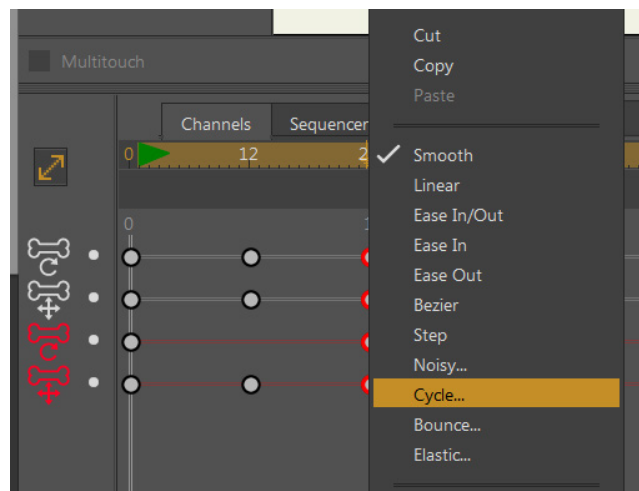
Select Cycle

What you're telling Moho is that you want these keys to cycle back to an earlier point in the timeline. A dialog will appear asking you what frame to cycle back to - enter the settings shown below. You're telling Moho that on this keyframe, the bone movement should cycle back to frame 1.

Quick Start
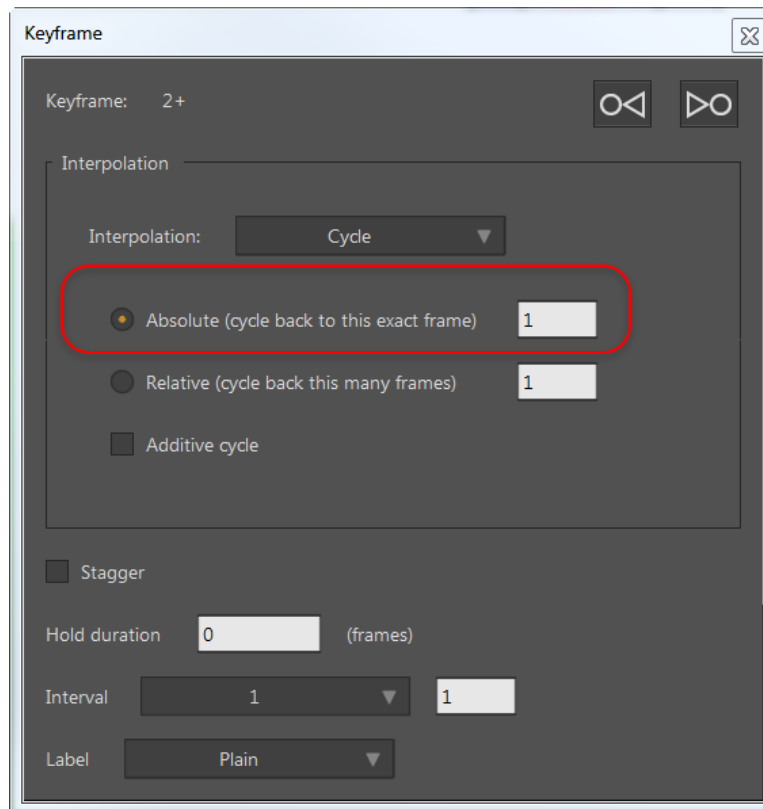
Cycle settings.

Close the Keyframe dialog and press the play button to see the difference. An animation channel with cycling turned on will repeat its animation over and over indefinitely. Typically this would be used for some kind of background element, not a foreground character like Frank, but it's a great time saver. In the timeline you can see an indication of the cycling in the bone channels:
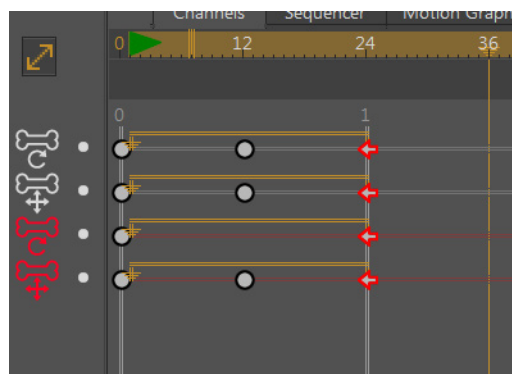
Cycling indicated in the timeline.

Point Animation

Using point animation, you drag around individual points (or groups of points) on an object. In theory, you could animate the same types of motion as with bone animation - bones just save you a lot of work. Point animation is more typically used when you want to change the shape of some object.

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Click the Clouds layer in the Layer panel to activate it.
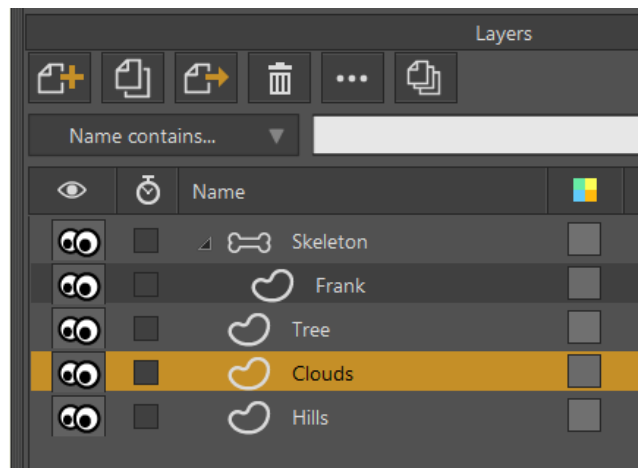
Activate the Clouds layer.

Pick the **Transform Points** tool from the toolbar.

Press the enter key on your keyboard to make sure no points are selected. Finally, click the Jump to End button to jump to the end of the animation.
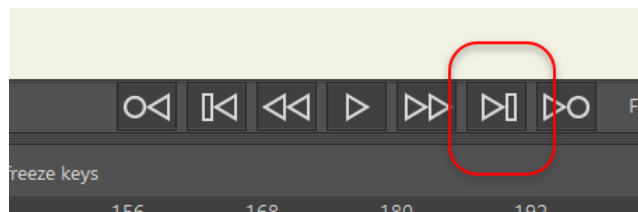
Jump to End button.

Click and drag individual points on the clouds in small amounts, just to reshape the clouds a bit. This will cause the clouds to change their shapes slightly from the beginning of the animation to frame 72.

Quick Start
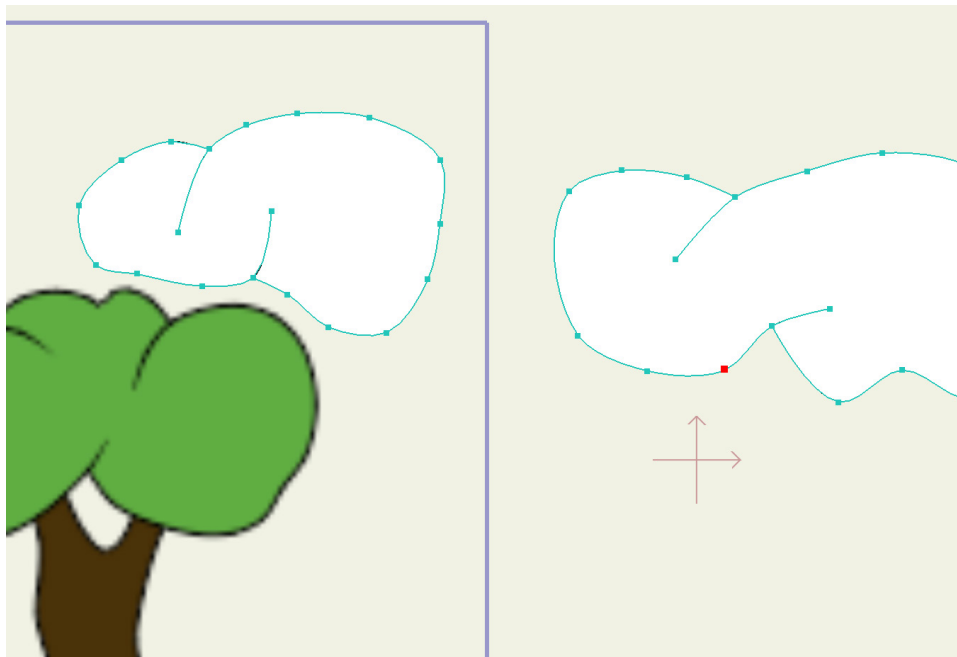
Change the shape of the clouds on the last frame.

Use the play and stop buttons to see the result.

Importing Animation

Remember how the Frank layer was imported into the project in the previous tutorial? Well, imported layers can also contain animation.

First, return to Frame 0 in your animation.
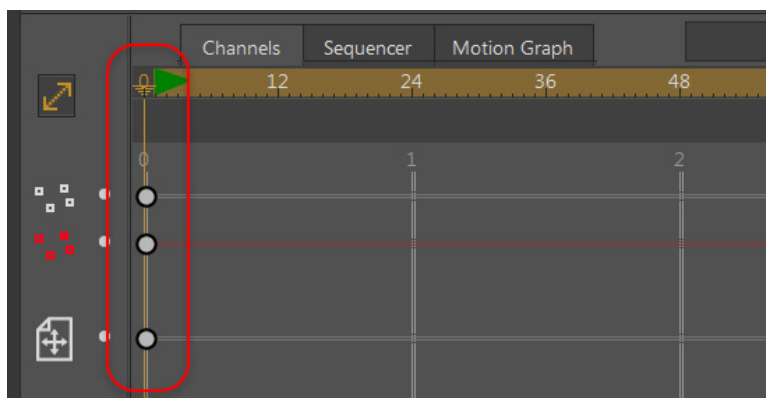
Return to frame 0.

Select **File > Import > Moho Object**.... When prompted, locate the/Tutorials/1-Basics folder (in your custom content folder), and open the file "Tutorial Extras."In the dialog that pops up, select the Beach Ball layer and click OK.
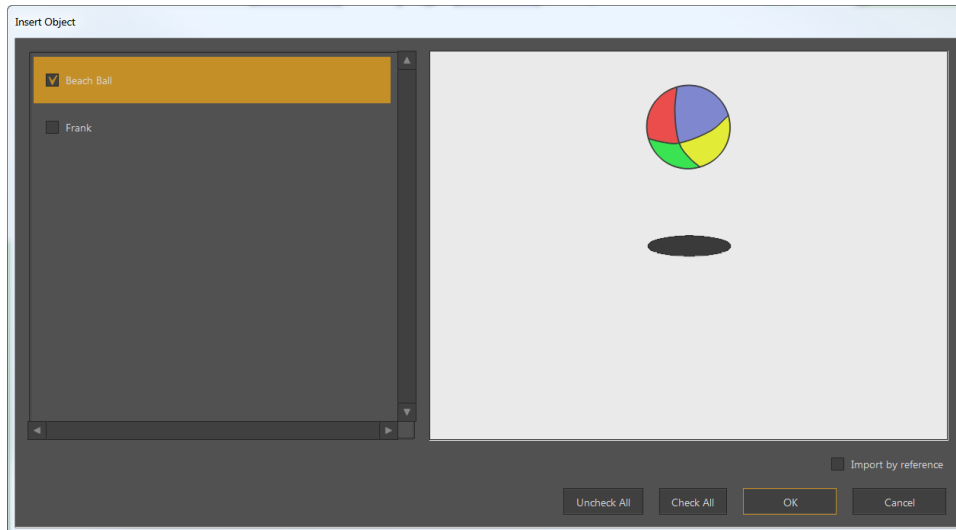
Import the beach ball.

A bouncing beach ball will appear in your project. Press the play button to watch it go. It bounces all right, but it's not really in the right position.

Switch back to frame zero (press the rewind button in the timeline) to set the ball's initial position.

 Using the **Transform Layer** tool, drag the beach ball to a better location.
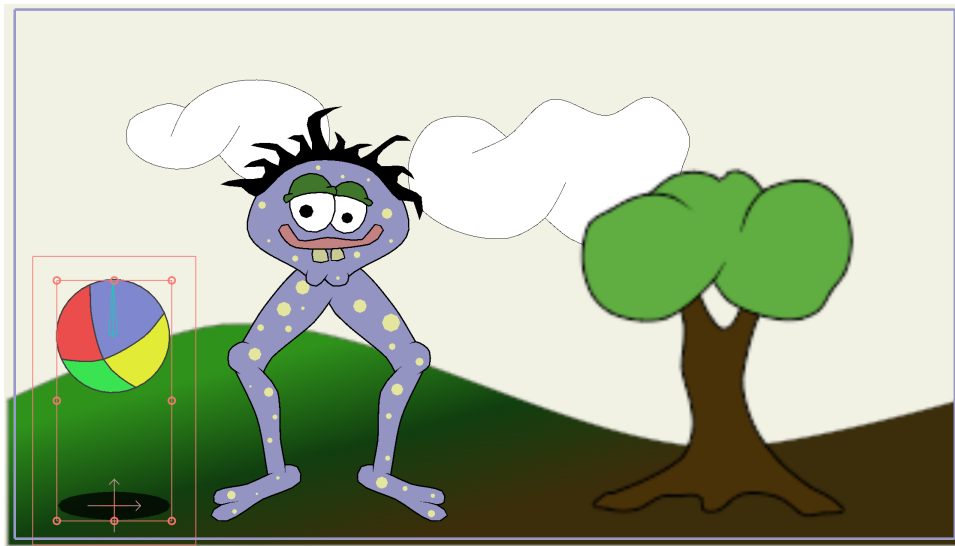
Repositioned beach ball.

 You can also use the **Transform Layer** tool to resize the ball. (Drag one of the corner handles of the scale control box to resize the beach ball the same amount in width and height.) Press the Play button to view the final animation.

Quick Start
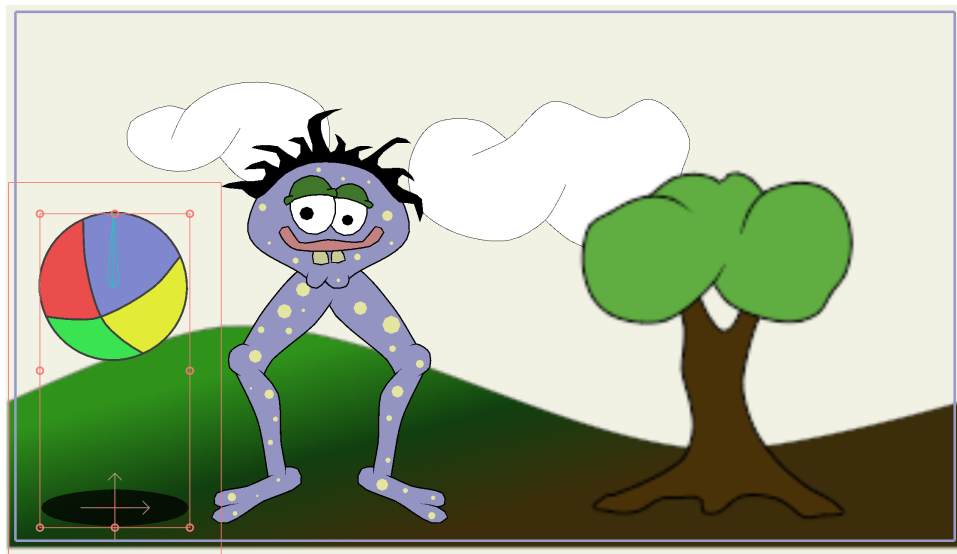
Play the final animation.

You now have a pretty good grasp of how to draw, fill, set up bones, and animate in Moho. Feel free to jump right in and start working with Moho. Or, you can read more tutorials that dig deeper into specific topics.

Quick Start

Drawing

Tutorial 2.1: Welding

As you learned in the Quick Start tutorials, Moho features an Auto Weld feature that automatically welds shapes and segments together when your cursor reaches a point that you can weld to. However, there are cases where you may want to manually weld points together.

When drawing in Moho's vector layers, the concept of "welding" points is very important. These tutorials will show you examples of how (and why) points can be welded, and will go on to show you some examples of good and bad welds you can do in Moho.

When you weld two points together in Moho, Moho really is combining those two points into one. There are a couple reasons to do this: First, welding the two endpoints of a curve together creates a closed curve. Second, if two shapes join up at a particular point, and you want them to remain joined during an animation, then welding those points together will guarantee that those two shapes will remain joined.

How to Weld Points

There are two ways to weld points in Moho: manually and automatically.

To manually weld two points together with the **Transform Points** tool, first uncheck the Auto-weld option for the tool.
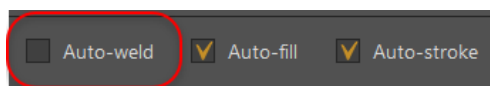
Auto-weld option unchecked

Drag one point on top of the other and press the Enter key. Here's an example of this method. Although you can't see the keyboard in the example, keep in mind that the Enter key was pressed at the moment when the two points overlap. After welding, notice how the two points move as one.

Click [this link](#) to view a brief video of Welding Example #1.
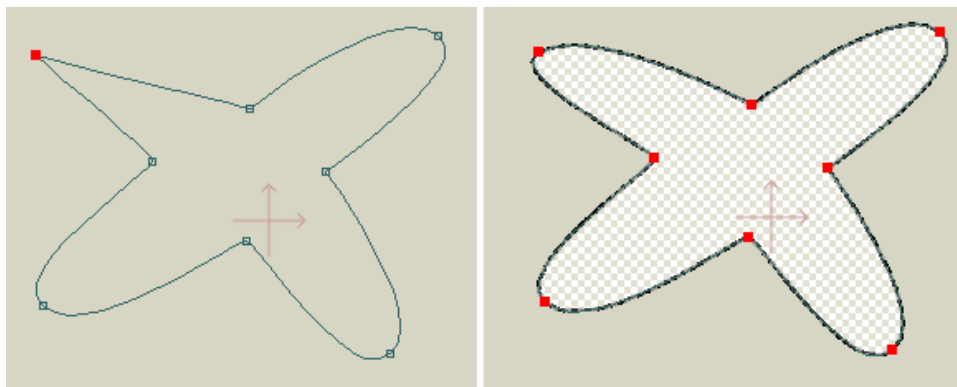
Before Enter key is pressed (left). After Enter key is pressed (right)

The second method of welding is automatic. For automatic welding to work, be sure that the **Auto-weld** checkbox is turned on in the tool options area when the Transform Points tool is active:

Make sure Auto-weld is on

Using this method, when you drag a curve endpoint on top of another point , the point turns green when it can be welded automatically. Let go of the mouse to automatically weld the points together.

Here's an example of automatic welding. In this case, the Enter key was not pressed to initiate the weld - as soon as the mouse is released, the two overlapping points are automatically welded together.

Click this link to view a brief video of Welding Example #2.
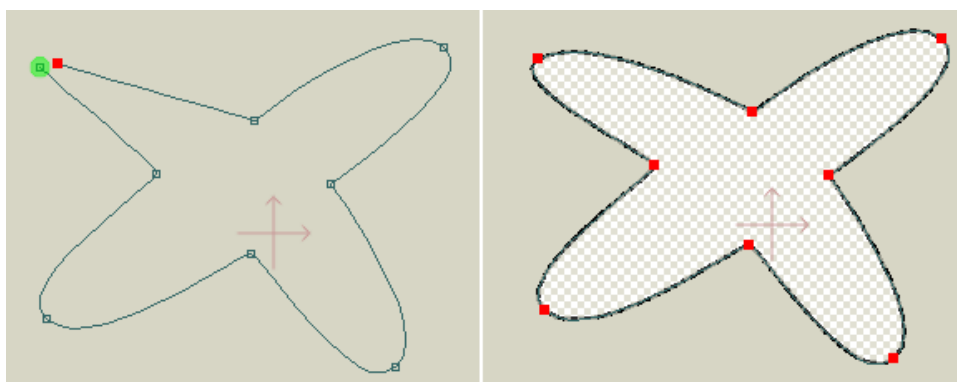
Automatic welding

Here's another example of automatic welding. Remember that only a curve endpoint can be automatically welded. However, the point that it is welded to does not need to be an endpoint:

Click this link to view a brief video of Welding Example #3.

Drawing

Automatic welding also works with the **Add Point** tool.

When you add a new point, you can drag it around as if you were using the Transform Points tool. As long as the new point you added is a curve endpoint, it can be automatically welded to another point. If the new point is not an endpoint, you can still weld it to another point manually by pressing the Enter key when it overlaps another point.
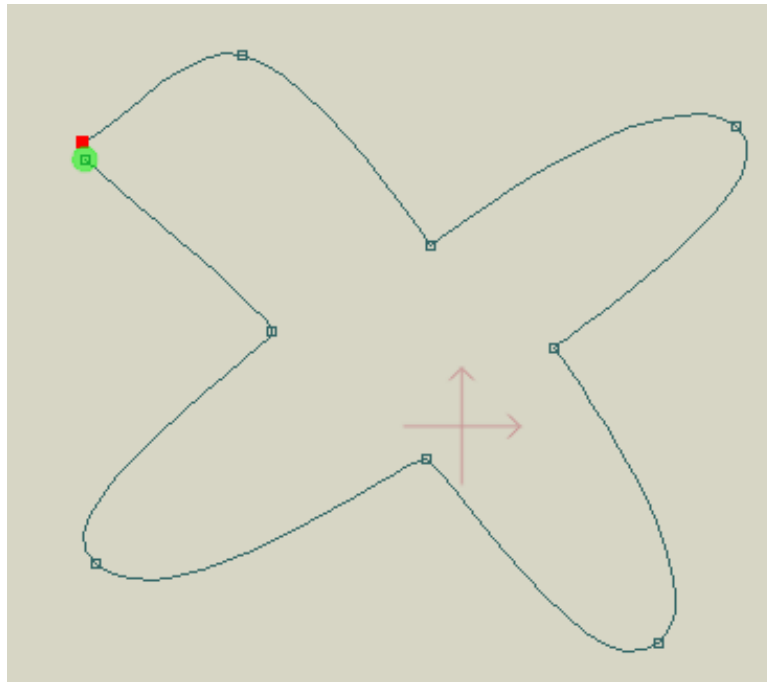
Add Point tool with Auto-weld option on

Besides welding two points together, Moho can weld a point to the middle of a curve segment. This can be done with either the automatic or manual welding methods.

Click this link to view a brief video of welding example #4.

Start Weld here
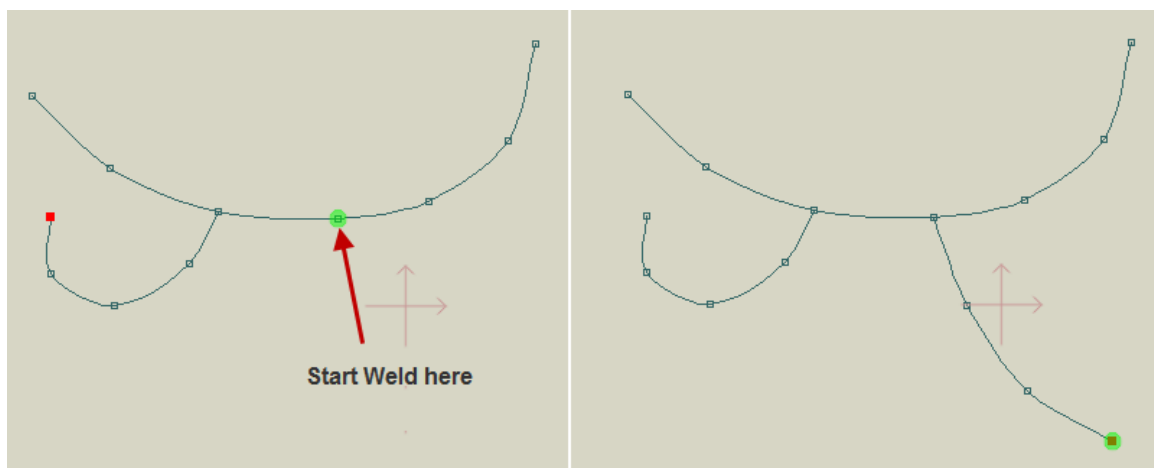
Welding to a curve segment

Drawing

Why to Weld Points

OK, so that covers welding points, but why do you want to weld points again? The main reason is to create fillable shapes. In order to fill a shape with color, that shape should be completely closed, either by overlapping lines or by shapes that are welded together so that there are no gaps in the shape that you want to fill.
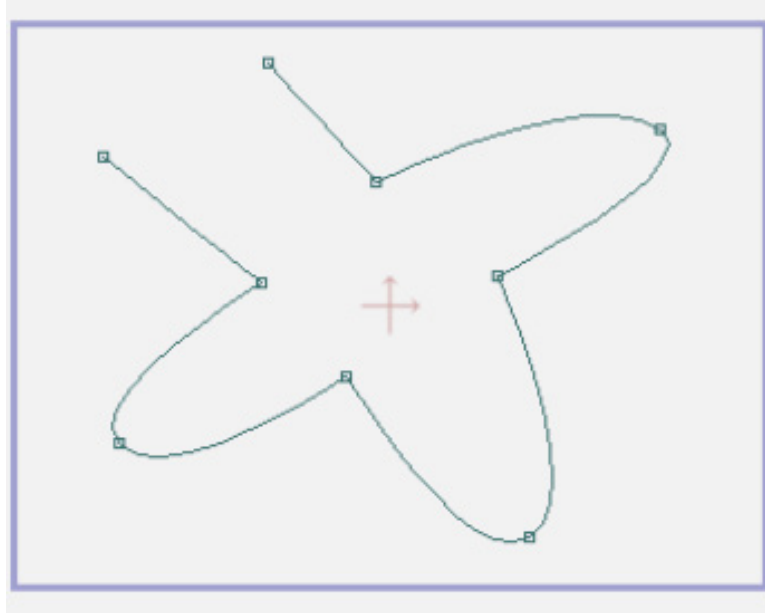
A non-closed shape

By welding the two endpoints together, we can create a closed shape that can then be filled:
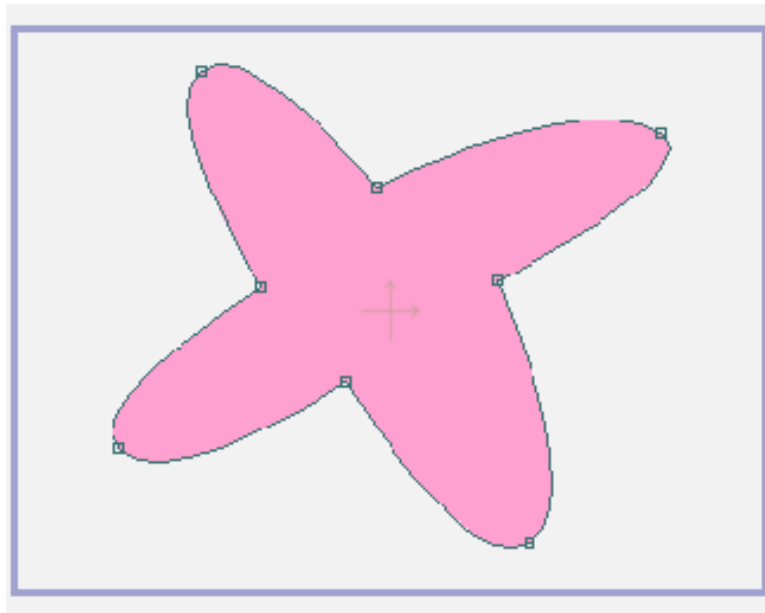
A closed shape that can be filled

Drawing

Examples of Good Welding

Let's look at some examples of good welding choices. First, the following two points could be welded to create a single, continuous curve:
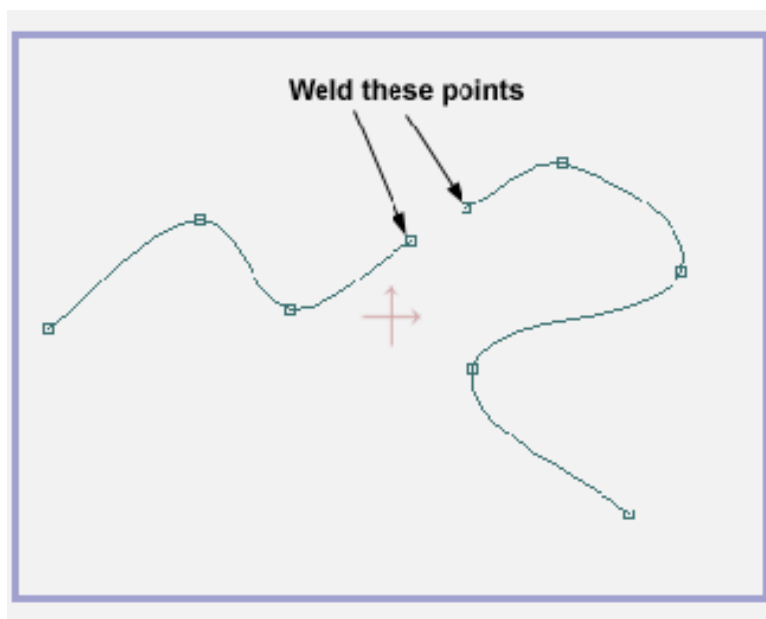
Joining two curves

The next case shows the classic case of welding a curve closed to create a fillable shape:
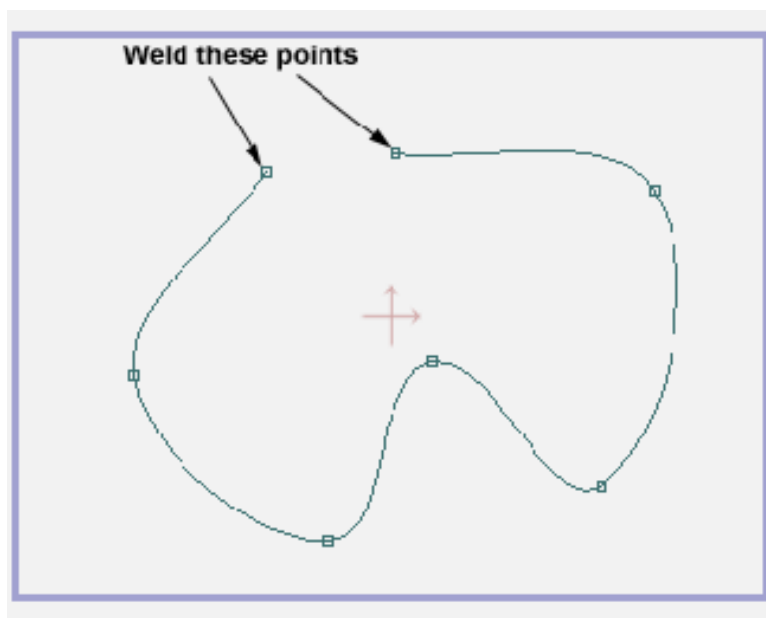
Closing a curve

Next, we show a shape made up of several curves. Notice that a closed, fillable shape does not need to be made up of a single curve. The shape below, after welding, is made up of three curve segments, but is still closed and can be filled with color:

Drawing
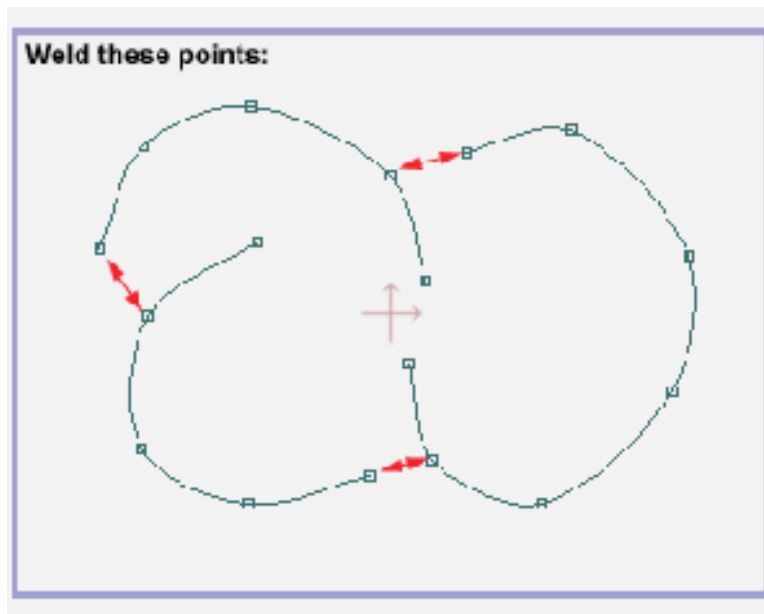
Joining multiple curves into a single closed shape
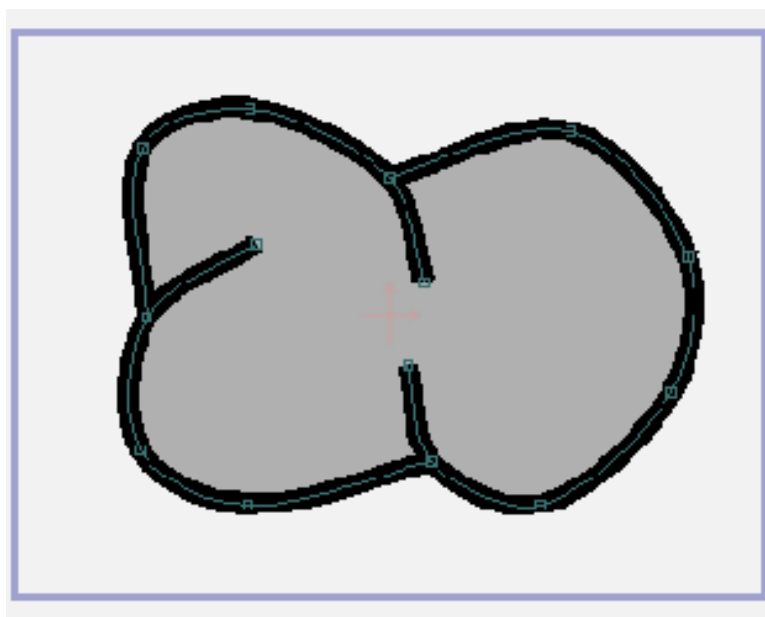
The welded and filled shape

Finally, the example below shows two circles lined up side-by-side. The two side points of the circles have been welded together so that when they move around during an animation they remain joined. If those points were not welded, moving them in sync like this would require a lot of extra work.

> *To maintain the separate colors in the two circles, Auto Fill is turned off before welding the two circles together at a common point.*

> *Click this link to view a brief video of the joined circles.*

Drawing

Examples of Bad Welding

Typically, when you weld together two points, one of them should be a curve endpoint. This isn't always true, but most often it is. If you find yourself welding together two points and neither is an endpoint, take a moment to think whether the weld is appropriate. Here's an example of a bad choice of welding. Suppose you had the following two shapes and you were considering welding the pairs of circled points:
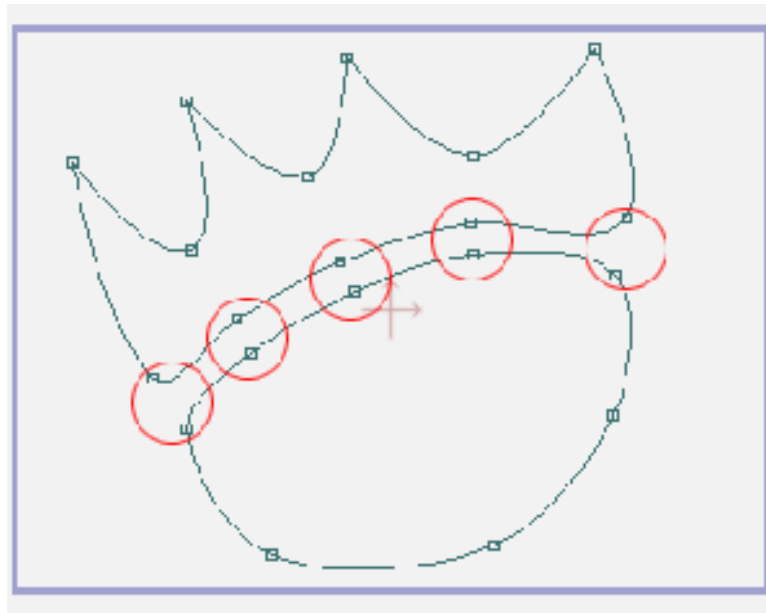
Before welding the marked points

Although Moho will let you perform those welds, it isn't really a good idea. What you would end up creating is a shape with lots of little holes in it. Along the section of curves that you welded together are little bubbles that make it impossible to fill the two main shapes:
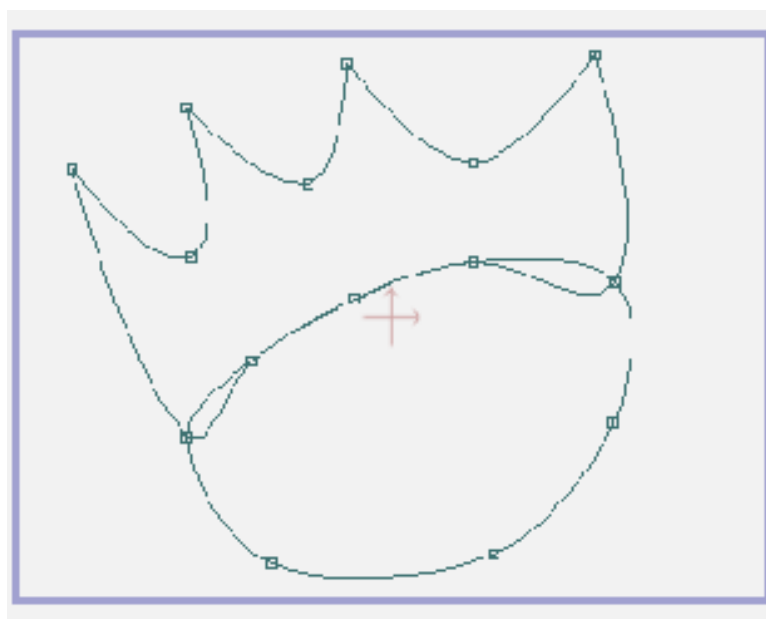
Bad welding

Drawing

Instead, a better approach is to just move the two shapes closer together without any welding at all. In this case, welding the two shapes together doesn't have any benefit.
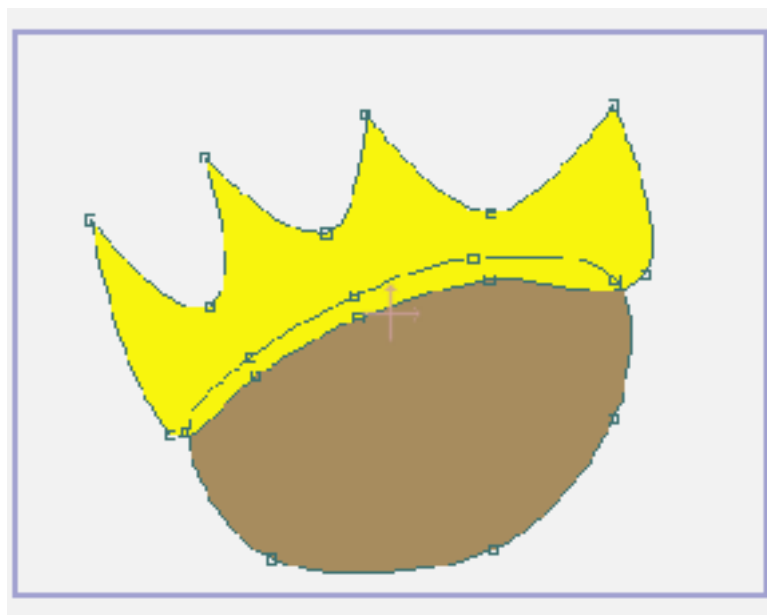
Fill the shapes without welding them together

Another approach in this situation would be to cut the top shape apart with the **Delete Edge** tool and then weld the remaining endpoints to the lower shape. First, cut the top shape apart:
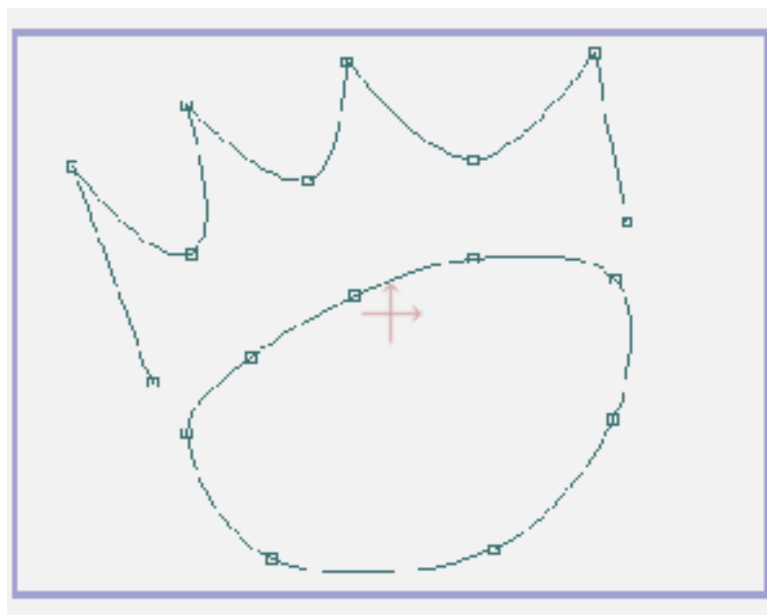
Cut the redundant curve away

Then, weld the newly-created endpoints onto the lower shape. With this approach you don't end up with a double curve all welded together. The resulting shape is much cleaner and easier to work with:
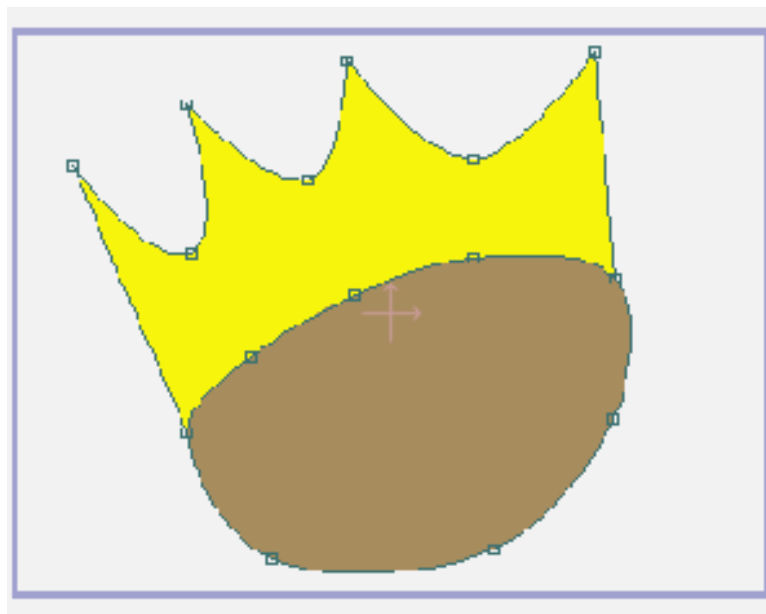
Drawing

Weld the new endpoints

Tutorial 2.2: Drawing Shapes with Holes

Drawing shapes with holes is very easy in Moho, but many new users don't realize that this can be done. There's really no trick at all - just follow the basic rules for creating a fill.

Reminder of Fill Rules

As a reminder, let's consider the rules for creating a fill shape: A fill must be composed of closed curves that define the border of the shape. So, as an example, below is a valid fill shape.
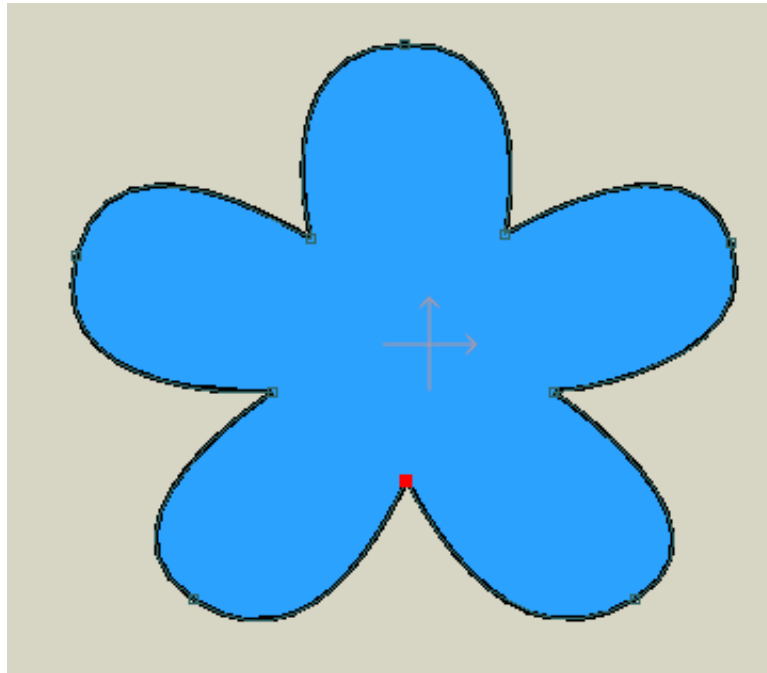
A basic fill shape

Creating Holes

So a fill shape is defined by the curves on its border. If we want to create a hole, then all we need to do is create curves that outline the shape of the desired hole(s). Below we've added some extra curves before creating a fill shape:
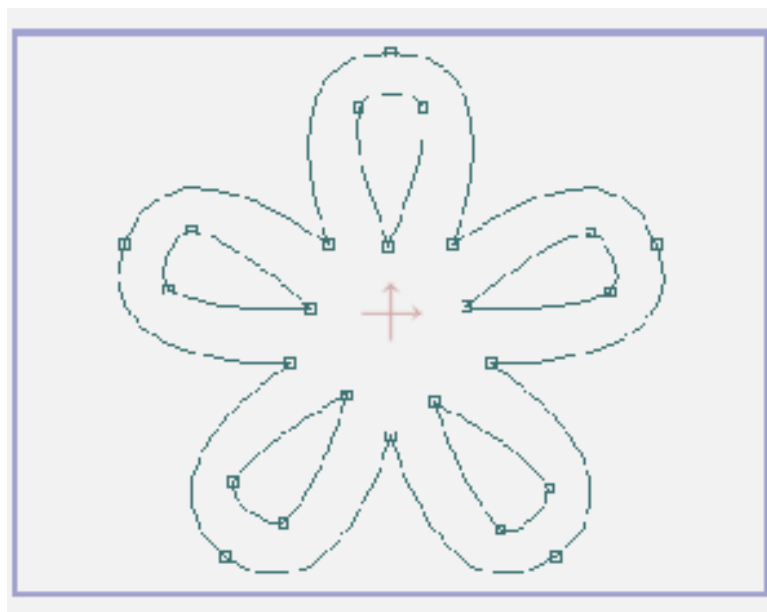
New curves added

Once you've set up curves to define the shape of the hole, all you need to do is select the outline and the hole(s) using the **Create Shape** tool. Notice that Moho automatically identifies the inner curves as borders of holes in the shape.

Drawing

There's nothing in particular you have to do, just draw the holes and Moho will know what to do with them. When you've selected all the correct points, press the Enter key to finalize the shape.
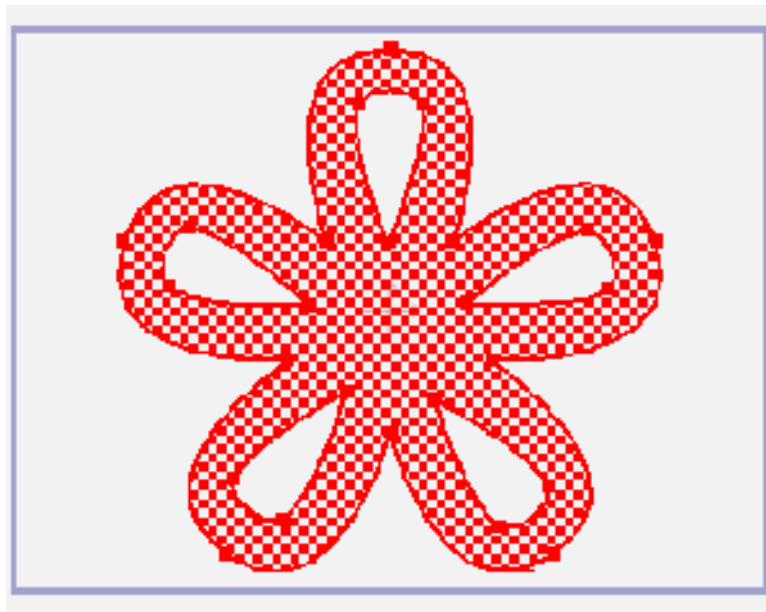
Selected points for filling

Finally, here is the resulting shape. (The Line Width tool was used to narrow the width of the outline at the corner points.)

The finished shape

Here's another example of a shape with a hole:

Drawing

Another shape with a hole

Tutorial 2.3: Hidden Edges

When drawing more complex objects like faces, you will often run into situations where you want an outline to only go **partway** around a shape. There's an easy way to accomplish this in Moho.

Start With a Sample File

For this tutorial, we'll start with a project file that's almost finished. It's named **Tutorial 2.3** and it's located in the **Tutorials > 2 - Draw** subfolder within your custom content folder. Open this file in Moho and you should see something like this:
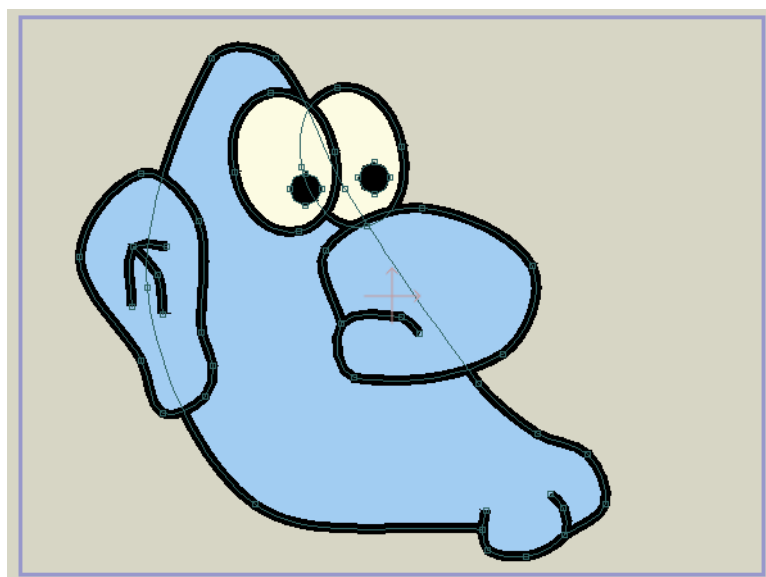
Starting point for this tutorial

Hidden Edges

The drawing we're working with could be the beginning of a character's face. In this face, the nose and ear are separate shapes from the main head outline. The general shape looks OK, but where the separate parts join up we don't want to have lines separating them. To fix this, activate the **Hide Edge** tool.

There are two edges we want to eliminate from this drawing. Click on these two edges as shown below. If you don't see an immediate result, try dragging the mouse across the lines in question to make sure you hit them.
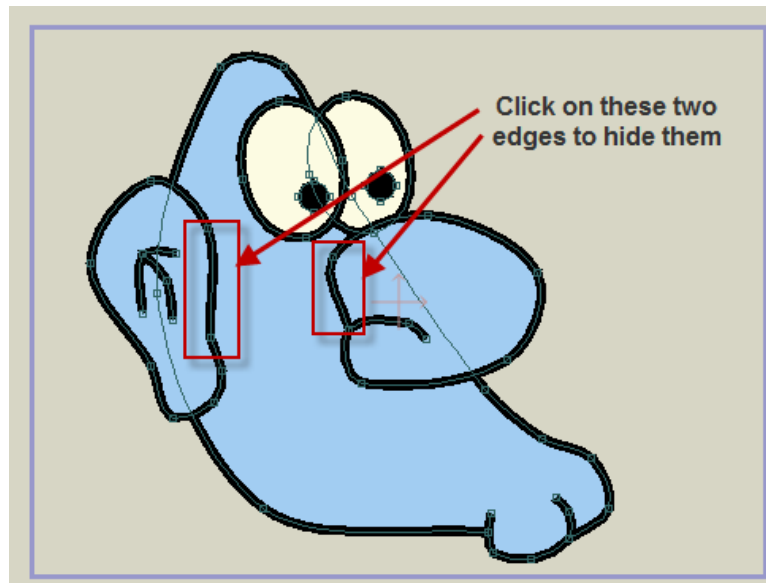
Edges to click on

After clicking on these edges, they should disappear from view, and the result should be as follows:
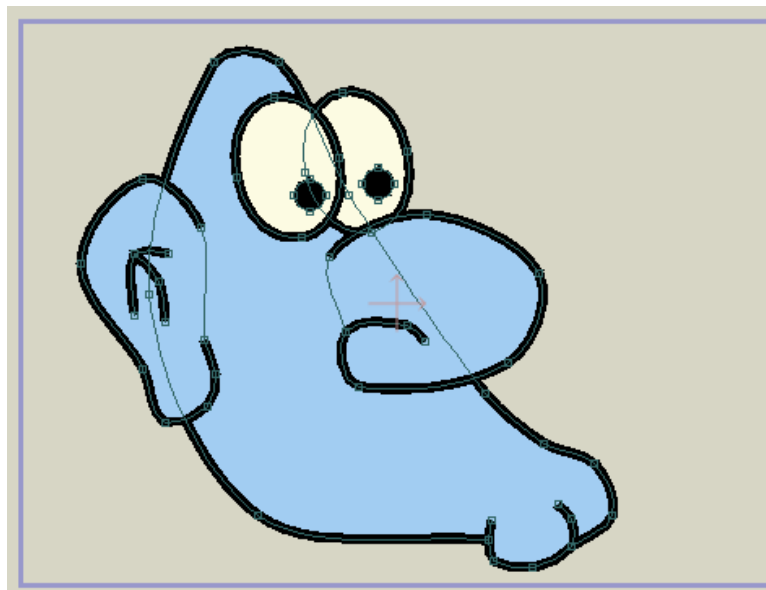
After hiding the edges

Drawing

The Hide Edge tool works by simply hiding the selected edges of an outline. It does not affect the underlying curve - the curve is still there, you just can't see the outline on that particular section of the curve. Because it works on the outline, and not the curve itself, be sure you only use the Hide Edge tool **after** you've created the outlines. Otherwise, with no outline, you would not see the result of hiding some edges.

The other thing to know about the Hide Edge tool is that you can also un-hide edges. If you change your mind, or hide the wrong edges, just click on a hidden edge to re-show it.

Finishing Touches

If you hide the edges of a thicker line, you'll often end up with abrupt ends to the outline. You can see this below:
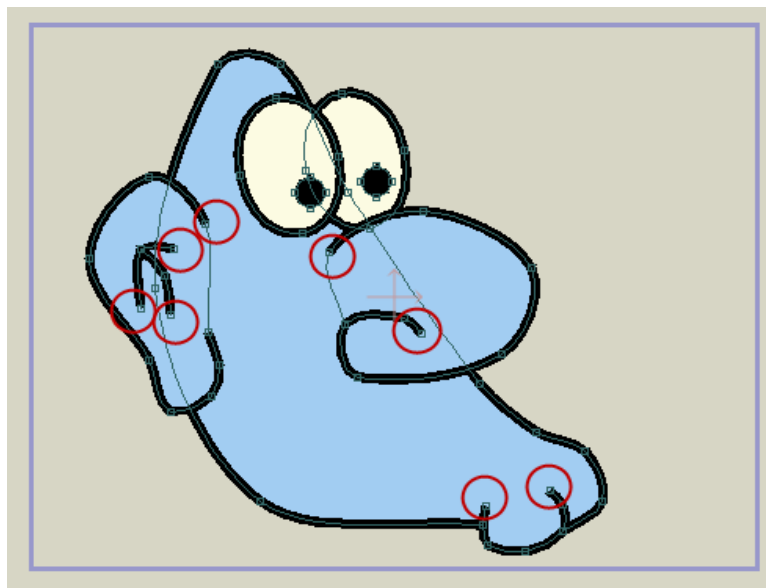
Blocky curve ends

A nice way to finish off these endpoints is to use the **Line Width** tool. With this tool, click on the endpoints to set their width to 0. You can also click and drag to adjust the width of any other points you choose. After cleaning up the endpoints, you should get a result like this:

Drawing
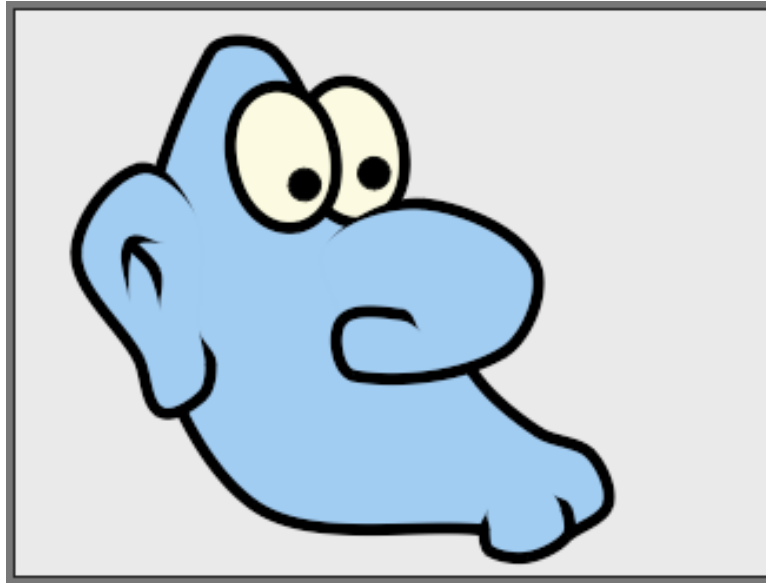
Tapered endpoints

Tutorial 2.4: Varying Line Widths

Moho allows you to change the width of a stroke at any point along the curve. Line width information is stored as a percentage value, rather than as an absolute value.

You can use varying line widths to create outlined shapes that maintain consistency when they are bent and animated.

Start With a New Project

Create a new project. In the Style window, select a color that you want to use for the outline color. Set the width of the stroke to around 100. Use the **Add Point** tool to draw a three-point curve. Bend the curve slightly, like an arm.
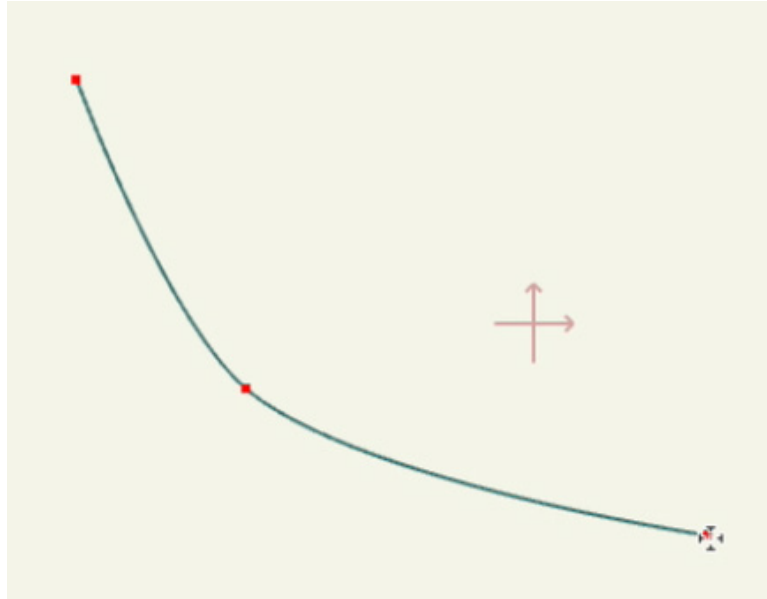
A simple three-point curve bent like an arm

Switch to the Create Shape tool, and make sure that the line is selected. Then press the Create Shape button in the toolbar to change the curve to a shape.

Next, switch to the **Line Width** tool to increase or decrease the width at the points until you have a shape resembling an arm. Your arm should look similar to the figure shown below.
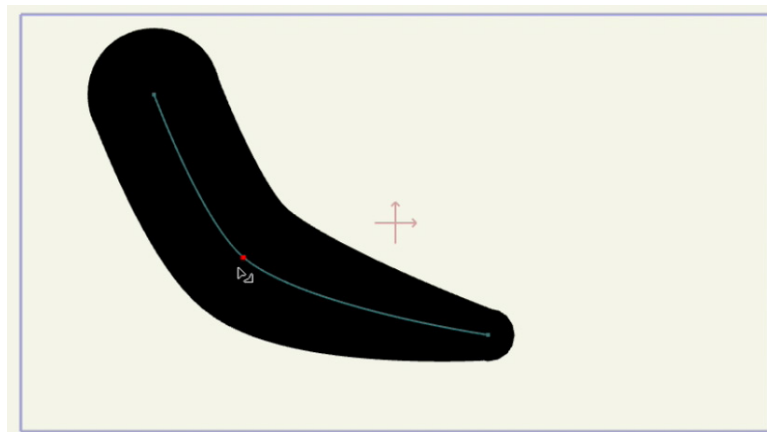
The curve reshaped to look like an arm

Now, select the points in the curve again with the Select Points tool, and use the Create Shape tool to create a second shape with the same curve.

Now you have two strokes that are superimposed directly on top of each other, with the top shape selected. You can use the top stroke as a fill, but you'll need to make some adjustments.

Click to select the new stroke with the Select Shape tool. With the top stroke selected, change the **stroke color** to the color that you want to use for the **fill** of the arm (such as yellow, shown here).

Drawing
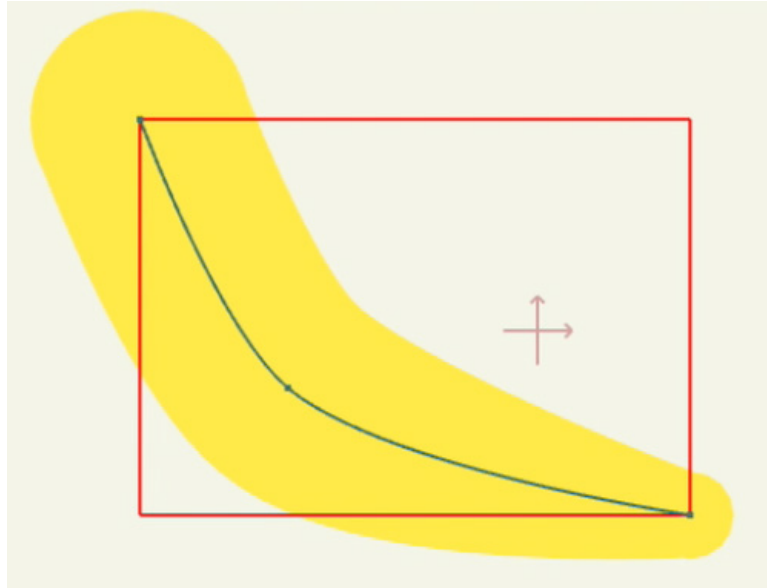
Change the color of the top stroke

Reduce the width of the top stroke to a value between 90 and 95 (depending on how thick you want your "outline" to be). Your project should now look similar to the figure shown below.
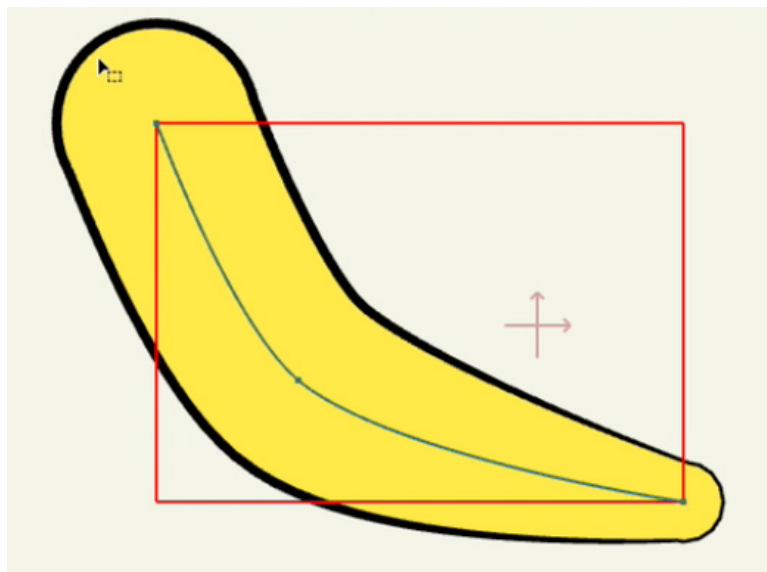
The curve reshaped to look like an arm

Remember that in this method, you are not working with a stroke and a fill. Instead, you are working with two strokes of different colors that are controlled by the same curve.

Now you can use the variable line width tool to adjust the width of both strokes at the same time, or make other transformations with the Transform Points tool to reshape or animate both curves at the same time. This allows you to quickly create character elements, such as arms or legs, which are easier to animate because they have fewer points to manipulate.

Drawing
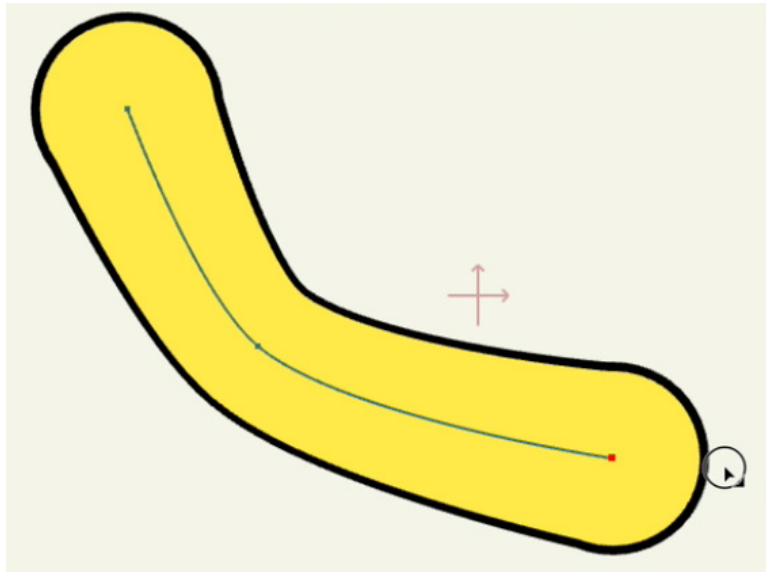
Line width and transformation changes made on the points or curves affect both strokes at the same time.

Tutorial 2.5: Shape Ordering

In a Moho vector layer, shapes are ordered from back to front. This ordering determines which shapes will appear in front of or behind others. This tutorial will show you how to work with shape ordering.

Start With a Sample File

For this tutorial, we'll start with a project file that's almost finished. It's named **Tutorial 2.4** and it's located in the **Tutorials > 2 - Draw** subfolder within your custom content folder. Open this file in Moho, and you should see something like this:
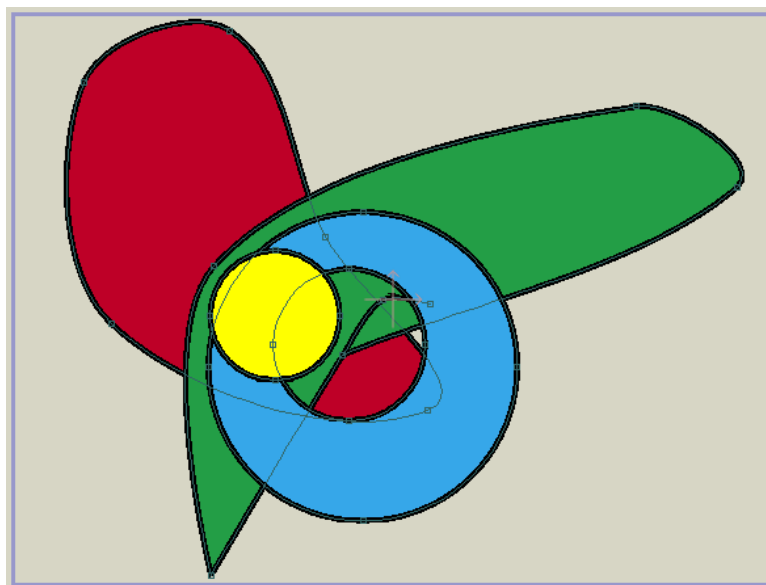
Starting point for this tutorial

As you can see, there are four shapes in this file. By the way they overlap one another, you can also tell their ordering. From back to front, there is a red shape, a green shape, a blue shape, and a yellow circle.

Raising and Lowering Shapes

If you want to change the order of some shapes, the first thing you need to do is select a shape to work with. Using the **Select Shape** tool, click anywhere on the red shape. It will become highlighted with a checkerboard to indicate that it is selected. Notice that you can also see it faintly beneath the other shapes - this is so that you can see the entire selected shape, even if it is normally obscured by other shapes.
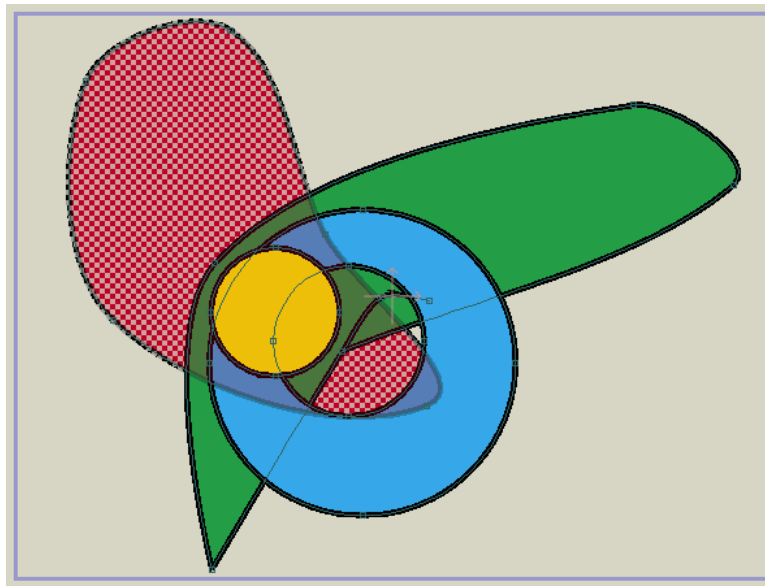
Selected shape highlighted

To raise the shape, press the Up arrow key on your keyboard. Notice that the red shape has now moved one step up in the layer order, above the green shape:

Drawing
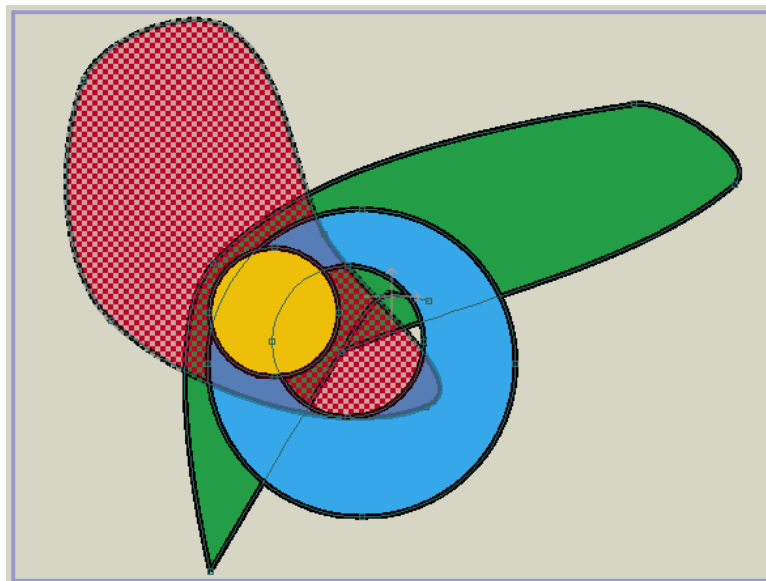
Raised shape

Right now, press the enter key to de-select all objects in the layer. The red shape will switch back to normal to indicate that it is not selected:
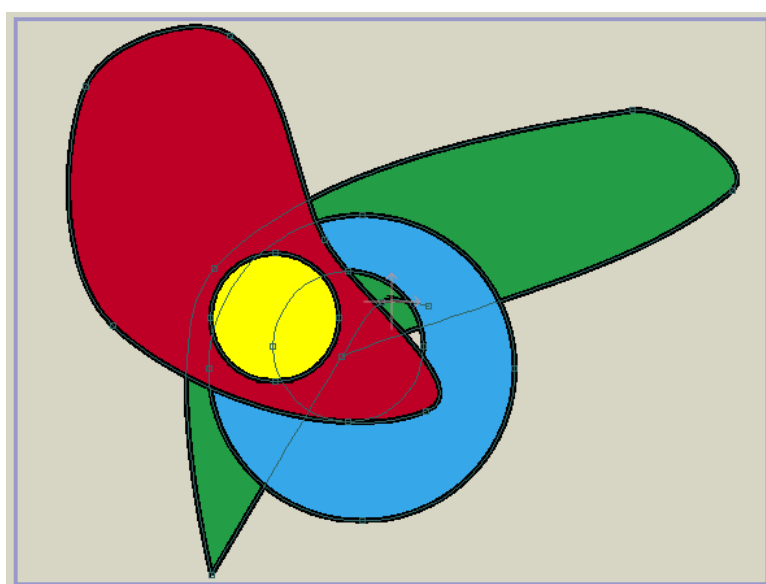
De-select the shape

Next, use the **Select Shape** tool and click on the blue shape to select it.

Press the Down-arrow key twice to lower the blue shape below the red shape, and then below the green shape:

Drawing
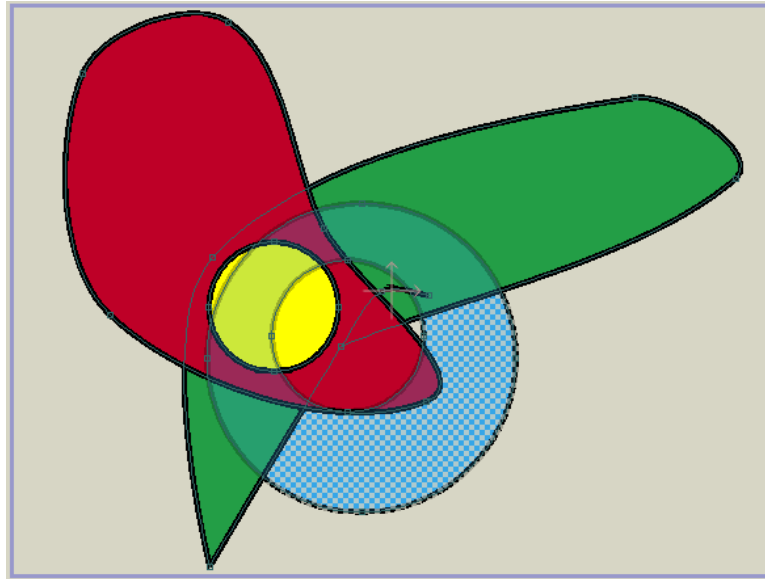
Lowered blue shape

You can also raise a shape to the top (above all others in that layer) or lower it to the bottom (behind all others in that layer). Select the green shape and hold down the **Shift** key while pressing the Up-arrow key. With a single key press, the green shape moves all the way to the top of the layer's shape order.

Selecting Hidden Shapes

If you now press the enter key, the green shape will be de-selected. Notice that at this point the yellow circle is behind the green shape, and can't be seen. You can still see the curves that make up the yellow circle, but the shape itself, being behind the green shape, is not visible:
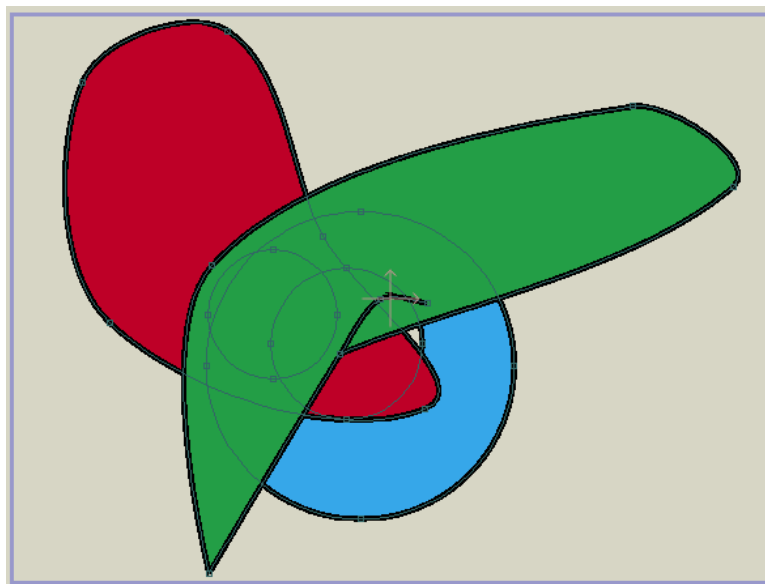
Hidden yellow circle

Drawing

Now we want to bring the yellow circle back to the front. Using the **Select Shape** tool, click on the yellow circle, even though it's hidden.

As you may have expected, the green shape gets selected because it is in front:
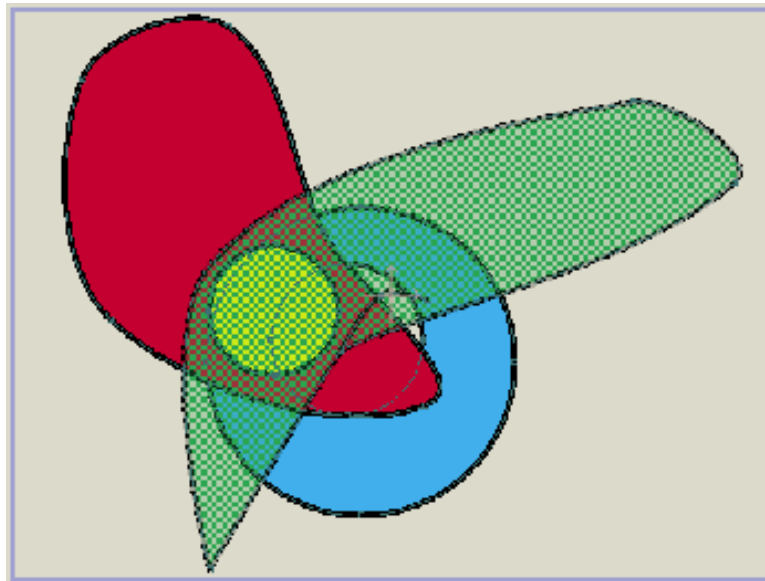
Selected green shape

Now comes the trick for selecting shapes lower in the ordering. Hold down the **Ctrl** key (Windows) or **Cmd** key (Mac) while pressing the down-arrow key. This tells Moho to pick the next deeper shape in the layer ordering at the same point you just clicked. The yellow circle will now be selected. It will be kind of faint to remind you that it is actually behind other shapes in the layer:
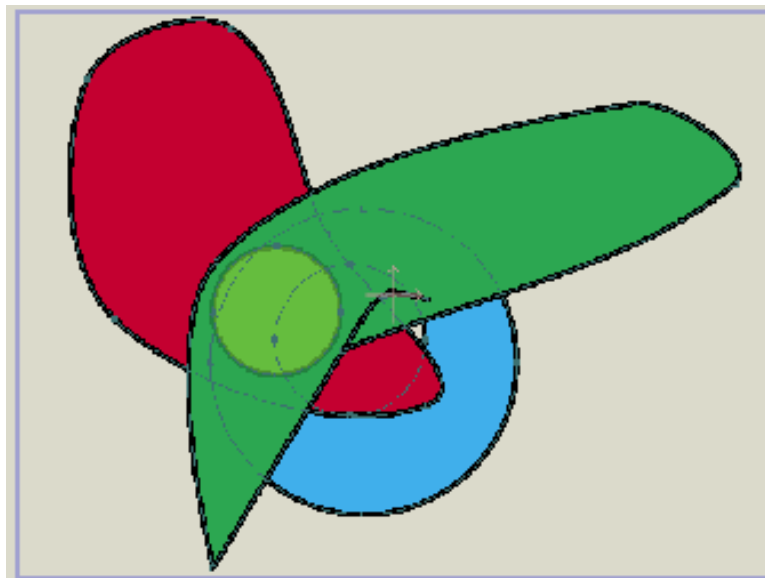
Selected yellow circle

Finally, hold down the **Shift** key while pressing the up-arrow to bring the yellow circle all the way to the top of the layer ordering, making it fully visible once again:

Drawing
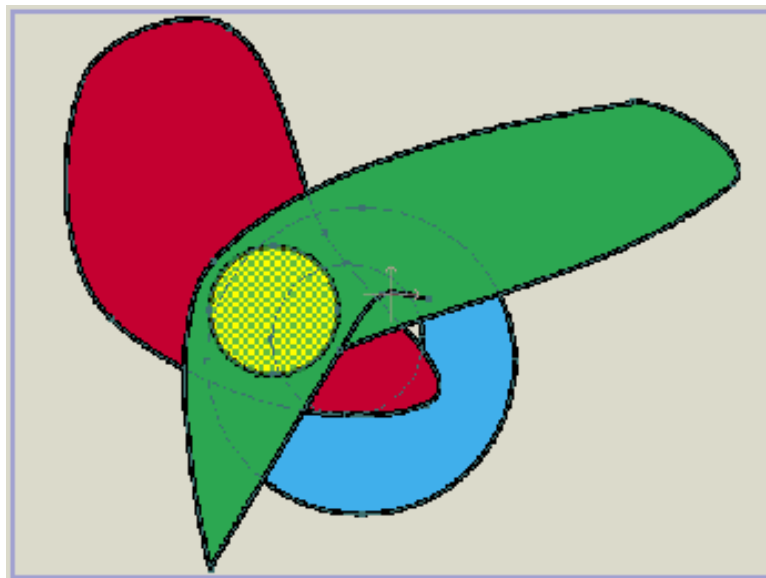
Raised yellow circle

Tutorial 2.6: Brushes

Moho allows you to apply brush effects to outlines if you choose. It's really easy to use brushes, and this tutorial will show you how.

Draw Some Freehand Curves

Start with a new, blank file in Moho. In the Style window, set the line width value to 16. Next, activate the **Freehand** tool. In the tool options area at the top of the main Moho window, adjust the settings for the Freehand tool to match those shown below:

- **Variable Line Width**: Use Pen Pressure

- **Width Variation:** 75%

- **Taper Start**: Checked, 20%

- **Taper End**: Checked, 20%

- **Point Reduction**: 50 (default)
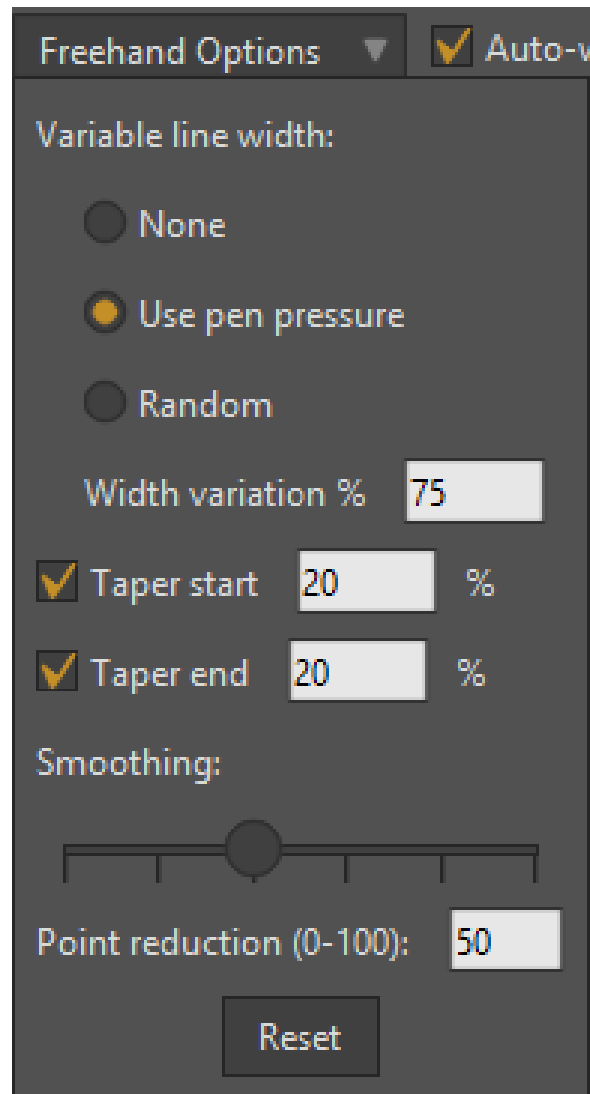
Freehand settings

Draw two or three curvy lines using the Freehand tool in the editing view:

Freehand curves

Drawing
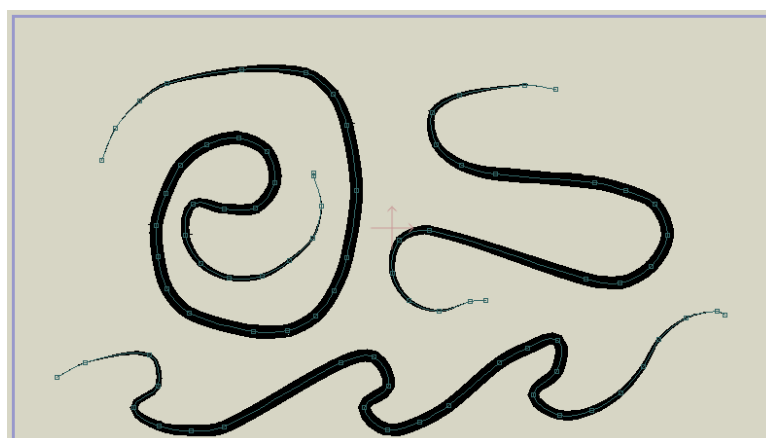
Because of the line width set in the Style window, these curves should be rather thick. The tapering settings in the Freehand options should make the ends of these lines taper down to narrow points. If you select **File > Preview** now, the result should look pretty much like what you see in the editing view:

Rendered curves

Close the rendering window, and use the **Select Shape** tool to select one of the curves:

Selected curve

In the Style window, click on the box that currently says **No Brush**.

No Brush

Drawing
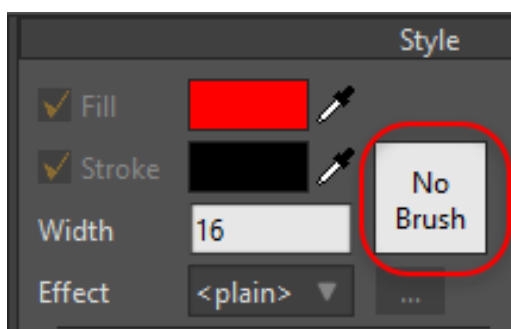
In the brush dialog that appears, select one of the brush shapes that interests you - you'll see a preview of the brush at the bottom of the dialog:
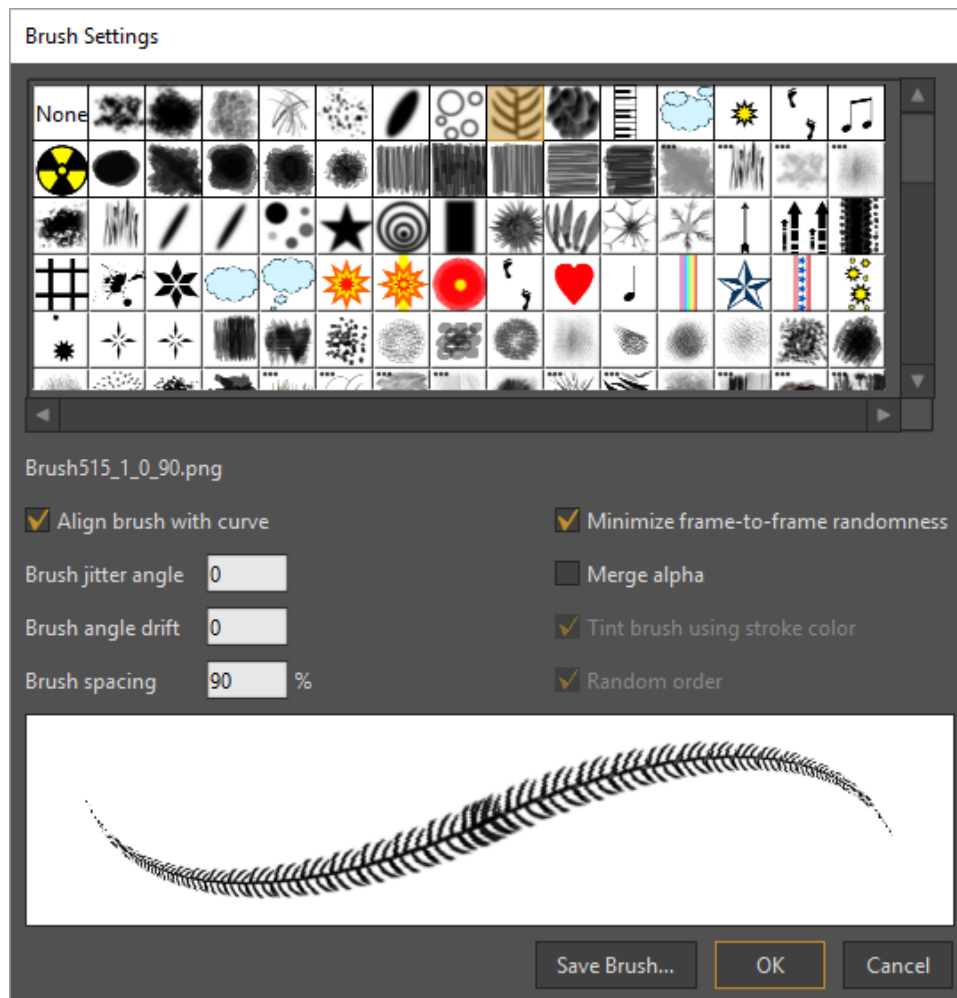
Brush Dialog (Pro version shown)

Click OK to close the brush dialog, and select **File > Preview** again. In the rendered result you can see the applied brush shape:
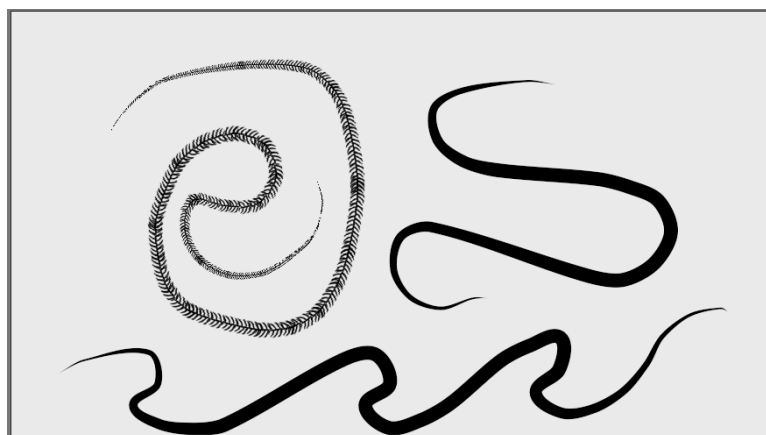
Rendered curves

Try applying other brush shapes and Stroke colors to the other curves:

Drawing
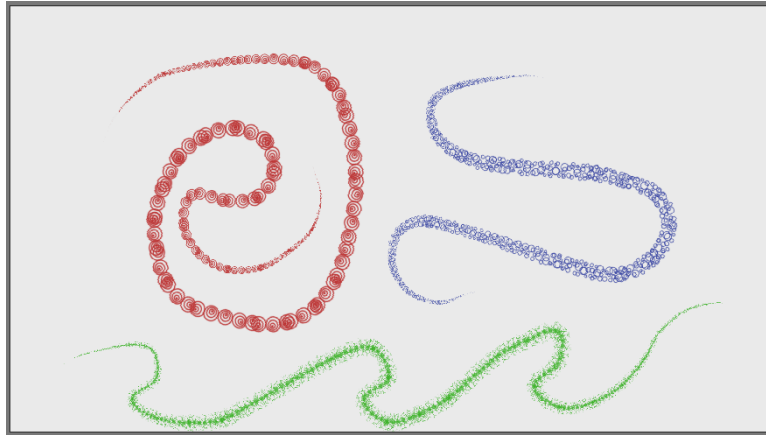
Different brush shapes

(Pro Only) If you notice that your brush effects are not visible until you render or export your animation (brush shapes are not possible when exporting to SWF format), you can change the display quality to show the effects during editing. In the lower-right corner of the main Moho window is the **Display Quality** *popup box. Click this box to open it. Turn on the* **Brushes** *checkbox. This will turn on brushes in Moho's editing view:*

Displaying brushes while editing requires a lot of computation and can slow Moho down, so it's best to use this as a kind of preview, but not to leave it on all the time. When you've got the brushes how you like them, switch this display option back off.
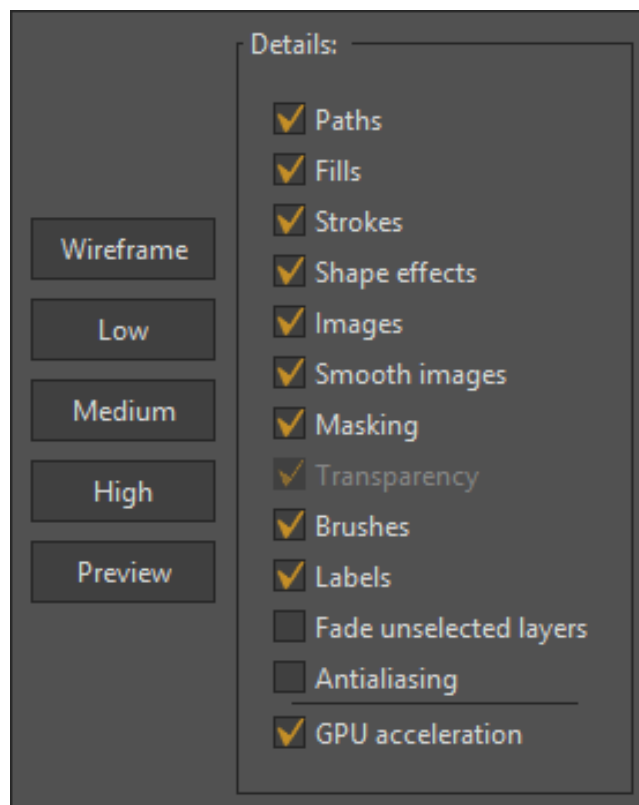
Turn on Brushes preview option
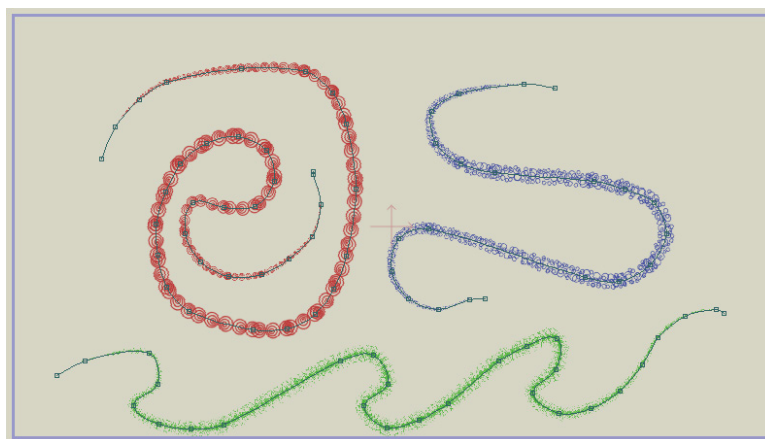
Brushes in editing view

Tutorial 2.7: Layer Masking (Pro Only)

This tutorial is more of a show & tell than a hands-on creation of an animation. We will demonstrate some examples of a powerful feature of Moho - layer masking. Layer masking can be used for all kinds of effects such as shadows, compositing, depth effects, transitions, and to simplify certain modeling and animation tasks.

Drawing

Start With a Sample File

For this tutorial, we'll start with a project file that's almost finished. It's named **Tutorial 2.6** and it's located in the **Tutorials > 2 - Drawing** subfolder within your custom content folder. Open this file in Moho, expand the **Masking Group** layer in the Layers window, and you should see something like this:
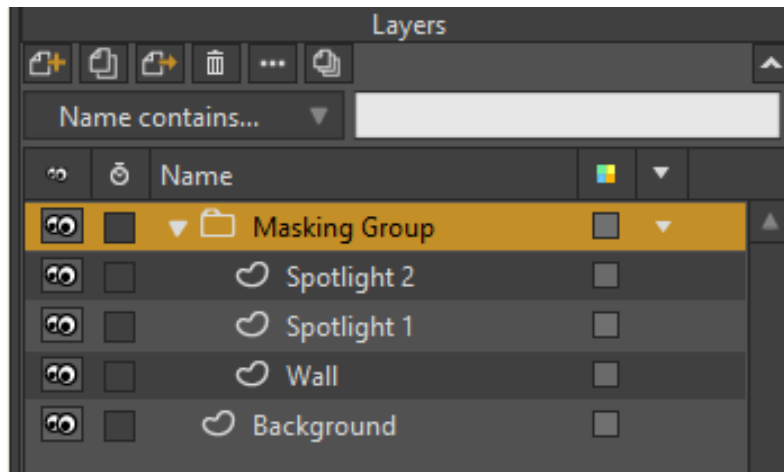
Starting point for this tutorial

This is a simple scene of a wall with a hole broken through it (a jailbreak maybe?). Set the current time to frame 24, and choose the **File > Preview** menu command. Notice how the spotlights spread across the hole as if it were a flat object as shown below:
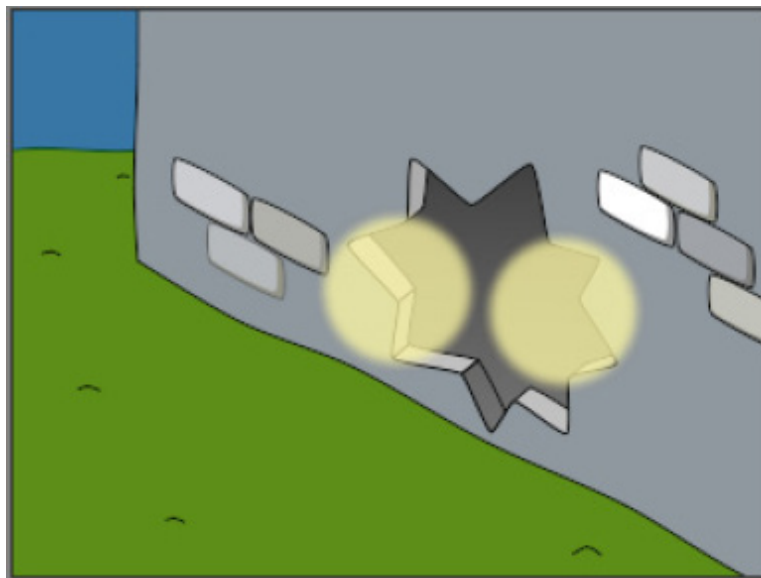
Spotlights shining across the hole

To make the spotlights more realistic, we can use Moho's masking feature. Double-click the **Masking Group** layer. In the Layer Settings dialog that appears, go to the **Masking** tab and set the **Group Mask** setting to **Hide all** as shown below and click OK.

Drawing
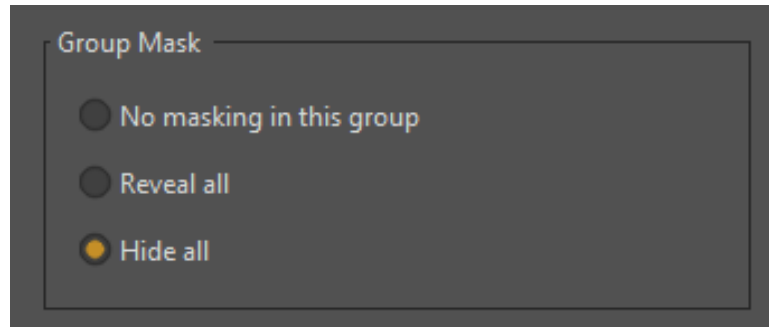
Mask setting for the **Masking Group** *layer*

In the editing view, you'll notice that the light no longer appears over the hole. This is because the masking mode we just set hides the areas of the light that fall within the area of the hole:
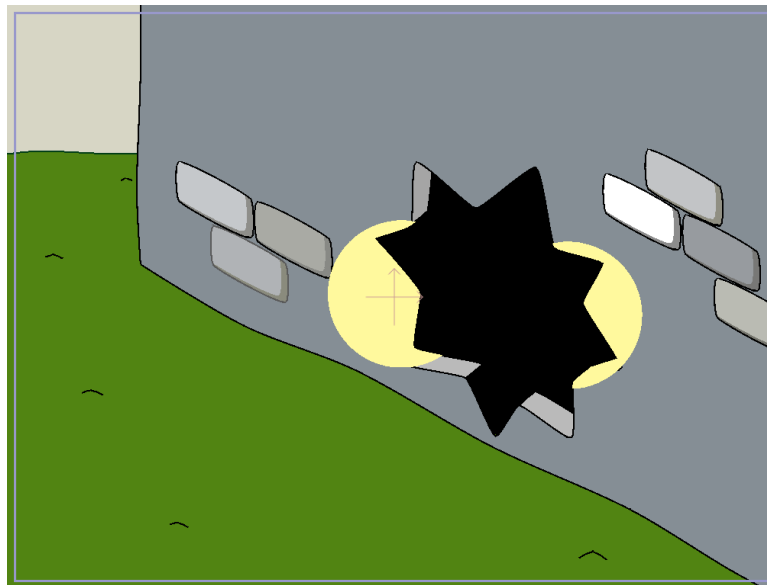
Everything in the group is hidden

The setting that controls how the mask reacts is found in the next section of the Masking tab. Double-click the **Wall** layer to bring up the Layer Settings dialog. In the Masking tab, notice that the **Layer masking** value is set to **+ Add to mask** as shown below. Click OK to exit the Layer Masking tab:

Drawing
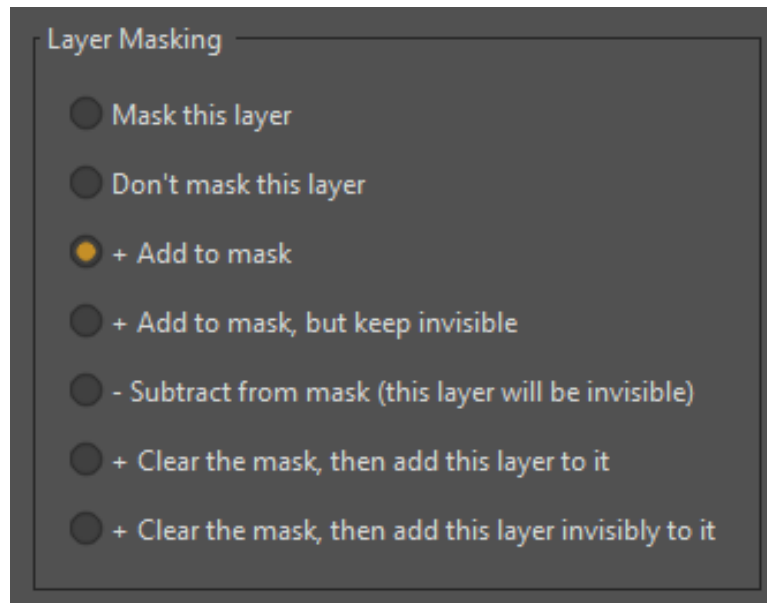
Mask setting for the **Wall** *layer*

What we've done is tell Moho to add the contents of the Wall layer to the visible region of all objects in the group. No other layers in the same group will be allowed to draw outside this visible region (the mask). If you temporarily turn off the **Background** layer, you'll see that there is an actual hole in the wall. Because the wall acts as a mask, the spotlights cannot draw themselves in this area. You're welcome to render out the entire animation as a movie to see the full, animated effect.
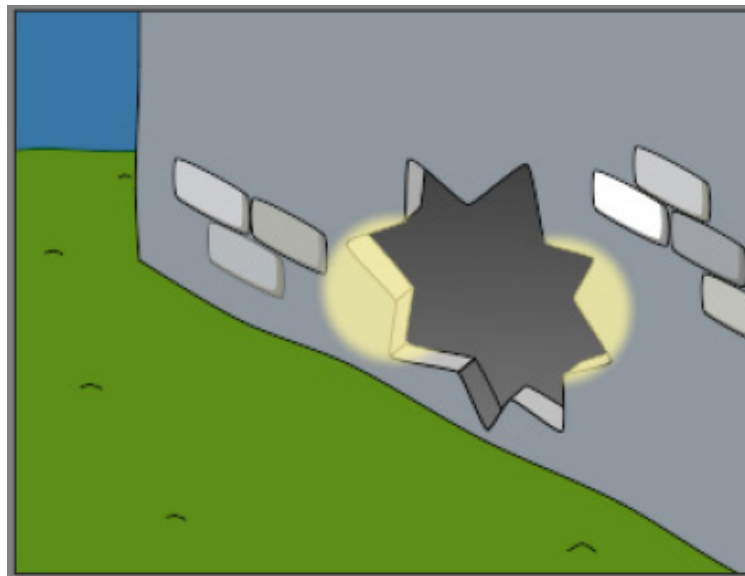
The wall acting as a mask

Another Example - Simplified Modeling

Now open the file **Tutorial 2.6_2**. Take a look at the masking group in this project (in this case, the masking function is already turned on). In this example, the eyes are used as a mask, and the eyelids are forced to render themselves only inside the

Drawing

eyes. This makes it much easier to construct and animate the eyelids, without having to worry about them spreading outside the eye region - with a mask layer, they can't.
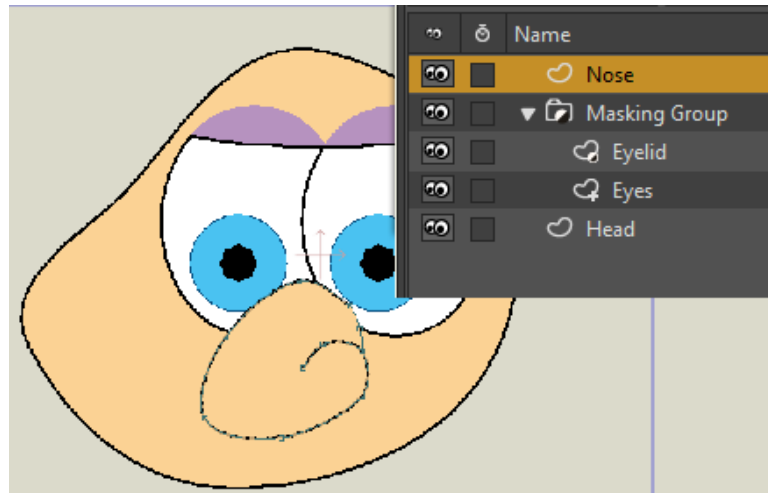
Eyes used as a mask

Another Example - Transition Effect

Finally, open the file **Tutorial 2.6_3**. This project uses a mask layer to cause a text object to fade into existence. Play back the animation, or export it as a movie, then play back the movie. In this example, a variation of the masking feature is used: the mask itself doesn't have to be visible. In this case, the mask is a rectangle that gradually exposes the text, but we don't really want to see the rectangle. To use an invisible mask, the Mask layer uses the **+ Add to mask, but keep invisible** option in the Masking tab.

Masking text.

Drawing

Tutorial 2.8: Styles (Pro Only)

In this tutorial we'll introduce Moho's **Style** feature. A style in Moho is a set of shape properties, including fill and line color, line width, fill effects, etc. Once you've defined a style, you can apply it to as many shapes as you wish. The benefit to this is that later on you can easily change the color and appearance of those shapes just by changing a single style.

Start With a Sample File

To start off, we'll take a look at a Moho file that already contains some styles. It's named **Tutorial 2.7** and it's located in the **Tutorials > 2 - Drawing** subfolder within your custom content folder. Open this file in Moho, and you should see something like this:
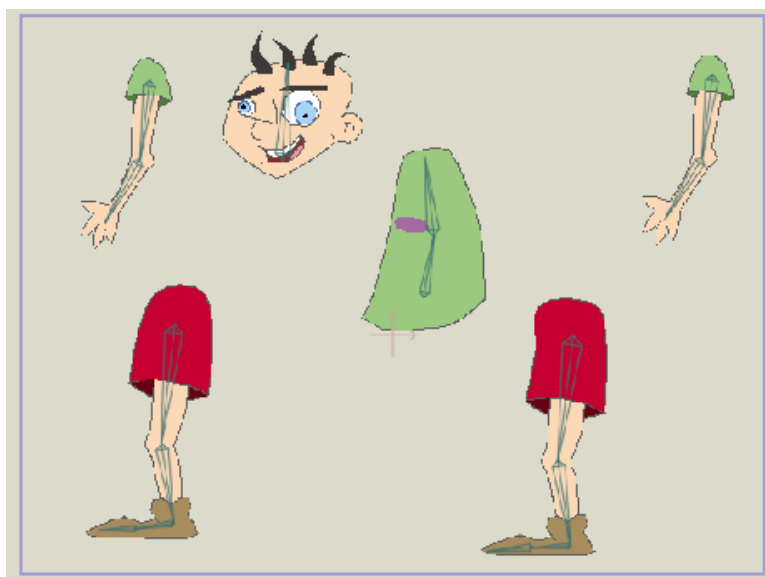
Starting point for this tutorial

(Don't worry that the character is all split apart. This is part of the bone setup described in another tutorial. If you want to try switching to frame 1, you'll see that the character snaps back together. Just be sure to go back to frame 0 before continuing.)

Let's see what a style is all about. In the Style window, display the Advanced settings by clicking the Advanced option.

Drawing
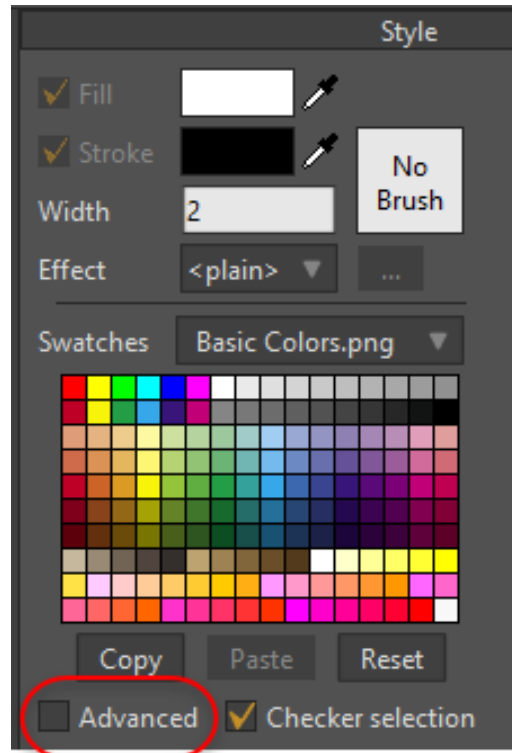
Click the Advanced checkbox to display more style options.

Select **Skin** from the Styles popup menu. The Skin style will become selected in the Style window:

Drawing
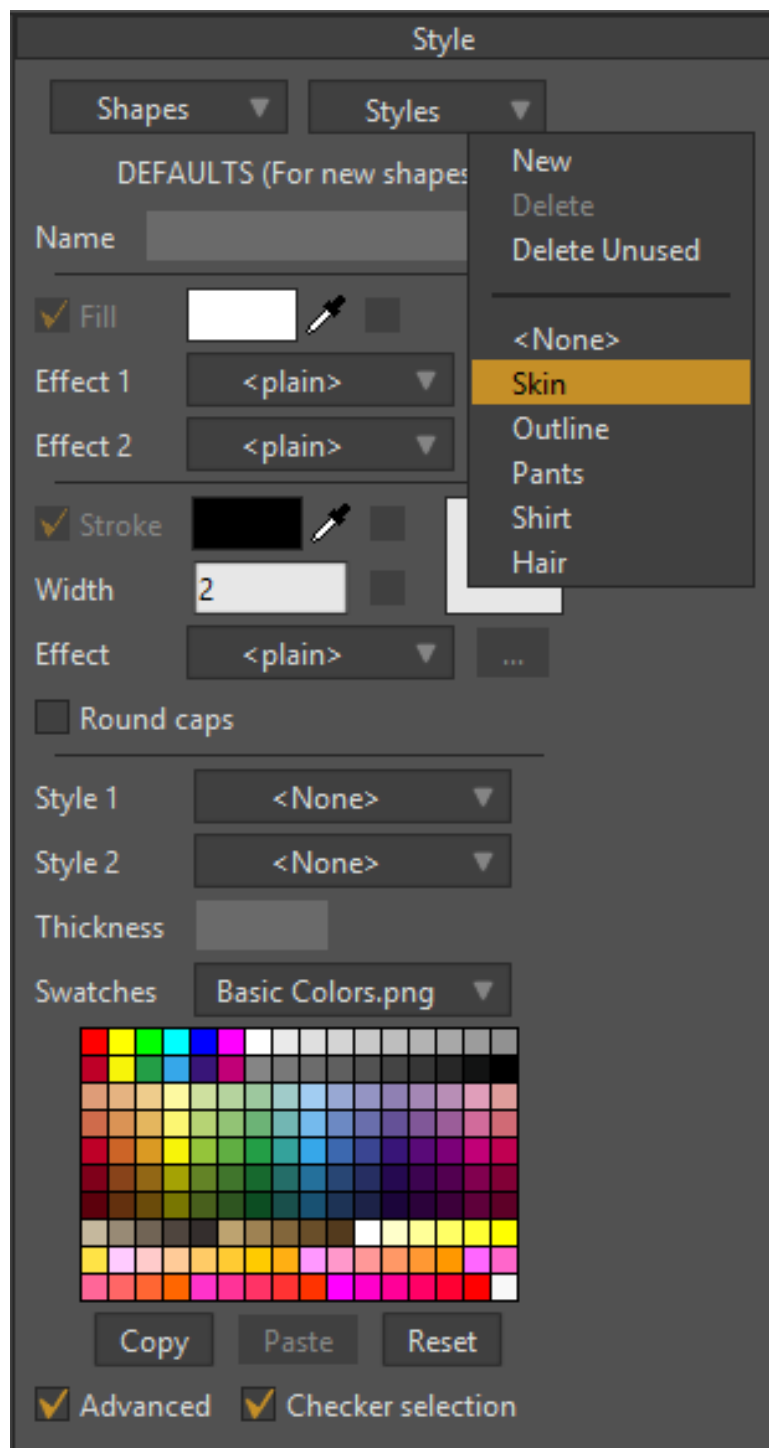
The skin style selected

Click the **Fill color** selector to change the Skin fill color. Pick any color you wish. Notice that the skin color updates instantly on all the body parts of the character, even though they are separate shapes and in several separate layers. Styles can be used throughout an entire Moho project, and are not limited to the shapes in a single layer.

Drawing
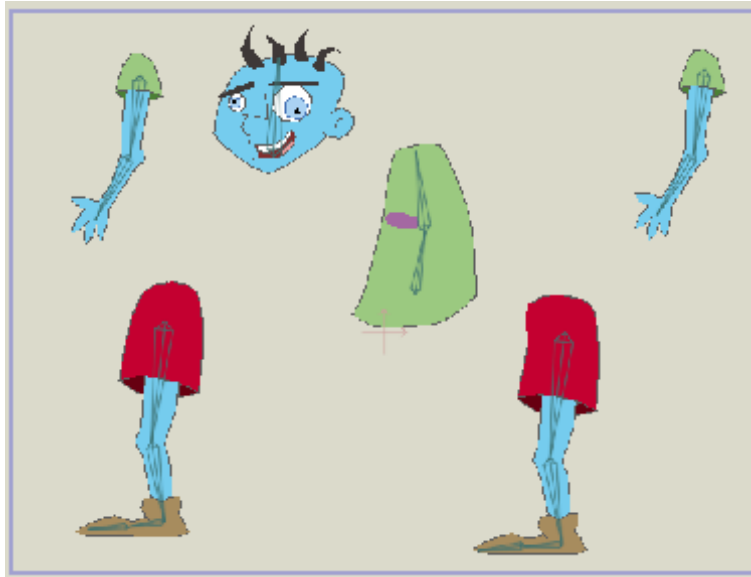
Modified skin color

If we look at the Style window, there are three things to notice about the Skin style:

1: The Skin style defines a fill color. 2: The Skin style does **not** define a line color. 3: The Skin style does **not** define a line width. Because the Skin style does not define a line color or width, changing these parameters will not affect the shapes that use this style.

Drawing
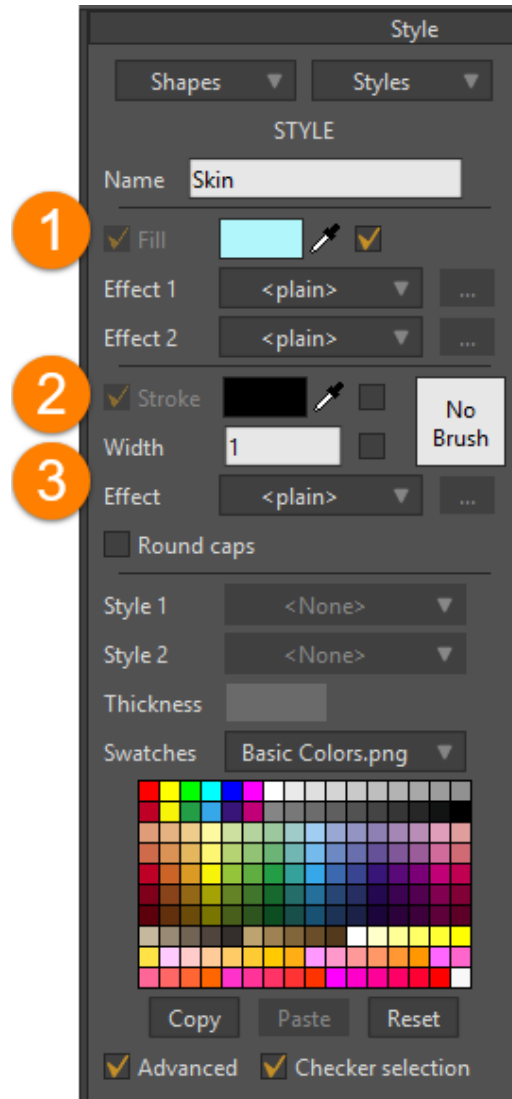
Skin style settings

Let's try a style that does control the properties of a line. Select the Outline style from the Styles popup menu in the Style window. Notice that this style does define a line color and width, but does not define a fill color. Change the Line Color to green and Line Width to 8 as shown below, and assign a brush to the line:

Drawing
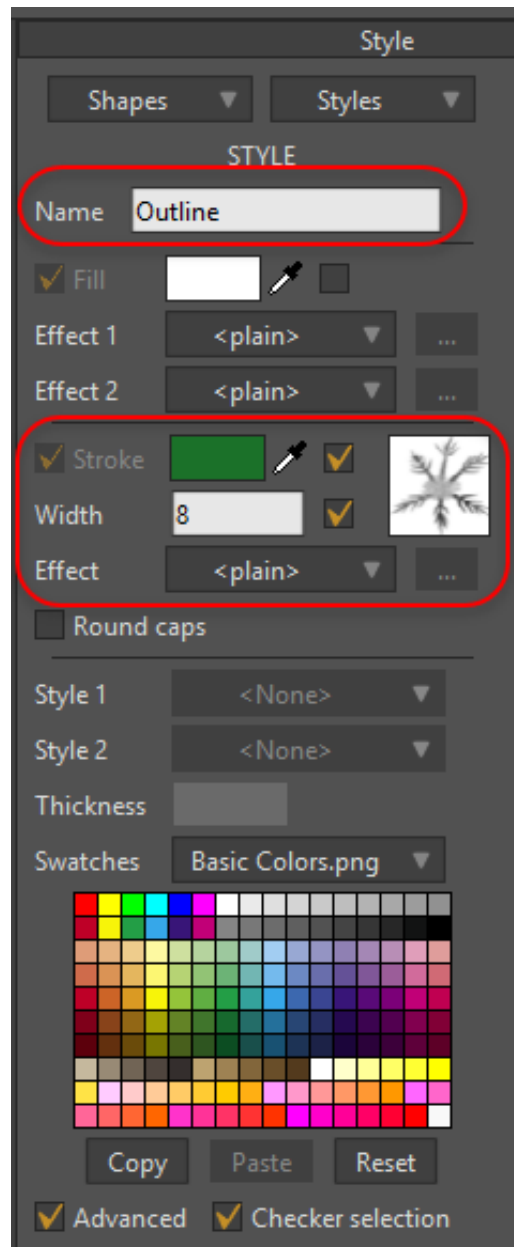
Modified Outline style

Notice that the Outline style has been applied to all the shapes in the entire character. Regardless of their other settings (like fill color), all the shapes use the Outline style to draw their outlines:

Drawing
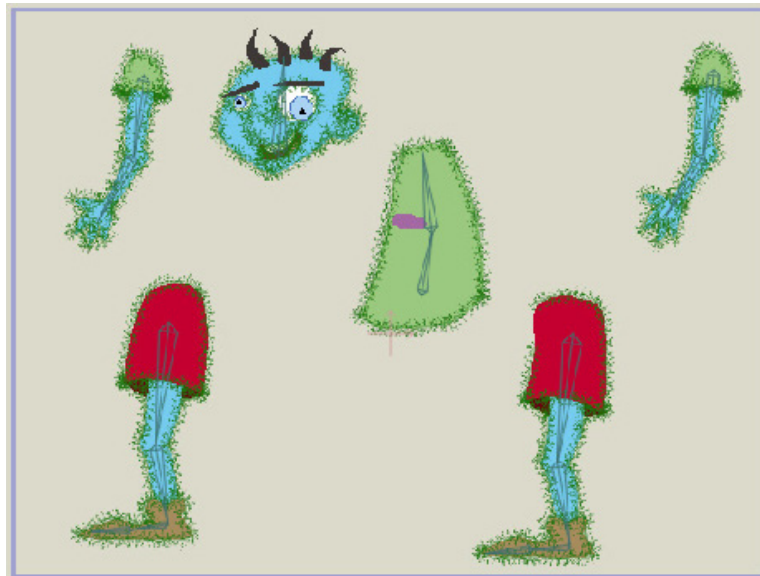
New Outline style

How Styles Are Applied

Now let's take a look at how styles are created and applied. Create a new Moho project file. In the Style window, select New from the Styles popup menu.
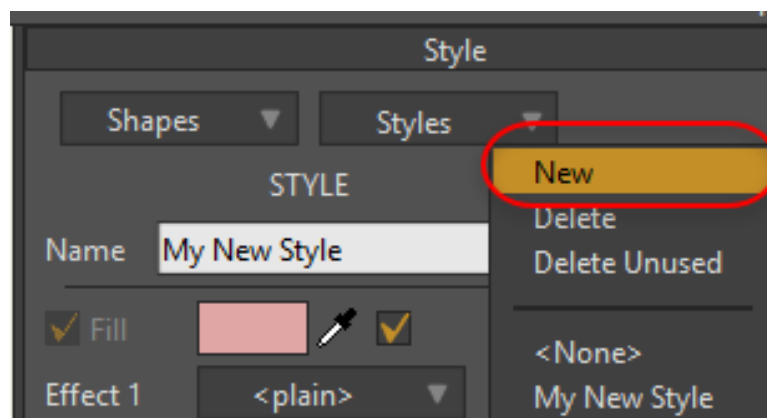
The Style window will now be editing the values for that style. Give the style a name (any name), and choose a fill and line color. Finally, set the line width to 8 or so. If you want to, you can also assign a brush and fill and line effects.

Drawing
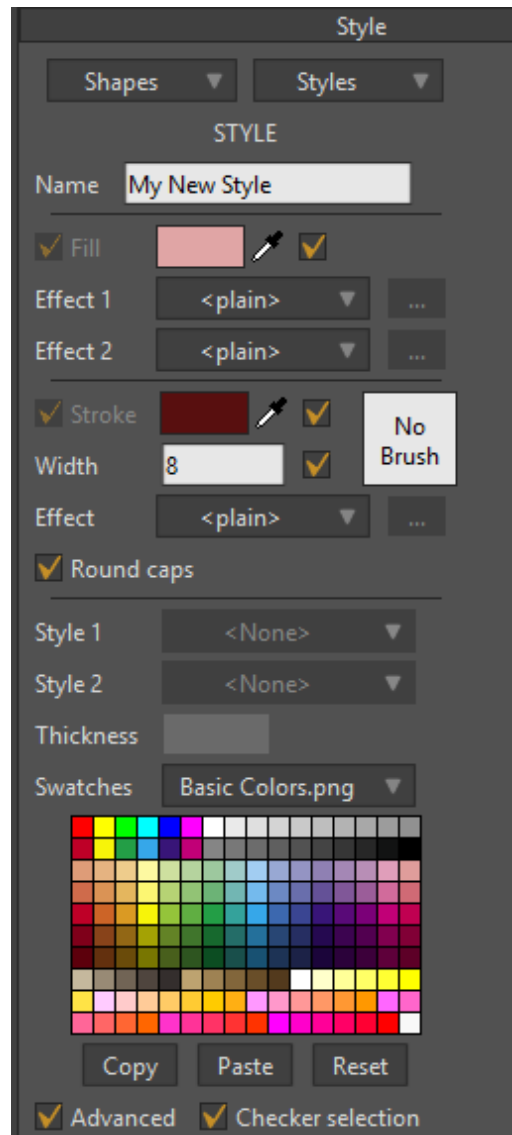
Creating a new style

Next, create a simple shape in the main window - a circle, rectangle, or text object would be fine. Make sure that the shape is filled.

Drawing
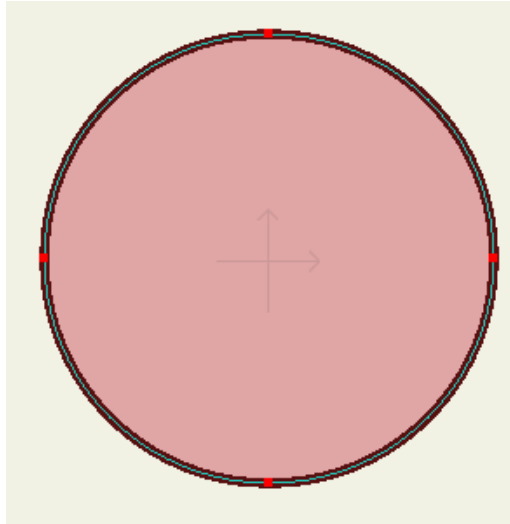
Create a simple shape
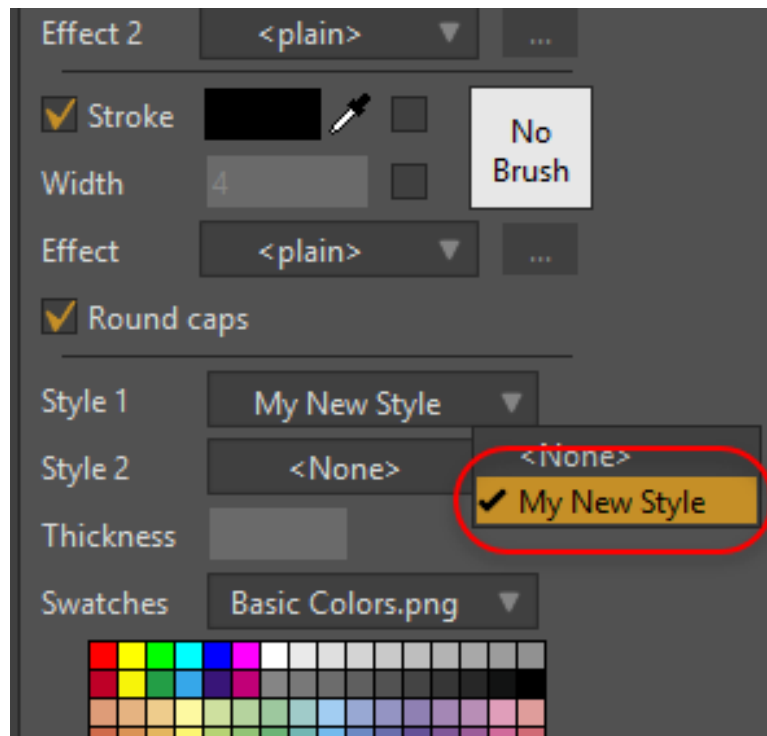
The new style in the Styles menu.

 If you want to apply a style to any other shape, use the Select Shape tool to click on your shape to select it. The Style window will update itself to show you the properties of the selected shape.

Select your style from either the Style 1 or Style 2 popup menu. This tells Moho to apply that style to the currently selected shape - you should see the properties of your style applied immediately in Moho's editing view.

That's it! As you've seen, it's quite easy to create and apply styles in Moho.

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Tutorial 2.9: Simple 3D Construction (Pro Only)

Moho is primarily a 2D program, although it does have some 3D tools for positioning the camera and individual layers. Still, even if you position layers in a 3D landscape and fly around them with the camera, each vector layer is really just a 2D plane in a 3D space.

While you can't create 3D objects in the same way that you can in a dedicated 3D modeling program, Moho does allow you to position and rotate two-dimensional planes in 3D space and then fly around them. If you need a more complex 3D shape you can import a 3D object as described in "Tutorial 6.9: Using 3D Models (Pro Only)" on page 269. You can also create 3D objects using a 2D vector shape, as described in "Tutorial 2.10: 3D Shape Design (Pro Only)" on page 97.

This tutorial will show you how to build a simple cube in Moho. If you need a more complex 3D shape, you can import a 3D object file created in a separate 3D modeling program (described in another tutorial).

Start With a Blank File

For this tutorial, start with a new, blank project in Moho. The completed file is also available for you to examine if you wish. It's named **Tutorial 2.8** and it's located in the **Tutorials > 2 - Draw** subfolder within your custom content folder.

Creating The Faces

The first step is to create the faces of the cube. In the initial, empty layer of your new project, use the **Draw Shape** tool to draw a square.

It's important that the square be precise. Choose the **View > Enable Grid** command to turn on the grid. This will help you draw this square.

The square must be centered at the layer origin, must be truly square (not a rectangle), and should touch the top and bottom of the viewable area exactly. To draw the square, press the Alt and Shift keys concurrently, and click at the layer origin point. The Alt key will draw the square outward from the point at which you clicked, and the Shift key will constrain the rectangle to create a square with four equal sides.

What's important for this square is that the corners are at (-1, 1), (1, 1), (1, -1), and (-1, -1) as shown in the following figure.

Don't worry too much about the coordinates - if you use the grid, center the square at the origin, and make sure the top and bottom touch the top and bottom of the viewable area, the corners will be correct.

Drawing
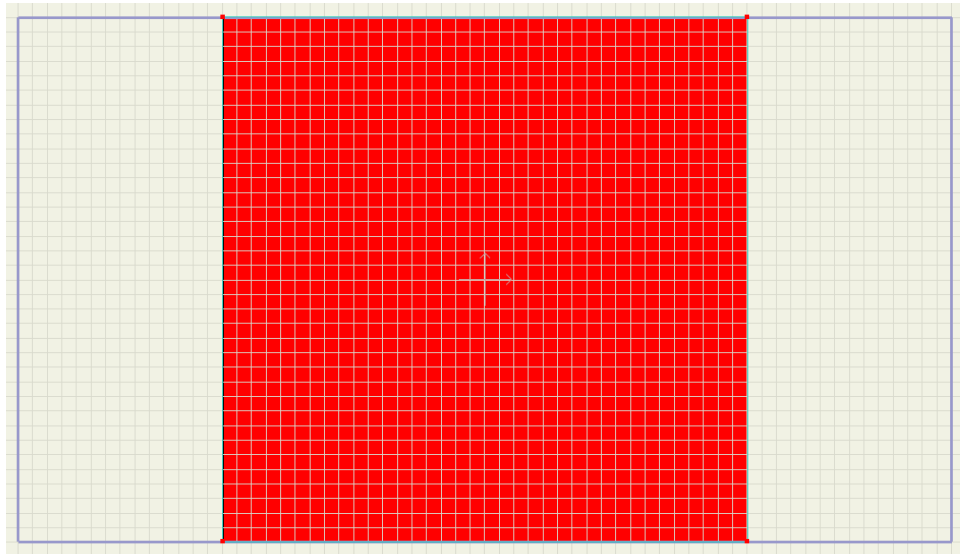
Start with a square

You can select the Transform Points tool and optionally enter the coordinates for each point manually in the tool options area.
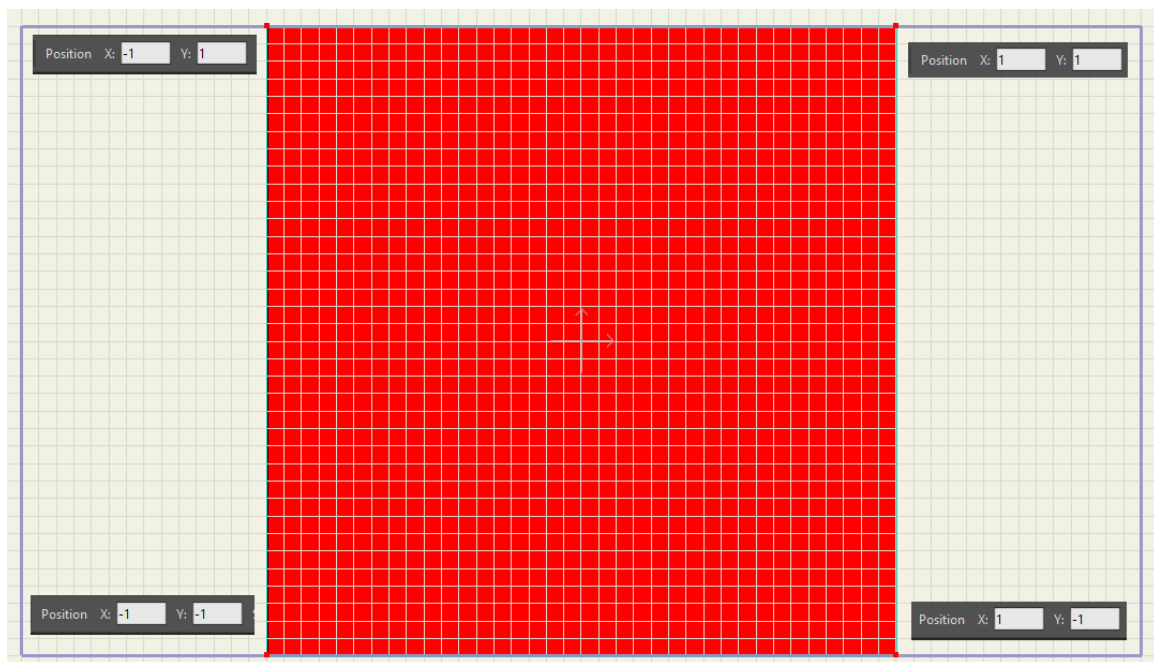
You can manually enter coordinates in the Tool Options area

Select the shape with the Select Shape tool. Then fill the square with a color of your choice and set its line width to 2.

In the Layers window, click the New Layer button. Create a Group layer, name it **Cube**, and put the layer with the square inside it. Duplicate the square layer five times and you should have a setup that looks like this:

Drawing
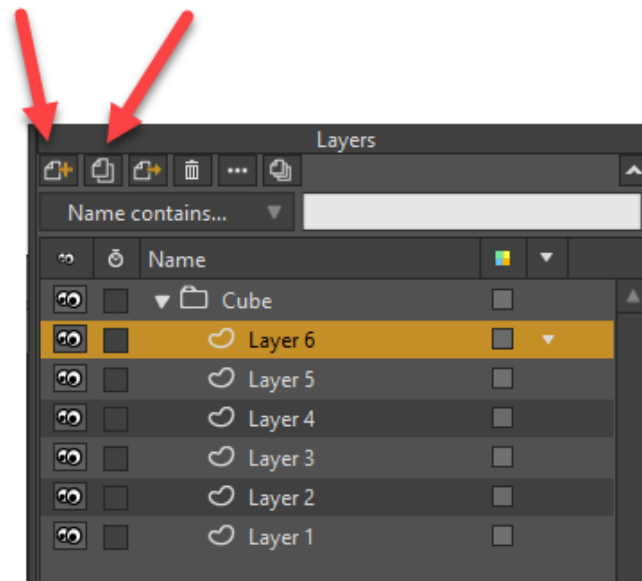
Arranging the layers

Positioning Faces

Select the lowest layer in the group, **Layer 1**, and make the **Transform Layer** tool active.

We're not going to actually use the Transform Layer tool, but making it active allows us to position a layer numerically. At the top of the main Moho window, in the tool options area, set the value of **X** to 0, **Y** to 0, and **Z** to 1. This changes the depth of the layer, bringing it forward toward the camera.
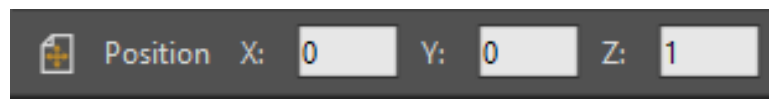
Layer 1 depth setting

Now select **Layer 2**, and set its **X** to 0, **Y** to 0, and **Z** value to -1. You've just positioned the front and back faces of the cube.
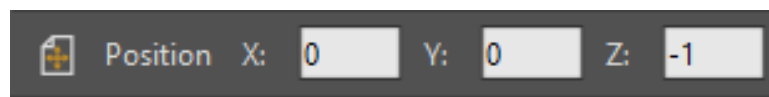
Layer 2 depth setting

The settings get a little more complex from here on out. Select **Layer 3**, and set its **X** value to 1. **Y** and **Z** remain at 0.

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Position	X:	1	Y:	0	Z:	0
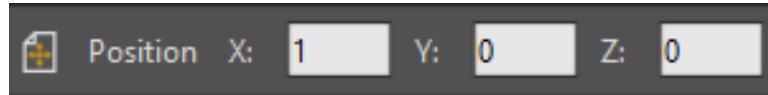
Layer 3 depth setting

Next, activate the **Rotate Layer XY** tool.

The tool area will reflect the rotation of the layer around the Y axis. Set the **Y Rotation** value to 90:

X rotation:	0	Y rotation:	90

Layer 3 rotated

Next up is **Layer 4** - adjust it similarly to Layer 3. With the **Transform Layer** tool, set **X** to -1 and **Y** and **Z** to 0, and use the **Rotate Layer XY** tool to set the layer **Y Rotation** to 90.

Position	X:	-1	Y:	0	Z:	0

Layer 4 Depth Setting
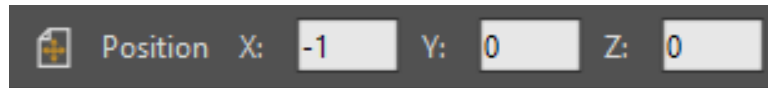
X rotation:	0	Y rotation:	90

Layer 4 Rotation Setting

Layer 5 is next - use the **Transform Layer** tool to set its Y position to 1 and the X and Z positions to 0. Next, choose the **Rotate Layer XY** tool and set **X Rotation** to 90 degrees.

Position	X:	0	Y:	1	Z:	0

Layer 5 Depth Setting
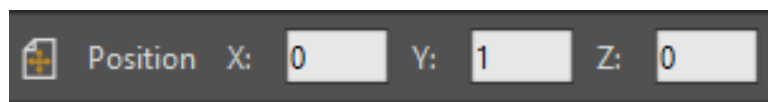
X rotation:	90	Y rotation:	0

Layer 5 Rotate Layer XY Setting

Finally, the last layer, **Layer 6** - adjust it similarly to Layer 5. Use the **Transform Layer** tool to set X and Z to 0, and Y to -1. Then choose the **Rotate Layer XY** tool and set **X Rotation** to 90.

Position	X:	0	Y:	-1	Z:	0

Layer 6 Depth Setting

Drawing

| X rotation: | 90 | Y rotation: | 0 |

Layer 6 Rotate Layer XY Setting

At this point the cube is basically finished, but it's a little too big to see in the workspace. Use the **Transform Layer** tool on the **Cube** group layer to make the entire thing a bit smaller.

It should look something like this:
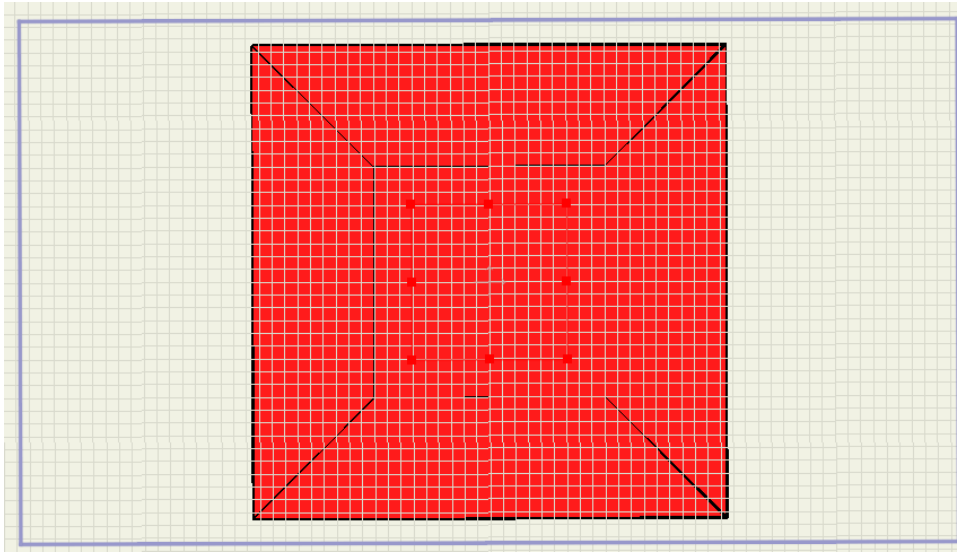
The finished cube

Depth Sorting

The final step required to finish the cube is to turn on depth sorting. Double-click the **Cube** layer to bring up the **Layer Settings** dialog. In the **Depth Sort** tab, turn on the checkboxes marked **Sort layers by depth** and **Sort by true distance** and click OK. The first checkbox tells Moho to draw the back faces of the cube first, then the front ones. The second checkbox is a different way of sorting the layers that is mostly used for 3D constructions like this cube.

Drawing
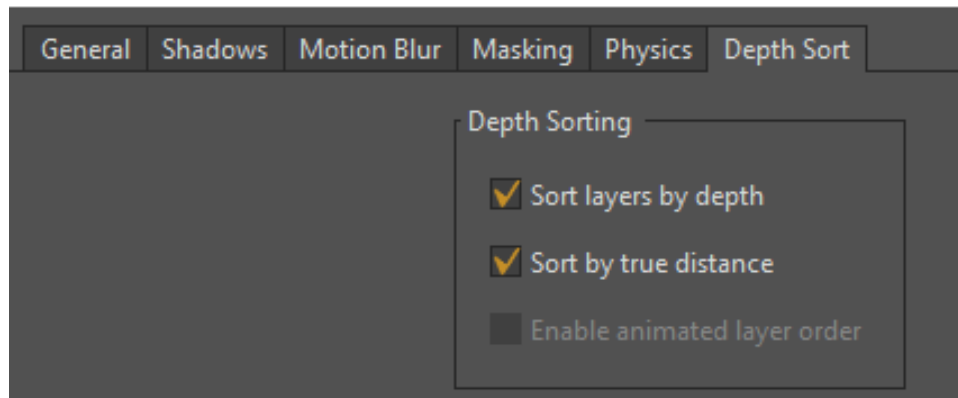
Try using the **Orbit Workspace** tool to view the cube from different angles. It should appear as a true 3D object.

You could now use the cube in a scene - using the Transform Layer and Rotate Layer XY tools to position it at an interesting angle, or to move it around during the animation.
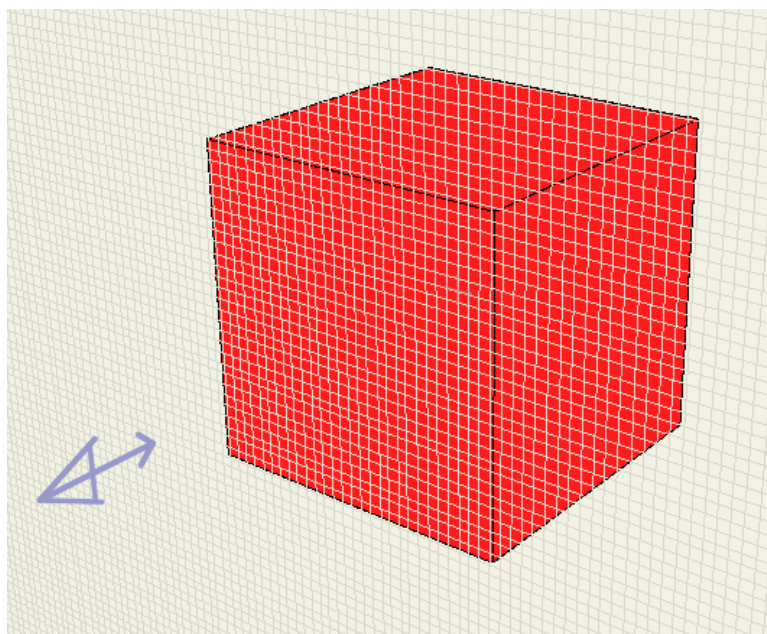
The finished cube, with depth sorting

Tutorial 2.10: 3D Shape Design (Pro Only)

Moho's 3D Shape Design feature allows you to convert a 2D vector layer into a 3D object. To demonstrate this, begin with a new project.

Use the Add Point Tool or the Draw Shape tool to create one or more vector shapes in the layer. Your objects can also include holes. All of the shapes that you create

Drawing

in the layer will be converted to 3D. Therefore, if you want some of the objects in your scene to remain two-dimensional, or if you want them to have different 3D properties, you will need to put them in separate layers.
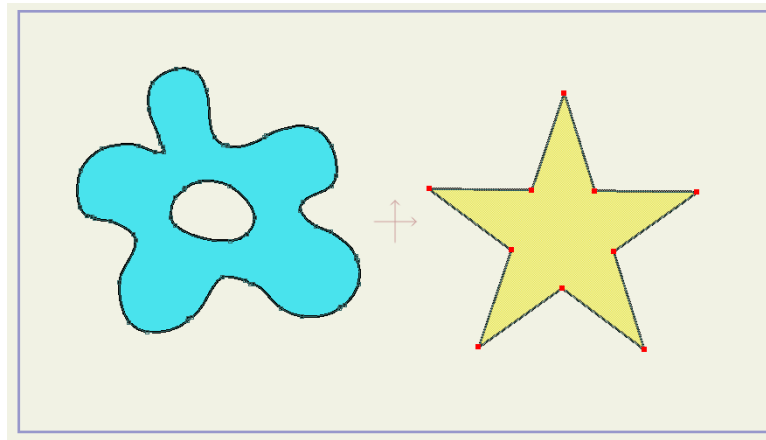
Start with two 2D shapes in the same layer.

After you create your 2D artwork, open the Layer Settings dialog for that layer. Choose the **3D Options** tab. You will find some options that allow you choose a 3D Conversion type. The choices are **Extrude**, **Lathe**, and **Inflate**, which are detailed in the following sections.
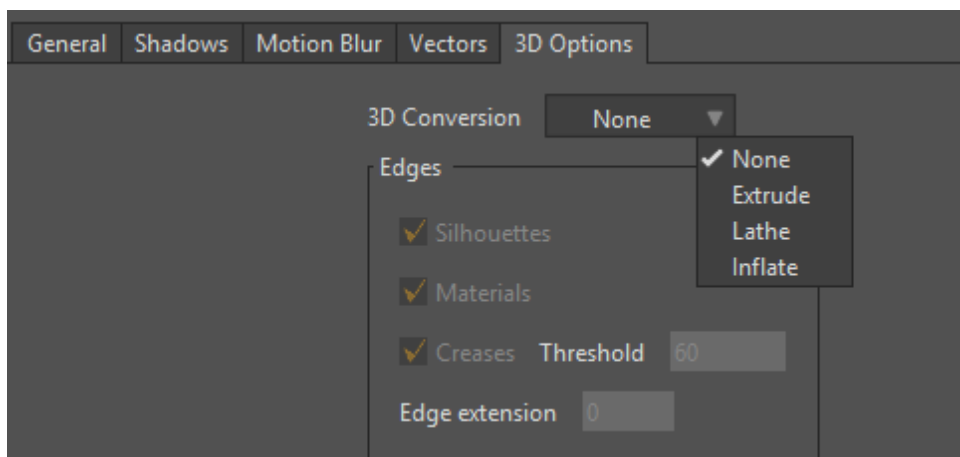
Options for 3D conversion

There are several settings that are common to each of the 3D conversion types. These options are similar to regular 3D layers, and they affect how the edges and shading appear in the 3D objects.

Drawing
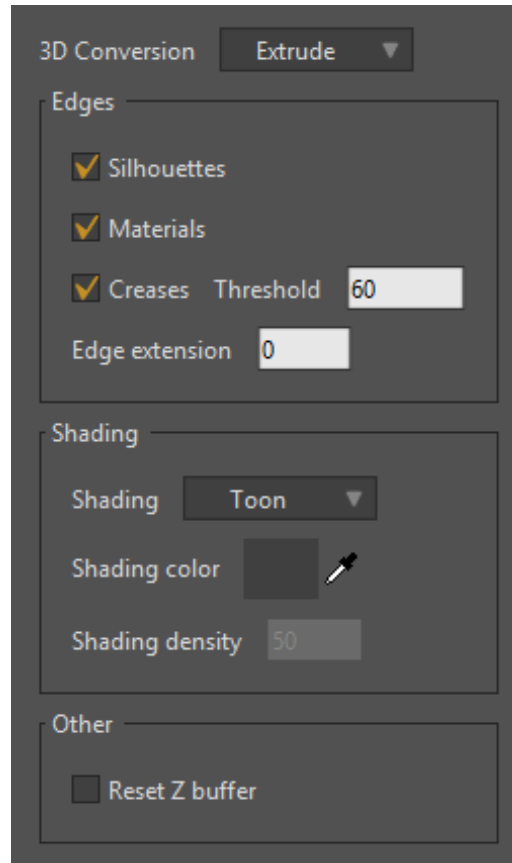
Options for Extrude conversion

- **Edges**: Controls which edges should be shown, and whether you want to show them on **Silhouettes**, **Materials**, or **Creases**. By default, edges are shown for all three. Uncheck the edges that you do not want to display. When displaying creases, you can adjust the **Threshold** setting to control the number of creases that are displayed. The **Edge Extension** setting controls how far beyond the edge of the object that edges will be drawn. Increase the Extension setting to make the objects it look like they have been sketched.

Drawing
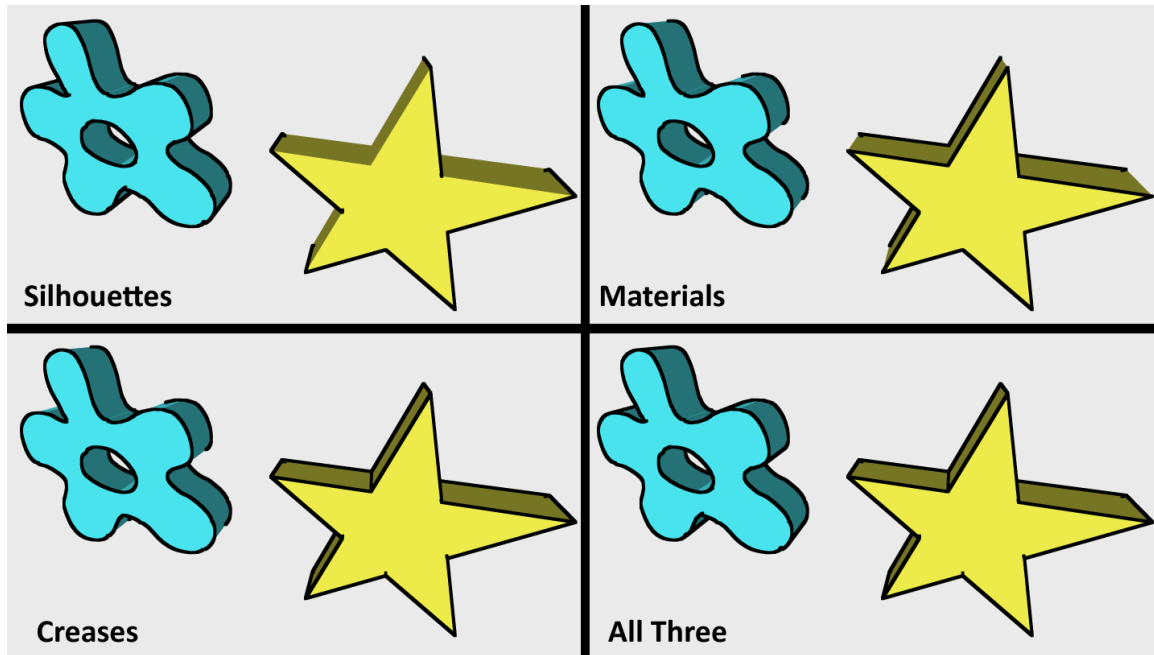
Edges options

- **Shading**: Choose between **None** (which gives the object a flat appearance), **Smooth** (which gives a smooth, more three-dimensional shaded look), **Toon** (which has stepped shading), or **Hatched** (which shades with a sketched line effect).

- **Shading Color:** To change the shading color of your 3D object, select **Hatched** from the Shading drop down menu, double click on the existing shading color and choose a different color from the color picker.

- **Shading Density:** To change the shading density of your 3D object, select **Hatched** from the Shading drop down menu, the input field for the shading density will be editable, enter a number from 0 to 100. Zero will be less dense whereas 100 will be more dense.

Extrude Conversions

When you choose the Extrude conversion, the 2D object is given a dimension of thickness: You can observe the thickness by using the Transform Layer tool in the Layer section of the tool box. You can increase or decrease the thickness of the 3D shape by adjusting the Thickness setting in the Style window.

Drawing
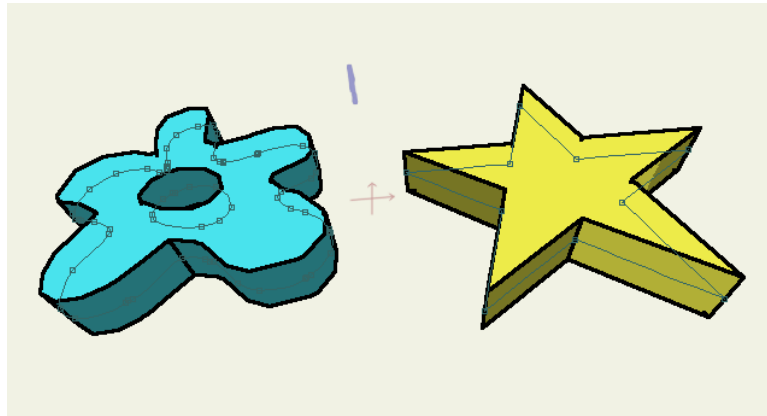
Extrude 3D Conversion

When paths are displayed, you can still edit the path to change the shape of the 3D object, and change its color. You can also add bones to the 3D layer as well.
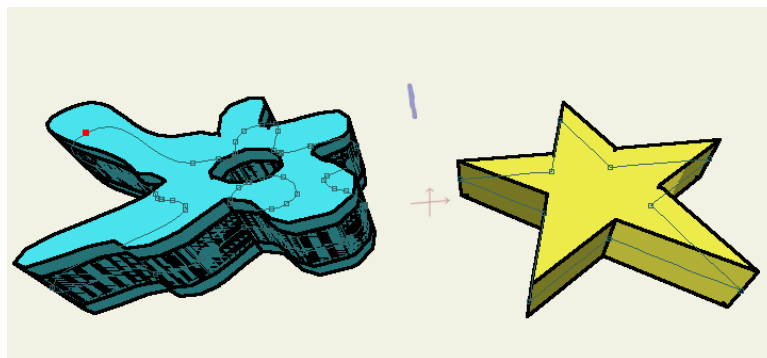
You can still edit the path to modify the 3D shape.

Lathe Conversions

The Lathe conversion allows you to create a three-dimensional path by drawing a two-dimensional profile shape that is then projected in a 360 degree circular fashion. The rotation occurs around the origin point of the shape (represented by the crosshairs in the workspace area).

The following conditions apply when using lathe conversions:

• If the vector shape only has a stroke, the stroke color will be used for the lathe object, and the outline will be black.

• If the vector shape has a fill color, the fill color will be used for the lathe object. The stroke color will be used for the outline of the lathe object. An example is shown in the following figure.

Drawing
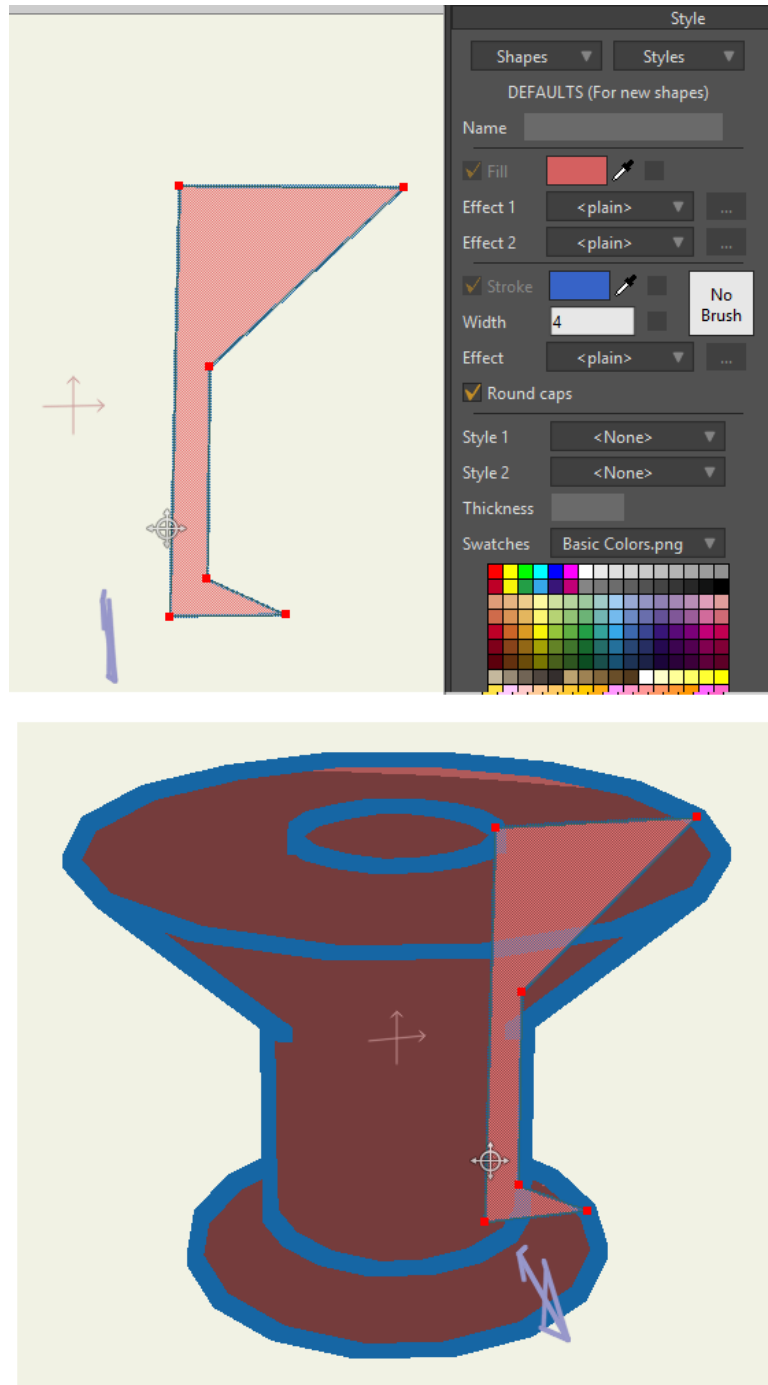
Original filled shape (top); resulting lathed object (bottom)

Inflate Conversions

Inflate is similar to Extrude, except that the edges are rounded, like a pillow. It also involves more computations than the Extrude option, so you will tend to see better results after you render it than you will during the preview.

Drawing
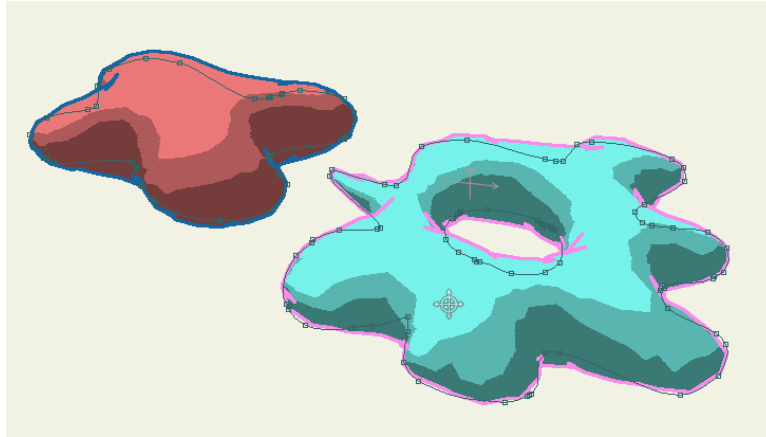
Two inflated shapes on the same layer.

Drawing

Bones

Tutorial 3.1: Bone Binding

The purpose of bones in Moho is to provide high-level objects that are easy to manipulate in place of moving around lots of individual points. In order for bones to do their job, vector control points and other objects must first be bound to the bones. There are three ways to bind objects to bones: automatic binding, manual binding, and layer binding. This tutorial will show you the difference between the three.

Start With a Sample File

For this tutorial, we'll start with a project file that contains some artwork to get started with. It's named **Tutorial 3.1** and it's located in the **Tutorials > 3 - Bones** subfolder within your custom content folder. Open this file in Moho, and you should see something like this:
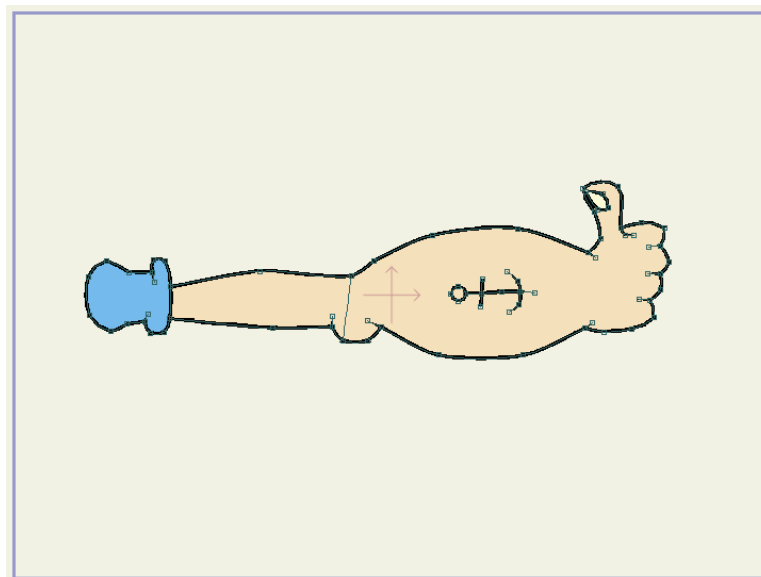
Starting point for this tutorial

Automatic Binding

The most common method of binding objects to bones is also the easiest - automatic bone binding. Whenever you draw new artwork in Moho (or import image files as image layers), those objects are set up for automatic bone binding. All you need to do is add the bones.

1.   In the Layers window, click the New Layer button, and select **Bone** from the popup menu. Name the new bone layer **Arm Bones** and press Enter/Return to assign the name.
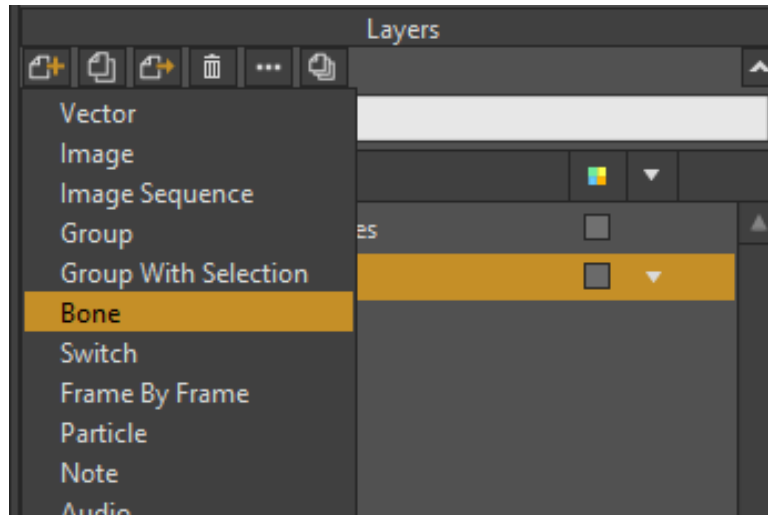
Bones

Create a new Bone layer (Pro shown)

2.   Drag the **Arm** vector layer upward to move it into the bone layer:
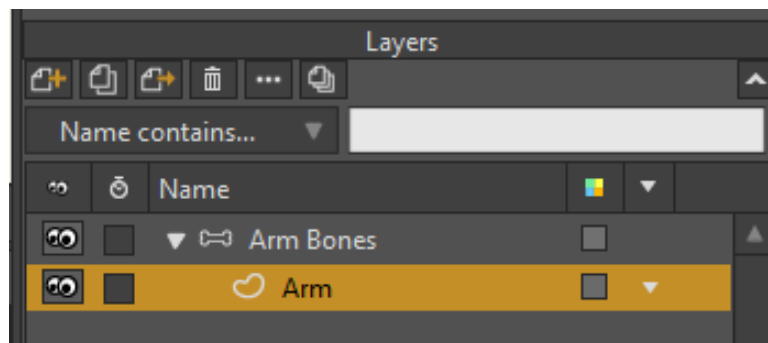
Arm layer placed inside a bone layer

 Make sure the **Arm Bones** layer is selected, then activate the **Add Bone** tool.

In the main editing view, create two bones: the first one starting at the shoulder and ending at the elbow, and the second starting where the first left off and ending in the hand. And that's all it takes for automatic bone binding.
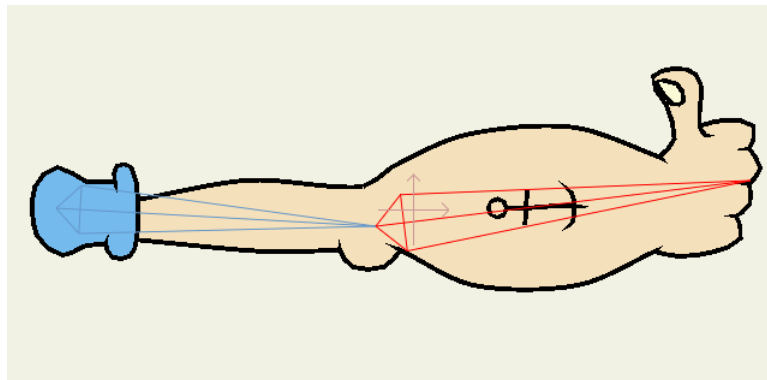
Create two new bones

Bones

Use the **Manipulate Bones** tool to try moving the bones around. The arm will move with the bones automatically, since it was, well, automatically bound to them.
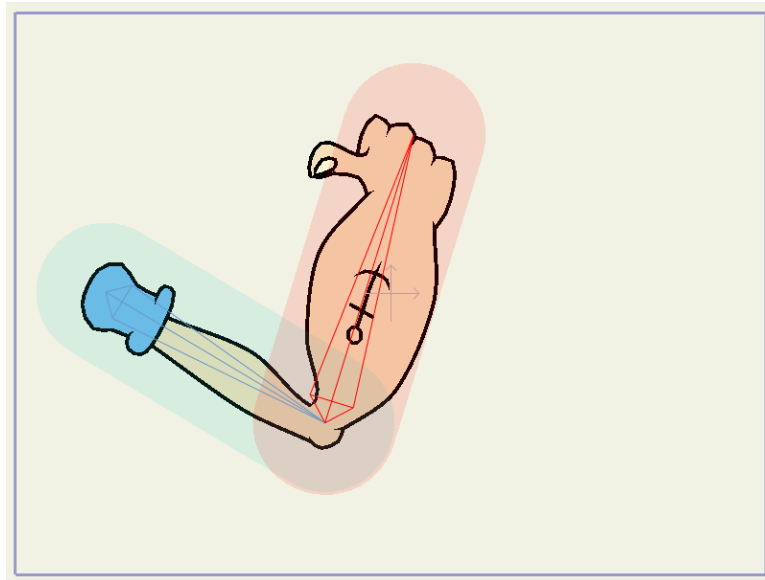
Test moving the bones

This arm setup works pretty well as it is, but let's try to refine it a bit. Double-click the **Arm Bones** layer to bring up the Layer Settings dialog. Go to the Bones tab, set the binding mode to **Region binding**, and click OK:
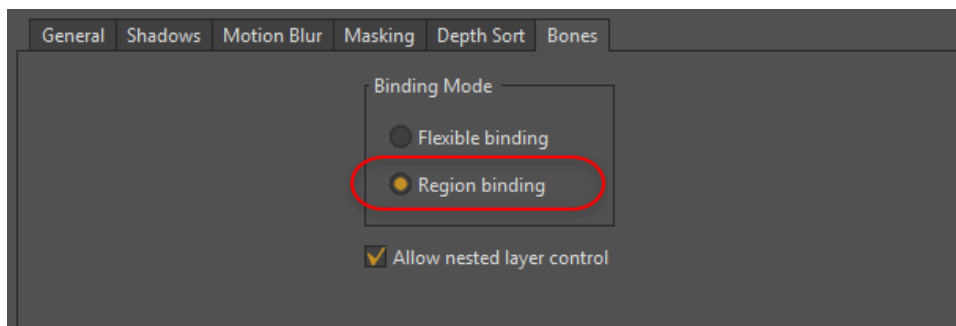
Turn on region binding

Flexible binding (the default for new bone layers) uses a method of bone binding where every bone has some influence over every point in a vector layer. The farther away a point is from a bone, the less influence that bone has over the point. However, you can still experience some rubbery movement where a moving arm can cause a toe to twitch a little bit.

With region binding, on the other hand, every bone has a cutoff radius, outside of which it will not affect the movement of vector points. This can be used for cleaner movement, but requires a little extra setup. Now that region binding is in effect, activate the **Bone Strength** tool.

Around each bone you will see its region of influence. Vector points are controlled by the bone(s) whose regions overlap them. If a vector point is not within any region of influence, it will move with the closest bone. Using the Bone Strength tool, click and drag on each of the bones to resize its region of influence. The idea is to make

Bones

the regions just large enough to contain the body part that the bone is meant to control:
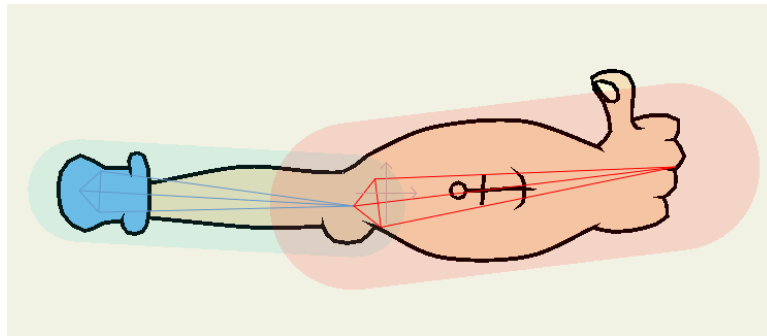
Resized regions of influence

Don't worry about the parts of the forearm that are outside the forearm bone's region of influence - they will just move with the closest bone, which is in fact the forearm.

Use the **Manipulate Bones** tool again to try moving the arm. The movement should be a little cleaner than it was with flexible binding.

Manual Binding

Manually binding points to bones is a process that exists mostly for compatibility with older versions of Anime Studio. Automatic binding, combined with bone regions of influence is the easiest way to work with bones in Moho. However, there may be some times where you want more control over exactly which bones control which points.

To manually bind the arm points to bones:

1.   Select the **Arm** vector layer.
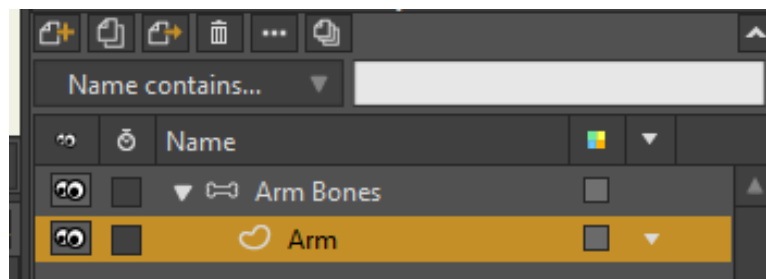
Arm Vector Layer

2.   Use the **Select Bone** tool to select the upper arm bone:

Bones
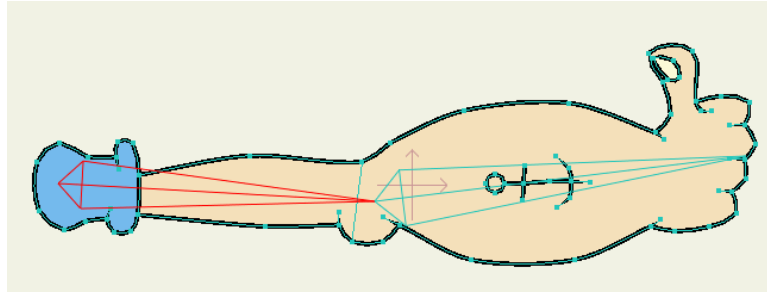
Bind all points to the upper arm

3.   [icon] Activate the **Bind Points** tool.

4.   Drag a rectangle around all the points in the arm to select them, and press the Enter key to bind the selected points to the selected bone. When you click an bind points to a bone, you will notice the points in the arm will be colored the same color as the bone they are bound to. This helps you determine which points are bound to which bone. In the following figure, all of the points are colored yellow because they are bound to the arm bone.
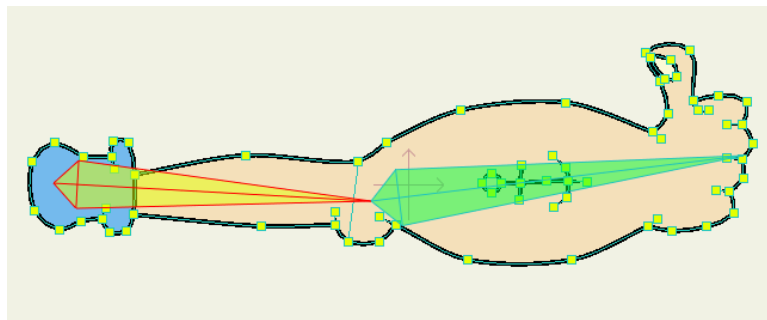
Bind all points to the upper arm

5.   With the Bind Points tool still active, hold down the **Alt** key and click on the lower arm bone to select it. Notice the following:

   ▪   When you select the lower arm bone, notice that no points are selected.

   ▪   When you select a bone with the Bind Points tool, the points that are bound to that bone are also selected. Because there are currently no points bound to the lower arm bone, no points are selected.

6.   Drag a selection rectangle around the points in the lower part of the arm, as shown below. Press the Enter key to bind the selected points to the selected bone:
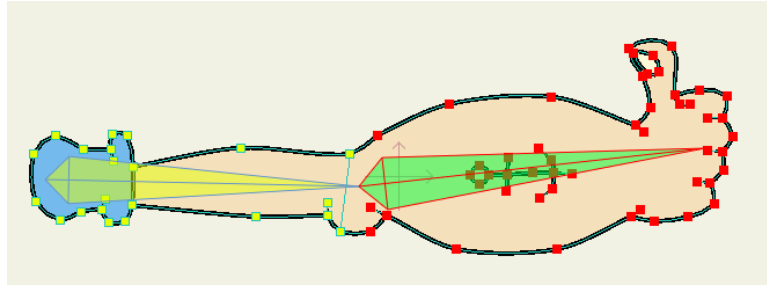
Bones

Select the lower arm bones

You're done - you have manually bound points to both bones in the arm. Now test it out with the **Manipulate Bones** tool.

Although this method does work for binding points to bones, we don't really recommend it unless you have a special need to bind specific points to specific bones. You may have noticed that the arm doesn't move so smoothly with manual point binding. This is because the points around the elbow only move with one bone or the other, and so stretch apart and get distorted. With automatic binding, on the other hand, the points around the elbow move under the influence of both bones, and so move more smoothly.

Manual point binding can also be very labor-intensive, especially when your artwork has lots of control points. Finally, automatic bone binding can be used to warp image layers, while manual binding can't - another reason to stick with automatic bone binding (using either flexible or region binding mode).

Layer Binding

The last way to bind an object to a bone is to bind an entire layer to a single arm.

7.   Make sure the Arm vector layer is still selected and activate the **Bind Layer** tool.

8.   Click on the lower arm bone to bind the entire Arm layer to the lower arm bone.
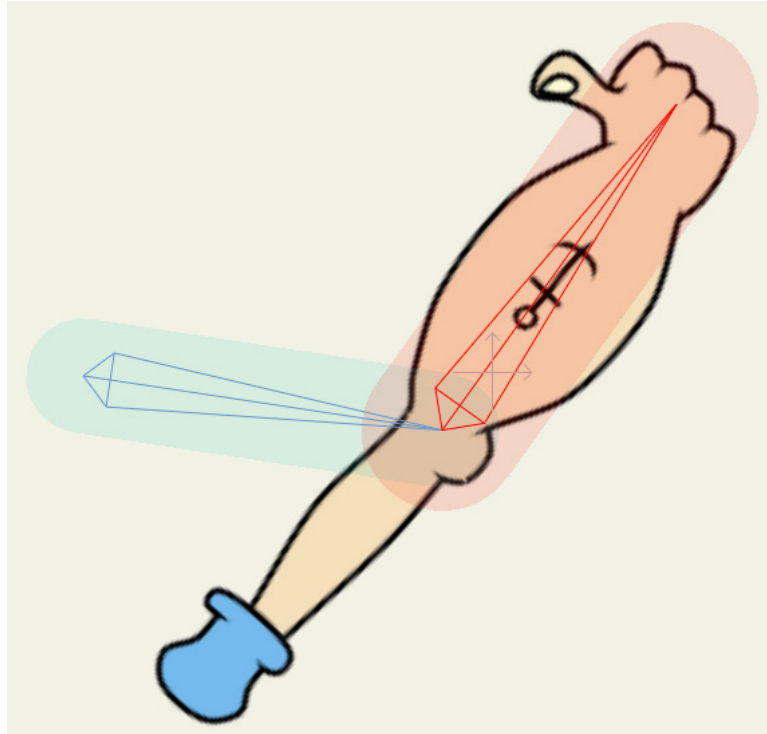
Bones

Bind the Arm layer to the lower arm bone

9. Select the Arm Bone layer and use the **Manipulate Bones** tool to try moving the bones around. Notice that the entire arm moves rigidly with the lower arm bone - the entire layer is bound to that one bone.

This isn't very useful for this particular arm, but binding a layer to a bone is useful when you want to attach an object to a character. For example, a switch group containing multiple mouth shapes can be attached to a bone in the head. Or, if you want to make a character hold an object in its hand, you might bind that object to the character's hand bone.

Go Back to Automatic Mode

Let's undo all of this extra binding and go back to automatic mode.

1. Reselect the Arm layer in the Layers window.

2. With the **Bind Layer** tool, click on some empty space in the editing view - this tells Moho to not bind the layer to any bone.

3. Select the **Edit > Select All** menu command to select all the vector points.

4. Choose the **Bone > Flexi-Bind Points** menu command to flexibly bind the points, as they were at the very beginning.
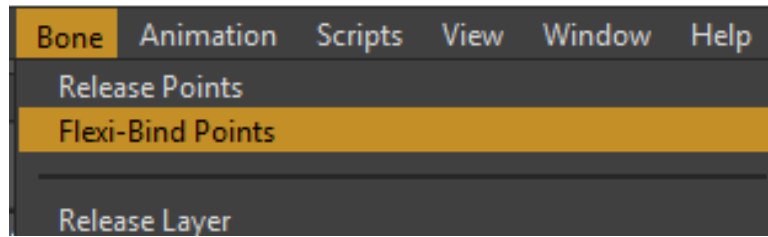
Bones

Chose Bone > Flexi-Bind Points to flexibly bind points as originally set in the beginning.

5. Reselect the Arm Bone layer, and use the Manipulate Bones tool if you wish to confirm that the points are automatically bound again.
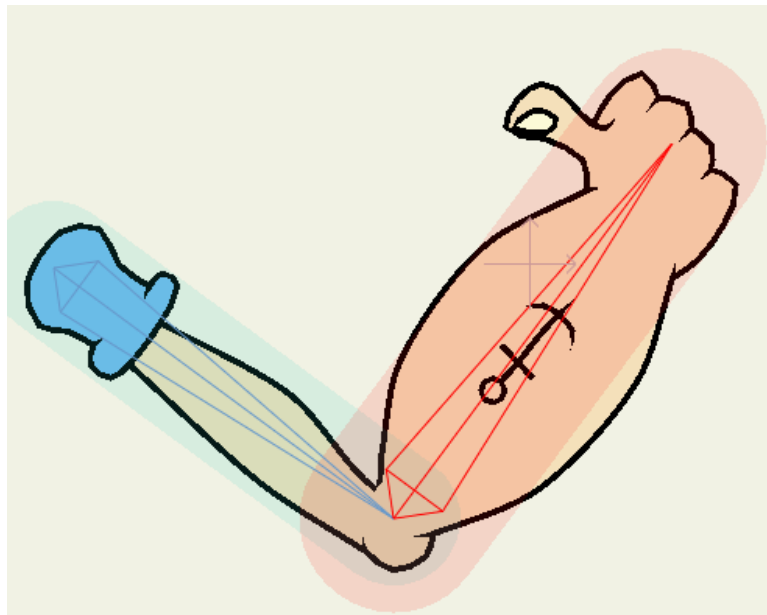
The arm under bone control.

Click this link to view a brief video of the finished results of your project.

Tutorial 3.2: Bone Constraints

This tutorial demonstrates Moho's bone constraint features. Bone constraints allow you to define limits on the way bones can move, simplifying your animation work. When used carefully, bone constraints can let the bone structures do some of the work for you.

Start With a Sample File

For this tutorial, we'll start with a project file that's almost finished. It's named **Tutorial 3.2** and it's located in the **Tutorials > 3 - Bones** subfolder within your custom content folder. Open this file in Moho, and you should see something like this:

Bones
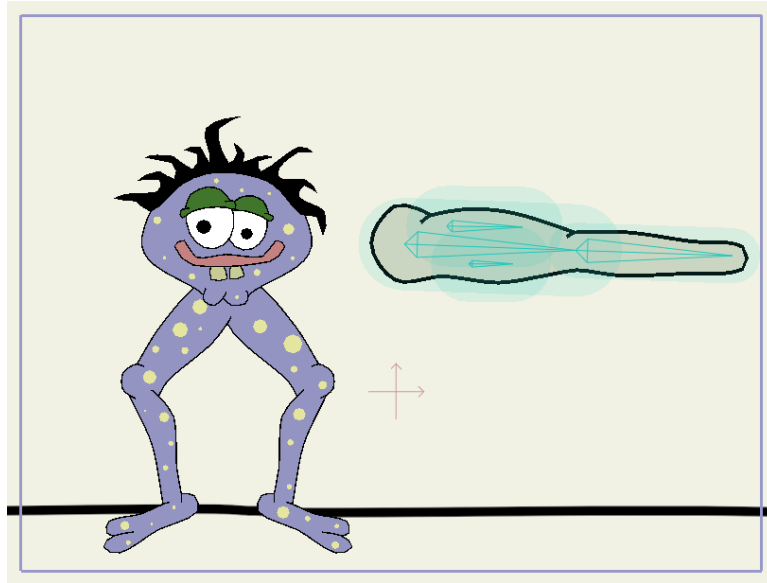
Starting point for this tutorial

This file contains two skeleton layers that have no constraints set up. We're going to add constraints to these skeletons to show how useful they can be.

Angle Constraints

The first type of bone constraint is angle limits. By limiting the angle that a bone can rotate, you can prevent arms and legs from bending backwards.

6.   Make sure the Arm layer is selected.
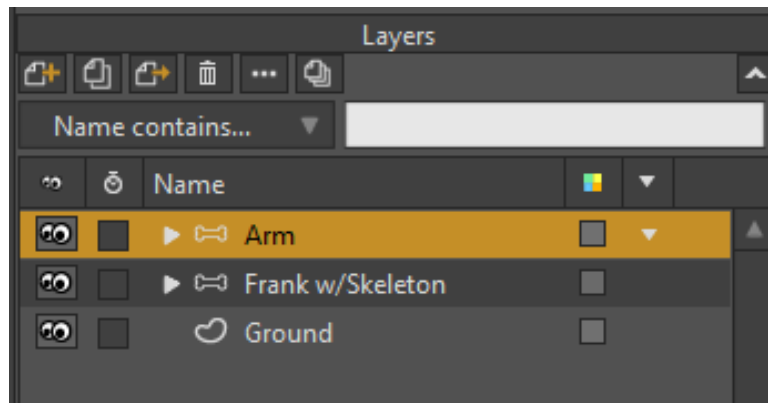
Select the Arm bone

7.   Use the **Select Bone** tool to select the bone in the Arm as shown below:
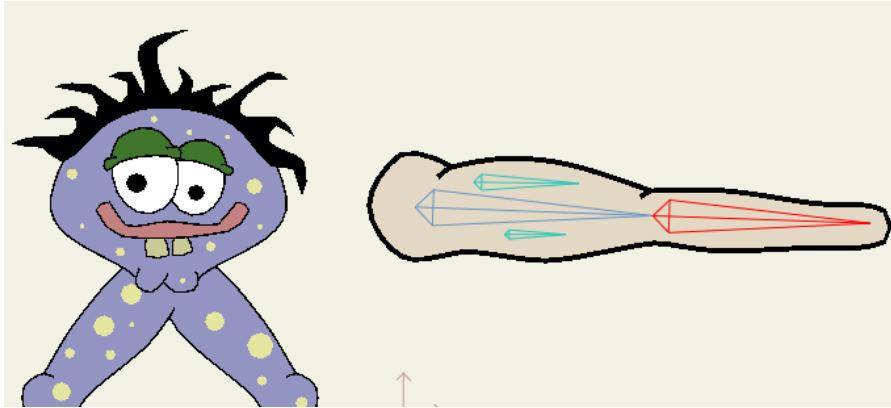
Select the lower arm bone

8. When the Select Bone tool is active and a bone is selected, the Bone Constraints popup box will be available in the tool options area of the main Moho window. Click the Bone Constraints popup to open it.

9. Adjust the settings as shown below. Specifically, turn on the **Angle constraints** checkbox, and set the min/max angle fields to -10 and 100.
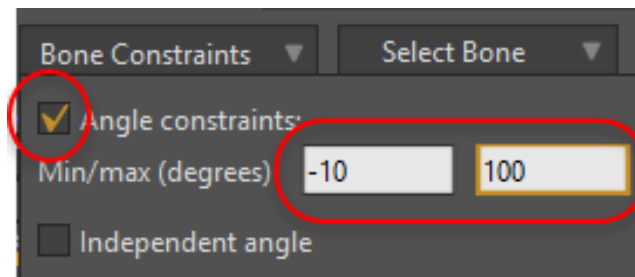
Set angle constraints

10. Click the Close button to close the constraints popup box.

11. Set the bone's name to **Forearm** in the toolbar options.
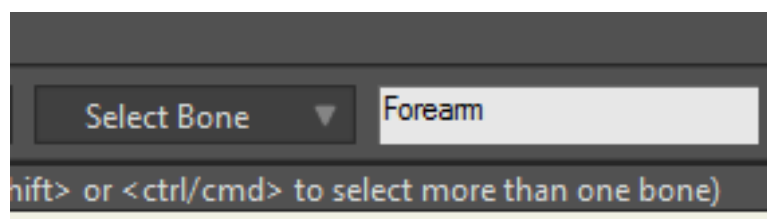
Name this bone **Forearm**

12. Once you've set up angle constraints, you can see them in the working area as two lines around the bone that indicate the minimum and maximum angles the bone is allowed to rotate between. Try using the **Manipulate Bones** tool and move the forearm - notice how Moho doesn't allow you to move the bone beyond the minimum and maximum angles you set up.

Bones
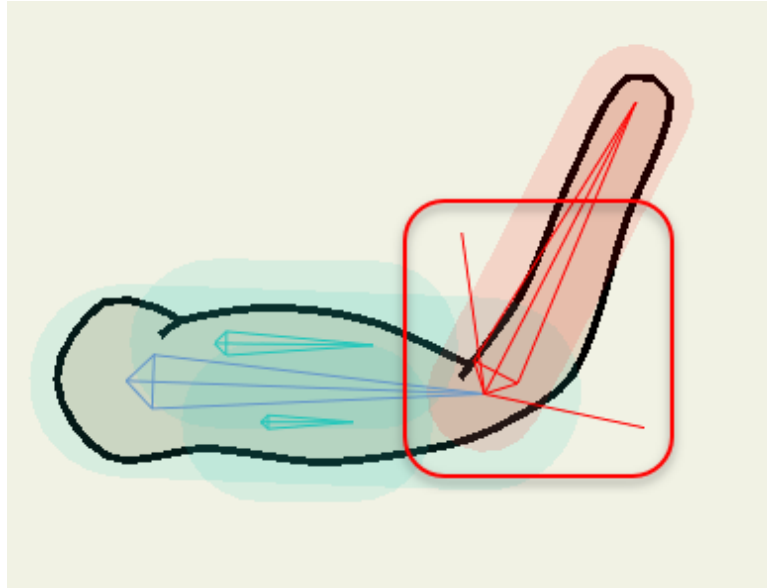
Visual display of angle constraints

> **m.** *Here's a handy little trick. Often, it can be hard to judge the correct numerical angles for bone constraints. There's an easy way to adjust them if you have a mouse with a scroll wheel. Hold the mouse over the angle constraint you wish to change (in the Bone Constraints popup), and roll the mouse wheel up and down. The angle will change, and the display in the editing view will update to match. With this method, you can watch the display in the editing view and not worry so much about the actual numerical value.*

Control Bones

The next type of bone constraint allows one bone to control the motion of another. This is a way to set up simple automatic animation.

13. Use the Select Bone tool to select the small bone above the upper arm:
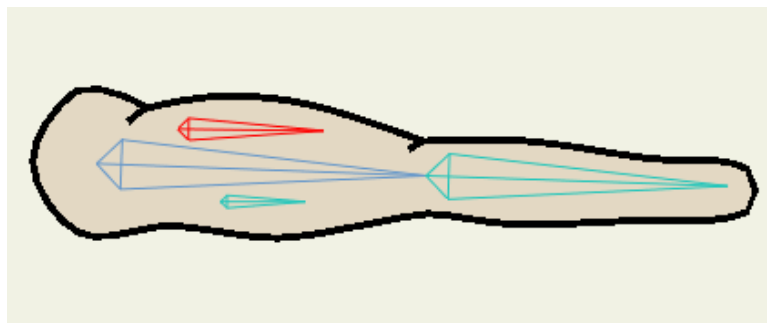
Upper forearm bone selected.

14. Bring up the Bone Constraints popup again, and select **Forearm** from the **Angle control bone** popup menu (this is why we named it earlier), and enter the value 0.5 in the angle control field as shown below:
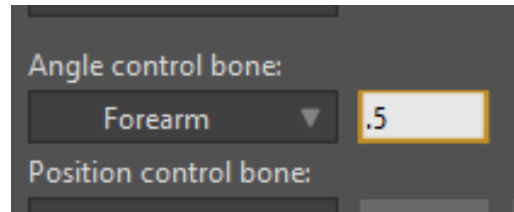
Bones

Angle control setup

15. We'll do something similar for the small bone below the upper arm. Select that bone, and set **Forearm** as the angle control bone, but this time set the angle control value to -0.5.
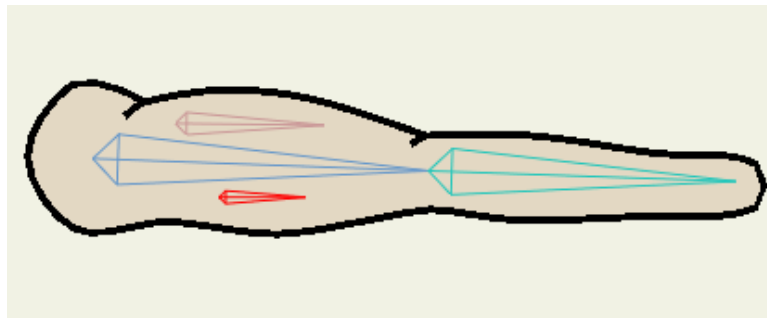
Lower forearm bone selected.
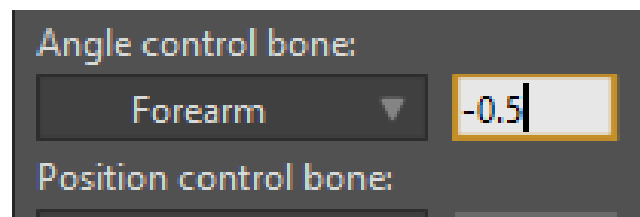
16. Finally, use the **Manipulate Bones** tool again to move the forearm. Notice that now the muscles in the upper arm move automatically - this is what the Angle Control Bone does - it tells other bones to move automatically when it moves.
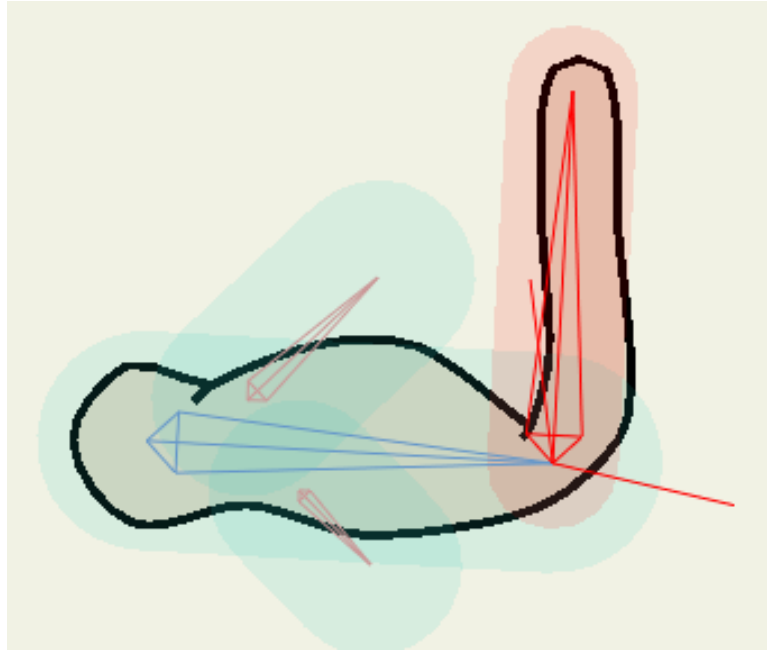
Bones

Upper Arm bones move automatically

Bone Locking

The third category of bone constraint is **bone locking**. When you lock a bone, you're telling Moho that you don't want it to move. Moho will try to keep the bone still by moving its parents as necessary to keep the bone in place. This isn't always possible (depending on what else is happening in the animation), but it is still an extremely useful feature.

Bone locking is often used to keep a character's feet from moving around on the ground. To do this, Moho needs to move the character's legs automatically. Thus, it helps to use angle constraints to keep the knees from bending backwards.

Moho Pro offers some target bone features that help keep a character's feet in place while moving bones above it. For more information about using target bones, see "Tutorial 3.6: Enhanced Bone Features (Pro Only)" *on page 140.*

1.   Select the Frank w/Skeleton layer in the Layers window.
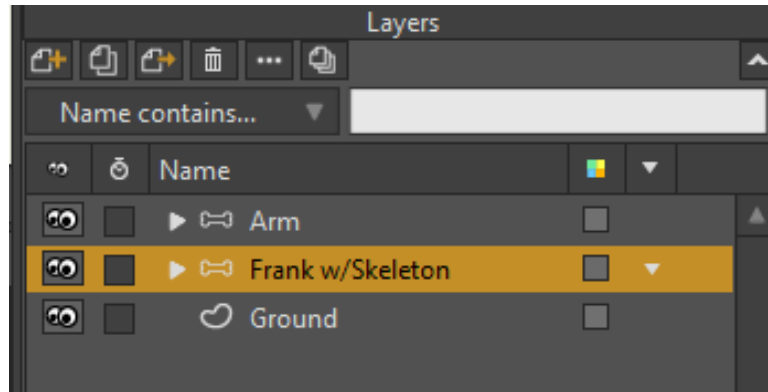
Select the Frank w/Skeleton layer.

2. Use the Select Bone tool to select Frank's left shin bone as shown:

Select the left shin

3. Now set up angle constraints for this bone. The minimum angle should be -10, and the maximum should be 120:

Bones
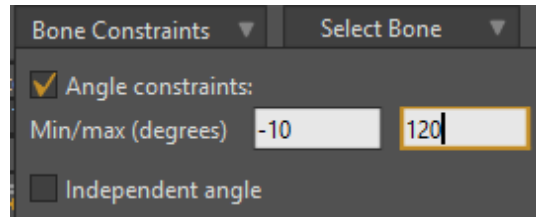
Angle constraints for left shin

4. Now select the right shin, and set its angle constraints to -120 and 10.
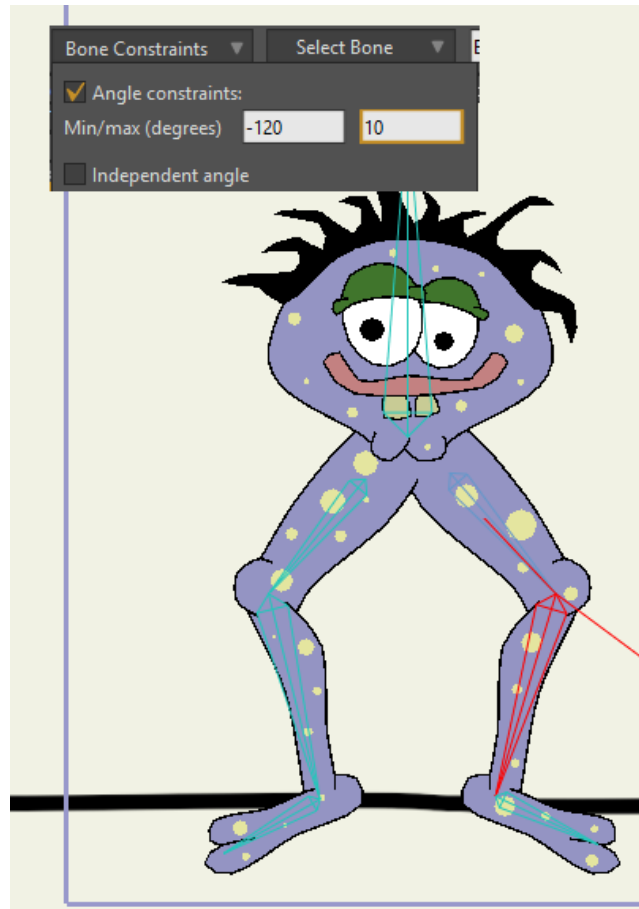
Angle constraints for right shin

5. Now that the legs are prepared, set the time to frame 24. Use the **Transform Bone** tool to drag Frank's spine bone around a small distance. Notice that his feet move around and don't stay in place.

6. Choose the Select Bone tool again. Go back to frame 0 and select the left foot bone:

Bones

Select the left foot

7. In the tool options area, turn on the **Lock bone** checkbox for this bone. Next, select the right foot bone and turn on **Lock bone** for it as well.
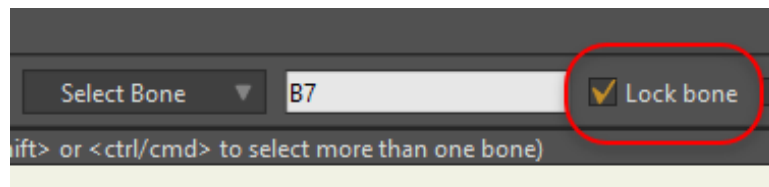
Lock both foot bones

8. Now that the feet are locked, go back to frame 24, and use the **Transform Bone** tool again to drag Frank's spine around.

9. Notice that now Moho tries to keep Frank's feet locked to the ground. If you lift Frank too high, his legs will completely straighten out and his feet will lift from the ground - there's really no helping that, the same thing would happen to you if you were lifted off the ground. You can try rotating the spine bone too and see how the skeleton reacts.

Bones
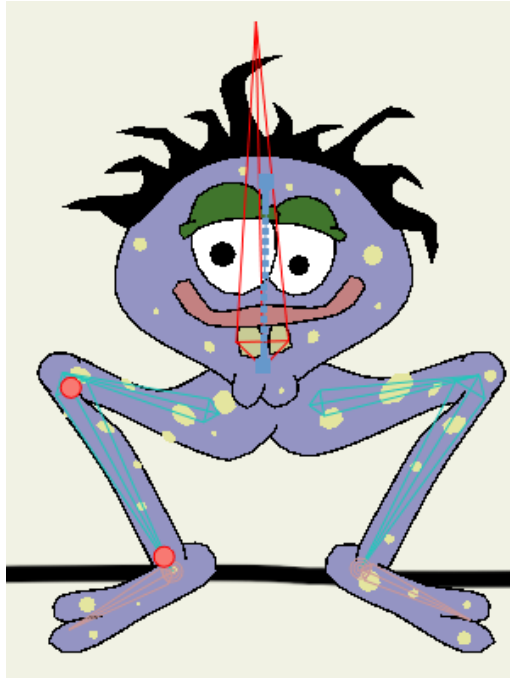
Locked feet

Bone locking is an animated parameter. You can turn on and off bone locking as many times as you want during an animation. This is especially useful when making a character walk - lock a bone as soon as a foot hits the ground, and unlock it just before the foot is to leave the ground for its next step.

Tutorial 3.3: Bone Dynamics

Moho's bone dynamics system can be used to automatically move bones around in response to higher-level movement. Moho uses a physical simulation of springs to calculate dynamic bone movement, making it suitable for a wide range of movements, such as flabby body parts, bouncy hair, waving arms, etc.

Start With a Sample File

For this tutorial, we'll start with a project file that's almost finished. It's named **Tutorial 3.3** and it's located in the **Tutorials > 3 - Bones** subfolder within your custom content folder.

1.   Open the Tutorial 3.3 file in Moho. You should see something like this:
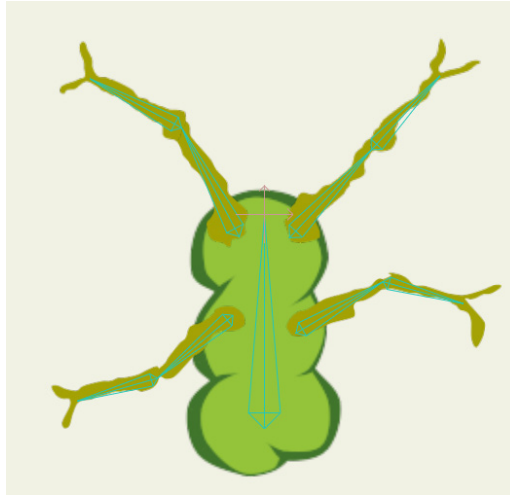
Starting point for this tutorial

2. Play back the animation to see what we're starting with. The entire structure will tilt side to side and bounce up and down, remaining rigid the whole time. Only the vertical bone in the center of the skeleton is animated - all the others move with it because they are its descendants. Rewind the animation to frame 0 when you've seen enough.

3. Use the **Select Bone** tool to select the top-left bone in the structure as shown below:
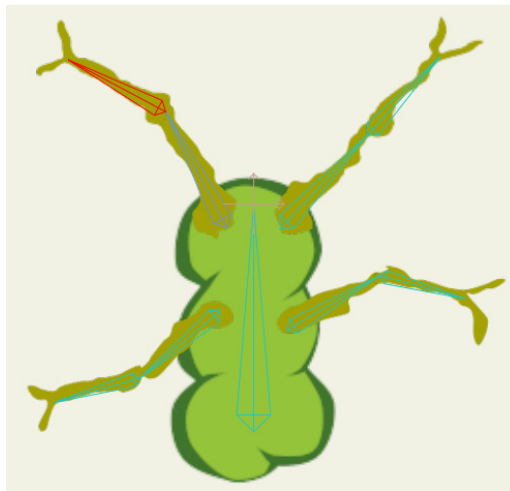
Select this bone

4. In the tool options area at the top of the main Moho window, click the **Bone constraints** popup box to open it. In the popup box, turn on the **Bone dynamics** check box. This tells Moho to move the selected bone automatically according to the spring simulation.
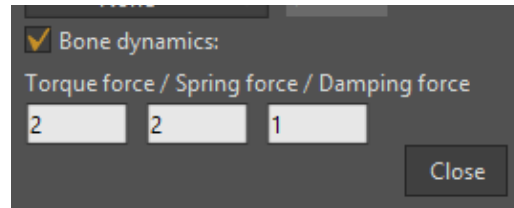
Bones

Turn on bone dynamics

5. Select seven more bones (two in each of the arms), and turn on bone dynamics for each one.

> *Here's a tip: you can leave the **Bone constraints** popup box open the whole time, just click on each bone in turn, then turn on bone dynamics for each one. If the **Bone constraints** popup box covers up some of the bones, you can pan the editing view by dragging with the right mouse button to expose the hidden bones. At this point, you should have turned on bone dynamics for every bone in the structure except the vertical center bone.*
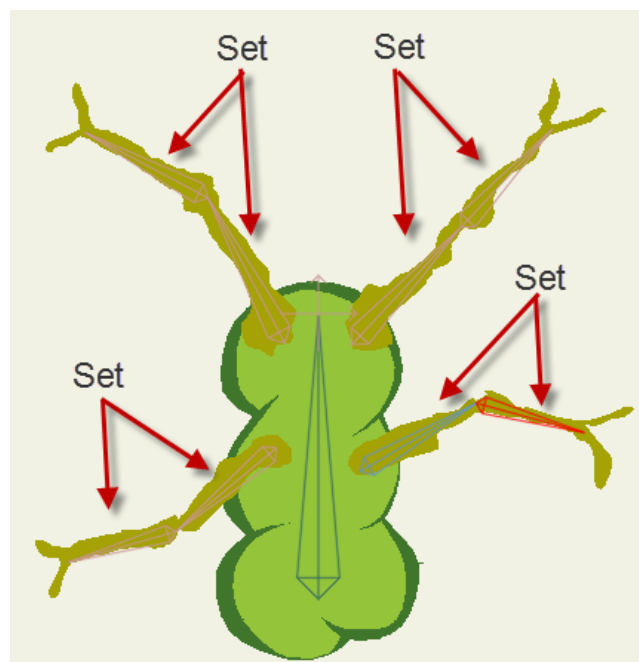
All eight leg bones set

Play back the animation to see the difference. Now as the structure tilts side to side, the arms will bounce around in response to the movement of the center bone.

Adjusting Spring Parameters

So that shows the basics of how to use bone dynamics. Now let's take a look at how you can make adjustments to the bounciness of the springs.

1. Select the top-left bone again, and re-open the **Bone constraints** popup box.

Bones

2. Below the **Bone dynamics** checkbox are three parameters that allow you to fine-tune the effect. Set as follows:

   - Torque force to 4,
   - Spring force to 2
   - Damping force to 2
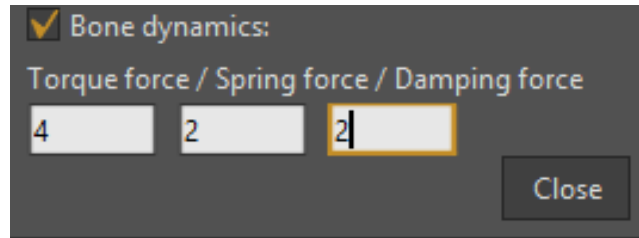
Adjusting dynamics parameters for both bones in the top left arm

3. Select the bone's immediate parent (the second bone in the top-left arm), and apply the same dynamics parameters.

   > *A higher Torque force means that a bone moves more in response to its parent's movement, Spring force determines how quickly it bounces back, and Damping force controls how quickly a dynamic bone stops moving (you can think of damping like friction). In this case, a high torque force means that the bone will move more strongly.*

4. Next, select the two bones of the top-right arm (one at a time), and set the bone dynamics parameters to 2, 2, 5 (Torque, Spring, Damping). These settings will cause these bones to slow down their dynamic movement quickly - a high damping value is like making the bone move through a thick fluid.
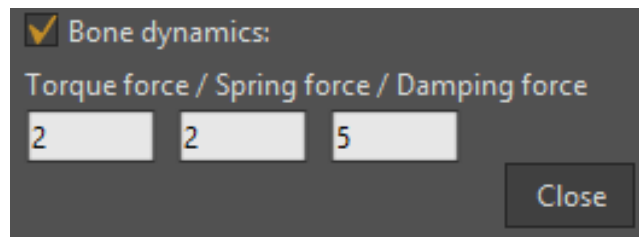
Settings for top right arm bones
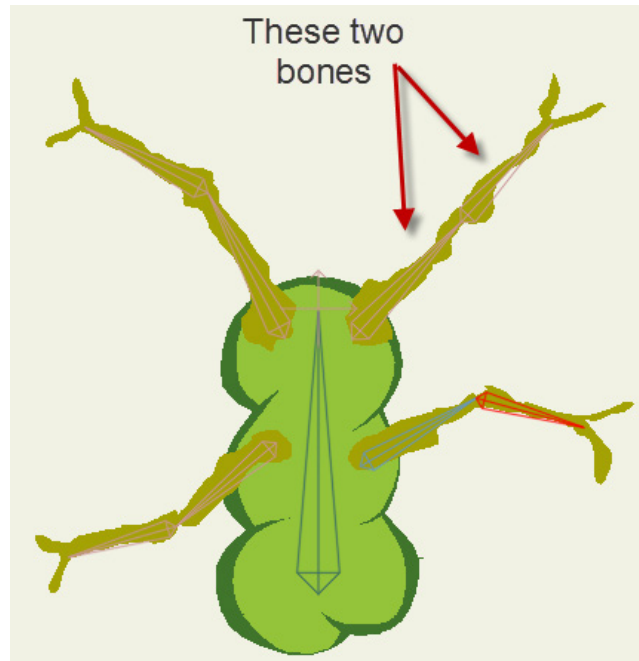
Bones

Set a high damping force on these bones

5.   Finally, select the two bones of the bottom-left arm (one at a time), and set the bone dynamics parameters to 2, 4, 1 (Torque, Spring, Damping). The high spring force will cause this arm to bounce back very quickly.
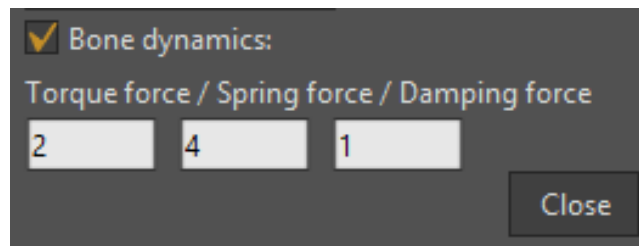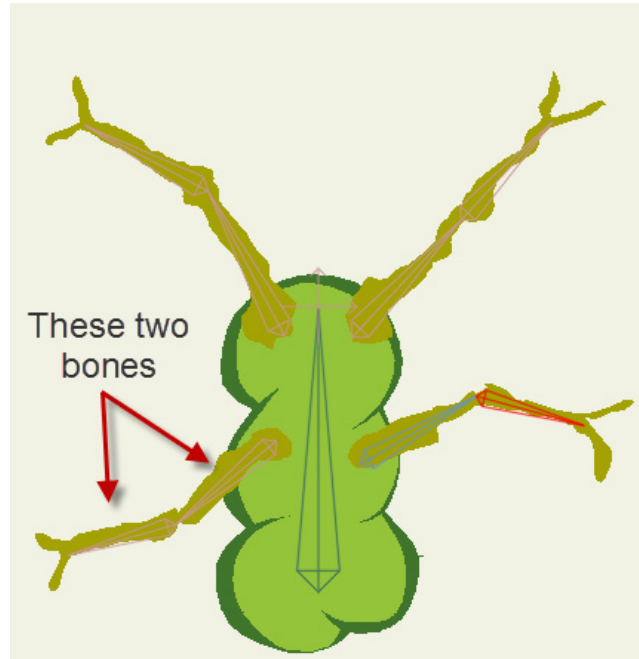
Bones

Set a high spring force on these bones

6. Try playing back the animation again. As you watch the final animation, note the differences between the four arms. The top-left arm swings in a wide arc because it has a strong response to the parent bone's movement. The top-right arm's movement is subdued because the damping force causes it to slow down more quickly. The bottom-left arm is very springy, and the bottom-right arm moves in accordance with the default bone dynamics settings.

> *Click this link to view a brief video of the finished results of your project.*

Tutorial 3.4: Character Setup

In this tutorial, you will learn how to set up the bone system for a complex character. This will involve splitting a character apart, creating bones, adjusting bone strength, and putting the character back together.

Start With a Sample File and Split Apart the Character

For this tutorial, we'll start with a project file that already has the artwork for the character drawn - you'll just set up the bones. It's named **Tutorial 3.4** and it's located in the **Tutorials > 3 - Bones** subfolder within your custom content folder.

To begin:

1. Open the Tutorials > 3 - Bones > Tutorial 3.4 file in Moho. There are six vector layers in this project, containing the body parts for this character. Although all the artwork could be drawn in one vector layer, it is often easier to draw a

Bones

character in multiple layers, arranging the body parts from back to front, as shown below:
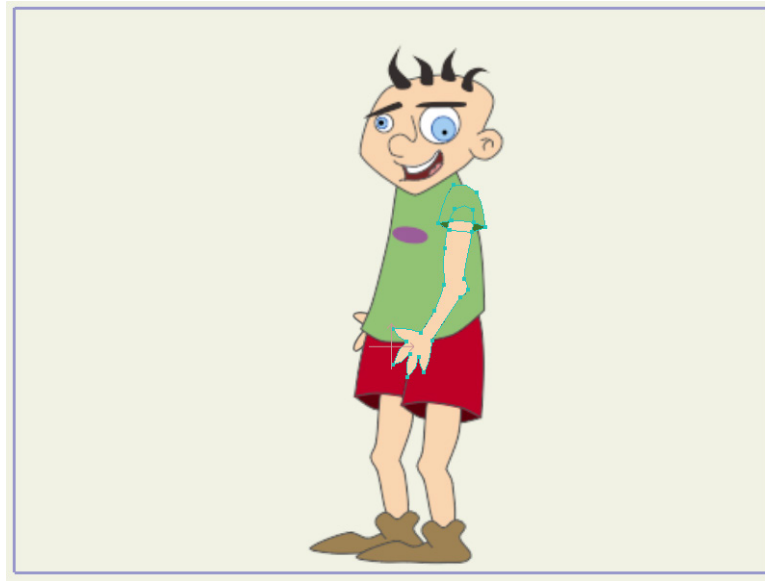
Starting point for this tutorial
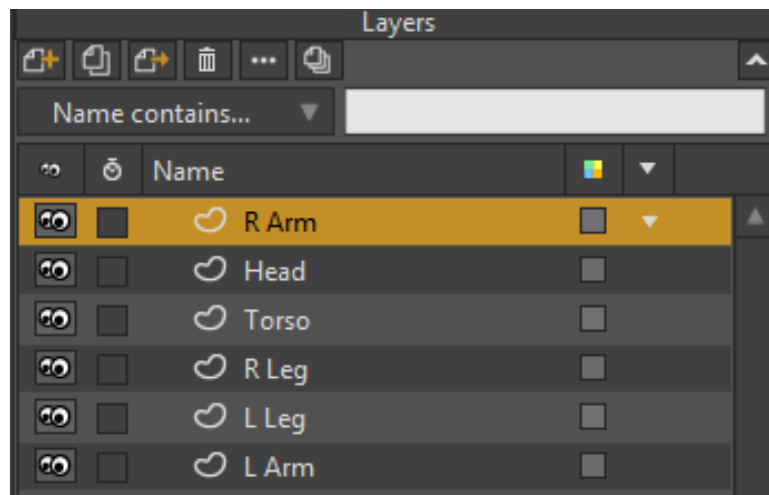
Starting point for this tutorial

2.   In order to make bone setup easier, the first thing to do is split apart the character. Choose the **Edit > Select All** menu command. All the points in the right arm (your right, his left) should be selected.

3.   Activate the **Transform Points** tool and drag the mouse to move the arm off to the side and up a bit:

Bones
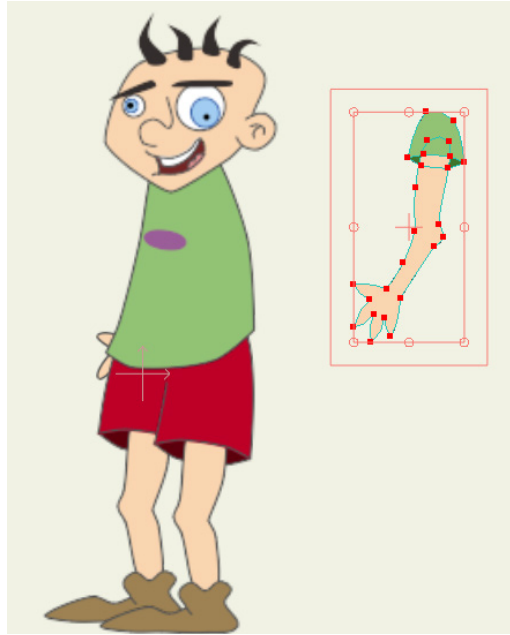
Arm moved off to the side

4. Select the Head layer, and select all of its points with the **Edit > Select All** command. Move all of its points upward.

5. Repeat the process for the **R Leg**, **L Leg**, and **L Arm** layers of the character (skip the **Torso** layer). Select all points on each of those layers, and move the body parts away from the center, as shown below:

> *The reason we split apart the character is so that we can add bones to each part, while keeping the bones independent of each other. Later in the tutorial we'll put the character back together again.*
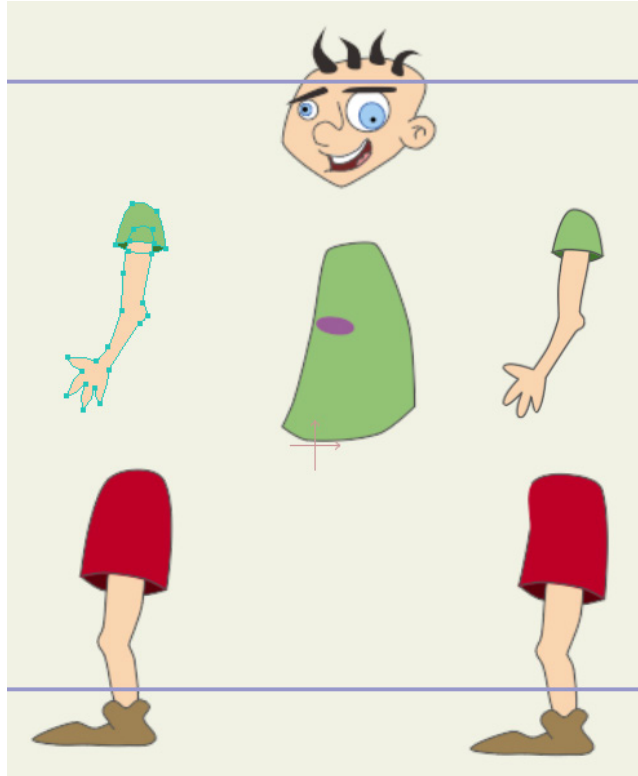
Bones

Body parts split apart

Add Bones

The next step is to add bones.

1. Add a new Bone layer to the project. Name the new Bone layer **Skeleton**. Move the new Bone layer to the top of the list if necessary.

2. Move all the vector layers into the new Skeleton layer, keeping the same order they are in now:
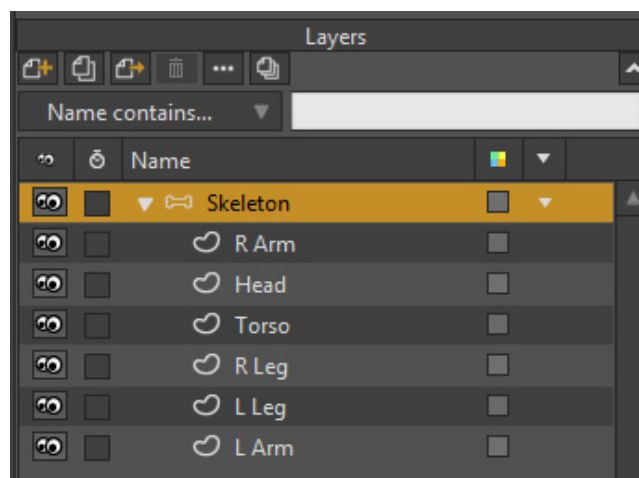
Move all of the body part layers into the Skeleton bone layer.

Bones

3. Double-click the Skeleton bone layer to open the Layer Settings palette. Switch to the Bones tab, and choose the **Region Binding** mode,
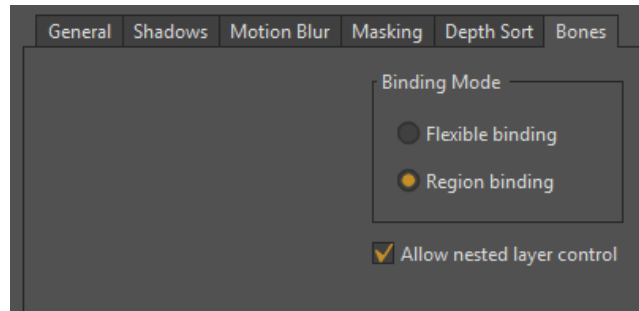
Turn on Region Binding for the Skeleton layer.

4.   Using the **Add Bone** tool, add two bones going up through the torso, starting with the bottom one:
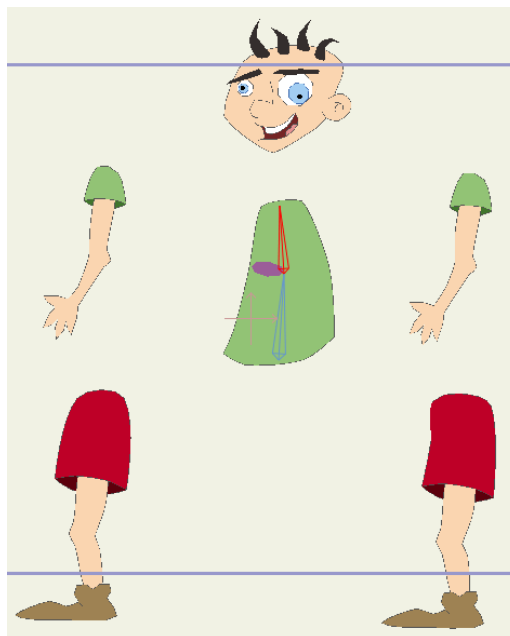
Two new bones

5. Next, add two bones to one of the arms, starting at the shoulder and going down.

6. Before you add bones to the second arm, use the **Select Bone** tool to reselect the upper torso bone. Then switch back to the **Add Bone** tool to add two bones to the other arm. This parents the second arm to the upper torso bone instead of continuing from the first arm.
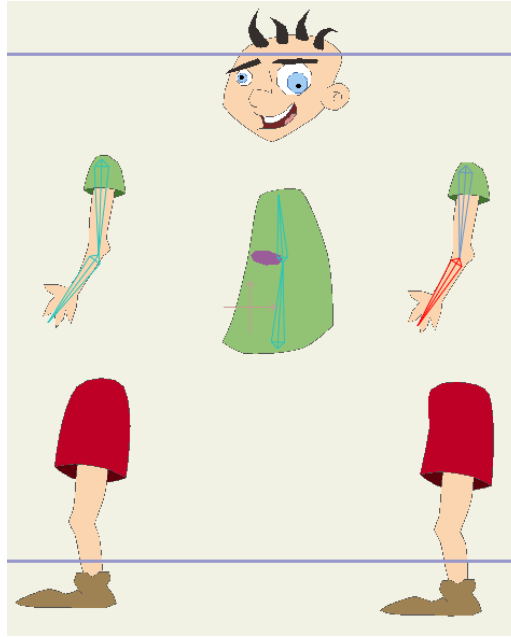
Bones

Arm bones added

7. Use the **Select Bone** tool to select the lower torso bone. Then, select the **Add Bone** tool and add three bones to one leg, starting at the hip and moving down through the foot. Repeat the process for the other leg, making sure to reselect the lower torso bone first. The upper leg bones should be parented to the lower torso bone.
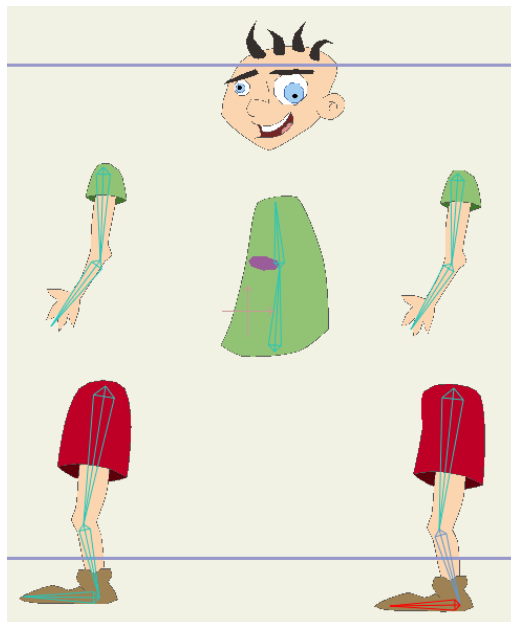
Leg bones added

8. Use the **Select Bone** tool to select the upper torso bone, and then use the **Add Bone** tool to add one bone to the head.
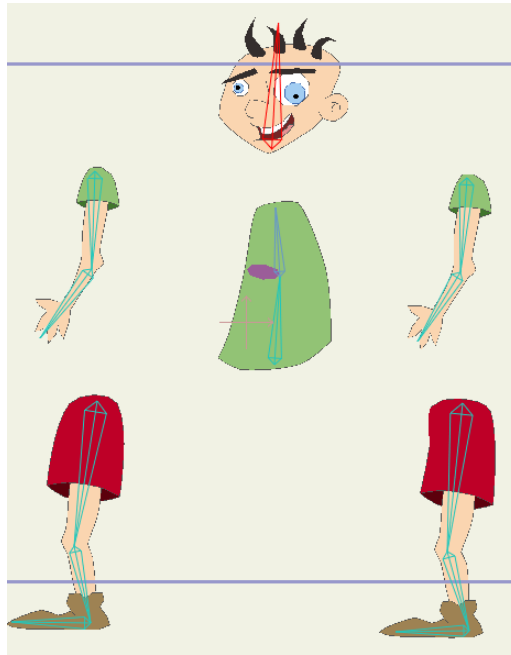
Bones

Head bone added

9. The next figure shows the parenting of all the bones. The parenting arrows point from child bone to parent bone, and can be seen by activating the **Reparent Bone** tool:
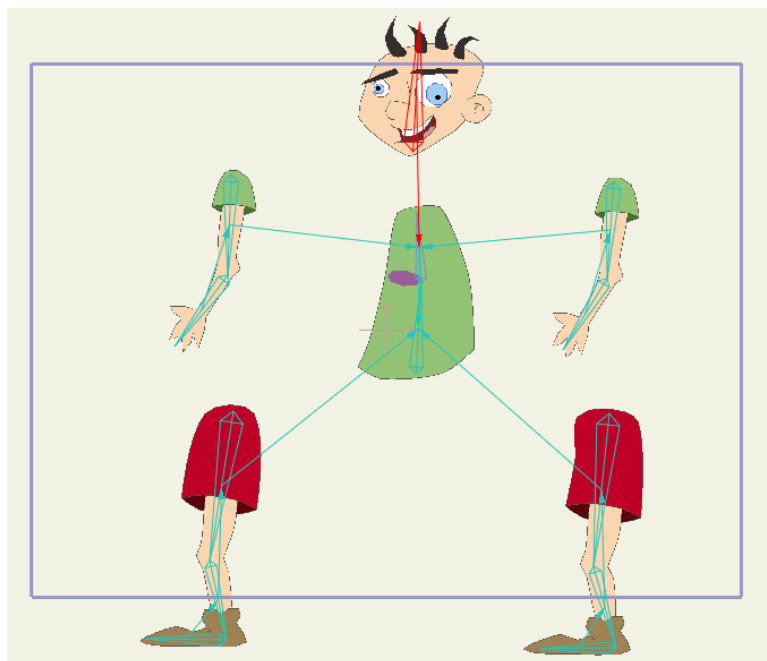
All the bones added

Bones

Adjust Bone Influence

At this point, feel free to try using the **Manipulate Bones** tool to see how the bone system works so far. The body parts should mostly move how you would expect, but not totally cleanly - the next step is to clean up the bones' influence.

1.   Double-click the **Skeleton** layer in the Layers window to bring up the **Layer Settings** dialog.

2.   Go to the Bones tab and set the binding mode to **Region binding**:
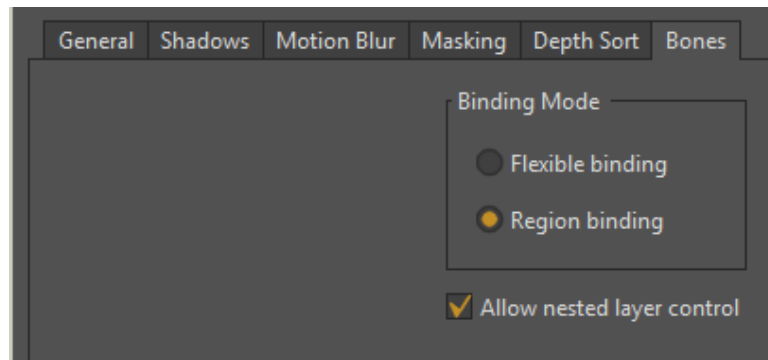
Turn on region binding

When region binding is used, bones only move the points that lie in their region of influence. If a point is overlapped by multiple regions of influence, it will be affected by all the corresponding bones. If a point is in no bone's region of influence, it will move with the nearest bone.

This is different from flexi-binding, where all bones affect all points. Flexi-binding can be quicker to set up, but leads to more rubbery motion, since moving a hand will always cause a little bit of movement in a foot. Region binding makes separate body parts truly separate.

3.   For region binding to work, you need to adjust the region of influence for each bone. To do this, activate the **Bone Strength** tool to display the bones' regions of influence:
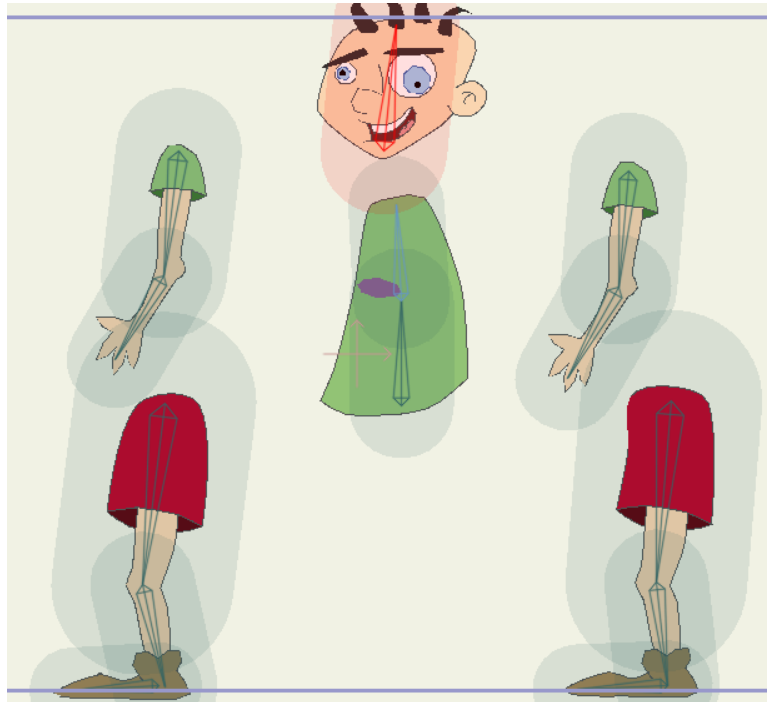
Bones

Initial regions of influence

4.   Using the Bone Strength tool, click and drag on each bone in turn to adjust its region of influence. The correct adjustment for a region of influence it generally to surround the points along that section of bone. The most important regions are at the joints - the knees and elbows and such. Those are the areas where the regions of two bones overlap, and points will bend under the control of both bones. For parts like this character's head, the region of influence isn't very important - since there's just one bone, the points outside the region of influence will still move with that bone. Here's how you should adjust the regions of influence (don't worry about matching this exactly, just try to get kind of close):Adjusted regions of influence.
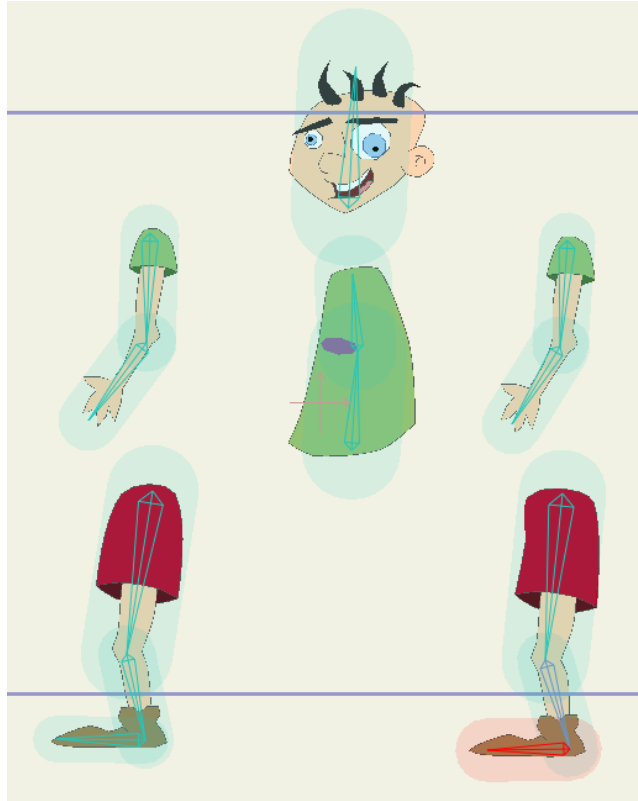
Bones

Adjusted regions of influence

5. Try using the **Manipulate Bones** tool again to test the bone setup. The character should move much more cleanly now - when moving an arm, for example, only that arm should move, and you should see no extra movement in other body parts.

Put the Character Back Together

The final step is to reassemble the character.

6. Activate the **Offset Bone** tool.

7. Click and drag on the top bone of each body part to move that part back into position. When each part is moved back into place, the character should look as shown in the following figure:

   ▪ Move each arm by the upper arm bone

   ▪ Move each leg by the thigh bone

   ▪ Move the head by its single bone.

Re-assembled character

> 🔶 *Frame 0 is considered the setup frame for bones. When the time is set to frame 0, the character will still appear split apart (unless you're using the Offset Bone or Manipulate Bones tools). However, at other frames in the animation, the character will be re-assembled according to how you used the Offset Bone tool.*

8.   🦴 Try moving the character around again with the **Manipulate Bones** tool. The body parts will still move independently, even though they now overlap. Because the bones were set up on a split-apart character, that character could be re-assembled while still keeping the body parts independent.

Bones

Final character

> If you're interested in taking a look at the final Moho file, it's named **Tutorial 3.4 Final** and it's located in the **Tutorials > 3 - Bones** subfolder within your custom content folder.

Tutorial 3.5: Flexi-Binding

Flexi-Binding

> If you have changed the binding mode for any reason, you can double-click the Bone group in the Layers palette, and switch back to Flexible binding in the Binding Mode section of the tab. See **"Bones Tab" on page 254 in your Moho Users Manual**.

For any layer that is a child of a bone group, you can select a subset of the bones in the bone group and then choose **Bone > Use Selected Bones for Flexi-Binding**. This allows you to isolate the influence of a set of bones from the rest of the skeleton (such as a Right Arm bone affecting only the right arm). This reduces the need for you to separate artwork on Frame 0 and then put it back together again with the Offset Bone tool.

To illustrate how this works, assume you have drawn a character in 2D bitmap or format. A sample character is included in Tutorial 3.5.moho, which you will find in the

Bones

Tutorials > 3 - Bones *subfolder within your custom content folder.* The various body parts appear in separate layers in a layered Photoshop file that was imported into Moho.

A bone layer named Gramps appears at the top, and the layers for the different parts of the character are placed into the Bone layer. Then you use the bone tools to create a skeleton for the character so that you can animate it. An example for the character and skeleton are shown in the following figure.
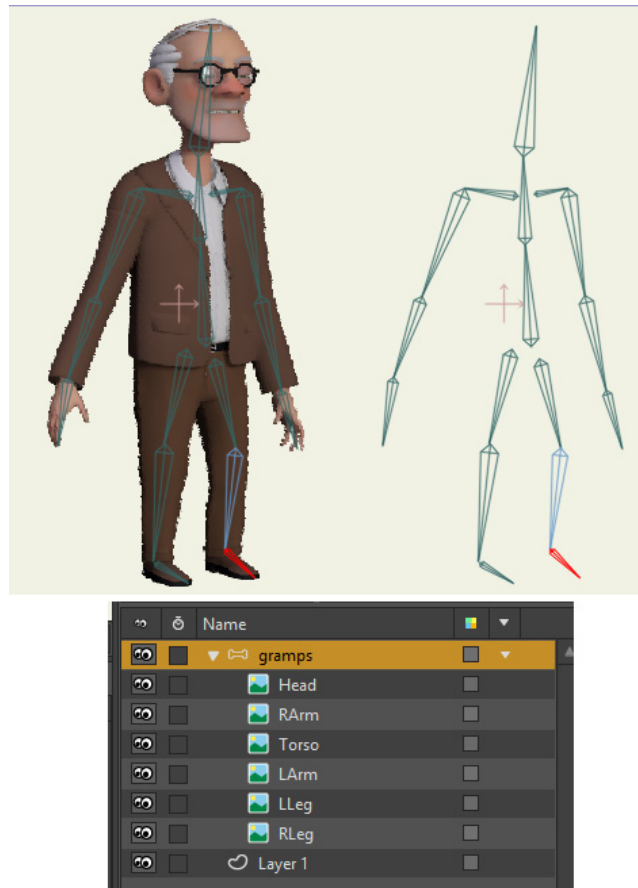
A layered character and its bones.

If you try to animate this layered character using standard flexi-binding, you find that the drawing distorts and stretches all the artwork. In previous versions of Anime Studio, you could break apart the bones and spread the artwork and bones apart, and then use the Offset Bone tool to put the parts together again, as described in "Tutorial 3.4: Character Setup" on page 125. However, sometimes it can be difficult to set up your character this way and it may not end up looking the way you want it to look.

Bones

The character distorts when the bones are manipulated.

To set up the project so that the arm artwork is only affected by the arm bones:

1. Select the **RArm** layer in the Layers palette.

2. Use the Select Bone tool to select the bones you want to control the arm.

3. Choose **Bone > Use Selected Bones for Flexi-Binding**.

Bones

Assigning selected bones for Flexi-Binding.

4. Repeat the above steps for each of the layers in your character. In other words, in this example we choose the Head layer and flexi-bind selected bones to it, then do the same for the Torso, Left Arm, Right Leg, and Left Leg.

Bones
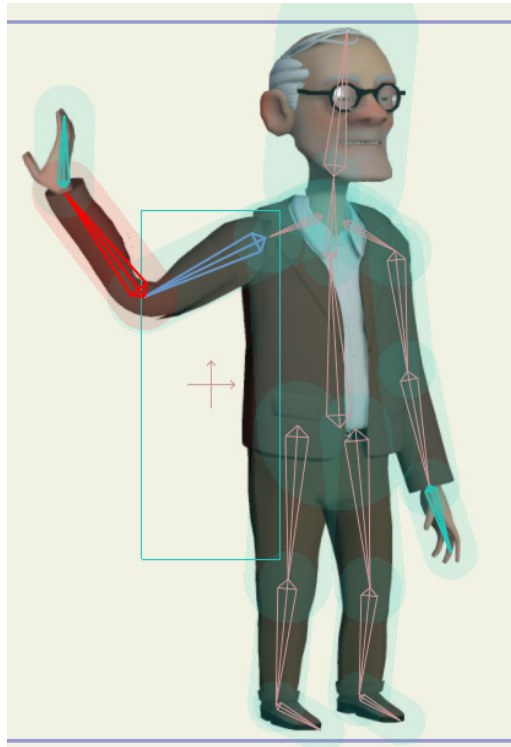
Improved bending.

Tutorial 3.6: Enhanced Bone Features (Pro Only)

This tutorial gives an overview of some of the enhanced bone features that you will find in Moho Pro. For this tutorial, we'll start with a project file that already has the artwork for the character drawn and the skeleton is already set up. You'll just focus on setting up these new features. The project is located in the **Tutorials > 3 - Bones** subfolder in your custom content folder, and it's named **Tutorial 3.6**.

Mr. Bean's skeleton is contained in a bone layer named Mr. Bean.psd. If you expand this layer you'll see the artwork for each of the body parts beneath it.

The bones in the skeleton are labeled with generic bone labels. The table below shows which body parts each bone belongs to. You can optionally rename the bones, but renaming them will not be necessary for this tutorial. In addition, the table will show the new features that you will apply to the bone, where applicable.

Label	Body Part	Feature
B1	Hip	Smooth Joint
B2	Head	
B3	RUpperArm	Smooth Joint
B4	RLowerArm	Smooth Joint
B5	RUpperLeg	Automatic Scaling, Squash and Stretch

Bones

B6	RLowerLeg	Target Bones, Automatic Scaling, Squash and Stretch
B7	RFoot	Independent Angles
B8	LUpperLeg	Automatic Scaling, Squash and Stretch
B9	LLowerLeg	Target Bones, Automatic Scaling, Squash and Stretch
B10	LFoot	Independent Angles
B11	LUpperArm	Smooth Joint
B12	LLowerArm	Smooth Joint
B13	Upper Torso	Smooth Joint
RFootTarget	--	Target Bones
LFootTarget	--	Target Bones

Target Bones

In our first example, you'll notice that two additional bones are created behind the character's feet. These bones are named **RFootTarget** and **LFootTarget**, and they serve as target bones. These bones are not parented to anything. The purpose for these two target bones is to serve as a target point for each leg to point toward as the character moves.
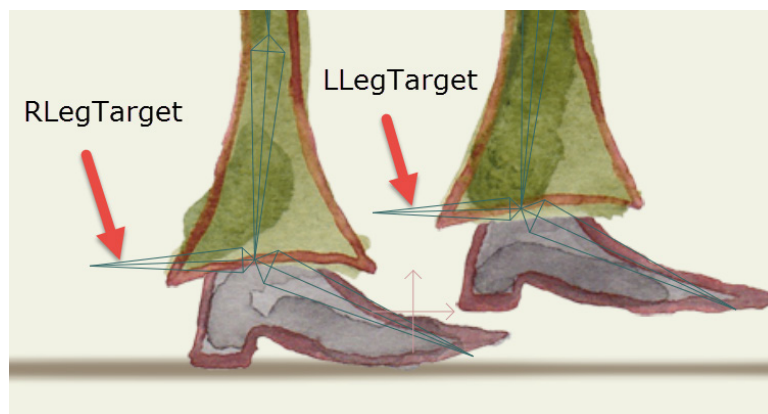
Two non-parented bones for the right and left leg targets.

If you press the **Play** button, you'll notice that the target bones are already animated for a walk cycle. All you need to do is set up the legs so that they point to the targets while your character walks from left to right.
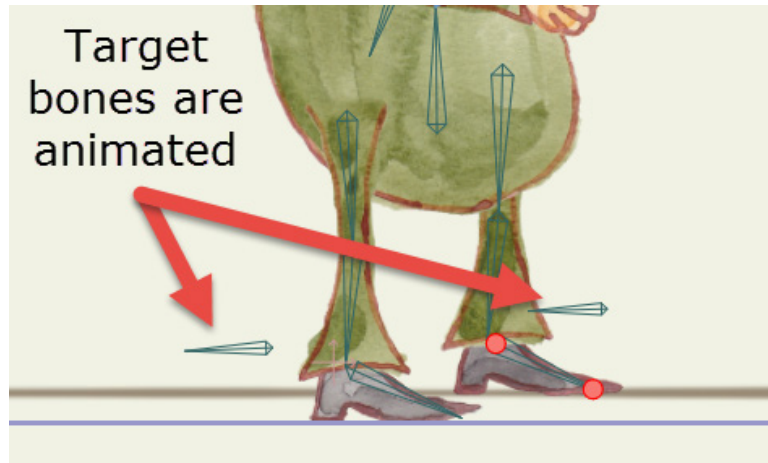
Bones

The target bones are pre-animated for a walk cycle.

To attach the legs to the targets, follow these steps:

1.   Select the bone layer (**MrBean.psd**) from the Layer palette, and then choose the **Select Bone** tool from the Bones tools. You don't have to return to Frame 0 to assign a bone target, this can be performed on any frame.

2.   Select bone **B6** (the right shin bone) and click the **Bone Constraints** button in the options toolbar to open the Bone Constraints window.

3.   From the **Target** dropdown menu, choose **R Foot Target** as the target for the right shin bone. You'll notice that the leg will snap in place to point to the selected target. Leave the Bone Constraints dialog open for the next step.

Bones

Assign the R Foot Target bone to the right shin (B6).

4. Now select bone **B9** (the left shin bone) and repeat the process, this time choosing **L Foot Target** from the Target menu. The left leg will snap into place to follow its target.

5. You'll return to the Bone Constraints dialog it later in the next section, but for now, click **Close** so that you can preview the results.

6. Press the **Play** button, and now you'll see that the character's legs animate to follow the target bones.

Even if you move the body far away by translating the hip bone (**B1**), the legs and feet follow. The shins will still point to the targets even when the character is above the ground. The targets will remain on the ground.

The Manipulate Bones tool has been enhanced to work with target bones. Normally, the Manipulate Bones tool works with a chain of bones. When you transform one of the bones, the other bones in the chain follow it.

If the chain has a target in it, the Manipulate Bones tool can also move a target, making it easier to create walk cycles. It can also be used to have characters hold on to objects. If you click and drag the target it will move the target.

Bones

Independent Angles

You'll notice when you preview the results of the targets that the legs now follow those animated targets quite nicely! However, pay attention to the feet. Normally, if you move or rotate a parent bone, the child bone moves or rotates with it. And what you see in your animation is that sometimes the feet poke through the floor, while at other times the stiffness of the foot makes the walk look unnatural.

The **Independent Angle** constraint causes a bone to maintain its original angle as its parent bones are moved. It is a good solution if you want a foot to remain parallel to the ground as a character bends his thighs or shins. You simply apply the Independent Angle setting to each foot.
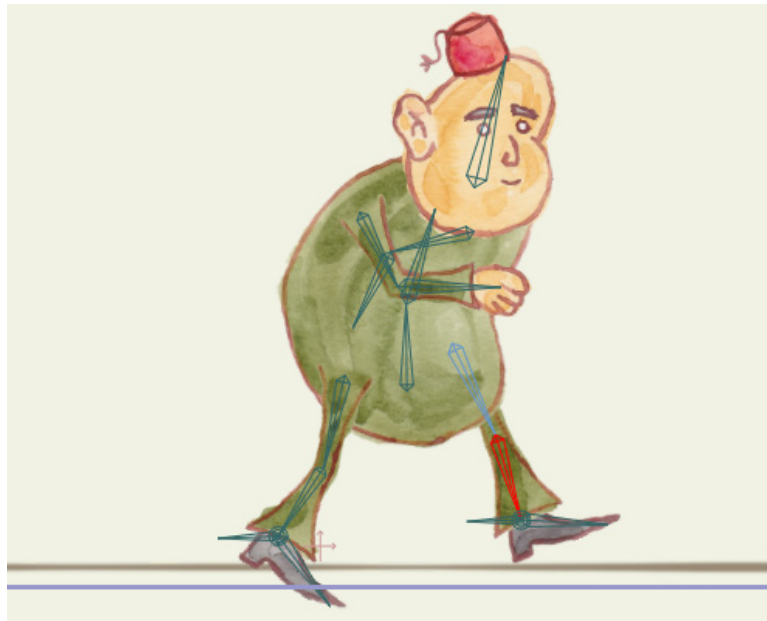
The legs follow the targets, but the feet are angled unnaturally for a walk.

To set up independent angles on Mr. Bean, proceed as follows:

1. Select bone **B7** (the right foot bone) and click the **Bone Constraints** button in the options toolbar to open the Bone Constraints window.

Bones
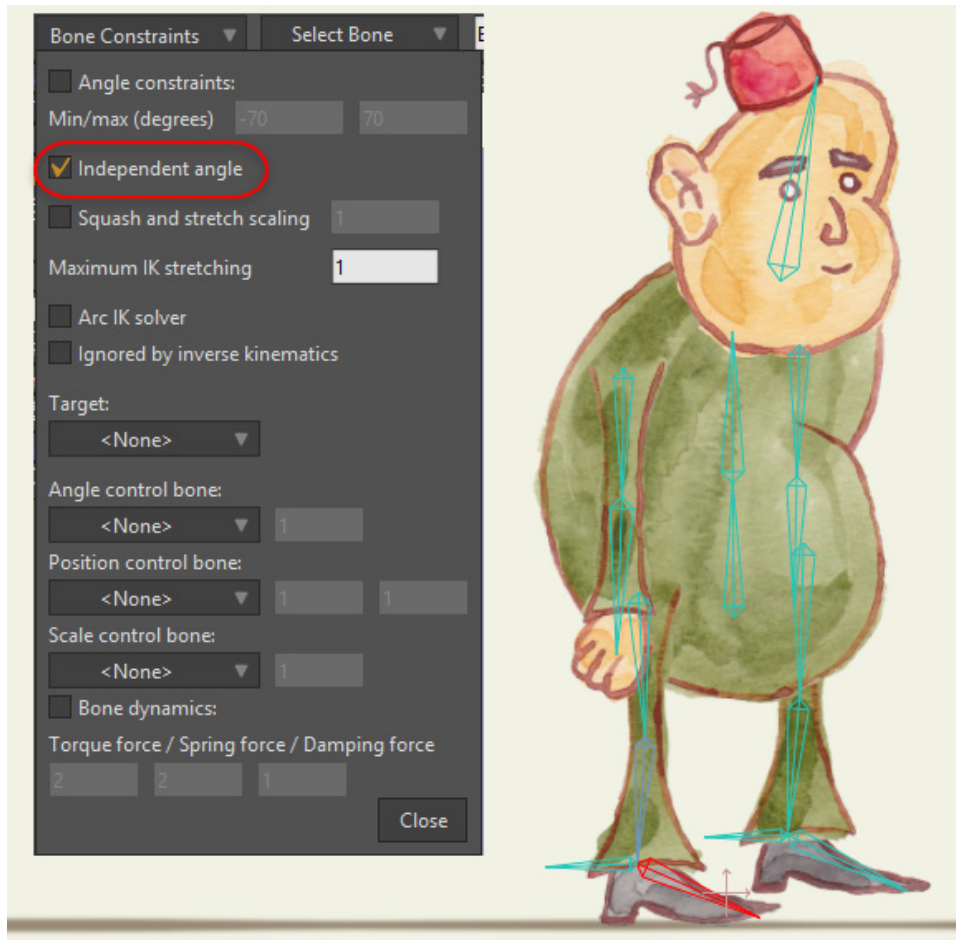
Check the Independent Angle option for both feet.

2. Check the **Independent angle** option. You should notice the foot will now return to its default angle (in other words, the same angle that the foot is in on frame zero).

3. Now, select bone B10 (the left foot) and check the Independent angle option for that foot as well.

4. Preview the results again to see how it looks.

After applying independent angles the feet are parallel to the floor.

Bones

Bones that have the independent angle setting are not locked at that angle, they only rotate independently of their parents. You can still manually rotate bones that have independent angles.

Squash and Stretch Scaling and IK Stretching

Normally, when you scale a bone, it scales in one direction. For example, if you increase the length of a forearm, the height or width of the arm is not affected.

With **Squash and Stretch** scaling, Moho tries to maintain some volume to the part that is affected by the bone. If a bone is stretched (lengthened), the width or height is decreased (squashed). Conversely, if a bone is shortened (squashed), the width or height of the affected object is increased (stretched).
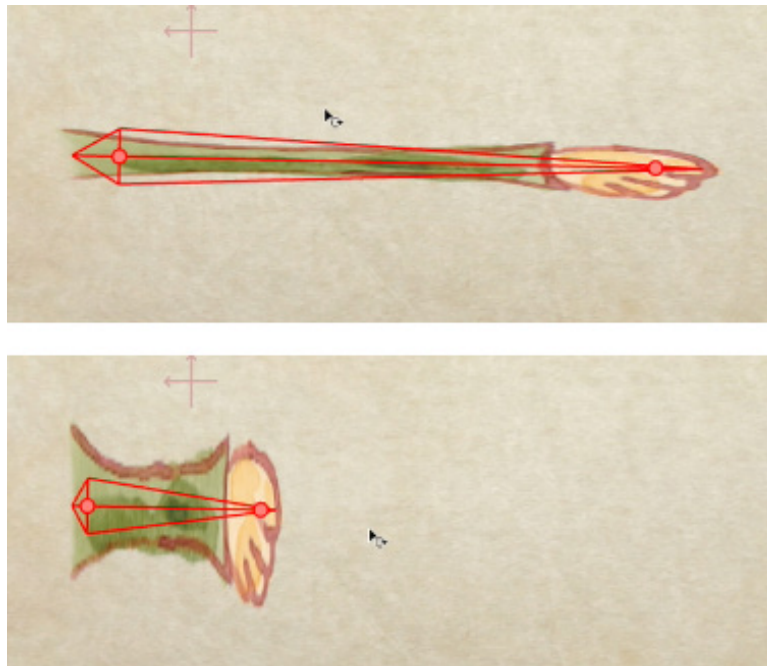
Squash and Stretch scaling applied to an arm.

Maximum IK Stretching has to do with bones that are locked or attached to targets. When a bone chain tries to reach for a target, if the target is too far away, the bones just point to it in a straight line. But if Maximum IK stretching has a value greater than 1, the bones can stretch that extra amount to reach the target. So a value of 1.5 means the bones can stretch 1.5 times their original length in order to reach the target. The user can always scale bones manually, but this stretching is automatic.

You can use these features quite effectively to create cartoony limbs. In the case of Mr. Bean, we'll apply both of these features to his legs. This way, if you raise him off the ground, his legs will stretch to a certain point (#2 below), and then when that point is exceeded the feet will raise off the floor (#3 below).
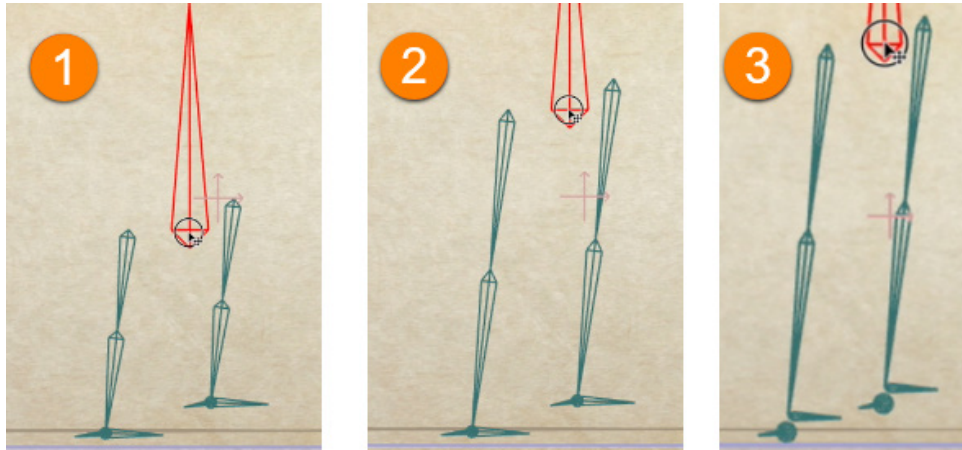
Bones

Squash and Stretch scaling applied to leg bones.

To add Squash and Stretch scaling to Mr. Bean's legs, follow these steps:

1.   Select bone **B5** (the right upper leg) and click the **Bone Constraints** button in the options toolbar to open the Bone Constraints window.

2.   Check the **Squash and Stretch** scaling option. Leave the value in the text field set to **1**. This will cause a bone to squash in the opposite direction by the same amount that an object is stretched.

3.   Enter a value of 1.5 in the **Maximum IK Stretching** field. This will allow his legs to stretch to one and a half times their size before moving away from the targets.

4.   Repeat steps 1-3 for the other bones in his legs: **B6** (right lower leg), **B8** (left upper leg), and **B9** (left lower leg). Then click Close to exit the Bone Constraints dialog.
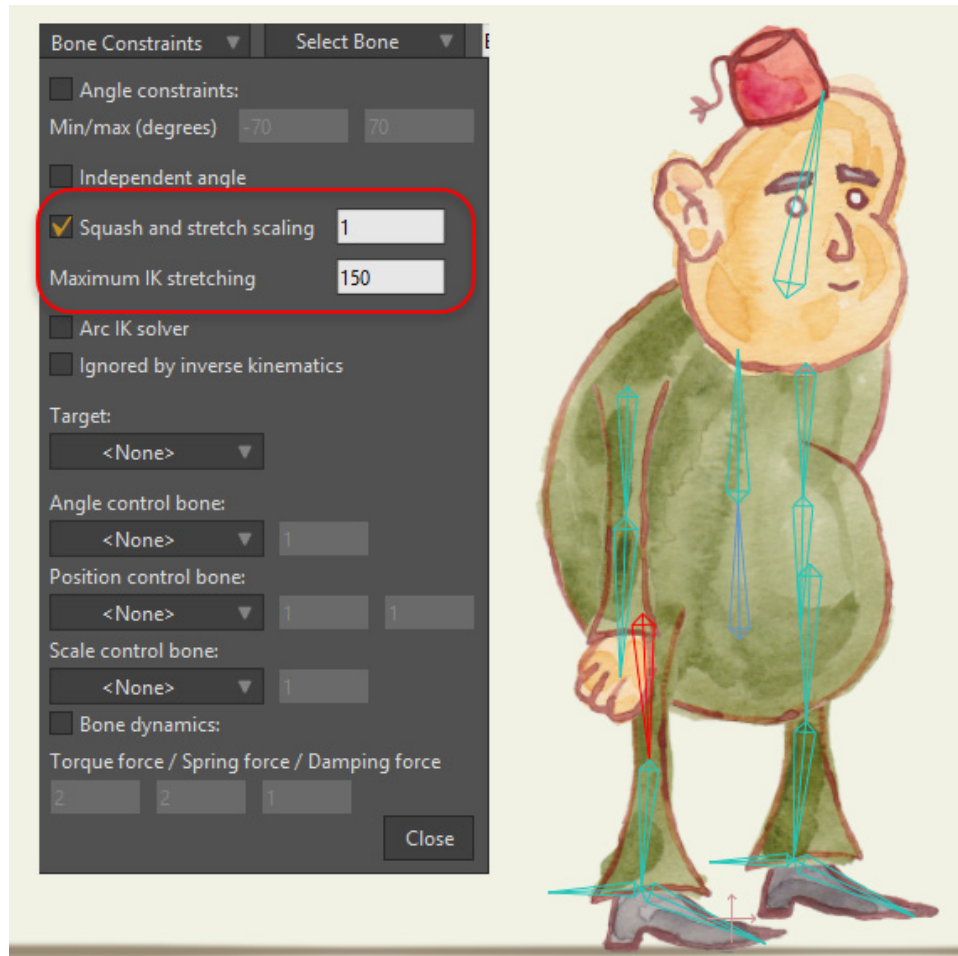
Bones

Squash and Stretch scaling and Maximum IK Stretching settings for the upper and lower leg bones.

Smooth Joints

The **Bones > Create Smooth Joint for Bone Pair** command allows you to select a pair of bones, and then creates a smooth bend between the two joints. While originally intended to improve bending on elbow and knee joints, you can also use it in other areas as well. We will use this on Mr. Bean's arms, legs, and torso.

To add smooth bending to those areas on Mr. Bean, follow these steps:

1.   With the **Select Bone** tool, click to select bone **B5** (right upper leg), then Shift-click to select bone **B6** (right lower leg). This is your first bone pair.

2.   In the Layers palette, select the **R Leg** layer. This is the part that will be linked to the two selected bones for smooth bending.

3.   Choose **Bone > Create Smooth Joint for Bone Pair**. This completes the first smooth joint. You have four more to go.
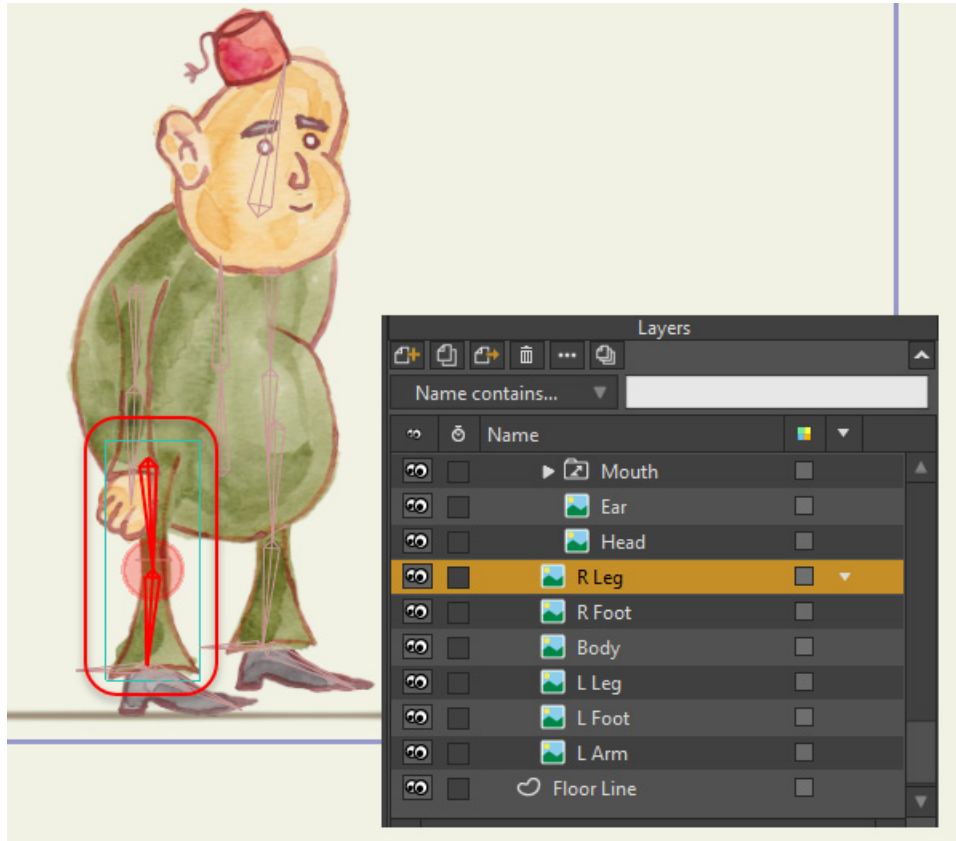
Bones

The first bone pair is connected to the RLeg layer.

4. For the remaining four smooth joints, repeat steps 1-3 as described previously, using the following bone pairs and layers:

  ▪ Select bones **B8** (left upper leg) and **B9** (left lower leg) and connect them to the **L Leg** layer.

  ▪ Select bones **B3** (right upper arm) and **B4** (right lower arm) and connect them to the **R Arm** layer.

  ▪ Select bones **B11** (left upper arm) and **B12** (left lower arm) and connect them to the **L Arm** layer.

  ▪ Select bones **B1** (hip) and **B13** (upper torso) and connect them to the **Body** layer.

5. With all the bone pairs connected to their layers, your setup is complete. Play the project and watch how the character responds to all the new settings. Feel free to experiment further with the animation that you have completed to learn more about how you can apply these new features to other characters.

> *Click [this link](#) to view a brief video of the finished results of your project. https://www.producturlsupport.com/cgi-bin/cscgi.pl?f =video&p=ASD&v=12.0&o=M&l=EN&vid=Circles*

Bones

Tutorial 3.7: Animated Bone Targets (Pro Only)

This tutorial will give you an overview of how animated bone targets can be configured in Moho.

1. Open **Tutorial 3.7.moho**, located in the **Tutorials > 3 - Bones** subfolder in your custom content folder.

2. Click the **Targets** layer to make it the active layer. Hide the other layers by clicking the Eye icon if necessary.
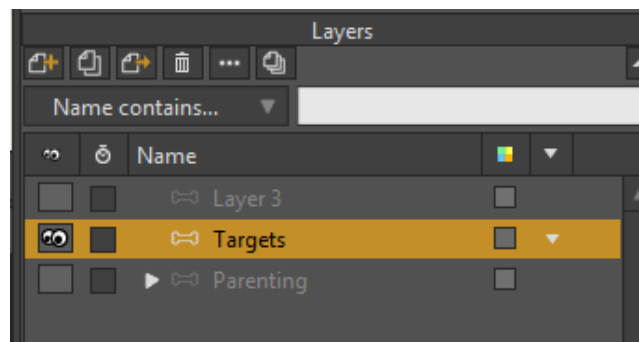
.Select the Targets layer and hide other layers if necessary.

3. You'll notice two bones labeled **Target** and **Target 2**. Scrub through the animation to see them moving in different cycles. However, there is nothing parented to them yet.

4. Rewind back to the beginning and play through one cycle of the Target bone (frames 1-24). You'll notice the Target moves toward Target 2 from frames 1-12, and returns back to the original point from frames 2-24.

5. At Frame 24, switch to the Select Bone tool and click on the "shin" bone. You want to target this bone to Target. You can do this in one of two ways:

   ▪ Click the **Bone Constraints** menu button, and choose the Target from the Target menu.

Bones
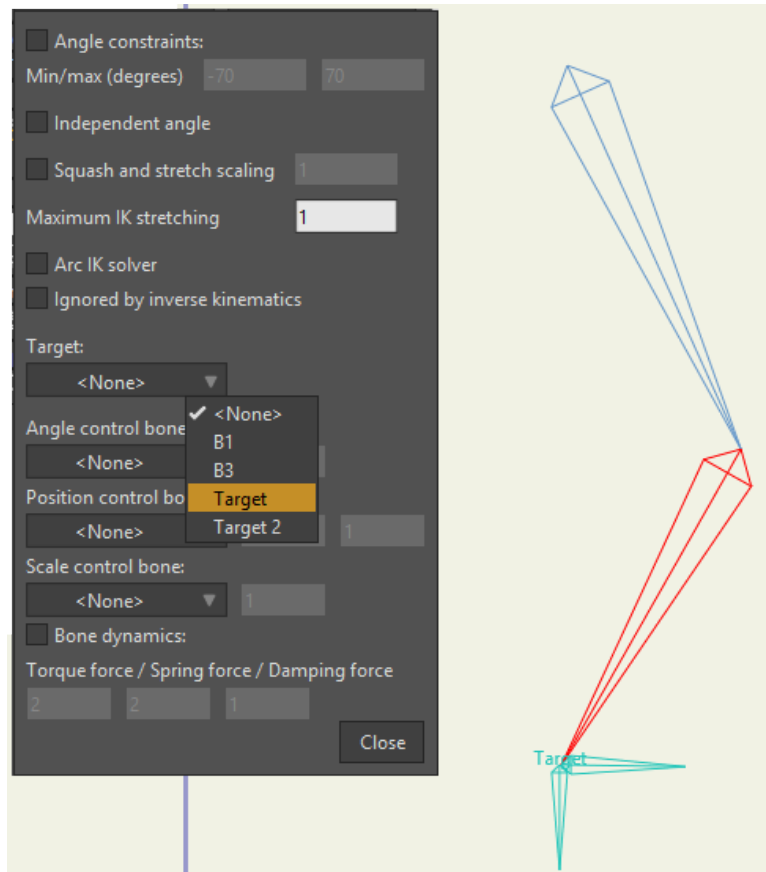
.Choosing the target from the Bone Constraints options window.

- Or, switch to the Reparent Bone tool. Press the **Ctrl** (Windows) or **Command** (Mac) key while you click on the Target bone. A target icon will appear on the bone.
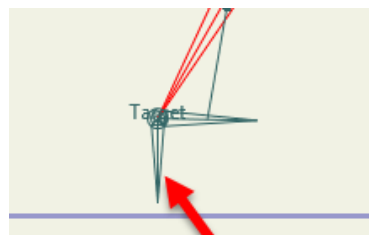
**Ctrl/Cmd click Target with
Select Bone tool**

.Ctrl/Command click the Target bone with the Reparent Bone tool.

6.   Continue to scrub through the timeline starting from frame 24. You'll notice that the shin bone now follows the target. When you pass Frame 72 you will see **Target 2** move toward the first **Target**. Advance to frame 108, where **Target** and **Target 2** overlap.

7.   At the point where the two targets overlap, you want to reparent the shin bone to Target 2. With the Reparent Bone tool selected, hold down the **Ctrl** (Windows) or **Command** (Mac) key and click **Target 2** to assign the new target.

Bones
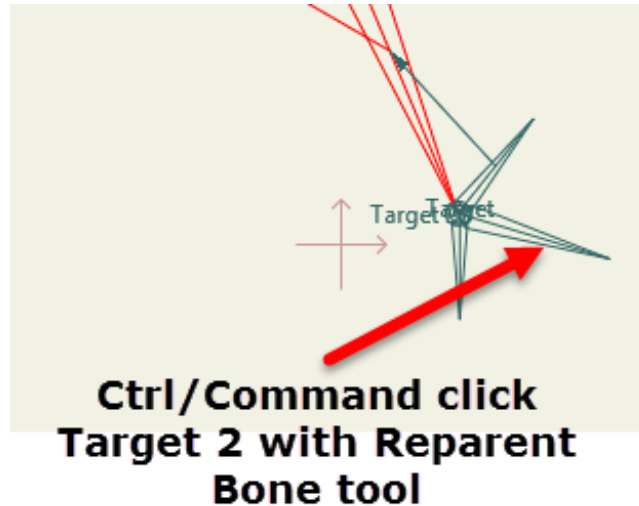
.At Frame 108, Ctrl/Command click the Target2 bone with the Reparent Bone tool.

8.   Continue to advance through the animation to see that the shin bone has switched targets.

> *While it isn't strictly necessary, it is recommended that you wait until the target bones overlap before you change the parent. Otherwise, you might see unintended skipping or jumping when the targets are switched.*

9.   Replay the animation, and notice the following:

   ▪   From Frames 1-24, nothing is targeted.

   ▪   At Frame 24, the shin bone is targeted to Target, and the "leg" bones follow this target until frame 108 is reached.

   ▪   At Frame 108, the shin bone is switched to Target 2. The following animation shows the result.

> *Click this link to view a brief video of the finished results of your project.*

10.   Choose **File > Save As** to save the project under a different filename. You will find a completed copy of this tutorial saved as **Tutorial 3.7 Finished.moho**.

Tutorial 3.8: Animated Bone Parenting (Pro Only)

In this tutorial you'll work with three chains of bones. There is a ball in a vector layer which is bound to the top bone in the chain on the left. When you play the animation you see that the left chain dips down to the floor and the ball follows it. The other two bone chains bend around toward and away from each other. You'll reparent the ball to the other bone chains during the course of this tutorial.

Bones

To follow this tutorial, you can either continue from the point at which you left off in Tutorial 3.7, or start with the **Tutorial 3.7 Finished.moho** *project in your User Content folder.*

1. Open **Tutorial 3.7 Finished.moho**, located in the **Tutorials > 3 - Bones** subfolder in your custom content folder.

2. Select the **Parenting** layer to make it active, and hide the other layers if necessary.
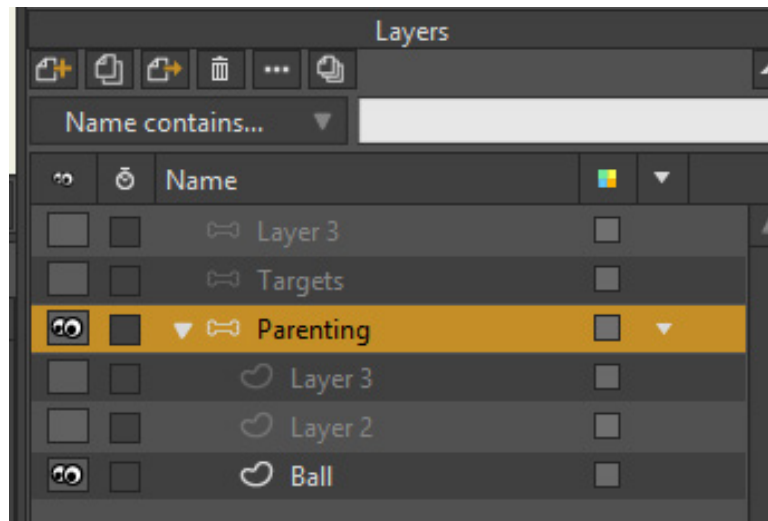
.Select the Parenting layer and hide the other layers.

3. You will see three chains of bones. There is a ball in a vector layer which is bound to the top bone in the chain on the left. When you play the animation you see that the left chain dips down to the floor and the ball follows it. The other two bone chains bend around toward and away from each other.

4. Advance the timeline to frame 24, where the ball is touching the floor. Activate the **Reparent Bone** tool. Then click on the background to remove the current bone parent.

Bones

Click on an empty area in the document to deselect the current parent at Frame 24.
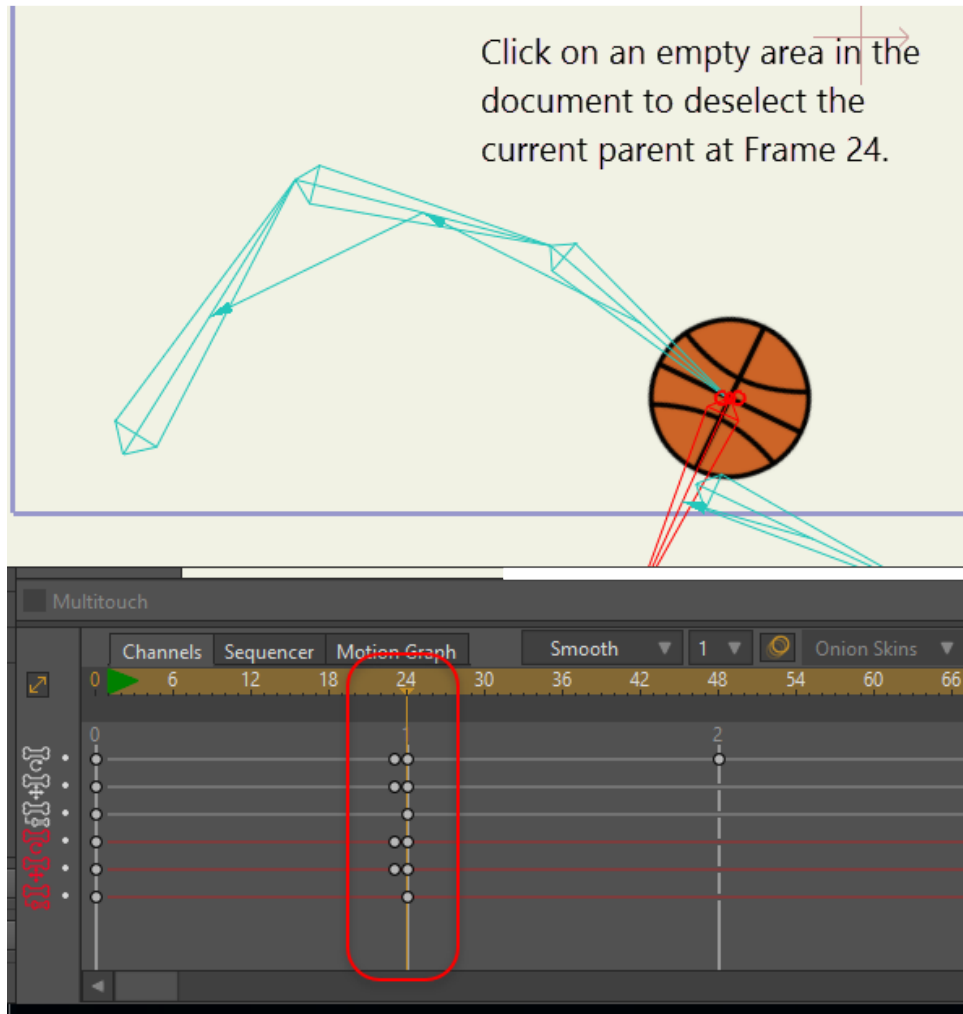
.Click an empty place in the document with the Reparent Bone tool.

5.   Now advance the timeline further, and you will see that the ball remains on the ground.

6.   At frame 48, the middle bone chain reaches the ball. Click the top bone in the middle bone chain with the Reparent Bone tool to assign it as the parent to the ball.

Bones
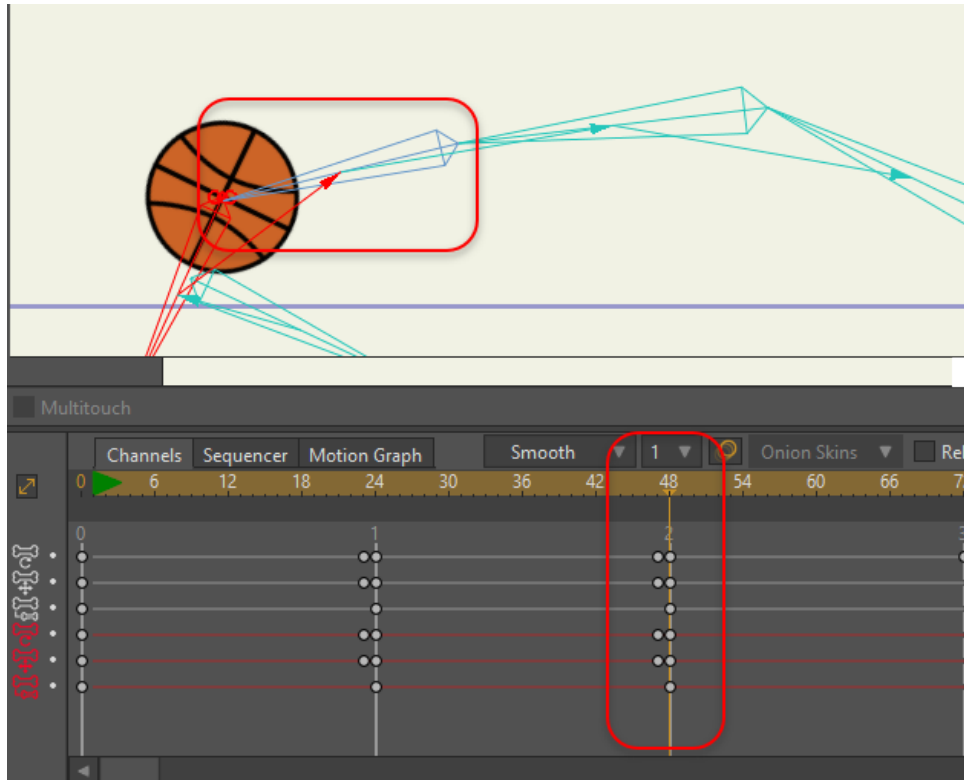
.At frame 48, click the top bone in the middle chain.

7.   Advance the timeline further and you will see the ball attached to the second bone chain. It starts moving toward the third bone chain at the right of the scene.Advance to frame 72, where the middle and right bone chains meet.

8.   At frame 72, click the top bone on the right bone chain with the Reparent Bone tool to select it for the new parent.

Bones
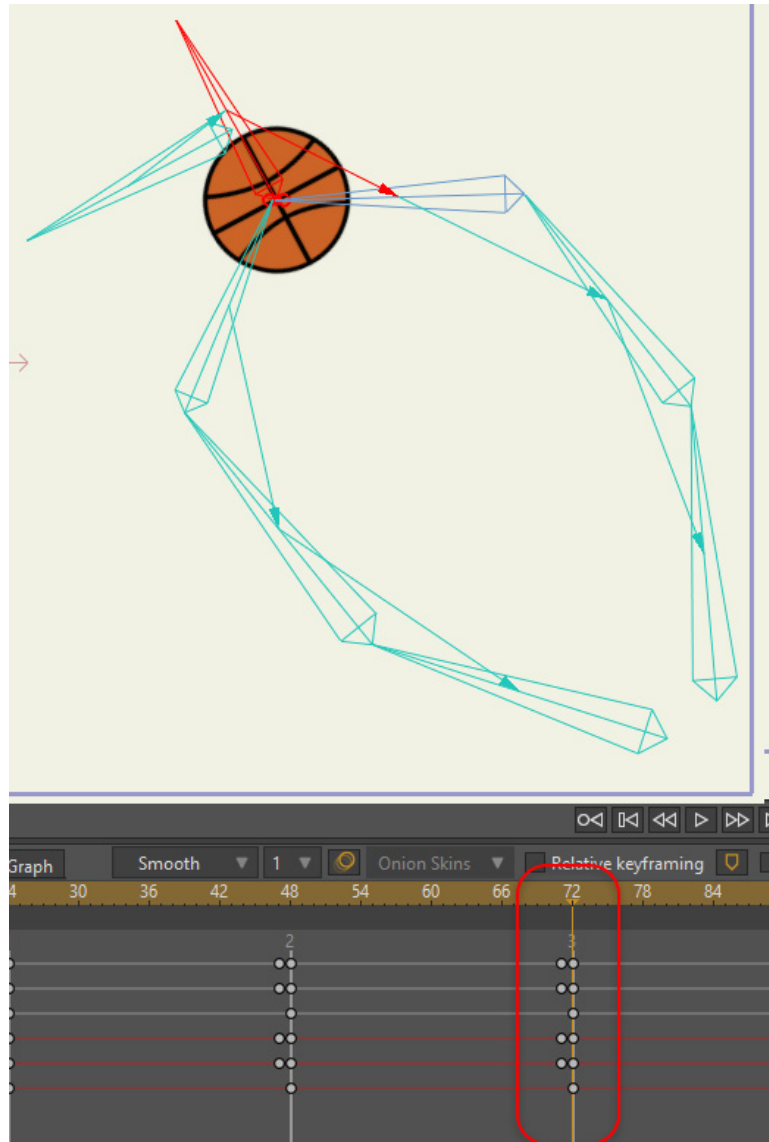
.Click an empty place in the document with the Reparent Bone tool.

9. Advance the timeline to Frame 96. Click the background with the Reparent Bone tool to remove the current parent.

10. Play the entire animation. Your results should be similar to the following animation. You will find a completed copy of this tutorial saved as **Tutorial 3.8 Finished.moho**.

> *Click [this link](#) to view a brief video of the finished results of your project.*

Bones

Tutorial 3.9: Isolating Bones from Parenting (Pro Only)

When you assign a parent to a bone, Moho takes a snapshot of the parenting at that state. You can animate a bone that is on top of the parented bone (with independent angles, for example). But you typically don't want to animate the bone that does the parenting because it has a snapshot taken of it and animation changes to the parent can cause unexpected changes in in the animation.

If you're animating bones by hand, you should avoid animating the bone that another bone is parented to. Instead, use small bones to isolate the animation as shown in this example.

> *To follow this tutorial, you can either continue from the point at which you left off in Tutorial 3.8, or start with the* **Tutorial 3.8 Finished.moho** *project in your User Content folder.*

1. Start with the project that you completed with the previous lesson, or open **Tutorial 3.8 Finished.moho**, which is located in your User Content folder.

2. Select Layer 3 as the current layer, and hide the other layers in the project.
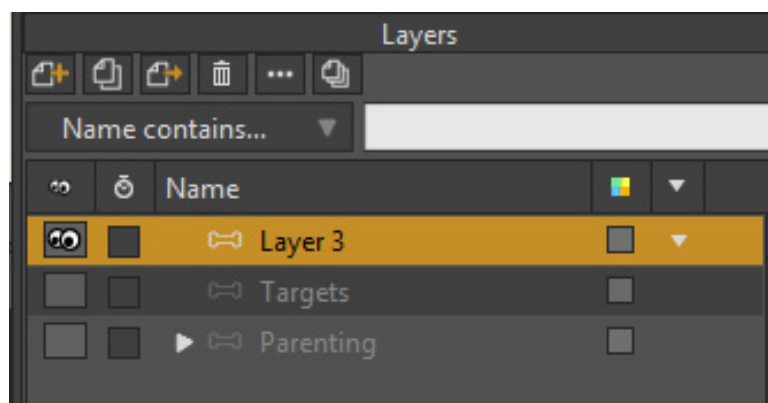
.Select the Parenting layer and hide the other layers.

3. Scrub through the timeline. You'll notice at frame 24 that the two outer arms reach down to the shorter arms in the middle. Then they move up again at Frame 36.

4. The two bone chains in the middle are already set up with bone dynamics, which are used in this tutorial in place of manual animation. The inner bone chains bounce in a springy manner. The inner left and right bone chains are identical except that the bone chain on the inner right has a small bone at the bottom. This bone will be used for parenting of the inner right bone chain so that you can understand the advantages of isolating bones in parenting.

Bones
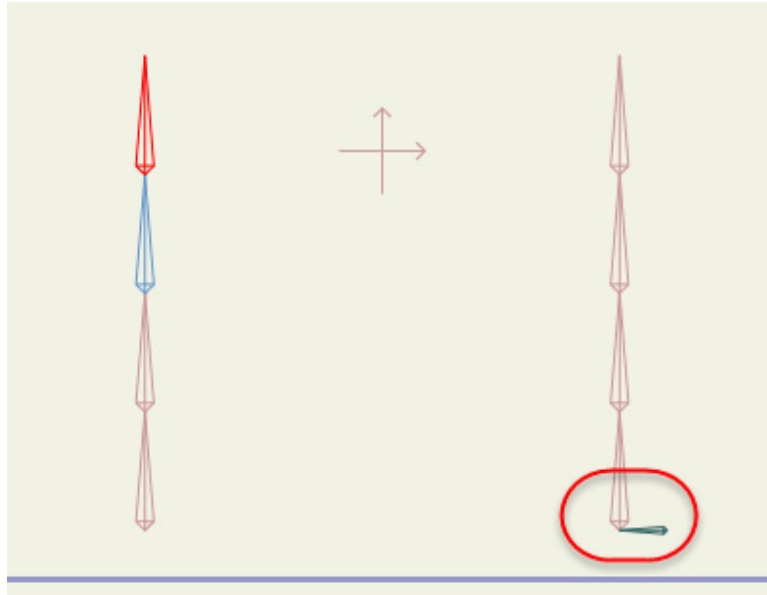
.The small bone for the inner right bone chain will be used for parenting.

5.   Move to frame 24. Click the bottom bone in the middle left chain with the Select Bone tool.

6.   Now switch to the Reparent Bone tool, and click the the top bone in the bone chain at the farthest left. In this bone chain, the bone dynamics will simulate what will happen when you try to animate bones that have a parent assigned.
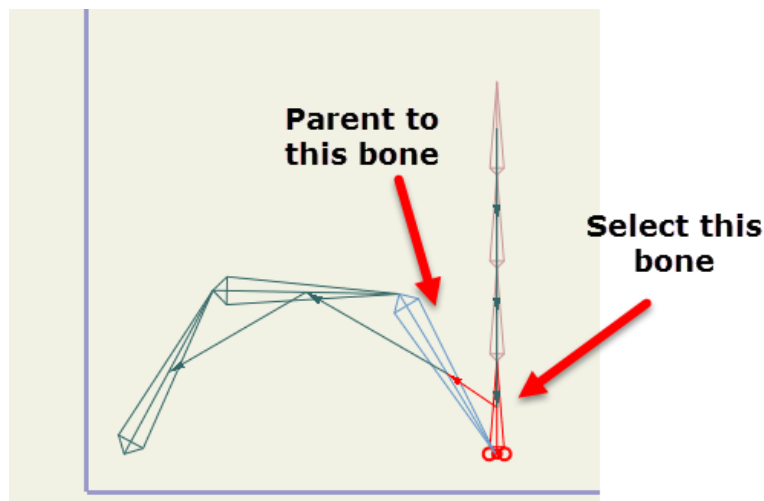
.The lower bone in the inner left chain is parented to the top bone in the far left chain.

7.   Now we'll work with the set of bones at the right, which have the extra small bone that we will use for parenting. This small bone will help isolate the animation of the bone chain from the parenting. While still at Frame 24, select the small bone with the Select Bone tool.

8.   Next, switch to the Reparent Bone tool and click the top bone in the bone chain at the farthest right.

Bones
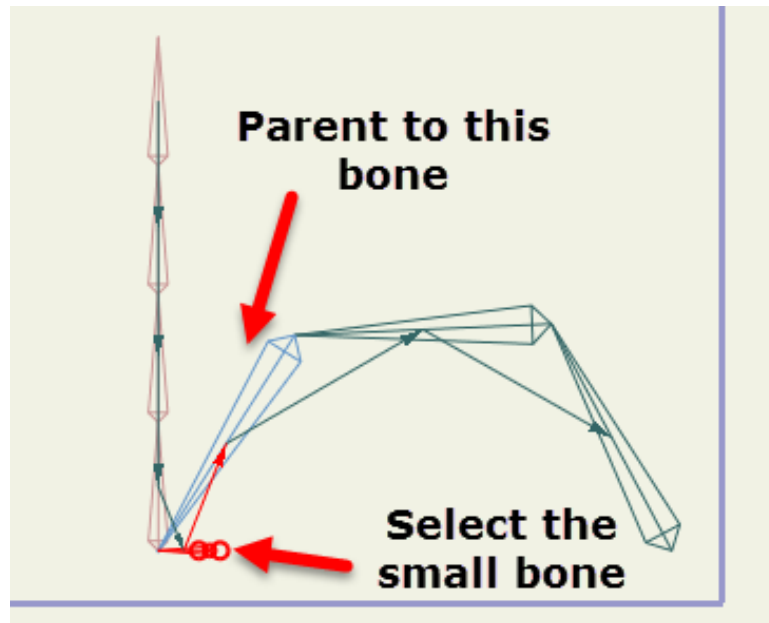
.The small bone in the inner right chain is parented to the top bone in the far right chain.

Play the animation back. You'll notice that when the animation reaches Frame 24, where the reparenting took place, there is a sudden change in the angle of the bone that was reparented in the chain on the left side. This is due to the mathematics in the physics because it's getting a sudden surge of springy action. You don't see this effect on the chain on the right side because it is isolated by the small bone that was assigned as the parent. In this case, the small bone gets a the sudden change in angle, but it isolates that change from the bones in the inner right bone chain.

Bones

Images

Tutorial 4.1: Image Layers

This tutorial introduces another type of layer in Moho: Image Layers. Image layers are a way of including artwork created in other programs in a Moho project. Any application that can produce image files can be used with Moho: photo editors, 3D modeling programs, natural media painting programs, the list goes on...

An image layer in Moho contains a single image file that can be used as a background, or combined with a bone layer to build a character. Although they're called Image layers, an Image layer can also make use of a movie file as its source. Image layers and vector layers can be mixed and matched in the same project.

Alpha Channels

You'll notice that the images used in this tutorial do not appear rectangular. This is because they make use of an alpha channel to mark some parts of the image as transparent. We recommend using PNG images with Moho because they support full alpha channel transparency. You'll need to use an image editing program (like Adobe Photoshop) to create images with transparency.

Start With a Sample File

For this tutorial, we'll start with a project file that's almost finished. It's named **Tutorial 4.1** and it's located in the **Tutorials > 4 - Images** subfolder within your custom content folder.

Open the T**utorials > 4 - Images > Tutorial 4.1** file in Moho. This project is almost complete as it is. The only thing that's missing is the dancer's left hand.

9.   Expand the **Hula Girl** layer in the Layers window, and you should see something like this:
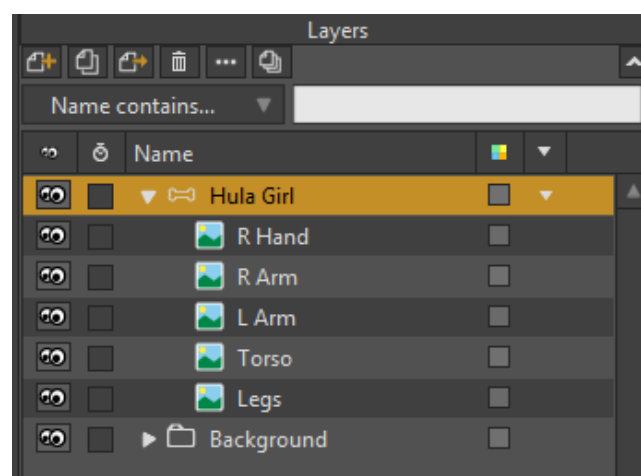
Starting point for this tutorial

Images

10. Click on the layer named **L Arm** (we want the new layer to be just above the left arm).

11. Click the **New Layer** button in the Layers window to create a new layer. In the popup menu that appears, choose **Image**.
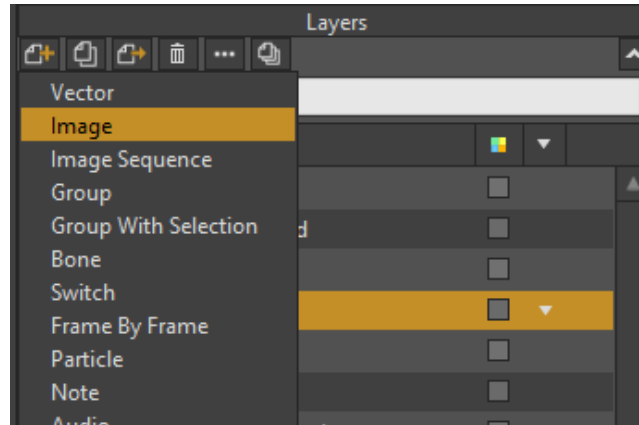
Create a new Image layer (Pro shown)

12. Moho will prompt you to select an image file. Choose the **Moho/Tutorials > 4 - Images** > **l_hand.png** image in your custom content folder.

13. In the Layers window, assign the new layer the name **L Hand**. At this point, your Layers window should look like this:
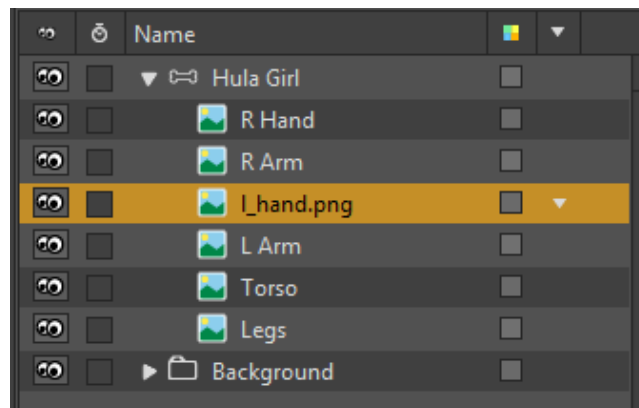
Left hand added

Images

The new hand

14. ![icon] You'll notice that new image layers are centered in the workspace, so the dancer's hand is not yet properly aligned: To position the arm properly, use the **Transform Layer** tool to drag the left hand into position at the end of the left arm. Allow for a little overlap between the two parts at the elbow:

Left hand in position

15. ![icon] The last step is to attach the new part to the dancer's skeleton. Select the **Bind Layer** tool, and click on the lower arm bone on the dancer, as shown below:

Images

Bind the image layer to the forearm

You're done! To see the animation in action, press the Play button. Of course, we skipped over the process of building and animating the skeleton, but the basics of working with skeletons were covered in previous tutorials - all of that information applies when using bones with image layers.

Click this link to view a brief video of the finished results of your project.

Tutorial 4.2: Image Warping

This tutorial demonstrates Moho's image warping feature. This feature allows you to use a skeleton to distort an image. In this way, you can animate photographs, hand-drawn artwork, or anything you can get into an image file in a flexible way.

Start With a Sample File

For this tutorial, we'll start with a project file that's almost finished. It's named **Tutorial 4.2** and it's located in the **Tutorials > 4 - Images** subfolder within your custom content folder.

Open the T**utorials > 4 - Images > Tutorial 4.2** file in Moho.

1.   Expand the **Skeleton** layer in the Layers window, and you should see something like the following figure. The **Skeleton** bone layer contains two sub-layers: an image layer (**statue.png**) and a vector layer (**vector sample**).
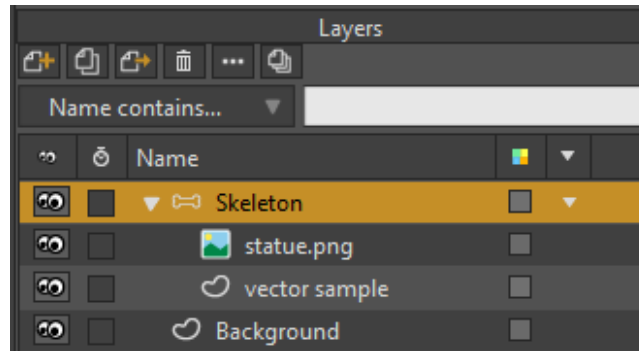
Images

Starting point for this tutorial

2.   Click the Play button in the timeline to play back the animation. Notice that only the vector layer moves with the skeleton. The reason that the image layer isn't moving is that it hasn't been connected to the bones yet (as the vector layer has been).
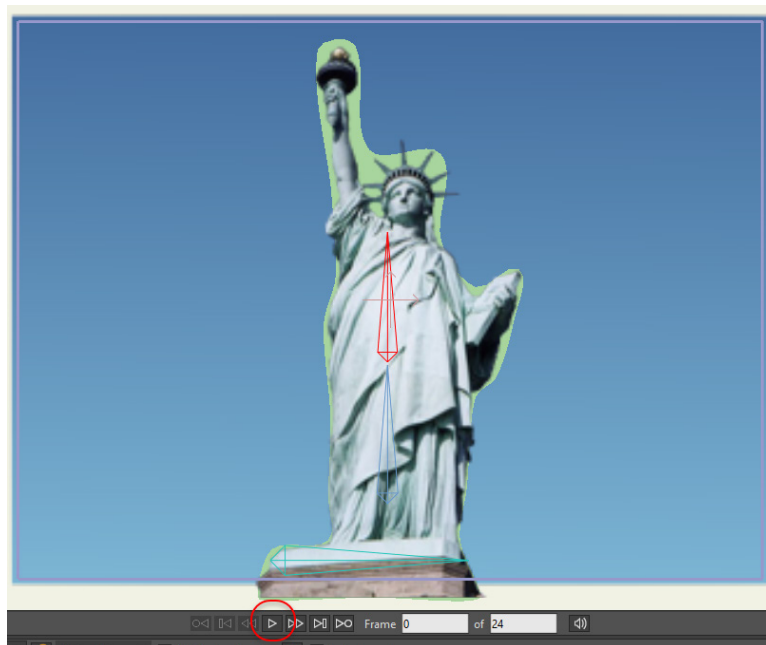
Only the vector layer moves

Using Image Warping

To warp the image layer with the skeleton, continue with the project as follows:

1.   Double-click the **statue.png** layer, and go to the **Image** tab in the Layer Settings dialog. Turn on the checkbox marked **Warp using bones** and click OK.

Images
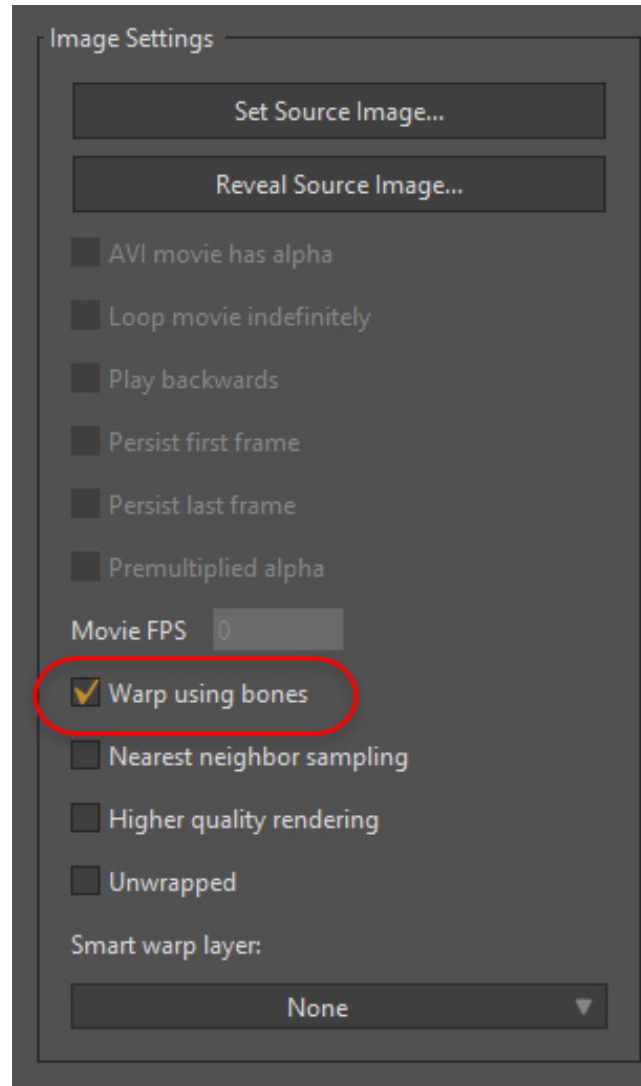
*Turn on the **Warp using bones** option*

2. In the Layers window, turn off the visibility for the **vector sample** layer (it is only an example, and we don't want it in the final animation).
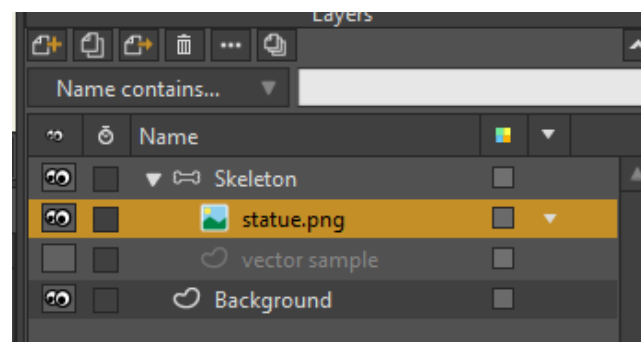
*Hide the **vector sample** layer*

3. Play back the animation again, and you should now see the image moving with the skeleton:

Images

Image warping

🔴 *Notice the horizontal bone at the base of the statue. This bone doesn't move at all in the animation, so why is it even there? When using image warping, the image is distorted by all the bones in the skeleton, and the nearest bone to any part of the image has the most influence. We don't really want the base of the statue to move, so an easy way to prevent this is to add a bone in the area we want to remain still, and not animate it. Another trick you might use when warping images is to break up an image into logical parts (for example, make the arms and legs of a person separate images from the main body). Then, use different skeletons to control the various re-assembled parts. This way, a leg bone can't have any influence over an arm.*

Tutorial 4.3: Image Textures

In this tutorial you will learn how to use images as textures to add detail to a character.

Start With a Sample File

For this tutorial, we'll start with a project file that's almost finished. It's named **Tutorial 4.4** and it's located in the **Tutorials > 4 - Images** subfolder within your custom content folder.

1.   Open the **Tutorials > 4 - Images > Tutorial 4.4** file in Moho, and you should see something like this:

Images
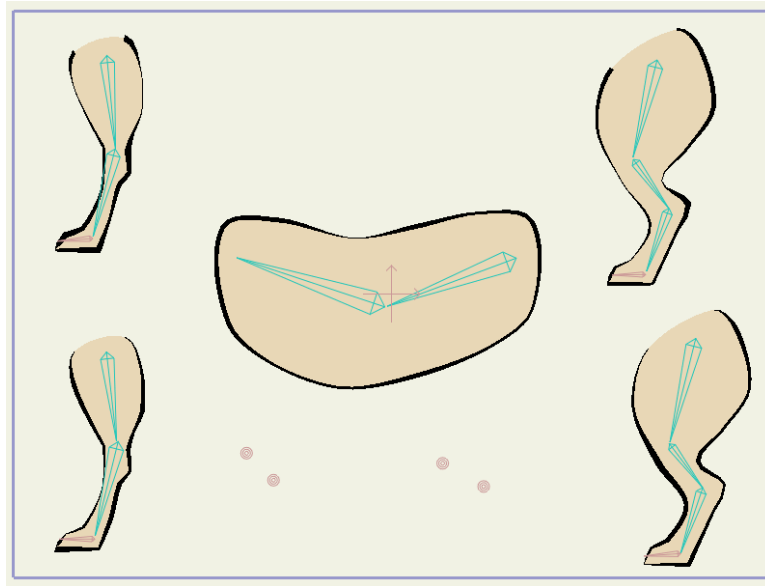
Starting point for this tutorial

2.   Play back the animation to see what's going on.

3.   Be sure to rewind the animation to frame 0 before you continue with the next section.

Paint the Textures

What you're going to do is hand paint some texture details to go on this character. The first step is to paint some textures to go on this headless animal's body.

1.   Select the **File > Preview** menu command to create a full-quality view of the animal's current state.

2.   In the popup menu at the bottom of the Render window, select **Copy To Clipboard**.
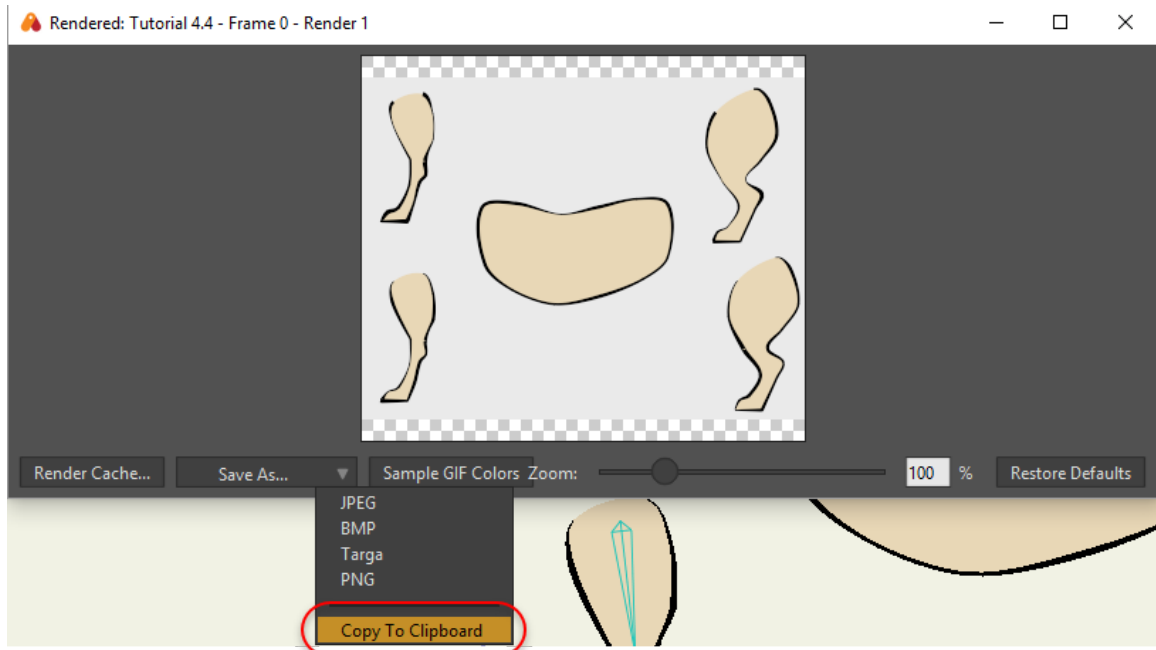
Images

Copy the render to the clipboard.

3. Start up your favorite image editing program (we recommend Adobe Photoshop) and create a new document the same size as the Moho project (320x240 in this case). Paste the copied image into the new document.

4. Create a new layer in your image editing program and paint some kind of texture details onto the animal's body parts. It's very important that the texture be on a layer of its own. If you're using Photoshop, the layer arrangement would look something like this:
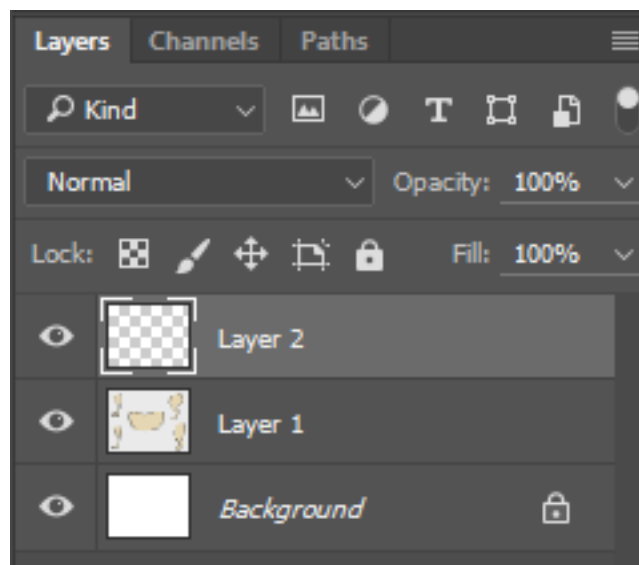
Layers in Photoshop

5. Paint whatever details you want. Here's an example of something you might paint in your image editor. Don't worry about painting outside the lines:

Images

Painted on texture

6. When your texture is finished, get rid of the background layers so that only the texture is left with a transparent background (you're still working in Photoshop or similar program at this point):
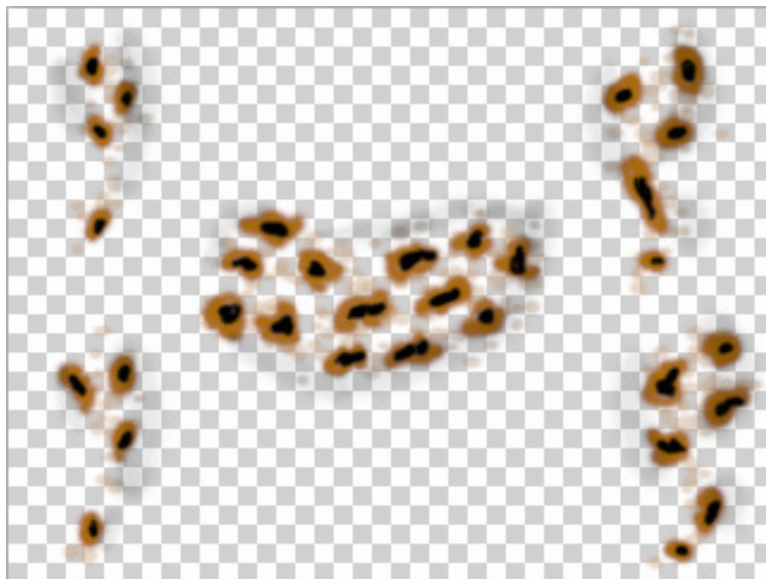
Background removed

7. You need to save the texture as three separate files. For each version of the texture, delete the parts of the texture that are not attached to the corresponding body parts. Save the images in PNG format, since PNG properly stores the transparent background. Examples of the three textures are shown in the figures that follow.

    ▪ Save an image for the back legs. Name the file **back_tex.png.**

    ▪ Save an image for the torso. Name the file **body_tex.png.**

    ▪ Save an image for the front legs. Name the file **front_tex.png**.

Images

8. After you save your images, you can close the image editor. It's time to bring the textures back into Moho.
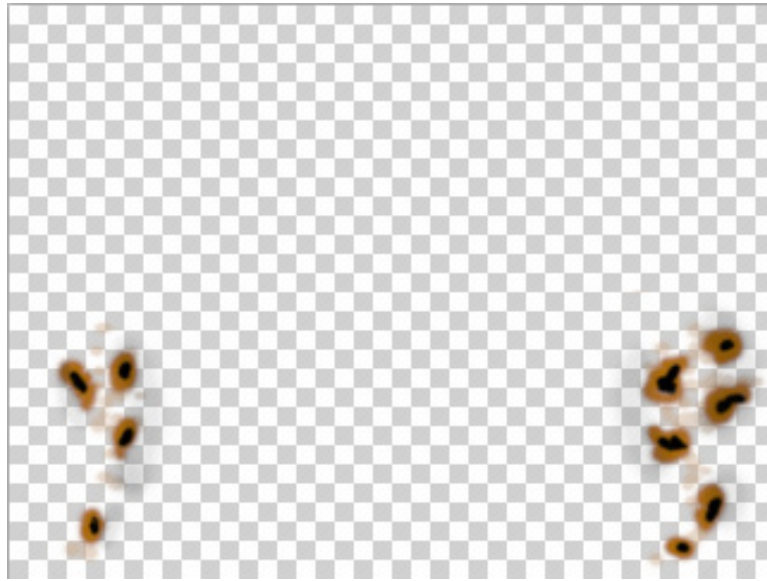
Back legs texture. back_tex.png
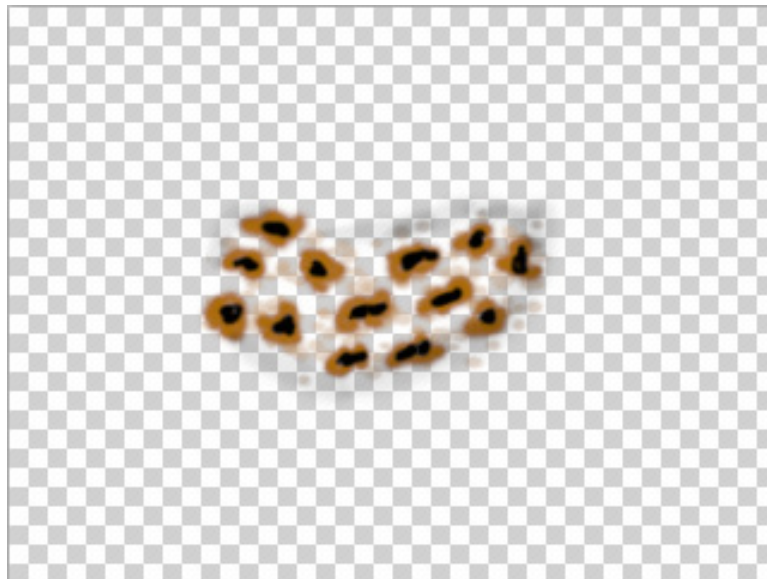
Body texture. body_tex.png
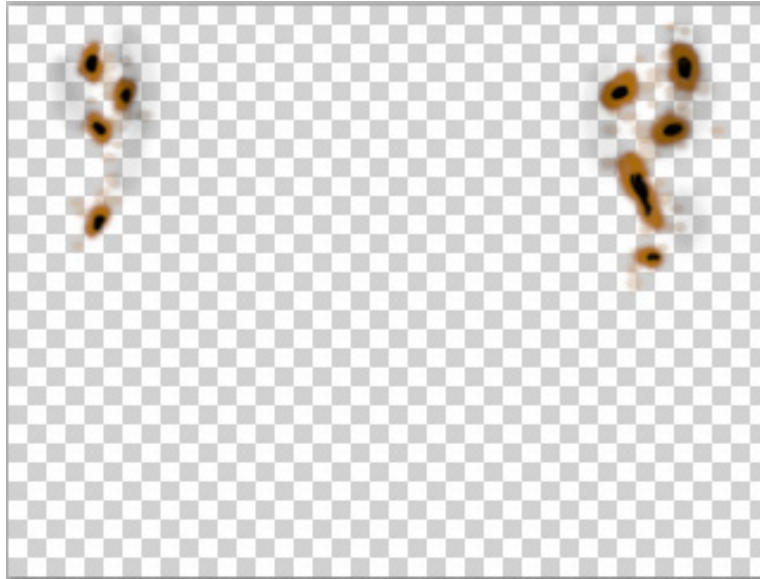
Images

Front legs texture. front_tex.png

*If you're having trouble creating the image textures, we have provided some files for you to examine. Look at the file **Tutorial 4.4 Texture.psd**, located in the **Tutorials > 4 - Images** subfolder within your custom content folder - this is the Photoshop file. Also, look at the files **back_tex.png**, **body_tex.png**, and **front_tex.png**, which are the finished texture files.*

Import Textures

To import your painted textures in Moho, follow these steps:

1. In the Layers window, highlight the **Back Legs** layer. The image file that you import will be placed above this layer.

2. Create a new Image layer and select **back_tex.png** as the source image. The new image layer appears in the layers list.

3. Select the **Body** layer as the current layer. Create another image layer for **body_tex.png** . The new layer should appear above the **Body** layer.

4. And finally, select the **Front Legs** layer, and create a third image layer for **front_tex.png**. The new layer appears above the **Front Legs** layer. Here's how the new image layers should be arranged:
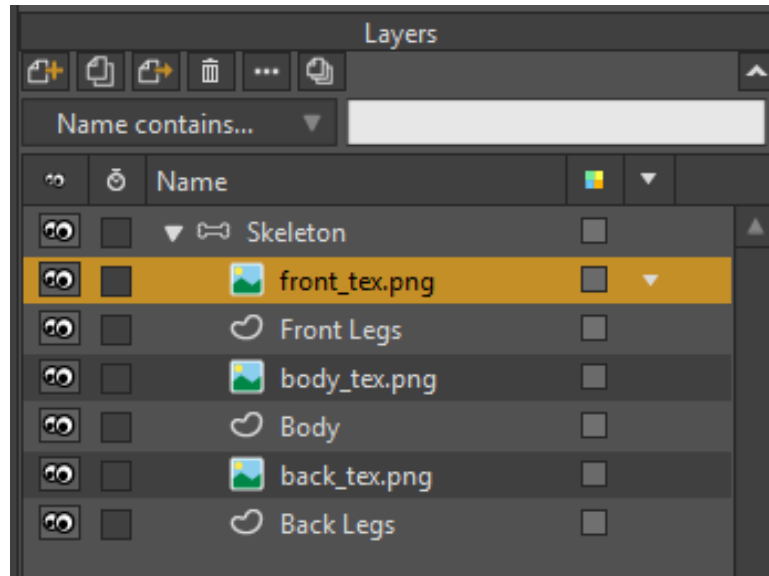
Images

Three new image layers
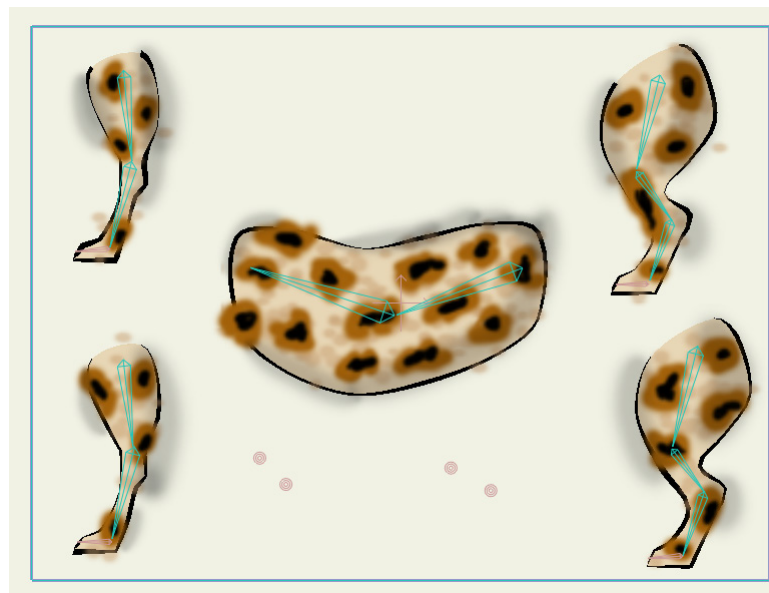
Textures applied in Moho

Use Masking for Clean Edges

At this point, the textures are finished and in place, but they are a little messy, and go outside the bounds of the actual body parts. The final step is to clean up the texture edges using layer masking.

1. Double-click the **Skeleton** layer in the Layers window to bring up the Layer Settings dialog. Go to the Masking tab, and set the group mask to **Hide all**:

Images
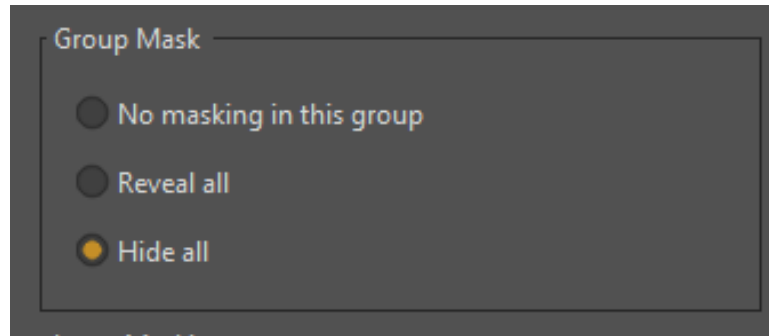
Turn masking on for the group

2. Next, double-click the **Back Legs** vector layer to bring up the Layer Properties dialog for that layer. Go to the Masking tab, and set the masking mode to **+ Clear the mask, then add this layer to it**. What this masking mode does is make all objects invisible, except where this layer has solid areas. So, the **back_tex. png** image layer will only be visible directly on top of the **Back Legs** vector layer, preventing the texture from going outside the lines of the back legs.
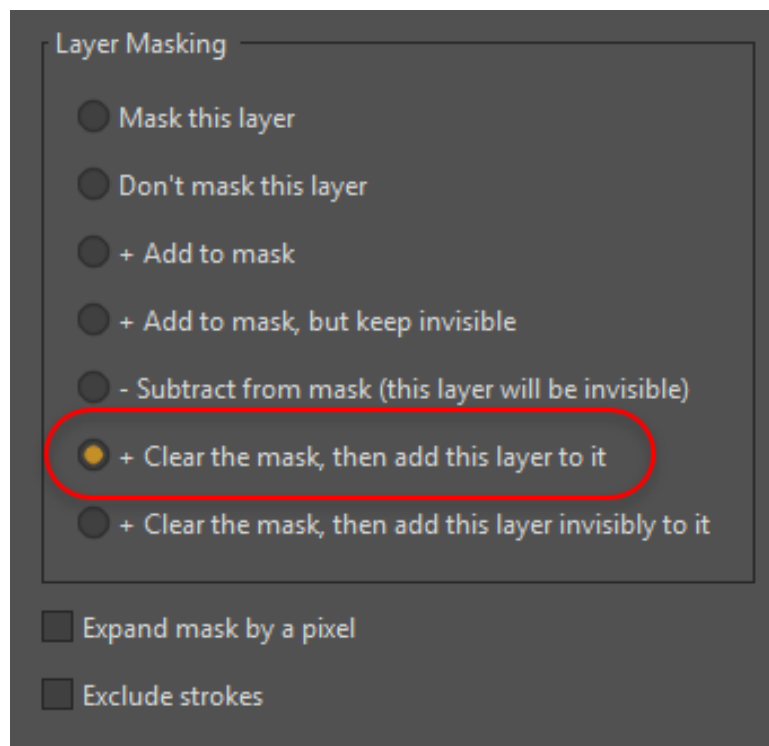
Set the masking mode for the Back Legs layer

Images
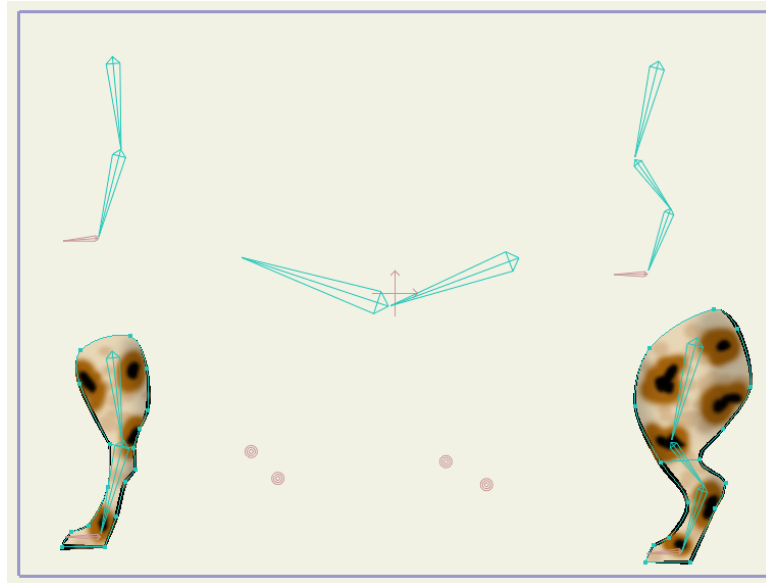
The Back Legs layer with mask

3. Repeat step 2 for the **Body** and **Front Legs** vector layers. Set the masking mode to **+ Clear the mask, then add this layer to it**, just like you did for the back legs. At this point, all the textures should be forced to stay inside the lines:
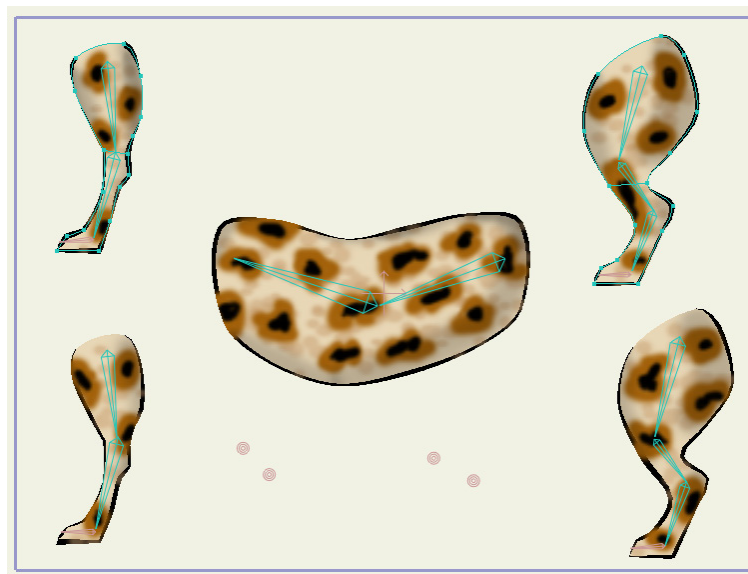
Textures cleaned up with masking

4. Play back the animation again and you'll see the image layers warp along with the vector layers in response to bone movement.

Images

Tutorial 4.4: Animating a Talking Head (Pro Only)

This shows you an easy way to animate a photograph to create a cheesy talking-head effect. The quality of the result will depend a lot on the photograph you start with and how the bone system is set up.

Start With a Sample File

For this tutorial, we'll start with a project file that's almost finished. It's named **Tutorial 4.3** and it's located in the **Tutorials > 4 - Images** subfolder within your custom content folder.

1. Open the **Tutorials > 4 - Images . Tutorial 4.3** file in Moho. The project contains an image layer enclosed in a bone layer. Bones have already been set up to control the mouth region, and extra bones have been set up around the border of the image to hold the rest of the head still. You should see this:

Starting point for this tutorial

2. In the Layers window, click to select the **reagan.png** layer.

3. Select the **Manipulate Bones** tool and press the **Alt** key while you use it to drag the bone at the lower right side of the mouth in the reagan.png layer. Notice that the other mouth bones move as well - they have been set up using bone constraints to move in sync with the lower-right bone.

Normally, the Manipulate Bones tool rotates bones. However, when a bone does not have a parent (as is the case with the mouth bones in this project), the Manipulate Bones tool translates the bone by default. Pressing the Alt key while using the Manipulate Bones tool on bones that have no parent will allow you to rotate the mouth bone.
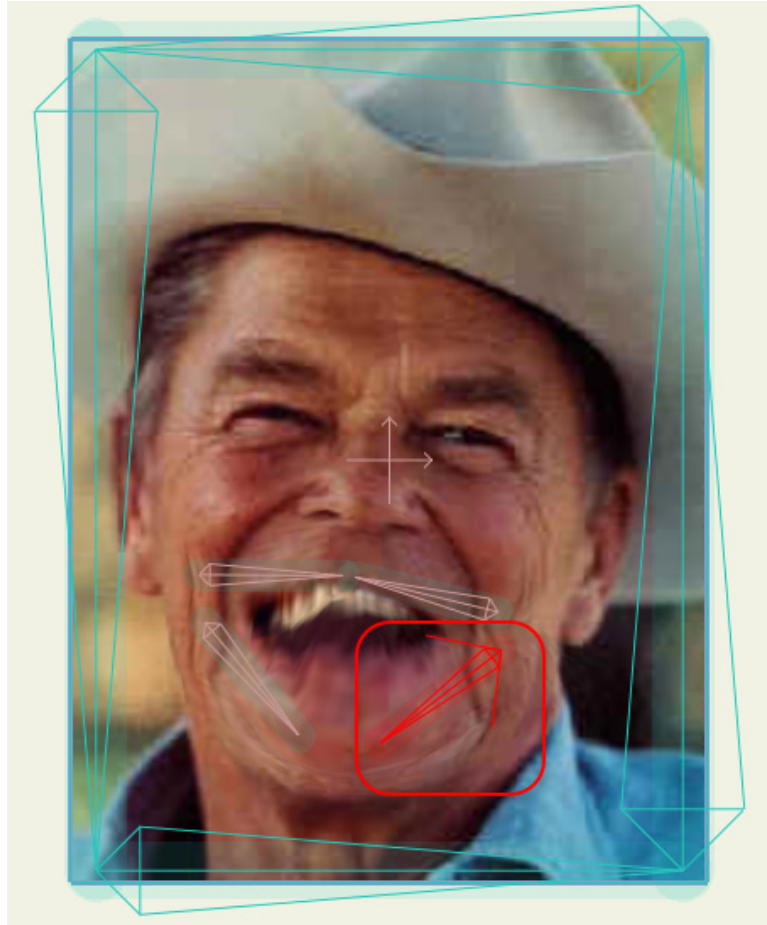
Images

Moving the mouth

Adding Sound and Motion

Now we'll add a soundtrack to this animation.

In the Layers window, click the **New Layer** icon and create a new **Audio** layer.

1. When prompted, pick the **reagan.wav** file from the **Moho/Tutorials > 4 - Images** folder.

2. Press the Play button in the timeline. The audio file will now play back with the project - try playing it back if you like.

3. The next step is to add some animation in sync with the soundtrack. Select the **Mouth Bones** bone layer, and activate the **Select Bone** tool. Make sure the bottom-right bone in the mouth is selected (it probably already is at this point).

4. In the timeline, set the current time to frame 1.

5. Select the **Scripts > Sound > Bone Audio Wiggle** menu command. This is a script that uses the volume of an audio file to control the angle of a bone.

Images
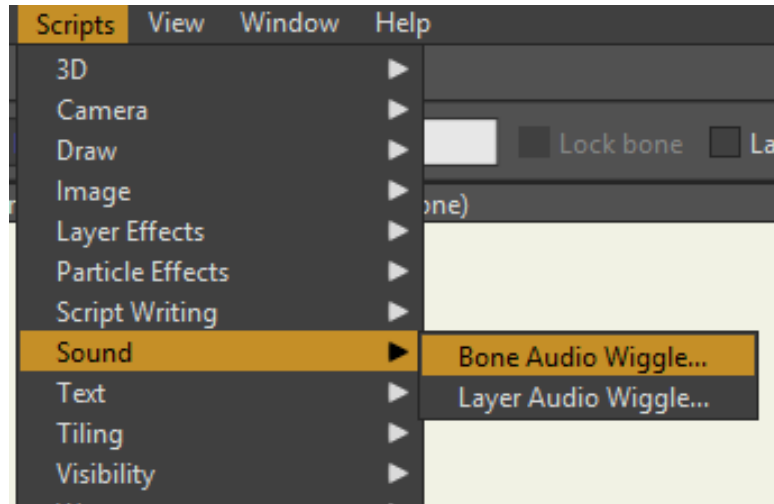
Bone Audio Wiggle script

6. The Bone Audio Wiggle dialog allows you to choose the sound file that you want to use. Select the same **reagan.wav** file you used for the soundtrack. You can only select one audio file if there are multiple sounds in your scene.
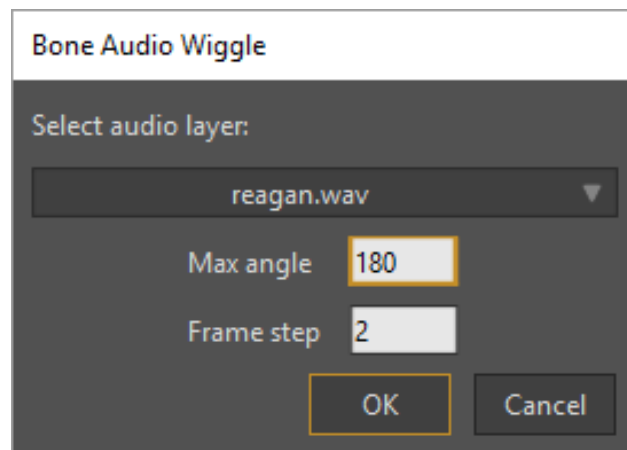
Bone Audio Wiggle dialog

7. There are two additional settings in the Bone Audio Wiggle dialog. Set the **Max angle** to **180**, and keep the **Frame Step** setting at 2. This creates keyframes at every other frame. Click **OK** to exit the dialog. The script will run and add keyframes to the timeline for the selected bone. Because the other bones are controlled by the selected one, the whole mouth will move.

Images
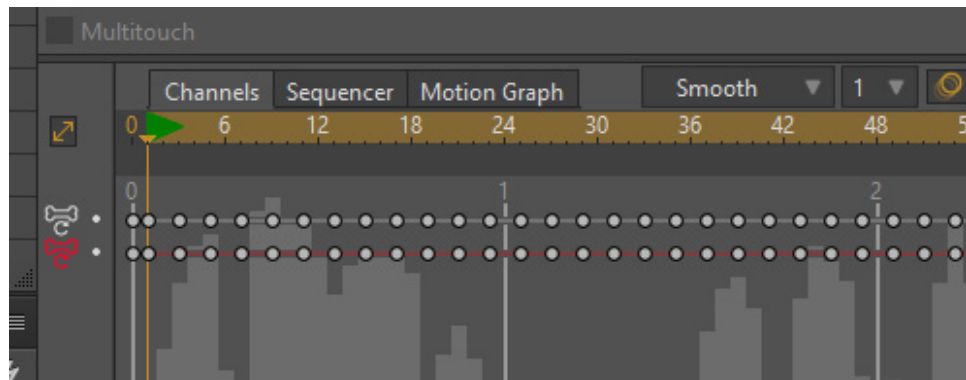
Keyframes for Bone Audio Wiggle

Images

Animation

After all the preparation time drawing your objects, assigning fill colors, and setting up bones, you move on to animating them. This is where things actually start to move around.

Animating in Moho is based on the concept of keyframes. A keyframe is a point in time where you position some object (either a point, a bone, or an entire layer). A keyframe tells Moho exactly where that object should be and when. Keyframes are set up at important moments in time - typically where an object begins moving, stops moving, or changes direction. Between keyframes, Moho automatically calculates how to move an object so that it gets from one keyframe to the next in the amount of time allowed between the keyframes.

To create a keyframe, just set the current time to whenever you want the keyframe to occur, then move the object to the desired position. Controlling the current time and working with keyframes after they've been created is discussed in **"Chapter 16: The Timeline Window" on page 332 in your Moho Users Manual**.

You can animate several types of motion in a Moho project, and they can each be used alone or in combination.

- The first type is point motion. Point motion very basic - it just involves moving individual points around in time. Point motion is good for small distortions to an object where you want something to look soft and flexible (turning up the corners of a mouth into a smile, bulging out a belly, etc.). You can move a shape in any way you want with point animation, but it might require manipulating a lot of points - in many cases bone animation can simplify the job.

- Bone animation involves setting up a skeleton system for an object and then moving the skeleton around. By carefully constructing a skeleton, you can easily move a character around like a puppet.

- Layer animation is for very simple, large-scale motion. When you move a layer, everything in it moves together. This doesn't give you a lot of flexibility as far as what you can animate this way, but it's a good way to get certain effects. If you want an entire group of objects to pan side to side or zoom in or out, then layer animation is the tool to use.

The keyframes you define are visible in the Timeline, starting at frame 1. Frame 0 is a special frame in a Moho project - the original placement of all your objects is stored at frame 0. If you want to modify an object's original shape or position, or add new objects, this should be done at frame 0. Whatever you do to an object in later frames can never affect an object's original shape and position, so even if you think you really screwed something up, you can always delete some keyframes and get back your original drawings.

This chapter has a useful hands-on overview of how to animate in Moho, using each type of motion (point, bone, and layer). Once you've mastered Moho's animation tools, animating is a simple job of repeatedly using the tools you already know, keyframe by keyframe.

Animation

Tutorial 5.1: Automatic Lip-Sync

This tutorial uses Moho's Switch layers to show you how to perform instant, automatic lip-syncing. A switch layer contains multiple sub-layers, but only one of the sub-layers can be displayed at a time. This makes it very useful for lip-sync animation: each sub-layer can be a mouth shape for a different sound.

The method of lip-sync described in this tutorial is quick and easy, though not always super-accurate (but give it a try - it may be accurate enough for your animation).

Start With a Sample File

For this tutorial, we'll start with a project file that's almost finished. It's named **Tutorial 5.1** and it's located in the **Tutorials > 5 - Animation** subfolder within your custom content folder.

1. Open the **Tutorials > 5 - Animation > Tutorial 5.1** file in Moho, expand the **Mouth** layer in the Layers window, and you should see something like this:
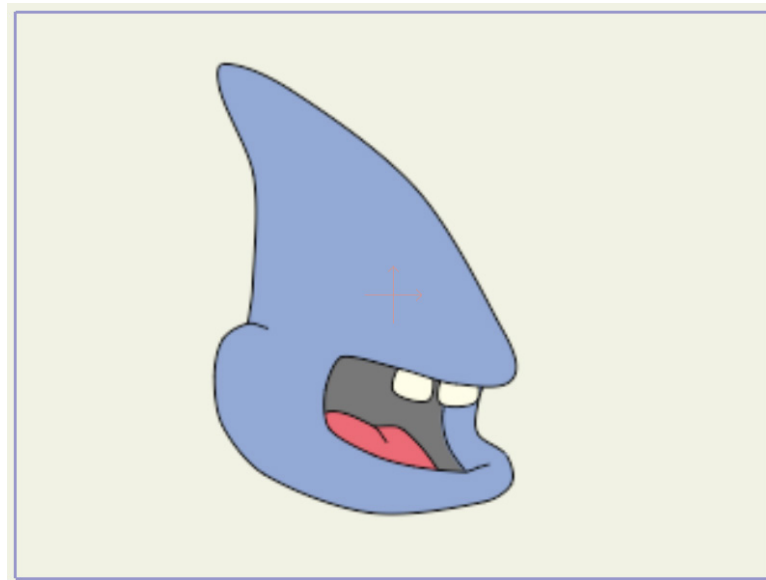
Starting point for this tutorial

2. Examine the sub-layers in the **Mouth** layer. Notice that from bottom to top they range from closed to wide open. This is the basic setup for automatic lip-syncing. The number and names of the sub-layers don't matter, as long as the lowest one is closed and the highest one is wide open.
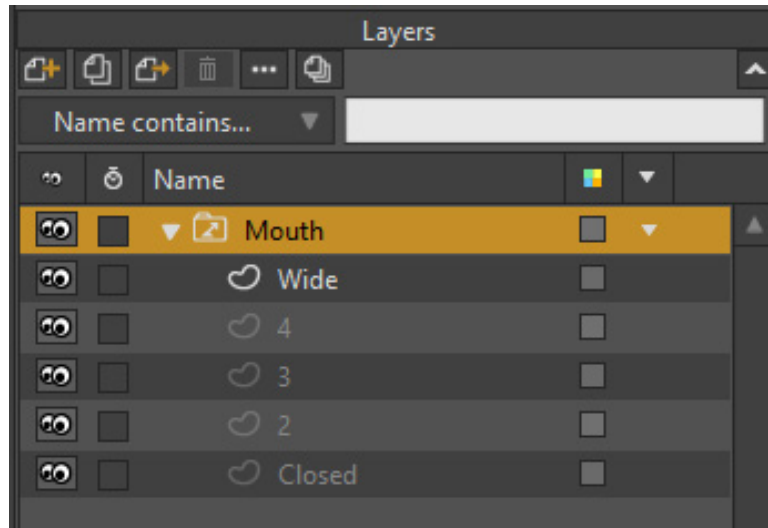
Layers in the Layers window

3. Next, add the audio file that will go along with the lip-syncing. Choose the **File > Import > Audio File** menu command and select the **Tutorials > 5 - Animation > MaryLamb-Man.wav** file in your custom content folder.

> *Make sure that you select the* **File > Import > Audio File** *command from the lower section of the file menu. This differs from the* **File > Import > Audio** *command in the upper section of the menu, which is used to open files in the Moho library.*
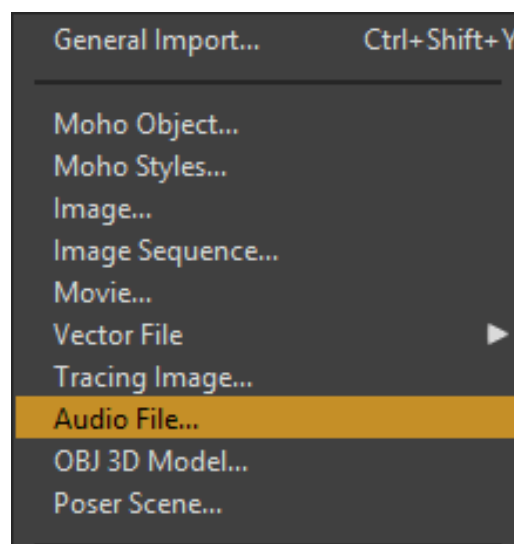
File > Import > Audio File command (Pro shown)

4. Play back the animation now to hear the result. You'll notice that the mouth doesn't move yet. Stop the playback before proceeding.

5. Double-click the **Mouth** layer. When the Layer Settings dialog opens, click the **Switch** tab:

Animation
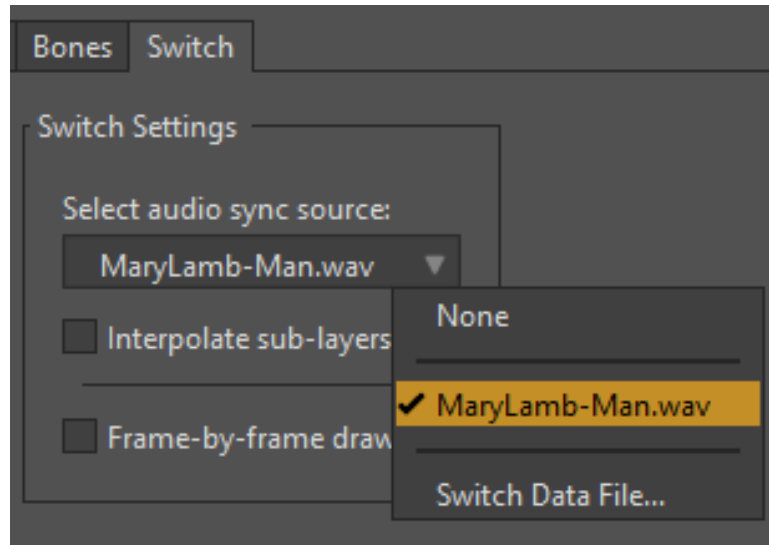
Layer settings for the mouth

6. Click the **Select audio sync source** button to select the file that will control the Switch layer. In the file dialog that appears, select the file **MaryLamb-Man.wav**. Click the dialog's OK button.

That's it! The audio file was analyzed and keyframes were attached to the Switch layer. When the audio is quiet, Moho activates the lowest layer (the closed mouth), and when the audio is loudest, Moho uses the highest layer (the wide open mouth). In between, Moho switches on the in between mouths. Play back the animation to see and hear the result. In general, because automatic lip-sync is based on the actual sound in the audio file, it is important to use an audio file without background noise or music.

Click *this link* to view a brief video of the finished results of your project.

Tutorial 5.2: Phoneme Lip-Sync

This tutorial covers another method of animating lip-sync. With this method, the lip-sync is based on **phonemes**. Phonemes are the basic building block sounds that make up words. When you do lip-sync based on phonemes, it requires you to break down the words of dialog into their basic sound elements.

Start With a Sample File

For this tutorial, we'll start with a project file that's almost finished. It's named **Tutorial 5.2** and it's located in the **Tutorials > 5 - Animation** subfolder within your custom content folder.

1. Open the **Tutorials > 5 - Animation > Tutorial 5.2** file in Moho.

2. Expand the **Head** layer in the Layers window, and you should see something like this:
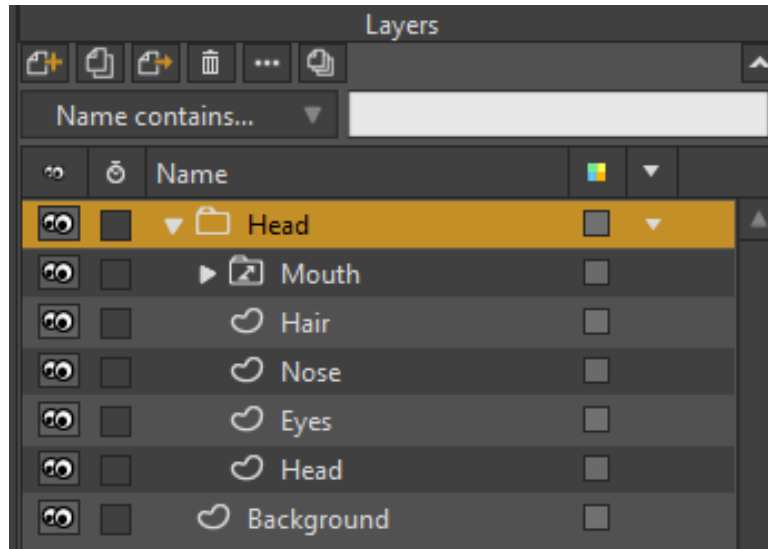
Animation

Starting point for this tutorial

3. This project is almost complete. The only thing apparently missing is the animation for the character's mouth. Play back the animation. The mouth is there (it's a switch layer), but no animation data has yet been assigned to it, so it doesn't move.

4. Double-click the **Mouth** layer. When the Layer Settings dialog opens, click the **Switch** tab:
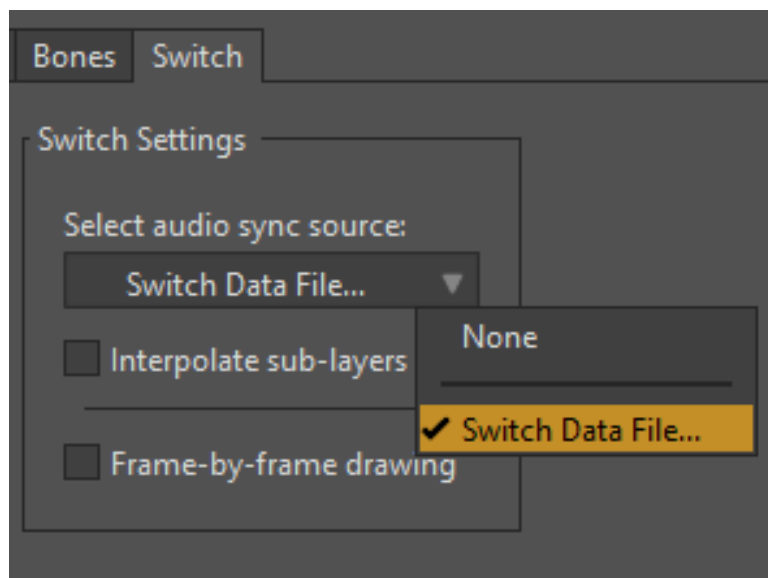
Options in the Switch tab

5. Click the **Select audio sync source** button to select the switch data file that will control this switch layer. In the file dialog that appears, select the file **vista.dat** located in the **Tutorials > 5 - Animation** subfolder within your custom content folder.

Animation

> *The Mouth layer contains all the mouth shapes needed to speak any phrase. You can examine the Mouth layer to see the sub-layers it contains. Each sub-layer is named after a different phoneme. You can use any set of phonemes you choose. The mouth shapes in this mouth are based on the same default set used by a great (and free) lip syncing program that we recommend: Papagayo (http://www.lostmarble.com/papagayo/) is a good place to get started. To make the mouth speak a different phrase, just create a different animation data file in Papagayo, and select it into the mouth layer as we just did for the vista.dat example.*

6.   To hear the sound along with the animation, choose the **File > Import > Audio File** command from Moho's menu and select the **vista.wav** file located in the **Tutorials > 5 - Animation** folder.

7.   Now, when you play back the animation in Moho you will hear the audio that goes with the lip-sync. Also, if you export the animation as a movie, the audio will be included in the movie file.

> *If you plan to export your animations to Flash (SWF) format, you will need to use MP3 audio files instead of WAV audio files. In addition, if you plan to render to SWF format, you can only use a single audio file in the project.*

> *Click this link to view a brief video of the finished results of your project.*

Tutorial 5.3: Cycling

It is possible in Moho to automatically cycle a section of animation, repeating it over and over as many times as you wish. Cycling is a special type of keyframe interpolation, and this tutorial will show you how to set it up.

Start With a Sample File

For this tutorial, we'll start with a project file that's almost finished. It's named **Tutorial 5.5** and it's located in the **Tutorials > 5 - Animation** subfolder within your custom content folder.

1.   Open the **Tutorials > 5 - Animation > Tutorial 5.5** file in Moho.
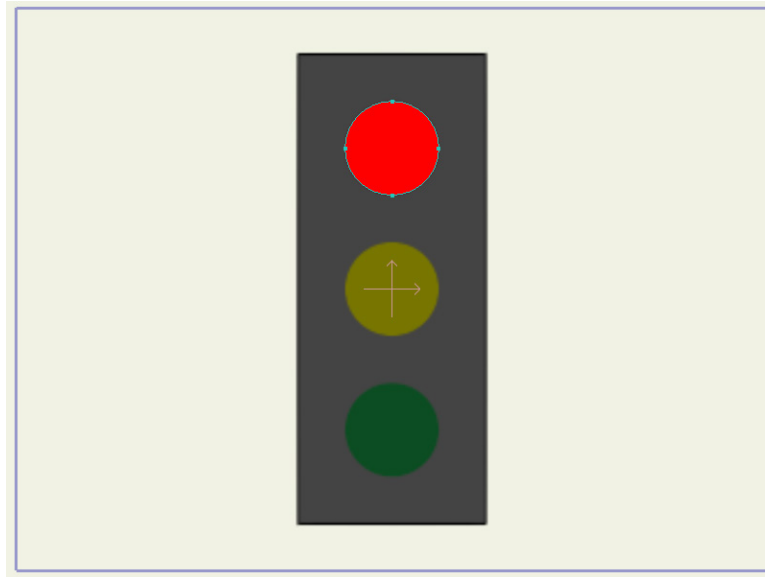
Starting point for this tutorial

2. In the timeline, you can see that the top layer, **Red Blinker**, has two keyframes in the Layer Visibility channel. The layer becomes invisi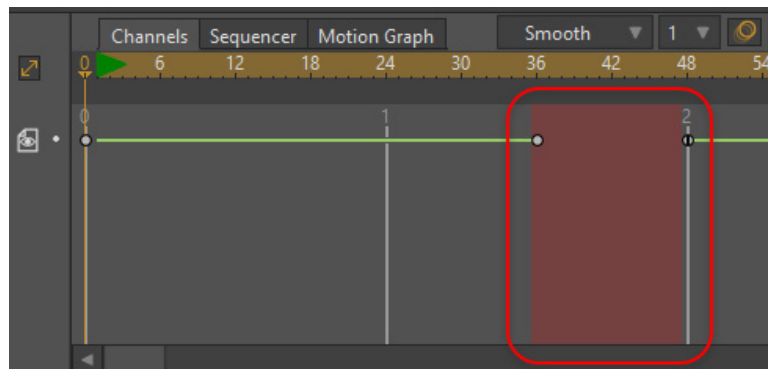ble at frame 36, and visible again at frame 48. This is also shown by the red background in the timeline during the layer's invisible period:

Starting point for this tutorial

3. You can play back the animation to see what's going on. Basically, the red light starts off turned on, then it shuts off for a while and finally turns back on.

4. Using cycling, you can make the light blink over and over. Right-click on the second keyframe (the one at frame 48), and in the popup menu that appears, select **Cycle...**. You're telling Moho that after this keyframe, you want the animation to cycle back to an earlier point in the animation. A dialog will appear asking you the specifics of the cycling. Select the **Absolute (cycle back to this exact frame)** option, and then enter **12** as shown below:

Animation
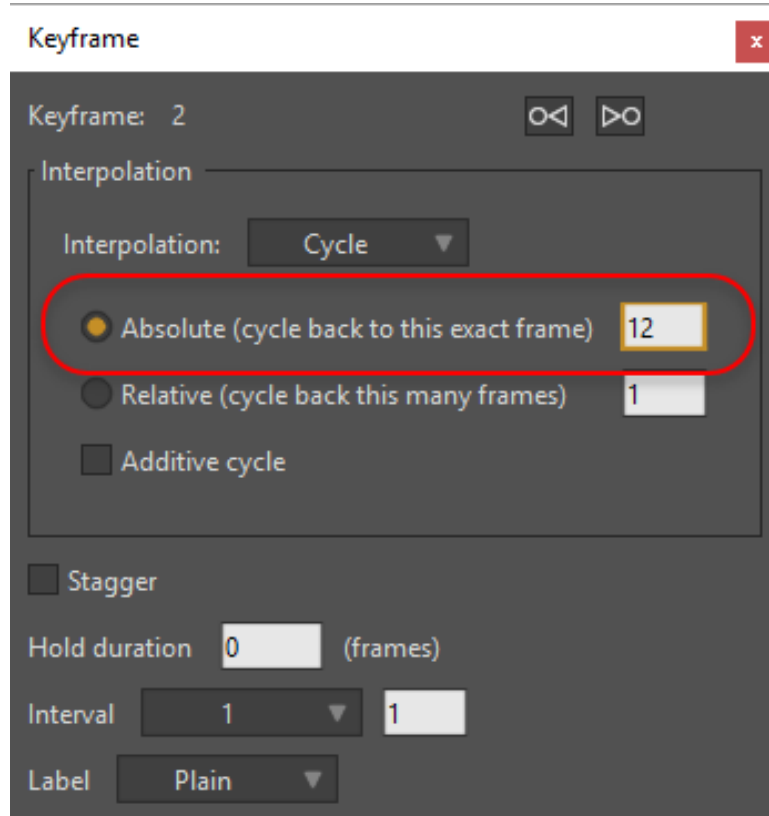
Cycle settings

5. When you close the cycle dialog, the timeline will update to show the cycle. There are three changes you will see:

    ▪ The keyframe in question will change to a left-pointing arrow to indicate that it cycles backwards.

    ▪ A long red arrow will point back to the point in the timeline that the visibility channel is cycling back to.

    ▪ Later in the timeline you will see other sections with red backgrounds to indicate that the layer is invisible during those periods:
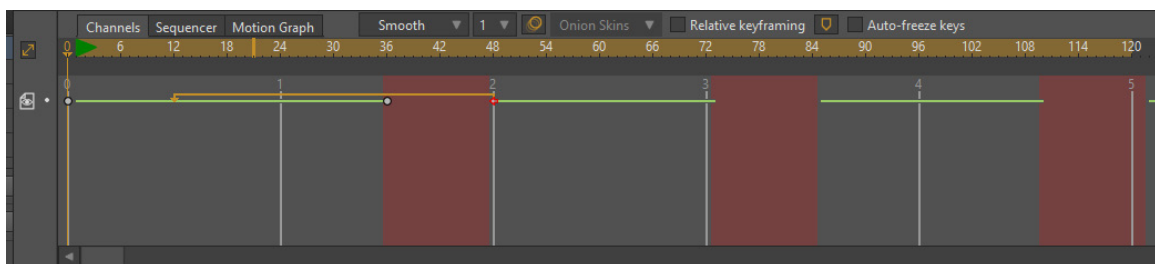
Cycling reflected in the timeline

6. You can play back the animation again to see the result. The **Red Blinker** layer will flash on and off multiple times, even though you didn't add any more keyframes - the Layer Visibility channel is just cycling back and repeating a section of animation over and over again.

Animation

7. Let's try adjusting the cycle duration. In the Timeline window, hold down the **Ctrl** key (Windows) or **Cmd** key (Mac) while you click and drag on the second keyframe (the one that cycles). As you drag the mouse side-to-side, you'll see that the cycle duration changes, as the arrow that points back from the cycling key gets longer and shorter. Adjust the cycle duration so that the keyframe cycles back to frame 24:
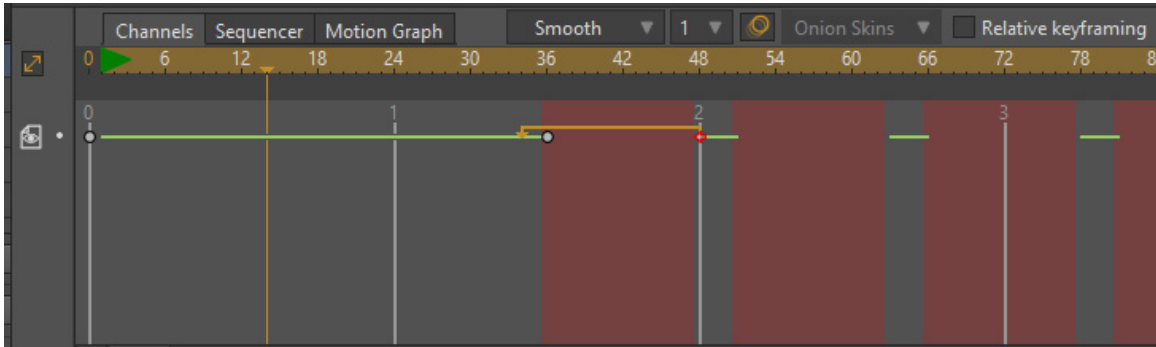
Adjusted cycle duration

8. If you play back the animation now, you'll see that the light blinks more quickly now, since the cycle duration is shorter.

9. Finally, to break a cycle, all you have to do is add another keyframe when you want the cycle to end. Set the current frame to 102, right click in the Layer Visibility channel, and select **Add Keyframe** from the popup menu that appears. The new keyframe will appear, and at that point the cycling will end. Play back the animation to confirm this.
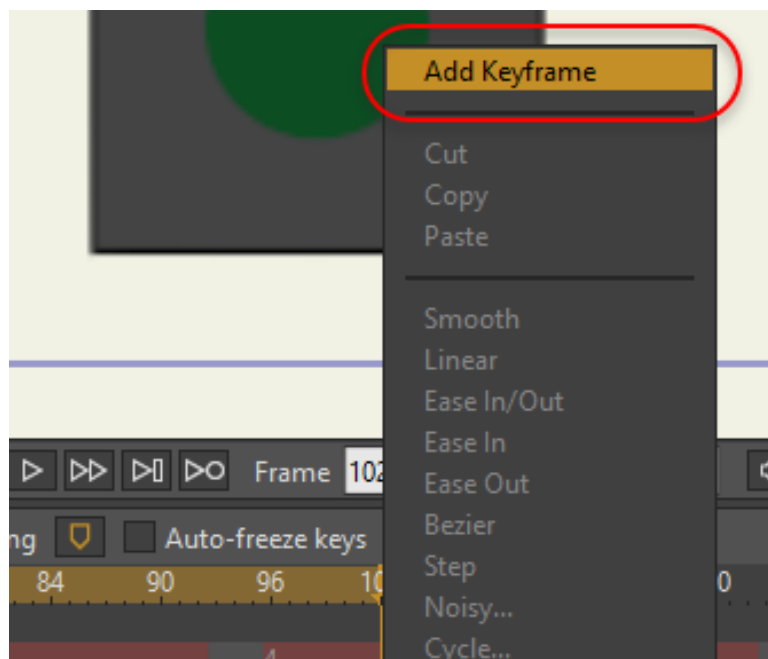
New keyframe at frame 102

Animation

Conclusion

Cycling can be used in any animation channel in Moho. Any keyframe can be made to cycle back in time by setting **Cycle** as the key's interpolation method. You can cycle a channel all the way back to the beginning of an animation, or just back a few frames. Cycling will repeat itself forever or until a new keyframe is reached.

Tutorial 5.4: Animation Curves (Pro Only)

Introduction

This tutorial introduces the graph mode of Moho's timeline. Graph mode allows you to inspect an animation curve plotted as values on a graph. Looking at things this way can help with evaluating acceleration, changes in direction, and other properties of motion.

Start With a Sample File

For this tutorial, we'll start with a project file that's almost finished. It's named **Tutorial 5.3** and it's located in the **Tutorials > 5 - Animation** subfolder within your custom content folder.

1.   Open the **Tutorials > 5 - Animation > Tutorial 5.3** file in Moho.

2.   We're interested in the Skeleton layer here - make sure it is the active layer.

> *The skeleton here is partially animated - go ahead and play it back to see what you're starting with. In case you were wondering, only the lowest vertical bone in the skeleton is actually animated. The other bones are using bone constraints to follow the motion of the lowest bone.*

Motion Curves

Continue with your project as follows to work with the motion curves:

3.   Rewind the animation to frame zero, and use the Select Bone tool to select the lowest vertical bone as shown below:

Animation
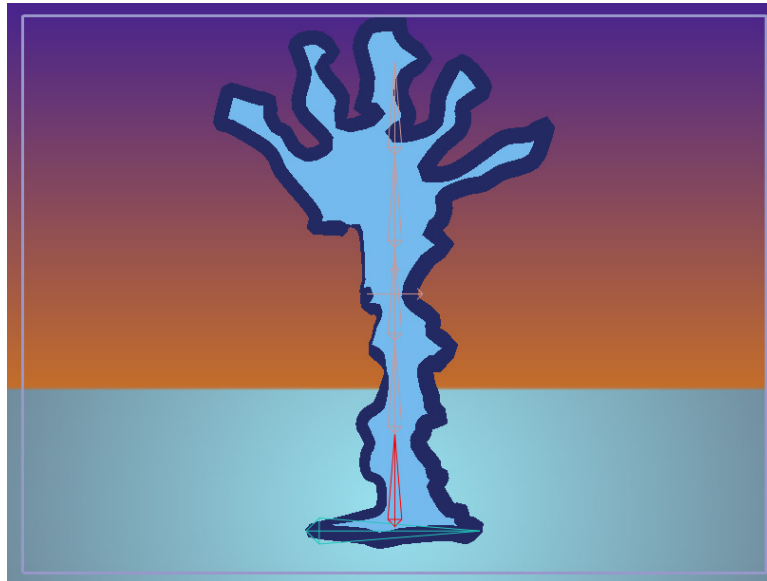
Select the lowest bone

4.   In the **Timeline** window, click the **Motion Graph** tab. Click the **Selected Bone Angle** channel icon - this is the channel icon on the left side of the timeline, and looks like this:
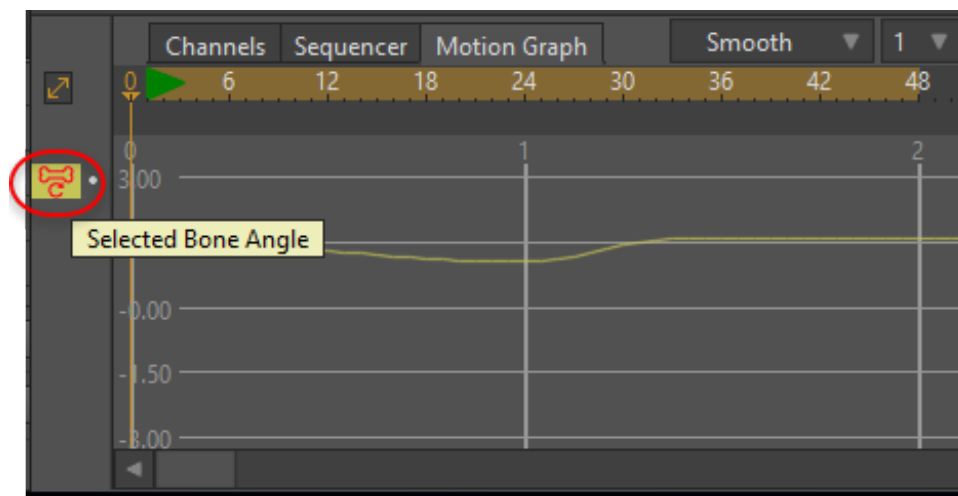
*Click the Selected Bone Angle icon*

5.   A single click turns on the display of the channel in the graph. A double-click makes the channel active for editing. Double-click the channel to continue.

> *By default, not all channels are visible, since this would just cause too much visual clutter in graph mode. For similar reasons, only one channel can be active for editing in graph mode. Double-clicking a channel's icon makes it active for editing.*

6.   Now, press the **End** key on your keyboard - this rescales the graph to accommodate the currently active channel, in this case the selected bone

Animation

rotation channel. After all of these adjustments to the graph, it should look like the following figure.

7.   In the graph you can see three keyframes. These are just like keyframes in the normal timeline, but instead of just being spread out along a horizontal line (time), they are also spaced vertically (value). Between the keyframes, a curve is drawn that represents the value of the selected bone's rotation angle. Looking at this curve, you can tell that over the first second (frames 1 to 24), the bone rotates from an angle of 1.57 to an angle of about 1.05 (we don't care about the exact values). Then, in less than half a second it rotates back again.
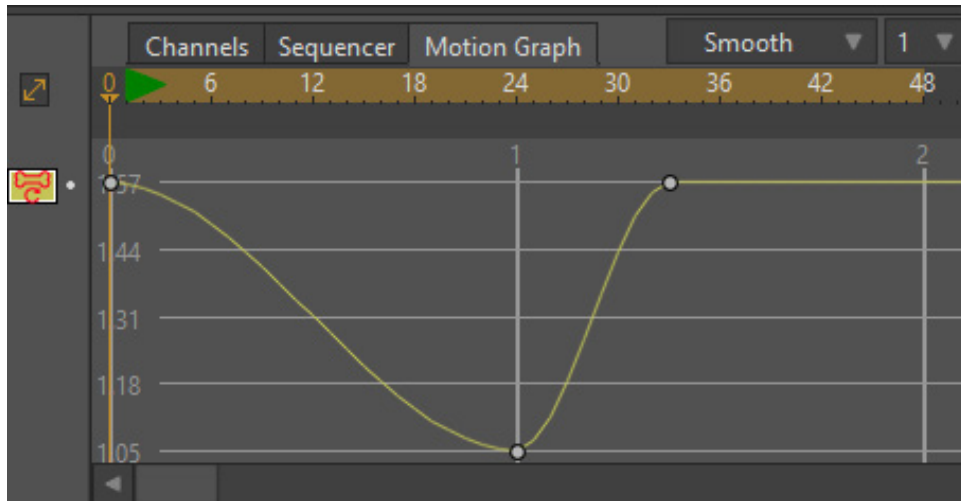

Graph mode

In the timeline's graph mode, angles are displayed in radians so that they'll be closer in magnitude to other values like translation and scale. However, if you want to see curves displayed in degrees you can tell the timeline to do that in Moho's preferences dialog.

8.   Now we're going to edit the bone's motion by modifying the graph. First, set the current time to frame 48 and choose the **Bone > Reset Bone** command.

9.   Press the Page Down key to give yourself some room in the graph to work (you may need to turn off your **Num Lock** key).

10.   Next, click the keyframe at frame 33 and drag it upwards slightly as shown below.

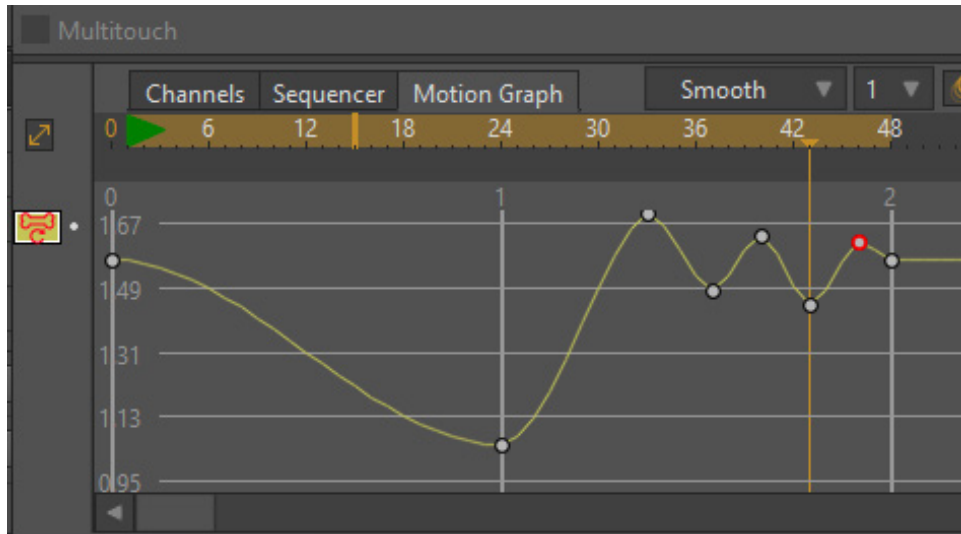**Animation**
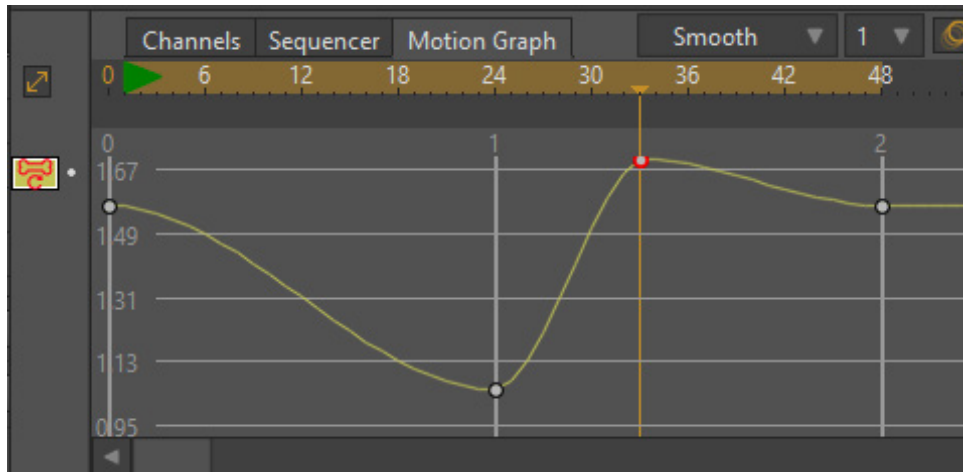
Move a keyframe

11. Next we're going to add a new keyframe directly on the graph. Right click
     on the graph around frame 37. In the popup menu that appears, select **Add
     Keyframe**. A new keyframe will appear on the graph - drag it to the location
     shown:
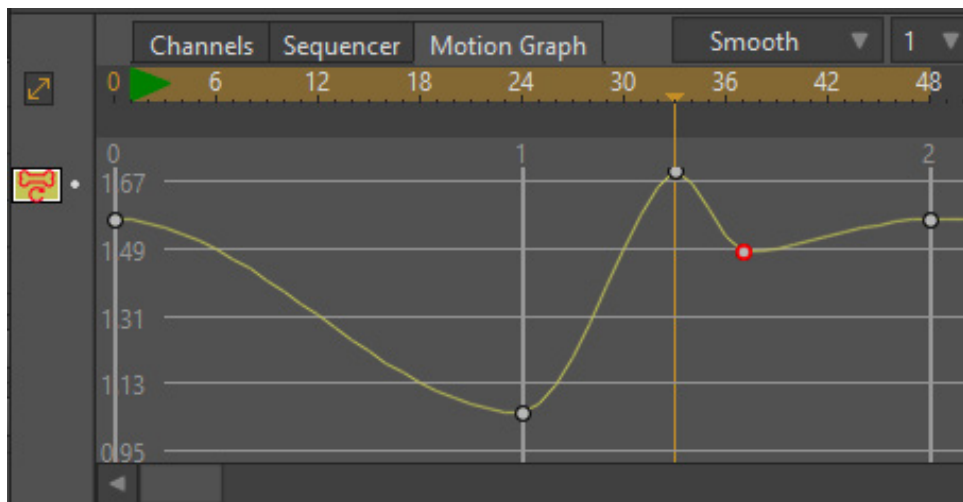
Add a new keyframe

12. Let's add three more keyframes like the previous one. Add these keys at frames
     40, 43, and 46. You don't need to set the time to the frame you want to add a
     key to - just right-click at the correct frame and add the new key. Don't worry if
     the key isn't exactly at the frame you wanted, since you can easily drag it into
     position. Move these new keys so that the curve looks like this:

     What this wiggling curve represents is sort of a springy back-and-forth motion
     that decreases over the span of just over half a second. You could have
     animated this using the normal timeline and the bone rotation tool, but this gives
     you another way to understand the motion you're creating.

Animation

The final graph
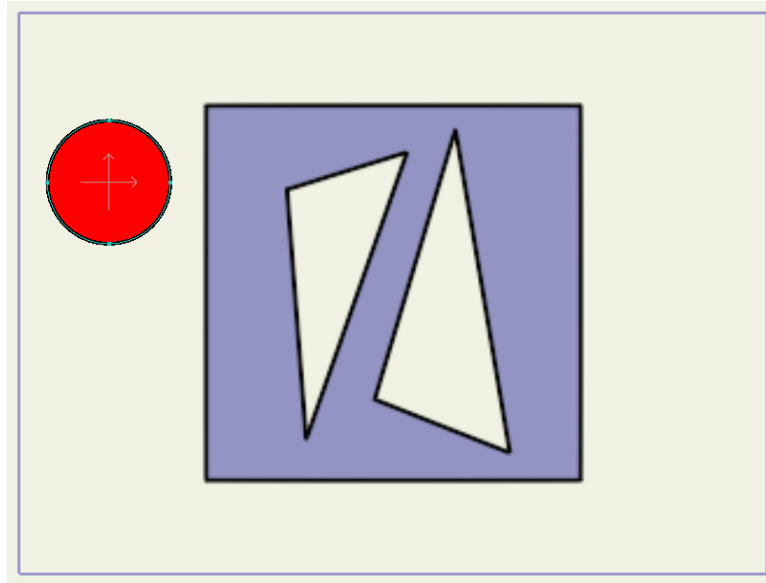
13. Play back the animation to see what it looks like.

Tutorial 5.5: Sorting Layers by Depth (Pro Only)

This tutorial shows you some of the 3D-related features of Moho. Moho allows you to move layers in three dimensions to create an accurate simulation of depth. In addition, Moho has the option of sorting layers by depth, allowing layers to move in front of and behind each other during the course of an animation.

Start With a Sample File

For this tutorial, we'll start with a project file that's almost finished. It's named **Tutorial 5.4** and it's located in the **Tutorials > 5 - Animation** subfolder within your custom content folder.

Open the **Tutorials > 5 - Animation > Tutorial 5.4** file in Moho. You should see something like this:

Starting point for this tutorial.

This file contains two layers and a simple animation of a circle moving back and forth in front of a square. Try playing back the animation to see what it looks like.

Creating Depth

Now we're going to try moving a layer in 3D - towards and away from the camera.

1.   Set the current frame to 12 and activate the **Transform Layer** tool.

2. Make sure the **Circle** layer is active. Now, while holding down the **Alt** key, drag downwards in the editing area. You'll see the circle get larger - this is because it is moving closer to the virtual camera. The **Alt** key modifies the Transform Layer tool to move a layer forward and back. Drag the Circle layer until it looks about like this:
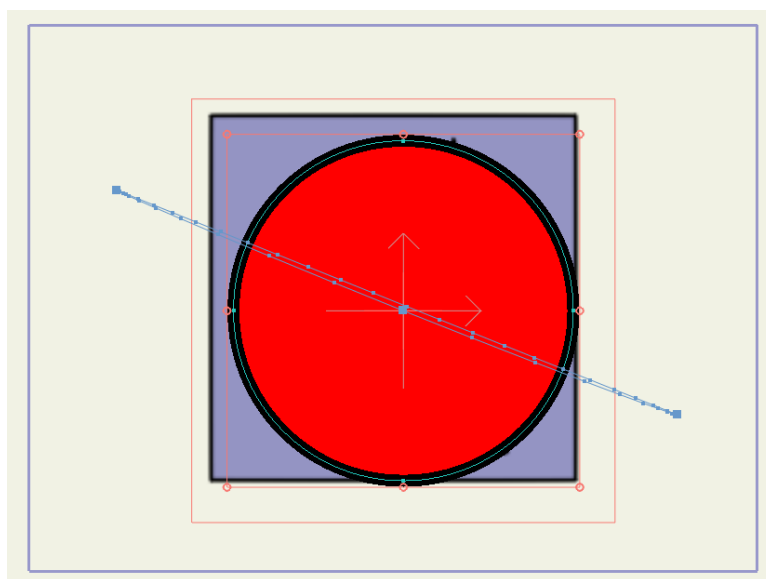
Circle moved forward

Animation

3.   In the tool options area at the top of the main Moho window, notice the value of the Z field. It should be somewhere around 1.0 (the exact value isn't important here). Positive depth (or Z) values are closer to the camera (in the direction out of your screen), while negative values point away from the camera (into the screen).

4.   Next we'll try moving the circle away from the camera. Set the current frame to 36. Again holding down the **Alt** key, use the Transform Layer tool and drag upward in the editing area. Keep going as the circle gets smaller (farther away), until it looks like this:

5.   The Z value in the tool options area should now be close to -1.0. Try playing back the animation again - the circle should now grow larger and smaller as it moves towards and away from the camera. However, it always appears in front of the square. As it moves farther away, it should be going behind the square, which brings us to the next section.
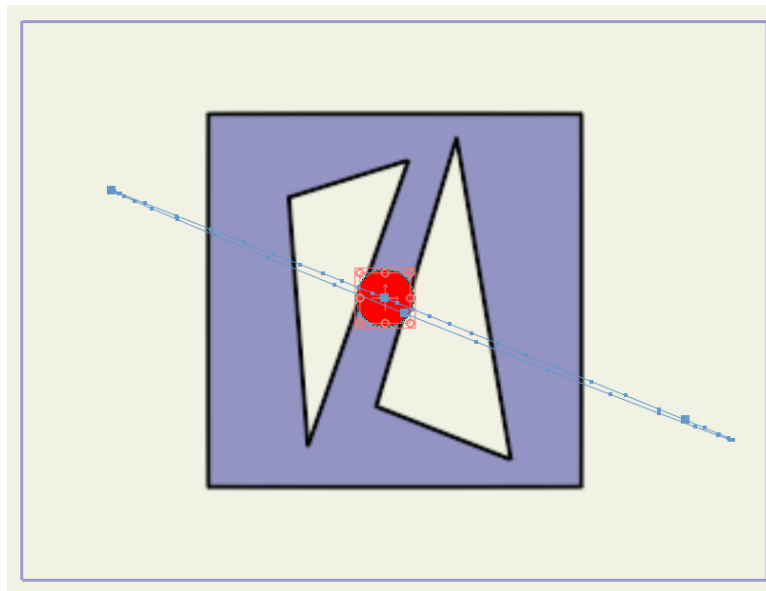

Circle moved backward
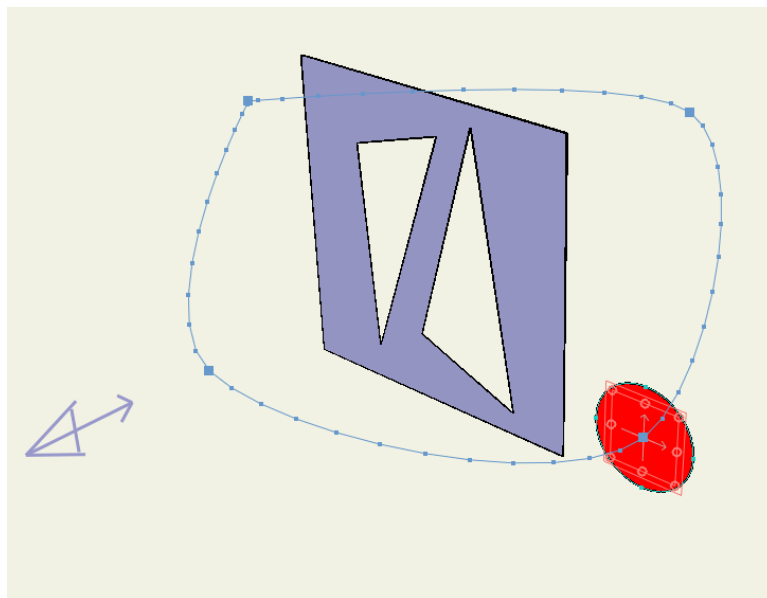
Sorting Layers by Depth

If you do move layers forward and back, as in this tutorial, you may also want layers to move behind and in front of each other. Moho can do this automatically - all you need to do is to turn on a single checkbox.

Select the **File > Project Settings** menu command. In the Project Settings dialog that appears, turn on the **Sort layers by depth** checkbox and click OK. This tells Moho to ignore the layer ordering in the Layers window, and instead draw layers in order from furthest to nearest.
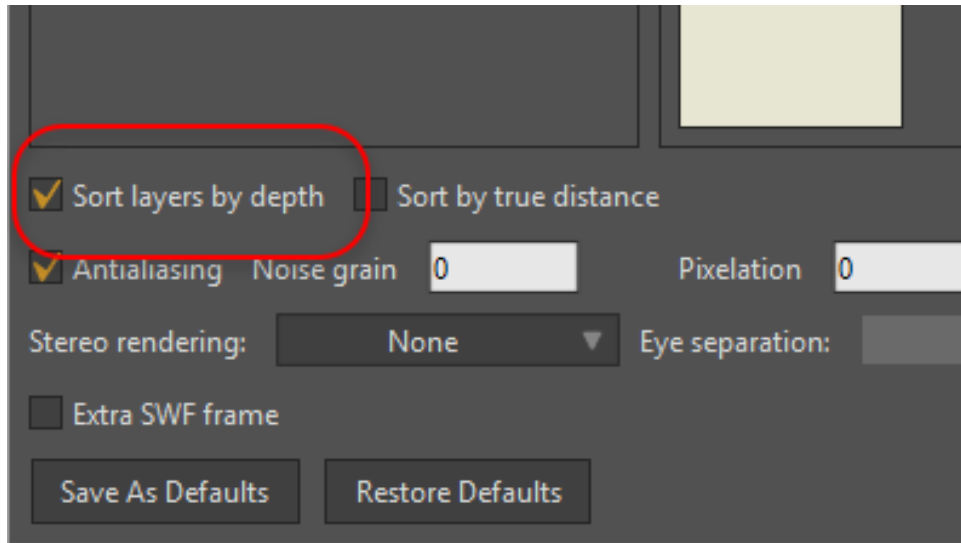
Animation

Sort layers by depth option

1. Play the animation again, and you'll see that the circle is drawn behind the square during the time that it is farther away.

2.   To get a clear idea of what's going on, use the **Orbit Workspace** tool to turn the scene to an oblique angle. If you play back the animation from this point of view, you can clearly see the circle moving forward and back as it moves around the square.

3. Once you have a good view, activate the Transform Layer tool to display the path of the Circle layer's motion.
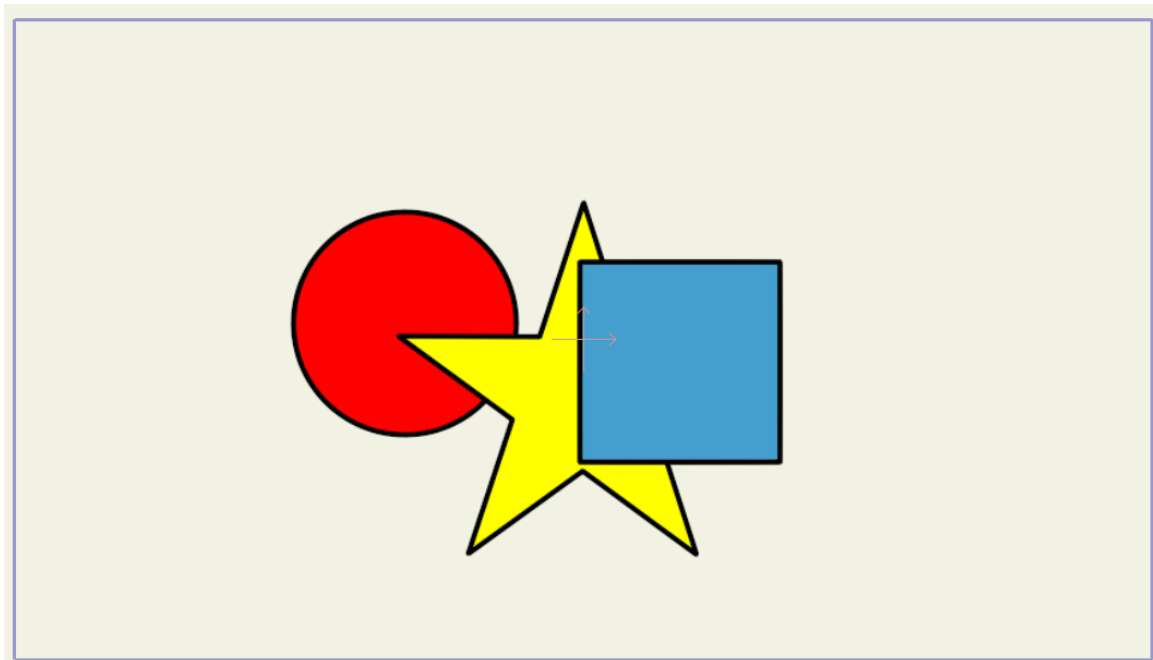

View from above

## Animation

Tutorial 5.5.1: Animated Layer Ordering

You can also use animated layer ordering to animate objects moving in front of or behind other layers. In the following example you'll learn how this works.

1. Open the **Tutorials > 5 - Animation > Tutorial 5.5.1** file in Moho. You should see something like the following image.


Starting point for this tutorial

2. This project consists of three different shapes in a layer named Shapes. Double-click the Shapes group in the Layers palette to open the Layer Settings dialog.

3. In the Depth Sort tab, check the **Enable animated layer order** option and click **OK**. This will apply the setting to all of the selected layers.
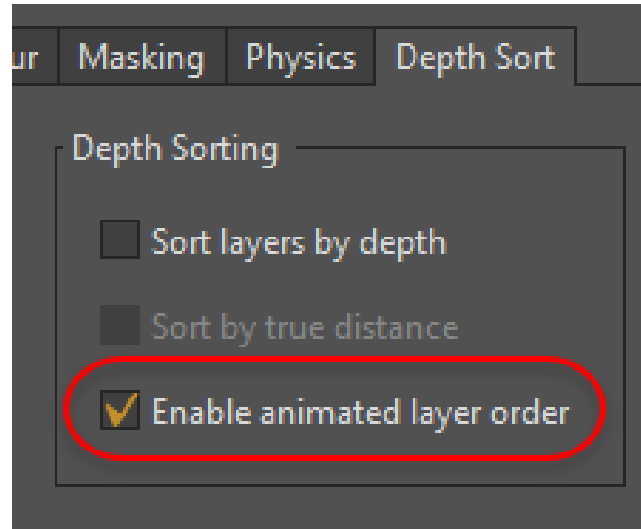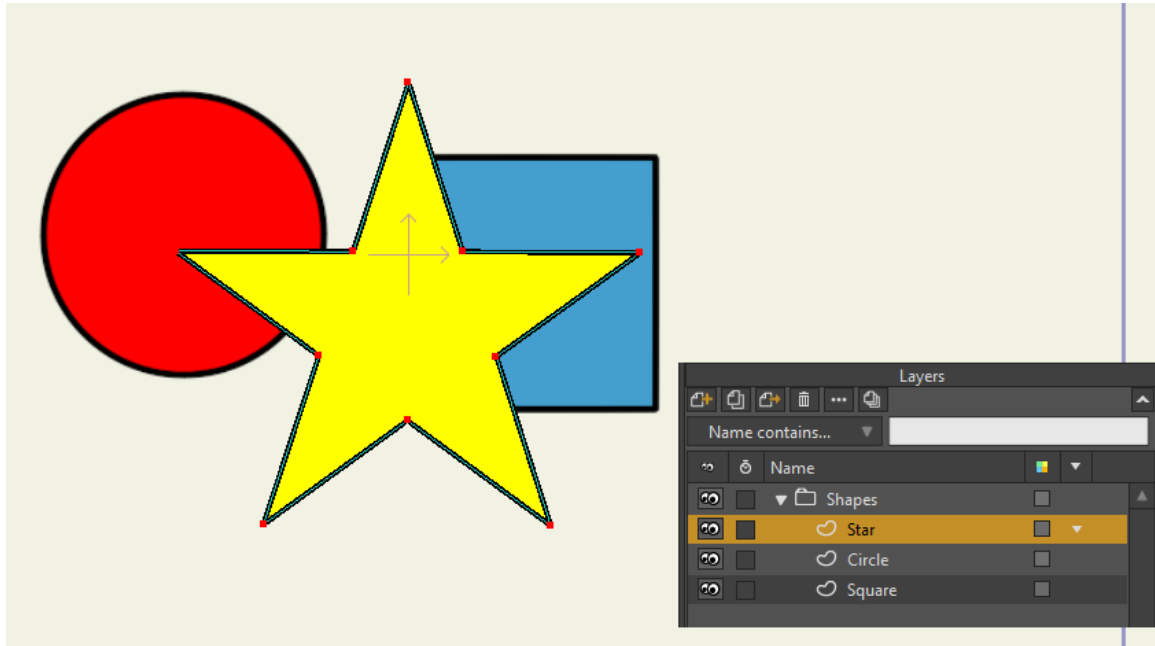
Enable Animated Layer Order in the Layer Settings dialog

4.   Advance the timeline to frame 24, and drag the Circle layer to the top layer in the group in the Layer Settings dialog. Your project should now look as follows.
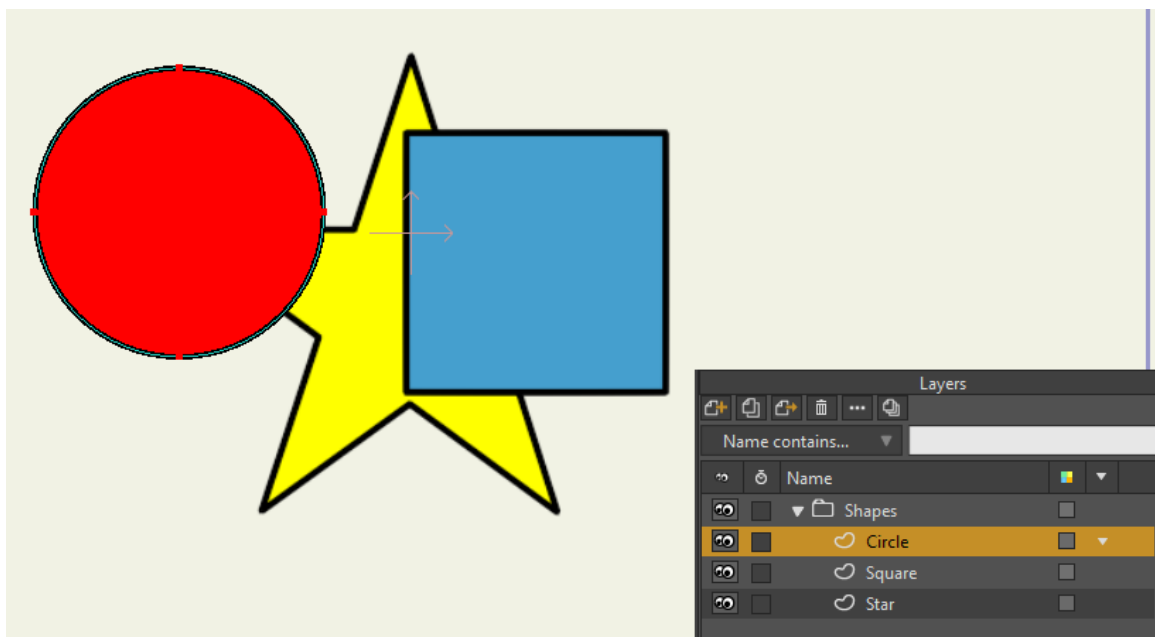
Circle appears on the top at frame 24

5.   At frame 48, move the star to the top layer as shown below.

Animation

Star appears on the top at frame 48

6. Finally, at Frame 72, move the Square back to the top as shown below.

7. Set the total number of frames in the animation to 72. The frame counter should read Frame 72 of 72.
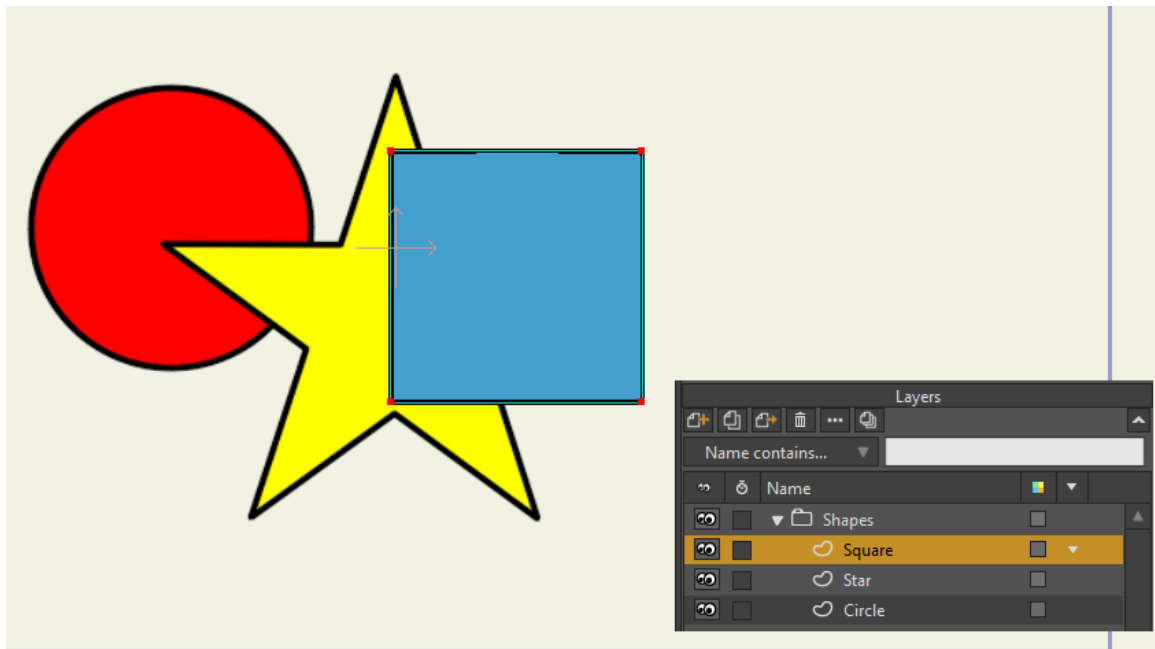
Square appears on the top again at frame 72

8. Now press the Play button. You'll see the layer order of the three shapes change over time.

Animation

Tutorial 5.6: Actions (Pro Only)

In Moho Pro, actions are little clips of animation that are associated with a layer (or group of layers). Using actions, you can create reusable animation for movements that you expect to use over and over again. In this tutorial you will learn you how to use actions.

Start With a Sample File

For this tutorial, we'll start with a project file that already has some actions set up. It's named **Tutorial 5.6** and it's located in the **Tutorials > 5 - Animation** subfolder within your custom content folder.

1.   Open the **Tutorials > 5 - Animation > Tutorial 5.6** file in Moho. You should see something like this. (Don't worry - the split-apart character is just part of the bone setup process):
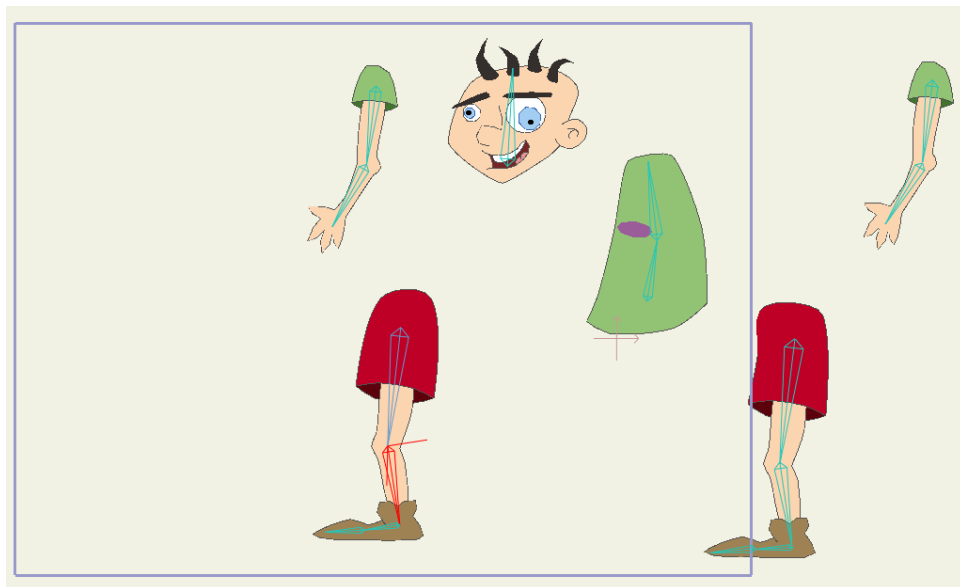
Starting point for this tutorial

2.   Let's take a look at the actions for this character. Select the **Window > Actions** menu command to bring up the Actions window. It should appear as shown below:

Each item listed in the Actions window is a clip of animation that this character can perform. The first entry in the list, **--- Mainline ---** is kind of special. **Mainline** is not an action - it represents the main timeline for the animation, the one that will ultimately be exported as your final movie.
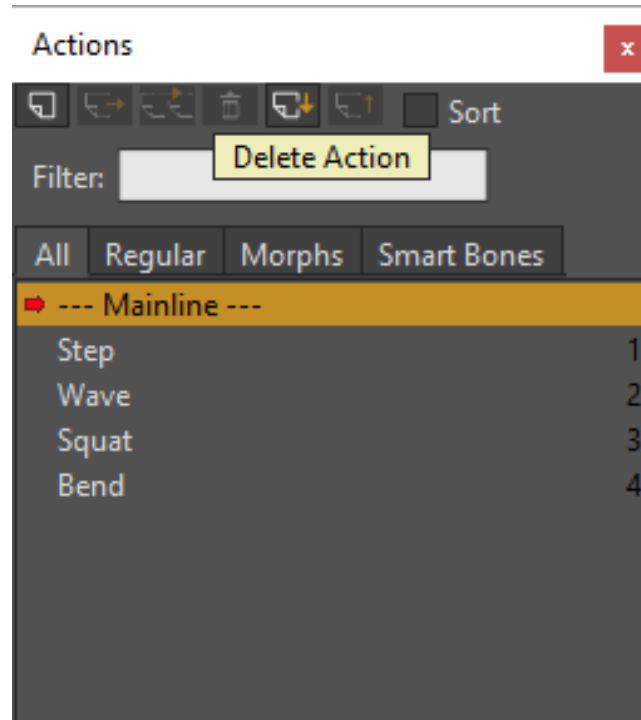
Animation

Actions for this character

3.   To view or edit an animation, double-click it in the Actions window. Let's do this now with the **Step** action. After double-clicking **Step**, a little red arrow will appear next to it in the Actions window. This indicates that Step is the currently active action.

Also notice that the Timeline window has changed. The background changed color to indicate that you're working with an action, not the main animation. Finally, some keyframes appeared in the timeline - these are the keys for the Step action.

Animation
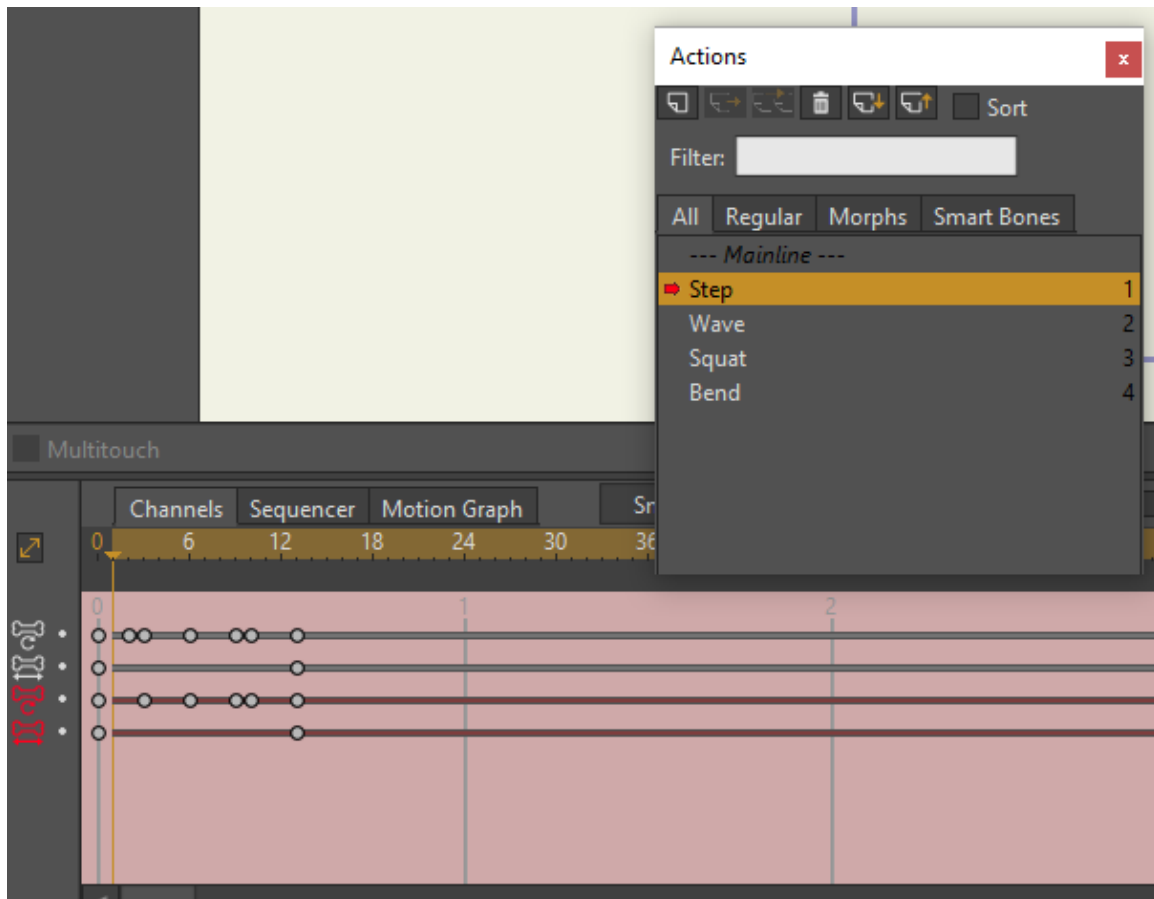
Activate the Step action

4. Press the playback button to watch this action, and stop it when you've seen enough.

5. Try playing back the other actions as well. For each one in turn (Wave, Squat, and Bend), double-click the action's name to activate it. Then, play back its motion to see the result.

6. When you've watched them all, double-click Mainline to go back to the main animation's timeline.
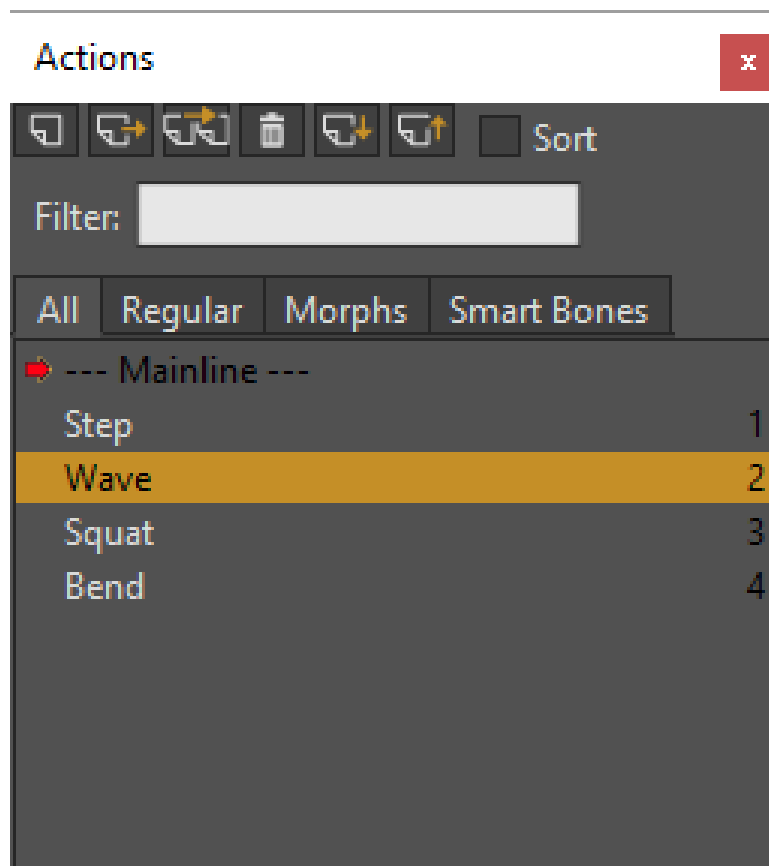
Using Actions

Now that we've seen which actions the character can perform, let's try using them in an animation.

Make sure that **Mainline** is active in the Actions window.

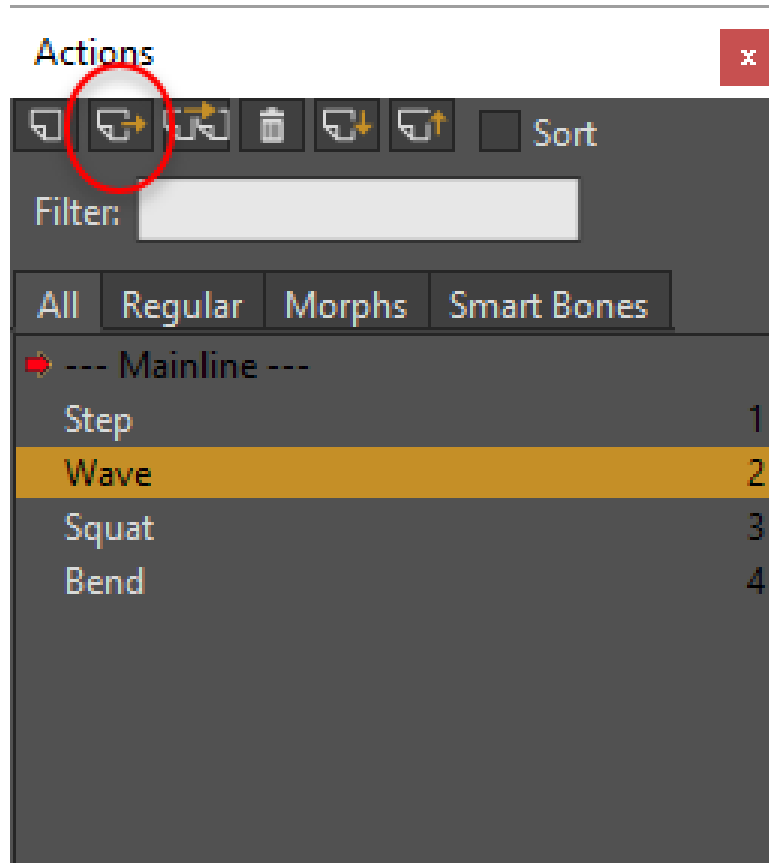1. Set the current frame to 3, and click once on the **Wave** action. Be sure to just click once - **Mainline** should still be active with an arrow next to it, and **Wave** should be highlighted:

Animation

Click once on **Wave**

2. Now that Wave is selected, we can insert it into the main timeline. Click the **Insert Reference** button at the top of the Actions window.

Animation

Inserting a reference to the Wave layer

When you insert an action by reference, Moho will use that action's motion in the timeline. If you later modify the action, those changes will be reflected in the main timeline. As you can see, the timeline has been updated to indicate that the Wave action was inserted, plus it shows how long the Wave action lasts:

Wave action inserted into the timeline

3. Actions can also be overlapped. Set the current time to frame 12.

4. Click once to select the Squat action in the Actions window.

5. Finally, click the **Insert Reference** button to insert the Squat action. Notice that the timeline now shows both actions (with the Squat action adding four channels in the timeline). Play back the animation to see how these two actions overlap.

Animation
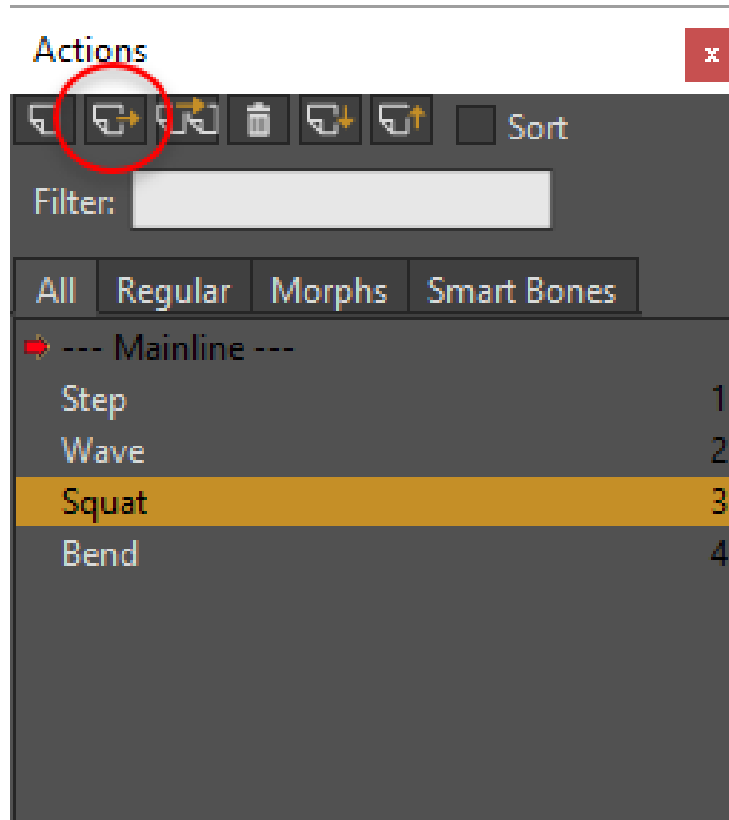
*Inserting a reference to the Squat layer*
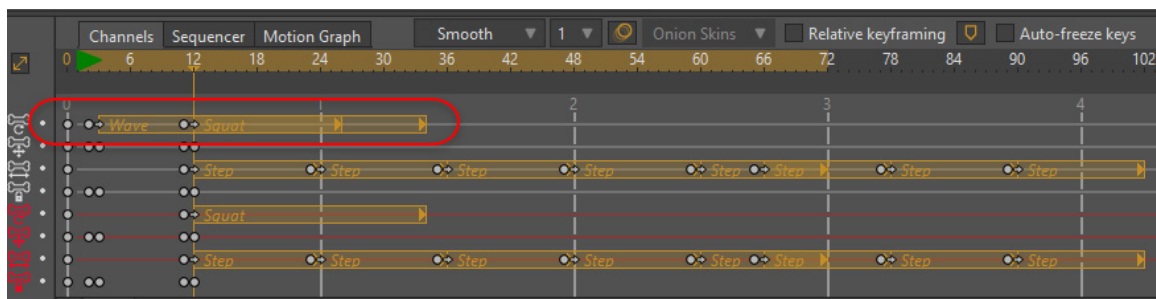
Wave and Squat actions overlapping

6. Let's overlap three actions now. Go to frame 40, and insert references to three actions: Wave, Squat, and Bend. One after another, click once on the action then click the **Insert Reference** button . Play back the animation now and see how the character performs the three actions together, starting at frame 40.

Animation
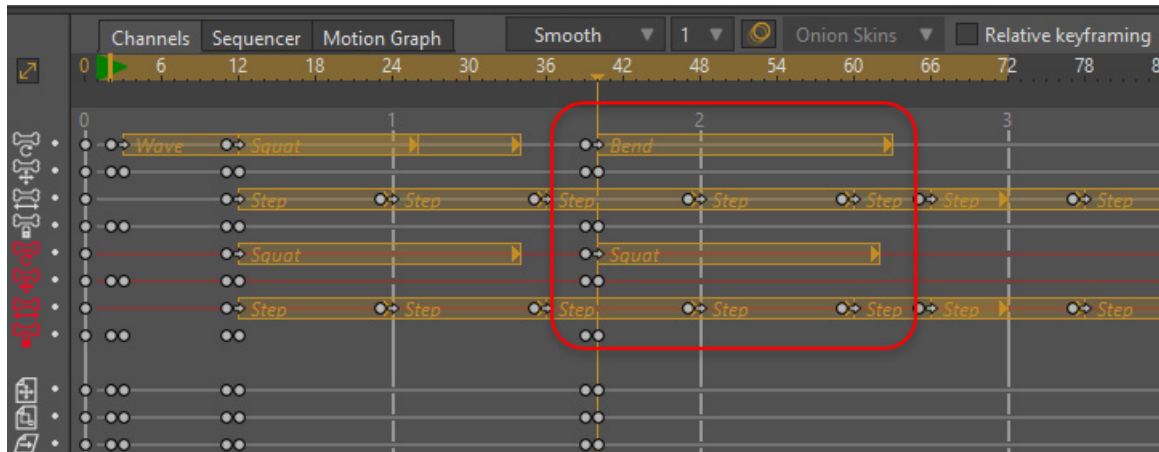
Wave, Squat, and Bend Overlapped

7. Let's try repeating an action a few times. Go to frame 66, and insert the Step action.

8. Then go to frame 78 (at the end of the first step action) and insert the step action again.

9. Do this once more at frame 90. The step action should now appear three times in sequence in the timeline:

Step repeated three times

10. The last thing we'll do is move the character off screen. Set the current frame to 66. Then select the Transform Layer tool and click inside the scene to set a keyframe.

11. Finally, set the current frame to 102, and the total number of frames to 102, then use the **Transform Layer** tool to move the character to the left off screen:

Animation
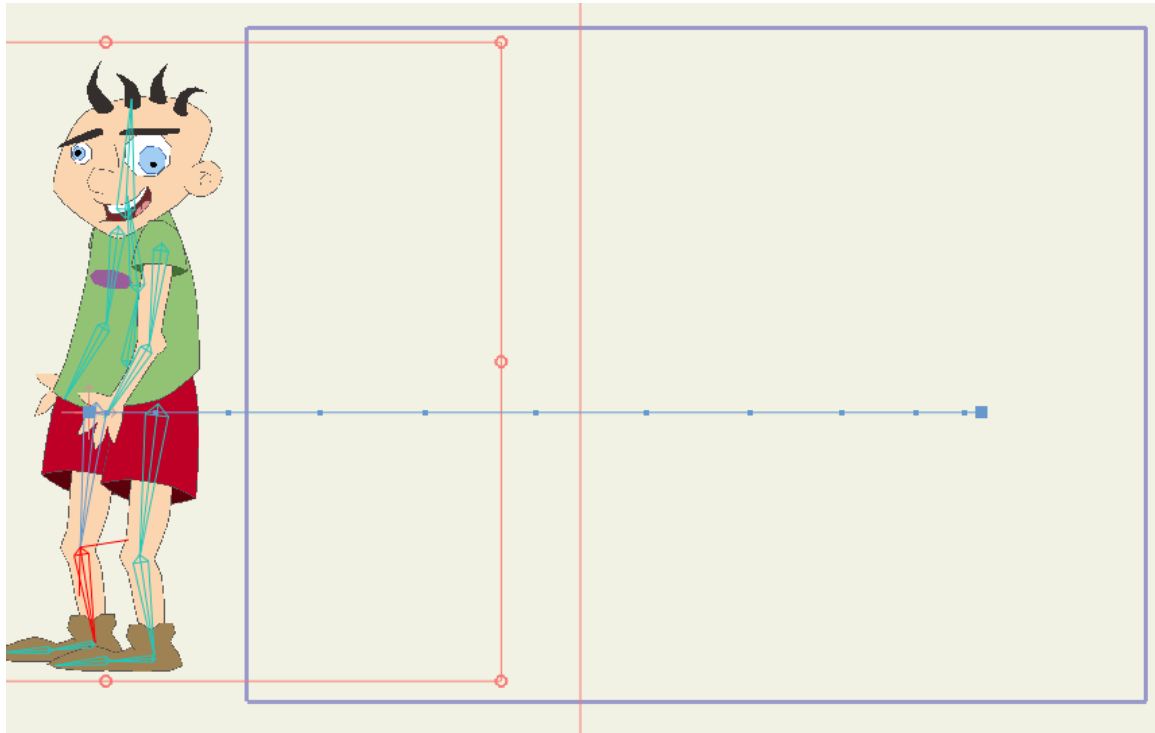
Character translated off screen

Tutorial 5.8: Creating a 3D Scene (Pro Only)

This tutorial will show you how to build and move around in a 3D scene in Moho. Moho isn't a full 3D program - layers in Moho are 2D planes that exist in a 3D space. However, by positioning these 2D layers carefully, and moving around them using the 3D camera, you can create a convincing 3D environment.

For this tutorial, we'll start with a project file that's almost finished. It's named **Tutorial 5.8** and it's located in the **Tutorials > 5 - Animation** subfolder within your custom content folder.
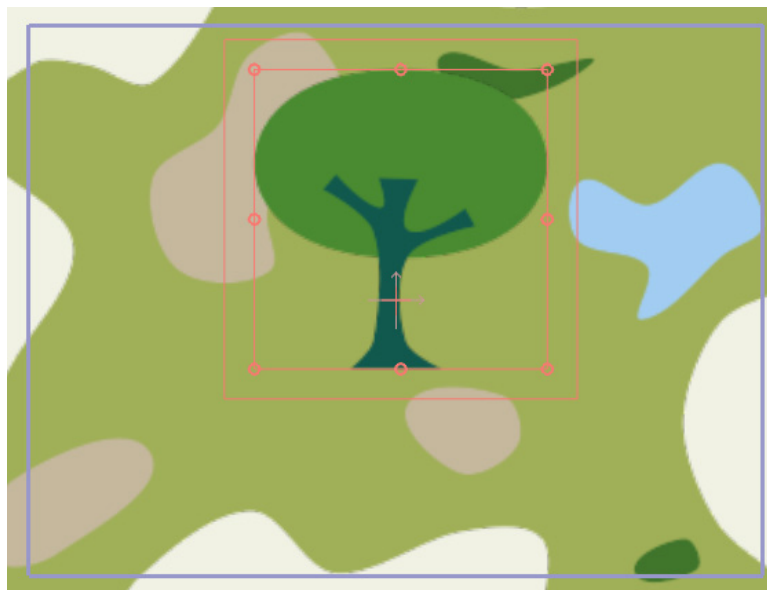
1.   Open the **Tutorials > 5 - Animation > Tutorial 5.8** file in Moho.

     This file has some simple artwork that we'll use to build a 3D scene. The layers in this file are set up as shown:
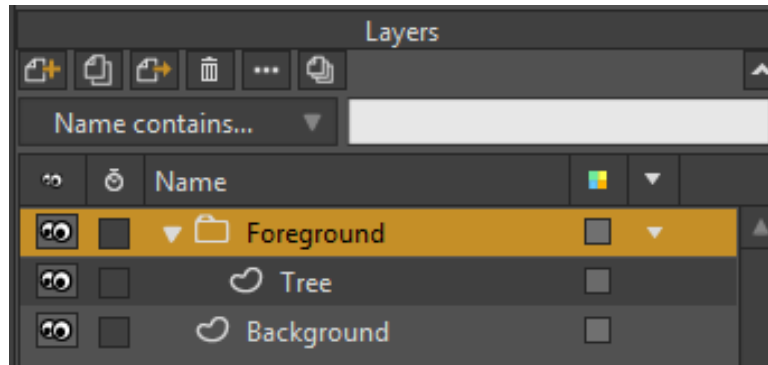
Starting point for this tutorial

The editing view should look like this to begin with:

Starting point for this tutorial

Creating a Ground Plane

The first step in creating our 3D scene is to set up the ground plane.

Select the **Background** layer - this layer has already had a simple terrain drawn onto it, we just need to position it correctly.

1. Activate the **Rotate Layer XY** tool, and in the tool options area at the top of the main Moho window, enter an X rotation angle of -90. Even though the Background layer is just a flat 2D object, it can still be rotated and positioned in true 3D space:

Adjusting X rotation

Animation

2. Next, activate the **Transform Layer** tool, and in the tool options area, enter -0.25 as the Y value:

Adjusting position

3. Finally, with the **Transform Layer** tool, enter 5, 5, 5 in the tool options area as the layer's scale values:

Adjusting scale
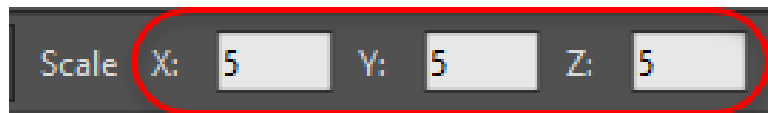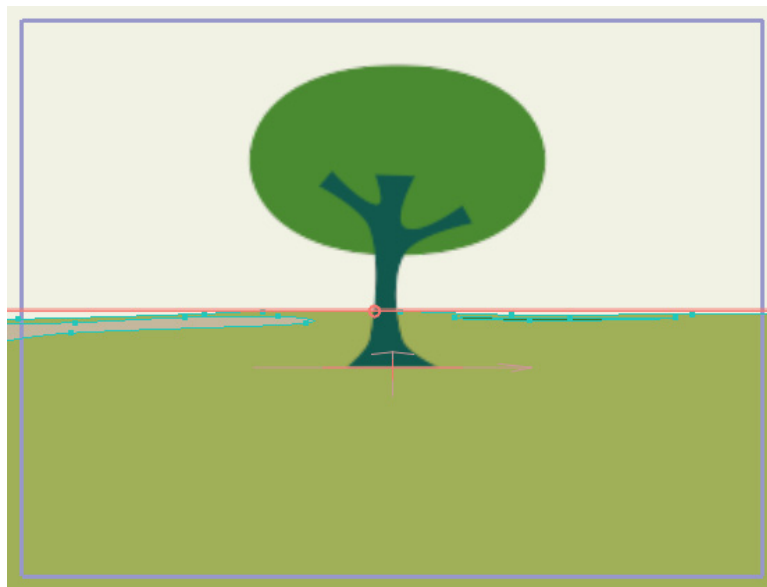
What these settings do is to rotate the Background layer so that it lies down horizontally, lower it a bit, and spread it out wide to cover a large area. Perfect settings for a ground plane. The scene should now look like this:

Ground in position

Arranging Foreground Objects

The next step is to create and position foreground objects. A simple tree has already been created for you - let's set it up in 3D.

1. Often, positioning objects in 3D can be easier done from an overhead view. Use the **Orbit Workspace** tool to rotate the view of the scene so that it looks something like this (partial view shown).

2. (Notice the little blue wedge in the scene - this represents the camera.)

Animation
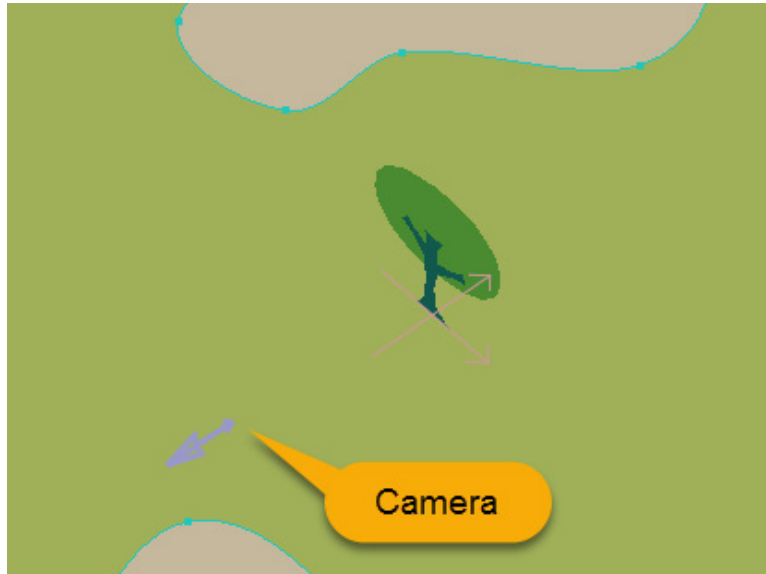
View from above

3. Now select the **Tree** layer, and make the **Transform Layer** tool active. Double-click the Tree layer. The Layer Settings dialog opens.

4. In the Options section of the General tab, select the **Rotate to face camera** popup and choose **Pivot Y Axis** (you'll see why this is important later).
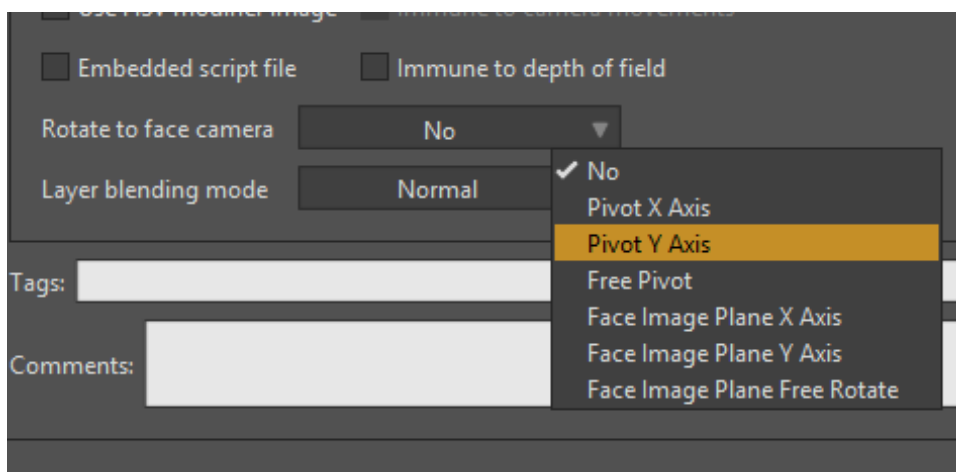
Layer Settings options

5. With the Transform Layer tool selected, in the tool options area, set the Position X value to -3.25, and the Z value to -2.25. The tree will be moved to the far corner of the scene:

Animation
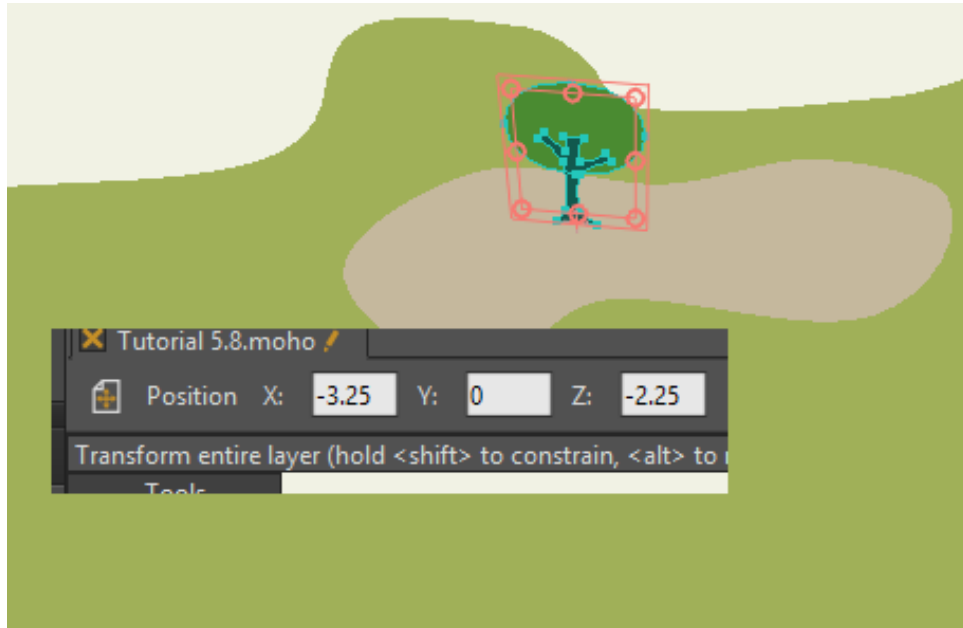
Moving the tree

6. OK, that's one tree - now add several more. In the Layers window, click the Duplicate layer button to duplicate the Tree layer, and set new values for the X Position and Z Position. Any values for X and Z Position will do, as long as they're roughly in the range between -3 and 3.

7. Repeat the process several more times, just scattering trees across the landscape. Keep going until you've created about 12 more trees. Position them all over the place - close to the camera, far away, behind it, etc. When you're done you should have a small forest:

Now the reason for the **Rotate to face camera** checkbox may be clear. The Tree layer (and all of its duplicates) automatically turns to face the camera - notice how each tree is turned in a slightly different direction. This makes sure the camera always has a full view of that layer. This may not always be what you want, but for scenery objects, it can be a good trick, especially when the camera starts moving.

Animation
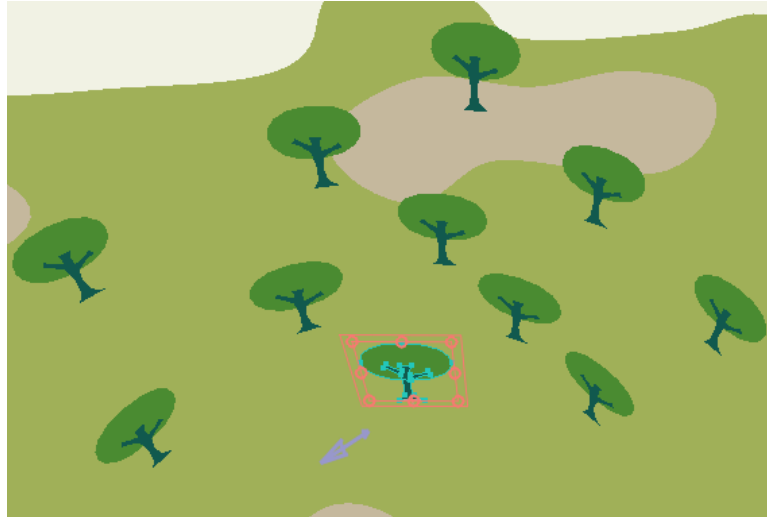
A forest

> (m) *Here's a trick: if you have a mouse with a scroll wheel, instead of typing in numbers for the X and Z values, try holding the mouse over those text fields and turning the wheel. The value in the field will change, and you can watch the layer move - just keep turning the wheel until the layer is where you want it.*

8.   The last step to finish off the forest is depth sorting. Double-click the **Foreground** group layer. In the Layer Settings dialog, click the **Depth Sort** tab. Turn on the **Sort layers by depth** checkbox and click OK. Now all the tree layers in this group will be sorted according to their distance from the camera.

Moving the Camera

Now that we've got a filled-in scene, lets take a tour.

Select the **View > Reset** menu command. You are now looking at the scene from the camera's point of view:

Animation
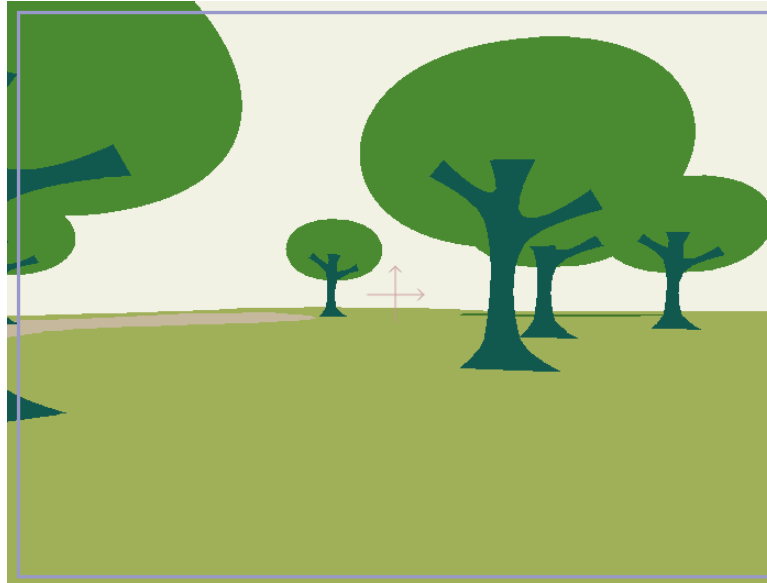
Camera view

9. Set the current frame to 48 and activate the **Track Camera** tool. While holding down the **Alt** key, click and drag downward in the editing area. (The **Alt** key tells the Track Camera tool to move the camera forward and back.). Keep dragging downward until you've moved forward almost to the edge of the ground layer.

Forward movement

10. Now activate the **Pan/Tilt Camera** tool. Hold down the **Shift** key and drag to the side to turn the camera around. (The **Shift** key prevents you from rotating the camera up and down.) It doesn't matter where you turn to - just point the camera in an interesting direction:

Animation

Pan/Tilt Camera Tool - Turn the camera.

11. ▨ Set the current frame to 96, and use the Track Camera tool to move forward again (be sure to hold down the **Alt** key to move forward).

12. After moving forward, turn the camera in a new direction with the Pan/ Tilt camera tool (be sure to hold down the **Shift** key). Continue this process (advance the current time, move forward, and turn the camera) as much as you want, taking a little tour of your 3D scene.

13. When you've moved around as much as you want, try playing back the animation. While playing back the animation, use the **Orbit Workspace** tool to view the scene from above.

14. There are two things to notice here:

   ▪ First, if you activate the Track Camera tool again, the path of the camera is visible when viewing the scene from above. If the path is not visible, check the **Show Path** option in the Track Camera tool status bar. This can be useful when planning out camera moves.

   ▪ Second, watch how the trees turn during the animation to always face the camera. That way, the camera never catches an edge-on view of any tree, which would kind of spoil the 3D effect.

Animation
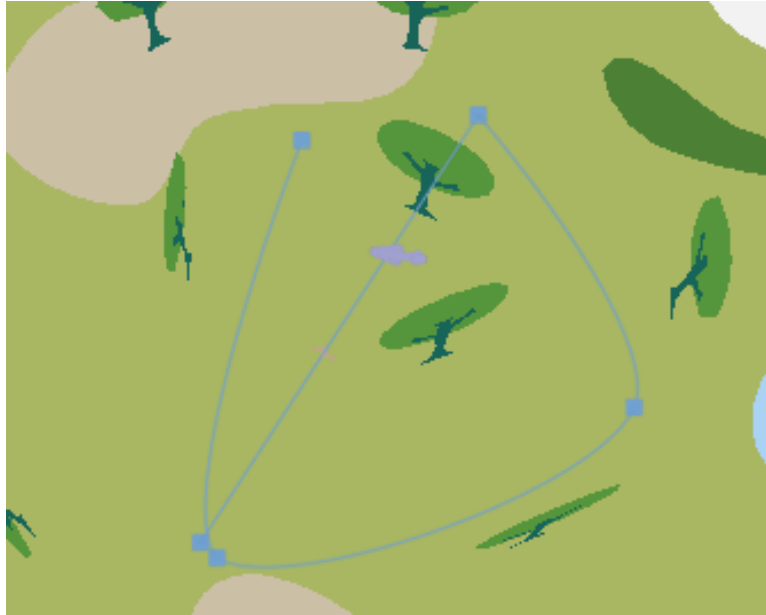
View from above

Feel free to experiment with more camera moves, or to add objects of your own to the scene.

Tutorial 5.9: Basic Physics (Pro Only)

Moho features a physics engine that allows objects to collide with and bounce off of each other.

๗. *Physics will only work with objects that are filled.*

Creating the Objects

A Moho project can contain objects that **are not** affected by physics, as well as objects that **are** affected by physics. The deciding factor between the two types of objects is a group layer that holds the objects that physics are applied to. Any objects not contained within this group are unaffected by the physics properties.

In the first steps in this tutorial, you'll create a base object Group layer that holds three objects, on three different layers.

To create a physics simulation,

1. Create a new project. Add a new Group layer in the Layers window. The new layer will be named Layer 2.
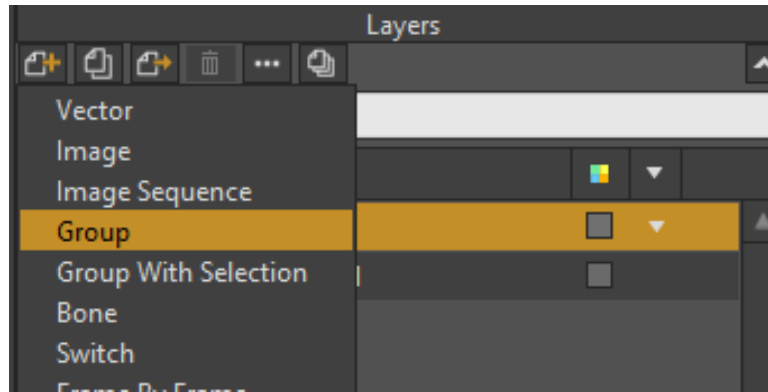
Create a new Group layer (Layer 2)

2. Drag the existing Layer 1 into the new group layer. On this layer, use the Add Point tool with the Sharp Corners option checked to create a base shape that the physics objects will collide with.
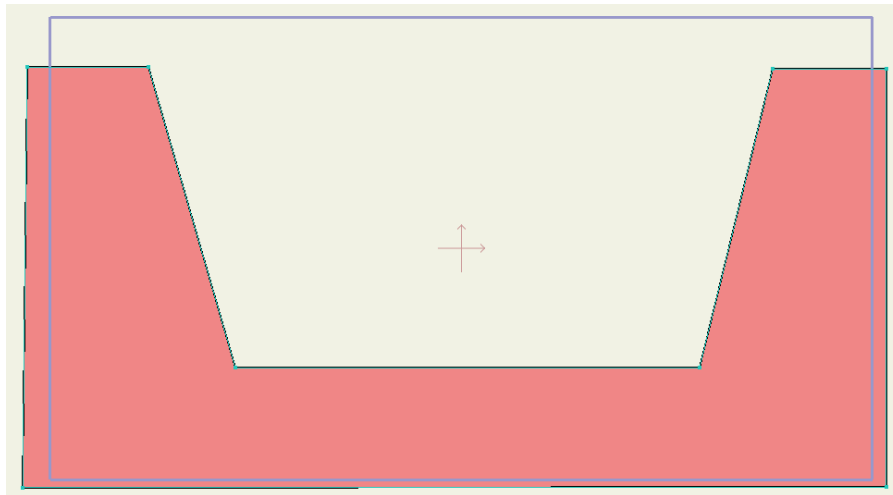
Create a Base object in Layer 1 and drag it into Layer 2

3. With layer 1 selected, add another vector layer (which will be named Layer 2 by default - rename it **Layer 3**). It will automatically be added to the Group layer. Use the Draw Shape tool to draw a circle on this layer. This will be one of the shapes that collide with Layer 1.

4. Add another vector layer (Layer 4) to the Group layer, and create a rectangle with the Draw Shape tool on this layer.

Animation
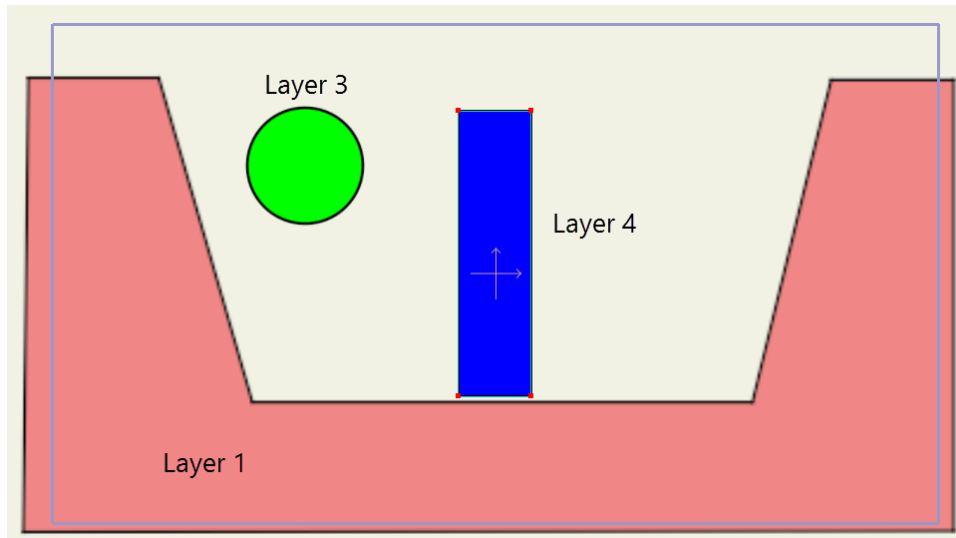
Three objects in the Group layer

Enabling Physics

You now have a scene with a group that contains three objects: a base object, and two additional objects that will bounce against it. The first thing you need to do is enable physics in the Group layer that holds these objects.
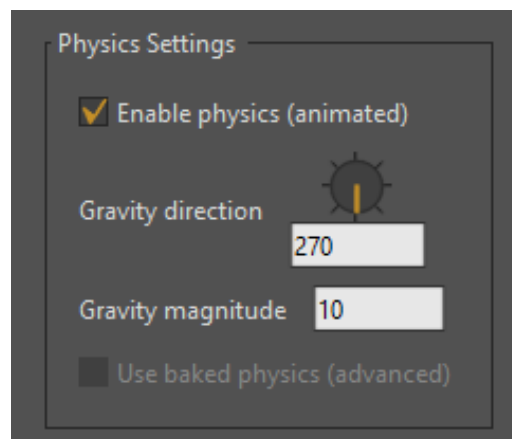
Select the Group layer (Layer 2) and open the Layer Settings dialog. Click the Physics tab to display the following settings:

Enable physics for the Group layer

- **Enable physics**: Check this option to turn the physics simulator on.

- **Gravity direction**: Use the directional slider to point to the direction from which gravity is originated. By default, the direction is straight down (270 degrees). 0/360 degrees is at the 3:00 position of the dial.

- **Gravity magnitude**: Controls the strength of the gravity. Lower values make the gravity less forceful (objects are lighter) and higher values make the gravity more forceful (objects are heavier).

Animation

5. Click OK to close the Layer Settings dialog. Your group layer is now configured to use physics

Creating a Collision Base

After you enable physics in the Group layer as described in the previous section, your next step is to assign one of the objects as a stationary collision base for the others to collide against. Otherwise, the gravity in the Physics engine will cause all of the objects to drop off the screen.

6. Select the base layer (Layer 1) in the Group layer. This is the object that the other objects will collide against. Open the Layer Settings window to the Physics tab. You will see the following settings:

   - **Enable Physics**: This option should automatically be turned on if it is in a Group layer that has Physics enabled. If you uncheck the option, physics will not work on the current layer.

   - **Non-moving object**: Check this option to make the current layer stationary. When this option is checked all of the other options in the Physics tab become disabled

7. Click OK to return to the scene
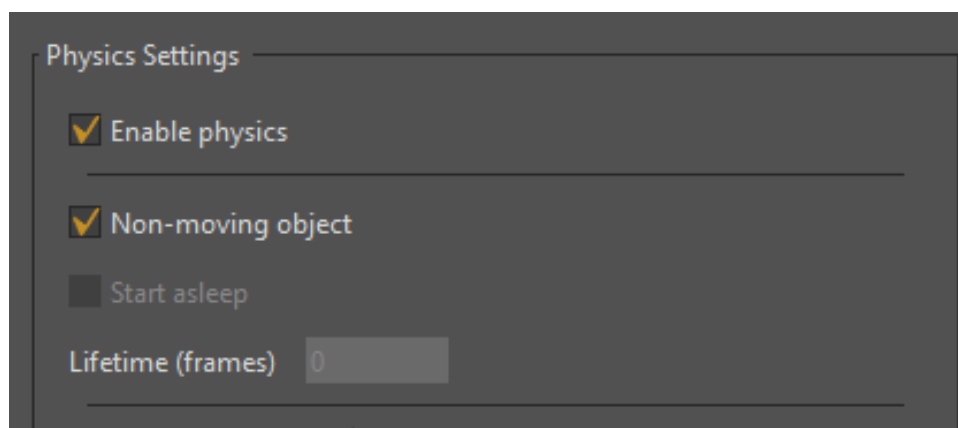
Check the Non-Moving Object option to create a stationary base object

Configuring Physics Objects

After you create one or more stationary objects, you then configure the properties for the other objects that will bounce against them. In the case of the scene that we have created, these objects are the circle and the rectangle. Start with the circle first, and then the rectangle, and proceed as follows

1. Select the circle layer (Layer 3) inside the Group layer. Open the Layer Settings window to the Physics tab. You will see the following settings:

Animation
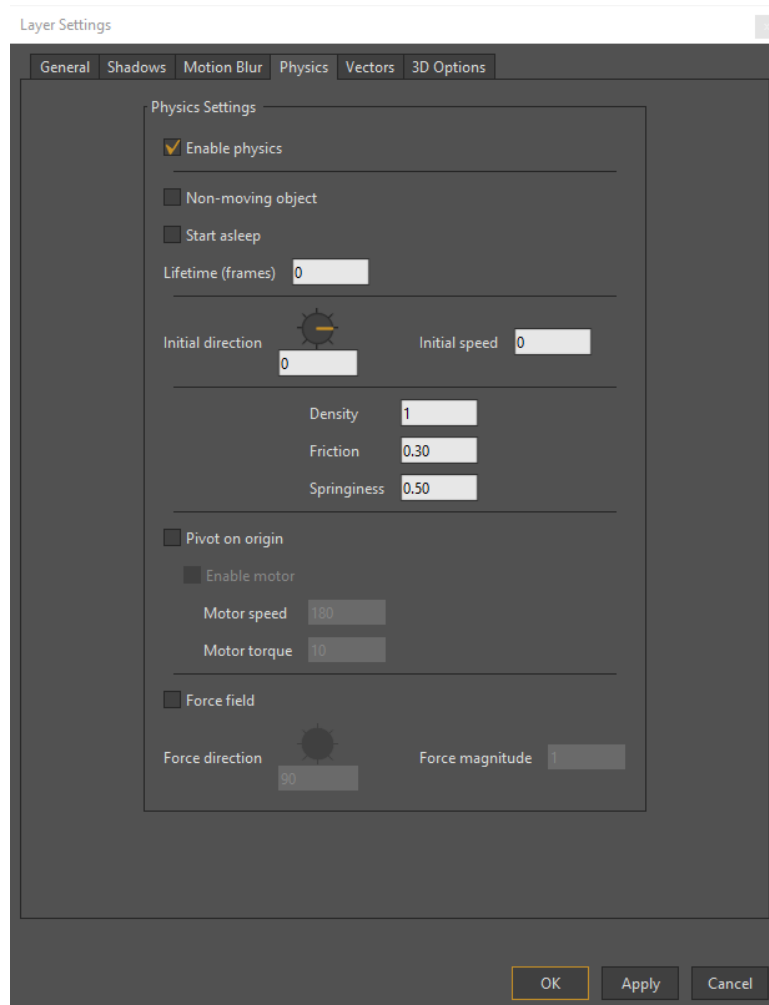
Physics Settings for Non-Stationary objects

- **Enable Physics**: This option should automatically be turned on as described in the previous section.

- **Non-moving object**: Leave this option unchecked for the circle and rectangle layers.

Leave the remainder of the settings at their default values for the circle and rectangle layers. The functions of the additional settings follow.

- **Start asleep**: Check this option if you want an object to stay still until something else bumps into it. To demonstrate how this works, compare two versions of the project.

- **Lifetime (frames)**: A physics object will fall, bounce around, etc. for the duration of its lifetime (number of frames). After that time, it will be sent back to its initial starting position, where it will start bouncing around again. A lifetime of zero means the object will never be sent back to its starting point. The Lifetime setting is useful for something like a hillside of falling boulders. Instead of creating hundreds of boulders, you can create a dozen or so and set the lifetime to the length of time it takes for the

Animation

boulders to fall from the top of the hill to the bottom. If the top and bottom of the hill are offscreen, this will look like an endless number of boulders falling down the hill.

- **Initial direction**: Works in conjunction with the Initial Speed setting below. If given an initial speed of something more than zero, a physics object will start flying out in the designated direction at the specified speed.

- **Initial speed**: Controls the speed at which physics objects move in the designated direction. Faster speeds allow you to create objects like bullets, rockets, etc.

- **Density**: The default Density setting is 1. Decrease this setting to make objects more responsive to collisions. Increase the setting to make objects less responsive to collisions.

- **Friction**: A contact force between two surfaces that controls how much they slow each other down when they touch. High friction objects (like a brick sliding on concrete) will generally slow down faster than low friction objects (blocks of ice).

- **Springiness**: When two objects collide, their springiness values define how much they will bounce apart. A basketball bouncing on a floor would have a high springiness value, while a stick of butter would have a low springiness value.

- **Pivot on origin**: This option sets an axle around the object's origin point. When another object collides with an object that is set to pivot, the object will spin around its origin rather than topple over.

- **Motor speed**: Works in conjunction with motor torque, which follows. The motor speed is the number of degrees per second the object will rotate (it can be negative to rotate backwards). Depending if the object bumps into obstacles or there are other influences, it may not actually rotate at that speed, but in a zero gravity setup with no collisions, that will be the speed of rotation.

- **Motor torque**: Motor torque controls the strength of the motor. With low torque, when a motorized object bumps into other objects it may come to a stop, depending on the size and density of the obstacles. With a high torque, it will tend to push obstacles out of its way. Even with no obstacles, if a motorized object is unbalanced (off center of its origin), a low torque setting may mean that it can even lift itself up.

2. Press Play to see what happens. The circle falls straight down and stops at the ground.

3. Rewind the project to frame zero, and use the Transform Layer tool to move the circle so that it is just above the left pillar of the collision base, as shown in the following figure. Also position the circle so that the bottom center is past the edge of the column.

Animation
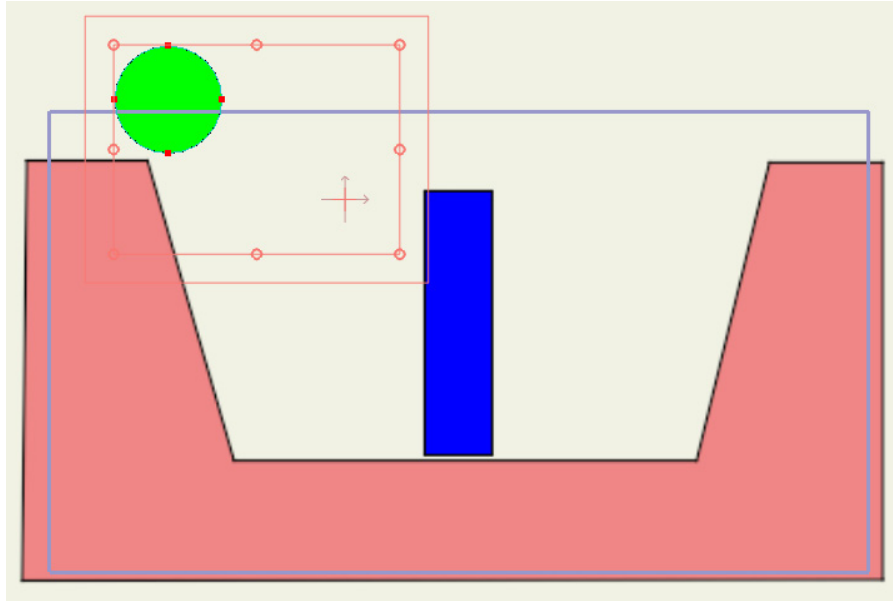
4. Press the Play button again to observe how the circle moves. This time, it should collide with the rectangle, and the rectangle will respond to the collision.

5. Experiment with additional settings to learn more about how they affect your objects.

Additional Comments

You can also apply physics to bone layers. The physics are applied to the region of influence of the bone. See **"Bone Physics (Pro Only)" on page 101 in your Moho Users Manual**.
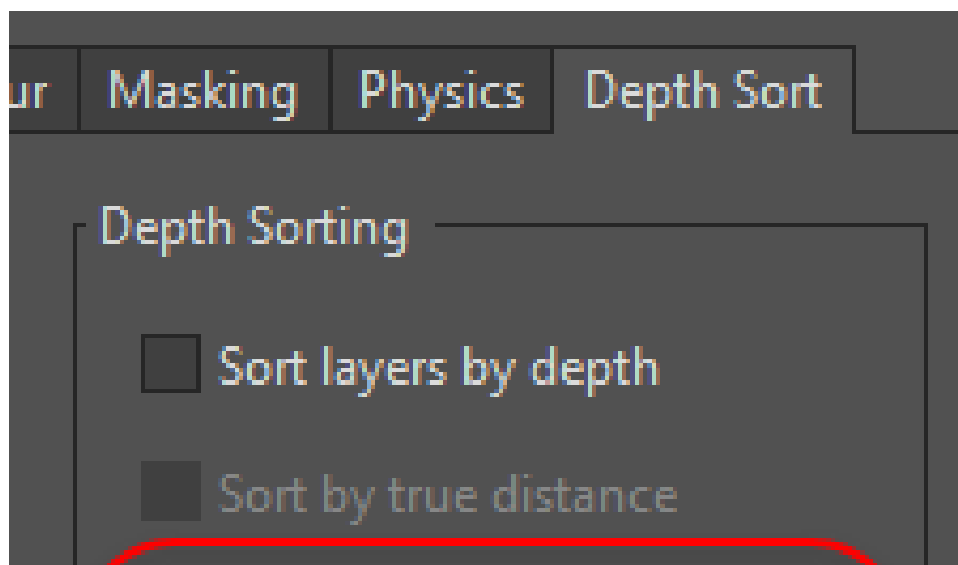
Animation

# Tutorial 5.10: Using Frame by Frame Layers for Animation (Pro Only)

Moho offers additional features that make frame by frame animation much easier. In this tutorial you'll create a similar inchworm animation using the new Frame by Frame Animation Layer features found in Moho.

There are two different ways that you can create frame by frame animation layers:

- After you create a switch layer and place a vector layer inside of it, double-click the switch layer to open the Layer Settings dialog. Select the Switch tab, and check the Frame-by-frame drawing option. Now the Switch Layer knows that it is being used for frame by frame animation.

- Or, from the menu in the Layers window, choose Frame by Frame to create a new Frame by Frame layer. This accomplishes the above method in a single step. Moho creates a new switch layer, sets it up for frame by frame animation, and places the first vector layer inside of it. You'll use this method in the tutorial that follows.

To complete this tutorial, follow these steps:

1. Choose **File > New** to create a new Moho project.

2. In the Layers palette, choose **Frame By Frame** to create a new Frame by Frame layer. Name the new layer **Inchworm**. When this layer is selected, all of the drawing tools become available. You will not need to expand the Inchworm layer and draw on the individual frames while you are working in a Frame by Frame Animation layer. You'll also see some new controls above the timeline. From left to right, these controls are used to **Add** a frame, **Delete** a frame, or **Duplicate** a frame. You can also enter a frame by frame advance interval, if desired, to represent the number of frames that you want to advance in the timeline each time you add a new frame.
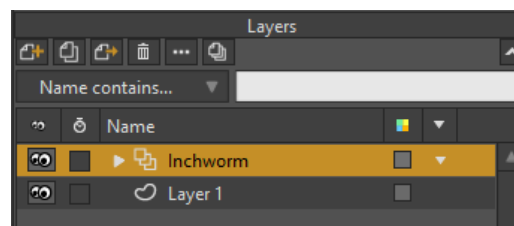

Create a Frame by Frame animation layer named Inchworm
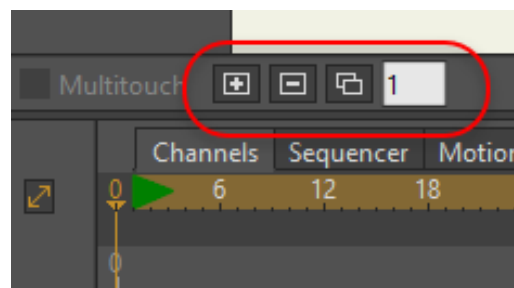
Frame by Frame controls in the timeline toolbar: Add frame, Delete frame, duplicate frame, and advance interval.

Animation

> ⓜ *You can use shortcuts to accomplish the same functions as the Frame by Frame controls in the timeline toolbar. Press **F5** to add a new frame/layer, **Shift+F5** to delete one, and **F6** to duplicate the current frame/layer and advance to the next frame.*

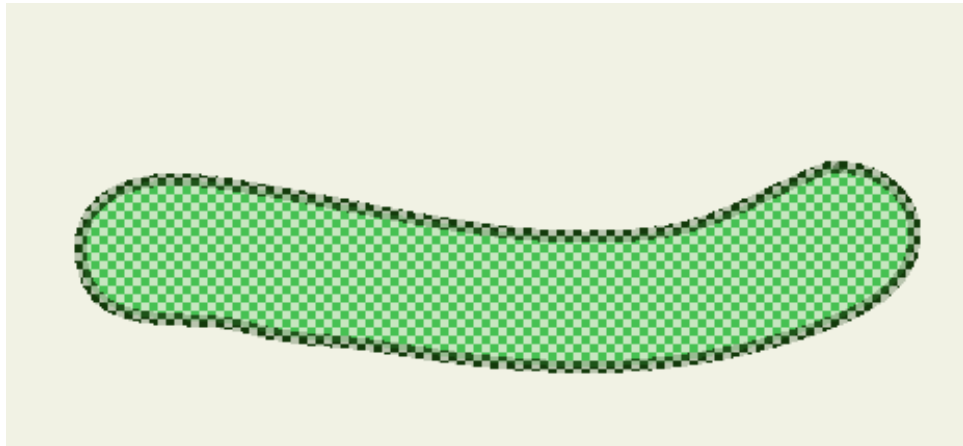3.   Select the **Blob Brush**. Set the brush radius to **.13**.
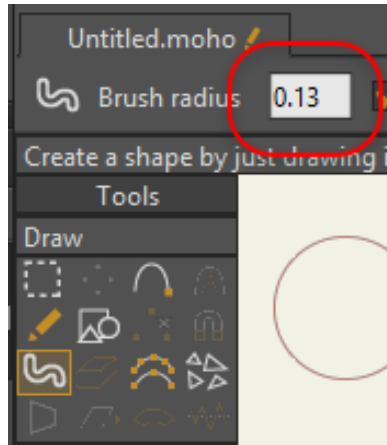
Set Blob Brush radius to .13

4.   From the Style window, select a medium green for a fill color, and a dark green for the stroke color. Set the stroke width to 10.
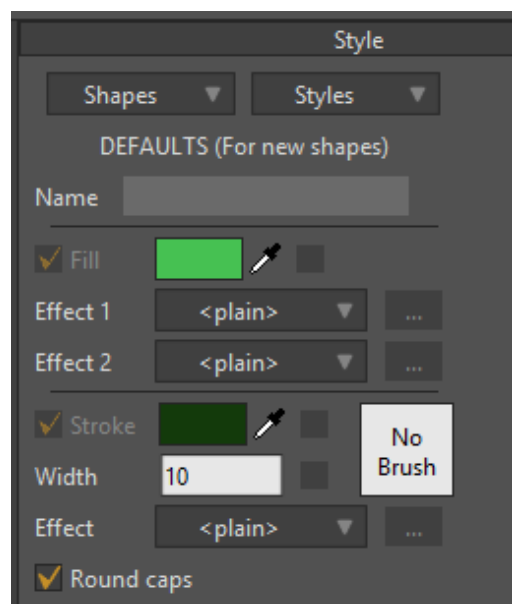

Choose a green fill color, dark green stroke color, and set stroke width to 10

5.   On Frame 0 (Layer 1), draw an inchworm that is almost flat to the ground.

Animation

First layer of inchworm

6. Press F5 to create a new frame/layer to the Inchworm switch layer. This will also advance the time by one frame

7. Turn on the Onion Skin feature by clicking the Enable Onion Skins button in the toolbar area above the timeline. This will allow you to see the outline of the previous frame.
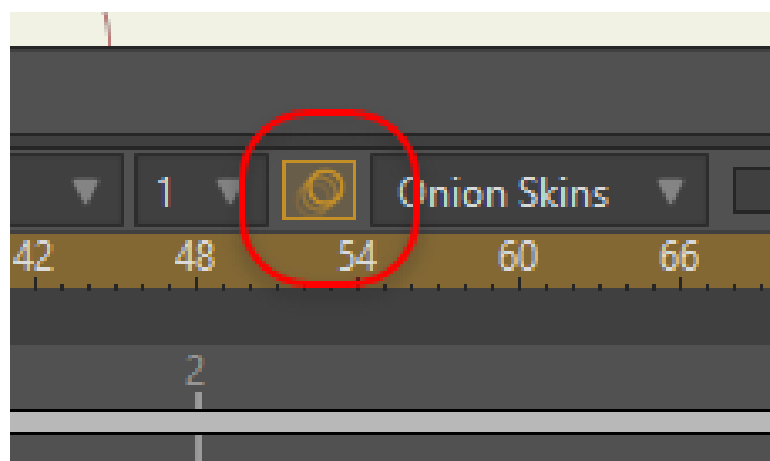

Enable Onion Skins so that you can see the outline of the previous layer

8. Now on Frame 1 (Layer 2) draw another inchworm that is raised in the middle, remembering to also consider that its length is shorter due to volume. The second frame should look something like the following figure.
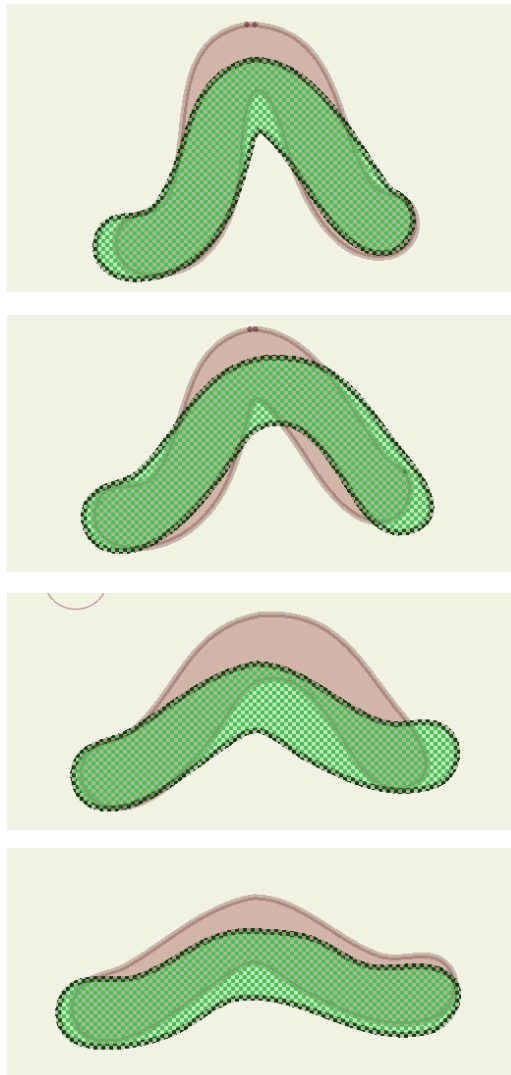
Animation
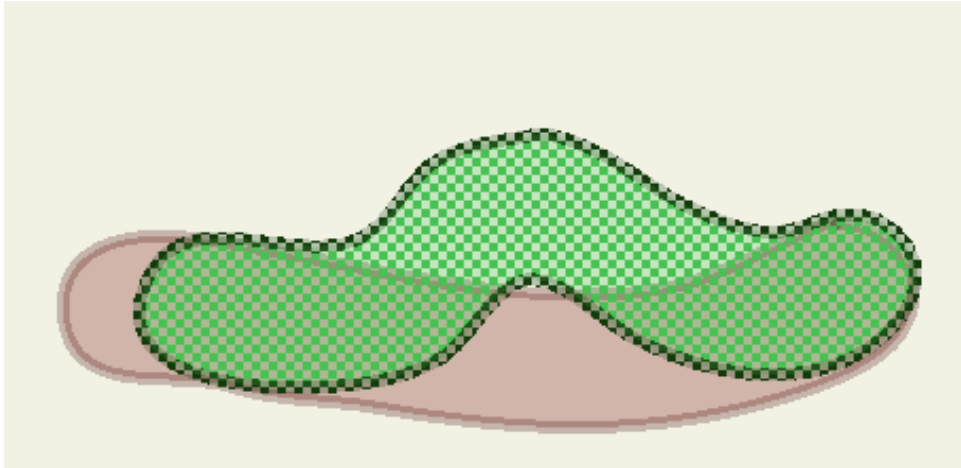
Second layer of the inchworm

9. Press F5 again and draw another version of the inchworm that has its middle raised a little more. Repeat this a few more times, drawing successive inchworms on Frame 2 (Layer 3), Frame 3 (Layer 4), and Frame 4 (Layer 5). The examples of each are shown below.
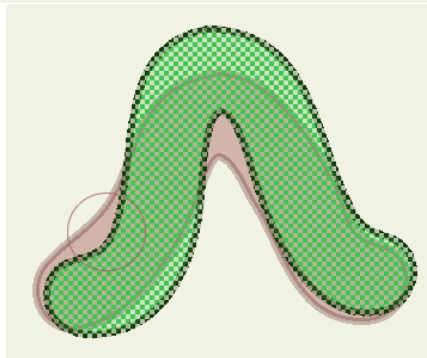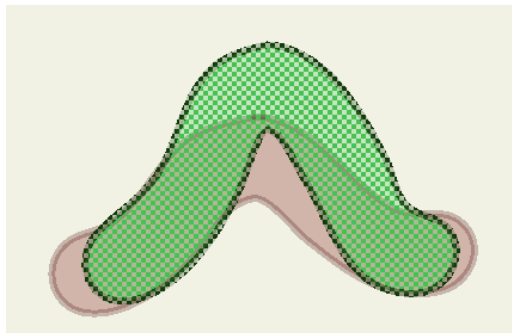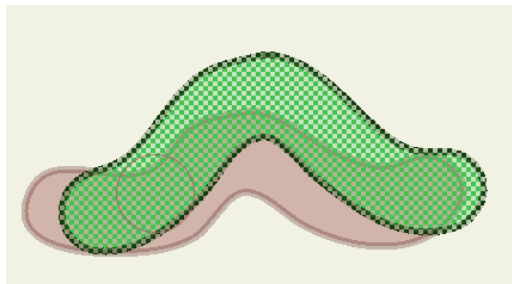
Third, fourth, and fifth layers of inchworm

Animation

10. In frames 5 through 8, you will create frames that move the inchworm back toward the flat to ground position. Again, press F5 as you advance through Frame 5 (Layer 6), Frame 6 (Layer 7), Frame 7 (Layer 8) and Frame 8 (Layer 9). Examples of each layer are shown below.


Sixth, seventh, eighth and ninth layers of inchworm

If you expand the Inchworm layer at this point, you will see Layers 1 through 9 in the Inchworm Frame by Frame Animation layer. After looking at the layers, collapse the Inchworm layer again and keep it selected for the following steps.

11. Now you can go back with the Freehand tool and add the details to the layers that are already there. Select the Freehand tool from the Draw tools. Verify that the following options are selected:

- **Auto Weld**: On
- **Trim Start**: Checked
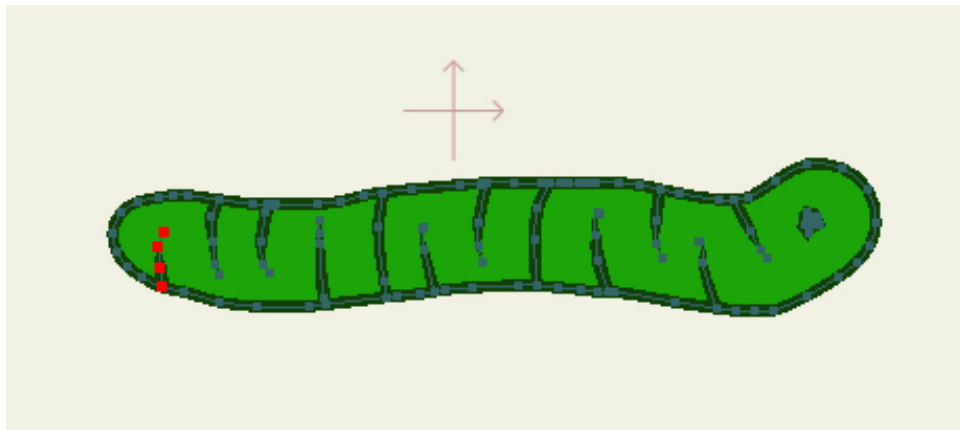- **Trim End**: Checked
- **Auto Close**: Unchecked

Animation

- **Auto Fill**: Unchecked
- **Auto Stroke**: Checked
- **Merge Strokes**: Checked
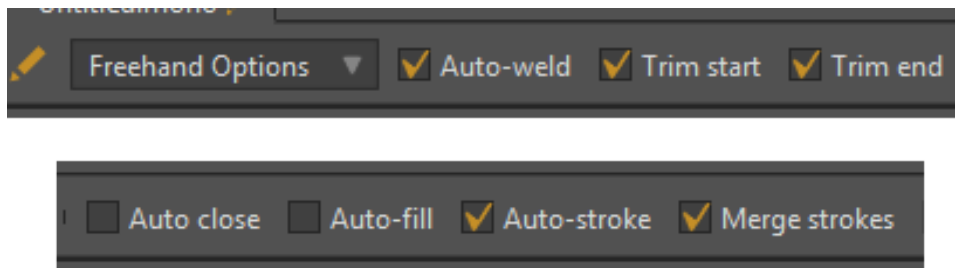
Freehand tool options

12. Return to Frame 0 in the timeline and add your details to the layer, similar to the following figure.


Add details to the first inchworm layer, then add similar details to the other eight layers

13. Now move to Frame 1 to add similar details in that layer. Continue on, adding the details to the remaining frames in the Inchworm Frame by Frame layer (make sure to include the last layer, Layer 9, which appears on Frame 8).

> *If you find the onion skin outlines too distracting, you can turn them off in the toolbar above the timeline.*

14. Now you can use any of Moho's standard retiming tools to change the timing if it moves too fast for you. For this project, choose **Animation > Rescale Keyframes**. In the Rescale Keyframes dialog, check the Rescale entire document option, and then enter 16 in the New End Frame field. This will cause the animation to move at half its current speed.
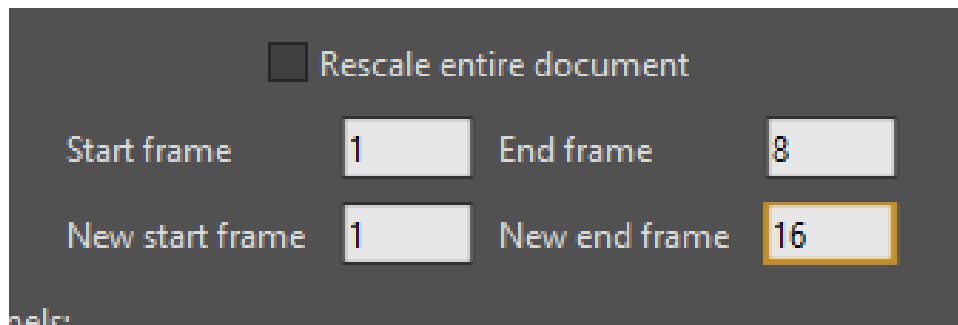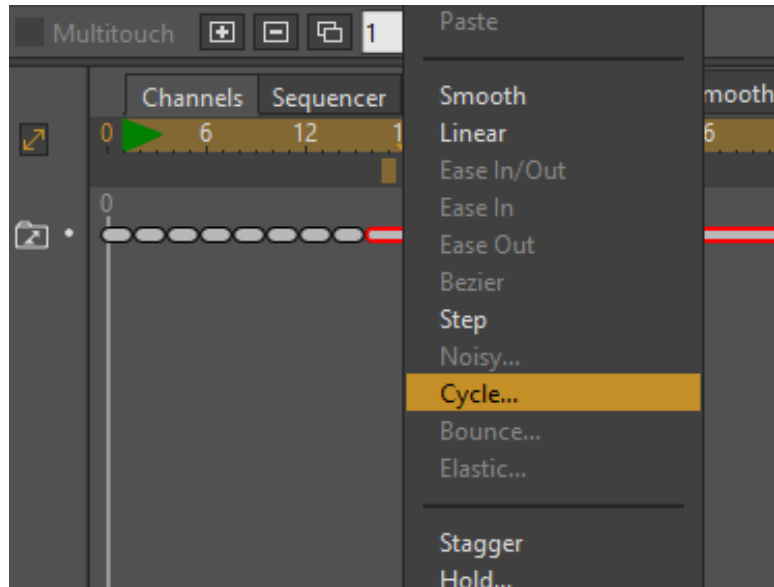
Animation

Rescale the keyframes to make the inchworm move slower

15. Now click Frame 18 to make it the current frame. Choose **Animation > Add Keyframe**. Moho will ask you if you want to add keyframes to the sublayers too. Choose **Yes**.
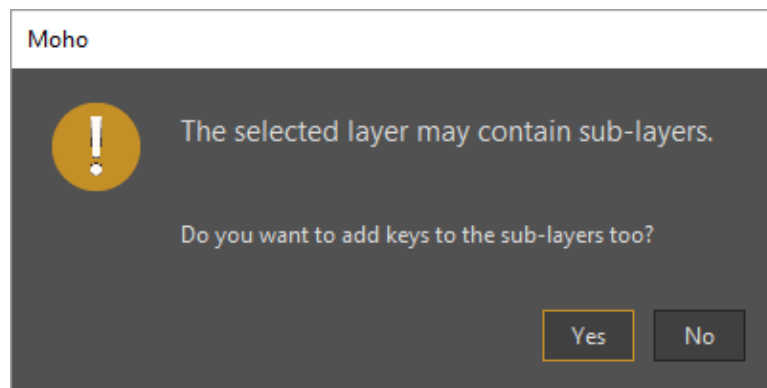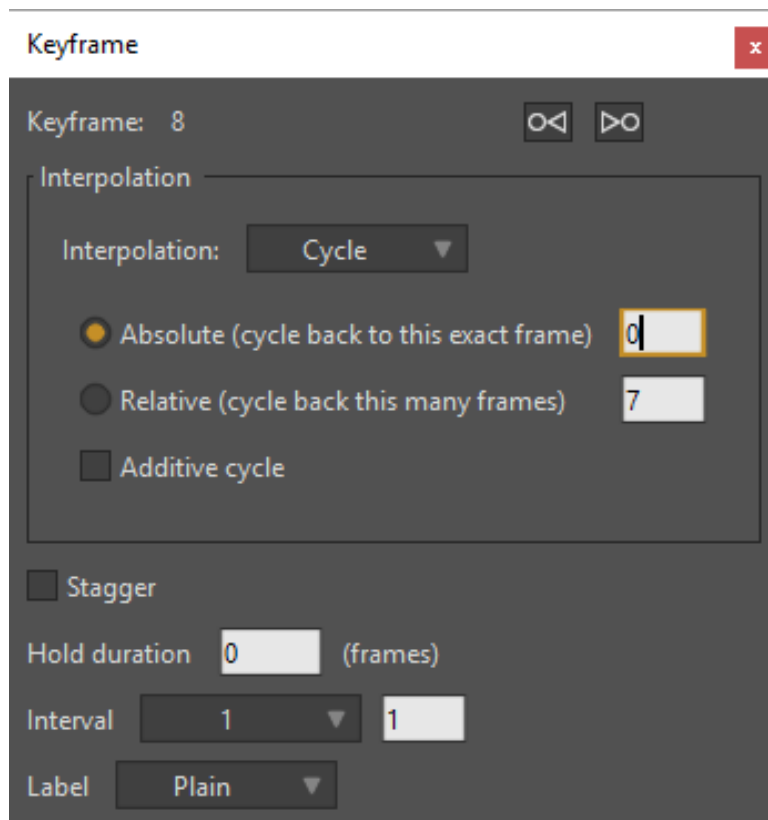

Add keyframes to the Inchworm layer and sublayers at Frame 18.

16. Now select the keyframe at Frame 18. Right-click again and choose **Cycle**. The default option is **Absolute** and it is set to cycle back to frame 1. Instead, change the value so it cycles back to **frame 0**. Then exit the dialog.

Animation

Cycle keyframes at frame 18.


Cycle Frame 18 back to Frame 0.

17. Press the **Play** button to watch your Inchworm crawling on the screen. Your inchworm animation should be similar to the following.

18. Save the project under a filename of your choosing. A finished version of the project is included in your User Content folder as **Tutorial 5.10 finished.moho**.

Animation

Tutorial 5.11: Animated Shape Ordering (Pro Only)

In "Tutorial 2.5: Shape Ordering" on page 68 you learned the basics about how to select and move shapes above or beneath others in the same layer. In this tutorial you'll follow steps that are slightly modified from Tutorial 2.5 to learn how to use animated shape ordering to make these changes over time.

To begin, follow these steps:

1. Open **Tutorial 5.11.moho**, which is located in the **Tutorials > 5 - Animation** folder in your User Content folder. This is a renamed version of the file that you started with in Tutorial 2.5.

2. Double-click Layer 1 to open the Layer Settings dialog. Switch to the Vectors tab, and check the **Animated shape order** checkbox. Click OK to close the Layer Settings dialog.
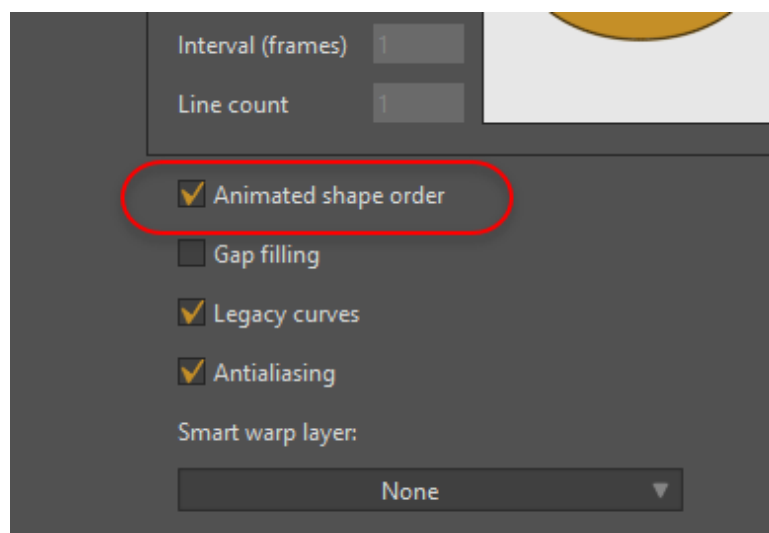

Enable the Animated shape order option in the Vectors tab.

3. Advance in the timeline by clicking frame 12.

4. With the **Select Shape** tool, click anywhere on the red shape. It will become highlighted with a checkerboard to indicate that it is selected.

5. Press the Up arrow on your keyboard twice, to move the red shape immediately behind the small yellow circle.

Animation
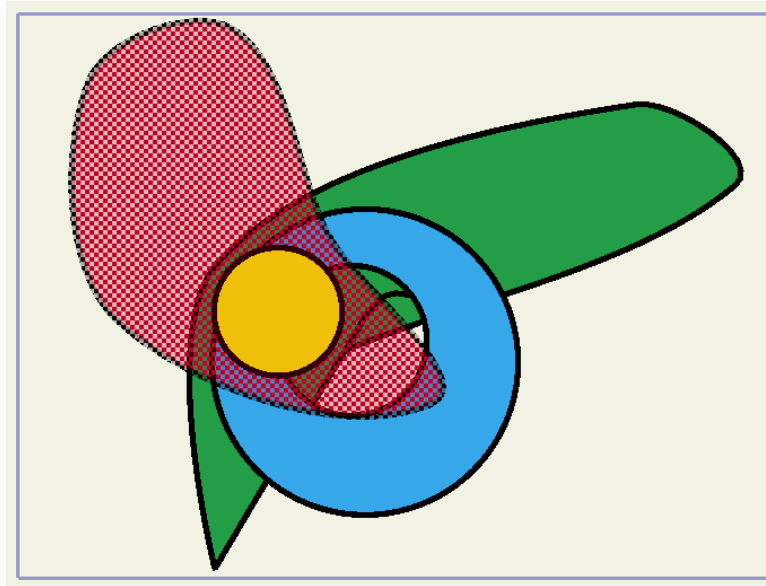
Raised shape on Frame 12

6.   At Frame 18, use the **Select Shape** tool to click on the blue shape to select it. Press the Down-arrow key twice to lower the blue shape below the green shape:
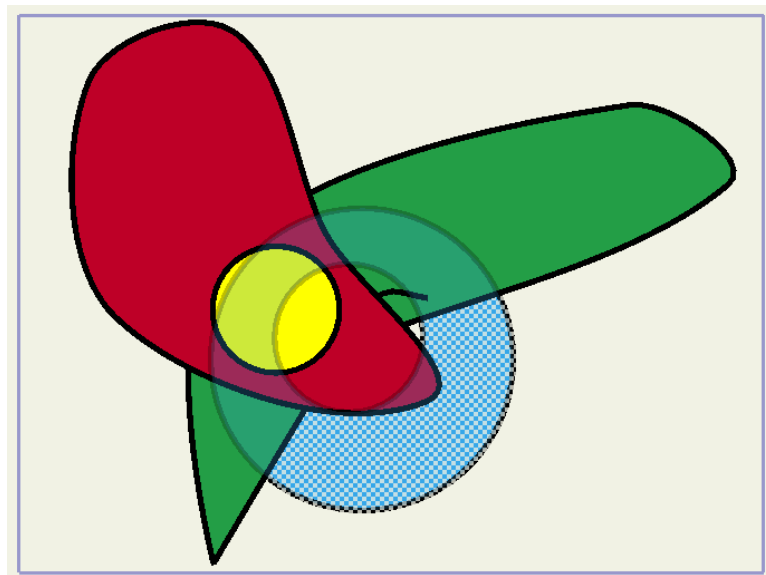

Lowered blue shapeat Frame 18

7.   Now advance to Frame 24. Click the green shape with the Select Shape tool, and hold down the **Shift** key while you press the Up-arrow key. The green shape moves all the way to the top of the layer's shape order.

Animation
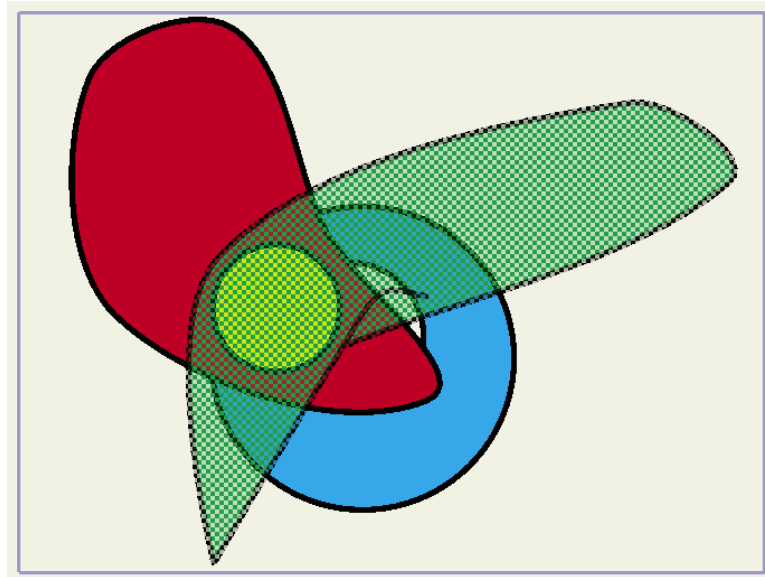
At Frame 24, move the green shape to the top.

8. Press Enter to deselect all shapes. You'll find that the yellow circle becomes hidden.

9. Now we want to bring the yellow circle back to the front. Using the **Select Shape** tool, click the Green shape to select it. Then press the down arrow once to move it back one level.

10. Click the yellow circle with the Select Shape tool to select it.

Animation
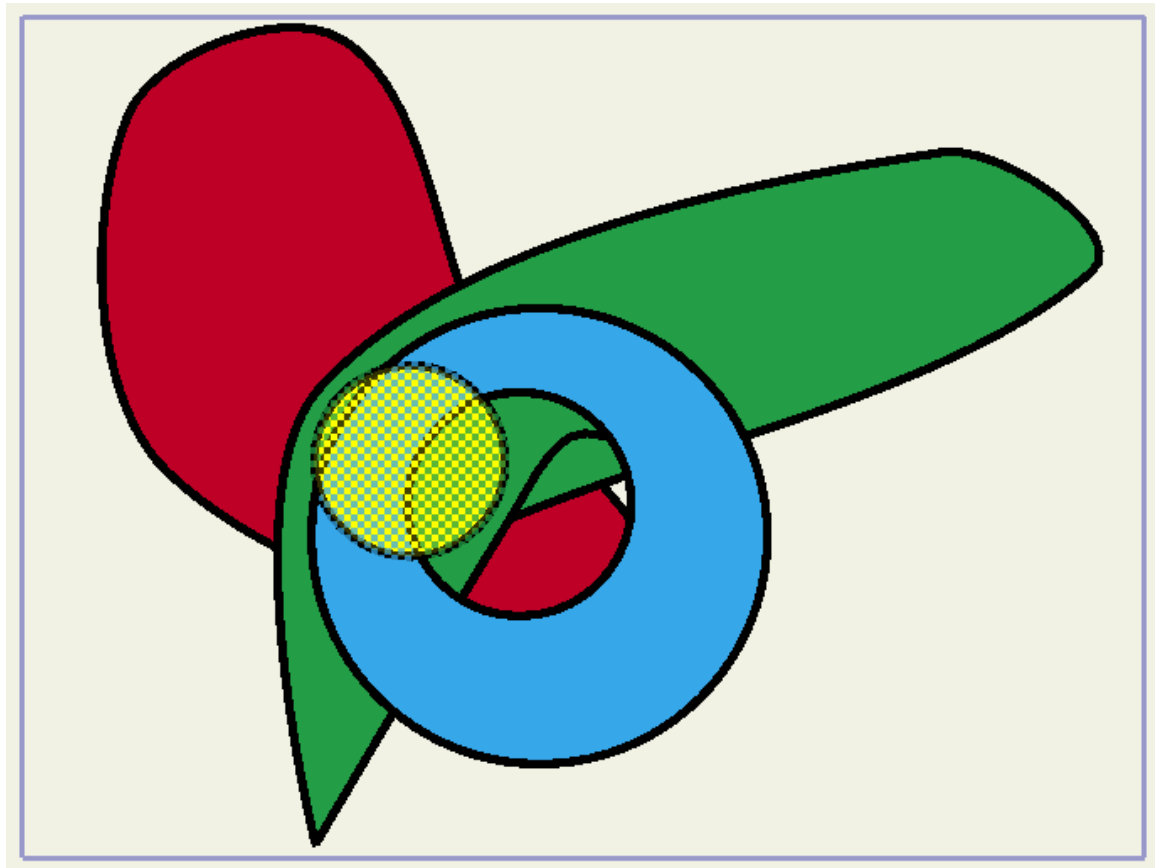
Raised yellow circle at Frame 30

11. Scrub through the timeline to see the shape ordering changing over time.

Animation

Effects

Tutorial 6.1: Shadow Tricks

This tutorial shows you how the layer shadow options can be used to create visual effects other than shadows. Glows and outlines are the two possibilities we'll look at.

Start With a Sample File

For this tutorial, we'll start with a project file that's almost finished. It's named **Tutorial 6.6** and it's located in the **Tutorials > 6 - Effects** subfolder within your custom content folder.

Open the **Tutorials > 6 - Effects > Tutorial 6.6** file in Moho. Render this file to see what it looks like to start with:
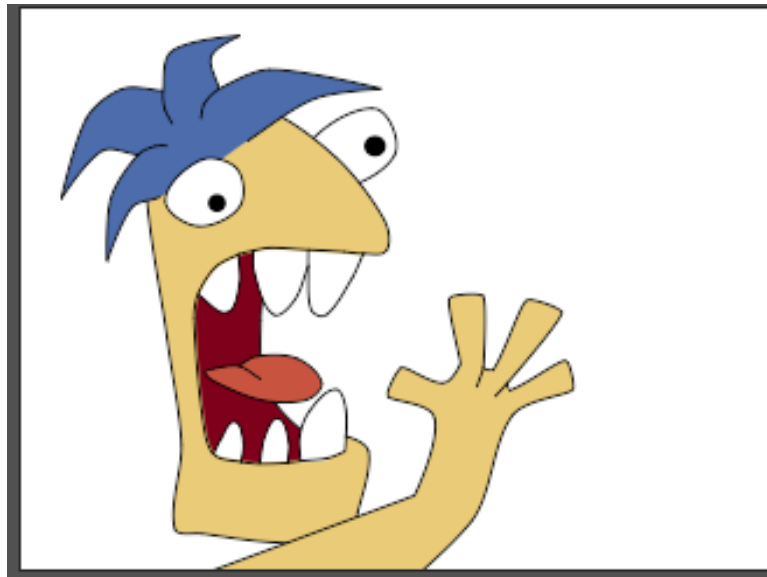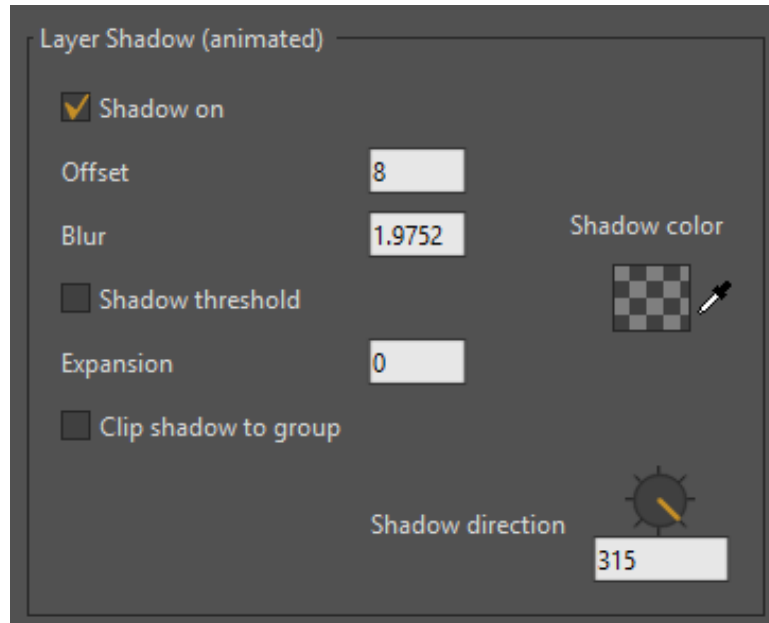

Starting point for this tutorial

Basic Layer Shadow

Before we try any tricks, let's take a look at a basic layer shadow.

1.   Double-click the only layer in this file, Layer 1, to bring up the Layer Settings dialog.

2.   Go to the Shadows tab, and leaving all the other settings alone, turn on the **Shadow on** checkbox. Click OK to dismiss the dialog.

Default shadow settings

3. Try rendering the scene again, just to be sure that you have an idea what a regular layer shadow looks like in Moho:
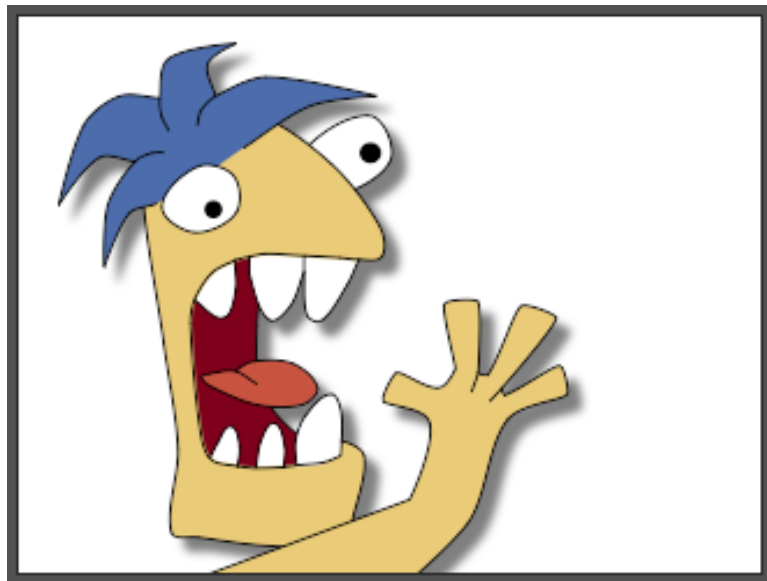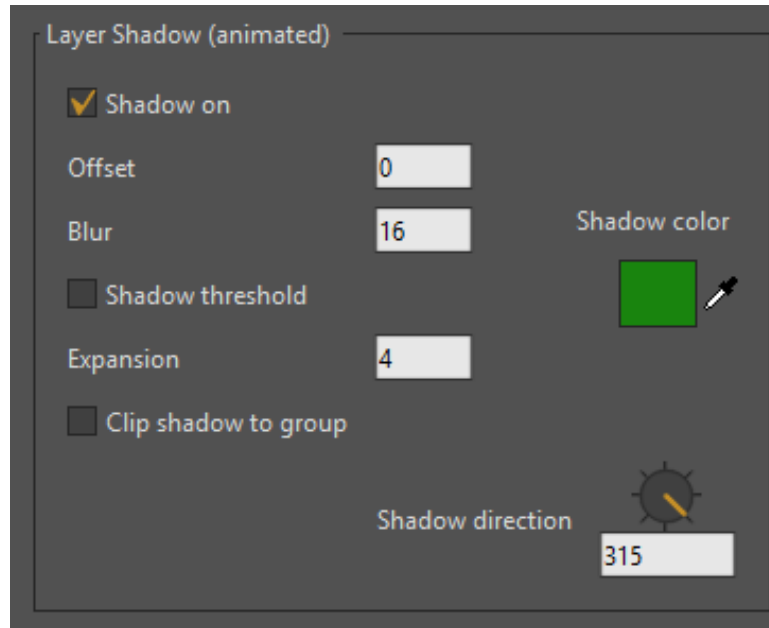

Layer shadow

Layer Glow

Now we'll change the shadow settings to create a glow effect.

Double-click Layer 1 again to bring up the Layer Settings dialog. Change the Layer Shadow settings to match the values below:

Effects

Glow settings

- An offset of 0 means the shadow will be centered under the layer that is casting it. With an offset of 0, the shadow direction has no significance.

- A high blur value of 16 gives the glow a nice soft edge.

- The expansion parameter tells Moho to expand the shadow, making it bigger than the layer itself. Without expansion, the glow would just barely extend beyond the edge of the layer.

- The exact color you choose is not important - just be sure to make the color opaque (Alpha = 255). A transparent glow may be too faint to see.

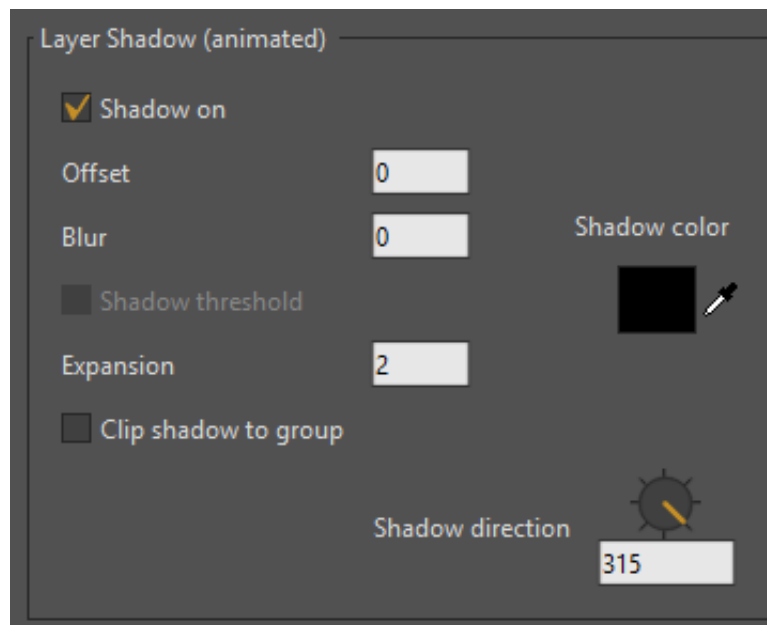- Render the scene again, and it should look like this:

Layer glow.

Effects

Layer Outline

Let's change the shadow options once again to create an outline effect. Some styles of animation use a heavier outline around the outside of objects than for interior lines. Adjusting the layer shadow values in the right way can make this style very easy to accomplish.

Double-click Layer 1 again to bring up the Layer Settings dialog.

1.   Change the Layer Shadow settings to match the values below:

   ▪   Again, we use an offset of 0 to keep the shadow centered under the layer.

   ▪   A blur value of 0 is used to keep a hard edge on the shadow.

   ▪   The expansion parameter is used in this case to set the width of the outline effect.

   ▪   For this effect, it's important to make the color totally black and totally opaque (Alpha = 255) to match the interior lines.

Outline settings.

2.   Render the scene again, and it should look like this:

Effects

Layer outline

Tutorial 6.2: Camera and Depth Effects

This tutorial demonstrates Moho's camera tools. These tools allow you to move an entire scene around as if you were pointing a camera at it. With a little setup work, you can even create different layers of depth in the scene.

Start With a Sample File

For this tutorial, we'll start with a project file that's almost finished. It's named **Tutorial 6.7** and it's located in the **Tutorials > 6 - Effects** subfolder within your custom content folder.

1. Open the **Tutorials > 6 - Effects > Tutorial 6.7** file in Moho, and you should see something like this:
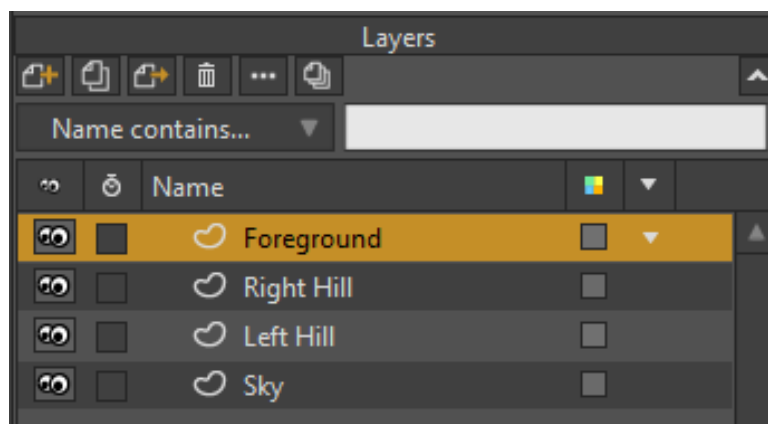
Starting point for this tutorial

2. [camera icon] This file contains a few layers of simple scenery that we will move the camera across. To do this, select the **Track Camera** tool and drag the mouse around in the main editing area.

3. Notice how all the layers move together, even though they aren't grouped. When you move the camera around, it affects **all** the layers in a project. In the tool options area at the top of the main Moho window, click the Reset button to reset the camera.

Creating Depth

Now we'll introduce some depth into the scene.

1. [transform layer icon] Activate the **Transform Layer** tool and select the layer called **Right Hill**.

2. In the tool options area at the top of the main Moho window, change the Z value to -1 and press **Enter**. Below you can see where to set the Z value for the layer.
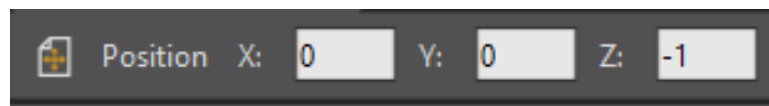
Setting a layer's Z value

3. Now select the **Left Hill** layer, and set its Z value to -2. Finally, select **Sky**, and set its Z value to -20. When you're finished, your scene should look similar to the following figure.
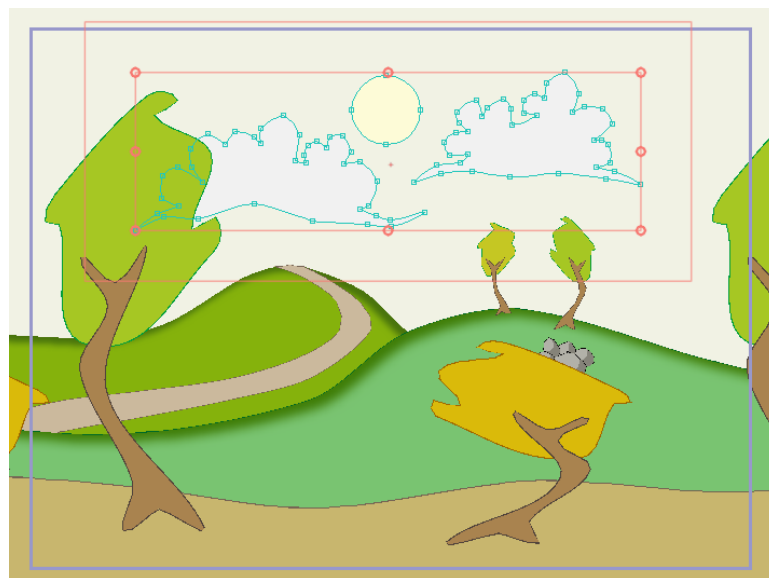
Right Hill, Left Hill, and Sky layers moved on the Z plane

4. [camera icon] Try dragging the **Track Camera** tool around again and notice the difference. It's like driving in a car - nearby objects go by quickly, while distant objects seem to move slowly.

Effects

5. In the tool options area at the top of the main Moho window, click the Reset button for the Track Camera tool to reset the camera.

*In Moho Pro, try dragging the **Orbit Workspace** tool around the workspace. This tool allows you to examine your scene in 3D, from outside the view of the virtual camera. In this case, notice how the different layers are spaced apart in the Z direction - this is what creates the sense of depth from the camera's point of view. The camera itself appears as a small blue wedge pointing in the direction of view.*

6. When you've seen enough, select the **View > Reset** menu command to go back to the default camera view.

Animating Camera Movement

Now we'll try animating the camera.

1. Make sure the current frame is set to 0, and select the **Zoom Camera** tool.

2. Enter a setting of 45 in the **Vertical field of view (degrees)** field in the tool settings area.

3. Next, select the **Track Camera** tool.

4. Drag to the left in the main editing area until you set up a view that looks about like this:
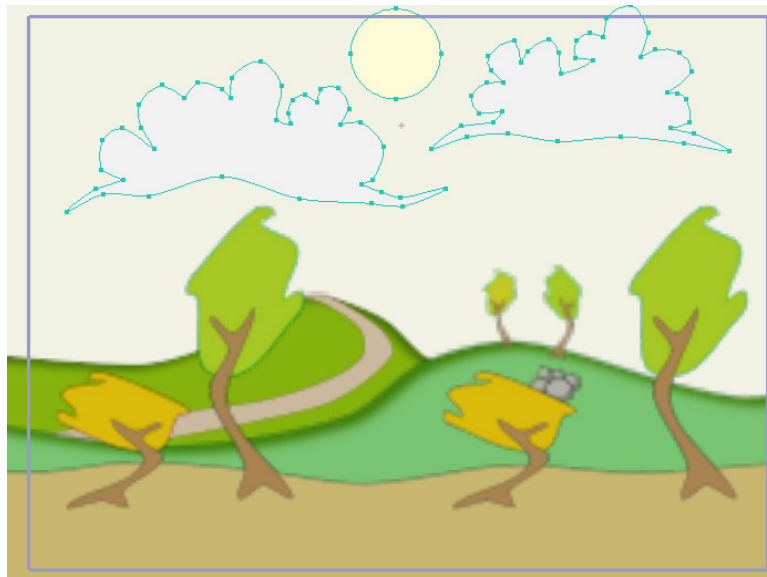
Camera view at frame 0

5. Next, set the current frame to 72, and drag to the right. This will pan the camera to the left - keep going until you have a view that looks like this:

Effects
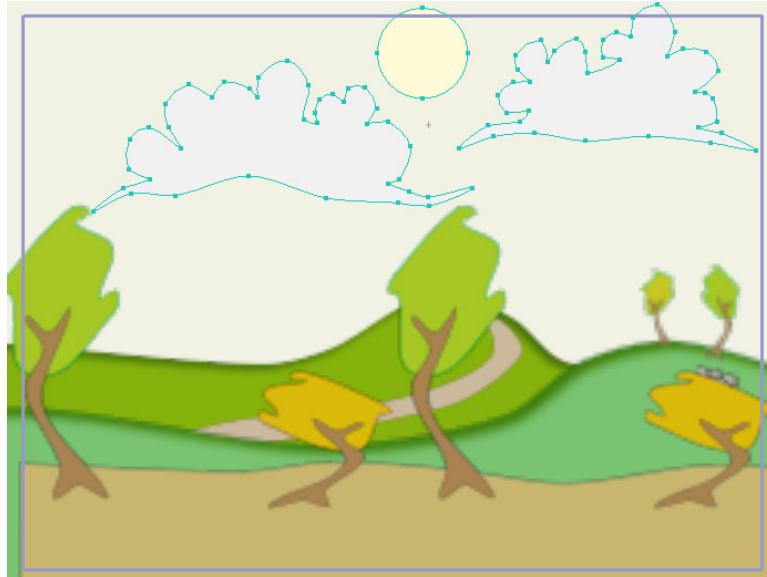
Track to the left

6. Press the Play button in the timeline to play back this simple camera animation. Notice how the layers of the project seem to pass in front of and behind each other. This is a simple way in Moho to create a sense of depth.

Click *this link* to view a brief video of the finished results of your project.

Tutorial 6.3: Moon and Clouds Effect

This tutorial shows you how to create the effect of clouds moving in front of a moon. Layer masking and blurring is used to create an effect that is not only good for a moon and clouds, but may inspire you to think of new ways to use layer masking.

Examine a Finished Animation

For this tutorial, we're going to examine an animation that is completely finished.

1. Open the **Tutorials > 6 - Effects > Tutorial 6.9** file in Moho. The layers in this file are arranged as shown below:
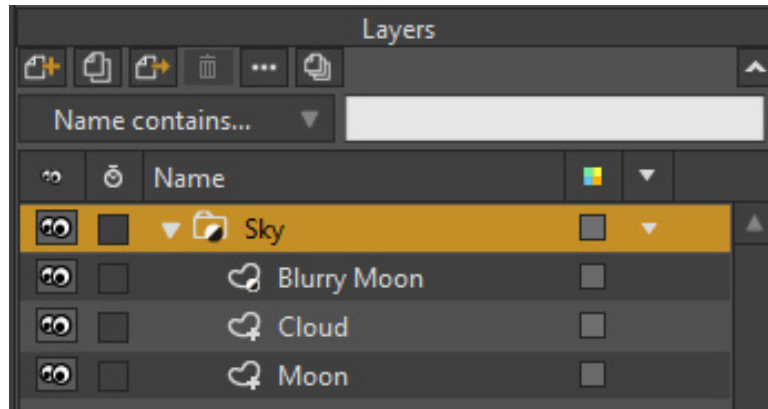
Starting point for this tutorial

2. This animation relies on masking and blurring effects that aren't apparent in Moho's editing view. To see what the final effect is, either export the animation as a movie. (Because blurring is a key part of this effect, exporting to SWF is not an option - SWF export does not support blurs.)

The final result

Notice that the moon appears sharp until the cloud moves in front of it. Then, the parts of the moon obscured by the cloud become blurry. This effect is easy to achieve using layer masking.

How It's Done

There are two parts to this effect. First, there are actually two moons in the animation:

- The **Moon** layer is the regular, sharp version of the moon you see in Moho's editing view.

Effects

- Two layers up is the **Blurry Moon** layer - this is a duplicate of the **Moon** layer, with some layer blur applied.

The trick is to control which moon is visible at which point in time in the final exported movie. To do this, we use layer masking.

Try double-clicking each of the layers in turn to bring up the Layer Settings dialog - then, go to the **Masking** tab. You'll find that the **Sky** group has masking turned on - by default, all objects are invisible. The **Moon** layer is set to be immune to masking, while the **Cloud** layer adds to the layer mask.

The result of these mask settings is that first the **Moon** layer is drawn - this is the regular, sharp moon - and is not affected by any masking. Next, the **Cloud** layer is drawn on top of that. When the cloud moves in front of the moon, it covers up the moon. Finally, the **Blurry Moon** layer is drawn on top of the cloud. Because of the mask, the blurry moon only appears on top of the cloud, it is not visible outside of the cloud object. Even though the blurry moon is in front of the clouds, the effect looks like the moon shining from behind the clouds.

Here's another example of the same technique. In this case, we see a character who appears to be blurred by the smoke passing in front of him. The exact same blurring and masking trick is used as in the case of the moon:

*Another example of blurring and masking*

Tutorial 6.4: Particles (Pro Only)

This tutorial demonstrates Moho's particle layers feature. Particle layers are used to create effects made up of many small objects flying around. This includes effects like water, smoke, and swarms of insects.

Start With a Sample File

For this tutorial, we'll start with a project file that's already started. It's named **Tutorial 6.1** and it's located in the **Tutorials > 6 - Effects** subfolder within your custom content folder.

1. Open the **Tutorials > 6 - Effects > Tutorial 6.1** file in Moho, and you should see something like this:
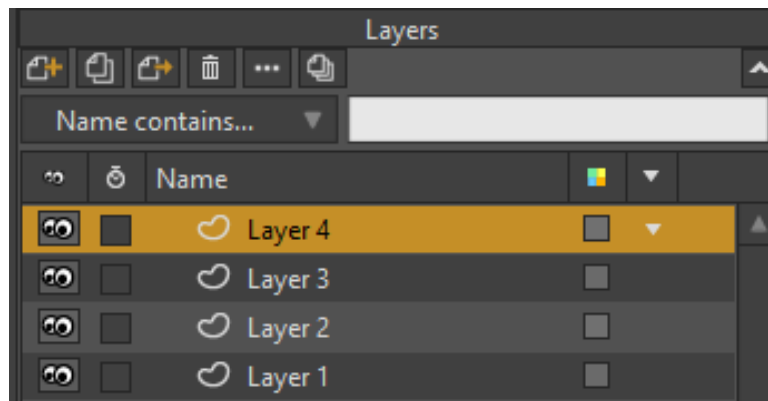
Starting point for this tutorial

2. There are four layers in this file, each containing a small gray blob-shaped object. You can zoom in to look more closely at these objects.
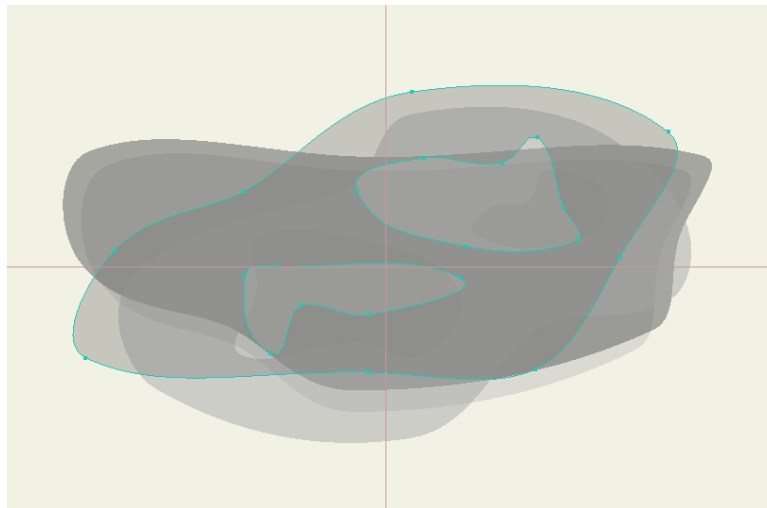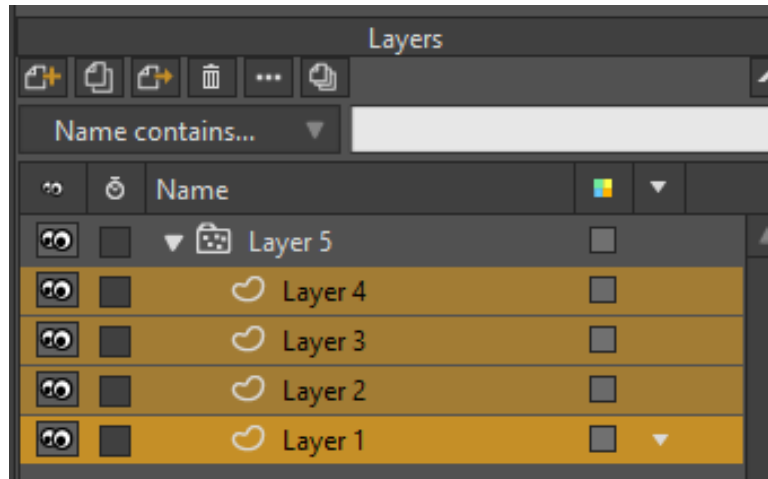

A smoke particle

3. These blobs will be used to create a smoke effect, using a particle layer. If you examine these blobs, you'll see that they are all semi-transparent, and have the soft edges fill effect applied to them. In addition, the blobs all have a simple animation applied to them - over the course of 48 frames, they spread out horizontally. Play back the animation to see this happen.

Using A Particle Layer

1. In the Layers window, create a new **Particle** layer. Particle layers are kind of like Group layers - they can contain sub-layers.

2. Drag all four of the original layers into the particle layer, and your project should look like this:

Effects

New particle layer

3. Play back the animation and see what we've got so far. The particles should be flowing, although they don't look much like smoke at this point.

4. Next, double-click the particle layer to bring up the Layer Settings dialog. Click the tab marked **Particles**. In this area, set the following values and click OK:

    ▪ **Lifetime (frames)**: 48

    ▪ **Orient particles**: unchecked

    ▪ **Velocity**: 0.3

    ▪ **Velocity spread**: 0.05

    ▪ **Acceleration**: Turn knob to point to the right, or enter 5

    ▪ **Rate**: 0.5

Effects
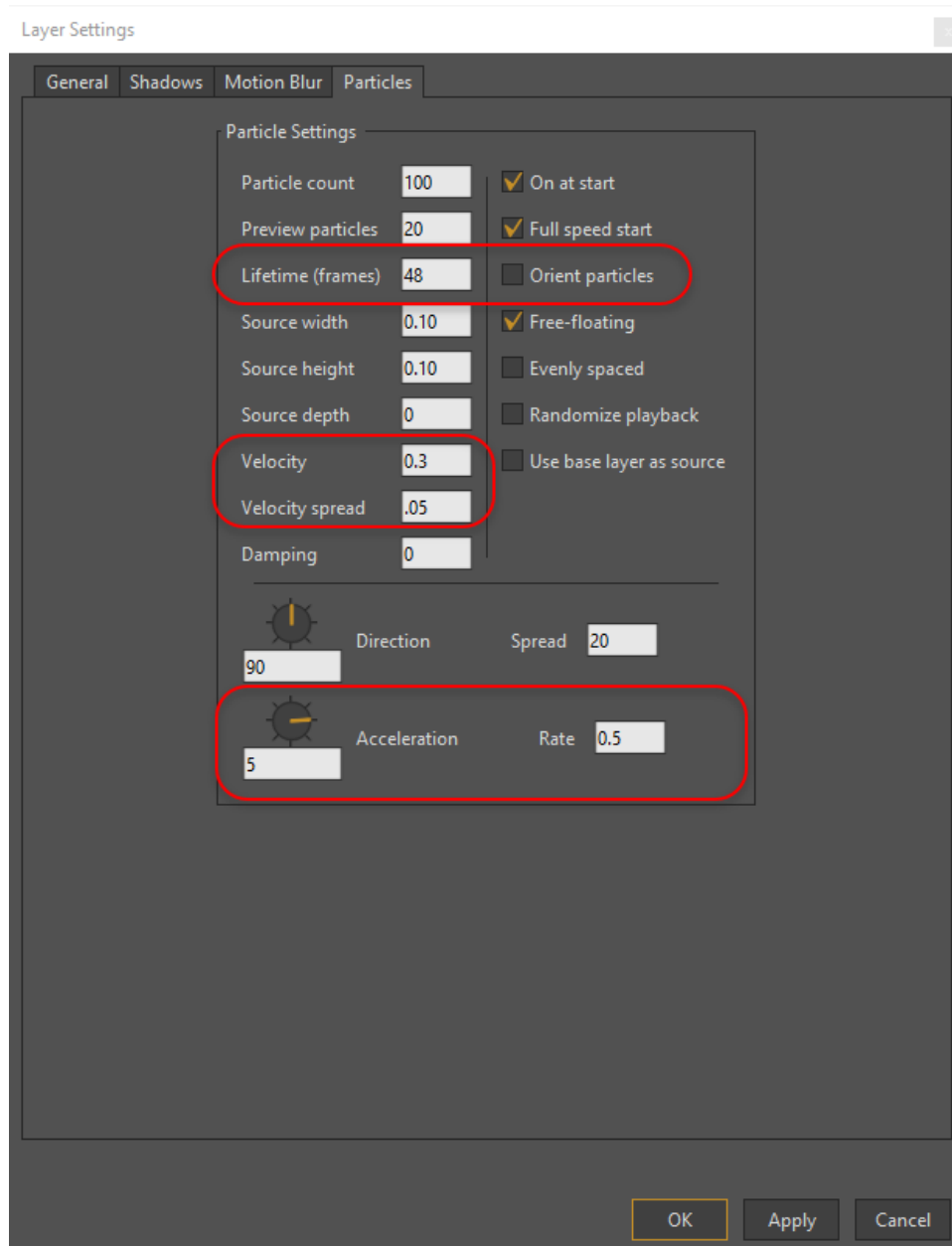
Particle settings

These settings tell the particle system that each particle should last for 48 frames after being created, and that the particles should not rotate to follow the direction they are moving in. Their initial velocity is moderately slow, and there is a gentle acceleration to the right (a soft breeze).

5. Play back the animation now, the motion of the particles should look more like the flow of smoke from a smokestack.

6. Export the animation to see how the blur and semi-transparent effects combine to create a smoky appearance. The reason four different particle types were used is that each has a different gray level, and combining them leads to a mottled, dirty effect.

Effects

A rendered example

7.   Save the tutorial under a new filename so that you can use it in the next tutorial.

Tutorial 6.4.2: Custom Particle Generators (Pro Only)

Normally, Moho starts with a simple circle as a particle generator. As you learned in the previous tutorial, you control the particles in the Particle Options dialog. The source width, height, and depth settings control the area where particles are generated.

You can add a shape beneath the particle layer and drag that shape into the particle layer. This can be used for a wide variety of effects ... grass blowing in the wind, fire coming from a log in the fireplace. Basically, any shape that appears in the bottom-most layer in the particle stack can be used as a particle generator.

In this tutorial you'll modify the file that you saved at the end of the previous tutorial. You'll learn about how you can use custom shapes as particle generators.

1.   If you have not saved the project after completing the previous tutorial, you will find a completed version in your Moho Content folder. Open the **Tutorial 6.4_2** file located in the **Tutorials > 6 - Effects** subfolder.

2.   In the Layers palette, create a new vector layer. Here, we call the new layer **New Generator**.
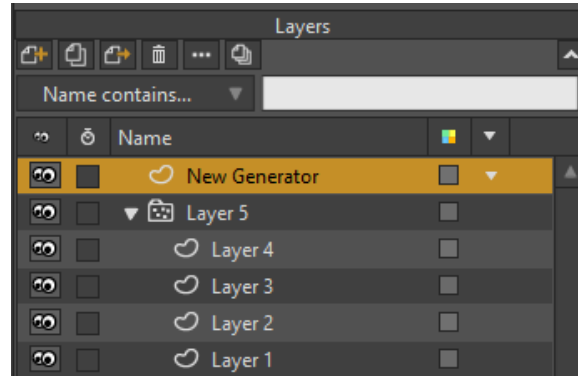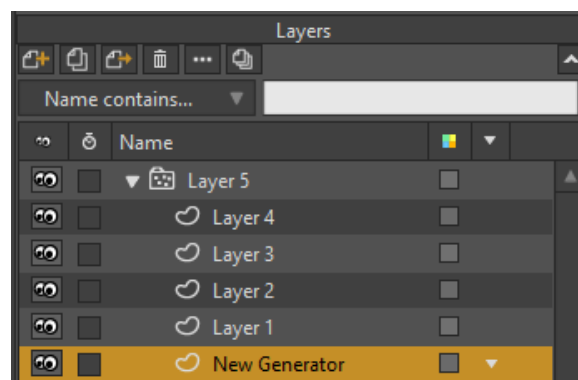
Create a new layer for your particle generator shape.

3. Draw any shape that you desire in the new layer. Here we'll keep it simple, and will add a star shape with the Draw Shape tool.
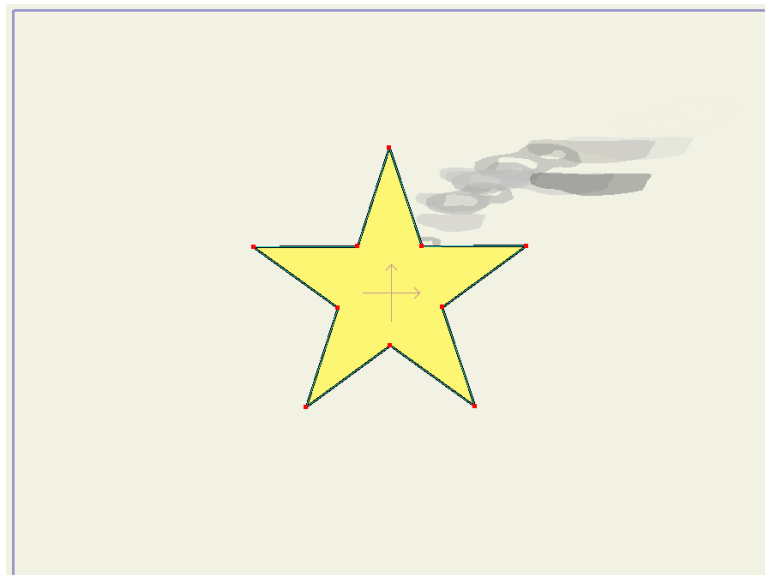
A shape added to the new layer.

4. Drag the new layer into the Particle group, positioning it at the bottom of the layers within that group.


Drag the generator shape into the Particle group and place it at the bottom.

Effects

5. Now, select **Layer 5** in the Layers palette. Initially, you'll notice that this new shape becomes part of the particle mixture, which isn't what you want to happen.


Initially the new shape becomes part of the particle mixture.

6. To fix this, double-click the Particle group layer (Layer 5) and switch to the Particles tab in the Layer Settings dialog. Check the **Use base layer as source** option.
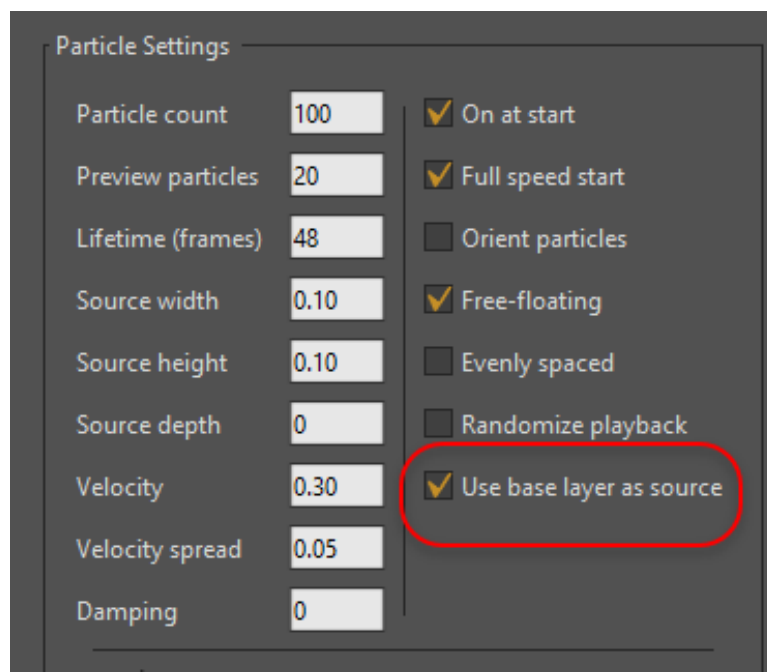
The Use base layer as source option turns the bottom-most layer into a particle generator.

7. Now the particle layer will look at the lowest layer in the stack and use that shape to generate the particles.

Effects
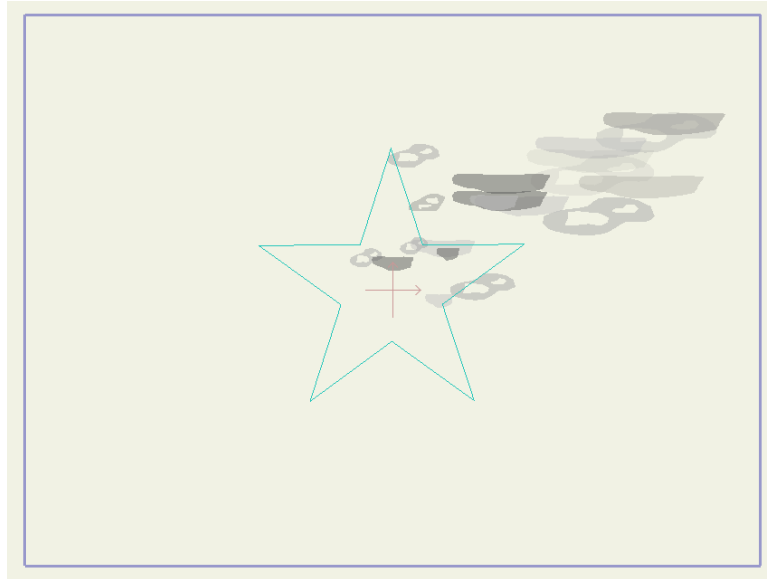
The particles are emitting from the star.

Later you can modify the shape, and the particles will automatically follow the new shape.

# Tutorial 6.5: Particle Tricks - Grass and Crowds (Pro Only)

This tutorial shows how to use particle layers for something other than swarming insects, smoke, or fireworks. Using the correct settings, particle layers can also be used to produce clusters of many objects, but without making them fly around like particles usually do. Fields of grass and crowds of people are just two possibilities that we'll explore.

Start With a Sample File

To get started quickly with this tutorial, start by opening the project file named **Tutorial 6.2**, located in the **Tutorials > 6 - Effects** subfolder within your custom content folder.
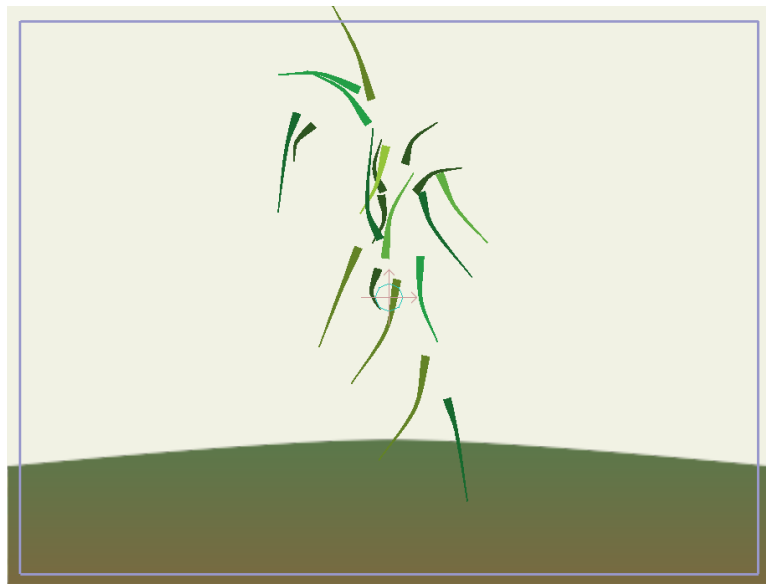
Open the **Tutorials > 6 - Effects > Tutorial 6.2** file in Moho. This file has a particle layer that we'll modify to simulate a field of grass. The layers in this file are set up as shown:
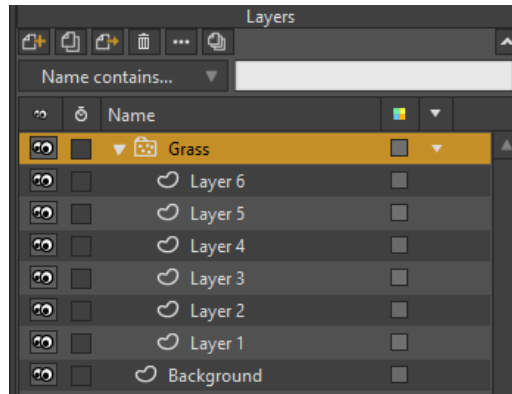
Starting point for this tutorial

The editing view should look like this to begin with:
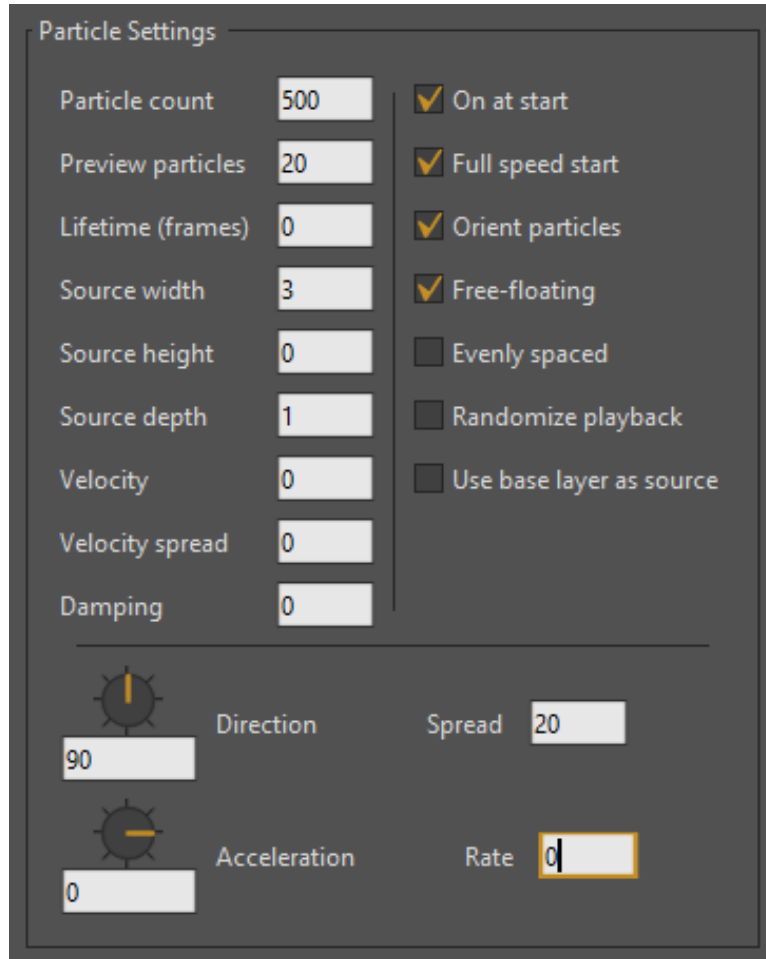

Starting point in editing view

8. The particle layer **Grass** in this file is currently set up with the default settings for a particle layer. The sub-layers (Layer 1 - Layer 6) are each a single blade of grass. Each one has a slightly different color and shape to create variety.

9. If you play back the animation, you'll see that the default particle layer settings aren't very good for a field of grass - the grass particles fly up in the air and then sink downwards. All we have to do is make a few small changes to get the grass to look right.

Changing Particle Settings

1. Double-click the Grass layer to bring up the Layer Settings dialog. Click the Particles tab to access the settings for the particle layer.

Effects

> *Below we describe why each of the settings is set the way it is. Any settings that aren't mentioned below don't matter for this situation (for example, orient particles doesn't matter since the particles have no velocity).*

2. Change the settings to match the ones below and click OK.

Grass particle settings

- **Particle Count: 500.** We need a lot of particles for a field of grass

- **Preview Particles: 20.** In the working view, only show a few particles in order not to slow down Moho

- **Lifetime (frames): 0.** A lifetime of zero means that particles will never die out (disappear).

- **Source width: 3.** Make the source nice and wide to cover the width of the screen

- **Source height: 0.** It's a flat field of grass, so the height is zero

- **Source depth: 1.** Spread the particles out in the Z direction for a feeling of depth

Effects

> (M) *Besides scattering particles in the Z direction, when source depth is set to a non-zero number, the particle layer will sort particles according to depth - this is very important for the kinds of animations we're working with in this tutorial. We wouldn't want far away blades of grass to appear in front of closer ones.*

- ▪ **Velocity: 0**. Set to zero to prevent the grass blades from flying around

- ▪ **Velocity Spread: 0**. Set to zero to prevent the grass blades from flying around.

- ▪ **Acceleration: 0**. Zero acceleration, again to prevent the grass blades from flying around

- ▪ **Rate: 0**. Again to prevent the grass blades from flying around

- ▪ **Randomize playback**: Checked. Plays back the blades' animations randomly, otherwise they would be in sync.

> (M) *Randomize playback makes the grass look better than if all the blades were moving in sync, but it can be even more important when working with a crowd of people, as we'll see later in this tutorial.*

3.   OK, the grass is almost finished. All we need to do is use the **Transform Layer** tool to move the Grass layer downwards (on Frame 0) so that it sits on the ground:

Grass lowered into place

In preview mode, it doesn't look like much, so you may want to try playing back the result and rendering it out as a movie file:
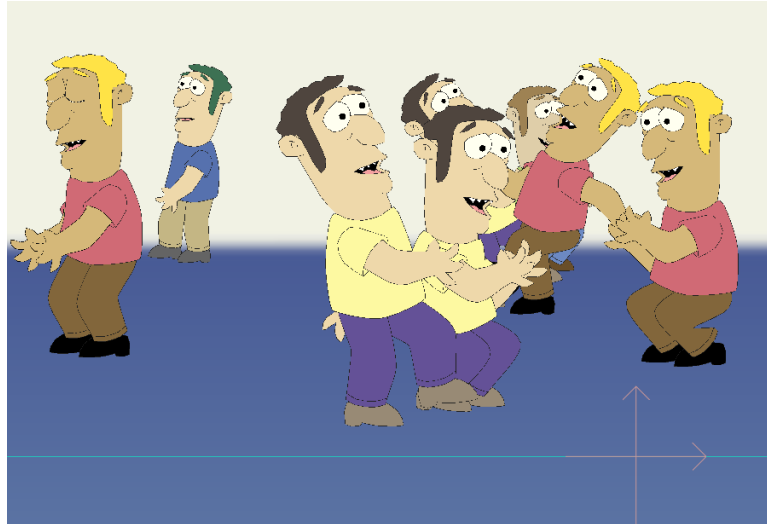
Effects

Final render

Tutorial 6:5.2: Crowds, Particles, and Depth of Field (Pro Only)

Now we'll show how to use the same general techniques to simulate a crowd of people. Also in this tutorial you'll learn how to set up depth of field.

1.   Open the file named **Tutorial 6.2_2**, located in the **Tutorials > 6 - Effects** subfolder within your custom content folder. There's nothing you need to change in this file in regards to the particle effects, it just shows another example of using particle layers.

> 🔴 *The default size of this project is 320 x 240 pixels. If you want a larger sized preview image when working on this tutorial, choose File > Project Settings and select another preset that renders a larger preview (such as NTSC D1).*

1.   The Crowd layer has the same basic settings we used for the field of grass, only using fewer particles. Note the following:

- Each of the sub-layers in the crowd was created from one layer with a simple cycling animation.

- This one layer was duplicated and had some colors changed just for variety.

- The **Randomize playback** setting for the particle layer is really important for this crowd - if it was turned off, then each character in the crowd would move in sync with all the others (you can try this yourself). This may be desirable in some cases, but here we want each character to move independently, even though they all have the same basic movement.

Effects

A crowd as particles

Depth of field is enabled in the Project Settings dialog - that's why some of the closer or farther characters appear a bit blurry. But we'll use some Moho enhancements to fine tune the depth of field effect.

Moho provides a visual indication that can help you set up Depth of Field more easily. To continue with the tutorial, follow these steps:

2.   Use the **Pan** and **Orbit** workspace tools to view the scene at an angle, similar to that shown below. You'll notice a box in the middle of the scene.
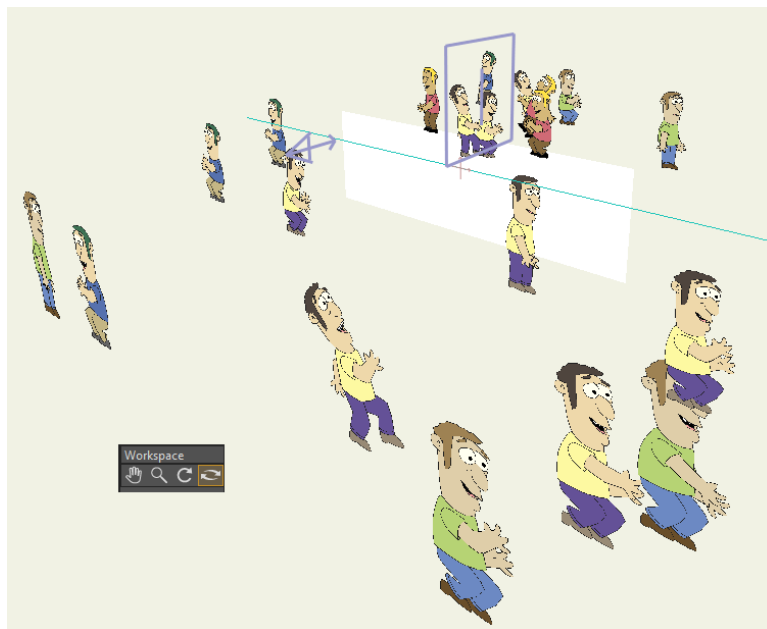
Use the Orbit Workspace tool to view your scene in 3D view

3.   Choose **File > Project Settings** to open the Project Settings dialog. You can quickly adjust the settings if you click in the text field and use your mouse scroll wheel to increase or decrease the values. As you adjust the **Focus Distance** and **Focus Range** settings in the dialog, you'll notice the box indicator changing in the scene:

Effects
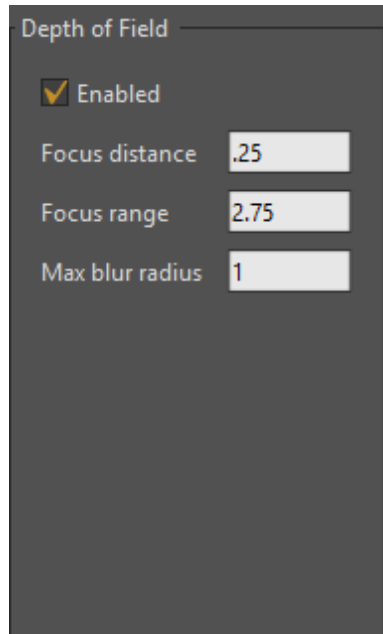
Increase or decrease the depth of field settings as you observe the position and size of the box indicator.

- **Focus distance**: This is the area that you want to focus on. It's represented by the center line in the box. Decrease the setting to bring the focus distance closer, and increase the setting to move it farther from the camera.

- **Focus range**: This is the range of the scene that will go from sharp to blurry when viewed through the camera. The deeper the box gets, the more slowly the scene will get out of focus. Higher settings will make the box deeper.

4. Choose **View > Reset** to return the scene to the default camera view.

5. Choose **File > Preview** to generate a preview image. After you complete your project, you can render an animation to see how it all comes together.

Effects

A preview of your settings.

Tutorial 6.6: Using Pre-made Particle Effects (Pro Only)

This tutorial shows how you can use the included scripting commands to make use of pre-made particle effects like smoke or explosions.

Start With a Sample File

For this tutorial, we'll start with a project file that's almost finished. It's named **Tutorial 6.3** and it's located in the **Tutorials > 6 - Effects** subfolder within your custom content folder.

1.   Open the **Tutorials > 6 - Effects > Tutorial 6.3** file in Moho.

2.   Expand the **Rocket Group** layer in the Layers window, and you should see something like this:
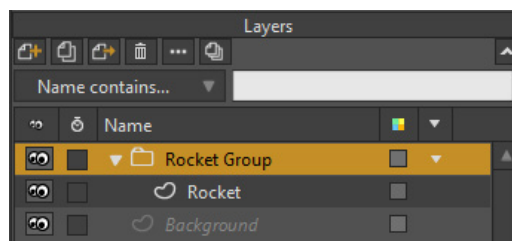

Starting point for this tutorial.

Effects

3. Try playing back the animation to see what we're starting with - it's just a simple animation of a rocket flying around the screen for a little while. When you've seen enough, rewind the animation back to frame 0.

Add the Smoke Effect

Now we'll add a smoke trail behind the rocket.

Select the **Scripts > Particle Effects > Smoke...** menu command. A dialog will appear asking you to customize the smoke effect. Use the settings shown below for the smoke and click OK:
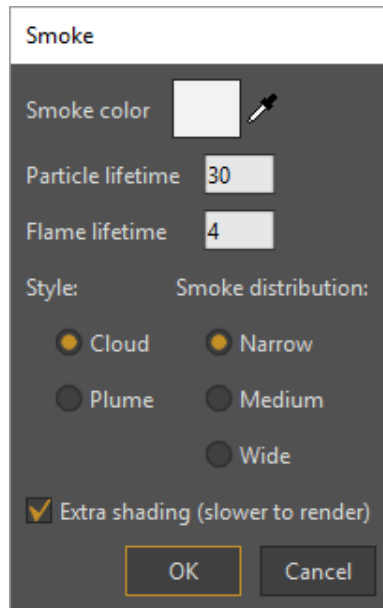

Smoke settings

4. The smoke script will then generate a bunch of layers that make up the smoke effect. The combined layers will end up grouped together in a group layer called **Smoke**. Move this new Smoke layer into the **Rocket Group** layer, just below the **Rocket** layer. The Smoke layer should end up positioned like this:
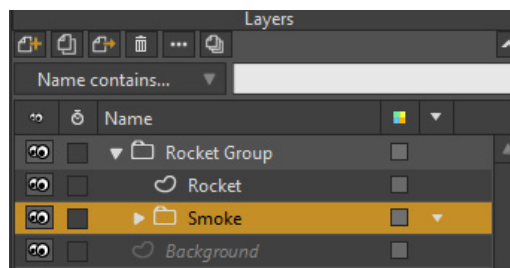
Smoke layer added to group

5. The final step is to move the smoke into place. Activate the **Transform Layer** tool and move the Smoke layer so that it sits just behind the rocket. The smoke itself won't immediately move until the animation is updated, so watch the origin of the Smoke layer and line it up behind the rocket. Feel free to zoom in close to get a better view:
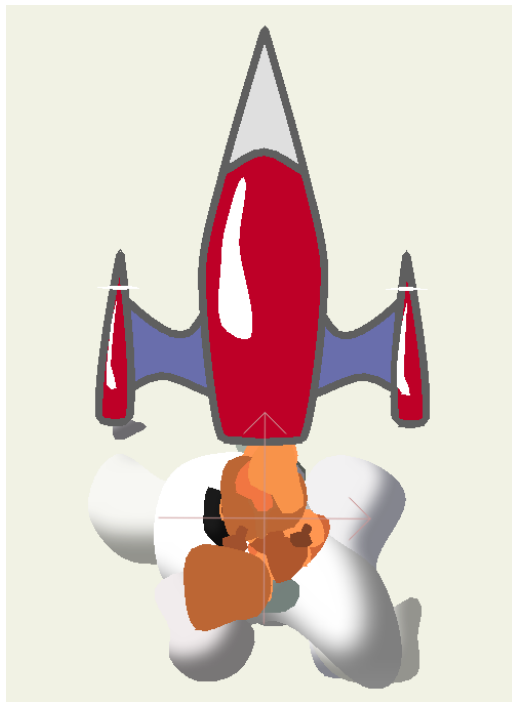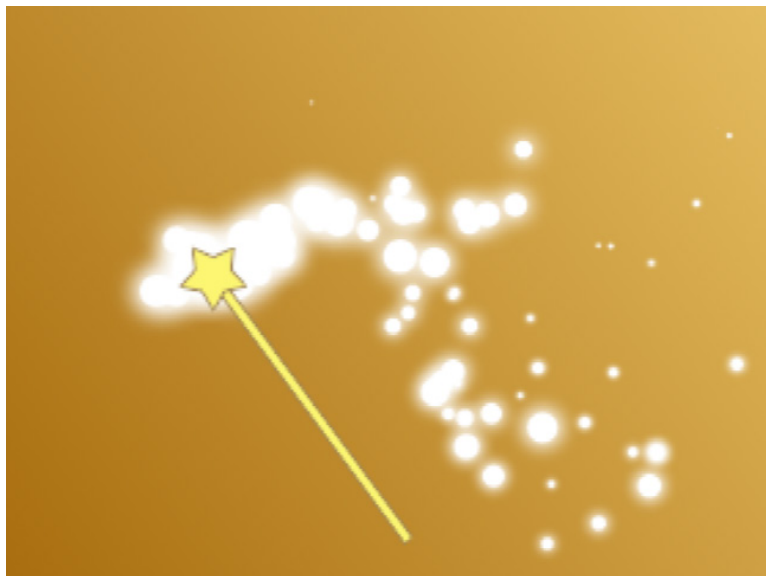
Effects

Smoke layer moved into position

That's it! You can now export the animation as a movie file to see the fully rendered result. Some of the particle effects in the script menu, including smoke, can take a long time to render. In "Tutorial 6.7: Speeding Up Particle Effects (Pro Only)" on page 259 we'll show you a way to speed up complex particle effects.

The final result

Effects

Another Effect - Sparkles

Here's an example of another particle effect - the Sparkles script. A great use of this effect is for magic wands. The fully finished file can be opened in Moho if you wish. It's called **Tutorial 6.3_2**. Here's what the rendered result looks like:

The Sparkles effect

Tutorial 6.7: Speeding Up Particle Effects (Pro Only)

In we showed how you can use Moho's included particle effect scripts to easily add effects like smoke and explosions. The only drawback to these effects is that they can take a very long time to render. In this tutorial, we'll show you a way to speed up the exporting of complex particle effects.

Rendering an Image Sequence

For this tutorial, we'll start by taking a look at a finished animation of an explosion effect.

1. Open the **Tutorials > 6 - Effects > Tutorial 6.4** file in Moho. Our goal is to re-use this explosion in another Moho animation, but make it a lot faster for rendering. To do this, we'll export the explosion animation as a PNG image sequence, using some special settings.

2. Choose **File > Export Animation** to open the Export Animation dialog.

3. Export the project animation using the following options:

   - **Format**: Image Sequence
   - **Preset**: PNG

Effects

- ▪ **Quality**: 90

- ▪ **Do not premultiply alpha channel**: Checked

- ▪ **All other settings**: Leave at default values.
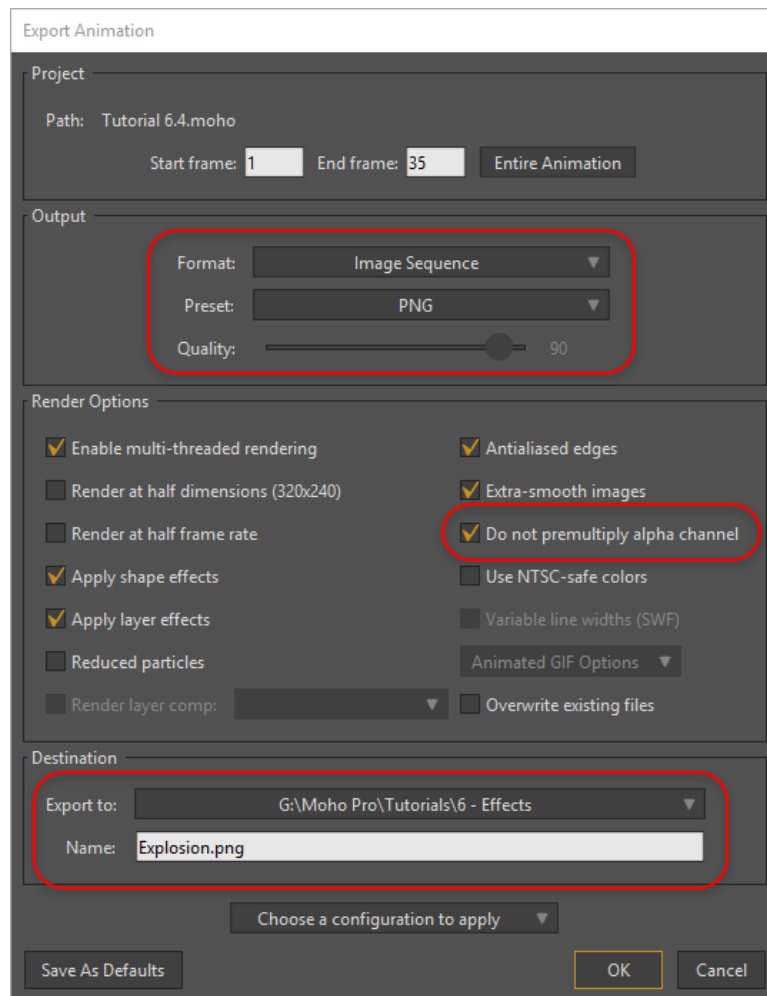
Export options

4. In the Destination section, choose the following options:

   - ▪ Click the **Export To** popup and select **Choose Folder**. Navigate to the folder into which you want to save the image sequence.

   - ▪ In the **Name** field, enter a root name for the animation sequence, such as Explosion.png.

5. Click **OK** to exit the Export Animation dialog. The render preview will show progress bars and sample frames as the image sequence renders. After the render is complete the preview window closes.

*A rendered version of the explosion sequence can be found in the **Tutorials > 6 - Effects** folder. The PNG files are named* **Explosion_00001.png** *through* **Explosion_00035.png**.

Effects

# Using Sequential Images in Image Layers

To work with the explosion movie, follow these steps:

1.   Start a new Moho project file.

2.   From the Layers palette, create a new Image Sequence Layer.
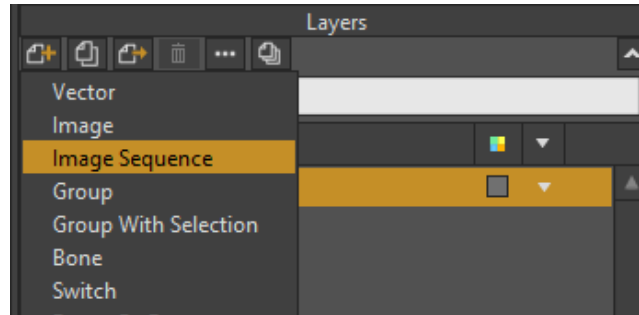
Create an Image Sequence layer

3.   Moho will prompt you to select images for the sequence. As long as there is an unbroken numerical sequence, all you need to do is select the first image in the sequence (Explosion_00001.png, in our case).

4.   After Moho imports the Image Sequence you will see the explosion in the project window, and the timeline will show a green arrow at the start of the image sequence, and a red arrow at the end of the image sequence.
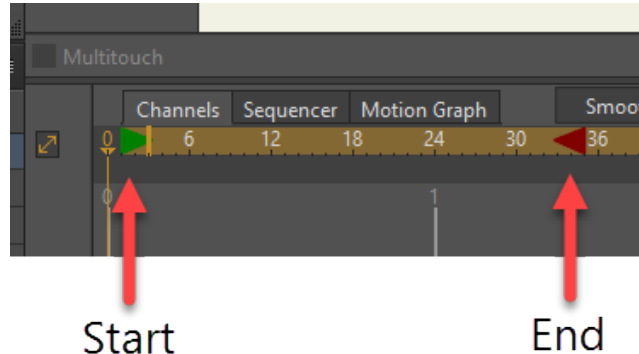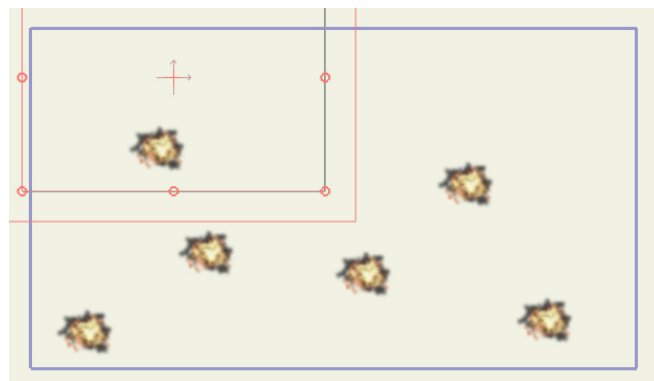

Image Sequence in the timeline.

5.   Use the **Transform Layer** tool to move the explosion off to the side a bit:

Effects
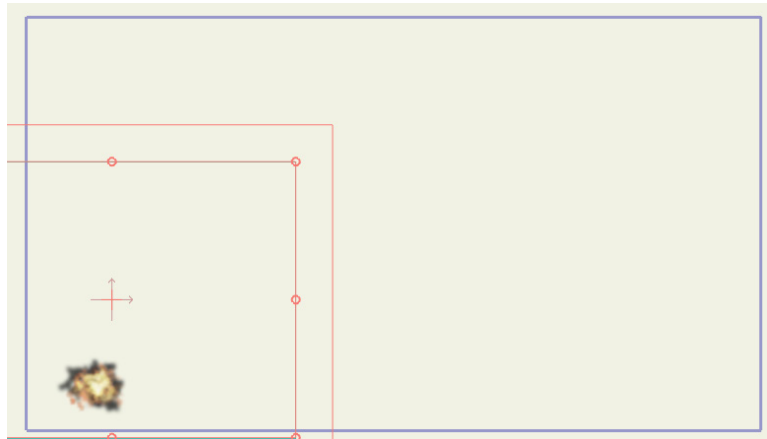
Move the explosion layer

6. In the Timeline, use the Duplicate Layer button to duplicate the explosion a few times (five or more - you want to fill the project with explosions).

7. On frame 0, select one explosion layer at a time. Use the Transform Layer tool to move them to random places in the timeline:

Lots of explosions.

8. Switch to the Sequencer in the timeline, and adjust the start positions of the explosions so that they don't start and stop at the same time:
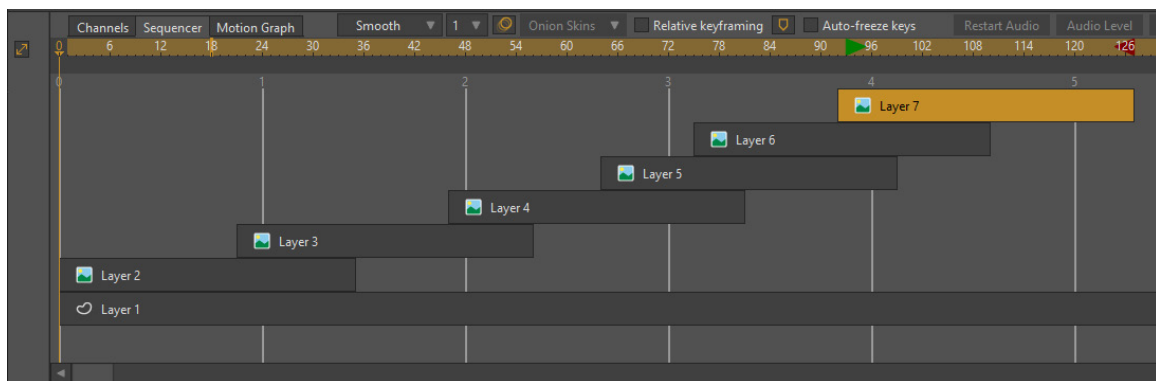
Stagger the start and stop times in Sequencer view.

Effects

9. When you've got as many explosions as you want, export the animation to your final desired animation format.

> *Notice that even though the single explosion took longer render, this combined set of explosions renders much more quickly. This is because the explosion effect has already been created - for the combined effect, Moho just needs to composite several explosions together. Using this technique, you can greatly speed up the time it takes to export an animation that uses one or many complex particle effects.*

Tutorial 6.8: Perspective Shadows (Pro Only)

In this tutorial you'll learn a little trick to create perspective shadows. This trick depends on Moho's layer masking feature, and uses it in a creative way.

Start With a Sample File

For this tutorial, we'll start with a project file that's almost finished. It's named **Tutorial 6.5** and it's located in the **Tutorials > 6 - Effects** subfolder within your custom content folder.

1. Open the **Tutorials > 6 - Effects > Tutorial 6.5** file in Moho, and you should see something like this:
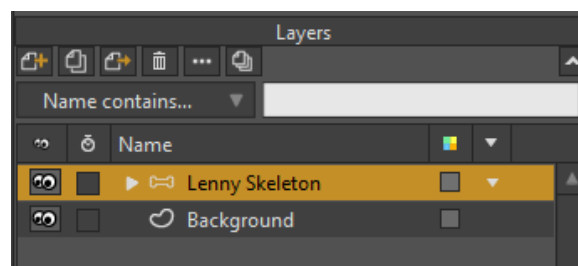

Starting point for this tutorial

2. Play back the animation to get an idea of what you're starting with.

3. When you've seen enough, rewind the animation back to frame 0. What we're going to do in this tutorial is give Lenny a shadow.

Moving a Layer Into Perspective

We're going to create a shadow that matches Lenny exactly.

1. At Frame 0, start off by duplicating the **Lenny Skeleton** layer, using the Duplicate Layer button.

2. Move this new copy below the original **Lenny Skeleton**, name it **Lenny Shadow**.

3. Add a new vector layer inside it as shown below. Make this new layer active, and name the new layer **Shadow**.
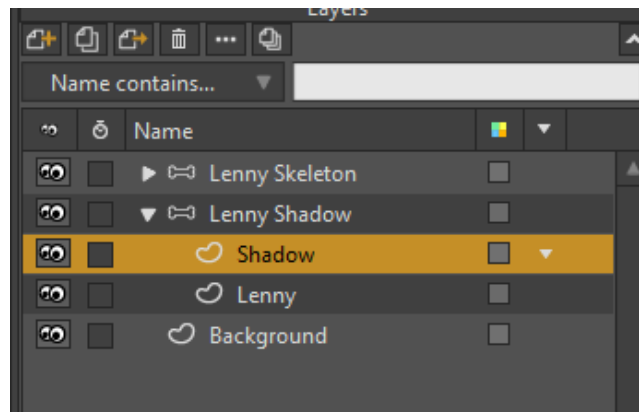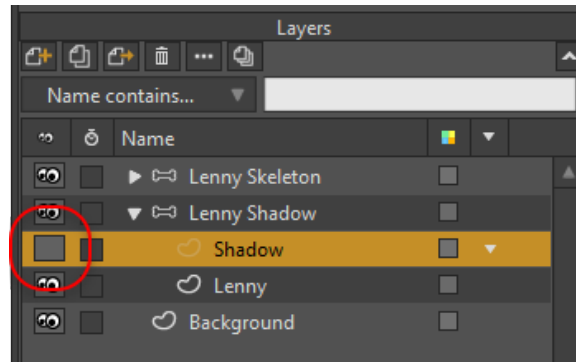

New Lenny Shadow with Shadow layer

4. In the new Shadow layer, draw a simple rectangle that takes up about 2/3 of the left side of the visible area, as shown below. Choose Black for the Fill and Stroke colors if they aren't selected already. The idea is to completely surround Lenny, with enough extra space for when he moves.
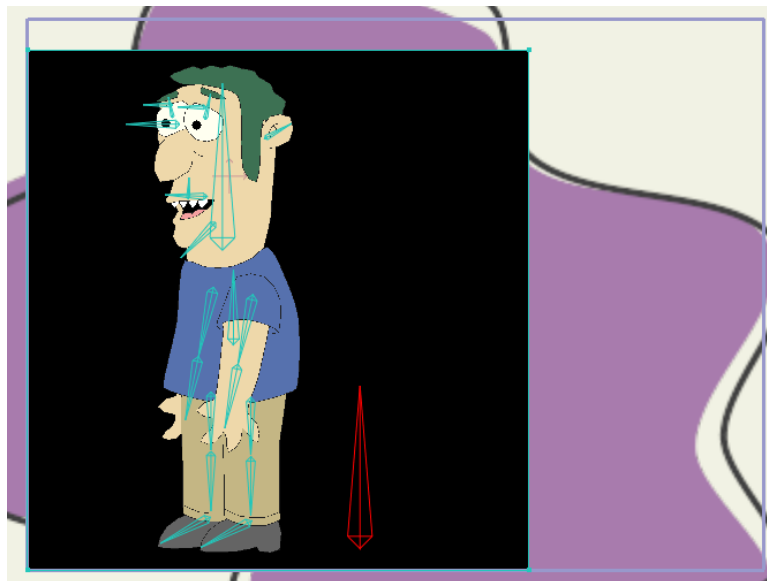
Rectangle in Shadow layer

5. We're going to temporarily hide the black shadow layer so that you can use the copy of Lenny to shear and reposition him for the shadow. To hide the black rectangle, click the Visibility icon to hide the Shadow layer as shown below.

## Effects

Temporarily hide the Shadow layer

6. Next, select the **Lenny Shadow** bone layer and use the **Shear Layer** tool to shear the lower copy of Lenny so that he leans to the right as shown below: You can also enter an X value of .60 or thereabouts in the Shear Layer tool options in the status bar.

Shear the lower copy of Lenny

7. Now use the **Transform Layer** tool to scale the **Lenny Shadow** layer down vertically. Be sure to leave it the same size horizontally - we just want it shorter vertically, as shown below:

Effects
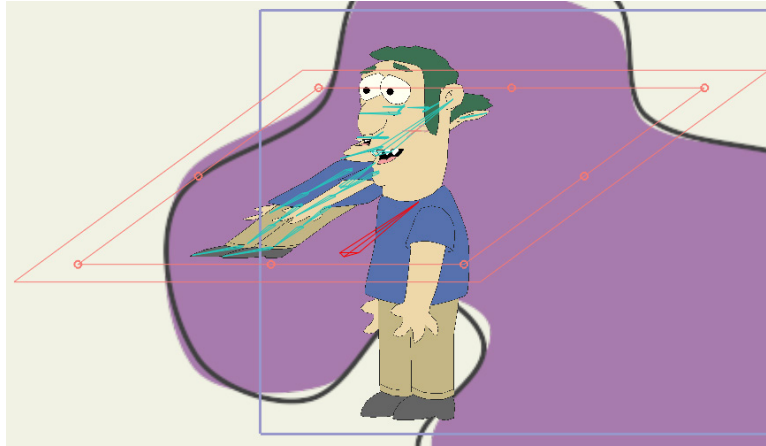
Scale down the shadow layer

8.   Next, use the **Transform Layer** tool to move the **Lenny Shadow** layer into position so that the back heels of the two Lennys line up like this:


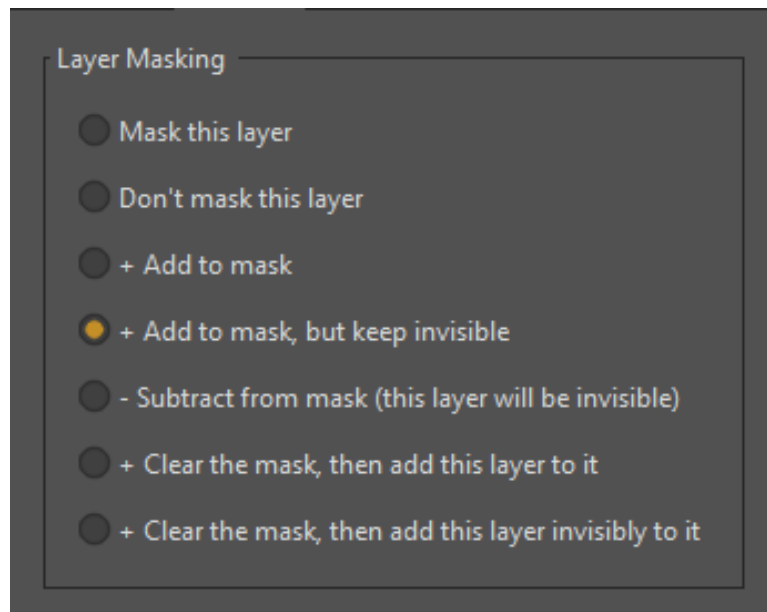*Position the shadow layer*

The Trick

So far we have two copies of Lenny, with the lower one shifted into perspective. Here comes the trick with layer masking.

1.   First, click the Visibility icon in the Shadow layer to make the sheared black rectangle visible again.

2.   To turn on masking, double-click the **Lenny Shadow** layer and in the Masking tab, set the **Group Mask** setting to **Hide all**.
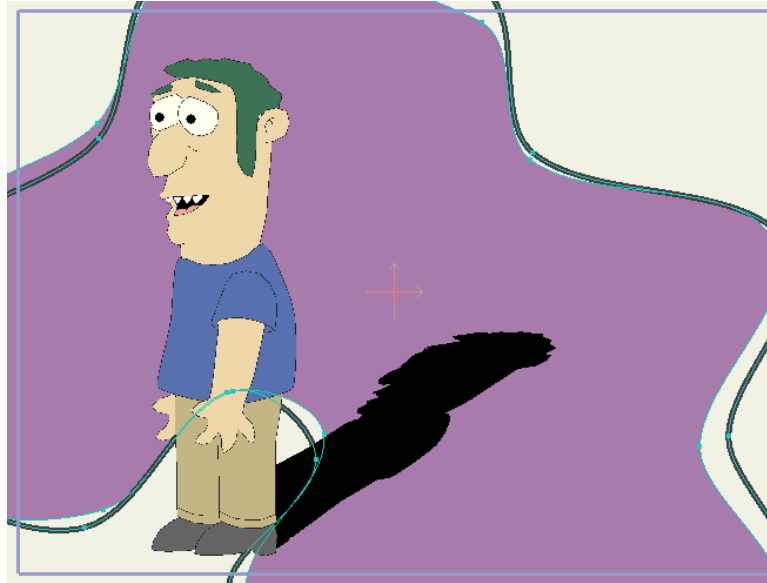
Effects
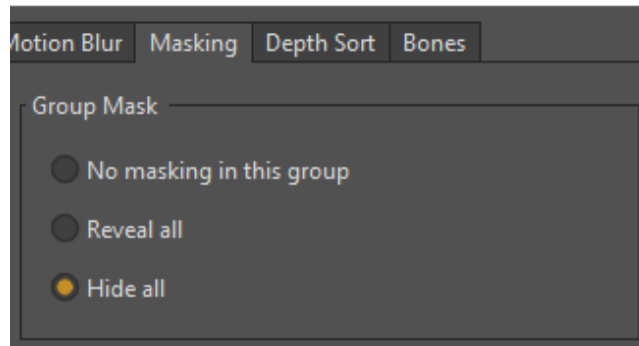
Mask settings for the Lenny Shadow layer

3. Next, double-click the Lenny layer and in the Masking tab, set the **Layer Masking** setting to **+ Add to mask, but keep invisible**. The result of these settings is that the big black rectangle will now be masked against the shape of Lenny himself:
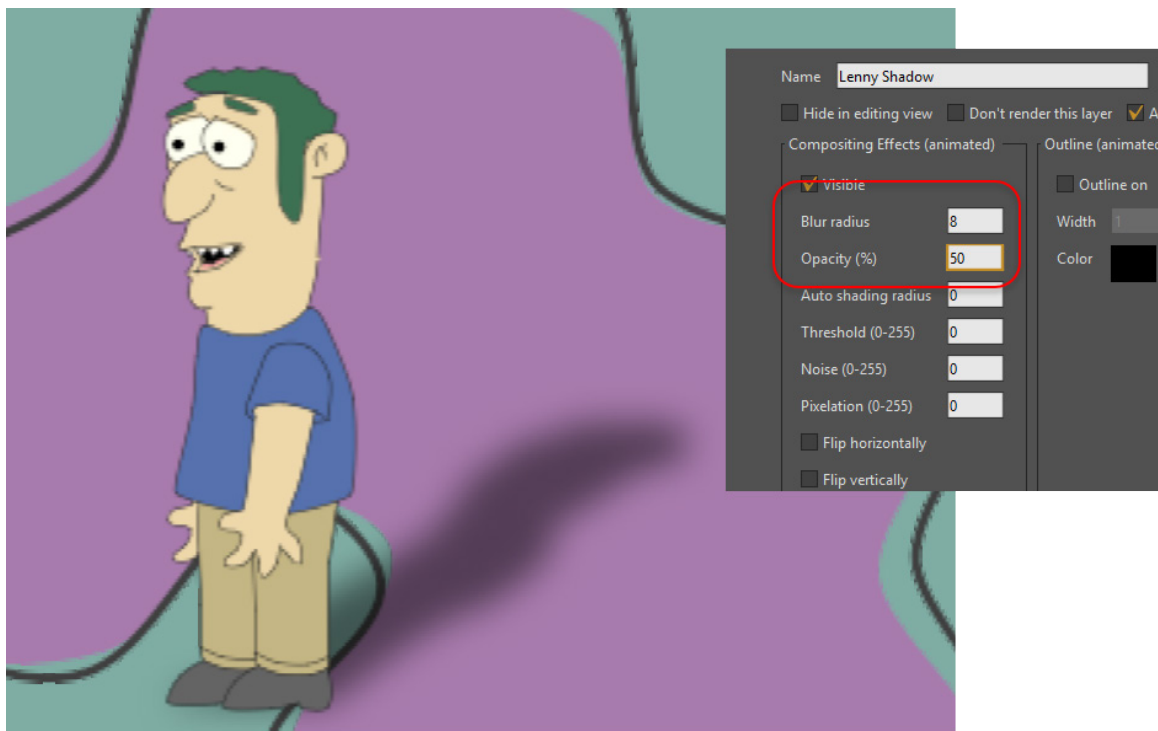

Mask settings for the Lenny layer

Effects

The shadow mask effect

4.   The final touch is to refine the appearance of the shadow. Double-click the
      Lenny Shadow layer. In the Layer Settings dialog General tab, set the Blur radius
      to 8 and Opacity to 50. That finishes the shadow effect - you can now export
      the animation as a movie file.

The adjusted shadow, rendered

The final result is also included as a Moho project file. It's called **Tutorial 6.5 Final** -
take a look at it if you have any trouble following the directions above. It's important
when using this trick to animate your subject first before you add the shadow - that
way the shadow will also be animated, leading to a more realistic effect.

Effects

Tutorial 6.9: Using 3D Models (Pro Only)

Although Moho is primarily a 2D program, it is possible to import 3D models and use them in a Moho animation. This tutorial will show you some of the things you can do with 3D models in Moho.

Import a Basic 3D Model

First, we'll try importing a basic 3D model.

1.   Start Moho and create a new, empty project.

2.   Next, select the **File > Import > OBJ 3D Model** menu command. Moho will prompt you to select a file - choose the file named **3dmodel.obj** located in the **Tutorials > 6 - Effects** subfolder within your custom content folder. Moho will import the model into a new 3D layer, and you should see something like this:
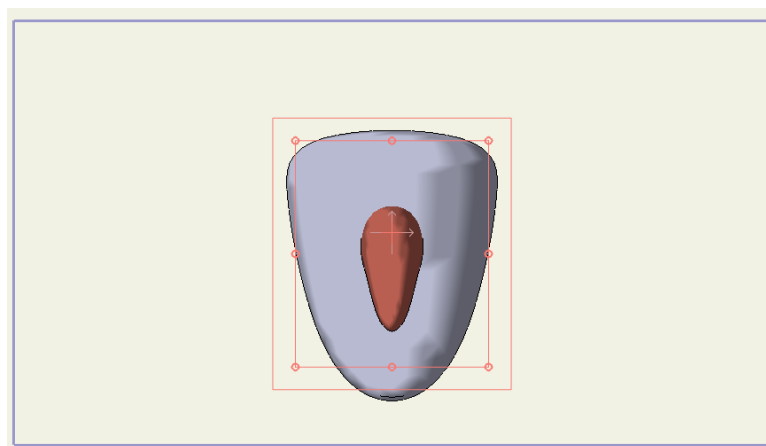

Imported 3D model

3.   Use the **Orbit Workspace** tool to rotate around the scene. As you rotate around the object, notice that it never appears flat from any side (like a vector layer) - it is a true three-dimensional object.

This object was created in a program called Wings 3D (http://www.wings3d.com). Whether you choose create models in Wings 3D or another 3D program, be sure to export them as OBJ files. OBJ is a common 3D file format that most 3D programs support, and is currently the only 3D format that Moho can import.

The colors of this model have been defined in the file **3dmodel.mtl** *- this is a material file that Wings 3D created along with the model itself. You cannot change the colors of a 3D model within Moho. However, you can change the color and width of the outline in the Layer Settings dialog, under the 3D Options tab, discussed in* **"3D Options (Pro Only)" on page 250 in your Moho Users Manual**.

Effects
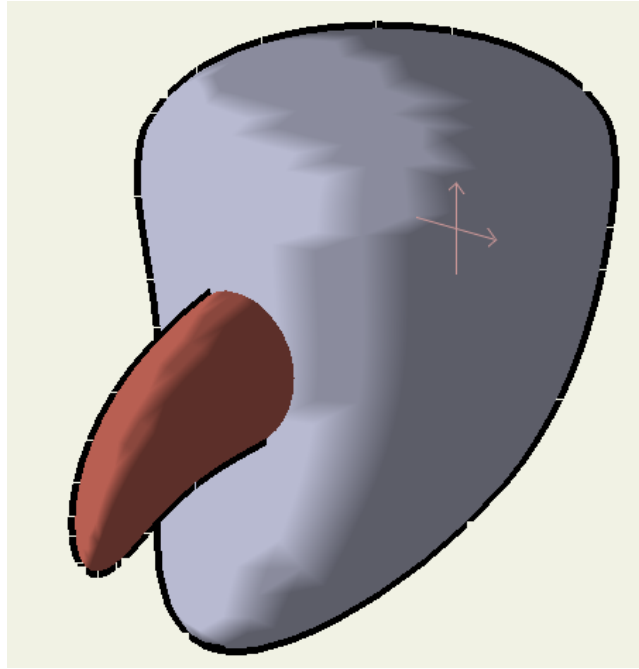
Side view of 3D model

Using 3D Models in a Face

Next, we'll show an example of how you can use a 3D model in the construction of a character's face. One of the limitation's of Moho's 2D nature is that it is difficult to rotate a head in 3D space. Using a 3D model can solve this problem.

1. Open the file **Tutorial 6.8** located in the **Tutorials > 6 - Effects** subfolder within your custom content folder. This is a completely finished animation - play it back to see what's going on.
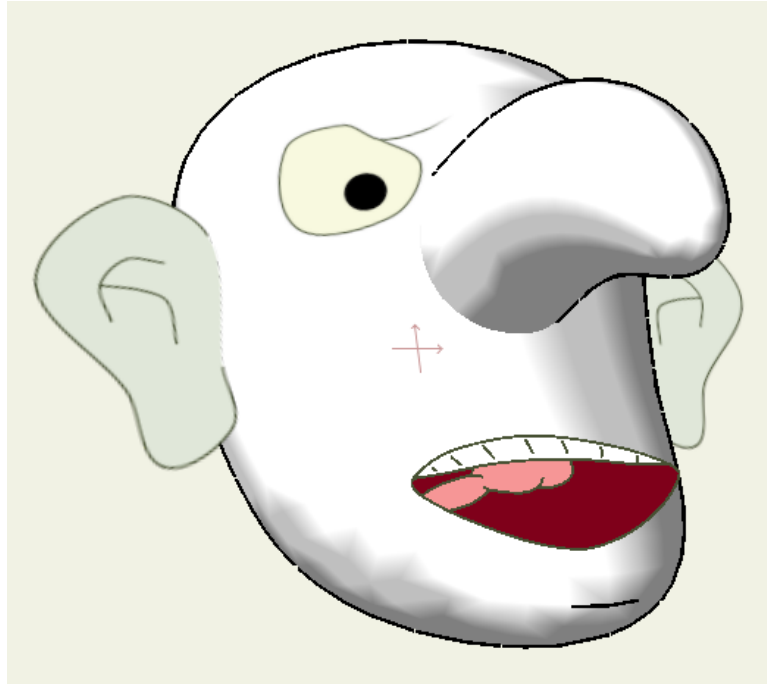
Face pointing up and right
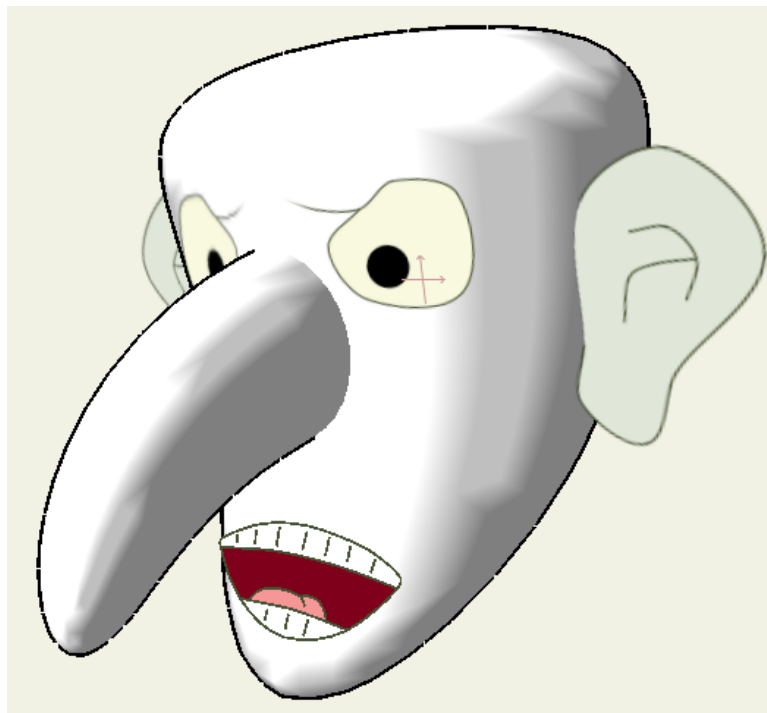
Now pointing down and left

2. Notice that unlike most faces in Moho, this one can freely turn from side to side. This is because the head and nose (the major 3D structures in a face) are built as actual 3D models. The mouth, eyes, and ears are all 2D vector layers that have been arranged in 3D space around the head.

3. The only other trick involved in getting this character's head to work was sorting the head and ears. Notice that the main 3D head shape and the ears are

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grouped together. This is so that those three shapes can be depth-sorted. As the head turns from side to side, one of the ears often needs to go behind the head layer and then come back in front, depending on the head's angle. Depth sorting is used to easily accomplish this reordering.

Textures and Scenery

Moho can also make use of textures on 3D models. You can't create the texturing within Moho itself, but if your imported 3D model uses texture maps, Moho will use them when it imports the model.

Now open the file **Tutorial 6.8_2** located in the **Tutorials > 6 - Effects** subfolder within your custom content folder. This scene makes use of the 3D model **simple_scene.obj**, which in turn uses a texture map file:

A textured 3D scene

One of the things you may notice in this scene is that the scenery has detailed shadows and shading on it. Moho does **not** provide lighting and shading for 3D models. Instead, these effects are part of the texture map for this 3D model. In this case, a separate 3D program was used to calculate the lighting effects and bake them into the texture map.

Of course, the other element in the scene is a regular Moho 2D animated character. Although this character is composed of 2D vector layers, it can be positioned in true 3D space, so it is quite easy to integrate it into the 3D scene.

Conclusion

We've looked at just a couple possible uses for 3D layers - with a little thought you can probably come up with many more. Keep in mind that Moho is still primarily a 2D program, so don't expect Moho to replace a true 3D modeling and animation program. However, for limited uses, like background scenery or a few parts of a character, 3D layers in Moho can be very useful.

Effects

Layer Referencing (Pro Only)

Layer referencing allows you to create one or more layers that reference back to an original layer. If you make changes to the original layer, all layers that reference back to the original layer will be changed accordingly. The tutorials in this chapter will step you through some of the important and exciting capabilities of layer referencing.

## Tutorial 7.1: Reference Layer Basics

In this tutorial you'll learn some basic principles relating to layer referencing. You'll begin with a project that is included in your User Content folder, and create several reference layers of the star in Layer 1.

1. Open Tutorial 7.1 Start.moho, located in the 7 - Layer Referencing folder in your User Content folder.

A single layer in the Document window

2. The Reference Layer button in the Layers palette is clicked for each new reference layer that you want to create. Each time you click the Reference Layer button, it will create a copy of the original layer (similar to the Duplicate Layer button), except that this reference copy will refer back to the original layer. To create five additional instances of the star, simply click the Reference Layer icon at the top of the Layers palette. When you initially create a reference layer, it is placed directly on top of its original layer.

Reference layer icon

Reference
layer

Original
layer
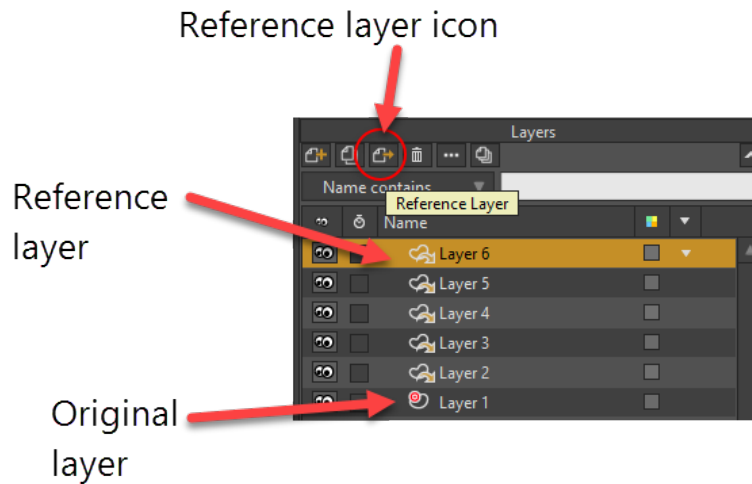
Reference Layer icon and five additional reference layers added to the scene.

3.   After you make all your copies, select each layer one at a time and move
     them into position on Frame 0. Move the reference layers into position with the
     Translate Layer tool as shown below.
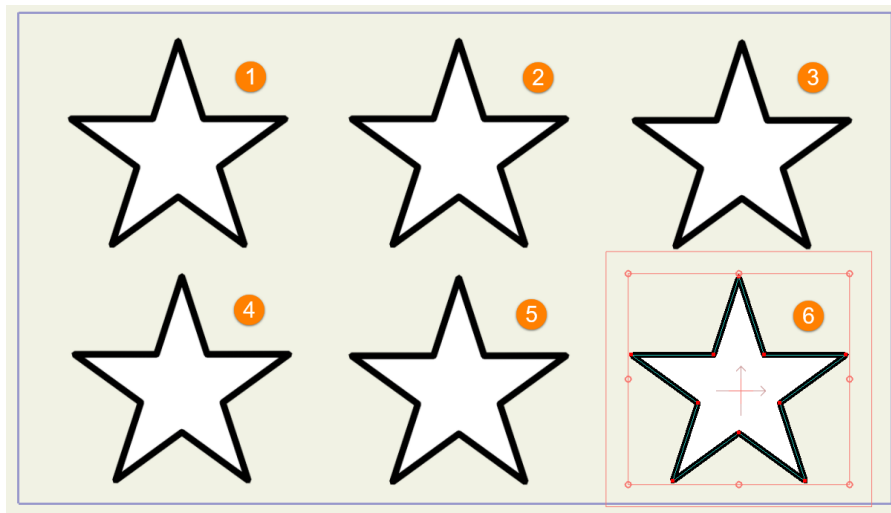
*Reference layers moved into position with the Translate Layer tool (layers 1-3 on top,
layers 4-6 on the bottom).*

4.   When you make changes to the original layer (Layer 1) those changes will
     automatically be applied to each of the references. To demonstrate this, select
     Layer 1, and choose a new fill color in the Style window. That color change is
     automatically applied to Layers 2 through 6.

5.   Reference layers also inherit other animatable properties such as translation and
     rotation. To demonstrate this, select the Transform Layer tool, and rotate layer 1.
     Now your project should look similar to the following.

Layer Referencing (Pro Only)

The color and rotation changes of the original Layer 1 (selected) are applied to reference layers 2 through 6.

6.   Other animateable changes are also replicated. For example, use the Transform Points tool to move one of the points in the star on Layer 1. That same point will move in the reference copies on Layers 2 through 6.
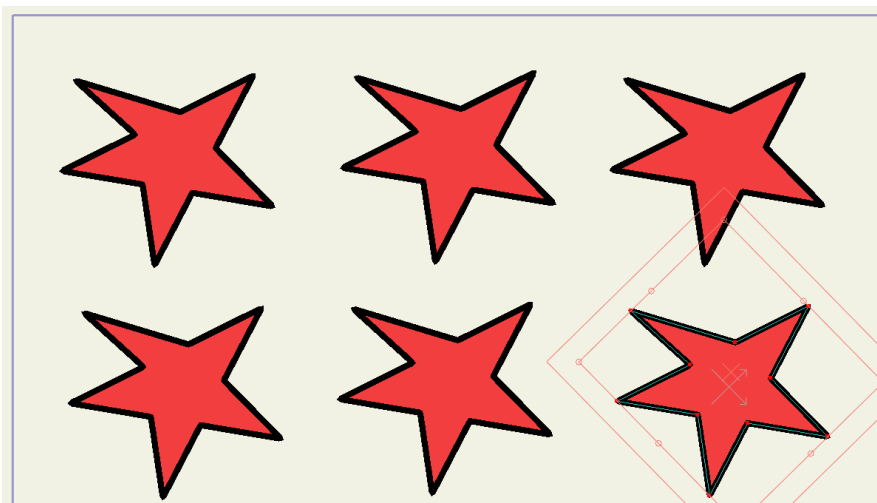
Point transformations are also replicated on reference layers.

7.   You'll also notice that reference layers also inherit animated properties. To demonstrate this, click in Frame 24, and make some changes to animate some of the points in Layer 1.

8.   Next, click on Frame 48 and animate more points in Layer 1.

9.   Now go back and play the animation. All of the animated points play together.

10.   Save this project as **Tutorial 7.1 Finished.moho**. A copy of this completed project is furnished in your User Content folder.

Layer Referencing (Pro Only)

Tutorial 7.2: Breaking and Updating Reference Layer Connections

In the previous tutorial you learned what happens when you make changes to the original layer in a project. Those changes are passed on to any layer that references back to that original layer.

In this tutorial, you'll learn how you can break connections with the original layer when you make changes to a reference layer. You can either continue on from your previous tutorial, or open the **Tutorial 7.1 Finished.moho** file that is found in your User Content folder.

1. Continue from the project that you completed in the previous lesson, or open **Tutorial 7.1 Finished.moho**, which is located in your User Content folder.

2. Go back to Frame 0. Select Layer 4, which is one of the reference layers in the project.

3. Click the star with the Select Shape tool, and then change the fill color in the Style window.
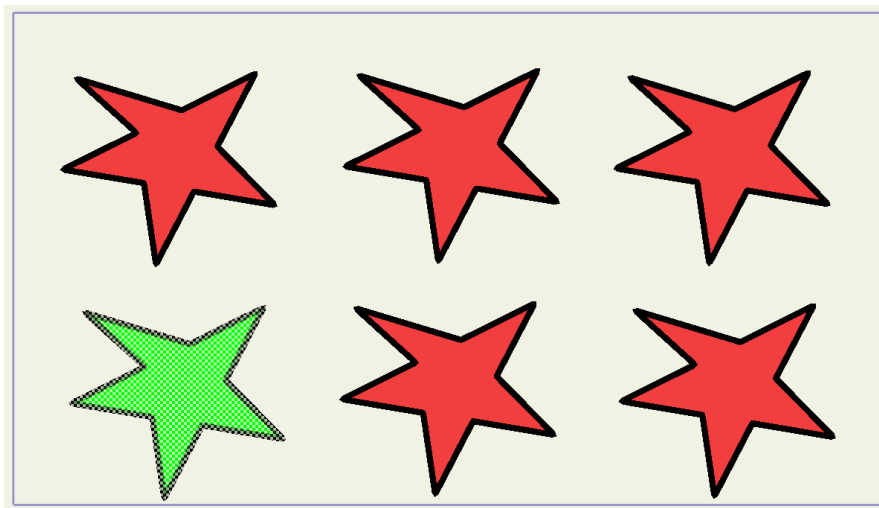
Change the color of Layer 4, which is one of the reference layers.

4. Now, select the original layer (Layer 1), and click the star in Layer 1. Change its fill color in the Style window.

5. Now play your animation from the beginning. You'll notice that even though the color of Layer 4 has changed, it still animates with the other layers.

Layer Referencing (Pro Only)
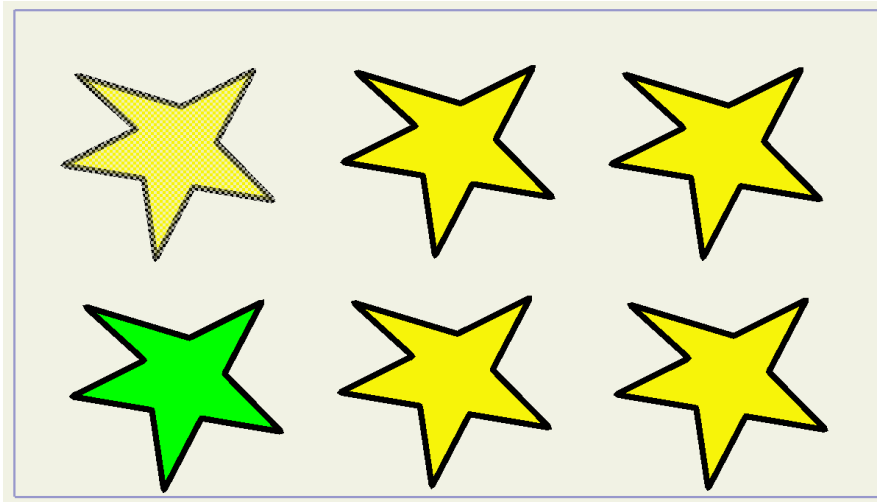
Change the color of Layer 4, which is one of the reference layers.

ⓜ *Steps 3 through 5 demonstrate that when you change a reference layer, it will break the connection of that particular property with the original layer. In this case, the only connection that is broken is the Color property. The color connection has been broken between Layer 4 and the original layer, but the animation that you created in the previous steps will remain connected.*

6.   With the original layer selected, advance to frame 38 in the timeline.

7.   Change the stroke color of the original layer. The stroke color change will be applied to all layers, including the layer that had the fill color changed.

8.   Play the animation again. The change in the stroke color will be animated.

At frame 38, change the stroke color of Layer 1 (the original layer).

9.   Now select Layer 4 again (the reference layer that has a different fill color). Make some structural changes on Frame 0, such as adding some points and

Layer Referencing (Pro Only)

changing the shape. The the following figure shows some additional points added, and changes to the shape.
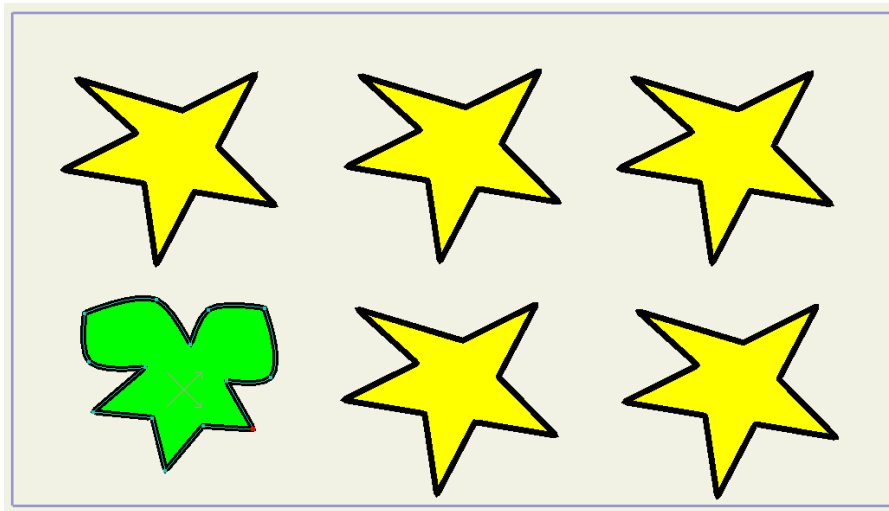

At frame 0, add some points and change the shape of Layer 4.

10. Play the animation again. You'll notice that Layer 4 still animates with the other layers, but the new points have broken the connection with the shape of the original layer and all the other reference layers that remain connected to its shape.

> *Layer 4 will still animate with the other layers, but the new points in Layer 4 have broken the connection with the shapes of the other layers that remain connected to the original layer. If you later make changes to the shape of original Layer 1, those changes will not be applied to Layer 5.*

11. Notice in the Layers palette that Layer 4 (the reference layer that has been changed) has a different icon. The badge shows a red arrow to indicate that there is a mismatch with the original layer.
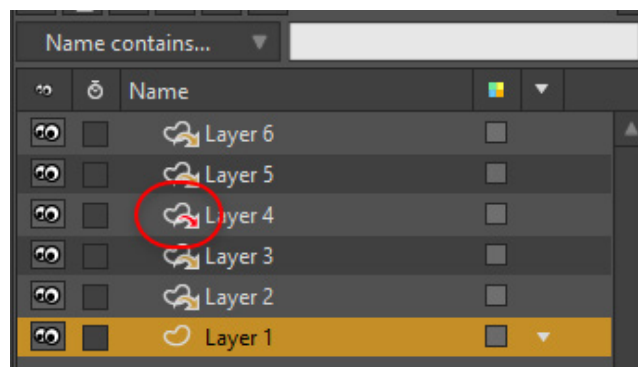

The arrow in the reference layer icon is red to indicate there is a mismatch between Layer 4 and the original layer.

12. Right-click Layer 4 to view the menu options. Choose **Update Layer Reference** to open the Reference Update Options dialog.

Layer Referencing (Pro Only)
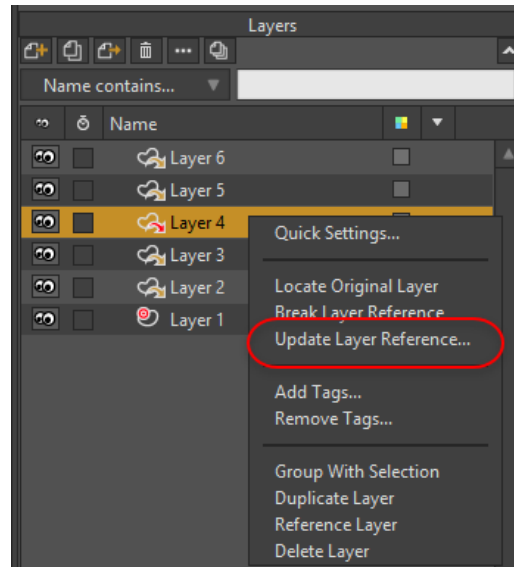
Choose Update Layer Reference.

13. In this dialog you check or uncheck the items that you want to resync with the original layer. Some of the layer differences are already checked. Check the **Replace Mismatched Vectors** option to bring Layer 4 back in sync with the original layer.

14. Save this project as **Tutorial 7.2 finished.moho**. You will find a copy of this completed project in your User Content folder.
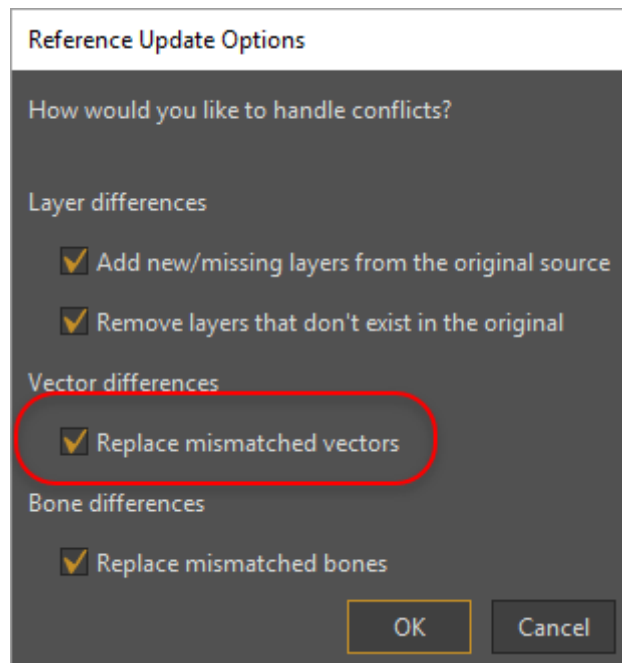

Choose Replace mismatched vectors to bring the shape of Layer 4 back in sync with the original layer.

Layer Referencing (Pro Only)

Tutorial 7.3: Breaking and Updating Original Layer Connections

In the previous tutorial you learned how you can break and update connections between a reference layer and the original layer. You can also break connections between the original layer and all of the other reference layers.

To follow this tutorial, you can start where you left off at the previous tutorial, or open **Tutorial 7.2 Finished.moho** from your User Content folder.

1. With **Tutorial 7.2 Finished** opened, select the original Layer 1. At Frame 0, add some points to it with the Add Point tool, and change the shape a little with the Translate Points tool.
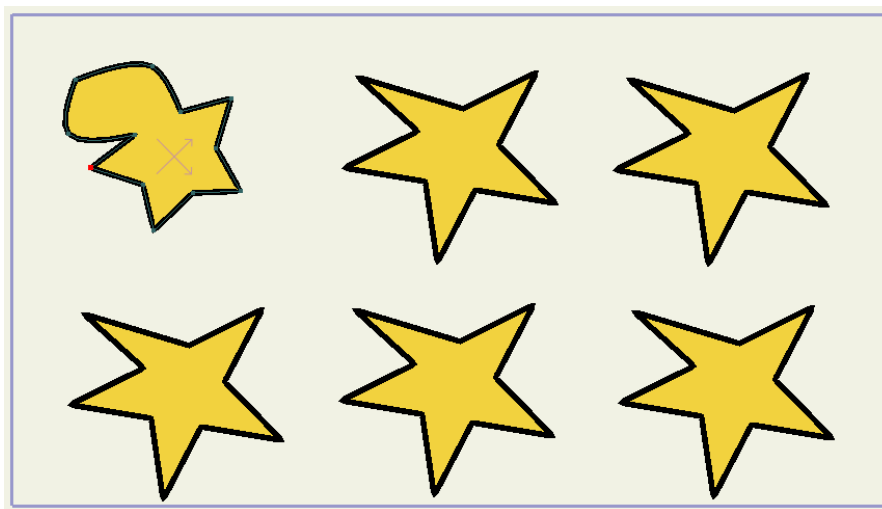
*At frame 0, add some points and change the shape of Layer 1.*

2. You'll notice that making this change breaks the connection with all of the other reference layers. The icons for the reference layers display a red arrow when the connections are broken.
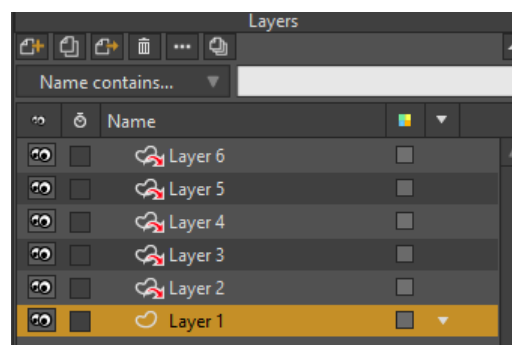
The reference layer icons turn red when you change the number of points in the original layer.

3. To reconnect one of the reference layers with the original layer, first select Layer 2. Right-click the layer and choose Update Layer Reference.

Layer Referencing (Pro Only)
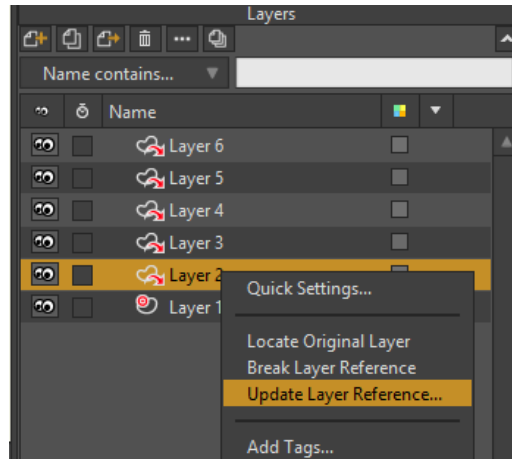
Choose Update Layer Reference.

4. From the Reference Update Options dialog, choose **Replace Mismatched Vectors** again to bring Layer 2 back in sync with Layer 1. Now Layer 2 has the new shape of Layer 1.
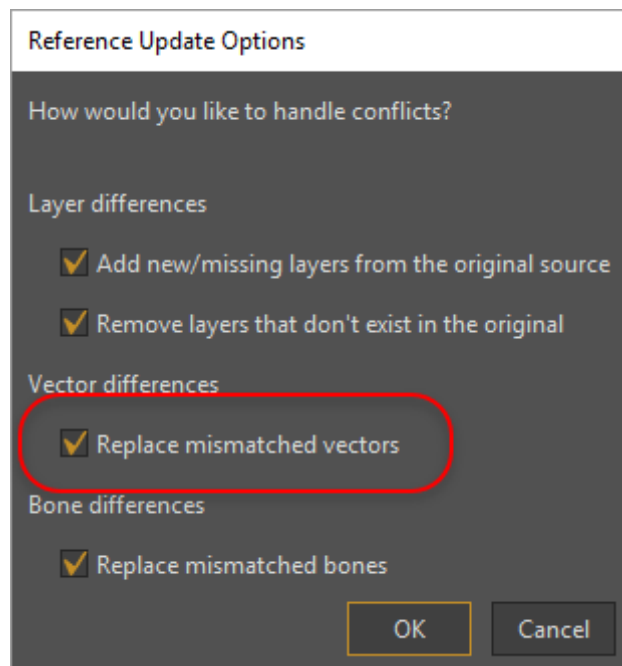
Choose Replace mismatched vectors to bring the shape of Layer 2 in sync with the new shape of the original layer.

5. Repeat steps 3 and 4 for each additional layer that you want to sync back up to the reshaped Layer 1. In our finished example, Layers 1 through 3 are in sync again, and Layers 4 through 6 are mismatched. You will find a copy of the finished project in your User Content folder, saved as Tutorial 7.3 Finished.moho.

Layer Referencing (Pro Only)
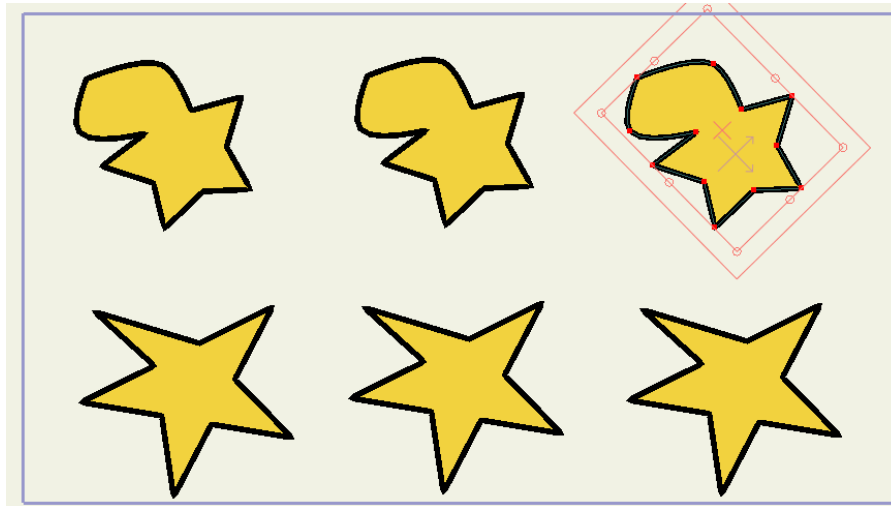
At frame 0, add some points and change the shape of Layer 1.

As your scene and reference layers become more complex it can be difficult to determine which layer a reference layer is linked with. This is easy to remedy. Right-click on the layer that you are not sure of. Then choose **Locate Original Layer**. *Moho will immediately select the original layer that the reference layer is connected with.*

You can also turn a reference layer back into a normal layer. Right-click on a reference layer and choose **Break Layer Reference**. *It will retain any properties that were added to the layer while it was referenced to the original layer.*

Tutorial 7.4: Using Reference Layers for Masking

In this tutorial you will work with a file that contains an eyeball that consists of three layers: Eye, Pupil, and Lid.
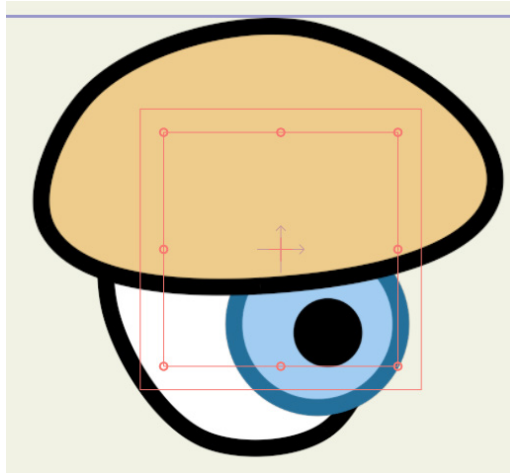
The pupil and lid layers will need some masking to follow the shape of the eye.

The pupil and lid layers in this eye will have to be masked so that they follow the shape of the eyeball. We can use Masking on the Eyeball group to mask the layers so that the areas outside the Eye layer are hidden. Follow these steps:

1.   Open **Tutorial 7.4 Start.moho**, which you will find in the **7 - Layer Referencing** folder in your User Content folder.

2.   Double-click the Eyeball group layer, and switch to the Masking tab. Set the Group Mask setting to Hide All. The bottom layer (Eye) is used for the mask, and the other layers (Pupil and Lid) are masked against it. However, you'll notice that the lid does not have the same outline that the other layers do.
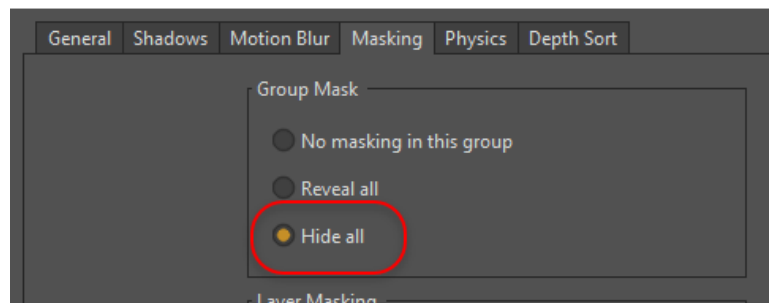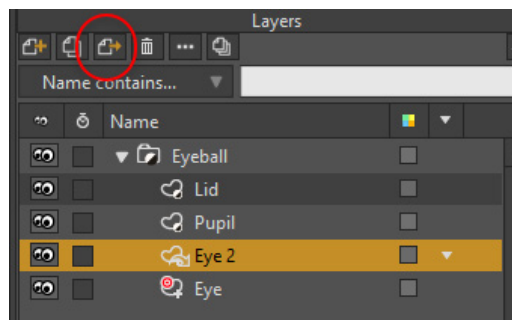

Set the Masking on the Eyeball layer to Hide All.
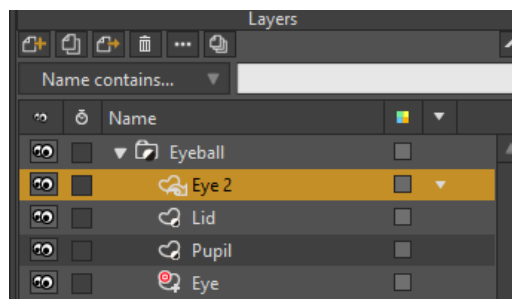
Layer Referencing (Pro Only)
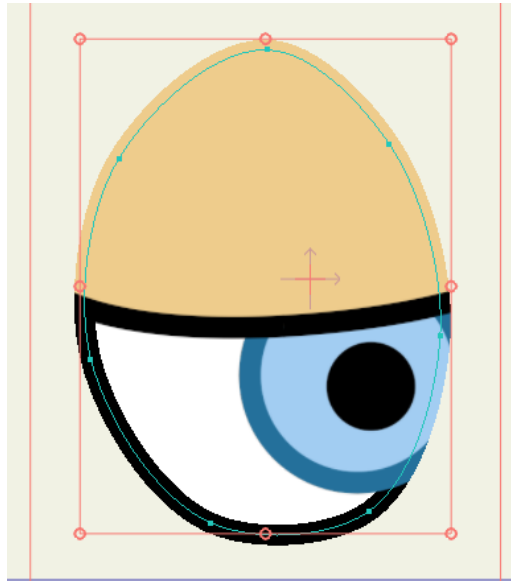
The eyelid lacks an outline.

3. While the Exclude Strokes option in the Masking tab can be used as a workaround for this, Layer Referencing offers a more powerful alternative. First, Select the **Eye** layer, then click the **Reference Layer** button to create a reference layer named Eye 2.

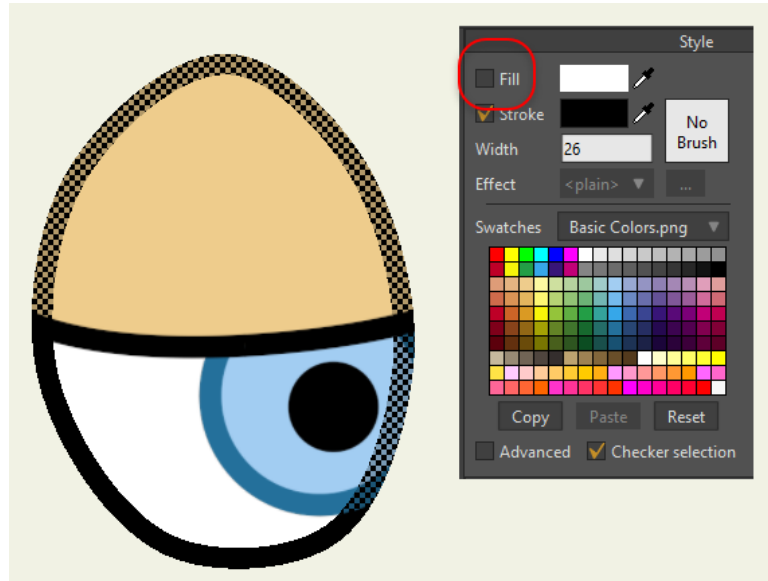*Click the Reference Layer button to create a copy of the eye.*

4. Move the Eye 2 reference copy up above all the other layers.

Move the Eye 2 layer above the other eye layers.

5. Now, select the Eye 2 layer with the Select Layer tool, and turn off the fill for the eye. Now you have an outline that surrounds the entire eye as you would expect.
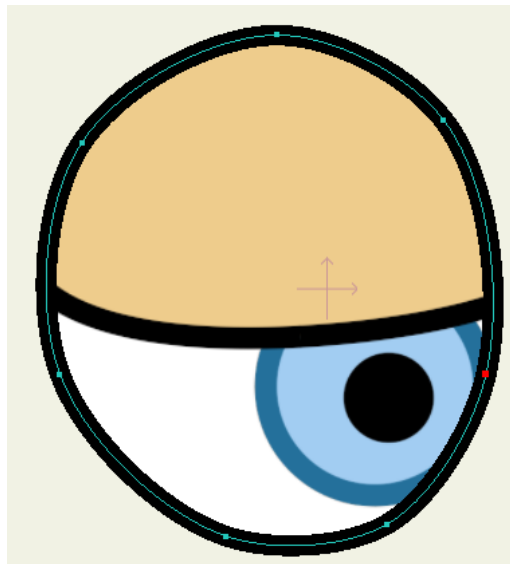
Layer Referencing (Pro Only)

Select the Eye with the Select Shape tool, and turn off the fill.

Alternatively, you can leave the fill on but adjust the transparency of the fill layer so that you can see the other elements through the Eye 2 layer.

6.   Now you can modify the shape of the original Eye layer with the Translate Points tool, and those changes will automatically be applied to the Eye 2 reference layer.

When you change the shape of the Eye layer, the outline on the Eye 2 layer automatically follows the new shape.

7.   Save the project as **Tutorial 7.4 Finished.moho**, if desired. A copy of the completed project is included in the **7 - Layer Referencing** folder in your Moho User Content folders.

Layer Referencing (Pro Only)

Tutorial 7.5: Referencing External Documents

Assume that you are working on a project that is divided amongst several people You are the animator, and other members of the team include a character artist and a background artist. You work in different offices or in different parts of the country. Layer referencing offers a way that you can easily collaborate on your project, because you can reference external documents in a Moho project.

In the project that follows you (as the animator) will create a new document that references two other documents that you will find in the **7 - Layer Referencing folder** in your User Content folder. These additional files represent the character and background art that other people are working on. In actuality, you'll make some minor changes to these files to demonstrate how the changes will be reflected in the project that the animator is working on.

Layer referencing can also be used by a person who wants to use the same character in more than one project. This allows you to create your character once, and then reference it in as many projects as you like. Then you can change rigging or colors or make other changes in the original character file, and those changes will carry through to all the projects in which that referenced character is used.

Part 7.5.1: The Main Project Document

1. Create a new document. Choose **File > Import > Moho Object**, and choose the **Background.moho** file.

2. When the Import Object dialog appears, select the Background (do not import the Future Work layer). Make sure you check the **Import by reference** checkbox in the Insert Object dialog.
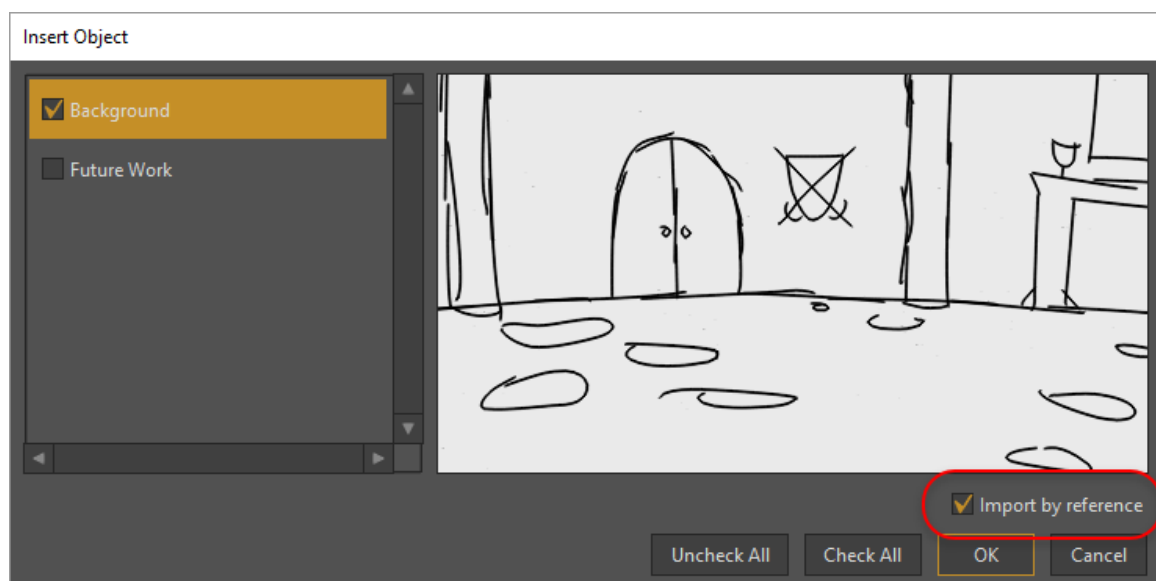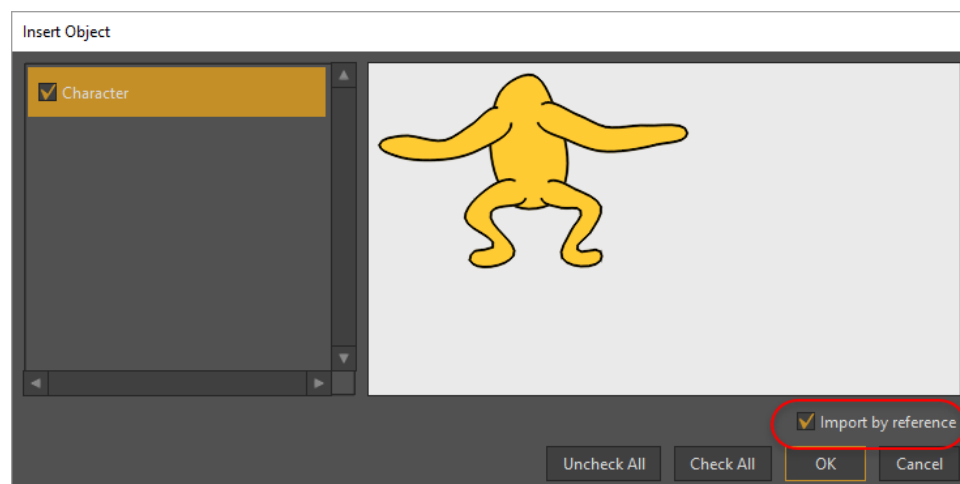

Check the Import by Reference option to import the working background.

Layer Referencing (Pro Only)

3. Click **OK** to import the background project, which is a quick sketch of the project that the background artist is working on. Moho inserts a reference copy of the document into your project. The icons in the Layers palette show a green arrow to indicate that an external file is referenced.
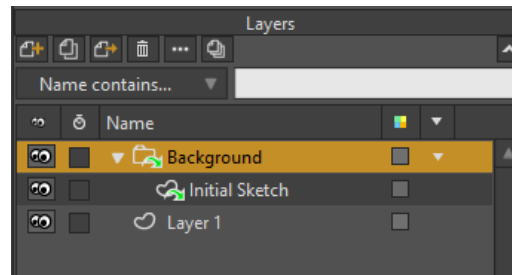

The reference layer icon shows a green arrow to indicate a reference to an external document.

4. Now you can import the artwork that the character artist is working on. Choose **File > Import > Moho Object** again, and choose **Character.moho**.

5. Make sure that the **Character** is checked, and also check the **Import by Reference** checkbox in the Insert Object dialog. Then choose **OK** to import the character.

*Check the Import by Reference option to import the working character.*

6. Select the Character layer, and use the Transform Layer tool to move the character to the left side of the scene on frame 0.

Layer Referencing (Pro Only)
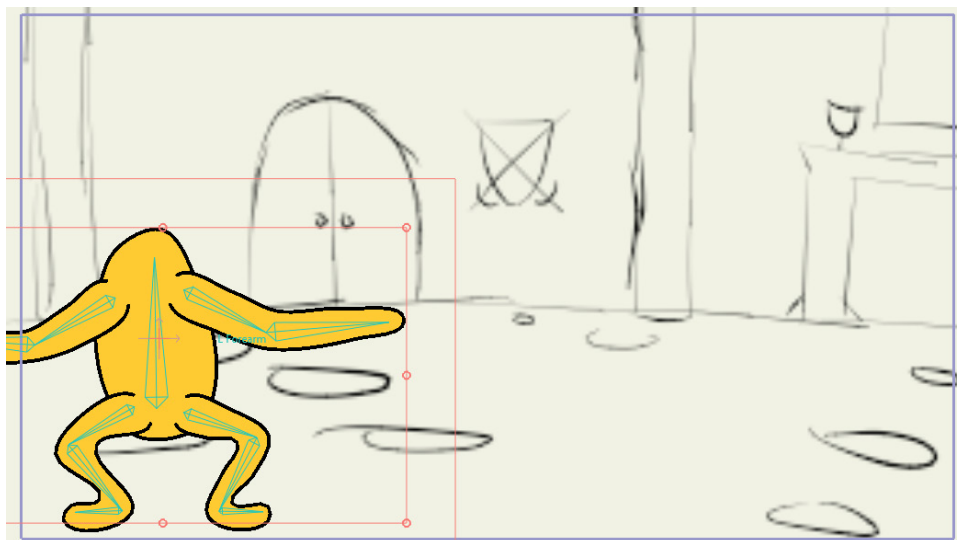
*Move the character to the left side of the scene.*

7.   Now add some simple animation to the camera using the Zoom Camera and Pan Camera tools, similar to that shown in the following figure.

▪   Zoom and pan the camera closer and to the left side of the scene in frame 0.

▪   At frame 96, zoom out again and pan toward the right side of the scene.
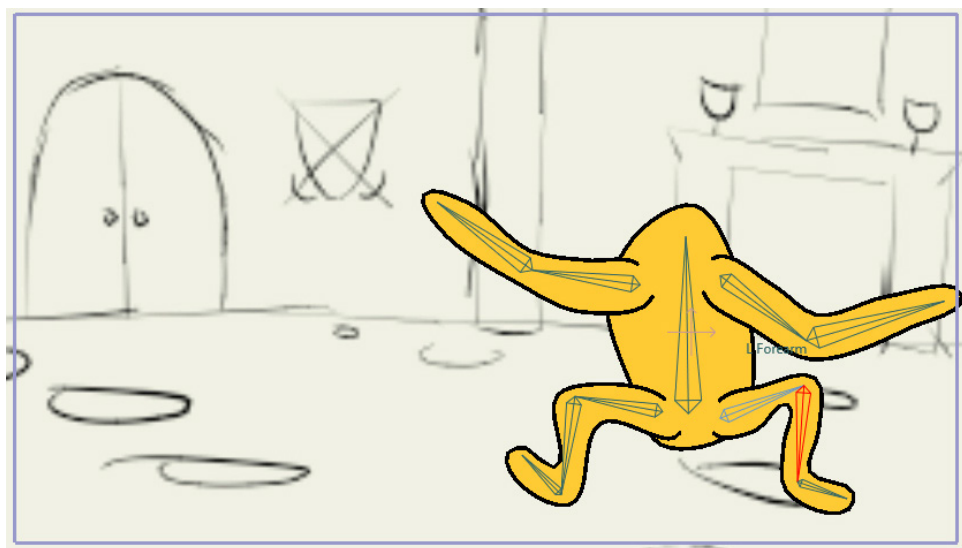
Layer Referencing (Pro Only)
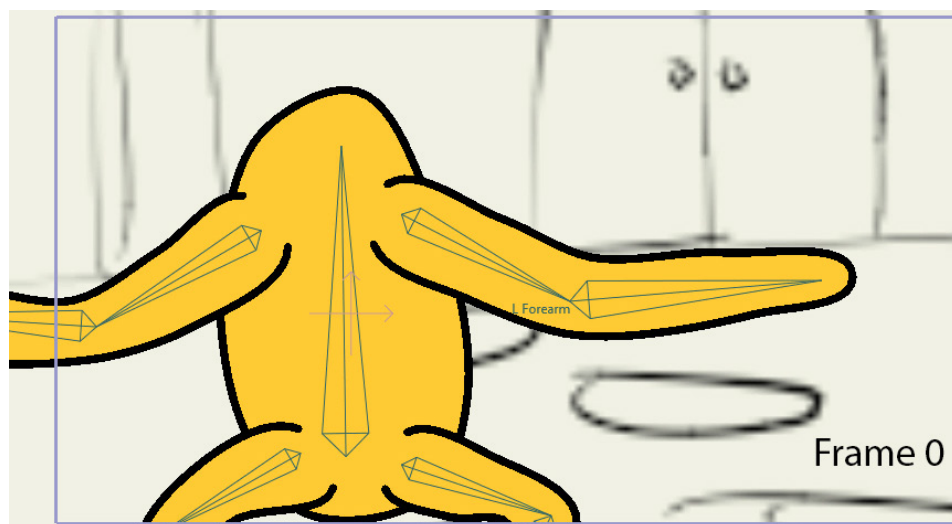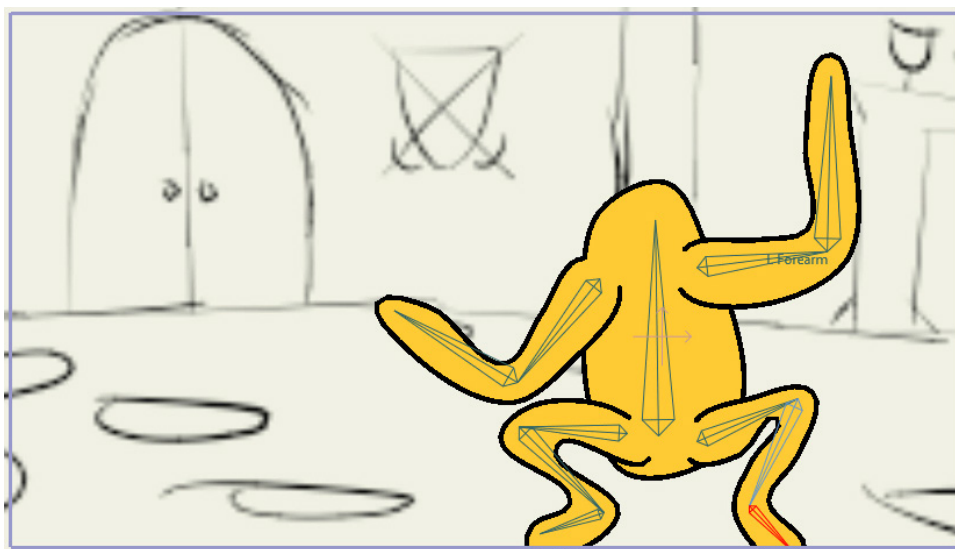
Frame 0

Frame 96

Camera positions at frames 0 and 96.

8. Now you'll work backward to add some simple animation to the arms and legs of the character, similar to the following figures:
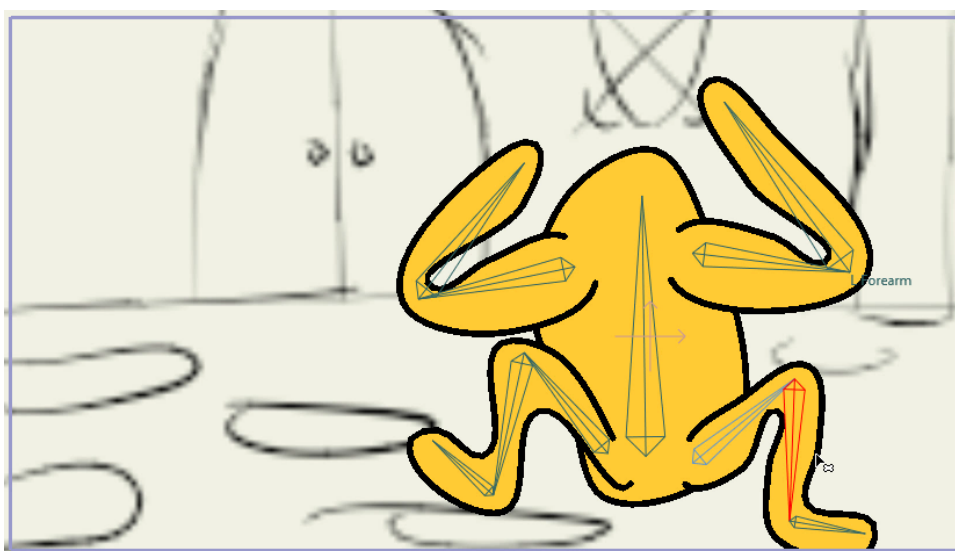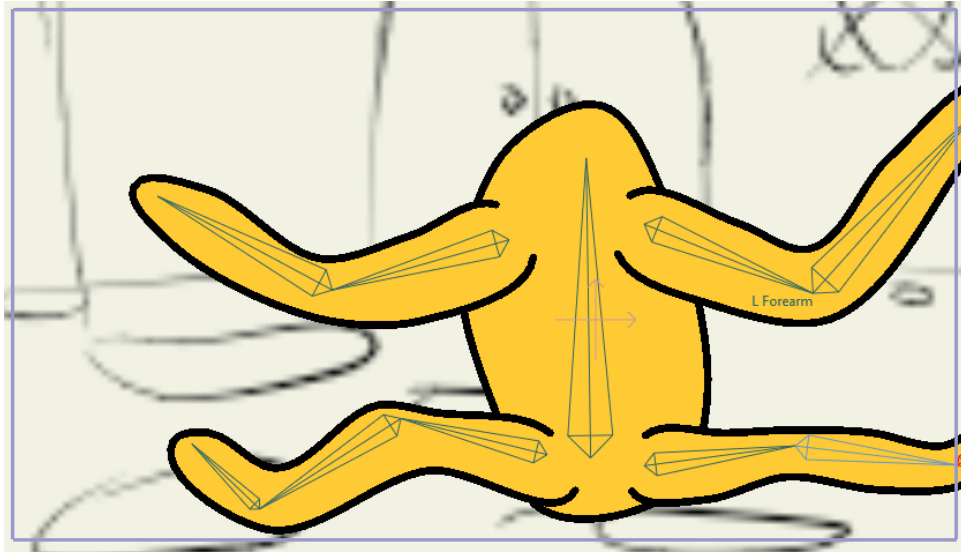
Layer Referencing (Pro Only)
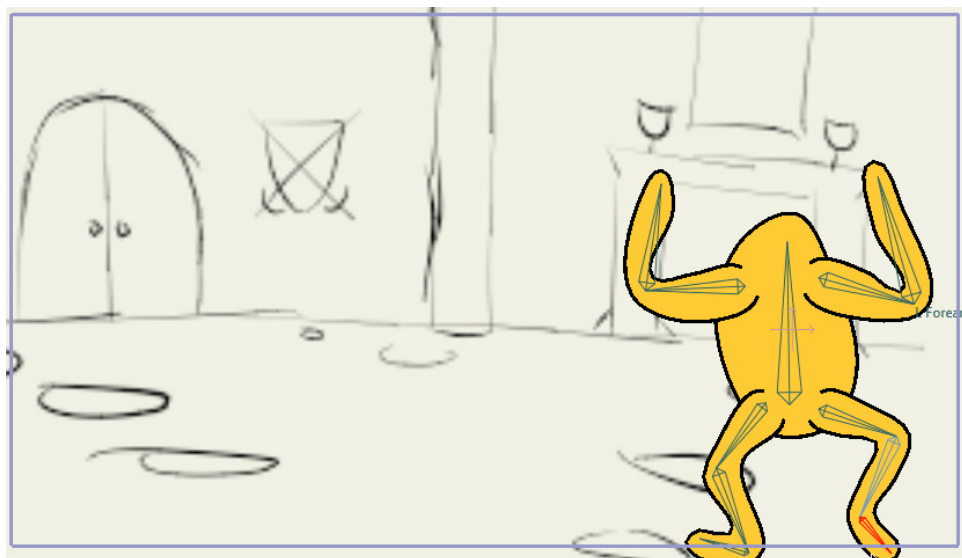
Arms and Legs at Frame 96.

Arms and Legs at Frame 78.

Layer Referencing (Pro Only)

Arms and Legs at Frame 60.

Arms and Legs at Frame 42.

Layer Referencing (Pro Only)

Arms and Legs at Frame 24.

9. Now rewind and play the project to watch all your hard work.

10. Save your project at this point, to a file location and filename of your choice.

Part 7.5.2: Adding a New Layer to the Character

While you've been working on the animation, the other two people have been working on the background and character artwork. You get word that there are updates to the character.

But to simulate the updates that have been made to the character, you'll have to make a few simple changes to the character.moho file yourself. To simulate this:

1. Open the **character.moho** file, and select the **L Leg** layer in the Character group.

2. Create a new vector layer named **Eyes**.

Layer Referencing (Pro Only)
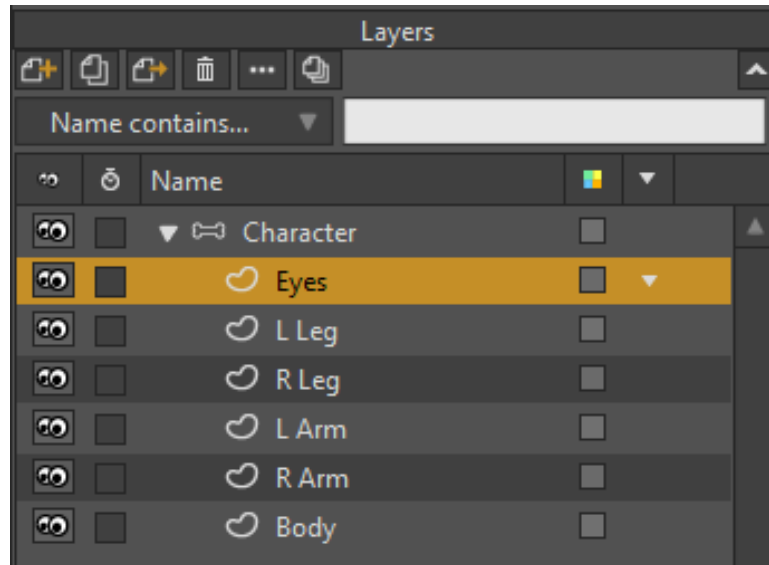
Create a new Eyes layer in the Character.moho file.

3.   Click the **Reset** button in the Style window to reset the stroke and fill properties to their default color and size. Then use the **Draw Shape** tool to add some simple eyes for the character.
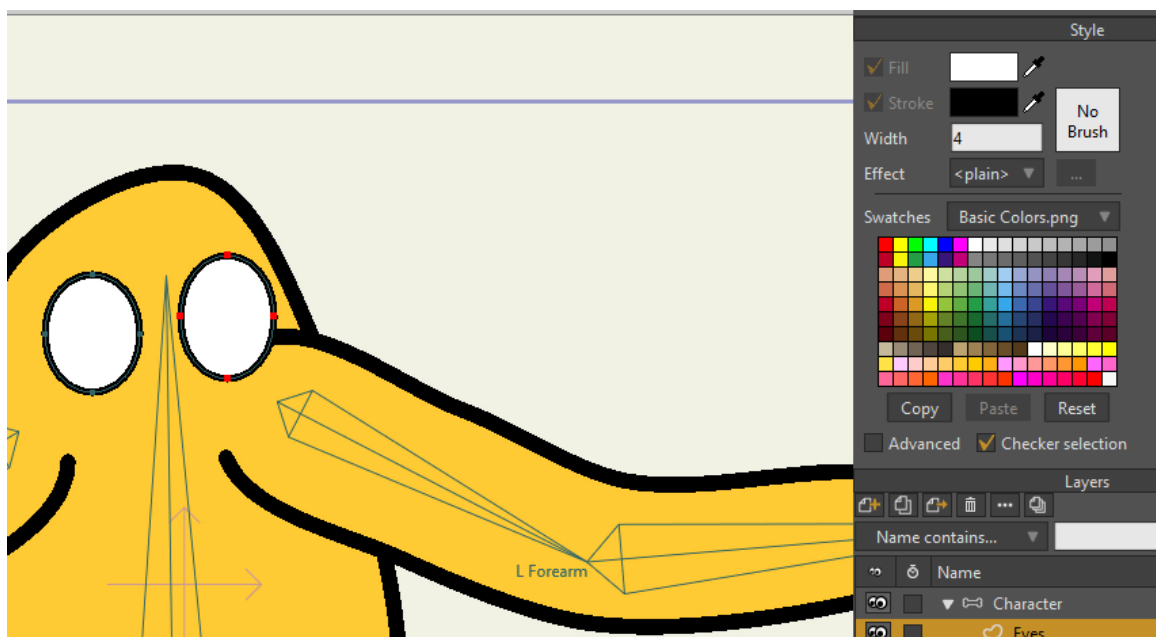

New character eyes.

> *The following step will overwrite the character.moho file that was furnished with Moho. If you want to save the original version, create a copy of **character.moho** and save it into your User Content folder as a different filename (such as **character-bak.moho** before you perform the next step.*

4.   Choose **File > Save** to save the project file, over the previous version.

Layer Referencing (Pro Only)

5. You should now be able to see the changes in your project file that contains
    a referenced copy of this file. Go back to your project and you will notice that
    the reference layer icons now display red arrows instead of green arrows, to
    let you know that there has been a change to the original character file that is
    referenced in your project.

6. Right click the **Character** group and choose **Update Layer Reference**.
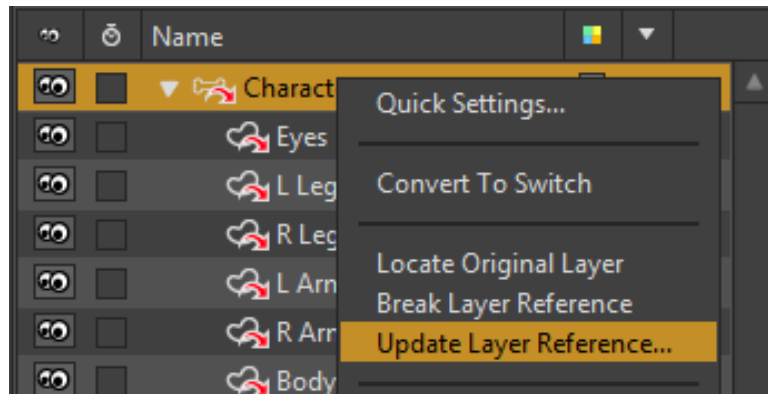
Choose Update Layer Reference.

7. The Reference Update Options dialog asks how you want to handle the
    conflicts. You know the character has a new Eye layer, so you want to make
    sure that **Add new/missing layers from the original source** is checked. The other
    options in this dialog don't really apply for the moment, but the options are:
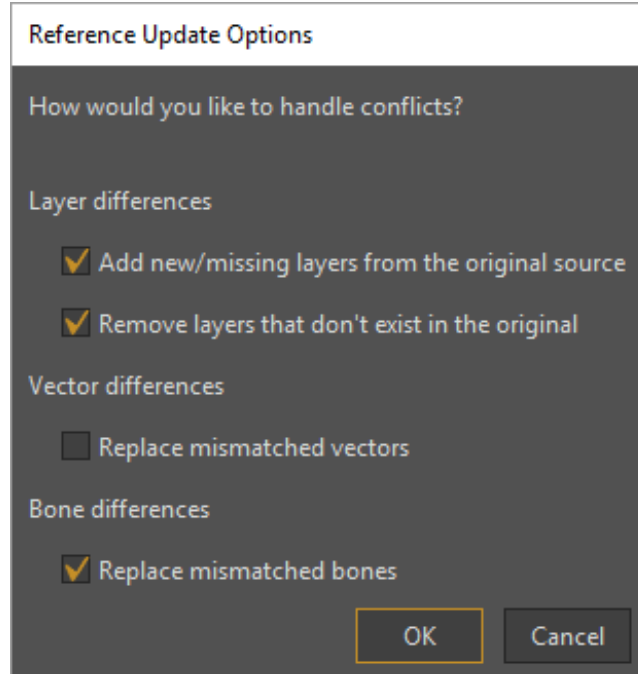

Reference Update Options.

-   **Add new/missing layers from original source**: Check this option if the
    original document contains new layers that do not exist in the document
    that references the original.

Layer Referencing (Pro Only)

- ▪ **Remove layers that don't exist in the original**: Check this option if the original document no longer has layers that currently exist in the document that references the original, because they were removed.

- ▪ **Replace mismatched vectors**: Check this option if structural changes were made to the shapes in the original document (adding or removing points).

- ▪ **Replace mismatched bones**: Check this option if changes were made to the bones in the original document.

8. Click **OK** to import the updated character into the scene. The eyes layer appears in your new document.

9. If you play back the animation you'll notice that it is still intact.
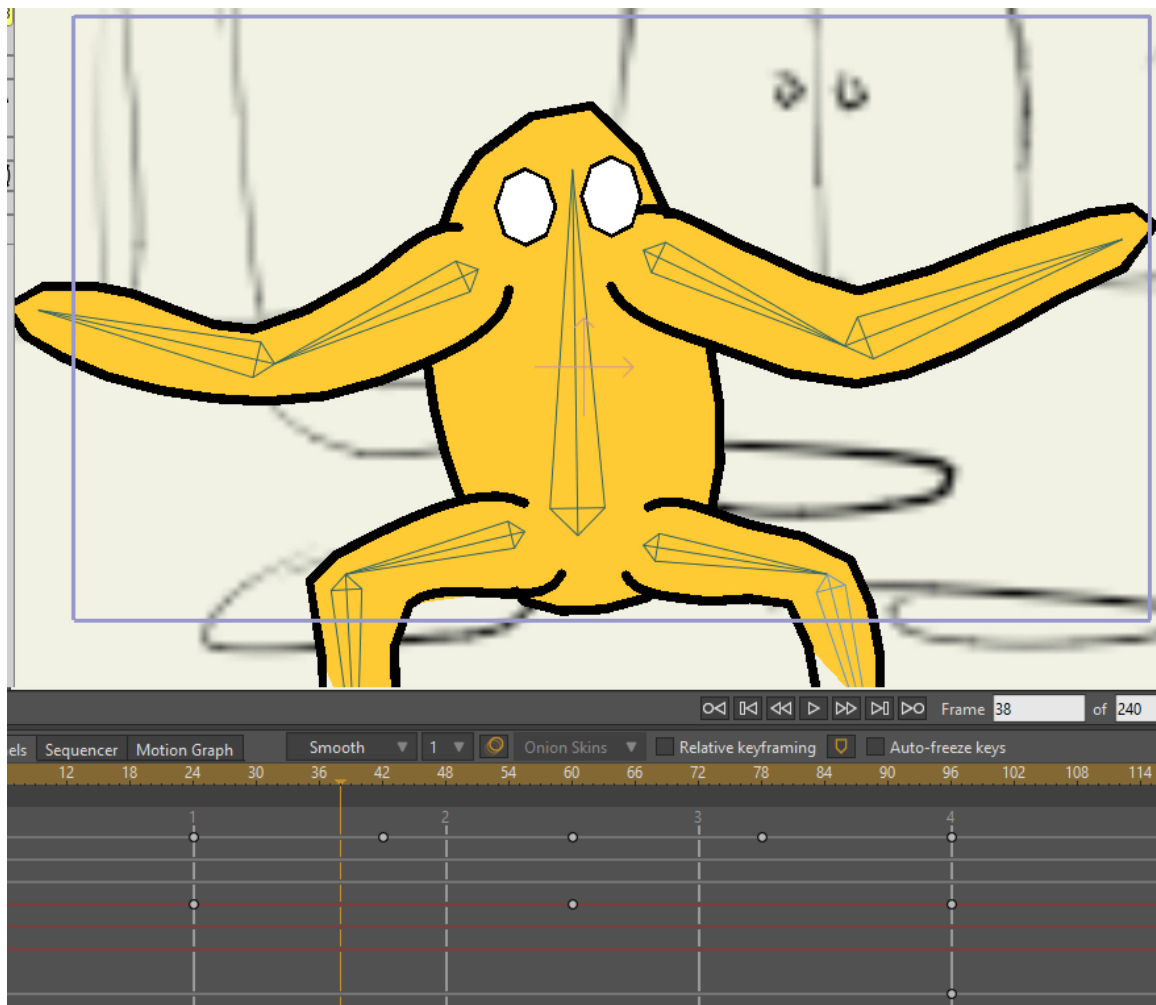
Play back the animation with the character changes.

Part 7.5.3: Rigging Changes

As you're working on your animation you notice that the bending of some of the body parts looks a little less than desireable. For example, when you bend one of the arms you notice that the arm bend looks a little squishy and could use some touching up. So you let your "rigger" know that some updates are needed.

**Layer Referencing (Pro Only)**
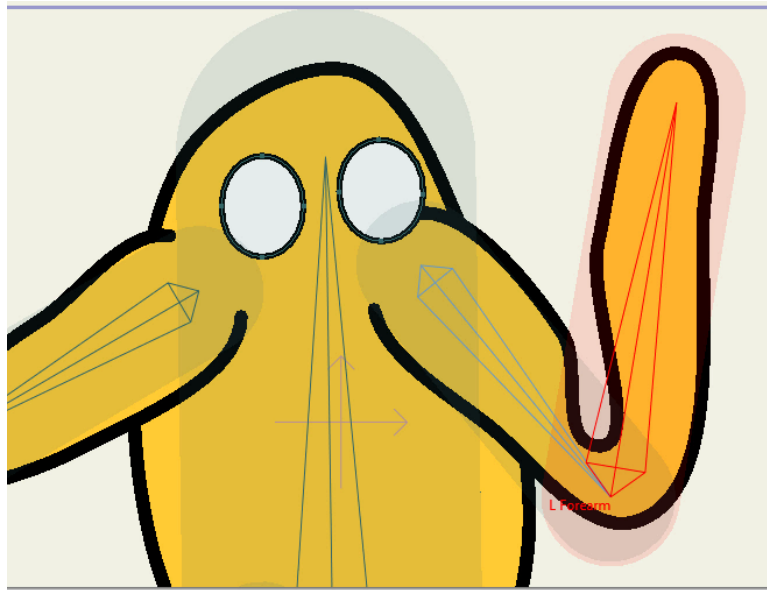
The character needs some bending improvements.

The rigger decides to add a smart bone that improves the bending of the arm. To simulate this change, you'll create a Smart Bone action that improves the bending of the left forearm bone. To simulate the changes, follow these steps:
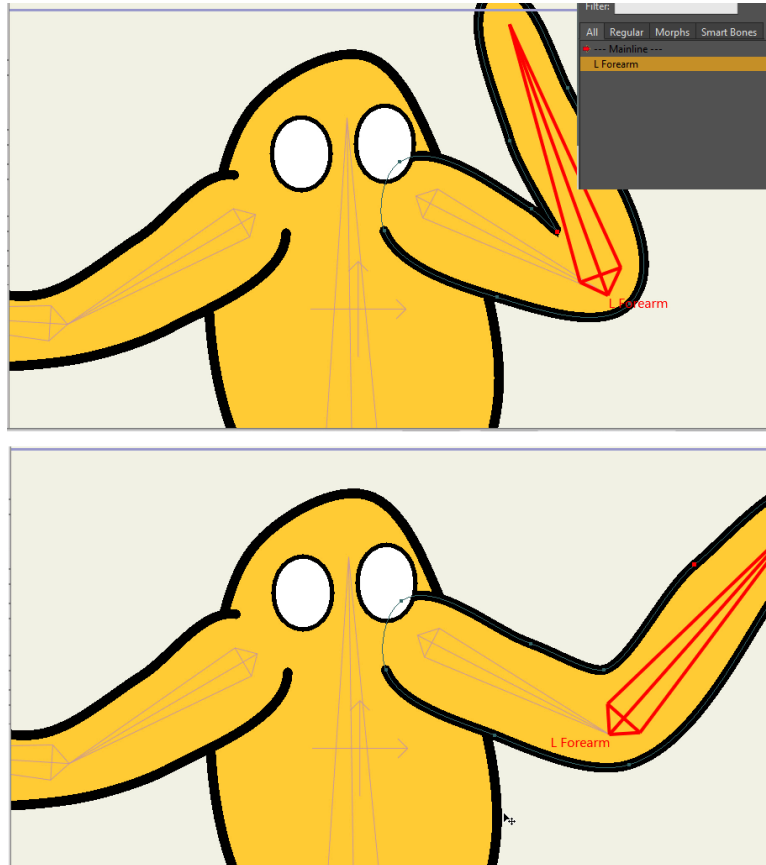
1. In the **character.moho** document, select the **Character** bone layer to activate the Bone tools.

2. Click the **L Forearm** bone with the **Select Bone** tool.

3. Choose **Window > Actions**, and click the **New** button to create a new smart bone action named **L Forearm** (the same as the bone you have selected).
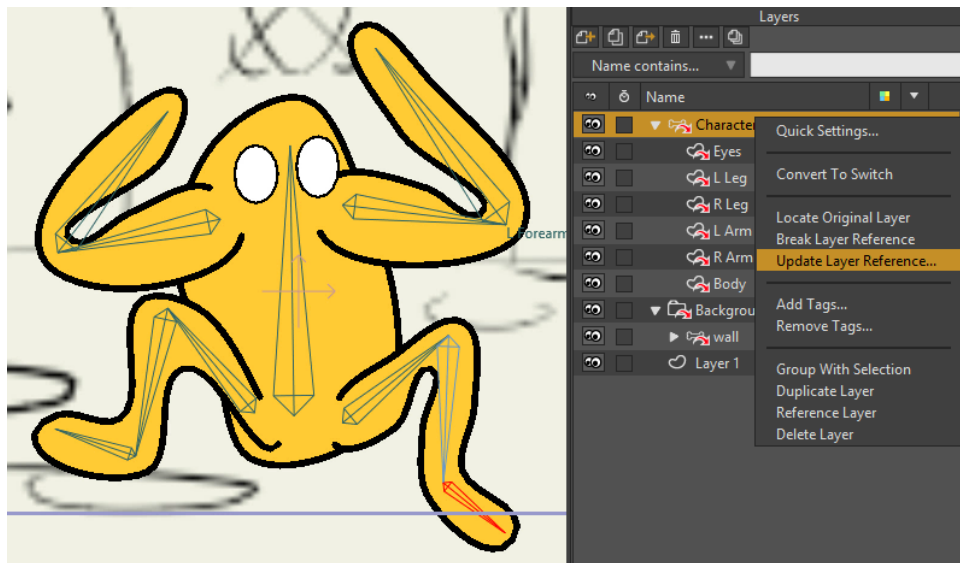
Layer Referencing (Pro Only)
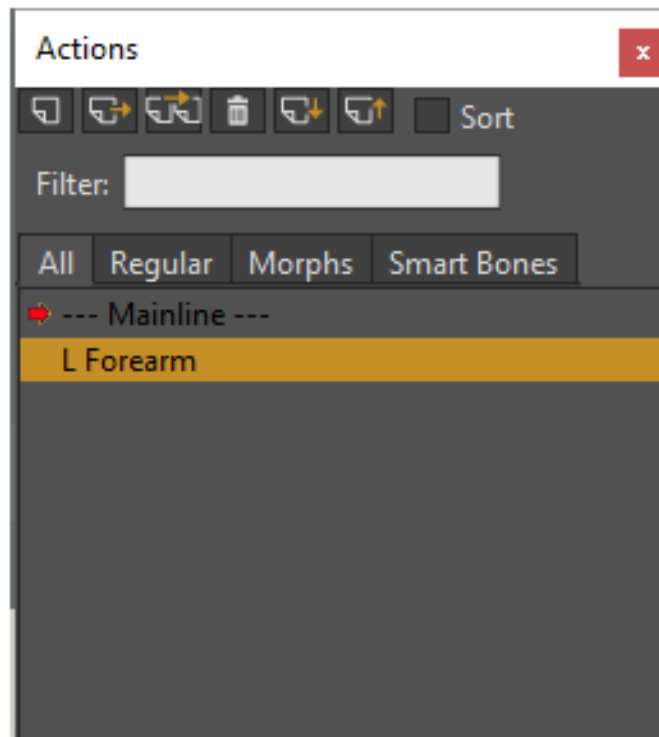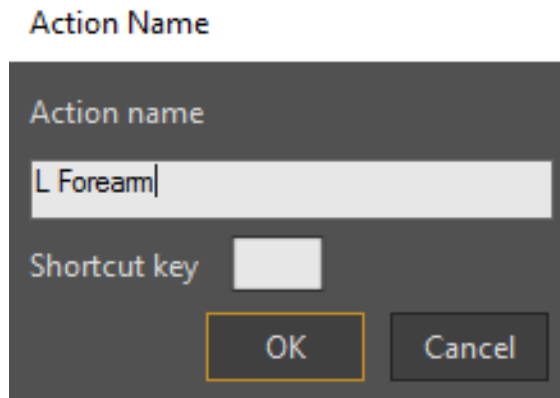
Create a Smart Bone action named L Forearm.

4.   Advance to a frame other than 0 (such as Frame 48) and bend the character's arm with the **Manipulate Bones** tool. Then use the Transform Points tool and the Curvature tool to improve the bending. Check the midway position as well, and makes some changes at Frame 24 if you feel it is necessary.

Layer Referencing (Pro Only)

*Tweak bending with the Transform Points and Curvature tools.*

5. Save these changes into the **character.moho** document.

6. Return to your project, and you see the bending problem area on Frame 42. Select the **Character** bone group and choose **Update Layer Reference**.
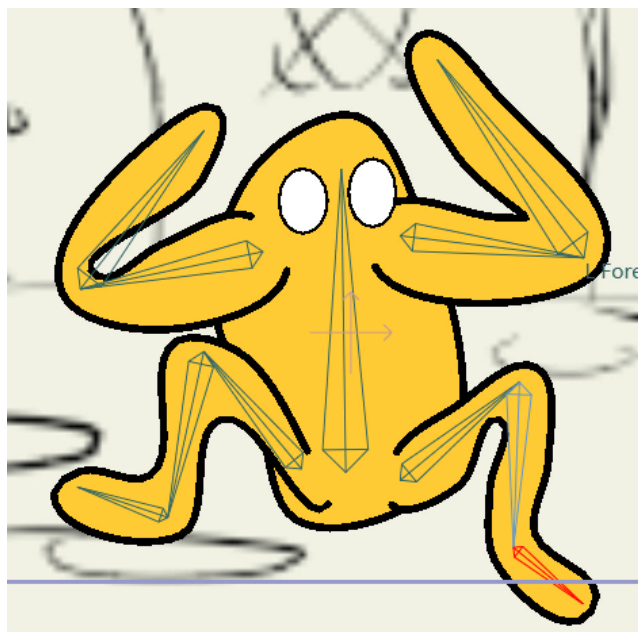

Left forearm bending problem on Frame 42.

Layer Referencing (Pro Only)

7. In the Reference Update Options dialog, verify that **Replace mismatched bones** is checked, and then click **OK** to update the reference layer. You'll notice the improved bending immediately.
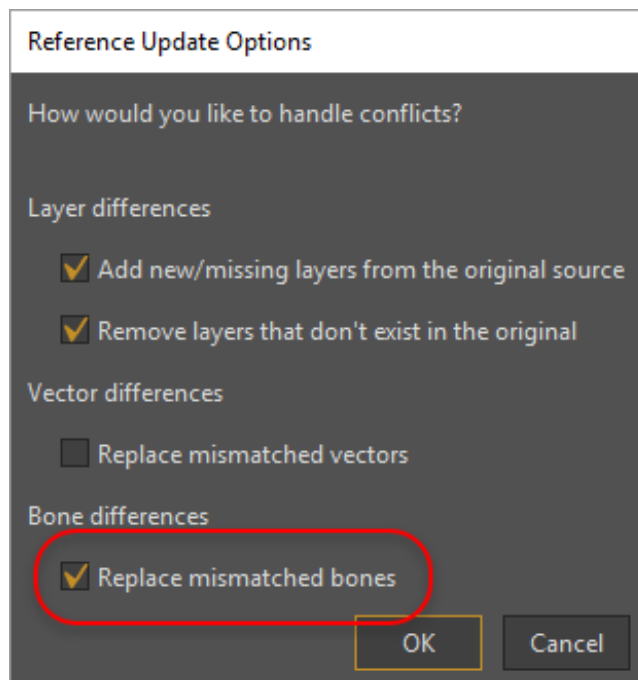
*Check Replace mismatched bones.*

The improved joint bending appears in your project.

Part 7.5.4: Updating the Background

Now the background artist has finished his artwork for the background. The background.moho document contains some extra layers that have completed artwork for the background. To make the applicable changes, follow these steps:
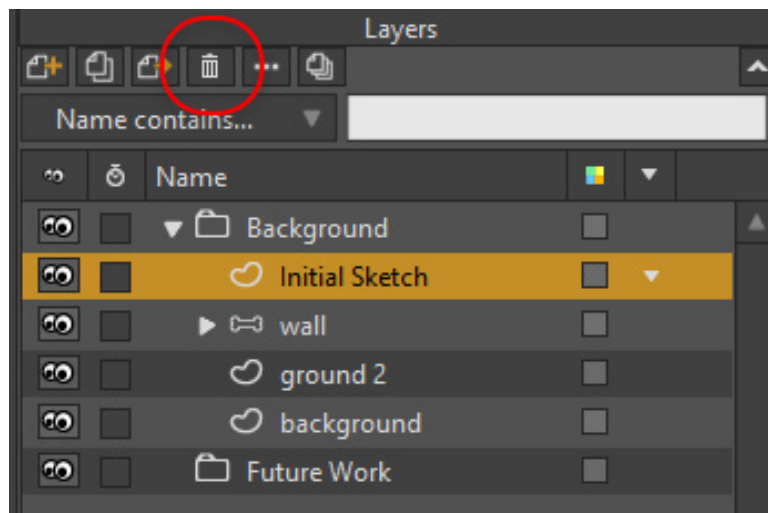
Layer Referencing (Pro Only)

1. Open the **background.moho** file and expand the **Future Work** group.

2. Move the wall, ground 2, and background layers into the Background group.
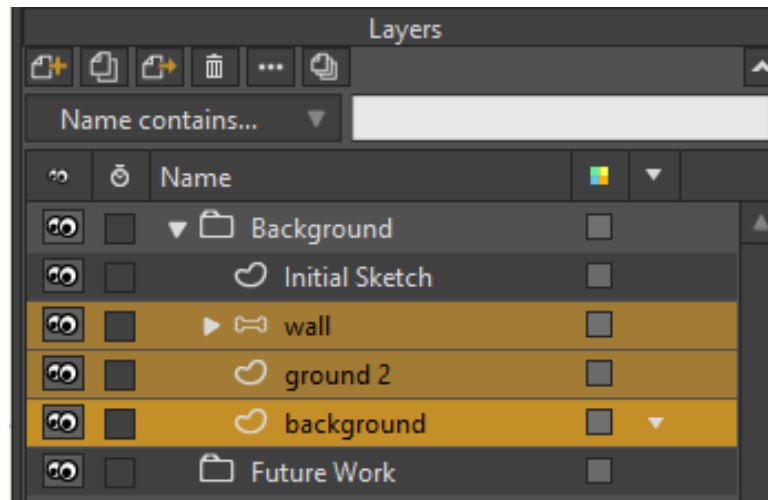
*Move the Future Work layers into the Background group.*

3. Select the **Initial Sketch** layer and delete it. Then save the **background.moho** document.

*Delete the Initial Sketch layer.*

4. When you go back to the project document you notice that the reference layers for the Background have changed to indicate that there has been a change in the **Background.moho** document.

5. Right-click on the **Background** reference group, and choose **Update Layer References**. Because there are new items in the Background layer, and because you also deleted the Initial Sketch layer, you want to make sure that both **Add new/missing layers from the original source** and **Remove layers that don't exist in the original** are checked.

Layer Referencing (Pro Only)
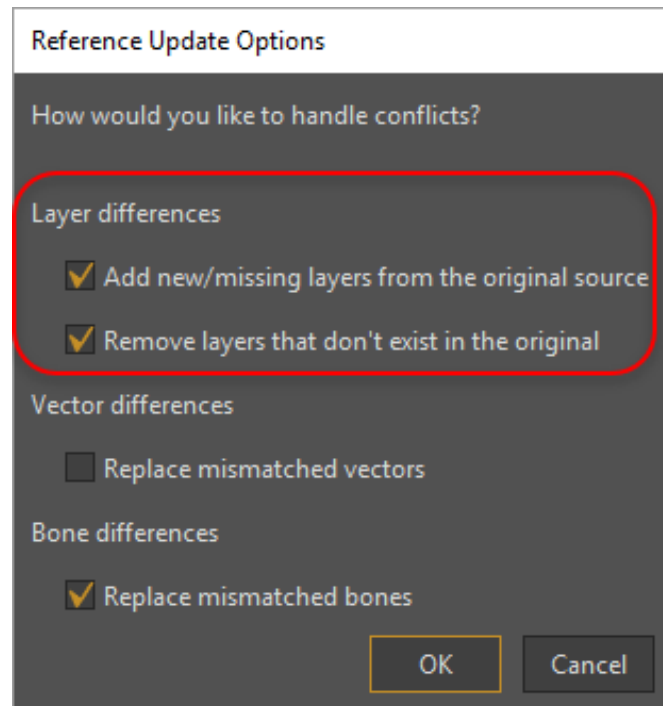
Reference Update Options dialog for new background.

6. After you press **OK**, you'll see the **Initial Sketch** layer in your project go away, and the layers that were moved into place in the Background layer will appear in the background.
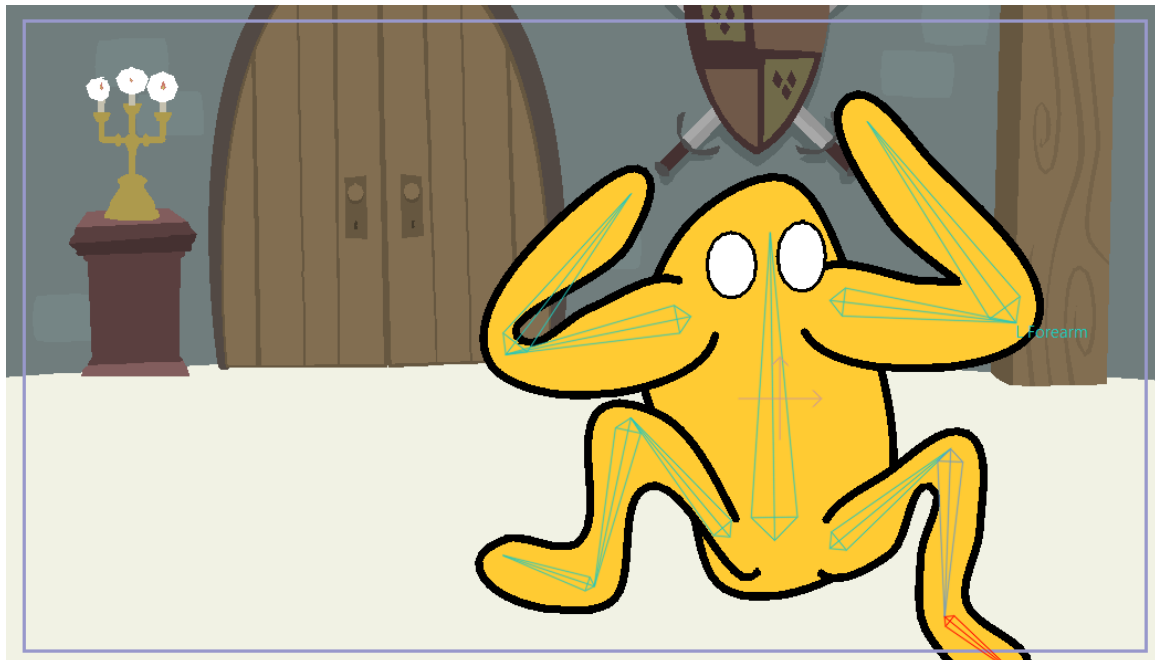
The finished project.

7. Choose **File > Save** to save your finished version of the project. A completed version is located in your User Content folder, and is named **Tutorial 7.5 Finished. moho**.

Layer Referencing (Pro Only)

Vitruvian Bones

Animating foreshortening and complex actions are easier than ever!

Inspired by Da Vinci's Vitruvian Man drawing, Vitruvian Bones (or V-bones) is a new and powerful way to rig your characters. The intuitive V-bones system allows you to alternate different drawings and sets of bones in one single layer. For instance, you can have different sets of heads, each with its own controllers. Or just draw the same limb in different perspectives and Vitruvian bones will allow you to group and animate them on the fly just by switching from one to the next. V-bones can be applied to any part of the body. You can even switch between entirely different bodies, all in the same bone layer! This unique approach to Vitruvian bones makes it easier to have a rigged character with the appeal of traditional animation.

Tutorial 8.1: Create a Vitruvian Group

To understand the basics. Let's create a simple Vitruvian Group in an empty file.
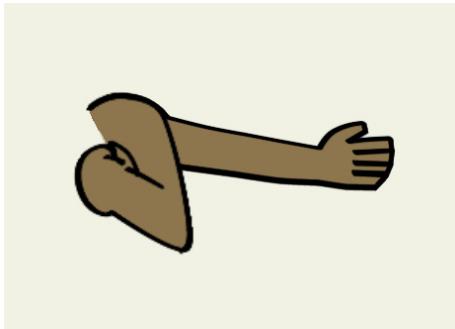
First, be sure to be in frame 0.

Change the name of the empty vector layer in the project to 'Arm 1' and use the drawing tools to create an arm.
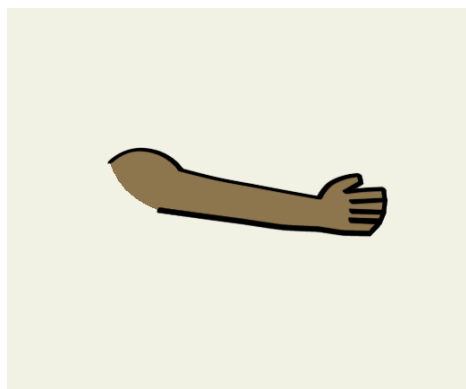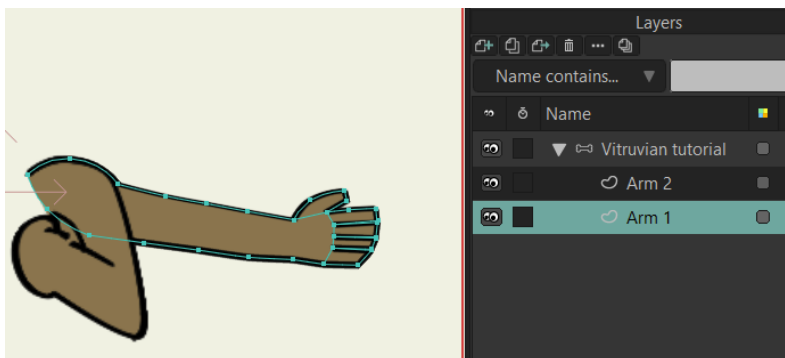

Now create a second vector layer, name it 'Arm 2' and draw the same arm, but in a different pose.

So now you have two arms, each one in its own vector layer.

Go to the Layers window, create a Bone layer and drag both arms inside of it.

Your layers should look similar to this:

Select the Bone layer and then the Add Bones tool (A) and create one bone for the body and then bones for each arm.

Even when we will see only one arm at the time, just rig your character as it has two arms.

You need to be sure both arms are children of the main body bone:
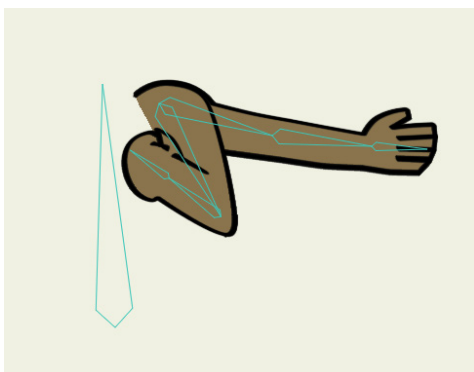
Vitruvian Bones

Once you have your bones created, Moho needs to know what bones should move and bend each arm. This step is not always necessary when you are creating a rig, but it's crucial for Vitruvian bones to work.

To give the software this information we will use the selective Flexi-Binding option.

Luckily, it's a simple and quick process.

Select the 'Arm 1' vector layer.

Now use the Select Bone tool and select the three bones related to that arm.

You can use the Rectangle selection, lasso mode or hold Shift + clicking to add bones to the selection.

Hold Ctrl and click over a bone if you need to remove it from the selection.
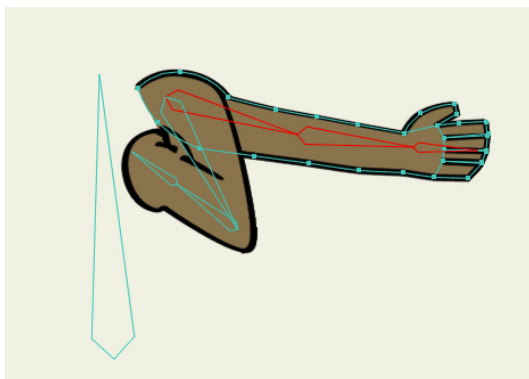

So now you have the 'Arm 1' layer selected and also the bones that should move that layer.

Go to the Bone menu and click on 'Use selected bones for Flexi-Binding' (or simply press Ctrl+Shift+F in Windows or Cmd+Shift+F in macOS)
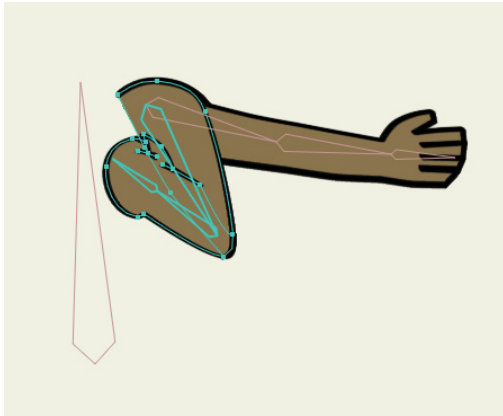

Vitruvian Bones
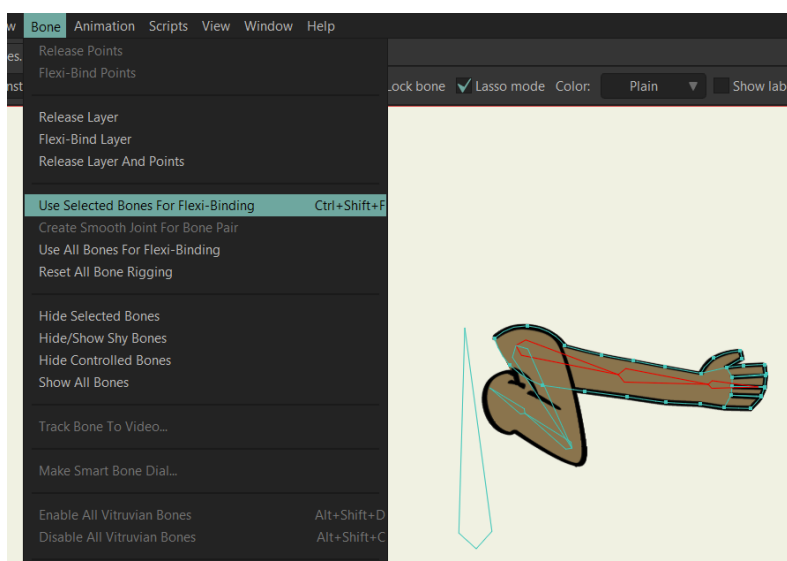
These bones will look bold everytime that vector layer is selected. This means that these bones are the only ones that will move that specific layer.
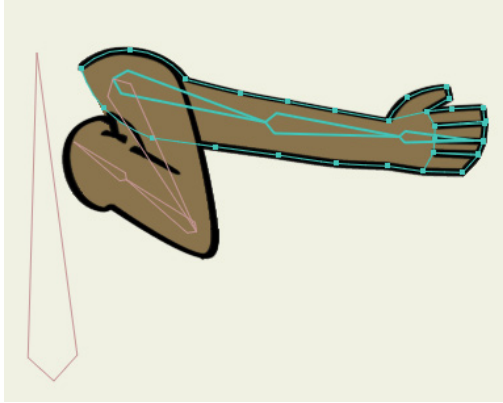

Now select the 'Arm 2' layer and repeat the same process: Select the bones and go to Bone -> Use Selected Bones for Flexi-Binding


In this exercise, we are only creating two different arms, but you can repeat the same process for as many limbs as you'd like to have in your character.

Now go to the Tools bar and use the Vitruvian Bones tool. This tool works very similar to the Select Bone tool, but also allows to create Vitruvian Groups.

To do it, simply select the first bone of each arm
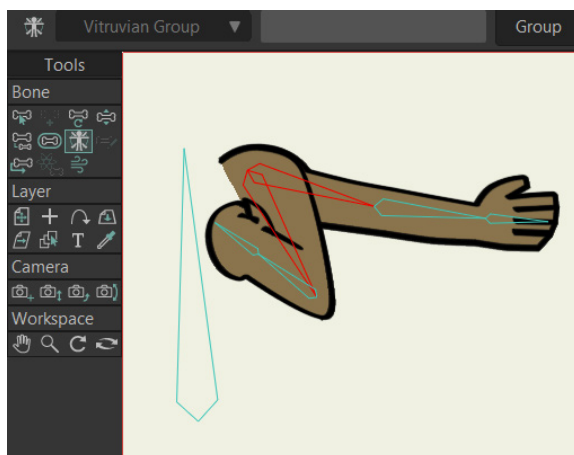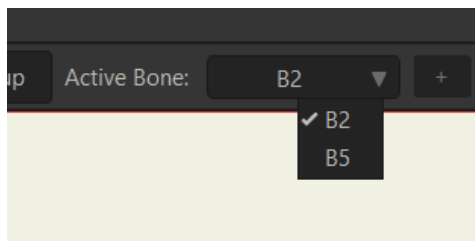

Vitruvian Bones

And then click on the Group button
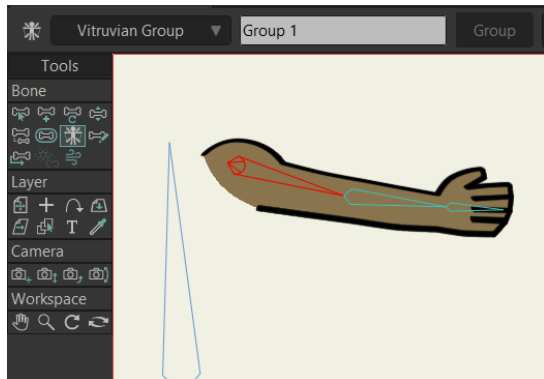
You will notice one arm will disappear and the other one will have a special design. This design means this is a Vitruvian Bone.

To test it, simply select any bone from the arm and then go to the Active Bone menu in the Vitruvian Bones toolbar

This menu shows you the names of the bones (in this case they have the default names, but you can rename the bones if you want). Depending on which one you select, that arm will appear on the screen.
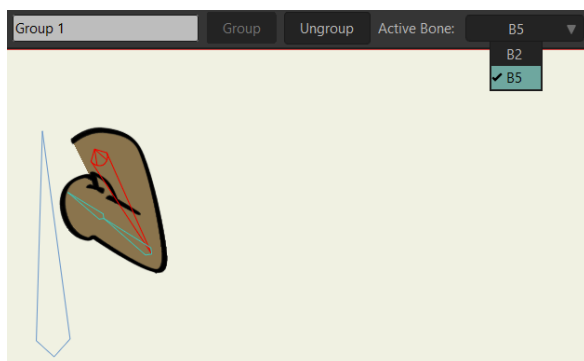
Vitruvian Bones

Tip:

You can also change the Active Bone by simply pressing Alt+D or Alt+C as many times as you need.

This method is much quicker and works without the need of using the Vitruvian Bone tool.

As far as one of the bones of the arm is selected, you will be able to use it.

(And, unrelated to this section, this shortcut also work with Switch Layers)

As you can see, the design of a Vitruvian Bone looks different to the rest of bones, with a semi-circle and two lines at the bottom.

This design will help animators know when they have the option to animate Vitruvian Bones.
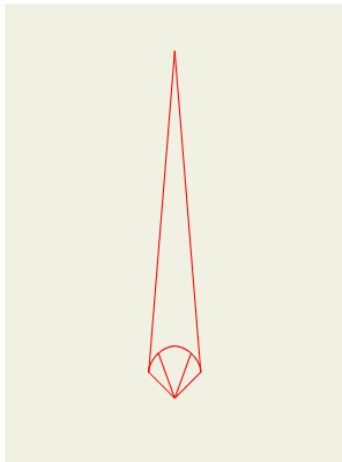
Tutorial 8.2: Rigging Vitruvian Bones

Although Vitruvian Bones need to be set up with the 'Use Selected Bones For Flexi-Binding' menu in order to work correctly, you are not limited to that option.

After you use that menu, you can still Bind points or Entire layers to specific bones, create Smart bones for joints or control Levers and use any tool you would normally use for rigging a character.

As you can see here, this character is using Point Binding for the arm:
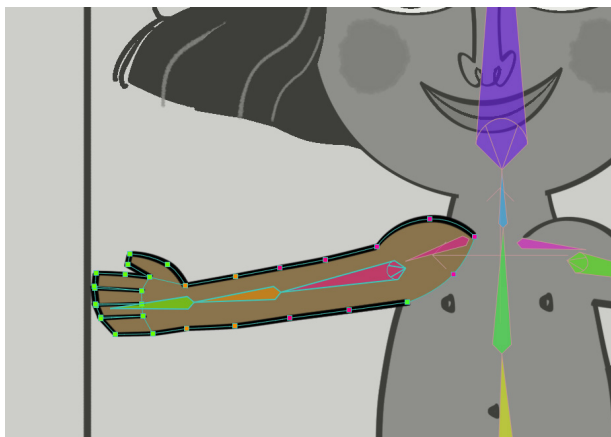
Vitruvian Bones

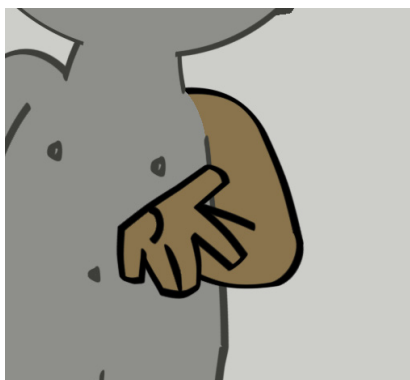Also, Vitruvian bones are not limited to one layer. You can attach as many layers as you want to Vitruvian Bones and they can be anywhere inside of the Bone layer.

So, for instance, an arm can be split in two layers: Arm and Forearm. Then the arm can be behind the body layer and the forearm in front of it, as you can see here:

Animating Vitruvian Bones

Basic concepts of the timeline:

To animate with Vitruvian Bones, it's very important to understand some basic concepts of Moho's timeline:

For most of the channels, there's a white and a red channel.

The red channel only shows the keyframes of the element you have selected at the moment.

The white channel shows you keyframes of any of the elements that have movement in the selected layer.

Vitruvian Bones

So, as a summary:

The **red channel** works to modify and re-time **specific movement**

The **white channel** is useful to modify and re-time all the elements at once.

Animating with Vitruvian Bones

When you start animating Vitruvian Bones, you will notice some new channels appearing in the timeline. These are special channels and behave a bit different from the rest.

First, you will notice the **Vitruvian Bones** channels. These channels will appear every time you change the Active Bone on a Vitruvian Bones Group (by using the tool menu or the Alt+D and Alt+C shortcuts):

Vitruvian Bones

Every time you change the Active Bone of any Vitruvian Group during your animation, this channel will show you a Keyframe at that frame.

Selected Vitruvian Bones

This channel is very similar to the previous one, but it only shows the keyframes of the Vitruvian Group selected at that moment.

If you select a bone that is part of a Vitruvian Group, this channel will show keyframes every time you change the Active Bone of that specific Vitruvian Group.

You also will see the **Vitruvian Bones Consolidated channels**:

Vitruvian Bones Consolidated

This channel shows a general summary of every Vitruvian bone animated.

If any of the Vitruvian Bones in the Bone layer has a keyframe (it can be in Rotation, Scale, Translation, Flip or any bone animation channel), a keyframe will also appear in the Vitruvian Bones Consolidated channel.

This channel is very important, because it shows the entire animation in the timeline, even for bones that are not visible at the time.

Vitruvian Bones

This allows to modify and re-time an entire animation easily.

Selected Vitruvian Bones Consolidated

This channel is very similar to the previous one, but it only shows the keyframes of the Vitruvian Group selected at that moment.

If you select a bone that is part of a Vitruvian Group, this channel will show keyframes in the frames where any of the bones of that group has keyframes.

This channel is especially useful if you want to modify the animation in a specific group. For instance, all your animation is working fine, but the left Arm is moving too slowly. Then you can modify the keyframes of this channel to adjust the timing of the entire group at once.

Look at this example:
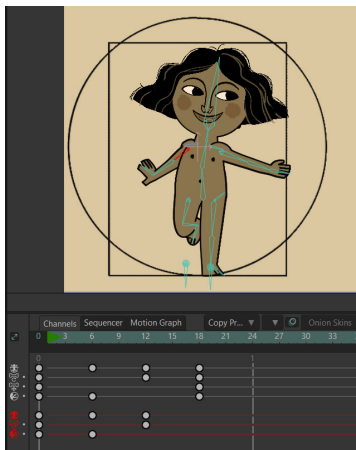
The **VItruvian Bones Consolidated** channel shows there's animation at frames 6, 12 and 18. This is a general summary that shows that in frames 6, 12 and 18 the Vitruvian Bones are animated.

The **Vitruvian Bones** channel shows that one or more Vitruvian **Active Bones** have been changed in frames 6 and 18.

Vitruvian Bones

The **Selected Vitruvian Bones Consolidated** channel shows that the bone selected (right arm of the character) is part of a VItruvian Group and that that group has keyframes in frames 6 and 12. This Vitruvian arm is not moving at frame 18, so there's no keyframe there.


The **Selected Vitruvian Bones** channel shows that the bone selected (right arm of the character) is part of a Vitruvian Group and that specific group has changed the Active Bone only in frame 6.
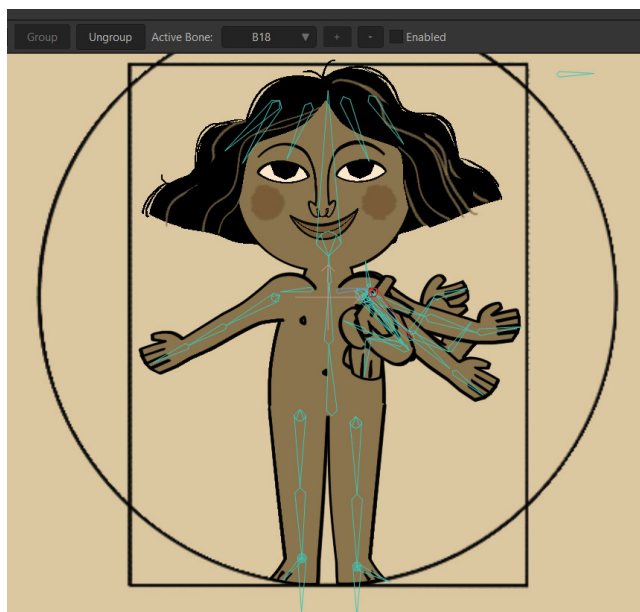
Disabling Vitruvian Bones Groups

If you want to see and edit all the bones and content from a Vitruvian group, you can temporarily disable that group.

This option is very useful to make changes on the overall design, add Smart Bones or make adjustments on the animation.

Just use the **Vitruvian Bones Tool**, select one bone from the Vitruvian Group you want to disable and uncheck the Enabled box in the toolbar
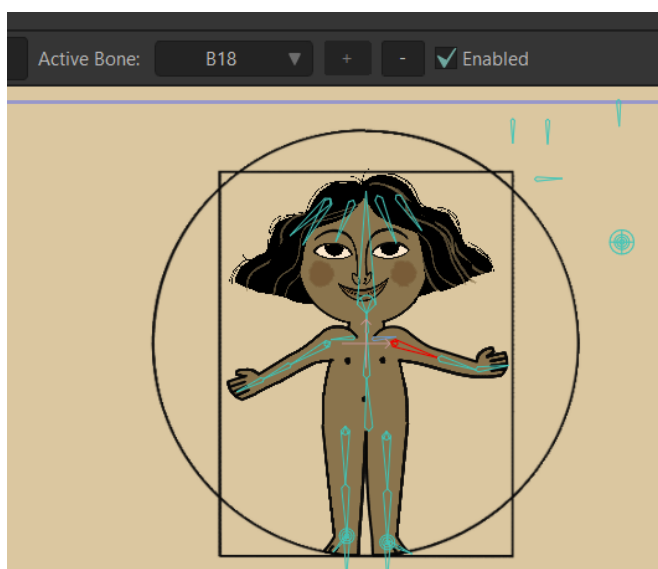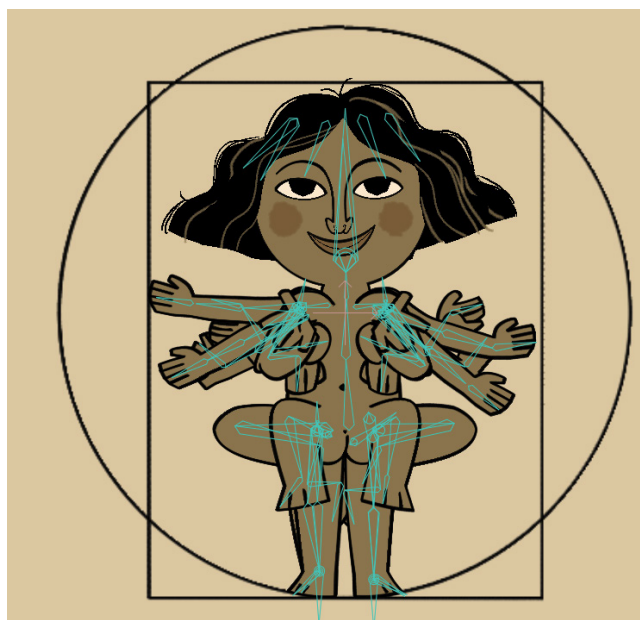

Vitruvian Bones

Disabled

You can also Disable or Enable every Vitruvian Group from a character by going to the menu

Bone -> Disable All Vitruvian Bones

Bone -> Enable All Vitruvian Bones

All Vitruvian Bones Disabled:
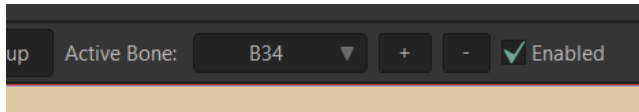

Vitruvian Bones

Adding and Removing Bones from a Vitruvian Group

If you want to Add a bone chain to an already created Vitruvian Group,

- Use the Vitruvian Bone tool

- Select one of the main bones from the Vitruvian Group you want to edit

- Holding shift, add the chain of bones you want to add to the selection

- Press the + button to add the chain to the Vitruvian Group

- If you want to remove a chain of bones from a Vitruvian Group

- Use Vitruvian Bones tool

- Select the main bone of the chain you want to remove from the group

- Press the - button

Vitruvian Bones

Wind

Tutorial 9.1: Wind Dynamics

Wind is the newest addition to the powerful and easy to use Physics toolset Moho offers. Take absolute control over the strength, direction and turbulence of wind and make your scenes come alive in minutes. Give your backgrounds and characters new life with Wind Dynamics!
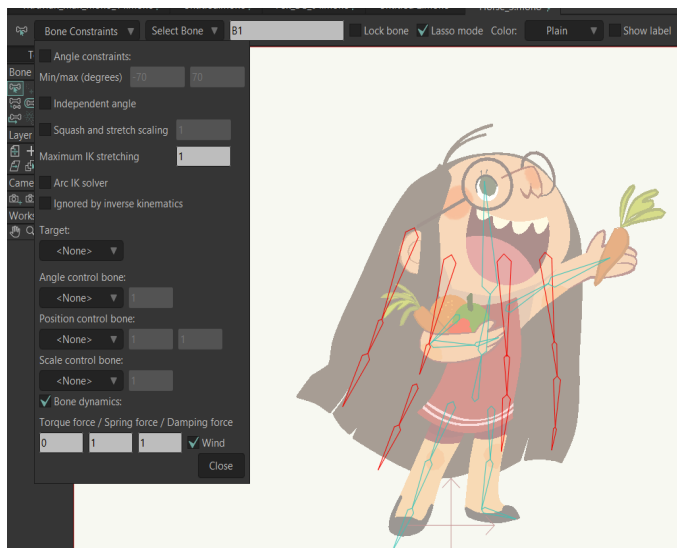
To use wind, you must select a **Bone layer** and be sure you are at frame 0.

Use the Select Bone tool (B) and select one or more bones you want to react with Wind
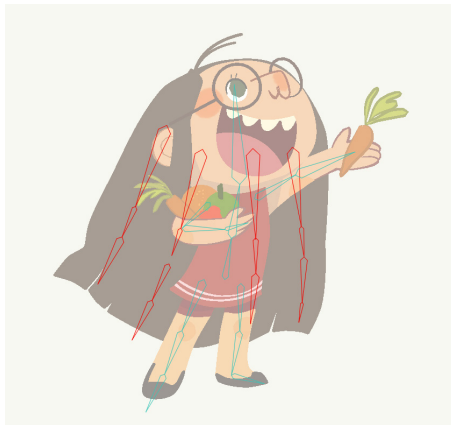
In this case, we want the hair to automatically move with the wind, so we select all the bones related to the hair

Now in the Select Bone toolbar, open the Bone Constraints window and activate both **Bone Dynamics** and **Wind**

Wind

Now the bones are ready to receive the wind.

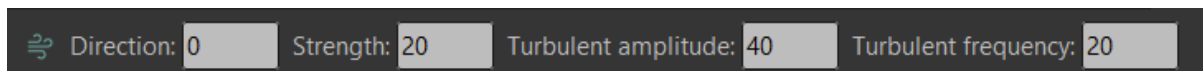Press Close in the Bone Constraints Window and now select the **Wind Tool**

A red Arrow will appear over the layer

This arrow shows how the wind is moving in real time and makes it easier to know what values to choose next.

Wind Values

With the Wind tool you can edit these four values

- **Direction:** This shows the direction of the Wind in degrees. A value of 0 means the wind will be fully horizontal and pointing to the right. Making the number smaller or bigger, will make the wind rotate clockwise or counterclockwise.

- **Strength:** This value shows how strong the wind is. A value of 0 means no wind at all and 100 is the maximum amount.

  When you modify this value, you will see the Red Arrow becomes shorter or longer, depending on the number.

- **Turbulent amplitude** and **Turbulent frequency**: These two values are related to each other and they modify and animate the angle and strength of the wind to give the sensation of turbulence.

  Without turbulence, the bones reacting to the wind can look unnatural, because their movement will be very flat, with no small variations.

  A higher value for **Turbulent amplitude** means the angle and strength of the wind will change more dramatically during the animation.

  A higher value for **Turbulent frequency** means those changes in angle and strength will occur more often, so the wind can jump from very strong to very weak in a few frames. And the same will happen with its angle.

Wind

Using right click or the mouse wheel to modify the values

You can edit **these and any numeric values** in Moho by using the mouse wheel or pointing the cursor over the number and **drag right click** to the left or right.

Holding Shift or Ctrl (Cmd in macOS) while doing it, you can make the change of values bigger or smaller.

Testing Wind in real time

To check how the Wind is affecting your characters, background elements or props, you can simply hit play in the timeline and then modify the wind values using the technique explained above.

Moho will show you in real time how the new values are affecting the bones with Wind Dynamics applied.

The red arrow will also be updated automatically, making easier the Wind adjustments.
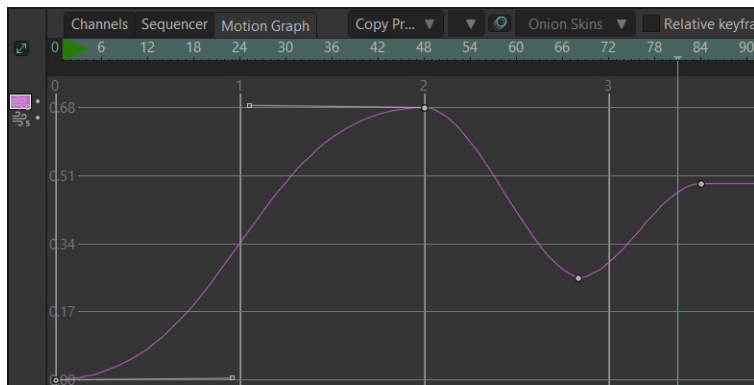
Animating Wind
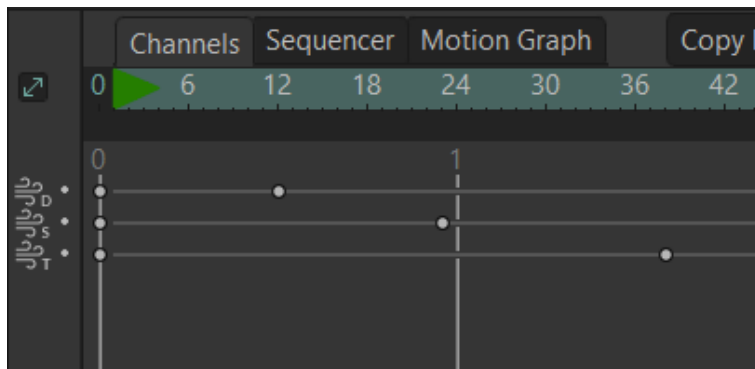
There are three new channels for Wind:

- Wind Direction

- Wind Strength

- Wind Turbulence

If you modify these values at any frame, a keyframe will be created there.

The values for Wind Direction and Wind Strength can be edited in the Motion Graph

Wind

You can also copy and paste Wind keyframes between different bone layers.

Bones properties

The Dynamics properties for each bone can also be modified.

If you use the Select Bone tool and select one or more bones, you can open the Bone Constraints window and change the values there too.

Depending on the values you pick for Torque, Spring and Damping, the reaction of the bone to the wind will be different
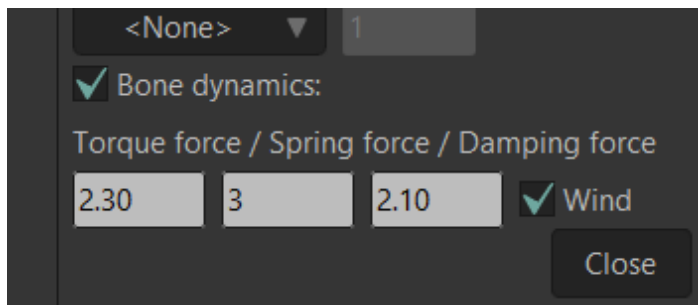
- **Torque Force:** Defines how big will be the movement

- **Spring Force:** Defines how much the movement will bounce. The smaller the value, the softer the movement will be

- **Damping Force:** Defines how long it will take to the bone to go back to its initial angle. The bigger the value, the less time it will take.

Wind

Perspective warp and Quad warp

Tutorial 10.1: Perspective warp and Quad warp

Animate backgrounds, props and characters in perspective with the new Perspective Mesh.

Just create a shape with four points, attach it to any image or vector layer and animate it.

This simple but powerful mesh can be used in combination with triangular meshes, making Moho more flexible than ever.
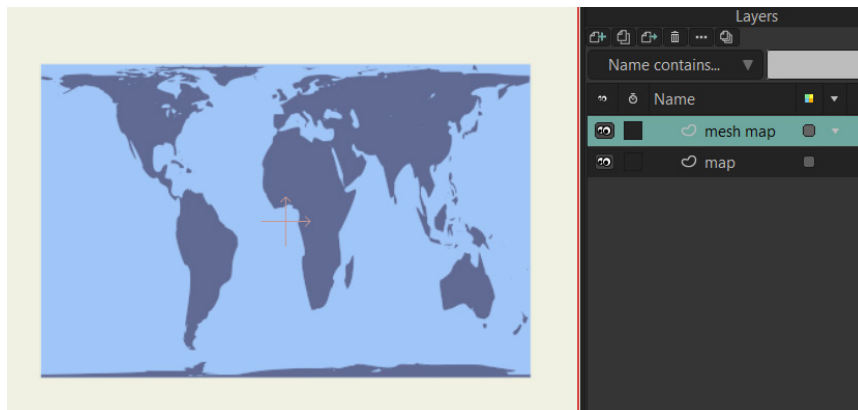
Creating a True Perspective Mesh

With Moho, you can create Meshes of 4 points and use them to animate any vector or image in true perspective.
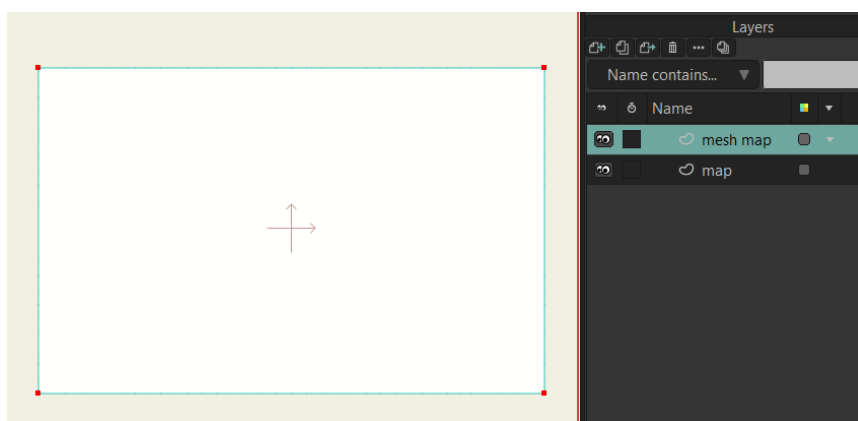
The process to do this is very simple. Let's say you have a vector layer with a map:
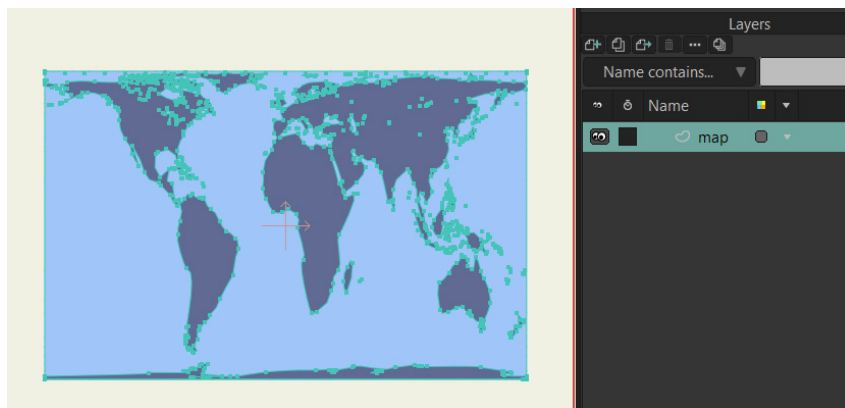
To create a Perspective mesh, create a new Vector Layer and call it 'mesh map'

In the 'mesh map' layer, draw and fill a rectangle covering the entire map

Now, since we don't want to see the rectangle, but only use it as a Mesh, go to the Layers window and double click the 'mesh map' layer to open its properties.

Then check **Hide in editing view** and **Don't render this layer** and click OK.

The rectangle will become invisible.
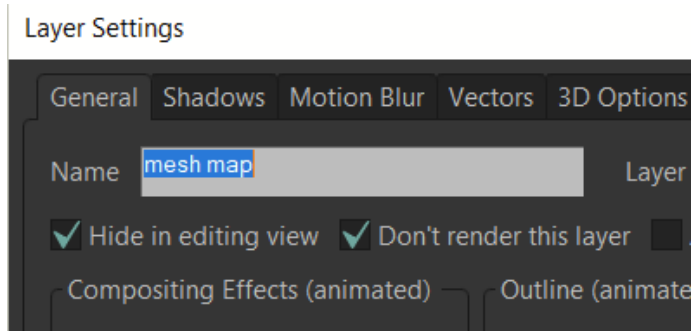
Open the Layer properties of the 'map' layer, go to the Vectors tab, select 'mesh map' as Smart warp layer and click OK.

Perspective warp and Quad warp
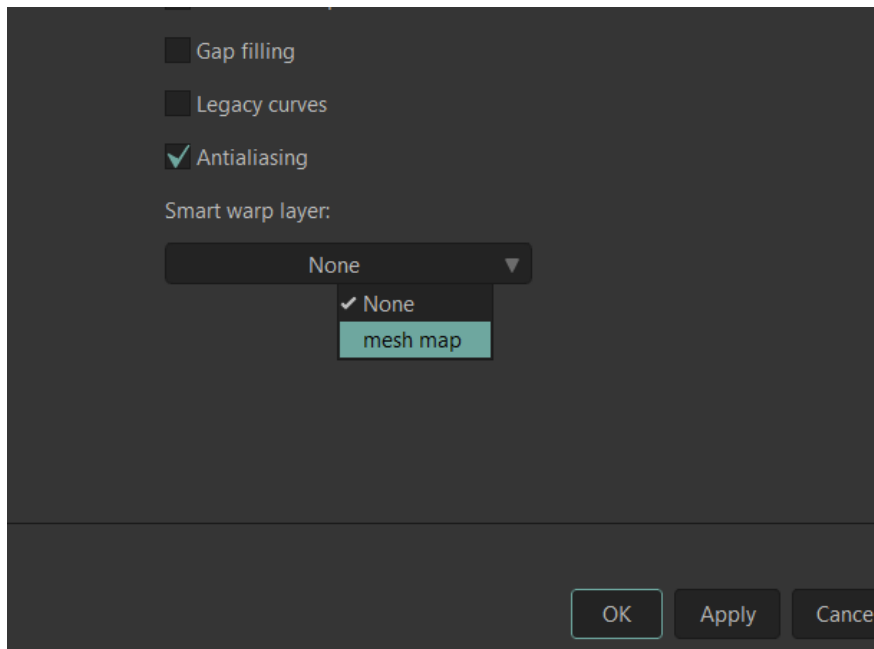
You are done!

Now to test the mesh, go to any frame different to frame 0 and use the Translate points tool to move the points in the mesh map layer.

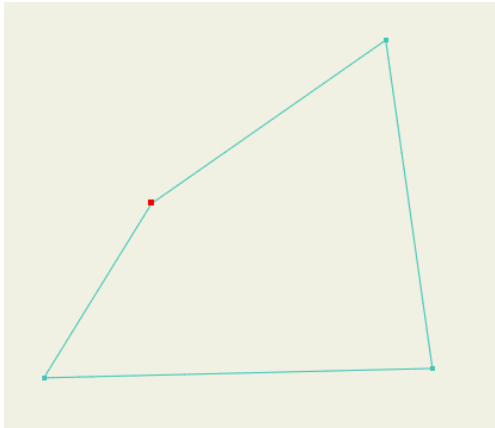You will see how the perspective changes while you move them.
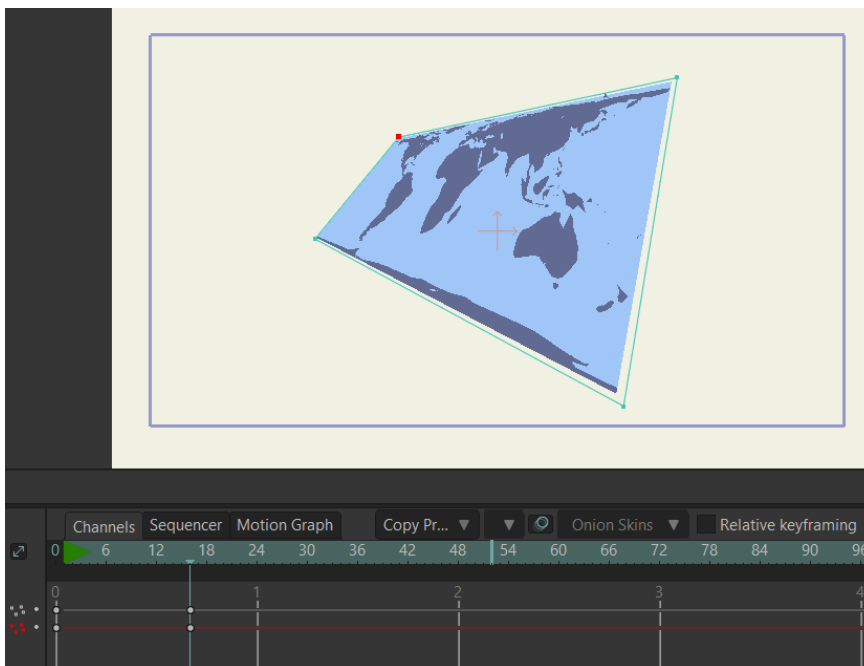
Tip: Perspective mesh only works if the shape of the mesh is valid. That the mesh won't work if you fold it over itself.
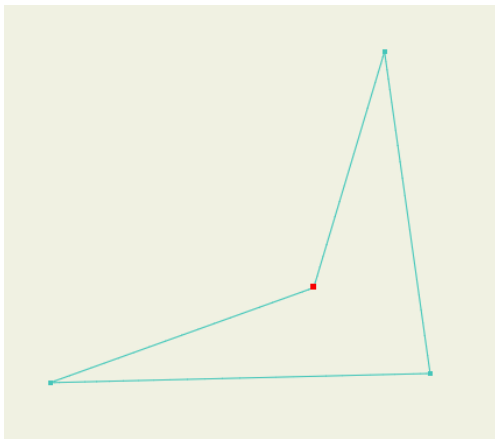
For instance. This shape will work well, because it's a valid perspective

Perspective warp and Quad warp

This shape instead is illegal, because it doesn't follow the logic of perspective, so it won't work
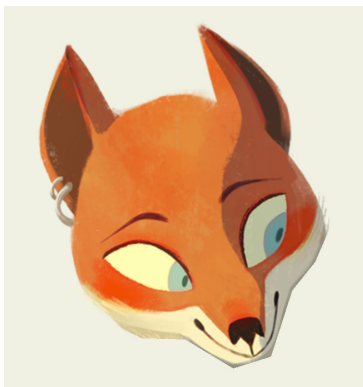

Quad warp

Quad warp works in a similar way to the perspective mesh, but it works to create better characters expressions, head turns, 3D effect or any modification over a vector or bitmap character.

Again, to create a Quad warp mesh is very simple.

Let's create a mesh for this character

Perspective warp and Quad warp

First, create a vector layer and call it 'mesh fox'

Now use the Add Points tool to create draw a mesh over it


To make the mesh you need to consider this

• The mesh must be bigger than the content. Otherwise, anything that is not inside of the mesh won't work well or won't be shown in the animation

• The mesh must be created using shapes of 3 or 4 points

Once you have your mesh done, you need to paint every single shape there. But don't worry, we have a script that does it automatically!
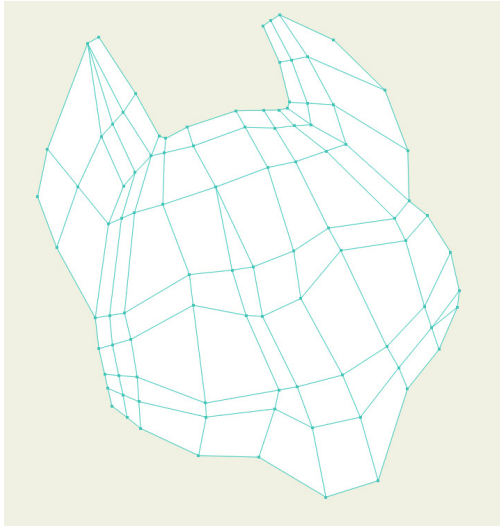
This script was generously donated by the Moho beta user Paul Cheshire (thanks again, Paul!)

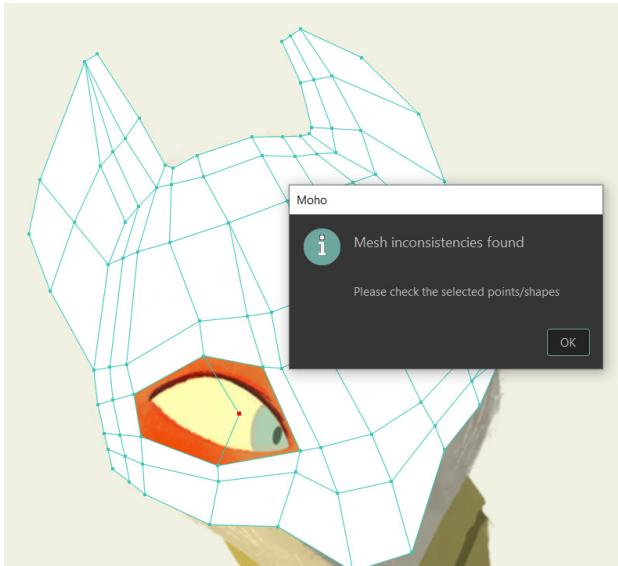So, be sure you have the 'mesh fox' layer selected and go to the Menu

Script -> Draw -> Fill Quad Mesh

Perspective warp and Quad warp
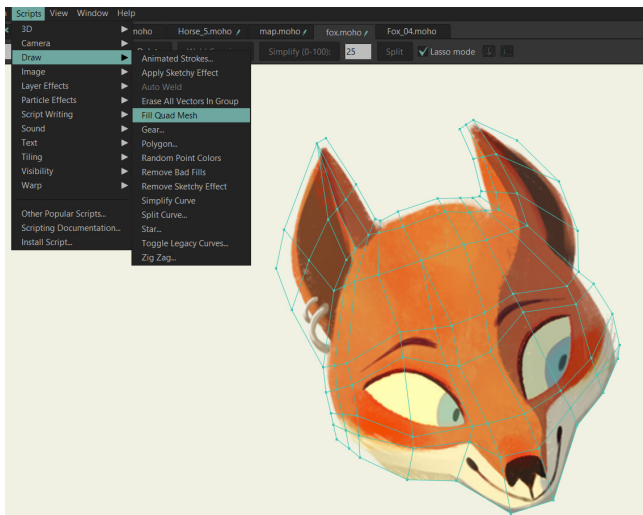
The script will automatically create a shape for every quad and triangle in the mesh.

If there's any issue with the mesh, you will get an error message and will able to see where is the issue:

In this case, there's a point in the eye that invalidates that part of the mesh, because it has 5 points instead of 4.
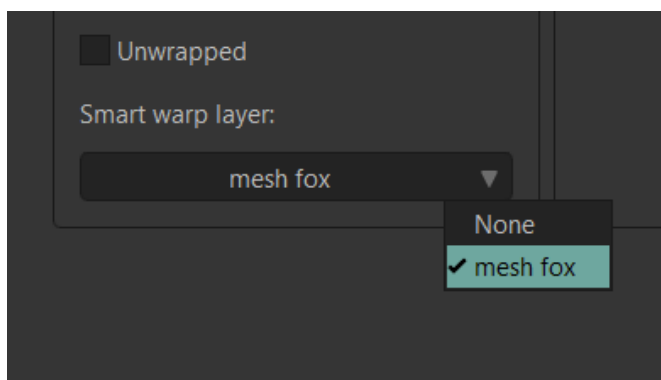
To fix it, simply remove the point and run the script again.

Once the mesh is ready, you need to open the Properties of the 'mesh fox' layer, check **Hide in editing view** and **Don't render this layer** and click OK.

Perspective warp and Quad warp
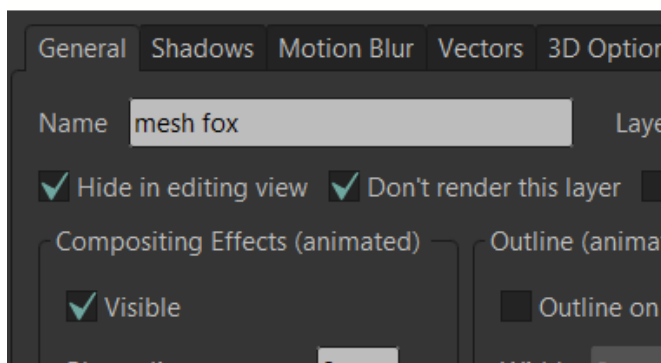
Now open the Properties of the image layer of the head, go to the Image tab, select 'mesh fox' as its smart warp layer and click OK.

Now the head is ready to be animated!

Some tips about rigging characters with meshes:

- You can assign the same mesh to as many layers as you want.

- You can even assign a mesh to another mesh, so you can have two or more levels of movement

- If a bone is moving a mesh and also an image/vector controlled by it, be sure to use the Bind Layer tool to bind both layers to the same bone. Doing this can avoid problems like having a layer moving twice as fast, which happens because the layer is moved in the same direction by both the bone and the mesh layer.

Perspective warp and Quad warp

Animating Quad warp meshes

Once you have everything setup, animating quad meshes is very simple. Just use the Translate Points tool (T) to move the points of the mesh.

You can also use the Magnet Tool (X) to nudge several points at the same time.

To modify the size of the magnet, just hold Alt in the keyboard and drag the mouse or pen left or right.

You can also try simpler meshes for objects and characters

Perspective warp and Quad warp