

## Animating in Maya

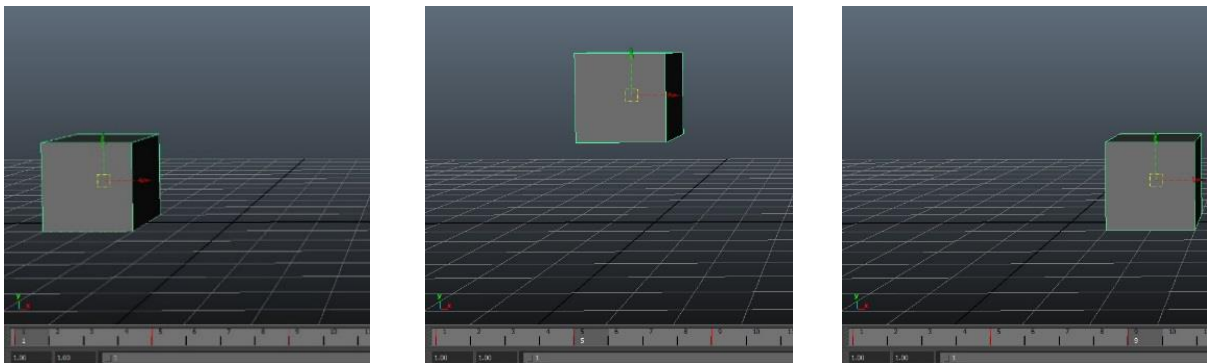
Animation in Maya is primarily key frame animation. The timeline splits time up into 'frames'; usually (for UK TV) 25 frames per second. For each frame then, you can 'key' any of an objects attributes (translation for example) to hold that value at that frame.

### Key Frame

Probably the most commonly renowned styles of animation used within today's industry is key frame animation. This involves positioning your character at a specific frame on the timeline to determine its appearance at that specific moment, *key* the relevant attributes and then move onto the point in time. When we scrub through the timeline we will see our character moving and deforming between each of our set frames.

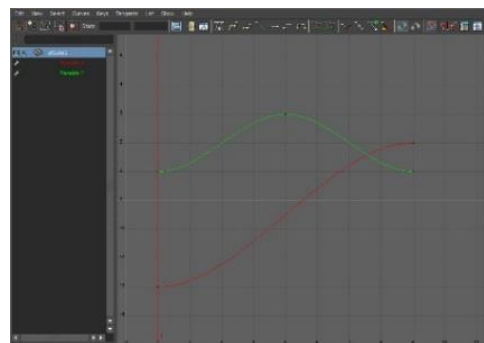
Maya will then connect these keys together into a curve, working out in-between values.

This means you can very quickly get nice fluid animation, using only a few key frames.



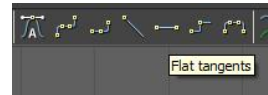
### Graph Editor

The graph editor (shown with the above cube animation) illustrates the keyed elements along the translate axis. As you can see from the diagram the attributes in question are colour coded, and each tell us information about how the animation will playback. We will have a more in depth look into the graph editor during our animation tutorials later in this section.



### Translate X:

The cube moves from a value of minus three to three over the course of eight frames. We could have a straight line here, but by using flat tangents on the start and end points we ensure that the cube eases in and out of the animation.

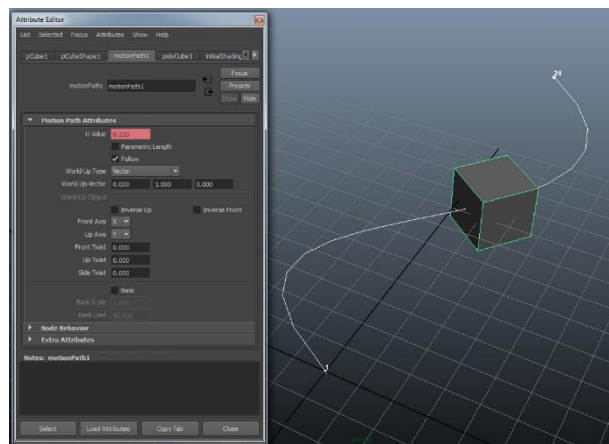


### Translate Y:

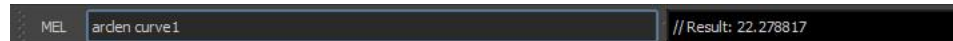
The cube moves from the floor, into the air and back onto the floor. This is shown by the green curve in the shape of a hump. Again we have flattened out our tangents to ease in and out of the animation.

### Path Animation:

You can make an object follow the path of a CV curve using *motion paths*. The motion path start and end time can then be manipulated to control the amount of time that the object travels along the curve for and other attributes can be set for twisting and banking relative to the curve bend. These make it easier when an object needs to be rotated 90° to face forwards, for example.



Motion paths are most often used to move an object (such as a car) or a character with an animated walk cycle along a specific route. In both of these cases, to avoid wheel or foot 'ghosting' you will need to match the timing of the wheel rotation or walk cycle to the start and end frame of the motion path relative to the distance of the path. This is easy to calculate however, in the command bar, type *arclen <object name>* which will return the length of the curve. You can then use this number to divide the distance travelled per walk cycle by, giving you the number of cycles during the motion path. Multiply the number of cycles by the time it takes to do one cycle, and this will give you the total length of time for the motion path.



You can also use motion paths for advanced rigging techniques, such as tank tracks or making an object follow the curvature of an animated creature, but these are more advanced techniques that we will cover in future resources.

### Expressions

Expressions are small snippets of code that are evaluated by Maya for each frame. These are used primarily for dynamics and particle systems, for example emitting particles when two rigid objects collide.

### Set Driven Key

Used to set up interactions between attributes whereby the driver, drives the driven. The unique feature of this tool is that the relationship is keyed between the driver and driven nodes, which means you can view and edit the relationship in the graph editor and take advantage of your curve editing tools. By driving multiple nodes from a single driver you can create some nice fluid animation that is keyable within your scene (for example our reverse foot lock that we have set up on page 152).

### Animation Layers

Animation layers give you multiple levels of animation that add together to give you a final result. For example, during the walk cycle we have created, we could create a new animation layer called head turn, and animate our head turning to face the camera a few steps into our animation and then back to default again.

Because our two animation layers are separate to each other, we can easily edit one without worrying about affecting the other.

## Useful Animation Techniques

### Silhouettes

When you are animating, especially while you are creating key poses it is valuable to check the silhouette of your character. This is a key instrument in keeping your gestures powerful and interesting for your audience.

In Maya a simple way to view your scene silhouette is to uncheck *Use All Lights* in your *Viewport > Lighting* menu and then also check *Use Default Material* in your *Viewport > Shading* menu. This stops any of your lights affecting the viewport (your character will turn flat) and then forces the viewport to use the default Maya material *lambert1*. Now all we need to do is change the *lambert1* diffuse colour to black in our *Hypershade* window.

This gives us a nice silhouette of our character, without changing the scene itself (when we hit render, the scene will render out as before).

### Smart Blocking

We can apply our principles of animation such as follow through during our pose to pose stage and include them in our key poses. This gives us a much more powerful bases for when we come in and fill the detail between poses.

We can also go in and tweak the finer details such as fingers and other secondary details at this stage. Check against your silhouette in your camera view while you are creating your poses to check the emotion and exaggeration is correct. You want to make each pose as interesting as possible.

### Moving Holds

Moving Holds are an important device to let the audience read what the character is doing and second guess what the character may be thinking. The easiest way to create a moving hold is to go to the key you wish to extend the hold until and then *middle-click* the key where the hold starts. You will notice that the animation does not change, so now if you key your attributes (press 'S' to key everything) it will key your original key frame with the value of the one your middle-clicked.

### Motion Trails / Ghosting

An easy and visual way to check our animation arcs is to use *Motion Trails* which can be accessed in our Animation menu set (*F2*) and then *Animate > Create Editable Motion Trail* . This will display a curve along the motion path of the selected object, including the location of any keys on that curve. New to recent revisions of Maya is the ability to move these keys in physical

space, or even change the frame number that they fall under giving us near graph editor control in 3D space.

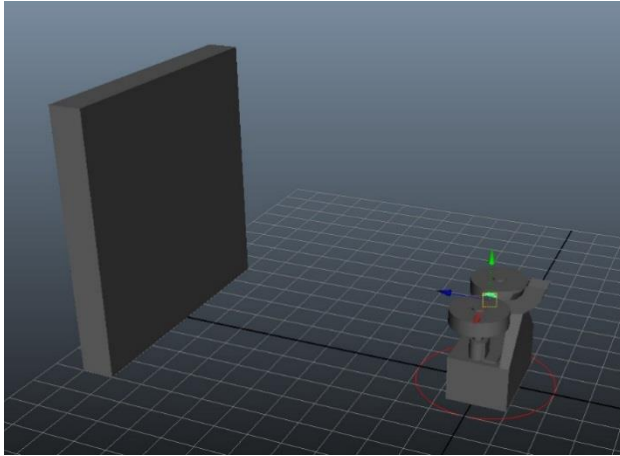
Ghosting is more suitable to checking our ease in and ease out keys. Still in your Animation menu set, *Animate > Ghost Selected* will show the selected objects previous and future locations by about three steps. Correct ease in and out is displayed by the frames getting closer together or further away respectively.

The feet and hands in this imaged are Ghosted:



## Animating a Tennis Ball

This tutorial will teach you the main principles of animation, specifically how to animate a tennis ball being fired from a cannon and bouncing off a wall to a stop.

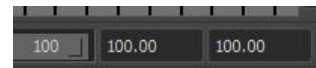


*Shift-Alt-D* before you start animating.

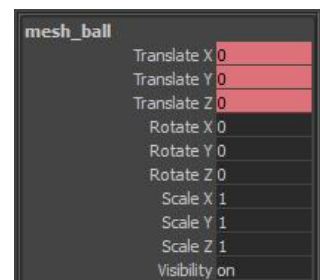
We would recommend you use your own scene for this as all you really need is a poly sphere to represent the tennis ball and a poly cube to represent the wall. If you are feeling extra adventurous you could build a tennis ball launcher like we have built in our scene. Make sure that you freeze your transformations *Modify > Freeze Transformations* and delete any history

First let's plan our animation. We want the ball to launch towards the wall at a slight upwards angle and then bounce off the wall, fly over the tennis launcher and bounce on the floor a few times before it comes to a stop. The ball will drop slightly as it is flung, but will lose speed and drop at a steeper angle after each bounce.

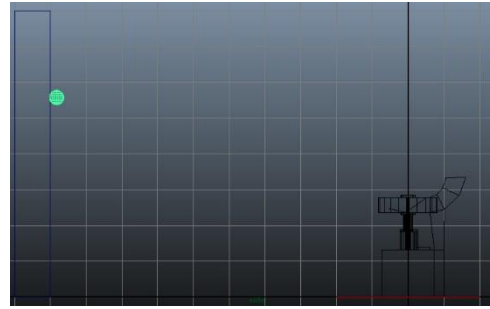
Most likely your time slider is set to 48 frames, we are going to increase this to 100 to give us more time to play with.



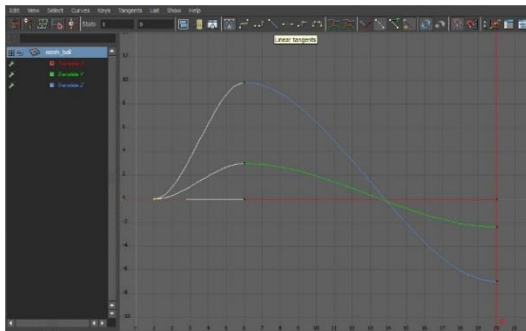
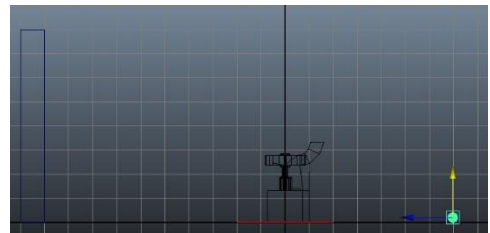
Ensuring we are at the frame one, select the ball and press *Shift-W* to key the translation in its starting position. We only want to create key frames for the attributes that we are animating; this keeps the *time slider* and *graph editor* clean and simple if we want to go in and change things. It also allows us to control other attributes such as rotation and scale without worrying about previous key frames getting in the way.



Move the time slider to *frame six* and in the side view move the ball to the wall in the *x axis* and up in the *y axis* by about one fifth of the distance and set another key frame.

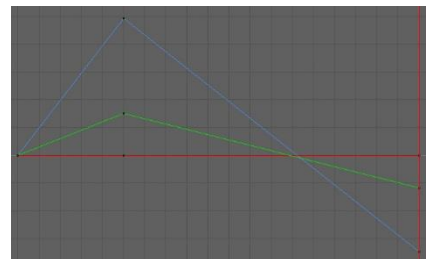


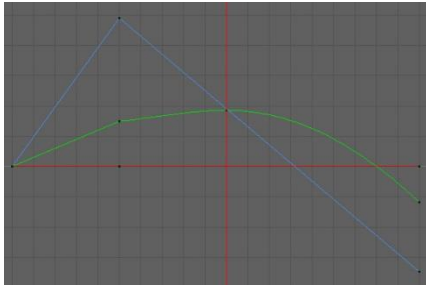
Now move the time slider further on to frame 20 and move the ball back behind the launcher and on the ground. If you play back the animation now, you will see that it is missing something – the ‘bounce’ off the wall is too soft and the ball leaves the wall in the wrong direction – it should bounce upwards first and then drop.



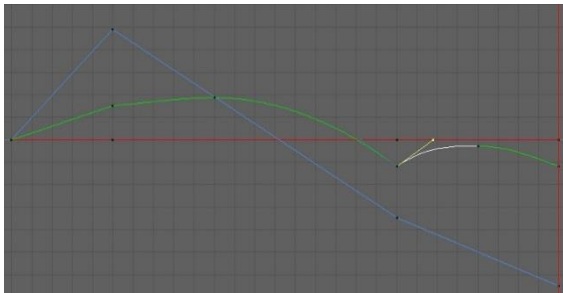
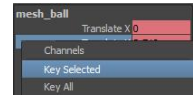
Open your graph editor *Window > Animation Editors > Graph Editor* and press *F* to frame the key frames. Select the first key frame, at the moment it has *Flat tangents* which means the ball will ease into the animation – because we are firing the ball straight from a cannon we want to change the tangents to *linear tangents*. This will give us an

instant trajectory. In similar vein we want to change our other keys to linear because they are currently all impact points where the ball will bounce.



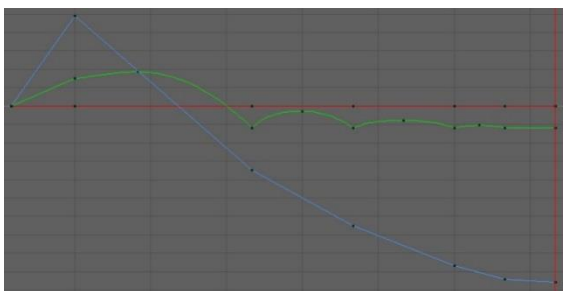
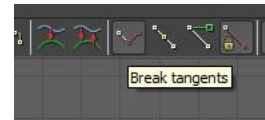


The bounce speed is more accurate, but we still need to make the ball continue upwards a little after the bounce. Move to *frame 11* and move the ball up in the *Y Axis*. *Right-click hold* the *Translate Y* attribute and select *Key Selected*. Keying the attribute individually ensures that the other translate values are not inhibited.



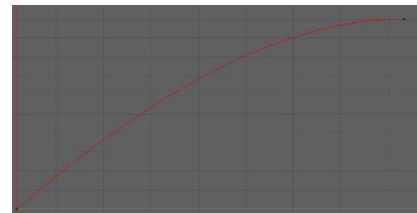
Now we want to use this method of animation to make the bounce again on the floor. When you have set your keys and are in the graph editor, one extra tool we will need to use is the *Break Tangents* button. This allows us to move the in and out tangents independently. To change our

tangents (the yellow lines coming from the point) make sure you are in move mode (*W* key) select the line and *middle-click drag* to change its direction.



Using the same techniques, add another couple of bounces, reducing the length and height each time. Your graph editor should resemble something similar to the one on the left.

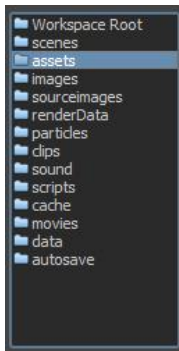
Before we finish, we are going to add some back spin to the ball. At *frame one* key the ball's *Rotate X* attribute at *zero* and then on our last frame set the value to something like *1000*. The initial key should be made linear to resemble the curve on the right.



Play with the in and out curves to get the correct bounce speed, and you should be left with a simple ball being fired into a wall and bouncing back.

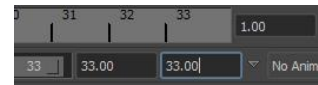




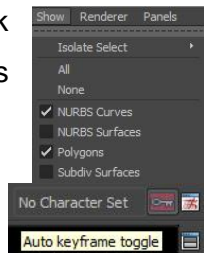


Copy your character rig into the assets folder, then back Maya click *Create Reference* from your File menu. Click on Assets from the left hand menu and select the rig your wish to animate with.

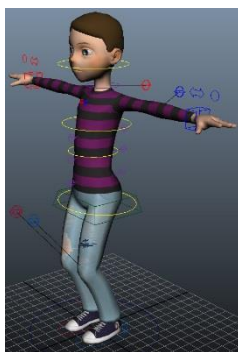
While we are still setting the scene up, change the playback range to 33. This is going to be the length of our walk cycle.



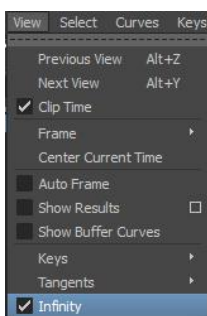
In your viewport *Show* menu, select *None* to hide all objects and then tick *NURBS Curves*, *NURBS Surfaces* and *Polygons* to make them visible. This will keep any joints and other visible objects hidden while we are animating.



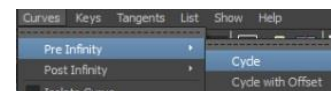
Select all of your controls (if you are working with your own rig then make sure that only controls are selected, not your mesh or any other nodes that could break if keys are applied). We can also turn on our *Auto Keyframe toggle* on in the bottom right.

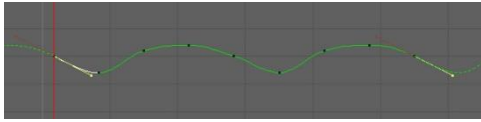


We have four key points during our walk cycle, causing our characters centre of gravity to create a wave pattern. Frames 5, and 21 are when the hips will be at their lowest, frames nine and 25 the highest. Let's plug some values in to give us this bob to work with. Make sure you are at frame one and key the hips *Translate Y* at zero, then key the value on frames 17 and 33. Move to frame five and bring the hips down, auto key should have created a new key for us. To set this same value you for frame 21, middle click on frame 21. You will see that the animation does not update, but if we key the *Translate Y* attribute it will create a new key with the previous value. This technique is also great for keying hold poses. Now on frames nine and 13 and then 13 and 29 key the hips in a more elevated position to give us a nice smooth bobbing effect.



Open up your *Graph Editor* and press 'F' to frame up your translate curve. In the Curves menu select *Pre-Infinity > Cycle* and *Post-Infinity > Cycle*. This will force the curves into a loop and to show us this loop we can enable the Infinity box in the view menu.

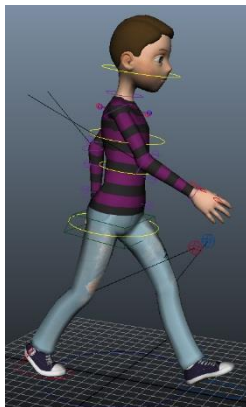




This will give us a dotted line either side of our key frames to show us how the value will continue. At the moment our loop has this 'step' or kink at the beginning. Select the first key frame and then shift select the last and press 'flat tangents' to make sure they are the same. Now select and shift select the tangents for the key frames and in ensuring you are in move mode (W) move the tangents down so that the curve is smooth.

Go back to frame one and move the feet into position (starting with your left foot leading) watching for any hyper-extension. We never want any of our limbs to be completely locked out because this will cause 'popping' to occur during our animation. We want to bring the rest of our character into a rough start pose. Rotate the body forwards a little and also rotate our hips to follow along with our legs. Your feet may be different if you are using your own character, but we are going to use our *Foot Roll* attribute on our foot controls to bring the toes up and heel forwards for our respective feet. We also want to ensure that auto stretch is turned off.

Translate X	0
Translate Y	-0
Translate Z	-4.252
Rotate X	0
Rotate Y	0
Rotate Z	0
Auto Stretch	off
Stretch	0
Lock Mid	0
Pivots	off
Heel Pivot	0
Ball Pivot	0
Toe Pivot	0
Roll	off
Foot Roll	0

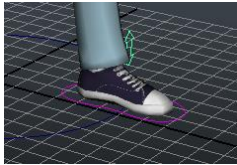


In our upper body, we want to bring our arms down and out (do not rotate them forward too far) and rotate our upper-body / chest control and shoulders out to follow our arms. For a female character it is often nice to rotate the arms out away from the body slightly, whereas with a male character we want to turn them in a little. I have also taken this opportunity to relax his fingers. With the first frame basic pose complete, select all of our controls and press S to key them in place. We also want to key everything at frame 33.

Now we need to build our right foot forward pose on frame 17. Starting with the feet copy the left foot values at frame one for your *Translate* and *Foot Roll* attributes and at frame 17 paste them onto our right foot values, then repeat the process for our other foot. Do the same process for our arms. The hips, chest and shoulders are easier – we simply want to put the negative (or positive) version of the current *Rotate Y* value to flip it.

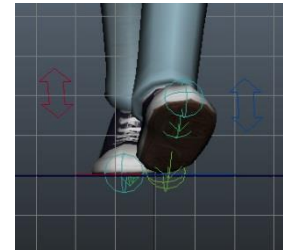
Ok, so if we play back our cycle it is already starting to resemble a nice walk.





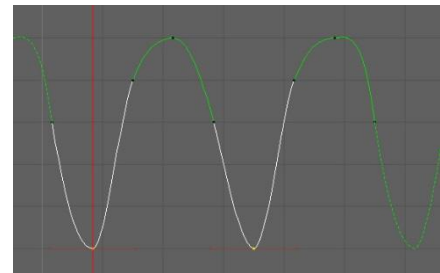
The feet are the most noticeable problems. By frame five (and 21) his foot should be completely planted, so let's go in and fix this by zeroing out the Ball Roll attribute on these keys.

Switch to the front view. We can see that his weight is way off, so let's centre our feet a little. At frames one, 17 and 33 we want to bring both feet closer to (but not on) the centre line, at frame 25 we want to move our left feet out to the side and at frame nine we want to move our right foot out to the side. While we have our feet selected, I have also used the *Toe Pivot* attribute to point our feet out a little.



The main thing missing now is our feet actually lifting off the floor. Select your feet and make sure that your *Translate Y* and *Rotate X* attributes are keyed at zero. Now at frames nine and 21 for your right and left feet respectively, rotate the foot down and lift the foot up. This should create a nice arc for your feet to travel in.

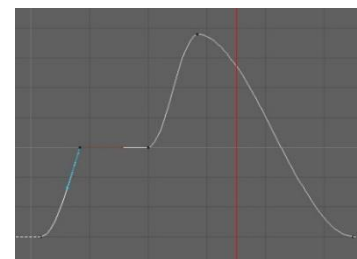
We need to add some weight to our animation, at the moment it is looking a little too floaty. With your hips selected open up your graph editor, select your *Translate Y* curve and press the *F* key to frame it. To increase the illusion of weight, select your bottom keys (frames five and



21) and click on *Break Tangents* to allow us to move the in and out tangents separately.

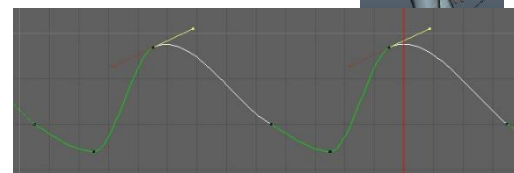
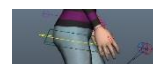


We want to increase the angle in and out of these points to make a point. Notice the weightier bounce when we play back our animation. We want to use a similar technique to give the feet more weight as they hit the ground. The left foot should resemble something like on the right, with a sharp in tangent at frame five.



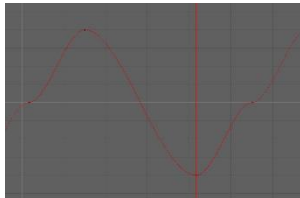
Our right foot will be similar, with the sharp tangent at frame 21.

Now when we play back our loop, we can see that the weighting is much more realistic; our footsteps much snappier. To finalise our feet, let's check our leg extension on the plant and lift, making sure that we don't have any over extension

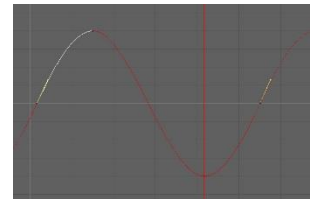


(popping). On frame nine, let's move our body up to straighten the leg. To mirror this on frame 25, middle click frame 25 and key the *Translate Y* attribute.

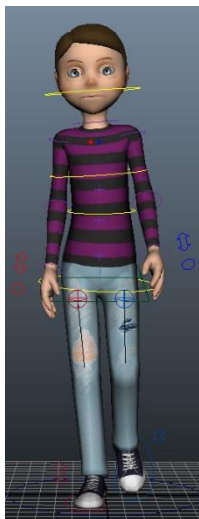
In your graph editor, grab the two top points and move the tangents to give the curve more of a hold on the higher position and lead into the next frame better.



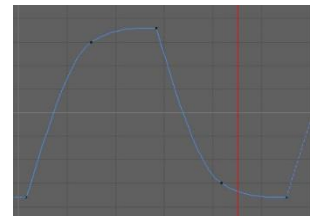
This is still looking much nicer, a much more dynamic walk. Moving on to our balance and weight distribution, move our body left on frame nine and right on frame 25 to match up with where our characters weight is being distributed. If we check our graph editor, we will find that we have a step again on the first and last frame, so let's select both of these points, flatten the tangents and then move both tangents up together.



This will give us a nice side to side movement which we can enhance by rotating his hips in line with the movement. It is also nice to add



weight to this rotation, to really emphasise the feet planting on the ground. Were nearly there but I'm still not quite happy with my foot planting – there is too long a delay between the heel hitting the ground and the toes. Go into your graph editor and bring the Foot Roll one frame sooner depending on your animation.



Now we can leave the bottom half for the moment and concentrate on the upper body.

Select your chest control and rotate it side to side on frames nine and 25 in the opposite direction of the hips. In the graph editor be sure to smooth the in and out tangents to remove the step from our loop. Playing the animation back you will see that instantly we have much more attitude going on in the walk cycle, especially from a more front facing angle.

The front to back rotation is ever so slightly more complicated because it is reacting to the hips so it will be slightly delayed. Key the chest forward at frame five and 21 and straighter at frame nine and 25. Now after we have fixed the curve in the graph editor, we want to select all the curve points and *Shift-Middle-Click* to the right to move all the frames right by one frames.



Use this same technique to animate our head nodding, but move the head *Rotate X* keys forwards by two frames.

Our arms still look a little robotic. For our hands, repeat the steps for the chest and head but move the rotation keys way forward so that the start key is on frame ten. This will make our hands drag behind the arms to give us more fluid animation. You could also move our elbow key frames on by one or two frames.

Check all of your key frames in the graph editor, especially for kinks or steps in the curves and also for areas where you wish to add weight. Also keep an eye on your legs for popping. Finally hide your curves and preview your animation using a *Playblast* by right clicking on the timeline and selecting *Playblast*. Although playback in Maya is a good start, sometimes the system can be choppy – a Playblast is much more realistic to your final outcome.



This concludes our walk cycle tutorial. You should now be well equipped to transfer these techniques onto your own characters and use the same techniques to create run, jump and other cycles within your animation.

## Animating a Arthropod (Scorpion)

Animating a scorpion is no simple task, even the fundamentals of a walk cycle takes some thinking about when you are dealing with eight legs. The key thing to remember is that research is your best friend so the first step is to work out how an arthropod walks. Watching spiders and scorpions, we can see that generally the legs work in pairs, in a logical pattern – so using that knowledge we can draw up a spreadsheet with frame numbers and write a plan for which frame each foot lands on and lifts during the cycle.

This takes planning and patience, but you will end up with something that looks a little like this:

Frames	1	3	5	7	9	11	13	15	17	19	21
R1	D	D	D	D	D	D	U	U	U	U	U
R2	U	U	U	U	U	U	D	D	D	D	D
R3	U	U	U	U	D	D	D	D	D	D	U
R4	D	D	D	D	D	U	U	U	U	U	U
L1	D	U	U	U	U	U	U	D	D	D	D
L2	U	D	D	D	D	D	D	U	U	U	U
L3	D	D	D	D	U	U	U	U	U	U	D
L4	U	U	U	U	U	D	D	D	D	D	D

Following these directions, you can start to make the laborious process of keying the feet. First animate your body control to get the correct timing and placement for your feet, then animate the feet to follow. You will find that as you go on, you will be able to animate quicker and quicker.

As with any walk cycle, be sure to add weight to your feet and body movements by manipulating (and breaking) your tangent weights. This will go a long way to make your scorpion look more dynamic.

Bear in mind that this should be used as a guide, obviously if the scorpion is in an action sequence then his movement will be different, and there are other times you might need to take some creative licence with the plan.