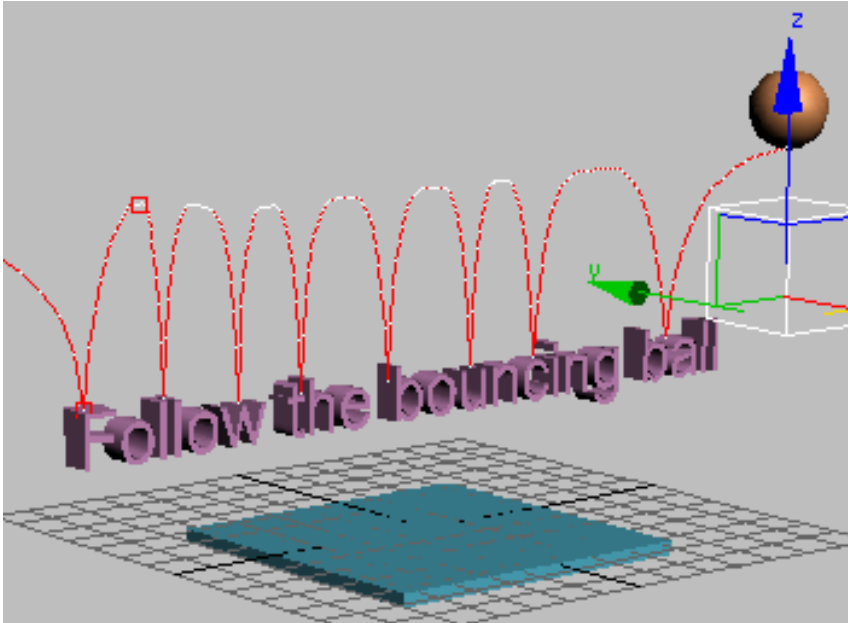


Animating with Auto Key: Bouncing a Ball

A bouncing ball is a common first project for new animators. This classic example is an excellent tool for explaining basic animation processes in 3ds Max.



In this tutorial, you will learn how to:

- Create animation using transforms.
- Cop keys in the track bar.
- Use ghosting to visualize in-betweens.
- Use tangent handles in the Function Curve Editor to control in-betweens.
- Create looping animation using Parameter Out-of-Range Types.
- Animate using dummy objects.
- Use Layout mode.
- Apply Multiplier curves.
- Work with the Dope Sheet Editor to speed up animation and reverse time.

- Animate using Set Key mode.


Skill level: Beginner

Time to complete: 1 hour 45 minutes

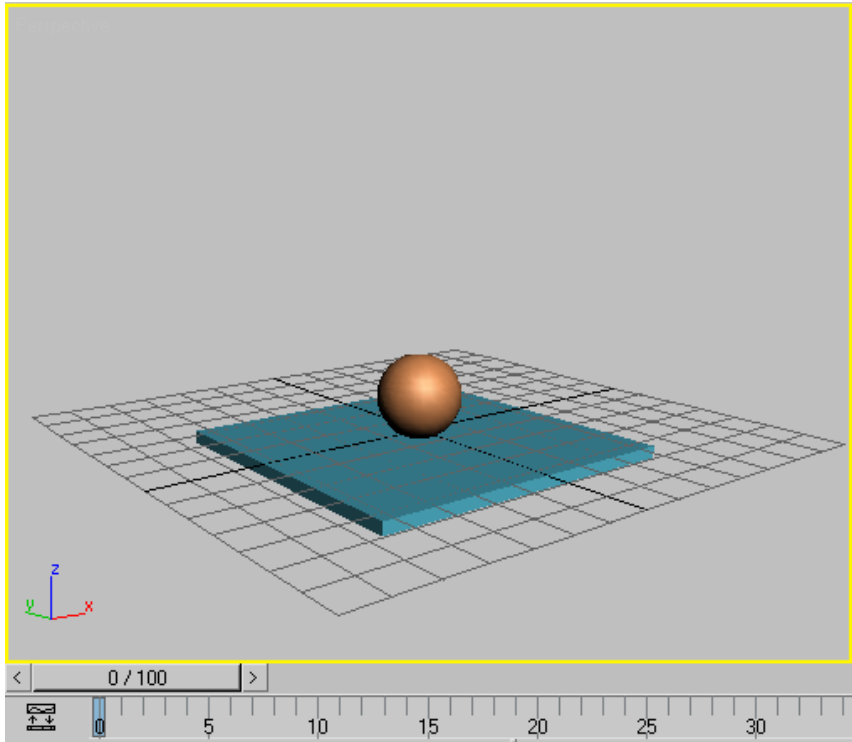
Creating Animation Using Auto Key

In this lesson, you'll start learning how to animate in 3ds Max.

Animate the ball using the Move transform:

- 1  On the Quick Access toolbar, click the Open File button, navigate to the *animation\auto_key* folder and open *bounce_start.max*.


NOTE The following illustrations display the grid differently than you will see in your viewports. For ease of use, press G on the keyboard to hide the display of your grid.

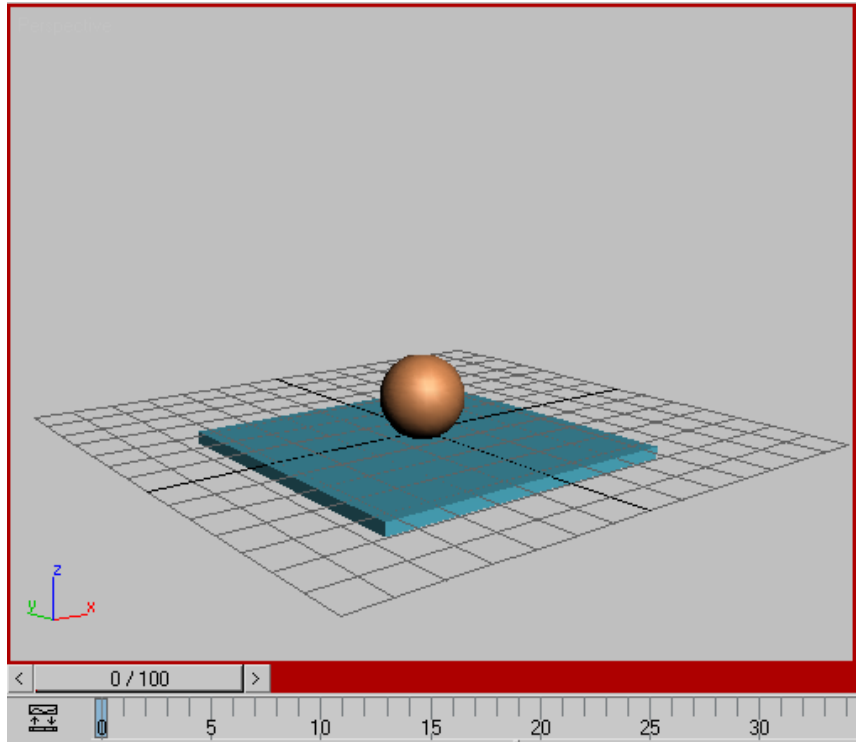


Perspective viewport: bounce_start.max

This file has the Perspective viewport displayed on the lower left. This is not the standard viewport layout; the layout has been customized for this lesson.

- 2  Click Auto Key to turn on this feature.

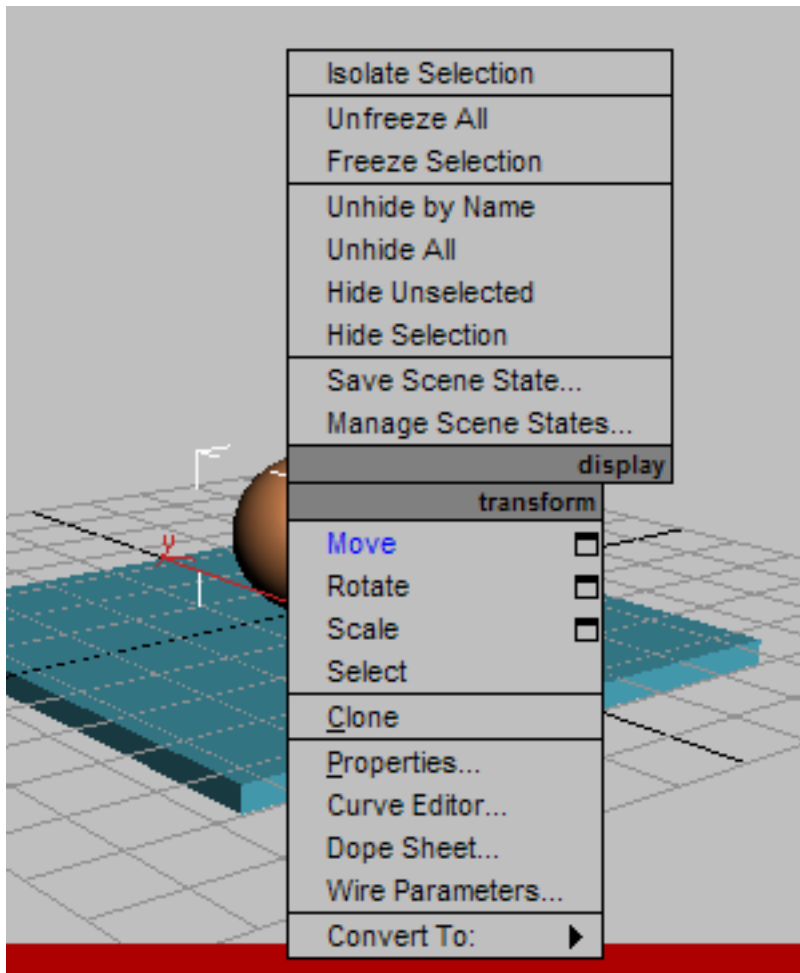
 The Auto Key button and the time slider background turn red to indicate that you are in animation mode. The viewport is outlined in red, as well. Now, when you move, rotate, or scale an object, you create keyframes automatically.



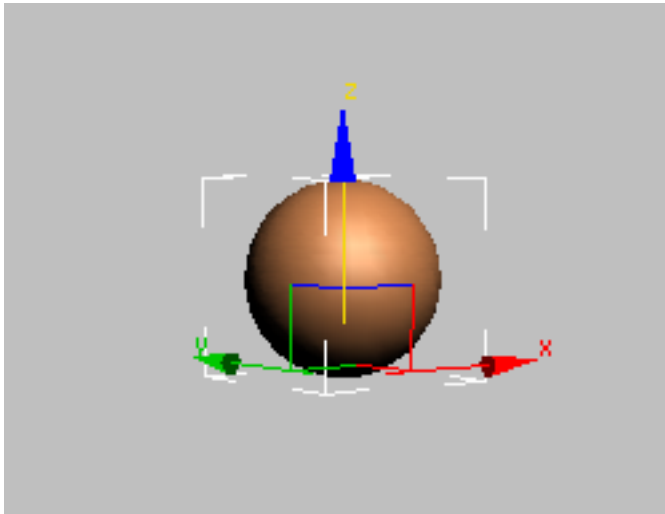
Time Slider background turns red



- 3 Click to select the ball in the Perspective viewport.
It is displayed within white selection brackets, indicating that it's selected.
- 4 Right-click the ball and choose Move from the Transform quadrant of the quad menu.



The Transform gizmo appears in the viewport. The Transform gizmo lets you easily perform constrained movements. As you move your cursor over the Transform gizmo, the different axes and their labels turn yellow.



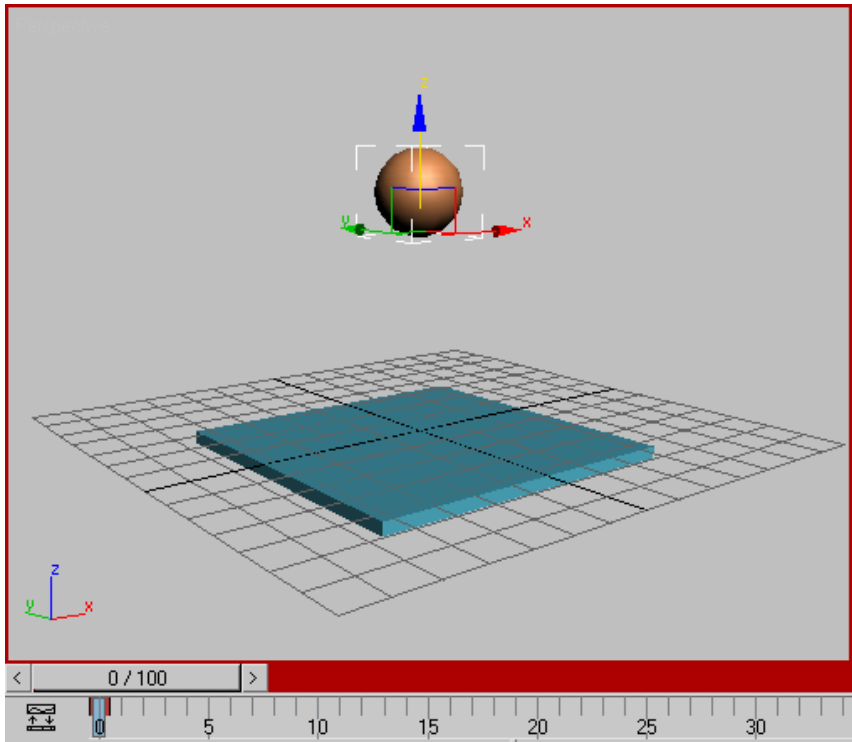
- 5 Position the mouse cursor over the Z axis, and when it turns yellow, click and drag upward to raise up the ball in the air.

As you move the ball up in the air, notice the Z value changing in the Coordinate Display below the track bar.

The ball's position at frame 0 is now fixed above the box.

A Position key is created when you do this. The key is displayed on the track bar.

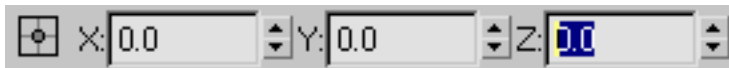
The track bar displays the keys for whatever is selected in the viewport. The track bar is found directly beneath the time slider and above the prompt area.



Keyframe created in Auto Key Mode

6 Move the time slider to frame 15.

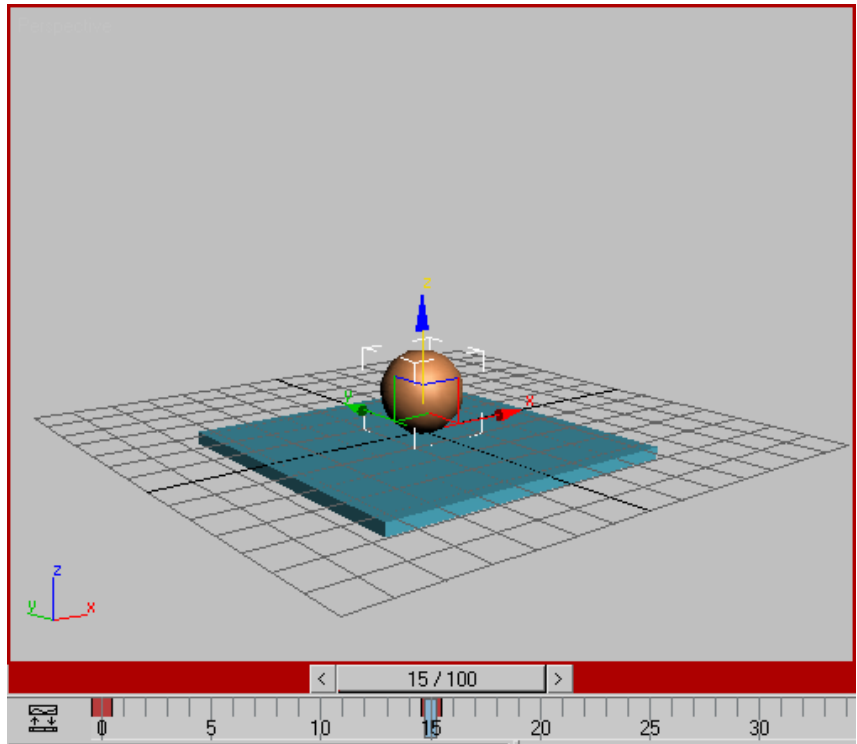
To move the ball precisely down to the table surface, put your cursor in the Coordinate display Z field, and change the value to 0.



Coordinate Display type-in for precision animation.

The box is built off the world origin, so a Z position value of 0 will set the ball directly in contact with the box.

NOTE The World Origin, (0,0,0) in XYZ coordinates, is shown by the intersection of the dark lines on the Home grid.



Frame 15: Ball is in contact with the box

You need to make the ball rise up to its original position at frame 30. Instead of moving to frame 30 and moving the ball back up in the air, you'll use a different method.

TIP You can zero the Z coordinate (or any other spinner) by right-clicking the spinner arrows.

- 7** Put your mouse over the time slider's frame indicator (the grey box that currently reads 15/100) and right-click.
The Create Key dialog appears.
- 8** In the Create Key dialog, change the Source Time to **1** and the Destination Time to **30**, then click OK.
This copies the key from frame 1 to frame 30.



- 9 Click Play Animation to play the animation, or drag the time slider back and forth between frames 1 and 30.

The ball moves down and up between frames 1 and 30, and stays up in the air between frames 30 and 100.



- 10 If you clicked Play Animation, click Stop (the same button) to end the playback.

Next, you will set the length of the active time segment to 30 frames.



- 11 In the time controls, click Time Configuration.

- 12 In the Time Configuration dialog > Animation group, set Start Time to **1** and End Time to **30**. *Don't* click the Re-Scale Time button. Click OK.

3ds Max lets you work in an active time segment that's a part of a larger animation. Here you are making frames 0 through 30 the active time segment. Notice that the time slider now shows only these frames. The other frames still exist, they just aren't part of the active segment at the moment.

- 13 Play the animation.

The ball goes up and down. Since the first and last frames are the same, the animation appears to cycle as it plays.

The ball moves, but it doesn't have "bounce" yet.

- 14 Stop the animation playback.

3ds Max made decisions on how the in-betweens are being distributed. Right now they are evenly distributed so the ball has no acceleration. It doesn't speed up or slow down; it just floats along with no sense of weight.

You need to simulate the effect of gravity so that the ball slows to a stop at the top of its bounce, speeds up as it approaches the table, and then bounces up again. To accomplish this, you'll use the key interpolation curves available on the Curve Editor. You'll also use the Ghosting feature to help visualize what the interpolation curves are doing.

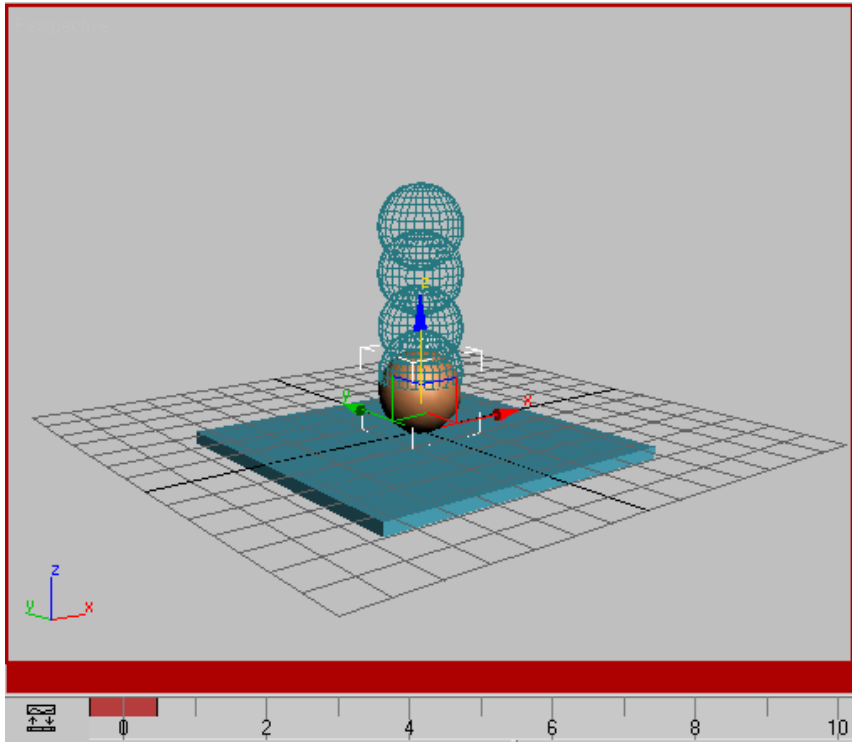
Controlling In-Betweens

To make the ball bounce more convincingly, you'll change the interpolation on the key at frame 15.

You'll use the tangency handles available in the Curve Editor. The tangency of the curve will determine the position in space of the in-between frames. Ghosting will let you see where the in-betweens are being positioned.

Using ghosting to visualize in-betweens:

- 1 Move the time slider to frame 15.
- 2 From the Views menu, click Show Ghosting to turn on this feature.
The ghosting feature shows object positions before the current keyframe in an aqua color.
- 3 Go to Customize menu > Preferences > Viewports tab, and set Ghosting Frames to **4** and set Display Nth frame to **3**. Click OK to exit the dialog.
The viewport displays the ghosting.



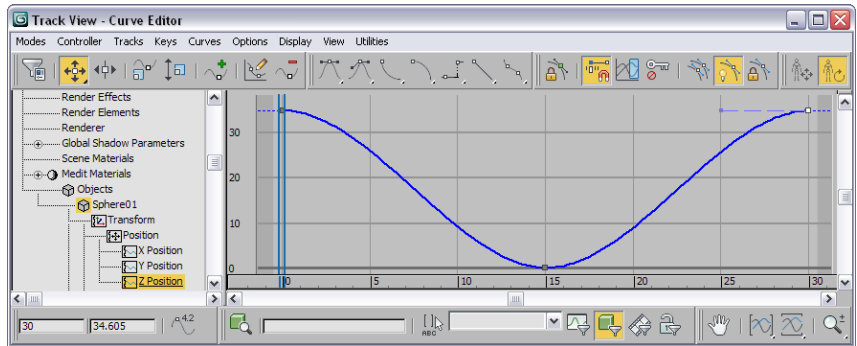
Ghosting shows the object positions on previous keyframes.

- 4 Play the animation, and then stop.
- 5 Now, to control the in-betweens, right-click the ball in the viewport and choose Curve Editor.
The Function Curve Editor is displayed across the top two viewports.
The Curve Editor is composed of two windows, a Controller window on the left that shows the names of tracks, and a Keys window on the right that shows keys and curves.
- 6 In the Controller window on the left, click to select only the Z position track.

NOTE If you don't see the Z Position track, click the plus icon to the left of the ball to expand the ball's tracks. If you don't see a plus icon, right-click and choose Manual Navigation, hold down Alt and right-click, and then choose Expand from the quad menu.

There are many possible configurations in the Curve Editor, so you may encounter variations from the standard.

Now the only curve displayed in the Keys window is the one you want to work on.



Function curve for bouncing ball Z position

- 7 Move the Track View time slider (the double aqua line in the Key window).

As you move back and forth the animation plays in the viewport.

If you look carefully you'll see a dark dot on the curve at frame 15.

- 8 Drag around the dark dot (the position key) to select it.

The selected key turns white on the curve.

You will now manipulate the curve using tangency handles. To access the handles, you must change the tangency type.



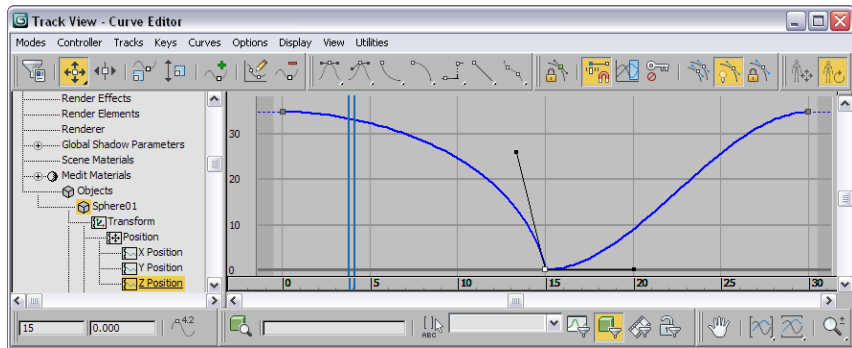
- 9 On the Track View toolbar, click Set Tangents To Custom.

If you look carefully, you'll see a pair of black tangency handles have appeared on the curve.

- 10 Hold down the Shift key and drag the left handle on the left upwards in the Key window.

Using the Shift key lets you manipulate the left handle independently from the right.

The curve now looks like this:

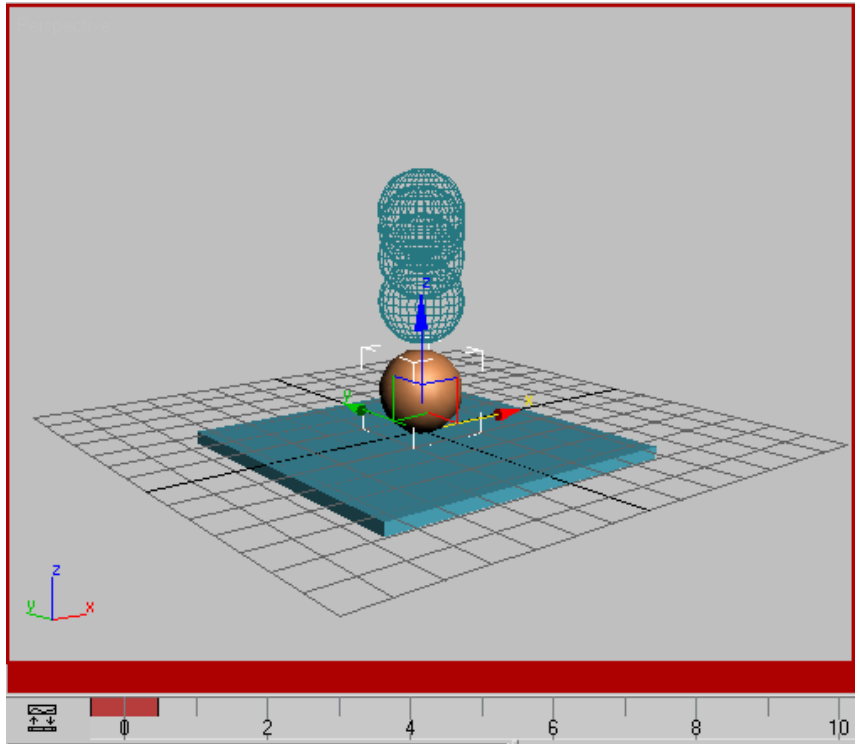


Shift key allows for manipulation of individual handles.

You'll change one more setting to make this tool more useful.

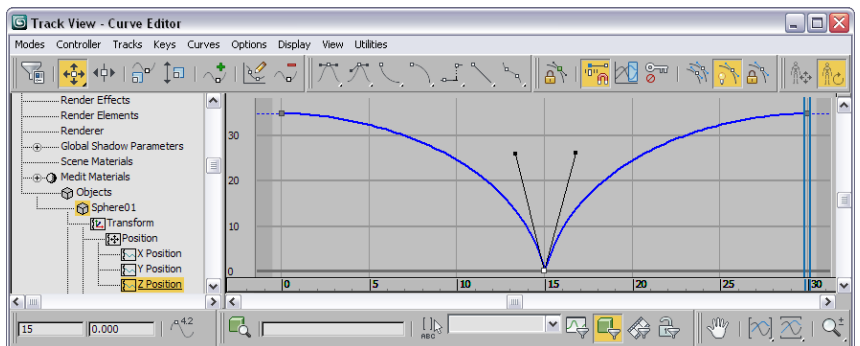
Using Interactive Update:

- 1 On the Track View Options menu turn on Interactive Update. Now move the time slider to frame 15, then manipulate the tangency handle while observing the effect in the ghosting. You can clearly see the changes as you work.
- 2 Set the tangency handle so the in-betweens are mostly drawn toward the raised position (see the illustration that follows). With interactive update on, you can do this with very fine control.




Interactive update and ghosting

- 3 Move the time slider to frame 30, then adjust the right tangency handle so it approximately matches the left one.



By manipulating this handle you can get different effects. The upward movement of the ball as it bounces off the table will determine the perception of the weight of the ball. The ball will appear to be bouncy, like a tennis ball, if the two handles are similar. The ball will appear to hang in space if enough of the in-betweens are drawn close to the topmost position.

- 4  Turn off Views > Show Ghosting and then play the animation. Concentrate on the movement of the ball. Adjust the curve handles some more while the animation plays. Observe the effect.
The ball leaves the table as quickly as it hit it, then begins to slow down as it rises.
- 5 Play the animation, and then stop.
The ball has bounce now. It looks like there is gravity at work here.
When you see something you like in the viewport, it's a reminder that you should save your work. It's easy to forget while you're being creative.
- 6 Save your work as **mybounce.max**.

You've made the ball bounce once. In the next section, you'll learn to repeat the bouncing of the ball using Out-of-Range types in Track View.

Adding Parameter Curve Out-of-Range Types

You can repeat a series of keys over and over in a variety of ways, without having to make copies of them and position them along the time line. In this lesson, you'll add Parameter Curve Out-Of-Range Types to the ball's position keys. Out-Of-Range Types let you choose how you want the animation to repeat beyond the range of the current keys. They have the advantage that when you change one set of keys, the changes are reflected throughout the animation

Most of the tools in Track View are available both from menu choices and from toolbars. This feature is also on the Controllers menu.

Repeat keyframed motion:

- 1 Continue from the previous lesson, or open *bounce_repeat.max*. This is a 3ds Max scene with the ball bouncing once.

- 2 If the Curve Editor isn't displayed already, select the ball in any viewport, right-click, and choose Curve Editor from the quad menu.
- 3 In the Controller window, make sure that only the Z Position track is selected.

Before you repeat the keyframes, you'll extend the length of the animation.

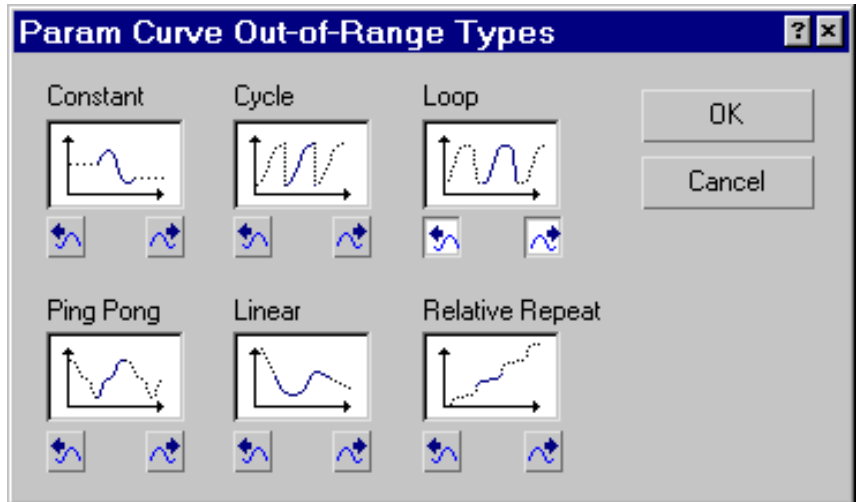


- 4 Click Time Configuration. This button is beneath the Go To End button in the animation playback controls at the bottom-right corner of the interface (not Track View).
- 5 Change the Animation End Time to **120**.

This adds 90 blank frames onto the existing 30 frames. It doesn't stretch the 30 frames over 120. The ball will still be bouncing once between frames 1 and 30.

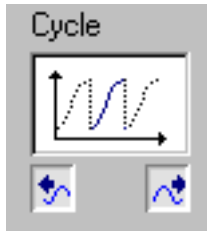


- 6 Now, back in Track View, click the Parameter Curve Out-Of-Range Types button on the toolbar.



Parameter curve out-of-range type choices

- Click both boxes under the Cycle graph to choose Cycle for In and Out. Click OK.



- Click Zoom Horizontal Extents on the Navigation: Track View toolbar at the lower right corner of the Track View window. The Keys window zooms back so the entire time segment is visible. The Parameter Out-of-Range curves are displayed as dotted lines.



Parameter Out-of-Range curve

There are no keys beyond frame 30. Any change made to the original keys will be reflected in the looping.

TIP You can create keys for the out-of-range curves by choosing Utilities > Track View Utilities > Create Out of Range Keys.


- Play the animation. The ball bounces over and over.
- Save your work as **mybounce_repeat.max**

Next, you will learn to link the ball to a dummy object and then use the dummy to animate the position of the ball. This allows you to keep the bouncing independent from the position, and makes it easier to control the animation.


Animating with Dummy Objects

In this lesson, you will link the bouncing ball to a helper object. Then you can animate the helper so that the ball bounces across the top of some text. This animation technique is useful because you can control the ball's bouncing and its traveling motion independently.

Set up the lesson:



-  On the Quick Access toolbar, click the Open File button.
- Navigate to the `\animation\auto_key` folder and open `bounce_dummy.max`. This file is similar to the bouncing ball created in the last lesson. The only difference is that it has a text object prepared for you in the scene and it has a longer active time segment.

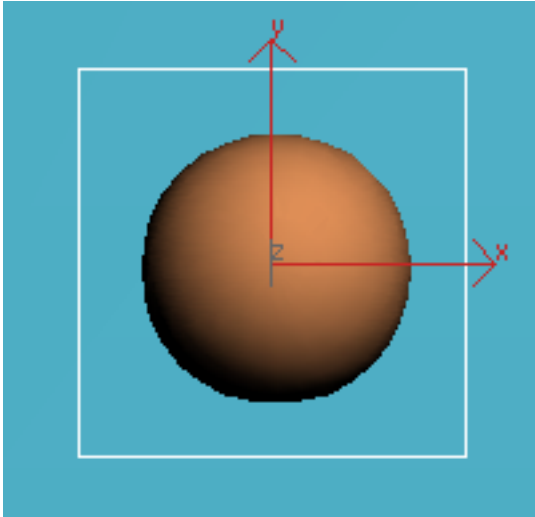
TIP If you want to keep using your own bouncing ball, you can merge the text object in from the `bounce_dummy.max` file by going to the Application menu and choosing Import > Merge.

-  If you didn't open `bounce_dummy.max`, you'll need to extend the active time segment to 240 frames. Click the Time Configuration button and then in the Animation group change End Time to **240**.

Create a dummy object:

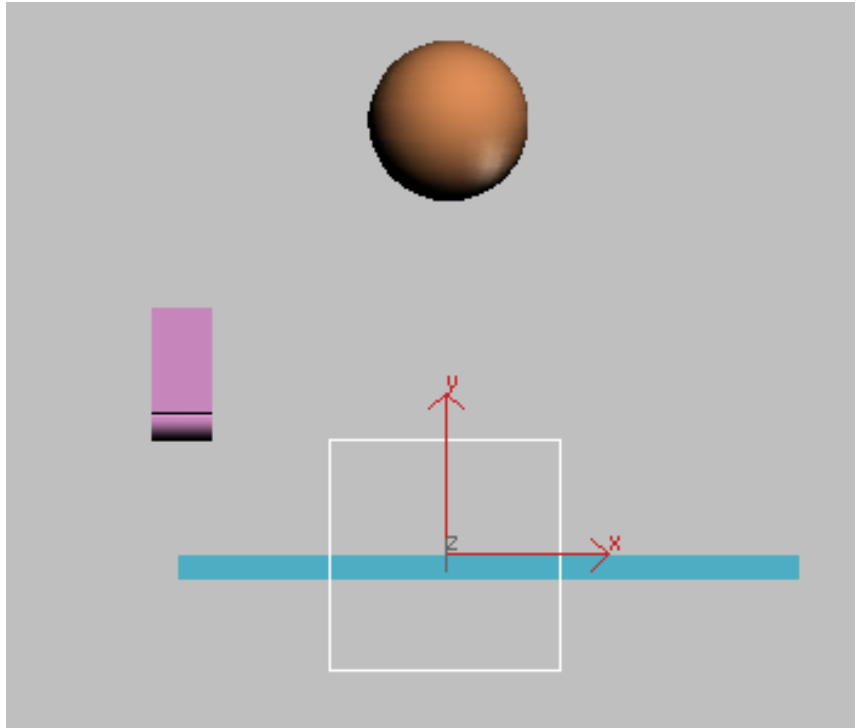
- Go to frame 1.
- Click the Top viewport to activate it, then zoom in on the ball and the box.

- 3   On the Create panel, click the helpers button, then on the Object Type rollout click Dummy.
- 4 In the Top viewport, move the cursor over the ball.
- 5 Hold down the mouse button and drag outwards to create a dummy object.



Make the dummy in the Top viewport.

If you look in the Front viewport, you'll see that while the ball is up in the air, the dummy is positioned at the same level as the box.



Dummy created below the ball

Next you will align the dummy so that it is centered over the ball when viewed from the top.



- 6 On the toolbar, click Align. Then in the Top viewport, click the ball.

The Align Selection dialog is displayed.

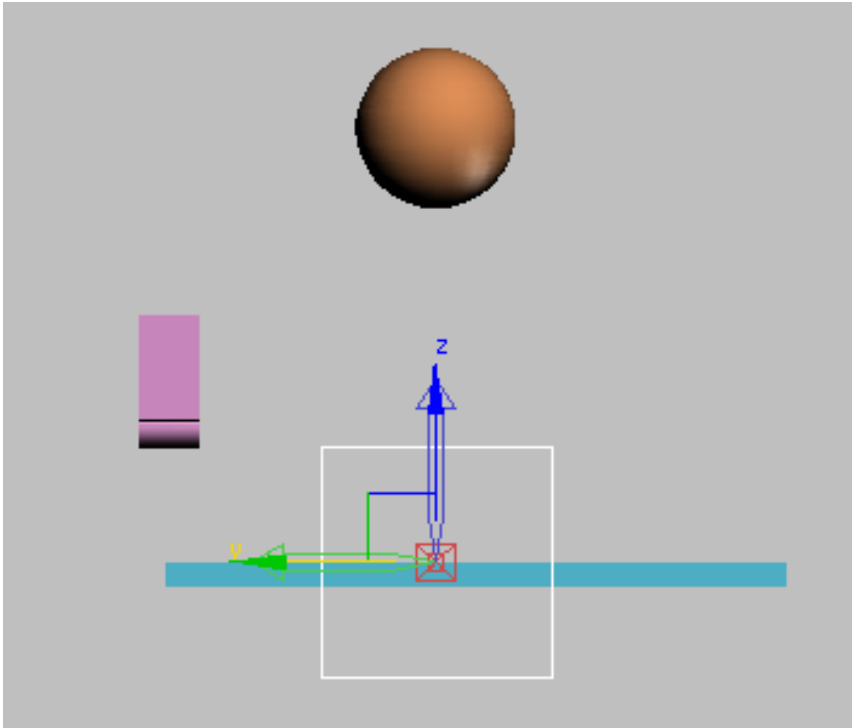
- 7 On the Align Selection dialog, turn on X Position and Y Position, but leave Z turned off. Click OK.

You'll see the dummy shift position so it is aligned to the ball.

Next, you'll align the dummy's pivot point with its base, and you will position the dummy so that it sits on top of the box. The idea is to set up the dummy so that its pivot point will match where the ball bounces. Then placing the dummy on any frame in time will ensure the correct alignment.



- 8 Select the dummy object, and go to the Hierarchy panel. Instead of moving the pivot, you will move the object using Affect Object Only. This moves the object but leaves the pivot unmoved.
- 9 On the Adjust Pivot rollout, click Affect Object Only to turn it on. The pivot icon is displayed in the viewport.



Pivot point tripod display

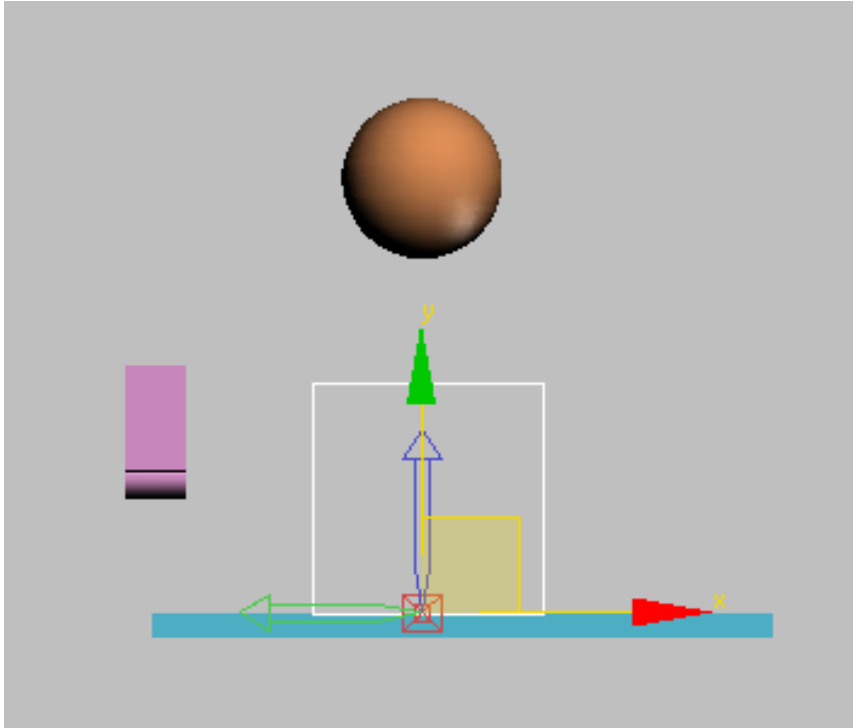
Now you can move the object to change its relationship with the pivot point.



- 10 Turn on Select And Move, and raise the dummy cube so its base is level with the pivot tripod. Use the Transform gizmo so the dummy only moves up.

You don't want to move in any other axis, since the dummy is already centered properly in the other axes.

TIP You can increase the size of the transform gizmo by pressing the = key repeatedly until the gizmo is the size you want.



= key used to grow the transform gizmo

11 Turn off Affect Object Only.

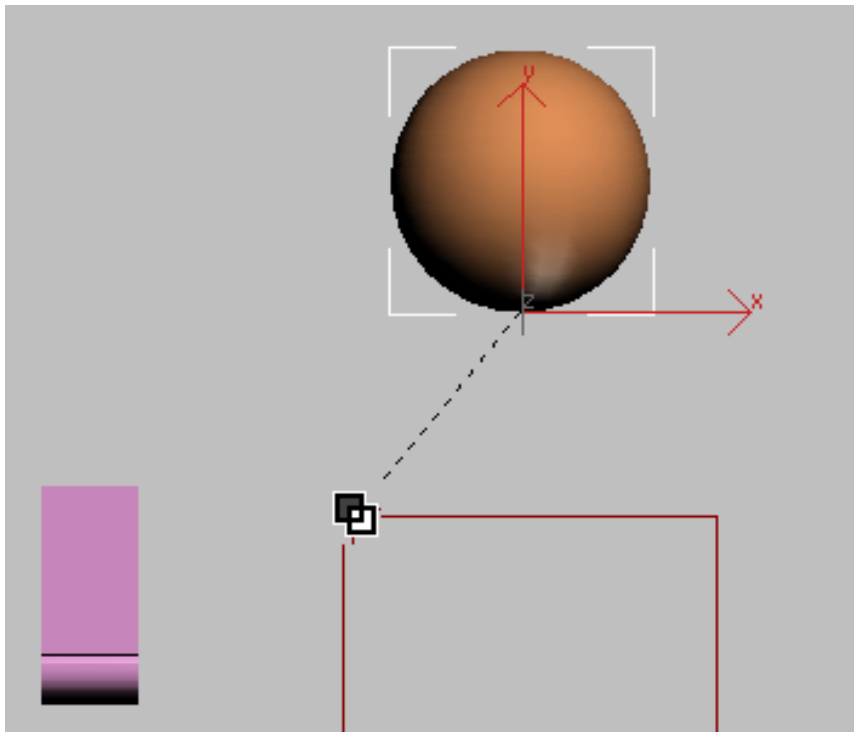
Now you will link the ball to the dummy. The dummy will become the parent to the bouncing ball.

Link the ball to the dummy:

1 In the Front viewport, zoom in so you can see the dummy and the ball.



- 2 On the main toolbar, turn on Select And Link.
- 3 Move the cursor over the ball, then press and hold the mouse button. The cursor changes to two interlinked boxes.
- 4 Move the mouse to the dummy. A rubber-band line follows the cursor. When the cursor passes over the dummy, it changes again. One box is white, showing you this object (the dummy) will be the parent of the first object (the ball). When the cursor has changed, release the mouse button.



Link the ball to the dummy

You just linked the ball to the dummy.

You can also create linkages in Schematic View. For something this simple, it's easier to link directly in the viewport.

When you've created a linkage, it's a good idea to test it out to make sure that you did what you think you did.

Verify that you've created the hierarchy:



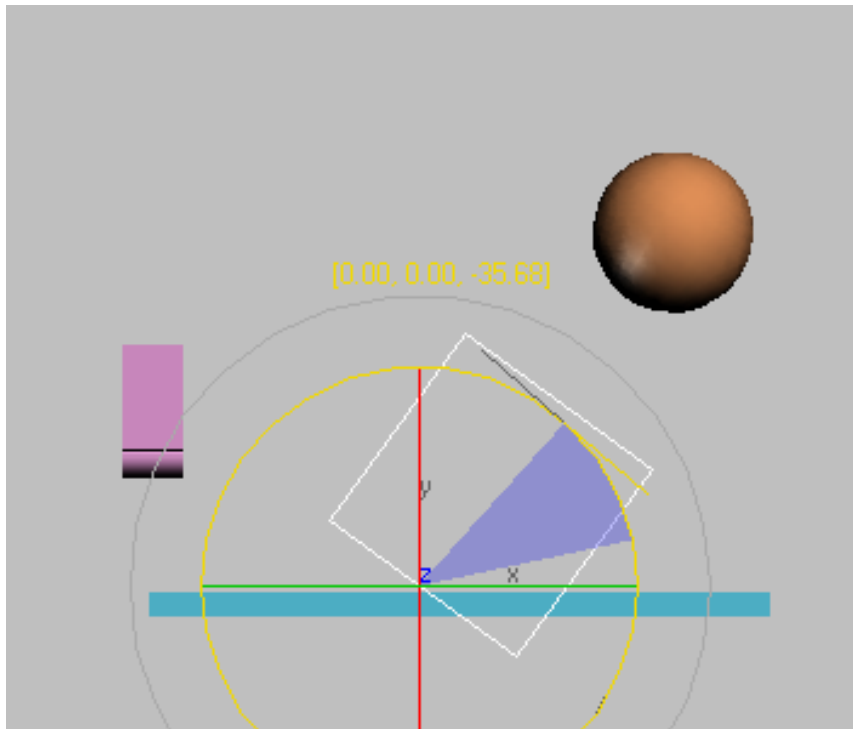
- 1 On the toolbar, turn on Select Object.



- 2 Press H to open the Select From Scene dialog. Choose Display > Display Children to make sure this toggle is on, then choose Display > Expand All.

The *Sphere01* object should appear indented below *Dummy01* in the object list. (You might have to click the plus (+) icon next to Scene Root in order to see the full list.)

- 3 Test the linkage by transforming the parent object. Rotate the dummy in the viewport. The ball should rotate as well.
- 4 Undo the transform after you've tested your linkage.



Testing the linkage

Now you're ready to animate the dummy. You'll use simple Auto Key animation first, so you can understand the process.

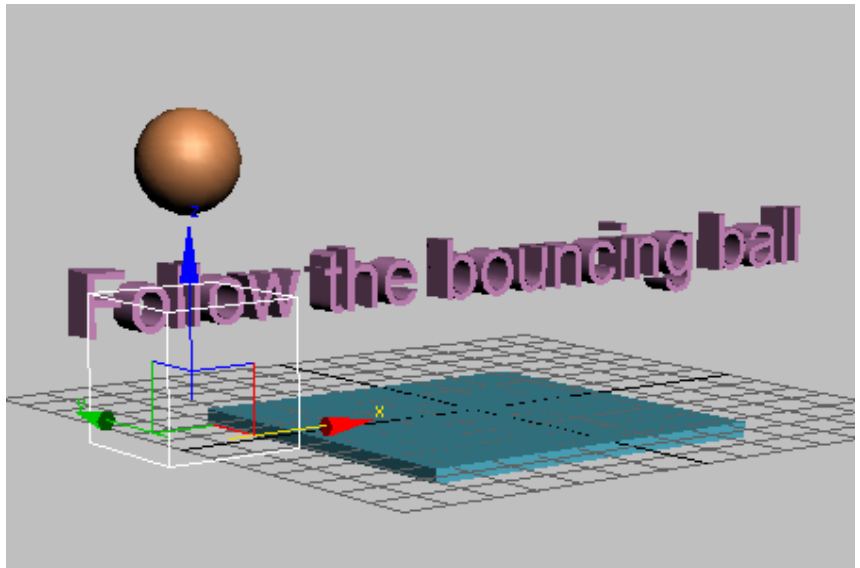
Animate the dummy:

- 1 Grab the divider lines between the viewports and drag them so the perspective viewport is wide screen.

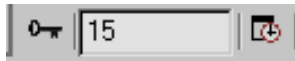
- 2  Turn on Auto Key



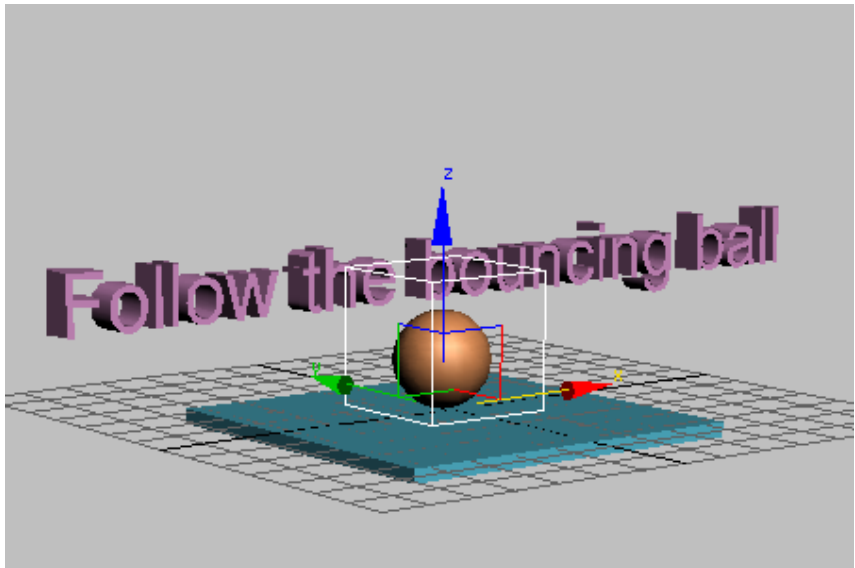
- 3 On the main toolbar, turn on Select And Move.
- 4 At frame 1, move the dummy so it is to the left of the box in the Perspective viewport.



Dummy at frame 1



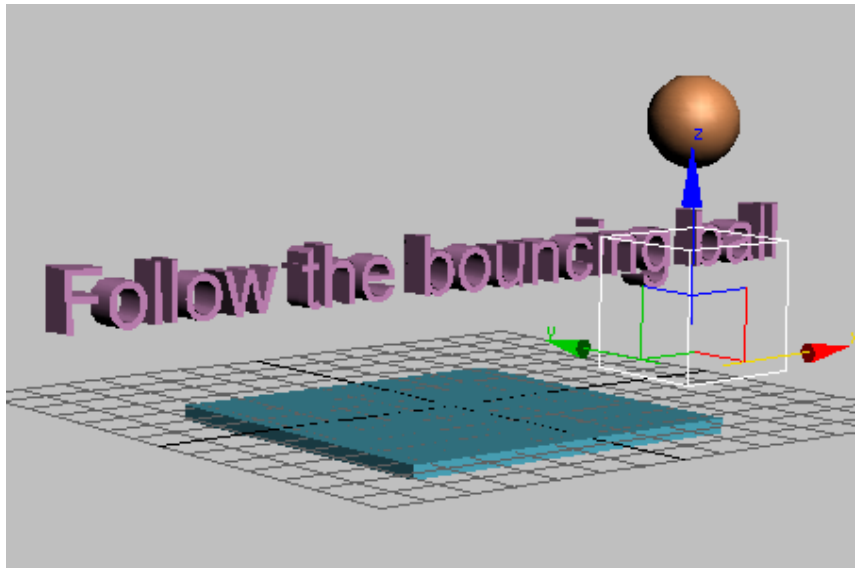
- 5 Use the time slider to move to frame 15, or type **15** in the Go To Frame field.
- 6 Move the dummy using the Transform gizmo so the ball is touching the box.



Dummy at frame 15

You just set two keys for the dummy, one at the start location at frame 0 and a second at frame 15.

- 7 Go to frame 30 and move the dummy again to the right of the box, so the ball continues to bounce away, rather than straight up in the air.



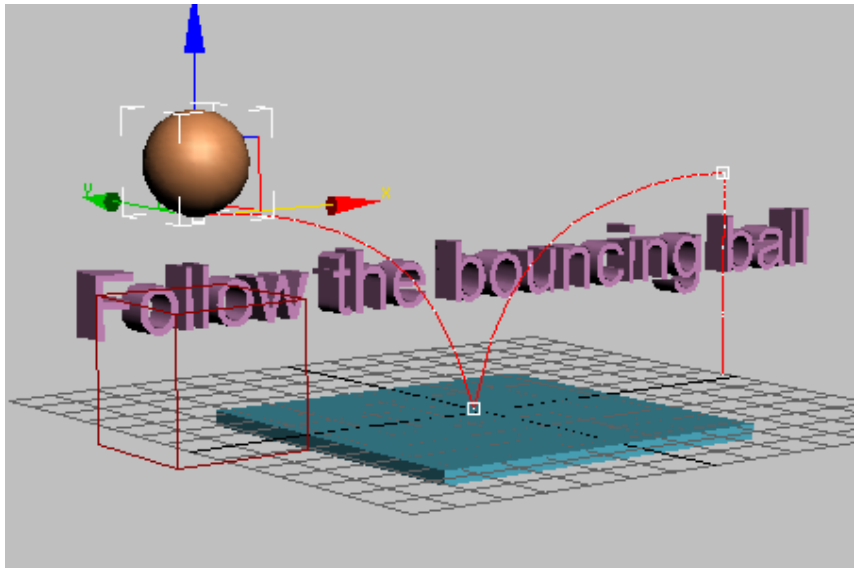
Dummy at frame 30

You've now set a third key at frame 30. If you play the animation, you'll see the ball bounce off the box as if it had been tossed.

You can display the trajectory of the ball to help visualize the animation. Here's how.



- 8** On the main toolbar, turn on Select Object.
You can use any transform tool for this, but using Select Object ensures that you don't accidentally transform the ball.
- 9** Select the ball, and then right-click it.
- 10** Choose Object Properties from the quad menu.
- 11** In the Object Properties dialog, in the Display Properties group, turn on Trajectory.




Trajectory display for the ball


12 Play the animation.

You see the ball bouncing onto the box and off, following the trajectory.

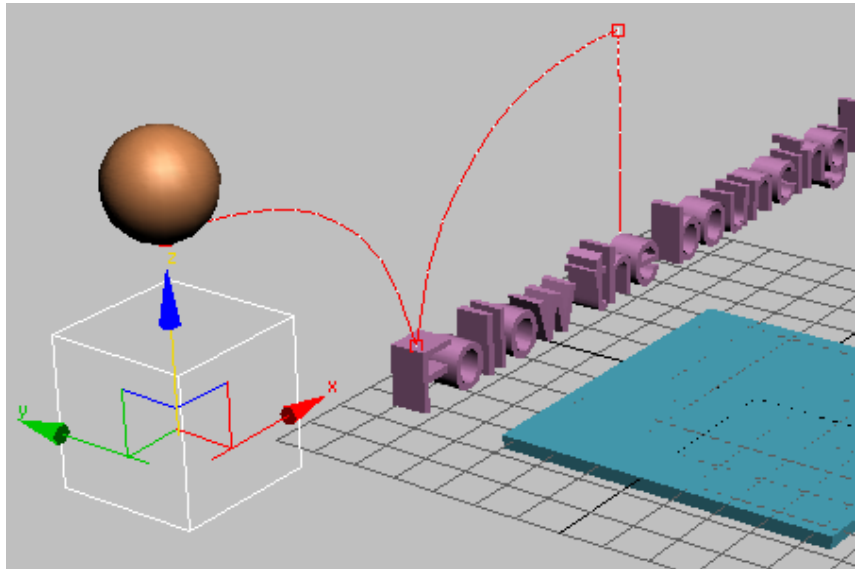
Try Layout mode:

If you turn off Auto Key and move the dummy, you will be moving the entire animation in space. When both Auto Key and Set Key are off, you are working in what is known as Layout mode. Here you will use Layout mode, so that instead of the ball bouncing on the block, the ball bounces off the letter F.

- 1**  Turn off Auto Key Mode.
The red disappears in the time slider background and viewport outline.

- 2**  Move the dummy object back toward the text.

- 3** Watch the position of the trajectory and move the dummy until the bounce point of the trajectory intersects the top of the letter F.




Layout Mode lets you move the animation in space.

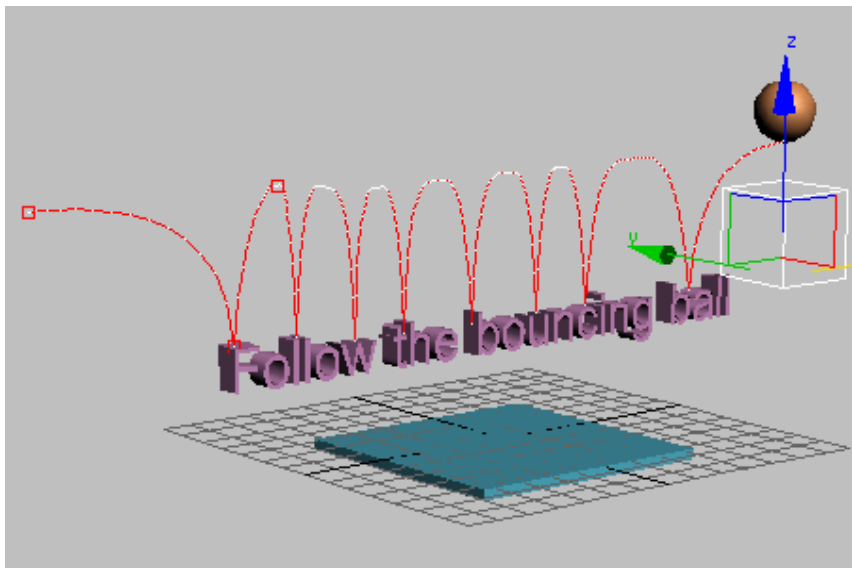
Bounce the ball on the letters:

Now you'll repeat what you've learned to create the ball bouncing on the letters.

The ball bounces 8 times, making contact with the letters at frames 15, 45, 75, 105, 135, 165, 195, and 220.

- 1  Turn on Auto Key.
- 2 In the track bar, select the key at frame 30 and delete it.
- 3 Move the time slider to frame 45 (or enter **45** in the Current Frame field).
- 4 Position the dummy so the ball bounces on the double L's in the word "Follow".

- 5 Move the time slider, then the dummy so the ball bounces on the following letters at these frames.
 - F at frame 15
 - ll at frame 45
 - w at frame 75
 - th at frame 105
 - b at frame 135
 - u at frame 165
 - c at frame 195
 - ba at frame 225



- 6 At frame 240, move the dummy so the ball move away from the letters.
- 7 Play the animation and observe the results.
- 8 Save your work as **mybounce_text.max**. If you had any trouble, you can open the file *bounce_text.max* to see the correct animation so far.
Next you will learn to use a multiplier curve to affect the height of the bouncing ball.

Add a multiplier curve:



- 1 Select the ball in the viewport, right-click and choose Curve Editor.

The Curve Editor window is displayed, if it wasn't already visible.

- 2 In the Controller window, click the Z Position track.
- 3 On the Curves menu, choose Apply Multiplier Curve. In the Controller window, click the plus icon. Click the Multiplier Curve to highlight it, and then hold down Ctrl and click the Z Position track. This way you have only these two curves displayed.

In the Controller window, the Multiplier curve is added beneath the Z position track. It's not very noticeable in the Keys window on the right.

The scaling of the multiplier track is quite small, so the slightest change to a key could result in a large change in the animation. You can counteract this by zooming in on the multiplier track.

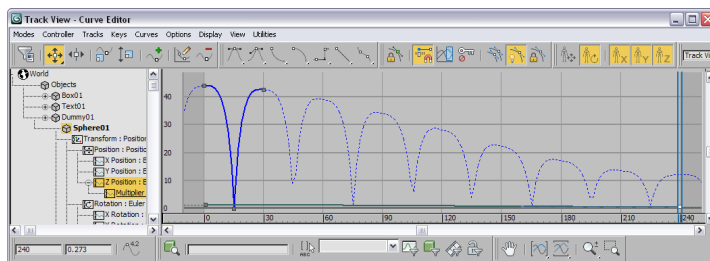


- 4 On the Navigation: Track View toolbar (at the lower right of the Keys window), click the Zoom Region button. Drag a zoom region window around the key at frame 240 on the multiplier track.

- 5 On the Options menu, turn on Interactive Update.

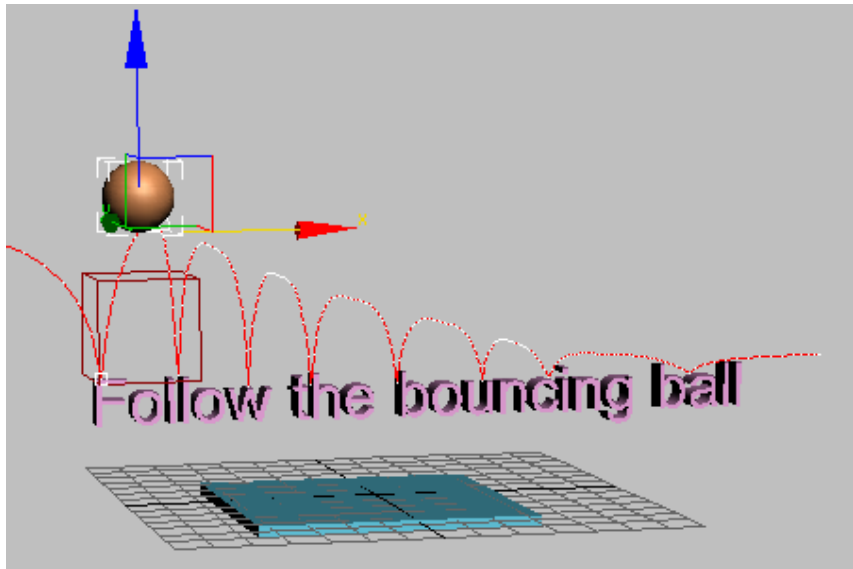


- 6 On the Track View toolbar click Move Keys to turn it on, then move the multiplier key downward, while observing the effect on the trajectory in the Perspective viewport.



Lowering the multiplier curve shows effect on Z position curve in Keys window

Don't move it below the horizontal zero value, or you will get some strange effects.



Multiplier curve shown on trajectory

TIP You can type in precision values on the Key Stats: Track View toolbar.

While working with Multiplier curves, if you're not sure you like the results, you can just turn them off. Select the Multiplier curve in the Controller window, then on the Curves menu choose On/Off.



- 7 Click Zoom Horizontal Extents on in the Navigation toolbar to see the entire curve again.

Using the Dope Sheet Editor

Track View also has a mode called Dope Sheet, which lets you work with keys and ranges. In this lesson, you'll use the range function to make your animation go faster. You'll also use the Time tools to reverse your animation.

Speed up the animation:

The bouncing ball doesn't have enough pep. To speed up the animation, you'll use Edit Ranges in Dope Sheet mode.

- 1 Continue from before or open *bounce_multiplied.max*.
- 2 Select the dummy object in the viewport. Then, on the Graph Editors menu, choose Track View — Dope Sheet.



- 3 On the Keys: Dope Sheet toolbar, click Edit Ranges. By default, the Keys: Dope Sheet toolbar is on the top left.

The Keys window now displays the ranges for the animation.

- 4 In the Controller window, highlight the item label *Dummy01*. This way you will adjust the ranges of all the dummy's tracks at the same time.

Before making changes to the dummy, you want to make sure that you also are making changes to the bouncing ball as well. Since the bouncing ball is the child of the dummy, you'll use the Modify Child Keys button.



- 5 On the Display: Dope Sheet toolbar, click Modify Child Keys to turn it on.

Now the changes you make to the dummy range will also be applied to the bouncing ball.

- 6 Click the end of the Dummy range and drag it to the left to around frame 100.



Range bars used to speed up the animation

This compresses the animation for the dummy and the bouncing ball so it happens within 100 frames.

TIP You can raise the time ruler up from the bottom of the Keys window for greater precision.

7 Play the animation.

The animation plays faster. The ball continues bouncing at the end of the animation. There are several different ways you could correct this. You could try to use an ease curve to stop the animation, or create keys from the out-of-range curve, and then delete the keys. Or you can set the active time segment to 100 frames.



8 Click the Time Configuration button beneath the animation playback controls.

9 Change the Animation End time to **100**.

Reverse time:

You can reverse the animation by using the Time tools available in Dope Sheet mode. It's easy to do.



1 On the Keys Dope Sheet toolbar, click Edit Keys.

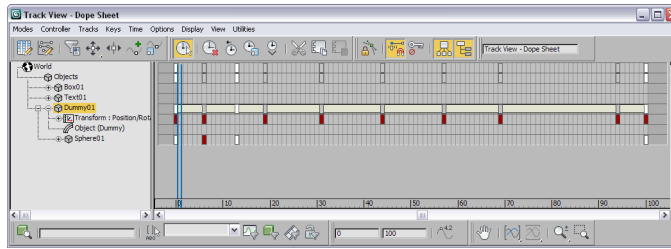
The range bars are replaced with keys.

2 On the Time menu, choose Select.

When working with Time commands, you first select the time, then make changes to it.

3 In the Keys window, on the Dummy track, drag from frame 0 to frame 100 to select the time.

The time is displayed as a light yellow band in the Dummy track.



Time displayed as light yellow band

4 On the Time menu, choose Reverse

The animation plays backwards. The ball bounces from right to left instead of left to right, and the last bounce now happens on the letter F instead of the double L in ball.

TIP You can easily reverse the playback of an animation using controls found in the Time Configuration menu. But if you need to reverse the keys themselves, this is the technique to use.

Summary

These Animation tutorials introduced you to the techniques of creating animation. You learned how to animate a bouncing ball using the Auto Key button and transforms, how to control in-betweens using key interpolation and ghosting, and how to loop animation using Track View controls. Finally, you've learned about animating with dummy objects, using the Dope Sheet editor and weighted list controllers.