15

Animating

Key Event Animation

In Ray Dream Studio, you create an animation by moving to different points in time and making changes in the scene to define the state of the action at that moment. These changes are called *key events*. Ray Dream Studio automatically fills in the *transitions* between key events to create the illusion of motion.

Most features in a Ray Dream Studio scene can be animated in this way:

- The motion of objects, lights, and the camera
- Object size, shape, and shading attributes
- Object deformer and behavior settings
- Camera and light parameters

- Ambient lighting, background, backdrop, and atmospheric effects

There is one important exception to key event animation. The physical force behaviors define object motion based on a real-world physical behaviors. Objects that have physics applied may not be animated with position or orientation key events. For more information on the physical behaviors, refer to "Behaviors" on page 314.

Time-Based Animation

In Ray Dream Studio*5*, key events are tied to real-world time increments—minutes and seconds—rather than to individual animation frames. This means you can create key events at specific points in time without worrying about the number of frames in your final rendered animation.

You might work at a low *frame rate* (6 frames per second is the default) to preview your animation on screen. Then increase the frame rate to render your final animation.

Once you have defined a key event, you can remove it, copy it, or move it along the time line to fine-tune the timing of your animation.

Animatable Properties

Each characteristic of an object or effect that can be animated is called a *property*. A typical object or effect has many animatable properties. Some properties, like those that define position and orientation, are common to all objects. Other properties are specific to certain types of objects.

Lights have special properties like brightness, fall off and sometimes gels.

Rendering Effects like backgrounds, backdrops and atmospheres have their own special properties.

The properties of an individual object depend on several factors, including what type of object it is, and what types of components are used in its shader.

Environmental primitives (like Fountain, Cloud and Fire) have special properties that determine their shape.

And when you apply a deformer or behavior to an object, you add the special animatable properties that define its effect.

This overview points out the differences in animatable properties for various objects. You can find out the specific properties of an object by expanding its listing in the hierarchy.

Properties in the Hierarchy

So that you can keep track of all of a scene's animatable properties, the hierarchy can be expanded to show all of the properties you can animate.

You can also control the hierarchy to limit which properties are displayed.

For a complete discussion of the hierarchy area, refer to "The Time Line Window" on page 297.

The Hierarchy Expanded to Show some of an Object's Properties (Macintosh version).

To change animatable property display in the Time Line window:

1. Bring the **Time Line** window to the front. You can either click in it or choose **Windows menu▸ Time Line of filename** .

2. Choose **View menu▸ Preset Views▸** and select the view option you want:

Hide still properties sets the hierarchy to display only animatable properties that have key events. (This exclude animatable properties that are constant throughout the animation.)

Hide non-transformation properties limits the hierarchy to display only transformation properties.

Hide non-existent properties sets the hierarchy to exclude animatable properties that have not been applied to the object.

Hide empty property groups sets the hierarchy to exclude properties that cannot be animated.

The Fixed Animation Hierarchy

Ray Dream Studio uses the hierarchy to manage an animation internally. For this reason, the hierarchy is fixed–*it cannot change during the course of an animation.* You cannot add or remove objects at specific points in time. Nor can you change groups or links.

You can Cloak (hide) or Uncloak (show) an object at any point during the animation. This allows an object to "exit" or "enter" during the course of the animation without changing the hierarchy. For more information, refer to "Cloaking an Object" on page 334.

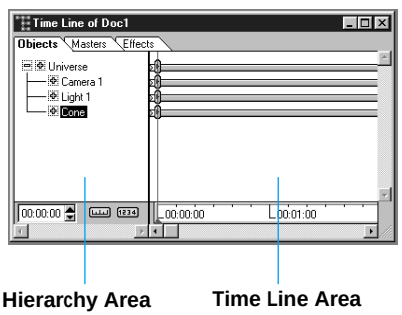
The values of the properties may change over time, but *the properties themselves must be constant.* For example, a spot light cannot become a distant light over time; a bitmap background cannot become a bi-gradient.

Most of the effects you might hope to achieve by changing the hierarchy over time can be achieved using other techniques. See "Animating Techniques" on page 327 for some examples.

The Time Line Window

This section describes the **Time Line** window, the heart of the animation interface. The window provides tools for several basic tasks:

- Viewing the animation hierarchy
- Changing the current time
- Setting the frame rate
- Specifying the render range (the start and end times of your animation)



The Time Line window allows you to control your animations.

The **Time Line** window provides a visual representation of the key events that make up an animation. It allows you to manipulate key events and move then to different points in time. The **Time Line** window consists of three areas:

The **Hierarchy area** located on the left side of the window displays the scene's hierarchical structure.

The **Time Line** area to the right of the hierarchy area displays a time *track* for each item (object, effect, or property) currently shown in the hierarchy area. *Key event markers* on these tracks represent key events in the animation.

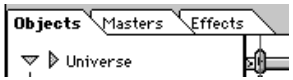
The **Time Axis** extending across the bottom of the window acts as a time ruler, with marks indicating time increments (minutes, seconds, and frames).

Hierarchy Area

All of the grouping, linking and organization tools of the Hierarchy are the same for producing a 3D illustration or an animation. Refer to "Building a Hierarchical Structure" on page 254 for more information on these features of the Hierarchy area.

Objects, Masters, and Effects Tabs

The contents of the hierarchy area (and therefore the tracks shown in the time line area) change depending on which tab is displayed.



The three tabs in the hierarchy area of the Time Line window s store hierarchies of the objects, master objects and render effects used in your scene.

- Click the **Objects** tab to show a hierarchical outline representation of all of the objects, lights, and cameras in the scene, with the Universe at the root.

For a discussion of organizing objects hierarchically, refer to "Building a Scene" on page 251.

- Click the **Masters** tab to show a list of the scene's master objects. Refer to "Working with Master Objects" on page 266 for information on working with master objects.

  Because the modelers operate on master objects, key events modifying a an object's shape appear on the time track of the corresponding master object. The Masters tab is useful for viewing these key events.

- Click the **Effects** tab to show a hierarchical representation of the scene's render effects. The general category **Render Effects** is at the root.

Expanding and Collapsing the Hierarchy

Expanding and collapsing the hierarchy allows you to control which time tracks appear in the **Time Line** window. This is useful when you are editing key events on the time line.

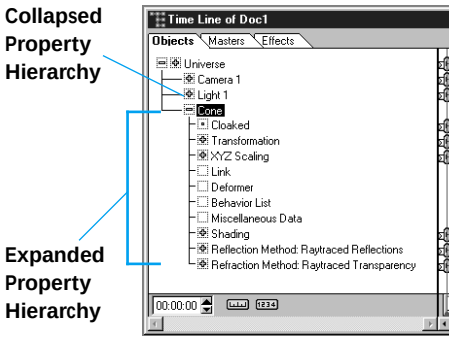
Expanding and Collapsing Property Hierarchies

You can expand individual objects, master objects, and effects to view their animatable properties.

To view the animatable properties of an item:

1. Click the **Time Line** window.
2. Click the green arrow (Macintosh) or green **plus**/**minus** sign (Windows) immediately to the left of its name.

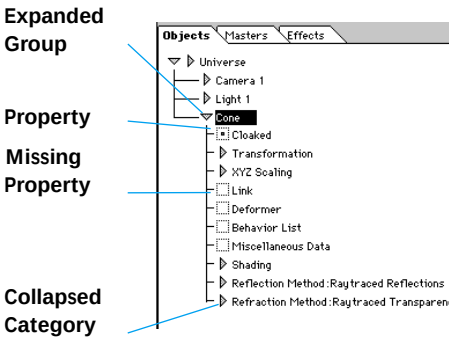
   A time track appears for each property. This allows you to edit the key events modifying individual properties. By expanding and collapsing the hierarchy, you can work with as little or as much detail as you like in the **Time Line** window.



The Hierarchy area of the Time Line window allows you to collapse and expand individual objects. This is the WIndows version.

Within the property hierarchy, related properties are grouped logically into categories, some of which may also include sub-categories. For example, **Transformation** is a category of properties which includes the sub-category **Position** and the individual properties **Hot Point**, **Scaling** and **Orientation**. The Position sub-category has three individual properties: **X**, **Y**, and **Z**, which together define the object's position in 3D space.

You can expand and collapse the categories and sub-categories within the property hierarchy by clicking their respective arrows (Macintosh) or plus/minus signs (Windows). Individual properties are represented by small green squares rather than arrows or plus/minus signs, indicating that they cannot be expanded any further.



Green squares in the Hierarchy area of the Time Line window indicate that the object cannot be expanded any further (Macintosh version).

Some items in the property hierarchy have no iconic representation, and no associated time track. This indicates that the item is not a property of the parent object or effect. In the figure above, the Cube has no Link property because no link has been assigned to it.

Scrolling and Resizing the Hierarchy Area

When you expand the hierarchy to show several levels, there may not be enough space horizontally to display all of the names. You can either scroll the view or widen the hierarchy portion of the window.

To scroll the hierarchy area:

1. Click the **Time Line** window.
2. Use the horizontal scroll bar to scroll the view of the hierarchy area.

To change the size of the hierarchy area in relation to the time line area:

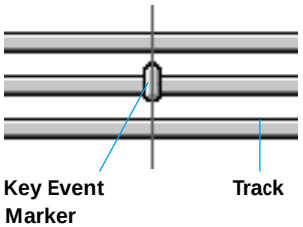
1. Position the cursor over the dividing line between the hierarchy area and the time line area. The cursor changes to indicate that you are over the divider.
2. Drag the divider to widen or shrink the hierarchy area. Release the mouse button when the size is right.

Time Line Area

The time Line area of the **Time Line** window displays a time *track* for each element (group, object, effect, property category, or individual property) currently shown in the hierarchy.

An animation's key events are represented by *key event markers* on the tracks of the time line. A *marker* may represent a single key event or several coincident key events, each relating to different properties of the

same object. For more information, refer to "Key Event Markers on Collapsed Time Line Tracks" on page 300.



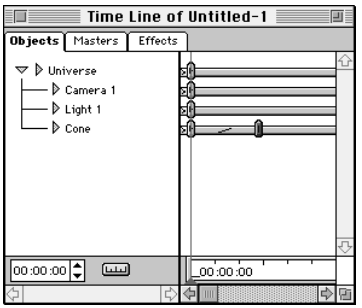
The Key Event marker in the Time Line Area indicates the position of a key frame in the animation time line.

The key event marker appears on the track for the object or effect it relates to. The location of a key event marker along its track indicates the time at which the key event occurs.

Key Event Markers on Collapsed Time Line Tracks

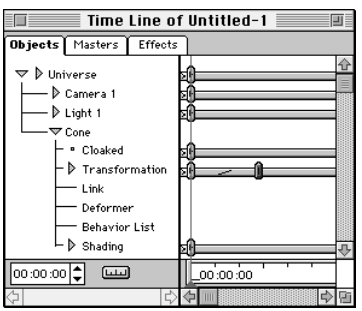
The term *key event* refers to the modification of a single property. Key event markers higher in the hierarchy—on the tracks of groups, objects, effects, and property categories—actually represent key events that modify the individual properties at the bottom of the hierarchy.

To illustrate, consider the specific example of an object that has been moved to a new position along the XY plane. A key event marker appears on its time track (a).



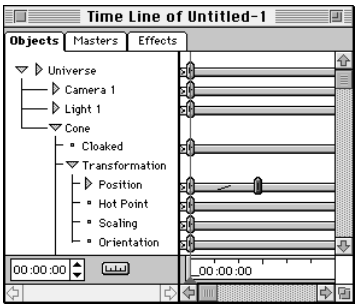
(a) A key event marker appears on its time track.

Expanding the object's property hierarchy shows a key event marker on the Transformation track (b).



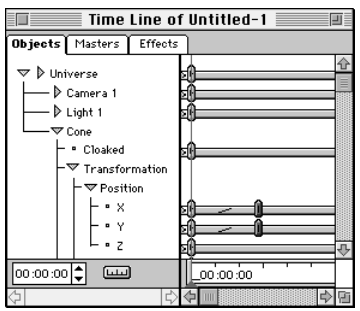
(b) Expand the objects hierarchy to display the event marker.

One level further down, a key event marker appears on the Position track (c).



(c) A key event marker appears on the Position track.

Finally, we see that key event markers appear on the X and Y tracks under the Position category (d). These markers represent two simultaneous key events: a change to the object's X coordinate, and a change to its Y coordinate.



(d) The key event markers appear on the X and Y tracks.

Whenever two or more coincident key events modify properties of the same object or effect, they are represented on higher levels by a single key event marker. So, when you move, copy, or delete a key event marker that represents several coincident key events, all of the key events beneath it are affected.

To manipulate the key events separately you need to expand the hierarchy to the individual property level, where the two key events are represented by different key event markers on separate tracks.

Step-by-step instructions for editing key events appear in "Editing the Time Line" on page 306.

Overlapping Key Event Markers

Sometimes two or more key event markers appear on the same time track at nearly, but not exactly the same time (they may represent key events modifying the same property, or key events modifying different properties of the same object or effect).

Depending on the current *time scale* (how closely you have zoomed in on the view of the time line area), these markers may overlap. In this case, the tiny vertical mark on the top key event changes to a plus sign, indicating that there are two or more closely spaced key event markers present.

This is what two overlapping key event markers look like on the time line.

Zooming in usually makes it easier to distinguish between overlapping key events. You can zoom in with the **Magnifying Glass** tool, or click the **Time Scale** button and change the settings in the **Set Time Axis** dialog. For instructions, refer to "Time Scale and Frame Rate" on page 301.

Time Axis

The **Time Axis** extends across the bottom of the **Time Line** window. It serves as a time ruler, with marks indicating time increments (minutes, seconds and frames).

The Time Axis shows the time increments used to measure your animation.

The **Time Axis** and its related interface items—the **Current Time Bar**, **Time Edit Controller**, **Render Range**, and **Time Scale** button—serve several important purposes:

Time Axis provides a temporal reference for the key event markers in the time line area.

Render Range (the white area of the Time Axis) indicates the beginning and end of the animation for the purposes of previewing and rendering.

Time Scale button allows you to change an animation's frame rate and the size of the time increments on the Time Axis.

Current Time Bar and the **Time Edit Controller** indicate the *current time*—the point in the animation currently displayed and edited in the **Perspective** window.

Time Scale and Frame Rate

The time scale describes the amount of time between each mark on the Time Axis. You can change the scale of the axis to see more time in a shorter distance, or less time in a longer distance.

The frame rate describes the number of frames displayed in each second. This applies to previews and renderings.

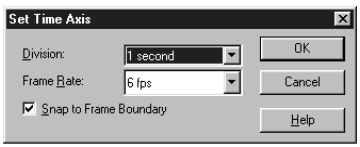
Note: The frame rate also determines the number of tics between major time divisions on the Time Axis.

You can set both these options in the **Set Time Axis** dialog.

To change the time unit divisions (scale) on the Time Axis:

1. Click the **Time Scale** button at the bottom of the **Time Line** window.

The **Set Time Axis** dialog appears.



Use the Set Time Axis dialog to change the unit divisions on the Time Axis in the Time Line window.

2. Choose a time scale from the **Division** pop-up.

Time scales range from 1/3 second to 2 minutes.

To set the Frame Rate for the animation (using the Set Time Axis dialog):

1. Click the **Time Scale** button at the bottom of the **Time Line** window.

2. Choose one of the frame rates from the **Frame Rate** pop-up.

The options range between 1 and 60 frames per second (fps). Typical frame rates are 15 or 18 fps for multimedia (CD-ROM), 24 fps for film, and 30 fps for NTSC video. You'll probably want to use a lower frame rate for previewing, then increase the rate for final rendering.

Note: The **Frame Rate** pop-up in the **Set Axis** dialog is synchronized with the frame rate menus in the **Time Controller** toolbar and the **Render Settings** dialog.

With snapping is turned on, the Current Time bar and key event markers will snap to individual frame boundaries when you drag them.

To control snapping to frame boundaries:

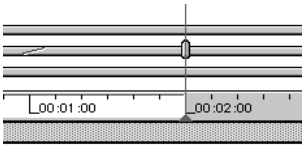
1. Click the **Time Scale** button at the bottom of the **Time Line** window.

2. Enable the **Snap** option.

The Current Time Bar

The **Current Time** bar is a vertical red slider with an arrow that points to the *current time* on the Time Axis.

The content of the **Perspective** window reflects the state of the scene at the current time. The title bar of the **Perspective** window also indicates the current time.



The Current Time Bar in the Time Line window indicates the current time in the Time Axis.

By default, when you drag the Current Time Bar it snaps to each tick (frame boundary) along the Time Axis. This allows you to set the current time precisely. You can turn snapping off by clicking the **Time Scale** button and disabling the **Snap** option in the **Set Time Axis** dialog. Refer to "Time Scale and Frame Rate" on page 301.

To change the current time with the time bar:

1. In the Time Line window, drag the **Current Time** bar to a different point along the **Time Axis**.

You can also click a point on the **Time Axis**.

If you drag the **Current Time** bar slowly, the contents of the **Perspective** Window updates interactively as you drag.

The Time Edit Controller

The **Time Edit Controller**, located to the left of the Time Axis and beneath the hierarchy area, displays the current time numerically in minutes, seconds, and frames (mm:ss:ff). For example, a reading of 00:08:23 refers to the moment that is eight seconds, 23 frames into the animation.

Note: The **Time Edit Controller** is synchronized with the Current Time Bar and the **Time Controller** toolbar (described "The Time Controller Toolbar" on page 303.

To change the current time (using the Time Controller toolbar):

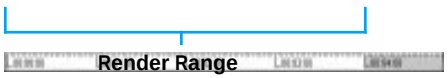
1. Make sure the Time Controller toolbar is displayed.
2. Type a new value, or use the arrows to scroll buttons to change the current time value.

Use the current time fields in the Time Controller toolbar to adjust the position of the Current Time Bar.

The Render Range

The **Render Range** describes which time segment will be previewed or rendered. The **Render Range** is shown in white on the Time Axis.

Note: The **Render Range** is synchronized with the **Scene Settings window: Output tab: File Format: Movie controls**. For more information, refer to "File Format" on page 362.



Render Range on the Time Axis indicates the length of your animation.

The **Render Range** must extend past all key events if you want to preview or render the entire animation. The animation stops at the right boundary of the render range. If your animation does not preview or render to the end, verify that the render range extends beyond the last key event.

In theory, the maximum render range is one frame short of one hour (the entire length of the Time Axis). In practice, an animation that long would exceed the capacity of most hardware configurations. Lengthy animations should be produced in several short clips, which can then be edited together in a video-editing application.

To change the Render Range start and end times:

1. Click the **Time Line** window.
2. Drag the right edge of the Render Range to set the end time.
3. Drag the left edge of the render range to set the start time of the animation.

The Time Controller Toolbar

The **Time Controller** toolbar contains VCR-like buttons for previewing and moving through your animation within the **Perspective** window, moving forward or back one frame, and moving to the beginning or end of the render range.

The render range is the white area of the Time Axis, which determines the starting and ending points for previewing or rendering an animation. Instructions for setting the render range appear in "The Time Line Window" on page 297.

Use the Time Controller toolbar to controls the preview your animation.

To display the Time Controller toolbar:

1. Choose **View menu ▸ Toolbars**. The **Toolbars** dialog appears.
2. Click the **Time Controller** item to enable its display.

   When the item has a check beside it, Ray Dream Studio displays that toolbar.

Note: Like all of Ray Dream Studio's toolbars, you can use the **Time Controller** as a floating palette or dock it on any side of the screen.

Previewing an Animation

You can use the **Time Controller** toolbar to preview your animation at any time. The animation will play in the **Perspective** window at the current display quality. Better Preview quality is not recommended for previewing animations.

When you preview an animation in a **Perspective** window, Ray Dream Studio won't skip any frames. If it can't draw frames fast enough to maintain the current frame rate, the preview will take longer to play.

Reducing the frame rate will produce choppier motion, but the preview will play closer to "real time." Lowering the current display quality to wireframe or box will speed up the preview without sacrificing smoothness of motion.

The **Time Controller** can also be used to change the current time. You can advance or back up one frame, or move to the beginning or end of the render range. You can also change the frame rate.

	Play	Click to preview the animation forward from the current time.
	Reverse Play	Click to preview the animation backward from the current time.
	Stop	Click to halt play.
	Loop	Click to loop when you play. Click again to disable looping.
	Rewind	Click to jump directly to the first frame of the render range.
	Fast Forward	Click to jump directly to the last frame of the render range.
	Previous Frame	Click to step back one frame.
	Next Frame	Click to advance one frame.

In some cases, you may want to render a low-resolution animation for preview purposes, rather than preview the animation in the **Perspective** window. For more information, refer to "Renderers" on page 342.

To change the frame rate using the Time Controller:

1. Make sure the **Time Controller** toolbar is displayed. If it's not choose **View menu ▸ Toolbars** and enable **Time Controller**.
2. Choose a frame rate from the **Frame Rate** pop-up. Values range from 1 to 60 frames per second.

Note: You can also set the frame rate using the Set Time Axis dialog or the **Scene Settings window: Output tab: File Format controls**.

If you are working with limited screen space, you can close the **Time Line** window and use the **Time Controller** toolbar to change the current time as you define key events. However, you won't be able to see the list of animatable properties, manipulate key event markers, or apply tweeners with the **Time Line** window closed.

Interactive Mode

Ray Dream Studio's Interactive Mode lets you see the objects move when you preview animations using Shaded or Better preview. When Interactive Mode is off, only projections (and bounding boxes for selected objects) move when you preview animations in **Preview**, **Shaded Preview** or **Better Preview Quality**.

To enable or disable Interactive Mode:

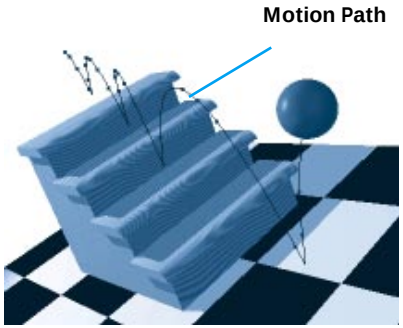
1. If necessary, display the **Rendering** toolbar, by choosing **View menu ▸ Toolbars** and enabling the **Rendering** option.
2. In the **Rendering** toolbar, click the **Interactive Mode** button.

   Interactive Mode is on when the button is darkened.

Enable the Interactive Mode button if you want to see your objects move in the Perspective window when you play an animation.

Viewing Motion Paths

To help you visualize the movements of your animated objects, Ray Dream Studio can display motion paths. A motion path is a line curving through space that describes where an object is located throughout the animation. Motion paths are 3D and cast projections.



Motion path let you see the path of your object in an animation.

The marks on the path describe the speed of the object through the animation. Where the marks are closer together, the object moves more slowly.

Note: The motion path is a visualization tool. You cannot change an object's trajectory by editing the path directly.

Motion paths apply to objects individually, so you can show or hide them for any particular object. The control for viewing motion paths is on the **Time Controller** toolbar.

Use the View Motion Path button to see the motion paths of your objects in the Perspective window.

To show or hide an object's motion path:

1. Select the object whose path you want to show or hide.
2. Click the **View Motion Path** icon on the **Time Controller** toolbar.
3. Ray Dream Studio toggles display of the object's motion path.

Note: Remember that motion paths are available for objects individually. You must select an object before clicking the icon to change its motion path display state.

To set Motion Path preferences:

1. Choose **File menu▸ Preferences**.
2. Choose **Motion Paths** from the pop-up.
3. Enable the **Display Frames** option if you want the path to show marks that indicate the object's position along the animation.
4. Choose a **Fidelity** level (Low, Medium or High) to set how precisely Ray Dream Studio should calculate and display the paths.

Defining Key Events

Key events are changes to the properties of objects and effects in your scene at specific points in time. You'll define *key events* to set the changes that create your animation. Ray Dream Studio automatically calculates the transitional states between key events.

After creating key events, you may want to modify the rule (tweener) Ray Dream Studio uses to calculate the transitional states between keys. For more information, see "Applying the Tweener" on page 310.

The physical force behaviors have special considerations. Their physical behaviors take precedence over arbitrary settings. Therefore, you cannot set key events for position or orientation on any object that has physics applied except on the first frame of the animation. See "Physical Forces" on page 318 for complete information on working with the physical forces.

Typically, you'll create a key event at the beginning and end of a particular action.

To define key events:

1. Click the **Time Line** window.
2. Set the current time to a time where you want to add one or more key events.

   You can drag the **Current Time Bar**, click a point on the **Time Axis**, or enter a time in the **Time Edit Controller** to set the time.
3. Use the standard Ray Dream Studio tools, editors, palettes, and dialogs to modify the properties of any object or effect you want animated.

   Ray Dream Studio places a key event marker on the appropriate track in the time line.
4. Continue creating key events for the several elements at various points along the **Time Axis**.

You can also add a key event directly to a time track in the **Time Line** window, using the Add Key Event tool. This doesn't change the existing action. It adds a key event at that point which you can then edit to change the timing of the animation. See Editing the Time Line, below.

Note: Notice that every element has a key event in frame one. That's because everything must have an initial state.

Editing the Time Line

After you've created several key events, you may want to change the timing of your entire animation, or synchronize individual events within the animation.

You can edit the time line to adjust the timing and content of your animation. You can add key event markers, delete them, or move them along the Time Axis. You can also copy and paste events between time tracks.

Selecting Key Event Markers

To select a key event marker:

1. Choose the **Selection** tool.
2. Click on the key event marker you want to select.

   - Hold down the **Shift** key and click additional markers you want to select.
   - You may also drag a marquee around one or several markers to select them.

Adding Key Events

To add a key event:

1. Click the **Time Line** window.
2. Choose the **Add Key Event** tool from the toolbar.

3. In the **Time Line** window, click on the time track at the point where you want to add the event.

You can select the new key event marker and move it to change the timing.

Note: The transitions before and after the new key event use the tweener options for the previous key event.

Removing Key Events

To remove key events:

1. Click the **Time Line** window.
2. Select one or more key event markers.
3. Press the **Delete**/**Backspace** key.

   You may also choose **Edit menu▸ Delete**.

Changing the Timing of Key Events

To change the timing of key events, you simply move key event markers horizontally along the time tracks to different points along the Time Axis.

To move one or more selected key events:

1. Drag the key event marker along the Time Axis to the point where you want it.

   If you've selected several markers, drag one of them and they all will move. The time intervals between the selected key events remain the same.

Ray Dream Studio lets you to move a key event marker past neighboring key event markers on the same time track. If you want to restrict a key event marker to stay between the previous and next key event markers, hold down the Shift key as you drag the key event marker.

Duplicating Key Events while Dragging

You can duplicate a key event to another location on the same time track by holding down a modifier key while you drag a key event marker. This is useful when you want to return an object or effect to the same state at several points during an animation.

To duplicate key events while dragging:

1. Click **Time Line** window.
2. Hold down the **Option**/**Alt** key, and drag one or more key event markers along their time track(s).

To nudge selected key event markers:

1. Click the **Time Line** window.
2. Select one or more key event markers on the time line.
3. Press the left or right arrow key to move the marker one screen pixel to the left or right.

   Hold the **Shift** key down and press the arrow keys to move one frame at a time.

When you duplicate an object (**Command-D**/**Ctrl+D**), or Copy and Paste an object, you duplicate all of its animatable properties. Likewise, when you copy and paste objects into other scenes, they carry their key events.

Stretching a Series of Key Events over Time

You can stretch a series of key events over time, while maintaining the proportional timing between the events. This is useful when you're satisfied with the relative animation of a particular sequence, but you want the entire sequence to be sped up or slowed down.

To compress or expand the timing between a series of key events:

1. Click the **Time Line** window.
2. Select three or more key event markers.
3. Hold down the **Command**/**Ctrl** key and drag one of the selected key event markers.

   The entire series of key events will be stretched or compressed, retaining the proportional timing between the key events.

Copying and Pasting Key Events

You can copy key events from one time track to another. The key events you are copying must modify properties that pertain to the destination track. For example, you can paste key events modifying an object's position to another object's track, but not to a render effect's track—render effects don't have positions.

When you paste key events, they keep both the timing and the property state.

To copy key events:

1. [Click the **Time Line** window.
2. Select one or more key event markers.
3. Choose **Edit menu▸ Copy**.

To paste key events:

1. In the Hierarchy area of the **Time Line** window, select the name of the object, group, effect, or property whose time track you want to paste onto.
2. Choose **Edit menu▸ Paste**.

   The key events (from the clipboard) are added to the destination track. If some of the key events copied do not pertain to the destination track, they cannot be pasted.

XYZ Key Event Mode

Ray Dream Studio offers two "recording" modes for when you create a key event by translating an object (change its position):

- Mark XYZ Together.
- Only Mark Changed.

The two modes produce different results when you create and play the animation.

You'll need to set the mode you want to use before translating the object to create key events.

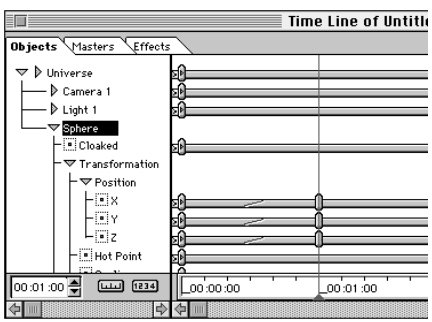
To choose the XYZ Key Event Mode:

Choose **Arrange menu▸ XYZ Key Event Mode▸** and select the mode you want—**Mark XYZ Together** or **Only Mark Changed**.

Mark XYZ Together

In this mode, Ray Dream Studio creates a key event on each of the separate X, Y, Z position tracks—even if you've changed the position in only one dimension. For example, if you raise the object (change Z position), Ray Dream Studio places a key event marker on the object's Transformation: Position: X, Y and Z time tracks.

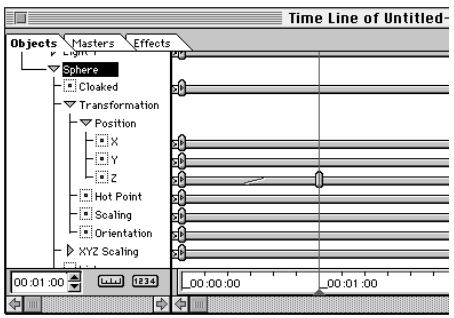
Mark XYZ Together is the default mode.



In Mark XYZ Together mode any change in position creates a key event on all position tracks.

Only Mark Changed

In this mode, Ray Dream Studio creates a key event only on the necessary X, Y, Z position tracks. For example, if you raise the object, Ray Dream Studio places a key event marker on the object's Transformation: Position: Z time track. Because you didn't change X or Y, there's no event on these tracks.



In Only Mark Changed mode, a key frame is only added to the position track where change occurs.

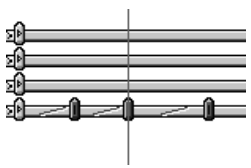
Key Event Actions

Ray Dream Studio provides some special features for duplicating and modifying a series of key events. You can reverse, repeat or mirror a key event sequence. You can also adjust the positioning of the events so that they coincide with the start of the next frame.

To use a Key Event Action:

1. Choose the **Selection** tool.
2. In the **Time Line** window, adjust the display to show the sequence of key events you want to work with.

   You may need to change the time scale or expand the properties of an object.
3. Select each marker in the sequence. You may drag a marquee or **Shift-click**.



Select a sequence of key events.

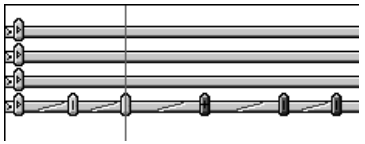
4. Choose **Arrange menu▸ Key Event Action▸** and select the action you want:

   Reverse flips the order of the events so that the last becomes first and vice versa.

   Repeat Sequence duplicates the sequence and places the duplicate immediately after the selected sequence.

   Mirror Sequence duplicates the sequence, reverses the duplicate, and places it immediately after the selected sequence.

   Snap to time adjusts the positioning of the selected events so that they coincide with the start of the next frame



This sequence was mirrored. [more descriptive]

Using Tweeners

Tweeners make it easy to create more interesting and subtle changes in the transitions between key events. Tweeners will save you time by automatically creating movements and changes that would be extremely difficult with key events alone. Tweeners make your animation motions and other changes more natural and sophisticated.

About Tweeners

The time period between any two key events is considered a transition. In the Time Line, you'll see the transition as the "gap" between key event markers. Ray Dream Studio uses a formula (the "tweener") to create the transitional states so that the object or effect changes smoothly between the two key events.

You won't always want a smooth, linear transition. Sometimes you'll want an abrupt change of state. Other times you'll want a transition that starts slowly and accelerates to finish in a rush. You might even want a transition that quickly alternates between the before and after states, like a florescent light flickering on.

All of these transitions are possible by setting your options for the tweener used between each pair of key frames.

A tweener requires a beginning and an ending key event, although you can place the ending key event far out in time.

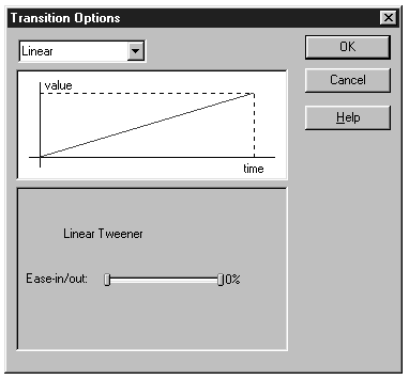
Note: The term tweener is derived from "in-between."

Applying the Tweener

Every "gap" between key events on the time track must have a tweener. The default tweener is **Linear**, which produces an even rate of change between the two states. You can achieve a different sort of transition by applying a different tweener.

To apply a Tweener:

1. Click the **Time Line** window.
2. Set up beginning and ending key events.
3. Double-click the time track segment between the two key event markers. The **Transition Options** dialog appears.



Use the Transition Options dialog to select a type of tweener to apply to your animation.

4. Select a tweener type from the pop-up.
5. Set the appropriate controls for the tweener. The controls for each type of tweener are described in the sections that follow.

   As you move the handles on a slider, the graph reflects the new settings.
6. Click **OK** to close the dialog.

Note: Notice the small graphic on each segment of the time track. This graphic indicates the kind of tweener that is applied.

When there's a tweener applied to a time track, the Tweener indicator appears.

Linear Tweener

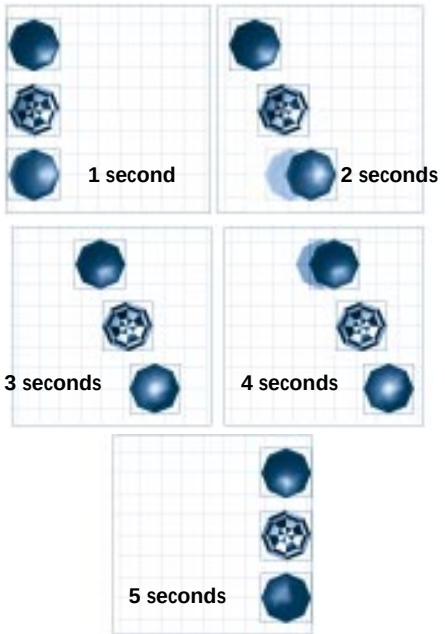
The **Linear** tweener creates gradual, direct transitions between actions.

When the graph line is straight, from the bottom left to the top right corner, the transition proceeds at an even rate from start to finish. This is the default, but you can change it.

To set Linear tweener options:

1. Click the **Time Line** window.
2. Double-click the time track segment between the two key event markers. The **Transition Options** dialog appears.
3. Select a **Linear** from the pop-up.
4. Adjust the two handles on the **Ease-In/ Ease-Out** slider on the **Linear** tweener to modify the rate of change at the beginning and end of the transition.

- Drag the left handle to the right to start slowly.
- Drag the right handle to the left to finish slowly.



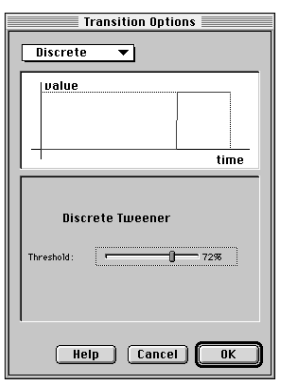
You can see how different Ease-In and Ease-Out settings affect your animation. Some objects move faster at the beginning of the animation while others move faster at the end of the animation.

Discrete Tweener

The **Discrete** tweener maintains the values from the key event that begins the transition until a specific time in the transition is reached. Then the values abruptly change to those of the key event that ends the transition. Use the **Discrete** tweener when you want a property to change immediately, like switching on a light.

To set discrete tweener options:

1. Click the **Time Line** window.
2. Double-click the time track segment between the two key event markers. The **Transition Options** dialog appears.
3. Select a **Discrete** from the pop-up.



Use the Discrete Tweener options dialog to set the tweeners options.

4. Adjust the **Threshold** slider to specify the exact point during the transition where you want the change to occur.

   The threshold value is a percentage of the transition's entire duration. For example, if you want the discrete change to occur halfway between the key events, set the threshold to 50%. If you want the change to occur at the time of the first or last key event, set the threshold to 0% or 100%, respectively.

Bézier Tweener

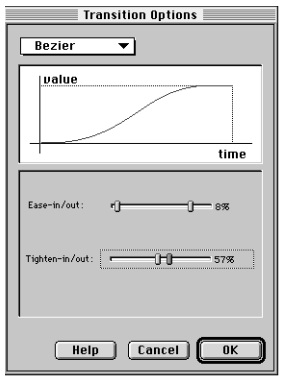
The **Bézier** tweener is designed especially for creating smooth motion paths. For best results, use it on an object's transformation track.

The **Bézier** tweener has two controls that you can adjust—**Ease-In/Out** and **Tighten-In/Out**.

To set Bézier tweener options:

1. Click the **Time Line** window.
2. Double-click the time track segment between the two key event markers. The **Transition Options** dialog appears.
3. Select a **Bezier** from the pop-up.

The Bezier tweener controls appear. The two handles on the **Ease-In/Ease-Out** slider on the **Linear** tweener to modify the rate of change at the beginning and end of the transition.



Use the Bezier Tweener options dialog to adjust the curve of the tweener.

4. Drag the left handle to the right to start slowly.

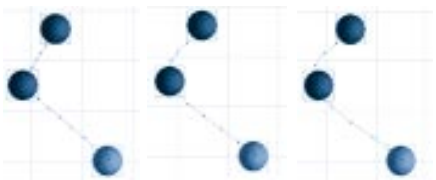
5. Drag the right handle to the left to finish slowly.

   The **Tighten In/Out** slider allows you to adjust the trajectory of the transition—the "path" the values take as they change from one key event to the next.

6. Drag the left handle to change the initial trajectory.

7. Drag the right handle to change the finishing trajectory.

   Values near the extremes (0% and 100%) result in tighter trajectories (closer to linear). Values near 50% result in looser (less direct) trajectories. The default settings (33% in and 67% out) are optimized for natural, smooth motion.



Extreme Tighten In/Out settings result in tighter trajectories. Values closer to 50% result in smoother trajectories.

Oscillate Tweener

The **Oscillate** tweener switches back and forth between the start and end values several times during the transition You can choose between several wave forms to describe the alternation.

To set Oscillate tweener options:

1. Click the **Time Line** window.

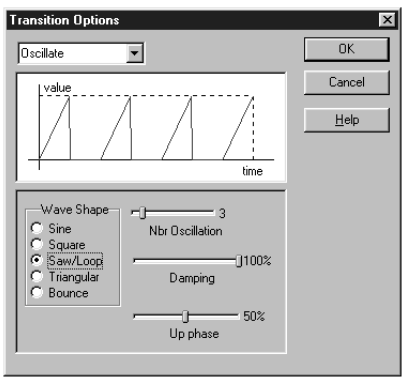
2. Double-click the time track segment between the two key event markers. The **Transition Options** dialog appears.

3. Select a **Oscillate** from the pop-up.

4. Click one of the **Wave Shape** radio buttons to choose the wave shape you want.

   The graph of the wave shape shows how the switch occurs between up and down phases.

   - The **Sine** wave uses a sine curve to alternate the before and after values.
   - The **Square** wave alternates back and forth between the first and last key events with no interpolation.

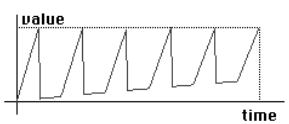


Use the Oscillate Tweener options dialog to set the shape of the oscillate wave and other attributes.

One way to make a light blink at one second intervals is to turn the light on and off by setting key events every second on the light's time track. A more efficient way is to turn a light on at Event A and then turn it off, perhaps ten seconds later, at Event B. Afterwards, apply the **Oscillate** tweener, and specify ten oscillations (using the Square wave so that the switches are abrupt). The **Oscillate** tweener switches the light on and off ten times during the ten-second interval, using only two key events and a single tweener.

- The **Saw/Loop** wave interpolates linearly from its beginning value to its ending value, then snaps back abruptly to the beginning value in each oscillation.

  You can use this option to replicate an action, such as hitting a gong. The character's arm is first placed in a drawn back position, moves to strike the gong, and then snaps back. You can also use Saw/Loop to play a movie from start to end in a loop.



This is what the Saw/Loop Wave Shape looks like when you apply Damping

- The **Triangular** wave shape causes the transition to alternate back and forth abruptly.
- The **Bounce** wave shape causes the transition to alternate, with abrupt change in and out of the second position and gradual change in and out of the first position. This works well when the first position is a ball at height, and the second position is the ball on the floor.

5. Adjust the **Nbr Oscillation** slider to set the number of times the values should alternate.

6. Adjust the **Damping** slider to progressively diminish the amplitude of the oscillations.

   After each oscillation, the amplitude diminishes by the damping factor percentage.

7. Adjust the **Up Phase** slider to control how much of each oscillation is dedicated to the "up phase."

   For example, if you set the Up Phase value to 90%, the object spends 90% of the oscillation changing from A to B and only 10% changing from B to A.

Formula Tweener

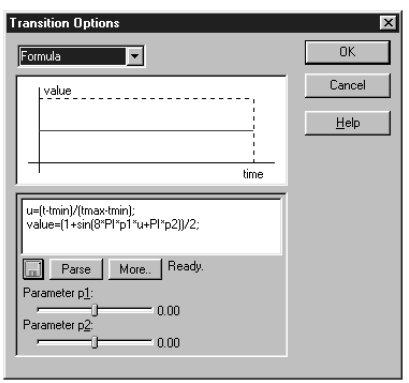
Formula creates a transition curve or pattern from a formula. You can devise your own formula to create a custom tweener.

To use a formula for the tweener:

1. Click the **Time Line** window.

2. Double-click the time track segment between the two key event markers. The **Transition Options** dialog appears.

3. Select a **Formula** from the pop-up. The **Formula** controls appear.]



The preview displays the result of the current formula.

4. If the current formula uses the **Parameter** sliders, you can adjust them to change the formula result.

The graph describes the result.

5 To load a new formula, click the disk icon.

Use the **Open** dialog to locate and open an appropriate formula. Sample formulas can be found in the **Samples: Formulas** folder on your Ray Dream Studio CD.

6 If you want to edit the formula or create your own, click **More** to open the Formula Editor.

Ray Dream Studio uses the **Formula Editor** in several places. Use of the editor is common, but the type of formula you're creating determines the valid input and output variables. Refer to the "Using Formulas in Ray Dream Studio 5 PDF" for details on using the Formula Editor.

Formula editing becomes technical quickly. You can learn a lot by loading the sample files.

7 When you're done with the **Formula Editor**, click **OK**.

8 To save a formula, click the disk icon and choose **Save As** from the pop-up.

Use the **Save** dialog to name the file and choose a disk location.

Behaviors

Behaviors allow you to give objects sets of instructions that give them an "activity" during the animation. Behaviors reduce the number of key events you need to create and allow you to create actions that are not otherwise possible.

Some behaviors, such as Bounce and Spin, automatically assign complex actions to an object. greatly reducing the number of key events you need to create. Others, such as Point At and Track, define or modify the motion of one object based on the location or motion of another object.

Inverse kinematics is a specialized behavior that ensures that complex, linked models move realistically.

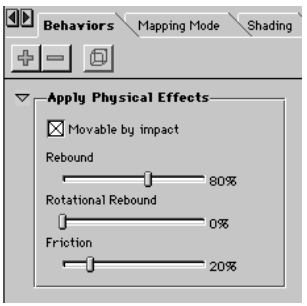
The physical force behaviors allow objects to move and interact as though they obeyed the laws of physics. The physical forces have special characteristics. See "Physical Forces" on page 318 for complete information.

Applying Behaviors

You can apply multiple behaviors to an object or group; however, some may override the others.

For example, you can apply both a bounce and a spin to an object. However, some behaviors are exclusive—they cannot be used together. It wouldn't make sense to assign the **Point At** behavior to an object and also give the object Spin—these behaviors would produce contradictory results.

When you apply a behavior, it remains in the object's behavior list for the duration of the animation. However, most behaviors can be turned on an off at different points along the time line.



Use the Behaviors tab in Properties palette to add or delete behaviors from an object.

To apply a behavior:

1 Select an object.

2 Display the **Properties palette: Behaviors tab**.

3 Click the **Plus** icon. A dialog appears with a list of the available behaviors.

4. Choose the behavior you want to apply. Click **OK**.

5. Set other options for the behavior.

   The options for **Spin**, **Bounce**, **Point At**, **Track** and **Inverse Kinematics** are described below. The options and use of the physical forces—**Apply Physical Effects**, **Initial Velocity**, **Directional Force**, **Point Force**, **Rotational Force**, **Flow Force** and **Damping Force**—are covered separately. Refer to "Physical Forces" on page 318.

6. Click **Apply** to send your changes to the object.

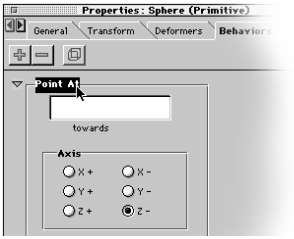
The basic behaviors (excluding the physical forces) are applied in the order that they appear in the list. Where two or more applied behaviors conflict, those further down the list override those above. After you add behaviors, you can drag them up or down to change the order.

To remove a behavior from the list:

1. Select the object or group that carries the behavior.

2. Display the **Properties palette: Behaviors tab**.

3. On the tab, click the title of the behavior you want to remove to select it.



Click the Behavior's name on the Behavior's tab to select it.

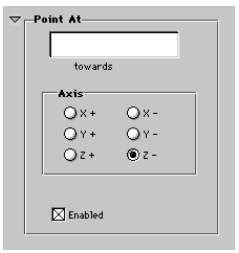
4. Click the **Minus** icon in the **Behaviors** tab.

Point At

The Point At behavior instructs an object to orient itself "toward" another object (hot point) through all or part of the animation.

You can use the Point At behavior to get a camera or light to follow a particular object or group. You can also use it to animate an object that always faces or points at another, such as a satellite dish as it tracks a satellite, or a sunflower as it follows the path of the sun.

Arrange menu▸ Point At differs from the **Point At** behavior in two respects. First, **Arrange menu▸ Point At** only operates on cameras and lights. Second, it only makes the change "right now," so it's not an animation tool.



Use the Point At Tab to select an object to point at.

To set point at options:

1. Apply the **Point At** behavior to an object. The **Point At** controls appear on the **Properties palette: Behaviors tab**.

   See "To apply a behavior:" on page 314 for instructions on applying behaviors.

2. Type the name of the object to be pointed at in the text box. Type the name exactly as it appears in the Hierarchy area. (The text box is case sensitive).

3. Use the radio buttons in the Axis area to select which face of the object should point at the target object.

   For objects other than camera or light, you'll need to specify which face of the object should be oriented toward the target. For example, if you're working with a "pointing finger" object, select the axis that describes the direction the finger points.

   This step is not necessary with a camera or light. By default, the face with the light beam or the camera lens is selected. Any other setting would point the light beam or camera lens at 90° or 180° to the target.

You can display the **Properties palette: Transform tab: Position controls** to show the axes. For a reference on the object itself, enable the **File menu: Preferences dialog: Perspective: Hot Point: Show Axis Information option**.

4. You can use the Enable checkbox to turn the behavior on and off at specific points in the animation.

   A key event is created each time you turn the behavior on or off.

5. Remember to click **Apply** to update your changes to the object.

The Point At behavior was applied to the rocket so that it continues to point at the dinosaur no matter where it moves.

Bounce

The Bounce behavior instructs an object to bounce up and down along the global z-axis. You can set the upper and lower limits for the bounce, and specify the number of bounces per second.

Note: The bounce behavior does not control an object's lateral movement (along the x and y planes).

The Bounce behavior is useful when you have a very specific effect in mind and wish to specify Bounce parameters (like height and frequency) by hand. However, natural bouncing is much easier to create using the physical forces. See "Physical Forces" on page 318.

To set bounce options:

1. Apply the **Bounce** behavior to an object. The **Bounce** controls appear on the **Properties palette: Behaviors tab**.

   See "To apply a behavior:" on page 314 for instructions on applying behaviors.

2. In the **Floor** entry box, enter the lower limit of the bounce. The value describes the distance from the global universe Z=0 plane that is the lower limit of bouncing.

3. In the **Height** entry box, enter the height of the bounce. The value describes the distance above the floor level that is the upper limit of bouncing.

4. In the **Bounces per Second** entry box, enter the number of bounces per second.

5. Enter values in the **Start Time** and **End Time** entry box to limit the bounce to a particular range in time.

6. Remember to click **Apply** to update your changes to the object.

Spin

The **Spin** behavior instructs an object to rotate on one of its axes. You can set the number of cycles of the spin per second.

You can also spin an object using the physical forces. see "Physical Forces" on page 318.

To set spin options:

1. Apply the **Spin** behavior to an object. The **Spin** controls appear on the **Properties palette: Behaviors tab**.

   See "To apply a behavior:" on page 314 for instructions on applying behaviors.

2. Select the axis of rotation.
3. In the **Cycles per second** entry box, enter the number of cycles per second for the spin. (A cycle is one complete 360° rotation.)
4. Enter values in the **Start Time** and **End Time** entry boxes to limit the spin to a particular range in time.
5. Remember to click **Apply** to update your changes to the object.

Track

The **Track** behavior instructs an object to "shadow" another as its moves through the universe.

To set track options:

1. Apply the **Track** behavior to an object. The **Track** controls appear on the **Properties palette: Behaviors tab**.

   See "To apply a behavior:" on page 314 for instructions on applying behaviors.

2. Type the name of the object to be tracked in the text box. Type the name exactly as it appears in the Hierarchy area. (The text box is case sensitive.)
3. Enable the checkboxes for each axis you want to track in.
4. Enable Track Rotation if you wan the object to track the rotation as well as position.
5. Use the Enable checkbox to toggle the behavior on and off at specific points in the animation.
6. A key event is created each time you turn the behavior on or off.
7. Remember to click **Apply** to update your changes to the object.

Inverse Kinematics

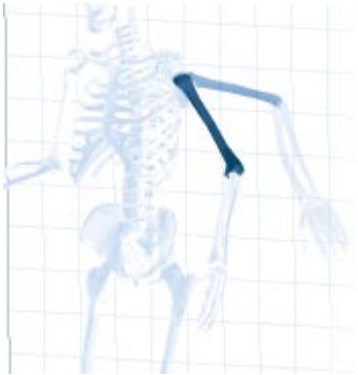
Inverse Kinematics is a specialized behavior that is applied to linked objects. Inverse Kinematics provides the versatility of child-to-parent control. It reduces the time it takes to create realistic animations.

Normally, movement is transmitted downward from parent to child in the hierarchy. When you link a child to a parent object and apply inverse kinematics, movement can also propagate up the hierarchy—from the child to the parent. This means that when you move a child object, the parent follows. Motion cannot propagate from a linked child to its parent without Inverse Kinematics.

The movement is affected by the type of link property and constraint you apply, for example, a Lock, Slider, or 2D link can constrain the movement of the child object in relation to the parent. Refer to "Linking Objects" on page 259 for information on link properties and constraints.

If you use an arm as an example, linking the objects that make up the arm in a hierarchical structure and placing the hot points at the joints, you can rotate the arm

at the shoulder or elbow, and everything below that joint (toward the hand) moves accordingly.

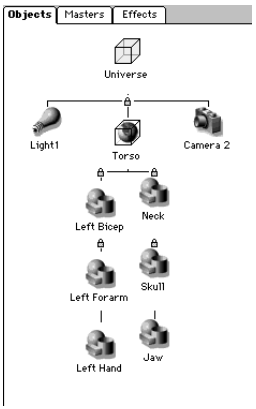


You can easily animate the natural motion of an arm using Inverse Kinematics

With Inverse Kinematics, you can move the hand, which in turn forces the forearm and upper arm to rotate and move to accommodate.

Before applying the **Inverse Kinematics** behavior to an articulated object, you must link the objects that make up the model and define properties and constraints for the movement of each child in relation to its parent. These constraints should describe the desired range of motion for each part.

Refer to "Linking Objects" on page 259 for information on linking one object to another. Refer to "Applying Link Properties" on page 260 for information on setting link properties and constraints.



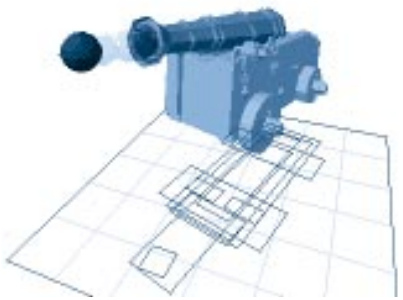
This is what the Arm with links looks like in hierarchy mode.

You must apply Inverse Kinematics to the last child object in the link chain. You may also apply it to other children higher up the link chain. Then if you start a movement farther up the chain, objects higher up the chain can move as well.

Physical Forces

The physical forces are a special form of behavior. These forces allow your objects to accelerate, move and interact in ways consistent with the laws of physics.

These physical force behaviors enable you to create realistic animations that would be virtually impossible with key framing. You can get objects to slide down a slope, bump into each other and bounce away, and other useful motions.



This cannon ball was animated using the Initial Velocity behavior

While the physical forces do an excellent job of simulating many physical events, it is not a complete model. Some types of interaction are not supported. These include true momentum exchange, perfect rolling, and some types of tumbling. This means you'll have trouble shooting billiard balls into pockets, knocking over bowling pins and tumbling dominoes one after the other.

The physics behaviors are as follows: **Apply Physical Effects**, **Initial Velocity**, **Directional Force**, **Point Force**, **Rotational Force**, **Flow Force** and **Damping Force**. Each of these is described in detail later in this section.

Note: You can learn a lot about the physical forces and how to use them be viewing the sample animations and demonstration files in the **Ray Dream Studio 5 CD: Samples: Sample Physics** folder.

The physical forces are exclusive of most other behaviors, and they may not work with some of the link property constraints and deformers.

Tip: You cannot use physics on an object for a while, then turn it off to allow some other type of event. What you can do is create a second copy of the object that does not use physics. Then cloak and de-cloak the objects to switch between them at the right moments.

Physics and Key Events

Physical forces preclude arbitrary settings in key events. For example, if you apply directional force to get an object to fall, you can't also set it's position above the floor. The object must either obey physics (and fall) or be "above the floor."

When you apply a physical force to an object, Ray Dream Studio removes all key events (not including the starting key in frame 1) that would arbitrarily set position or orientation on the object. Its other properties, like scale and shading, remain animatable with key frames.

You can't set position or orientation key events for objects that use physics. You can, however, set key events for the property values in the physical forces themselves. For example, you can accelerate an object, then apply damping to stop it, then accelerate it in a different direction. You'll learn more about this later in this section.

Note: Initial Velocity describes the object's inertia in frame 1. Therefore, this force cannot be changed with a key event.

You might want an object to respect physics, but still be animated with key events. The primary application of this is to create an object that can move with key events while having objects responding to physical forces will bounce off of it.

You can create this type of action by using the **Properties palette: Miscellaneous tab** to add the **Physical Effects Solid** property to the object you want to animate using key events.

Another possibility is to develop the animation using physical effects, then translate the result into key events with the **Record Behaviors** command. This feature is described in "Record Behaviors" on page 326.

Using Physics

To apply physical effects:

1. Rewind your animation to frame 1.
2. Select the object you want to apply physics to.
3. Display the **Properties palette: Behaviors tab**.
4. Click the **Plus** icon.
5. In the dialog, choose **Apply Physical Effects**.

   Ray Dream Studio loads the basic settings that tell this object to obey physics. For complete information on **Apply Physical Effects**, see below.
6. You can click the **Plus** icon again and load one of the specific physical forces, described below. You can apply any number of forces. The order you add them doesn't matter.
7. Adjust the settings for the forces you've loaded.
8. Click **Apply**.
9. Preview the animation to see how the forces influence object motion. You might want to extend the Render Range to see more action.

Refer to "Previewing an Animation" on page 304 for complete information on using the animation preview controls. Refer to "The Time Line Window" on page 297 for on using the time line.

Important: After previewing, remember to rewind to frame 1. If you make changes without rewinding, you'll be setting a key event at this later moment of the animation.

Note: Ray Dream Studio allows you to disable physical effects. Disabling the physics prevents Ray Dream Studio from recalculating the effect when you make changes. This is more efficient if your changes don't directly relate to the physical effects. For more information, refer to "Physical Effects Preferences" on page 325.

Apply Physical Effects

Apply Physical Effects is required for all objects that take part in physics. It tells the object to obey physics and to interact with other objects that obey physics.

If you use physics to accelerate one object into another, the resulting collision depends on whether the target object respects physics. If it does not, the missile object will simply pass through the target and continue on its way. If the target does respect physics, the two objects will bounce apart.

Note: You can get an object to respect physics for collisions by going to its **Properties palette: Miscellaneous tab** and adding the **Physical Effects Solid** property.

Apply Physical Effects is required for any object that uses one of the physical forces.

To set Apply Physical Effects options:

1. Apply the **Apply Physical Effects** behavior.

   See "To apply physical effects:" on page 319 for instructions on applying behaviors. The **Apply Physical Effects** controls appear on the **Behaviors** tab.

2. Disable the **Moveable by impact** option if you want the object to stay in one place.

   For example, if you drop a ball onto a table, you want the ball to bounce and the table to stay where it is. If both objects are "Moveable by impact", the collision will send them in opposing directions. Disable the **Moveable by impact** option for the table to keep it stationary.

3. Adjust the **Rebound** slider to control this object's tendency to rebound.

   For example, a rubber ball will rebound better than a stone, so you should set the **Rebound** slider to describe the object's material.

   Objects don't have actual mass, but you can simulate relative mass by giving colliding objects different rebound strengths.

4. Adjust the **Rotational Rebound** slider to control this object's tendency to rotate when it rebounds.

   The direction of rotation depends on the angle of incident.

5. Adjust the **Friction** slider to control this object's resistance to sliding along a surface.

   For example, if you want an object to slide down a slope, set its Friction very small and give it downward (-Z) Directional Force (see below).

6. Click **Apply** to send your changes to the object.

Initial Velocity

Initial Velocity applies directional or rotational motion to an object in frame 1. If no other force influences the object, it will maintain its initial velocity indefinitely.

To set Initial Velocity options:

1. Apply the **Initial Velocity** behavior.

   See "To apply physical effects:" on page 319 for instructions on applying behaviors The **Initial Velocity** controls appear on the **Behaviors** tab.

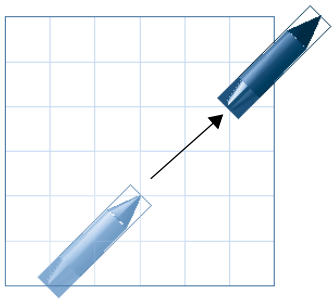
2. Enter values for velocity in the X, Y and Z dimensions.

   Use a negative value to set velocity opposite to the arrow in the xyz axis graphic.

3. Enter values for rotational velocity in terms of **Yaw**, **Pitch** and **Roll**.

   Use a negative value to set rotation counter to the arrow in the xyz/yaw pitch roll graphic.

4. Click **Apply** to send your changes to the object.



Initial Velocity takes care of the lateral movement on this rocket.

The **Initial Velocity** behavior's **Direct Manipulation Control** lets you see a wire reference of the Initial Velocity directional vector. You can drag the handle on the wire to change the vector and velocity.

To use the Direct Manipulation Controls with Initial Velocity:

1. Apply the **Initial Velocity** behavior to an object.

   See "To apply physical effects:" on page 319 for instructions on applying behaviors

2. In the **Properties palette: Behaviors tab**, click once in the Initial Velocity panel (or on its title) to select it.

   Ray Dream Studio activates the **Direct Manipulation Controls** icon.

3. Click the **Direct Manipulation Controls** icon.

   In the **Perspective** window, Ray Dream Studio displays a wire reference that shows the Initial Velocity vector. Rotational velocity is not shown.

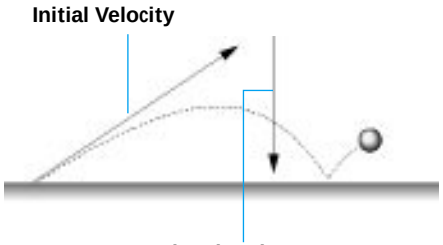
4. Drag the handle at the end of the wire (or one of the projections) to change the vector and velocity. Increasing the length of the wire increases the initial velocity.

   Ray Dream Studio updates the Initial Velocity X, Y, Z values as you drag.

Directional Force

Directional force accelerates an object in one direction.

You can use directional force to produce the effect of gravity—falling objects.



Without direction force, the ball would continue along its original trajectory indefinitely.

To set directional force options:

1. Apply the **Directional Force** behavior.

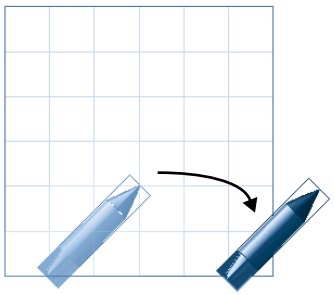
   See "To apply physical effects:" on page 319 for instructions on applying behaviors The **Directional Force** controls appear on the **Behaviors** tab.

2. Enter values to describe the force in the X, Y and Z dimensions. (These are in terms of the Universe.)

   Use a negative value to apply force opposite to the arrow in the xyz axis graphic.

Note: Units of force are arbitrary.

3. Click **Apply** to send your changes to the object.



This ballistic trajectory is accomplished with an initial velocity and a -Z directional force.

Note: Directional force applies a force to an object. It does not set velocity.

The **Directional Force** behavior's **Direct Manipulation Control** lets you see a wire reference of the **Directional Force** vector. You can drag the handle on the wire to change the vector and amount of force.

To use the Direct Manipulation Controls with Directional Force:

1. Apply the **Directional Force** behavior to an object.

   See "To apply physical effects:" on page 319 for instructions on applying behaviors

2. In the **Properties palette: Behaviors tab**, click once in the **Directional Force** panel (or on its title) to select it.

   Ray Dream Studio activates the **Direct Manipulation Controls** icon.

3. Click the **Direct Manipulation Controls** icon.

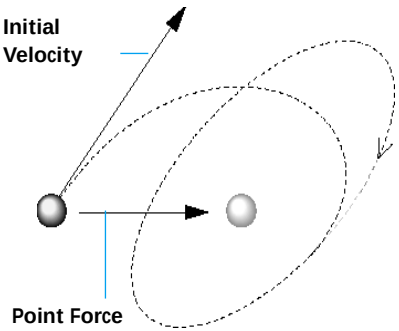
   In the **Perspective** window, Ray Dream Studio puts a wire reference that shows the Directional Force vector. Rotational velocity is not shown.

4. Drag the handle at the end of the wire (or one of the projections) to change the vector and force amount. Increasing the length of the wire increases the amount of force.

   Ray Dream Studio updates the **Directional Force X**, **Y** and **Z** values as you drag.

Point Force

Point Force accelerates an object toward another object. You can use point force to "shoot" one object at another. You may also invert the force to repulse one object from another.



When you use Initial velocity with Point Force you can create an object that orbits another.

To set Point Force options:

1. Apply the **Point Force** behavior.

   See "To apply physical effects:" on page 319 for instructions on applying behaviors The **Point Force** controls appear on the **Behaviors** tab.

2. Click in the **Point to object named** field and type the name of the object you want as the target.

3. Use the **Strength** slider to describe the amount of attraction (or repulsion).

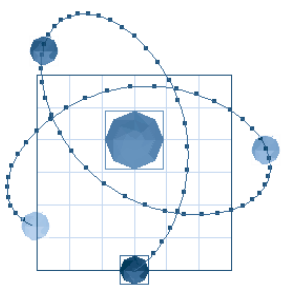
   Strength relates to the maximum acceleration.

4. Use the **Field Decay Rate** slider to describe the range (between the objects) where the attraction field begins to decay.

   At a low setting, the object accelerates toward the target slowly. At a high setting, the object accelerates quickly.

5. Enable the **Repulse** option if you want the object to move away from the target instead of toward it.

6. Click **Apply** to send your changes to the object.



You can use Point Force to place an object in orbit around another.

Rotational Force

Rotational Force accelerates an object to rotate around its hot point. You can use **Rotational Force** to spin an object.

To set Rotational Force options:

1. Apply the **Rotational Force** behavior.

   See "To apply physical effects:" on page 319 for instructions on applying behaviors The **Rotational Force** controls appear on the **Behaviors** tab.

2. Enter values for rotational force in terms of **Yaw**, **Pitch** and **Roll**.

   Use a negative value to set rotation counter to the arrow in the xyz/yaw pitch roll graphic.

3. Click **Apply** to send your changes to the object.

Flow Force

Flow Force creates randomized directional motions. You can use Flow Force to create engine vibrations or to give motion to Autumn leaves swept up by the wind.

You can use Flow Force to shoot a fleet of rockets out in every direction.

To set Flow Force options:

1. Apply the **Flow Force** behavior.

   See "To apply physical effects:" on page 319 for instructions on applying behaviors The **Flow Force** controls appear on the **Behaviors** tab.

2. Enter values for the amount of **Flow Force** in the **X**, **Y** and **Z** dimensions.

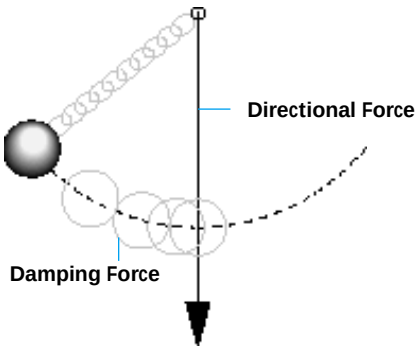
   For certain effects, you might want to set the force in one dimension to zero. This will constrain the action of the force to the plane defined by the other two dimensions.

3. Use the **Turn Density** slider to set the frequency of direction changes.

4. If you want the object to rotate with the flow, enable the **Rotate with flow** option.

Damping Force

Damping Force counters any other forces working on the object. Regardless of what inertia an object has or what force is applied, damping "slows it down."



Damping Force counters any force applied to an object.

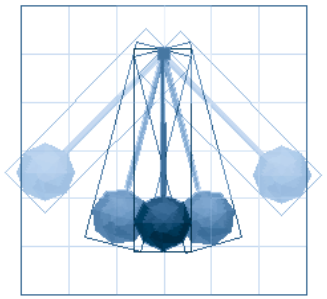
To set Damping Force options:

1. Apply the **Damping Force** behavior.

   See "To apply physical effects:" on page 319 for instructions on applying behaviors The **Damping Force** controls appear on the **Behaviors** tab.

2. Drag the slider to set the amount of damping.

Damping is not immediate. It's like applying the brakes in a car. Even at maximum braking, the car takes a few feet to slow down and stop.



When you apply Damping Force to a pendulum in your scene, it slowly brings it to rest.

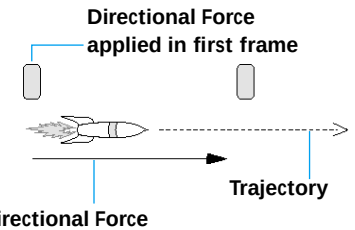
About Key Events in Physical Forces

You can change the physical force settings to create key events. Before you try this, you need to understand that the forces describe acceleration, not velocity. (**Initial Velocity** does set velocity, but it is only the initial state. It cannot be used for a key event.)

For example, you can start an object moving with a Directional Force that's X=10. A couple of seconds into the animation, you change the Directional Force values so that X=0 to create a key event.

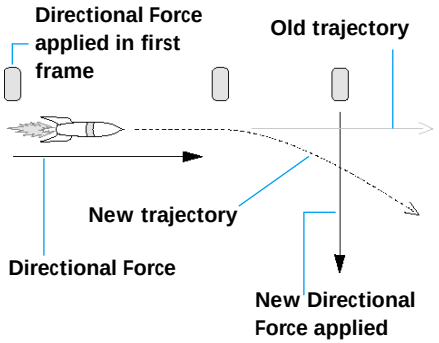
When you play the animation, the object will not stop at the moment of the key event. It will continue moving in X until it encounters a physical object (and rebounds) or some other force acts on it.

This follows the behavior of a rocket in space because Ray Dream Studio doesn't take into account friction or gravity. **Applying Directional Force** is equivalent to an engine burn. Shut off the engines and the rocket coasts along on its trajectory. Without friction to slow it down or gravity to pull it aside, the rocket continues on this vector at this velocity indefinitely.



In the first frame Directional Force was set at X=10. In the second frame Directional Force is set to X=0. Since no change in direction occurs, velocity and trajectory remain unchanged.

Next, the rocket rotates 90° and does another engine burn (this is the same as adding a new perpendicular Directional Force). The new trajectory is the combined effect of the initial acceleration and the secondary, perpendicular acceleration. The new velocity is the product of the old velocity and the new force (acceleration).



When the direction is changed in the third frame, trajectory changes, but velocity remains constant.

Note: If you want to exert more control over transitions, you can use a **Discrete** tweener or use **Damping Force** in key events just prior to a change of acceleration.

For more information, refer to "Defining Key Events" on page 306.

Physical Effects Preferences

When objects that use physics collide, they bounce away and spin. You can set a preference for how accurately Ray Dream Studio calculates the result from such interaction.

You can also disable physical effects completely. You might want to do this while you're working, and you don't want Ray Dream Studio to recalculate the effect each time you make changes.

To set physics accuracy:

1. Display the **Scene Settings window: Misc. Data tab**.
2. Click the radio button for the physics simulation accuracy you want.

   High is better than medium only when objects interact at an exceedingly rapid rate.

To disable/enable physical effects:

1. Display the **Scene Settings window: Misc. Data tab**.
2. Enable the **Enable Physical Effects** checkbox.

   When the box is empty, physics is turned off. Remember to turn it back on when you need it.

Record Behaviors

When you apply a behavior, Ray Dream Studio automatically calculates the position and orientation of objects over the course of the animation. The objects move to positions and orientations not explicitly defined by key events.

This is particularly noticeable with the Physical Force behaviors, which can create a complete animation segment without a single key event (excluding the initial state in frame 1).

You might decide that you want to control the position or orientation that's determined by a behavior. Ray Dream Studio lets you do this by converting the behavior action to a series of key events. After creating the key events, you can adjust them individually.

To convert behaviors to key events:

1. Set up the behavior to animate the object. See "To apply physical effects:" on page 319 for instructions on applying behaviors

2. Choose the frame rate you want for this project.

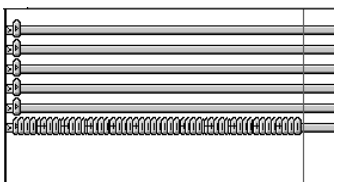
   Ray Dream Studio creates a key event marker for each frame, so it's important to set the frame rate first.

3. Set the render range to extend as far as necessary for this segment.

   Ray Dream Studio creates key event markers through the end of the render range, so it's important that the range extend to the end of this object's behavior.

4. Select the object whose behavior you want to convert.

5. Choose **Arrange menu▸ Record Behavior**.



This is what the Flow Force behavior looks like when it's converted to key frames.