SCRATCH PAINT EDITOR

Scratch has a built-in Paint Editor that you can use to create or edit sprites, costumes, and backdrops. This editor supports two drawing modes: bitmap graphics (also called raster graphics) and vector graphics. In this appendix, you'll learn the difference between these modes and how to use the Paint Editor to create your own program features.

Image Representation

An image is composed of small picture elements called *pixels*. These pixels are arranged in a rectangular area, sometimes referred to as a *raster*. The image size is frequently given by its width and height in pixels, as illustrated in Figure 1.
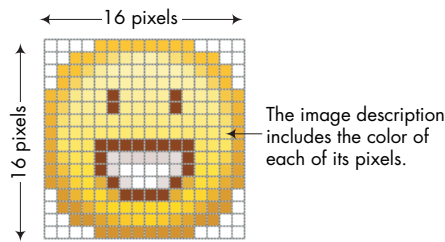
Figure 1: A 16 × 16–pixel bitmap image

When you use an image editor, the software saves certain information that allows it to reload the image when you want to open it again. The saved data and the way that data is arranged give rise to the *image format*.

One option is to save the information associated with each pixel of the image, including its position and color. This approach is usually called *bitmap graphics* (or raster graphics). Common bitmap image formats include BMP, JPEG, PNG, GIF, and TIFF.

Other formats, called *vector graphics*, store the instructions or rules for drawing pixels instead of information about the pixels themselves. These rules use points, lines, curves, and mathematical expressions to represent the image. Sprites drawn with vector graphics usually look much smoother than bitmaps when you zoom in on them. Scratch recognizes the Scalable Vector Graphics (SVG) format.

Scratch's Paint Editor allows you to create both bitmap and vector graphics. Bitmap graphics are the default, and vector graphics were added in Scratch 2. The layout of the Paint Editor changes based on which mode you select.

Bitmap Mode

When you create a new sprite or costume, the Paint Editor starts in bitmap mode, as illustrated in Figure 2.

If you have used programs like Microsoft Paint, you're probably familiar with many of these options. You may be able to guess what the buttons in Figure 2 do, but if you can't, each button has a *tool tip* that describes its function. You can see the tool tip by hovering the mouse pointer over any button. The following sections provide more information, but the best way to get familiar with this tool is to try it out as you read along.
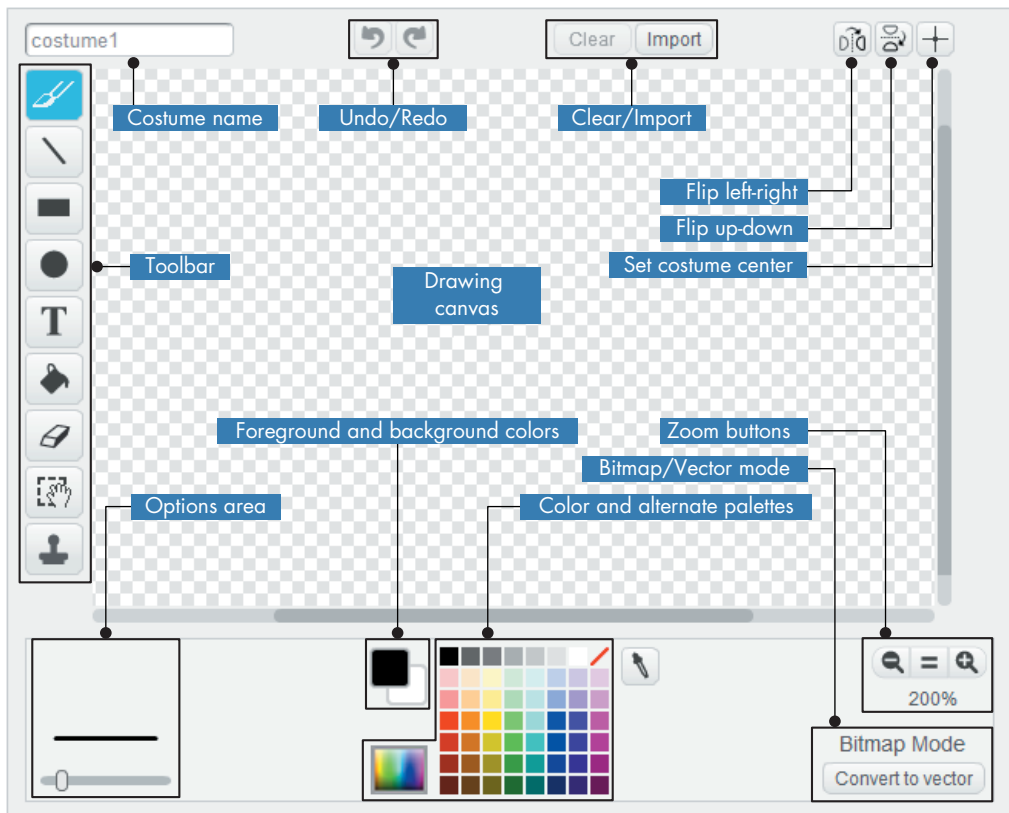
Figure 2: Scratch's Paint Editor in bitmap mode

Toolbar and Options Area

The toolbar and the options area provide the tools you need to draw on the Canvas. Just click the button for the tool you want, adjust the settings in the options area, and start drawing.

Table 1 provides a description of each tool available from the toolbar along with the options you can change when you select it. Unless the description says otherwise, a drawing tool uses your current foreground color.

Table 1: Toolbar Buttons in Bitmap Mode

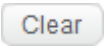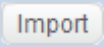| Icon	Function	Description
	Brush	Paint freehand. The slider changes the brush size.
	Line	Draw a line (SHIFT-drag for a straight horizontal or vertical line). Use the slider to change the line width.

(continued)

Icon	Function	Description
	Rectangle	Draw a filled or outlined rectangle (SHIFT-drag for a square). You can choose a fill style (solid or outlined) and change the outline thickness with the buttons shown below.
	Ellipse	Draw a filled or outlined ellipse (SHIFT-drag for a circle). You can change the fill style (solid or outlined) and outline thickness with the buttons shown below.
T	Text	Add text. Click anywhere on the Canvas, type the text you want when you see the cursor, and then click outside the text area. The Select tool (see below) automatically selects your text so you can change its size and orientation.
	Fill	Fill a closed region with a solid color or gradient. Choose one of the fill styles (solid color, horizontal gradient, vertical gradient, or radial gradient) shown below. Gradients blend from the selected foreground color to the selected background color.
	Eraser	Erase with freehand strokes and adjust the eraser size with the slider. The areas that you erase become transparent.
	Select	Select a rectangular region and move it to a new location. Press the DELETE key to remove the selection, or use SHIFT-DELETE to crop (that is, delete the nonselected part of the image).
	Stamp	Select a rectangular region to create a copy of it. Drag the copy and place it where you want.
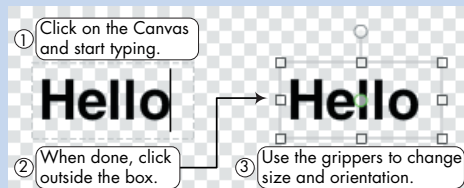
Other Paint Editor Buttons

The Paint Editor also contains a number of buttons that don't draw. The function of each of these buttons is summarized in Table 2.

Table 2: Button Controls in the Paint Editor

Icon	Function	Description
	Undo/Redo	If you make a mistake, you can click Undo as many times as needed to reverse your most recent actions. Click Redo if you want to restore those actions.
Clear	Clear	Click this button to remove all content from the Canvas.
Import	Import	Click this button to open an image from a file and add it to the Canvas.
	Flip	Flip the Canvas content (or just the current selection) horizontally or vertically.
	Costume center	Clicking this button displays a set of cross-axes on the Canvas that represent the costume's center of rotation. Drag these axes to pick a new center of rotation.
	Zoom	Increase or decrease the view magnification of the Canvas. When the zoom is greater than 100 percent, scroll bars are used to pan around the Canvas. Zoom does not change the size of the image.

Color Settings

The color controls allow you to set the foreground and background colors of your drawing. These controls are described in Table 3.

Table 3: Buttons for Setting the Drawing Color

Icon	Function	Description
	Current colors	This control shows the current foreground and background colors. Click the squares to switch the two colors.
	Color palette	Pick a color from this palette to specify a new foreground color. The transparent option is in the upper-right corner.
	Alternate palette	Switch between the default palette and the continuous color palette.

Drawing in Bitmap Mode: Some Practice

Let's put some of the tools described into practice by drawing a truck. Follow these steps to create the drawing:

1. Using the Rectangle tool, create two rectangles, as shown in Figure 3.
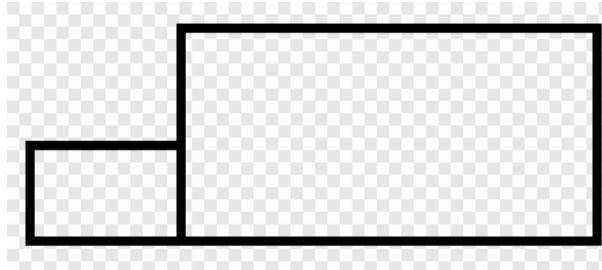
Figure 3: Create two rectangles using the Rectangle tool.

2. Use the Line tool to draw three diagonal lines across the corners of the two rectangles, as shown in Figure 4.
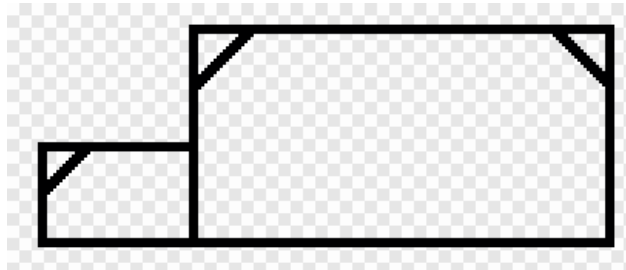
Figure 4: Use the Line tool to draw diagonal lines.

3. Use the Eraser tool to erase the parts of the rectangles that extend beyond the lines you just drew. Then use the Line tool to draw a vertical line as shown in Figure 5.
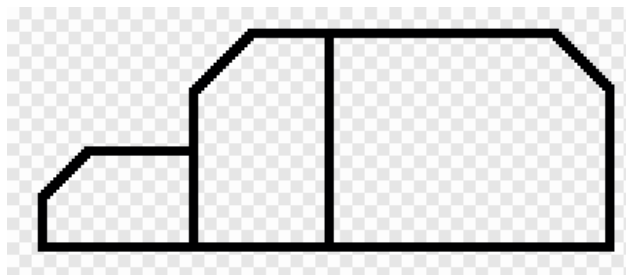
Figure 5: Use the Eraser tool to delete some parts of the figure and use the Line tool to draw a vertical line.

4. After you use the Ellipse tool to create a circle, create an identical copy of this circle with the Stamp tool. Move the two circles to be the wheels of your vehicle, as shown in Figure 6.
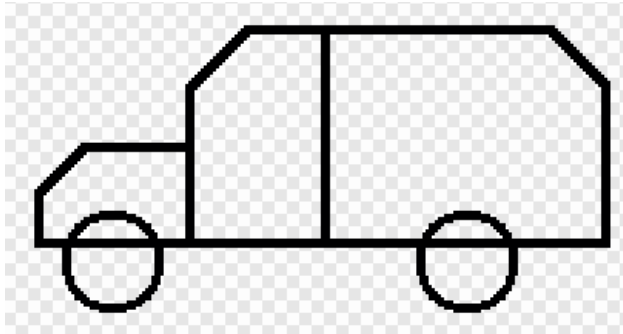

Figure 6: Use the Ellipse and Stamp tools to create two tires.

5. Use the Eraser tool to clean up the horizontal lines inside the circles, as shown in Figure 7.
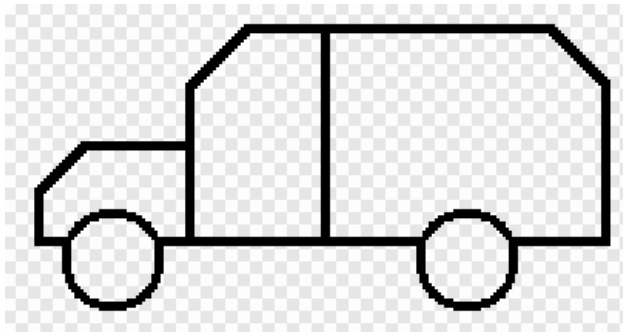

Figure 7: Use the Eraser tool to erase the lines inside the wheels.

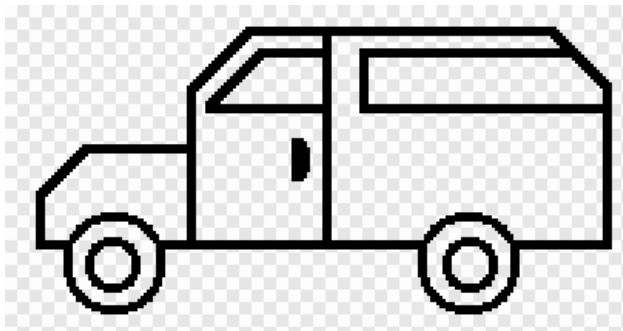6. Using the Line, Circle, and Stamp tools, finish the drawing as shown in Figure 8.

Figure 8: Use the Line, Circle, and Stamp tools to add the finishing touches.

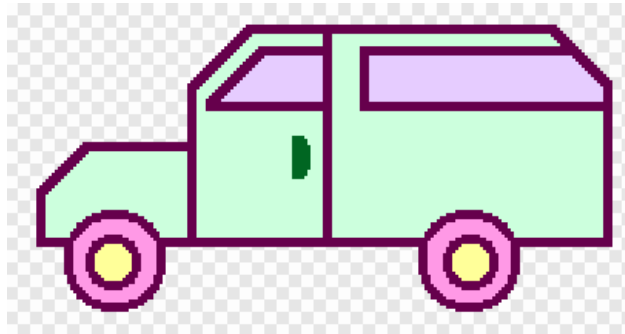7. Using the Fill tool, color the truck in any way you like. My finished drawing is shown in Figure 9.

Figure 9: Color the car using the Fill tool.

Vector Mode

Let's now learn how to draw in vector mode. Start by clicking the **Paint new sprite** button in the *Sprite List* area to create a new sprite. The Paint Editor will start in the default bitmap mode, so click the **Convert to vector** button at the bottom-right corner of the Paint Editor. The editor should now appear as shown in Figure 10.
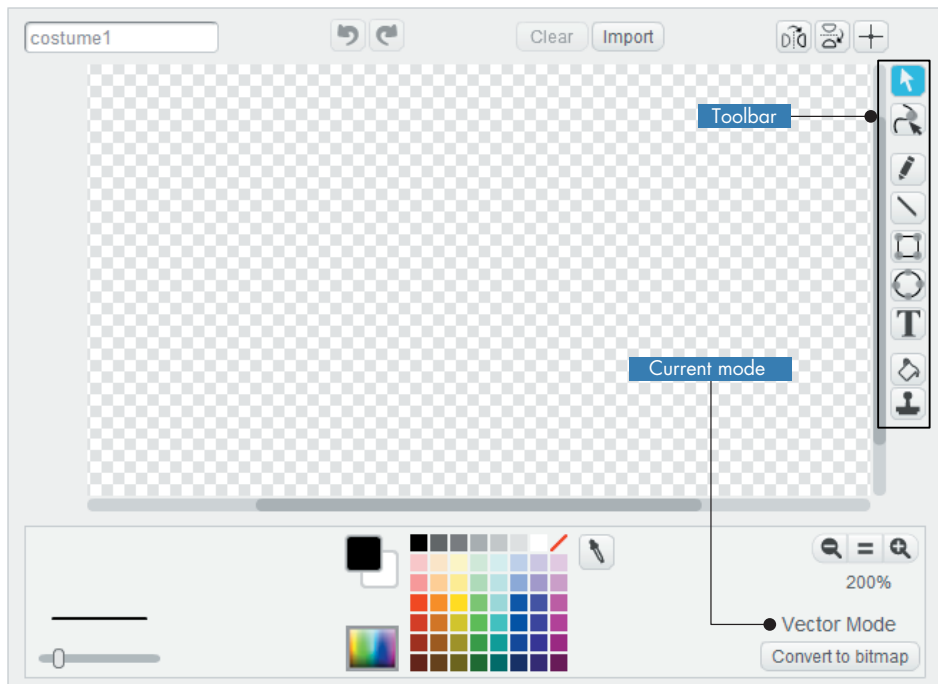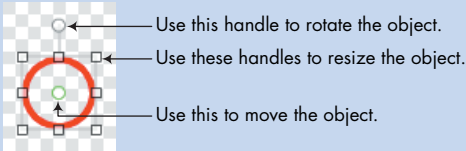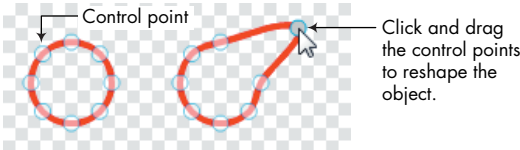

Figure 10: Scratch's Paint Editor in vector mode
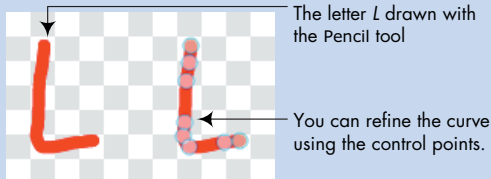
Toolbar

The toolbar now appears at the right side of the Paint Editor, and the buttons in this toolbar are different from the bitmap buttons. Table 4 describes these buttons. Note that some of the buttons in Table 4 only show up when an object (or a group of objects) is selected.

Table 4: Toolbar Buttons in Vector Mode

Icon	Function	Description
	Select	Use this tool to move, resize, or rotate objects. When you click an object, a box appears around it, as illustrated in the following figure. To rotate the object around its center (the small green circle in the figure), grab and drag the small, gray circle of the selection box. You can resize the object by dragging any of the small square boxes around the edges of the object. When you move the mouse close to the object's center, the mouse pointer changes to a hand cursor, which allows you to move the object around the Canvas. You can also move a selected object using the keyboard arrow keys. Click and drag the mouse over multiple objects to select them all at once. You can also SHIFT-click to add an object to (or remove it from) a selection. Press the DELETE key to delete the selected object(s).
	Reshape	Use this tool to change the shape of an object. Select the object you want to reshape, and a set of *control points* will appear on the object's perimeter, as shown below. The control points can be used to reshape the object. You can create additional control points by clicking the object's perimeter. To delete a control point, click it without moving it. The Smooth button that appears in the options area lets you remove sharp edges from the shape's outline.

(continued)

Icon	Function	Description
	Pencil	This tool is similar to the Brush tool in the bitmap mode. Hold down the mouse cursor and move it to scribble a curve on the Canvas. The curve is defined by a set of control points (rather than pixels), which you can change with the Reshape tool, as illustrated below. The letter *L* drawn with the Pencil tool You can refine the curve using the control points.
	Line	A line is defined by the two control points at its two ends. To draw a line, click the mouse where you want the line to start and drag it to the endpoint. To create a horizontal or vertical line, press SHIFT while dragging the mouse. 　　To draw a curved line, start with a straight line. Then using the Reshape tool, SHIFT-click anywhere on the line to create a new control point. Drag the new control point to create and shape your curve.
	Rectangle	Use this tool to draw rectangles using the current foreground color. Click to mark the first corner and drag (SHIFT-drag for a square) until the shape is the size you want. You can change the fill style (solid or outlined) and the outline thickness using the buttons in the options area. The resulting rectangle has four control points, one at each corner.
	Ellipse	Use this tool to draw ellipses using the current foreground color. Click where you want to draw the ellipse, and drag (SHIFT-drag for a circle) to the size you want. You can change the fill style (solid or outlined) and the outline thickness using the buttons in the options area.
	Text	Select this tool, click anywhere on the Canvas, and enter the text you want where the cursor appears. When you're done, click outside the text area. The Select tool will automatically select your text so you can change its size and orientation. 　　Unlike text in bitmap mode, vector-mode text can be edited anytime, even after you exit the Paint Editor. Just select the text box and edit its contents.
	Color	Use this tool to fill the interior or the outline of an object. This works differently from bitmap mode, where the tool fills connected regions. After selecting this tool, click on the outline or interior of any object to fill it with the current foreground (or gradient) color.

Icon	Function	Description
	Duplicate	After selecting this tool, click on the object (or group) you want to duplicate. The duplicate will automatically be selected, allowing you to move it wherever you want. SHIFT-click to create multiple copies.
	Forward	When you have multiple objects in your drawing, they can appear in front of or behind one another. This tool lets you move an object (or a group) one layer to the front. SHIFT-click to bring the object in front of all other objects in the drawing.

Select this object and click the Forward button to bring it to the front.

Icon	Function	Description
	Back	This button is similar to the Forward button, but it moves the selected object (or group) back one layer. SHIFT-click to send the object behind all other objects in the drawing.
	Group	Use this tool to group multiple objects so that they will stay together if they are moved. Click and drag over the objects to select them, and then click this button to create the group.
	Ungroup	When you select a group, this button becomes visible, allowing you to ungroup the objects.

More on the Reshape Tool

The Reshape tool has some other handy features. For example, you can SHIFT-click a straight line segment to create a curved segment. Similarly, you can SHIFT-click a curved segment to create a straight segment, as shown in Figure 11.
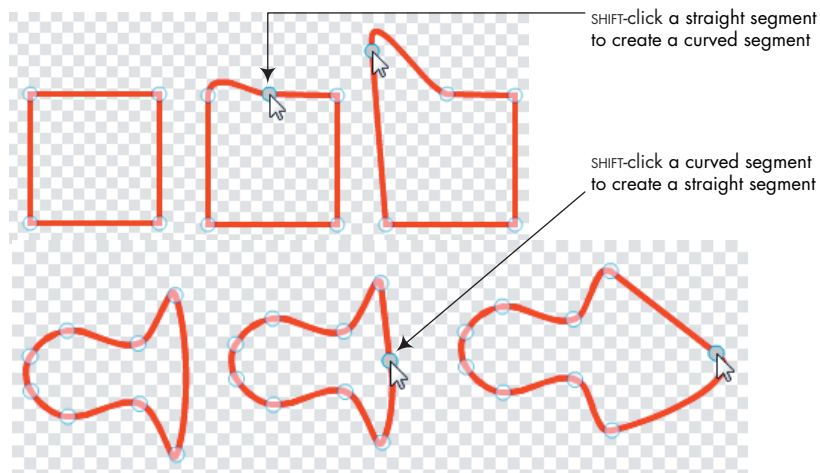

SHIFT-click a straight segment to create a curved segment

SHIFT-click a curved segment to create a straight segment

Figure 11: Using SHIFT-click to create straight and curved segments

You can also merge two segments by connecting their endpoints. The resulting segment will have the color and thickness of the segment whose control point has been dragged to form the connection, as shown in Figure 12.
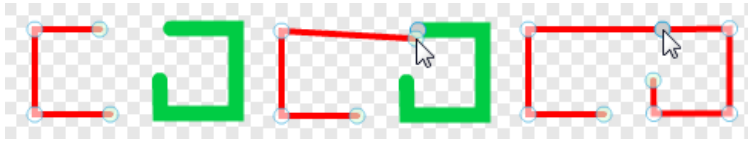

Figure 12: Merging segments by connecting their endpoints

You can create a gap in a segment by using SHIFT-click on a control point without moving it, as illustrated in Figure 13. Alternatively, you can connect the endpoints of a segment to create a closed path.
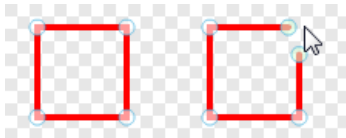

Figure 13: Breaking a connected segment by SHIFT-clicking a control point

Drawing in Vector Mode: Some Practice

Let's go through a simple example that demonstrates how you can use these tools: We'll draw a penguin.

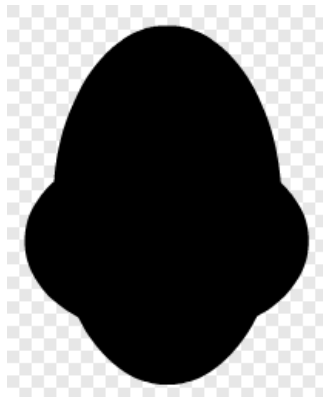1. Draw two black ellipses for the body and the wings, as shown in Figure 14.

Figure 14: Drawing the body and the wings

2. Draw another ellipse for the belly and fill it with a gradient color, as shown in Figure 15.
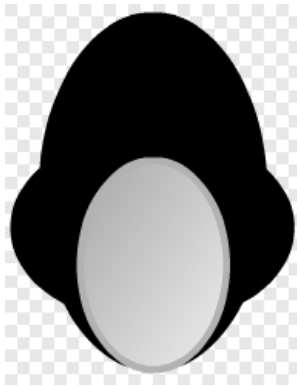

Figure 15: Drawing the belly

3. Draw an ellipse for the foot. Use the Duplicate tool to create another copy, and position the two feet as shown in Figure 16. Use the Back button to send the two feet back so that they appear to originate behind the body.

Figure 16: Adding the feet

4. Use the Ellipse tool to draw circles for the two eyes and the pupils, as shown in Figure 17.

Figure 17: Adding the eyes

5. Use the Rectangle tool to draw the beak. Reshape the rectangle as shown in Figure 18 by dragging the control points.

Figure 18: Adding the beak

And there it is—a penguin! What else can you draw with these tools?