Hello Scratch!

Learn to Program by Making Arcade Games

Gabriel Ford, Sadie Ford, and Melissa Ford

MANNING

Hello Scratch!

by Gabriel Ford, Sadie Ford, and Melissa Ford

Sample Chapter 6

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Brief contents

Part 3

Coding and playing games

Y ou'll make four more games in the final nine chapters following the same format used for part two, with one important distinction: the training wheels are off, because at this point, you're familiar enough with Scratch that you can make design decisions and easily find the blocks for your code.

What if you're not quite ready to move on? That's okay. We created a set of extra practice chapters for a game called Salad Catch. If you're reading the print version, this extra practice can be downloaded at the Manning site, or you can register your book and download a free e-book version that contains the extra practice. If you're reading the e-book version, this extra practice is at the back of the book.

But if you are ready to move on, there are four more games to make. You'll finish off the book learning a bit about how to share your games with others as well as how to be a good member of the Scratch community.

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Designing a fixed shooter
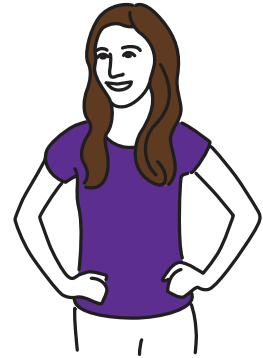
You are a powerful wizard with one annoying enemy: ghosts. The only way to destroy the ghosts is to blast them with magic using your wand. One night, you decide to rid the world of these pesky apparitions. You go out in an open field and wait for the ghosts to descend. Moments later, they're swooping down on you. As the ghosts fall from the sky to attack, you cast a spell with your wand and fire the red sparks seen in figure 6.1, hitting the ghosts with magic before they reach the ground.

Figure 6.1   A game of Wizards vs. Ghosts means making an open field and night sky backdrop, the wizard, a ghost, red sparks, and a barrier line (not shown in image).

Wizards vs. Ghosts is a fixed shooter like Intellivision's *Astrosmash*. In *Astrosmash*, you're a space cannon with blasters, and you need to shoot down falling asteroids before they hit the ground. In Wizards vs. Ghosts, you're a wizard, shooting down ghosts with sparks from your wand. The wizard moves left and right across the grass. The ghosts fall from the sky. The goal is to avoid the ghosts. Scoring moves in two directions, removing points if you miss a ghost and giving you points if you hit a ghost.

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Once again, as you make the sprites for the game, you'll learn some key art concepts, such as proportion and scale.

In this chapter, you will learn

- How to realistically size sprites
- How to keep sprites scaled to their surroundings
- How to proportion elements of a sprite to keep it visually in balance
- How to make a background that uses the rule of thirds
- How to predict where the eye will go when looking at the screen

Once again, you'll start off by making a simple nighttime background.

Prepping the background and learning about proportion, scale, and the rule of thirds

Ghosts come out at night, and the dark blue or black backdrop will make the white ghosts pop on the screen. A scattering of stars across the top of the screen and a field of green grass at the bottom break up the background into three distinct sections.

Making the nighttime backdrop

The backdrop in figure 6.2 sets the tone for the game. It's not the visual focus of the game, like the ghosts and wizard, but instead plays a supporting role.

In Wizards vs. Ghosts, it's nighttime and the goal is to *avoid and shoot* the ghosts. That twist in the goal steps up the intensity of the game, and the backdrop matches that feeling. Night is when everything creepy and crawly comes out to play...or haunt.

Figure 6.2   The empty field and the night sky set the scene for Wizards vs. Ghosts.

Open the Backdrop Art Editor and get ready to make the nighttime backdrop:

1   Select the darkest green paint sample square and the Line tool.

2   Draw a horizontal green line about a third of the way from the bottom of the Stage.

3   Switch to the Paint Bucket tool and click anywhere in the bottom third of the screen to fill the area with green paint.

4   Choose either the darkest blue or black paint. Click anywhere in the empty, top section of the canvas to fill it with either dark blue or black for the sky.

5   Switch to a pale yellow or white paint. You are about to draw the stars, so choose a color that contrasts nicely with the night sky. If the sky is dark blue, choose pale yellow. If the sky is black, choose white.

6   Click the Paintbrush tool and make random dots in the top third of the Stage, as in figure 6.3. Don't try to create any order—unless you happen to know a few star constellations. (Then feel free to draw them in the night sky, making tiny dots for stars.) Group the stars close

Figure 6.3   Close up of the tiny yellow dots indicating stars at the top of the Stage

together at the top of the Stage, and diffuse the stars as they move toward the bottom of the upper third of the Stage.

You now you have a big empty field for your wizard.

ANSWER THIS   WHICH IS BETTER? THE BLACK SKY OR THE BLUE SKY?

Question: is it better to make the sky black or blue?

Answer: there is no right answer to this question, though thinking about these types of decisions will make you a better artist. So much of art is going with your gut and making decisions based on what looks good *to you*. Art is about trying out a few options and seeing which one feels best when you look at it. If you made the sky black, duplicate the backdrop and use the Paint Bucket tool to turn the sky blue (or vice versa). Ask yourself which one you like best, and go with that option. Congratulations; you're now thinking like an artist.

Before you draw the wizard and ghosts, you need to understand the difference between scale and proportion in order to make your sprites fit the Stage.

Figuring out scale and proportion

I made a drawing of my family when I was younger that is in our living room. My mother is a short woman, but in the picture, I made her the biggest person in the family. My father is super tall, but I made him the smallest person in the family. I made myself as tall as my mum, and I drew Gabriel half off the frame. We were clearly not scaled properly.

You may have heard people talk about scale and proportion. *Scale* compares two items, like making sure if you draw a person next to a giant oak tree that the tree is much larger than the person, as in figure 6.4. Scale requires the artist to judge all the objects or people in the picture and make them work with one another. For instance, you may look at a person holding a balloon and notice that the balloon is slightly smaller than the person's head. When you draw the picture, you use a slightly smaller oval for the balloon than the face. Scale makes your picture look realistic.

This cat is not scaled properly. It is too big next to the tree to be realistic.

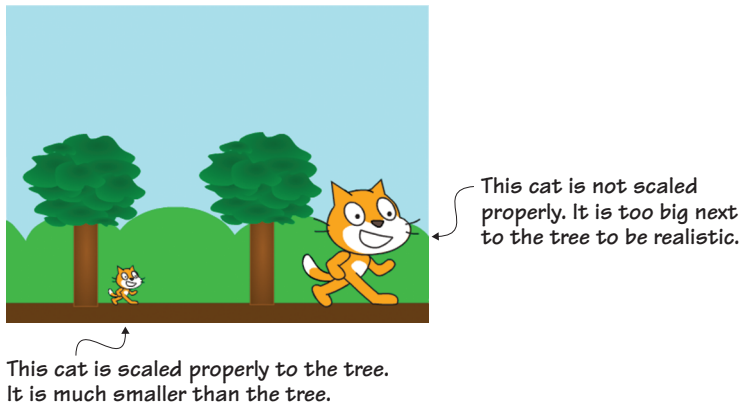This cat is scaled properly to the tree. It is much smaller than the tree.

Figure 6.4   The cat on the left is scaled properly in comparison to the tree from the sprite library. The cat on the right is way too big to look realistic.

Proportion looks at the parts of the whole, such as how the eyes are sized to the whole face. Proportion creates balance within the object so

that each element of the object is properly placed. For instance, did you know that the space between your two eyes is the length of one eye? Place your index finger and thumb on the two corners of your left eye. Now, keeping your fingers the same distance apart, move them so the thumb is on the corner of your left eye, and the index finger is on the corner of your right eye. That space over the bridge of your nose is one eye-length long. Hold your hand over your face with your fingers out. Your hand is probably slightly smaller than your face. What about your feet? They should be longer than your hands. When you draw a person, you need to look at the size of the two eyes and space them properly on the face. You need to look at the size of the head and proportion the hands and feet accordingly, as in figure 6.5. And yes, even pixel drawings follow some proportional rules.

The space between the eyes is one eye-length apart.

Hands are slightly smaller than a face.

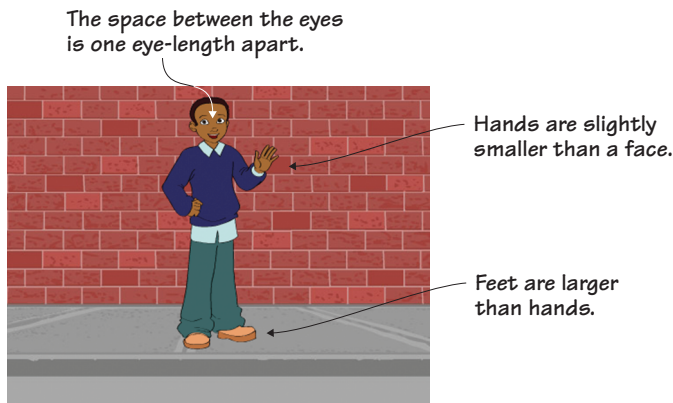Feet are larger than hands.

Figure 6.5   The Devin sprite from the Scratch sprite library is well-proportioned even though he is a cartoon drawing. All his body parts are in sync with each other.

Scale is outwardly focused, looking at two objects and how they work together. Proportion is inwardly focused, looking at how the parts relate to one another. When you create your sprites, you need to think about creating proportional sprites and scaling all objects in the image and background to work together in harmony.

Your background is scaled well, with the ground placed in the bottom third of the screen and the stars' tiny pinpricks of light at the top of the screen. But the way you divided the screen is more important than only supporting good scale. It also helps you to use the Rule of Thirds.

Learning the Rule of Thirds

Take a piece of paper and hold it horizontally. Fold it into thirds, bringing the sides toward the middle of the paper. Open it up and turn the paper, now holding it vertically. Fold it into thirds the other way, bringing the two longer sides toward the center of the paper. If you did this correctly, you should have your paper divided into nine squares, as in figure 6.6.

This illustrates the *Rule of Thirds*. What it means is that centering important visual items on those four intersections creates a visually interesting picture. Everyone's eyes are super picky. We don't like to see objects out of balance on the screen. We don't mind objects in the center column, though we think that's a little boring. We definitely don't like an item in the left or right column. But we love it when an item is right on one of those lines, using those intersections, as in figure 6.7. Layouts that use the Rule of Thirds make our eyes happy.
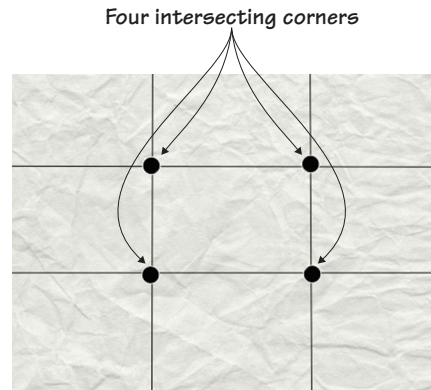
Four intersecting corners

Figure 6.6   The two sets of parallel lines divide the paper both ways into thirds, while dots mark the four important intersections.
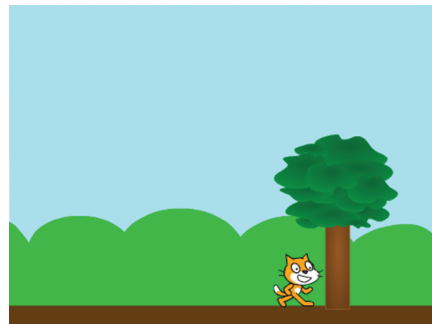
Figure 6.7   Instead of putting the cat and tree in the center of the Stage, position the cat and tree on one of the invisible third lines.

You're going to have to estimate those creases on the Stage because you can't fold the screen. You've made your life a little easier, though, with this particular background. The ground covers one third of the bottom, and the stars cover one third of the top. It will be easy to have the sprites extend over those intersection points on the virtual creases. In fact, let's make a wizard so you can position him on one of those sweet spots on the screen.

Prepping the main sprites

The Rule of Thirds is about how to lay out all the elements in a game, but you can also work that magic number three into your wizard, breaking up the sprite into three equal parts. You'll repeat that number by creating three smoky grey layers on the ghost. Think about various ways you can incorporate *three* into your game. You can remove the default cat on the Stage by clicking the scissors in the Grey Toolbar and clicking the cat.

Making the wizard

The wizard in figure 6.8 is wearing purple robes and a matching purple hat and he's carrying a wand that will fire sparks at the ghosts.
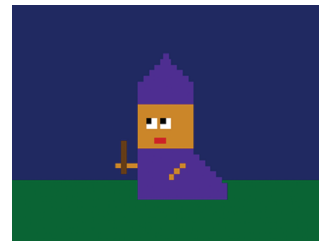

Figure 6.8   **The finished wizard with purple robes and a matching purple hat**

Keep proportion in mind as you make your sprites. Okay, ghosts and magical wizards aren't the most realistic beings in the world, but you can still keep general rules about proportion in mind. For instance, after you make the wizard's eyes, use them to determine how big to make the mouth, or look at the size of the wizard's head to decide how big to make the hat.

Open the Art Editor to make the wizard:

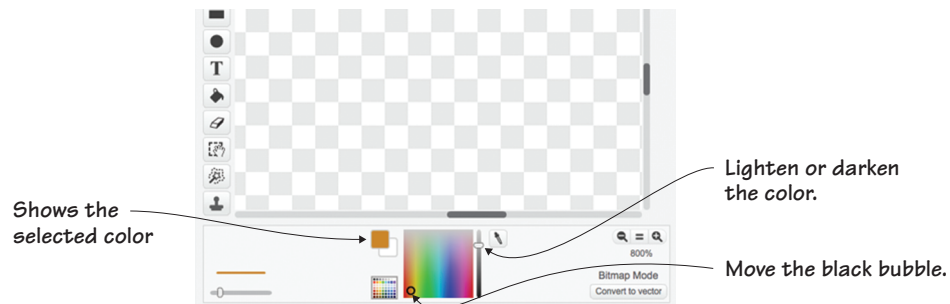1 Zoom in to 800%. Select the Paintbrush tool and a skin tone using the rainbow box shown in figure 6.9.

Shows the selected color

Lighten or darken the color.

Move the black bubble.

Figure 6.9   **Choose the wizard's skin tone using the rainbow box.**
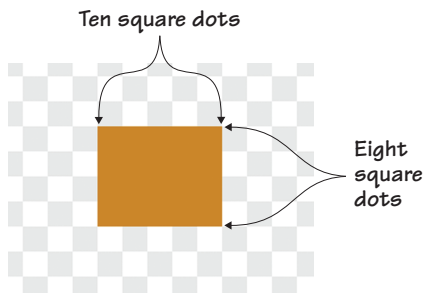
Ten square dots

Eight square dots

Figure 6.10   The wizard's head begins with a simple square made out of pixels from the Paintbrush tool.

2 Draw a 10-by-8-pixel head close to the plus sign in the center of the canvas. Fill in the center of the square, like the one in figure 6.10, using the Paint Bucket tool.

3 Switch to the paint sample squares and choose the second darkest shade of purple and the Paintbrush tool. Draw a purple, 10-pixel line directly underneath the line of skin tone pixels that form the bottom of the wizard's head.

4 Start a pixel staircase from the right end of the purple line. Make one pixel underneath the line, then one pixel to the right. Again, make one pixel underneath that new, dangling pixel, and again, make one pixel to the right. Do this six times, as shown in figure 6.11. Make sure you end with one pixel going down, but don't make the final pixel to the right.

5 Make a horizontal line beginning underneath the single purple pixel at the bottom of the staircase on the right side of the wizard's robe, and make it parallel to that top row of purple pixels under the head. You're drawing the bottom of the wizard's robe, which can also be seen in figure 6.11.

6 Make a final vertical line of pixels closing off the left side of the wizard's robe, and fill in the middle of the robe either pixel-by-pixel or save yourself some time with the Paint Bucket tool. You should see the finished purple robe.
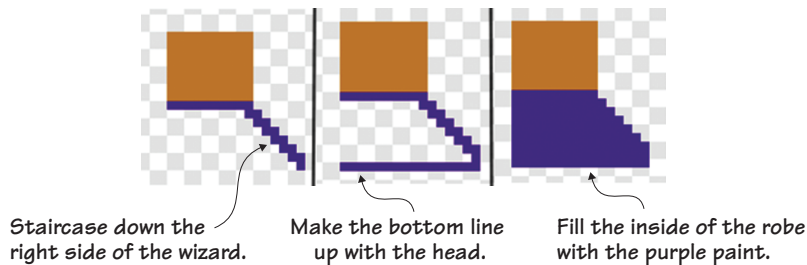
Staircase down the right side of the wizard.

Make the bottom line up with the head.

Fill the inside of the robe with the purple paint.

Figure 6.11   Create a purple pixel staircase to make the wizard's robe.

7 Move to the top of the wizard's head and draw a similar line of purple pixels going across the top of the skin tone pixels, as you did in step three, to make the neck of the wizard's robe. The line should be 10 pixels long.

8 Starting at either end of the new purple line, draw three square dots going up. Repeat this line of three pixels on the opposite side.

9 Make four diagonal square dots from the top of both lines, moving toward the center. You should end with two pixels touching each other, as in figure 6.12. Place a single pixel on top of that double pixel line to form a point.
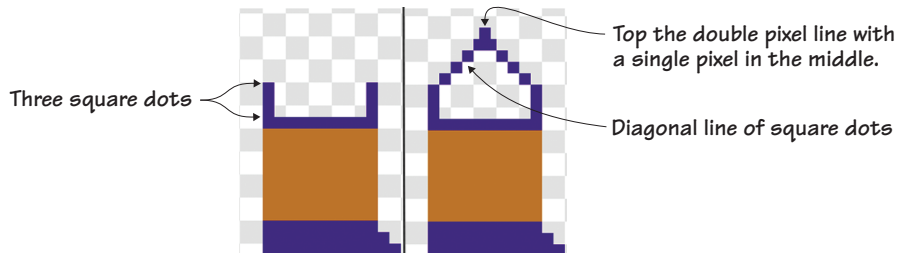

Top the double pixel line with a single pixel in the middle.

Three square dots

Diagonal line of square dots

Figure 6.12   The wizard's hat is formed by drawing a pentagon out of pixels.

10 Fill the hat using the Paint Bucket tool. The hat should be a solid purple pentagon. It's now time to make the wizard's arms.

11 Navigate back to the Color Toolbar and look for the Eyedropper tool seen in figure 6.13. This eyedropper will allow you to set your color by clicking anywhere that color already appears on the screen.

Pick up color

Click the eyedropper icon, and then click the color you want anywhere it appears on the screen.
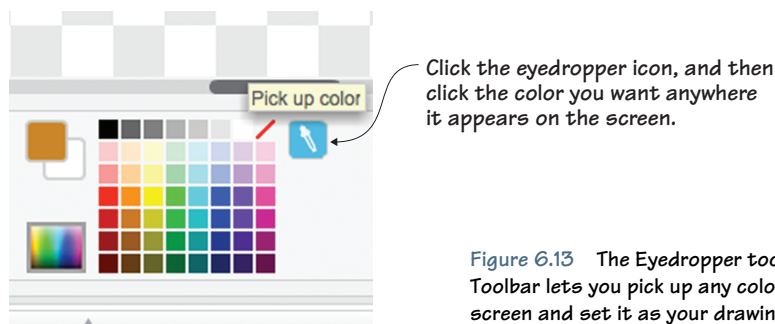
Figure 6.13   The Eyedropper tool in the Color Toolbar lets you pick up any color on the screen and set it as your drawing color.

12 Click the eyedropper and then click anywhere on the wizard's face in the Art Editor. This sets your current color as that skin tone color.

13 Return to the Paintbrush tool and draw three diagonal square dots in the middle of the robe. Next, visually judge the height of the top of the arm and draw four pixels coming out of the front of the wizard's robe. Finally, switch to a dark brown paint sample square and make a four-pixel vertical line so the wand intersects with the left arm, as shown in figure 6.14.

14 Choose the white paint sample square for the wizard's eyes. Make two small squares, four pixels each, in the middle of the wizard's face, like step one of figure 6.15.

15 Switch to the black paint sample square and make a single black square dot in each white eye. You can decide where to place it. I placed mine in the top left corner, as in step two of figure 6.15.

16 Switch to the red paint sample square and make a two-pixel red line toward the bottom of the face, as in step three of figure 6.15.

That's it! You should have a worried-looking wizard like the one in figure 6.16. Make sure you go to the Sprite Zone and rename your sprite Wizard.

Right now, the wizard is probably somewhere near the middle of the Stage. But if you want to draw the player's attention to the wizard, you want to position him in a visually interesting place.
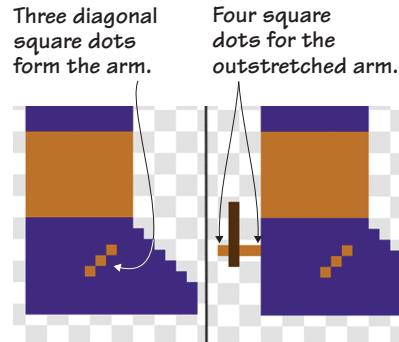
Three diagonal square dots form the arm.   **Four square dots for the outstretched arm.**

Figure 6.14   A few pixels make the wizard's arms, either diagonally or horizontally.
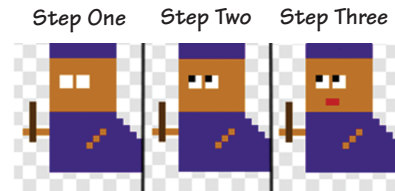
Step One   Step Two   Step Three

Figure 6.15   The wizard's eyes are two white-and-black squares, and his mouth is a worried-looking, two-pixel red line.
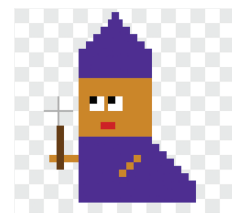

Figure 6.16   The wizard sprite is ready to fight some ghosts.

Use the Rule of Thirds and put him on one of the imaginary creases dividing the Stage into nine invisible, equal parts. To better understand this concept, I drew real lines on the background and placed the wizard right on the crease, as shown in figure 6.17. Look at the general area where that wizard is standing and drag your wizard to match that on your Stage.
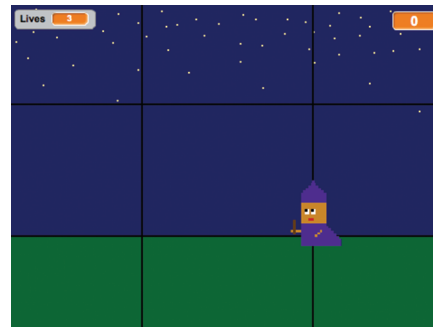

Figure 6.17   Place the wizard at a visually interesting place at an invisible intersection on the Stage.

ANSWER THIS   IS THE WIZARD IN PROPORTION?

Question: is this pixelated wizard in proportion?

Answer: yes...and no. On the one hand, you've kept in mind that both arms should be the same size, and certain features—such as the body—should be larger than other features—such as the mouth. But the wizard is a great example of how you can exploit proportion to convey an idea once you understand how proportion works. For instance, I made the wizard's eyes oversized to make him look vulnerable. It's scary to fight ghosts, and I wanted to make sure that the wizard looked the part. You can enlarge or shrink certain features to immediately clue the viewer in to a part of their personality, such as making a neutral-looking creature have enormous teeth to make it seem scary, or giving a person a longer-than-usual neck to make them look more elegant. Think about ways you can tweak proportion to tell a story.

Making the ghost

You now need to make the ghosts that fight the wizard. You only need to make the one ghost as shown in figure 6.18 for Wizards vs. Ghosts. You'll once again code many copies to generate during the game.

Figure 6.18   The completed ghost doesn't look that scary when it's not in motion, but look out when the ghosts start swooping down from the sky.
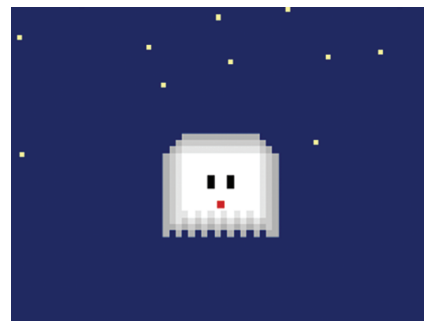
Make a new sprite and return to the Art Editor:

1   Zoom in to 800%. Select the Paintbrush tool and the fourth lightest shade of grey (four over from the left). You are going to use three shades of grey to make your ghost, so make sure you have room to move lighter and lighter for the next three layers.

2   Make a 12-pixel horizontal line near the center of the canvas. The ghost is *symmetrical*, which means that if you divided him down the middle, both sides would be exactly the same. Keep this in mind as you work, because any pixel you make on the right side of the ghost should match with a pixel you make on the left side.

3   Make a diagonal line three pixels down on either side of the horizontal line.

4   Draw a vertical line, 13 pixels long, on either side of the ghost using the end of the diagonal line as a starting point.

5   Finish the ghost by connecting pixels on the diagonal across the bottom in an in-and-out pattern, as shown in figure 6.19.

12 pixels across

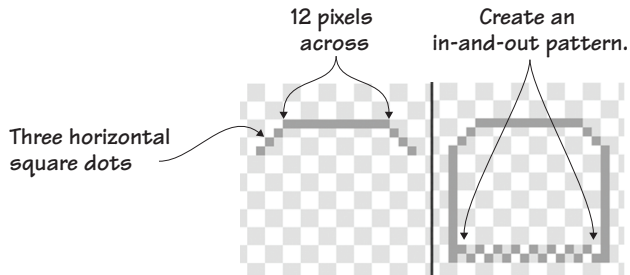Create an in-and-out pattern.

Three horizontal square dots

Figure 6.19   The darkest grey is used to form the outline of the ghost.

6   Switch to a slightly lighter shade of grey and outline the inside of the ghost, touching the new lighter grey pixels to the existing darker grey pixels, as shown in figure 6.20.

7   Switch again to the lightest shade of grey and outline the inside of the ghost, touching the lightest grey pixels to the medium light grey pixels.

8 Choose the white paint sample square and the Paint Bucket tool. Click anywhere in the center of the ghost to fill the empty space, as in figure 6.20.
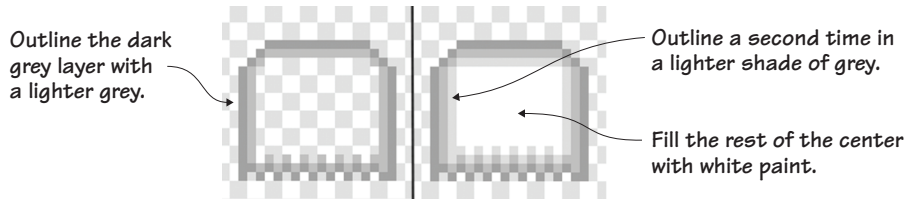
Outline the dark grey layer with a lighter grey.

Outline a second time in a lighter shade of grey.

Fill the rest of the center with white paint.

Figure 6.20 Two shades of grey outline the inside of the ghost, and a white center finishes off the sprite.

FIX IT **HELP! I CAN'T SEE WHERE THE PIXELS SHOULD GO!** It can be hard to see the three versions of grey pixels against that grey and white canvas of the Art Editor. If you're having trouble making the ghost, use three shades of blue. Then, when you are finished with the sprite, use the Paint Bucket tool to change each blue section to a corresponding grey. For instance, use the darkest blue in place of the darkest grey in the sprite. Once the sprite is complete, switch to the correct shade of grey and the Paint Bucket tool and click one of the dark blue pixels. This should spill that new color through all the connecting dark blue pixels without spilling over into any of the other lighter blue sections of the ghost. Repeat this with each layer to make the ghost a little easier to draw against the grey and white canvas.

9 Choose the black paint sample square and Paintbrush tool. Draw eyes that are two vertical pixels in the center of the ghost.

10 Switch to the red paint sample square and make a single red pixel underneath the eyes to serve as the mouth.

You should now have a finished, spooky, transparent-looking ghost, as shown in figure 6.21.

Rename the sprite Ghost by going into the Sprite Zone and clicking the blue *i* on the sprite. Now that the wizard and the
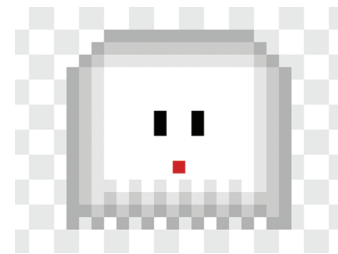
Figure 6.21 The ghost sprite is ready to swoop down from the sky.

ghost are ready to square off, it's time to give the wizard some red sparks to blast out of his wand.

Making the wand sparks

Your wizard is holding a wand, but right now it can't cast a spell. Give the wand the ability to shoot red sparks, like the ones in figure 6.22, from the end when the wizard is squaring off against the ghosts.

Make a new sprite and get ready to make the sparks in the Art Editor:

1 Choose the red paint sample square and Paintbrush tool.

Figure 6.22   The wizard looks with surprise at the sparks coming out of his wand.

2 Make a shower of sparks, placing spaces between each pixel. You'll want the sparks to come to a point at the bottom and spread out toward the top because they're coming out of the wand.

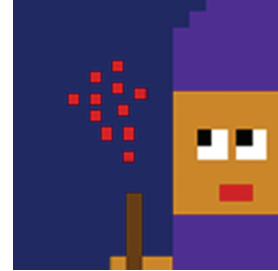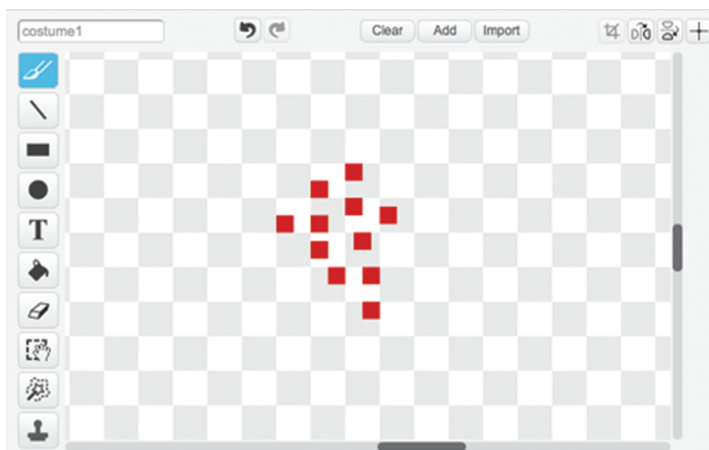3 You should now have a little cluster of red pixels, as shown in figure 6.23.

Figure 6.23   Tiny square dots with spaces in between become the sparks shooting out of the wizard's wand.

Finish off the main sprites by navigating once again to the Sprite Zone and clicking the *i* to rename this sprite Sparks. Look at the sparks on the Stage and click and drag them so they hover over the wizard's wand.

Prepping the odds and ends

You still have to make the single line that will serve as a barrier when you start coding your game. It's a boring sprite, but it will make coding your game a little more precise.

Making the barrier line

You'll want this single horizontal line at the bottom of the Stage, so once again draw it at the bottom of the Art Editor's canvas:

1   Select the darkest green paint sample square and Line tool. Zoom out to 100%.

2   Draw a line that starts at the bottom left corner of the canvas and ends at the bottom right corner. Hold down the Shift key on the keyboard as you drag your mouse to make the line completely straight, as in figure 6.24.
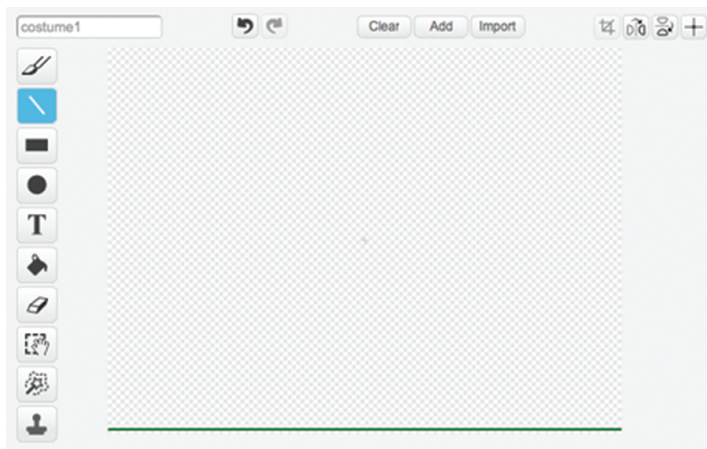

Figure 6.24   Draw your green line at the bottom of the Art Editor; it will be a barrier when you code your game.

Go to the Sprite Zone and rename this sprite Barrier Line.

Preparing to code

You've learned a lot of design concepts in this chapter, so let's review them and play with them before you jump into coding your game.

Play with the game

Right now, everything should be in balance on your Stage. But what if you take all your sprites out of scale with one another or play with proportion?

> **CHALLENGE**   The mood of the game, believe it or not, is influenced by the scale of the sprites. Make the ghost enormous and think about how the game feels with the ghost looming over the little wizard. Turn it around and make the ghost small and the wizard enormous. Do you still feel sympathy toward the wizard when he is clearly so much larger than his enemy?

> **CHALLENGE**   Your wizard has big eyes to show his vulnerability and a little, worried mouth. Can you reopen the wizard sprite and play with his features to make them more in proportion for an actual face? While you're in there, can you add a nose? What do you think of this version of the wizard versus the original one?

> **CHALLENGE**   Right now, the stars fill the top third of the screen. What happens if you extend the stars to the midway point on the Stage or all the way to the green grass? Does it change the feel of the game? Does the game feel off-balance?

> **CHALLENGE**   The sparks are all one version of red, but you can make them more visually interesting by blending a few shades of red, or even incorporating a few orange or yellow pixels to make them feel more like fire.

What did you learn?

Proportion and scale are important in other areas of STEAM. What if an engineer designing a new mobile phone didn't take into account the size of a person's hand and scaled their device for a giant? What if elements of a house were built out of proportion and no one could get

inside because the door was too small? Well-made inventions are not only proportional, but they're also scaled toward the people who will use them.

Pause for a moment and think about everything you learned in this chapter:

- How scale is different from proportion
- How to tweak proportion to convey an idea about a sprite
- How scale affects the difficulty of a game
- How to use the Rule of Thirds to make the game visually interesting

You now have a crew of four sprites ready to be coded. Continue on to the next chapter to learn how to make this reflex-testing game.

Hello Scratch!

Gabriel Ford, Sadie Ford, and Melissa Ford

Can 8-year-olds write computer programs? You bet they can! In Scratch, young coders use colorful blocks and a rich graphical environment to create programs. They can easily explore ideas like input and output, looping, branching, and conditionals. Scratch is a kid-friendly language created by MIT that is a safe and fun way to begin thinking like a programmer, without the complexity of a traditional programming language.

Hello Scratch! guides young readers through five exciting games to help them take their first steps in programming. They'll experiment with key ideas about how a computer program works and enjoy the satisfaction of immediate success. These carefully designed projects give readers plenty of room to explore by imagining, tinkering, and personalizing as they learn.

What's inside

- Learn by experimentation
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