Spirographs

STEM TOPIC
Technology: Technology Operations and Concepts
Engineering: Defining Engineering Problems
Math: Numbers and Operations in Base Ten & Measurement and Data

DURATION
60 minutes

MATERIALS
• Computers (1 per student)
• Projector connected to instructor computer (if available)

SCHEDULE
• Intro (5 min)
• Draw a Square (15 min)
• Square Spirograph (15 min)
• Spirograph Challenge (20 mins)
• Wrap Up (5 min)
OBJECTIVE
Create complex spirograph drawings through the use of repeating motion and pen commands.

ALIGNED STANDARDS
NGSS K-2-ETS1-1 Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

CCSS.MATH.CONTENT.2.NBT.A.1
Understand that the three digits of a three-digit number represent amounts of hundreds, tens, and ones; e.g., 706 equals 7 hundreds, 0 tens, and 6 ones.

CCSS.MATH.CONTENT.4.MD.C.5
Recognize angles as geometric shapes that are formed wherever two rays share a common endpoint, and understand concepts of angle measurement:

CCSS.MATH.CONTENT.4.MD.C.5.A
An angle is measured with reference to a circle with its center at the common endpoint of the rays, by considering the fraction of the circular arc between the points where the two rays intersect the circle. An angle that turns through 1/360 of a circle is called a “one-degree angle,” and can be used to measure angles.

CCSS.MATH.CONTENT.4.MD.C.5.B
An angle that turns through n one-degree angles is said to have an angle measure of n degrees.

21ST CENTURY SKILLS
• Critical Thinking and Problem Solving
• Flexibility and Adaptability
• Information, Media, and Technology Literacy

HABITS OF MIND
• Thinking Flexibly
• Responding with wonderment and awe

KEY TERMS (OR CONCEPTS)
• Degrees of an angle: a degree is a measurement of an angle. A full circle is 360 degrees, so an angle of 1 degree is 1/360 of a full circle.
• Spirograph: a shape that is repeated a number of times to produce a new, more complex, shape.
DAILY PREP

Prep Tips:

• Work through the activities on your own.

• Have the Scratch homepage visible or saved as a favorite in the browser.

• Make sure each student either knows or has access to their Scratch login information.

• **Highly Recommended:** Use a projector to demonstrate each new skill. If this technology just isn’t available, the student handouts are designed to serve as mini-screen shares, giving students a visual reference to go along with your verbal directions.
STEP-BY-STEP DIRECTIONS FOR INSTRUCTOR

INTRO (5 MINS)

Welcome back to Scratch Camp! Is everyone ready for their third day of scripting and sprites? It’s today that we can begin to see the power of programming! One very important block we’ll use is the “forever” loop. Does anyone remember what it did? We are going to be drawing some fantastic shapes today!

Introduce the “repeat” block and drawing spirographs as the main projects of the day.

As a computer program, Scratch can run hundreds of commands almost instantly, as we will soon see. Fortunately, we don’t have to program hundreds of steps! We can just tell the sprite to repeat certain steps over and over. And when the pen is used on repeat, we can draw some really stunning pictures.

DRAW A SQUARE (WHOLE GROUP)

Add a new sprite

Let’s start by adding a new sprite today. Open the Sprite Library and choose a sprite you haven’t worked with before. Then delete the Scratch Cat from the sprite list by using the mouse to right click on it and then choosing delete from the menu.

Talk about how to make a sprite move in a square using “turn __ degrees” blocks.

We’re going to have a sprite make a simple shape first: a square. But all we actually need to program is one straight line, and then one turn. We can use a new block to do the rest! With your new sprite selected, add a when green flag clicked event block. Then open the Motion section. At the top of the list, there are two blocks called “turn __ degrees.” Try experimenting with these two blocks. What happens when you change the number inside the block?
Talk about how to make a 90 degree turn for a square.

The “turn __ degrees” block can make a sprite change the direction it moves in. Have you ever walked around a corner? The turn block does the same thing for the sprite. We want the sprite to make a square though. And squares need to have certain angle: 90 degrees. Start with just one turn block that has 90 in its number area.

Add a “move __ steps” block to the script.

The square script is already almost finished! We still need to tell the sprite to actually move though. Click and drag a “move __ steps” block and drop it at the top of the script. Then change its number of steps to be 100. Try clicking the green flag four times. Did your sprite move in a square shape?

Model how to add a repeat script.

Luckily we don’t need to keep clicking on the green flag over and over to the run the program. Instead go to the Control section. Look for the “repeat” block and then drag and drop it into the scripting area. Just like the “forever” block, it will surround the other blocks like the bread of a sandwich. Then change the repeat number to 4. Why are we only repeating the script 4 times?
Draw a square with the pen commands.

The repeat and forever blocks make scripting much faster and easier! Let’s try adding the pen to this project now. Open the pen section and drag over the “clear” and “pen down” blocks. Add them to the very top of your script, so they are not inside the repeat. If you want, choose the color and pen size too. With the pen blocks down, try running your program. Did you draw a square?

**SQUARE SPiroGRAPH (WHOLE GROUP)**

Introduce spirographs and how to make them in Scratch.

The square is a pretty easy shape to draw, but it’s not very exciting or cool. Let’s see if we can slightly adjust the script to make it more interesting. But adding only a couple of new blocks, a new and astounding shape can be made. It’s known as a spirograph!
Add a “loop” and “turn ___ degrees” block to the repeat script to make a spirograph.

To make a spirograph, open the Motion section. Drag over a new turn block and drop it at the bottom of the script, beneath the repeat block. Then click on the number in the turn block and change it to 5. Open the Control section next and drag over a forever block. Surround both the repeat and turn blocks with the forever. When you are ready, start your script!

Model how to create a rainbow colored spirograph.

Did you think that the spirograph is a cool shape? Even just watching the sprite draw it is exciting. What if you want to make it even more exciting though? Like making it rainbow colored? Let’s do it! Open the Pen section and look for the “change pen color by ___” block. When you have found it, drag it over and drop it above the repeat block. It should be the first block in the forever script. Now the color should change every time it starts a new square. Test it out!
SPIROGRAPH CHALLENGE (INDEPENDENT)

Challenge students to add new sprites and create a different spirograph with each one.

Congratulations everyone! You have just made a complex and multi-step program that made a sophisticated drawing. Let's see if we can go one step further. Try adding a new sprite and then making a new spirograph based on a different shape. Instead of a square, you could try a triangle spirograph, or even a pentagon spirograph. What happens when you change the numbers in the "turn __ degrees" blocks? You can also experiment with some of the new blocks like the change color or repeat. Just have fun with whatever you are doing!

Whole Group Discussion

WRAP UP (DISCUSSION)

At the end of the day, have everyone log out of Scratch and then turn off their computers and screens.

It's been a big day, guys! You experimented with turning blocks and make some amazing shapes! I can't wait to see what you come up with tomorrow.

• What was your favorite shape to draw in a spirograph?
• Did the repeat or forever block make drawing spirographs easier? How so?

CHECK FOR UNDERSTANDING:

• Can you repeat a forever block? Why or why not?
• What did the degree number in a turn block change?

EXTENSIONS:

• Discuss how to determine the needed angle of a shape by dividing 360 by the number of sides in the shape (i.e. 360/4 for a square).
• Challenge students to make a circle spirograph.