Scratching Out the Coordinate Plane
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Summary
This lesson will introduce students to the Scratch environment and allow them to read code, debug it, and create their solutions. The students will also review coordinate planes and drawing shapes in a location on the plane.

Intended Grade Level
This lesson is designed for 5th grade students with no programming experience.

Idaho Content Standards
Computer Science:
- 3-5.CS.01—“Create code to model intelligent behavior in computing devices.”
- 3-5.AP.02—“Construct and test problem solutions using a block-based visual programming language...”
- 3-5.AP.05—“Understand, explain, and debug the sequencing in an algorithm.”
- 3-5.AP.07—“Construct an algorithm to accomplish a task...”

Mathematics:
- 5.G.01—“Use a pair of perpendicular number lines, called axes, to define a coordinate system, with the intersection of the lines (the origin) arranged to coincide with the 0 on each line and a given point in the plane located by using an ordered pair of numbers, called its coordinates. Understand that the first number indicates how far to travel from the origin in the direction of one axis, and the second number indicates how far to travel in the direction of the second axis, with the convention that the names of the two axes and the coordinates correspond (e.g., x-axis and x-coordinate, y-axis and y-coordinate).”

Lesson Objectives
Students will:
1. Graph points on the coordinate plane.
2. Be introduced to Scratch and create their own profiles.
3. Explore Scratch.
4. Construct algorithms to create, test, and debug their code and explain code parts through comments.

Tasks to be Completed
1. Create student Scratch profiles
   a. Go to http://scratch.mit.edu
   b. Students are not to use their names within their usernames. They are to write down on a piece of paper their chosen usernames and turn it in at the end of class.
   c. Have the students use Jan 2001 as the birth month and year and their school email address.
   d. Password has to be six characters long.
2. Exploration
   a. Allow students five minutes to explore on their own. (During this time, continue to help with student account setups.)
   b. Introduce them to vocabulary:
      i. Stage, scripts area, blocks palette, sprite list, sprite, costume, blocks, background, script, coordinate plane, code.
ii. Point out the areas: stage, scripts, blocks palette, and sprite list. (The backpack will be introduced in a later lesson.)

c. Introduce them to Scratch the Cat. Explain its purpose as a sprite and that it only has one costume. Using the sprite Dinosaur1, which has seven costumes, show them that sprites can be changed.

d. Add a background and model a block of code.
   i. See Example 2.1—Why can’t we see what we drew?
   ii. See Example 2.2—Change the size of the sprite to 50%. We can start to see it, but everything is still small. What can we make bigger? Increase the number of steps taken by the sprite to 30 to create a larger polygon.
   iii. See Example 2.3—Show how to choose a background. Select the xy-grid background.

3. Review coordinate planes
   a. Review origin, x-axis, y-axis, x-coordinate, y-coordinate.
   b. Have them look for the x and y at the lower right corner of the stage.
   c. Ask the students to move their mouse slowly around the stage area. What happens to the numbers by x and y?

4. Teach the kids to write scripts while exploring how to move the sprite Scratch. You will need to run a single code once using penup to stop Scratch from drawing.
   a. Move Scratch from origin to:
      i. (240, 0) and then to (-240, 0) See Example 4.1 (Repeat for each location)
      ii. (0, 180) and then to (0, -180)
      iii. (240, 180) and then to (240, -180)
      iv. (-240, 180) and then to (-240, -180)
      v. Have the students write a single process that moves Scratch to all previous locations. (See Example 4.2.) Why don’t we see Scratch visiting each location?
      vi. Introduce “wait” and “glide” commands. (See Example 4.3)

5. Problem: We need Scratch to draw a square on the stage at coordinates: (50, 50), (50, 150), (150, 150), and (150, 50).
   a. Have the students create a coordinate plane on a sheet of paper (x and y-axes should be labeled from -250 to 250 in units of 50) and draw the square as it should be placed. Ensure the square is placed in the correct quadrant.
   b. Write the code in Scratch. (See Example 5.1)
   c. Debug
      i. Why didn’t Scratch draw a square?
      ii. Insert “pendown” into the code, but place it first in the code sequence. (See Example 5.2)
   d. Redraw the square.
      i. Let the kids debug the proper sequencing of commands so that the extraneous line is not drawn. Solution is shown in Example 5.3.

Questions for Review

1. How does the program start? (Click the flag)
2. What are sprites? (Avatars) Costumes? (different versions of the avatar)
3. How do you change sprites?
4. What’s the white area of the screen used for? (The stage is used to visually show the results of the code we write.)
5. What is an algorithm? (A set of procedures or rules to follow.)
6. How do we use algorithms to solve problems? (Examples include: order of operations, division, multiplication, word problems, conflict resolution, etc.)
7. How is the stage similar to a coordinate plane? (Each spot on the stage can be located with an (x, y) coordinate.)
Assessment
1. Choose a different sprite than Scratch the Cat.
2. Using the xy-grid as the background, have the students choose a different sprite and draw a rectangle whose corners are located at: (-25, 25), (-25, -25), (-125, -25), and (-125, 25).
3. A possible variation of the solution is shown in Example Assessment Solution.

Examples

Example 1.1

Example 1.2
Example 1.3

Example 4.1 (Repeat for each of the locations.)
Example 4.2

Scratching Out the Coordinate Plane
by HardyScratched (unshared)

Y

(x:6, y:180)

(x:0, y:0)

(x:240, y:0)

(x:0, y:0)

(x:-240, y:0)

(x:6, y:-180)

Example 4.3

Scratching Out the Coordinate Plane
by HardyScratched (unshared)

Y

(x:6, y:180)

(x:0, y:0)

(x:240, y:0)

(x:0, y:0)

(x:-240, y:0)

(x:6, y:-180)
Example 5.1
Scratching Out the Coordinate Plane
by HardlyScratched (unshared)

Example 5.2

Example 5.3
Scratching Out the Coordinate Plane
by HardlyScratched (unshared)

Example Assessment Solution (possible variation)