

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

The screenshot shows the Scratch interface with the title "Scratching Out the Coordinate Plane" by "HardlyScratched (unshared)". The stage background is the "xy-grid". The Scratch Cat sprite is visible. The Scripts palette is open, showing the following script:

```
when green flag clicked  
clear  
set pen size to 4  
pen down  
repeat 10  
  move 10 steps  
  turn 360 / 10 degrees
```

The status bar at the bottom indicates "x: 240 V: 180".

Example 1.2

The screenshot shows the Scratch interface with the title "Scratching Out the Coordinate Plane" by "HardlyScratched (unshared)". The stage background is the "xy-grid". The Scratch Cat sprite is visible, surrounded by a blue circle. The Scripts palette is open, showing the following script:

```
when green flag clicked  
say hello! for 2 secs  
say hello!  
think Hmm... for 2 secs  
think Hmm...  
show  
hide  
switch costume to costume2  
next costume  
switch backdrop to xy-grid2
```

The status bar at the bottom indicates "x: -184 y: 180".

Example 1.3

Scratching Out the Coordinate Plane
by HardlyScratched (unshared)

The coordinate plane shows a grid with X and Y axes. The origin is labeled $(X:0, Y:0)$. The X-axis has labels $(X:-240, Y:0)$ and $(X:240, Y:0)$. The Y-axis has labels $(X:0, Y:180)$ and $(X:0, Y:-180)$. Grid lines are spaced at 100-unit intervals. A cat sprite is positioned at the origin $(0, 0)$. A blue octagon is drawn around the cat. The current position of the cat is $x: 240$ $y: 180$.

Scripts: Backdrop

New backdrop:

1. backdrop1 480x360
2. xy-grid 480x360
3. xy-grid2 480x360

Sprites: New sprite:

Stage: 3 backdrops

Sprite1

New backdrop:

Example 4.1 (Repeat for each of the locations.)

Coordinate Plane
unshared)

The coordinate plane shows a grid with X and Y axes. The origin is labeled $(X:0, Y:0)$. The X-axis has labels $(X:0, Y:0)$ and $(X:240, Y:0)$. The Y-axis has labels $(X:0, Y:180)$ and $(X:0, Y:-180)$. Grid lines are spaced at 100-unit intervals. A cat sprite is positioned at the origin $(0, 0)$. The current position of the cat is $x: -178$ $y: 180$.

Scripts: Costumes: Sounds

- Motion
- Looks
- Sound
- Pen
- Data
- Events
- Control
- Sensing
- Operators
- More Blocks

Script:

```
when clicked  
clear  
stamp  
go to x: 240 y: 0  
pen down  
pen up  
set pen color to [red]  
change pen color by 10  
set pen color to [red]  
change pen shade by 10
```

Example 4.2

Scratching Out the Coordinate Plane
by HardlyScratched (unshared)

Scripts | Costumes | Sounds

Motion | Events | Control | Sensing | Operators | More Blocks

when green flag clicked

- clear
- go to x: 0 y: 0
- go to x: 240 y: 0
- go to x: -240 y: 0
- go to x: 0 y: 180
- go to x: 0 y: -180
- go to x: 240 y: 180
- go to x: 240 y: -180
- go to x: -240 y: 180
- go to x: -240 y: -180

Coordinates: (X:0,Y:180), (X:0,Y:0), (X:240,Y:0), (X:-240,Y:0), (X:0,Y:-180), (X:240,Y:-180), (X:-240,Y:-180)

Sprite: Sprite1

Example 4.3

Scratching Out the Coordinate Plane
by HardlyScratched (unshared)

Scripts | Costumes | Sounds

Motion | Events | Control | Sensing | Operators | More Blocks

when green flag clicked

- clear
- go to x: 0 y: 0
- glide 1 secs to x: 240 y: 0
- wait 1 secs
- glide 1 secs to x: -240 y: 0
- wait 1 secs
- glide 1 secs to x: 0 y: 180
- wait 1 secs
- glide 1 secs to x: 0 y: -180
- wait 1 secs
- glide 1 secs to x: 240 y: 180
- wait 1 secs
- glide 1 secs to x: 240 y: -180
- wait 1 secs
- glide 1 secs to x: -240 y: 180
- wait 1 secs
- glide 1 secs to x: -240 y: -180
- wait 1 secs
- glide 1 secs to x: 0 y: 0

Coordinates: (X:0,Y:180), (X:0,Y:0), (X:240,Y:0), (X:-240,Y:0), (X:0,Y:-180), (X:240,Y:-180), (X:-240,Y:-180)

Sprite: Sprite1

Example 5.1

Scratching Out the Coordinate Plane
by HardlyScratched (unshared)

The coordinate plane shows the origin (0,0) with the cat. The x-axis is labeled with (X:240,Y:0) and the y-axis with (X:0,Y:180) and (X:0,Y:-180). Grid lines are marked at 100 and 200 units.

Scripts:

- when green flag clicked
 - clear
 - go to x: 0 y: 0
 - glide 1 secs to x: 50 y: 50
 - wait 1 secs
 - glide 1 secs to x: 50 y: 150
 - wait 1 secs
 - glide 1 secs to x: 150 y: 150
 - wait 1 secs
 - glide 1 secs to x: 150 y: 50
 - wait 1 secs
 - glide 1 secs to x: 50 y: 50
 - go to x: 0 y: 0

Motion:

- move 10 steps
- turn 15 degrees
- turn 15 degrees
- point in direction 90
- point towards mouse-pointer
- go to x: 50 y: 50
- go to mouse-pointer
- glide 1 secs to x: 50 y: 50

Example 5.2

Scratching Out the Coordinate Plane
by HardlyScratched (unshared)

The coordinate plane shows the origin (0,0) with the cat. A blue square is drawn with its bottom-left corner at the origin. The x-axis is labeled with (X:240,Y:0) and the y-axis with (X:0,Y:180) and (X:0,Y:-180). Grid lines are marked at 100 and 200 units.

Scripts:

- when green flag clicked
 - clear
 - pen down
 - go to x: 0 y: 0
 - glide 1 secs to x: 50 y: 50
 - wait 1 secs
 - glide 1 secs to x: 50 y: 150
 - wait 1 secs
 - glide 1 secs to x: 150 y: 150
 - wait 1 secs
 - glide 1 secs to x: 150 y: 50
 - wait 1 secs
 - glide 1 secs to x: 50 y: 50
 - go to x: 0 y: 0

Pen:

- clear
- stamp
- pen down
- pen up
- set pen color to green
- change pen color by 10
- set pen color to 0
- change pen shade by 10

Example 5.3

Scratching Out the Coordinate Plane
by HardlyScratched (unshared)

Coordinate Plane: X-axis from -300 to 300, Y-axis from -180 to 180. A blue square is drawn with its top-left corner at (0, 180) and its bottom-right corner at (240, 0). The cat sprite is at (0, 0).

Scripts:

- when green flag clicked
 - clear
 - go to x: 0 y: 0
 - glide 1 secs to x: 50 y: 50
 - pen down
 - wait 1 secs
 - glide 1 secs to x: 50 y: 150
 - wait 1 secs
 - glide 1 secs to x: 150 y: 150
 - wait 1 secs
 - glide 1 secs to x: 150 y: 50
 - wait 1 secs
 - glide 1 secs to x: 50 y: 50
 - pen up
 - go to x: 0 y: 0
- clear
- stamp
- pen down
- pen up
- set pen color to [red]
- change pen color by 10
- set pen color to [red]
- change pen shade by 10

Example Assessment Solution (possible variation)

Scratching Out the Coordinate Plane
by HardlyScratched (unshared)

Coordinate Plane: X-axis from -300 to 300, Y-axis from -180 to 180. A blue square is drawn with its top-left corner at (-25, 25) and its bottom-right corner at (125, -25). The cat sprite is at (0, 0).

Scripts:

- when green flag clicked
 - clear
 - go to x: 0 y: 0
 - glide 1 secs to x: -25 y: 25
 - pen down
 - wait 1 secs
 - glide 1 secs to x: -25 y: -25
 - wait 1 secs
 - glide 1 secs to x: 125 y: -25
 - wait 1 secs
 - glide 1 secs to x: 125 y: 25
 - wait 1 secs
 - glide 1 secs to x: -25 y: 25
 - pen up
 - go to x: 0 y: 0
- clear
- stamp
- pen down
- pen up
- set pen color to [red]
- change pen color by 10
- set pen color to [red]
- change pen shade by 10
- set pen shade to 50