Shaping Algorithms

with Finch robots & FinchBlox app

Students will construct shapes out of repeating patterns, first by coding a "human robot" and then by coding Finch robots.

AGE

- Gr 2-4
  - This lesson also works well for multi-grade mixed groups (eg. K-5 classes at small schools)

OBJECTIVES

Curricular content:

- Curricular competencies from Math & ADST across many grade levels
- Math 1-2: 2D shapes
- Math 4: polygons, perimeter

Lesson objectives:

- Students will understand the repeating patterns that make up regular polygons.
- They will express those patterns as an algorithm, a series of step-by-step instructions.

MATERIALS

- Finch robots, 1 per 2-3 students
- Computer devices, 1 per 2-3 students
  - Bluetooth required on those devices
  - FinchBlox app (app available on Android or iOS, or the webpage https://finchblox.birdbraintechnologies.com/FinchBlox.html on computers with bluetooth)
- Space for the robots to move around
- Drawing supplies:
  - Washable markers, pencils, or pens (best are washable brush markers)
  - Paper (larger is better), flat for the robots to draw on
    - To conserve markers, you can use laminated paper

SET UP

- Gather supplies
- Load microbits with BBTFirmware.hex file from this page https://learn.birdbraintechnologies.com/install-shortcuts/

ACTIVITY OUTLINE

Overview and Suggested Timeline:

Introduction	5 minutes
Code-a-human	10 minutes
Finch	25 minutes
Reflection and Wrap-Up	5 minutes

Additionally, we gratefully acknowledge the support of the YP Heung Foundation, The McLean Foundation, and the Province of British Columbia.

Introduction

- What is coding?
  - Coding is how we give machines instructions.
  - We have to learn to talk to the machine in a way that it understands.
  - What kinds of machines do we need to give instructions to? What is the way you give instructions to that machine?
    - Eg: dishwasher (press buttons), apps (touch the touchscreen), computer (type on keyboard, move mouse), car (press buttons, push pedals, turn wheel)
  - We're going to be giving our robots instructions to move around and move in particular shapes

Code-a-human

- Let's start by coding a human robot to move in a shape. What's a simple shape we can start with?
  - *Do NOT do a circle – that's too complicated. A square is best, but for older students you can take their suggestions. (The following instructions assume a square)*
- As a human, you can tell me to "walk in a square" and I know what that means, so I can do it. *(Do it.)*
- But as a robot, I don't know what that means, you have to tell me how to move my body.
  - You also have to tell me when to start moving.
- What's the first thing I should do?
  - *Deliberately misinterpret their instructions, until they tell you to*
    - Move forward
    - # of steps
    - Size of steps
    - *Eg: "Move forward 3 medium steps"*
  - *Eg: if they say "go forward", move forward without stopping until you run into something. If they say "2 steps", take the tiniest possible steps.*
  - *Same for the turns. If they just say "turn right", spin right in a circle*
    - *If they've covered degrees before (or if you want to use this activity to introduce degrees!), you can make them tell you how many degrees to turn. Otherwise, just small/medium/big turn is ok.*
  - *Only let them give 1 instruction at a time (eg. Not "move forward then turn")*
  - *Make them say "start" after giving you the instruction*
- *Repeat until you've done the whole square.*
  - What did we learn about how we have to give instructions to robots?
    - Tell them when to do something ("start")
    - Be specific
    - Give instructions in the right order

Finch

- Now we're going to take what we've learned and apply that to some robots!
- These are the Finches. They can move around, and we're going to control them through this app!
- *Show how to use the app, level 1:*
  - Bluetooth connecting to the microbit
  - Adding, moving, & deleting blocks
  - Testing code
- In your groups, your first challenge is to make the Finch move in a square. Remember to test out as you go!
- *Once groups of students have solved the square, give them the paper & markers to see the shape*

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- *For groups that are ready, show them level 2 (which allows them to specify distance & degrees), then level 3 (which adds speed and repeats)*
- *Challenge successful groups to try new shapes (eg triangle, hexagon), especially using the repeating loops in level 3.*

Optional Extensions

- Perimeter: have the students make shapes with a particular perimeter
  - Eg. Make both a square and an equilateral triangle with a perimeter of 36 cm. How is that different in the triangle and the square? What about a hexagon?

Reflection and Wrap-Up

- Put away robots & supplies before asking reflection questions
- Share challenges and successes from the activity with each other
- Ask the reflection questions (below)

REFLECTION QUESTIONS

- Why is it important for us to test out our code whenever we make a change, even if the change is small?
- What were some of the repeating patterns that we saw in our shapes?

TROUBLESHOOTING TIPS

- Check that the Finch has been turned on properly
- Check that the connected Finch is the right one
- If you can't connect at all, check that bluetooth is enabled (method differs by device) and the FinchBlox app has bluetooth permissions
- Angles: remember that the Finch actually is turning the outside angle, not the internal angle of the shape. For grades that haven't done angles yet, they can solve this through trial-and-error, but for older grades you will want to include a discussion of angles.
  - For example, to draw a triangle, the Finch will have to turn 120° (the outside angle of the internal 60° of an equilateral triangle)

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