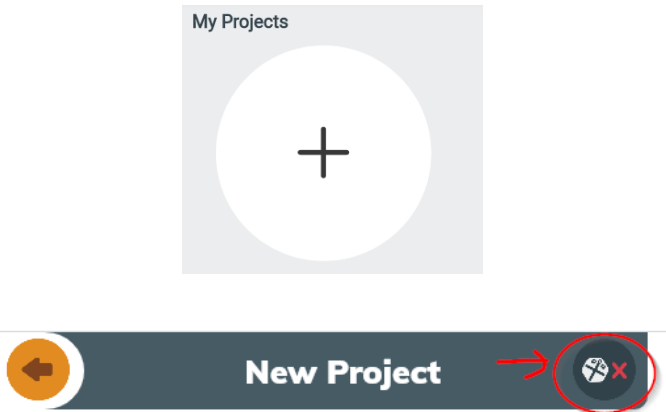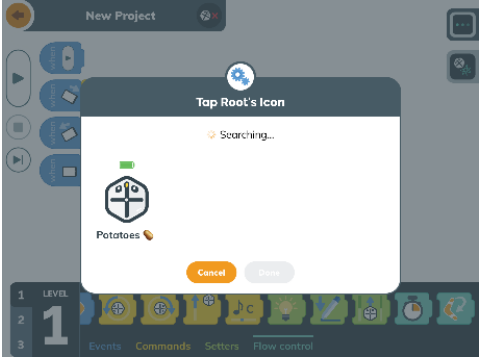# Fractal Geometry and Root
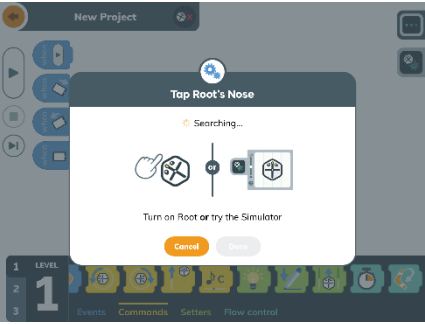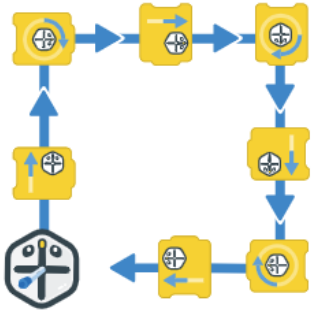
Introduction

Students will design a fractal image in the Root Robot App, and implement their project using the markers and the boomerang function.

Materials:

Ipads (enough for 1:2 students), Root Robots (1:2 students), laminated mats (1:2 students. Available in LRC Root kits), dry erase markers (in LRC Root kits), dry towels or paper towel to erase lines (1:2 students), Large tables or solid, flat, clean surface to place mats.

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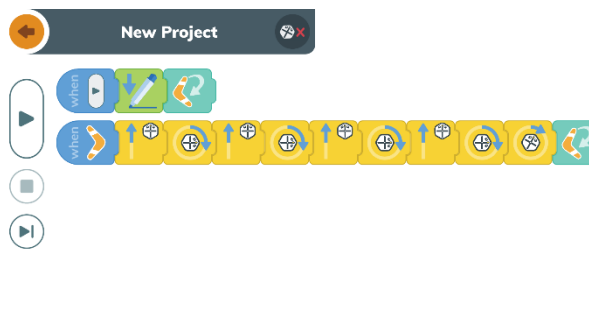| Steps		
1		Divide Students into groups of 2 Give each student group a Robot, an Ipad, one dry erase pen, and a laminated mat (all are available in the Root Robot kits from the LRC)
2		In their Ipads, have students begin a new project in the Root app by clicking on the + sign (left). Then have students connect to their robot by clicking on the icon to the right of the project label.
3		When students click on the connection icon, a list of available robots should show up on the screen. Available robots are robots that are turned on but not currently connected to any ipad apps. Your robot should be turned on and you will know if it is yours when, if you click on its name, it lights up blue at the same time. Click 'done' when you have selected your robot.

4		If your robot is **not** turned on, and no other robots are available, the screen to the left will appear. Make sure your robot is turned on! You turn on your robot by pressing the yellow 'nose' of your bot for two seconds. You will know it is turned on because the 'eyes' will light up and it will make a little sound.
5		In their new project, students will first pull up the 'marker' function onto the 'When Play" setting.
6		They will then pull up a "When Boomerang" setting from the blue section labelled 'events'. This block tells Root what to do if it sees a matching Boomerang Block
7		Teach students to create a closed shape in the 'When Boomerang' event. Closed shapes include: triangles, squares, hexagons, pentagons, and octagons. Circles are also closed shapes. A simple closed shape, like a square (left), must bring the root back to it's starting place.
8		Attach a Boomerang Block to the 'When Play' Block. Now, whenever Root sees a Boomerang Block, it will start to draw a square.

9		Attach a Turn Block at the end of your closed shape in the 'When Boomerang' program. Edit to make Root turn just a little at the end of making each square. Each time the robot creates the shape, it will turn to the right or left just enough to begin making a fractal image. Depending on how long the program is run, your image will begin to look like a snowflake or star.
10		Now, to create unlimited shapes with very little effort, attach a Boomerang Block to the end of your 'When Boomerang' program. This will create a continuous loop that will not end until you press the 'stop' button or until you leave the app altogether.
11		Fractal images are a wonderful opportunity to teach spatial geometry with immediate real-world applications. Have students try making a variety of shapes on their mats, documenting their work with photographs as they create each iteration. This is a wonderful way to learn and practice mathematical principles!

Tip…

1. If student robots are moving slowly, have them leave the app (press the home button) to disconnect from their robot. When they go back in, they can reconnect and the robot should go much faster.
2. For best results, have students rename their robot at the beginning of the lesson. This way, when they accidentally disconnect from their robot (as they inevitably will), they will easily be able to find their bot on the list. The robot re-naming function is available in the 'Hello' program (see below for icon)

3. Students can also use their dry-erase pens to 'dress up' their Root. Just remember to wipe clean with a dry cloth afterward!