LESSON 7: SHUTTLE RUN

Overview:

Students will use the DroneBlocks program to fly their aircraft in a "shuttle run" pattern. A shuttle run pattern is a series of out and back lengths of increasing distance. This lesson will build on the navigational skills presented in previous lessons and will introduce the concept of variables. Students will have the opportunity to first write a program without using a variable, then compare the finished mission with the variable block in place. Extension lesson ideas are included to provide opportunities for students to add depth to their learning.

Objective:

Students will:
- Enjoy introductory activities that review the concept of variables and the shuttle run pattern
- Calculate and determine program blocks for altitude, distance, and yaw
- Use variables to more efficiently code the mission
- Run a test-flight of the program through a Preview Mission
- Launch a field mission that will take their drone in a "shuttle run" pattern

Common Core State Standards:

Common Core Standards provided focus on grades 5 and 6, as a baseline. Educators should adjust standards based on the ability and/or experience of their students.

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.

CCSS.ELA-LITERACY.RST.6-8.3: Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

CCSS.MATH.CONTENT.6.EE.A.2.C: Evaluate expressions at specific values of their variables.

CCSS.MATH.CONTENT.6.EE.B.5: Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true?

CCSS.MATH.CONTENT.6.EE.B.6: Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.

International Society for Technology in Education Standards:

ISTE 1.a Apply existing knowledge to generate new ideas, products, or processes

ISTE 1.c Use models and simulations to explore complex systems and issues

ISTE 2.d Contribute to project teams to produce original work or solve problems

ISTE 3.a Plan strategies to guide inquiry

ISTE 3.d Process data and report results

ISTE 4.a Identify and define authentic problems and significant questions for investigation

ISTE 4.b Plan and manage activities to develop a solution or complete a project

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Materials Needed:

- Pre-Flight Checklist
- DroneBlocks App Downloaded on iOS devices for students
- Drone
- Propeller Guards

Part 1: Vocabulary

Variable - In programming, a variable is a value that can change, depending on conditions or on information passed to the program. Variables hold a value and make it more efficient to change this value throughout a program.

Be creative and provide your students with analogies of how to teach variables, especially if any of your students are struggling with the concept. Think of jars, lockers, or containers… Each variable may have the same appearance but be represented by a different value.

Variables also may hold information or data for later use. Similar to putting something in your backpack, you can get it later and you can add more information to it if needed!

Part 2: Understanding the Shuttle Run

This mission is called "Shuttle Run" because students will program the aircraft to fly in a "shuttle run" pattern, which is a series of out and back flights of increasing distance, as shown in **Figure 7.1**. The shuttle run is used to test students during the Presidential Youth Fitness Program and is used by the NFL to gauge the speed and agility of their athletes.
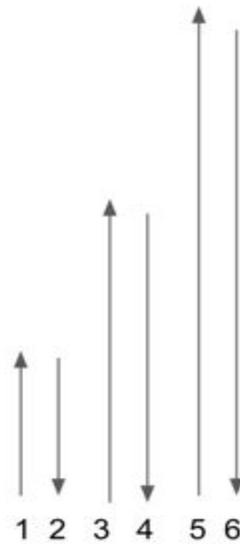

Figure 7.1

Begin this section by adding a kinesthetic component to your lesson! Take your students outside to participate in a fun shuttle run! Remind students to completely run to the start/stop lines to make sure their "mission" is complete. If their DroneBlocks mission doesn't command the drone to go to the specified distance, the shuttle run is incorrectly executed.

Integrate STEM learning with this activity and discuss the physics of the shuttle run or determine whether greater speeds can be achieved running the shorter or longer legs of the run. You might even have students physically run through their missions, once programmed, as a kinesthetic simulator! Review the importance of procedural text and remind them to follow specific directions to achieve the desired results of each programming challenge.

💡 Did you know? The Presidential Council on Youth Fitness was established in 1956 to promote and assess physical fitness in education. It was established by President Dwight Eisenhower. This council has been reorganized over the years and is currently named the President's Council on Fitness, Sports & Nutrition. Why do you think the name of this council was changed? Do some research... How has the mission of this program also changed since the 1950s?

Part 3: Mission Plan

Key components of the shuttle run:

- Takeoff to altitude (recommend 50 feet or a height that is clear of nearby obstacles)
- Repeat the following sequence
  - Fly out 25 feet and back
  - Fly out 50 feet and back
  - Fly out 75 feet and back
- Land

Figure 7.2 shows an example of the shuttle run mission program **without using variables**. Allow your students to try programming the mission without guiding them toward the use of variables.
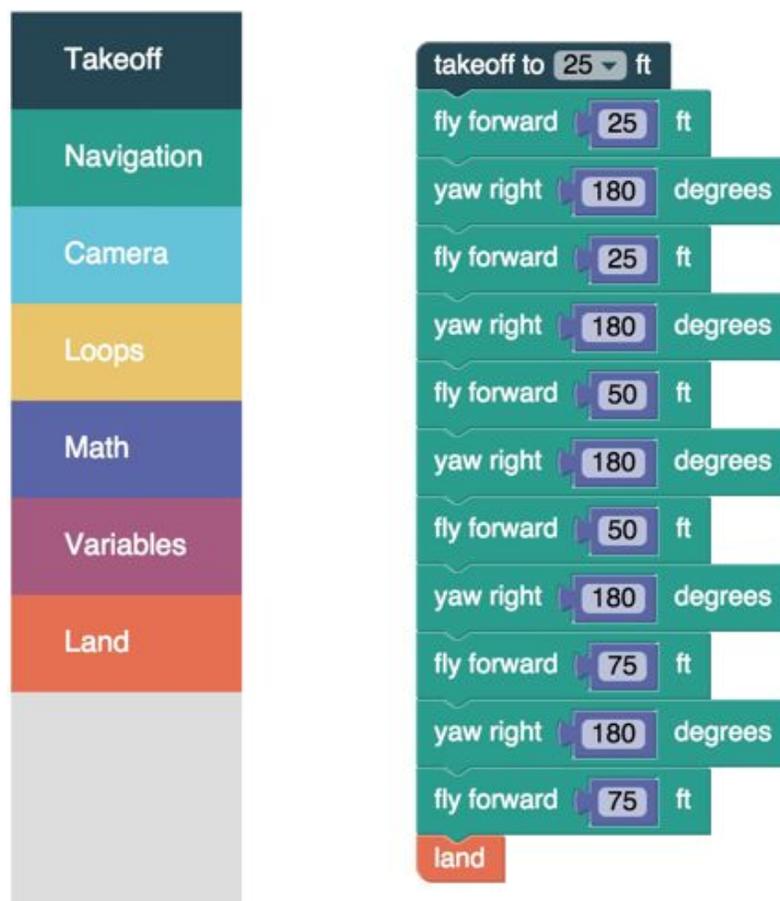

Figure 7.2

Next, introduce the variables block and challenge your students to incorporate a variable into their program. As you can see in **Figure 7.3**, using variables allows the mission to be completed in far fewer steps. Imagine how long the above mission would be if you wanted to extend the shuttle run out to 200 feet!

Figure 7.3

For additional information regarding variable and loop blocks, read this DroneBlocks blog post.

Students may individually program this mission on their own or in teams. Let your students explain their missions and run them in "Preview Mission".

REMEMBER:

- When running preview missions indoors, the aircraft and remote should be powered off.

- Never let the students connect to the aircraft indoors, as they could accidentally activate the mission, resulting in an extremely dangerous indoor flight.

Previewing missions allows you to see if your mission is programmed correctly. When programming you may forget a simple instruction. Seeing the code run on the preview simulator is a clear indicator of what needs to be fixed.

Part 4: Field Mission

Now that the mission has been reviewed by the teacher and run in the mission preview, it is time to take the program to the field. Most of the hard work has already been completed and now it is time to enjoy the rewards of students' programming and testing. Before running the mission in the field make sure to review the safety steps as you have done previously. These steps will apply to every field mission.

IMPORTANT:

- Take a copy of the Pre-Flight Checklist to the flying area, and complete every step of the pre-flight checklist before running the mission.

- As the Phantom 3 is flying, always be prepared to manually take control of the aircraft if it behaves unexpectedly by switching back to P-mode. If operating a Phantom 4, manually resume control by switching to S-mode. Click here for a video discussing flight modes.

- Note: As tempting as it may be to take a photo directly beneath your drone, don't ever do this. You should not operate a drone above or within 25 feet of people under any circumstances.

Your mission is now complete! Share your photos and creations with @droneblocks and tag us #droneblocks so that we can see your hard work. This is an opportunity to let the world see what you have programmed and created!

With this particular mission, choosing your launch point will be CRITICAL. Orient your drone AWAY from the group so that it does not fly over students. Be sure you have sufficient space along the flight path.

Did you know? Boolean is a real word! A Boolean is a type of data that can be represented by a variable. It has only two values, true or false. What do you think is the origin for this word?

Part 5: Extensions

Try changing the distance of the shuttle run – begin with increments of 15 feet.

Rather than flying this mission horizontally, code the mission to fly vertically. Carefully monitor your coordinates so your aircraft continues to fly within safe parameters.

Do you have access to tech toys such as Spheros or Ozobots? Use these gadgets to program a shuttle run pattern! Have your students share this activity with younger students to expose them to the basics of programming!

Additional Resources

Would you like to learn more about the shuttle run?

Start by visiting these websites:

https://www.presidentschallenge.org/challenge/physical/activities/shuttle-run.shtml

http://www.nfl.com/news/story/0ap2000000326903/article/how-to-master-the-shuttle-run

http://news.bbc.co.uk/sport2/hi/health_and_fitness/4271376.stm

Would you like to learn more about variables?

Start by visiting these websites:

http://cs-blog.khanacademy.org/2013/09/teaching-variables-analogies-and.html

http://scratched.gse.harvard.edu/discussions/teaching-scratch/teaching-elementary-students-about-variables

http://www.bbc.co.uk/guides/zw3dwmn

https://www.kidscodecs.com/variables/

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