**Youth Explore Trades Skills Electronics and Robotics**

**Robot Golf: Autonomous Challenge**

# Description

This activity is a programming challenge that puts the robot in autonomous mode to complete a task. Students will create a series of programmed instructions that will be installed in the robot. These instructions are then executed by the robot. Students are evaluated by the success of the robot’s task performance.

On a large sheet of paper, draw a short “golf course” consisting of four “holes.” Identify the four starting points (tee-offs) and four ending points (holes) as the golf course. See the example supplied in Figure 1.

Students will start their robot on the first tee and drive it to the hole without going off course. Repeat until the robot successfully completes all four of the golf course holes. Adjust the installed program accordingly.

This activity helps students to:

* Apply mathematics to their robot design and computer program
* Learn from their mistakes and course-correct
* Apply iterative programming and testing to complete a task

# Lesson Outcomes

Students will be able to:

* Program a robot to navigate and complete the golf course
* Test and improve robot performance
* Work as a team to accomplish a goal

# Assumptions

Students will have:

* Knowledge and understanding of basic construction techniques
* Access to robotics platforms and necessary equipment
* Access to computers and programming software

# Key Terminology

**Boundary**: a physical or non-physical barrier within which the robot operates.

**Feedback**: information from either the robot or a teammate with respect to actual performance.

**Line tracker**: allows a robot to follow a line over a surface.

**Sensor**: a device that provides information about the environment to a device or robot.



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# Estimated Time

Total time: 1¾ hours to about 3 hours:

* + 30–45 minutes to create the golf course (if not prepared ahead of time by teacher)
  + 15–20 minutes for demonstration and verbal instruction exercise
  + 60–120 minutes to write/test/improve program

# Recommended Number of Students

Two to five students per robot, per team (ideal: three students) Two to five teams

# Facilities

A large, flat surface in a cafeteria, gym or large classroom where the golf course can fit—ideally on a table or a clean floor

# Tools

Tools are platform-specific based on the robotics platform selected.

A basic tool kit that includes pliers, wrenches, nail files (to round off sharp corners)

Desktop or laptop computer with programming software for the robot (e.g., FLOWOL, RobotC, EasyC, Modkit, etc.)

# Materials

A large piece of paper with a golf course painted or drawn on it One robot per team

# Resources

Search YouTube for robot programming demonstration videos.

You may also reference:

### Jr. Robotics: a place for teachers, students and parents

https://vsbrobotics.wordpress.com/challenge-1a-robot-golf/

Website forums for team-to- team or peer-to-peer online discussions regarding programming their robot:

### Vex IQ Forum

<http://www.vexiqforum.com/>

### Vex EDR Community Forum

<http://www.vexforum.com/>

### FIRST Forums

<http://forums.usfirst.org/>

# Demonstration

This human demonstration helps students to develop a programming mindset before working with a robot.

First, have the students form teams and identify one person in the team to act as a robot, another to act as a programmer (gives instructions to the robot) and a third to act as a scribe.

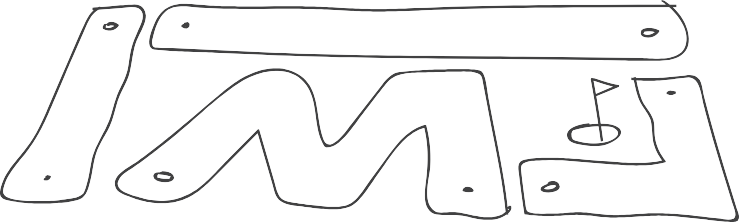
The programmer gives exact instructions to the “robot” to walk to a specific destination while the scribe records the exact information.

# Procedure

Ideally, students should first complete the robot golf challenge by using a hand-held remote control (driver). A partner(s) should take notes of the exact series of instructions to be given to the robot to perform the task, such as completing a golf course hole. Next, the students should write a computer program to do the same task autonomously. Repeat this process until all the golf course holes are completed.

The steps for the activity are:

1. Have students form robot teams consisting of programmers and scribes. (Ideally two to three students per team)
2. Draw a golf course consisting of four holes on a large piece of paper. Make sure the golf course holes are large enough for the robots to fit into the hole. See Figure 1.



**Figure 1—**Example of a four-hole robot golf course

1. Teams take turns driving their robot through the course using a remote control. It might be easier to have teams start on different holes so as to avoid congestion on the course. Team scribes take notes of the exact controller movements and robot behaviour for their first hole.
2. Teams then begin writing their programs in order to complete their first hole.
3. At this point, teams can start testing/rewriting their programs, working their way through all of the holes.

# Assessment

The evaluation of this lesson is based on the learning outcomes outlined above.

Prior to teachers using the evaluation grid it is recommended that students perform some form of peer-assessment and self-assessment.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Outcome To Be Assessed** | **6** | **5** | **4** | **3** | **2** | **1** | **0** |
| **Outcome 1** | **Program a robot to navigate and complete the golf course** | | | | | | | |
| **1.1** | Robot navigated the maze(s)/obstacle(s). |  |  |  |  |  |  |  |
| **1.2** | Robot successfully avoided object(s). |  |  |  |  |  |  |  |
| **1.3** | Computer program operated as expected. |  |  |  |  |  |  |  |
| **Outcome 2** | **Test and improve robot performance** | | | | | | | |
| **2.1** | Uses field to test program. |  |  |  |  |  |  |  |
| **2.2** | Uses information from testing to improve performance. |  |  |  |  |  |  |  |
| **Outcome 3** | **Teamwork** | | | | | | | |
| **3.1** | Students able to resolve errors when encountered. |  |  |  |  |  |  |  |
| **3.2** | Division of work. |  |  |  |  |  |  |  |
| **3.3** | Effort of each team member. |  |  |  |  |  |  |  |

## Total Points:

|  |  |  |
| --- | --- | --- |
| 6 | Completed successfully at the exceptional level | Exemplary |
| 5 | Completed successfully at higher than the expected level | Accomplished |
| 4 | Completed successfully to the expected level | Emerging |
| 3 | Attempted successfully at the minimum level | Developing |
| 2 | Attempted - Unsuccessful - Close to Successful | Beginning |
| 1 | Attempted - Unsuccessful | Basic |
| 0 | Not Attempted | N/A |

**Comments:**

**Extension Activities**

Go to the Classroom Challenges section at the bottom of the following webpage to see possible extension activities.

### Jr. Robotics: a place for teachers, students and parents

https://vsbrobotics.wordpress.com/