**Multi-bot Challenge**

# Description

Robotics competitions help students by engaging them in a time-bound activity, encouraging teamwork and having them follow rules similar to those outlined by a governing body. The benefits of competition include promoting collaborative work among students in diverse communities, offering pride in awards, and encouraging innovation and problem-solving in an energized, public education forum.

The students’ primary objective in this activity is to attempt to complete one of the competition challenges listed below. You may choose to select a classroom challenge from the resources recommended or create your own challenge. Two recommended game challenges appear in this activity. Before beginning the activity you may want to prepare a scoreboard and have a timer handy.

# Lesson Outcomes

Students will be able to work in a team environment to:

* Construct and operate a robot to perform the game challenge(s)
* Follow instructions to complete a complex task
* Solve technical problems individually and collaboratively

# Assumptions

Students will:

* Understand basic construction techniques
* Have formed teams and partnerships within the classroom
* Have access to robotics platforms and necessary equipment
* Have little or no experience in working with a larger team, coordinating work and allocating resources
* Have some experience with basic robots

# Key Terminology

**De-scoring**: the act of removing a game element from within a goal or from within a score zone.

**Game element**: items used by the robot to achieve a score.

**Field**: the arena area where the competition takes place.

**Goals**: a location where the game elements must be placed to obtain a score.



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**Score zone**: the scoring area within the competition arena. When a game element enters this area, a score is usually assigned, but not as high as if it was inside the goal.

**Scoring**: the act of placing a game element within a goal or within a score zone.

# Estimated Time

4–8 hours per game challenge

# Recommended Number of Students

Two to four students per robot

# Facilities

* + A competition arena – ideally one from VEX Robotics or FIRST LEGO League. This should be a middle- to large-sized space that can accommodate a large table or floor area where the competition can take place (e.g., cafeteria, gym or large classroom).
  + Work benches (optional)
  + Storage for robots, kits and tools

# Tools

* + Tools are platform-specific based on the robotics platform selected.
  + A basic tool kit that includes pliers, wrenches and files (to round off sharp corners)
  + Computers with appropriate software, ideally laptop computers (1 per team)
  + Timer

# Materials

* + An area to construct robots
  + A competition arena – ideally using a competition arena from VEX robotics or FIRST LEGO League.
  + Timer
  + Scoreboard (can use a blackboard or whiteboard to record most scores)
  + Robots that can move, grab and release
  + The intermediate-level challenge requires robots with a sensor at the back, programmed to pause the robot for three seconds when touched.

You may choose to purchase or custom-design your own game elements and arena from the dollar store or the hardware store.

**Resources**

**VEX Robotics**

https://[www.vexrobotics.com/](http://www.vexrobotics.com/)

Every spring the Robotics Education and Competition Foundation establishes a new VEX game to be played around the world. This game can be found at: <http://www.roboticseducation.org/vex-robotics-competitionvrc/current-game/>

The current year’s VEX IQ game can be found at: <http://www.roboticseducation.org/vex-iq-challenge/viq-current-game/>

### LEGO

https://[www.lego.com/en-us/mindstorms/](http://www.lego.com/en-us/mindstorms/)

Each year FIRST LEGO League creates a new game to be played with LEGO robots. More information can be found here:

[http://www.firstlegoleague.org](http://www.firstlegoleague.org/)

When researching specific tasks or troubleshooting unique problems, teams should be directed to seek assistance from the larger robotics community. There are discussion forums focussed on each of the major robotics platforms. Your students may find tips, advice and answers to their questions at the sites below. Please remind them that it is standard forum etiquette to “search before you post” to see if your question (or something like it) has already been answered.

### VEX IQ Forum

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

### VEX FORUM

https://[www.vexforum.com/](http://www.vexforum.com/)

### FIRST Lego Robotics Forums

<http://forums.usfirst.org/forumdisplay.php?24-FIRST-LEGO-League>

While international challenges can be fun and exciting and form part of a larger robotics course or club activity, there are many small “in-house” competitions that can be held within the time frame of a Youth Explore Trades Skills module.

One example is “Freeze Tag,” where robots attempt to get behind their opponents and tap a bumper switch, “freezing” the opponent. This is a video of such a competition at Highland Middle School, in Courtenay:

https://[www.youtube.com/watch?v=UrHt1S720zk&feature=youtu.be](http://www.youtube.com/watch?v=UrHt1S720zk&amp;feature=youtu.be)

Another game, using golf balls, can be seen at: https://[www.youtube.com/watch?v=CB-zp3Yi7qU](http://www.youtube.com/watch?v=CB-zp3Yi7qU)

A game suitable for VEX IQ or LEGO style robots can be seen at: https://[www.youtube.com/watch?v=w3ROKA1j21E](http://www.youtube.com/watch?v=w3ROKA1j21E)

# Demonstration

Introduce your students to the game by showing a video and describing the rules of the game. It helps to have the game arena and game pieces available as part of this introduction.

# Procedure

1. Determine which game challenge you will follow; arrange the playing field and game elements.
2. Introduce the challenge to the students and assign each team a designation (e.g., Team A, B, C).
3. Guide the students through a design and build process to create a robot capable of playing the game.
4. Create a scoreboard either on paper or in MS Excel so that each robot has a chance to be paired up with every other robot once. Keep score for each team. Use Table 1 as an example.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Blue Team (Blue Alliance)** | | **Red Team (Red Alliance)** | |
| Round 1 | A | B | C | D |
| Round 2 | A | C | D | B |
| Round 3 | A | D | C | B |
| Playoff Round 2 | Winning team 1 from Playoff Round 1 | | Winning team 2 from Playoff Round 1 | |

**Table 1–**Competition scoreboard for four teams

## Game Challenge #1: Clear the Field (Beginner Level)

In this challenge, two teams with two robots each compete to clear the field of balls. The four competing robots are placed inside the game field.

Both teams will have two minutes to clear the field by picking up and placing the balls in the four corner goal areas (two corner goal areas per team). See Figure 1 for an example.

All balls must be touching the game floor mat before and after the game.

The goal area posts can be moved but must be put back before time expires.



**Figure 1—**Clear the field arena

## Game Challenge #2: Bumper Bot (Intermediate Level)

This is a challenge played with two, three or four robots, each with a sensor at the back. When the sensor is touched it causes the robot to pause for three seconds.

The object of the game is to collect as many game objects as possible. To gain advantage, robots can bump competitors on the back side sensor, which will cause it to pause for three seconds.

Each round of the game lasts 90 seconds.

The robot (or team of robots) with the highest number of game objects in their corner wins. An example of this game appears here:

https://youtu.be/UrHt1S720zk

# Assessment

The evaluation of this lesson is based on the four 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** | **Constructs and operates a robot to perform the game challenges** | | | | | | | |
| **1.1** | Quality of robot construction. |  |  |  |  |  |  |  |
| **1.2** | Quality of robot software. |  |  |  |  |  |  |  |
| **Outcome 2** | **Follows instructions to complete a complex task** | | | | | | | |
| **2.1** | Robot has been designed in keeping with recommended best practices. |  |  |  |  |  |  |  |
| **Outcome 3** | **Solves technical problems individually and collaboratively** | | | | | | | |
| **3.1** | Works together with team members and other teams. |  |  |  |  |  |  |  |
| **3.2** | Engages in leadership roles, provides critical insight or ideas. |  |  |  |  |  |  |  |

## 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:**

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

# Extension Activities

”Classroom Challenges” on the following website lists additional activities that can be completed as an extension to this activity.

https://vsbrobotics.wordpress.com/