Challenge

Students will design and build a robot that works with one other robot to compete in an obstacle robot relay race without dropping a baton.

Materials Needed

Each pair of students will create one robot. You will work with another team to compete together in the relay race.

- Use one of these sets:
  - TETRIX® PRIME R/C Robotics Set (44320)
  - TETRIX PRIME Dual-Control Robotics Set (44322)
- Items to create challenge field: painter's tape, objects to represent the baton
- Engineering logbook

Objectives

By the end of the lesson, students will be able to:

- Design and build a challenge field.
- Build a robot within the constraints to meet the challenge.
- Write the steps for the robot to follow that meet the challenge.
- Test and refine the steps the robot follows and its design.
- Demonstrate the effectiveness of the robot to meet the challenge.
- Reflect on and share the challenge and its real-world applications.

Activity

Relay Race Challenge

Difficulty

Intermediate

Class Time

Five or more 45-minute class periods

Grade Level

- Middle school
- High school

Learning Focus

- Engineering problem-solving
- Robot assembly
- Computer science

Step 1: Introduce (15 minutes)

- Share, define, and refine the challenge. Document this information in the engineering logbook.
- Write the challenge in your own words. Record the constraints you should follow, the materials that can be used for the solution, and what the testing field will look like. Discuss the constraints and materials that are allowed.

Step 2: Brainstorm (30 minutes)

- Brainstorm ideas to solve the challenge. Create quick sketches and describe solutions to the challenge.
- Considerations for your design:
  - Your robot needs the ability to grab a baton and let go.
  - Your robot should stay within its lane during the relay.
  - You must navigate Robot 2 to where Robot 1 left the baton to be picked up.
  - Robot 1 must know where to pick up the baton to take it down the track.
  - Rules of play:
    - Robot 1 picks up the baton, goes down to Line 1, drops the baton, and returns, tagging its partner. Tagging occurs when the robot arm touches the other robot.
    - Robot 2 goes down to Line 1, picks up the baton, drops it at Line 2, and returns to the start line.
    - When Robot 2 tags Robot 1, Robot 1 goes to Line 2, picks up the baton, and drops it off at Line 1.
      - Robot 1 then returns to the start line and tags Robot 2.
    - Robot 2 then goes to Line 1 and picks up the baton and brings it back to the start line.
    - The first team to cross the start line with its baton wins.
  - Penalties:
    - Starting before being tagged means the team must start over.
    - Losing the baton means that robot must start over.
    - Straying out of bounds or across into the other team's lane means the team must start over.

Constraints

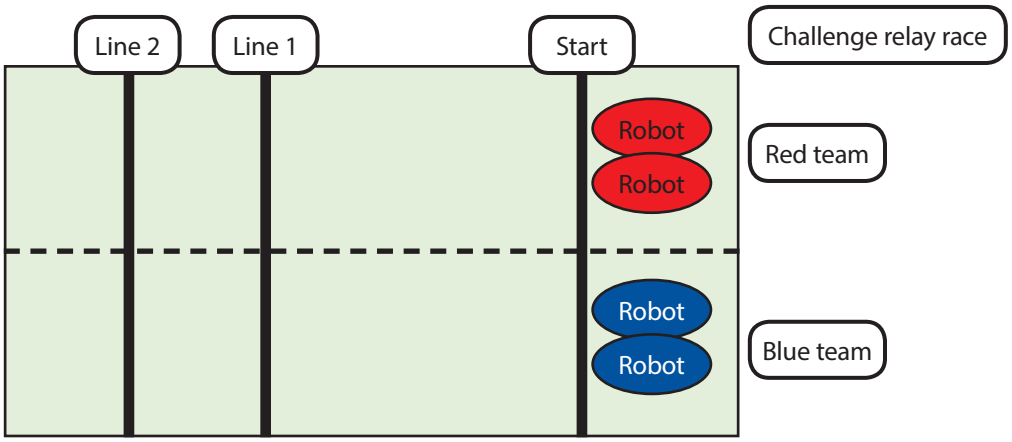
The team's robots must:

- Contain parts from only one set.
- Measure less than 30 cm x 40 cm x 40 cm.
- Pick up and drop off a small object.

Step 3: Set Up (15 minutes)

- Build the challenge field following the pictured guide.
  - The field should be about 1 m x 3 m with a start line and two goal lines. See the sample diagram.
  - Have a small, lightweight object to represent a baton, such as a 5 cm cube, for each team.

Possible Challenge Field



Step 4: Plan (30 minutes)

- Before building, think about the potential design of the robot and draw or record ideas in the engineering logbook. Consider the following:
  - Drivetrain for speed and control
  - Robot chassis for size
  - Baton placement for pickup by Robot 1 and Robot 2
- Create a detailed sketch of your selected solution to the challenge. Label the materials you will use. Write a detailed description of how your solution meets the challenge, constraints, and criteria.

Step 5: Create (45 minutes)

- Design and build the robot. Remember to update the solution in the engineering logbook as the design is improved.
  - **Note:** The creation of the robot could take longer depending on the complexity of the robot solution.

Step 6: Write the Steps (15 minutes)

- Think through the steps or series of actions that the robot will have to complete to meet the challenge. Planning this series of steps is sometimes referred to as creating pseudocode for your robot.
    - Record these steps in the engineering logbook and use them as a guide when operating the robot. Notice that the steps are like writing code for the robot to follow. Make sure the robot performs all the steps required in the challenge.

Step 7: Test (45 minutes)

- Test the solution. Place the robot into the challenge field and follow the written steps.
- Refine the solution. Adjust the design and steps as needed. Document any changes in the engineering logbook.

Step 8: Demonstrate (15 minutes)

- When the robot has been tested and successfully navigates the challenge field, demonstrate its performance in a final test.

Step 9: Reflect and Share (15 minutes)

- Look back at the prototype. How does it compare to the final design?
- Look back at the original steps. How do they compare to the final steps?
- Discuss the original prototype, the steps for the robot to follow, how the solution was implemented, and how this challenge applies to the real world of robot design.

Step 10: Extensions

- Design Your Own Relay
    - Design a relay race that follows a different sequence of steps. Each robot could perform a different action before the baton is passed. Robots could be required to avoid obstacles along the relay path or form a larger relay team.

Robot 1 Sample Steps

1. Pick up the baton at the start line.
2. Go forward to Line 1.
3. Drop off the baton.
4. Return to the start line.
5. Tag my partner.
6. Wait to be tagged by my partner.
7. Go forward to Line 2.
8. Pick up the baton.
9. Return to Line 1.
10. Drop off the baton.
11. Return to the start line.
12. Tag my partner.
13. Wait until my partner returns.
14. Celebrate.

Robot 2 Sample Steps

1. Wait to be tagged by my partner.
2. Pick up the baton at Line 1.
3. Go forward to Line 2.
4. Drop off the baton.
5. Go backward to the start line.
6. Tag my partner.
7. Wait to be tagged by my partner.
8. Go forward to Line 1.
9. Pick up the baton.
10. Return to the start line.
11. Celebrate.