TETRIX® PRIME Limited Edition Echo Robot Blended Learning Scope and Sequence

This scope and sequence is an example of how activities from the *TETRIX® PRIME Limited Edition Echo Robot Guide* can be done in remote learning, blended learning, or in-class learning implementations. The Echo Robot Set is designed to be a one-to-one robotics set, meaning each student has his or her own robot. However, in some situations it might not be feasible for each student to have his or her own robot. In this example scope and sequence, the class is split in half and requires half the number of robot kits as students in the class. Group 1 completes the activities for the Echo Robot while Group 2 completes alternate robotics activities. After Group 1 has completed the *Echo Robot Guide*, Group 2 completes the guide while Group 1 completes the alternate activities.

- Remote Learning Implementations
  - Group 1 takes the Echo Robot Set and guide home to complete the activities remotely while Group 2 completes the alternate learning activities remotely.
  - The Echo Robot Sets are returned to school so they can be sanitized, inventoried, and redistributed.
  - Group 1 completes the alternate learning activities while Group 2 completes the Echo Robot activities.
- Blended Learning Implementations
  - Echo Robot activities are done at school while the alternate activities are done remotely. This keeps the Echo Robot from leaving the classroom.
  - The following scope and sequence will most likely need to be adjusted to where the groups alternate doing each activity. For example, on Day 3, Group 1 would build the robot in class while Group 2 does the alternate activity remotely. Then, on Day 4, Group 2 would build the robot in class while Group 1 does the alternate activity remotely. Groups alternate back and forth between remote and in-class activities.
  - This implementation will likely require more sanitization as groups share robots between days.
- In-Class Learning Implementations
  - Group 1 completes the entire *Echo Robot Guide* while Group 2 completes the alternate learning activities.
  - The Echo Robot Sets are then sanitized and inventoried for use by the next group.
  - Group 1 completes the alternate learning activities while Group 2 completes the *Echo Robot Guide*.

The *Echo Robot Guide* is designed to use TETRIX Ardublockly as the coding interface. Ardublockly will run on only PC or Mac computers and is not compatible with Chromebooks or tablets. However, it is possible to complete these same activities using only the Arduino Software (IDE), which is a syntax coding interface. This will be more challenging, however, as the guide provides no instruction on syntax coding in the IDE. Syntax coding instructions will likely need to be supplemented by the teacher. The benefit of using the Arduino IDE is that there is a web-based version that works on most devices, including Chromebooks and tablets. Refer to these resources for more information on using the Arduino Web Editor.

- Code Using the Arduino Web Editor
- TETRIX Arduino Web Editor Instructions
- Getting Started with Arduino Web Editor on Various Platforms

All Echo Robot activities and alternate learning activities should be completed in an engineering logbook. In a remote situation, consider having students submit pictures of their logbook pages as proof of learning.

TETRIX robotics is a hands-on learning experience. Unfortunately, hands-on means an increased risk of spreading germs as robots, kits, and components get passed between students. To minimize this risk, we recommend these guidelines for cleaning and disinfecting workstations, tools, robots, and TETRIX components. Consider labeling the robot sets and having each student use the same set to minimize contact.

Key:	Echo Robot Activity	Alternate Learning Activity

Class Period	Group 1 Activity	Group 2 Activity	Notes and Tips
1	**TETRIX PULSE™ Overview and DC Motor Assembly:** • Read through the Safety, Set Components, Setup/Construction Tips, PULSE Controller Technology Overview, and PULSE Setup sections of the guide. • Complete the DC Motor Assembly according to the Setup/Construction Tips section of the guide. • **RoboBench Video:** Introducing the TETRIX PULSE Robotics Controller	**Research Robots:** • What makes a machine a robot? • Do all robots have to be electronic? • Where are common places that robots are used? **Graphic Organizer:** • Complete a KWL chart on what you know (K column) and want to know (W column) about programmable robots. The what you learned (L) column will be completed later.	• Assign a kit/robot to each student to use for the duration of the class to minimize the number of students touching the sets. • The RoboBench video mentions the *PULSE Programming Guide*. This is a free download from the Pitsco website. Although it is not needed for the activities in this guide, it might be a helpful resource.
2	**Software Setup and Overview:** • Read the Software Overview section of the guide. • Install the Arduino Software (IDE), TETRIX PULSE Library, and Ardublockly software according to the Software Overview section of the guide. • **RoboBench Video:** Installing the PULSE Software	**Career Connections Day 1:** • Complete the Introductory Activities on the Career Connections page at the back of the *Echo Robot Guide*. • Research a specific career related to robotics.	• The RoboBench video mentions the *PULSE Programming Guide*. This is a free download from the Pitsco website. Although it is not needed for the activities in this guide, it might be a helpful resource. • Resources for career research: ◦ Occupational Outlook Handbook ◦ CareerOneStop
3	**Activity 1 – Building the Robot:** • Assemble the Echo Robot.	**Career Connections Day 2:** • Complete Advanced Activities 1 and 2 on the Career Connections page at the back of the *Echo Robot Guide*. • Research a specific career related to robotics. • Create a poster with information about that job.	• Resources for career research: ◦ Occupational Outlook Handbook ◦ CareerOneStop
4	**Activity 2 – Forward, Reverse:** • Program the Echo Robot to move a specific distance.	**Career Connections Day 3:** • Complete Advanced Activity 5 on the Career Connections page at the back of the *Echo Robot Guide*. • Create a presentation about a career related to robotics.	• Resources for career research: ◦ Occupational Outlook Handbook ◦ CareerOneStop
5	**Challenge 1 – Go the Distance Day 1:** • Program the Echo Robot to move several different distances. • Complete the extension activities.	**Career Presentations:** • Deliver robotics career presentations. • Display career posters.	• Resources for career research: ◦ Occupational Outlook Handbook ◦ CareerOneStop • Encourage students to use good presentation skills and good listening skills during career presentations.
6	**Challenge 1 – Go the Distance Day 2:** • Program the Echo Robot to move several different distances. • Complete the extension activities.	**Research Systems and Systems Thinking:** • Investigate these concepts: system, subsystem, systems thinking, inputs, processes, outputs, and feedback. • Write a description of each concept with examples. • Identify the common systems and subsystems of a robot. • Evaluate the components in the Echo Robot Set and separate them into potential systems and subsystems.	• Students should use whatever resources are available for research. • Consider providing students a copy of the Echo Robot Set Parts Index from the guide for students to use when separating parts into potential systems and subsystems. They should not physically separate the parts at this time.

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7	**Activity 3 – Turn, Turn, Turn:** • Program the Echo Robot to make turns.	**Open and Closed Systems:** • Research open- and closed-loop systems. • Complete a graphic organizer that compares open- and closed-loop systems. • Venn diagrams, bubble maps, and compare/contrast matrix diagrams are examples of graphic organizers that can be used. • List systems found in school or around the house that are examples of open- and closed-loop systems.	• Students should use whatever resources are available for research.
8	**Activity 4 – Obstacle Avoidance:** • Program the Echo Robot to avoid obstacles by using input collected from the Ultrasonic Sensor.	**Systems Model:** • Evaluate the Echo Robot and how it works in relation to the Universal Systems Model of inputs, processes, outputs, and feedback. • Create a graphic of the systems model showing specifics on how the Echo Robot works. The graphic should include inputs, processes, outputs, and any feedback loops that control the system. • Identify whether the Echo Robot is an open-loop or a closed-loop system.	• Students should use whatever resources are available for research. • Consider allowing students to make posters of the Universal Systems Model with specifics related to the Echo Robot.
9	**Challenge 2 – Maneuver the Course Day 1:** • Program the Echo Robot to complete a driving course while avoiding obstacles.	**Robot Industry – Safety and Security:** • Research robots that are used by police, bomb squads, fire departments, and rescue personnel. • Choose a safety and security robot and write a few paragraphs describing the robot, the company that makes it, the tasks it performs, the materials and components it is made from, the cost of the robot, and so on.	• Students should use whatever resources are available for research. • Consider allowing students to research robots in industries of their choosing such as medical, service, assistive, exploration, agriculture, food preparation, manufacturing, military, and so on.
10	**Challenge 2 – Maneuver the Course Day 2:** • Program the Echo Robot to complete a driving course while avoiding obstacles. • Disassemble the Echo Robot when finished.	**Robot Industry – Exploration:** • Research robots that are used by scientists and space agencies for exploration. • Choose an exploratory robot and write a few paragraphs describing the robot – who made it, the tasks it performs, the materials and components it is made from, the cost of the robot, and so on.	• Students should use whatever resources are available for research. • Consider allowing students to research robots in industries of their choosing such as medical, service, assistive, exploration, agriculture, food preparation, manufacturing, military, and so on.
11	**Final Challenge – Build the Smallest Autonomous Vehicle Day 1:** • Complete the Challenge Introduction. • Brainstorm ideas to solve the challenge.	**Robot Design – Safety and Security or Exploration:** • Design a robot that performs tasks related to safety and security or exploration. • The design should include written descriptions of the robot, its systems and subsystems, and the tasks it performs; sketches of what the robot looks like; and materials and components lists of what the robot is made from.	• Consider allowing students with CAD experience to design their robots in a CAD software. • The final challenge is a highly modifiable build/programming challenge. It can easily be tailored to meet the needs of your classroom. • For students completing the final challenge, it might be helpful to build the challenge maze (currently set for Day 2) before they brainstorm ideas to solve the challenge (currently set for Day 1). • For the final challenge, consider allowing students access to other helpful resources such as the *PULSE Programming Guide*. • Make sure students follow the engineering design process as they complete the final challenge.

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12	**Final Challenge – Build the Smallest Autonomous Vehicle Day 2:** • Build the challenge maze. • Begin creating a plan/design for the robot from the brainstorming list.	**Robot Ethics Day 1:** • Research some of the ethical debates that surround the development of advanced robotics. For example: robots taking human jobs, robots being used for military purposes, decision-making in autonomous vehicles, privacy and security, artificial intelligence, and humanoid robots that impersonate real people. • Choose a topic related to robot ethics. • Write a two-paragraph essay on the topic. The first paragraph should explain the ethical debate. The second paragraph should state an opinion on the issue with supporting details.	• It's a good idea to approve student topics before they invest a lot of time in research and writing about robotic ethical issues. • As students state their opinions about ethical issues related to robots, encourage them to use facts to support their opinions. • For students completing the final challenge, it might be helpful to build the challenge maze (currently set for Day 2) before they brainstorm ideas to solve the challenge (currently set for Day 1).
13	**Final Challenge – Build the Smallest Autonomous Vehicle Day 3:** • Complete the robot plan. • Begin building the robot according to the plan/design.	**Robot Ethics Day 2:** • Complete the two-paragraph essay on robot ethics. The first paragraph should explain the ethical debate. The second paragraph should state an opinion on the issue with supporting details.	• It's a good idea to approve student topics before they invest a lot of time in research and writing about robotic ethical issues. • As students state their opinions about ethical issues related to robots, encourage them to use facts to support their opinions. • For students completing the final challenge, it might be helpful to build the challenge maze (currently set for Day 2) before they brainstorm ideas to solve the challenge (currently set for Day 1).
14	**Final Challenge – Build the Smallest Autonomous Vehicle Day 4:** • Finish building the robot according to the plan/design. • Create pseudocode for the robot.	**Robot Industry – Service:** • Use available resources to investigate different types of service robots. • Brainstorm ways to turn the Echo Robot into a service robot that performs a specific task. What new robot components would be needed? • Choose one idea from your brainstorming to carry forward.	• Students should use whatever resources are available for research. • Consider allowing students to research robots in industries of their choosing such as medical, service, assistive, exploration, agriculture, food preparation, manufacturing, military, and so on.
15	**Final Challenge – Build the Smallest Autonomous Vehicle Day 5:** • Create the program for the robot.	**Service Robot Design:** • Create a drawing of your chosen service robot idea from the previous remote learning day. • Write a detailed description of the task(s) that the Echo Robot service robot performs and how it improves the lives of humans. • Create a parts list of new parts that would be needed to create the service robot.	• Consider allowing students with CAD experience to design their robots in a CAD software.
16	**Final Challenge – Build the Smallest Autonomous Vehicle Day 6:** • Test the robot on the challenge course. • Adjust the code or design of the robot as needed.	**History of Robotics Day 1:** • Research a historical person in the field of robotics. • Write a three-paragraph biography on the chosen person and his or her contributions to the field of robotics.	• Students should use whatever resources are available for research.
17	**Final Challenge – Build the Smallest Autonomous Vehicle Day 7:** • Demonstrate your robot by competing in the challenge. • Calculate your robot's score and determine who wins. • Reflect and share on the final challenge.	**History of Robotics Day 2:** • Research a historical person in the field of robotics. • Complete a three-paragraph biography on the chosen person and his or her contributions to the field of robotics.	• Students should use whatever resources are available for research. • This is competition day for the final challenge. Promote the competition and generate excitement by giving away prizes or trophies for finishing first, second, or third. Consider videoing or livestreaming the competition so parents, other students, or other school employees can participate.

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18	**Disassembly and Cleanup:** • Disassemble the final challenge robots. • Inventory and organize sets. • Sanitize sets if needed.	**Future of Robotics:** • Investigate current trends and potential future advancements in robotics. What will robots be able to do in two, five, or 10 years from now? • Create a short video of yourself talking about the future of robotics and your opinions on how robotics will change society.	• After the competition, make sure robots are disassembled and sets are inventoried and organized. Any missing pieces should be replaced for the next group. • Follow these guidelines for sanitizing robots, sets, and workstations.
19	**Research Robots:** • What makes a machine a robot? • Do all robots have to be electronic? • Where are common places that robots are used? **Graphic Organizer:** • Complete a KWL chart on what you know (K column) and want to know (W column) about programmable robots. The what you learned (L) column will be completed later.	**TETRIX PULSE Overview and DC Motor Assembly:** • Read through the Safety, Set Components, Setup/Construction Tips, PULSE Controller Technology Overview, and PULSE Setup sections of the guide. • Complete the DC Motor Assembly according to the Setup/Construction Tips section of the guide. • **RoboBench Video:** Introducing the TETRIX PULSE Robotics Controller	• Assign a kit/robot to each student to use for the duration of the class to minimize the number of students touching the sets. • The RoboBench video mentions the *PULSE Programming Guide*. This is a free download from the Pitsco website. Although it is not needed for the activities in this guide, it might be a helpful resource.
20	**Career Connections Day 1:** • Complete the Introductory Activities on the Career Connections page at the back of the *Echo Robot Guide*. • Research a specific career related to robotics.	**Software Setup and Overview:** • Read the Software Overview section of the guide. • Install the Arduino Software (IDE), TETRIX PULSE Library, and Ardublockly software according to the Software Overview section of the guide. • **RoboBench Video:** Installing the PULSE Software	• The RoboBench video mentions the *PULSE Programming Guide*. This is a free download from the Pitsco website. Although it is not needed for the activities in this guide, it might be a helpful resource. • Resources for career research: ◦ Occupational Outlook Handbook ◦ CareerOneStop
21	**Career Connections Day 2:** • Complete Advanced Activities 1 and 2 on the Career Connections page at the back of the *Echo Robot Guide*. • Research a specific career related to robotics. • Create a poster with information about that job.	**Activity 1 – Building the Robot:** • Assemble the Echo Robot.	• Resources for career research: ◦ Occupational Outlook Handbook ◦ CareerOneStop
22	**Career Connections Day 3:** • Complete Advanced Activity 5 on the Career Connections page at the back of the *Echo Robot Guide*. • Create a presentation about a career related to robotics.	**Activity 2 – Forward, Reverse:** • Program the Echo Robot to move a specific distance.	• Resources for career research: ◦ Occupational Outlook Handbook ◦ CareerOneStop
23	**Career Presentations:** • Deliver robotics career presentations. • Display career posters.	**Challenge 1 – Go the Distance Day 1:** • Program the Echo Robot to move several different distances. • Complete the extension activities.	• Resources for career research: ◦ Occupational Outlook Handbook ◦ CareerOneStop • Encourage students to use good presentation skills and good listening skills during career presentations.

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31	**Robot Ethics Day 2:** • Complete the two-paragraph essay on robot ethics. The first paragraph should explain the ethical debate. The second paragraph should state an opinion on the issue with supporting details.	**Final Challenge – Build the Smallest Autonomous Vehicle Day 3:** • Complete the robot plan. • Begin building the robot according to the plan/design.	• It's a good idea to approve student topics before they invest a lot of time in research and writing about robotic ethical issues. • As students state their opinions about ethical issues related to robots, encourage them to use facts to support their opinions. • For students completing the final challenge, it might be helpful to build the challenge maze (currently set for Day 2) before they brainstorm ideas to solve the challenge (currently set for Day 1).
32	**Robot Industry – Service:** • Use available resources to investigate different types of service robots. • Brainstorm ways to turn the Echo Robot into a service robot that performs a specific task. What new robot components would be needed? • Choose one idea from your brainstorming to carry forward.	**Final Challenge – Build the Smallest Autonomous Vehicle Day 4:** • Finish building the robot according to the plan/design. • Create pseudocode for the robot.	• Students should use whatever resources are available for research. • Consider allowing students to research robots in industries of their choosing such as medical, service, assistive, exploration, agriculture, food preparation, manufacturing, military, and so on.
33	**Service Robot Design:** • Create a drawing of your chosen service robot idea from the previous remote learning day. • Write a detailed description of the task(s) that the Echo Robot service robot performs and how it improves the lives of humans. • Create a parts list of new parts that would be needed to create the service robot.	**Final Challenge – Build the Smallest Autonomous Vehicle Day 5:** • Create the program for the robot.	• Consider allowing students with CAD experience to design their robots in a CAD software.

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35	**History of Robotics Day 2:** • Research a historical person in the field of robotics. • Complete a three-paragraph biography on the chosen person and his or her contributions to the field of robotics.	**Final Challenge – Build the Smallest Autonomous Vehicle Day 7:** • Demonstrate your robot by competing in the challenge. • Calculate your robot's score and determine who wins. • Reflect and share on the final challenge.	• Students should use whatever resources are available for research. • This is competition day for the final challenge. Promote the competition and generate excitement by giving away prizes or trophies for finishing first, second, or third. Consider videoing or livestreaming the competition so parents, other students, or other school employees can participate.
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