Automation and Robotics at a Glance

PLTW Automation and Robotics is a nine-week, STEM unit of study. The focus of this unit is the development of automation and robotics and their use to improve daily life. Students investigate mechanical systems, motion transfer, machine automation, and computer control systems. Using the VEX® Robotics platform, students design, build, and program real-world devices, such as food dispenser, robot pet companion, and transport system.

Automation and Robotics uses the PLTW activity-, project-, and problem-based (APB) instructional design approach, which centers on hands-on, real-world activities, projects, and problems that help students understand how the knowledge and skills they develop in the classroom can be applied in everyday life. The APB approach scaffolds student learning through structured activities and projects that empower students to become independent in the classroom and help them build skill sets to apply to an open-ended, real-world problem.

This approach provides students unique opportunities to work collaboratively, identify problems, apply what they know, persevere through challenges, find unique solutions, and lead their own learning.

The student learning progression starts with basic concepts and practices in Lesson 1 and moves to more advanced concepts and practices in Lesson 2. Students learn and add more tools to their tool belts as they progress through the unit and prepare for taking on the challenge of designing and developing solutions that meet the needs of users.

The following is an overview of the lessons in the PLTW Automation and Robotics unit. The lessons scaffold the students' knowledge and skills in basic mechanisms and computer science concepts and practices.

Lesson 1: Automating Mechanisms

Students explore how gear trains and other mechanisms transfer movement in mechanical systems and design, build, and program automated systems to meet the needs of clients. In the end-of-lesson project, students can choose to design an interactive device to keep pets physically and mentally active, a spinning street sign to warn drivers to slow down and stop, or a high-speed dragster.

Activity 1.1 Welcome Interns!

Students build a simple structure to create a gear train with 3 gears, driven by a hand crank. Students are presented with two challenges where they explore how changing the input gear affects the output movements.

Activity 1.2 On the Move

Using the structure they built in the previous activity, students replace the hand crank with a motor to drive the gears and control the motor using a program in VEXcode.

Activity 1.3 Rescue Mission

Students use the motorized structure from the previous activity to build a chassis for a 4-wheel rescue vehicle prototype. They attach the VEX Brain to the vehicle to make it autonomous.

Activity 1.4 Robot Shuffle

Students add a bumper or limit switch to the four-wheel vehicle they created in the previous activity. They develop a program to make the robot move along a line and change directions based on physical inputs.

Activity 1.5 Looping Shuffles

Students add loops to their programs from the previous activity to create more elaborate dance sequences with programmed actions.

Activity 1.6 Time to Switch Gears

Students explore the relationship of the size of the gears and changes to speed and torque in a simple gear train.

Activity 1.7 It is Universal

Students build a device that includes a universal joint, a mechanism that can change the direction of motion through a range of angles while the device is being used.

Activity 1.8 Bevel Up

Students complete an instant design challenge to build a device that includes a bevel gear, a mechanism used to change the direction of motion by 90 degrees.

Project 1.9 Purposeful Design

Students apply their knowledge and skills from Lesson 1 to the end-of-lesson project. The project choices include creating a pet entertainment center for a humane shelter that is short on people volunteers, creating a spinning sign to make a dangerous crosswalk safer, or creating a robot drag racer for a fun drag race contest.

Lesson 2: Sensors and Systems

Students investigate the versatility of an optical sensor as a programmed input device. Students extend their knowledge of mechanisms as they design increasingly complex prototypes to serve the needs of users. In the

end-of-lesson project, students connect inputs to outputs through programming to create effective solutions that help their communities.

Activity 2.1 Makes Sense

Students explore an optical sensor and further their programming skills to include conditional statements within loops.

Activity 2.2 Color Coded

Students detect color as an input with an optical sensor as they continue to create more complex programs with conditional statements and loops.

Activity 2.3 Follow Me

Students build an interactive decoration that moves using a cam and follower when an optical sensor detects an object.

Activity 2.4 End of the Line

Students build a chain drive system to move cubes of a specific color from a storage location to a shipping location.

Project 2.5 Helping Hand

Students apply their knowledge and skills from Lessons 1 and 2 to the end-of-lesson project. The project choices include creating an amusement park ride that moves along a track and has an animatronic pop up when the cart is detected, creating an automated robot toy that works like a pull toy, or creating an automated animatronic design for a restaurant or store front.

Lesson 3: Create and Automate

Students design solutions using an automated mechanical system and the programming necessary for communication between the sensors, motors, and building components. Students pick their own problems or select problems that highlight their creativity and are of service to others. Throughout the unit students reflect on their growing skills and interests and explore careers in the field.

Project 3.1 Show Your Skills

Students apply their knowledge and skills from Lessons 1 and 2 to the end-of-unit problem. The problem choices include creating an automated art installation, creating automated agricultural systems for a local farm, creating an assembly line to produce a product, creating an automated animatronic set for play or movie, creating an automated system for a food pantry warehouse, or creating a solution to a problem of their own choosing.