Robotics Engineering Unit 1: Fundamentals and the Role of the Programmer

Unit Focus

Students will be introduced to the fundamentals of building and programming a robot to do specific tasks. Implementing the Engineering Design Process throughout the course students will work respectfully and responsibly with others in exchanging and evaluating ideas in building and programming a robots performance. Utilizing engineering notebooks as a tool, students will also be expected to document and analyze their performance throughout the process to evaluate progress in determining their next step. A PBA will have students develop an autonomous program for their robot to perform a "Programming" challenge for the current VEX EDR game.

Stage 1: Desired Results - Key Understandings

Standard(s)

Connecticut Goals and Standards
Pre-Engineering Technology: 12

- Describe and utilize the steps in the design process. (ENG.02.01)
- Describe the process for researching known, relevant information, constraints and limitations. (ENG.02.03)
- Brainstorm possible solutions. (ENG.02.05)
- Analyze and research between alternate solutions. (ENG.02.06)
- Develop details of a solution. (ENG.02.07)
- Build a prototype from plans. (ENG.02.08)
- Test a prototype. (ENG.02.09)
- Redesign prototypes. (ENG.02.10)
- Communicate processes and results. (ENG. 02.11)
- Describe the steps of the design process (e.g. create. evaluate. synthesis. final solution. findings. and present.) (ENG.02.12)
- Read and understand design documentation and technical manuals. (ENG.05.01)
- Use all tools and equipment safely (ENG. 06.03)
- Describe and demonstrate the components of personal and group laboratory safety. (ENG. 06.05)

ITEEA - Standards for Technological Literacy
Technological Literacy: K-12

- Students will develop an understanding of the attributes of design. (8)
- Students will develop an understanding of engineering design. (9)

Transfer

Students will be able to independently use their learning to...
T1 Explore and hone techniques, skills, methods, and processes to create and innovate
T2 Work together on a common goal to meet deadlines through addressing challenges and problems along the way both individually and collectively.

Meaning

Understanding(s)

Students will understand that...
U1 An engineering notebook is a book in which an engineer will formally document, in chronological order, all of his or her work that is associated with a specific design project.
U2 The Engineering Design Process is a *circular* process: you repeat some or all of the steps of the design cycle until your design meets all of the defined specifications.
U3 Robots are complex devices made up of systems that interact, relate and connect.
U4 One important thing designers should note is that iteration does not just take place at the end of the process, it will happen during EVERY stage in the process.
U5 Debugging is a methodical process of finding and reducing the amount of defects in coding.

Essential Question(s)

Students will keep considering...
Q1 Why is it important to document all aspects of the engineering design process when developing a solution to a problem?
Q2 How do I manually control a robot to make real time adjustments? How can I build those adjustments back into the programming?
Q3 How do I use the Engineering Design Process in programming a robot to perform a specific task?
Q4 What happened when we tested the robot? How do we use that data and available resources to make the robot better over time?

Stage 1: Desired Results - Key Understandings

- Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving. (10)

NGSS/NSTA Science & Engineering Practices

NGSS Science & Engineering Practices: 9-12

- Ask questions that arise from careful observation of phenomena, or unexpected results, to clarify and/or seek additional information. (SE.9-12.1.1)
- Ask questions to clarify and refine a model, an explanation, or an engineering problem. (SE.9-12.1.4)
- Define a design problem that involves the development of a process or system with interacting components and criteria and constraints that may include social, technical and/or environmental considerations. (SE. 9-12.1.8)
- Develop a complex model that allows for manipulation and testing of a proposed process or system. (SE.9-12.2.5)
- Analyze data using tools, technologies, and/ or models (e.g., computational, mathematical) in order to make valid and reliable scientific claims or determine an optimal design solution. (SE.9-12.4.1)

CSTA: Computer Science Standards (2017-)

CSTA: 6-8

- Seek and incorporate feedback from team members and users to refine a solution that meets user needs. *2-AP-15*
- Systematically test and refine programs using a range of test cases. *2-AP-17*
- Document programs in order to make them easier to follow, test, and debug. *2-AP-19*

Madison Public Schools Profile of a Graduate

- Collective Intelligence: Working respectfully and responsibly with others, exchanging and evaluating ideas to achieve a common objective. (POG.3.1)
- Self-Awareness: Examining current performance critically to identify steps/strategies to persist. (POG.4.1)

Acquisition of Knowledge and Skill

Knowledge

Students will know...

K1 Engineering notebooks documents the following: written ideas, sketches, work session summaries, research findings and iterations.

K2 Basic components of a robot: frame, control system, manipulators and drivetrain.

K3 The VEX ARM® Cortex®-based Microcontroller coordinates the flow of all information and power on the robot. All other electronic system components (motors, sensors, etc.) interface with the microcontroller.

K4 Components of RobotC (programming platform)

K5 An autonomous program is a logical and step by step set of directions for the robot to follow after the run command has been executed.

K6 Vocabulary: Cortex microcontroller, VexNet joystick, VexNet remote control, VexNet link, autonomous program

Skill(s)

Students will be skilled at...

S1 Build a robot using plans and a system of unified parts and components.

S2 Manually control a robot to simultaneously perform functions for a given task (driver control).

S3 Do something repeatedly until a specific result is achieved (Iterative Process).

S4 Program robot to react to input from controller.

S5 Create an autonomous program to solve a specific problem/task for a robot to follow.

S6 Capture the vital details of the Engineering Design Process as an ongoing record of the project.