Madison Public Schools

# 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

### Established Goals

**Connecticut Goals and Standards**
*Pre-Engineering Technology: 12*

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

### Transfer

**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

#### Understandings

**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 Questions

**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?

| **CSTA: Computer Science Standards (2017- )**<br>*CSTA: 6-8*<br>• Seek and incorporate feedback from team members and users to refine a solution that meets user needs. *2-AP-15*<br>• Systematically test and refine programs using a range of test cases. *2-AP-17*<br>• Document programs in order to make them easier to follow, test, and debug. *2-AP-19*<br><br>**Student Growth and Development 21st Century Capacities Matrix**<br>*Collaboration/Communication*<br>• Collective Intelligence: Students will be able to work respectfully and responsibly with others, exchanging and evaluating ideas to achieve a common objective. *MM.3.1*<br>*Self-Direction*<br>• Reflection: Students will be able to analyze their performance to evaluate progress toward learning goals in order to determine next step(s). *MM.4.1* | **Acquisition of Knowledge and Skill** | |
|---|---|---|
| | **Knowledge** | **Skills** |
| | **K1** Engineering notebooks documents the following: written ideas, sketches, work session summaries, research findings and iterations.<br>**K2** Basic components of a robot: frame, control system, manipulators and drivetrain.<br>**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.<br>**K4** Components of RobotC (programming platform)<br>**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.<br>**K6** Vocabulary: Cortex microcontroller, VexNet joystick, VexNet remote control, VexNet link, autonomous program | **S1** Build a robot using plans and a system of unified parts and components.<br>**S2** Manually control a robot to simultaneously perform functions for a given task (driver control).<br>**S3** Do something repeatedly until a specific result is achieved (Iterative Process).<br>**S4** Program robot to react to input from controller.<br>**S5** Create an autonomous program to solve a specific problem/task for a robot to follow.<br>**S6** Capture the vital details of the Engineering Design Process as an ongoing record of the project. |