Madison Public Schools

Grade 7 - Introduction to Robotics Engineering

Unit Focus

Within the ***Introduction to Robotics Engineering*** course, students will develop a working knowledge of control systems and an understanding of the basic hardware and software required to navigate and manipulate a simple robot. Both block-based programming and constructing autonomous robotic systems will be employed. Students will be exposed to concepts related to structures and mechanisms, control systems, and basic logical sequencing and coding frameworks. The PBA will have students create an autonomous program for the Clawbot to perform a specific challenge.

Stage 1: Desired Results - Key Understandings

Standard(s)

Connecticut Goals and Standards
Computer Information Systems: 8

- Apply design principles to programming tasks. *CIS.6.1.I.2*
- Test, debug, and document code. *CIS.6.1.I.3*

Pre-Engineering Technology: 9

- Describe and utilize the steps in the design process. *ENG.02.01*
- Read and understand design documentation and technical manuals. *ENG.05.01*
- Actively contribute to a team project. *ENG.05.04*
- Identify characteristics of an effective design team (e.g. leadership. responsibility. respect. rapport and time management). *ENG.05.05*

CSTA: Computer Science Standards (2017-)
CSTA: 6-8

- Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals. *2-AP-12*
- Decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs. *2-AP-13*
- 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*

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

Transfer

T1 Work together on a common goal to meet deadlines through addressing challenges and problems along the way both individually and collectively.
T2 Develop a product/solution that adheres to key parameters (e.g., cost, timeline, restrictions, available resources and audience).

Meaning

Understanding(s)	Essential Question(s)
U1 Robotics Engineering involves both design and programming components. **U2** Various components, including sensors, of a robot can be altered to produce different results in movement and reaction. **U3** Failures and setbacks are an essential part of the robotics engineering process. **U4** Engineers often work cooperatively in teams to accomplish a goal. **U5** 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.	**Q1** How do the physical components of a robot interact, relate, and connect? **Q2** How can a robot be designed to perform specific tasks using a variety of sensors that acquire information about the world external to the robot? **Q3** What role do robots play in our current society and how may this change the future? **Q4** Why is it important to document all aspects of the design when developing a solution to a problem?

Stage 1: Desired Results - Key Understandings

- Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study. *3*
- Students will develop an understanding of the attributes of design. *8*
- Students will develop an understanding of engineering design. *9*
- Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving. *10*
- Students will develop the abilities to apply the design process. *11*

NGSS/NSTA Science & Engineering Practices

NGSS Science & Engineering Practices: 6-8

- Ask questions to clarify and/or refine a model, an explanation, or an engineering problem. *SE.6-8.1.4*
- Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. *SE.6-8.1.8*
- Develop and/or use a model to generate data to test ideas about phenomena in natural or designed systems, including those representing inputs and outputs, and those at unobservable scales. *SE.6-8.2.7*
- Undertake a design project, engaging in the design cycle, to construct and/or implement a solution that meets specific design criteria and constraints. *SE.6-8.6.7*
- Optimize performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and retesting. *SE.6-8.6.8*

Student Growth and Development 21st Century Capacities Matrix

Creative Thinking

- Imagining: Students will be able to conceive of a novel approach to create a text, performance, solution, application, or inquiry. *MM.2.2*

Collaboration/Communication

- 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*

Self-Direction

- Perseverance: Students will be able to identify problem(s) and use appropriate strategies to continue toward a desired goal. *MM.4.2*

Acquisition of Knowledge and Skill

Knowledge

K1 Robotics kits typically have a system to identify all their parts and uses.
K2 Tele-operated, autonomous, and hybrid as methods to control robots.
K3 Robots can have several different sensors that provide various functions to a robot's movements and purpose.
K4 An Engineering Notebook is used to document the process in solving a problem. The following questions are used to reflect and guide future work:

- What did I do?
- How did I do it?
- What were the problems I encountered?
- What are some solutions to this problem?
- What are my next steps?

Skill(s)

S1 Build a robot using plans and a system of unified parts and components.
S2 Demonstrate how to sync the remote to achieve a wireless connection between the robot's brain and the remote.
S3 Evaluate the effectiveness of the connections (motors and sensors) by running through the *Device Info* on the brain.
S4 Create an autonomous program where several systems of the robot need to be programmed all together to serve a function.
S5 Demonstrate troubleshooting in achieving a specific result by utilizing an engineering notebook. (Iterative Process)