Unit 01 - Robotics and the Engineering Design Process

Content Area: **Science**
Course(s): **Robotics A**
Time Period: **Semester 1**
Length: **8 weeks**
Status: **Published**

Standards

SCI.HS-ETS1-1	Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. Asking questions and defining problems in 9–12 builds on K–8 experiences and progresses to formulating, refining, and evaluating empirically testable questions and design problems using models and simulations. Use mathematical models and/or computer simulations to predict the effects of a design solution on systems and/or the interactions between systems. Both physical models and computers can be used in various ways to aid in the engineering design process. Computers are useful for a variety of purposes, such as running simulations to test different ways of solving a problem or to see which one is most efficient or economical; and in making a persuasive presentation to a client about how a given design will meet his or her needs.
CS.9-12.8.2.12.ED.1	Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.
CS.9-12.8.2.12.ED.2	Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.
CS.9-12.8.2.12.ED.3	Evaluate several models of the same type of product and make recommendations for a new design based on a cost benefit analysis.
CS.9-12.8.2.12.ETW.1	Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation, and maintenance of a chosen product.
TECH.9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities (e.g., 1.4.12prof.CR2b, 2.2.12.LF.8).
TECH.9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).
TECH.9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice (e.g., 1.1.12acc.C1b, 2.2.12.PF.3).
TECH.9.4.12.DC.8	Explain how increased network connectivity and computing capabilities of everyday objects allow for innovative technological approaches to climate protection.

Enduring Understandings

- A team equipped with a variety of specialized knowledge, unique backgrounds, and experience often has the most success when designing to solve problems.
- The design process is a necessary requirement for developing a solution to any engineering problem.
- A successful engineering team will document all aspects of the development of an idea, from defining a problem to testing the final product and the iterative process.
- The design process can be applied independently to parts of a problem in conjunction with the design to solve the full problem at hand.

- Cooperation between all parts of a design is required to produce a successful solution to a problem.
- A tested and reliable product with predictable outcomes is essential to instilling confidence in the success of a design.
- Computer-aided design software allows for an efficient and timely workflow, because of its flexibility with editing, ability to perform calculations, and duplication/sharing capabilities.
- Robotics and automation are critical components to the advancement of our way of life and will continue to play a role in issues presented on the world stage.

Essential Questions

1. How does incorporating real-life constraints affect the approach to the engineering process?
2. Why is making multiple prototypes crucial to the design process?
3. When is the appropriate time to begin the iterative process during the engineering design loop?
4. How is robotic operation benefiting society?
5. Why does a robot require a microprocessor to function?
6. What steps can be taken to improve robot design through controllers and sensors?
7. When is creating an assembly of a model necessary when designing a robot?

Knowledge and Skills

Knowledge:

- Robots/Robotic operation is commonly used to improve everyday aspects of our lives, including industry, research, and education.
- A robot is created through design, fabrication, electronics, and computer programming.
- Robotic design requires the application and implementation of the engineering design process.
- A microprocessor, also known as a central processing unit (CPU) is an integrated circuit responsible for regulating all electronic functions of a computer.
- A robot obtains information about its environment through the use of sensors that communicate with software running on a microprocessor.
- Communication with a robot is possible through multiple programming languages, but all require defined input and information from the user.
- Robots can be dangerous and precautions should be taken to ensure a safe environment.

Skills: SWBAT

- establish useful entries into their engineering notebook utilizing skills obtained in Introduction to Engineering.
- replicate a robot through fabrication, electronic connection, and programming.
- produce a CAD design with the intent of improving an existing robot.
- 3D print their CAD design for real-life testing.
- select a sensor that will improve the capability of their replicated robot and justify their choice.
- reflect on their design based on data obtained through testing.

- communicate the need for future iterations of their design, citing specific steps of the design process that require attention.

Transfer Goals

Throughout this unit, students will build upon the knowledge and skills acquired in previous engineering and design courses, combining them with newly learned concepts and abilities related to the engineering design process. Using this integrated understanding, students will work to identify and address flaws in an existing system. This experience will enable them to apply these skills more meaningfully to their designs and with greater competence in future units. Students will complete stages 1-4 of the engineering design process for their team's unique designs in the next unit.

Resources

Core Resource: https://sites.google.com/whrhs-stu.org/ponzio/robotics/vex-edr/unit-01

Assessments

https://docs.google.com/document/d/1wR7bQF-8AQoRrt0g4C3hKja0yjwDjC9_BiAmONWbTcI/edit?usp=sharing

Modifications

https://docs.google.com/document/d/1ODqaPP69YkcFiyG72fIT8XsUIe3K1VSG7nxuc4CpCec/edit?usp=sharing