



School District of Marshfield Course Syllabus

Course Name: Grade 8 Automation and Robotics

Length of Course: Semester

Credit: 1/2 Credit

Program Goal:

Empower learners to be college and career ready through standards-based experiences in the classroom and career-based learning experiences with business and industry partners.

Learners will engage through technology in design, building, problem-solving, repair or service, in a collaborative environment through theory and hands-on experiences.

Course Description:

This Project Lead the Way course builds on student skills and experiences while helping learners prepare for our technological world through problem-solving and teamwork. Learners will utilize VEX® Robotic Systems to design, build, and program solutions to challenging problems while exploring the development and influence of automation and robotics. Class activities will also push and inspire learners to be innovators as they create and explore mechanical systems, energy transfer, machine automation and computer control systems.

Wisconsin Standards for Technology and Engineering (TE)	
Broad-Based (BB)	
BB1: Students will analyze the core concepts of technology.	
Analyze and use technological systems BB1.a	1.a.3.m: Identify inputs, processes, outputs and, at times, feedback components for technological systems. 1.a.4.m: Explain how common energy, power and transportation systems have provisions that detect, bypass, or compensate for failures within a system.
Analyze and use tools and materials BB1.b	1.b.3.m: Students will describe how resources are the things needed to complete a task (e.g., tools, machines, materials, information, energy, people, capital, and time). 1.b.4.m: Use appropriate tools to measure and layout a piece of material (e.g., length, width, thickness, angles, circles, arcs and volume) within tolerances.
Analyze and use mechanisms BB1.c	1.c.2.m: Explain the relationship between the inputs and outputs of linear, rotary and compound motion mechanisms in terms of direction, distance, and force. 1.c.3.m: Define mechanical concepts such as force, work, power, torque, velocity, mechanical advantage, and gear ratio.
Analyze, explain, and use control systems BB1.e	1.e.3.m: Explain how control systems sense what is happening in a system, compare it to what people want to happen within the system and trigger subsystems that will make needed adjustments. 1.e.4.m: Explain how quality control is a planned process to ensure that a product, service, or system meets established criteria.
Architecture and Construction (AC)	
AC1: Students will be able to select and use architecture and construction technologies.	
Apply measurement systems in the planning and layout process used in the residential construction industry AC1.b	1.b.8.m: Demonstrate basic dimensioning skills including the use of: dimension, extension, center, and leader lines. 1.b.9.m: Demonstrate use of the Standard Measuring System to the 1/16” and the Metric Measuring System to millimeters. 1.b.10.m: Add, subtract, multiply, and divide in the Standard Measuring System to the 1/16” and the Metric Measuring System to millimeters.
Demonstrate the safe and appropriate use of hand tools common to the residential and commercial construction industry AC1.c	1.c.3.m: Demonstrate proficiency in the use of simple hand tools such as hammers, screwdrivers, handsaws, planes, sandpaper, nail sets, tin shears, framing squares, utility knives, chalk lines, etc. 1.c.4.m: Demonstrate proficiency in obtaining and storing simple hand tools.
Demonstrate the safe and appropriate use of portable power tools that are common to the residential construction industry and are appropriate to the individual student’s level	1.d.4.m: Demonstrate proficiency in the proper care of all tools used in a class or lab.

AC1.d	
Demonstrate project management procedures and processes as they occur in a construction project AC1.e	1.e.11.m: Explain the importance of positive and constructive communication skills.
Demonstrate the value and necessity of practicing occupational safety in the construction industry facility and job site AC1.f	1.f.4.m: Recognize the potential accidents and injuries that may occur in a given work environment.
Electronics (EL)	
EL3: Students will analyze and use digital electronics.	
Analyze, develop, use and apply digital electronics EL3.a	3.a.2.m: Demonstrate basic logic decision making using switches. 3.a.4.m: Interpret a flowchart based on a decision-making logic sequence and write a basic program.
EL6: Students will explain the role of microcontrollers in process control and demonstrate use.	
Program and construct a microcontroller that satisfies a need to design constraints EL6.a	6.a.2.m: Communicate using electronic circuit diagrams.
Engineering (ENG)	
ENG1: Students will analyze and demonstrate the attributes of design.	
Analyze engineering design theory ENG1.a	1.a.5.m: Design is a creative planning process that leads to useful products and systems. 1.a.6.m: There is no perfect design. 1.a.7.m: Explain how the design process has many criteria which ultimately lead to a solution. 1.a.8.m: Requirements for a design are made up of criteria and constraints.
ENG2: Students will analyze and demonstrate engineering design.	
Analyze the attributes of engineering design ENG2.a	2.a.3.m: Design involves a set of steps, which can be performed in different sequences and repeated as needed. 2.a.4.m: Examine how brainstorming is an individual or group design process step used to generate ideas to solve a problem. 2.a.5.m: Discuss the engineering design process involves defining a problem, generating ideas, selecting a solution, testing the solution(s), making the item, evaluating it, and presenting the results.
Describe and apply engineering design ENG2.b	2.b.3.m: Modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions.
ENG3: Students will demonstrate and analyze the role of troubleshooting, research and development, invention and innovation and experimentation in problem solving.	

Discuss the importance of the problem solving process ENG3.a	3.a.4.m: Explain troubleshooting is a problem-solving method used to identify the cause of a malfunction in a system.
Analyze the procedures for innovation and invention ENG3.b	3.b.3.m: Invention is a process of turning ideas and imagination into devices and systems. Innovation is the process of modifying an existing product or system to improve it. 3.b.4.m: Explain some technological problems are best solved through experimentation.
ENG4: Students will develop abilities to apply the design process.	
Research the background information of a proposed design ENG4.a	4.a.3.m: Specify criteria and constraints for the design. 4.a.4.m: Demonstrate two-dimensional and three-dimensional representations of the designed solution.
Design solutions based on gathered information ENG4.b	4.b.3.m: Apply a design process to solve problems in and beyond the laboratory-classroom.
Evaluate completed solutions and provide feedback ENG4.c	4.c.4.m: Test and evaluate the design in relation to pre-established criteria and constraints and refine as needed. 4.c.5.m: Make a product or system and document the solution.
ENG5: Students will develop the abilities to use and maintain technological products and systems.	
Use information to describe and design systems ENG5.a	5.a.4.m: Identify information provided in manuals, protocols or by experienced people to identify how things work. 5.a.5.m: Demonstrate and use tools, materials, and machines safely to create, diagnose, adjust, and repair systems.
Use tools to maintain systems ENG5.b	5.b.4.m: Operate and maintain systems in order to achieve a given purpose. 5.b.5.m: Use computers, calculators, and technology in various applications.
ENG6: Students will develop the abilities to assess the impact of products and systems.	
Collect information about products and systems ENG6.a	6.a.2.m: Design and use instruments and technology to gather data.
Interpret data from collected information to assess impacts of products and systems ENG6.b	6.b.4.m: Collect data to analyze and interpret trends in order to identify the positive and negative effects of a technology. 6.b.5.m: Identify trends and monitor potential consequences of technological development. 6.b.6.m: Interpret and evaluate the accuracy of the information obtained and determine if it is useful.
Information and Communication Technology (ICT)	
ICT1: Students will analyze, select, and use information and communication technologies.	
Analyze how communication happens, the different forms of communication and how it affects society ICT1.a	1.a.10.m: Analyze how the use of symbols, measurements and drawings promotes clear communication by providing a common language to express ideas.

Manufacturing (MNF)	
MNF1: Students will be able to select and use manufacturing technologies.	
Identify, select and safely use tools, machines, products and systems for specific tasks MNF1.a	1.a.4.m: Discuss health and safety procedures in the workplace that keep workers safe. 1.a.5.m: Use tools, materials, and machines safely to diagnose, adjust and repair systems. 1.a.6.m: Explore both customary and metric systems of measurement and conversions.
Create and communicate alternative solutions MNF1.b	1.b.3.m: Practice appropriate problem-solving approaches and critical thinking skills to on-the-job issues and tasks. 1.b.4.m: Comprehend and engage in communication methods to convey ideas, concepts and requirements to other individuals and teams.
Demonstrate cooperation with others in ways to exhibit respect for individual and cultural differences and for the attitudes and feelings of others MNF1.c	1.c.3.m: Learn how to cooperate with others in ways to exhibit respect for individual and cultural differences and for the attitudes and feelings of others. 1.c.4.m: Recognize characteristics and benefits of teamwork, leadership and citizenship in the school, community, and manufacturing settings. 1.c.5.m: Participate in the student organization SkillsUSA competitive career development events to enrich academic skills, encourage career choices and contribute to employability.
Analyze and use GMAW, GTAW, SMAW and oxy-acetylene welding MNF1.g	1.g.7.m: Discuss how robotics and automation play a role in manufacturing.
Power and Energy (PE)	
PE1: Students will be able to select and use energy and power technologies.	
Discuss, analyze and use energy systems PE1.a	1.a.6.m: Define how energy is the ability to do work. 1.a.7.m: Discuss how energy can be used to do work, using various processes. 1.a.8.m: Analyze how power is the rate at which energy is converted from one form to another or transferred from one place to another or the rate at which work is done. 1.a.9.m: Examine how power systems are used to drive and provide propulsion to other technological products and systems. 1.a.10.m: Discuss that much of the energy used in our environment is not used efficiently.
Analyze, use and discuss machine and tool use relating to energy and power systems PE1.b	1.b.5.m: Explain the machines and systems used in energy systems to do work. 1.b.6.m: Explain the emerging machine technology trends in developing power systems are needed for the future. 1.b.7.m: Follow safe procedures when using tools and equipment related to power and energy systems.
Transportation (TR)	
TR1: Students will be able to select and use transportation technologies.	

Analyze and explain how transportation vehicles and transportation vehicle systems work TR1.b	1.b.5.m: Explain that transportation vehicles are made up of subsystems, such as structural, propulsion, suspension, guidance, control, and support that must function together to make them work effectively.
Develop the skill set necessary to diagnose, problem solve and repair transportation vehicles TR1.c	1.c.5.m: Use STEM – Science, Technology, Engineering and Math to solve problems related to the transportation field. 1.c.6.m: Use simple machines to construct transportation-related devices.
Wisconsin Common Career Technical Standards (WCCTS)	
Creativity, Critical Thinking, Communication and Collaboration (4C)	
4C1: Students will think and work creatively to develop innovative solutions to problems and opportunities.	
Develop original solutions, products, and services to meet a given need 4C1.a	1.a.4.m: Analyze elements of a problem to develop creative solutions. 1.a.6.m: Describe how past experiences can inform current problem solving.
Work creatively with others to develop solutions, products, and services 4C1.b	1.b.4.m: Explain how multiple people can develop better solutions than an individual. 1.b.5.m: Explain how multiple people and perspectives can develop better ideas than an individual. 1.b.6.m: Explain how multiple people and perspectives can improve an existing product or process better than an individual.
4C2: Students will formulate and defend judgments and decisions by employing critical thinking skills.	
Develop effective resolutions for a given problem, decision or opportunity using available information 4C2.a	2.a.5.m: Analyze symptoms to identify the root cause of a problem. 2.a.6.m: Develop multiple resolutions for a given problem, decision, or opportunity. 2.a.7.m: Identify problems that became worse due to poorly thought out or poorly informed solutions. 2.a.8.m: Explain how implementation of a solution or action may affect one or more corresponding systems. 2.a.9.m: Explain how different resolutions may be appropriate under different circumstances. 2.a.10.m: Explain the process for choosing an action or making a decision.
Develop and implement a resolution for a new situation using personal knowledge and experience 4C2.b	2.b.3.m: Analyze problems to determine what past experiences might be related and relevant. 2.b.4.m: Analyze a problem to determine how it relates to existing knowledge.
4C3: Students will communicate and collaborate with others to accomplish tasks and develop solutions to problems and opportunities.	
Communicate thoughts and feelings with others using verbal and non-verbal language 4C3.a	3.a.8.m: Implement effective listening skills in resolving a situation.

Work collaboratively with others 4C3.b	3.b.4.m: Use idea generating practices as part of a group. 3.b.5.m: Describe ways to facilitate group collaboration. 3.b.6.m: Demonstrate the use of various tools to communicate effectively with an individual or a group.
Use interpersonal skills to resolve conflicts with others in an ethical manner 4C3.c	3.c.5.m: Contribute to resolving conflicts that occur within a team or group. 3.c.6.m: Explore the ethical considerations of a current or historical action or decision.
Career Development (CD)	
CD1: Students will consider, analyze, and apply an awareness of self, identity, and culture to identify skills and talents.	
Identify person strengths, aptitudes, and passions CD1.a	1.a.2.m: Assess personal strengths, aptitudes and passions related to potential future careers.
Demonstrate effective decision-making, problem solving and goal setting CD1.b	1.b.4.m: Identify long and short-term goals.
Interact effectively with others in similar and diverse teams CD1.c	1.c.7.m: Display cooperative behavior and identify personal strengths and assets in groups.
Apply a range of relevant decision-making strategies CD1.d	1.d.4.m: Apply decision-making strategies to personal and team interactions.
CD2: Students will identify the connection between educational achievement and work opportunities in order to reach personal and career goals.	
Apply academic experiences to the world of work, inter-relationships, and the community CD2.a	2.a.2.m: Describe a diverse range of opportunities available beyond high school.
Assess attitudes and skills that contribute to successful learning in school and across the life span CD2.b	2.b.5.m: Apply academic information from a variety of sources to enhance career preparedness and lifelong learning. 2.b.6.m: Research local and regional labor market and job growth information to analyze career opportunities.
CD3: Students will create and manage a flexible and responsive individualized learning plan to meet their career goals.	
Investigate the world of work in order to gain knowledge of self in order to make informed career decisions CD3.a	3.a.5.m: Demonstrate the ability to use technology to retrieve and manage career information that inspires educational achievement. 3.a.6.m: Build an ongoing awareness of personal abilities, skills, interests, and motivation and determine how these fit with chosen career pathway. 3.a.7.m: Develop an individual learning plan to enhance educational achievement and attain career goals based on a career pathway. 3.a.9.m: Use assessment results in educational planning including career awareness.

Examine and evaluate opportunities that could enhance life and career plans and articulate plans to guide decisions and actions CD3.b	3.b.2.m: Describe educational levels (e.g., work-based learning, certificate, two-year, four-year, and professional degrees) and performance skills needed to attain personal and career goals. 3.b.3.m: Demonstrate openness to exploring a wide range of occupations and career pathways.
Employ career management strategies to achieve future career success and satisfaction CD3.c	3.c.3.m: Identify work values and needs. 3.c.4.m: Define adaptability and flexibility in the world of work.
CD4: Students will identify and apply employability skills.	
Identify and demonstrate positive work behaviors and personal qualities needed to be employable CD4.a	4.a.4.m: Demonstrate flexibility and willingness to learn new knowledge and skills. 4.a.5.m: Identify positive work-qualities typically desired in each of the career cluster's pathways.
Demonstrate skills related to seeking and applying for employment to find and obtain a desired job CD4.b	4.b.3.m: Use technology to assist in career exploration and job-seeking activities. 4.b.4.m: Compare and contrast personal attributes with employment needs and trends.
Identify and exhibit traits for retaining employment CD4.c	4.c.3.m: Distinguish between appropriate behaviors in a social vs. professional setting.
Develop positive relationships with others CD4.d	4.d.4.m: Use cooperative behavior in helping peers accomplish goals and tasks.

Key Vocabulary:			
Design/Problem Solving Process	Open/Closed Loop Systems	Programming	Automated Systems
Mechanisms	Troubleshooting	Experimentation	Constraint
Criteria	Invention	Innovation	Binary
Analog	Digital	3D Modeling	Re-design
Cortex	Sensors	LED	Gear Ratio
Input/output	Drive/Driven	Reciprocating	Rotary
Linear			

Topics/Content Outline- Units and Themes:

Quarter 1:

- **Applied Design Process**
 - Designers Notebook
 - Measurement
 - 3D Modeling
 - Orthographic Drawing
 - Design Solution Testing
- **What is Automation and Robotics**
 - Understanding Robotic Systems
 - Robotic Research Presentation
 - Algorithms

Quarter 2:

- **Mechanical Systems**
 - Mechanism Research
 - Observing Mechanisms
 - Gear Ratios
 - Types of Motion
 - Designing and Problem-Solving Mechanical Systems
- **Automated Systems**
 - Programming
 - Robot Sensing and Control Demonstration
 - Robot Behaviors and Writing Pseudocode
 - Automation through Programming
 - Mechanical and Automated Design Final Project

Primary Resource(s):

Autodesk Inventor Software

Project Lead the Way Curriculum

RobotC – Programming Language for Robotics