WGSD Curriculum
Industrial Technology Department

Course: Introduction to Robotics
Grade Level: 9-12
LG 1 The Nature of Technology

<table>
<tr><td colspan="2">High Priority Standards

International Technology Education Association http://www.iteaconnect.org/TAA/PDFs/xstnd.pdf
Standards for Technological Literacy : The Nature of Technology
Standard 1. Students will develop an understanding of the characteristics and scope of technology.
Standard 2. Students will develop an understanding of the core concepts of technology.
Standard 3. Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.</td></tr>
<tr><td>Learning Goal

Students will understand the role of technology in our society.</td><td>Proficiency Scale

Level 4: Student demonstrates an in-depth inference or advanced application or innovates with the learning goal.

Level 3: Student demonstrates mastery with the learning goal as evidenced by:
• Utilizing science in solving real problems.
• Utilizing technology in solving real problems.
• Utilizing mathematics in solving real problems.
• Applying types and properties of technological systems, such as open loop and closed loop.
• Comparing and identifying the relationships between technology, STEAM, and other disciplines.

Level 2: Student demonstrates he/she is nearing proficiency by:
• Recognizing and recalling specific vocabulary, such as: voltage, resistance, energy, science, technology, electronics, arts, mathematics.</td></tr>
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	• Performing processes such as:
	  o Describing the role of technology in solving problems.
	  o Identifying factors that affect the development of technology.
	  o Recognizing the relationships between technology and other fields.
	
	Level 1: Student demonstrates a limited understanding or skill with the learning goal.

Learning Targets

The student knows how to:

- Solve real problem, such as:
  - Recognize and analyze alternative explanations and models.
  - Identify a problem.
  - Implement a solution.
  - Conduct systematic observation.
- Use technology to solve real problems, such as:
  - Construct models.
  - Evaluate technological design.
  - Use mechanisms – gears.
  - Use mechanisms - axles/wheels.
  - Program in Robot C for LEGO MINDSTORMS software.
- Use mathematics to solve real problems, such as:
  - Apply angles, ratios, and proportion to predict and robotic movement.
  - Informally and formally measure distance, time, speed, and work.
  - Utilize measurement of light sensors and threshold to demonstrate inequalities.
  - Utilize Boolean logic to program robots.
- Utilize mathematical knowledge through problem solving:
  - Solve problems that arise in mathematics and other contexts.
  - Apply and adapt a variety of appropriate strategies to solve problems.
  - Monitor and reflect on the process of problem solving.

- Analyze types and properties (e.g., open loop, closed loop) of technological systems.
- Analyze the relationship between technology, STEAM, and other disciplines.
- Examine robotic technology that is built upon a series of behaviors that can be measured mathematically and are understandable and predictable.
- Examine both robotics systems as a whole and as identifiable subsystems:
    - Navigation systems (e.g. sensor tells the robot where it is, programmable controller tells the robot how to interpret this information, motors move in order to achieve the desired result).
    - Sensing systems (electrical, mechanical, and programming elements of a sensor).
    - Power & transmission systems (motor, axle, gear, wheel).
    - Manipulator systems.
    - Lifting systems, vision systems, etc.
- Utilize robots to:
    - Apply systems concepts to make sensors, actuators, and other components work together.
    - Design processes take into account goals resources, and trade-off factors to achieve optimal results.
    - Apply technology exists in proper context alongside applications in science, math, and engineering.
    - Utilize several different technologies (e.g. desktop computer, USB/Bluetooth peripheral interface.
- Design mobile robotics controllers, electromechanical sensors and actuators) that are routinely used together in the operation of the MINDSTORMS robot system, and are necessary for it to work.

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LG 2 Understanding of Design

High Priority Standards

International Technology Education Association ***http://www.iteaconnect.org/TAA/PDsF/xstnd.pdf***
Standards for Technological Literacy : Understanding of Design
Standard 8. Students will develop an understanding of the attributes of design.
Standard 9. Students will develop an understanding of engineering design.
Standard 10. Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.

Standards for Technological Literacy : Abilities for a Technological World
Standard 11. Students will develop abilities to apply the design process.

Learning Goal	Proficiency Scale
Students will be able to apply engineering concepts to problem-solving.	Level 4: Student demonstrates an in-depth inference or advanced application or innovates with the learning goal. Level 3: Student demonstrates mastery with the learning goal as evidenced by: • Developing a strategy for envisioning and building a robot. • Building a robotic prototype. • Writing pseudo-code for the robot using Robot C. • Running trial runs with the robot. • Modifying the design or the programming as indicated by the trial runs. • Applying concepts associated with research and development, invention and innovation, and experimentation.

	• Applying characteristics of the iterative design process to solve problems. • Applying strategies for to integrate science, mathematics, and technology to solve engineering design problems. Level 2: Student demonstrates he/she is nearing proficiency by: • Recognizing and recalling specific vocabulary, such as: abutment, activation, amplitude, analysis, angle, assembly, automation, axis, balance, bearing, blueprint, calculation, cantilever, combustion, component, compress, constriction, construction, control, conversion, conveyance, cooling, coupling, crank, current, degree, diagram, electrical, element, energy, engine, excavation, expert, fabrication, flexible, flow, fluid, force, frame, fuel, fulcrum, gimbals, hoist, horizontal, hydraulic, instrument, intersection, joint, lift, load, machine, mechanize, motion, object, operation, physics, plumb, pneumatic, precision, process, production, project, propulsion, pulley, radiate, ream, refine, regulation, retrofit, rotation, scheme, schooling, scientific, sequence, shape, slide, stability, strength, structure, superstructure, suspension, technology, tools, transform, transmission, transmit, turbine, vacuum, valve, vertical, vibration, weight, weld, withstand • Performing processes such as: o Demonstrating a basic understanding of the process of prototyping, writing pseudo code, trial and error, and receiving feedback. o Formulating an engineering goal. o Identifying robotic construction techniques and parts. o Identify steps in revision of a project. o Reflecting on feedback and results. Level 1: Student demonstrates a limited understanding or skill with the learning goal.

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Learning Targets

The student knows how to:

- Envision what the robot will be like and what it will do.
- Build a prototype.
- Write a program for the prototype using “pseudo-code”.
- Run trials of the robot to see if it will do what it has been designed for-(Prototyping Round 2).
- Design modifications and/or program modifications.
- Receive feedback and reflect on feedback.
- Apply concepts associated with research and development, invention and innovation, and experimentation.
- Identify steps in the iterative design process.
- Apply characteristics of the iterative design process to solve problems.
- Apply strategies to integrate science, mathematics, and technology to solve engineering design problems.

Learning Design

Students will self-select an engineering problem with instructor approval.

- Students will work in pairs to identify and design a physical computer to interact with the real world and attempt to overcome the problem.
- Students will create a PERT chart before construction of the robot.
- Students will maintain an engineering journal throughout the project.
- Student is able to demonstrate understanding of Robot C code syntax and structure.
- Students can demonstrate and define usage of C-based source code editor (an industry standard C-programming language); software debugger tools allowing the user to see the real time states of all motors and sensor, demonstrate both autonomous and user control of robots. Differentiation can be achieved via basic and expert modes targeting both novice and advanced students.
- Student is able to successful and precisely controls movement of the robot through a minimum of two motors and Robot C programing instructions.

Student is able to control movement of the robot through a minimum of two motors and Robot C programing instructions.

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LG 3 Abilities for a Technological World

<table>
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International Technology Education Association http://www.iteaconnect.org/TAA/PDF/xstnd.pdf
Standards for Technological Literacy: Abilities for a technological world.

12. Using and maintaining technological products and systems.
13. Assessing the impact of products and systems.</td></tr>
<tr><td>Learning Goal

Students will be able choose, use, and maintain advanced technological tools at school and in the workplace.</td><td>Proficiency Scale

Level 4: Student demonstrates an in-depth inference or advanced application or innovates with the learning goal.

Level 3: Student demonstrates mastery with the learning goal as evidenced by:
• Developing and applying an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.
• Utilizing programming software to demonstrate robotic movement.
• Applying programming software functions functions, such as interacting with robotic microcontrollers, producing data graphs, connecting peripheral interfaces, and connecting electromechanical systems and actuators.

Level 2: Student demonstrates he/she is nearing proficiency by:
• Recognizing and recalling specific vocabulary, such as: Robot C software, behaviors, Boolean Logic, display text, encoder, flowcharts & pseudo code, functions, global variables, if-else statement, bluetooth adapter, joystick controller, motor synchronization, pid speed control, random numbers, reserved words, running a</td></tr>
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	program, sense-plan-act, switch-case statement, TETRIX Servos, thresholds, timers, variables and data types, while loops, and whitespace.
	• Performing processes such as:
	  o Selecting and using the appropriate tool for a given purpose.
	  o Applying procedure to maintain technological systems.
	  o Correctly and safely operating tools and machines.
	  o Using robotic sensing functions and interacting with the environment using various advanced sensors.
	  o Identifying mathematical and computer science concepts to solve real world engineering problems.
	
	Level 1: Student demonstrates a limited understanding or skill with the learning goal.

Learning Targets

The student knows how to:

- Demonstrate knowledge of the correct and safe operation of tools and machines.
- Select an appropriate tool or machine for a given purpose.
- Demonstrate knowledge of measurement units and instruments.
- Apply principles of troubleshooting to ensure safe and proper operation of technological systems.
- Demonstrate knowledge of procedures for maintaining technological systems.
- Demonstrate knowledge of federal and state health and safety regulations and agencies (e.g., OSHA, EPA, DNR).
- Move the robot forward.
- Program a proportional-integral-derivative (PID) controller as a feedback mechanism.
- Program various levels of Motor Power.
- Use encoders to converts information from one format to another, for the purposes of standardization, speed, and accuracy.
- Demonstrate robotic sensing and interaction with the environment utilizing various sensors like Touch, Sound, Ultrasonic, Light Sensor, and color sensors.

- Demonstrate robotic sensing and interacting with the environment utilizing various advanced sensors like: angle, acceleration, tilt, barometric, electro Optical Proximity Detector (EOPD), Gyro, force, and compass.
- Use mathematical and computer science concepts to solve real world engineering problems such as while loops , sense-plan-act algorithm automatic thresholds, values and variables, text to display, automatic calculations, automatic thresholds, variables and functions/counting, global variables, bluetooth connections, and remote control.
- Work with many important technologies as part of the operation of the Robot C system:
    - Electronic microcontrollers.
    - Desktop/laptop computer and software (Robot C Programming Software, word processor for write ups, spreadsheets for data graphs).
    - Peripheral interfaces (USB or Bluetooth wireless).
    - Electromechanical systems (touch, light, rotation, sound, ultrasonic sensors).
    - Electromechanical actuators (Interactive Servo Motors).

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LG 4 The Designed World

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International Technology Education Association http://www.iteaconnect.org/TAA/PDsF/xstnd.pdf
Standards for Technological Literacy: The Designed World.
Standard 16. Students will develop an understanding of and be able to select and use energy and power technologies.
Standard 17. Students will develop an understanding of and be able to select and use information and communication technologies.
Standard 19. Students will develop an understanding of and be able to select and use manufacturing technologies.
Standard 20. Students will develop an understanding of and be able to select and use construction technologies.</td></tr>
<tr><td>Learning Goal

Students will understand the multiple roles of technology.</td><td>Proficiency Scale

Level 4: Student demonstrates an in-depth inference or advanced application or innovates with the learning goal.

Level 3: Student demonstrates mastery with the learning goal as evidenced by:
• Analyzing careers and career development in Robotics.
• Utilizing drafting and graphic communication tools in robot design.
• Applying the principles of electronic communication and of information and communications technologies in robot design.
• Applying the principles of energy and power, and energy and power technologies in robot design.

Level 2: Student demonstrates he/she is nearing proficiency by:
• Recognizing and recalling specific vocabulary, such as: actuator, algorithm, axis, base, CAD, Cartesian topology, clam, closed loop, control, dead man switch, error, encoder, feedback control, , gripper, inductive sensors, kinematics laser,</td></tr>
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	link, optical encoder, pick and place, real-time, reliability, repeatability, robot, sensor, servo, simulation, tool, vision sensor. • Performing processes such as: o Identifying career opportunities in industry, technology, and engineering. o Applying basic drafting concepts. o Identifying concepts of electronics use to analyze series and parallel circuits and interpret schematics. Level 1: Student demonstrates a limited understanding or skill with the learning goal.

Learning Targets

The student knows how to:

- Investigate the various fields in which robotics have been used.
  - Identify career opportunities in industry, technology, and engineering.
  - Apply knowledge of sources of information about technology careers; and personal interests, education, and experience needed for careers in technology and engineering.
  - Apply knowledge of career-planning strategies and skills related to job search and job acquisition.
  - Demonstrate knowledge of career, technical, student, and professional organizations related to technology engineering.

- Utilize drafting and graphic communication tools:
  - Use drawings in graphic design and drafting (e.g., thumbnail, sometric, orthographic).
  - Use the elements (e.g., color, shape) and principles (e.g., proportion, balance, symmetry) of graphic design.
  - Apply basic drafting concepts (e.g., drafting tools, alphabet of lines).
  - Use software for Computer-aided design (CAD).
  - Use techniques such as storyboarding and image processing in the design and creation of communication products.
  - Choose from a variety of representations to best illustrate and communicate a point using many different formats of both technical and nontechnical information, across different media:
    - Graphs

- Charts
- Tables/Matrices
- Photographs
- Sketches
- Timelines
- PERT and Gantt Charts
- Multimedia presentation
- Text

- Apply the principles of electronic communication:
  - Concepts of electronics (e.g., voltage, resistance, energy) use to analyze series and parallel circuits and interpret schematics.
  - Characteristics of electromagnetic waves and analog communication system.
  - Analyze characteristics of digital circuits and digital communication system.
  - Analyze characteristics of a variety of electronic communication systems (e.g., telephone, satellite, radio, computer).

- Apply knowledge of energy and power technologies:
  - Technologies and processes for the transmission and control of power and energy.
  - Various robotic systems.
  - Concepts of work, potential energy, kinetic energy, and power.
  - Mechanical power systems and their components (e.g. Pulleys and belts, gear systems).