PUBLIC SCHOOLS OF EDISON TOWNSHIP
OFFICE OF CURRICULUM AND INSTRUCTION

ROBOTICS

Length of Course:	Full Year
Elective/Required:	Elective
Schools:	High School
Eligibility:	10-12
Credit Value:	5 Credits
Date Approved:	September 21, 2015

Table of Contents

Modifications will be made to accommodate IEP mandates for classified students.

Statement of Purpose

Robotic Systems presents an overview of robotics in practice and includes the following topics: motion planning, mobile mechanisms, sensors, control mechanisms, and programing. Students in this course will become familiar with electronic, mechanical and pneumatic systems common to robots and the techniques used to program controllers and robots. The focus in this class is on the application of course topics through the planning, development, programming, and testing of solutions to a series of design problems. Students are encouraged to participate in a state/national robotics competition as part of the course. FIRST FRC.

Course Objectives

- Understand and implement sustainable design.
- Read and interpret schematic diagrams and technical documents.
- Use appropriate terminology for electricity and electronics in context.
- Become knowledgeable about various principles and characteristics of electricity and electrical engineering.
- Analyze circuits and predict their output.
- Knowledgeable and skilled with different materials and devices and their applications in the electrical engineering field.
- Design and build circuits or system to an acceptable standard capable of producing a desired output.
- Work safely and cooperatively with other students and handle materials in a safe manner.
- Demonstrate the safe use and knowledge of meters, hand and power tools used in the electrical industry.
- Read and interpret meter readings.
- Test and evaluate the integrity of electrical and electronic components.
- Be knowledgeable about career opportunities in electrical and electrical engineering fields.
- Become aware of post-secondary programs in the electrical and electrical engineering fields.
- Increase self-esteem from success with equipment, materials and techniques, in field of electrical engineering.

Timeline

Course Outlines and Time Allocations:

Unit	Recommended Lessons
What is Robotics	5 days
Robotic Soft Skills	10 days
Programming & Robotic Sensors	20 days
Robot Componentry	17 days
Mechanical Systems	18 days
Electrical Systems	17 days
Robotic Manipulators	18 days
Pneumatic & Hydraulic Control	15 days
Robots in Actions (Work Cell)/Careers	20 days

UNIT 1: WHAT IS ROBOTICS?

Targeted Standards:

8.2.12.A.1: Design and create a technology product or system that improves the quality of life and identify trade-offs, risks, and benefits.
8.2.12.C.3: Evaluate the positive and negative impacts in design by providing a digital overview of a chosen product and suggest potential modifications to address the negative impacts.
8.2.12.B.3: Analyze the full costs, benefits, trade-offs and risks related to the use of technologies in a potential career path
8.2.12.F.1 Determine and use the appropriate application of resources in the design, development, and creation of a technological product or system.
9.4.12.B.(1).2 Employ appropriate representational media to communicate concepts and design.
9.4.12.B.54 Apply ethical reasoning to a variety of situations in order to make ethical decisions

Unit Objectives/Conceptual Understandings: What is a robot, and how do their Benefits and limitations affect humans' capacity for technological change?

Essential Questions:

- Why are robots used?
- How have robots changed over time?
- How has public perception of robots changed over time?
- What are the limitations of using robots?
- In what ways can/will robots replace human abilities/capabilities?
- What are the safety considerations related to working with robots?

Unit Assessment:

Formative Assessment:

Preparation of a Robot profile display board that includes why it is a robot, features, human capabilities, history, public perception, influences, limitation, and etc.
Students will identify the primary purpose/function on a series of robots.
Compare/Contrast robot functions of teacher provide examples.
Student discussion about robots in the 1930s, 1950s, 1970s, 1990s, and present (teacher prepared video clips of robots of each era).
Students will complete safety worksheets.
Students will identify Asimov's Three Laws of Robotics (Exit Ticket)
Describe the features that make anything a robot.

Summative Assessment:

Passing safety Test for tools equipment and materials.
The Rise of Personal Robots Activity (Rubric-Based) – Designing your own robot
Robot profile display board (Rubric-Based)
Students will analyze perceptions from pre- and post survey about robots.
Pose to a variety of robots and discussion reasoning to be a robot or not. (player piano, pick and place arm, CD player)

UNIT 1: WHAT IS ROBOTICS? (CONT.)

	Core Content Objectives		Instructional Actions	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Analyze a given technological product, system, or environment to understand how the engineering design process and design specification limitations influenced the final solution. Evaluate the function, value, and appearance of technological products, systems, and environments from the perspective of the user and the producer. Develop methods for creating possible solutions, modeling and testing solutions, and modifying proposed design in the solution of a technological problem using hands-on activities Diagnose a malfunctioning product and system using appropriate critical thinking methods Create a technological product, system, or environment using given design specifications and constraints by applying design and engineering principles.	Representation in media over time. The role of humans in robotic development and operation. Categories and uses of Robots. History and Pioneers.	Present and discuss a significant milestone in the development of robotics over time.	Teacher introduces students to robotics course Pass out course syllabus Review class rules & expectations Teacher presents What is a Robot? PPT. Function/Purpose Classifications Limitations Students complete guided worksheet related to PPT presentation Teacher discusses Asimov's Three Laws of Robotics ppt. / discussion Video Clip from iRobot Movie Teacher introduces The Rise of Personal Robots Activity & Rubric Students work individually on activity and present solutions to class. Teacher shows *Robots in History* video and discusses attributes and common misconceptions with students. Students complete chalk talk activity on provided example robots. Fact or Fiction? Success and Failures Teacher introduces Pioneer Robots in History Profile Display Board & Rubric. Prominent robots are listed on the board	Explanation Students will communicate their understanding of robotics and its importance. Students will discuss the types of robots and the common perceptions. Interpretation Students will identify common features, characteristic and influences of various robots throughout history. Application Students will use skills learned in class to design a History Profile display board of a chosen robot in history. Perspectives Students will select robot that they like best and explain what features appeal to them and why. Empathy Students will assess the role robots play

UNIT 1: WHAT IS ROBOTICS? (CONT.)

	Core Content Objectives		Instructional Actions	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
			and students select on to research. Students work presented, discussed and displayed in classroom. Teacher initiates discussion on tools and design lab safety. Safety procedures are demonstrated and discussed. Student's model practice safety procedures as teacher observes. Students pass safety quizzes on tools and machines in the design lab.	throughout the world. Self-knowledge Students will recognize the complexity of robots and they can be used to solve a vast quantity of technological issues.
Resources: Carnegie Mellon Robotics Curriculum: History of Robotics http://www.education.rec.ri.cmu.edu/roboticscurriculum/curriculum/introductiontorobotics.htm VEX Curriculum: http://www.education.rec.ri.cmu.edu/roboticscurriculum/vex_online/curriculum/index.htm Carnegie Mellon Robotics Curriculum: Safety Information http://www.education.rec.ri.cmu.edu/roboticscurriculum/vex_online/safety/safety.html Wikipedia: Robotics and Robots http://en.wikipedia.org/wiki/Robot http://en.wikipedia.org/wiki/Robotics *Robot Technology Fundamentals*, J.G. Kermas *Robotics: Theory and Industrial Applications,* Ross et. al. Activity sheet, template and rubric for the Robot profile display board assignment Video/Movie clips of robots throughout history PowerPoint Slides of various robots Pre and Post Survey Safety packet with worksheets Safety Test Robot Artifacts			**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings	

UNIT 2: ROBOTICS SOFT SKILLS

Targeted Standards:

8.2.8.E.1: Work in collaboration with peers and experts in the field to develop a product using the design process, data analysis, and trends, and maintain a digital log with annotated sketches to record the development cycle.
8.2.12.F.1: Determine and use the appropriate application of resources in the design, development, and creation of a technological product or system.
8.2.12.F.3: Select and utilize resources that have been modified by digital tools (e.g., CNC equipment, CAD software) in the creation of a technological product or system.
8.2.12.B.2: Design and create a prototype for solving a global problem, documenting how the proposed design features affect the feasibility of the prototype through the use of engineering, drawing and other technical methods of illustration.
9.4.12.B.19 Employ critical thinking and interpersonal skills to resolve conflicts.
9.4.12.B.20 Identify, write, and monitor performance goals to guide progress in assigned areas of responsibility and accountability.
9.4.12.O.21 Effectively develop and apply the skills inherent in systems engineering in which requirements, configuration, integration, project management, quality assurance, and process applications are necessary.
9.4.12.O.(1).11

Unit Objectives/Conceptual Understandings: What types of attitudes and interactions are associated with the successful design of robotics in a contemporary society?

Essential Questions:

- What types of time management skills/ resources does an engineer/ designer use to manage a project?
- What types of personnel management skills/ resources does an engineer/ designer use to manage a project?
- What types of planning skills/ resources does an engineer/ designer use to manage a project?

Unit Assessment:

Formative Assessment:

Students will design a simple robot and represent all data in sample OPEN PROJECT format.
Understand and utilize both a GANTT and PERT Chart when designing and building a robot.
Learn to work in groups properly and effectively to accomplish a task.
Students will complete a worksheet on reading scale and Vernier caliper.
Students will show proper usage and measuring with a DMM on common sample electronic circuits.
Students will discuss and view sample engineers notebooks in order to stress key concepts and practices when documenting all project work throughout the course in their own engineer's notebook.

Summative Assessment:

Sample Robot Design in OPEN PROJECT (Rubric-based)
Blind Robot Construction Challenge (Rubric-based)
Sample Engineers Notebook Check (Rubric-based) (Course Long)

UNIT 2: ROBOTICS SOFT SKILLS (CONT.)

	Core Content Objectives		Instructional Actions	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Analyze a given technological product, system, or environment to understand how the engineering design process and design specification limitations influenced the final solution. Evaluate the function, value, and appearance of technological products, systems, and environments from the perspective of the user and the producer. Develop methods for creating possible solutions, modeling and testing solutions, and modifying proposed design in the solution of a technological problem using hands-on activities Diagnose a malfunctioning product and system using appropriate critical thinking methods Create a technological product, system, or environment using given design specifications and constraints by applying design and engineering principles	How engineers plan a project What is the purpose of a GANTT and PERT chart. Skills that enhance team collaboration and productivity. Personnel management skills to manage a project. Planning skills to manage a project. How to read a scale to 1/16” accuracy. How to read a DMM. How to read a Vernier caliper.	Utilize MicrosoftProject,Visio, Excel and Outlook to manage a design project (OPEN PROJECT). Work collaboratively to develop a solution to a technological problem Create a T chart of leadership skills and following directions. Utilize precision measurement tools to measure	Teacher introduces Blind Robot Construction Activity. Students devise methods of communication in order to construct a robot, using nonverbal methods of directions between team members. Teacher initiates discussion on effective teamwork skills/ collaboration and refers to experiences encountered during their previous activity. Teacher leads retracted discussion on team leader skills Students complete 10 leadership skills guide sheet. Teacher initiates discussion about engineering & planning. Students read pages 287-288 of Engineering Your Future. Teacher discusses what a GANTT & PERT chart is. Teacher demonstrates steps for utilizing OPEN PROJECT. Student completes sample Robot GANTT or PERT chart. Teacher discusses importance of measurement and demonstrates of reading a scale and Vernier caliper. Student use scales and Vernier calipers to measure sample objects (measurement activity	Explanation Students will discuss the positives of using a GANT or PERT chart when designing and building a robot. Students will discuss methods used by robotics engineers to increase/improve the creativity and quality of work. Students will be able to describe the process for using an engineer's, architect’s scale and Vernier caliper. Interpretation Students will be able to determine whether a size or measurement is within an expected or reasonable range. Application Students will utilize robotic/engineering soft skills to create a planning map for a sample robot using a GANT or PERT chart. Perspectives Students will analyze and critique GANT or PERT chart prepared by their classmates and discuss why they laid out their robot planning the way they

UNIT 2: ROBOTICS SOFT SKILLS (CONT.)

	Core Content Objectives		Instructional Actions	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
			sheet). Students take Unit quiz.	did. Self-Knowledge Students will recognize the complexity of robots and the difficulty of designing, building and programming a functional robo
Resources: Computers (one per student) Color and ink jet printer Engineers notebooks/ weekly rubric Engineers & architectural scales (one per student) Vernier calipers/ digital calipers LEGO MINDSTORMS robotics build kit (one per student) Carnegie Mellon Robotics Academy curriculum: OPEN PROJECT (Free-based software) Robot Technology Fundamentals, J.G. Kermas Sample Robot GANNT/PERT to Success Design-Brief/Rubric			**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings	

UNIT 3: PROGRAMMING AND ROBOTICS SENSORS

Targeted Standards:

8.1.12.F.2 Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and society needs.
8.2.4.A.2: Investigate factors that influence the development and function of technology products and systems.
8.2.12.F.1: Determine and use the appropriate application of resources in the design, development, and creation of a technological product or system.
8.2.12.F.3: Select and utilize resources that have been modified by digital tools (e.g., CNC equipment, CAD software) in the creation of a technological product or system.
8.2.12.G.1: Analyze the interactions among various technologies and collaborate to create a product or system demonstrating their interactivity.
9.1.12.B.2 Create and respond to a feedback loop when problem solving.
9.4.12.B.20 Identify, write, and monitor performance goals to guide progress in assigned areas of responsibility and accountability.
9.4.12.B.22 Create and implement project plans to accomplish realistic planning in design and construction situations, considering available resources and requirements of a project/problem.
9.4.12.B.33 Use computer-based equipment (containing embedded computers or processors) to control devices.
9.4.12.O.(1).9 Employ concepts and processes for the application of technology to engineering

Unit Objectives/Conceptual Understandings: How do programming language, machine code, and the actual circuit components work in concert with each other?

Essential Questions:

- What are the benefits and limitations of using “C” as a programming language to control robots?
- What strategies can be used to minimize programming problems and errors when working with robots?
- In what ways does ROBOTC resemble the written English language, in what ways is it different?
- Why are feedback systems important in the design of robots?
- How does the type of input impact the type of sensor to be used in the design of a robot?
- How can designers work towards creating increasingly intelligent systems?
- What are the limits of a robots capability with regard to the sensory data they collect?
- Why must the purpose of the robot be factored into the design/implementation of sensors?
- What types of parameters affect the effectiveness of robotic sensors?

Unit Assessment: (**What is the evidence (authentic) that students have achieved the targeted standards/unit objectives?)**

Formative assessment:

Students will design a simple robot and represent all data in sample OPEN PROJECT format.
Understand and Logic Gates and participate in quiz.
Learn to work in groups properly and effectively to accomplish a task.
Students will complete bread boarding applications involving sensory electronic components.

Summative Assessment:

Students will complete bread boarding applications involving sensory electronic components.
Students will participate in sensory robotic building design challenges- VEX and LEGO
Sample Robot Design in OPEN PROJECT (Rubric-based)

	Core Content Objectives		Instructional Actions	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Analyze a given technological product, system, or environment to understand how the engineering design process and design specification limitations influenced the final solution. Evaluate the function, value, and appearance of technological products, systems, and environments from the perspective of the user and the producer. Develop methods for creating possible solutions, modeling and testing solutions, and modifying proposed design in the solution of a technological problem using hands-on activities Diagnose a malfunctioning product and system using appropriate critical thinking methods Create a technological product, system, or environment using given design specifications and constraints by applying design and engineering principles.	The basic components involved in controlling a robot. There are a variety of languages to control robots. The basic programming commands used to control a robot. What a robotics interface is and how it works. The difference between an analog and digital system and how they are used in robots. The differences between and open and closed loop feedback system. The various types (light, touch, motion, thermal, etc.) of sensors and what their strengths and weaknesses are. Instances in which sensory parameters limit the viability of a sensors.	Connect components necessary to complete a robotic task Troubleshoot/ Debug program and components. Utilize programming and/ or machine language to control a robot. Create and read a feedback loop chart. Utilize appropriate sensors to meet design criteria. Implement robotic sensors to have robots complete basic tasks Identify and select appropriate sensors and data collection tools related to design challenges.	Teacher discusses basics of programming and shows students how and where to store and organize their work on the computers. Students will utilize Interactive web-based Carnegie Mellon Robotics Academy ROBOTC Curriculum to understand the basics of using ROBOTC Programming. Teacher will provide an overview of using the software. Fundamentals of Programming: Students will use online computer-based tools and videos to understand an introduction to ROBOTC programming language and coding. Setup of NXT Brick: Students will use online computer-based tools and videos on how to properly setup and download ROBOTC programming on to the NXT Brick. Movement – Making the Robot Move: Students will use online computer-based tools and videos on how to program a robot to have seamless motion to obtain a provided goal. Sensors: Students will use online computer-based tools and videos on how to program touch, ultrasonic, light/line	Explanation Students will be able to explain how a variety of robotic processes and tasks are completed using programming software. Students will discuss and share methods for programming sensors, servos and motors using programming software. Interpretation Students will be able to determine why certain information is and isn't included in coding and how key symbols and identifying commands change the phrasing of single or multiple lines of code. Application Students will use skills learned from ROBOTC apply programming to sensors in various scenarios. Students will utilize the design process to build and program a robot to solve the challenge of the ROBOTC Labyrinth Challenge. Perspective Students will analyze and critique programming code prepared by their classmates and discuss why their programming

Unit 3: Programming and Robotics Sensors (Cont.)

	Core Content Objectives		Instructional Actions	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
			tracking and sound sensors. Variables – Improving Movement and Sensing: Students will use online computer-based tools and videos on how to program motors to have accurate movement and gain an understanding of Boolean logic. Teacher implements daily entrance/exit ticket activities on the previously mentioned topics. Teacher monitors student progress and addresses individual needs. Students complete activity guide sheets related to sensors. Teacher introduces design brief for ROBOTC Labyrinth Challenge. Students work collaboratively in small groups to document, design, build, test and evaluate solution to design problem. Teacher guides group through documentation and time management details. Students present final designs to teacher and peers. Students take Programming Basics quiz	code is laid out the way it is. Empathy Students will recognize issues and frustrations associated with programming a robot in ROBOTC to accomplish a task(s). Self-Knowledge Students will recognize the construction of a robot determines the type and complexity of programming needed to accomplish a goal. Students will realize that using ROBOTC as a design tool requires considerable time, effort, and focus.

Unit 3: Programming and Robotics Sensors (Cont.)

Resources:	Instructional Adjustments: Modifications, student difficulties, possible misunderstandings
Computers (one per student) Color & ink jet printer ROBOTC Software (one seat license per student) Carnegie Mellon Robotics Academy ROBOTC Curriculum (LEGO MINDSTORMS and TETRIX) LEGO MINDSTORMS Building Kits (one per student) LEGO & HiTechnic Sensors: Ultra sonic, sound, light, color, touch, compass, gyro, HD color, magnetic, angle ROBOTC Exit/Entrance tickets on the following topics: Thinking about Programming & Programming Moving Forward & Speed and Direction Improved Movement Wall Detection (touch) & Wall Detection (ultrasonic) Forward until Dark (light) & Line Tracking Volume and Speed Programming basics quiz ROBOTC Labyrinth Challenge Design Brief/ Rubric	

Unit 4: Robotic Componentry

Targeted Standards:
8.2.12. A.1: Design and create a technology product or system that improves the quality of life and identify trade-offs, risks, and benefits.
8.2.12. F.2: Explain how material science impacts the quality of products.
8.2.12.C.3 Evaluate the positive and negative impacts in a design by providing a digital overview of a chosen product and address the negative impacts
8.2.12.F.3 Select and utilize resources that have been modified by digital tools in the creation of a technological product or system (CNC equipment, CAD software.
9.4.12.B.7 Demonstrate use of the concepts, strategies, and systems for obtaining and conveying ideas and information to enhance communication.
9.4.12.B.74 Read, interpret, and use technical drawings, documents, and specifications to plan a project.
9.4.12.B.75 Use and maintain appropriate tools, machinery, equipment, and resources to accomplish project goals.

Unit Objectives/Conceptual Understandings: What are the fundamental components of all robots?

Essential Questions:
- How is the form and function of a robot affected by its structural system?
- How does the purpose of a robot determine the type of power source?
- How does the purpose of a robot determine the type of actuation necessary?
- How does the purpose of a robot determine the type of locomotion necessary?
- How does the purpose of a robot determine the type of manipulators necessary?
- How does the purpose of a robot determine the type of sensors necessary?
- What processes should be incorporated to maximize the reliability of a robot??

Unit Assessment:

Formative Assessment:
Students will practice building simple chassis design to familiar themselves with the TETRIX robot building platform.
Students will setup the basic platform of motors and servos along with their controllers, power source and connectors to wire a TETRIX robot to the NXT Intelligence Brick.
Students will follow a CAD software tutorial to create a 3D model representation of a TETRIX sample robot (Tools of Design in Inventor, LEGO/TETRIX).

Summative Assessment:
TETRIX sample robot in Autodesk Inventor (Rubric-Based)

	Core Content Objectives		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Analyze a given technological product, system, or environment to understand how the engineering design process and design specification limitations influenced the final solution. Evaluate the function, value,	How the various types of actuators work and what their strengths/ weaknesses are. The various types of manipulators and what their strengths and weaknesses are.	Utilize appropriate tools, machines, processes, and materials in a safe and efficient manor to design, create, test and modify the structural system of a robot that meets design criteria.	Teacher discusses similarities and differences between LEGO and TETRIX parts and construction. Students receive TETRIX basic component building kits and building packet. Teacher demonstrates using a	Explanation Students will explain the purpose of TETRIX components when constructing the structure of a robot. Students will discuss the importance of CAD when designing

Unit 4: Robotic Componentry (Cont.)

	Core Content Objectives		Instructional Actions	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
and appearance of technological products, systems, and environments from the perspective of the user and the producer. Develop methods for creating possible solutions, modeling and testing solutions, and modifying proposed design in the solution of a technological problem using hands-on activities Diagnose a malfunctioning product and system using appropriate critical thinking methods Create a technological product, system, or environment using given design specifications and constraints by applying design and engineering principles.	The differences between and open and closed loop feedback system. The various types of sensors and what their strengths and weaknesses are. Safety rules and procedure for tools, machines, processes and materials to be used in class.	Design the power/ locomotion system of a robot that meets design criteria. Design manipulators to meet design criteria. Create and read a feedback loop chart. Utilize appropriate sensors to meet design criteria. Utilize engineering software to analyze the effectiveness and operation of all robotic components/ systems. Utilize technical drawing and Computer aided Design skills to design and model a solution to a technological problem	document camera proper procedures for fastening TETRIX components together Students use kits to construct the basic chassis as documented in building packet. Teacher provides individual instruction and guidance as needed. Teacher demonstrates using document camera proper procedures for motors and servo mounting and wiring and power setup. Teacher provides individual instruction and guidance as needed. Students will build sample TETRIX robot from building packet. Teacher instructs students on how to make their robot move. Students write program and edit changes Teacher provides guidance. Teacher discuss importance of CAD Teacher provides overview of CAD software and file storage to students. Students will follow a tutorial to better understand utilizing CAD software to create a 3D model representation of the sample robot (Tools of Design, LEGO/TEXTRIX). Students print and display CAD drawings and programmed robot.	a robot. Interpretation Students will discuss how well their robot is constructed and moves based on its structure and assembly. Application Students will construct a basic TETRIX robot chassis and program it to incorporate movement. Perspectives Students will discuss what it is like to construct a robot from a set of CAD plans. Students will discuss what it is like to work as a team to build a robot. Students will discuss what impact “time” had on their ability to construct a quality robot. Empathy Students will recognize issues and frustrations associated with building a robot from a set of CAD plans and what can be done to make things more clear. Self-knowledge Students will realize that using building a quality robot in an efficient manner requires considerable talent and organization.

Unit 5: Mechanical Systems

Targeted Standards:
8.2.12.F.1: Determine and use the appropriate application of resources in the design, development, and creation of a technological product or system.
8.2.12. A.1: Design and create a technology product or system that improves the quality of life and identify trade-offs, risks, and benefits
9.4.12.B.74 Read, interpret, and use technical drawings, documents, and specifications to plan a project.
9.4.12.B.75 Use and maintain appropriate tools, machinery, equipment, and resources to accomplish project goals.
8.2.12.G.1 Analyze the interactions among various technologies and collaborate to create a product or system demonstrating their interactivity
9.1.12.A.1 Apply critical thinking and problem-solving strategies during structured learning experiences.
9.1.12.B.2 Create and respond to a feedback loop when problem solving.

Unit Objectives/Conceptual Understandings: How does the purpose of a robot determine the type of locomotion necessary?

Essential Questions:
- How are torque, speed, and power of a motor related?
- How do gear ratios affect speed and torque
- Why must the purpose of the robot be factored into the design of the locomotion system
- How do the size, alignment, and number of wheels or tracks affect the performance of a robot?

Unit Assessment:
Formative Assessment:

Students will complete a worksheet on how to calculate gear ratios.
Students will complete and online based learning worksheet on mechanical advantage
In a class discussion, students will identify the forces act on robots.
Students will apply gear calculations when developing the powertrain for their robot design. (Operation School Delivery)
Students will submit initial design work to instructor for TETRIX Robot Challenge (Operation School Delivery) prior to obtaining materials.
Students will continue to test and analyze for the best possible solution and necessary modifications to complete the TETRIX Robot Challenge (Operation School Delivery)

Summative Assessment:

TETRIX Robot Challenge (Operation School Delivery) (Design Rubric)

	Core Content Objectives		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Analyze a given technological product, system, or environment to understand how the engineering design	What torque and power and how they factor into the design of a robot	Measure the mechanical and electrical characteristics of a motor.	Teacher initiates discussion about mechanical systems of robots and relationship to locomotion types.	Explanation Students will discuss the various mechanical systems in the construction of a

Unit 5: Mechanical Systems (Cont.)

	Core Content Objectives		Instructional Actions	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
how the engineering design process and design specification limitations influenced the final solution. Evaluate the function, value, and appearance of technological products, systems, and environments from the perspective of the user and the producer. Develop methods for creating possible solutions, modeling and testing solutions, and modifying proposed design in the solution of a technological problem using hands-on activities Diagnose a malfunctioning product and system using appropriate critical thinking methods Create a technological product, system, or environment using given design specifications and constraints by applying design and engineering principles000	There are different types of motors (DC, stepper, servo, solenoid, etc.) How the design characteristics of a motor impact the performance of a robot. What a compound gear system is The strengths and limitations of various types of electro-mechanical devices (motor, solenoid, servo, relay, motor controller, etc.) used in robots What forces act on a robot (weight, reaction, friction) What impact center of gravity has on a robot What statics is and how it affects the design of a robot What impact the mass moment of inertia What kinematics is and how position, velocity and acceleration are related	Calculate the mechanical efficiency of the power train of a robot and use that information in the design of a robot power system. Calculate static, kinematic, and dynamic forces and use this information in the design of a robot. Design and implement an appropriate power transmission system for a robot. Design, build, and program a functional robot to deliver messages across distances autonomously.	Teacher presents PPT presentation on robotic movement, types and purposes. Students discuss advantages and limitations of various techniques. Teacher initiates discussion on gears and power transmission. Students complete gear ratio problems (Gear Ratios Worksheet). Teacher demonstrates concepts of torque, HP and speed (prony brake demo) of motors and gear/pulley transmissions. Students use tools to calculate actual and theoretical and torque and speed. Teacher demonstrates TETRIX parts for mechanical movement (motors and servos). Teacher demonstrates proper motor, transmission, servo installation, alignment and maintenance. Teacher introduces design brief for TETRIX Robot Challenge (Operation School Delivery). Students will preparation of a TETRIX robot that is able navigates and delivers a package to a specified destination autonomously. Students work collaboratively in small groups to document, design, build, test and evaluate solution to design problem. Teacher guides group through documentation and time	TETRIX robot. Students will explain how gear ratios and mechanical advantage effect the design on a robot Interpretation Students will discuss how effective their mechanical systems was for their robot to accomplish the task. Application Students will design, build and program a robot to solve the mechanical tasks of the TETRIX Robot Challenge (Operation School Delivery) Perspectives Students will discuss what it's like to add gearing systems to a robot and how it affects the robots performance and programming Empathy Students will recognize the complexity of mechanical systems and their limitations in a robots design. Self-knowledge Students will realize that using mechanical systems in an efficient and effective manner requires considerable knowledge, experience

Unit 5: Mechanical Systems (Cont.)

	Core Content Objectives		Instructional Actions	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
			management details. Teacher monitors group/ individual progress and provides small-based instructions as needed. Students present final designs to teacher and peers.	and organization.
Resources: Computers (one per student) Color & Ink Jet Printer Carnegie Mellon Robotics Academy ROBOTC Curriculum (LEGO MINDSTORMS and TETRIX) Autodesk Inventor 2014 (one seat license per student) Tools for Design with LEGO MINDSTORMS NXT & TETRIX (one per student) TETRIX Building Kits (one per student) TETRIX Resources Kits (one per student) LEGO & HiTechnic Sensors: ● Ultra sonic, sound, light, color, touch, compass, gyro, HD color, magnetic, angle TETRIX Robot Challenge (Operation School Delivery) Design-Brief/ Rubric			**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings	

Unit 6: Electrical Systems

Targeted Standards:
8.2.12.F.1: Determine and use the appropriate application of resources in the design, development, and creation of a technological product or system.
8.1.12.F.2 Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and social needs.
8.2.12.G.1 Analyze the interactions among various technologies and collaborate to create a product or system demonstrating their interactivity
9.1.12.A.1 Apply critical thinking and problem-solving strategies during structured learning experiences.
9.1.12.B.2 Create and respond to a feedback loop when problem solving.
9.4.12.B.21 Conduct technical research to gather information necessary for decision-making.
9.4.12.B.22 Create and implement project plans to accomplish realistic planning in design and construction situations, considering available resources and requirements of a project/problem.
9.4.12.O.(1).6 Explain relationships among specific scientific theories, principles, and laws that apply to technology and engineering.

Unit Objectives/Conceptual Understandings: What factors influence the design of the electrical system of a robot?

Essential Questions:
- How are Ohms and Watts law applicable to the electrical design of a robot?
- Why must the purpose of the robot be factored into the design of the electrical system?
- How can analog and digital circuitry be used to add intelligence to systems?
- In what ways do electrical systems capabilities limit the abilities of the robots they are installed in

Unit Assessment:

Formative Assessment:

Measure volts, resistance and current in sample circuits.
Calculate theoretical voltage, resistance, current and power in sample circuits.
Identify fundamental components.

Summative Assessment:

Electrical Safety Quiz
Electrical Components and Calculations Quiz
Use Arduino Board and proto-board to design, test and evaluate an automated device. (SMART Pattern Stop light)

	Core Content Objectives		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Analyze a given technological product, system, or environment to understand how the engineering design process and design specification	Robots, depending upon their purpose and needs can be powered by a variety of sources including: electrical, pneumatic, hydraulic, mechanical, organic,	Measure the voltage and current of an electrical circuit Use Ohms Law and Watts Law Descripe the various types of available batteries and	Teacher introduces topic of electrical components and relationship to robotics Teacher discusses how to identify parts and test parts while working with students on an individual basis. Students construct a voltage supply module from a set of plans.	Explanation Students will discuss the Materials and processes associated with electrical systems. Students will discuss proper electrical safety procedures.

Unit 6: Electrical Systems (Cont.)

	Core Content Objectives		Instructional Actions	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
limitations influenced the final solution. Evaluate the function, value, and appearance of technological products, systems, and environments from the perspective of the user and the producer. Develop methods for creating possible solutions, modeling and testing solutions, and modifying proposed design in the solution of a technological problem using hands-on activities Diagnose a malfunctioning product and system using appropriate critical thinking methods Create a technological product, system, or environment using given design specifications and constraints by applying design and engineering principles.	and radioactive Power is a critical component of robot design How amps, volts, and power impact the design of a robot The basic components of a circuit The basic electrical schematic symbols The basic tools available/ necessary for construction of the electrical system of a robot	how they are rated Use basic tools and safe processes/ procedures to create functional electrical circuits Utilize and create an electrical schematic Use electronic systems to design a controlled autonomous device	Teacher discusses voltage supply project and components needed to construct it and techniques for constructing it. Students test voltage supply against expectations. Teacher demonstrates process and procedures for using a proto-board. Students use proto-board to replicate model circuits. Teacher leads discussion about problems and issues related to circuits. Teacher details design problems utilizing Arduino controller and proto-boards Students utilize Arduinos to program a model program. Students work in collaborative teams to build circuit and write a program to accomplish goal. Teacher leads discussion about batteries (theory, construction, classifications, maintenance, monitoring). Teacher leads discussion on safety Students complete safety packet on electrical safety Students pass test on Electrical Safety	Students will explain the purpose for the various components of electrical systems. Student will explain the basic theory of electronics and electricity. Interpretation Students will discuss how well their Arduino/ proto-board was able to create a SMART traffic pattern and involve basic memory to its logic Application Students will construct a SMART traffic light. Perspectives Students will discuss what it is like to construct an electrical robotic system for a SMART traffic light. Students will discuss what it is like to construct an electrical robotic system for a SMART traffic light. Students will discuss what impact “electrical theory” had on their ability to construct a SMART Traffic light. Empathy Students will recognize issues and frustrations associated with building an electrical circuit. Self-knowledge Students will realize that building an electrical system in an efficient manner requires

Unit 6: Electrical Systems (Cont.)

	Core Content Objectives		Instructional Actions	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
				considerable talent, organization and knowledge of electrical theory and components.
Resources: Electronic Safety Test Arduino board & USB connector cords (one per student) Arduino Software (free-based) Proto-Boards Resistors LEDs Wire Micro Servos Switches Light/ color sensors Soldering Iron Crimpers Digital Multi-Meters (one per Student) SMART Pattern Traffic Light Design-Brief/ Rubric			**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings	

Unit 7: Robotic Manipulators

Targeted Standards:
8.2.12.F.1: Determine and use the appropriate application of resources in the design, development, and creation of a technological product or system.
8.2.12. A.1: Design and create a technology product or system that improves the quality of life and identify trade-offs, risks, and benefits
9.4.12.B.74 Read, interpret, and use technical drawings, documents, and specifications to plan a project.
9.4.12.B.75 Use and maintain appropriate tools, machinery, equipment, and resources to accomplish project goals.
8.2.12.G.1 Analyze the interactions among various technologies and collaborate to create a product or system demonstrating their interactivity
9.1.12.A.1 Apply critical thinking and problem-solving strategies during structured learning experiences.
9.1.12.B.2 Create and respond to a feedback loop when problem solving.

Unit Objectives/Conceptual Understandings: How does the purpose of a robot determine the type of manipulators that will be most effective?

Essential Questions:
- Explain the reasons why Gantry, Cylindrical, Polar, and Jointed-arm manipulators are used and their limitations.
- Describe the benefits and limitations of using the various types of effectors (mechanical, vacuum, and general purpose).
- Develop a manipulator/effector system that addresses the needs of a design scenario.
- Use CAD software to model a manipulator/effector system of a robot.

Unit Assessment:
Formative Assessment:

Students will submit initial design work to instructor for FIRST Robot Challenge prior to obtaining materials.
Students will continue to test and analyze for the best possible solution and necessary modifications to complete the TETRIX Robot Challenge (IED Disposal)

Summative Assessment:

TETRIX Robot Challenge (IED Disposal) (Design Rubric)

	Core Content Objectives		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Analyze a given technological product, system, or environment to understand how the engineering design process and design specification	The purpose of manipulators and effectors. Why industrial robots require exact tolerances in their design.	Explain the reasons why Gantry, Cylindrical, Polar, and Jointed-arm manipulators are used and their limitations.	Teacher presents and discusses the classifications of manipulator PPT. Students complete a worksheet on various robots and what types Of work they do. Students describe or draw how the manipulators on the robots work.	Explanation Students will communicate their understanding of robotics and its importance. Students will discuss the types of robots and the common perceptions. Interpretation Students will identify

Unit 7: Robotic Manipulators (Cont.)

	Core Content Objectives		Instructional Actions	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
limitations influenced the final solution. Evaluate the function, value, and appearance of technological products, systems, and environments from the perspective of the user and the producer. Develop methods for creating possible solutions, modeling and testing solutions, and modifying proposed design in the solution of a technological problem using hands-on activities Diagnose a malfunctioning product and system using appropriate critical thinking methods Create a technological product, system, or environment using given design specifications and constraints by applying design and engineering principles.	The benefits and limitation of various manipulator and effector designs. Why humanoid hand simulation is such a challenge to design. What the term “degrees of freedom” means.	Describe the benefits and limitations of using the various types of effectors (mechanical, vacuum, and general purpose). Develop a manipulator/effector system that addresses the needs of a design scenario. Use CAD software to model a manipulator/effector system of a robot.	Teacher discusses variations of manipulators, degrees of freedom and control systems Teacher presents the design scenario for the role of IED detecting robots. Teacher introduces design brief for the FIRST FRC Robot Challenge Students work collaboratively in small groups to document, design, build, test and evaluate solution to design problem. Teacher guides group through documentation and time management details. Students present final designs to teacher and peers	common features, characteristic and influences of various robots throughout history. Application Students will use skills learned in class to design a History Profile display board of a chosen robot in history. Perspectives Students will select robot That they like best and Explain what features appeal to them and why. Empathy Students will assess the role robots play throughout the world. Self-knowledge Students will recognize the complexity of robots and they can be used to solve a vast quantity of technological issues.
Resources: Computers (one per student) ROBOTC Software (one seat license per student) Robotic Arms/ Manipulators PPT. Manipulators Guide sheet Sample robot manipulator arms/ basic movement activity LEGO & HiTechnic Sensors: ● Ultra sonic, sound, light, color, touch, compass, gyro, HD color, magnetic, angle FIRST FRC Robot Challenge			**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings .	

Unit 8: Pneumatic and Hydraulic Control

Targeted Standards:

8.2.12.F.1: Determine and use the appropriate application of resources in the design, development, and creation of a technological product or system.
8.1.12.F.2 Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address educational, career, personal, and social needs.
8.2.12.G.1 Analyze the interactions among various technologies and collaborate to create a product or system demonstrating their interactivity
9.1.12.A.1 Apply critical thinking and problem-solving strategies during structured learning experiences.
9.1.12.B.2 Create and respond to a feedback loop when problem solving.
9.4.12.B.21 Conduct technical research to gather information necessary for decision-making.
9.4.12.B.22 Create and implement project plans to accomplish realistic planning in design and construction situations, considering available resources and requirements of a project/problem.
9.4.12.O.(1).6 Explain relationships among specific scientific theories, principles, and laws that apply to technology and engineering

Unit Objectives/Conceptual Understandings: Why are pneumatic/hydraulic controls used in robots?

Essential Questions:

- What are the advantages and disadvantages of using pneumatic/hydraulic actuators?
- How are hydraulic/pneumatic area/pressure, speed, and power related?
- Why must the purpose of the robot be factored into the design of the pneumatics system?

Unit Assessment:

Formative Assessment:

ID pneumatic components/ schematics and explain their function (guide sheet)
Calculate sample pneumatic circuits.

Summative Assessment:

- Utilize Pneumatic Safety Quiz

	Core Content Objectives		**Instructional Actions**	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Analyze a given technological product, system, or environment to understand how the engineering design process and design specification	What components comprise a pneumatic system (air pressure generator, regulator, reservoir, solenoid, cylinder) Boyles Law and its relationship to pneumatic control	*Use calculations discussed in class to design, build, test,and evaluate a pneumatic control system.* *Safely use tools/machines and resources to design, build, test and evaluate a pneumatic system.*	Teacher leads discussion on hydraulics/pneumatic components and theory of operation. Teacher shows how to calculate pressure, volume, and speed in basic circuits. Teacher demonstrates techniques for safely working	**Demonstration of Understanding (Six facets of understanding)** Explanation Students will communicate their understanding of robotics and its importance. Students will discuss the types of robots and the

Unit 8: Pneumatic and Hydraulic Control (Cont.)

	Core Content Objectives		Instructional Actions	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
limitations influenced the final solution. Evaluate the function, value, and appearance of technological products, systems, and environments from the perspective of the user and the producer. Develop methods for creating possible solutions, modeling and testing solutions, and modifying proposed design in the solution of a technological problem using hands-on activities Diagnose a malfunctioning product and system using appropriate critical thinking methods Create a technological product, system, or environment using given design specifications and constraints by applying design and engineering principles.	The strengths and limitations of various types of air generators, control valves, solenoids, cylinders. The process and procedures for safely using pneumatic systems	*Use/program a PLC to control a basic electrical/ mechanical/ hydraulic and pneumatic system.*	with pneumatic components. Students take safety quiz on safe and proper usage of pneumatic components. Student in groups of four model pneumatic circuits and complete guide sheets Teacher demonstrates techniques for using and programming logic controller (PLC). Students in groups utilize a PLC to control a pneumatic circuit.	common perceptions. Interpretation Students will identify common features, characteristic and influences of various robots throughout history. Application Students will use skills learned in class to design a History Profile display board of a chosen robot in history. Perspectives Students will select robot that they like best and explain what features appeal to them and why. Empathy Students will assess the role robots play throughout the world. Self-knowledge Students will recognize the complexity of robots and they can be used to solve a vast quantity of technological issues.
Resources: PLC Controllers PLC Guide Sheet 8 solenoids (80 2 port valves (8) 3 port valves			**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings	

Unit 9: Robots in Action (Work Cell)/ Careers

Targeted Standards:

8.2.12.B.1: Design and create a product that maximizes conservation and sustainability of a scarce resource, using the design process and entrepreneurial skills throughout the design process.
8.2.12.B.2: Design and create a prototype for solving a global problem, documenting how the proposed design features affect the feasibility of the prototype through the use of engineering, drawing, and other technical methods of illustration.
8.2.12.B.3: Analyze the full costs, benefits, trade-offs, and risks related to the use of technologies in a potential career path.
8.2.12.C.2: Evaluate ethical considerations regarding the sustainability of resources that are used for the design, creation, and maintenance of a chosen product.
8.2.12.G.1: Analyze the interactions among various technologies and collaborate to create a product system demonstrating their interactivity.
8.2.12. A.1: Design and create a technology product or system that improves the quality of life and identify trade-offs, risks, and benefits
9.4.12.B.74 Read, interpret, and use technical drawings, documents, and specifications to plan a project.
9.4.12.B.75 Use and maintain appropriate tools, machinery, equipment, and resources to accomplish project goals.

Unit Objectives/Conceptual Understandings:

In what ways are robots anticipated to be used in the future?
What types of careers are related to robot design, programming, and maintenance?

Essential Questions:

- In what ways are all robots similar?
- What anticipated advances are expected in the areas of bio-mimicry, industrial, research, special purpose, and nanotechnology robotics?
- What types of knowledge, skills, and attitudes are essential in the design, use, programming, and maintenance of robotic systems.
- What post high school experiences/programs of study are available for students interested in further study in the field of robots?

Unit Assessment:

Formative Assessment:

Students will submit initial design work to instructor for Robotic Work Cell Challenge prior to obtaining materials.
Students will continue to test and analyze for the best possible solution and necessary modifications to complete the Robotic Work Cell Challenge.
Students will be able to generate a flow process chart and time analysis of a work cell.

Summative Assessment:

Robotic Career Exploration (Rubric-Based)
Work Cell planning sheet
Program of Work cell (Rubric)
FIRST FRCRobotic Work Cell Challenge (Design Rubric)

Unit 9: Robots in Action (Work Cell)/ Careers (Cont.)

	Core Content Objectives		Instructional Actions	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
Analyze a given technological product, system, or environment to understand how the engineering design process and design specification limitations influenced the final solution. Evaluate the function, value, and appearance of technological products, systems, and environments from the perspective of the user and the producer. Develop methods for creating possible solutions, modeling and testing solutions, and modifying proposed design in the solution of a technological problem using hands-on activities Diagnose a malfunctioning product and system using appropriate critical thinking methods Create a technological product, system, or environment using given design specifications and constraints by applying design and engineering principles.	The fundamental components of robots designed for bio-mimicry, industrial/work cell, research, specific, and nanotechnology scenarios. What mechatronics is and what types of careers are related to the field. The process used to develop an industrial/work cell robotic system. Which colleges offer programs of study in robotics.	Design an industrial work cell that demonstrates how multiple robots can be interfaced to accomplish complex tasks. Research a robotic trend and discuss the anticipated advances in that area. Utilize online resources to explore educational, trade, and experiential opportunities in the robotics field.	Teacher will initiate a discussion about the future uses of robotics and careers related to the field. Students will research a career and develop a multimedia presentation. Students will make a field visit to make connections to real-world to work cell robotics and explore educational requirements for possible future careers. Students will develop program to control work cell at NJIT. Students will test and evaluate solution. Teacher will discuss fine management and planning and the impacts on work cells. Students will perform calculations of time management. Teacher will detail final project/ Rubric Students in groups of four will complete initial stages of work cell design. Teacher will provide guidance and instruction as needed.	Explanation Students will communicate their understanding of robot-related careers. Interpretation Students will identify common features and characteristic of collegiate level robotics programs. Application Students will use skills learned in class to design, program, and test/evaluate a component of a work cell. Perspectives Students will describe their role as a robotic system designer for a component of a work cell. Empathy Students will assess the role robotic designer encounter when addressing complicated design tasks. Self-knowledge Students will recognize the complexity of robots and that they can be used in a variety of manners/situations.

Unit 9: Robots in Action (Work Cell)/ Careers (Cont.)

	Core Content Objectives		Instructional Actions	
Cumulative Progress Indicators	**Concepts** *What students will know.*	**Skills** *What students will be able to do.*	**Activities/Strategies** Technology Implementation/ Interdisciplinary Connections	**Assessment Check Points**
			Students design, build, test, evaluate and modify design. Students Digitize design portfolio	
Resources: Essential Materials, Supplementary Materials, Links to Best Practices Computers (one per student) ROBOTC Software (one seat license per student) LEGO & HiTechnic Sensors: ● Ultra sonic, sound, light, color, touch, compass, gyro, HD color, magnetic, angle FIRST FRC Miscellaneous parts ● Sprocket and chain ● Servo motors Work Cell planning worksheet FIRST FRC Robot Resources			**Instructional Adjustments:** Modifications, student difficulties, possible misunderstandings	