Wayne
Township Public Schools

Technology Education
Grades 11 - 12
Robotics III
July 23, 2018
Robert Yost

Dr. Mark Toback, Superintendent

This curriculum may be modified through varying techniques, strategies, and materials as per an individual student's Individualized Educational Plan (IEP)

Wayne School District
Curriculum Format

Content Area/ Grade Level/ Course:	**Applied Technology** **11,12** **Robotics III**
Unit Plan Title:	**Unit 1. Review and Reflection of Robotics I and II: Understanding the characteristics and fundamentals of robotics**
Time Frame	**6 Weeks**

Anchor Standards/Domain* ***i.e: ELA: reading, writing i.e.: Math: Number and Operations in Base 10**

8.2 Design Thinking This standard, previously standard 8.2 Technology Education of the 2014 NJSLS – Technology, outlines the technological design concepts and skills essential for technological and engineering literacy. The new framework design, detailed previously, includes Engineering Design, Ethics and Culture, and the Effects of Technology on the Natural world among the disciplinary concepts

9.2 Career Awareness, Exploration, Preparation and Training. This standard outlines the importance of being knowledgeable about one's interests and talents, and being well informed about postsecondary and career options, career planning, and career requirements.

Standard 9.4 Life Literacies and Key Skills. This standard outline key literacies and technical skills such as critical thinking, global and cultural awareness, and technology literacy* that are critical for students to develop to live and work in an interconnected global economy.

Anchor Companion Standards (Reading and Writing Grades 9-10)

Anchor Companion Standards (Reading and Writing Grades 11-12)

Unit Summary

Unit 1. Review and Reflection of Robotics I and II: Understanding the characteristics and fundamentals of robotics

- What is "Robotics and Control"?
- Simple and Complex Machines
- Programming and Motion
- Open ended Problem Solving- Parts Analysis, Strategy and Planning
- Trouble Shooting, Design Revision and Implementation
- Design Solutions for Assembly- The motor is connected to the chassis…

Standard Number(s)

8.2.5.ETW.1: Describe how resources such as material, energy, information, time, tools, people, and capital are used in products or systems.
8.2.5.ETW.2: Describe ways that various technologies are used to reduce improper use of resources.
8.2.5.ETW.3: Explain why human-designed systems, products, and environments need to be constantly monitored, maintained, and improved
8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.

8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modifications to increase optimization based on feedback.

8.2.12.ITH.2: Propose an innovation to meet future demands supported by an analysis of the potential costs, benefits, trade-offs, and risks related to the use of the innovation.

Essential Question(s)

- What makes a robot a robot?
- What are the positive and negative impacts of robots on society?
- How is a robot able to perform tasks?
- What is programming?
- How do programs communicate to robots?
- What is autonomous operation for robots?

Enduring Understandings

- Robots are complex devices that continue to impact society.
- Programs are organized sequences of events a robot follows.
- Robots are complex devices made up of systems.
- Robots can be controlled in a variety of ways.
- Sensors on robots react to obstacles with analog and digital signals.

In this unit plan, the following 21st Century themes and skills are addressed.

Check all that apply.
21st Century Themes

X	**Global Awareness**
	Environmental Literacy
	Health Literacy
	Civic Literacy
X	**Financial, Economic, Business, and Entrepreneurial Literacy**

*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.*
21st Century Skills

E,T,A	**Creativity and Innovation**
E,T,A	**Critical Thinking and Problem Solving**
E,T,A	**Communication**
E,T,A	**Collaboration**

Student Learning Targets/Objectives (Students will know/Students will understand)

1. 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.
2. Create a technological product, system, or environment using given design specifications and constraints by applying design and engineering principles.
3. Apply communications and data analysis to the problem-solving and decision making processes in a variety of life situations.
4. Engage in an informed discussion about rules and laws designed to promote safety and health.
5. Discussion and critique as a means of engineering development.
6. A multitude of smaller systems at work in order for a robot to operate as designed.
7. Verbally explain the process of managing a workforce to design, build, test, and operate a rolling platform robot.
8. Identify several uses for robotics in modern society, including industry, military, personal, and medical.
9. Explain how frequency crystal, antenna and transmitter are used to control a robot
10. Describe how wheel size can impact acceleration.
11. Download the default code to the robot.
12. Utilize the online code to control the robots motors using the computer.
13. Create a robot map that diagrams the values and directions for each motor.
14. Identify sensors that are used in society.

Assessments (Pre, Formative, Summative, Other)	***Denote required common assessments with an ****

Learning experiences will be design and inquiry based. Both extended task activities, as well as shorter, more focused resource tasks/practical tasks will be utilized to maximize learning. Each learning experience will reinforce the following elements for students:

A. Engineering Design Process (real-world design & problem solving)
• open-ended problems with constraints & specifications
• design, draw, build and test
• modeling and optimizing solutions

B. Team Building Skills (working on a design team)
• group dynamics
• social and leadership skills
• delegating and accepting responsibility
• 3 R's (respect, responsibility and results)

C. Technical Writing
• providing a context for written communication
• producing engineering reports
• maintaining written logs
• documenting learning in a design portfolio

D. Public Speaking
• preparing an oral presentation
• developing poise and self confidence
• improving oral communications skills

E. Design Brief
• A real life situation forms the context of the activity
• Define the problem to be solved
• Determine design criteria: specifications and constraints

F. Develop Solutions
• Form design teams/cooperative learning groups
• Investigate possible solutions
• Generate alternative solutions
• Test solutions
• Optimize solutions
• Test and evaluate final design solution

G. Assessment
• Performance of final design solution relative to constraints and specifications
• Student design portfolios containing: reports, drawings, daily logs, data and analysis
• Multimedia and oral presentation of design solution
• Standardized authentic assessment instrument

Teaching and Learning Activities	
Activities	• Lecture and class discussion. • Review past robotic in-class competitions including: Climb and deploy, robotic Lego machine challenge, engineering journals • Review and rebuild of robotic arm • "Go to the videotape" of projects
Differentiation Strategies	• Individual and collaborative research, design and problem solving • Student interest and skill level assessment (Learning Style Assessment results) • Individual, small group, and large group instruction • Media presentations and guest speakers • Student presentations and Flipped Lessons
Resources	

- http://www.state.nj.us/education/cccs/
- http://curriculum.vexrobotics.com/curriculum/intro-to-engineering/introduction
- https://sites.google.com/site/manufacturingfordummies/home/the-3-primary-manufacturing-processes
- http://www.nextgenscience.org/hsets-ed-engineering-design

Wayne School District
Curriculum Format

Content Area/ Grade Level/ Course:	**Applied Technology** **11,12** **Robotics III**
Unit Plan Title:	**Unit 2. Robotics in the Real World**
Time Frame	**6 Weeks**

Anchor Standards/Domain* ***i.e: ELA: reading, writing i.e.: Math: Number and Operations in Base 10**

8.2 Design Thinking This standard, previously standard 8.2 Technology Education of the 2014 NJSLS – Technology, outlines the technological design concepts and skills essential for technological and engineering literacy. The new framework design, detailed previously, includes Engineering Design, Ethics and Culture, and the Effects of Technology on the Natural world among the disciplinary concepts

9.2 Career Awareness, Exploration, Preparation and Training. This standard outlines the importance of being knowledgeable about one's interests and talents, and being well informed about postsecondary and career options, career planning, and career requirements.

Standard 9.4 Life Literacies and Key Skills. This standard outline key literacies and technical skills such as critical thinking, global and cultural awareness, and technology literacy* that are critical for students to develop to live and work in an interconnected global economy.

Anchor Companion Standards (Reading and Writing Grades 9-10)

Anchor Companion Standards (Reading and Writing Grades 11-12)

Unit Summary

Unit 2. Robotics in the Real World

- History and Evolution of Robotics: from Automata to Imagineering
- Historical events leading to the development of robotics
- Robots, Androids and Animatronics: In-depth
- The Role of Robotics in Today's Manufacturing
- NASA: Planet Exploration

Standard Number(s) **i.e: Math: 3.NBT.1** **i.e.: RL 8.1**

8.2.5.ETW.1: Describe how resources such as material, energy, information, time, tools, people, and capital are used in products or systems.

8.2.5.ETW.2: Describe ways that various technologies are used to reduce improper use of resources.

8.2.5.ETW.3: Explain why human-designed systems, products, and environments need to be constantly monitored, maintained, and improved

8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.

8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modifications to increase optimization based on feedback.

8.2.12.ITH.2: Propose an innovation to meet future demands supported by an analysis of the potential costs, benefits, trade-offs, and risks related to the use of the innovation.

Essential Question(s)

- How do engineers solve problems using the engineering design process?
- How is creativity and innovation used in engineering design?
- What does it look like to be safe in an engineering lab?
- How do teams efficiently and effectively solve problems in an increasingly complex world?
- What are the elements of good engineering design?

Enduring Understandings

- The engineering design process is how creative ideas are turned into inventions and innovations.
- The engineering design process is how engineers solve problems.
- Safety is everyone's responsibility.
- Communication and collaboration are essential to efficient and effective problem solving.
- Design is determined by a number of factors that include criteria, constraints and task

In this unit plan, the following 21st Century themes and skills are addressed.

Check all that apply. 21st Century Themes		*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* 21st Century Skills	
	Global Awareness	E,T, A	Creativity and Innovation
X	Environmental Literacy	E,T, A	Critical Thinking and Problem Solving
	Health Literacy	E,T, A	Communication
	Civic Literacy	E,T, A	Collaboration
X	Financial, Economic, Business, and Entrepreneurial Literacy		

Student Learning Targets/Objectives (Students will know/Students will understand)

1. Analyze a given technological product, system, or environment to understand how the engineering design process and design specification limitations influenced the final solution.
2. Evaluate the function, value, and appearance of technological products, systems, and environments from the perspective of the user and the producer.
3. 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.
4. Robotics has evolved through many centuries of invention and critical thinking.
5. The Three Laws of Robotics.
6. Discussion and critique as a means of engineering development.

7. The similarities and differences between robots and man in the production of a product.
8. Describe the process of how humans create new technology using the engineering design process.
9. Identify several uses for robotics in modern society, including industry, military, personal, and medical.
10. Identify the positive and negative impacts of robots on culture, society, industry, economics, environment and history.
11. Identify the role of society and literature in the development of robotics in pop-culture and industry.
12. Evaluate the positive and negative impacts of robots on culture, society, industry or history.

Assessments (Pre, Formative, Summative, Other) ***Denote required common assessments with an ****

A. Engineering Design Process (real-world design & problem solving)
• open-ended problems with constraints & specifications
• design, draw, build and test
• modeling and optimizing solutions
B. Team Building Skills (working on a design team)
• group dynamics
• social and leadership skills
• delegating and accepting responsibility
• 3 R's (respect, responsibility and results)
C. Technical Writing
• providing a context for written communication
• producing engineering reports
• maintaining written logs
• documenting learning in a design portfolio
D. Public Speaking
• preparing an oral presentation
• developing poise and self confidence
• improving oral communications skills
E. Design Brief
• A real life situation forms the context of the activity
• Define the problem to be solved
• Determine design criteria: specifications and constraints
F. Develop Solutions
• Form design teams/cooperative learning groups
• Investigate possible solutions
• Generate alternative solutions
• Test solutions
• Optimize solutions
• Test and evaluate final design solution
G. Assessment
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• Student design portfolios containing: reports, drawings, daily logs, data and analysis
• Multimedia and oral presentation of design solution
• Standardized authentic assessment instrument

Teaching and Learning Activities

Activities	• Machines of the ancient world • Leonardo Di Vinci machines • Robotic toy analysis • Modify a stuffed animal into an animatronic mobile toy
Differentiation Strategies	• Individual and collaborative research, design and problem solving • Student interest and skill level assessment (Learning Style Assessment results) • Individual, small group, and large group instruction • Media presentations and guest speakers • Student presentations and Flipped Lessons

Resources
• http://www.state.nj.us/education/cccs/ • http://www.corestandards.org/ELA-Literacy • http://www.state.nj.us/education/cccs/ • http://curriculum.vexrobotics.com/curriculum/intro-to-engineering/introduction • https://sites.google.com/site/manufacturingfordummies/home/the-3-primary-manufacturing-processes • https://www.wethersfield.k12.ct.us/uploaded/Board_Education/Packets/2012-2013/5d_RoboticsEng1.pdf • http://www.glenridge.org/cms/lib02/NJ01001358/Centricity/Domain/25/8th%20grade%20Robotics.pdf

Wayne School District
Curriculum Format

Content Area/ Grade Level/ Course:	**Technology Education** **11,12** **Robotics III**
Unit Plan Title:	**Unit 3. Control Systems and Component Specs**
Time Frame	**6 Weeks**

Anchor Standards/Domain* ***i.e: ELA: reading, writing i.e.: Math: Number and Operations in Base 10**

8.2 Design Thinking This standard, previously standard 8.2 Technology Education of the 2014 NJSLS – Technology, outlines the technological design concepts and skills essential for technological and engineering literacy. The new framework design, detailed previously, includes Engineering Design, Ethics and Culture, and the Effects of Technology on the Natural world among the disciplinary concepts

9.2 Career Awareness, Exploration, Preparation and Training. This standard outlines the importance of being knowledgeable about one's interests and talents, and being well informed about postsecondary and career options, career planning, and career requirements.

Standard 9.4 Life Literacies and Key Skills. This standard outline key literacies and technical skills such as critical thinking, global and cultural awareness, and technology literacy* that are critical for students to develop to live and work in an interconnected global economy.

Anchor Companion Standards (Reading and Writing Grades 9-10)

Anchor Companion Standards (Reading and Writing Grades 11-12)

Unit Summary

Unit 3. Control Systems and Component Specs

- Hands-on exploration into various languages and techniques used to program robots
- Dealing with power supplies and movement systems
- Electromechanical systems used with robotic platforms
- Study pneumatic and hydraulic power for linear movement
- Predicting component failures through destructive testing
- Robotic sensing and end-of-arm tooling

- Design and build a pick and place robotic manufacturing work cell

Standard Number(s) **i.e: Math: 3.NBT.1** **i.e.: RL 8.1**

• 8.2.5.ETW.1: Describe how resources such as material, energy, information, time, tools, people, and capital are used in products or systems.

8.2.5.ETW.2: Describe ways that various technologies are used to reduce improper use of resources.

8.2.5.ETW.3: Explain why human-designed systems, products, and environments need to be constantly monitored, maintained, and improved

8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.

8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modifications to increase optimization based on feedback.

8.2.12.ITH.2: Propose an innovation to meet future demands supported by an analysis of the potential costs, benefits, trade-offs, and risks related to the use of the innovation.

Essential Question(s)

- How do the components within each system of a robot interact, relate and connect?
- How do you troubleshoot and maintain a robot system?
- What is the best design for a robot?
- What safe practices are required in the engineering lab?
- How do the control components within a robot interact, relate and connect?
- How can robots be controlled?
- How do robots use energy?
- How do the power components within a robot interact, relate and connect?
- How is energy transformed?
- How do robots move?
- How do the drive train components within a robot interact, relate and connect?
- How does a gear ratio impact robot speed and force?
- Where does electricity come from?
- What is the relationship between magnetism and electricity?
- How do motors work?
- How do robots use electricity?
- How do the programming components of a robot interact, relate and connect?
- What is the best way of programming a robot for a given task?
- What is the value of using programming to control a robot?
- How do the sensor components of a robot interact, relate and connect?
- What is the value of using sensors on a robot?

Enduring Understandings

- Robots are complex devices made up of systems that interact, relate and connect
- Robot systems require troubleshooting and maintenance to ensure safe and proper function and precision.
- Safety is everyone's responsibility.
- Robots can be controlled in different ways.
- Energy can be converted to one form to another.
- The components of a robot drive train can be changed to produce motion, speed, torque and acceleration.
- There is a close relationship between electricity and magnetism. Electricity and magnetism are used to control motors.
- Robot design and programming is a process that must consider all the systems within a robot and the required task.

- Using sensors on a robot is a process that must consider all the systems within a robot and the required task

In this unit plan, the following 21st Century themes and skills are addressed.

Check all that apply. **21st Century Themes**		*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* **21st Century Skills**	
X	**Global Awareness**	E,T,A	**Creativity and Innovation**
	Environmental Literacy	E,T,A	**Critical Thinking and Problem Solving**
X	**Health Literacy**	E,T,A	**Communication**
	Civic Literacy	E,T,A	**Collaboration**
X	**Financial, Economic, Business, and Entrepreneurial Literacy**		

Student Learning Targets/Objectives (Students will know/Students will understand)

1. Analyze a given technological product, system, or environment to understand how the engineering design process and design specification limitations influenced the final solution.
2. 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.
3. Practice the safe use of tools and equipment.
4. Participate in a structured learning experience that demonstrates interpersonal communication, teamwork, and leadership skills.
5. Working in cross-curricular areas to solve problems.
6. A multitude of smaller systems at work in order for a robot to operate as designed.
7. Research, documentation, and communication skills needed to produce a working robot.
8. Work safely in a lab environment.
9. Build a robot test bed to test and troubleshoot the operation of robot parts before the robot is built
10. Describe the process of how a battery creates electricity.
11. Describe the process of recharging batteries.
12. Differentiate between current and voltage.
13. Determine the gear ratio of a given gear train.
14. Identify and differentiate between a driver gear, output gear, idler gear, and compound gear.
15. Differentiate between the effect of torque and speed on a gear ratio
16. Describe different methods of transferring power from the motor into motion
17. Differentiate between a standard motor and a servo motor
18. Describe how wheel size can impact acceleration.

Assessments (Pre, Formative, Summative, Other) ***Denote required common assessments with an ****

A. Engineering Design Process (real-world design & problem solving)
- open-ended problems with constraints & specifications
- design, draw, build and test
- modeling and optimizing solutions

B. Team Building Skills (working on a design team)
- group dynamics
- social and leadership skills
- delegating and accepting responsibility
- 3 R's (respect, responsibility and results)

C. Technical Writing
• providing a context for written communication
• producing engineering reports
• maintaining written logs
• documenting learning in a design portfolio
D. Public Speaking
• preparing an oral presentation
• developing poise and self confidence
• improving oral communications skills
E. Design Brief
• A real life situation forms the context of the activity
• Define the problem to be solved
• Determine design criteria: specifications and constraints
F. Develop Solutions
• Form design teams/cooperative learning groups
• Investigate possible solutions
• Generate alternative solutions
• Test solutions
• Optimize solutions
• Test and evaluate final design solution
G. Assessment
• Performance of final design solution relative to constraints and specifications
• Student design portfolios containing: reports, drawings, daily logs, data and analysis
• Multimedia and oral presentation of design solution
• Standardized authentic assessment instrument

Teaching and Learning Activities	
Activities	• Construct a large fixed-base rogot with pneumatic gripper • Use RCX/NXT/VEX/Arduino controllers to communicate to robot with programming
Differentiation Strategies	• Individual and collaborative research, design and problem solving • Student interest and skill level assessment (Learning Style Assessment results) • Individual, small group, and large group instruction • Media presentations and guest speakers • Student presentations and Flipped Lessons

Resources

- **http://www.state.nj.us/education/cccs/**
- **http://www.corestandards.org/ELA-Literacy**
- **http://www.state.nj.us/education/cccs/**
- **http://curriculum.vexrobotics.com/curriculum/intro-to-engineering/introduction**
- **https://sites.google.com/site/manufacturingfordummies/home/the-3-primary-manufacturing-processes**
- **https://www.wethersfield.k12.ct.us/uploaded/Board_Education/Packets/2012-2013/5d_RoboticsEng1.pdf**
- **http://www.glenridge.org/cms/lib02/NJ01001358/Centricity/Domain/25/8th%20grade%20Robotics.pdf**

Wayne School District
Curriculum Format

Content Area/ Grade Level/ Course:	**Applied Technology** **11,12** **Robotics III**
Unit Plan Title:	**Unit 4. Research, Design and Problem Solving for Competitions and Custom Projects**
Time Frame	**6 Weeks**

Anchor Standards/Domain* ***i.e: ELA: reading, writing i.e.: Math: Number and Operations in Base 10**

8.2 Design Thinking This standard, previously standard 8.2 Technology Education of the 2014 NJSLS – Technology, outlines the technological design concepts and skills essential for technological and engineering literacy. The new framework design, detailed previously, includes Engineering Design, Ethics and Culture, and the Effects of Technology on the Natural world among the disciplinary concepts

9.2 Career Awareness, Exploration, Preparation and Training. This standard outlines the importance of being knowledgeable about one's interests and talents, and being well informed about postsecondary and career options, career planning, and career requirements.

Standard 9.4 Life Literacies and Key Skills. This standard outline key literacies and technical skills such as critical thinking, global and cultural awareness, and technology literacy* that are critical for students to develop to live and work in an interconnected global economy.

Anchor Companion Standards (Reading and Writing Grades 9-10)

Anchor Companion Standards (Reading and Writing Grades 11-12)

Unit Summary

Unit 4. Research, Design and Problem Solving for Competitions and Custom Projects

- Timelines, Deadlines and Commitment
- Documentation Notebook
- Understanding creativity, imagination, and good knowledge base are all required in the work of engineering
- Brainstorming and choosing the best design
- CAD and 3D Modeling Software

Standard Number(s) **i.e: Math: 3.NBT.1** **i.e.: RL 8.1**

- • 8.2.5.ETW.1: Describe how resources such as material, energy, information, time, tools, people, and capital are used in products or systems.
- 8.2.5.ETW.2: Describe ways that various technologies are used to reduce improper use of resources. 8.2.5.ETW.3: Explain why human-designed systems, products, and environments need to be constantly monitored, maintained, and improved
- 8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.

- 8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modifications to increase optimization based on feedback.
- 8.2.12.ITH.2: Propose an innovation to meet future demands supported by an analysis of the potential costs, benefits, trade-offs, and risks related to the use of the innovation.

Essential Question(s)

- How to determine a competition worthy of participation within the confine of class?
- How is prior knowledge in physics, scienceand CAD important to solving technical problems in robotics?
- List the skill sets that are needed for building a competitive robot?
- What is mechatronics?
- List three major suppliers of robotic machines in the United States?
- What are some of the hidden costs associated with building competitive robots?
- How is research and investigation important to the fabrication of a working robot?
- List safety concerns dealing with the machining of aluminum on a milling machine?
- What is CNC machining?
- Explain three methods of joining two metal plates together?

Enduring Understandings

- The Engineering Process is the creative design and problem solving process, delineated by a series of steps or procedures. It is the process by which creative ideas are turned into inventions and innovations.
- The design loop is spiraling rather than linear..
- Design is determined by a number of factors including criteria, constraints, tasks and cost.
- Communication and collaboration are essential to effective problem solving and construction of a competition ready robot.
- Participation in a robotic competition adds life-long learning to the student.
- Engineers must document work and justify results to management.

In this unit plan, the following 21st Century themes and skills are addressed.

Check all that apply. 21st Century Themes		*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* 21st Century Skills	
X	Global Awareness	E,T,A	Creativity and Innovation
	Environmental Literacy	E,T,A	Critical Thinking and Problem Solving
	Health Literacy	E,T,A	Communication
X	Civic Literacy	E,T,A	Collaboration
X	Financial, Economic, Business, and Entrepreneurial Literacy		

Student Learning Targets/Objectives (Students will know/Students will understand)

1. Analyze a given technological product, system, or environment to understand how the engineering design process and design specification limitations influenced the final solution.
2. Evaluate the function, value, and appearance of technological products, systems, and environments from the perspective of the user and the producer.
3. Use a computer assisted design (CAD) system in the development of an appropriate design solution.

4. Create a technological product, system, or environment using given design specifications and constraints by applying design and engineering principles.
5. Participate in a structured learning experience that demonstrates interpersonal communication, teamwork, and leadership skills.
6. The study and application of robotics is a scientific process with calculations and processes
7. Sketching and visualization of a proposed idea.
8. Research, documentation, and communication skills needed to produce a working robot.
9. Promote our school through gracious professionalism while representing our robot to a panel of professional engineers.
10. Create a report on the use of the engineering design process, which includes: identify the problem, brainstorm a solution, select a solution, test and evaluate the solution, and make changes.
11. Communicate findings using an oral presentation, written documents, visual charts and computer based presentations.
12. Draw engineering sketches of a proposed design.
13. Collaborate with peers to solve a problem using written, verbal and online communication.
14. Utilize the steps of the engineering design process to solve a problem.
15. Define a problem, brainstorm possible solutions, draw sketches, create a model, test a model, and make changes to improve the model.
16. Identify the six subsystems of a robot system, including structure design, control, power, motion, programming, and sensors.

Assessments (Pre, Formative, Summative, Other) ***Denote required common assessments with an ****

A. Engineering Design Process (real-world design & problem solving)
• open-ended problems with constraints & specifications
• design, draw, build and test
• modeling and optimizing solutions
B. Team Building Skills (working on a design team)
• group dynamics
• social and leadership skills
• delegating and accepting responsibility
• 3 R's (respect, responsibility and results)
C. Technical Writing
• providing a context for written communication
• producing engineering reports
• maintaining written logs
• documenting learning in a design portfolio
D. Public Speaking
• preparing an oral presentation
• developing poise and self confidence
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E. Design Brief
• A real life situation forms the context of the activity
• Define the problem to be solved
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F. Develop Solutions
• Form design teams/cooperative learning groups
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• Generate alternative solutions
• Test solutions
• Optimize solutions
• Test and evaluate final design solution
G. Assessment
• Performance of final design solution relative to constraints and specifications
• Student design portfolios containing: reports, drawings, daily logs, data and analysis
• Multimedia and oral presentation of design solution

	• Standardized authentic assessment instrument	
	Teaching and Learning Activities	
	Activities	• Demonstrations of desired work • Critique of student work • Lecture/discussion
	Differentiation Strategies	• Individual and collaborative research, design and problem solving • Student interest and skill level assessment (Learning Style Assessment results) • Individual, small group, and large group instruction • Media presentations and guest speakers • Student presentations and Flipped Lessons
	Resources	
	• **http://www.state.nj.us/education/cccs/** • **http://www.corestandards.org/ELA-Literacy** • **http://www.state.nj.us/education/cccs/** • **http://curriculum.vexrobotics.com/curriculum/intro-to-engineering/introduction** • **https://sites.google.com/site/manufacturingfordummies/home/the-3-primary-manufacturing-processes** • **https://www.wethersfield.k12.ct.us/uploaded/Board_Education/Packets/2012-2013/5d_RoboticsEng1.pdf** • **http://www.glenridge.org/cms/lib02/NJ01001358/Centricity/Domain/25/8th%20grade%20Robotics.pdf**	

Wayne School District
Curriculum Format

Content Area/ Grade Level/ Course:	**Technology Education** **11-12** **Robotics III**
Unit Plan Title:	**Unit 5. Prototyping and model building**
Time Frame	**6 Weeks**

Anchor Standards/Domain* ***i.e: ELA: reading, writing i.e.: Math: Number and Operations in Base 10**

- **8.2 Design Thinking** This standard, previously standard 8.2 Technology Education of the 2014 NJSLS – Technology, outlines the technological design concepts and skills essential for technological and engineering literacy. The new framework design, detailed previously, includes Engineering Design, Ethics and Culture, and the Effects of Technology on the Natural world among the disciplinary concepts
-
- **9.2 Career Awareness, Exploration, Preparation and Training.** This standard outlines the importance of being knowledgeable about one's interests and talents, and being well informed about postsecondary and career options, career planning, and career requirements.
-
- **Standard 9.4 Life Literacies and Key Skills.** This standard outline key literacies and technical skills such as critical thinking, global and cultural awareness, and technology literacy* that are critical for students to develop to live and work in an interconnected global economy.
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- Anchor Companion Standards (Reading and Writing Grades 9-10)
- Anchor Companion Standards (Reading and Writing Grades 11-12)

Unit Summary

Unit 5. Prototyping and model building

A. Material Selection Process
   1. Three primary processes in manufacturing used to turn a raw material into an industrial materia:
      a. Chemical processes- using chemicals to change a raw material into an industrial material. Ex: Making aluminum; Polymer steel formation
      b. Thermal processes- using heat to change a raw material into an industrial material. Ex: Quenching- heating a metal and then quickly dipping it into a solution to harden the metal; Smelting- heating metallic ores and separating the impurities
      c. Mechanical processes- using physical means to change a raw material into an industrial material. Ex: Crushing- using applied force to smash rocks; shearing- using shearing forces to cut objects such as wood
   2. Six secondary manufacturing processes used to turn industrial materials into finished products:
      a. Casting and Molding- a liquid material is poured into a mold, and there the liquid hardens into the proper size and shape. Ex: Injection molding- injecting plastic material that has been melted by heat into a mold, and then cooling and solidifying them ; permanent molds- molds that are made with some type of metal to keep it together for a long period of time
      b. Forming- uses force applied from a die or roll to reshape material. Ex: Rolling; drawing
      c. Separating- uses tools to shear away unwanted material from an object. Also helps shape and size the product. Ex: Shearing; turning
      d. Conditioning- uses heat, chemicals, or mechanical forces to alter the internal structure of a material and give it new, desirable properties. Ex: Mechanical; thermal

e. Finishing- adds coats or modifies the surface of the product to protect it and make it more appealing to the customer. Ex: Spraying; flow coating.
f. Assembling- puts materials and parts together to make a finished product. Ex: Bonding; mechanical fastening

B. Extensive testing of competition robot
C. Revisions and Modifications
D. Engineering Presentation for competition
E. Robotics Competition Events Participation
F. Video review, Discussion and analysis of competition results

Standard Number(s) **i.e: Math: 3.NBT.1** **i.e.: RL 8.1**

- • 8.2.5.ETW.1: Describe how resources such as material, energy, information, time, tools, people, and capital are used in products or systems.
- 8.2.5.ETW.2: Describe ways that various technologies are used to reduce improper use of resources. 8.2.5.ETW.3: Explain why human-designed systems, products, and environments need to be constantly monitored, maintained, and improved
- 8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.
- 8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modifications to increase optimization based on feedback.
- 8.2.12.ITH.2: Propose an innovation to meet future demands supported by an analysis of the potential costs, benefits, trade-offs, and risks related to the use of the innovation.

Essential Question(s)

- What are some of the challenges of designing and building a robot?
- How is the engineering process used in designing, building and programming a robot?
- How can variables, programming statements, decision statements, loops and functions be used to navigate robot through its functions?

Enduring Understandings

- Robots are complex devices made up of systems that interact, relate and connect.
- The challenges to building a robot are time, talent, materials, costs, information and programming, equipment, and impacts caused by the creation and operation of the robot, including Asimov's 3 Laws of Robotics.
- Robot systems require troubleshooting and maintenance to ensure safe and proper function and precision.

In this unit plan, the following 21st Century themes and skills are addressed.

Check all that apply. **21st Century Themes**		*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* **21st Century Skills**	
X	**Global Awareness**	**E,T,A**	**Creativity and Innovation**
	Environmental Literacy	**E,T,A**	**Critical Thinking and Problem Solving**
	Health Literacy	**E,T,A**	**Communication**

	X	Civic Literacy	E,T,A	Collaboration
	X	Financial, Economic, Business, and Entrepreneurial Literacy		

Student Learning Targets/Objectives (Students will know/Students will understand)

1. 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.
2. Diagnose a malfunctioning product and system using appropriate critical thinking methods.
3. Apply project planning and management skills in academic and/or occupational settings.
4. Cooperative Discipline's purpose is to create a classroom where all students are Capable, Connected, and Contributing to the education process
5. The artist and creator plays a tremendous role in the transfer of conceptual ideas into a formal drawing for a robotic device
6. Sketching and visualization of a proposed idea
7. Work safely in a lab environment
8. Use Cooperative Discipline techniques to ensure all students are connected to the learning process
9. Design, build, test and modify a prototype.
10. Demonstrate safe practices in the engineering lab.
11. Build a robot test bed to test and troubleshoot the operation of robot parts before the robot is built
12. Explain proper safety procedures and possible hazards when working in a lab setting.
13. Describe the importance of stability, vulnerability, sturdiness and interaction when designing a robot.

Assessments (Pre, Formative, Summative, Other) ***Denote required common assessments with an ****

A. Engineering Design Process (real-world design & problem solving)
• open-ended problems with constraints & specifications
• design, draw, build and test
• modeling and optimizing solutions
B. Team Building Skills (working on a design team)
• group dynamics
• social and leadership skills
• delegating and accepting responsibility
• 3 R's (respect, responsibility and results)
C. Technical Writing
• providing a context for written communication
• producing engineering reports
• maintaining written logs
• documenting learning in a design portfolio
D. Public Speaking
• preparing an oral presentation
• developing poise and self confidence
• improving oral communications skills
E. Design Brief
• A real life situation forms the context of the activity
• Define the problem to be solved
• Determine design criteria: specifications and constraints
F. Develop Solutions
• Form design teams/cooperative learning groups
• Investigate possible solutions
• Generate alternative solutions
• Test solutions
• Optimize solutions
• Test and evaluate final design solution
G. Assessment
• Performance of final design solution relative to constraints and specifications

	• Student design portfolios containing: reports, drawings, daily logs, data and analysis • Multimedia and oral presentation of design solution • Standardized authentic assessment instrument
	Teaching and Learning Activities
Activities	• Lecture/discussion • Hands-on drilling and tapping activities • Tool use/safety • Choose the best materials for given design • Assembly of component pieces
Differentiation Strategies	• Individual and collaborative research, design and problem solving • Student interest and skill level assessment (Learning Style Assessment results) • Individual, small group, and large group instruction • Media presentations and guest speakers • Student presentations and Flipped Lessons
	Resources
	• **http://www.state.nj.us/education/cccs/** • **http://www.corestandards.org/ELA-Literacy** • **http://www.state.nj.us/education/cccs/** • **http://curriculum.vexrobotics.com/curriculum/intro-to-engineering/introduction** • **https://sites.google.com/site/manufacturingfordummies/home/the-3-primary-manufacturing-processes** • **https://www.wethersfield.k12.ct.us/uploaded/Board_Education/Packets/2012-2013/5d_RoboticsEng1.pdf** • **http://www.glenridge.org/cms/lib02/NJ01001358/Centricity/Domain/25/8th%20grade%20Robotics.pdf**

Wayne School District
Curriculum Format

Content Area/ Grade Level/ Course:	**Technology Education** **10,11,12** **Robotics III**
Unit Plan Title:	**Unit 6. Intro to the world of Robotic Competition**
Time Frame	**6 Weeks**

Anchor Standards/Domain* ***i.e: ELA: reading, writing i.e.: Math: Number and Operations in Base 10**

- **8.2 Design Thinking** This standard, previously standard 8.2 Technology Education of the 2014 NJSLS – Technology, outlines the technological design concepts and skills essential for technological and engineering literacy. The new framework design, detailed previously, includes Engineering Design, Ethics and Culture, and the Effects of Technology on the Natural world among the disciplinary concepts
- **9.2 Career Awareness, Exploration, Preparation and Training.** This standard outlines the importance of being knowledgeable about one's interests and talents, and being well informed about postsecondary and career options, career planning, and career requirements.
- **Standard 9.4 Life Literacies and Key Skills.** This standard outline key literacies and technical skills such as critical thinking, global and cultural awareness, and technology literacy* that are critical for students to develop to live and work in an interconnected global economy.
- Anchor Companion Standards (Reading and Writing Grades 9-10)
- Anchor Companion Standards (Reading and Writing Grades 11-12)

Unit Summary

Unit 6. Intro to the world of Robotic Competition

A. How competitions prepare engineers to design for the real world
B. Competitions: Analysis of existing competitions- a feasibility study for involvement
    1. FTC FIRST
    2. NJ Student Competitions
    3. Corporate Competitions
    4. Scholarship Competitions, etc- Analysis of existing competitions- a feasibility study for involvement
C. Career exploration in Robotics Engineering

Standard Number(s) **i.e: Math: 3.NBT.1** **i.e.: RL 8.1**

- • 8.2.5.ETW.1: Describe how resources such as material, energy, information, time, tools, people, and capital are used in products or systems.
- 8.2.5.ETW.2: Describe ways that various technologies are used to reduce improper use of resources. 8.2.5.ETW.3: Explain why human-designed systems, products, and environments need to be constantly monitored, maintained, and improved
- 8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.
- 8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modifications to increase optimization based on feedback.

- 8.2.12.ITH.2: Propose an innovation to meet future demands supported by an analysis of the potential costs, benefits, trade-offs, and risks related to the use of the innovation.
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Essential Question(s)

- What is the best way of designing a robot for a competition?
- What are the benefits of competing in a robot competition?
- How do the sensor components of a robot interact, relate and connect?
- What is the value of using sensors on a robot?

Enduring Understandings

- Robots are complex devices made up of systems that interact, relate and connect.
- Robots are used by students in competitions worldwide.
- Robot design and programming is a process that must consider all the systems with a robot and the required task.
- Robots use sensors to evaluate their surroundings and make choices.

In this unit plan, the following 21st Century themes and skills are addressed.

Check all that apply. 21st Century Themes		*Indicate whether these skills are **E**-Encouraged, **T**-Taught, or **A**-Assessed in this unit by marking **E, T, A** on the line before the appropriate skill.* 21st Century Skills	
X	Global Awareness	E,T,A	Creativity and Innovation
	Environmental Literacy	E,T,A	Critical Thinking and Problem Solving
	Health Literacy	E,T,A	Communication
X	Civic Literacy	E,T,A	Collaboration
X	Financial, Economic, Business, and Entrepreneurial Literacy		

Student Learning Targets/Objectives (Students will know/Students will understand)

1. Analyze a given technological product, system, or environment to understand how the engineering design process and design specification limitations influenced the final solution.
2. Evaluate the function, value, and appearance of technological products, systems, and environments from the perspective of the user and the producer.
3. Create a technological product, system, or environment using given design specifications and constraints by applying design and engineering principles.
4. Describe and apply constructive responses to criticism.
5. Computer software can improve a robot design.
6. Discussion and critique as a means of engineering development.
7. Research, documentation, and communication skills needed to produce a working robot.
8. Verbally explain the process of managing a workforce to design, build, test, and operate a rolling platform robot.
9. Promote our school through gracious professionalism while representing our robot to a panel of professional engineers.
10. Communicate findings using an oral presentation, written documents, visual charts and computer based presentations.
11. Design a robotics competition task that will include description, directions, rules, scoring rules, and diagram of the playing field

12. Troubleshoot and maintain a robotic system to ensure safe and proper functioning during a classroom competition.
13. Identify and describe at least three youth robot competitions.
14. Complete a Robot Competition Design Journal for the in-class robot competition that describes the steps of the design process.

Assessments (Pre, Formative, Summative, Other) ***Denote required common assessments with an ****

A. Engineering Design Process (real-world design & problem solving)
• open-ended problems with constraints & specifications
• design, draw, build and test
• modeling and optimizing solutions
B. Team Building Skills (working on a design team)
• group dynamics
• social and leadership skills
• delegating and accepting responsibility
• 3 R's (respect, responsibility and results)
C. Technical Writing
• providing a context for written communication
• producing engineering reports
• maintaining written logs
• documenting learning in a design portfolio
D. Public Speaking
• preparing an oral presentation
• developing poise and self confidence
• improving oral communications skills
E. Design Brief
• A real life situation forms the context of the activity
• Define the problem to be solved
• Determine design criteria: specifications and constraints
F. Develop Solutions
• Form design teams/cooperative learning groups
• Investigate possible solutions
• Generate alternative solutions
• Test solutions
• Optimize solutions
• Test and evaluate final design solution
G. Assessment
• Performance of final design solution relative to constraints and specifications
• Student design portfolios containing: reports, drawings, daily logs, data and analysis
• Multimedia and oral presentation of design solution
• Standardized authentic assessment instrument

Teaching and Learning Activities	
Activities	• Lecture/discussion • Review video of competition for feasibility • Design, document, and build a robot • Career exploration and college direction research project
Differentiation Strategies	• Individual and collaborative research, design and problem solving • Student interest and skill level assessment (Learning Style Assessment results) • Individual, small group, and large group instruction • Media presentations and guest speakers • Student presentations and Flipped Lessons

Resources

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- http://www.glenridge.org/cms/lib02/NJ01001358/Centricity/Domain/25/8th%20grade%20Robotics.pdf