Career and Technical Education (CTE)

10-12 Grade/Robotics Technology

BOARD APPROVAL DATE: 9-24-2019

BOARD ADOPTION OF STATE STANDARDS: 10-1-2014

Unit Overview (Standards Coverage)				
Unit	**Standards**	**Unit Focus**	**Skills Overview**	**Suggested Pacing**
Unit 1 Intro to Engineering	• **9.3.ST- ET.4 Apply the elements of the design process.** • **Determine and use the appropriate resources (e.g., CNC (Computer Numerical Control) equipment, 3D printers, CAD software) in the design, development and creation of a technological product or system.**	**The focus of this unit is to allow students to get an understanding of basic engineering design process and how to draw using a CAD software.**	• **Engineering Design** • **Computer Aided Drawing** • **Solid Modeling** • **Measurement**	**3-6 weeks**
Unit 2 Safety and Equipment	• **9.3.MN- HSE.1 Demonstrate the safe use of manufacturing equipment.**	**The focus of this unit is to allow students to become comfortable with manufacturing equipment found in the lab.**	• **Safety of manufacturing equipment** • **Basic hand tools**	**2 weeks**
Unit 3 Robots and How they work	• **9.3.MN- HSE.1 Demonstrate the safe use of manufacturing equipment.** • **9.3.ST- ET.4 Apply the elements of the design process.**	**The focus of this unit it to allow students to become more comfortable with manufacturing equipment and learn the engineering design process through the use of Lego Mindstorm.**	• **Safety** • **Hydraulics** • **Engineering Design** • **Mechanical movements**	**5-7 weeks**
Unit 4 VEX V5 Robot build and Mechanical Understandings	• **9.3.MN- HSE.1 Demonstrate the safe use of manufacturing equipment.** • **9.3.ST- ET.4 Apply the elements of the design process.** • **9.3.ST.1 Apply engineering skills in a project that requires project management, process control and quality assurance.**	**The focus of this unit is to allow students to get a more in depth understanding of the engineering design process as well as how to completely assemble the VEX V5 Clawbot**	• **Safety** • **Robot Build** • **Problem Solving** • **Mechanical movements**	**10 weeks**
Unit 5 VEX V5 Programming and Design	• **9.3.IT- PRG.6 Program a computer application using the appropriate programming language.**	**The focus of this unit it to allow students to get a complete understanding of how to write**	• **Coding** • **Collaboration** • **Engineering Design** • **Problem Solving**	**10 weeks**

	• **9.3.ST.1 Apply engineering skills in a project that requires project management, process control and quality assurance.**	**code for the Clawbot they previously build.**		

This document outlines in detail the answers to following four questions:

1. **What do we want our students to know?**
2. **How do we know if they learned it?**
3. **What do we do if they did not learn it?**
4. **What do we do when they did learn it?**

Unit 1: Intro to Engineering		
Content & Practice Standards (write in full)	**Interdisciplinary Standards for Practice**	**Critical Knowledge & Skills**
• **9.3.ST- ET.4 Apply the elements of the design process.** • **8.2.12.D.1 Design and create a prototype to solve a real world problem using a design process, identify constraints addressed during the creation of the prototype, identify trade-offs made, and present the solution for peer review.**	• **CRP11. Use technology to enhance productivity.** • **CRP2. Apply appropriate academic and technical skills.**	• **2-D and 3-D Drawing/Modeling** • **Problem Solving** • **Collaboration** • **Measurement techniques**

Unit 1: Intro to Engineering	
Stage 1 – Desired Results	
UNIT SUMMARY	**CORE AND SUPPLEMENTAL MATERIALS/RESOURCES (OPEN RESOURCES)**
In this unit students will cover 2-D and 3-D modeling software such as Onshape and Solidworks, a brief overview of the engineering design process, measurement as well as engineering careers.	Powerpoint presentations Engineering Design Process Solidworks Onshape
UNDERSTANDINGS	
Students will understand the difference between a 2-D and 3-D drawing. Students will understand the different types of drawing software and how to use them effectively. Students will understand how to correctly draw and dimension different parts for a VEX V5 Clawbot. Students will understand how to correctly use different measurement tools such as rulers and micrometer.	
Students will know…	**Students will be able to…**
Students will know how to use 2-D and 3-D software. (Onshape and Solidworks) Students will know how to dimension computer aided drawings. Students will know whether to use 2-D or 3-D design based on the task at hand. Students will understand why we use these computer softwares versus hand drawing all of the parts we need.	Students will be able to model many different parts needed for a Clawbot using Solidworks or Onshape. Students will be able to effectively use Solidworks and Onshape with minimal help from the instructor. Students will be able to clearly understand what type of jobs exist in the Engineering robotics field.
Stage 2 – Assessment Evidence	
Performance Tasks: Students will create 2-D and 3-D drawings such as gears and screws. Students will take a physical part, measure it and then draw it using Onshape or Solidworks. Students will create a short powerpoint presentation of different robotics engineering careers.	Other Evidence **(Alternate Assessments)**: *Quick Writes* *Rubrics*

Students will design and model their own robot as part of a project.	

Stage 3 – Learning Plan

Students will begin with 2D sketches of simple geometric shapes. These will be the basis of all future models. The students will learn how to read a dimensioned sketch and how to add constraints. The tools include:

- Points
- Lines
- Rectangles
- Circles
- Constraints

Students will next learn the 3D tools that convert the above sketches to actual models. They will learn how the difference between an Extruded part and a Revolved part. They will also learn how to add rounded and cut edges to parts to make them more realistic and manufacturable. The tools include:

- Extrudes
- Revolves
- Fillets
- Chamfers

Students will move on to pattern tools. These allow the designer to replicate identical features without having to recreate them multiple times. They also simplify the design tree which leads to enhanced performance of the system. The tools include:

- Mirror tool
- Linear Patterns
- Circular Patterns

Students will next learn 3D shortcut tools that create common designs that industry Engineers use every day. These are all methods that could be completed using the knowledge learned in the previous sections, however the purpose is to teach the most efficient way to achieve a particular design. The tools include:

- Shell tool
- Holes
- Ribs

The final section of this unit teaches construction geometry. These are tools that allow the designer to build complex models using existing features. The tools include:

- Planes
- Use tool
- Intersection tool

Students will then do a simple PowerPoint presentation on different types of jobs related to robotics technology.

Planned Differentiation & Interventions for Tiers I, II, III, ELL, 504s, SPED, and Gift & Talented Students

Planned differentiation and interventions strategies for select tiers and student are as listed below.

Gifted & Talented: Depending on the current content student will be able to watch videos on how to do more advanced techniques on the software covered for this unit or do more research on robotic technology jobs.
Tier I: Depending on the current content student will be able to watch videos on how to do more advanced techniques on the software covered for this unit or do more research on robotic technology jobs.
Tier II: Students in this tier will be given extra assistance through the use of guided notes, study guides and shared PowerPoints. These students could receive extra dimensioning to further assist in the drawing of the part.
Tier III: Students in this group will be retaught the lesson to focus more on the area where these students are struggling. These students could get parts drawn for them with a few missing lines or dimensions missing.
ELL: Students in this group will be given added assistance through their ELL teacher as well have printed and complete guided notes, if needed, they will also get the notes translated. These students could get parts drawn for them with a few missing lines or dimensions missing.
504s: Students in this group will get the modifications that are on their 504 plans such as preferential seating, extended testing and completed guided notes. These students could get parts drawn for them with a few missing lines or dimensions missing.
SPED: Students in this group will get the accommodations stated in their IEP such as preferential seating and extended testing times. If they have an aid, the aid will assist further. These students could get parts drawn for them with a few missing lines or dimensions missing.

Unit 2: Safety and Equipment		
Content & Practice Standards	**Interdisciplinary Standards for Practice**	**Critical Knowledge & Skills**
• **9.3.MN- HSE.1 Demonstrate the safe use of manufacturing equipment.**	• **CRP2. Apply appropriate academic and technical skills.** • **CRP6. Demonstrate creativity and innovation.**	• **Knowledge of simple machines and how to use them safely.** • **Lab equipment is dangerous and will cause life altering injuries.**

Unit 2: Safety and Equipment

Stage 1 – Desired Results

UNIT SUMMARY	CORE AND SUPPLEMENTAL MATERIALS/RESOURCES (OPEN RESOURCES)
In this unit students will review all safety rules for the lab as well as all of the equipment. Tools, machines and robotics hardware will be the base of this unit with additional safety on overall lab safety.	• https://www.ise.ncsu.edu/processes/laboratory-equipment/saws/vertical-band-saw-safety/ • http://www.fundamentalsofwoodworking.com/woodworking-resources/Woodworking-Articles/safety-tips-for-working-with-a-drill-press • https://www.vexrobotics.com/vexedr

UNDERSTANDINGS

Students will understand that safety is to never be taken lightly.
Students will understand that the equipment in the lab is dangerous and should not be looked at as a toy.

Students will know…	Students will be able to…
Students will know what equipment to use for each specific application.	Students will be able to pass all safety tests with 100% proficiency. Students will be able to effectively use all machines in the lab safely.

Stage 2 – Assessment Evidence

Performance Tasks:	Other Evidence **(Alternate Assessments)**:
Students will do handouts on the major machines in the classroom (bandsaw, drill press and rotary tool). Students will also take safety tests on all machines in the lab and must pass with a 100%.	Safety Test on all machines in the lab. Students will use the machines with instructor for the first time to get the final approval before solo use. (Pass/Fail)

Stage 3 – Learning Plan

- Safety overview on the major machines in the lab will take place for multiple days.
- Equipment overview on all materials used with the robots.
- Tools that will be used the majority of the time will be taught more thoroughly.
- Students can use scrap pieces of material to get comfortable using the machines
- Students will be making a sample project that included all tools reviewed.

Planned Differentiation & Interventions for Tiers I, II, III, ELL, 504s, SPED, and Gift & Talented Students
Planned differentiation and interventions strategies for select tiers and student are as listed below.
Gifted & Talented: Students in this group could be given a more detailed explanation of these machines or use the machines to produce a more detailed introduction project.
Tier I: Students in this group could be given a more detailed explanation of these machines or use the machines to produce a more detailed introduction project.
Tier II: Students in this tier will be given extra assistance through the use of guided notes, study guides and shared PowerPoints. These students could receive additional one on one instruction before attempting to use the equipment as well as have some pieces cut for them.
Tier III: Students in this group will be retaught the lesson to focus more on the area where these students are struggling. These students could receive additional one on one instruction before attempting to use the equipment as well as have almost all of the pieces cut for them.
ELL: Students in this group will be given added assistance through their ELL teacher as well have printed and complete guided notes, if needed, they will also get the notes translated. These students could receive additional one on one instruction before attempting to use the equipment as well as have almost all of the pieces cut for them.
504s: Students in this group will get the modifications that are on their 504 plans such as preferential seating, extended testing and completed guided notes. These students could receive additional one on one instruction before attempting to use the equipment as well as have almost all of the pieces cut for them.
SPED: Students in this group will get the accommodations stated in their IEP such as preferential seating and extended testing times. If they have an aid, the aid will assist further. These students could receive additional one on one instruction before attempting to use the equipment as well as have almost all of the pieces cut for them.

Unit 3: Robots and how they work		
Content & Practice Standards	Interdisciplinary Standards for Practice	Critical Knowledge & Skills
• 9.3.MN- HSE.1 Demonstrate the safe use of manufacturing equipment. • 9.3.ST- ET.4 Apply the elements of the design process.	• CRP2. Apply appropriate academic and technical skills. • CRP6. Demonstrate creativity and innovation.	• Safe use of small hand tools • Knowledge that the robots are fragile • Teamwork and creativity.

Unit 3: Robots and How they work

Stage 1 – Desired Results

UNIT SUMMARY	CORE AND SUPPLEMENTAL MATERIALS/RESOURCES (OPEN RESOURCES)
This unit will go over three different types of robots and how they are put together. The three robots covered will be Lego Mindstorm, T-Bot and Vex V5.	• https://www.vexrobotics.com/vexedr • https://www.pitsco.com/T-bot-II-Hydraulic-Arm • https://www.lego.com/en-us/mindstorms

UNDERSTANDINGS

Students will understand the difference between the Lego Mindstorm, T-Bot and Vex V5 robots.
Students will understand the major parts of the robots and how each part functions.
Students will understand how the robots as a whole work on a basic level.

Students will know…	Students will be able to…
Students will know how a Lego Mindstorm operates. Students will know how a Vex V5 operates. Students will know how hydraulics work through the use of the T-Bot. Students will know the major functions of each robot and how they are different.	Students will be able to determine the difference between the type of code used for Lego Mindstorm and VEX V5. Students will be able to code the Lego Mindstorm by themselves. Students will be able to assemble and operate the T-Bot.

Stage 2 – Assessment Evidence

Performance Tasks:	Other Evidence (Alternate Assessments):
Lego Mindstorm challenge. Vex V5 challenge. T-Bot Basketball challenge.	Coding challenges (rubric) Robot assembly check (rubric)

Stage 3 – Learning Plan

- Build Lego Mindstorm and start learning how to code using drag and drop option.
- Watch a demonstration on Vex V5 robot and observe how it moves, does it move better or worse than the Lego Mindstorm.
- Take apart Lego Mindstorm and prepare to build Vex V5 robot.
- Build and operate the hydraulic T-Bot.
- T-Bot basketball challenge.

- Lego Mindstorm challenges as made by instructor.

PROGRESS MONITORING
The one issues students mine come across will be how to code the Lego Mindstorms but this will be easily fixed by pairing students together and giving additional assistance. Progress checks will be assessed during these stages with coding challenges.

Planned Differentiation & Interventions for Tiers I, II, III, ELL, 504s, SPED, and Gift & Talented Students

Planned differentiation and interventions strategies for select tiers and student are as listed below.

Gifted & Talented:
Students in this group could be given a more detailed explanation of these machines or use the machines to produce a more detailed project which could be diving deeper into coding the lego mindstorm or drawing a part to adapt the T-Bot.

Tier I:
Students in this group could be given a more detailed explanation of these machines or use the machines to produce a more detailed project which could be diving deeper into coding the lego mindstorm or drawing a part to adapt the T-Bot.

Tier II:
Students in this tier will be given extra assistance through the use of guided notes, study guides and shared powerpoints. These students could receive some of the code written for them to make the coding process easier.

Tier III:
Students in this group will be retaught the lesson to focus more on the area where these students are struggling. These students could receive most of the code written for them to assist in the coding process.

ELL:
Students in this group will be given added assistance through their ELL teacher as well have printed and complete guided notes, if needed, they will also get the notes translated. These students could receive most of the code written for them to assist in the coding process.

504s:
Students in this group will get the modifications that are on their 504 plans such as preferential seating, extended testing and completed guided notes. These students could receive most of the code written for them to assist in the coding process.

SPED:
Students in this group will get the accommodations stated in their IEP such as preferential seating and extended testing times. If they have an aid, the aid will assist further. These students could receive most of the code written for them to assist in the coding process.

Unit 4 ELA VEX V5		
Content & Practice Standards	Interdisciplinary Standards for Practice	Critical Knowledge & Skills
• 9.3.IT- PRG.6 Program a computer application using the appropriate programming language. • 9.3.MN- HSE.1 Demonstrate the safe use of manufacturing equipment. • 9.3.ST- ET.4 Apply the elements of the design process. • 9.3.ST.1 Apply engineering skills in a project that requires project management, process control and quality assurance.	• CRP2. Apply appropriate academic and technical skills. • CRP6. Demonstrate creativity and innovation.	• Safe use of hand tools as well as machinery. • Teamwork and collaboration. • Basic understanding of the Engineering Design Process.

Unit 4 VEX V5	
Stage 1 – Desired Results	
UNIT SUMMARY	CORE AND SUPPLEMENTAL MATERIALS/RESOURCES (OPEN RESOURCES)
This unit is the bulk of the class where students will build the VEX V5 Clawbots frame as well as the arm and claw assembly.	• Youtube videos of Clawbot • Guided Notes for Lessons • https://www.cmu.edu/roboticsacademy/
UNDERSTANDINGS	
Students will understand that these robots are expensive and should not be “messed” with. Students will understand that these robots have many functions and many build on top of each other. Students will understand different parts of the V5 robot and why they have to go together the way they do. Students will understand how to assembly the V5 robot, how to change motors and add sensors.	
Students will know…	Students will be able to…
Students will know how to completely assemble and disassemble a VEX V5 robot. Students will know what the robots are capable of doing and how they assist us in real life applications. Students will learn about...and know how to attach such part to the Clawbot V5 Robot Brain V5 Controller V5 Robot Radio V5 Robot Battery Li-Ion 1100mAh V5 Robot Battery Cable V5 Robot Battery Charger	Students will be able to • completely assemble and disassemble a V5 Clawbot. • explain why the robot goes together the way it does and why we do not take shortcuts. • know that the virtual world is a perfect world where no slip and drag is a factor and how to factor for this in the real world.

V5 Smart Motors Bumper Switch v2	

Stage 2 – Assessment Evidence	
Performance Tasks: Student projects will include many different challenges. During the building process, different checks will take place such as checking the tightness of nuts and bolts, making sure there are no loose pieces or dangling wires.	Other Evidence (Alternate Assessments): Robot assembly check will take place as a rubric that focus on tightness of parts, how well wires are connected and tied together as well as overall readiness.

Stage 3 – Learning Plan

Building of the ClawBot

- Frame assembly for base
- Claw assembly for arm
- Attach wheels and motors
- Attach brain and battery pack
- Attach sensors (as needed)

Additional Robots

- Squarebot
- Swervebot
- Buggy Bot
- Mammal Bot

Planned Differentiation & Interventions for Tiers I, II, III, ELL, 504s, SPED, and Gift & Talented Students

Planned differentiation and interventions strategies for select tiers and student are as listed below.

Gifted & Talented:
Students in this group could be given a more detailed explanation of these machines or use the machines to produce a more detailed project which could be diving deeper into coding the lego mindstorm or drawing a part to adapt the T-Bot.

Tier I:
Students in this group could be given a more detailed explanation of these machines or use the machines to produce a more detailed project which could be diving deeper into coding the lego mindstorm or drawing a part to adapt the T-Bot.

Tier II: Students in this tier will be given extra assistance through the use of guided notes, study guides and shared powerpoints. These students could receive some of the code written for them to make the coding process easier.
Tier III: Students in this group will be given added assistance through their ELL teacher as well have printed and complete guided notes, if needed, they will also get the notes translated. These students could receive most of the code written for them to assist in the coding process.
ELL: Students in this group will be given added assistance through their ELL teacher as well have printed and complete guided notes, if needed, they will also get the notes translated.
504s: Students in this group will get the modifications that are on their 504 plans such as preferential seating, extended testing and completed guided notes. These students could receive most of the code written for them to assist in the coding process.
SPED: Students in this group will get the accommodations stated in their IEP such as preferential seating and extended testing times. If they have an aid, the aid will assist further. These students could receive most of the code written for them to assist in the coding process.

Unit 5: VEX V5 Programming and Design		
Content & Practice Standards	Interdisciplinary Standards for Practice	Critical Knowledge & Skills
• 9.3.IT- PRG.6 Program a computer application using the appropriate programming language. • 9.3.MN- HSE.1 Demonstrate the safe use of manufacturing equipment. • 9.3.ST- ET.4 Apply the elements of the design process. • 9.3.ST.1 Apply engineering skills in a project that requires project management, process control and quality assurance.	• CRP2. Apply appropriate academic and technical skills. • CRP6. Demonstrate creativity and innovation.	• Safe use of hand tools as well as machinery. • Teamwork and collaboration. • Basic understanding of the Engineering Design Process. • Coding skills • Problem Solving

Unit 5: VEX V5 Programming and Design	
Stage 1 – Desired Results	
UNIT SUMMARY	CORE AND SUPPLEMENTAL MATERIALS/RESOURCES (OPEN RESOURCES)
This unit is the bulk of the class where students will build and learn to code the Vex V5 robot with C++ coding language. Students will be paired in groups and put their robot together to make a basic ClawBot. They will added sensors and motors as needed for more extensive code.	• Virtual World • Guided Notes for Lessons • https://www.cmu.edu/roboticsacademy/
UNDERSTANDINGS	
Students will understand that these robots are expensive and should not be "messed" with. Students will understand that these robots have many functions and many build on top of each other. Students will understand many different types of sensors and motors. Students will understand different parts of the V5 robot and why they have to go together the way they do. Students will understand how to assembly the V5 robot, how to change motors and add sensors. Students will understand the Robot Virtual World and how to use this tool.	
Students will know…	Students will be able to…
Students will know how to completely assemble and disassemble a VEX V5 robot. Students will know what the robots are capable of doing and how they assist us in real life applications. Students will learn about... V5 Robot Brain	*Students will be able to...* • understand the different types of sensors, the controller, radio, batteries and motors. • completely code the virtual reality robot to work without issues. • code physical robot to perform many different challenges to completion. • code physical robot to be able to use the remote controller and be able to control the robot.

V5 Controller V5 Robot Radio V5 Robot Battery Li-Ion 1100mAh V5 Robot Battery Cable V5 Robot Battery Charger V5 Smart Motors Bumper Switch v2 Students will know what the different sensors are for and how to use them correctly as well as how they are placed on the robot. Students will know that many functions of the robot will need to be learned before others or they will not make sense or function correctly. Students will know how virtual worlds work and why we use this tool instead of just applying the code right to the physical robot.	• know that the virtual world is a perfect world where no slip and drag is a factor and how to factor for this in the real world.

Stage 2 – Assessment Evidence

Performance Tasks: Student projects will include many different challenges. Virtual World checks will be done for every code written to ensure they function correctly. Physical robot checks will take place the day before the next component is taught so that students have time to test and perfect their code.	Other Evidence (Alternate Assessments): Virtual world will be used as a Pass/Fail check to either move to the real world or adjust in virtual. Physical robot will be graded as a Pass/Fail. If the robot successfully does the task at hand it will pass, if not it will not pass. Code check, make sure the comments are correct.

Stage 3 – Learning Plan

Coding the robot

- Speed, Power, Motors and Torque
- Challenges with motor values
- Challenges with sensors
- Challenges with Remote controller

Challenges

- Basketball
- Labyrinth Challenge
- Sentry Simulation 1
- Sumo Bot
- Bull-in-the-ring
- Minefield Challenge
- Robo Slalom
- Turn Buttons
- Robo Slalom II and III
- Sonic Scanner

- Speed of Sound

Remote control

- Minefield
- Basketball
- Competition challenge (changes every year)

Planned Differentiation & Interventions for Tiers I, II, III, ELL, 504s, SPED, and Gift & Talented Students

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Gifted & Talented:
Students in this group could be given a more detailed explanation of these machines or use the machines to produce a more detailed project which could be diving deeper into coding the lego mindstorm or drawing a part to adapt the T-Bot.

Tier I:
Students in this group could be given a more detailed explanation of these machines or use the machines to produce a more detailed project which could be diving deeper into coding the lego mindstorm or drawing a part to adapt the T-Bot.

Tier II:
Students in this tier will be given extra assistance through the use of guided notes, study guides and shared powerpoints. These students could receive some of the code written for them to make the coding process easier.

Tier III:
Students in this group will be given added assistance through their ELL teacher as well have printed and complete guided notes, if needed, they will also get the notes translated. These students could receive most of the code written for them to assist in the coding process.

ELL:
Students in this group will be given added assistance through their ELL teacher as well have printed and complete guided notes, if needed, they will also get the notes translated.

504s:
Students in this group will get the modifications that are on their 504 plans such as preferential seating, extended testing and completed guided notes. These students could receive most of the code written for them to assist in the coding process.

SPED:
Students in this group will get the accommodations stated in their IEP such as preferential seating and extended testing times. If they have an aid, the aid will assist further. These students could receive most of the code written for them to assist in the coding process.