Curriculum: Mechatronics I

Curricular Unit: Safety Procedures (Both Electronics and Robotics)

Instructional: A. Identify and apply workplace safety procedures

**Standard Alignments (Section 2)**

<table>
<thead>
<tr>
<th>Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>HECLE: HME.4.A</td>
</tr>
<tr>
<td>PEGLE: PALW.3.B</td>
</tr>
<tr>
<td>SCCLE: SC1.1.E (Chemistry I)</td>
</tr>
<tr>
<td>Knowledge: (CA) 3 (H/PE) 6,7</td>
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<tr>
<td>CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4</td>
</tr>
<tr>
<td>NETS: 1c</td>
</tr>
<tr>
<td>Performance: 3.1, 4.7</td>
</tr>
</tbody>
</table>

**Unit (Section 3)**

**Learning Targets:**

- Identify types, purposes, and operations of fire extinguishers and suppression resources
- Recognize when first aid is needed for occupational injuries and follow proper procedures
- **Identify electrical hazards**
  - Demonstrate appropriate work place safety practices (e.g., electrical, hand tools, power tools, fall protection, PPE, lockout/tag out, and environmental hazards)
  - Identify hazard of RF radiation devices
  - Demonstrate safe and proper use of AC line operated equipment (e.g., isolation transformers, grounding, leakage current testing, and GFI)

**Instructional Strategies**

- IML safety curriculum – correct ways to measure current voltage and resistance
- Labs:
  - Current
  - Voltage
  - Resistance
Assessments/Evaluations:

- Formative:
  - IML safety worksheets from Units I, II, and III (evaluated using a scoring guide)
  - Techniques introduced in the unit are observed and monitored every day with each activity
  - End of unit questions
  - Student demonstration/performance of proper safety procedures
- Summative: Three practical exams evaluated using a scoring guide

Sample Assessment Questions:

- The device that opens the circuit (burns out) when the circuit is overloaded is a fuse? T or F

Instructional Resources/Tools:

- Instructional materials laboratory
- Instructional Materials Laboratory – University of Missouri-Columbia (IML)

Cross Curricular Connections:

- ELA:
  - Technical reading
  - Writing
  - Discussion
  - Speaking within content
- Health: Applying practices that preserve and enhance the safety and health of others
- Physical Education: Differentiating between life threatening and non-life threatening injuries and select the appropriate level of treatment
- Science: Identifying electrical and radiation hazards

Depth of Knowledge (Section 5)

DOK: 3
Curriculum: Mechatronics I

Curricular Unit: Basic Electronic Circuits and Devices (Electronics I Portion)

Instructional: B. Test basic electronic circuits and devices

### Standard Alignments (Section 2)

<table>
<thead>
<tr>
<th>SCCLE: SC7.1.A (Physical Science)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge: (CA) 1 (MA) 1 (SC) 7</td>
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<tr>
<td>CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; A-CED.4</td>
</tr>
<tr>
<td>NETS: 6c</td>
</tr>
<tr>
<td>Performance: 1.8, 2.2, 3.5</td>
</tr>
</tbody>
</table>

### Unit (Section 3)

**Learning Targets:**

- Evaluate and test sources of DC and AC signals and power

- **Apply Ohm’s law**

- Interpret schematics in order to design, analyze, test, and troubleshoot the following circuits:
  - DC circuits (e.g., parallel and series-parallel)
  - Bridge circuits
  - Magnetic and electromagnetic devices
  - Transformers
  - Capacitors
  - Inductors
  - Resistive devices
  - Basic circuit controls (e.g., switches, fuses, and circuit breakers)
  - AC series R/L/C (resistance, inductance, capacitance) and filter circuits
  - AC parallel R/L/C and filter circuits
  - Time constants
  - Transformers, basic circuit controls, R/L/C series and parallel circuits

**Instructional Strategies:**

- Chapters 3-13:
  - Lecture and discussion using Fowler PowerPoints
  - Perform labs assigned from Fowler lab book
  - Read and answer chapter questions:
    - Self-test
    - Review from Fowler text
- Demonstrate skills collaboratively and individually using simulation and virtual lab software
- Complete relevant live work when available

**Assessments/Evaluations:**

- Formative assessment of:
  - Fowler PowerPoint quizzes
  - chapters 3-13:
    - self-tests
    - review questions
    - worksheets
- Two lab evaluations:
  - One formative
  - One summative
- Electricity textbook chapters 3-13 summative tests
- Summative/formative assessment of relevant live work when available

**Sample Assessment Questions:**

- True or false. The resistance of a parallel resistor can be measured while the resistor is connected in the circuit.

**Instructional Resources/Tools:**

- *Electricity Principles and Applications* (Richard J. Fowler):
  - textbook, and teacher resources
  - lab manual
- National Instruments Multisim Computer Simulation Programs
- ETCAI Electronics training software
- Electronic supplies

**Cross Curricular Connections:**

- **ELA:**
  - Technical reading
  - Writing
  - Discussion
- **Math:**
  - Number sense
  - Solving problems with formulas

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics I

Curricular Unit: Amplifiers (Electronics I Portion)

Instructional: C. Analyze and test amplifiers

**Standard Alignments (Section 2)**

SCCLE: SC1.2.A,B (Physical Science); SC7.1.A (Physical Science)
Knowledge: (CA) 1  (MA) 1  (SC) 7
CCSS: A-CED.4; 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1
NETS: 3a,b; 6c
Performance: 1.4, 1.5, 3.5, 4.1

**Unit (Section 3)**

Learning Targets:

- Interpret schematics in order to design, analyze, test, and troubleshoot the following circuits:
  - Amplifiers
  - Transistor switching
  - Bipolar transistor amplifier
  - FET amplifier
  - Operational amplifier
  - Multistage amplifier

Instructional Strategies:

- Chapters 6-8:
  - Lecture and discussion over Fowler PowerPoints
  - Perform labs assigned from Fowler lab book
  - Read and answer chapter:
    - self-test questions
    - review questions from Fowler text
- Demonstrate skills collaboratively and individually using simulation and virtual lab software
- Complete relevant live work when available

Assessments/Evaluations:

- Formative assessment of:
  - Fowler PowerPoint quizzes
  - chapters 6-8:
    - self-tests
    - review questions
    - worksheets
Two lab evaluations:
- One formative
- One summative
- Electricity textbook chapters 6-8 summative tests
- Summative/formative assessment of relevant live work when available

Sample Assessment Questions:
- What is the name of the terminals used to null the effect of internal dc imbalance in an op amp?

Instructional Resources/Tools:
- *Electricity Principles and Applications* (Richard J. Fowler):
  - textbook, and teacher resources
  - lab manual
- Electronic supplies
- Multisim computer simulation software
- ETCAI training software
- Electronic supplies

Cross Curricular Connections:
- ELA:
  - Technical reading
  - Writing
  - Discussion
- Math: Number sense and solve problems with formulas

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics I

Curricular Unit: Semiconductor Devices (Electronics I Portion)

Instructional: D. Test semiconductor devices consistent with industry and safety standards

**Standard Alignments (Section 2)**

| SCCLE: SC1.2.A,B (Physical Science); SC7.1.A (Physical Science) |
| Knowledge: (CA) 3 (SC) 7 (MA) 1 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; A-CED.4 |
| NETS: 3b |
| Performance: 1.3, 3.1, 4.1 |

**Unit (Section 3)**

**Learning Targets:**

- Interpret schematics in order to design, analyze, test, and troubleshoot the following circuits:
  - Diodes
  - Transistors (e.g., BJTs and FETs)
  - Thyristors (e.g., SCRs, TRIACs, and DIACs)

- Select semiconductors using specification sheets and substitution guides

- Demonstrate proper semiconductor handling and replacing

**Instructional Strategies:**

- Chapters 3 and 5:
  - Lecture and discussion using Schuler PowerPoints
  - Perform labs assigned from Schuler lab book.
  - Read and answer chapter:
    - self-test questions
    - review questions of Schuler text

- Demonstrate skills collaboratively and individually using simulation and virtual lab software

- Complete relevant live work when available

**Assessments/Evaluations:**

- Formative assessment of:
  - Fowler PowerPoint quizzes
  - chapters 3 & 5:
    - self-tests
    - review questions
    - worksheets
- Two lab evaluations:
  - One formative
  - One summative
- Electronics textbook chapters 3 and 5 summative tests
- Summative/formative assessment of relevant live work when available

Sample Assessment Questions:

- In the making of N-type semiconductor material, a typical doping level is about 10 arsenic atoms for every 90 silicon atoms.  T or F

Instructional Resources/Tools:

- *Electronics Principles and Applications* (Charles A. Schuler):
  - textbook and teacher resources
  - lab manual
- Multisim computer simulation software
- ETCAI computer training software

Cross Curricular Connections:

- ELA:
  - Technical reading
  - Writing
  - Discussion
- Math:  Number sense and solve problems with formulas

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics I

Curricular Unit: Power Supplies (Electronics I Portion)

Instructional: E. Analyze and repair power supplies

**Standard Alignments (Section 2)**

<table>
<thead>
<tr>
<th>SCCLE:</th>
<th>SC1.2.F (Physical Science); SC7.1.A (Physical Science)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge:</td>
<td>(CA) 3 (SC) 1</td>
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<tr>
<td>CCSS:</td>
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</tr>
<tr>
<td>NETS:</td>
<td>3a,b; 6c</td>
</tr>
<tr>
<td>Performance:</td>
<td>3.1, 4.7</td>
</tr>
</tbody>
</table>

**Unit (Section 3)**

Learning Targets:

- Interpret schematics in order to design, analyze, test, and troubleshoot the following circuits:
  - Power supplies A/C
  - Power supplies D/C
- **Demonstrate proper power supply handling and replacing**

Instructional Strategies:

- Chapter 15:
  - Lecture and discussion over chapters 15 using Schuler PowerPoints
  - Perform labs assigned from chapters 15 of Schuler lab book
  - Read and answer chapter self-test questions and review questions from chapters 15 of Schuler text
  - Demonstrate skills collaboratively and individually using simulation and virtual lab software
  - Complete relevant live work when available

Assessments/Evaluations:

- Formative assessment of:
  - Fowler PowerPoint quizzes
  - chapter 15:
    - self-test
    - review questions
    - worksheet
- Two lab evaluations:
  - One formative
  - One summative
- Electronics textbook chapter 15 summative test
- Summative/formative assessment of relevant live work when available
Sample Assessment Questions:

- Why must a capacitor be connected across the secondary of a ferroresonant transformer?
  - A. To filter out ac ripple.
  - B. To change dc to ac.
  - C. To cause core saturation.
  - D. To eliminate radio-frequency interference.

Instructional Resources/Tools:

- *Electronics Principles and Applications* (Charles A. Schuler):
  - textbook and teacher resources
  - lab manual
- Multisim computer simulation software
- ETCAI computer training software

Cross Curricular Connections:

- ELA:
  - Technical reading
  - Writing
  - Discussion

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics I

Curricular Unit: Frequency Generation Equipment (Electronics I Portion)

Instructional: F. Analyze and repair frequency generation equipment consistent with industry and safety standards

**Standard Alignments (Section 2)**

<table>
<thead>
<tr>
<th>SCCLE:</th>
<th>SC1.1.B (Physical Science); SC7.1.A (Physical Science)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge:</td>
<td>(CA) 3  (MA) 4  (SC) 1</td>
</tr>
<tr>
<td>CCSS:</td>
<td>11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; A-CED.4</td>
</tr>
<tr>
<td>NETS:</td>
<td>3a,b; 6c</td>
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</table>

| Performance: | 1.4, 1.8, 4.1 |

<table>
<thead>
<tr>
<th>Unit (Section 3)</th>
</tr>
</thead>
</table>

**Learning Targets:**

- Interpret schematics in order to design, analyze, test, and troubleshoot the following circuits:
  - Oscillators
  - Pulse generators and multivibrators

- Apply the oscillator operation theory

**Instructional Strategies:**

- Chapters 9-11:
  - Lecture and discussion using Schuler PowerPoints
  - Perform labs assigned from Schuler lab book
  - Read and answer chapter:
    - self-test questions
    - review questions of Schuler text
  - Demonstrate skills collaboratively and individually using simulation and virtual lab software
  - Complete relevant live work when available

**Assessments/Evaluations:**

- Formative assessment of:
  - Schuler PowerPoint quizzes
  - chapter 9-11:
    - self-tests
    - review questions
    - worksheets
- Two lab evaluations:
  - One formative
  - One summative
- Electronics textbook chapters 9-11 summative tests
- Summative/formative assessment of relevant live work when available

### Sample Assessment Questions:

- True or false. Digital frequency meters are limited to measuring power and audio frequencies

### Instructional Resources/Tools:

- *Electronics Principles and Applications* (Charles A Schuler):
  - textbook
  - lab manual
- Multisim computer simulation software
- ETCAI training products
- Electronic supplies

### Cross Curricular Connections:

- ELA:
  - Technical reading
  - Writing
  - Discussion
- Math:
  - Number sense
  - Solving problems with formulas

### Depth of Knowledge (Section 5)

DOK: 4
Curriculum: Mechatronics I

Curricular Unit: Test Equipment (Electronics I Portion)

Instructional: G. Operation of test and measurement equipment

### Standard Alignments (Section 2)

| SCCLE: SC1.1.B (Physical Science); SC7.1.A (Physical Science) |
| Knowledge: (CA) 1,3,4 (MA) 1 (SC) 1,7 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-RN.2; N-Q.1; A-CED.4 |
| NETS: 3b-d |
| Performance: 1.2, 1.4, 3.1, 4.1 |

### Unit (Section 3)

#### Learning Targets:

- Measure voltage, time, and frequency using an oscilloscope
- **Measure voltage, current, and resistance using multimeters (e.g., VOM, EVM, and DVM)**
- Operate signal generators (e.g., audio, RF, and Function)

#### Instructional Strategies:

- Chapters 3-13:
  - Lecture and discussion using Fowler and Schuler PowerPoints
  - Perform labs assigned from Fowler and Schuler lab books
  - Read and answer chapter:
    - self-test questions
    - review questions
    of Fowler and Schuler text
  - Demonstrate skills collaboratively and individually using simulation and virtual lab software
  - Complete relevant live work when available

#### Assessments/Evaluations:

- Formative assessment of:
  - Fowler and Schuler PowerPoint quizzes
  - chapters 3-13:
    - self-tests
    - review questions
    - worksheets
• Two lab evaluations:
  • One formative
  • One summative
• Electricity and Electronics textbook chapters 3-13 summative tests
• Summative/formative assessment of relevant live work when available

Sample Assessment Questions:

• Does an iron-vane movement respond to alternating current, direct current, or both?

Instructional Resources/Tools:

• *Electronics Principles and Applications*:
  • textbook (Charles A. Schuler)
  • textbook (Richard J. Fowler)
  • lab manual (Charles A. Schuler)
• Multisim computer simulation software
• ETCAI training software

Cross Curricular Connections:

• ELA:
  • Technical reading
  • Writing
  • Discussion
• Math:
  • Number sense
  • Solve problems with formulas

**Depth of Knowledge (Section 5)**

DOK: 3
Curriculum: Mechatronics I

Curricular Unit: Optical Devices (Electronics I Portion)

Instructional: H. Analyze and test optical devices

### Standard Alignments (Section 2)

| SCCLE: SC1.2.A (Physical Science); SC7.1.A (Physical Science) |
| Knowledge: (CA) 3 (MA) 1 (SC) 1 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-RN.2; N-Q.1; A-CED.4 |
| NETS: 3a,b |
| Performance: 1.10, 3.1, 3.2, 4.1 |

### Unit (Section 3)

#### Learning Targets:

- Interpret schematics in order to design, analyze, test, and troubleshoot the following circuits:
  - Optical devices (e.g., photodetectors, emitters, optical isolators, and LEDs)
  - Fiber optic cable to transmit a digital or analog signal

#### Instructional Strategies:

- Chapters 3 and 5:
  - Lecture and discussion using Schuler PowerPoints
  - Perform labs assigned from Schuler lab book
  - Read and answer chapter:
    - self-test questions
    - review questions of Schuler text
- Demonstrate skills collaboratively and individually using simulation and virtual lab software
- Complete relevant live work when available

#### Assessments/Evaluations:

- Formative assessment of:
  - Schuler PowerPoint quizzes
  - chapters 3 and 5:
    - self-tests
    - review questions
    - worksheets
- Two lab evaluations:
  - One formative
  - One summative
- Electronics textbook chapters 3 and 5 summative tests
- Summative/formative assessment of relevant live work when available
Sample Assessment Questions:

• A device containing an LED and a photodiode in the same sealed package is called an optoisolator. T or F

Instructional Resources/Tools:

• *Electronics Principles and Applications* (Charles A. Schuler):
  • textbook
  • lab manual
• Multisim computer simulation software
• ETCAI training software
• Electronics supplies

Cross Curricular Connections:

• ELA:
  • Technical reading
  • Writing
  • Discussion
• Math:
  • Number sense
  • Solve problems with formulas

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics I

Curricular Unit: Construction of Circuits (Electronics I Portion)

Instructional: I. Construct circuits consistent with industry and safety standards

**Standard Alignments (Section 2)**

<table>
<thead>
<tr>
<th>SCCLE: SC7.1.A (Physical Science)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge: (CA) 3</td>
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<tr>
<td>CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4</td>
</tr>
<tr>
<td>NETS: 3b,c</td>
</tr>
<tr>
<td>Performance: 1.8, 1.10, 3.1, 3.2</td>
</tr>
</tbody>
</table>

**Unit (Section 3)**

Learning Targets:

- **Construct multistage circuits according to schematic diagrams**
- Surface mount solder and desolder components (e.g., defective and replacement) to IPC standards
- **Thru-Hole solder and desolder components (e.g., defective and replacement)**
- Troubleshooting soldering kits the students construct

Instructional Strategies:

- Textbooks: *Electricity, Electronics, Digital*
- Soldering handouts
- Students will:
  - solder and desolder various electronic components in printed circuit boards
  - build functional electronic devices from soldered board work kits

Assessments/Evaluations:

- Formative:
  - Soldering techniques observed by the teacher of student demonstration/ performance
  - Unit questions
- Summative – created by the teacher:
  - Projects
  - Practical exam
  - Tests
- Lab evaluations formative/summative by the teacher – assessed using informal observation
- Summative/formative assessment of relevant live work when available
Sample Assessment Questions:

- What are the six parts of a complete circuit?

Instructional Resources/Tools:

- Electronic supplies
- YouTube videos on soldering
- Teacher-created:
  - PowerPoints
  - handouts

Cross Curricular Connections:

- ELA:
  - Technical reading
  - Writing
  - Discussion

**Depth of Knowledge (Section 5)**

DOK: 3
Curriculum: Mechatronics I

Curricular Unit: Leadership (Both Electronics and Robotics)

Instructional: J. Demonstrate leadership skills in the classroom, industry, and society

**Standard Alignments (Section 2)**

- MGGE: PS.1.C; CD.9.A
- SCCLE: ECP.4.A
- Knowledge: (CA) 1,4,7 (SS) 6
- CCSS: 11-12.WHST.4; 11-12.WHST.5; 11-12.WHST.6
- NETS: 1b; 6a,b
- Performance: 1.4, 1.8, 1.10, 2.1

**Unit (Section 3)**

Learning Targets:
- Demonstrate an understanding of SkillsUSA, its structure, and activities
- Demonstrate an understanding of one’s personal values
- Perform tasks related to effective personal management skills
- Demonstrate interpersonal skills
- Demonstrate etiquette and courtesy
- Demonstrate effectiveness in oral and written communication
- Develop and maintain a code of professional ethics
- Maintain an appropriate professional appearance
- Perform tasks related to securing and terminating employment
- Perform basic parliamentary procedures in a group meeting
Instructional Strategies:

- Students will develop leadership qualities through:
  - character building exercises
  - student organization involvement
- Leadership development will be observed by the teacher both in and out of the classroom:
  - Skills USA meetings and functions
  - Community service projects
  - Fund raising activities

Assessments/Evaluations:

- Skills USA Leadership handbook – evaluated by a judge during competition
- Teacher observation

Sample Assessment Questions:

- What is the Skills USA pledge?

Instructional Resources/Tools:

- Websites:
  - MidMoCareers.com
  - Monster.com
  - Careerbuilder.com
  - BLS Occupational Outlook Handbook (online)
- Google Drive and Docs
- Computer

Cross Curricular Connections:

- ELA:
  - Technical reading
  - Writing
  - Discussion
- Model Guidance:
  - Citizenship skills
  - Personal skills for job success

**Depth of Knowledge (Section 5)**

DOK: 2
Curriculum: Mechatronics I

Curricular Unit: Getting Started (Robotics I Portion)

Instructional Unit: K. Set up the Boe-Bot hardware and software

**Standard Alignments (Section 2)**

<table>
<thead>
<tr>
<th>GLE/CLE: N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge: (CA) 1, 3 (MA) 1</td>
</tr>
<tr>
<td>CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1</td>
</tr>
<tr>
<td>NETS: 3b-d</td>
</tr>
<tr>
<td>Performance: 3.1, 3.4, 4.5</td>
</tr>
</tbody>
</table>

**Unit (Section 3)**

**Learning Targets:**

- Load *Basic Stamp II* software on computers
- Connect hardware together on the Boe-Bots
- Test the communication of the software to the Boe-Bots
- Demonstrate knowledge of DEBUG and its uses
- Demonstrate knowledge of the ASCII code
- Write comments within a code

**Instructional Strategies:**

- The teacher will help if needed, while trying to implement troubleshooting skills
- *What’s a Microcontroller* textbook Chapter 1, activities 1-7
- Lectures on various parts of the text

**Assessments/Evaluations:**

- *What’s a Microcontroller* – Chapter 1, activities 1-7
- Formative: Teacher observation of student demonstration of activities 1-7:
  - Getting the software
  - Installing the software
  - Setting up the hardware and testing the system
  - First program
  - Looking up answers
  - Introducing the ASCII code
- Summative: Chapter 1 written exam and performance lab test

**Sample Assessment Questions:**

- What PBASIC commands did you learn in this chapter?
Instructional Resources/Tools:

- *What's a Microcontroller* textbook by Parralax
- Overhead projector of Basic Stamp II software by Parralax

Cross Curricular Connections:

- ELA – Technical:
  - reading
  - writing
  - discussion
- Math: Number sense

**Depth of Knowledge (Section 5)**

DOK: 3
Curriculum: Mechatronics I

Curricular Unit: Lights On-Off (Robotics I Portion)

Instructional Unit: L. Create a program to turn a LED on and off

Standard Alignments (Section 2)

| SCCLE: SC7.1.A (Physical Science)                               |
| Knowledge: (CA) 1,3  (MA) 1  (SC) 1                           |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3 |
| NETS: 3b-d                                                     |
| Performance: 3.1, 3.4, 4.5                                    |

Unit (Section 3)

Learning Targets:

- Interpret schematics in order to design, evaluate, test, and troubleshoot the following circuits:
  - Light Emitting Diodes (LED)
  - Resistors: Color coding, how they work
  - Vss and Vdd
  - Pause commands in milliseconds
  - Pin out functions: High, Low
  - How to interpret schematic diagrams
  - Multi-meters: reading capacitors, resistors, LED’s
  - Series circuit design and troubleshooting

Instructional Strategies:

- The teacher will help if needed, while trying to implement troubleshooting skills
- *What’s a Microcontroller* textbook Chapter 2, activities 1-5
- Lectures on various parts of the text

Assessments/Evaluations:

- *What’s a Microcontroller* – Chapter 2, activities 1-5
- Formative: Teacher observation of student demonstration of activities 1-5:
  - Building and testing a LED circuit
  - On/off control with the BASIC Stamp
  - Counting and repeating
  - Building and testing a second LED circuit
  - Using current direction to control a bi-color LED
- Summative: Chapter 1 written exam and performance lab test

Sample Assessment Questions:

- What do you always have to do before modifying a circuit that you built on a breadboard?
Instructional Resources/Tools:

- *What’s a Microcontroller* textbook by Parralax
- Overhead projector of Basic Stamp II software by Parralax

Cross Curricular Connections:

- English – Technical:
  - reading
  - writing
  - discussion
- Math: Number sense and building new functions
- Science:
  - Investigate
  - Reason
  - Critical thinking

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics I

Curricular Unit: Digital Inputs (Robotics I Portion)

Instructional Unit: M. Build and test a pushbutton switch circuit

Standard Alignments (Section 2)

<table>
<thead>
<tr>
<th>SCCLE: SC7.1.A (Physical Science)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge: (CA) 1,3  (MA) 1  (SC) 1</td>
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<tr>
<td>CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3</td>
</tr>
<tr>
<td>NETS: 3b,c</td>
</tr>
<tr>
<td>Performance: 1.5, 3.1, 3.3, 3.4, 4.5</td>
</tr>
</tbody>
</table>

Unit (Section 3)

Learning Targets:

- Interpret schematics in order to design, analyze, test, and troubleshoot the following circuits:
  - Pushbutton
  - Reaction timer
  - Breadboard connections
  - Proper DC wire coloring
  - DO, LOOP statements and their uses
  - Carriage returns and their uses

Instructional Strategies:

- The teacher will help if needed, while trying to implement troubleshooting skills
- *What's a Microcontroller* textbook Chapter 3, activities 1-5
- Lectures on various parts of the text

Assessments/Evaluations:

- *What's a Microcontroller* – Chapter 3, activities 1-5
- Formative: Teacher observation of student demonstration of activities 1-5:
  - Testing a pushbutton with a LED circuit
  - Reading a pushbutton with the BASIC Stamp
  - Pushbutton control of a LED circuit
  - Two pushbuttons controlling two LED circuits
  - Reaction timer test
- Summative: Chapter 3 written exam and performance lab test

Sample Assessment Questions:

- What is the difference between sending and receiving HIGH and LOW signals using the BASIC Stamp?
**Instructional Resources/Tools:**

- *What’s a Microcontroller* textbook by Parralax
- Overhead projector of *Basic Stamp II* software by Parralax

**Cross Curricular Connections:**

- English – Technical:
  - reading
  - writing
  - discussion
- Math:
  - Number sense and building new functions
- Science:
  - Investigate
  - Reason
  - Critical thinking

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics I

Curricular Unit: Controlling Motion (Robotics I Portion)

Instructional Unit: N. Control motion with a servomotor

**Standard Alignments (Section 2)**

SCCLE: SC7.1.A (Physical Science)
Knowledge: (CA) 1,3  (MA) 6  (SC) 2
CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3
NETS: 3b,c
Performance: 1.5, 3.1, 3.3, 3.4, 4.5

**Unit (Section 3)**

**Learning Targets:**

- Interpret schematics in order to design, evaluate, test, and troubleshoot the following circuits:
  - Timed Servomotor computer control
  - Degree control of Servomotor
  - Servomotor pushbutton control
  - Servomotor functions and understanding
  - PULSOUT counters
  - Digital signals vs. analog signals
  - ELSE, IF statements and their uses

**Instructional Strategies:**

- The teacher will help if needed, while trying to implement troubleshooting skills
- *What’s a Microcontroller* textbook Chapter 4, activities 1-4
- Lectures on various parts of text

**Assessments/Evaluations:**

- *What’s a Microcontroller* – Chapter 4, activities 1-4
- Formative: Teacher observation of student demonstration of activities 1-4:
  - Connecting and testing the servo
  - Controlling position with your computer
  - Converting position to motion
  - Pushbutton controlled servo
- Summative: Chapter 4 written exam and performance lab test

**Sample Assessment Questions:**

- Is an LED circuit required to make a servo work?
**Instructional Resources/Tools:**

- *What’s a Microcontroller* textbook by Parralax
- Overhead projector of *Basic Stamp II* software by Parralax

**Cross Curricular Connections:**

- English – Technical:
  - reading
  - writing
  - discussion
- Math: Number sense and building new functions
- Science:
  - Investigate
  - Reason
  - Critical thinking

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics I

Curricular Unit: Measuring Rotation (Robotics I Portion)

Instructional Unit: O. Utilize a potentiometer to measure rotation

**Standard Alignments (Section 2)**

<table>
<thead>
<tr>
<th>SCCLE: SC7.1.A (Physical Science)</th>
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</thead>
<tbody>
<tr>
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<td>NETS: 3b,c</td>
</tr>
<tr>
<td>Performance: 1.5, 3.1, 3.3, 3.4, 4.5</td>
</tr>
</tbody>
</table>

**Unit (Section 3)**

**Learning Targets:**

- Interpret schematics in order to design, evaluate, test, and troubleshoot the following circuits:
  - RC (resistance, capacitance) time circuit
  - Potentiometer
  - Potentiometer controlled Servomotor
  - Capacitors: functions, differences, measuring

**Instructional Strategies:**

- The teacher will help if needed, while trying to implement troubleshooting skills
- *What’s a Microcontroller* textbook Chapter 5, activities 1-4
- Lectures on various parts of text

**Assessments/Evaluations:**

- *What’s a Microcontroller* – Chapter 5, activities 1-4
- Formative: Teacher observation of student demonstration of activities 1-4:
  - Building and testing the potentiometer circuit
  - Measuring resistance by measuring time
  - Reading the dial with the BASIC Stamp
  - Controlling a servo with a potentiometer
- Chapter 5 written exam and performance lab test

**Sample Assessment Questions:**

- What happens to the RC discharge time as the value of R (the resistor) gets larger or smaller?

**Instructional Resources/Tools:**

- *What’s a Microcontroller* textbook by Parralax
- Overhead projector of Basic Stamp II software by Parralax
Cross Curricular Connections:

- English – Technical:
  - reading
  - writing
  - discussion
- Math: Number sense and building new functions
- Science:
  - Investigate
  - Reason
  - Critical thinking

Depth of Knowledge (Section 5)

DOK: 4
Curriculum: Mechatronics I

Curricular Unit: Digital Displays (Robotics I Portion)

Instructional Unit: P. Interpret schematics in order to design, evaluate, test, and troubleshoot 7-Segment LED Displays

<table>
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<tr>
<th>Standard Alignments (Section 2)</th>
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<tbody>
<tr>
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<tr>
<td>NETS: 3b,c</td>
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<table>
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<tr>
<th>Unit (Section 3)</th>
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<tbody>
<tr>
<td>Learning Targets:</td>
</tr>
<tr>
<td>- Interpret schematics in order to design, evaluate, test, and troubleshoot the following circuits:</td>
</tr>
<tr>
<td>1. 7-Segment Display</td>
</tr>
<tr>
<td>2. Potentiometer controlled 7-Segment Display</td>
</tr>
<tr>
<td>3. Parallel circuit design and troubleshooting</td>
</tr>
<tr>
<td>4. Series-parallel circuit design and troubleshooting</td>
</tr>
<tr>
<td>5. OUTH and DIRTH statements</td>
</tr>
<tr>
<td>6. Using Index and LOOKUP index’s</td>
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<table>
<thead>
<tr>
<th>Instructional Strategies:</th>
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<tr>
<td>- The teacher will help if needed, while trying to implement troubleshooting skills</td>
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<tr>
<td>- What’s a Microcontroller textbook Chapter 6, activities 1-4</td>
</tr>
<tr>
<td>- Lectures on various parts of text</td>
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<table>
<thead>
<tr>
<th>Assessments/Evaluations:</th>
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</thead>
<tbody>
<tr>
<td>- What’s a Microcontroller – Chapter 6, activities 1-4</td>
</tr>
<tr>
<td>- Formative: Teacher observation of student demonstration of activities 1-4:</td>
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<tr>
<td>1. Building and testing the 7-Segment LED display</td>
</tr>
<tr>
<td>2. Controlling the 7-Segment LED display</td>
</tr>
<tr>
<td>3. Displaying digits</td>
</tr>
<tr>
<td>4. Displaying the position of a dial</td>
</tr>
<tr>
<td>- Chapter 6 written exam and performance lab test</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Sample Assessment Questions:</th>
</tr>
</thead>
<tbody>
<tr>
<td>- What is the group of wires that conduct signals to and from a parallel device called?</td>
</tr>
</tbody>
</table>
### Instructional Resources/Tools:

- *What's a Microcontroller* textbook by Parralax
- Overhead projector of Basic Stamp II software by Parralax

### Cross Curricular Connections:

- English – Technical:
  - reading
  - writing
  - discussion
- Math: Number sense and building new functions
- Science:
  - Investigate
  - Reason
  - Critical thinking

### Depth of Knowledge (Section 5)

DOK: 4
Curriculum: Mechatronics I

Curricular Unit: Measuring Light (Robotics I Portion)

Instructional Unit: Q. Utilize photo resistors to measure light

**Standard Alignments (Section 2)**

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<th>SCCLE: SC7.1A (Physical Science)</th>
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<tr>
<td>NETS: 3b,c</td>
</tr>
<tr>
<td>Performance: 1.5, 3.1, 3.3, 3.4, 4.5</td>
</tr>
</tbody>
</table>

**Unit (Section 3)**

**Learning Targets:**

- Interpret schematics in order to design, evaluate, test, and troubleshoot the following circuits:
  - Photo resistors
  - Photo resistor RC (resistance, capacitance)
  - Photo resistor controlled servomotor
  - EPROM and EEPROM

**Instructional Strategies:**

- The teacher will help if needed, while trying to implement troubleshooting skills
- *What’s a Microcontroller* textbook Chapter 7, activities 1-4
- Lectures on various parts of text

**Assessments/Evaluations:**

- *What’s a Microcontroller* – Chapter 7, activities 1-4
- Formative: Teacher observation of student demonstration of activities 1-4:
  - Building and testing the light meter
  - Graphing light measurements
  - Tracking light events
  - Simple light meter
- Summative: Chapter 7 written exam and performance lab test

**Sample Assessment Questions:**

- What command do you use to store a value in EEPROM?
- What command do you use to retrieve a value from EEPROM?
- Which one requires a variable?

**Instructional Resources/Tools:**

- *What’s a Microcontroller* textbook by Parralax
- Overhead projector of Basic Stamp II software by Parralax
Cross Curricular Connections:

- English – Technical:
  - reading
  - writing
  - discussion
- Math: Number sense and building new functions
- Science:
  - Investigate
  - Reason
  - Critical thinking

Depth of Knowledge (Section 5)

DOK: 4
Curriculum: Mechatronics I

Curricular Unit: Frequency and Sound (Robotics I Portion)

Instructional Unit: R. Interpret schematics in order to design, evaluate, test, and troubleshoot computer-controlled speakers

**Standard Alignments (Section 2)**

<table>
<thead>
<tr>
<th>SCCLE: SC7.1.A (Physical Science)</th>
<th>Knowledge: (CA) 1,3 (MA) 6 (SC) 2</th>
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<td>CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3</td>
<td>NETS: 3b,c</td>
</tr>
<tr>
<td>Performance: 1.5, 3.1, 3.3, 3.4, 4.5</td>
<td></td>
</tr>
</tbody>
</table>

**Unit (Section 3)**

**Learning Targets:**

- Interpret schematics in order to design, evaluate, test, and troubleshoot the following circuits:
  - Piezoelectric
  - Computer controlled music
  - Computer controlled ringtones
  - FREQOUT commands and their functions
  - Hertz
  - Noteletter
  - NoteFreq
  - NoteDuration
  - Octaves
  - RTTL_File DATA
  - ENDSELECT
  - ENDFIF
  - Bytes and Bits

**Instructional Strategies:**

- The teacher will help if needed, while trying to implement troubleshooting skills
- *What's a Microcontroller* textbook Chapter 8, activities 1-5
- Lectures on various parts of text
### Assessments/Evaluations:
- *What’s a Microcontroller* – Chapter 8, activities 1-5
- Formative: Teacher observation of student demonstration of activities 1-5:
  - Building and testing the speaker
  - Action sounds
  - Musical notes and simple songs
  - Microcontroller music
  - Cell phone ringtones
- Chapter 8 written exam and performance lab test

### Sample Assessment Questions:
- How do you modify a DATA directive or READ command if you want to store and retrieve word values?

### Instructional Resources/Tools:
- *What’s a Microcontroller* textbook by Parralax
- Overhead projector of *Basic Stamp II* software by Parralax

### Cross Curricular Connections:
- English – Technical:
  - reading
  - writing
  - discussion
- Math: Number sense and building new functions
- Science:
  - Investigate
  - Reason
  - Critical thinking

---

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics I

Curricular Unit: Building the Clawbot (Robotics I Portion)

Instructional Unit: S. Construct a Clawbot that uses the fundamentals of building and programming for manual control

### Standard Alignments (Section 2)

<table>
<thead>
<tr>
<th>GLE/CLE: N/A</th>
<th>Knowledge: (CA) 1,3</th>
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<tr>
<td>CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4</td>
<td>NETS: 3b,c</td>
</tr>
<tr>
<td>Performance: 3.1, 3.4, 4.5</td>
<td></td>
</tr>
</tbody>
</table>

### Unit (Section 3)

#### Learning Targets:

- Discuss how robots are used today in industry, research and in education
- Orally articulate what the different basic components of a robot are and how they perform their function
- Assemble the Vex Clawbot using the directions provided in the kit
- Understand the use of the tools in Robotics

#### Instructional Strategies:

- The teacher will help if needed, while trying to implement troubleshooting skills
- Instructional videos at Robotc.net VEX Cortex Curriculum: Fundamentals, Setup
- Lectures on various parts of the videos

#### Assessments/Evaluations:

- Completion of videos
- Written quizzes on specifics
- Formative: Teacher observation of student demonstration of activities:
  - Building and testing Clawbot
  - Program Clawbot for basic control
- Summative: Student will be able to program Clawbot for basic control and present this to the teacher

#### Sample Assessment Questions:

- What are 10 part names that comprise the Clawbot?

#### Instructional Resources/Tools:

- Robotc.net curriculum
- Vex Clawbot building manual
Cross Curricular Connections:

- English – Technical:
  - reading
  - writing
  - discussion

Depth of Knowledge (Section 5)

DOK: 3
Curriculum: Mechatronics I

Curricular Unit: Programming the Clawbot (Robotics I Portion)

Instructional Unit: T. Program the Clawbot to operate autonomously

**Standard Alignments (Section 2)**

| SCCLE: SC2.1.A (Physics I); SC7.1.A (Physics I) |
| Knowledge: (CA) 1,3 (MA) 4 (SC) 2 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3 |
| NETS: 3c; 4b; 6a |
| Performance: 3.1, 3.4, 4.5 |

**Unit (Section 3)**

**Learning Targets:**

- Identify problems with autonomous mode
- Identify benefits of autonomous mode
- Create a program for the robot to move autonomously
  - Task main
  - Wait
  - Motor speed and direction

**Instructional Strategies:**

- The teacher will help if needed, while trying to implement troubleshooting skills
- Instructional videos at Robotc.net VEX Cortex Curriculum: Fundamentals, Setup, Movement
- Intellitek REC curriculum:
  - Instructional videos
  - Reading material
  - Exercise
  - Lectures on various parts of the videos

**Assessments/Evaluations:**

- Students will be able to connect to the robot via VEXnet wireless keys
- Formative: Teacher observation of student demonstration of activities:
  - Program Clawbot to move in a straight line for 6 ft. with ¼” error
  - Program Clawbot for autonomous control
- Summative: Students will be able to program Clawbot to perform above tasks within guidelines and present this to the teacher

**Sample Assessment Questions:**

- What code differences are present when programming autonomously vs. manual control?
Instructional Resources/Tools:

- Robotc.net curriculum
- Intellitek REC curriculum

Cross Curricular Connections:

- English – Technical:
  - reading
  - writing
  - discussion
- Math: Number sense and recognizing the relationship of various functions
- Science:
  - Investigate
  - Reason
  - Critical thinking
  - Analyze the motion of an object

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics I

Curricular Unit: Programming the Clawbot (Robotics I Portion)

Instructional Unit: U. Create, analyze, and troubleshoot a program that utilizes motor control during 90-degree turns

**Standard Alignments (Section 2)**

| SCCLE: SC2.1.A (Physics I); SC7.1.A (Physics I) |
| Knowledge: (CA) 1,3 (MA) 4 (SC) 2 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3 |
| NETS: 3c; 4b; 6a |
| Performance: 3.1, 3.4, 4.5 |

**Unit (Section 3)**

Learning Targets:

- Program the robot to run autonomously with no use of the manual controller other than connection
- Identify problems with 90-degree turns
- Create a program with a 90-degree turn with accuracy
- Identification, execution, and troubleshooting of these commands and statements:
  - Task main
  - Wait
  - Motor speed and direction

Instructional Strategies:

- The teacher will help if needed, while trying to implement troubleshooting skills
- Instructional videos at Robotc.net VEX Cortex Curriculum: Fundamentals, Setup, Movement
- Intellitek REC curriculum:
  - Instructional videos
  - Reading material
  - Exercise
- Lectures on various parts of the videos
Assessments/Evaluations:

- Students will be able to connect to the robot via VEXnet wireless keys
- Formative: Teacher observation of student demonstration of activities:
  - Program Clawbot to move in a straight line for 6 ft. with ¼” error, then turn 90 degrees and complete 3 ft. with ¼” error
  - Program Clawbot for autonomous control
- Summative: Students will be able to program Clawbot to perform above tasks within guidelines and present this to the teacher

Sample Assessment Questions:

- What code differences are present when programming a 90-degree turn?

Instructional Resources/Tools:

- Robotc.net curriculum
- Intellitek REC curriculum

Cross Curricular Connections:

- English – Technical:
  - reading
  - writing
  - discussion
- Math: Number sense and recognizing the relationship of various functions
- Science:
  - Investigate
  - Reason
  - Critical thinking
  - Analyze the motion of an object

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics I

Curricular Unit: Sensors (Robotics I Portion)

Instructional Unit: V. Create, analyze, and troubleshoot a program that utilizes Line Trackers

Standard Alignments (Section 2)

<table>
<thead>
<tr>
<th>SCCLE:</th>
<th>SC2.1.A (Physics I); SC7.1.A (Physics I)</th>
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<td>NETS:</td>
<td>3c; 4b; 6a</td>
</tr>
<tr>
<td>Performance:</td>
<td>3.1, 3.4, 4.5</td>
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</tbody>
</table>

Unit (Section 3)

Learning Targets:

- Program the robot to follow a line provided on the floor of the classroom
- Identify problems with line trackers
- Identify benefits of line trackers
- Identification, execution, and troubleshooting of these commands or statements:
  - If, Else statements
  - While
  - Light and Dark thresholds
  - Clear Timer
  - Sensor Values
  - Sensor Configuration

Instructional Strategies:

- The teacher will help if needed, while trying to implement troubleshooting skills
- Instructional videos at Robotc.net VEX Cortex Curriculum: Movement, Sensors
- Intellitek REC curriculum:
  - Instructional videos
  - Reading material
  - Exercise
- Lectures on various parts of the videos
Assessments/Evaluations:

- Students will be able to connect to the robot via VEXnet wireless keys
- Formative: Teacher observation of student demonstration of activities:
  - Program Clawbot to follow a black line on the floor at full speed
  - Program Clawbot line trackers
- Summative: Student will be able to program Clawbot to perform above tasks within guidelines and present this to the teacher

Sample Assessment Questions:

- What real world applications do line-tracking robots have?

Instructional Resources/Tools:

- RoboTc.net curriculum
- Intellitek REC curriculum

Cross Curricular Connections:

- English – Technical:
  - reading
  - writing
  - discussion
- Math: Number sense and recognizing the relationship of various functions
- Science:
  - Investigate
  - Reason
  - Critical thinking
  - Analyze the motion of an object

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</thead>
<tbody>
<tr>
<td>DOK: 4</td>
</tr>
</tbody>
</table>
Curriculum: Mechatronics I

Curricular Unit: Sensors (Robotics I Portion)

Instructional Unit: W. Create a program that assesses the possibility of Line Trackers that go AWOL

### Standard Alignments (Section 2)

<table>
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<th>SCCLE: SC2.1.A (Physics I); SC7.1.A (Physics I)</th>
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<td>NETS: 3c; 4b; 6a</td>
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<tr>
<td>Performance: 3.1, 3.4, 4.5</td>
<td></td>
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</tbody>
</table>

### Unit (Section 3)

#### Learning Targets:

- Create a program to find the line autonomously no matter where it is
- Combine the line tracker program to the line finder program and make them work together
- Program the robot to find the line after losing it for “x” amount of time
- Identification, execution, and troubleshooting of these commands or statements:
  - INT or initiate
  - Timer

#### Instructional Strategies:

- The teacher will help if needed, while trying to implement troubleshooting skills
- Instructional videos at Robotc.net VEX Cortex Curriculum: Movement, Sensors
- Intellitek REC curriculum:
  - Instructional videos
  - Reading material
  - Exercise
- Lectures on various parts of the videos
Assessments/Evaluations:
- Students will be able to connect to the robot via VEXnet wireless keys
- Formative: Teacher observation of student demonstration of activities:
  - Program Clawbot to follow a black line on the floor at full speed. Then when the line is interrupted, it will find its way back to the line autonomously
  - Program Clawbot line trackers with an imbedded code to compensate for the above statement
- Summative: Students will be able to program Clawbot to perform above tasks within guidelines and present this to the teacher

Sample Assessment Questions:
- What real world problems could arise if a robot got off the line provided?

Instructional Resources/Tools:
- RoboC.net curriculum
- Intellitek REC curriculum

Cross Curricular Connections:
- English – Technical:
  - reading
  - writing
  - discussion
- Math: Number sense and recognizing the relationship of various functions
- Science:
  - Investigate
  - Reason
  - Critical thinking
  - Analyze the motion of an object

**Depth of Knowledge (Section 5)**

DOK: 4
Standard Alignments (Section 2)

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<td>CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4</td>
</tr>
<tr>
<td>NETS: 3b,c</td>
</tr>
<tr>
<td>Performance: 1.8, 1.10, 3.1, 3.2</td>
</tr>
</tbody>
</table>

Unit (Section 3)

Learning Targets:

- Construct multistage circuits according to schematic diagrams
- Surface-mount solder and desolder components (e.g., defective and replacement) to IPC standards
- Through-hole solder and desolder components (e.g., defective and replacement)
- Troubleshoot student-constructed soldering kits

Instructional Strategies:

- Soldering handouts
- Students will:
  - solder and desolder various electronic components in printed circuit boards
  - build functional electronic devices from soldered board work kits

Assessments/Evaluations:

- Formative:
  - Soldering techniques observed by the teacher of student demonstration/performance
  - Unit questions
- Formative/summative:
  - Lab evaluations created by the teacher – assessed using informal observation
  - Assessment of relevant live work when available
- Summative:
  - Projects
  - Practical exam
  - Tests developed by the teacher

Sample Assessment Questions:

- What are the six parts of a complete circuit?
### Instructional Resources/Tools:
- Electronic supplies
- YouTube videos on soldering
- Handouts made by the teacher

### Cross Curricular Connections:
- ELA – Technical:
  - reading
  - writing
  - discussion

### Depth of Knowledge (Section 5)
DOK: 3
Curriculum: Mechatronics I

Curricular Unit: Sensors (Robotics II Portion)

Instructional Unit: Y. Create, analyze, and troubleshoot a program that utilizes ultrasonic range finders

Standard Alignments (Section 2)

SCCLE: SC7.1.A (Physics I); SC2.1.A (Physics I)
Knowledge: (CA) 1,3  (MA) 4  (SC) 2
CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3
NETS: 3c; 4b; 6a
Performance: 3.1, 3.4, 4.5

Unit (Section 3)

Learning Targets:

- Program the robot to run autonomously
- Recognize benefits of ultrasonic range finders
- Identify benefits of ultrasonic range finders
- Identification, execution, and troubleshooting of these commands and statements: Sonar Sensor Values

Instructional Strategies:

- The teacher will help if needed, while trying to implement troubleshooting skills
- Instructional videos at Robotc.net VEX Cortex curriculum: Movement, Sensors
- Intellitek REC curriculum:
  - Instructional videos
  - Reading material
  - Exercise
  - Lectures on various parts of the videos

Assessments/Evaluations:

- Students will be able to connect to the robot via VEXnet wireless keys
- Formative: Teacher observation of student demonstration of activities:
  - Program Clawbot to follow a black line on the floor at full speed. Then, when the line is interrupted it will find its way back to the line autonomously
  - Program Clawbot to make decisions based on the color of the line on the floor as to where to go
  - Program Clawbot line trackers with imbedded code to compensate for the above statement
- Add a Ultrasonic Range Finder to the Clawbot
- Program the URF to stop the Clawbot when something is in its path
- Summative: Students will be able to program Clawbot to perform above tasks within guidelines and present this to the teacher

Sample Assessment Questions:

- What real world problems could arise if the URF was not present?

Instructional Resources/Tools:

- Robotc.net curriculum
- Intellitek REC curriculum

Cross Curricular Connections:

- ELA – Technical:
  - reading
  - writing
  - discussion
- Math: Number sense and recognizing the relationship of various functions
- Science:
  - Investigate
  - Reason
  - Critical thinking
  - Analyze the motion of an object

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics I

Curricular Unit: Sensors (Robotics II Portion)

Instructional Unit: Z01. Create, analyze, and troubleshoot a program that utilizes an ultrasonic range finders’ diverting path

**Standard Alignments (Section 2)**

| SCCLE: SC2.1.A (Physics I); SC7.1.A (Physics I) |
| Knowledge: (CA) 1,3  (MA) 4  (SC) 2 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3 |
| NETS: 3c; 4b; 6a |
| Performance: 3.1, 3.4, 4.5 |

**Unit (Section 3)**

Learning Targets:

- Create a program when the line tracker finds an object it:
  1. stops, then moves around the object
  2. finds the line back
  3. runs this program as a loop

- Identify benefits of ultrasonic range finders

- Combine multiple program codes together

Instructional Strategies:

- The teacher will help, if needed, while trying to implement troubleshooting skills
- Instructional videos at Robotc.net VEX Cortex curriculum: Movement, Sensors
- Intellitek REC curriculum:
  - Instructional videos
  - Reading material
  - Exercise
  - Lectures on various parts of the videos

Assessments/Evaluations:

- Students will be able to connect to the robot via VEXnet wireless keys
- Formative: Teacher observation of student demonstration of activities:
  - Program Clawbot to follow a black line on the floor at full speed. Then when the line is interrupted it will find its way back to the line autonomously
  - Program Clawbot to make decisions based on the color of the line on the floor as to where to go
  - Program Clawbot line trackers with imbedded code to compensate for the above statement
- Program the URF to stop the Clawbot when something is in its path
- Program the URF to wait 3 seconds when something is in its path, then slowly move around the object, find the line back and continue
- Summative: Students will be able to program Clawbot to perform above tasks within guidelines and present this to the teacher

Sample Assessment Questions:

- What real world problems could arise if robots must stop due to objects in the way?

Instructional Resources/Tools:

- Robotic.net curriculum
- Intellitek REC curriculum

Cross Curricular Connections:

- ELA – Technical:
  - reading
  - writing
  - discussion
- Math: Number sense and recognizing the relationship of various functions
- Science:
  - Investigate
  - Reason
  - Critical thinking
  - Analyze the motion of an object

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics I

Curricular Unit: Swept Away Challenge (Robotics II Portion)

Instructional Unit: Z02. Designing and competing with robots

**Standard Alignments (Section 2)**

| SCCLE: SC2.1.A (Physics I); SC7.1.A (Physics I) |
| Knowledge: (CA) 1,3  (MA) 4  (SC) 2 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3 |
| NETS: 3c; 4b; 6a |
| Performance: 3.1, 3.4, 4.5 |

**Unit (Section 3)**

**Learning Targets:**
- Design a robot that meets the specifications of the Swept Away Challenge game
- Program a robot to meet the specifications of the Swept Away Challenge game

**Instructional Strategies:**
- The teacher will help, if needed, while trying to implement troubleshooting skills
- Instructional videos at Robotc.net VEX Cortex curriculum: Movement, Sensors, The Game
- Intellitek REC curriculum:
  - Instructional videos
  - Reading material
  - Exercise
  - Lectures on various parts of the videos

**Assessments/Evaluations:**
- Students will be able to connect to the robot via VEXnet wireless keys
- Formative: Teacher observation of student demonstration of activities:
  - Design a robot that meets the Swept Away Challenge specifications
  - Build a robot that meets the Swept Away Challenge specifications
  - Program a robot that meets the Swept Away Challenge specifications
  - Compete, in the game, against other students in the classroom as teams of 2
  - Keep detailed notes in Engineering notebooks as stated by the teacher
- Summative: Students will be able to perform above tasks within guidelines and present this to the teacher

**Sample Assessment Questions:**
- How does the design process benefit by having partners?
Instructional Resources/Tools:

- *Robotc.net* curriculum
- *Intellitek REC* curriculum

Cross Curricular Connections:

- ELA – Technical:
  - reading
  - writing
  - discussion
- Math: Number sense and recognizing the relationship of various functions
- Science:
  - Investigate
  - Reason
  - Critical thinking
  - Analyze the motion of an object

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics I

Curricular Unit: Gantry Crane (Robotics II Portion)

Instructional Unit: Z03. Research, develop, and build robots

### Standard Alignments (Section 2)

| SCCLE: SC2.1.A (Physics I); SC7.1.A (Physics I) | Knowledge: (CA) 1,3  (MA) 4  (SC) 2 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3 |
| NETS: 3c; 4b; 6a | Performance: 3.1, 3.4, 4.5 |

### Unit (Section 3)

**Learning Targets:**

- Design a robot that meets the specifications provided by the teacher
- Create a program robot to meet the specifications provided by the teacher
- Basic understanding of:
  - structural strength based on height
  - block and tackle systems
  - rack and gear systems

**Instructional Strategies:**

- The teacher will help, if needed, while trying to implement troubleshooting skills
- Instructional videos at Robotc.net VEX Cortex curriculum: Movement, Sensors, The Game
- Intellitek REC curriculum:
  - Instructional videos
  - Reading material
  - Exercise
  - Lectures on various parts of the videos

**Assessments/Evaluations:**

- Formative: Teacher observation of student demonstration of activities:
  - Design a robot that lifts a minimum of 25 lbs.
  - Build a robot that is able to drive around with weight attached
  - Program a robot that can steer with weight attached
  - Keep detailed notes in their Engineering Notebooks as stated by the teacher
- Summative: Students will be able to perform above tasks within guidelines and present this to the teacher
Sample Assessment Questions:

- How does a “block and tackle assembly” work?

Instructional Resources/Tools:

- *Robotc.net* curriculum
- *Intellitek REC* curriculum

Cross Curricular Connections:

- ELA – Technical:
  - reading
  - writing
  - discussion
- Math: Number sense and recognizing the relationship of various functions
- Science:
  - Investigate
  - Reason
  - Critical thinking
  - Analyze the motion of an object

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics I

Curricular Unit: Autodesk Inventor (Robotics II Portion)

Instructional Unit: Z04. Designing a chess piece (Part A)

**Standard Alignments (Section 2)**

<table>
<thead>
<tr>
<th>GLE/CLE: N/A</th>
<th>Knowledge: (CA) 1,3</th>
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<tr>
<td>CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4</td>
<td>NETS: 3b,c</td>
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<tr>
<td>Performance: 3.1, 3.4, 4.5</td>
<td></td>
</tr>
</tbody>
</table>

**Unit (Section 3)**

**Learning Targets:**

- Locate, understand, and use the tools in Autodesk
- Create a chess piece using Autodesk
- Utilize the MakerBot 3D printer to print the pawn or rook

**Instructional Strategies:**

- The teacher will help, if needed, while trying to implement troubleshooting skills
- Instructional videos at:
  - Autodesk Inventor curriculum in printed form
  - Youtube.com
- Lectures on various parts of the videos

**Assessments/Evaluations:**

- Formative: Teacher observation of student demonstration of activities:
  - Find the tools available for the design process
  - Design a pawn or rook using the software
- Summative: Students will be able to perform above tasks within guidelines and present this to the teacher

**Sample Assessment Questions:**

- What is the process for making a curved line?

**Instructional Resources/Tools:**

- Robotc.net curriculum
Cross Curricular Connections:

- ELA – Technical:
  - reading
  - writing
  - discussion

**Depth of Knowledge (Section 5)**

DOK: 3
Curriculum: Mechatronics I

Curricular Unit: Autodesk Inventor (Robotics II Portion)

Instructional Unit: Z05. Designing and printing an advanced chess piece (Part B)

### Standard Alignments (Section 2)

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<tr>
<th>GLE/CLE: N/A</th>
<th>Knowledge: (CA) 1,3</th>
<th>CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4</th>
<th>NETS: 3b,c</th>
<th>Performance: 3.1, 3.4, 4.5</th>
</tr>
</thead>
</table>

### Unit (Section 3)

**Learning Targets:**

- Utilize “supports” option in MakerWare to have vertical and horizontal printing ability
- Create and print a chess piece, king or queen, using Autodesk

**Instructional Strategies:**

- The teacher will help, if needed, while trying to implement troubleshooting skills
- Instructional videos at:
  - Autodesk Inventor curriculum in printed form
  - Youtube.com
- Lectures on various parts of the videos

**Assessments/Evaluations:**

- Formative: Teacher observation of student demonstration of activities:
  - Find the tools available for the design process
  - Design a king or queen using the software
- Summative: Students will be able to perform above tasks within guidelines and present this to the teacher

**Sample Assessment Questions:**

- Can you describe the process of measuring the piece with the software?

**Instructional Resources/Tools:**

- Roboc.net curriculum
Cross Curricular Connections:

- ELA – Technical:
  - reading
  - writing
  - discussion

Depth of Knowledge (Section 5)

DOK: 4
Curriculum: Mechatronics I

Curricular Unit: 3D Printing (Robotics II Portion)

Instructional Unit: Z06. Discover the uses of the MakerWare software and maintain and repair the MakerBot 3D printer

**Standard Alignments (Section 2)**

<table>
<thead>
<tr>
<th>GLE/CLE: N/A</th>
</tr>
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<tbody>
<tr>
<td>Knowledge: (CA) 1,3  (MA) 1</td>
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<td>CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1</td>
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<tr>
<td>NETS: 3c; 6a</td>
</tr>
<tr>
<td>Performance: 3.1, 3.4, 4.5</td>
</tr>
</tbody>
</table>

**Unit (Section 3)**

**Learning Targets:**
- Locate, understand, and use the tools in the MakerWare software
- Load/unload filament for the 3D printer
- Level the building plate on the 3D printer
- Print chess pieces and clear faults if they occur
- Troubleshoot problems with the extruder and filament spooling

**Instructional Strategies:**
- The teacher will help, if needed, while trying to implement troubleshooting skills
- Instructional information found at:
  - Autodesk Inventor curriculum in printed form
  - [https://www.youtube.com/watch?v=FIDEK1WymhA](https://www.youtube.com/watch?v=FIDEK1WymhA)
  - Lectures on various parts of the videos

**Assessments/Evaluations:**
- Formative: Teacher observation of student demonstration of activities:
  - Find the tools available for the printing process
  - Maintain the 3D printer
  - Troubleshoot problems with the 3D printer
  - Print objects on the printer
- Summative: Students will be able to perform above tasks within guidelines and present this to the teacher
Sample Assessment Questions:

- How do you change the filament during the printing process?

Instructional Resources/Tools:

- *Robotc.net* curriculum

Cross Curricular Connections:

- ELA – Technical:
  - reading
  - writing
  - discussion
- Math: Number sense

### Depth of Knowledge (Section 5)

DOK: 4
Curriculum: Mechatronics I

Curricular Unit: Mechanical Collectors Swept Away Challenge (Robotics II Portion)

Instructional Unit: Z07. Designing and competing with robots using a mechanical collector system

**Standard Alignments (Section 2)**

| SCCLE: SC2.1.A (Physics I); SC7.1.A (Physics I) |
| Knowledge: (CA) 1,3  (MA) 4  (SC) 2 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3 |
| NETS: 3c; 4b; 6a |
| Performance: 3.1, 3.4, 4.5 |

**Unit (Section 3)**

**Learning Targets:**
- Design a robot that meets the specifications of the game while using mechanical collector systems for obtaining the balls and delivering them
- Create a program their robot to use their type of mechanical collection system to meet the specifications of the game

**Instructional Strategies:**
- The teacher will help, if needed, while trying to implement troubleshooting skills
- Instructional videos at Robotc.net VEX Cortex curriculum: Movement, Sensors, The Game
- Lectures on various parts of the videos
- Intellitek REC curriculum:
  - Instructional videos
  - Reading material
  - Exercise

**Assessments/Evaluations:**
- Students will be able to connect to the robot via VEXnet wireless keys
- Formative: Teacher observation of student demonstration of activities:
  - Design a robot with a motorized mechanical collection system that meets the Swept Away Challenge specifications
  - Build a robot motorized mechanical collection that meets the Swept Away Challenge specifications
  - Program a robot that utilizes a motorized mechanical collection that meets the Swept Away Challenge specifications
  - Compete in the game against other students in the classroom as teams of 2
  - Keep detailed notes in Engineering notebooks as stated by the teacher
- Summative: Students will be able to perform above tasks within guidelines and present this to the teacher

Sample Assessment Questions:

- How many types of motorized mechanical collection systems did you find and what were they?

Instructional Resources/Tools:

- Robotc.net curriculum
- Intellitek REC curriculum

Cross Curricular Connections:

- ELA – Technical:
  - reading
  - writing
  - discussion
- Math: Number sense and recognizing the relationship of various functions
- Science:
  - Investigate
  - Reason
  - Critical thinking
  - Analyze the motion of an object

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics I

Curricular Unit: Traction and Center of Gravity (Robotics II Portion)

Instructional Unit: Z08. Design and construct a robot that competes in a game of Tug of War

**Standard Alignments (Section 2)**

| SCCLE: SC2.1.A,B (Physics I); SC7.1.A (Physics I) |
| Knowledge: (CA) 1,3  (MA) 4  (SC) 2 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3 |
| NETS: 3c; 4b; 6a |
| Performance: 3.1, 3.4, 4.5 |

**Unit (Section 3)**

**Learning Targets:**

- Design a robot that utilizes traction and center of gravity to out-pull opponents
- Design and construct a robot that competes in a game of Tug of War
- Basic understanding of using weight properties to affect traction, center of gravity, and torque

**Instructional Strategies:**

- The teacher will help, if needed, while trying to implement troubleshooting skills
- Instructional videos at Robotc.net VEX Cortex curriculum: Movement, Sensors, the Game.
- Intellitek REC curriculum:
  - Instructional videos
  - Reading material
  - Exercise
  - Lectures on various parts of the videos

**Assessments/Evaluations:**

- Students will be able to connect to the robot via VEXnet wireless keys
- Formative: Teacher observation of student demonstration of activities:
  - Design a robot with maximum traction and center of gravity
  - Build a robot that can out-pull their opponents
  - Program a robot that utilizes traction and center of gravity
  - Compete in the game against other students in the classroom as teams of 2
  - Keep detailed notes in Engineering notebooks as stated by the teacher
- Summative: Students will be able to perform above tasks within guidelines and present this to the teacher
Sample Assessment Questions:

- How did you decide on the wheels or tracks used on your robot?

Instructional Resources/Tools:

- Robotc.net curriculum
- Intellitek REC curriculum

Cross Curricular Connections:

- ELA – Technical:
  - reading
  - writing
  - discussion
- Math: Number sense and recognizing the relationship of various functions
- Science:
  - Investigate
  - Reason
  - Critical thinking
  - Analyze the motion of an object
  - Describe the gravitational force on objects

**Depth of Knowledge (Section 5)**

DOK: 4
Curriculum: Mechatronics I

Curricular Unit: Alternate Methods of Wheel Systems *(if time permits)* (Robotics II Portion)

Instructional Unit: Z09. Design a robot that utilizes Mecanum Wheels

**Standard Alignments (Section 2)**

| SCCLE: SC2.1.A (Physics I); SC7.1.A (Physics I) |
| Knowledge: (CA) 1,3  (MA) 4  (SC) 2 |
| CCSS: 11-12.SL.1; 11-12.L.4; 11-12.RST.3; 11-12.RST.4; 11-12.WHST.4; N-Q.1; F-BF.3 |
| NETS: 3c; 4b; 6a |
| Performance: 3.1, 3.4, 4.5 |

**Unit (Section 3)**

**Learning Targets:**

- Design a robot that utilizes Mecanum wheels
- Utilize partner controller to perform multiple functions at a time

**Instructional Strategies:**

- The teacher will help, if needed, while trying to implement troubleshooting skills
- Instructional videos at *Robotc.net* VEX Cortex curriculum: Movement, Sensors, and YouTube
- *Intellitek REC* curriculum:
  - Instructional videos
  - Reading material
  - Exercise
  - Lectures on various parts of the videos

**Assessments/Evaluations:**

- Students will be able to connect to the robot via VEXnet wireless keys
- Formative: Teacher observation of student demonstration of activities:
  - Design a robot with Mecanum wheels
  - Build a robot that uses Mecanum wheels
  - Program a robot that utilizes Mecanum wheels with one controller and with a partner controller as well
  - Compete in the game against other students in the classroom as teams of 2
  - Keep detailed notes in Engineering notebooks as stated by the teacher
- Summative: Students will be able to perform above tasks within guidelines and present this to the teacher
Sample Assessment Questions:

- What real world applications did you find for Mecanum wheels and why are these better than conventional wheels?

Instructional Resources/Tools:

- *Robotc.net* curriculum
- *Intellitek REC* curriculum

Cross Curricular Connections:

- ELA – Technical:
  - reading
  - writing
  - discussion
- Math: Number sense and recognizing the relationship of various functions
- Science:
  - Investigate
  - Reason
  - Critical thinking
  - Analyze the motion of an object

**Depth of Knowledge (Section 5)**

DOK: 4