**Essentials of STEM Robotics**

**Rationale**

The Virginia Beach City Public Schools STEM Robotics Challenge (SRC) is designed to stimulate the interest and enthusiasm of all students, but in particular young women and minorities in grades 5-12 in the fields of science, technology, engineering, and mathematics (STEM). The goal is to increase student interest in STEM related fields by engaging them in hands-on, real world activities.

Students will explore issues/problems that address the VBCPS 21st Century Skills. To problem solve effectively students will utilize both critical and creative thinking strategies in a collaborative setting. Additionally, students will communicate their findings to an authentic audience. Concepts such as sustainability, social responsibility, and interdependence will be explored to allow students to make conscious informed decisions.

The engineering design process (EDP), used by professionals in multiple occupations, is the framework that will guide teachers and students in SRC activities. This framework will provide students with the tools needed to make process decisions culminating in the production of a robot that performs a specific function.

Students will conduct an in-depth exploration of systems through the SRC. Throughout the year, they will understand how parts contribute to the whole and how systems interact with each other. Additionally, students will grapple with system failures which mirror real-life experiences. Ultimately, sustainability [where economics, environment and society foster responsible development] is the lens through which students examine systems.

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| **Enduring Understandings** | **Essential Questions** |
| The success of a system often relies on the interdependence on its parts. | Why do systems to fail?  How is mechatronics an example of a complex system? |
| Sustainability is a dynamic condition often characterized by the interconnection and interdependency among ecological, economic, and social systems. | How does the Virginia Beach oceanfront environment impact tourism (economic impact)?  Why is waste such a hard problem to solve? |
| Engineering design process is a problem-solving method that can be utilized as a tool to make informed decisions. | Why is it important to be knowledgeable of various problem-solving methods?  When is the engineering design process an effective problem-solving method?  How is the engineering by design process non-linear? |

**Objectives**

*It is expected that students will:*

* Practice proper safety techniques while working with electronics.
* Explain the importance and need for sustainability in our society.
* Utilize the steps of the Engineering Design Loop used by VBCPS.
* Identify sources of energy.
* Identify voltage, current, and electricity.
* Utilize the tools and components used in the STEM Robotics Challenge.
* Utilize proper soldering/de-soldering techniques to solder and de-solder components on a printed circuit boards.

**Performance Assessment**

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| Activity | Assessment | Weight |
| Electronic Portfolio  (Engineering Design Process) | Electronic Portfolio Rubric | 50% |
| Level I Challenge | Level I Guidelines | 50% |

* The electronic portfolio will be used to document the groups understanding and implementation of the engineering design process throughout the entire SRC. A scoring rubric will be used to assess the quality of the electronic portfolio.
* A rubric will be used to assess the electronic portfolio according to established criteria utilizing the engineering design process.
* The Level I guidelines will be used to assess the performance of the robots each group designed for the SRC.

**SRC Key Terms – (see Appendix)**

**Scope & Sequence**

**SRC Overview**

* The mentor will initiate a conversation on electronics with students. Students will discuss how life would be if they were unable to use any electronics (PS3, TV, iPod, iPad, etc.). Have students list the electronics they can’t live without and why they are so important to them.
* The mentor will give students an overview of the SRC, the activities they will engage in, and what skills they will have obtained by the end of the school year.
  + [SRC Overview](http://srcvb1.weebly.com/index.html)
  + [STEM Robotics Video](http://www.vbschools.com/TCE/STEM.asp) – click on the 1st video on the website
* Design Brief Challenge – Introduction to this years “problem statement”
* The mentor will describe the [three systems of sustainability](http://www.vbschools.com/TCE/Green/). *(The hyperlinked webpage has lots of useful info and videos related to sustainability)*
* Students will take notes.
* Students will compose a paragraph explaining their understanding of sustainability and describe one way it impacts Virginia Beach.

**Engineering Design & Engineering Journal**

* The mentor will review the [SRC Engineering Design Loop](Lessons/Engineering%20Design%20&%20Engineering%20Journal/Mentor%20Resources/SRC%20ENGINEERING%20DESIGN%20LOOP.doc) with students.
* Students will take notes.
* The mentor will review the presentation on Engineering Journals with students.
  + [Engineering Journal Presentation](Lessons/Engineering%20Design%20&%20Engineering%20Journal/Engineering%20Journal.ppt)
* Students will take notes and answer the following question: *Why is it important to keep a written journal of your experience when working on a project?*
* The mentor will introduce this year’s [**Electronic Portfolio**](Lessons/Engineering%20Design%20&%20Engineering%20Journal/ePortfolio/VBCPS_Eportfolio.ppt) to the students and its role in the challenge**.\*\*\*(1 e-portfolio per team required)**

For additional info refer to the [Mentors e-Portfolio Guide](Lessons/Engineering%20Design%20&%20Engineering%20Journal/Mentor%20Resources/Mentor's%20ePortfolio%20Guide.docx).

* The mentor will introduce Step 1 of the [Engineering Design Loop](Lessons/Engineering%20Design%20&%20Engineering%20Journal/Mentor%20Resources/SRC%20ENGINEERING%20DESIGN%20LOOP.doc) (have students copy the [Guiding Question](Lessons/Engineering%20Design%20&%20Engineering%20Journal/Mentor%20Resources/Guiding%20Questions.docx) for Step 1.
* Students will do research on the need to find a solution to the problem identified in the [Clean the Beach Level 1 Design Brief](Lessons/Engineering%20Design%20&%20Engineering%20Journal/Mentor%20Resources/Clean%20the%20Beach%20Level%201%20Design%20Brief%209.12.12.doc).
* The mentor will introduce Step 2 of the [Engineering Design Loop](Lessons/Engineering%20Design%20&%20Engineering%20Journal/Mentor%20Resources/SRC%20ENGINEERING%20DESIGN%20LOOP.doc) (have students copy the [Guiding Questions](Lessons/Engineering%20Design%20&%20Engineering%20Journal/Mentor%20Resources/Guiding%20Questions.docx) for Step 2.
* Students will conduct research on what current and past measures have been done to address this problem.
* The mentor will begin pairing students up in teams (2 robots per team = 4 students).
  + Students will develop team names & logos.

***PowerPoints***

Engineering Journal Presentation

Electronic Portfolio

***Documents***

Mentors Guide to Using the E-portfolio

Engineering Design Loop

Guiding Questions

Clean the Beach Level 1 Design Brief

**SRC Level 1 Guidelines**

* The mentor will review [SRC Level I Guidelines](Lessons/SRC%20Level%20I%20Guidelines/SRC%202013%20Level%201%20RULES%2010.10.12.docx) with students.
* Students will take notes in their journal (make sure students take notes on topics related to time and distance constraints in challenge).
* The mentor will introduce Step 2 of the [Engineering Design Loop](Lessons/Engineering%20Design%20&%20Engineering%20Journal/Mentor%20Resources/SRC%20ENGINEERING%20DESIGN%20LOOP.doc) (have students copy the [Guiding Questions](Lessons/Engineering%20Design%20&%20Engineering%20Journal/Mentor%20Resources/Guiding%20Questions.docx) for Step 2.
* Students will conduct research on what current and past measures have been done to address this problem.

***Documents***

Level I Guidelines

SRC Engineering Design Loop

Guiding Questions

**Mechatronics-Charlie**

* Electrical/Mechanical Connection – Charlie

**SRC Safety Overview**

* The mentor will pass out and review [Parent Letter/Safety Pledge](Lessons/Safety/SRC%20Students%20and%20Parents%20Letter-Safety%20Pledge.doc) with students.
* The mentor will review the [Safety PPT](Lessons/Safety/SRC%20General%20Safety%20Procedures.ppt) with the students
* The mentor will give review a test on Safety (make students write down each question).
* Students will take [Safety Test](Lessons/Safety/SRC%20Safety%20Test-Final.doc)

***PowerPoints***

SRC Safety Procedures

***Documents***

SRC Safety Pre-test

**Appendix**

**SRC Key Terms**

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| * Sustainability * Design Process * Capacitor |
| * Cog |
| * Cold Solder Joint |
| * Digital Multimeter |
| * LED |
| * Microcontroller |
| * Ohm's Law |
| * Parralax Propeller |
| * Pin header |
| * Printed Circuit Board |
| * Resistor |
| * Resistor Color Code |
| * Scientific Notation |
| * SI Notation |
| * Solder |
| * Solder Bridge |
| * Soldering |
| * Soldering Iron |
| * Tinning |
| * Transistor |
| * Antenna |

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**Standards and Benchmarks Addressed**

***Standards for Technological Literacy –*** *Numerous Standards for Technological Literacy are*

*addressed.*

***National Science Education Standards***

Standard K-12: Unifying Concepts and Processes:  As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes;

* Form and function
* Evidence, models, and explanation

***Principles and Standards for School Mathematics***

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| Number and Operations: | Instructional programs from pre-kindergarten through grade 12 should enable all students to; understand numbers, ways of representing numbers, relationships among numbers, and number systems; understand meanings of operations and how they relate to one another; compute fluently and make reasonable estimates. |
| Algebra: | Instructional programs from pre-kindergarten through grade 12 should enable all students to; understand patterns, relations, and functions; represent and analyze mathematical situations and structures using algebraic symbols;  use mathematical models to represent and understand quantitative relationships; analyze change in various contexts. |

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| Data Analysis and Probability: | Instructional programs from pre-kindergarten through grade 12 should enable all students to; formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them; select and use appropriate statistical methods to analyze data; develop and evaluate inferences and predictions that are based on data; understand and apply basic concepts of probability |

***Standards for English Language Arts***

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| Standard 4: | Students adjust their use of spoken, written, and visual language (e.g. conventions, style, vocabulary) to communicate effectively with a variety of audiences and for different purposes. |
| Standard 12: | Students use spoken, written and visual language to accomplish their own purposes (e.g. for learning, enjoyment, persuasion, and the exchange of information). |