Unit 2: Coding (Robotics) and STEM

CONTENT AREA: STEM	**GRADES:** 8	**UNIT:** 2 of 2
Pacing: February to June (1 Semester)		

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.

- Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1)

Developing and Using Models
Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4)

Analyzing and Interpreting Data
Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing

Disciplinary Core Ideas

8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

A. Technology Operations and Concepts
- Understand and use technology systems.
- Select and use applications effectively and productively.

B. Creativity and Innovation
- Apply existing knowledge to generate new ideas, products, or processes.
- Create original works as a means of personal or group expression.

C. Communication and Collaboration
- Interact, collaborate, and publish with peers, experts, or others by employing a variety of digital environments and media.
- Communicate information and ideas to multiple audiences using a variety of media and formats.
- Develop cultural understanding and global awareness by engaging with learners of other cultures.

Crosscutting Concepts

Influence of Science, Engineering, and Technology on Society and the Natural World

- All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ETS1-1)
- The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1)

between correlation and causation, and basic statistical techniques of data and error analysis. ● Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3) **Engaging in Argument from Evidence** Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world. ● Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2)	● Contribute to project teams to produce original works or solve problems. **D. Digital CitizenShip** ● Advocate and practice safe, legal, and responsible use of information and technology. ● Demonstrate personal responsibility for lifelong learning. ● Exhibit leadership for digital citizenship. **E. Research and Information Fluency** ● Plan strategies to guide inquiry. ● Locate, organize, analyze, evaluate, synthesize, and ethically use information from a variety of sources and media. ● Evaluate and select information sources and digital tools based on the appropriateness for specific tasks. ● Process data and report results. **F. Critical thinking, problem solving, and decision making.** ● Identify and define authentic problems and significant questions for investigation. ● Plan and manage activities to develop a solution or complete a project. ● Collect and analyze data to identify solutions and/or make informed decisions. ● Use multiple processes and diverse perspectives to explore alternative solutions.	

	<u>8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming:</u> All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment. **A. The Nature of Technology: Creativity and Innovation** ● The characteristics and scope of technology. ● The core concepts of technology. ● The relationships among technologies and the connections between technology and other fields of study. **B. Technology and Society** ● The cultural, social, economic and political effects of technology. ● The effects of technology on the environment. **C. Design** ● The attributes of design. ● The application of engineering design. ● The role of troubleshooting, research and development, invention and innovation and experimentation in problem solving. **D. Abilities for a Technological World** ● Apply the design process. ● Use and maintain technological products and systems.	

	● Assess the impact of products and systems. **E. Computational Thinking - Programming** ● Computational thinking and computer programming as tools used in design and engineering.	

Connections to MS-ETS1.A: Defining and Delimiting Engineering Problems include:

- Physical Science: MS-PS3-3

Connections to MS-ETS1.B: Developing Possible Solutions Problems include:

- Physical Science: MS-PS1-6, MS-PS3-3, Life Science: MS-LS2-5

Connections to MS-ETS1.C: Optimizing the Design Solution include:

- Physical Science: MS-PS1-6

Articulation of DCIs across grade-bands: 3-5.ETS1.A (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3); 3-5.ETS1.B (MS-ETS1-2),(MS-ETS1-3),(MS-ETS1-4); 3-5.ETS1.C (MS-ETS1-1), (MSETS1-2), (MS-ETS1-3), (MS-ETS1-4); HS.ETS1.A (MS-ETS1-1), (MS-ETS1-2); HS.ETS1.B (MS-ETS1-1), (MS-ETS1-2), (MS-ETS1-3), (MS-ETS1-4); HS.ETS1.C (MS-ETS1-3), (MS-ETS1-4)

Common Core State Standards Connections:

ELA/Literacy –

- RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts. (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3)
- RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-ETS1-3)
- RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic. (MS-ETS1-2),(MS-ETS1-3)
- WHST.6-8.7 Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-ETS1-2)
- WHST.6-8.8 Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-ETS1-1)
- WHST.6-8.9 Draw evidence from informational texts to support analysis, reflection, and research. (MS-ETS1-2)
- SL.8.5 Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. (MS-ETS1-4)

Mathematics –

- MP.2 Reason abstractly and quantitatively. (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3),(MS-ETS1-4)

- 7.EE.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. (MS-ETS1-1),(MS-ETS1-2),(MS-ETS1-3)
- 7.SP Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. (MS-ETS1-4)

Performance Expectations:

8.1.8.A: Educational Technology

- 8.1.8.A.1 Demonstrate knowledge of a real world problem using digital tools.
- 8.1.8.A.2 Create a document (e.g. newsletter, reports, personalized learning plan, business letters or flyers) using one or more digital applications to be critiqued by professionals for usability.
- 8.1.8.A.3 Use and/or develop a simulation that provides an environment to solve a real world problem or theory.
- 8.1.8.A.4 Graph and calculate data within a spreadsheet and present a summary of the results.
- 8.1.8.A.5 Create a database query, sort and create a report and describe the process, and explain the report results.

8.2.8.A: Technology Education, Engineering, Design, and Computational Thinking - Programming

- 8.2.8.A.1 Research a product that was designed for a specific demand and identify how the product has changed to meet new demands (i.e. telephone for communication - smart phone for mobility needs).
- 8.2.8.A.2 Examine a system, consider how each part relates to other parts, and discuss a part to redesign to improve the system.
- 8.2.8.A.3 Investigate a malfunction in any part of a system and identify its impacts.
- 8.2.8.A.4 Redesign an existing product that impacts the environment to lessen its impact(s) on the environment
- 8.2.8.A.5 Describe how resources such as material, energy, information, time, tools, people, and capital contribute to a technological product or system.

Evidence Statement(s): See Anticipatory Set(s)

Essential Question: How can we use coding to expand our use and knowledge of robotics?

21st Century Skills and Career Ready Practices: CRP2, CRP4, CRP5, CRP6, CRP7, CRP8 ,CRP11,CRP12

Technology: 8.1.8.A.1, 8.1.8.A.2, 8.1.8.A.3, 8.1.8.A.4, 8.1.8.A.5, 8.1.8.D.2, 8.1.8.D.3, 8.1.8.D.4, 8.1.8.D.5, 8.2.8.A.2, 8.2.8.B.1

Technical Terms (Suggested)	Core Instructional Materials	Assessment Statement
Coding Programming Log Scratch Operating System / Software Scripts	Technology: Chromebooks Smart Board Google Apps for Education (Docs, Sheets, Slides, etc.) Snap Circuits	Students who understand the concepts are able to: ● Think creatively and critically ● Collaborate with peers

Language (Python, CSS, C++, Rasperian, ...) Terminal Robotics ** All terms should be taught in context rather than in isolation. These terms should be addressed after conceptual understanding.**	Raspberry Pi KANO Computers Pi Accessories (Wheels, Sensors, Lights, etc.) Scratch YouTube <u>Classroom Materials</u>: Notebooks Pens/Pencils Colored Pencils Screwdrivers (flathead and phillips) Pliers Wrenches Wire cutters Wire String Scissors	● Understand the parts of the system(s) being discussed ● Use newfound skills to solve real world problems.

Modifications

<u>English Language Learners</u>	<u>Special Education</u>	<u>At Risk</u>	<u>Gifted & Talented</u>
Scaffolding Word walls Sentence/paragraph frames Bilingual dictionaries/translation Think alouds Read alouds Highlight key vocabulary Annotation guides Think-pair-share Visual aides Modeling Cognates	Word walls Visual aides Graphic organizers Multimedia Leveled readers Assistive technology Notes/summaries Extended time Answer masking Answer eliminator Highlighter Color contrast	Teacher tutoring Peer tutoring Study guides Graphic organizers Extended time Parent communication Modified assignments Counseling	Curriculum compacting Challenge assignments Enrichment activities Tiered activities Independent research/inquiry Collaborative teamwork Higher level questioning Critical/Analytical thinking tasks Self-directed activities

5E Model

Performance Expectation: 8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.	
Engage: Anticipatory Set	Coding - Famous Codes throughout World/US history (morse code, etc.)...with technology, codes have also changed. After a class discussion and some historical points the class will use the following link to summarize one example of a code or cypher from history. https://www.comparitech.com/blog/information-security/famous-codes-and-ciphers-through-history-and-their-role-in-modern-encryption/#gref Today coding is done much differently and we have infinite more "directions" thanks to computer programming.
Exploration: Student Inquiry	How to Keep track and Document your code? https://blog.liveedu.tv/code-documentation-tools/ Keep a Log: As the students work through the Scratch activities they should keep track of each step to learn what the code and program does (for the next time). This will help to build familiarity with the "language" and codes that are used.
Explanation: Concepts & Practices	In these lessons: Teachers Should: Introduce formal labels, definitions, and explanations for concepts, practices, skills or abilities. Students Should: Verbalize conceptual understandings and demonstrate scientific and engineering practices. Topics to Be Discussed in Teacher Directed Lessons (Disciplinary Core Ideas): 8.1 Educational Technology (A-F) and 8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming (A-E).
Elaboration: Extension Activity	Have students complete additional activities from the following unit: 1. What is coding? https://www.youtube.com/watch?v=N7ZmPYaXoic 2. Hour of Code: https://hourofcode.com/us 3. Scratch: https://scratch.mit.edu/ - Introducing Scratch, Exploring It, Introducing blocks/make scripts, Breaking up a script, accessing other tools, stopping scripts, using operators and variables. -Username Generator: https://codeclubprojects.org/en-GB/scratch/username-generator/

Evaluation: Assessment	Assessment Tasks The students will write a formal lab report about one of the three elaboration activities from this topic. Students will also have at least two quizzes on the material covered and scientific principles used during each activity. Online activities will count as lab grades and their code notebook will be factored into their homework grades.

5E Model	
Performance Expectation: 8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.	
Engage: Anticipatory Set	ROBOT Wars /Battlebots/ FIRST Robotics TV Show: I would like to gauge the students interest in robotics, coding and building by showing them an expert example of what we can accomplish with the tools we will acquire throughout this unit. We will discuss and look up further examples as we go through this introduction. Robot Wars: https://www.youtube.com/watch?v=ASKJsHa5n2U Battlebots: https://www.youtube.com/watch?v=qsJ1JmxGMK8 https://www.youtube.com/watch?v=CDDGBcs0TFM FIRST: https://www.firstinspires.org/robotics/frc
Exploration: Student Inquiry	In groups the students will open up the Raspberry Pi Kits and follow the directions to get their units started. Putting together and connecting your system, starting the NOOBS software and installing new software (Raspbian), exploring the task bar, main menu, programming tools and using the raspberry pi terminal. (How will we use them? Types of projects, etc.) The students will work in pairs to put together and take apart the KANO laptop computers. All students will need to be familiar with these since with will use various parts from it on multiple projects.

Explanation: Concepts & Practices	In these lessons: Teachers Should: Introduce formal labels, definitions, and explanations for concepts, practices, skills or abilities. Students Should: Verbalize conceptual understandings and demonstrate scientific and engineering practices. Topics to Be Discussed in Teacher Directed Lessons (Disciplinary Core Ideas): 8.1 Educational Technology (A-F) and 8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming (A-E).
Elaboration: Extension Activity	Have students complete additional activities from the following unit: 1. What is Raspberry Pi? - Getting Started: Putting together and connecting your system, starting the NOOBS software and installing new software (Raspbian), exploring the task bar, main menu, programming tools and using the raspberry pi terminal. -Projects (https://curriculum.raspberrypi.org/): - RetroPi - Robot Antanae: https://projects.raspberrypi.org/en/projects/robot-antenna - Design, Developer: Create files for a 3D body of a robot which can be used in a 3D printer - Create an Animation - https://codeclubprojects.org/en-GB/scratch/lost-in-space/ - Create your own game - https://codeclubprojects.org/en-GB/scratch/ghostbusters/ OR https://projects.raspberrypi.org/en/projects/flappy-astronaut - Laser Tripwire: https://projects.raspberrypi.org/en/projects/laser-tripwire - Echolocation: https://projects.raspberrypi.org/en/projects/see-like-a-bat - 3D Printer Directions for a Game Boy Clone (Manufacture, maker). - Grandpa Scarer: https://projects.raspberrypi.org/en/projects/grandpa-scarer 2. Python Program -Getting Started: Starting Python, finding the shell window, opening the code window, writing code, saving/running/learning to code. -Password Generator: https://codeclubprojects.org/en-GB/python/password-generator/ 3. KANO Computer Kits - Getting Started:

	4. <u>EOY Skills Challenge</u>: Students must work together in a team to successfully take apart and put back together a working piece of motorized electronics.
Evaluation: Assessment	<u>Assessment Tasks</u> The students will write a formal lab report about any two elaboration activities that we completed from this topic. Students will also have at least two quizzes on the material covered and scientific principles used during each activity. Online activities will count as lab grades and their code notebook will be factored into their homework grades.