Wayne Township Public Schools

**Wayne, New Jersey**

**Middle School Technology Department**
**8th Grade Tech Ed Curriculum Guide**
**August 2023**
**Revised**

Dr. Mark Toback, Superintendent
Mrs. Donna Reichman, Assistant Superintendent

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

Approved by the Wayne Township Board of Education at the regular meeting held on

***Wayne School District***
**Curriculum Format**

| | |
|---|---|
| **Content Area/ Grade Level/ Course:** | Unit 1<br>Grade 8<br>STEM |
| **Unit Plan Title:** | The Design and Problem-Solving Process, computational thinking, simple machines and project based learning |
| **Time Frame** | Three weeks |

**2020 New Jersey Student Learning Standards – Computer Science and Design Thinking**

- 8.2.8.ED.1: Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.
- 8.2.8.ED.2: Identify the steps in the design process that could be used to solve a problem.
- 8.2.8.ED.3: Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).
- 8.2.8.ED.4: Investigate a malfunctioning system, identify its impact, and explain the step-by-step process used to troubleshoot, evaluate, and test options to repair the product in a collaborative team.
- 8.2.8.ED.5: Explain the need for optimization in a design process.
- 8.2.8.ED.6: Analyze how trade-offs can impact the design of a product.
- 8.2.8.ED.7: Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).
- 8.2.8.ETW.1: Illustrate how a product is upcycled into a new product and analyze the short- and long-term benefits and costs.
- 8.2.8.ETW.2: Analyze the impact of modifying resources in a product or system (e.g., materials, energy, information, time, tools, people, capital).
- 8.2.8.ETW.3: Analyze the design of a product that negatively impacts the environment or society and develop possible solutions to lessen its impact.
- 8.2.8.ETW.4: Compare the environmental effects of two alternative technologies devised to address climate change issues and use data to justify which choice is best.
- 8.2.8.EC.1: Explain ethical issues that may arise from the use of new technologies.
- 8.2.8.EC.2: Examine the effects of ethical and unethical practices in product design and development.

**2022 New Jersey Student Learning Standards for Science**

- **MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.**
- **MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.**
    - ***DCI:*** *The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful.*
    - ***PRACTICE:*** *Define a 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.*

- *CROSS-CUTTING CONCEPT: 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.*
- *CROSS-CUTTING CONCEPT: 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-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.**
  - ***DCI:*** *There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.*
  - ***PRACTICE:*** *Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.*
- **MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.**
  - ***DCI:*** *Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process--that is, some of those characteristics may be incorporated into the new design.*
  - ***PRACTICE:*** *Analyze and interpret data to determine similarities and differences in findings.*
- **MS-ETS1-4: Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.**
  - ***DCI:*** *The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.*
  - ***PRACTICE:*** *Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs.*

**MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.**
**MS-PS2-2.Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.**
**MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.**
**MS-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.**
**MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.**

## Interdisciplinary Standards: New Jersey Student Learning Standards For English Language Arts Companion Standards Grade 6-8

NJSLS.ELA-LITERACY.RST.6-8.4
Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 6-8 texts and topics*.
NJSLS.ELA-LITERACY.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).

## Unit Summary

Students will be given the opportunity to review and recall the simple machines and Engineering design process. They will identify the steps of the engineering design process and follow those steps to complete a cereal box marble maze utilizing various simple machines. Students will learn the tools of Computational Thinking (decomposition, pattern matching, abstraction, and algorithms) to help learn how to problem solve. Students will have to accommodate their build revolving around the criteria and constraints given to the groups. They will create a five minute presentation to touch upon all the items researched and share their findings with the class.

**Essential Question(s)**

- Why do we use the engineering design process to solve design challenges?
- How can the engineering design process benefit us in solving problems?
- How can engineering design be used to create solutions to a problem?
- How is it possible to find several valid solutions to a single problem?
- Why is it a good idea to keep testing a design?
- How does the design meet the criteria for success presented in the challenge?
- What constitutes evidence? When do you know you have enough evidence?
- Why is it necessary to justify and communicate an explanation?
- How can energy be transferred from one material to another? What happens to a material when energy is transferred to it?
- How are levers used to help complete work?
- What is the relationship between the effort force and the effort distance?
- How do simple machines transfer energy?

**Enduring Understandings**

- The Engineering Design Process is a method that is used to solve technological challenges to change and improve products for the way we live.
- The design process gives structure to creativity.
- The design loop allows engineers to find not "a" solution but the "best" solution to a problem.
- Changes take place because of the transfer of energy. Energy is transferred to matter through the action of forces. Different forces are responsible for the transfer of the different forms of energy.

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

| *Check all that apply.* | **21st Century Themes** | *Check all that apply.* | **21st Century Skills** |
|---|---|---|---|
| X | **Global Awareness** | X | **Creativity and Innovation** |
| X | **Environmental Literacy** | X | **Critical Thinking and Problem Solving** |
| | **Health Literacy** | X | **Communication** |
| | **Civic Literacy** | X | **Collaboration** |
| X | **Financial, Economic, Business, and Entrepreneurial Literacy** | | |

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

- That creativity is a process.
- The steps and function of each step of a design process.
- That engineering design is a multi-step process.
- Why revision and refinement are imperative to the design process.
- What a design loop is.
- What products utilize simple machines, how they have changed through time and why we still use them.
- That by utilizing the simple machines many jobs can be accomplished by one device.

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

- Quizzes/Tests/recall activity
  - recall the processes involved in a design loop.
  - Identify the simple machines and their use
- *Self-assessment of performance task
- *Teacher observation of student performance tasks for evidence of process and innovation.
- *Rubric evaluation
- Presentation on the evaluation of the history and impact of sustainability on the development of the product, identity of the desired and undesired consequences from the product, and the research and analysis of the ethical issues of the product on the environment.

**Teaching and Learning Activities**

| | |
|---|---|
| *Activities* | ● Review simple machines and the design loop<br>● Students will Design and Build a marble maze that will control the fall of a marble using minimal materials while meeting specific criteria |
| *Differentiation Strategies* | Strategy and flexible groups based on formative assessment or student choice<br>One:One conferring with teacher<br>Choice of narrative or persuasive text composition<br>Differentiated checklists and rubrics (if appropriate)<br>Student selected goals for writing<br>Level of independence<br>Craft additional leads and endings for mentor texts<br>Consult mentor texts to support writing<br>ELL Supports and Extension activities are included with each lesson<br>Differentiation Strategies for Special Education Students<br>Differentiation Strategies for Gifted and Talented Students<br>Differentiation Strategies for ELL Students<br>Differentiation Strategies for At Risk Students |

**Resources**

- Computational Thinking https://code.org/curriculum/course3/1/Teacher
- Video to review Simple Machines https://www.youtube.com/watch?v=fvOmaf2GfCY
- Reviewing the engineering design process https://www.youtube.com/watch?v=MAhpfFt_mWM
- Simple machines game https://www.msichicago.org/experiment/games/simple-machines/
- Marble maze https://youtu.be/03DiH1m6hvc
- Marble Maze Rubric: https://docs.google.com/presentation/d/13X5e-xZIJ4ek4m4bkgtqd8Y5VYQ9nO-hOf-ie39hi4o/edit#slide=id.g162fbee0b47_0_50
- Article on the simple machines used in products https://sciencing.com/types-simple-machines-found-home-6387889.html

***Wayne School District***
**Curriculum Format**

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|---|---|
| **Content Area/ Grade Level/ Course:** | Unit 2<br>Grade 8<br>STEM |
| **Unit Plan Title:** | Robotics |
| **Time Frame** | 5 weeks |

**2022 New Jersey Student Learning Standards for Science**

- **MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.**
- **MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.**
    - ***DCI:*** *The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful.*
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    - ***PRACTICE:*** *Analyze and interpret data to determine similarities and differences in findings.*
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    - ***DCI:*** *The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.*

- ***PRACTICE:*** *Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs.*

**MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.**
**MS-PS2-2.Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.**
**MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.**
**MS-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.**
**MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.**

**Interdisciplinary Standards: New Jersey Student Learning Standards For English Language Arts Companion Standards Grade 6-8**

NJSLS.ELA-LITERACY.RST.6-8.4
Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 6-8 texts and topics*.
NJSLS.ELA-LITERACY.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).

**2020 New Jersey Student Learning Standards – Computer Science and Design Thinking**

8.1.5.CS.1: Model how computing devices connect to other components to form a system.
8.1.5.CS.2: Model how computer software and hardware work together as a system to accomplish tasks.
8.1.5.CS.3: Identify potential solutions for simple hardware and software problems using common troubleshooting strategies.
8.1.5.AP.1: Compare and refine multiple algorithms for the same task and determine which is the most appropriate.
8.1.5.AP.2: Create programs that use clearly named variables to store and modify data.
8.1.5.AP.3: Create programs that include sequences, events, loops, and conditionals.
8.1.5.AP.4: Break down problems into smaller, manageable sub-problems to facilitate program development. •
8.1.5.AP.5: Modify, remix, or incorporate pieces of existing programs into one's own work to add additional features or create a new program.
8.1.5.AP.6: Develop programs using an iterative process, implement the program design, and test the program to ensure it works as intended.
8.1.8.AP.1: Design and illustrate algorithms that solve complex problems using flowcharts and/or pseudocode.
8.1.8.AP.2: Create clearly named variables that represent different data types and perform operations on their values.
8.1.8.AP.3: Design and iteratively develop programs that combine control structures, including nested loops and compound conditionals.
8.1.8.AP.4: Decompose problems and subproblems into parts to facilitate the design, implementation, and review of programs.
8.1.8.AP.5: Create procedures with parameters to organize code and make it easier to reuse.

**Unit Summary**

Coding and Computational Thinking with LEGO SPIKE Prime (2.0) provides a structured sequence of programming activities in real-world project-based contexts. The projects are designed to get students thinking about the patterns and structure of not just robotics, but also programming and problem-solving more generally. This curriculum includes videos, animations, and step-by-step lessons designed to help beginners learn behavior-based programming using the LEGO SPIKE Prime hardware and the legacy 2.0 version of the Scratch-based programming software. In addition, Tello Drones may be used to have students continue programming and problem-solving using block coding. The drones can be flown in class or via simulator using the DroneBlock curriculum.

**Essential Question(s)**

- How are robots utilized in society
- How are the Spike Prime robots programmed to follow simple commands?
- How do robots utilize sensors to make decisions?
- What are the limitations of using robots?
- In what ways can/will robots replace human abilities/capabilities?
- What are the safety considerations related to working with robots?
- What types of time management skills/ resources does an engineer/ designer use to manage a project?
- What types of personnel management skills/ resources does an engineer/ designer use to manage a project?
- What types of planning skills/ resources does an engineer/ designer use to manage a project?
- What are the benefits and limitations of using scratch as a programming language to control robots?
- Why are feedback systems important in the design of robots?
- How does the type of input impact the type of sensor to be used in the design of a robot?
- Why must the purpose of the robot be factored into the design/implementation of sensors?
- What types of parameters affect the effectiveness of robotic sensors?

**Enduring Understandings**

- Students will understand…
  - How coding is used in everyday life.
  - How to code basic creations using Scratch.
  - Scratch is considered software that can interact with hardware depending on the project, task, or types of hardware and software.
  - There are many different types of programming or coding languages that range from basic to very complex.
  - Programming languages are used with various types of hardware in order to make the hardware perform the specific functions.

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

| *Check all that apply.* **21st Century Themes** | | *Check all that apply.* **21st Century Skills** | |
|---|---|---|---|
| X | **Global Awareness** | X | **Creativity and Innovation** |
| X | **Environmental Literacy** | X | **Critical Thinking and Problem Solving** |
| | **Health Literacy** | X | **Communication** |
| | **Civic Literacy** | X | **Collaboration** |
| X | **Financial, Economic, Business, and Entrepreneurial Literacy** | | |

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

- Learn the parts in the Spike Prime robotics kit.
- Analyze how the module (HUB) works and how to program.
- Operate the functions on the remote control.
- Understand loops and sequencing in programming.
- Investigate how physics/engineering concepts relate to robotics.

- Differentiate between the different types of sensors and how they work in robots: pressure, color, distance
- Construct programs for the tacobots and/or drones
- Write a basic program on computer using scratch and/or block coding
- Program, test and redesign robots/drones.

| **Assessments (Pre, Formative, Summative, Other)** | ***Denote required common assessments with an **** |
|---|---|
| *Mini challenge check ins<br>*Self-assessment of performance task<br>*Teacher observation of student performance tasks for evidence of process and innovation.<br>Presentation on group design<br>Reflection sheet | |
| **Teaching and Learning Activities** | |
| *Activities* | • Mini challenges such as:<br>  ○ Light up Matrix<br>  ○ Moving forward and backwards<br>  ○ Turning in place<br>  ○ Avoiding craters<br>  ○ Cleaning the home<br>• Combined Challenges using matrix, sensors and commands |
| *Differentiation Strategies* | Strategy and flexible groups based on formative assessment or student choice<br>One:One conferring with teacher<br>Choice of narrative or persuasive text composition<br>Differentiated checklists and rubrics (if appropriate)<br>Student selected goals for writing<br>Level of independence<br>Craft additional leads and endings for mentor texts<br>Consult mentor texts to support writing<br>ELL Supports and Extension activities are included with each lesson<br>Differentiation Strategies for Special Education Students<br>Differentiation Strategies for Gifted and Talented Students<br>Differentiation Strategies for ELL Students<br>Differentiation Strategies for At Risk Students |
| **Resources** | |
| • Carnegie Mellon Robotics Academy- https://www.cs2n.org/u/track_progress?id=539<br>• LEGO Education- https://spike.legoeducation.com/#/<br>• DroneBlocks Curriculum- https://learn.droneblocks.io/courses | |

***Wayne School District***
**Curriculum Format**

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|---|---|
| **Content Area/ Grade Level/ Course:** | Unit 3<br>Grade 8<br>STEM |
| **Unit Plan Title:** | Career Readiness |
| **Time Frame** | One week |

**2022 New Jersey Student Learning Standards for Science**

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**Unit Summary**

This unit will help students build foundational STEM knowledge, skills, and dispositions while also supporting opportunities in connecting their interests, readiness, skills, and aptitudes toward relevant STEM career pathways for future use.

| Essential Question(s) |
|---|
| ● How does exploring potential career options benefit future decisions?<br>● How do I take ownership of my future?<br>● How do decisions I make today directly influence my future?<br>● How do I start career planning now?<br>● Why must I grow and develop college and career readiness skills? |

| Enduring Understandings |
|---|
| ● Students will understand/comprehend…<br>○ In what ways they are confident, self-reliant. How do they interact with their peers? How do they know they are a critical thinker, an informed risk-taker, a self-advocate, resilient?<br>○ Where do they see themself in 2 years, 5 years, 10 years?<br>○ What are the options that they have? How can they get exposure/experience?<br>○ What are the areas of growth for the careers that they are interested in?<br>○ In what ways have personal experiences impacted or influenced their journey? |

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

| *Check all that apply.*<br>**21st Century Themes** | | *Check all that apply.*<br>**21st Century Skills** | |
|---|---|---|---|
| X | **Global Awareness** | X | **Creativity and Innovation** |
| X | **Environmental Literacy** | X | **Critical Thinking and Problem Solving** |
| | **Health Literacy** | X | **Communication** |
| | **Civic Literacy** | X | **Collaboration** |
| X | **Financial, Economic, Business, and Entrepreneurial Literacy** | | |

| Student Learning Targets/Objectives (Students will know/Students will understand) |
|---|
| ● Learn about careers in the STEM field.<br>● Describe what each job entails.<br>● Learn about schooling for various careers<br>● Build self-awareness.<br>● Discover intrinsically interesting careers. |

| Assessments (Pre, Formative, Summative, Other) *Denote required common assessments with an ** |
|---|
| Quizzes/Tests – Vocabulary<br>Self-assessment of performance task<br>*Teacher observation of student performance tasks for evidence of process and innovation.<br>*Google Form or doc |

| Teaching and Learning Activities | |
|---|---|
| *Activities* | ● Students will learn about Hollands Model, The Riasec and take the Riasec Survey using an online platform. |
| *Differentiation Strategies* | Strategy and flexible groups based on formative assessment or student choice<br>One:One conferring with teacher<br>Choice of narrative or persuasive text composition |

| | |
|---|---|
| | Differentiated checklists and rubrics (if appropriate)<br>Student selected goals for writing<br>Level of independence<br>Craft additional leads and endings for mentor texts<br>Consult mentor texts to support writing<br>ELL Supports and Extension activities are included with each lesson<br>Differentiation Strategies for Special Education Students<br>Differentiation Strategies for Gifted and Talented Students<br>Differentiation Strategies for ELL Students<br>Differentiation Strategies for At Risk Students |
| **Resources** | |

- https://www.mynextmove.org/
- https://docs.google.com/forms/d/1q992BfPJBLSjSzXpt7YLhAht415sokOdE1-FzzldYYo/edit
- https://www.hopkinsmedicine.org/fac_development/_documents/lisa_heiser_faculty_development_handout.pdf
- https://docs.google.com/document/d/1aqP82f4yrRZrlEayr9TP7ycxEZfQp2nDVoHYR8C_zkI/edit?usp=sharing
- https://www.careerinstem.com

***Wayne School District***
**Curriculum Format**

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| **Content Area/ Grade Level/ Course:** | Unit 4<br>Grade 8<br>STEM |
| **Unit Plan Title:** | Quick builds |
| **Time Frame** | One week |
| **2020 New Jersey Student Learning Standards – Computer Science and Design Thinking** | |

- 8.2.8.ED.1: Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer.
- 8.2.8.ED.2: Identify the steps in the design process that could be used to solve a problem.
- 8.2.8.ED.3: Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch).
- 8.2.8.ED.4: Investigate a malfunctioning system, identify its impact, and explain the step-by-step process used to troubleshoot, evaluate, and test options to repair the product in a collaborative team.
- 8.2.8.ED.5: Explain the need for optimization in a design process.
- 8.2.8.ED.6: Analyze how trade-offs can impact the design of a product.
- 8.2.8.ED.7: Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches).
- 8.2.8.ETW.1: Illustrate how a product is upcycled into a new product and analyze the short- and long-term benefits and costs.
- 8.2.8.ETW.2: Analyze the impact of modifying resources in a product or system (e.g., materials, energy, information, time, tools, people, capital).

- 8.2.8.ETW.3: Analyze the design of a product that negatively impacts the environment or society and develop possible solutions to lessen its impact.
- 8.2.8.ETW.4: Compare the environmental effects of two alternative technologies devised to address climate change issues and use data to justify which choice is best.
- 8.2.8.EC.1: Explain ethical issues that may arise from the use of new technologies.
- 8.2.8.EC.2: Examine the effects of ethical and unethical practices in product design and development.

**2022 New Jersey Student Learning Standards for Science**

- **MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.**
- **MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.**
    - ***DCI:*** *The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful.*
    - ***PRACTICE:*** *Define a 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.*
    - ***CROSS-CUTTING CONCEPT:*** *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.*
    - ***CROSS-CUTTING CONCEPT:*** *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-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.**
    - ***DCI:*** *There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.*
    - ***PRACTICE:*** *Evaluate competing design solutions based on jointly developed and agreed-upon design criteria.*
- **MS-ETS1-3: Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.**
    - ***DCI:*** *Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process--that is, some of those characteristics may be incorporated into the new design.*
    - ***PRACTICE:*** *Analyze and interpret data to determine similarities and differences in findings.*
- **MS-ETS1-4: Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.**
    - ***DCI:*** *The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution.*
    - ***PRACTICE:*** *Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs.*

**MS-PS2-1. Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.**
**MS-PS2-2.Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.**

**MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.**
**MS-PS2-4. Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.**
**MS-PS2-5. Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.**

**Interdisciplinary Standards: New Jersey Student Learning Standards For English Language Arts Companion Standards Grade 6-8**

NJSLS.ELA-LITERACY.RST.6-8.4
Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 6-8 texts and topics*.
NJSLS.ELA-LITERACY.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).

**Unit Summary**

Students will be given the opportunity to work individually and as a team on various quick challenges. Most of these quick builds will be a one day exploration of a topic. These quick builds will be spread throughout the marking period for students to explore various strategies with solving problems on a small scale. Students may not go all the way through the engineering design process, instead they will be given a challenge and quickly "draft" a design to build. Working together, problem-solving, and planning to come up with solutions encourages interaction and cooperation with peers.

**Essential Question(s)**

- Why do we use parts of the engineering design process to solve quick build design challenges?
- How can parts of the engineering design process benefit us in solving problems in our daily lives?
- How can parts of the engineering design be used to create solutions to a problem?
- How is it possible to find several valid solutions to a single problem?
- Why is it a good idea to keep testing a design?
- What specific goal are you trying to achieve, and how will you know if you've been successful?
- How does the design meet the criteria for success presented in the challenge?
- How are science and engineering skills used to solve design problems?

**Enduring Understandings**

- The Engineering Design Process is a method that is used to solve technological challenges to change and improve products for the way we live.
- The design process gives structure to creativity.
- The design loop allows engineers to find not "a" solution but the "best" solution to a problem.

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

| *Check all that apply.* **21st Century Themes** | | *Check all that apply.* **21st Century Skills** | |
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| X | **Global Awareness** | X | **Creativity and Innovation** |
| | **Environmental Literacy** | X | **Critical Thinking and Problem Solving** |
| | **Health Literacy** | X | **Communication** |

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| X | **Civic Literacy** | X | **Collaboration** |
| X | **Financial, Economic, Business, and Entrepreneurial Literacy** | | |

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

- Finding patterns within inquiry cubes:
    - Sometimes those patterns are very clear.
    - Sometimes there are several patterns that all describe the same thing
    - Sometimes there don't seem to be any patterns at all
    - Sometimes we find patterns that trick us into thinking unrelated data sets are connected
- Design and build various structures using KEVA planks
- Design and build a wallet out of duct tape
- Students will be able to design circuits of various functionalities and create their own circuits using the components provided in the snap circuit kit.
- Critically think to work as a group to decipher and narrow that list down

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

Quizzes/Tests – Vocabulary
Self-assessment of performance task
*Teacher observation of student performance tasks for evidence of process and innovation.

**Teaching and Learning Activities**

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| *Activities* | ● KEVA planks<br>● STEM Improv<br>● Snap Circuits<br>● Inquiry cubes<br>● Origami<br>● Duct tape wallet<br>● Cryptography |
| *Differentiation Strategies* | Strategy and flexible groups based on formative assessment or student choice<br>One:One conferring with teacher<br>Choice of narrative or persuasive text composition<br>Differentiated checklists and rubrics (if appropriate)<br>Student selected goals for writing<br>Level of independence<br>Craft additional leads and endings for mentor texts<br>Consult mentor texts to support writing<br>ELL Supports and Extension activities are included with each lesson<br>Differentiation Strategies for Special Education Students<br>Differentiation Strategies for Gifted and Talented Students<br>Differentiation Strategies for ELL Students<br>Differentiation Strategies for At Risk Students |

**Resources**

- STEM improv: https://youtu.be/c6-6ol4CccM
- Inquiry cubes: https://passionatelycuriousssci.weebly.com/blog/patterns-in-science-inquiry-cubes?fbclid=IwAR3vbdilWV1ExrONZ_jn6SyvqOexbaqwgKndkGJPznLeDTmXgyHMoaHwpgc_aem_AcZPT1rd6nzuf6rEctCTcW9qH4RmS473cOilOiWhm59gWnVsenHKxHXgwHTJEYuycas&mibextid=Zxz2cZ
- Duct tape wallets: https://scoutlife.org/hobbies-projects/projects/35660/make-a-duct-tape-wallet/

- Cryptography: https://passionatelycuriousssci.weebly.com/blog/cryptography-murder-mystery
- Nasa & Origami https://www.jpl.nasa.gov/edu/learn/project/space-origami-make-your-own-starshade/