FAIRFIELD TOWNSHIP SCHOOL DISTRICT

Computer Science and Design Thinking NJSLS 2020

CURRICULUM GUIDE GRADE 8

BOARD OF EDUCATION APPROVED AUGUST, 2022

RENEE' C. RING, SUPERVISOR OF CURRICULUM AND INSTRUCTION

PURPOSE AND GOALS

The middle school (grades 6-8) Engineering and Design course addresses the Next Generation Science Standards for Engineering Design. Students are exposed to problems and scenarios in which they implement the engineering and design process to design, develop, model, and iterate on solutions. The Engineering and Design course builds upon the technological literacy skills developed in the elementary Educational Technology course, the middle school Applied Technology course, and the middle school Science courses. Students will experience opportunities to investigate personal skills and interests within the engineering and design process, while integrating the relevant principles of engineering, architecture, industrial design, technology, and computer sciences. Through cross curricular engineering and design challenges students will realize the relationship between theory and practical application, while building upon Mathematics and English Language Arts skills aligned to the New Jersey State Learning Standards. Design challenges require students to implement problem solving strategies, creativity, and teamwork. All activities are designed for safe and effective use of tools, equipment, materials, processes, and techniques within the context of the human-designed world. By the end of 8th grade, students will develop an understanding of the nature and impact of engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, economic, natural resources and the environment as it relates to the Next Generation Science Standards for Engineering Design.

Abbreviations used in curriculum guide:

NGSS: Next Generation Science Standards
NJSLS: New Jersey Student Learning Standards

THE SPECIAL EDUCATION PROGRAM USES THE FOLLOWING CURRICULUM WITH APPROPRIATE MODIFICATION BEING MADE TO ADDRESS THE NEEDS OF THE INDIVIDUAL STUDENTS.

<u>DIVERSITY AND INCLUSION</u>

In alignment with the NJSLS, the technology curriculum materials will:

- Cultivate respect towards minority groups to foster appreciation of their differences as well as recognize their contributions to the advancement of science and technology.
- Evaluate experiences of people of diverse backgrounds and their unique journeys, including challenges and successes, and their significant historic contributions to the economic, political and social development of New Jersey and the United States.
- Analyze grade-level texts highlighting the technological and scientific contributions of persons of different genders, ethnicities, and abilities.
- Apply the design thinking process to develop empathy, challenging biases, to better understand different perspectives and experiences to creatively problem-solve and innovate solutions for diverse groups of people with specific needs.
- Engage in authentic learning experiences that enable students to acquire and incorporate varied perspectives, and communicate with diverse audiences about the use and effects of computing while applying content knowledge, integrating concepts across disciplines, and developing computational thinking skills.
- Participate in an inclusive and diverse computing culture that appreciates and incorporates perspectives from people of different genders, ethnicities, and abilities.
- Understand how economic, political, social, and cultural aspects of society drive development of new technological products, processes, and systems.
- Reflect on personal experiences and the experiences of others building empathy and promoting a climate of respect and acceptance of people with different backgrounds and abilities.

Climate
Equity and Inclusion
SEL
Holocaust
Amistad
Career Readiness, Life Literacies, and Key Skills

NJ Student Learning Standard 9: Career Readiness, Life Literacies, and Key Skills (Grades 6-8)

Grade 8 Engineering and Design Curriculum

Content Area	**Next Generation Science Standards**	
Standard	**MS-ETS - 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.**	
Strand	**1-1**	
Enduring Understandings: Criteria and constraints impact real world designs as they provide the framework in which a design must be structured by engineers. Designs are often unique and established based not only on human need but environmental pressures as well. Design solutions should be formulated and organized in a step by step manner utilizing the engineering design process.		**Essential Questions:** How do we define a problem and a target audience? What are the definitions of criteria and constraints? How to effectively apply criteria and constraints to a design? Why are criteria and constraints important to follow when designing? How does the natural environment impact design? How does time, material, and cost affect design solutions?
Science & Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**

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.	**ETS1.A: Defining and Delimiting Engineering Problems 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. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions.**	**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. 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.**

Grade Level 8	**Students will be able to:**	**Indicator**	**Observable features of the student performance by the end of the course:**	**Instructional Guidance and Classroom Activities**
NGSS: MS-ETS1-1 MS-PS3-3 MS-PS1-6 MS-PS3-3 **NJSLS:** **ELA** RST.6-8.1 WHST.6-8.8 **Math** MP.2 7.EE.3	**Identify the problem to be solved.**	**1**	a. Students describe a problem that can be solved through the development of an object, tool, process, or system.	<u>**Engineering Design Process:**</u> **Identify the Problem (Ask)** **Brainstorm (Imagine)** ***Teacher will reinforce the steps of the Engineering Design Process throughout each activity.*** Record each step of the process to document and utilize for monitoring progress, accessing notes and sketches, making connections through research and comparing various team's designs for redesign. Present a scenario to students that requires them to identify a problem. Examples could include real - life or imaginary type situations. Identify criteria as the requirements that must be met to effectively solve a problem. Identified constraints based on limitations of
	Define the process or system boundaries and the components of the process or system.	**2**	a. Students identify the system in which the problem is embedded, including the major components and relationships in the system and its boundaries, to clarify what is and is not part of the problem. In their definition of the system, students include:	
			i. Which individuals or groups need this problem to be solved.	
			ii. The needs that must be met by solving the problem.	
			iii. Scientific issues that are relevant to the problem.	
			iv. Potential societal and environmental impacts of solutions.	
			v. The relative importance of the various issues and components of the process or system.	
	Define the		a. Students define criteria that must be taken into account in the solution that:	

	criteria and constraints.	**3**	*i. Meet the needs of the individuals or groups who may be affected by the problem (including defining who will be the target of the solution).*	cost, materials, size, time and any other factors that must be foreseen to effectively complete the design solution. Determine the target audience as the group of individuals that are affected by the problem thus those that will benefit or need a solution. Consider the impact their design may have on the environment and society. Research scientific knowledge and previously completed solutions. From the research, students will begin brainstorming possible solutions to the identified problem.
			ii. Enable comparisons among different solutions, including quantitative considerations when appropriate.	
		3	b. Students define constraints that must be taken into account in the solution, including:	
			i. Time, materials, and costs.	
			ii. Scientific or other issues that are relevant to the problem.	
			iii. Needs and desires of the individuals or groups involved that may limit acceptable solutions.	
			iv. Safety considerations.	
			v. Potential effect(s) on other individuals or groups	

			vi. Potential negative environmental effects of possible solutions or failure to solve the problem.	Identify all safety factors to ensure students are following classroom procedures before proceeding with a design.

Unplugged Activities: Unplugged Programming 6-8

https://teachinglondoncomputing.org/pixel-puzzles/
https://technologyforlearners.com/wp-content/uploads/2015/03/KS1-Crazy-Character-Algorithms-Activity-PDF-Barefoot-Computing2.pdf
https://sites.google.com/sfusd.edu/k-2cs/orange/unit-1-unplugged-cs
https://code.org/curriculum/course1/1/Teacher#Vocab
https://s3.amazonaws.com/assets.flocabulary.com/pdfs/units/coding-events-activities.pdf
https://girlswhocode.com/assets/downloads/craft-prod/downloads/Girls-Who-Code-At-Home-Debug-the-Way.pdf
https://f.hubspotusercontent10.net/hubfs/5592815/At-Home%20Activities%20Assets/Offline/Code%20Break%20Unplugged/Root-Code-Break_2019-L1-Unplugged.pdf
http://csunplugged.mines.edu/index.html
https://csfirst.withgoogle.com/c/cs-first/en/cs-first-unplugged/overview.html
https://f.hubspotusercontent10.net/hubfs/5592815/At-Home%20Activities%20Assets/Offline/Code%20Break%20Unplugged/Root-Code-Break_2019-L1-Unplugged.pdf

Internet Safety
https://beinternetawesome.withgoogle.com/en_us

Books in our Library:
Girls Who Code
Real World Math: Coding

	Kids Get Coding: Kids Get Coding: Programming Games and Animation Kids Get Coding: Kids Get Coding: Learn to Program Rookie Get Ready to CodeTM: Design a Game

Special Education/504/Students at Risk of Failure Modifications:
Specific collaborative groupings of students per interpersonal skills and observations.
Providing vocabulary and concept resources, diagrams and videos, among other resources to assist with understanding concepts and terms.
Teacher Assistance with hands-on activities/projects and research. Teacher modeling and/or providing (more or less) guidance during the inquiry process.
Sentence starters for student write-ups, reports, research and development communication.
Student copies of any notes as needed, partial outlines to complete during note taking tasks.
Trading student's incomplete notes for a copy of complete notes.
Scaffolding the amount of work (decrease or increase) based on skill sets and time allocations, modified time allocations and other constraints.
Multiple check-in opportunities for students, particularly during hands-on activities.
Adapt the amount of personal assistance for specific learners.
Adapt the extent to which learners are actively (hands-on or research) involved in tasks, and construction of models.
Modify the skill-level, problem type, and/or constraints to the projects allowing the learning to approach the work with a high degree of success.
Scaffold the problem solving process as needed, leading to a high-level of success.

G&T/Enrichment Modifications:
Extend research by offering new and novel resources.
Extend projects based on additional constraints or scenarios to projects. Offer additional opportunities for collaboration, presentation, or extension.
Additional opportunities for synthesis - Asking questions that encourage students to create new information from existing data.
Advance Metacognition - Asking questions which prompt students to think about their own thinking process, (successes and challenges).
Extend Connections - Asking students questions that ensure the ability to apply new learning to their lives.

ESL Modifications: Please see the last page.

<table>
<tr><td colspan="2">Content Area</td><td colspan="3">Next Generation Science Standards</td><td></td></tr>
<tr><td colspan="2">Standard</td><td colspan="4">MS-ETS - Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.</td></tr>
<tr><td colspan="2">Strand</td><td colspan="4">1-2</td></tr>
<tr><td colspan="5">Enduring Understandings:
Designs must be evaluated in a non-bias way to ensure that criteria and constraints are met. If a design fails to meet parameters, it cannot be justified as a solution even though it may satisfy the problem.</td><td>Essential Questions
Explain how specific scientific knowledge and knowledge gained from previous attempts can be applied to a design solution.
What are effective ways to test a solution?
Does the solution meet all necessary criteria and constraints?
Can data be used to support these claims?
What can be done to ensure a fair method of evaluation that includes both strengths and weaknesses?</td></tr>
<tr><td colspan="4">Science & Engineering Practices</td><td>Disciplinary Core Ideas</td><td>Crosscutting Concepts</td></tr>
<tr><td colspan="4">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.</td><td>ETS1.B: Developing Possible Solutions There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.</td><td>N/A</td></tr>
<tr><td>Grade Level 8</td><td colspan="2">Students will be able to:</td><td>Indicator</td><td>Observable features of the student performance by the end of the course:</td><td>Instructional Guidance and Classroom Activities</td></tr>
<tr><td rowspan="4">NGSS:
MS-ETS1-1
MS-PS1-6
MS-PS2-2
MS-PS2-4
MS-PS3-3
MS-PS3-5</td><td colspan="2" rowspan="3">Identify the given design solution and associated claims and evidence.</td><td rowspan="3">1</td><td>a. Students identify the given supported design solution.</td><td rowspan="4"><u>Engineering Design Process:</u> Brainstorm (Imagine) Design (Plan) Construct (Build)
Test
Redesign (Improve)
*Teacher will reinforce the steps of the</td></tr>
<tr><td>b. Students identify scientific knowledge related to the problem and each proposed solution.</td></tr>
<tr><td>c. Students identify how each solution would solve the problem.</td></tr>
<tr><td colspan="2">Identify</td><td></td><td>a. Students identify and describe* additional evidence necessary for their evaluation, including:</td></tr>
</table>

NJSLS: ELA	**additional evidence.**	**2**	*i. Knowledge of how similar problems have been solved in the past.*	***Engineering Design Process throughout each activity.***
RST.6-8.1 RST.6-8.9 WHST.6-8.7 WHST.6-8.9 **Math** MP.2 7.EE.3			*ii. Evidence of possible societal and environmental impacts of each proposed solution.*	Record each step of the process to document and utilize for monitoring progress, accessing notes and sketches, making connections through research and comparing various team's designs for redesign. Utilizing scientific knowledge and research previously done, compare and contrast various solutions to the problem while identifying weakness and the strengths of each one. Recognize solutions that may have achieved all criteria and maintained all constraints initiated in the presentation of the original problem. Defend and describe how their solution effectively solved the original problem through sharing test results during class trials, presentations, mock advertisements, etc.
	Evaluate and critique evidence.	**3**	a. Students use a systematic method (e.g., a decision matrix) to identify the strengths and weaknesses of each solution. In their evaluation, students:	
			i. Evaluate each solution against each criterion and constraint.	
			ii. Compare solutions based on the results of their performance against the defined criteria and constraints	
		3	b. Students use the evidence and reasoning to make a claim about the relative effectiveness of each proposed solution based on the strengths and weaknesses of each.	

Special Education Modifications:
Specific collaborative groupings of students per interpersonal skills and observations.
Providing vocabulary and concept resources, diagrams and videos, among other resources to assist with understanding concepts and terms.
Teacher Assistance with hands-on activities/projects and research. Teacher modeling and/or providing (more or less) guidance during the inquiry process.
Sentence starters for student write-ups, reports, research and development communication.
Student copies of any notes as needed, partial outlines to complete during note taking tasks.
Trading student's incomplete notes for a copy of complete notes.
Scaffolding the amount of work (decrease or increase) based on skill sets and time allocations, modified time allocations and other constraints.
Multiple check-in opportunities for students, particularly during hands-on activities.
Adapt the amount of personal assistance for specific learners.
Adapt the extent to which learners are actively (hands-on or research) involved in tasks, and construction of models.
Modify the skill-level, problem type, and/or constraints to the projects allowing the learning to approach the work with a high degree of success.
Scaffold problem solving process, assisting students in identifying potential solutions, experiments, and their design of the scientific process.
G&T/Enrichment Modifications:
Extend research by offering new and novel resources.
Increase student independence and constraints data analysis, offering scaffolded challenge to advance student thinking.
Extend projects based on additional constraints or scenarios to projects. Offer additional opportunities for collaboration, presentation, or extension.
Additional opportunities for synthesis - Asking questions that encourage students to create new information from existing data.
Advance Metacognition - Asking questions which prompt students to think about their own thinking process, (successes and challenges).
Extend Connections - Asking students questions that ensure the ability to apply new learning to their lives.
ESL Modifications: Please see the last page.

Content Area	**Next Generation Science Standards**	
Standard	**MS-ETS - 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.**	
Strand	**1-3**	

Enduring Understandings:	**Essential Questions:**
Data must be collected and analyzed for reference comparisons of multiple designs. The design process is iterative allowing engineers to make improvements to new designs based upon past solutions. Even though a solution has been found that meets all criteria, it may be inferior to future solutions.	How can data be used to compare designs? How can data collected be used to improve one's design? How do multiple solutions allow for the emergence of new designs?

Science & Engineering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
Analyzing and Interpreting Data Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis. Analyze and interpret data to determine similarities and differences in findings.	**ETS1.B: Developing Possible Solutions There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors.** **ETS1.C: Optimizing the Design Solution 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.**	**N/A**

Grade Level 8	**Students will be able to:**	**Indicator**	**Observable features of the student performance by the end of the course:**	**Instructional Guidance and Classroom Activities**
NGSS: MS-ETS1-1 MS-PS3-3 MS-PS1-6 MS-PS3-3 **NJSLS:** **ELA** RST.6-8.1 RST.6-8.7	**Organize Data.**	**1**	a. Students organize given data (e.g., via tables, charts, or graphs) from tests intended to determine the effectiveness of three or more alternative solutions to a problem	<u>**Engineering Design Process:**</u> **Redesign (Improve)** **Analysis/Communication (Share)** ****Teacher will reinforce the steps of the Engineering Design Process throughout each activity.*** Record each step of the process to document and utilize for monitoring progress, accessing
	Identify Relationships.	**2**	a. Students use appropriate analysis techniques (e.g., qualitative or quantitative analysis; basic statistical techniques of data and error analysis) to analyze the data and identify relationships within the datasets, including relationships between the	

RST.6-8.9 **Math** MP.2 7.EE.3			design solutions and the given criteria and constraints.	notes and sketches, making connections through research and comparing various team's designs for redesign. Brainstorm / Decide effective ways to compare and contrast devices through use of qualitative and quantitative data. Utilizing the test results of devices, record, analyze and justify effectiveness of various designs.. Use data to propose and defend modifications needed to satisfy all criteria and constraints for a redesign.
	Interpret Data.	**3**	a. Students use the analyzed data to identify evidence of similarities and differences in features of the solutions.	
			b. Based on the analyzed data, students make a claim for which characteristics of each design best meet the given criteria and constraints.	
			c. Students use the analyzed data to identify the best features in each design that can be compiled into a new (improved) redesigned solution.	

Cyber bullying:
https://www.commonsense.org/education/digital-citizenship/lesson/the-power-of-words
Digital Drama:
https://www.commonsense.org/education/digital-citizenship/lesson/digital-drama-unplugged
Upstanders & Allies:
https://www.commonsense.org/education/digital-citizenship/lesson/upstanders-and-allies-taking-action-against-cyberbullying
https://www.commonsense.org/education/digital-citizenship/lesson/responding-to-online-hate-speech
Climate/Responsibility:
https://www.commonsense.org/education/digital-citizenship/lesson/your-rings-of-responsibility
Minorities in technology:
https://www.readworks.org/article/Important-African-American-Figures/c46412b6-57bc-4027-90a5-d038d30ff3c2#!articleTab:content/contentSection:2555eb35-6e1d-408b-9723-1014cee7e977/
Gender Stereotypes:
https://www.commonsense.org/education/digital-citizenship/lesson/beyond-gender-stereotypes

Special Education/504/Students at Risk of Failure Modifications: Specific collaborative groupings of students per interpersonal skills and observations. Providing vocabulary and concept resources, diagrams and videos, among other resources to assist with understanding concepts and terms. Teacher Assistance with hands-on activities/projects and research. Teacher modeling and/or providing (more or less) guidance during the inquiry process. Sentence starters for student write-ups, reports, research and development communication. Student copies of any notes as needed, partial outlines to complete during note taking tasks. Trading student's incomplete notes for a copy of complete notes. Scaffolding the amount of work (decrease or increase) based on skill sets and time allocations, modified time allocations and other constraints. Multiple check-in opportunities for students, particularly during hands-on activities. Adapt the amount of personal assistance for specific learners. Adapt the extent to which learners are actively (hands-on or research) involved in tasks, and construction of models. Modify the skill-level, problem type, and/or constraints to the projects allowing the learning to approach the work with a high degree of success. Assist students with data analysis, through scaffolding, reteaching, data organization, and formula assistance. **G&T/Enrichment Modifications:** Extend research by offering new and novel resources. Increase student independence and constraints data analysis, offering scaffolded challenge to advance student thinking. Extend projects based on additional constraints or scenarios to projects. Offer additional opportunities for collaboration, presentation, or extension. Additional opportunities for synthesis - Asking questions that encourage students to create new information from existing data. Advance Metacognition - Asking questions which prompt students to think about their own thinking process, (successes and challenges). Extend Connections - Asking students questions that ensure the ability to apply new learning to their lives. **ESL Modifications:** Please see the last page.

Content Area	**Next Generation Science Standards**		
Standard	**MS-ETS - 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.**		
Strand	**1-4**		
Enduring Understandings: Engineers often rely on models to formulate ideas and produce data for designs that may be too costly, difficult to demonstrate, or harmful to life or the environment. Models can be a simple representation or a working device; thus, models can be computerized, vary in scale, be an unrefined version, or a prototype of the final design.			**Essential Questions:** How do models and prototypes differ? What is the importance of an iterative design process? What data can be acquired from a model?
Science & Engineering Practices		**Disciplinary Core Ideas**	**Crosscutting Concepts**

<table>
<tr><td colspan="3">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.</td><td>ETS1.B: Developing Possible Solutions A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. Models of all kinds are important for testing solutions.

ETS1.C: Optimizing the Design Solution 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.</td><td>N/A</td></tr>
<tr><td>Grade Level 8</td><td>Students will be able to:</td><td>Indicator</td><td>Observable features of the student performance by the end of the course:</td><td>Instructional Guidance and Classroom Activities</td></tr>
<tr><td rowspan="5">NGSS:
MS-ETS1-1
MS-PS3-3
MS-PS1-6
MS-PS3-3
NJSLS:
ELA
RST.6-8.1
SL.8.5
Math
MP.2
7.SP</td><td rowspan="3">Identify the components of the model.</td><td rowspan="3">1</td><td>a. Students develop a model in which they identify the components relevant to testing ideas about the designed system, including:</td><td rowspan="5"><u>Engineering Design Process:</u>
Design (Plan)
Construct (Build)
Redesign (Improve)
Analysis/Communication (Share)
*Teacher will reinforce the steps of the Engineering Design Process throughout each activity.
Record each step of the process to document and utilize for monitoring progress, accessing notes and sketches, making connections through research and comparing various team’s designs for redesign..</td></tr>
<tr><td>i. The given problem being solved, including criteria and constraints.</td></tr>
<tr><td>ii. The components of the given proposed solution (e.g., object, tools, or process), including inputs and outputs of the designed system.</td></tr>
<tr><td rowspan="2">Identify relationships.</td><td rowspan="2">2</td><td>a. Students identify and describe the relationships between components, including:</td></tr>
<tr><td>i. The relationships between each component of the proposed solution and the functionality of the solution.</td></tr>
</table>

<table>
<tr><td rowspan="3"></td><td rowspan="3"></td><td rowspan="3"></td><td>ii. The relationship between the problem being solved and the proposed solution.</td><td rowspan="3">Create models meant to represent a solution to the problem. These models may be a visual representation, demonstrating how a device might be constructed, or a prototype, physically demonstrating how the device will work.

Make correlations between all components of their model and the proposed solution to the</td></tr>
<tr><td>iii. The relationship between each of the components of the given proposed solution and the problem being solved.</td></tr>
<tr><td>iv. The relationship between the data generated by the model and the functioning of the proposed solution.</td></tr>
</table>

	Make connections.	**3**	a. Students use the model to generate data representing the functioning of the given proposed solution and each of its iterations as components of the model are modified.	problem. Collect data from the model that will be used to determine the effectiveness of the proposed solution. Data will then be analyzed to determine how to further improve said design.
			b. Students identify the limitations of the model with regards to representing the proposed solution.	
			c. Students describe how the data generated by the model, along with criteria and constraints that the proposed solution must meet, can be used to optimize the design solution through iterative testing and modification.	

Special Education Modifications:

Specific collaborative groupings of students per interpersonal skills and observations.

Providing vocabulary and concept resources, diagrams and videos, among other resources to assist with understanding concepts and terms.

Teacher Assistance with hands-on activities/projects and research. Teacher modeling and/or providing (more or less) guidance during the inquiry process.

Sentence starters for student write-ups, reports, research and development communication.

Student copies of any notes as needed, partial outlines to complete during note taking tasks.

Trading student’s incomplete notes for a copy of complete notes.

Scaffolding the amount of work (decrease or increase) based on skill sets and time allocations, modified time allocations and other constraints.

Multiple check-in opportunities for students, particularly during hands-on activities.

Adapt the amount of personal assistance for specific learners.

Adapt the extent to which learners are actively (hands-on or research) involved in tasks, and construction of models.

Modify the skill-level, problem type, and/or constraints to the projects allowing the learning to approach the work with a high degree of success.

Assist with modeling and data analysis as needed.

G&T/Enrichment Modifications:

Extend research by offering new and novel resources.

Increase student independence and constraints with modeling and data analysis.

Extend projects based on additional constraints or scenarios to projects. Offer additional opportunities for collaboration, presentation, or extension.

Additional opportunities for synthesis - Asking questions that encourage students to create new information from existing data.

Advance Metacognition - Asking questions which prompt students to think about their own thinking process, (successes and challenges).

Extend Connections - Asking students questions that ensure the ability to apply new learning to their lives.

ESL Modifications: Please see the last page

Key Domain Specific Vocabulary:
<u>Engineering Design Process</u>: Problem (Ask), Brainstorming (Imagine), Design (Plan), Build (Construct), Test & Evaluate, Redesign (Improve), Communicate (Share). **criteria, constraints, target audience, modification, device, iterative, model, prototype, reverse engineering, Newton's Laws, friction, potential and kinetic energy, engineer and specific disciplines of engineering: mechanical, electrical, environmental,**

ESL Modifications:

This list includes the accommodations and modifications commonly used to address the needs of ELL students.

<u>Content/Material Accommodations/Modifications</u> Allow extra time for task completion	<u>Organizational Accommodations</u> Use a consistent daily routine Break down tasks into manageable units
<u>Instructional Accommodations</u> Frequently check for understanding Emphasize use of visual aids Simplify task directions Provide hands-on learning activities Provide modeling Assign peer buddies Modify pace of instruction to allow additional processing time Provide small group instruction Demonstrate directions and provide a model or example of completed task Emphasize multi-sensory presentation of data Allow for repetition and/or clarification of directions, as needed Directions repeated, clarified or reworded Provide multi-sensory instruction Allow wait time for processing before calling on student for response Provide visual models of completed tasks	<u>Accommodations for Attention/Focus</u> Seat student near front of room Preferential seating Monitor on-task performance Establish and maintain eye contact when giving oral directions Provide short breaks when refocusing is needed Refocusing and redirection <u>Supplemental Services</u> 1:1 Assistant Prompting, cueing and redirecting student participation Reinforcing of personal, social, behavioral and academic learning goals
<u>Social/Behavioral Accommodations</u> Provide opportunities for peer interactions Encourage student to self-advocate Present alternatives to negative behavior Monitor for overload, excess stimuli Maintain communication with home Provide positive reinforcement Provide consistent praise to elevate self esteem Model and role play problem solving	