Introduction to Engineering Design - PLTW Curriculum

This curricula and accompanying instructional materials have been developed to align with the NJSLS and in accordance with the NJ Department of Education's guidelines to include: Curriculum designed to meet grade level expectations, integrated accommodations and modifications for students with IEPs, 504s, ELLs, and gifted and talented students, assessments including benchmarks, formative, summative, and alternative assessments, a list of core instructional and supplemental materials, pacing guide, interdisciplinary connections, integration of 21st century skills, integration of technology, and integration of 21st Century Life and Career standards.

About the Standards

In 1996, the New Jersey State Board of Education adopted the state's first set of academic standards called the Core Curriculum Content Standards. The standards described what students should know and be able to do upon completion of a thirteen-year public school education. Over the last twenty years, New Jersey's academic standards have laid the foundation for local district curricula that is used by teachers in their daily lesson plans.

Revised every five years, the standards provide local school districts with clear and specific benchmarks for student achievement in nine content areas. Developed and reviewed by panels of teachers, administrators, parents, students, and representatives from higher education, business, and the community, the standards are influenced by national standards, research-based practice, and student needs. The standards define a "Thorough and Efficient Education" as guaranteed in 1875 by the New Jersey Constitution. Currently the standards are designed to prepare our students for college and careers by emphasizing high-level skills needed for tomorrow's world.

The New Jersey Student Learning Standards include Preschool Teaching and Learning Standards, as well as nine K-12 standards for the following content areas: **21st Century Life and Careers, Comprehensive Health and Physical Education, English Language Arts, Mathematics, Science, Social Studies, Technology, Visual and Performing Arts, World Languages**

The most recent review and revision of the standards occurred in 2014. However, the standards in language arts and math underwent an additional review in 2015 with adoption by the New Jersey State Board of Education in May 2016.

Lower Cape May Regional School District Career and Technical Education - Engineering Curriculum	
Content Area: Career and Technical Education - Engineering	
Course Title: Introduction to Engineering Design	**Grade level:9-10**
Unit 1: Design and Problem Solving	**Dates for Units Weeks 1-9**
Unit 2: Assembly Design	**Dates for Units Weeks 10-19**
Unit 3: Thoughtful Product Design	**Dates for Units Weeks 20-29**
Unit 4: Making Things Move	**Dates for Units Weeks 30-40**
Date Created: 9/15/2022	**Board Approved On:**

Lower Cape May Regional School District Career and Technical Education - Engineering Curriculum **Unit 1 Overview**
Content Area: Career and Technical Education - Engineering
Unit Title: Design and Problem Solving
Target Course/Grade Level: Career and Technical Education – Engineering Grades 9-10
Unit Summary: In this unit, students will learn and apply an engineering design process to collaboratively design a carnival game. As part of the design process, they will practice the art of brainstorming and begin to develop skills in graphically representing ideas through concept sketching. They will develop and test a

solution and improve the design through iteration. In addition, they will apply statistical techniques to evaluate design solutions and apply those techniques to inform design decisions related to your game design. They will use isometric and orthographic technical sketching as a means to model and communicate ideas, designs, and problem solutions. Students will develop basic 3D solid models of simple designs and produce technical drawings using CAD. Students will learn the importance of precision measurement. They will use dial calipers to make precise measurements as they come to understand the concepts of precision and accuracy and their implication on engineering design and manufacturing. Students will apply statistics to quantify the precision and accuracy of measurements and of measuring tools. Students will individually apply the design process and the skills and knowledge gained in this unit to evaluate and improve the design of a consumer product to meet stakeholder needs. Students will learn effective presentation techniques and present their solutions to an audience.

Interdisciplinary Connections:

Math:

N.Q.1 - Quantities Use units as a way to understand problems and to guide the solution of multi step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

N.Q.2 - Quantities Define appropriate quantities for the purpose of descriptive modeling.

N.Q.3 - Quantities Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

G.MG.1 - Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder). Modeling with Geometry

S.ID.1 - Interpreting Categorical and Quantitative Data Represent data with plots on the real number line (dot plots, histograms, and box plots).

G.GMD.3 - Geometric Measurement and Dimension Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems.

S.ID.4 - Interpreting Categorical and Quantitative Data Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.

English and Language

NJSLSA.W4. - Writing Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

SL9-10.1. - Speaking and Listening Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

NJSLSA.L6. - Language Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career

readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

21st Century Themes, Skills, and Standards:

- **CRP1-**Students will act as responsible and contributing citizens*
- **CRP2-**Students will apply applicable academic skills*
- **CRP3-**Students will attend to personal health and financial well-being
- **CRP4-**Students will communicate effectively, clearly and with reason*
- **CRP5-**Students will consider the environmental, social, and economic impacts of decisions*
- **CRP6-**Students will demonstrate creativity and innovation*
- **CRP7-**Students will employ valid and reliable research strategies*
- **CRP8-**Students will utilize critical thinking to make sense of problems and persevere in solving* them
- **CRP9-**Students will model leadership, integrity, and effective management*
- **CRP10-**Students will plan education and career paths aligned to personal goals*
- **CRP11-**Students will utilize technology to enhance productivity*
- **CRP12-**Students will work productively in teams while using cultural, global competence*

For more information regarding 21st Century Skills and for classroom resources click here.

Integration of Technology Standards

- **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 create and communicate knowledge.
- **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.*

For more information regarding Technology Standards click here.

Integration of 21st Century Life and Career Standards

- **9.1 Personal Financial Literacy:** Students will understand the important fiscal knowledge, habits, and skills that must be mastered in order to make informed decisions about personal finance. Financial literacy is an integral component of a student's college and career readiness, enabling students to achieve fulfilling, financially-secure, and successful careers.

- **9.2 Career Awareness, Exploration, and Preparation:** Students will understand the importance of being knowledgeable about one's interests and talents, and being well informed about postsecondary and career options, career planning, and career requirements.*

- **9.3 Career and Technical Education:** Students will know and understand the expectations

aligned with the completion of a CTE Program of Study.*

- **9.4 Career Readiness, Life Literacies, and Key Skills:** Students will understand key literacies and technical skills such as critical thinking, global and cultural awareness, and technology literacy that are critical for students to develop to live and work in an interconnected global economy.

For more information regarding 21st Century Life and Career Standards click here.

Learning Targets

CPI #	Cumulative Progress Indicators (CPI) for Unit
8.1.12.F.1	Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs.
8.1.12.C.1	Develop an innovative solution to a real world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community.
8.2.12.B.4	Investigate a technology used in a given period of history, e.g., stone age, industrial revolution or information age, and identify their impact and how they may have changed to meet human needs and wants.
8.2.12.C.2	Analyze a product and how it has changed or might change over time to meet human needs and wants.
9.2.12.C.1	Review career goals and determine steps necessary for attainment.
9.1.2.CAP.1:	Make a list of different types of jobs and describe the skills associated with each job.
9.3.ST.5	Demonstrate an understanding of the breadth of career opportunities and means to those opportunities in each of the Science, Technology, Engineering & Mathematics Career Pathways.
9.3.ST-ET.5	Apply the knowledge learned in STEM to solve problems**.**

9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas
9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities
9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition

Unit Enduring Questions:

- What are the steps of the engineering design process and how can they be used to solve problems?
- How can we evaluate data to determine the precision and accuracy of our solutions?
- How can we model effectively through concept sketching?
- How can we model effectively through technically drawing isometric pictorials?
- How can we model effectively through technically drawing orthographic projections?
- How do we properly dimension Multiview drawings?
- How can we model effectively through CAD design?
- How can we appropriately measure objects to appropriate levels of accuracy and precision?
- How can we appropriately document design intent using detailed views and title blocks?

Unit Enduring Understandings:

- The design process is applied to creatively solve problems.
- Collaboration is necessary to contribute to the efforts of a team to develop ideas.
- Practicing the art of brainstorming and spatial visualization will develop skills in graphically representing ideas through concept sketching and isometric sketching.
- Models are developed to represent a design idea.
- Using hand sketches, isometric views of a simple object or part at a given scale using the actual object, a detailed verbal description of the object, Orthographic projections of objects effectively communicates design intent.
- Giving and receiving effective feedback influences personal and professional development.
- As part of a design process, you develop conceptual models, graphical models, computer models, and physical models.
- Skills in producing basic 3D solid modeling of simple designs and technical drawings using CAD are gained.
- Applying an iterative design process, including developing appropriate models and/or simulations, creatively addresses a need or solve a problem.
- Creating technical drawings using 3D computer-aided design (CAD) software documents a design according to standard engineering practices.
- Demonstrating independent thinking and self-direction leads to accomplishing a goal.
- To communicate effectively with an audience is based on the characteristics of the intended audience.

Unit Objectives: ***Students will know….*** ● How the design process is used to creatively solve a problem. ● Different forms of models can be used to represent an idea. ● How effectively documenting engineering work in an organized notebook so someone unfamiliar with the work can follow and understand the process. ● The difference between accuracy and precision of a measurement. ● The 6 primary views of any object. ● How to identify error and omissions in orthographic projections and multiview drawings. ● Models use abstraction to represent a simplified version of a complex object and there is no guarantee that the model accurately represents the real object. ● All measurements are an approximation of the true value of a quantity. ● How to read and interpret a hole note to identify the size and type of hole specified. ● Necessary/appropriate views to fully detail a part or assembly. ● Appropriate and sufficient annotation (including dimensioning) to a drawing to fully describe an object. ● Necessary/appropriate views, especially a section view, to fully detail a part or assembly. ● How to create technical drawings using 3D computer-aided design (CAD) software to document a design according to standard engineering practices**.**	**Unit Objectives:** ***Students will be able to…...*** ● Contribute to the efforts of a team to develop ideas. ● Develop a model to represent a design idea. Iterate on steps of the design process to improve a solution. ● Use statistics to compare the center and spread of two or more data sets. ● Draw conclusions related to a prediction and support conclusions using experimental data. ● Give and receive feedback to influence personal and professional development. ● Develop a model (a realistic sketch) to represent a design idea. ● Build a mathematical model to represent data and justify design decisions using data. ● Effectively use different types of models (conceptual, graphical, mathematical) to inform a design. ● Hand sketch isometric views of a simple object or part at a given scale using the actual object, a detailed verbal description of the object, or a pictorial view of the object. ● Build a 3D computer model to represent a physical object. ● Build a 3D computer model to represent a design idea. ● Hand sketch an isometric view or build a physical representation of an object based on a multiview drawing of the object. ● Use CAD software to generate orthographic projections and create a multiview drawing from a 3D solid model. ● Generate an annotated multiview drawing using CAD software. ● Identify three-dimensional objects generated by rotation of a two-dimensional object. ● Develop a model to represent important characteristics of an object for an intended purpose. ● Build a physical representation of an object

	based on graphical representations of the object. ● Choose a measurement device based on the level of precision and accuracy needed. ● Apply inferential reasoning to make and/or support claims about populations based on data. ● Create a computer model to represent a conceptual idea and inform design decisions. ● Create and constrain a 3D model to represent the physical characteristics of a design idea or physical object. ● Correctly build and constrain a three-dimensional solid computer model to accurately represent the physical characteristics and behaviors of a design idea or real object. ● Identify errors and omissions in a full- or half-section view (including errors in line locations, line types, location of cutting plane line, scale, dimensioning, and view orientation) to fully detail an object or part. ● Develop a potential solution and evaluate the solution with respect to design criteria and constraints. ● Apply an iterative design process, including developing appropriate models and/or simulations, to creatively address a need or solve a problem. ● Demonstrate independent thinking and self-direction in pursuit of accomplishing a goal. ● Communicate effectively with an audience based on the characteristics of the intended audience**.**

Unit 2 Overview

Content Area: Career and Technical Education - Engineering

Unit Title: Assembly Design

Target Course/Grade Level: Introduction to Engineering Design 9-10

Unit Summary:
In this unit, students learn methods to physically join parts in an assembly, including mechanical fasteners, adhesives, press fits, and hinges. They learn about different types of fit and how to specify tolerances to achieve desired fits between interacting parts. Students then learn how to assemble parts using CAD and create simple bottom-up assemblies that realistically simulate physical mechanical systems. Assemblies are documented in CAD with assembly drawings. Students apply engineering principles and practices to reverse engineer and improve a consumer product by disassembling and analyzing a product or system to understand and document the visual, functional, and/or structural aspects of its design. Students will also conduct a case study of a common consumer product to identify potential ways to improve the manufacturability and ease of assembly of the product. Students will also use top-down modeling to model the consumer product students have reverse engineered. They will apply the design process again to design and prototype (3D print) an integrated accessory for the reverse engineered product and present the design. Finally, in this unit students investigate a variety of materials through experimentation and are tasked with selecting materials to serve a specific purpose. The types of materials investigated include wood, metals, ceramics, plastics, and composites to identify properties that may impact material selection. Properties investigated can include density, conductivity, strength, flexibility, hardness, and so on. Students learn how to assign specific materials to CAD models and to differentiate between assigning the physical properties of a material to a part and only changing the visual appearance of the part. Students work within a team to imagine the future through research of innovative materials and the redesign of a product using advanced materials. Lastly, students work collaboratively to reverse engineer and troubleshoot a non-working, multi-component mechanical device. Then, team members work together to redesign the device, produce working drawings, and produce new parts to correct the design and manufacture a working physical model.

Interdisciplinary Connections:
Math:

- NJSLSA.W2. - Writing Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

NJSLSA.W4. - Writing Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
G.MG.1 - Modeling with Geometry Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
G.MG.2 - Modeling with Geometry Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).

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English and Language:

- SL9-10.1. - Speaking and Listening Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
- NJSLSA.L6. - Language Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

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Integration of 21st Century Skills

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Integration of 21st Century Life and Career Standards

- **9.1 Personal Financial Literacy:** Students will understand the important fiscal knowledge, habits, and skills that must be mastered in order to make informed decisions about personal finance. Financial literacy is an integral component of a student's college and career readiness, enabling students to achieve fulfilling, financially-secure, and successful careers.
- **9.2 Career Awareness, Exploration, and Preparation:** Students will understand the importance of being knowledgeable about one's interests and talents, and being well informed about postsecondary and career options, career planning, and career requirements.
- **9.3 Career and Technical Education:** Students will know and understand the expectations aligned with the completion of a CTE Program of Study.
- **9.4 Career Readiness, Life Literacies, and Key Skills:** Students will understand key literacies and technical skills such as critical thinking, global and cultural awareness, and technology literacy that are critical for students to develop to live and work in an interconnected global economy.

For more information regarding 21st Century Life and Career Standards click here.

Learning Targets

CPI #	Cumulative Progress Indicators (CPI) for Unit
8.1.12.D.5	Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address personal, social, lifelong learning, and career needs.
8.1.12.C.1	Develop an innovative solution to a real world problem or issue in collaboration with peers and experts, and present ideas for feedback through social media or in an online community.
8.2.12.ED.2	Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.
8.2.12.ED.5	Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).
8.2.12.E.3	Use a programming language to solve problems or accomplish a task (e.g., robotic functions, website designs, applications, and games).
8.2.12.D.5	Explain how material processing impacts the quality of engineered and fabricated products.

8.2.12.A.2	Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste.
9.2.5.CAP.4:	Explain the reasons why some jobs and careers require specific training, skills, and certification (e.g., life guards, child care, medicine, education) and examples of these requirements.
9.2.8.CAP.3:	Explain how career choices, educational choices, skills, economic conditions, and personal behavior affect income.
9.3.ST.1	Apply engineering skills in a project that requires project management, process control and quality assurance.
9.3.ST-ET.1	Use STEM concepts and processes to solve problems involving design and/or production.
9.3.ST-ET.4	Apply the elements of the design process.
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas
9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities
9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition

Unit Enduring Questions:

- **Insert enduring questions for unit here**
- What are the different types of tolerance and how can I use tolerance to achieve desired fits between interacting parts?
- What are the different types of joining techniques?
- What are assembly joints and how can I use them to create assembled products on CAD?
- How can we appropriately document design intent using exploded views and parts lists?
- What is reverse engineering?
- What is visual analysis and how can I use it to better understand a product?
- What is functional analysis and how can I use it to better understand a product?
- What is structural analysis and how can I use it to better understand a product?

Unit Enduring Understandings:

- **Insert enduring understandings for unit here.**
- CAD skills are built upon.
- There are several methods used to physically join parts into an assembly (including mechanical fasteners and adhesives as well as press fits and hinges).
- It is important to learn Interference and clearance fits and to specify tolerances to achieve desired fits between interacting parts.
- CAD assembly modeling is used to create simple bottom-up assemblies that realistically simulate physical assemblies and document assemblies with CAD drawings.
- Iteration is applied to earlier design projects to incorporate new skills and knowledge learned.
- Applying appropriate engineering tolerances will specify the allowable variation, size of individual features, and orientation and

● What is the difference between top down and bottom up modeling and what is it advantageous to use each? ● What are the principles of design for manufacturing and how can they be used to improve products? ● What are the different properties materials can have and how can they be used to identify materials, and to recommend the best materials for certain uses.	location between features of an object. Using the mean and standard deviation of a data set will fit it to a normal distribution and using the Empirical Rule estimates population percentages. ● Applying engineering principles and practices to reverse engineer and improve a consumer product is also a part of the design process. ● The process of Reverse Engineering involves analyzing the product's function, structure, and visual elements. ● It is necessary to conduct a case study of a common consumer product to identify potential ways to improve the manufacturability and ease of assembly of the product. ● You'll learn a second method of CAD assembly modeling, top-down modeling, to help you more efficiently model mechanical systems. And finally, you'll have an opportunity to design and prototype (3D print) an integrated accessory for a product that you have reverse engineered and present the design. ● Investigating a variety of materials through experimentation and selecting materials to serve a specific purpose is part of the engineering design process. ● Types of materials investigated include wood, metals, ceramics, plastics, and composites and that identifying properties may impact material selection. ● There are different properties investigated that may include density, conductivity, strength, flexibility, hardness, and so on. ● Assigning specific materials to CAD models differentiates between assigning the physical properties of a material to a part and only changing the visual appearance of the part. ● Listing material properties are important to design, including mechanical, chemical, electrical, and magnetic properties. ● Performing an experimental protocol investigates a phenomenon and/or helps to gain knowledge. ● Conducting non-destructive tests (hardness, flexure, conductivity) on different material types investigates material properties.

	● Creating and interpreting a computer model or simulation of simple objects, assemblies, or systems to inform engineering decisions solve problems. ● Creating technical drawings using 3D computer-aided design (CAD) software documents a design according to standard engineering practices. ● Communicating effectively with an audience is based on audience characteristics.
Unit Objectives: ***Students will know….*** ● **Insert unit objectives here in the form of student will know.** ● **.** How to use the mean and standard deviation of a data set to fit it to a normal distribution and use the Empirical Rule to estimate population percentages. ● Methods to rigidly join physical parts of an assembly. ● Joints that allow movement between parts in an assembly and the resulting degrees of freedom. ● Necessary and appropriate views to fully detail an assembly. ● How to apply appropriate engineering tolerances to specify the allowable variation, size of individual features, and orientation and location between features of an object. ● The processes and purposes of reverse engineering. ● The reverse engineering process of visual analysis. ● The reverse engineering process of	**Unit Objectives:** ***Students will be able to…...*** ● **Insert unit objectives here in the form of student will be able to.** ● Apply appropriate engineering tolerances to specify the allowable variation, size of individual features, and orientation and location between features of an object. ● Present information, findings, and supporting evidence clearly, concisely, and logically in writing, in which the development, organization, and style are appropriate to task, purpose, and audience. ● Present information, findings, and supporting evidence clearly, concisely, and logically, such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task. ● Correctly build and constrain a three-dimensional solid computer model to accurately represent the physical characteristics and behaviors of a physical object. ● Correctly apply joints to constrain multi-

functional analysis. ● The reverse engineering process of structural analysis. ● How to use sketches to clearly communicate information. ● How to create relationships among part features and dimensions using parametric relationships. ● How to correctly constrain multi-component models. ● Measurable visual, functional, and structural design requirements (criteria) and realistic constraints against which solution alternatives can be evaluated and optimized. ● Material properties that are important to design, including mechanical, chemical, electrical, and magnetic properties. ● How design criteria and constraints (cost, performance, safety, risk, aesthetics, environmental impact) often limit the material choices available for a given design. ● Different types of materials and their common usages in product design. ● Engineering as the creation of solutions, such as new and improved products, technologies, systems and processes, to meet the needs of people and society.	component models and/or simulate realistic relative motion of the component parts. ● Apply an iterative design process to creatively address a need or solve a problem. ● Generate an annotated assembly drawing of components and details of assembly. ● Generate an annotated multiview drawing to fully describe a simple part. ● Perform a visual analysis of an object and describe the apparent visual elements and principles of design. ● Perform a functional analysis of a product or system to determine the purpose, inputs and outputs, and operation of a product or system. ● Perform a structural analysis of a product or system to determine the materials used, the form of component parts, as well as the configuration and interaction of component parts when assembled. ● Develop a model to accurately represent information or important characteristics of an object, data, process, or design idea for an intended purpose. ● Correctly build and constrain a three-dimensional solid computer model to accurately represent the physical characteristics and behaviors of a design idea or real object. ● Apply the principles of design for manufacturability and assembly of mechanical products. ● Identify design flaws of and potential enhancements to a proposed design solution. ● Apply effective techniques and appropriate guidelines to generate multiple creative ideas and solutions to a problem. ● Carry out a plan to compare competing solution ideas and justify the selection of a solution path with respect to design requirements and constraints. ● Present information, findings, and supporting evidence clearly, concisely, and logically in writing in which the development, organization, and style are appropriate to task, purpose, and audience. ● Perform an experimental protocol to investigate a phenomenon and/or gain

	knowledge. ● Conduct non-destructive tests (hardness, flexure, conductivity) on different material types to investigate material properties. Evaluate a solution to a complex, real-world problem and identify the need for trade-offs to address a range of criteria and constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. ● Select and justify the use of materials for prototyping and manufacturing products. ● Draw valid conclusions based on supporting evidence while acknowledging limitations, opposing views, and biases. ● Create a computer model or simulation to represent an object or conceptual idea and inform design decisions. ● Synthesize an ill-formed problem into a meaningful, well-defined problem using relevant information. ● Persevere to solve a problem or achieve a goal. ● Create and interpret a computer model or simulation of simple objects, assemblies, or systems to inform engineering decisions and solve problems. ● Create technical drawings using 3D computer-aided design (CAD) software to document a design according to standard engineering practices. ● Communicate effectively with an audience based on audience characteristics.

Lower Cape May Regional School District Career and Technical Education - Engineering Curriculum
Unit 3 Overview

Content Area: Career and Technical Education - Engineering

Unit Title: Thoughtful Product Design

Target Course/Grade Level: Introduction to Engineering Design

Unit Summary:
In this unit, students reverse engineer a multi-material consumer product. Then they identify and research the component materials and the material properties that contribute to their selection for use in the product. Students are introduced to life cycle analysis, systems thinking, and ethical considerations in design, and they compare the life cycle of common competing products (such as plastic versus paper shopping bags). This lesson emphasizes the importance of identifying measurable design criteria that define a successful solution and that can be used to evaluate a potential solution. The concept of human-centered design is introduced as students are led through a design experience focused on user needs, perceptions and behaviors, and the design trade-offs necessary in every design process. Students also apply systems thinking to engineering design and consider the ethical implications of engineering decisions. A modern CAD feature, generative design is introduced as a tool to optimize design solutions. Students use the output from a generative design algorithm to explore and select a potential design alternative. In teams, students identify a problem worth solving and apply human-centered design principles and systems thinking to design a gadget to solve the problem as they practice collaboration and communication skills. In teams, students act as an engineering consulting group to solve a problem from a list of problems gathered from school and/or community stakeholders. As part of the design process, the team applies the engineering design process to develop a sustainable solution that includes consideration of material choices and the life cycle of the design. Students meet with the client to understand user needs, develop effective design criteria to inform the design, and create a project design brief. Students also practice important project management skills including developing a task and delivery schedule to manage and monitor project work and facilitating project meetings to report project progress.

Interdisciplinary Connections:
Math:
N.Q.2 - Quantities Define appropriate quantities for the purpose of descriptive modeling.
G.MG.1 - Modeling with Geometry Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

G.MG.2 - Modeling with Geometry Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).
S.ID.1 - Interpreting Categorical and Represent data with plots on the real number line (dot plots, histograms, and box plots). Quantitative Data
S.ID.4 - Interpreting Categorical and Quantitative Data Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.

English and Language:
NJSLSA.W2. - Writing Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.
NJSLSA.W4. - Writing Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
NJSLSA.W7. - Writing Conduct short as well as more sustained research projects, utilizing an inquiry-based research process, based on focused questions, demonstrating understanding of the subject under investigation.
SL9-10.1. - Speaking and Listening Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with peers on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
NJSLSA.L6. - Language Acquire and use accurately a range of general academic and domain-specific words and phrases sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression

21st Century Themes, Skills, and Standards:

Integration of 21st Century Skills

- **CRP1-**Students will act as responsible and contributing citizens*
- **CRP2-**Students will apply applicable academic skills*
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- **CRP11-**Students will utilize technology to enhance productivity*
- **CRP12-**Students will work productively in teams while using cultural, global competence*

For more information regarding 21st Century Skills and for classroom resources click here.

Integration of Technology Standards

- **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 create and communicate knowledge.

- **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.*

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Integration of 21st Century Life and Career Standards

- **9.1 Personal Financial Literacy:** Students will understand the important fiscal knowledge, habits, and skills that must be mastered in order to make informed decisions about personal finance. Financial literacy is an integral component of a student's college and career readiness, enabling students to achieve fulfilling, financially-secure, and successful careers.

- **9.2 Career Awareness, Exploration, and Preparation:** Students will understand the importance of being knowledgeable about one's interests and talents, and being well informed about postsecondary and career options, career planning, and career requirements.

- **9.3 Career and Technical Education:** Students will know and understand the expectations aligned with the completion of a CTE Program of Study.

- **9.4 Career Readiness, Life Literacies, and Key Skills:** Students will understand key literacies and technical skills such as critical thinking, global and cultural awareness, and technology literacy that are critical for students to develop to live and work in an interconnected global economy.

- **For more information regarding 21st Century Life and Career Standards click here.**

Learning Targets

CPI #	Cumulative Progress Indicators (CPI) for Unit
8.2.12.ED.2	Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.
8.2.12.ED.5	Evaluate the effectiveness of a product or system based on factors that are related to its requirements, specifications, and constraints (e.g., safety, reliability, economic considerations, quality control, environmental concerns, manufacturability, maintenance and repair, ergonomics).

8.2.12.D.5	Explain how material processing impacts the quality of engineered and fabricated products.
9.2.8.CAP.20	Identify the items to consider when estimating the cost of funding a business
9.3.ST-ET.1	Use STEM concepts and processes to solve problems involving design and/or production.
9.3.ST.1	Apply engineering skills in a project that requires project management, process control and quality assurance.
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas
9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities
9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition

Unit Enduring Questions:

- **Insert enduring questions for unit here**
- **.** What are the steps of a product life cycle and how can we use the product lifecycle to compare the environmental impact of products?
- What is sustainable design and how does the choice of material used for a product affect sustainable design?
- How do you create measurable criteria and constraints?
- What role does empathy play in human centered design?
- What can a systems model tell us about how a product interacts with its surroundings?
- What is generative design and how can we use generative design to determine the effectiveness of our solutions?
- How can we use statistics to optimize solutions?
- What behaviors lead to a successful team?
- What are the roles of a project manager and how can we use a Gantt Chart to

Unit Enduring Understandings:

- **Insert enduring understandings for unit here.**
- All products have a life cycle.
- Analysis, systems thinking, and ethical considerations in design is conducted to compare the life cycle of common competing products (such as plastic versus paper shopping bags).
- The importance of identifying measurable design criteria that defines a successful solution and that can be used to evaluate a potential solution.
- Making strategic use of digital media in presentations enhances understanding of findings, reasoning, and evidence and to add interest.
- Analyzing a consumer product using reverse engineering techniques document visual, functional, and structural aspects of the design.
- Explaining the benefits of human-centered design and applying principles aligns to product design with intended use.
- Design quality concepts such as performance,

schedule projects?	usability, accessibility, reliability, and safety impact product development.
Unit Objectives: ***Students will know….*** ● How to make strategic use of digital media in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. ● Different engineering solutions can have significantly different impacts on individuals, society, and the natural world. ● The life cycle of a product or service. ● How to present information, findings, and supporting evidence clearly, concisely, and logically. ● How design criteria and constraints often limit the material choices available for a given design. ● How to ask new probing questions to expand and build upon an idea and explore personal curiosities throughout a creative process. ● The benefits of human-centered design and apply principles to align product design with intended use. ● Design quality concepts such as performance, usability, accessibility, reliability, and safety impact product development. ● A system in terms of its components and/or subsystems and their interactions. Predict what the effect of making a change to a component of a system will have on the system as a	**Unit Objectives:** ***Students will be able to…...*** ● Analyze a consumer product using reverse engineering techniques to document visual, functional, and structural aspects of the design. ● Evaluate a solution to a complex, real-world problem and identify the need for trade-offs to address a range of criteria and constraints, including environmental impacts. ● Consider the impact of potential engineering solutions on future generations to inform the development of sustainable solutions. ● Apply an iterative design process, including developing appropriate models, to creatively address a need or solve a problem. ● Predict the local and global risks and impacts of an engineering decision/solution, including some that were not anticipated. ● Apply effective techniques and appropriate guidelines to generate multiple creative ideas and potential solutions to a problem. ● Collect, analyze, and interpret information relevant to the problem or opportunity at hand to support engineering decisions. ● Use computer-aided engineering tools to optimize design performance of a mechanical part or assembly. ● Select and use collaborative tools, such as cloud-based tools, document sharing, and video and text functions, to successfully complete a project. ● Facilitate an effective team environment to

whole. ● Sustainability and identify principles that help guide development of sustainable solutions (e.g. generative design and life cycle assessment). ● How to develop and follow team norms. ● One's individual role and expectations of performance within the team, including communication protocol and rules of engagement per the team norms. ● The project deliverables and constraints, such as scope, time, cost, quality, resources, and risk. ● How to develop a project schedule (with the critical path identified when appropriate), allocate tasks among team members, and track progress for successful completion of the project.	promote successful goal attainment. ● Apply systems thinking to consider how an engineering problem and its solution may be thought of as containing subsystems and as being a sub-system of a larger system. ● Develop models and simulations to represent information, processes, and/or objects to an appropriate level of abstraction for the intended purpose.

Lower Cape May Regional School District Career and Technical Education - Engineering Curriculum
Unit 4 Overview

Content Area: Career and Technical Education - Engineering

Unit Title: Making Things Move

Target Course/Grade Level: Introduction to Engineering Design

Unit Summary:
This unit focuses on familiarizing students with basic engineering knowledge related to simple mechanical and electrical systems and the use of mathematical models to represent design ideas and to inform design decisions. Students begin by reverse engineering a mechanical device to identify simple machines and mechanisms that influence motion and contribute to the function of the device. Students identify different types of motion (rotary, oscillating, linear, and reciprocating) and investigate mechanisms that cause motion (including cams, gears, pulleys, chain and sprockets) and later use these mechanisms to create, transform, and control motion to solve a problem. Students practice CAD skills by developing assembly models of the mechanisms they investigate and simulating motion in the CAD environment. To support efficient CAD modeling, students will also learn to use mathematical functions to represent dimensional relationships in a 3D solid model. Students investigate forces that resist motion. First students study spring forces and develop a mathematical model to determine the relationship between spring displacement and force for a given spring. Students also learn about simple electrical circuits and how to transform electrical power to motion using a motor. Students design and install a

circuit to run a hobby motor that powers their previously designed automaton. As part of the electrical circuit, students develop a mathematical model to inform the design of a simple potentiometer to control the speed of the motor. As an end of course project, students design and build a toy that includes an electro-mechanical system that will produce realistic motion of a figure(s) or object(s) resulting from the rotation of an axle powered by a motor with minimal frictional resistance. As part of the automaton design process, each student creates a CAD assembly model and creates a computer simulation of automata motion, CAD technical drawings, and a physical working model of their design.

Interdisciplinary Connections:

Math:

N.Q.2 - Quantities Define appropriate quantities for the purpose of descriptive modeling.
G.MG.1 - Modeling with Geometry Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).
G.MG.2 - Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot). Modeling with Geometry S.ID.1 - Interpreting Categorical and Quantitative Data Represent data with plots on the real number line (dot plots, histograms, and box plots). S.ID.4 - Interpreting Categorical and Quantitative Data Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.

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economy.

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Learning Targets

CPI #	Cumulative Progress Indicators (CPI) for Unit
8.1.12.D.5	Analyze the capabilities and limitations of current and emerging technology resources and assess their potential to address personal, social, lifelong learning, and career needs.
8.2.12.E.3	Use a programming language to solve problems or accomplish a task (e.g., robotic functions, website designs, applications, and games).
8.2.12.D.5	Explain how material processing impacts the quality of engineered and fabricated products.
8.2.12.A.2	Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste.
9.2.8.CAP.20	Identify the items to consider when estimating the cost of funding a business
9.3.ST-ET.1	Use STEM concepts and processes to solve problems involving design and/or production.
9.3.ST.1	Apply engineering skills in a project that requires project management, process control and quality assurance.
9.4.12.CI.1	Demonstrate the ability to reflect, analyze, and use creative skills and ideas
9.4.12.CI.2	Identify career pathways that highlight personal talents, skills, and abilities
9.4.12.CI.3	Investigate new challenges and opportunities for personal growth, advancement, and transition

Unit Enduring Questions:	Unit Enduring Understandings:
● What is a mechanical system? How can we effectively model mechanical systems? ● How can we use mathematical models	● There are different types of motion. ● Separating a complex process into multiple subprocesses is implemented in an organized way to complete a larger process.

to model linear motion? ● What is Hooke's Law? What are spring characteristics and how can they be modeled mathematically? ● What is friction? How does an object's coefficient of friction affect its motion? ● How can simple machines be used to transfer motion? ● How can friction be reduced using a bushing? ● What is a circuit and how can we use circuits to create motion? ● What is a variable resistor?	● To create relationships among part features and dimensions, parametric formulas are used. ● Performing a functional analysis of a product or system to determine the purpose, inputs, outputs and operation of a product system. ● Correctly applying constraints to a multi-component model simulates realistic relative motion of the component parts. ● Making strategic use of digital media in presentations enhances understanding of findings, reasoning, and evidence and to add interest. ● Analyzing a consumer product using reverse engineering techniques document visual, functional, and structural aspects of the design. ● Explaining the benefits of human-centered design and applying principles aligns to product design with intended use. ● Design quality concepts such as performance, usability, accessibility, reliability, and safety impact product development.
Unit Objectives: ***Students will know….*** ● Different types of motion. ● How to separate a complex process into multiple subprocesses that can be implemented in an organized way to complete the larger process. ● How to use mathematical modeling to optimize design criteria. ● How to select and use simple mechanisms to create and control motion to solve a problem. ● How to use mechanisms in a design to	**Unit Objectives:** ***Students will be able to…...*** ● Create relationships among part features and dimensions using parametric formulas. ● Perform a functional analysis of a product or system to determine the purpose, inputs and outputs, and operation of a product or system. ● Use a mathematical model to describe the relationship between the motion of objects. ● Correctly apply constraints to a multi-component model and/or simulate realistic relative motion of the component parts. Represent data for two quantitative variables

transform a motion without changing its type. ● Cams and followers can be used to move objects in periodic motion. ● How to use sketches, tables, charts, and graphs when appropriate to clearly communicate information and in making arguments and claims in oral, written, and visual presentations. ● Friction is a force that opposes motion. ● The force of friction between two interacting components in a mechanism, explain how the frictional force impacts the function and efficiency of the mechanism, and recommend design revisions to improve performance. ● Frictional force impacts the function and efficiency of a mechanism, and recommend design revisions to improve performance. ● How to calculate and measure the resistance, current, and voltage of a circuit. ● Different machine elements influence motion of a mechanical system.	on a scatter plot, and describe how the variables are related. ● Fit a function to data and use the function to make predictions in the context of the data. Build and use a mathematical model to represent data, describe relationships, describe processes, or to make predictions in the context of a problem. ● Correctly build and constrain a three-dimensional solid computer model to accurately represent the physical characteristics and behaviors of a design idea or real object. ● Generate an annotated multiview technical drawing using CAD software to fully describe a simple part. ● Develop a model to accurately represent the motion of a system with a series of cams. ● Correctly apply joints to constrain a multi-component model to simulate realistic relative motion. ● Develop a potential solution to a problem and implement a plan to test and evaluate the solution with respect to the design criteria and constraints. ● Collect, analyze, and interpret information relevant to the problem or opportunity at hand to support engineering decisions. ● Determine the coefficient of friction between two surfaces. ● Select and justify the use of materials for prototyping and manufacturing products. ● Select and use simple mechanisms (cams, gears, pulleys and belts, sprockets and chains, springs, levers) to create and control motion to solve a problem. ● Develop a project schedule and track progress for successful completion of the project. ● Design and build an electrical circuit that includes a DC power source, a motor, and a switch. ● Design and build an electrical circuit that includes a variable resistance to control the speed of a mechanism. ● Demonstrate persistence in accomplishing a difficult challenge. ● Make strategic use of digital media (textual,

	graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence, and to add interest. ● Build a physical representation of an object or system based on graphical representations of the object or system. Includes building solid objects, electrical circuits, mechanical devices, and complex systems according to technical drawings. ● Apply systems thinking to consider how an engineering problem and its solution may be thought of as containing a subsystem and as being a subsystem of a larger system. ● Integrate an electrical circuit with a machine to solve a problem. ● Apply scientific knowledge related to frictional forces, to solve a problem or design a physical system. ● Synthesize an ill-formed problem into a meaningful, well-defined problem using relevant information. ● Consider the impact of potential engineering solutions on future generations to inform the development of sustainable solutions. ● Assess the sustainability of an engineering solution based on the impacts (within the system or interrelated systems) that result from implementation of the solution. ● Communicate effectively with an audience based on audience characteristics.

Lower Cape May Regional School District (Insert Subject/Content Area) Curriculum Evidence of Learning
Specific Formative Assessments Utilized in Daily Lessons: ● Design Process ● Engineering Notebook Documentation ● Unit Conversion and Dimensional Analysis ● Descriptive Statistics: Mean, Median, Mode, Range ● Problem-solving Scenarios ● Technical Drawings

- Precision and Accuracy
- Measuring with a Dial Caliper
- Modeling of 3D Objects with CAD software
- Quizzes and Tests
- Unit Test
- Presentations:
  Students will formally present all design challenge work through their engineering notebook documentation.
  Students will orally present their solution to their projects and problem-solving scenarios as if they were pitching their idea to their client.

Summative Assessment Utilized throughout Units:

- QBA's
- Benchmarks listed or linked here

Modifications for ELL's, Special Education, 504, and Gifted and Talented Students:

- Teacher tutoring
- Peer tutoring
- Cooperative Learning Groups
- Modified Assignments
- Differentiated Instruction
- Response to Intervention (www.help4teachers.com)
- Follow all IEP and 504 modifications
- ADD TO LIST AS YOU SEE NECESSARY

Teacher Notes:

- As required by the NJ Department of Education, teachers in all content areas will integrate the 21st Century Life and Careers Standards. As the NJDOE indicates, "Providing New Jersey students with the life and career skills needed to function optimally within this dynamic context is a critical focus and organizing principle of K-12 public education. New Jersey has both an obligation to prepare its young people to thrive in this environment, and a vested economic interest in grooming an engaged citizenry made up of productive members of a global workforce that rewards innovation, creativity, and adaptation to change." The links below indicate the CPIs for grade ranges and need to be addressed throughout the units of study:
  Life and Career Standards
- As indicated in the NJSLS, standards and interdisciplinary connections will be integrated throughout content area curriculum. Links to relevant content standards can be found below:
  LINK APPROPRIATE INTERDISCIPLINARY CONNECTIONS & RELEVANT NJSLS HERE

Project-based Learning Tasks:

- Design Innovation
- Autodesk Inventor Work

- Reverse Engineering
- CAD Model Features

Vocabulary:

- In-text vocabulary should be incorporated into every unit. Word journals, vocabulary walls, and/or various other activities should be utilized by the instructor to teach vocabulary.

The Research Process:

- The research process must be integrated within each course curriculum. Student will be provided with opportunities to investigate issues from thematic units of study. As the NJSLS indicate, students will develop proficiency with MLA or APA format as applicable.
- Link Research resources here.

Technology:

- Students must engage in technology applications integrated throughout the curriculum. Applicable technology utilized in this curricula are included below:
- Google Classroom
- Autodesk Inventor
- PowerPoint

Resources:

- Ancillary resources and materials used to deliver instruction are included below:

Differentiation Strategies

Differentiation strategies can require varied amounts of preparation time. High-prep strategies often require a teacher to both create multiple pathways to process information/demonstrate learning and to assign students to those pathways. Hence, more ongoing monitoring and assessment is often required. In contrast, low-prep strategies might require a teacher to strategically create process and product choices for students, but students are allowed to choose which option to pursue given their learning profile or readiness level. Also, a low-prep strategy might be focused on a discrete skill (such as vocabulary words), so there are fewer details to consider. Most teachers find that integration of one to two new low-prep strategies and one high-prep strategy each quarter is a reasonable goal.

Low Prep Strategies (add to list as needed)	
Varied journal prompts, spelling or vocabulary lists	Students are given a choice of different journal prompts, spelling lists or vocabulary lists depending on level of proficiency/assessment results.
Anchor activities	Anchor activities provide meaningful options for students when they are not actively engaged in classroom activities (e.g., when they finish early, are waiting for further directions, are stumped, first enter class, or when the teacher is working with other students). Anchors should be directly related to the current learning goals.
Choices of books	Different textbooks or novels (often at different levels) that students are allowed to choose from for content study or for literature circles.
Choices of review activities	Different review or extension activities are made available to students during a specific section of the class (such as at the beginning or end of the period).
Homework options	Students are provided with choices about the assignments they complete as homework. Or, students are directed to specific homework based on student needs.
Student-teacher goal setting	The teacher and student work together to develop individual learning goals for the student.
Flexible grouping	Students might be instructed as a whole group, in small groups of various permutations (homogeneous or heterogeneous by skill or interest), in pairs or individual. Any small groups or pairs change over time based on assessment data.
Varied computer programs	The computer is used as an additional center in the classroom, and students are directed to specific websites or software that allows them to work on skills at their level.
Multiple Intelligence or Learning Style options	Students select activities or are assigned an activity that is designed for learning a specific area of content through their strong intelligence (verbal-linguistic, interpersonal, musical, etc.)
Varying scaffolding of same organizer	Provide graphic organizers that require students to complete various amounts of information. Some will be more filled out (by the teacher) than others.

Think-Pair-Share by readiness, interest, and/or learning profile	Students are placed in predetermined pairs, asked to think about a question for a specific amount of time, then are asked to share their answers first with their partner and then with the whole group.
Mini workshops to re-teach or extend skills	A short, specific lesson with a student or group of students that focuses on one area of interest or reinforcement of a specific skill.
Orbitals	Students conduct independent investigations generally lasting 3-6 weeks. The investigations "orbit" or revolve around some facet of the curriculum.
Games to practice mastery of information and skill	Use games as a way to review and reinforce concepts. Include questions and tasks that are on a variety of cognitive levels.
Multiple levels of questions	Teachers vary the sorts of questions posed to different students based on their ability to handle them. Varying questions is an excellent way to build the confidence (and motivation) of students who are reluctant to contribute to class discourse. Note: Most teachers would probably admit that without even thinking about it they tend to address particular types of questions to particular students. In some cases, such tendencies may need to be corrected. (For example, a teacher may be unknowingly addressing all of the more challenging questions to one student, thereby inhibiting other students' learning and fostering class resentment of that student.)
High Prep Strategies (add to list as needed)	
Cubing	Designed to help students think about a topic or idea from many different angles or perspectives. The tasks are placed on the six sides of a cube and use commands that help support thinking (justify, describe, evaluate, connect, etc.). The students complete the task on the side that ends face up, either independently or in homogenous groups.
Tiered assignment/ product	The content and objective are the same, but the process and/or the products that students must create to demonstrate mastery are varied according to the students' readiness level.
Independent studies	Students choose a topic of interest that they are curious about and wants to discover new information on. Research is done from questions developed by the student and/or teacher. The researcher produces a product to share learning with classmates.
4MAT	Teachers plan instruction for each of four learning preferences over

	the course of several days on a given topic. Some lessons focus on mastery, some on understanding, some on personal involvement, and some on synthesis. Each learner has a chance to approach the topic through preferred modes and to strengthen weaker areas
Jigsaw	Students are grouped based on their reading proficiency and each group is given an appropriate text on a specific aspect of a topic (the economic, political and social impact of the Civil War, for example). Students later get into heterogeneous groups to share their findings with their peers, who have read about different areas of study from source texts on their own reading levels. The jigsaw technique allows you to tackle the same subject with all of your students while discreetly providing them the different tools they need to get there.
Multiple texts	The teacher obtains or creates a variety of texts at different reading levels to assign strategically to students.
Alternative assessments	After completing a learning experience via the same content or process, the student may have a choice of products to show what has been learned. This differentiation creates possibilities for students who excel in different modalities over others (verbal versus visual).
Modified Assessments	Assessments can be modified in a variety of ways – for example by formatting the document differently (e.g. more space between questions) or by using different types of questions (matching vs. open ended) or by asking only the truly essential questions.
Learning contracts or Personal Agendas	A contract is a negotiated agreement between teacher and student that may have a mix of requirements and choice based on skills and understandings considered important by the teacher. A personal agenda could be quite similar, as it would list the tasks the teacher wants each student to accomplish in a given day/lesson/unit. Both Learning contracts and personal agendas will likely vary between students within a classroom.
Compacting	This strategy begins with a student assessment to determine level of knowledge or skill already attained (i.e. pretest). Students who demonstrate proficiency before the unit even begins are given the opportunity to work at a higher level (either independently or in a group).
Literature circles	Flexible grouping of students who engage in different studies of a piece of literature. Groups can be heterogeneous and homogeneous.
Learning Centers	A station (or simply a collection of materials) that students might use independently to explore topics or practice skills. Centers allow

	individual or groups of students to work at their own pace. Students are constantly reassessed to determine which centers are appropriate for students at a particular time, and to plan activities at those centers to build the most pressing skills.
Tic-Tac-Toe Choice Board (sometimes called "Think-Tac-Toe"	The tic-tac-toe choice board is a strategy that enables students to choose multiple tasks to practice a skill, or demonstrate and extend understanding of a process or concept. From the board, students choose (or teacher assigns) three adjacent or diagonal. To design a tic-tac-toe board: - Identify the outcomes and instructional focus - Design 9 different tasks - Use assessment data to determine student levels - Arrange the tasks on a tic-tac-toe board either randomly, in rows according to level of difficulty, or you may want to select one critical task to place in the center of the board for all students to complete.

Curriculum development Resources/Instructional Materials:

List or Link Ancillary Resources and Curriculum Materials Here:

- Google Classroom for Assignments and Videos
- EdPuzzle
- Google Sheets
- Google Docs
- Google Slides
- Autodesk Inventor
- Desktop Computers with large monitors
- Big Screen Monitor in the front of the room
- 3D Printers

Board of Education Approved Text(s)

- List BOE Approved text here