FREEHOLD REGIONAL HIGH SCHOOL DISTRICT
OFFICE OF CURRICULUM AND INSTRUCTION
TECHNOLOGY DEPARTMENT CURRICULUM

TECHNOLOGICAL SYSTEMS & DESIGN

Grade Level: 9-12

Credits: 5

BOARD OF EDUCATION ADOPTION DATE: August 24, 2023
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FREEHOLD REGIONAL HIGH SCHOOL DISTRICT

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TECHNOLOGICAL SYSTEMS AND DESIGN

Course Description

This course provides an overview of technology's impact on society, including its historical context, current effects, and potential future developments. Unit 1 of *Technological Systems and Design* provides an overview of technology's impact on society, including its historical context, current effects, and potential future developments. Unit 2: Design and Reverse Engineering explores the process of design and reverse engineering. Unit 3's Technical Literacy covers the fundamentals of sketching and technical drawing. During Unit 4 Structures, students will be introduced to different types of forces and structural members. Unit 5: Mechanisms introduces and experiments with various mechanical forces, materials and mechanisms. During Unit 6 Power and Energy, students will learn about and experiment with various forms of mechanical, electrical and fluid energy forms. Finally, in Unit 7 students will demonstrate that they can apply the design/ engineering process in a practical and/ or theoretical situation in "capstone-like" projects.

Course Sequence and Pacing

Unit Title	Section Focus	Suggested Pacing
Unit 1: Technology in History and Society	Section 1.1: The History of Technology Section 1.2: Technology Today and Its Effects on Society Section 1.3: The Future of Technology	5 sessions
Unit 2: Technical Literacy	Section 2.1: Technological Literacy Section 2.2: Sketching/Technical Drawing Section 2.3: 2D to 3D (Paper to Physical)	13 sessions
Unit 3: Design and Reverse Engineering	Section 3.1: The Evolution of Technological Artifacts Section 3.2: Exploration of Technological Resources Section 3.3: Reverse Engineering Activity	6 sessions
Unit 4: Structures	Section 4.1: Forces and Components Section 4.2: Methods and Materials Section 4.3: Structural Design (Build - Test - Evaluate)	20 sessions
Unit 5: Mechanisms	Section 5.1: Forces and Components Section 5.2: Methods and Materials Section 5.3: Mechanical Design (Build - Test - Evaluate)	28 sessions
Unit 6: Power & Energy	Section 6.1: Mechanical Energy Section 6.2: Electrical Energy Section 6.3: Fluid Energy Section 6.4: Power and Energy Design (Build - Test -Evaluate)	30 sessions
Unit 7: Applied Problem Solving and Solution Development	Section 7.1: Theoretical Model Development Section 7.2: Working Model/Prototype Development Section 7.3:Portfolio Development and Presentation of Design Solutions	25 sessions

Support Resources

Supporting resources and appendices for this curriculum are available. These include a Resource Catalog of standards-aligned activities, common formative assessment and interdisciplinary items for performance expectations and objectives in this course.

- Technological Systems and Design Resource Catalog
- Appendix A: Accommodations and Modifications for Various Student Populations
- Appendix B: Assessment Evidence
- Appendix C: Interdisciplinary Connections

TECHNOLOGICAL SYSTEMS AND DESIGN **Suggested Pacing: 1 session**
Unit 1: Technology in History & Society
Section 1.1
Focus: The History of Technology

Unit 1 provides an overview of technology's impact on society, including its historical context, current effects, and potential future developments. Sections 2 and 3 respectively examine technology's present-day effects on society and explore potential future technological advancements.

NJSLS-M Performance Expectations

9.3.12.ST-ET.4 Apply the knowledge learned in the study of STEM to provide solutions to human and societal problems in an ethical and legal manner.

9.3.12.AC-DES.5 Identify the diversity of needs, values, and social patterns in project design, including accessibility standards, to appropriately meet client needs.

Standards-Aligned Objectives. Instruction and assessment will align to the following objectives:

1.1 [1] Explain why and how the contributions of great innovators are important to society.
A. Famous Innovators and Inventors in history (eg: DaVinci, Galileo, etc.).

1.1 [2] Identify the geographic and cultural issues related to project design in a given situation.
A. Historical Context

TECHNOLOGICAL SYSTEMS AND DESIGN **Suggested Pacing: 2 sessions**
Unit 1: Technology in History & Society
Section 1.2
Focus: Technology Today and Its Effects on Society

Unit 1 provides an overview of technology's impact on society, including its historical context, current effects, and potential future developments. Sections 2 and 3 respectively examine technology's present-day effects on society and explore potential future technological advancements.

NJSLS-M Performance Expectations

9.3.12.ST-ET.4 Apply the knowledge learned in the study of STEM to provide solutions to human and societal problems in an ethical and legal manner.

9.3.12.AC-DES.5 Identify the diversity of needs, values, and social patterns in project design, including accessibility standards, to appropriately meet client needs.

Standards-Aligned Objectives. Instruction and assessment will align to the following objectives:

1.2 [1] Explain why and how the contributions of great innovators are important to society.
A. Modern day innovators and inventors (eg: Gates, Hopper, Lovelace, Jobs, etc.).

1.2 [2] Identify the geographic and cultural issues related to project design in a given situation.
A. Current situations
B. Environmental Impacts
C. OSHA

TECHNOLOGICAL SYSTEMS AND DESIGN **Unit 1: Technology in History & Society** **Section 1.3** **Focus: The Future of Technology**	**Suggested Pacing: 2 sessions**
Unit 1 provides an overview of technology's impact on society, including its historical context, current effects, and potential future developments. Sections 2 and 3 respectively examine technology's present-day effects on society and explore potential future technological advancements.	
NJSLS-M Performance Expectations	
9.3.12.MN.1 Evaluate the nature and scope of the Manufacturing Career Cluster and the role of manufacturing in society and in the economy.	
8.2.12.ED.6: Analyze the effects of changing resources when designing a specific product or system (e.g., materials, energy, tools, capital, labor).	
9.3.12.ST-ET.4 Apply the knowledge learned in the study of STEM to provide solutions to human and societal problems in an ethical and legal manner.	
Standards-Aligned Objectives. Instruction and assessment will align to the following objectives:	
1.3 [1] Explain the impact of technology changes. *A. Future manufacturing trends and advancements in our local and national society.*	
1.3 [2] Explain how and why new materials will affect the sustainability in the design of products.	
1.3 [3] Explain why and how the contributions of great innovators are important to society. *A. Predict outcomes including AI, Global Impacts.*	

TECHNOLOGICAL SYSTEMS AND DESIGN **Unit 2: Technical Literacy** **Section 2.1** **Focus: Technical Literacy**	**Suggested Pacing: 5 sessions**
Unit 2 emphasizes the importance of technical literacy and covers the fundamentals of sketching and technical drawing. The unit also explores the process of converting 2D designs to 3D physical objects.	
NJSLS-M Performance Expectations	
9.3.12.ST-ET.5 Apply the elements of the design process.	
9.4.12.IML.2: Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources.	
Standards-Aligned Objectives. Instruction and assessment will align to the following objectives:	
2.1 [1] Complete a simple design challenge that tests the effectiveness of a design solution.	
2.1 [2] Identify and explain the steps of the design process and how they can be applied to the previous solution. *a. Identify the problem* *b. Investigation/Research* *c. Brainstorm Possible Solutions* *d. Choose the best solution* *e. Develop your solutions* *f. Test your solutions* *g. Evaluation and Redesign*	
2.1[3] Demonstrate proficiency in the use of digital tools used to research, create, and document information.	

TECHNOLOGICAL SYSTEMS AND DESIGN **Suggested Pacing: 5 sessions** **Unit 2: Technical Literacy** **Section 2.2** **Focus: Sketching/ Technical Drawing**
Unit 2 emphasizes the importance of technical literacy and covers the fundamentals of sketching and technical drawing. The unit also explores the process of converting 2D designs to 3D physical objects.
NJSLS-M Performance Expectations
9.3.12.AC.6 Read, interpret, and use technical drawings, documents and specifications to plan a project.
9.3.12.AC-DES.7 Employ appropriate representational media to communicate concepts and design.
9.3.12.AC-DES.6 Apply the techniques and skills of modern drafting, design, engineering, and construction to projects.
9.3.12.AC.6 Read, interpret, and use technical drawings, documents and specifications to plan a project.
Standards-Aligned Objectives. Instruction and assessment will align to the following objectives:
2.2 [1] Interpret drawings used in project planning.
2.2 [2] Recognize elements and symbols of blueprints and drawings.
2.2 [3] Convey graphic information using multi-dimensional drawings. (i.e. orthographic, isometric, etc).
2.2 [4] Read and produce technical drawings, understanding the significance of each line in a drawing (i.e. line types, line weights).
2.2 [5] Use proper measurements to determine layout.

TECHNOLOGICAL SYSTEMS AND DESIGN **Suggested Pacing: 3 sessions** **Unit 2: Technical Literacy** **Section 2.3** **Focus: 2D to 3D (Paper to Physical)**
Unit 2 emphasizes the importance of technical literacy and covers the fundamentals of sketching and technical drawing. The unit also explores the process of converting 2D designs to 3D physical objects.
NJSLS-M Performance Expectations
9.3.12.AC-DES.7 Employ appropriate representational media to communicate concepts and design.
9.3.12.AC-DES.6 Apply the techniques and skills of modern drafting, design, engineering, and construction to projects.
Standards-Aligned Objectives. Instruction and assessment will align to the following objectives:
2.3 [1] Conceptualize a three-dimensional form from a two-dimensional drawing to visualize proposed work. a. eg: Pattern Development.
2.3 [2] Read and produce technical drawings, understanding the significance of each line in a drawing. a. Effectively draw a 3D model from a 2D technical drawing/plan.
2.3 [3] Students will identify the key stages of the engineering design process (define problem, research, brainstorm, design, prototype, test, improve, communicate).
2.3 [4]Students will explain the importance of technical drawings and specifications in engineering communication.
2.3 [5]Students will use basic drafting tools (physical or digital) to create sketches and dimensioned drawings of simple objects.
2.3 [6]Students will interpret common engineering drawing symbols and notations.
2.3 [7] Students will apply design principles (form, function, strength, stability) to develop 2D models for solving a defined engineering challenge.

TECHNOLOGICAL SYSTEMS AND DESIGN **Suggested Pacing: 6 sessions**
Unit 3: Design and Reverse Engineering
Section 3.1
Focus: The Evolution of Technological Artifacts

Unit 3 explores the process of design and reverse engineering. The unit covers the evolution of technological artifacts, the exploration of technological resources, and a hands-on reverse engineering activity.

NJSLS-M Performance Expectations

8.2.12.ITH.1: Analyze a product to determine the impact that economic, political, social, and/or cultural factors have had on its design, including its design constraints.

Standards-Aligned Objectives. Instruction and assessment will align to the following objectives:

3.1 [1] Explain how a piece of technology has evolved into its modern day counterpart. (eg. the quill to word processor, hammer to cordless nailer, abacus to calculator).

TECHNOLOGICAL SYSTEMS AND DESIGN **Suggested Pacing: 2 sessions**
Unit 3: Design and Reverse Engineering
Section 3.2
Focus: Exploration of Technological Resources

Unit 3 explores the process of design and reverse engineering. The unit covers the evolution of technological artifacts, the exploration of technological resources, and a hands-on reverse engineering activity.

NJSLS-M Performance Expectations

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).

Standards-Aligned Objectives. Instruction and assessment will align to the following objectives:

3.2 [1] Identify how resource availability, quality and usability affect the production and application of technological artifacts.
A. Identify common resources and their unique characteristics.
B. Identify four basic materials: Ceramics, metals, polymers, composites.

TECHNOLOGICAL SYSTEMS AND DESIGN **Suggested Pacing: 3 sessions**
Unit 3: Design and Reverse Engineering
Section 3.3
Focus: Reverse Engineering Activity

Unit 3 explores the process of design and reverse engineering. The unit covers the evolution of technological artifacts, the exploration of technological resources, and a hands-on reverse engineering activity.

NJSLS-M Performance Expectations

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).

Standards-Aligned Objectives. Instruction and assessment will align to the following objectives:

3.3 [1] Reverse-engineer a product and analyze the effectiveness of resource choice as it applies to products requirements.
A. Identify the requirements for the product and whether or not those requirements were met.
B. Evaluate what materials were utilized in the design of the product.
C. Explain how sustainable engineering was/was not considered in the design of this product. (maintenance, repairability, end of life).

TECHNOLOGICAL SYSTEMS AND DESIGN **Suggested Pacing: 2 sessions**
Unit 4: Structures
Section 4.1
Focus: Forces and Components

During this unit, the students will be introduced to different types of forces and structural members. The students will later experiment with different types of structures and then utilize them in a problem solving activity.

NJSLS-M Performance Expectations

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).

9.3.12.ST-SM.2 Apply science and mathematics concepts to the development of plans, processes and projects that address real world problems.

Standards-Aligned Objectives. Instruction and assessment will align to the following objectives:

4.1 [1] Evaluate the success of a structure based on the design and forces acting upon it (structural failure videos, articles, etc.)
A. Identify factors that impact a structure's success or failure.
B. Describe the forces impacting a structure.

4.1 [2] Research a topic, collect data, analyze the data and draw conclusions from the results.
A. Include vocabulary that describes forces such as compression, tension, torsion, dynamic load and static load.
B. Include vocabulary that describes structural elements such as column, beam, brace, tie, strut.

TECHNOLOGICAL SYSTEMS AND DESIGN **Suggested Pacing: 3 sessions**
Unit 4: Structures
Section 4.2
Focus: Methods and Materials

During this unit, the students will be introduced to different types of forces and structural members. The students will later experiment with different types of structures and then utilize them in a problem solving activity.

NJSLS-M Performance Expectations

8.2.12.ITH.1: Analyze a product to determine the impact that economic, political, social, and/or cultural factors have had on its design, including its design constraints.

8.2.12.ED.3: Evaluate several models of the same type of product and make recommendations for a new design based on a cost benefit analysis.

Standards-Aligned Objectives. Instruction and assessment will align to the following objectives:

4.2 [1] Determine the factors that influence material choice in the construction of a design
A. Positives and negatives of using wooden, concrete, steel, etc. (i.g. availability, environmental impacts, costs, strength, efficiency, etc)

4.2 [2] Compare materials in relation to how they are used to fulfill the same purpose.
A. Efficiency in design (cost vs. load).
B. Build cost based upon material selection.

TECHNOLOGICAL SYSTEMS AND DESIGN **Suggested Pacing: 15 sessions**
Unit 4: Structures
Section 4.3
Focus: Structural Design (Build - Test - Evaluate)

During this unit, the students will be introduced to different types of forces and structural members. The students will later

experiment with different types of structures and then utilize them in a problem solving activity.
NJSLS-M Performance Expectations
9.3.12.ST.3 Describe and follow safety, health and environmental standards related to science, technology, engineering and mathematics (STEM) workplaces.
8.2.12.ED.4: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.
9.3.12.AC.6 Read, interpret, and use technical drawings, documents and specifications to plan a project.
9.3.12.AC-DES.7 Employ appropriate representational media to communicate concepts and design.
9.3.12.ST-ET.1 Use STEM concepts and processes to solve problems involving design and/or production.
9.3.12.ST.2 Use technology to acquire, manipulate, analyze and report data.
Standards-Aligned Objectives. Instruction and assessment will align to the following objectives:
4.3 [1] Demonstrate safe use of tools and equipment. *A. Describe potential safety issues related to the classroom or real-world applications.* *B. Identify the tools and technology used in the class.*
4.3 [2] Design and construct a structural engineering solution based upon a problem with specifications.
4.3 [3] Interpret drawings used in project planning.
4.3 [4] Recognize elements and symbols of blueprints and drawings.
4.3 [5] Convey graphic information using multi-dimensional drawings.
4.3 [6] Conceptualize a three-dimensional form from a two-dimensional drawing to visualize proposed work.
4.3 [7] Predict the outcomes based on data collected in a project or experiment. *A. Predict the potential efficiency of a structural design solution based upon material use, weight, and load bearing qualities.*
4.3 [8] Apply a technological, scientific, or mathematical concept (use of algorithms) when communicating with others on issues, plans, processes, problems, or concepts.
4.3 [9] Use simulation, modeling, and prototype techniques to solve problems.

TECHNOLOGICAL SYSTEMS AND DESIGN **Unit 5: Mechanisms** **Section 5.1** **Focus: Forces and Components**	**Suggested Pacing: 2 sessions**
During unit 5, students will be introduced and experiment with various mechanical forces, materials and mechanisms. The students will later experiment with the various methods and materials in order to complete various problem solving activities related to mechanisms.	
NJSLS-M Performance Expectations	
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).	
9.3.12.ST-SM.1 Apply science and mathematics to provide results, answers and algorithms for engineering and technological activities.	
Standards-Aligned Objectives. Instruction and assessment will align to the following objectives:	
5.1 [1] Evaluate the success of a mechanism based on the design and forces acting upon it. A. Identify factors that impact a mechanisms success or failure. B. Describe the forces impacting a mechanisms' functioning.	
5.1 [2] Use the skills and abilities in science and mathematics to access, share, and use data to develop plans, processes, projects and solutions. A. *Include vocabulary that describes mechanical force such as potential and kinetic energy.*	

B. Include vocabulary that describe rotary and linear motion such as speed, velocity and acceleration.
C. Include vocabulary that describes mechanical components such as gears, springs, pulleys, chains, sprockets.

TECHNOLOGICAL SYSTEMS AND DESIGN **Suggested Pacing: 2 sessions**
Unit 5: Mechanisms
Section 5.2
Focus: Methods and Materials

During Unit 5, students will be introduced and experiment with various mechanical forces, materials and mechanisms. The students will later experiment with the various methods and materials in order to complete various problem solving activities related to mechanisms.

NJSLS-M Performance Expectations

8.2.12.ITH.1: Analyze a product to determine the impact that economic, political, social, and/or cultural factors have had on its design, including its design constraints.

8.2.12.ED.3: Evaluate several models of the same type of product and make recommendations for a new design based on a cost benefit analysis.

Standards-Aligned Objectives. Instruction and assessment will align to the following objectives:

5.2 [1] Determine the factors that influence material choice in the construction of a design
A. Positives and negatives of using wooden, concrete, steel, etc. (i.g. availability, environmental impacts, costs, strength, efficiency, etc).

5.2 [2] Evaluate different materials in relation to how they are used to fulfill the same purpose.
A. Compare forces found in structures with those found in moving parts.
B. Compare methods for providing motion and analyze appropriateness within applications.

TECHNOLOGICAL SYSTEMS AND DESIGN **Suggested Pacing: 24 sessions**
Unit 5: Mechanisms
Section 5.3
Focus: Mechanical Design (Build - Test - Evaluate)

During Unit 5, students will be introduced to and experiment with various mechanical forces, materials and mechanisms. The students will later experiment with the various methods and materials in order to complete various problem solving activities related to mechanisms.

NJSLS-M Performance Expectations

9.3.12.ST.3 Describe and follow safety, health and environmental standards related to science, technology, engineering and mathematics (STEM) workplaces.

8.2.12.ED.4: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.

9.3.12.AC.6 Read, interpret, and use technical drawings, documents and specifications to plan a project.

9.3.12.AC-DES.7 Employ appropriate representational media to communicate concepts and design.

9.3.12.ST-ET.1 Use STEM concepts and processes to solve problems involving design and/or production.

9.3.12.ST.2 Use technology to acquire, manipulate, analyze and report data.

Standards-Aligned Objectives. Instruction and assessment will align to the following objectives:

5.3 [1] Demonstrate safe use of tools and equipment.
A. Describe potential safety issues related to the classroom or real-world applications.
B. Identify the tools and technology used in the class.

5.3 [2] Design and construct a mechanical engineering solution based upon a problem with specifications.
A. Simple Mechanisms Projects (eg. Rubber Band Car, Catapult, Sail Boat).
B. Intermediate Mechanisms Projects (eg. Mousetrap Car, Rube Goldberg).

5.3 [3] interpret drawings used in project planning.
5.3 [4] Recognize elements and symbols of blueprints and drawings.
5.3 [5] Convey graphic information using multi-dimensional drawings.
5.3 [6] Conceptualize a three-dimensional form from a two-dimensional drawing to visualize proposed work.
5.3 [7] Predict the outcomes based on data collected in a project or experiment. *A. Potential work output vs. work input.* *B. Accuracy, precision & functionality.*
5.3 [8] Apply a technological, scientific, or mathematical concept (use of algorithms) when communicating with others on issues, plans, processes, problems, or concepts.
5.3 [9] Use simulation, modeling, and prototype techniques to solve problems.

TECHNOLOGICAL SYSTEMS AND DESIGN **Unit 6: Power and Energy** **Section 6.1** **Focus: Mechanical Energy**	**Suggested Pacing: 3 sessions**
During unit 6, the students will learn about and experiment with various forms of mechanical, electrical and fluid energy forms. The students will later experiment with each energy form and utilize them in a problem solving activity.	
NJSLS-M Performance Expectations	
9.3.12.ST-ET.6.8 Apply Newton's Laws of Motion to analyze static and dynamic systems with and without the presence of external forces.	
Standards-Aligned Objectives. Instruction and assessment will align to the following objectives:	
6.1 [1] Use the laws of conservation of energy, charge, and momentum to solve a variety of problems involving mechanical, fluid, chemical, biological, electrical and thermal systems.	
6.1 [2] Show how the relationships between energy, work, and power can be used to solve a variety of problems involving mechanical, fluid, electrical and thermal systems. *A. Potential vs. Kinetic Energy.* *B. Units of measure (Newtons, Joules, in/lb, etc.).*	

TECHNOLOGICAL SYSTEMS AND DESIGN **Unit 6: Power and Energy** **Section 6.2** **Focus: Electrical Energy**	**Suggested Pacing: 3 sessions**
During Unit 6, the students will learn about and experiment with various forms of mechanical, electrical and fluid energy forms. The students will later experiment with each energy form and utilize them in a problem solving activity.	
NJSLS-M Performance Expectations	
9.3.12.ST-ET.6.8 Apply Newton's Laws of Motion to analyze static and dynamic systems with and without the presence of external forces."	
Standards-Aligned Objectives. Instruction and assessment will align to the following objectives:	
6.2 [1] Use the laws of conservation of energy, charge, and momentum to solve a variety of problems involving mechanical, fluid, chemical, biological, electrical and thermal systems. *A. Units of measure (Volts, Ams, Ohms, Watts etc.).*	
6.2 [2] Show how the relationships between energy, work, and power can be used to solve a variety of problems involving mechanical, fluid, electrical and thermal systems. *A. Explain the the interaction of Voltage, Current and Resistance.*	

B. Identify the components of a simple circuit (power source, pathway, load).
C. Identify how primary energy sources are used to produce electricity.
D. Electrical Lab - eg. breadboards, soldering.

TECHNOLOGICAL SYSTEMS AND DESIGN **Suggested Pacing: 3 sessions**
Unit 6: Power and Energy
Section 6.3
Focus: Fluid Energy

During unit 6, the students will learn about and experiment with various forms of mechanical, electrical and fluid energy forms. The students will later experiment with each energy form and utilize them in a problem solving activity.

NJSLS-M Performance Expectations

9.3.12.ST-ET.6.8 Apply Newton's Laws of Motion to analyze static and dynamic systems with and without the presence of external forces.

Standards-Aligned Objectives. Instruction and assessment will align to the following objectives:

6.3 [1] Use the laws of conservation of energy, charge, and momentum to solve a variety of problems involving mechanical, fluid, chemical, biological, electrical and thermal systems.
A. Units of measurement: Pressure (PSI), Volume Per Minute.

6.3 [2] Show how the relationships between energy, work, and power can be used to solve a variety of problems involving mechanical, fluid, electrical and thermal systems.
A. Explain the components of a Hydraulic and Pneumatic System - Valves, compressors, cylinders.
B. Explain the similarities and differences between Hydraulic and Pneumatic Systems - forces, speed, positioning, maintenance.
C. Fluid Lab - eg. syringe and tubing, buoyancy and displacement.

TECHNOLOGICAL SYSTEMS AND DESIGN **Suggested Pacing: 21 sessions**
Unit 6: Power and Energy
Section 6.4
Focus: Power & Energy Design (Build - Test - Evaluate)

During Unit 6, the students will learn about and experiment with various forms of mechanical, electrical and fluid energy forms. The students will later experiment with each energy form and utilize them in a problem solving activity.

NJSLS-M Performance Expectations

9.3.12.ST-ET.6.8 [2] Show how the relationships between energy, work, and power can be used to solve a variety of problems involving mechanical, fluid, electrical and thermal systems.

9.3.12.ST-ET.6.6 Apply and create appropriate models, concepts, and processes for an assigned situation, and apply the results to solving the problem.

8.2.12.ED.4: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.

Standards-Aligned Objectives. Instruction and assessment will align to the following objectives:

6.4 [1] Demonstrate safe use of tools and equipment.
A. Describe potential safety issues related to the classroom or real-world applications.
B. Identify the tools and technology used in the class.

6.4 [2] Design a solution for a given problem, using at least two types of power and energy technologies.

6.4 [3] Design and construct a mechanical engineering solution based upon a problem with specifications
A. Mechanical Mechanisms Projects (eg. Claw Game, CO2 Car, Trebuchet).
B. Electrical Mechanisms Projects (eg. Motor Car, Motor Airplane, Solar Power).
C. Fluid Mechanisms Projects (eg. Hungry Hippos, Prop Boat).

TECHNOLOGICAL SYSTEMS AND DESIGN **Suggested Pacing: 8 sessions** **Unit 7: Applied Problem Solving and Solution Development** **Section 7.1** **Focus: Theoretical Model Development**
In Unit 7 the students will demonstrate that they can apply the design/ engineering process in a practical and/ or theoretical situation in "capstone-like" projects.
NJSLS-M Performance Expectations
9.3.12.ST-ET.6 Apply the knowledge learned in STEM to solve problems.
8.2.12.ETW.3: Identify a complex, global environmental or climate change issue, develop a systematic plan of investigation, and propose an innovative sustainable solution.
9.3.12.ST-SM.2.10 Research a topic, collect data, analyze the data and draw conclusions from the results.
8.2.12.ED.4: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.
9.3.12.ST-ET.5.1 Apply the design process using appropriate modeling and prototyping, testing, verification and implementation techniques.
Standards-Aligned Objectives. Instruction and assessment will align to the following objectives:
7.1 [1] Identify, analyze, and solve defined engineering technology problems.
7.1 [2] Students will brainstorm various global environmental or climate change issues and then select a teacher approved problem to solve.
7.1 [3] Use proper research techniques to assist in decision making and solution development.
7.1 [4] Properly cite technical sources used in research.
7.1 [5] Design and construct a complex theoretical model for a global solution that has been designed and selected by the student and approved by the instructor.
7.1 [6] Exhibit an understanding of customer needs in the design process. *A. Create an evaluation rubric for a solution idea.* *B. Evaluate the effectiveness of a solution using chosen criteria.*

TECHNOLOGICAL SYSTEMS AND DESIGN **Suggested Pacing: 14 sessions** **Unit 7: Applied Problem Solving and Solution Development** **Section 7.2** **Focus: Working Model/Prototype Development**
In Unit 7 the students will demonstrate that they can apply the design/ engineering process in a practical and/ or theoretical situation in "capstone-like" projects.
NJSLS-M Performance Expectations
9.3.12.ST-ET.6 Apply the knowledge learned in STEM to solve problems.
9.3.12.ST-SM.2.10 Research a topic, collect data, analyze the data and draw conclusions from the results.
8.2.12.ED.4: Design a product or system that addresses a global problem and document decisions made based on research, constraints, trade-offs, and aesthetic and ethical considerations and share this information with an appropriate audience.
9.3.12.ST-ET.5.1 Apply the design process using appropriate modeling and prototyping, testing, verification and implementation techniques.
8.2.12.ETW.3: Identify a complex, global environmental or climate change issue, develop a systematic plan of investigation, and propose an innovative sustainable solution.
Standards-Aligned Objectives. Instruction and assessment will align to the following objectives:

7.2 [1] Identify, analyze, and solve defined engineering technology problems.
7.2 [2] Use proper research techniques to assist in decision making and solution development.
7.2 [3] Properly cite technical sources used in research.
7.2 [4] Design and construct a complex and working technological solution for a design problem selected by the student/instructor.
7.2 [5] Exhibit an understanding of customer needs in the design process. *A. Create an evaluation rubric for a solution idea.* *B. Evaluate the effectiveness of a solution using chosen criteria.*
7.2 [6] Evaluate the effectiveness of design solutions using student designed criteria.

TECHNOLOGICAL SYSTEMS AND DESIGN **Unit 7: Applied Problem Solving and Solution Development** **Section 7.3** **Focus: Portfolio Development & Presentation of Design Solutions**	**Suggested Pacing: 3 sessions**
In Unit 7 the students will demonstrate that they can apply the design/ engineering process in a practical and/ or theoretical situation in "capstone-like" projects.	
NJSLS-M Performance Expectations	
9.3.12.AC-DES.2 Use effective communication skills and strategies (listening, speaking, reading, writing, and graphic communications) to work with clients and colleagues.	
9.3.12.AC-DES.7 Employ appropriate representational media to communicate concepts and design.	
Standards-Aligned Objectives. Instruction and assessment will align to the following objectives:	
7.3 [1] Deliver a presentation that explains a concept of design or preconstruction.	
7.3 [2] Utilize computer technology when communicating concepts and designs.	

NJSLS Career Awareness, Exploration, Preparation, and Training, and Life Literacies and Key Skills	
9.2.12.CAP.1	Analyze unemployment rates for workers with different levels of education and how the economic, social, and political conditions of a time period are affected by a recession.
9.2.12.CAP.2	Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs.
9.2.12.CAP.3	Investigate how continuing education contributes to one's career and personal growth.
9.2.12.CAP.4	Evaluate different careers and develop various plans (e.g. costs of public, private, training schools) and timetables for achieving them, including educational/training requirements, costs, loans, and debt repayment.
9.2.12.CAP.5	Assess and modify a personal plan to support current interests and postsecondary plans.
9.2.12.CAP.6	Identify transferable skills in career choices and design alternative career plans based on those skills.
9.2.12.CAP.7	Use online resources to examine licensing, certification, and credentialing requirements at the local, state, and national levels to maintain compliance with industry requirements in areas of career interest.
9.2.12.CAP.8	Determine job entrance criteria (e.g., education credentials, math/writing/reading comprehension tests, drug tests) used by employers in various industry sectors.
9.2.12.CAP.9	Locate information on working papers, what is required to obtain them, and who must sign them.
9.2.12.CAP.10	Identify strategies for reducing overall costs of postsecondary education (e.g., tuition assistance, loans, grants, scholarships, and student loans).
9.2.12.CAP.11	Demonstrate an understanding of Free Application for Federal Student Aid (FAFSA) requirements to apply for postsecondary education.
9.2.12.CAP.11*	Explain how compulsory government programs (e.g., Social Security, Medicare) provide insurance against some loss of income and benefits to eligible recipients.
9.2.12.CAP.12	Analyze how the economic, social, and political conditions of a time period can affect the labor market.
9.2.12.CAP.13	Analyze and critique various sources of income and available resources (e.g., financial assets, property, and transfer payments) and how they may substitute for earned income.
9.2.12.CAP.14	Demonstrate how exemptions, deductions, and deferred income (e.g. retirement or medical) can reduce taxable income.
9.2.12.CAP.15	Explain why taxes are withheld from income and the relationship of federal, state, and local taxes (e.g. property, income, excise, and sales) and how the money collected is used by local, county, state, and federal governments.
9.2.12.CAP.16	Analyze the impact of the collective bargaining process on benefits, income, and fair labor practice.
9.2.12.CAP.17	Differentiate between taxable and nontaxable income from various forms of employment (e.g. cash business, tips, tax filing and withholding).
9.2.12.CAP.18	Explain the purpose of payroll deductions and why fees for various benefits (e.g., medical benefits) are taken out of pay, including the cost of employee benefits to employers and self-employment income.
9.2.12.CAP.19	Analyze a Federal and State Income Tax Return.
9.2.12.CAP.20	Explain low-cost and low-risk ways to start a business.
9.2.12.CAP.21	Compare risk and reward potential and use the comparison to decide whether starting a business is feasible.
9.2.12.CAP.22	Identify different ways to obtain capital for starting a business.
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
9.4.12.CT.1	Identify problem-solving strategies used in the development of an innovative product or practice.
9.4.12.CT.2	Explain the potential benefits of collaborating to enhance critical thinking and problem solving.
9.4.12.CT.3	Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why solutions may work better than others (e.g., political. economic, cultural).

9.4.12.CT.4	Enlist input from a variety of stakeholders (e.g., community members, experts in the field) to design a service learning activity that addresses a local or global issue (e.g., environmental justice).
9.4.12.CT.5	Participate in online strategy and planning sessions for course-based, school-based or other projects and determine the strategies that contribute to effective outcomes.
9.4.12.DC.1	Explain the beneficial and harmful effects that intellectual property laws can have on the creation and sharing of content.
9.4.12.DC.2	Compare and contrast international differences in copyright laws and ethics.
9.4.12.DC.3	Evaluate the social and economic implications of privacy in the context of safety, law, or ethics.
9.4.12.DC.4	Explain the privacy concerns related to the collection of data (e.g. cookies) and generation of data through automated processes that may not be evident to users.
9.4.12.DC.5	Debate laws and regulations that impact the development and use of software.
9.4.12.DC.6	Select information to post online that positively impacts personal image and future college and career opportunities.
9.4.12.DC.7	Evaluate the influence of digital communities on the nature, content and responsibilities of careers, and other aspects of society.
9.4.12.DC.8	Explain how increased network connectivity and computing capabilities of everyday objects allow for innovative technological approaches to climate protection.
9.4.12.TL.1	Assess digital tools based on features such as accessibility options, capacities and utility for accomplishing a specific task
9.4.12.TL.2	Generate data using formula-based calculations in a spreadsheet and draw conclusions about the data.
9.4.12.TL.3	Analyze the effectiveness of the process and quality of collaborative environments.
9.4.12.TL.4	Collaborate in online learning communities or social networks or virtual worlds to analyze and propose a resolution to a real-world problem.
9.4.12.GCA.1	Collaborate with individuals analyze a variety of potential solutions to climate change effects and determine why solutions may work better than others (e.g., political. economic, cultural).
9.4.12.IML.1	Compare search browsers and recognize features that allow for filtering of information.
9.4.12.IML.2	Evaluate digital sources for timeliness, accuracy, perspective, credibility of the source, and relevance of information, in media, data, or other resources.
9.4.12.IML.3	Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions.
9.4.12.IML.4	Assess and critique the appropriateness and impact of existing data visualizations for an intended audience.
9.4.12.IML.5	Evaluate, synthesize and apply information on climate change from various sources appropriately.
9.4.12.IML.6	Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender and age diversity.
9.4.12.IML.7	Develop an argument to support a claim regarding a current workplace or societal/ethical issue such as climate change.
9.4.12.IML.9	Evaluate media sources for point of view, bias and motivations.
9.4.12.IML.10	Analyze the decisions creators make to reveal explicit and implicit messages within information and media.

* ID 9.2.12.CAP.11 duplicated in NJDOE NJSLS file page 1 and 2