Kingsway Regional School District

Committed to Excellence

Course Name: College Prep Principles of Engineering	**Grade Level(s): 11-12**
Department: Science	**Credits: 3**
BOE Adoption Date: October 2016	**Revision Date(s): October 2019**

ABSTRACT

Principles of Engineering (POE) is a foundation course of the high school engineering pathway. This survey course exposes students to some of the major concepts that they will encounter in a post secondary engineering course of study. Through problems that engage and challenge, students explore a broad range of engineering topics, including mechanisms, the strength of materials and structures, automation, and kinematics. The course applies and concurrently develops secondary level knowledge and skills in mathematics, science, and technology.

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Mission Statement

The Kingsway Regional School District believes that this school district is responsible for developing and maintaining a comprehensive educational program that will foster the academic, social, and personal growth of all students. The Kingsway Regional School District provides a secure, supportive environment. It also provides high quality resources to challenge and empower each individual to pursue his/her potential, to develop a passion for learning in a diverse and challenging world, to encourage active citizenship, and to reach a high standard of achievement at all grade levels as defined by the New Jersey Student Learning Standards (NJSLS).

Curriculum & Instruction Goals

To ensure the District continues to work toward its mission of excellence in G.R.E.A.T. Instruction, the following curriculum and instruction goals direct the conversation:

Goal(s):

1. To ensure students are college and career ready upon graduation
2. To vertically and horizontally align curriculum K-12 to ensure successful transition of students at each grade level
3. To identify individual student strengths and weaknesses utilizing various assessment measures (formative, summative, alternative, etc.) so as to differentiate instruction while meeting the rigor of the applicable content standards
4. To improve student achievement as assessed through multiple measures including, but not limited to, state testing, local assessments, and ongoing progress monitoring

How to Read this Document

This curricular document contains both *pacing guides* and *curriculum units*. The pacing guides serve to communicate an estimated timeframe as to *when* skills and topics will be taught throughout the year. The pacing, however, may differ slightly depending upon the unique needs of each learner. The *curriculum units* contain more detailed information as to the content, goals, and objectives of the course well as how students will be assessed. The terms and definitions below will assist the reader to better understand the sections and components of this curriculum document.

Terms to Know

1. **Accommodation(s):** ***Accommodations*** are adaptations that do not alter the learning goal or standards being measured; accommodations can be for all students.
2. **Differentiated Instruction (DI):** The idea of differentiating instruction to accommodate the different ways that students learn involves a hefty dose of common sense, as well as sturdy support in the theory and research of education (Tomlinson & Allan, 2000). It is an approach to teaching that advocates

active planning for student differences in classrooms. Teachers can differentiate content, process, product, or environment. DI can be done according to students' readiness, interest, or learning profile.

3. **Enduring Understanding:** Enduring understandings (aka big ideas) are statements of understanding that articulate deep conceptual understandings at the heart of each content area. Enduring understandings are noted in the alongside essential questions within each unit in this document.

4. **Essential Question:** These are questions whose purpose is to stimulate thought, to provoke inquiry, and to spark more questions. They extend beyond a single lesson or unit. Essential questions are noted in the beginning of each unit in this document.

5. **Formative Assessments:** Formative assessments monitor student learning to provide ongoing feedback that can be used by (1) instructors to improve teaching and (2) by students to improve their learning. Formative assessments help identify students' strengths and weaknesses and address problems immediately.

6. **Learning Activity(s):** Learning activities are those activities that take place in the classroom for which the teacher facilitates and the students participate in to ensure active engagement in the learning process. (Robert J. Marzano, *The Art and Science of Teaching*)

7. **Learning Assignment(s):** Learning assignments are those activities that take place independently by the student inside the classroom or outside the classroom (i.e. homework) to extend concepts and skills within a lesson.

8. **Learning Goal(s):** Learning goals are broad statements that note what students "should know" and/or "be able to do" as they progress through a unit. Learning goals correlate specifically to the NJSLS noted within each unit.

9. **Learning Objective(s):** Learning objectives are more specific skills and concepts that students must achieve as they progress towards the broader learning goal. These are included within each unit and are assessed frequently by the teacher to ensure students are progressing appropriately.

10. **Modification(s):** ***Modifications*** are adaptations that alter the learning goals and grade-level standards. Modifications are warranted when the learner has significant needs that impede his or her ability to access grade-level concepts. They are most appropriate for appropriate some students with IEPs and some English Language Learners.

11. **Performance Assessments: (**aka alternative or authentic assessments) Performance assessments are a form of assessment that requires students to perform tasks that generate a more authentic evaluation of a student's knowledge, skills, and abilities. Performance assessments stress the application of knowledge and extend beyond traditional assessments (i.e. multiple-choice question, matching, true & false, etc.).

12. **Standards:** Academic standards, from which the curriculum is built, are statements that of what students "should know" or "be able to do" upon completion of a grade-level or course of study. Educational standards help teachers ensure their students have the skills and knowledge they need to be successful by providing clear goals for student learning.

- **State:** The New Jersey Student Learning Standards (NJSLSs) include Preschool Teaching and Learning Standards as well as K-12 standards for: *Visual and Performing Arts; Comprehensive Health and Physical Education; Science; Social Studies; World Languages; Technology; 21st-Century Life and Careers; Language Arts Literacy; and, Mathematics*

13. **Summative Assessments:** Summative assessments evaluate student learning at the end of an instructional time period by comparing it against some standard or benchmark. Information from summative assessments can be used formatively when students or faculty use it to guide their efforts and activities in subsequent courses.

14. **21st Century Skills & Themes:** These elements emphasize the growing need to focus on skills that prepare students to successfully compete in a global environment by focusing on the following: learning and innovation skills; information, media and technology skills; and life and career skills. These concepts are embedded in each unit of the curriculum.

Proficiencies and Pacing Guide:

Course Title: Principles of Engineering
Prerequisite(s):

Unit Title:	Duration/ Month(s)	Related Standards:	Learning Goals:	Topics and Skills:
Unit 1: Energy and Power	September-December 12 weeks	**Science:** NJSLS-S.HS.PS3.3 NJSLS-S.HS.PS3.4 NJSLS-S.HS.ESS3.1 NJSLS-S.HS.ESS3.2 NJSLS-S.HS.ESS3.4 NJSLS-S.HS.ETS1.1 NJSLS-S.HS.ETS1.2 NJSLS-S.HS.ETS1.3 NJSLS-S.HS.ETS1.4 **E/LA:** NJSLS.RST.11-12.1 NJSLS.RST.11-12.7 NJSLS.RST.11-12.8 NJSLS.RST.11-12.9 NJSLS.WHST.9-12.2 NJSLS.WHST.9-12.7 NJSLS.WHST.11-12.8 NJSLS.WHST.9-12.9 **Mathematics:** NJSLS.HSN-Q.A.1 NJSLS.HSN-Q.A.2 NJSLS.HSN-Q.A.3 **Technology:** NJSLS.8.1.12.A.1 NJSLS.8.1.12.A.4 NJSLS.8.1.12.C.1 NJSLS.8.1.12.D.1 NJSLS.8.1.12.E.1	• Students will demonstrate an ability to identify, formulate, and solve engineering problems. • Students will demonstrate an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. • Students will demonstrate an ability to design and conduct experiments, as well as to analyze and interpret data.	Students will be able to: 1. Distinguish among the six simple machines, their attributes, and components. 2. Calculate mechanical advantage, drive ratios, work, and power of mechanisms. 3. Design, create, and test systems using simple machines and drive mechanisms and determine efficiency in a mechanical system. 4. Design, create, test, and evaluate a compound machine design. 5. Describe the characteristics of various sources of energy. 6. Calculate electrical power developed in a circuit. 7. Determine efficiency of a system that converts an electrical energy to a mechanical energy. 8. Calculate circuit resistance, current, and voltage using Ohm's law, including circuits with elements in series and/or parallel to compare and contrast the behavior of electrical circuits with parallel and series circuit designs. 9. Describe convection, conduction, and radiation as they relate to thermal energy transfer. 10. Calculate the rate at which energy is transferred by conduction and radiation through materials having various R-values.

Unit Title:	Duration/ Month(s)	Related Standards:	Learning Goals:	Topics and Skills:
		NJSLS.8.1.12.F.1 NJSLS.8.2.12.A.3 NJSLS.8.2.12.A.2 NJSLS.8.2.12.B.2 **21st Century Life and Careers:** CRP2 CRP4 CRP5 CRP6 CRP7 CRP8 CRP10 CRP11 CRP12 NJSLS.9.1.12.A.3 NJSLS.9.1.12.A.4 NJSLS.9.2.12.C.1 NJSLS.9.2.12.C.3 NJSLS.9.2.12.C.4 NJSLS.9.2.12.C.5 NJSLS.9.2.12.C.7		
Unit 2: Materials and Structures	December-February 10 weeks	**Science:** NJSLS-S.HS.PS1.1 NJSLS-S.HS.PS1.3 NJSLS-S.HS.ESS3.4 NJSLS-S.HS.ETS1.2 NJSLS-S.HS.ETS1.3 NJSLS-S.HS.ETS1.4 **E/LA:** NJSLS.RST.9-10.7 NJSLS.RST.11-12.1 NJSLS.RST.11-12.7	• Students will demonstrate an ability to apply knowledge of mathematics, science, and engineering. • Students will demonstrate an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. • Students will pursue the broad	Students will be able to: 1. Know beam deflection is related to cross sectional geometry and material properties and moment of inertia is related to cross sectional geometry. 2. Know the modulus of elasticity defines the stiffness of an object related to material and chemical properties. 3. Understand how Newton's Laws are applied to determine the forces acting on an object and are in equilibrium. 4. Calculate the area moment of inertia of structural members and locate the centroid of structural members 5. Calculate the deflection of a center-loaded beam from

Unit Title:	Duration/ Month(s)	Related Standards:	Learning Goals:	Topics and Skills:
		NJSLS.RST.11-12.8 NJSLS.RST.11-12.9 NJSLS.WHST.9-12.7 NJSLS.WHST.11-12.8 NJSLS.WHST.9-12.9 **Mathematics:** NJSLS.HSN-Q.A.1 NJSLS.HSN-Q.A.2 NJSLS.HSN-Q.A.3 **Technology:** NJSLS.8.1.12.A.1 NJSLS.8.1.12.A.4 NJSLS.8.1.12.C.1 NJSLS.8.1.12.D.1 NJSLS.8.1.12.E.1 NJSLS.8.1.12.F.1 NJSLS.8.2.12.A.3 NJSLS.8.2.12.A.2 NJSLS.8.2.12.B.2 **21st Century Life and Careers:** CRP2 CRP4 CRP5 CRP6 CRP7 CRP8 CRP10 CRP11 CRP12 NJSLS.9.1.12.A.3 NJSLS.9.1.12.A.4 NJSLS.9.2.12.C.1 NJSLS.9.2.12.C.3	education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.	the beam's geometry and material properties. 6. Calculate moments or torques given a force and a point of application relative to a specified axis. 7. Use equations of equilibrium to calculate unknown external forces on a truss and the method of joints to calculate tension and compression forces in the members of a statically determinate truss. 8. Distinguish between stress and strain and between elastic and plastic deformation. 9. Describe the relationship between the tensile force applied to a material and the elongation of the material and define the modulus of elasticity. 10. Measure axial force and elongation data of material samples and create stress-strain diagrams describing the intrinsic properties of the materials.

Unit Title:	Duration/ Month(s)	Related Standards:	Learning Goals:	Topics and Skills:
		NJSLS.9.2.12.C.4 NJSLS.9.2.12.C.5 NJSLS.9.2.12.C.7		
Unit 3: Control Systems	February-May 11 weeks	**Science:** NJSLS-S.HS.PS3.3 NJSLS-S.HS.ETS1.2 NJSLS-S.HS.ETS1.3 NJSLS-S.HS.ETS1.4 **E/LA:** NJSLS.WHST.9-12.7 NJSLS.RST.11-12.7 NJSLS.RST.11-12.8 NJSLS.RST.11-12.9 **Mathematics:** NJSLS.HSN-Q.A.1 NJSLS.HSN-Q.A.2 NJSLS.HSN-Q.A.3 **Technology:** NJSLS.8.1.12.A.1 NJSLS.8.1.12.A.4 NJSLS.8.1.12.C.1 NJSLS.8.1.12.D.1 NJSLS.8.1.12.E.1 NJSLS.8.1.12.F.1 NJSLS.8.2.12.A.3 NJSLS.8.2.12.A.2 NJSLS.8.2.12.B.2 **21st Century Life and Careers:** CRP2 CRP4 CRP5 CRP6	• Students will demonstrate an understanding of professional and ethical responsibility. • Students will demonstrate an ability to function on multidisciplinary teams. • Students will demonstrate an ability to communicate effectively.	Students will be able to: 1. Distinguish between digital and analog data, and between the inputs and outputs of a computational system. 2. Distinguish open and closed loop systems based on whether decisions are made using time delays or sensor feedback and identify the relative advantage of an open-loop or closed-loop control system for a given technological problem. 3. Choose appropriate input and output devices based on the need of a technological system. 4. Analyze and describe an algorithm represented as a flowchart or as programming code. 5. Create a computer program to implement an algorithm, including conditional statements and iterations. 6. Design and create a control system, including the inputs, computer program, and outputs, based on given needs and constraints. 7. Identify the advantages of hydraulic and pneumatic systems relative to each other and devices that utilize hydraulic and pneumatic power. 8. Identify and explain basic components and functions of fluid power devices. 9. Distinguish between pressure and absolute pressure, between temperature and absolute temperature, and between hydrodynamic and hydrostatic systems. 10. Calculate values in a pneumatic system utilizing the ideal gas laws and flow rate, flow velocity, power, and mechanical advantage in a fluid power system.

Unit Title:	Duration/ Month(s)	Related Standards:	Learning Goals:	Topics and Skills:
		CRP7 CRP8 CRP10 CRP11 CRP12 NJSLS.9.1.12.A.3 NJSLS.9.1.12.A.4 NJSLS.9.2.12.C.1 NJSLS.9.2.12.C.3 NJSLS.9.2.12.C.4 NJSLS.9.2.12.C.5 NJSLS.9.2.12.C.7		
Unit 4: Statistics and Kinematics	May-June 7 weeks	**Science:** NJSLS-S.HS.PS2.1 NJSLS-S.HS.PS3.3 **E/LA:** NJSLS.RST.11-12.1 NJSLS.RST.11-12.7 NJSLS.WHST.9-12.7 NJSLS.WHST.9-12.9 **Mathematics:** NJSLS.HSN-Q.A.1 NJSLS.HSN-Q.A.2 NJSLS.HSN-Q.A.3 NJSLS.HSA-SSE.A.1 NJSLS.HSA-SSE.B.3 NJSLS.HSA-CED.A.1 NJSLS.HSA-CED.A.2 NJSLS.HSA-CED.A.4 NJSLS.HSF-IF.C.7 NJSLS.HSS-ID.A.1 **Technology:** NJSLS.8.1.12.A.1	• Students will gain knowledge of contemporary issues. • Students will recognize the need for, and develop an ability to engage in life-long learning.	Students will be able to: 1. Name measures of central tendency and variation and describe their meaning. 2. Distinguish between sample statistics and population statistics and know appropriate applications of each. 3. Calculate the theoretical probability that a simple event will occur. 4. Produce a frequency distribution to describe experimental results and create a histogram to communicate these results. 5. Calculate the probability of making a set of observations in a series of trials where each trial has two distinct possible outcomes. 6. Apply AND, OR, and NOT logic to probability. 7. Apply Bayes' Theorem to calculate a probability in a manufacturing context. 8. Calculate the central tendency of a data set, including mean, median, and mode. 9. Calculate the variation in a set of data, including range, standard deviation, and variance 10. Determine the angle needed to launch a projectile a

Unit Title:	Duration/ Month(s)	Related Standards:	Learning Goals:	Topics and Skills:
		NJSLS.8.1.12.A.4 NJSLS.8.1.12.C.1 NJSLS.8.1.12.D.1 NJSLS.8.1.12.E.1 NJSLS.8.1.12.F.1 NJSLS.8.2.12.A.3 NJSLS.8.2.12.A.2 NJSLS.8.2.12.B.2 **21st Century Life and Careers:** CRP2 CRP4 CRP5 CRP6 CRP7 CRP8 CRP10 CRP11 CRP12 NJSLS.9.1.12.A.3 NJSLS.9.1.12.A.4 NJSLS.9.2.12.C.1 NJSLS.9.2.12.C.3 NJSLS.9.2.12.C.4 NJSLS.9.2.12.C.5 NJSLS.9.2.12.C.7		specific range given the projectile's initial velocity.

Unit: 1 Energy and Power	Recommended Duration: September-December 12 weeks
Unit Description: The goal of Unit 1 is to introduce students to mechanisms, energy sources, and alternative energy applications. Students will gain an understanding of mechanisms through the application of theory-based calculations accompanied by lab experimentation. They will also learn that as energy and power are transferred and transformed, losses to friction in the system will occur. Students will understand that such losses affect the overall efficiency of the system. They will have an opportunity to investigate thermal energy and alternative energy applications. Students will explore and gain experiences relating to solar hydrogen systems and thermal energy transfer through materials. The unit concludes with students working in teams to solve a design problem that focuses on energy and power. They will use the knowledge and understanding built through the previous learning events to create a solution to the problem. It is important for students to understand that an acceptable solution is one that fits the criteria and constraints of the design brief.	

Essential Questions:	Enduring Understandings:
1. What are some current applications of simple machines, gears, pulleys, and sprockets and what are some strategies that can be used to make everyday mechanisms more efficient? 2. What are the different energy sources that are used to deliver energy to your community and what is the relationship between resistance, current, and voltage within electrical systems of series and parallel circuits? 3. How does system configuration affect voltage and current while thermodynamics relate to energy and power?	1. Most mechanisms are composed of gears, sprockets, pulley systems, and simple machines and are used to redirect energy within a system by manipulating force, speed, and distance. Mechanical advantage ratios mathematically evaluate input work versus output work of mechanisms. 2. Energy often needs to be converted from one form to another to meet the needs of a given system. An understanding of work, energy, and power is required to determine system efficiency. An understanding of the basics of electricity requires the understanding of the three fundamental concepts of voltage, current, and resistance. The atomic structure of a material determines whether it is a conductor, an insulator, or a semiconductor. 3. Energy systems can include multiple energy sources that can be combined to convert energy into useful forms. Hydrogen fuel cells create electricity and heat through an electrochemical process that converts hydrogen and oxygen into water. Solar cells convert light energy into electricity by using photons to create electron flow. Thermal energy can transfer via convection, conduction, or radiation.

Relevant Standards:	Learning Goals:	Learning Objectives:
NJSLS-S.HS.PS3.3 - Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. NJSLS-S.HS.PS3.4 - Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics). NJSLS-S.HS.ESS3.1 - Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. NJSLS-S.HS.ESS3.2 - Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios. NJSLS-S.HS.ESS3.4 - Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. NJSLS-S.HS.ETS1.1 - Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and	1. Demonstrate an ability to identify, formulate, and solve engineering problems. 2. Demonstrate an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. 3. Demonstrate an ability to design and conduct experiments, as well as to analyze and interpret data.	1. Apply the engineering design process to design a system using mechanisms to redirect energy within a system by manipulating force, speed, and distance. **Honors will also manipulate angle of their point of application using trigonometric functions.* 2. Determine the mechanical advantage of a simple machine or system of simple machines and characterize the work done by and power of a mechanical system. **Honors will determine ideal mechanical advantage, actual mechanical advantage, and efficiency of mechanical systems.* 3. Design and characterize electrical circuits by calculating and describing the relationships between the current, voltage, and resistance in series circuits and parallel circuits. **Honors will also describe relationships in combination circuits.* 4. Identify the means of energy loss and calculate the efficiency of a system that converts electrical energy into mechanical energy. **Honors will also maximize power from a system that converts electrical energy into mechanical energy.* 5. Design a system to convert solar power to mechanical power using photovoltaic and fuel cells and design, construct, and test insulation materials for reducing thermal energy transfer. 6. Analyze system energy requirements to select the best energy sources for a system. 7. Predict and manipulate the amount of heat energy transferred in a system resulting from the material properties and system design. 8. Apply an engineering design process to the creation

Relevant Standards:	Learning Goals:	Learning Objectives:
wants. NJSLS-S.HS.ETS1.2 - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. NJSLS-S.HS.ETS1.3 - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. NJSLS-S.HS.ETS1.4 -Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.		of a renewable electrical energy design and apply a decision matrix in a design process to best defend a selection or choice in a design process. 9. Apply professional skills and work within a design team. 10. Design and create a renewable electrical energy generating and distribution system that utilizes wind, solar electric, and fuel cell energy conversion systems as part of a team.

Formative Assessments	Summative Assessments:	Performance Assessments:	Major Activities/ Assignments (required):

• Simple Machines Assessment
• Energy Sources Assessment
• Assessment retakes (optional)
• White board responses and presentations
• Entrance Ticket or Exit Ticket
• Drawing/interpretation of models
	• Benchmarks
	• Assessment questions asked throughout the year which are specifically designed to show cumulative knowledge and mastery of previous topics. These questions will address various DOK
		• Power Train Practical
		• Circuits Practical
		• Lab practical
		• Lab results
		• Writing Task involving science literacy explaining a phenomenon
		• Design, implementation and revision of engineering tasks
			• Labs
			  ○ Mechanics
			  ○ Energy Sources and Applications
			  ○ Power
			• Graphic organizers
			• Design and perform a task to demonstrate their understanding of

Formative Assessments	Summative Assessments:	Performance Assessments:	Major Activities/ Assignments (required):

• Questioning/Discussions (Q &A, A&Q)
• Checks for understanding with responses through:
  ○ small whiteboards
  ○ Kahoot
  ○ thumbs up scale 1-4 Student/Teacher/ Peer Conferences
• Graphic Organizers (Venn diagram)
• of relationships)
• Lab Reports (rubric used)
• Think/Pair/Share
• Homework
	skills/concepts and will be asked in a variety of ways (MC, short answer, data interpretation, investigation design, implementation and revision)
	• Lab practical
			the concepts associated with energy and/or power

Possible Assessment Modifications /Accommodations/ Differentiation:			
Special Education	ELLs	Struggling Learners	Advanced Learners
• Clarification on questions • Fewer multiple choice • No scantron tests • Extended time for unit test on energy and power • Formating by skill area • Read directions to student • Eliminating distractors • Corrections for unit test of energy and power • Provide study guide prior to the unit test on energy and power	• Clarification on questions • Fewer multiple choice • No Scantron tests • More picture prompts • More specific concrete questions • Extended time for unit test on energy and power • Chunking questions/choices • Formating (Enlarge font/increase spacing/make font bold for emphasis)	• Clarification on questions • Extended time for unit test on energy and power • Chunking questions/choices • Formating (Enlarge font/increase spacing/make font bold for emphasis) • Eliminating distractors • Corrections for unit test of energy and power	• Corrections on unit test on energy and power • Challenge question using maximization of motor power • Calculator and equation sheet provided in class for assessments

Possible Assessment Modifications /Accommodations/ Differentiation:			
• No penalty for spelling errors in literacy question • No penalty for significant figure errors • Calculator and equation sheet provided in class for assessments	• Read directions to student • Eliminating distractors • Corrections for unit test of energy and power • Provide study guide prior to the unit test on energy and power • No penalty for spelling errors in literacy question • No penalty for significant figure errors • Calculator and equation sheet provided in class for assessments	• Provide study guide prior to the unit test on energy and power • No penalty for spelling errors in literacy question • Calculator and equation sheet provided in class for assessments	

Instructional Strategies (*Robert Marzano's* 41 Elements):

- Prove-its on Learning Goals and Scales
- Review of syllabus and reinforcement of classroom rules
- Student interest survey
- Graphic organizers
- Stations- Guided/Independent Practice (explanation and citing evidence as to
- why a phenomena happens)
- Pre-tests (for DI grouping)
- Checks for understanding
- Chunking
- Scaffolding
- Monitoring response times
- Student self-evalution
- SMART lunch invitations for reinforcement, revisions and remediation
- Friendly controversy- examining errors in reasoning (whiteboard battles)
- Kahoot
- Whiteboarding (small and large)

Instructional Strategies (*Robert Marzano's* 41 Elements):
• Direct Instruction • Homework • Note-taking • Investigation (Design and conduct an investigation)

Possible Instructional Modifications /Accommodations/Differentiation:			
Special Education	ELLs	Struggling Learners	Advanced Learners
• Add work areas for energy and power calculations • Highlighted key terms in questions such as: ideal, actual etc. • Reword questions in energy and power problems using simpler language • Provided copy of on-line resourse materials from NJCTL website related to energy and power • Additional time for compound machine design project • Review directions • Vebal and visual cues • Varied reinforcement of energy related to power • Concrete energy and power examples • Calculators provided in class • Equation sheet provided in class • Visual schedule • Preferential seating	• Provide computer time to work on assigned energy based PhET simulations during class • Provide additional work space for class and homework related to energy and power • Provided copy of on-line resourse materials from NJCTL website related to energy and power • Review sessions during SMART • Add work areas for power relationships and calculations • Highlighted key terms in questions such as: mechanical advantage/efficiency/gear ratio/parallel/series etc. • Reword questions in energy and power problems using simpler language prior to unit test • Additional time for compound machine design project • Review directions • Vebal and visual cues • Concrete energy and power examples	• Provide computer time to work on assigned power based PhET simulations during class • Provided copy of on-line resourse materials from NJCTL website related to energy and power • Allow extended time for compound machine design project • Review sessions during SMART prior to unit test • Calculators provided in class • Equation sheet provided in class • Visual schedule • Preferential seating	• Challenge question (multiple step) problem solving related to complex efficiency problems • Hands on activiites to extend learning of energy and power • Calculators provided in class • Equation sheet provided in class • Visual schedule

Possible Instructional Modifications /Accommodations/Differentiation:			
	• Graphic organizers • Calculators provided in class • Equation sheet provided in class • Visual schedule • Preferential seating		

Unit Vocabulary:
Essential: acceleration, combustion, design, dimension, electrical, generator, machine, nuclear, propulsion, radiate, turbine, power, mechanical **Non-Essential:** vibration, weight

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
E/LA: RST.11-12.1 - Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. RST.11-12.8 - Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. RST.11-12.9 - Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.	• VEX equipment (M) • ROBOTC software/programming (M) • Google Docs (S) • Google Classroom (A) • Promethean Board (S) • Chrome books (S) • Teacher websites with resources (S) • Vernier (A) • Gizmos (A) • PhET (A)	__x__ Global Awareness __x__ Civic Literacy __x__ Financial, Economic, Business, & Entrepreneurial Literacy	__x__ Creativity & Innovation __x__ Media Literacy __x__ Critical Thinking and Problem Solving __x__ Life and Career Skills __x__ Information & Communication Technologies Literacy __x__ Communication & Collaboration

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
WHST.9-12-7 - Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. WHST.11-12-8 - Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. **Mathematics:** HSN-Q.A.1 - 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. HSN-Q.A.2 - Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 - Choose a level of accuracy appropriate to limitations on			

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
measurement when reporting quantities. A.SSE.1.a - Interpret parts of an expression, such as terms, factors, and coefficients. A.SSE.1.b - Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P*. A.CED.1 - Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions*. A.CED.4 - Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R*. A.REI.3 - Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. 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). G.MG.3 - Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy			

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
physical constraints or minimize cost; working with typographic grid systems based on ratios). **21st Century Life and Careers:** CRP2 - Apply appropriate academic and technical skills. CRP4 - Communicate clearly and effectively and with reason. CRP5 - Consider the environmental, social and economic impacts of decisions. CRP6 - Demonstrate creativity and innovation. CRP7 - Employ valid and reliable research strategies. CRP8 - Utilize critical thinking to make sense of problems and persevere in solving them. CRP10 - Plan education and career paths aligned to personal goals. CRP11 - Use technology to enhance productivity. CRP12 - Work productively in teams while using cultural global competence. NJSLS.9.1.12.A.3 - Assess how a variety of problem-solving strategies are being used to address solutions to global problems by participating in online discussions with peers from other countries. NJSLS.9.1.12.A.4 - Justify problem-solving strategies used in the development of a particular innovative product or practice in the United States			

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
and in another country. NJSLS.9.2.12.C.1 - Compare and contrast the financial benefits of different products and services offered by a variety of financial institutions. NJSLS.9.2.12.C.3 - Compute and assess the accumulating effect of interest paid over time when using a variety of sources of credit. NJSLS.9.2.12.C.4 - Compare and contrast the advantages and disadvantages of various types of mortgages. NJSLS.9.2.12.C.5 - Analyze the information contained in a credit report and explain the importance of disputing inaccurate entries. NJSLS.9.2.12.C.7 - Explain the rights and responsibilities of buyers and sellers under consumer protection laws, and discuss common unfair or deceptive business practices. **Technology:** NJSLS.8.1.12.A.1 - Create a personal digital portfolio which reflects personal and academic interests, achievements, and career aspirations by using a variety of digital tools and resources NJSLS.8.1.12.A.4 - Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions,			

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
charts and data from all worksheets to convey the results. NJSLS.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. NJSLS.8.1.12.D.1 - Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work. NJSLS.8.1.12.E.1 - Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources. NJSLS.8.1.12.F.1 - Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs. NJSLS.8.2.12.A.3 - Research and present information on an existing technological product that has been repurposed for a different function. NJSLS.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. NJSLS.8.2.12.B.2 - Evaluate ethical considerations regarding the sustainability of environmental			

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
resources that are used for the design, creation and maintenance of a chosen product.			

Resources:
Texts/Materials: PLTW Canvas Program (PowerPoints, worksheets, software), Vex Equipment Leveled Reading-Using Wordify

Unit: 2 Materials and Structures	Recommended Duration: December-February 10 weeks
Unit Description: The goal of Unit 2 is for students to have a more concrete understanding of engineering through materials properties and statics. Students begin by learning about beam deflection and then forces on truss structures. They learn to identify forces acting on those structures and then gain the ability to calculate internal and external forces acting on those structures.The students learn about material properties, which lead students to the ability to properly select a material for a given task. Creating new products to meet a given need or want is not the only concern in this area of study. How to reuse/recycle materials for continued and unique uses is also learned.The primary way of studying materials properties in this unit is through destructive and non-destructive material testing on various materials. Tensile testing is the major destructive test. Students are engaged in how machines perform these tests and use either a classroom machine or a simulation to further their understanding of these processes.This unit concludes with a design problem whereby students, working in teams, follow the design process to solve a design problem.	

Essential Questions:	Enduring Understandings:
1. Why is it crucial for designers and engineers to construct accurate free body diagrams of the parts and structures that they design and to calculate forces acting on bodies and structures? 2. How does an engineer predict the performance and safety for a selected material and how can an existing product be changed to incorporate different processes to make it less expensive and provide better performance?	1. Structural member properties including centroid location, moment of inertia, and modulus of elasticity are important considerations for structure design. Static equilibrium occurs when the sum of all forces acting on a body are equal to zero. In a statically determinate truss, translational and rotational equilibrium equations can be used to calculate external and internal forces. 2. Materials consist of pure elements, compounds and mixtures and are

3. How is material testing data useful and what specific material properties are stress-strain curve date points useful in determining?	typically classified as metallic, ceramic, organic, polymeric, and composite. Material selection is based upon mechanical, thermal, electromagnetic, and chemical properties. 3. Engineers perform destructive and nondestructive tests on material specimens for the purpose of identifying and verifying the properties of various materials. Tensile testing data is used to create a test sample stress-strain curve. Stress-strain data points are used to identify and calculate sample material properties including elastic range, proportional limit, modulus of elasticity, elastic limit, resilience, yield point, plastic deformation, ultimate strength, failure, and ductility.

Relevant Standards:	**Learning Goals:**	**Learning Objectives:**
NJSLS-S.HS.PS1.1 - Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. NJSLS-S.HS.PS1.3 - Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. NJSLS-S.HS.ESS3.4 - . Evaluate or refine a technological solution that reduces impacts of human activities on natural systems. NJSLS-S.HS.ETS1.2 - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	1. Demonstrate an ability to apply knowledge of mathematics, science, and engineering. 2. Demonstrate an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. 3. Pursue the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context.	1. Explore career opportunities in engineering and gain insight to current state of engineering. 2. Characterize the forces acting on an object or system. **Honors will also characterize multiple forces by breaking into components or combining into resultant forces.* 3. Use vectors and moments to analyze forces acting on objects and design structural elements to transfer force effectively. **Honors will also modify/improve on modern day systems and designs.* 4. Describe the role and impact of engineering and engineering solutions within a global, economic, environmental, and societal context. 5. Describe the properties of material and calculate or identify through testing basic properties such as weight, volume, mass,

Relevant Standards:	Learning Goals:	Learning Objectives:
NJSLS-S.HS.ETS1.3 - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. NJSLS-S.HS.ETS1.4 - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.		density, surface area, and continuity, is the material ferrous metal, its hardness, and flexure. **Honors will also describe properties such as stress and strain on composite materials.* 6. Select materials to meet design criteria based upon mechanical, thermal, electromagnetic, and chemical properties and describe the importance of recycling and consideration of a products end of life while being designed. 7. Use a systematic process to solve problems. 8. Interpret and calculate material properties utilizing a stress strain curve for a tested sample. **Honors will also be able to identify materials by analysis of their stress strain curve.* 9. Apply an engineering design process to the creation of a simulated bridge design and apply professional skills and work within a design team. 10. Design and create the most efficient simulated bridge design based on specific design criteria.

Formative Assessments	Summative Assessments:	Performance Assessments:	Major Activities/ Assignments (required):

• Centroids Assessment
• Statics Assessment
• Assessment retakes (optional)
• White board responses and presentations
• Entrance Ticket or Exit Ticket
• Drawing/interpretation of models
	• Benchmarks
	• Assessment questions asked throughout the year which are specifically designed to show cumulative knowledge and mastery of previous topics. These questions will address various DOK
		• Truss Analysis Practical
		• Lab results
		• Writing Task involving science literacy explaining a phenomenon
		• Design, implementation and revision of engineering tasks
			• Labs
			  ○ Statics
			  ○ Material Properties
			  ○ Material Testing
			  ○ Bridge Simulated Structural Design
			• Graphic organizers
			• Design and perform a task to

• Questioning/Discussions (Q &A, A&Q)
• Checks for understanding with responses through:
  ○ small whiteboards
  ○ Kahoot
  ○ thumbs up scale 1-4 Student/Teacher/ Peer Conferences
• Graphic Organizers (Venn diagram)
• of relationships)
• Lab Reports (rubric used)
• Think/Pair/Share
• Homework
	skills/concepts and will be asked in a variety of ways (MC, short answer, data interpretation, investigation design, implementation and revision)
	• Lab practical
			demonstrate their understanding of the concepts associated with energy and/or power
			
			Major Assignments (required):
			Design and perform a task to demonstrate their understanding of the concepts associated with statistics and/or kinematics using technology in the form of Chromebooks/Laptops/iPads

Possible Assessment Modifications /Accommodations/ Differentiation:			
Special Education	ELLs	Struggling Learners	Advanced Learners
• Clarification on questions • Fewer multiple choice • No scantron tests • Extended time for unit test on materials and structures • Formating by skill area • Read directions to student • Eliminating distractors • Corrections for unit test of materials and structures • Provide study guide prior to the unit test on materials and structures • No penalty for spelling errors in literacy question	• Clarification on questions • Fewer multiple choice • No Scantron tests • More picture prompts • More specific concrete questions • Extended time for unit test on materials and structures • Chunking questions/choices • Formating (Enlarge font/increase spacing/make font bold for emphasis) • Read directions to student • Eliminating distractors	• Clarification on questions • Extended time for unit test on materials and structures • Chunking questions/choices • Formating (Enlarge font/increase spacing/make font bold for emphasis) • Eliminating distractors • Retake for unit test of materials and structures • Provide study guide prior to the unit test materials and structures	• Corrections on unit test on materials and structures • Challenge question using 3-D truss analysis • Calculator and equation sheet provided in class for assessments

• No penalty for significant figure errors • Calculator and equation sheet provided in class for assessments	• Corrections for unit test of materials and structures • Provide study guide prior to the unit test on materials and structures • No penalty for spelling errors in literacy question • No penalty for significant figure errors • Calculator and equation sheet provided in class for assessments	• No penalty for spelling errors in literacy question • Calculator and equation sheet provided in class for assessments	

Instructional Strategies (*Robert Marzano's* 41 Elements):

- Prove-its on Learning Goals and Scales
- Review of syllabus and reinforcement of classroom rules
- Student interest survey
- Graphic organizers
- Stations- Guided/Independent Practice (explanation and citing evidence as to
- why a phenomena happens)
- Pre-tests (for DI grouping)
- Checks for understanding
- Chunking
- Scaffolding
- Monitoring response times
- Student self-evalution
- SMART lunch invitations for reinforcement, revisions and remediation
- Friendly controversy- examining errors in reasoning (whiteboard battles)
- Kahoot
- Whiteboarding (small and large)
- Direct Instruction
- Homework
- Note-taking
- Investigation (Design and conduct an investigation)

Possible Instructional Modifications /Accommodations/Differentiation:			
Special Education	ELLs	Struggling Learners	Advanced Learners
• Add work areas for materials and structures relationships and calculations • Highlighted key terms in questions such as: stress and strain etc. • Reword questions in materials and structures problems using simpler language • Provided copy of on-line resource materials from NJCTL website related to force vector analysis • Review directions • Vebal and visual cues • Varied reinforcement of materials and structures • Concrete materials and structures examples • Calculators provided in class • Equation sheet provided in class • Visual schedule • Preferential seating	• Provide computer time to work on assigned materials and structures based PhET simulations during class • Provide additional work space for class and homework related to materials and structures • Provided copy of on-line resourse materials from NJCTL website related to force vector analysis • Review sessions during SMART • Add work areas for materials and structures and calculations • Highlighted key terms in questions such as: stress and strain, indeterminate etc. • Reword questions materials and structures problems using simpler language prior to unit test • Review directions • Vebal and visual cues • Varied reinforcement materials and structures • Concrete materials and structures examples • Graphic organizers • Calculators provided in class • Equation sheet provided in class • Visual schedule • Preferential seating	• Provide computer time to work on assigned materials and structures based PhET simulations during class • Provided copy of on-line resourse materials from NJCTL website related to materials and structures • Review sessions during SMART prior to unit test • Calculators provided in class • Equation sheet provided in class • Visual schedule • Preferential seating	• Challenge question (multiple step) problem solving related to 3D truss analysis • Hands on activities to extend learning of materials and structures • Calculators provided in class • Equation sheet provided in class • Visual schedule

Unit Vocabulary:
Essential: angle, bearing, blueprint, building, construction, dimension, fabrication, force, fulcrum, grading, hydraulic, insulation, installation, joint, lift, load, measurement, pivot, pulley, strength, stability, structure, suspension **Non-Essential:** excavation, ream, weld

Interdisciplinary Connections (Applicable Standards):	**Integration of Technology:**	**21st Century Themes:**	**21st Century Skills:**
E/LA: RST.11-12.1 - Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. RST.11-12.8 - Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. RST.11-12.9 - Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. WHST.9-12-7 - Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a	• VEX equipment (M) • ROBOTC software/programming (M) • Google Docs (S) • Google Classroom (A) • Promethean Board (S) • Chrome books (S) • Teacher websites with resources (S) • Vernier (A) • Gizmos (A) • PhET (A)	__x__ Global Awareness _x___ Civic Literacy __x__ Financial, Economic, Business, & Entrepreneurial Literacy	__x__ Creativity & Innovation __x__ Media Literacy __x__ Critical Thinking and Problem Solving __x__ Life and Career Skills __x__ Information & Communication Technologies Literacy __x__ Communication & Collaboration

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. WHST.11-12-8 - Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. **Mathematics:** HSN-Q.A.1 - 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. HSN-Q.A.2 - Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. N.Q.1 - Use units as a way to			

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
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 - Define appropriate quantities for the purpose of descriptive modeling. N.Q.3 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. G.GMD.3 - Use volume formulas for cylinders, pyramids, cones, and spheres to solve problems. G.GMD.4 - Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects. 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). G.MG.2 - Apply concepts of density based on area and volume in modeling situations A.SSE.1.a - Interpret parts of an expression, such as terms, factors, and coefficients. A.SSE.1.b - Interpret complicated expressions by viewing one or more of			

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
their parts as a single entity. *For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P*. **21st Century Life and Careers:** CRP2 - Apply appropriate academic and technical skills. CRP4 - Communicate clearly and effectively and with reason. CRP5 - Consider the environmental, social and economic impacts of decisions. CRP6 - Demonstrate creativity and innovation. CRP7 - Employ valid and reliable research strategies. CRP8 - Utilize critical thinking to make sense of problems and persevere in solving them. CRP10 - Plan education and career paths aligned to personal goals. CRP11 - Use technology to enhance productivity. CRP12 - Work productively in teams while using cultural global competence. NJSLS.9.1.12.A.3 - Assess how a variety of problem-solving strategies are being used to address solutions to global problems by participating in online discussions with peers from other countries. NJSLS.9.1.12.A.4 - Justify problem-			

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
solving strategies used in the development of a particular innovative product or practice in the United States and in another country. NJSLS.9.2.12.C.1 - Compare and contrast the financial benefits of different products and services offered by a variety of financial institutions. NJSLS.9.2.12.C.3 - Compute and assess the accumulating effect of interest paid over time when using a variety of sources of credit. NJSLS.9.2.12.C.4 - Compare and contrast the advantages and disadvantages of various types of mortgages. NJSLS.9.2.12.C.5 - Analyze the information contained in a credit report and explain the importance of disputing inaccurate entries. NJSLS.9.2.12.C.7 - Explain the rights and responsibilities of buyers and sellers under consumer protection laws, and discuss common unfair or deceptive business practices. **Technology:** NJSLS.8.1.12.A.1 - Create a personal digital portfolio which reflects personal and academic interests, achievements, and career aspirations by using a variety of digital tools and resources NJSLS.8.1.12.A.4 - Construct a			

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results. NJSLS.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. NJSLS.8.1.12.D.1 - Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work. NJSLS.8.1.12.E.1 - Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources. NJSLS.8.1.12.F.1 - Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs. NJSLS.8.2.12.A.3 - Research and present information on an existing technological product that has been repurposed for a different function. NJSLS.8.2.12.A.2 - Analyze a current technology and the resources used, to identify the trade-offs in terms of			

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
availability, cost, desirability and waste. NJSLS.8.2.12.B.2 - Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation and maintenance of a chosen product.			

Resources:
Texts/Materials: PLTW Canvas Program (PowerPoints, worksheets, software), Vex Equipment Leveled Reading-Using Wordify

Unit: 3 Control Systems	Recommended Duration: February-May 11 weeks

Unit Description:

The goal of Unit 3 is for students to recognize the abundance of and infinite variety of computer use in our daily lives. Students learn to control mechanical systems by recognizing computer outputs and gaining an understanding of how to write code to control them. They additionally experiment with various input devices and learn how they can adapt computer code to control computer outputs. Furthermore students gain an understanding of fluid power, both hydraulic and pneumatic. They begin to recognize the power and control advantages of fluid power. The unit concludes with students working in teams to solve a design problem that focuses on using control systems. They will integrate their prior knowledge, skills, and understandings from Unit 1: Simple Machines, Unit 2: Material Properties, and this unit. Students will decide what input devices to use, how to code their use, and the various output devices necessary to create a solution to the problem.

Essential Questions:	Enduring Understandings:
• What are the advantages and disadvantages of using programmable logic to control machines versus monitoring and adjusting processes manually? • What questions must designers ask when solving problems in order to decide between digital or analog systems and between open or closed loop systems? • What impact does fluid power have on our everyday lives and what are the similarities and differences of mechanical advantage in simple machines and hydraulic systems?	1. Control systems are designed to provide consistent process control and reliability and protocols are an established set of commands or functions typically created in a computer programming language. 2. Closed loop systems use digital and analog sensor feedback to make operational and process decisions while open loop systems use programming constants such as time to make operational and process decisions. 3. Fluid power systems are designed to transmit force over great distances, multiply an input force, and increase the distance that an output will move.

Relevant Standards:	Learning Goals:	Learning Objectives:
NJSLS-S.HS.PS3.3 - Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. NJSLS-S.HS.ETS1.2 - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.	1. Demonstrate an understanding of professional and ethical responsibility. 2. Demonstrate an ability to function on multidisciplinary teams. 3. Demonstrate an ability to communicate effectively.	1. Explore career opportunities, salaries, and required education to engineering. 2. Create control system operating programs that utilize computer software given needs and constraints. 3. Design a system to solve a problem using hydraulic or pneumatics components. **Honors will design a system to solve a problem using a combination of hydraulic and*

Relevant Standards:	Learning Goals:	Learning Objectives:
NJSLS-S.HS.ETS1.3 - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts. NJSLS-S.HS.ETS1.4 - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.		*pneumatic components.* 4. Apply an engineering design process to the creation of a material sorter design. 5. Apply a decision matrix in a design process to best defend a selection or choice in a design process. 6. Apply professional skills and work within a design team. 7. Design and create a renewable electrical energy generating and distribution system that utilizes wind, solar electric, and fuel cell energy conversion systems as part of a team. 8. Distinguish between digital and analog data, and between the inputs and outputs of a computational system. 9. Distinguish open and closed loop systems based on whether decisions are made using time delays or sensor feedback. 10. Identify the advantages of hydraulic and pneumatic systems relative to each other.

Formative Assessments	Summative Assessments:	Performance Assessments:	Major Activities/ Assignments (required):

• Assessments (Quizzes & Tests)
• Assessment retakes (optional)
• White board responses and presentations
• Entrance Ticket or Exit Ticket
• Drawing/interpretation of models
• Questioning/Discussions (Q &A, A&Q)
• Checks for understanding with
	• Benchmarks
	• Assessment questions asked throughout the year which are specifically designed to show cumulative knowledge and mastery of previous topics. These questions will address various DOK skills/concepts and will be asked in a variety of ways
		• Lab practical
		• Lab results
		• Writing Task involving science literacy explaining a phenomenon
		• Design, implementation and revision of engineering tasks
			• Labs
			  ○ Machine Control
			  ○ Fluid Power
			  ○ Materials Sorter
			• Graphic organizers
			• Design and perform a task to demonstrate their understanding of the concepts associated with energy and/or power
			•

Formative Assessments	Summative Assessments:	Performance Assessments:	Major Activities/ Assignments (required):
responses through: o small whiteboards o Kahoot o thumbs up scale 1-4 Student/Teacher/ Peer Conferences • Graphic Organizers (Venn diagram) • of relationships) • Lab Reports (rubric used) • Think/Pair/Share • Homework	(MC, short answer, data interpretation, investigation design, implementation and revision) • Lab practical		**Major Assignments (required):** Design and perform a task to demonstrate their understanding of the concepts associated with statistics and/or kinematics using technology in the form of Chromebooks/Laptops/iPads

Possible Assessment Modifications /Accommodations/ Differentiation:			
Special Education	ELLs	Struggling Learners	Advanced Learners
• Clarification on questions • Fewer multiple choice • No scantron tests • Extended time for unit test • Formating by skill area • Read directions to student • Eliminating distractors • Corrections for unit test • Provide study guide prior to the unit test • No penalty for spelling errors in literacy question • No penalty for significant figure errors • Calculator and equation sheet provided in class for assessments	• Clarification on questions • Fewer multiple choice • No Scantron tests • More picture prompts • More specific concrete questions • Extended time for unit test • Chunking questions/choices • Formating (Enlarge font/increase spacing/make font bold for emphasis) • Read directions to student • Eliminating distractors • Corrections for unit test • Provide study guide prior to the unit test • No penalty for spelling errors in literacy question	• Clarification on questions • Extended time for unit test • Chunking questions/choices • Formating (Enlarge font/increase spacing/make font bold for emphasis) • Eliminating distractors • Corrections for unit test • Provide study guide prior to the unit test • No penalty for spelling errors in literacy question • Calculator and equation sheet provided in class for assessments	• Corrections on unit test • Challenge question using coding including ifwhile loops within ifwhile loops • Calculator and equation sheet provided in class for assessments

Possible Assessment Modifications /Accommodations/ Differentiation:			
Special Education	ELLs	Struggling Learners	Advanced Learners
	• No penalty for significant figure errors • Calculator and equation sheet provided in class for assessments		

Instructional Strategies (*Robert Marzano's* 41 Elements):

- Prove-its on Learning Goals and Scales
- Review of syllabus and reinforcement of classroom rules
- Student interest survey
- Graphic organizers
- Stations- Guided/Independent Practice (explanation and citing evidence as to
- why a phenomena happens)
- Pre-tests (for DI grouping)
- Checks for understanding
- Chunking
- Scaffolding
- Monitoring response times
- Student self-evalution
- SMART lunch invitations for reinforcement, revisions and remediation
- Friendly controversy- examining errors in reasoning (whiteboard battles)
- Kahoot
- Whiteboarding (small and large)
- Direct Instruction
- Homework
- Note-taking
- Investigation (Design and conduct an investigation)

Possible Instructional Modifications /Accommodations/Differentiation:			
Special Education	ELLs	Struggling Learners	Advanced Learners
• Add work areas for relationships and calculations • Highlighted key terms in questions such as: conditional, digital, analog etc. • Reword questions in problems using simpler language • Review directions • Verbal and visual cues • Concrete examples • Calculators provided in class • Equation sheet provided in class • Visual schedule • Preferential seating	• Provide computer time to work on assigned ROBOTC simulations during class • Provide additional work space for class and homework • Review sessions during SMART • Add work areas for calculations • Highlighted key terms in questions • Reword questions in problems using simpler language prior to unit test • Review directions • Vebal and visual cues • Concrete programming examples • Graphic organizers • Calculators provided in class • Equation sheet provided in class • Visual schedule • Preferential seating	• Review sessions during SMART prior to unit test • Calculators provided in class • Equation sheet provided in class • Visual schedule • Preferential seating	• Challenge question (multiple step) problem solving related to including ifwhile loops within ifwhile loops • Hands on activities • Calculators provided in class • Equation sheet provided in class • Visual schedule

Unit Vocabulary:
Essential: activation, analysis, cell, communication, component, concept, consultation, coupling, depth, device, elastic, element, expert, generate, grading, injection, liquid, manufacturing, management, motor, operations, process, production, revolution, regulation, technology **Non-Essential:** advise, schematic, fabrication

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
E/LA: RST.11-12.1 - Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. RST.11-12.8 - Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information. RST.11-12.9 - Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. WHST.9-12-7 - Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. WHST.11-12-8 - Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific	• VEX equipment (M) • ROBOTC software/programming (M) • Google Docs (S) • Google Classroom (A) • Promethean Board (S) • Chrome books (S) • Teacher websites with resources (S) • Vernier (A) • Gizmos (A) • PhET (A)	__x__ Global Awareness __x__ Civic Literacy __x__ Financial, Economic, Business, & Entrepreneurial Literacy	__x__ Creativity & Innovation __x__ Media Literacy __x__ Critical Thinking and Problem Solving __x__ Life and Career Skills __x__ Information & Communication Technologies Literacy __x__ Communication & Collaboration

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. **Mathematics:** HSN-Q.A.1 - 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. HSN-Q.A.2 - Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. N.Q.3 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. **21st Century Life and Careers:** CRP2 - Apply appropriate academic and technical skills. CRP4 - Communicate clearly and effectively and with reason. CRP5 - Consider the environmental, social and economic impacts of			

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
decisions. CRP6 - Demonstrate creativity and innovation. CRP7 - Employ valid and reliable research strategies. CRP8 - Utilize critical thinking to make sense of problems and persevere in solving them. CRP10 - Plan education and career paths aligned to personal goals. CRP11 - Use technology to enhance productivity. CRP12 - Work productively in teams while using cultural global competence. NJSLS.9.1.12.A.3 - Assess how a variety of problem-solving strategies are being used to address solutions to global problems by participating in online discussions with peers from other countries. NJSLS.9.1.12.A.4 - Justify problem-solving strategies used in the development of a particular innovative product or practice in the United States and in another country. NJSLS.9.2.12.C.1 - Compare and contrast the financial benefits of different products and services offered by a variety of financial institutions. NJSLS.9.2.12.C.3 - Compute and assess the accumulating effect of interest paid over time when using a variety of sources of credit.			

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
NJSLS.9.2.12.C.4 - Compare and contrast the advantages and disadvantages of various types of mortgages. NJSLS.9.2.12.C.5 - Analyze the information contained in a credit report and explain the importance of disputing inaccurate entries. NJSLS.9.2.12.C.7 - Explain the rights and responsibilities of buyers and sellers under consumer protection laws, and discuss common unfair or deceptive business practices. **Technology:** NJSLS.8.1.12.A.1 - Create a personal digital portfolio which reflects personal and academic interests, achievements, and career aspirations by using a variety of digital tools and resources NJSLS.8.1.12.A.4 - Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results. NJSLS.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.			

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
NJSLS.8.1.12.D.1 - Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work. NJSLS.8.1.12.E.1 - Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources. NJSLS.8.1.12.F.1 - Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs. NJSLS.8.2.12.A.3 - Research and present information on an existing technological product that has been repurposed for a different function. NJSLS.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. NJSLS.8.2.12.B.2 - Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation and maintenance of a chosen product.			
Resources:			
Texts/Materials: PLTW Canvas Program (PowerPoints, worksheets, software), Vex Equipment Leveled Reading-Using Wordify			

Unit: 4 Statistics and Kinematics	Recommended Duration: May-June 7 weeks
Unit Description: In Unit 4 students are engaged in learning to use statistics to evaluate an experiment. Later they begin a study of dynamics, specifically kinematics, and apply statistical skills to study freefall motion. Students use theoretical and experimental data as a basis for learning statistical analysis. By collecting, organizing, and interpreting the data, students build the skills needed to understand data results. They further use these new skills and knowledge to design a vehicle that will propel itself. Later, students will address the problem of designing a machine to accurately launch an object a specified distance. Examining projectile motion is at the core of this design problem.	

Essential Questions:	Enduring Understandings:
1. Why is it crucial for designers and engineers to utilize statistics throughout the design process and why is process control a necessary statistical process for ensuring product success? 2. Why is theory-based data interpretation valuable in decision making and why is experiment-based data interpretation valuable in decision making? 3. What are the relationships between distance, displacement, speed, velocity, and accelerationand why is it important to understand and be able to control the motion of a projectile?	1. Analyze and interpret data in order to make valid and reliable claims or determine optimal design solutions. 2. Determine the theoretical probability that an event will occur. 3. Predict theoretically where a projectile should land based on the calculated initial velocity and the angle the projectile is fired at.

Relevant Standards:	Learning Goals:	Learning Objectives:
NJSLS-S.HS.PS2.1 - Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. NJSLS-S.HS.PS3.3 - Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.	1. Gain knowledge of contemporary issues. 2. Recognize the need for, and develop an ability to engage in life-long learning.	1. Analyze and interpret data in order to make valid and reliable claims or determine optimal design solutions. 2. Determine the theoretical probability that an event will occur. 3. Name measures of central tendency and variation and describe their meaning. 4. Distinguish between sample statistics and population statistics and know appropriate applications of each. 5. Produce a frequency distribution to describe experimental results and create a histogram to

Relevant Standards:	Learning Goals:	Learning Objectives:
		communicate these results. 6. Predict theoretically where a projectile should land based on the calculated initial velocity and the angle the projectile is fired at. 7. Describe freefall motion of a projectile as having constant velocity in the horizontal direction and uniformly accelerating motion in the vertical direction. 8. Know the purpose of each part of a design brief. 9. Describe a step-by-step, iterative design process. 10. Calculate distance, displacement, speed, velocity, and acceleration from data.

Formative Assessments	Summative Assessments:	Performance Assessments:	Major Activities/ Assignments (required):

• Assessments (Quizzes & Tests)
• Assessment retakes (optional)
• White board responses and presentations
• Entrance Ticket or Exit Ticket
• Drawing/interpretation of models
• Questioning/Discussions (Q &A, A&Q)
• Checks for understanding with responses through:
  ○ small whiteboards
  ○ Kahoot
  ○ thumbs up scale 1-4 Student/Teacher/ Peer Conferences
• Graphic Organizers (Venn
	• Benchmarks
	• Assessment questions asked throughout the year which are specifically designed to show cumulative knowledge and mastery of previous topics. These questions will address various DOK skills/concepts and will be asked in a variety of ways (MC, short answer, data interpretation, investigation design, implementation and revision)
	• Lab practical
		• Lab practical
		• Lab results
		• Writing Task involving science literacy explaining a phenomenon
		• Design, implementation and revision of engineering tasks
			• Labs
			  ○ Statistics
			  ○ Kinematics
			• Graphic organizers
			• Design and perform a task to demonstrate their understanding of the concepts associated with kinematics and/or statistics

Formative Assessments	Summative Assessments:	Performance Assessments:	Major Activities/ Assignments (required):
diagram) • of relationships) • Lab Reports (rubric used) • Think/Pair/Share • Homework			

Possible Assessment Modifications /Accommodations/ Differentiation:			
Special Education	ELLs	Struggling Learners	Advanced Learners
• Clarification on questions • Fewer multiple choice • No scantron tests • Extended time for unit test • Formating by skill area • Read directions to student • Eliminating distractors • Corrections for unit test • Provide study guide prior to the unit test • No penalty for spelling errors in literacy question	• Clarification on questions • Fewer multiple choice • No Scantron tests • More picture prompts • More specific concrete questions • Extended time for unit test • Chunking questions/choices • Formating (Enlarge font/increase spacing/make font bold for emphasis) • Read directions to student • Eliminating distractors • Corrections for unit test • Provide study guide prior to the unit test • No penalty for spelling errors in literacy question	• Clarification on questions • Extended time for unit test • Chunking questions/choices • Formating (Enlarge font/increase spacing/make font bold for emphasis) • Eliminating distractors • Corrections for unit test • Provide study guide prior to the unit test • No penalty for spelling errors in literacy question	• Corrections on unit test

Instructional Strategies (*Robert Marzano's* 41 Elements):
• Prove-its on Learning Goals and Scales • Review of syllabus and reinforcement of classroom rules • Student interest survey • Graphic organizers • Stations- Guided/Independent Practice (explanation and citing evidence as to • why a phenomena happens) • Pre-tests (for DI grouping) • Checks for understanding • Chunking • Scaffolding • Monitoring response times • Student self-evalution • SMART lunch invitations for reinforcement, revisions and remediation • Friendly controversy- examining errors in reasoning (whiteboard battles) • Kahoot • Whiteboarding (small and large) • Direct Instruction • Homework • Note-taking • Investigation (Design and conduct an investigation)

Possible Instructional Modifications /Accommodations/Differentiation:			
Special Education	ELLs	Struggling Learners	Advanced Learners
• Highlighted key terms in questions • Reword questions using simpler language • Review directions • Vebal and visual cues • Concrete probability examples • Visual schedule • Preferential seating	• Provide computer time to work on assigned statistics PhET simulations during class • Provide additional work space for class and homework • Review sessions during SMART • Add work areas for calculations • Highlighted key terms in questions.	• Provide computer time to work on assigned probability based simulations during class • Review sessions during SMART prior to unit test • Visual schedule • Preferential seating	• Hands on activities to extend learning of statistics and kinematics • Visual schedule

Possible Instructional Modifications /Accommodations/Differentiation:			
Special Education	ELLs	Struggling Learners	Advanced Learners
	• Reword questions using simpler language • Review sheet prior to unit test • Review directions • Vebal and visual cues • Concrete examples • Graphic organizers • Visual schedule • Preferential seating		

Unit Vocabulary:
Essential: analysis, assembly, automation, axis, calculation, current, diameter, distribution, flow, gears, gimbels, information, mark, mechanize, oscilloscope, plumb, project, retrofit, regulation, stability, transmit, turbine **Non-Essential:** concept, frame, hardware

Interdisciplinary Connections (Applicable Standards):	**Integration of Technology:**	**21st Century Themes:**	**21st Century Skills:**
E/LA: RST.11-12.1 - Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. RST.11-12.8 - Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other	• VEX equipment (M) • ROBOTC software/programming (M) • Google Docs (S) • Google Classroom (A) • Promethean Board (S) • Chrome books (S) • Teacher websites with resources (S) • Vernier (A) • Gizmos (A)	__x__ Global Awareness __x__ Civic Literacy __x__ Financial, Economic, Business, & Entrepreneurial Literacy	__x__ Creativity & Innovation __x__ Media Literacy __x__ Critical Thinking and Problem Solving __x__ Life and Career Skills __x__ Information & Communication Technologies Literacy __x__ Communication & Collaboration

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
sources of information. RST.11-12.9 - Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible. WHST.9-12-7 - Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. WHST.11-12-8 - Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. **Mathematics:** HSN-Q.A.1 - Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently	• PhET (A)		

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
in formulas; choose and interpret the scale and the origin in graphs and data displays. HSN-Q.A.2 - Define appropriate quantities for the purpose of descriptive modeling. HSN-Q.A.3 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. S.ID.1 - Represent data with plots on the real number line (dot plots, histograms, and box plots). S.ID.2 - Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets. S.ID.3 - Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). S.ID.4 - 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. S.IC.1 - Understand statistics as a			

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
process for making inferences about population parameters based on a random sample from that population. S.IC.2 - Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. *For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model*? S.IC.4 - Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling. S.CP.1 - Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not"). S.CP.2 - Understand that two events A and B are independent if the probability of A and B occurring together is the product of their probabilities, and use this characterization to determine if they are independent. S.CP.3 - Understand the conditional probability of A given B as P(A and B)/P(B), and interpret independence of A and B as saying that the conditional probability of A given B is the same as			

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
the probability of A, and the conditional probability of B given A is the same as the probability of B. S.CP.4 - Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. *For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.* S.CP.5 - Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. *For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.* S.CP.6 - Find the conditional probability of *A* given *B* as the fraction of *B*'s outcomes that also belong to *A*, and interpret the answer in terms of the model. S.CP.7 - Apply the Addition Rule, P(A or			

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
B) = P(A) + P(B) – P(A and B), and interpret the answer in terms of the model. S.CP.8 - Apply the general Multiplication Rule in a uniform probability model, P(A and B) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the model. S.CP.9 - Use permutations and combinations to compute probabilities of compound events and solve problems. N.RN.2 - Rewrite expressions involving radicals and rational exponents using the properties of exponents. N.Q.1 - 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 - Define appropriate quantities for the purpose of descriptive modeling. N.Q.3 - Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. N.VM.1 - Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and			

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
their magnitudes A.SSE.1.a - Interpret parts of an expression, such as terms, factors, and coefficients. A.SSE.1.b - Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P*. A.CED.3 - Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods*. A.CED.4 - Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R*. A.REI.3 - Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. A.REI.4 - Solve quadratic equations in one variable. F.TF.7 - Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the			

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
solutions using technology, and interpret them in terms of the context G.SRT.6 - Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles. G.SRT.8 - Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. G.MG.3 - Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios). **21st Century Life and Careers:** CRP2 - Apply appropriate academic and technical skills. CRP4 - Communicate clearly and effectively and with reason. CRP5 - Consider the environmental, social and economic impacts of decisions. CRP6 - Demonstrate creativity and innovation. CRP7 - Employ valid and reliable research strategies. CRP8 - Utilize critical thinking to make sense of problems and persevere in solving them. CRP10 - Plan education and career paths aligned to personal goals.			

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
CRP11 - Use technology to enhance productivity. CRP12 - Work productively in teams while using cultural global competence. NJSLS.9.1.12.A.3 - Assess how a variety of problem-solving strategies are being used to address solutions to global problems by participating in online discussions with peers from other countries. NJSLS.9.1.12.A.4 - Justify problem-solving strategies used in the development of a particular innovative product or practice in the United States and in another country. NJSLS.9.2.12.C.1 - Compare and contrast the financial benefits of different products and services offered by a variety of financial institutions. NJSLS.9.2.12.C.3 - Compute and assess the accumulating effect of interest paid over time when using a variety of sources of credit. NJSLS.9.2.12.C.4 - Compare and contrast the advantages and disadvantages of various types of mortgages. NJSLS.9.2.12.C.5 - Analyze the information contained in a credit report and explain the importance of disputing inaccurate entries. NJSLS.9.2.12.C.7 - Explain the rights and responsibilities of buyers and			

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
sellers under consumer protection laws, and discuss common unfair or deceptive business practices. **Technology:** NJSLS.8.1.12.A.1 - Create a personal digital portfolio which reflects personal and academic interests, achievements, and career aspirations by using a variety of digital tools and resources NJSLS.8.1.12.A.4 - Construct a spreadsheet workbook with multiple worksheets, rename tabs to reflect the data on the worksheet, and use mathematical or logical functions, charts and data from all worksheets to convey the results. NJSLS.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. NJSLS.8.1.12.D.1 - Demonstrate appropriate application of copyright, fair use and/or Creative Commons to an original work. NJSLS.8.1.12.E.1 - Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources.			

Interdisciplinary Connections (Applicable Standards):	Integration of Technology:	21st Century Themes:	21st Century Skills:
NJSLS.8.1.12.F.1 - Evaluate the strengths and limitations of emerging technologies and their impact on educational, career, personal and or social needs. NJSLS.8.2.12.A.3 - Research and present information on an existing technological product that has been repurposed for a different function. NJSLS.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. NJSLS.8.2.12.B.2 - Evaluate ethical considerations regarding the sustainability of environmental resources that are used for the design, creation and maintenance of a chosen product.			

Resources:
Texts/Materials: PLTW Canvas Program (PowerPoints, worksheets, software), Vex Equipment Leveled Reading-Using Wordify