Principles of Engineering (21.0122) (**Taught**)

District High School > 2016-2017 > Intermediate > Technology & Engineering > Principles of Engineering (21.0122) (**Taught**) > Byrom, Tony; Watts, Milton

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Unit	CTE Standards and Objectives	Essential Questions	Content	Skills	Vocabulary	Formative & Summative Assessments
Unit 1 Energy and Power Lesson 1.1 Mechanisms *(Week 1, 2 Weeks)*	UT: CTE: Technical and Engineering UT: Grades 9-12 Project Lead The Way "Principles of Engineering" Standard 210122.01 OVERVIEW AND PERSPECTIVE OF ENGINEERING. STUDENTS LEARN ABOUT THE TYPES OF ENGINEERS AND THEIR CONTRIBUTION TO SOCIETY. Objective 210122.0101 Students will have an understanding of engineering and be able to identify engineering achievements through history. (Engineers as Problem Solvers) Objective 210122.0102 Students will be able to identify five historical engineering role models, including minorities and women. (Engineers as Problem Solvers)	1. Why is it important to begin considering career paths during high school? 2. What career opportunities are available to match your specific interests? 3. What are some current applications of simple machines, gears, pulleys, and sprockets? 4. What are some strategies that can be used to make everyday mechanisms more efficient? 5. What are the trade-offs of mechanical advantage related to design? 6. Why must efficiency be calculated and understood	1. Differentiate between engineering and engineering technology. 2. Conduct a professional interview and reflect on it in writing. 3. Identify and differentiate among different engineering disciplines. 4. Measure forces and distances related to mechanisms. 5. Distinguish between the six simple machines, their attributes, and components. 6. Calculate mechanical advantage and drive ratios of mechanisms. 7. Design, create, and test gear, pulley, and		**ABET** **Actual Mechanical Advantage** **Belt** **Career Chain** **Effort Force** **Efficiency** **Friction** **Fulcrum** **Gear** **Ideal Mechanical Advantage** **Idler Gear** **Inclined Plane** **Lever** **Mechanism** **Moment** **Pitch** **Pulley** **Resistance Force** **Screw** **Simple Machine** **Sprocket** **Static Equilibrium** **Technical Communication** **Torque** **Wedge** **Wheel and Axle**	

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	Objective 210122.0103 Students will be able to identify problems for engineers to solve in the future. (Engineers as Problem Solvers) Objective 210122.0104 Students will be able to define attributes associated with being a successful engineer. (Engineers as Problem Solvers) Objective 210122.0105 Understand that an engineering team must work together to solve problems, with each team member having individual and collective responsibilities. (Engineering Team) Objective 210122.0106 Understand the role of out-sourcing in the engineering process, and how effective communication is essential. (Engineering Team) Objective 210122.0107 Understand how gender-bias, racial-bias and other forms of stereotyping and discrimination can adversely affect communications within an engineering team. (Engineering Team)	during the design process?	sprocket systems. 8. Calculate work and power in mechanical systems. 9. Determine efficiency in a mechanical system. 10. Design, create, test, and evaluate a compound machine design.			

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	Objective 210122.0108 Understand how ethics influences the engineering process. (Engineering Team) Objective 210122.0109 Understand how social, environmental and financial constraints influence the engineering process. (Engineering Team) Objective 210122.0110 Students will have an understanding of the difference between engineering disciplines and job functions. (Careers in Engineering) Objective 210122.0111 Students will understand the professional and legal responsibilities associated with being an engineer. (Careers in Engineering) Objective 210122.0112 Students will research and discover the educational requirements to become an engineer. (Careers in Engineering) Objective 210122.0113 Students will become familiar with an area of engineering by preparing for and conducting an interview with an					

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	engineer in that field of engineering. (Careers in Engineering)					
Unit 1 Energy and Power 1.2 Energy Sources *(Week 3, 2 Weeks)*	UT: CTE: Technical and Engineering UT: Grades 9-12 Project Lead The Way "Principles of Engineering" Standard 210122.04 ENGINEERING SYSTEMS. STUDENTS LEARN ABOUT MECHANICAL, THERMODYNAMICS , FLUID, ELECTRICAL, AND CONTROL SYSTEMS. Objective 210122.0403 Students will mathematically explain the mechanical advantage gained and explain the function of the six different types of simple machines in a presentation on the SMET device. (Mechanisms) Objective 210122.0404 Students will apply simple machines to	1. What sources of energy are available for use? What are the benefits and drawbacks regarding efficiency, usefulness, and the environment? 2. What emerging technologies are or may be on the horizon that will provide energy more efficiently? 3. What are the different energy sources that are used to deliver energy to your community? 4. Describe examples in your community of individuals or businesses harnessing their own energy. 5. Describe where and how the electricity that reaches your	1. Energy source classifications include nonrenewable, renewable, and inexhaustible. 2. Energy source processes include harnessing, storing, transporting, and converting. 3. Energy often needs to be converted from one form to another to meet the needs of a given system. 4. An understanding of work, energy, and power is required to determine system efficiency. 5. An understanding of the basics of electricity	It is expected that students will: • Identify and categorize energy sources as nonrenewable, renewable, or inexhaustible. • Create and deliver a presentation to explain a specific energy source. • Summarize and reflect upon information collected during a visit to a local utility company. • Define the possible types of power conversion.	**Alternative Energy** **Ampere** **Biomass** **Current Electrical Energy** **Electricity** **Electromagnetic Induction** **Efficiency** **Energy** **Energy Conversion** **Environmental Protection Agency** **Fossil Fuel** **Generator** **Geothermal Energy** **Gravitational Energy** **Induction** **Inexhaustible Energy** **Kinetic Energy** **Nonrenewable Energy** **Ohm** **Ohm's Law** **Parallel Circuit** **Potential Energy** **Power Converter**	

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	create mechanical systems in the solution of a design problem. (Mechanisms) Objective 210122.0405 Students will conduct an energy analysis on a section of their home and calculate the heat loss through walls and windows. (Thermodynamics) Objective 210122.0406 Students will develop effective presentation skills. (Thermodynamics) Objective 210122.0407 Students will research and evaluate systems undergoing thermodynamic cycles for efficiency and present findings to the group. (Thermodynamics) Objective 210122.0408 Students will give an oral presentation incorporating the first and second laws of thermodynamics, describing the concept and function of a heat engine of their choice. (Thermodynamics) Objective 210122.0409 Students will evaluate and select specific fluid power sources for	home is produced. 6. Describe and identify inefficient use of energy and power at home, school, or work. 7. What is the relationship between resistance, current, and voltage within an electrical system? 8. Explain the distinguishing characteristics between series and parallel circuits. 9. Describe how to calculate the efficiency of an electrical mechanical system.	requires the understanding of the three fundamental concepts of voltage, current, and resistance. 6. The atomic structure of a material determines whether it is a conductor, an insulator, or a semiconductor.	• Calculate work and power. • Demonstrate the correct use of a digital multimeter. • Calculate power in a system that converts energy from electrical to mechanical. • Determine efficiency of a system that converts an electrical input to a mechanical output. • Calculate circuit resistance, current, and voltage using Ohm's law. • Understand the advantages and disadvantages of parallel and series circuit design	**Power Grid** **Renewable Energy** **Resistance** **Work** **Turbine** **Power** **Rotor** **Series Circuit** **Volt** **Voltage**	

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	different functions. (Fluid Systems) Objective 210122.0410 Students will create a flow diagram schematic sketch and compare it to an actual fluid power circuit during a presentation to the class. (Fluid Systems) Objective 210122.0411 Students will mathematically calculate and explain the work being done by a specific fluid power device as part of an oral presentation. (Fluid Systems) Objective 210122.0412 Students will safely demonstrate proper setup and adjustment of a fluid power system. (Fluid Systems) Objective 210122.0413 Students will create schematic drawings to facilitate experimental measurements of electrical circuits. (Electrical Systems) Objective 210122.0414 Students will apply ohm's and watt's laws in designing safe electrical circuits. (Electrical Systems)			in an application.		

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	Objective 210122.0415 Students will appraise community needs and evaluate the impact supplying electrical generation has on their communities. (Electrical Systems) Objective 210122.0416 Students will be able to estimate current consumption by a circuit and be able to compare estimates to accurate measurements they perform. (Electrical Systems) Objective 210122.0417 Students will design, diagram and implement a program to control a device they construct to perform a sorting operation. (Control Systems) Objective 210122.0418 Students will select and apply concepts of mechanical, electrical, and control systems in solving design problems. (Control Systems) Objective 210122.0419 Students will formulate a plan for evaluating the functioning of their sorting device and to make appropriate changes in design,					

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	circuitry or programming. (Control Systems) Objective 210122.0420 Students will demonstrate and defend their solution to the design problem in an oral presentation to the class. (Control Systems)					
Unit 1 Energy and Power Lesson 1.3 Energy Applicat *(Week 5, 1 Week)*	UT: CTE: Technical and Engineering UT: Grades 9-12 Project Lead The Way "Principles of Engineering" Standard 210122.04 ENGINEERING SYSTEMS. STUDENTS LEARN ABOUT MECHANICAL, THERMODYNAMICS , FLUID, ELECTRICAL, AND CONTROL SYSTEMS. Objective 210122.0401 Students will identify and explain the function of the essential components of a mechanical system on a display they create. (Mechanisms)	1. What limitations affect electricity production using solar cells? 2. What limitations affect electricity production using hydrogen fuel cells? 3. How can system configuration affect voltage and current? 4. How does thermodynamics relate to energy and power? 5. What are some everyday examples of the First and Second Laws of Thermodynamics?	1. Energy management is focused on efficient and accessible energy use. 2. System energy requirements must be understood in order to select the proper energy source. 3. Energy systems can include multiple energy sources that can be combined to convert energy into useful forms. 4. Hydrogen fuel cells create electricity and heat through an electrochemical process that	It is expected that students will: • Test and apply the relationship between voltage, current, and resistance relating to a photovoltaic cell and a hydrogen fuel cell. • Experiment with a solar hydrogen system to produce mechanical power. • Design, construct, and test recyclable insulation materials.	**Active Solar Energy Collection** **Alternative Energy** **Ampere** **Conduction** **Convection** **Current** **Electrical Energy** **Electricity** **Electromagnetic Energy** **Electrolysis** **Energy** **Entropy** **First Law of Thermodynamics** **Fuel Cell Stack** **Heat** **Kelvin** **Line of Best Fit** **Ohm** **Ohm's Law** **Passive Solar Energy Collection**	

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	Objective 210122.0402 Students will create a display of a mechanical system from a household item they disassemble. (Mechanisms) Objective 210122.0403 Students will mathematically explain the mechanical advantage gained and explain the function of the six different types of simple machines in a presentation on the SMET device. (Mechanisms) Objective 210122.0404 Students will apply simple machines to create mechanical systems in the solution of a design problem. (Mechanisms) Objective 210122.0405 Students will conduct an energy analysis on a section of their home and calculate the heat loss through walls and windows. (Thermodynamics) Objective 210122.0406 Students will develop effective presentation skills. (Thermodynamics) Objective 210122.0407 Students will research and evaluate systems		converts hydrogen and oxygen into water. 5. Solar cells convert light energy into electricity by using photons to create electron flow. 6. Thermodynamics is the study of the effects of work, thermo energy, and energy on a system. 7. Thermal energy can transfer via convection, conduction, or radiation. 8. Material conductivity, resistance, and energy transfer can be calculated.	• Test and apply the relationship between R-values and recyclable insulation. • Complete calculations for conduction, R-values, and radiation.	**Product Development Lifecycle** **Radiation** **Renewable Energy** **Resistance** **R-value** **Second Law of Thermodynamics** **Temperature** **Thermal Equilibrium** **Thermodynamic System** **Thermodynamics** **U-value** **Volt** **Voltage** **Zeroth Law of Thermodynamics**	

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	undergoing thermodynamic cycles for efficiency and present findings to the group. (Thermodynamics) Objective 210122.0408 Students will give an oral presentation incorporating the first and second laws of thermodynamics, describing the concept and function of a heat engine of their choice. (Thermodynamics)					
Unit 1 Energy and Power Lesson 1.4 Design Problem *(Week 6, 1 Week)*	UT: CTE: Technical and Engineering UT: Grades 9-12 Project Lead The Way "Principles of Engineering" Standard 210122.02 COMMUNICATION AND DOCUMENTATION. STUDENTS COLLECT AND CATEGORIZE DATA, PRODUCE GRAPHIC Objective 210122.0208 Students will design and deliver a presentation utilizing appropriate support materials about	1. What is a design brief and what are design constraints? 2. Why is a design process so important to follow when creating a solution to a problem? 3. What is a decision matrix and why is it used? 4. What does consensus mean, and how do teams use consensus to make decisions?	1. Design problems can be solved by individuals or in teams. 2. Engineers use a design process to create solutions to existing problems. 3. Design briefs are used to identify the problem specifications and to establish project constraints. 4. Teamwork requires constant	It is expected that students will: • Brainstorm and sketch possible solutions to an existing design problem. • Create a decision making matrix for their design problem. • Select an approach that meets or satisfies the constraints provided in a design brief.	**Accuracy** **Assembly** **Brainstorming** **Component** **Consensus** **Constraint** **Decision Matrix** **Design Brief** **Design Modification** **Design Process** **Design Statement** **Designer** **Open-Ended** **Pictorial Sketch** **Problem Statement** **Purpose** **Sketch** **Solid Modeling** **Target Consumer**	

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	research they have conducted. (Presentation) Objective 210122.0209 Students will create and assemble support materials to appropriate demonstrate concepts used in their presentations. (Presentation) Standard 210122.03 DESIGN PROCESS. STUDENTS LEARN ABOUT PROBLEM SOLVING AND HOW PRODUCTS ARE DEVELOPED TO INCLUDE HOW ENGINEERS WORK IN TEAMS. REPRESENTATIONS, KEEP AN ENGINEER'S NOTEBOOK, AND MAKE WRITTEN AND ORAL PRESENTATIONS. Objective 210122.0301 Students will compose and diagram the product development lifecycle of an invention of their choice and report findings to the class. (Design Process)		communication to achieve the desired goal. 5. Design teams conduct research to develop their knowledge base, stimulate creative ideas, and make informed decisions.	• Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix. • Present a workable solution to the design problem.	**Team**	

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	Objective 210122.0302 Students will trace the history of an invention and evaluate its effects on society and the environment. (Design Process) Objective 210122.0303 Students will examine the evolution of an invention to observe and report on how the design process is applied to continuously redesign and improve the product. (Design Process)					
Unit 2 Lesson 2.1 Statics *(Week 7, 1 Week)*	UT: CTE: Technical and Engineering UT: Grades 9-12 Project Lead The Way "Principles of Engineering" Standard 210122.05 STATICS. STUDENTS LEARN ABOUT MEASUREMENT, SCALARS AND VECTORS, EQUILIBRIUM, STRUCTURAL ANALYSIS, AND STRENGTH OF MATERIALS.	1. Why is it crucial for designers and engineers to construct accurate free body diagrams of the parts and structures that they design? 2. Why must designers and engineers calculate forces acting on bodies and structures? 3. When solving truss forces, why is it important to know that the structure is	1. Laws of motion describe the interaction of forces acting on a body. 2. Structural member properties including centroid location, moment of inertia, and modulus of elasticity are important considerations for structure design. 3. Static equilibrium occurs when the sum of all	It is expected that students will: • Create free body diagrams of objects, identifying all forces acting on the object. • Mathematically locate the centroid of structural members. • Calculate moment of inertia of structural members.	**Cable** **Centroid** **Compression** **Force** **Concurrent Force Systems** **Cross-Sectional Area** **Direction** **Fixed Support** **Flange** **Free Body Diagram** **Gusset** **Joint** **Magnitude** **Member** **Method of Joints** **Moment** **Moment of Inertia**	

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	Objective 210122.0501 Students will mathematically analyze a simple truss to determine types and magnitude of forces supported in the truss. (Statics) Objective 210122.0502 Students will design, construct and test a model bridge to support the greatest amount of weight per gram of bridge mass. (Statics) Objective 210122.0503 Students will prepare and present a mathematical analysis of a truss design as part of a minute oral presentation about their bridge design. (Statics) Objective 210122.0504 Students explain the use of factors of safety in the design process. Objective 210122.0505 Students will be able to explain the difference between the area of a cross section of an object and the second moment of the area (Moment of Inertia) and predict the relative strength of one shape vs. another. (Strength of Materials)	statically determinate?	forces acting on a body are equal to zero. 4. Applied forces are vector quantities with a defined magnitude, direction, and sense, and can be broken into vector components. 5. Forces acting at a distance from an axis or point attempt or cause an object to rotate. 6. In a statically determinate truss, translational and rotational equilibrium equations can be used to calculate external and internal forces. 7. Free body diagrams are used to illustrate and calculate forces acting upon a given body.	• Differentiate between scalar and vector quantities. • Identify magnitude, direction, and sense of a vector. • Calculate the X and Y components given a vector. • Calculate moment forces given a specified axis. • Use equations of equilibrium to calculate unknown forces. • Use the method of joints strategy to determine forces in the members of a statically determinate	**Newton's First Law** **Newton's Second Law** **Newton's Third Law** **Pinned Support** **Planar Truss** **Resultant Force** **Roller Support** **Scalar** **Sense** **Simple Truss** **Static Equilibrium** **Statically Indeterminate Structure** **Tension Force** **Vector Quantity**	

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	Objective 210122.0506 Students will be able to use a computer aided engineering package to analyze a shape. (Strength of Materials) Objective 210122.0507 Students will explain the effects that stress has on a material and explain how the material will react. (Strength of Materials) Standard 210122.06 MATERIALS AND MATERIALS TESTING. STUDENTS LEARN THE CATEGORIES AND PROPERTIES OF MATERIALS, HOW MATERIALS ARE SHAPED AND JOINED, AND MATERIALS TESTING. Objective 210122.0601 Students will be able to identify and differentiate the five basic categories of solid engineering materials. (Categories of Materials) Objective 210122.0602 Students will be able to compare and contrast the physical properties of					

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	organic, metals, polymers, ceramics, and composites. (Categories of Materials) Objective 210122.0603 Students will be able to trace the production of raw material to finished product. (Categories of Materials) Objective 210122.0604 Students will be able to identify practical applications of each material category to engineered products and processes. (Categories of Materials) Objective 210122.0605 Students will be able to collect, analyze, and test samples of the four basic materials. (Categories of Materials) Objective 210122.0606 Students will be able to document and present laboratory data related to studies of material classifications. (Categories of Materials) Objective 210122.0607 Students will be able to identify and document the properties of materials. (Properties of Materials) Objective 210122.0608 Students will be able to					

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	design an experiment to identify an unknown material. (Properties of Materials) Objective 210122.0609 The student will be able to formulate conclusions through analysis of recorded laboratory test data for presentations in the form of charts, graphs, written, verbal, and multi-media formats. (Properties of Materials) Objective 210122.0610 Students will be able to analyze word problems about forces acting on materials. (Properties of Materials) Objective 210122.0611 Students will be able to define and state examples of the major categories of Production Processes. (Production Process) Objective 210122.0612 Students will be able to analyze a component of a product and describe the processes used in its creation. Objective 210122.0613 Students will be able to interpret a drawing and produce a part. (Production Process)					

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	Objective 210122.0614 Students will give an oral presentation on the production processes used to create products from a category of materials and a demonstration about one of the processes. (Production Process) Objective 210122.0615 Students will be able to state the difference between mass and weight. (Quality Assurance) Objective 210122.0616 Students will be able to utilize a variety of precision measurement tools to measure appropriate dimensions, mass, and weight. (Quality Assurance) Objective 210122.0617 Students will be able to understand and explain why companies have a need for quality control and will describe what customers and companies refer to when the term “quality” is used. (Quality Assurance) Objective 210122.0618 Students will be able to calculate the mean, median, mode, and standard deviation for a					

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	set of data and apply that information to an understanding of quality assurance. (Quality Assurance) Objective 210122.0619 Students will be able to explain the difference between process and product control. (Quality Assurance) Objective 210122.0620 Students will be able to distinguish between the characteristics of quality in a final product and the control of quality in each step of a process. (Quality Assurance) Objective 210122.0621 Students will understand how control charts are used in industry and will be able to predict whether a process is “out of control,” or not by using a control chart. (Quality Assurance) Objective 210122.0622 Students will be able to describe and safely conduct destructive and non-destructive material testing and will be able to use the data collected through these tests to compute and document mechanical properties. (Material Testing Processes)					

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	Objective 210122.0623 Students will be able to analyze a product that breaks and be able to explain how the material failed. (Material Testing Processes)					
Unit 2 Lesson 2.2 Materials Processing *(Week 8, 1 Week)*	UT: CTE: Technical and Engineering UT: Grades 9-12 Project Lead The Way "Principles of Engineering" Standard 210122.06 MATERIALS AND MATERIALS TESTING. STUDENTS LEARN THE CATEGORIES AND PROPERTIES OF MATERIALS, HOW MATERIALS ARE SHAPED AND JOINED, AND MATERIALS TESTING. Objective 210122.0601 Students will be able to identify and differentiate the five basic categories of solid engineering materials. (Categories of Materials)	1. How does an engineer predict the performance and safety for a selected material? 2. What are the advantages and disadvantages of utilizing synthetic materials designed by engineers? 3. What ethical issues pertain to engineers designing synthetic materials? 4. What did you learn about the significance of selecting materials for product design? 5. How can an existing product be changed to incorporate different processes to	1. Materials are the substances in which all things are made. 2. Materials are composed of elements and area categorized by physical and chemical properties. 3. Materials consist on pure elements, compounds and mixtures and are typically classified as metallic, ceramic, organic, polymeric, and composite. 4. Material properties including recyclability and cost are important	It is expected that students will: • Investigate specific material properties related to a common household product. • Conduct investigative non-destructive material property tests on selected common household product including testing for continuity, ferrous metal, hardness, and flexure. • Calculate weight, volume,	**Additive Process** **Ceramic** **Codes** **Composite** **Decision Matrix** **Finishing** **Forming** **Liability** **Manufacturing Material** **Mechanical Properties** **Metals** **Physical Properties** **Polymers** **Product Life Cycle** **Raw Material** **Recycling** **Subtractive** **Synthetic**	

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	Objective 210122.0602 Students will be able to compare and contrast the physical properties of organic, metals, polymers, ceramics, and composites. (Categories of Materials) Objective 210122.0603 Students will be able to trace the production of raw material to finished product. (Categories of Materials) Objective 210122.0604 Students will be able to identify practical applications of each material category to engineered products and processes. (Categories of Materials) Objective 210122.0605 Students will be able to collect, analyze, and test samples of the four basic materials. (Categories of Materials) Objective 210122.0606 Students will be able to document and present laboratory data related to studies of material classifications. (Categories of Materials) Objective 210122.0607 Students will be able to identify and document the properties of	make it less expensive and provide better performance? 6. How does an engineer decide which manufacturing process to use for a given material? 7. How do the recycling codes and symbols differ from state to state?	considerations for engineers when choosing appropriate materials for a design. 5. Material selection is based upon mechanical, thermal, electromagnetic, and chemical properties. 6. Raw materials undergo various manufacturing processes in the production of consumer goods.	mass, density, and surface area of selected common household product • Identify the manufacturing processes used to create the selected common household product. • Identify the recycling codes. • Promote recycle using current media trends.		

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	materials. (Properties of Materials) Objective 210122.0608 Students will be able to design an experiment to identify an unknown material. (Properties of Materials) Objective 210122.0609 The student will be able to formulate conclusions through analysis of recorded laboratory test data for presentations in the form of charts, graphs, written, verbal, and multi-media formats. (Properties of Materials) Objective 210122.0610 Students will be able to analyze word problems about forces acting on materials. (Properties of Materials) Objective 210122.0611 Students will be able to define and state examples of the major categories of Production Processes. (Production Process) Objective 210122.0612 Students will be able to analyze a component of a product and describe the processes used in its creation. Objective 210122.0613 Students will be able to					

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	interpret a drawing and produce a part. (Production Process) Objective 210122.0614 Students will give an oral presentation on the production processes used to create products from a category of materials and a demonstration about one of the processes. (Production Process) Objective 210122.0615 Students will be able to state the difference between mass and weight. (Quality Assurance) Objective 210122.0616 Students will be able to utilize a variety of precision measurement tools to measure appropriate dimensions, mass, and weight. (Quality Assurance) Objective 210122.0617 Students will be able to understand and explain why companies have a need for quality control and will describe what customers and companies refer to when the term “quality” is used. (Quality Assurance)					

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	Objective 210122.0618 Students will be able to calculate the mean, median, mode, and standard deviation for a set of data and apply that information to an understanding of quality assurance. (Quality Assurance)					
Unit 2 Lesson 2.3 Material Testing *(Week 9, 1 Week)*	UT: CTE: Technical and Engineering UT: Grades 9-12 Project Lead The Way "Principles of Engineering" Standard 210122.06 MATERIALS AND MATERIALS TESTING. STUDENTS LEARN THE CATEGORIES AND PROPERTIES OF MATERIALS, HOW MATERIALS ARE SHAPED AND JOINED, AND MATERIALS TESTING. Objective 210122.0601 Students will be able to identify and differentiate the five basic categories of solid engineering	1. Why is it critical for engineers to document all calculation steps when solving problems? 2. How is material testing data useful? 3. Stress strain curve date points are useful in determining what specific material properties?	1. Engineers utilize a design process and mathematical formulas to solve and document design problems. 2. Material testing aids in determining a product's reliability, safety, and predictability in function. 3. Engineers perform destructive and non-destructive tests on material specimens for the purpose of identifying and verifying the properties of	• Utilize a five-step technique to solve word problems. • Obtain measurements of material samples. • Tensile test a material test sample. • Identify and calculate test sample material properties using a stress strain curve.	**Axial Stress** **Breaking Stress** **Compression** **Deformation** **Destructive Testing** **Elastic Limit** **Elongation** **Factor of Safety** **Failure Point** **Fatigue** **Hooke's Law** **Modulus of Elasticity** **Nondestructive Testing** **Problem Solving** **Proportional Limit** **Quality Control** **Reliability** **Resilience** **Rupture Strength** **Shear Stress** **Standard Deviation** **Statistics**	

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	materials. (Categories of Materials) Objective 210122.0602 Students will be able to compare and contrast the physical properties of organic, metals, polymers, ceramics, and composites. (Categories of Materials) Objective 210122.0603 Students will be able to trace the production of raw material to finished product. (Categories of Materials) Objective 210122.0604 Students will be able to identify practical applications of each material category to engineered products and processes. (Categories of Materials) Objective 210122.0605 Students will be able to collect, analyze, and test samples of the four basic materials. (Categories of Materials) Objective 210122.0606 Students will be able to document and present laboratory data related to studies of material classifications. (Categories of Materials) Objective 210122.0607 Students will be able to		various materials. 4. Material testing provides a reproducible evaluation of material properties. 5. Tensile testing data is used to create a test sample stress strain curve. 6. 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.		**Strain** **Stress** **Stress-Strain Curve** **Tension** **Toughness** **Ultimate Stress** **Variance**	

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	identify and document the properties of materials. (Properties of Materials) Objective 210122.0608 Students will be able to design an experiment to identify an unknown material. (Properties of Materials) Objective 210122.0609 The student will be able to formulate conclusions through analysis of recorded laboratory test data for presentations in the form of charts, graphs, written, verbal, and multi-media formats. (Properties of Materials) Objective 210122.0610 Students will be able to analyze word problems about forces acting on materials. (Properties of Materials) Objective 210122.0611 Students will be able to define and state examples of the major categories of Production Processes. (Production Process) Objective 210122.0612 Students will be able to analyze a component of a product and describe the processes used in its creation.					

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	Objective 210122.0613 Students will be able to interpret a drawing and produce a part. (Production Process) Objective 210122.0614 Students will give an oral presentation on the production processes used to create products from a category of materials and a demonstration about one of the processes. (Production Process) Standard 210122.07 ENGINEERING FOR QUALITY AND RELIABILITY. STUDENTS WILL USE PRECISION MEASUREMENT TOOLS TO GATHER AND APPLY STATISTICS FOR QUALITY AND PROCESS CONTROL. STUDENTS WILL ALSO LEARN ABOUT RELIABILITY, REDUNDANCY, RISK ANALYSIS, FACTORS OF SAFETY, AND					

Unit	CTE Standards and Objectives	Essential Questions	Content	Skills	Vocabulary	Formative & Summative Assessments
	LIABILITY AND ETHICS. Objective 210122.0701 Students will be able to diagram a system and identify the critical components. (Reliability) Objective 210122.0702 Students will be able to mathematically estimate chance of failure of a system given information on certain components. (Reliability) Objective 210122.0703 Students will list the causes of failure and be able to propose solutions. (Reliability) Objective 210122.0704 Students will prepare and defend a position on an ethical engineering dilemma. (Reliability)					
Unit 2 Lesson 2.4 Design Problem *(Week 10, 1 Week)*	UT: CTE: Technical and Engineering UT: Grades 9-12 Project Lead The Way "Principles of Engineering" Standard 210122.02 COMMUNICATION AND DOCUMENTATION.	1. What is a design brief? What are design constraints? 2. Why is a design process so important to follow when creating a solution to a problem? 3. What is a decision matrix	1. Design problems can be solved by individuals or in teams. 2. Engineers use a design process to create solutions to existing problems. 3. Design briefs are used to	It is expected that students will: • Brainstorm and sketch possible solutions to an existing design problem. • Create a decision making	**Accuracy** **Assembly** **Brainstorming** **Component** **Consensus** **Constraint** **Decision Matrix** **Design Brief** **Design Modification** **Design Process** **Design Statement**	

Unit	CTE Standards and Objectives	Essential Questions	Content	Skills	Vocabulary	Formative & Summative Assessments
	STUDENTS COLLECT AND CATEGORIZE DATA, PRODUCE GRAPHIC Objective 210122.0202 Students will select the appropriate sketching styles for presentation of a design problem to a group. (Sketching) Objective 210122.0203 Students will use proper proportioning while producing annotated sketches. (Sketching) Objective 210122.0204 Students will plan and compose a written technical report about the research they conduct about a career field in engineering. (Technical Writing) Objective 210122.0205 Students will be able to formulate an organized outline for a technical paper. (Technical Writing) Objective 210122.0206 Students will be able to design and create tables, charts, and graphs to illustrate data they have collected. (Data Representation and Presentation)	and why is it used? 4. What does consensus mean, and how do teams use consensus to make decisions? 5. How do the properties and types of materials affect the solution to a design problem?	identify the problem specifications and establish project constraints. 4. Teamwork requires constant communication to achieve the desired goal. 5. Design teams conduct research to develop their knowledge base, stimulate creative ideas, and make informed decisions.	matrix for the design problem. • Select an approach that meets or satisfies the constraints given in a design brief. • Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon your team's decision matrix. • Present a workable design solution.	**Designer** **Open-Ended** **Pictorial Sketch** **Problem Statement** **Purpose** **Sketch** **Solid Modeling** **Target Consumer** **Team**	

Unit	CTE Standards and Objectives	Essential Questions	Content	Skills	Vocabulary	Formative & Summative Assessments
	Objective 210122.0207 Students will evaluate and select an appropriate type of table, chart, or graph to accurately communicate collected data for written work or presentations. (Data Representation and Presentation) Objective 210122.0208 Students will design and deliver a presentation utilizing appropriate support materials about research they have conducted. (Presentation) Objective 210122.0209 Students will create and assemble support materials to appropriate demonstrate concepts used in their presentations. (Presentation) Standard 210122.03 DESIGN PROCESS. STUDENTS LEARN ABOUT PROBLEM SOLVING AND HOW PRODUCTS ARE DEVELOPED TO INCLUDE HOW ENGINEERS WORK IN TEAMS. REPRESENTATION					

Unit	CTE Standards and Objectives	Essential Questions	Content	Skills	Vocabulary	Formative & Summative Assessments
	S, KEEP AN ENGINEER'S NOTEBOOK, AND MAKE WRITTEN AND ORAL PRESENTATIONS. Objective 210122.0301 Students will compose and diagram the product development lifecycle of an invention of their choice and report findings to the class. (Design Process) Objective 210122.0302 Students will trace the history of an invention and evaluate its effects on society and the environment. (Design Process) Objective 210122.0303 Students will examine the evolution of an invention to observe and report on how the design process is applied to continuously redesign and improve the product. (Design Process)					
Unit 3 Lesson 3.1 Machine Control *(Week 11, 2 Weeks)*	UT: CTE: Technical and Engineering UT: Grades 9-12	1. What are the advantages and disadvantages of using programmable logic to control machines	1. Flowcharts provide a step by step schematic representation of an algorithm or process.	It is expected that students will: • Create detailed flow charts that utilize a	**Algorithm** **Analog Signal** **Analog to Digital** **Closed Loop System** **Data**	

Unit	CTE Standards and Objectives	Essential Questions	Content	Skills	Vocabulary	Formative & Summative Assessments
	Project Lead The Way "Principles of Engineering" Standard 210122.01 OVERVIEW AND PERSPECTIVE OF ENGINEERING. STUDENTS LEARN ABOUT THE TYPES OF ENGINEERS AND THEIR CONTRIBUTION TO SOCIETY. Objective 210122.0101 Students will have an understanding of engineering and be able to identify engineering achievements through history. (Engineers as Problem Solvers) Objective 210122.0102 Students will be able to identify five historical engineering role models, including minorities and women. (Engineers as Problem Solvers) Objective 210122.0103 Students will be able to identify problems for engineers to solve in the future. (Engineers as Problem Solvers) Objective 210122.0104 Students will be able to define attributes	versus monitoring and adjusting processes manually? 2. What are some everyday seemingly simple devices that contain microprocessors, and what function do the devices serve? 3. What questions must designers ask when solving problems in order to decide between digital or analog systems and between open or closed loop systems?	2. Control systems are designed to provide consistent process control and reliability. 3. Control system protocols are an established set of commands or functions typically created in a computer programming language. 4. Closed loop systems use digital and analog sensor feedback to make operational and process decisions. 5. Open loop systems use programming constants such as time to make operational and process decisions.	computer software application. • Create control system operating programs that utilize computer software. • Create system control programs that utilize flowchart logic. • Choose appropriate input and output devices based on the need of a technological system. • Differentiate between the characteristics of digital and analog devices. • Judge between open and closed loop systems in order to choose the most	**Digital Signal** **Digital to Analog** **Electromagnet** **Feedback** **Flowchart** **Input** **Interface** **Microprocessor** **Normally Closed** **Normally Open** **NTC Resistor** **Open Loop System** **Output** **Photocell** **Polarity** **Potentiometer** **Programmable Logic Controller** **Reed Switch** **Sensor** **Subroutine** **Switch** **Transistor**	

Unit	CTE Standards and Objectives	Essential Questions	Content	Skills	Vocabulary	Formative & Summative Assessments
	associated with being a successful engineer. (Engineers as Problem Solvers) Objective 210122.0105 Understand that an engineering team must work together to solve problems, with each team member having individual and collective responsibilities. (Engineering Team) Objective 210122.0106 Understand the role of out-sourcing in the engineering process, and how effective communication is essential. (Engineering Team) Objective 210122.0107 Understand how gender-bias, racial-bias and other forms of stereotyping and discrimination can adversely affect communications within an engineering team. (Engineering Team) Objective 210122.0108 Understand how ethics influences the engineering process. (Engineering Team) Objective 210122.0109 Understand how social, environmental and			• appropriate system for a given technological problem. • Design and create a control system based on given needs and constraints.		

Unit	CTE Standards and Objectives	Essential Questions	Content	Skills	Vocabulary	Formative & Summative Assessments
	financial constraints influence the engineering process. (Engineering Team) Objective 210122.0110 Students will have an understanding of the difference between engineering disciplines and job functions. (Careers in Engineering) Objective 210122.0111 Students will understand the professional and legal responsibilities associated with being an engineer. (Careers in Engineering) Objective 210122.0112 Students will research and discover the educational requirements to become an engineer. (Careers in Engineering) Objective 210122.0113 Students will become familiar with an area of engineering by preparing for and conducting an interview with an engineer in that field of engineering. (Careers in Engineering) Standard 210122.04 ENGINEERING SYSTEMS. STUDENTS LEARN					

Unit	CTE Standards and Objectives	Essential Questions	Content	Skills	Vocabulary	Formative & Summative Assessments
	ABOUT MECHANICAL, THERMODYNAMICS , FLUID, ELECTRICAL, AND CONTROL SYSTEMS. Objective 210122.0413 Students will create schematic drawings to facilitate experimental measurements of electrical circuits. (Electrical Systems) Objective 210122.0414 Students will apply ohm's and watt's laws in designing safe electrical circuits. (Electrical Systems) Objective 210122.0415 Students will appraise community needs and evaluate the impact supplying electrical generation has on their communities. (Electrical Systems) Objective 210122.0416 Students will be able to estimate current consumption by a circuit and be able to compare estimates to accurate measurements they perform. (Electrical Systems)					

Unit	CTE Standards and Objectives	Essential Questions	Content	Skills	Vocabulary	Formative & Summative Assessments
	Objective 210122.0417 Students will design, diagram and implement a program to control a device they construct to perform a sorting operation. (Control Systems) Objective 210122.0418 Students will select and apply concepts of mechanical, electrical, and control systems in solving design problems. (Control Systems) Objective 210122.0419 Students will formulate a plan for evaluating the functioning of their sorting device and to make appropriate changes in design, circuitry or programming. (Control Systems) Objective 210122.0420 Students will demonstrate and defend their solution to the design problem in an oral presentation to the class. (Control Systems)					
Unit 3 Lesson 3.2 Fluid Power *(Week 13, 2 Weeks)*	UT: CTE: Technical and Engineering UT: Grades 9-12	1. What impact does fluid power have on our everyday lives? 2. Can you identify devices or systems that do	1. Fluid power systems are categorized as either pneumatic, which utilizes gas, or	It is expected that students will: 1. Identify devices that utilize fluid power.	**Absolute Pressure** **Atmospheric Pressure** **Boyle's Law** **Charles' Law** **Check Valve**	

Unit	CTE Standards and Objectives	Essential Questions	Content	Skills	Vocabulary	Formative & Summative Assessments
	Project Lead The Way "Principles of Engineering" Standard 210122.04 ENGINEERING SYSTEMS. STUDENTS LEARN ABOUT MECHANICAL, THERMODYNAMICS , FLUID, ELECTRICAL, AND CONTROL SYSTEMS. Objective 210122.0409 Students will evaluate and select specific fluid power sources for different functions. (Fluid Systems) Objective 210122.0410 Students will create a flow diagram schematic sketch and compare it to an actual fluid power circuit during a presentation to the class. (Fluid Systems) Objective 210122.0411 Students will mathematically calculate and explain the work being done by a specific fluid power device as part of an oral presentation. (Fluid Systems)	not use fluid power that might be improved with the use of fluid power? 3. What are similarities and differences of mechanical advantage in simple machines and hydraulic systems? 4. Why are Pascal's Law, the perfect gas laws, Bernoulli's Principle, and other similar rules important to engineers and designers of fluid power systems?	hydraulic, which utilizes liquid. 2. Fluid power is possible because in a system of confined fluid, pressure acts equally in all directions. 3. The most basic components of all fluid power systems include a reservoir or receiver, a pump or compressor, a valve, and a cylinder. 4. Fluid power systems are designed to transmit force over great distances, multiply an input force, and increase the distance that an output will move. 5. Laws about the behavior of fluid systems and standard conventions for calculating values within	2. Identify and explain basic components and functions of fluid power devices. 3. Differentiate between the characteristics of pneumatic and hydraulic systems. 4. Distinguish between hydrodynamic and hydrostatic systems. 5. Design, create, and test a hydraulic device. 6. Design, create, and test a pneumatic device. 7. Calculate values in a fluid power system utilizing Pascal's Law. 8. Distinguish between pressure and	**Compressor** **Crank** **Cylinder** **Directional-Control Valve** **Double-Acting Cylinder** **Filter** **Flow Meter** **Flow Rate** **Flow Velocity** **Flow-Control Valve** **Fluid Power** **Gay-Lussac's Law** **Hydraulics** **Lubricator** **Pascal's Law** **Piston** **Pneumatics** **Pressure** **Pressure Regulator** **Pressure Relief Valve** **Pump** **Receiver Tank** **Reservoir** **Single-Acting Cylinder** **Solenoid** **Transmission Lines** **Valve** **Viscosity** **Volume**	

Unit	CTE Standards and Objectives	Essential Questions	Content	Skills	Vocabulary	Formative & Summative Assessments
	Objective 210122.0412 Students will safely demonstrate proper setup and adjustment of a fluid power system. (Fluid Systems)		fluid systems aid in the design and understanding of such systems. 6. Standard schematic symbols and conventions are used to communicate fluid power designs.	absolute pressure. 9. Distinguish between temperature and absolute temperature. 10. Calculate values in a pneumatic system utilizing the perfect gas laws. 11. Calculate flow rate, flow velocity, and mechanical advantage in a hydraulic system.		
Unit 3 Lesson 3.3 Design Problem *(Week 14, 2 Weeks)*	UT: CTE: Technical and Engineering UT: Grades 9-12 Project Lead The Way "Principles of Engineering" Standard 210122.03 DESIGN PROCESS. STUDENTS LEARN ABOUT PROBLEM SOLVING AND HOW PRODUCTS	1. What is a design brief and what are design constraints? 2. Why is a design process so important to follow when creating a solution to a problem? 3. What is a decision matrix and why is it used?	1. Design problems can be solved by individuals or in teams. 2. Engineers use a design process to create solutions to existing problems. 3. Design briefs are used to identify the	It is expected that students will: • Brainstorm and sketch possible solutions to an existing design problem. • Create a decision-making matrix for	**Accuracy** **Assembly** **Brainstorming** **Component** **Consensus** **Constraint** **Decision Matrix** **Design Brief** **Design Modification** **Design Process** **Design Statement** **Designer** **Open-Ended**	

Unit	CTE Standards and Objectives	Essential Questions	Content	Skills	Vocabulary	Formative & Summative Assessments
	ARE DEVELOPED TO INCLUDE HOW ENGINEERS WORK IN TEAMS. REPRESENTATIONS, KEEP AN ENGINEER'S NOTEBOOK, AND MAKE WRITTEN AND ORAL PRESENTATIONS. Objective 210122.0301 Students will compose and diagram the product development lifecycle of an invention of their choice and report findings to the class. (Design Process) Objective 210122.0302 Students will trace the history of an invention and evaluate its effects on society and the environment. (Design Process) Objective 210122.0303 Students will examine the evolution of an invention to observe and report on how the design process is applied to continuously redesign and improve the product. (Design Process)	4. What does consensus mean, and how do teams use consensus to make decisions? 5. How does the use of mechanisms affect the overall solution to a design problem?	problem specifications and to establish project constraints. 4. Teamwork requires constant communication to achieve the desired goal. 5. Design teams conduct research to develop their knowledge base, stimulate creative ideas, and make informed decisions.	their design problem. • Select an approach that meets or satisfies the constraints provided in a design brief. • Create a detailed pictorial sketch or use 3D modeling software to document the best choice, based upon the design team's decision matrix. • Present a workable solution to the design problem.	**Pictorial Sketch** **Problem Statement** **Purpose** **Sketch** **Solid Modeling** **Target Consumer** **Team**	

Unit	CTE Standards and Objectives	Essential Questions	Content	Skills	Vocabulary	Formative & Summative Assessments
Unit 4 Lesson 4.1 Statistics *(Week 16, 2 Weeks)*	UT: CTE: Technical and Engineering UT: Grades 9-12 Project Lead The Way "Principles of Engineering" Standard 210122.01 OVERVIEW AND PERSPECTIVE OF ENGINEERING. STUDENTS LEARN ABOUT THE TYPES OF ENGINEERS AND THEIR CONTRIBUTION TO SOCIETY. Objective 210122.0110 Students will have an understanding of the difference between engineering disciplines and job functions. (Careers in Engineering) Objective 210122.0111 Students will understand the professional and legal responsibilities associated with being an engineer. (Careers in Engineering) Objective 210122.0112 Students will research and discover the educational requirements to become	1. Why is it crucial for designers and engineers to utilize statistics throughout the design process? 2. Why is process control a necessary statistical process for ensuring product success? 3. Why is theory-based data interpretation valuable in decision making? 4. Why is experiment-based data interpretation valuable in decision making?	1. Engineers use statistics to make informed decisions based upon established principles. 2. Visual representations of data analyses allow for easy distribution and understanding of data. 3. Statistics is based upon both theoretical and experimental data analysis.	It is expected that students will: 1. Calculate the theoretical probability that an event will occur. 2. Calculate the experimental frequency distribution of an event occurring. 3. Apply the Bernoulli process to events that only have two distinct possible outcomes. 4. Apply AND, OR, and NOT logic to probability. 5. Apply Bayes' theorem to calculate the probability of multiple events occurring. 6. Create a histogram to illustrate frequency distribution. 7. Calculate the central tendency of	**Accuracy** **Bar Chart** **Bayes' Theorem** **Data** **Data Variation** **Deviation** **Experiment** **Event** **Frequency Distribution** **Frequency Polygons** **Histogram** **Mean** **Mean Deviation** **Median** **Mode** **Normal Distribution** **Outcome** **Pie Chart** **Probability** **Process Control** **Qualitative Data** **Quantitative Data** **Quality Assurance** **Reliability** **Sample Space** **Standard Deviation** **Statistics** **Statistical Process Control** **Tolerance** **Variance**	

Unit	CTE Standards and Objectives	Essential Questions	Content	Skills	Vocabulary	Formative & Summative Assessments
	an engineer. (Careers in Engineering) Objective 210122.0113 Students will become familiar with an area of engineering by preparing for and conducting an interview with an engineer in that field of engineering. (Careers in Engineering) Standard 210122.07 ENGINEERING FOR QUALITY AND RELIABILITY. STUDENTS WILL USE PRECISION MEASUREMENT TOOLS TO GATHER AND APPLY STATISTICS FOR QUALITY AND PROCESS CONTROL. STUDENTS WILL ALSO LEARN ABOUT RELIABILITY, REDUNDANCY, RISK ANALYSIS, FACTORS OF SAFETY, AND LIABILITY AND ETHICS.			a data array, including mean, median, and mode. 8. Calculate data variation, including range, standard deviation, and variance.		

Unit	CTE Standards and Objectives	Essential Questions	Content	Skills	Vocabulary	Formative & Summative Assessments
	Objective 210122.0701 Students will be able to diagram a system and identify the critical components. (Reliability) Objective 210122.0702 Students will be able to mathematically estimate chance of failure of a system given information on certain components. (Reliability) Objective 210122.0703 Students will list the causes of failure and be able to propose solutions. (Reliability) Objective 210122.0704 Students will prepare and defend a position on an ethical engineering dilemma. (Reliability) Objective 210122.0705 Students will research the engineering, legal, social, and ethical issues related to a final design developed in a case study. (Case Study) Objective 210122.0706 Students will analyze an engineering failure for the purpose of presenting an aural report which identifies; causes, damage done, design failures, and other areas where the failure has impacted the					

Unit	CTE Standards and Objectives	Essential Questions	Content	Skills	Vocabulary	Formative & Summative Assessments
	environment or society. (Case Study) Objective 210122.0707 Students will prepare a written report explaining their analysis of an engineering failure. (Case Study)					
Unit 4 Lesson 4.2 Kinematics *(Week 18, 2 Weeks)*	UT: CTE: Technical and Engineering UT: Grades 9-12 Project Lead The Way "Principles of Engineering" Standard 210122.08 DYNAMICS. STUDENTS WILL BE INTRODUCED TO LINEAR AND TRAJECTORY MOTION. Objective 210122.0801 Students will be able to explain the difference between distance traveled and displacement. Objective 210122.0802 Students will design and build a device for the purpose of conducting experiments of acceleration, displacement, and velocity.	1. What are the relationships between distance, displacement, speed, velocity, and acceleration? 2. Why is it important to understand and be able to control the motion of a projectile?	1. When working with bodies in motion, engineers must be able to differentiate and calculate distance, displacement, speed, velocity, and acceleration. 2. When air resistance is not taken into account, released objects will experience acceleration due to gravity, also known as freefall. 3. Projectile motion can be predicted and controlled using kinematics equations.	It is expected that students will: 1. Calculate distance, displacement, speed, velocity, and acceleration from data. 2. Design, build, and test a vehicle that stores and releases potential energy for propulsion. 3. Calculate acceleration due to gravity given data from a free fall device. 4. Calculate the X and Y components of a projectile motion.	**Acceleration** **Free Fall** **Distance** **Displacement** **Velocity** **Speed**	

Unit	CTE Standards and Objectives	Essential Questions	Content	Skills	Vocabulary	Formative & Summative Assessments
	Objective 210122.0803 Students will be able to explain how velocity and acceleration are calculated. (Trajectory Motion) Objective 210122.0804 Students will be able to calculate range and initial acceleration from data they record from experiments. (Trajectory Motion) Objective 210122.0805 Students will design and produce a three-fold pamphlet to include an explanation of their ballistic device, drawings and a summarization of data recorded from experiments. (Trajectory Motion) Objective 210122.0806 Students will be able to analyze test data and utilize the results to make decisions. (Trajectory Motion)		4. When a projectile is launched, velocity in the x direction remains constant; whereas, with time, the velocity in the Y direction in magnitude and direction changes due to gravity.	5. Determine the needed angle to launch a projectile a specific range given the projectile's initial velocity.		