PITTSGROVE TOWNSHIP SCHOOL DISTRICT

Pittsgrove Township
School District
P.R.I.D.E. Patience Respect Integrity Diligence Empathy

Course Name: SEED: Sustainable Energy and Engineering Design	**Grade Level(s): 7**
Department: STEM	**Credits: n/a**
BOE Adoption Date: October 17, 2019	**Revision Date(s):**

Course Description

STEM concepts on renewable energy will be covered throughout this course. Students compare and contrast the power and efficiency that can be harnessed from wind-, solar-, and water-powered machines while working on projects of real-world significance. Both the pros and cons of these renewable energy are addressed. Students will work through the scientific method and test variables working to create their own lab report. In addition, students will learn some basic simple machines.

Mission Statement

The Pittsgrove Township School District believes in growing all learners to thrive. *The district offers an intellectually rigorous, dynamic curriculum aligned to state and national standards coupled with research-based practices in classrooms. The Pittsgrove Township School District strives to highlight critical thinking, problem-solving, intercultural literacy, digital literacy, collaboration, innovation, and a growth mindset as part of the instructional core of learning. The district provides high quality resources to provide young people the knowledge they need to approach the future as leaders and learners.*

Curriculum & Instruction Goals

1. To ensure students are college and career ready upon graduation
2. To vertically and horizontally align curriculum PreK-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 a *pacing guide* and *curriculum units*. The pacing guide serves to communicate an estimated timeframe as to *when* critical knowledge and skills 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, objectives, instructional strategies, resources, and assessments.

NJ Administrative Code and Statutes Key
^=Amistad Law **O=Diversity & Inclusion Law** **<>=Holocaust** **+=LGBT and Disabilities Law** ***=AAPI (Asian American and Pacific Islanders)** **$=Financial Literacy** **Use this key to understand where the NJ mandates are being implemented in the K-12 curriculum units.**

Pacing Guide

Course Title: SEED Sustainable Energy and Engineering Design
Prerequisite(s):

Unit Title	Duration/ Days	Related Standards	Learning Goals	Critical Knowledge and Skills
Unit 1: Solar Energy	**Solar/ 20 days**	● MS-ETS1-1. ● MS-ETS1-2. ● MS-ETS1-3. ● MS-ETS1-4. ● ETS1.A: ● ETS1.B: ● ETS1.C ● CRP5 ● RI.7.7	*Students will be able to determine the pros and cons of solar energy* *Students will use engineering techniques to build three solar devices (solar car, solar crank, and solar amusement park rides)* *Students will work through the scientific method creating a valid experiment* *Students will determine constants and understand their importance* *Students will determine constraints and criteria* *Students will determine how solar panels work* *Students will compare passive and active solar.*	● Watch video determining pro and cons of solar daily: take notes ● Build solar car, solar crank, and amusement park rides ● Complete scientific method for solar car (Does the amount of wattage affect the number of rotations) ● Complete class data chart to determine that increasing trials increases validity ● Complete scientific method of solar crank (Does the distance between the light and panel affect the number of cranks) ● Read and discuss the article, “Solar Energy” ● Complete guided notes based on article, “Solar Energy” ● Complete crossword based

				on article, “Solar Energy” ● Read and discuss the article “How Solar Works” ● Create a diagram of “How Solar Works” article
Unit 2:	**Wind / 20**	● MS-ETS1-1. ● MS-ETS1-2. ● MS-ETS1-3. ● MS-ETS1-4. ● ETS1.A: ● ETS1.B: ● ETS1.C ● CRP5 ● RI.7.7	● Students will be able to determine the pros and cons of wind energy ● Students will use engineering techniques to build wind powered devices (windmill that generates electricity to power a second device, sail car, wind power water lift) ● Students will work through the scientific method creating a valid experiment ● Students will determine constants and understand their importance ● Students will determine how wind turbine work	● Watch video determining pro and cons of wind daily: take notes ● Build windmill, sail car, and wind powered water lift water lift ● Complete scientific method for windmill (Does the amount of blades affect the number of rotations of a second device and Does the speed of the fan affect the number of rotations of a second device)) ● Complete scientific method of solar sail (Differmine own independent variable, etc…) ● Read and discuss the article, “Solar Energy” ● Complete guided notes based on article, “Wind Energy” ● Complete crossword based on article, “Wind Energy”

				• Discuss the workings of a wind turbine • Create a diagram of wind turbine
Unit 3:	**Hydro/ 10**	• MS-ETS1-1. • MS-ETS1-2. • MS-ETS1-3. • MS-ETS1-4. • ETS1.A: • ETS1.B: • ETS1.C • CRP5 • RI.7.7	• Students will be able to determine the pros and cons of hydro energy • Students will use engineering techniques to build hydror devices (hydro generator) • Students will work through the scientific method creating a valid experiment • Students will determine constants and understand their importance • Students will determine how hydro turbines work	• Watch video determining pro and cons of hydro daily: take notes • Build hydro generator • Complete scientific method for hydro generator • Complete scientific method of hydro generator : Design and type lab • Read and discuss the article, “Hydro Energy” • Complete guided notes based on article, “Hydro Energy” • Complete crossword based on article, “Hydro Energy” • Create a diagram of hydro turbine

Instructional Unit Map					
Course Title: Sustainable Energy and Engineering Design					
Unit Title	Sustainable Energy and Engineering Design Solar Energy			**Start Date:**	First part of trimester
				Length of Unit:	20 days
Content Standards *What do we want them to know, understand, & do?*	● MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. ● MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how	**Learning Goals**	*Students will be able to determine the pros and cons of solar energy* *Students will use engineering techniques to build three solar devices (solar car, solar crank, and solar amusement park rides)* *Students will work through the scientific method creating a valid experiment* *Students will determine constraints and criteria* *Students will determine constants and understand their importance* *Students will determine how solar panels work* *Students will compare passive and active solar.*		

	well they meet the criteria and constraints of the problem. ● MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. ● MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.		

	• ETS1.A: Defining and Delimiting Engineering Problems The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. • ETS1.B: Developing Possible Solutions A solution needs to be tested, and then modified on the basis of the test results, in		

	order to improve it. ● ETS1.C: Optimizing the Design Solution Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design.		
Essential Questions	*How can solar improve the world we live in?* *Who can benefit most from solar energy?* *Is solar energy a good choice for our future or why not?*		
Assessments *How will we know they have*	**Formative**	**Summative**	**Alternative**

gained the knowledge & skills?	• Notebooks • Questioning • Observation • Demonstration of working solar car and solar crank • Online graph • Guided notes on solar article • Diagram of the workings of solar panel • Solar crossword puzzle • Word wall “vocabulary talk”	• Unit test • Presentation of amusement park rides	
Unit Pre-Assessment(s) *What do they already know?*	• Teacher-generated warm up questions		
Instructional Strategies/Student Activities	• Watch video determining pro and cons of solar daily: take notes • Build solar car, solar crank, and amusement park rides • Complete scientific method for solar car (Does the amount of wattage affect the number of rotations) • Create class chart on wattages determining increasing trials increases validity • Complete line graph on create a graph web site • Complete scientific method of solar crank (Does the distance between the light and panel affect the number of cranks) • Read and discuss the article, “Solar Energy” • Complete guided notes based on article, “Solar Energy” • Complete crossword based on article, “Solar Energy” • Read and discuss the article “How Solar Works” • Create a diagram of “How Solar Works” article		

Instructional/Assessment Scaffolds *(Modifications /Accommodations) – planned for prior to instruction*	**English Language Learners**	**Special Education Learners**	**Struggling Learners**	**Advanced Learners**
	• Additional time • Vary essay lengths • Allow redos/retakes • Read aloud test • Clarify test directions • Preview test procedures • Give one on one test • Provide a buddy	• Additional time • Vary essay lengths • Allow redos/retakes • Read aloud test • Clarify test directions • Preview test procedures • Flexible grouping • Guide to appropriate area of notebook during test	• Additional time • Vary essay lengths • Allow redos/retakes • Read aloud test as needed • Clarify test directions • Preview test procedures • Flexible grouping	• Challenge activities (using a capacitor, maximum distance of solar car) • Create online graph of class data from solar car • Google classroom engineering games • Additional amusement park rides • Additional details on amusement park rides • Working with other accelerated learners

Differentiated Instructional Methods: *(Multiple means for students to access content and multiple modes for student to express understanding)*	**Access** (Resources and/or Process)		**Expression** (Products and/or Performance)	
	● Google classroom ● Hard copies		● Lab reports ● Model demonstrations	
Vocabulary *Highlight key vocabulary (both Tier II and Tier III words)*	**Tier 2** **K'nex terms:** gear- a disk, wheel, or section of a shaft, having cut teeth of such form, size, and spacing that they mesh with teeth in another part to transmit or receive force and motion. axle- the pin, bar (sticks), shaft, or the like, on which or by means of which a wheel or pair of wheels rotates. jack- a connecting device in an electrical circuit designed for the insertion of a plug. motor- a machine that converts electrical energy into mechanical energy generator-a machine converts one form of energy into another, especially mechanical energy into electrical energy capacitor- a device for accumulating and holding a charge of electricity (stores electricity) shaft-a rotating or oscillating straight bar for transmitting motion **Engineering terms:** Engineer: a person who uses technology and scientific knowledge to solve practice problems Design process: a series of steps that engineers follow to come up with a solution to a problem Redesign: to design again or to fix a problem or improve a design Aesthetics: pleasing in appearance (the art in engineering) Constraints: limit in the design process (ex. Appearance, funding, space, materials, time) EX. (You don't have enough space to build a real solar car) Criteria: specifications of a product (what you must have) EX. You must use gears and a solar panel Modify:change to ensure accuracy or success Model: a visual, mathematical, or 3D representation of the design, often smaller than the original. Often used for testing. **Scientific Method terms:** valid - an experiment that has followed the scientific method and can be used to make conclusions (invalid= cannot be used) Independent variable: a variable that is intentionally changed (changed on purpose) to observe its effect (valid			

	experiment has only 1) Dependent variable- the event studied and expected to change when the independent variable is changed. (it's what you write in your data chart or what you are measuring) *Quantitative Data*: Data in number form Constant variables- unchanging elements in an experiment to keep the experiment valid- Valid experiments have as many constants as possible trials- the act of trying, testing, or putting to the proof (3 trials are sufficient for classroom experiments) Increasing the trials, increasing the validity. Always calculate an average when applicable. Graphs X –axis- horizontally on a graph- independent variable Y –axis- vertically on a graph- dependent variable Question Hypothesis Procedure Data Conclusion **Tier 3** **Solar Vocabulary:** incandescent- the emission of visible light by a body, caused by its high temperature. *Needed to work solar panels*. fluorescent- a type of low voltage light in which an electrical gas discharge is maintained in a tube with a thin layer of phosphor on its inside surface. The gas, which is often mercury vapor, emits ultraviolet radiation. photons- the smallest unit of light or other electromagnetic energy from the sun, having no mass and no electric charge. silicon-. Photons hit these atoms of the solar cell, they transfer their energy to lose electrons P & N Type-, two different types of silicon n-type, which have spare electrons p-type, which is missing electrons, leaving 'holes' in their place. When placed side by side inside a solar cell, the n-type silicon spare electrons jump over to fill the gaps in the p-type silicon. This means that the n-type silicon becomes positively charged, and the p-type silicon is negatively charged, creating an electric field across the cell. photoelectric cell/ solar cell- an electric generating device that uses light (photo) energy to generate electricity. Passive vs active solar

<table>
<tr><td>Integration of Technology
SAMR</td><td colspan="2">Substitution:
Use Google Classroom to take and review notes
https://classroom.google.com/u/0/c/MjIyMzgwMDA4M1pa/t/MTI0NjUyNDQ5Njda
View youtube solar videos identifying pros and cons for discussion, questions, and essays on test
Augmentation
https://docs.google.com/presentation/d/1tRZKLpQ_IYSP4-GMqwhcBsIJlLssWZSb2lCo_yN4oos/edit#slide=id.p</td></tr>
<tr><td>Interdisciplinary Connections
NJ Student Learning Standards</td><td colspan="2">● CRP5 Consider the environmental, social, and economic impacts of decisions
● RI.7.7. Compare and contrast a text to an audio, video, or multimedia version of the text, analyzing each medium’s portrayal of the subject</td></tr>
<tr><td rowspan="2">21st Century Themes/Skills
P21 Framework</td><td>Themes</td><td>Skills</td></tr>
<tr><td>● Global Awareness
● Environmental Literacy</td><td>● Flexibility and adaptability
● Initiative and self direction
● Leadership and responsibility
● Creativity
● Collaboration
● Communication
● Critical Thinking
● Media Literacy</td></tr>
<tr><td>Resources/Materials</td><td colspan="2">● K’nex
● K’nex instructions
● Notebooks
● Chromebooks
● “Solar Energy” Article
● “How Solar Works” Article
● Crossword puzzle with “Solar Energy” article
● Solar panels with wires
● Light bulbs of various watts with caged lanterns</td></tr>
</table>

	• Motors • Capacitors

Instructional Unit Map					
Course Title: Sustainable Energy and Engineering Design					
Unit Title	Wind Energy			**Start Date:**	Second part of trimester
				Length of Unit:	20 days
Content Standards *What do we want them to know, understand, & do?*	• MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible	**Learning Goals**	*Students will be able to determine the pros and cons of wind energy* *Students will use engineering techniques to build wind powered devices (windmill that generates electricity to power a second device, sail car, wind power water lift)* *Students will work through the scientific method creating a valid experiment* *Students will determine constraints and criteria* *Students will determine constants and understand their importance* *Students will determine how wind turbine work*		

	solutions. ● MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. ● MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. ● MS-ETS1-4. Develop a model to generate data for iterative		

	testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. ● ETS1.A: Defining and Delimiting Engineering Problems The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. ● ETS1.B:		

	Developing Possible Solutions A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. ● ETS1.C: Optimizing the Design Solution Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design.		

<table>
<tr><td>Essential Questions</td><td colspan="3">How can solar improve the world we live in?
Who can benefit most from solar energy?
Is solar energy a good choice for our future why or why not?</td></tr>
<tr><td rowspan="2">Assessments
How will we know they have gained the knowledge & skills?</td><td>Formative</td><td>Summative</td><td>Alternative</td></tr>
<tr><td>● Notebooks
● Questioning
● Demonstration of working windmill, sail car, and wind powered water lift
● Guided notes on wind article
● Diagram of workings of wind turbine
● Solar crossword puzzle
● Word wall “vocabulary talk”</td><td>● Unit test
● Presentation of wind powered water lift</td><td></td></tr>
<tr><td>Unit Pre-Assessment(s)
What do they already know?</td><td colspan="3">● Teacher-generated warm up questions</td></tr>
<tr><td>Instructional Strategies/Student Activities</td><td colspan="3">● Watch video determining pro and cons of wind daily: take notes
● Build windmill, sail car, and wind powered water lift water lift
● Complete scientific method for windmill (Does the amount of blades affect the number of rotations of a second device and Does the speed of the fan affect the number of rotations of a second device))
● Complete scientific method of solar sail (Differmine own independent variable, etc…)
● Read and discuss the article, “Solar Energy”
● Complete guided notes based on article, “Wind Energy”</td></tr>
</table>

	● Complete crossword based on article, “Wind Energy” ● Discuss the workings of a wind turbine ● Create a diagram of wind turbine label with text boxes			
Instructional/Assessment Scaffolds *(Modifications /Accommodations) – planned for prior to instruction*	**English Language Learners**	**Special Education Learners**	**Struggling Learners**	**Advanced Learners**
	● Additional time ● Vary essay lengths ● Allow redos/retakes ● Read aloud test ● Clarify test directions ● Preview test procedures ● Give one on one test ● Provide a buddy	● Additional time ● Vary essay lengths ● Allow redos/retakes ● Read aloud test ● Clarify test directions ● Preview test procedures ● Flexible grouping ● Guide to appropriate area of notebook during test	● Additional time ● Vary essay lengths ● Allow redos/retakes ● Read aloud test as needed ● Clarify test directions ● Preview test procedures ● Flexible grouping	● Challenge activities (using a capacitor, to create maximum rotations of windmill and sail car maximum distance) ● Google classroom engineering games ● Additional K’nex chart challenge ● Working with other accelerated learners or assist “teach”

				struggling learners
Differentiated Instructional Methods: *(Multiple means for students to access content and multiple modes for student to express understanding)*	**Access** (Resources and/or Process)		**Expression** (Products and/or Performance)	
	● Google classroom ● Hard copies		● Lab reports ● Model demonstrations	
Vocabulary *Highlight key vocabulary (both Tier II and Tier III words)*	**Tier 2** **K'nex terms:** gear- a disk, wheel, or section of a shaft, having cut teeth of such form, size, and spacing that they mesh with teeth in another part to transmit or receive force and motion. axle- the pin, bar (sticks), shaft, or the like, on which or by means of which a wheel or pair of wheels rotates. jack- a connecting device in an electrical circuit designed for the insertion of a plug. motor- a machine that converts electrical energy into mechanical energy generator-a machine converts one form of energy into another, especially mechanical energy into electrical energy capacitor- a device for accumulating and holding a charge of electricity (stores electricity) shaft-a rotating or oscillating straight bar for transmitting motion **Engineering terms:** Engineer: a person who uses technology and scientific knowledge to solve practice problems Design process: a series of steps that engineers follow to come up with a solution to a problem Redesign: to design again or to fix a problem or improve a design Aesthetics: pleasing in appearance (the art in engineering) Constraints: limit in the design process (ex. Appearance, funding, space, materials, time) EX. (You don't have enough space to build a real solar car) Criteria: specifications of a product (what you must have) EX. You must use gears and a solar panel Modify:change to ensure accuracy or success Model: a visual, mathematical, or 3D representation of the design, often smaller than the original. Often used for testing. **Scientific Method terms:** valid - an experiment that has followed the scientific method and can be used to make conclusions (invalid= cannot			

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<table>
<tr><td></td><td>Can change the speed of the wind’s blades
Tower:
The base structure that supports and elevates a wind turbine rotor and nacelle.
Gets narrower as elevates.
Wind Vane:
Measures wind direction and communicates with the yaw drive to orient the turbine properly with respect to the wind.
Yaw:
Used to keep a turbine rotor facing into the wind as the wind direction changes. Term actually means turn.
Cables
Wires are bound together to form these and carry electricity to grid.
Foundation
Made of concrete and used to support the tower</td></tr>
<tr><td>Integration of Technology
SAMR</td><td>Substitution:
Use Google Classroom to take and review notes
https://classroom.google.com/u/0/c/MjIyMzgwMDA4M1pa/t/MTIyOTMzMTY2NjJa

View youtube wind videos identifying pros and cons for discussion, questions, and essays on test
Augmentation
https://docs.google.com/presentation/d/1KiYB3ZZsrUD89Dx1GoTS3_LyZkWavQXzc3CQYeZf0GY/edit#slide=id.g1369f1a9bd_1_0</td></tr>
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		• Creativity • Collaboration • Communication • Critical Thinking • Media Literacy
Resources/Materials	• K'nex • K'nex instructions • Notebooks • Chromebooks • "Wind Energy" Article • Crossword puzzle with "Wind Energy" article • Fans • Motors • Capacitors • Various materials for sail (aluminum foil, plastic wrap, fabric, tissue paper)	

Instructional Unit Map					
Course Title: Sustainable Energy and Engineering Design					
	Hydro Energy			**Start Date:**	Last part of trimester
				Length of Unit:	10 days
Content Standards *What do we want them to know, understand, & do?*	• MS-ETS1-1. Define the criteria and	**Learning Goals**	*Students will be able to determine the pros and cons of hydro energy* *Students will use engineering techniques to build hydro*		

	constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. ● MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. ● MS-ETS1-3. Analyze data from tests to determine similarities and		*devices (hydro generator)* *Students will work through the scientific method creating a valid experiment* *Students will determine constraints and criteria* *Students will determine constants and understand their importance* *Students will determine how hydro turbines work*

	differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success. ● MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. ● ETS1.A: Defining and Delimiting Engineering Problems The more precisely a design task's criteria and constraints can be		

	defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. ● ETS1.B: Developing Possible Solutions A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. ● ETS1.C: Optimizing the Design Solution Although one design may not perform the best across all		

	tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design.		
Essential Questions	*How can hydro power improve the world we live in?* *Who can benefit most from hydro energy?* *Is hydro energy a good choice for our future why or why not?*		
Assessments *How will we know they have gained the knowledge & skills?*	**Formative**	**Summative**	**Alternative**
	● Notebooks ● Questioning ● Demonstration of working hydro generator ● Guided notes on hydro article ● Diagram of hydro turbine ● Solar crossword puzzle ● Word wall “vocabulary	● Unit test ● Presentation	

	talk”		
Unit Pre-Assessment(s) *What do they already know?*	● Teacher-generated warm up questions		
Instructional Strategies/Student Activities	● Watch video determining pro and cons of hydro daily: take notes ● Build hydro generator ● Complete scientific method for hydro generator ● Complete scientific method of hydro generator : Design and type lab ● Read and discuss the article, “Hydro Energy” ● Complete guided notes based on article, “Hydro Energy” ● Complete crossword based on article, “Hydro Energy” ● Create a diagram of hydro turbine		

Instructional/Assessment Scaffolds *(Modifications /Accommodations) – planned for prior to instruction*	**English Language Learners**	**Special Education Learners**	**Struggling Learners**	**Advanced Learners**
	● Additional time ● Vary essay lengths ● Allow redos/retakes ● Read aloud test ● Clarify test directions ● Preview test procedures ● Give one on one test ● Provide a buddy	● Additional time ● Vary essay lengths ● Allow redos/retakes ● Read aloud test ● Clarify test directions ● Preview test procedures ● Flexible grouping	● Additional time ● Vary essay lengths ● Allow redos/retakes ● Read aloud test as needed ● Clarify test directions ● Preview test procedures ● Flexible grouping	● Challenge activities (Challenge chart) ● Google classroom engineering games ● Working with other accelerated learners

		• Guide to appropriate area of notebook during test		• "Teaching" others
Differentiated Instructional Methods: *(Multiple means for students to access content and multiple modes for student to express understanding)*	**Access** (Resources and/or Process)		**Expression** (Products and/or Performance)	
	• Google classroom • Hard copies		• Lab reports • Model demonstrations	
Vocabulary *Highlight key vocabulary (both Tier II and Tier III words)*	**Tier 2** **K'nex terms:** gear- a disk, wheel, or section of a shaft, having cut teeth of such form, size, and spacing that they mesh with teeth in another part to transmit or receive force and motion. axle- the pin, bar (sticks), shaft, or the like, on which or by means of which a wheel or pair of wheels rotates. jack- a connecting device in an electrical circuit designed for the insertion of a plug. motor- a machine that converts electrical energy into mechanical energy generator-a machine converts one form of energy into another, especially mechanical energy into electrical energy capacitor- a device for accumulating and holding a charge of electricity (stores electricity) shaft-a rotating or oscillating straight bar for transmitting motion **Engineering terms:** Engineer: a person who uses technology and scientific knowledge to solve practice problems Design process: series of steps that engineers follow to come up with a solution to a problem Redesign: to design again or to fix a problem or improve a design Aesthetics: pleasing in appearance (the art in engineering) Constraints: limit in the design process (ex. Appearance, funding, space, materials, time) EX. (You don't have enough space to build a real solar car) Criteria: specifications of a product (what you must have) EX. You must use gears and a solar panel Modify:change to ensure accuracy or success Model: a visual, mathematical, or 3D representation of the design, often smaller than the original. Often used for testing. **Scientific Method terms:**		

	valid - an experiment that has followed the scientific method and can be used to make conclusions (invalid= cannot be used) Independent variable- a variable that is intentionally changed (changed on purpose) to observe its effect (valid experiment has only 1) Dependent variable- the event studied and expected to change when the independent variable is changed. (it's what you write in your data chart or what you are measuring) *Quantitative Data*: Data in number form Constant variables- unchanging elements in an experiment to keep the experiment valid- Valid experiments have as many constants as possible trials- the act of trying, testing, or putting to the proof (3 trials are sufficient for classroom experiments) Increasing the trials, increasing the validity. Always calculate an average when applicable. Graphs X –axis- horizontally on a graph- independent variable Y –axis- vertically on a graph- dependent variable Question Hypothesis Procedure Data Conclusion **Tier 3** **Hydro Terms** HYDROPOWER: the process of generating electricity by capturing the potential energy of falling water through the use of a water wheel (turbine) to mechanically spin rotating magnets which create electrical current POWERHOUSE: the physical structure of an electric generating facticity LOAD: the total amount of electricity required to meet customer demands DAM: a barrier constructed to store or divert water for different purposes, including electricity productions. Typically made of earth, rock, or concrete INTAKE: the entrance or gate to a turbine at dam RUNNER: the rotating part of the turbine that converts the energy of falling water into mechanical energy. PENSTOCK: a closed conduit or pipe for conducting water to the powerhouse FISH LADDER: a series of pools arranged like steps that allow fish to pass upstream over a dam FLOW: volume of water passing a point in a given amount of time (expressed in cubic feet or cubic meters per second) TAILRACE: the downstream *channel* that carries water away from a dam or powerhouse

	HEAD: the vertical change in elevation between the reservoir level (head water) and downstream river (tailwater) LOW HEAD: 66 feet or less SPILL: release of water from dam or hydropower without passing it through the powerhouse: Lost power! Reservoir: storage space for water
Integration of Technology SAMR	Substitution: Use Google Classroom to take and review notes https://classroom.google.com/u/0/c/MjIyMzgwMDA4M1pa/t/MTI0NjU0MDczNjRa Augmentation: View youtube hydro videos identifying pros and cons for discussion, questions, and essays on test https://docs.google.com/presentation/d/1sXna1xdaEGVmnwxHaOg1K2x0pYSQxBnOqM7oddkgMFI/edit#slide=id.p
Interdisciplinary Connections NJ Student Learning Standards	• CRP5 Consider the environmental, social, and economic impacts of decisions • RI.7.7. Compare and contrast a text to an audio, video, or multimedia version of the text, analyzing each medium's portrayal of the subject
21st Century Themes/Skills P21 Framework	**Themes** • Global Awareness • Environmental Literacy **Skills** • Flexibility and adaptability • Initiative and self direction • Leadership and responsibility • Creativity • Collaboration • Communication • Critical Thinking

		• Media Literacy
Resources/Materials	• K'nex • K'nex instructions • Notebooks • Chromebooks • "Hydro Energy" Article • Crossword puzzle with "Hydro Energy" article • water • Motors • Capacitors	

Instructional Unit Map					
Course Title: Sustainable Energy and Engineering Design					
	Marble Mover			**Start Date:**	Last part of trimester
				Length of Unit:	10 days
Content Standards *What do we want them to know, understand, & do?*	• MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to	**Learning Goals**	• Students will build various a machines • Students will understand how these machines help people throughout the word?		

	ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions. ● MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem. ● MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best		

	characteristics of each that can be combined into a new solution to better meet the criteria for success. ● MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved. ● ETS1.A: Defining and Delimiting Engineering Problems The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful.		

	Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. ● ETS1.B: Developing Possible Solutions A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. ● ETS1.C: Optimizing the Design Solution Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the		

	best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design.		

Essential Questions	*How can simple machines improve the world we live in?* *Who can benefit most from simple machines?*		
Assessments *How will we know they have gained the knowledge & skills?*	**Formative**	**Summative**	**Alternative**
	• Notebooks • Questioning • Word wall "vocabulary talk" • diagrams	• Unit test • Presentation • Final experiment	
Unit Pre-Assessment(s) *What do they already know?*	• Teacher-generated warm up questions		
Instructional Strategies/Student Activities	• Draw a diagram of each labeling all parts • Create an experiment		

<table>
<tr><td rowspan="2">Instructional/Assessment Scaffolds (Modifications /Accommodations) – planned for prior to instruction</td><td>English Language Learners</td><td>Special Education Learners</td><td>Struggling Learners</td><td>Advanced Learners</td></tr>
<tr><td>● Additional time
● Vary essay lengths
● Allow redos/retakes
● Read aloud test
● Clarify test directions
● Preview test procedures
● Give one on one test
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● Clarify test directions
● Preview test procedures
● Flexible grouping
● Guide to appropriate area of notebook during test</td><td>● Additional time
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● Preview test procedures
● Flexible grouping</td><td>● Challenge activities ()
● Google classroom engineering games
● Working with other accelerated learners</td></tr>
<tr><td rowspan="2">Differentiated Instructional Methods:
(Multiple means for students to access content and multiple modes for student to express understanding)</td><td colspan="2">Access (Resources and/or Process)</td><td colspan="2">Expression (Products and/or Performance)</td></tr>
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Resources/Materials	• K'nex • K'nex task cards and instructions • Notebooks • Chromebooks	