The Power of Solar STEM Unit

Content Area: **STEM**
Course(s): **Generic Course, TAG Language Arts 4**
Time Period: **1 marking period**
Length: **Length of unit**
Status: **Published**

Unit Overview

The Power of Solar engages young learners in hands-on inquiry and design as they explore one of the greatest challenges of the twenty-first century—making solar energy economical. This fourth grade Building Block in the TEEMS Integrative Curriculum for Elementary STEM integrates concepts of science, technology, engineering, and mathematics through the environmental context of sustainable sources of energy. Science and mathematics concepts that are reinforced include the solar system, energy transfer, temperature, electricity, decimals, perimeter, area, angles, points, lines, rays, and symmetry. By utilizing an experiential approach, students collaboratively investigate solar energy as a global issue and learn that stewardship and innovation can make a difference in solving the world's problems. Following guided inquiry activities, a design challenge provides an opportunity for students to apply knowledge and skills in a meaningful way as they build and test models of solar power for structures. A Grand Challenge for Engineering, identified by the National Academy of Engineering—Make Solar Energy Economical—serves as a real-world inspiration for students to connect their learning with the present and the future.

Transfer

1. Technology is created, used and modified by humans.
2. Engineering design is a creative process, which may result in new inventions and innovations.
3. A technological world requires that humans develop capabilities to solve technological challenges and improve products for the way we live.
4. Science uses different types of investigations to answer questions about the natural world.
5. Energy can transfer from an object or system of objects to another and can change forms.
6. The earth system is part of a larger system.
7. Science and technology are interrelated, in which science is concerned with the natural world and technology with the human-made world.
8. Science and technology are human endeavors that have benefits and consequences.
9. Information to gain or expand knowledge can be acquired through a variety of sources.
10. Writing is a process that conveys and documents ideas, thoughts, and opinions.
11. Effective speaking and listening are essential for productive communication.

Meaning

Understandings

Students will understand that...

-the difference between scientists and engineers.

-the steps of the scientific method and the engineering design process.

-identify basic forms of energy

-differentiate between renewable and nonrenewable energy.

-recognize how a system works

-identify the sun as the energy source of light and heat on earth

-illustrate a complete direct current series circuit

-explain that energy can transfer from one object to another and change forms

Essential Questions

Students will keep considering...

-What thought provoking questions will foster inquiry, meaning making and transfer?

-What is an engineer?

-What can energy do?

-Where does energy come from?

-How does a ight switch work?

-How do you transfer energy?

Application of Knowledge and Skill

Students will know...

Students will know...

What facts and basic concepts should students know and be able to recall?

-energy costs money

-energy consumption varies

-what solar energy is

-what the greenhouse effect is

-how to build a series circuit

-thermal energy is a physical property of matter

Students will be skilled at...

Students will be skilled at...

What discrete skills and processes should students be able to use?

-following the scientific method and engineering design process

-Working collaboratively

-oral presenations

-defend a position

-annotate a text

-write a persuasive letter

-use tools to complete tasks

-think outside the box

Academic Vocabulary

absorb

biomass

chemical energy

circuit

consumption

current

decimal

electricity

energy

energy source

fossil fuels

greenhouse effect

input

insulate

LED

mechanical energy

nonrenewable

output

process

quad

radiant energy

renewable

solar

solar cell

solar panel

system

Learning Goal 1

Design a solution to an engineering problem and conduct a scientific investigation.

SCI.3-5.3-5-ETS1-1	Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
SCI.3-5.3-5-ETS1-2	Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
SCI.3-5.3-5-ETS1-3	Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
3-5-ETS1-3.ETS1.B.1	Tests are often designed to identify failure points or difficulties, which suggest the elements of the design that need to be improved.
3-5-ETS1-2.ETS1.B.2	At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.
3-5-ETS1-3.ETS1.C.1	Different solutions need to be tested in order to determine which of them best solves the problem, given the criteria and the constraints.

Target 1

Students identify and describe relationships between engineering and science.

Target 2

Students compare and contrast science, as a way of answering questions and explaining the natural world, and engineering, as a way of inventing tools and techniques to solve human problems.

Target 3

Students design, conduct, and/or describe the steps of an engineering challenge or experiement to test one variable.

Target 4

Students analyze data to form and defend a conclusion.

Learning Goal 2

Design a system that transfers energy from one object to another.

LA.RI.4.10	By the end of year, read and comprehend literary nonfiction at grade level text-complexity or above, with scaffolding as needed.
MA.4.NF.C.6	Use decimal notation for fractions with denominators 10 or 100.
MA.4.MD.A.3	Apply the area and perimeter formulas for rectangles in real world and mathematical problems.
MA.4.G.A.1	Draw points, lines, line segments, rays, angles (right, acute, obtuse), and perpendicular and parallel lines. Identify these in two-dimensional figures.
MA.4.G.A.3	Recognize a line of symmetry for a two-dimensional figure as a line across the figure such that the figure can be folded along the line into matching parts. Identify line-symmetric figures and draw lines of symmetry.
LA.W.4.10	Write routinely over extended time frames (time for research, reflection, metacognition/self-correction and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.
SCI.4-ESS3-1	Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.
SCI.4-PS3-4	Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
SCI.4-PS3-2	Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
4-PS3-2.5.1	Energy can be transferred in various ways and between objects.
4-PS3-2.PS3.A.1	Energy can be moved from place to place by moving objects or through sound, light, or electric currents.
4-PS3-2.PS3.B.3	Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy.

Target 1

Students investigate reverse-engineering of a solar calculator.

Target 2

Students compare and contrast the design challenge scenario, Off the Grid, to the real-world Grand Challenge of Engineering #1, Making Solar Engery Economical.

Target 3

Students describe solar energy and its use by humans.

Target 4

Students conduct research on the energy consumption.

Target 5

Students investigate the movement of wind and systems through the construction of a wind turbine.

Target 6

Students investigate properties of materials in regards to absorbtion or reflection of thermal energy.

Target 7

Students construct a model of a greenhouse as they explore energy transfer.

Target 8

Students construct electrical circuits with battery power.

Target 9

Students construct electrical circuits using solar cells as power.

Target 10

Students write a persuasive letter to show understanding of the importance energy resources and the role of technology in harnessing it.

Target 11

Students annotate text during a close read about inventor Lonnie Johnson and his Johnson Thermoelectric Energy Conversion System (JTEC).

Target 12

Students interpret real data about the consumption and production of various sources of energy.

Target 13

Students design model mini ice cooler.

Target 14

Students create solutions to the Off the Grid design challenge in order to heat and illuminate a model of a structure with solar energy.

Summative Assessment

Off the Grid Design Challenge

Unit Test

21st Century Life and Careers

Select all applicable standards from the applicable standards

CRP.K-12.CRP2	Apply appropriate academic and technical skills.
CRP.K-12.CRP4	Communicate clearly and effectively and with reason.
CRP.K-12.CRP6	Demonstrate creativity and innovation.
CRP.K-12.CRP8	Utilize critical thinking to make sense of problems and persevere in solving them.
CRP.K-12.CRP11	Use technology to enhance productivity.
CRP.K-12.CRP12	Work productively in teams while using cultural global competence.

Formative Assessment and Performance Opportunities

Think-Pair-Share

3-2-1 Reflection

Exit Ticket

Teacher Observation

STEM notebook

Quick-writes

graphic organizers

oral presentation

class participation

Differentiation/Enrichment

As this is a TAG class, rigor is already increased. Students have the opportunity to participate in:

invention convention

STEM night

self-directed research

WordMasters Compeition

Poetry, art, and writing compeitions

Unit Resources