Course: Renewable Energies
Grade Level: 10- 12
LG 1 Thermodynamics

High Priority Standards

NEXT GENERATION NATIONAL SCIENCE STANDARDS

HS-PS3-1

Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

HS-PS3-3.

Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy

HS-PS3-4.

Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

Learning Goal	**Proficiency Scale**
. Students will be able to apply the Laws of Thermodynamics to building materials.	Level 4: Student demonstrates an in-depth inference or advanced application or innovates with the learning goal. Level 3: Student demonstrates mastery with the learning goal as evidenced by: • Using geographical positioning of structures to make the most of a structure's south facing wall. • Explaining the factors that affect energy efficiency in homes. • Using different materials to affect a home's energy performance. • Applying knowledge of energy use and efficiency to real life situations. • Comparing different building materials and techniques to achieve the most efficient structure.

	Level 2: Student demonstrates he/she is nearing proficiency by:
	• Recognizing and recalling specific vocabulary, such as: energy, energy star, solar mass, energy efficiency, climate, passive solar, r-value, energy transference, shading u-value, BTU, solar gain
	• Performing processes such as:
	  ○ Identifying geographical positions that affect a home's energy use.
	  ○ Identify the factors that affect energy efficiency in homes.
	  ○ Describe the relationship between energy use and real life situations.
	  ○ Compare different building materials and techniques.
	
	Level 1: Student demonstrates a limited understanding or skill with the learning goal.

Learning Targets

Students know how to:

- Use geographical positioning of structures to make the most of a structure's south facing wall.
- Identify the factors that affect energy efficiency in homes.
- Use different materials to affect a home's energy performance.
- Apply knowledge of energy use and efficiency to real life situations.
- Compare different building materials and techniques to achieve the most efficient structure.

Course: Renewable Energies
Grade Level: 10-12
LG 2 Carbon Footprint

<table>
<tr><th colspan="2">High Priority Standards</th></tr>
<tr><td colspan="2">NEXT GENERATION NATIONAL SCIENCE STANDARDS

HS-ESS3-4
Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*</td></tr>
<tr><th>Learning Goal</th><th>Proficiency Scale</th></tr>
<tr><td>Students will understand how to recognize and reduce the carbon footprint of manmade structures.</td><td>Level 4: Student demonstrates an in-depth inference or advanced application or innovates with the learning goal.

Level 3: Student demonstrates mastery with the learning goal as evidenced by:
• Monitoring a simulated home’s energy use with mathematical models.
• Defining and describing the forms of energy that are used in a home using scientific data.
• Explaining the most efficient uses of the energy purchased for a home or structure.

Level 2: Student demonstrates he/she is nearing proficiency by:
• Recognizing and recalling specific vocabulary, such as: energy, energy star, BTU, energy conservation, KWh, carbon footprint, fuel, climate, heating/cooling, degree day
• Performing processes such as:
o Identifying a simulated home’s energy use.
o Describing the forms of energy that are used in a home.</td></tr>
</table>

	Level 1: Student demonstrates a limited understanding or skill with the learning goal.
Learning Targets Students know how to: • Monitor home energy use • Define and describe the forms of energy that are used in homes • Get the most efficient use of the energy purchased for the home or structure.	

Course: Renewable Energies
Grade Level: 10-12
LG 3 Energy Choices

<table>
<tr><th colspan="2">High Priority Standards</th></tr>
<tr><td colspan="2">NEXT GENERATION NATIONAL SCIENCE STANDARDS
HS-ESS3-1.
Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity
HS-ESS3-6
Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity.</td></tr>
<tr><th>Learning Goal</th><th>Proficiency Scale</th></tr>
<tr><td>Students will be able to make choices about energy use and global climate change supported by scientific data.</td><td>Level 4: Student demonstrates an in-depth inference or advanced application or innovates with the learning goal.

Level 3: Student demonstrates mastery with the learning goal as evidenced by:
Describing and analyzing similarities and differences of energy forms using scientific data.
Explaining contribution to global climate change based on differing energy forms using scientific data.
Defining the influences that energy, science and technology have on our lives.
Level 2: Student demonstrates he/she is nearing proficiency by:
Recognizing and recalling specific vocabulary, such as: peak oil, entropy, ohms, climate change, greenhouse effect, kinetic energy, fossil fuels, amps, potential energy, laws of thermodynamics, volts.</td></tr>
</table>

	• Performing processes such as:
	  ○ Identifying different energy forms.
	  ○ Describing global climate changes based on the relationship between energy use and human activity.
	  ○ Identifying the key issues that are at the forefront of energy use.
	
	Level 1: Student demonstrates a limited understanding or skill with the learning goal.

Learning Targets

Students know how to:

- Describe similarities and differences of energy forms.
- Know their contribution to global climate change.
- Define the influences that energy, science and technology have on our lives.
- Identify the key issues that are at the forefront of energy use.

Course: Renewable Energies
Grade Level:10-12
LG 4 Solar Energy

High Priority Standards

NEXT GENERATION NATIONAL SCIENCE STANDARDS
HS-PS3-3.
Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy

The National Association of State Directors of Career Technical Education Consortium (NASDCTEc)
GREEN/SUSTAINABILITY STANDARDS ARCHITECTURE & CONSTRUCTION CAREER CLUSTER

6. Understand options to reduce energy loads and use green energy sources for building applications

Learning Goal	**Proficiency Scale**
Students will understand how to convert the Sun's energy into electricity.	Level 4: Student demonstrates an in-depth inference or advanced application or innovates with the learning goal. Level 3: Student demonstrates mastery with the learning goal as evidenced by: • Explaining different types of solar energy capture. • Measuring solar energy capture. • Capturing the energy from the sun, store it, and convert it to power for use in items such as electric cars or solar lighting. Level 2: Student demonstrates he/she is nearing proficiency by: ● Recognizing and recalling specific vocabulary, such as: Entropy, parabolic trough, Solar spectrum, Solar thermal, BTU, Active solar, Solar cell, Photon, Solar gain, Photovoltaic, Multimeter, Inverter

	• Performing processes such as:
	  o Identifying ways to capture energy from the sun.
	  o Identifying the factors that enhance or hinder the success in gathering the sun's energy
	
	Level 1: Student demonstrates a limited understanding or skill with the learning goal.

Learning Targets

Students know how to:

- Define different types of solar energy capture
- Capture the energy from the sun, store it, and convert it to power an electrically driven item (vehicle)
- Identify the factors that enhance or hinder the success in gathering the sun's energy
- Use appropriate tools to measure solar energy capture.

Course: Renewable Energies
Grade Level: 10-12
LG 5 Wind Energy

High Priority Standards

NEXT GENERATION NATIONAL SCIENCE STANDARDS

HS-ESS3-4.	Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*

Learning Goal	Proficiency Scale
. Students will understand how to capture the energy from the wind for electricity.	Level 4: Student demonstrates an in-depth inference or advanced application or innovates with the learning goal. Level 3: Student demonstrates mastery with the learning goal as evidenced by: • Applying the knowledge of calculating "Swept area" to a wind turbine blade design. • Building and testing the efficiency of wind turbine blades. • Harnessing, storing, and converting the energy created by a wind turbine to power an electrical item. • Measuring the energy collected by a wind turbine. Level 2: Student demonstrates he/she is nearing proficiency by: • Recognizing and recalling specific vocabulary, such as: wind turbine, Nacelle,

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<td></td>
<td>Yaw, blade, generator, aerodynamic lift, swept area, pitch, anemometer
• Performing processes such as:
o Identifying how wind energy can be harnessed, stored, and converted.
o Identifying areas that would be best to build a wind turbine.

Level 1: Student demonstrates a limited understanding or skill with the learning goal.</td>
</tr>
<tr>
<td colspan="2">Learning Targets

Students know how to:
● Apply the knowledge of calculating “Swept area” to a wind turbine blade design.
● Build and test the efficiency of wind turbine blades.
● Identify areas that would be best to build a wind turbine.
● Harness, store, and convert the energy created by a wind turbine to power an electrical item.
● Measure the energy collected by a wind turbine.</td>
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</table>

Course: Renewable Energies
Grade Level: 10-12
LG 6 Hydropower

<table>
<tr><td colspan="2">High Priority Standards

NEXT GENERATION NATIONAL SCIENCE STANDARDS
HS-ESS3-3. Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.*</td></tr>
<tr><td>Learning Goal

Students will be able to apply knowledge of water energy capture to real life situations.</td><td>Proficiency Scale

Level 4: Student demonstrates an in-depth inference or advanced application or innovates with the learning goal.

Level 3: Student demonstrates mastery with the learning goal as evidenced by:
• Using the energy from flowing water to make, store, and use electricity.
• Applying knowledge of water energy capture to real life situations.
• Calculate energy collected from moving water.

Level 2: Student demonstrates he/she is nearing proficiency by:
● Recognizing and recalling specific vocabulary, such as: Head, OTEC, barrage, flow, tidal energy, sluice, hydropower, wave energy, reservoir, topographic map, potential energy, germanium diode, solder.
• Performing processes such as:
o Defining and describing different types of water energy capture.
o Choosing the most appropriate method for collecting energy from</td></tr>
</table>

	moving water. Level 1: Student demonstrates a limited understanding or skill with the learning goal.
Learning Targets Students know how to: ● The student knows how to: ● Define and describe different types of water energy capture ● Apply knowledge of water energy capture to real life situations ● Choose the most appropriate method for collecting energy from moving water. ● Calculate energy collected from moving water	

Course: Renewable Energies
Grade Level:10-12
LG 7 Fuel Cells

<table>
<tr><td colspan="2">High Priority Standards

NEXT GENERATION NATIONAL SCIENCE STANDARDS
HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.*

HS-PS4-5. Communicate technical information about how some technological devices use</td></tr>
<tr><td>Learning Goal

Students will be able to build and use fuel cells.</td><td>Proficiency Scale

Level 4: Student demonstrates an in-depth inference or advanced application or innovates with the learning goal.

Level 3: Student demonstrates mastery with the learning goal as evidenced by:
• Defining different types of fuel cells by how they work and the fuels that they use.
• Building and using fuels cells in simulated real life situations.
• Comparing different building materials and techniques to achieve the most efficient outcome.
• Choosing the most beneficial fuel cells to use for stationary or transportation applications.

Level 2: Student demonstrates he/she is nearing proficiency by:
• Recognizing and recalling specific vocabulary, such as: P.E.M. fuel cell, reformation, electrolysis, electrolyte, electrolyzer, hydrogen, energy carrier</td></tr>
</table>

	• Performing processes such as:
	  ○ Identifying different types of fuel cells.
	  ○ Comparing and contrasting building materials and techniques.
	
	Level 1: Student demonstrates a limited understanding or skill with the learning goal.

Learning Targets

Students know how to:

- Define different types of fuel cells by how they work and the fuels that they use.
- Build and use fuels cells in simulated real life situations.
- Compare different building materials and techniques to achieve the most efficient outcome.
- Choose the most beneficial fuel cells to use for stationary or transportation applications.