NATIONAL GUARD
MOBILE LEARNING CENTER

| Grade 11 | **SOLAR ENERGY** | Science |
|---|---|---|
| Concept: Endothermic & Exothermic Heat | | Level: I/II |
| | *Transfer of Energy & Heat Storage* | |

Connections to the Mobile Learning Center Energy Lab:
- The Fire Experience focuses on capturing solar energy via solar panels, solar arrays and solar farms

General Goal(s) of the Lesson:
Students should be able to…
- Understand that energy can move from one place to another by means of radiation, conduction or convection

Lesson Objectives:
- Understand that radiation is any light source that can transfer energy
- Know that when items touch each other, energy is transferred from warmer object to the cooler one
- In fluids, warmer parts tend to rise (convection properties)

***(Based on Massachusetts State Standard 6.4 for Chemistry, Science)***

Assessment Based on Objectives:
- Give an example of each type of energy transfer and be able to identify each one

| Learning Adaptations: | Learning Extensions: |
|---|---|
| - Provide a demonstration of each type of energy transfer | - Identify examples of radiation, conduction and convection in everyday life |

Resources:

***Basic Physics: A Self-Teaching Guide*** by Karl Kuhn (ISBN: 0471134473)
***Advances in Energy Transfers Processes*** by Baldassase Di Bartolo (ISBN: 9810247281)
***The Evaluation of Converters for Exothermic and Endothermic Catalytic Reactions*** by Gustav Wirth (ASIN: B003HKQZIQ)
***Solid Propellent and Exothermic Compositions*** by James Taylor (ASIN: B0000CK7OF)
***Exothermic: Webster's Timeline History, 1902-2007*** by Icon Group International

NATIONAL GUARD
MOBILE LEARNING CENTER

| | | |
|---|---|---|
| Grade 11 | **SOLAR ENERGY** | Science |
| Concept: Endothermic & Exothermic Heat | | Level: III |
| | *Identifying Endo- and Exothermic Reactions* | |

Connections to the Mobile Learning Center Energy Lab:
- The Fire Experience focuses on capturing solar energy via solar panels, solar arrays and solar farms

General Goal(s) of the Lesson:
Students should be able to…
- Understand that some chemical reactions absorb energy while others give off, or release, energy

Lesson Objectives:
- Identify an exothermic reaction and provide an example of one
- Identify an endothermic reaction and provide an example of one

***(Based on Massachusetts State Standard 6.4 for Chemistry, Science)***

Assessment Based on Objectives:
- Given a specific example of energy transfer, identify which is endothermic and exothermic. Explain your reasoning.

Learning Extensions:
- Ask for an example of endothermic and exothermic reactions in everyday life.
- Ask if heat transfer can be quantified (and how to do it)

Resources:

***Basic Physics: A Self-Teaching Guide*** by Karl Kuhn (ISBN: 0471134473)
***Advances in Energy Transfers Processes*** by Baldassase Di Bartolo (ISBN: 9810247281)
***The Evaluation of Converters for Exothermic and Endothermic Catalytic Reactions*** by Gustav Wirth (ASIN: B003HKQZIQ)
***Solid Propellent and Exothermic Compositions*** by James Taylor (ASIN: B0000CK7OF)
***Exothermic: Webster's Timeline History, 1902-2007*** by Icon Group International

NATIONAL GUARD
MOBILE LEARNING CENTER

| Grade 11 | **EARTH ENERGY** | Science |
|---|---|---|
| Concept: Renewable & Non-Renewable Energy | | Level: I/II |
| | *Discussing Non-Renewable Energies* | |

Connections to the Mobile Learning Center Energy Lab:
- The Earth Experience focuses on balancing worldwide fossil fuel demands vs. energy output

General Goal(s) of the Lesson:
Students should be able to…
- Identify non-renewable energy sources from all sources of energy

Lesson Objectives:
- Be able to define and distinguish non-renewable energy sources

***(Based on Massachusetts State Standard 1.1 & 2.1 for Earth Science)***

Assessment Based on Objectives:
- Students should provide examples of non-renewable energy sources used today as well as in the past

Learning Extensions:
- Students should understand that the term "renewable" can be tricky for some. Wind continues to blow, coal is burned up, but what about wood? Trees will re-grow but it takes time. It is non-renewable if it is used faster than it can re-grow, based on human life spans. Discuss the implications.

Resources:

***Exploring Energy Non Renewable Resources YouTube Teaching Video***
http://videos.howstuffworks.com/hsw/19078-exploring-energy-nonrenewable-resources-video.htm

**Online Non-Renewable Energies Identification Quiz**
http://www.neok12.com/quiz/ENESRC01

***Non-Renewable Energy Research Projects Teaching Booklet***
http://www1.eere.energy.gov/biomass/pdfs/highschool_projects.pdf

***Modern Marvels: Renewable Energy Amazon DVD***
http://www.amazon.com/dp/B0019KAQB8?tag=lowepric20&camp=211493&creative=379993&linkCode=op1&creativeASIN=B0019KAQB8&adid=1B1HB5VCFMXN4V6DCKWF&

NATIONAL GUARD
MOBILE LEARNING CENTER

| | | |
|---|---|---|
| Grade 11 | **SOLAR, WIND & WATER ENERGY** | Science |
| Concept: Renewable & Non-Renewable Energy | | Level: III |
| | *Exploring Renewable Energy Resources* | |

Connections to the Mobile Learning Center Energy Lab:

- The Fire Experience focuses on capturing solar energy via solar panels, solar arrays and solar farms
- The Wind Experience focuses on the different variables that affect wind turbine performance
- The Water Experience focuses on harnessing energy through wave production in open water

General Goal(s) of the Lesson:
Students should be able to…

- Identify renewable energy resources from all sources of energy

Lesson Objectives:

- Be able to define and distinguish renewable energy sources and explain why they are renewable

***(Based on Massachusetts State Standard 1.1 & 2.1 for Earth Science)***

Assessment Based on Objectives:

- Students provide examples of renewable energy resources

KEY POINT: All energy is used (from the sun or geothermal energy) but from the human perspective, energy is indefinite

Learning Extensions:

- Energy sources are only renewable if they can be regenerated before they are used up. Give examples of when renewable energy becomes non-renewable.

Resources:

***Renewable Energy Made Easy: Free Energy from Solar, Wind, Hydropower and Other Alternative Energy Sources*** by David Craddock (ISBN: 978-1-60138-240-5)

***Winning Our Energy Independence: An Energy Insider Shows How***
by S. David Freeman (ISBN: 1423601564)

***Renewable Energy Technologies: A Review of the Status and Costs of Selected Technologies***
by Kulsum Ahmed (ISBN: 9780821327449)

***Kicking the Carbon Habit: Global Warming and the Case for Renewable and Nuclear Energy***
by William Sweet (ISBN: 9780231137119)

NATIONAL GUARD
MOBILE LEARNING CENTER

| | | |
|---|---|---|
| Grade 11 | **EARTH, WIND, SOLAR & WATER ENERGY** | Science |
| Concept: Energy Transfer: Potential to Kinetic | | Level: I/II |
| | *What is Potential Energy? What is Kinetic Energy?* | |

Connections to the Mobile Learning Center Energy Lab:

- The Earth Experience focuses on balancing worldwide fossil fuel demands vs. energy output
- The Wind Experience focuses on the different variables that affect wind turbine performance
- The Fire Experience focuses on capturing solar energy via solar panels, solar arrays and solar farms
- The Water Experience focuses on harnessing energy through wave production in open water

General Goal(s) of the Lesson:
Students should be able to…

- Distinguish between potential and kinetic energy

Lesson Objectives:

- The student should be able to explain how kinetic energy can be converted into potential energy and vice versa

***(Based on Massachusetts State Standard 2.2 for Physics, Science)***

Assessment Based on Objectives:

- Students should explain the energy transfer steps involved in different scenarios (ex. converting wind energy into raising water to a higher land reservoir)

Learning Extensions:

- Examine other types of transfer: kinetic to batteries, fly wheels, capacitors, etc.

Resources:

***Kinetic and Potential Energy: Understanding Changing Within Physic Systems***
by Jennifer Binding (ISBN: 1404203338)
***No Regret Potentials in Energy Conservation*** by Katrin Ostertag (ISBN: 379081539X)

NATIONAL GUARD
MOBILE LEARNING CENTER

| | | |
|---|---|---|
| Grade 11 | **EARTH, WIND, SOLAR & WATER ENERGY** | Science |
| Concept: Energy Transfer: Potential to Kinetic | | Level: III |
| | *Discussing Work and Power* | |

Connections to the Mobile Learning Center Energy Lab:

- The Earth Experience focuses on balancing worldwide fossil fuel demands vs. energy output
- The Wind Experience focuses on the different variables that affect wind turbine performance
- The Fire Experience focuses on capturing solar energy via solar panels, solar arrays and solar farms
- The Water Experience focuses on harnessing energy through wave production in open water

General Goal(s) of the Lesson:

Students should be able to…

- Understand that energy (joules) per unit time is power (watts)
- Understand that work is power over time (in seconds)

Lesson Objectives:

- Students should know energy is measured in joules (using SI units) and that power is measured in watts, which is joules/seconds

***(Based on Massachusetts State Standard 2.3 & 2.4 for Physics, Science)***

Assessment Based on Objectives:

- Students can manipulate units in a problem to solve for work, power or energy

Learning Extensions:

- Consider line loss due to power transmission

Resources:

***Kinetic and Potential Energy: Understanding Changing Within Physic Systems***
by Jennifer Binding (ISBN: 1404203338)
***No Regret Potentials in Energy Conservation*** by Katrin Ostertag (ISBN: 379081539X)

NATIONAL GUARD
MOBILE LEARNING CENTER

| Grade 11 | **EARTH, WATER & WIND ENERGY** | Science |
|---|---|---|
| Concept: Recognizing C, H, O, N, S & P | | Level: I/II |
| | *Molecules Found in the Oceans, Earth and Air* | |

Connections to the Mobile Learning Center Energy Lab:

- The Earth Experience focuses on balancing worldwide fossil fuel demands vs. energy output
- The Water Experience focuses on harnessing energy through wave production in open water
- The Wind Experience focuses on the different variables that affect wind turbine performance

General Goal(s) of the Lesson:
Students should be able to…

- Recognize the main element and chemical compounds found in the oceans, earth and air that are associated with the transfer of energy

Lesson Objectives:

- Students will recognize that all fossil fuels are hydrocarbons that can release energy when burned
- Students will recognize that fossil fuels are easily transported, which is the reason they are used so much
- Students will recognize that fossil fuels have a high energy to mass ratio, which is the reason they are used so much

***(Based on Massachusetts State Standard 3.3 for Chemistry, Science)***

Assessment Based on Objectives:

- Given sample fossil fuels, students should be able to highlight the costs and benefits of each

Resources:

***Exploring Earth Visualizations Online Tutorial***
http://www.classzone.com/books/earth_science/terc/navigation/visualization.cfm
***The Causes of Different Density Lesson Plan***
http://www.pz.harvard.edu/ucp/curriculum/density/s3_lesson8_lessonplan.htm
***Online Chemistry Experiment Simulations and Conceptual Computer Animations***
http://www.chem.iastate.edu/group/Greenbowe/sections/projectfolder/simDownload/

NATIONAL GUARD
MOBILE LEARNING CENTER

| Grade 11 | **EARTH ENERGY** | Science |
|---|---|---|
| Concept: Recognizing C, H, O, N, S & P | | Level: III |

*Measuring and Comparing Energy Content in Fossil Fuels*

Connections to the Mobile Learning Center Energy Lab:
- The Earth Experience focuses on balancing worldwide fossil fuel demands vs. energy output

General Goal(s) of the Lesson:
Students should be able to…
- Determine the amount of energy contained in masses or volumes of fossil fuels

Lesson Objectives:
- Given specific masses of designated fossil fuels, students will be able to determine the amount of energy contained in them
- Given specific volumes of designated fossil fuels, students will be able to determine the amount of energy contained in them
- Given prices of designated fossil fuels, students will be able to determine the amount of energy available per dollar

***(Based on Massachusetts State Standard 5.5 for Chemistry, Science)***

Assessment Based on Objectives:
- Given problems expressing types of fossil fuels of a given volume and price, students should be able to determine the yield of energy per dollar

Resources:

***PBS Fossil Fuels and Beyond Online Video***
http://video.pbs.org/video/1095269427/

***Fuel Free!: Living Well Without Fossil Fuels (Volume 1)*** ISBN:144958859X
http://www.amazon.com/Fuel-Free-Living WithoutFossil/dp/144958859X/ref=sr_1_10?ie=UTF8&s=books&qid=1279813018&sr=1-10

***No Impact Man Documentary Amazon DVD***
http://www.hotmoviesale.com/store/productView.aspx?idProduct=195629&ec=1&ver=9.B&ProdId=29&utm_source=google&utm_medium=cpc&utm_term=no%20impact%20man%20movie&utm_campaign=adw25-3515-B&b=GGL_HMS_29_adw25_3515_195629_verB_*GeoUSCA*__no%20impact%20man%20movie