

EARTH ENERGY

Identifying Endo- and Exothermic Reactions

Grade 12

Concept: Endothermic & Exothermic Heat

Science

Level: I/II

Connections to the 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...

- Understand that some chemical reactions absorb energy while others give off, or release, energy

Lesson Objectives:

- To be able to provide examples of endothermic and exothermic reactions without prompting
- To know that the consumption of any fuel is an exothermic reaction

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

Assessment Based on Objectives:

- Students will identify different types of endothermic and exothermic reactions and distinguish which are more likely to be useful in heat production than others

Learning Extensions:

- Give examples of all types of exothermic reactions, not just fossil fuels (ex. power plants)

Resources:

Advances in Energy Transfers Processes by Baldassare Di Bartolo (ISBN: 9810247281)

The Evaluation of Converters for Exothermic and Endothermic Catalytic Reactions by Gustav Wirth (ASIN: B003HKQZIQ)

Solid Propellant and Exothermic Compositions by James Taylor (ASIN: B0000CK7OF)

Exothermic: Webster's Timeline History, 1902-2007 by Icon Group International

EARTH ENERGY

Balancing Endo- and Exothermic Equations

Grade 12

Concept: Endothermic & Exothermic Heat

Science

Level: III

Connections to the 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...

- Balance endothermic and exothermic equations in order to quantitatively state the amount of energy required to make the reaction happen to the amount of energy released by the reaction

Lesson Objectives:

- To be able to balance either type of equation
- To be able to determine energy flow quantitatively
(Based on Massachusetts State Standard 5.1 & 6.4 for Chemistry, Science)

Assessment Based on Objectives:

- Students will be able to answer balancing questions quantitatively

Learning Adaptations:

- Given the results of an experiment, carry out the balancing equation

Learning Extensions:

- Carry out an experiment where mass and temperature can be measured in order to do this type of work empirically

Resources:

Advances in Energy Transfers Processes by Baldassare Di Bartolo (ISBN: 9810247281)
The Evaluation of Converters for Exothermic and Endothermic Catalytic Reactions by Gustav Wirth (ASIN: B003HKQZIQ)
Solid Propellant and Exothermic Compositions by James Taylor (ASIN: B0000CK7OF)
Exothermic: Webster's Timeline History, 1902-2007 by Icon Group International

SOLAR, WIND & WATER ENERGY
Exploring Renewable Energy Resources

Grade 12

Concept: Renewable & Non-Renewable Energy

Science

Level: I/II

Connections to the 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 sources from all energy sources

Lesson Objectives:

- Be able to identify and explain why specific energy sources are renewable
(Based on Massachusetts State Standard 2.1 & 2.2 for Earth Science)

Assessment Based on Objectives:

- Students will provide examples of renewable energy sources and why they are renewable

Learning Extensions:

- Use solar panels and mirrors for solar energy
- Use windmills for wind energy
- Use waves, tides and flowing water for hydro-energy
- Use geothermal energy for earth

Resources:

Renewable Energy by Godfrey Boyle (ISBN: 0199261784)
Got Sun? Go Solar by Rex A. Ewing (ISBN: 978-0965809870)
Wind Power (Revised Edition): Renewable Energy for Home, Farm and Business
by Paul Gipe (ISBN: 978-1931498142)
MicroHydro: Clean Power from Water by Scott Davis (ISBN: 978-0865714847)

SOLAR, WIND & WATER ENERGY
Creating Solutions for the Future

Grade 12

Concept: Renewable & Non-Renewable Energy

Science

Level: III

Connections to the 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...

- Apply different renewable energy sources to specific energy needs

Lesson Objectives:

- Students will know the pros and cons of solar, wind and water energy sources
- Students will be able to apply specific energy sources to specific geographical and demand areas
(Based on Massachusetts State Standard 2.1 & 2.2 for Earth Science)

Assessment Based on Objectives:

- Given a geographical location with some specific energy needs, students will select the types of renewable energy that would most likely meet those needs

Learning Extensions:

- Based on the assessment above, include estimates of the relative costs associated with those energy solutions

Resources:

Kicking the Carbon Habit: Global Warming and the Case for Renewable and Nuclear Energy by William Sweet (ISBN: 978-0231137119)

Cool Energy: Renewable Solutions to Environmental Problems by Michael B. Brower (ISBN: 978-0262521758)

Smart Power: An Urban guide to Renewable Energy and Efficiency by William H. Kemp (ISBN: 978-0973323313)

SOLAR ENERGY

Heat Conversion (Absorption)

Grade 12

Concept: Radiation: Absorption vs. Reflection

Science

Level: I/II

Connections to the 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...

- Know that received energy will be either absorbed or reflected and the degree to which that is done depends on the properties of the material to retain heat as well as the surface of that material

Lesson Objectives:

- Students should know that energy is not destroyed, but it can be concentrated or dissipated
- Understand that wavelengths can change. Light received in visual wavelengths can be re-emitted in infrared wavelengths

(Based on Massachusetts State Standard 3.1 & 3.2 for Physics, Science)

Assessment Based on Objectives:

- Explain why white reflects more than black
- Explain why smooth objects reflect more than rough objects
- Explain why some materials, water in particular, absorb more heat than metals

Learning Adaptations:

- Experiment with different kinds of materials by heating and cooling them to feel heat absorption

Learning Extensions:

- Conduct experiments quantitatively and qualitatively

Resources:

Heat Conversion Systems by George Alefeld and Reinhard Radermacher (ISBN: 0849389283)

EARTH & WATER ENERGY

Introducing Fluid Properties

Grade 12

Concept: Fluid Mechanics & Fluid Properties

Science

Level: I/II

Connections to the 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

General Goal(s) of the Lesson:

Students should be able to...

- Understand that gases and liquids are both fluids, but that liquids do not compress while gases do compress under normal circumstances

Lesson Objectives:

- To be able to define the difference between a gas and a liquid
- To be able to explain how energy can be stored by compressing a gas
(Based on Massachusetts State Standard 6.1 for Chemistry, Science)

Assessment Based on Objectives:

- Given a particular type of container, determine whether it is capable of holding either type of fluid, or just a liquid

Learning Extensions:

- Use a variety of gas demonstrations

Resources:

In-Class Experiment Properties of Water

http://www.delta-education.com/downloads/samples_dsm/InvestigateWaterLink2.pdf

The Miraculous Properties of Ionized Water - The Definitive Guide to the World's Healthiest Substance (ISBN:0970393326)

<http://www.amazon.com/Miraculous-Properties-Ionized-Water-Definitive/dp/0970393326/>

ref=sr_l_3?ie=UTF8&s=books&qid=1279820351&sr=1-3

Water and Life: The Unique Properties of H₂O (ISBN:1439803560)

http://www.amazon.com/Water-Life-Unique-Properties-H2O/dp/1439803560/ref=sr_l_5?ie=UTF8&s=books&qid=1279820441&sr=1-5