**Lesson Plan Template**

**Modified 5/08/13 from** [**LEARN NC**](http://www.learnnc.org/) **(**[www.learnnc.org](http://www.learnnc.org))

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For LEARN NC partners

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| **Title (Required)** | **Activity 1 – Introduction to Energy, Heat and Temperature** |
| **Introduction (Required)** | This introductory activity begins with an overall picture of energy. Students respond to questions such as “What is energy?” and “Is all energy good?” Students will be aware of several forms of energy, but are not likely to introduce biodiesel or biofuel. The teacher uses commercial video clips to introduce the idea that fuel can be made from organic sources and that will reduce the waste currently produced with petroleum-based fuels.In order to study energy, students need some background with heat, temperature and the enthalpy change in a reaction. Demonstrations let students experience an endothermic and exothermic reaction. Energy diagrams and balanced thermochemical equations are introduced. Finally, students develop the Q = CmT equation and calorimetry as a tool to study the energy content of a system. |
| **Learning Outcomes (Required)** | **Students will*** Practice solving thermochemical problems.
* Compare and evaluate the usefulness of alternative fuel sources.
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| **Curriculum Alignment (Required)** | From the NC Essential Standards “unpacked” content for chemistry:* **2.1.1** Explain the energetic nature of phase changes (contrast heat and temperature, including temperature as a measure of average kinetic energy, and appropriately use the units Joule, Celsius, and Kelvin)
* **2.1.2** Explain heating and cooling curves (complete calculations of: q=mCT, q=mHf, q=mHv using heating/cooling curve data)
* **2.1.4** Infer simple calorimetric calculations based on the concepts of heat lost equals heat gained and specific heat.
* **2.2.1** Explain the energy content of a chemical reaction (interpret potential energy diagrams for endothermic and exothermic reactions including reactants, products, and activated complex-with and without the presence of a catalyst)
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| **Critical Vocabulary (Required)** | * Triglyceride – oils or fats found in plants and animals; composed of a glycerol (3 carbon chain) backbone with three fatty acid chains (long straight chains of carbon atoms) attached
* Biodiesel – a diesel fuel produced from organic sources, such as cooking oil, animal fat, or plant seeds (canola, sunflower, soybean)

The US Department of Energy maintains a full text glossary of terms related to the Biomass Program. The link is www1.eere.energy.gov/bioenergy/glossary\_full\_text.html |
| **Classroom Time Required (Required)** | **Activity 1** - one 90 minute block. |
| **Materials Needed (Required)** | **Activity 1 Materials:**Teacher: computer with internet access, class monitor, power point software, 500 g calcium hydroxide, 32 g barium hydroxide, 11 g ammonium chloride, egg, frying pan, spatula, balsa wood board, water, 250 ml beaker, large porcelain dishStudents: computer with internet access, handouts or slides from power point (optional) |
| **Pre-activities (Required)** | **Activity 1 – Introduction to Energy, Heat and Temperature**The teacher needs to prepare the chemicals for the endothermic and exothermic reactions before class begins. |
| **Activities (Required)** | **Activity 1 – Introduction to Energy, Heat and Temperature**This activity gets students thinking about all the types of energy in the world, where it comes from and how it is used and studied. Students watch an introductory 30 second video in photopeach.com. The link is <http://photopeach.com/album/h5ew30?invitecode=93fb20d5df>The video contains 7 questions to engage student discussion.* What is energy?
* Where does it come from?
* What are some examples?
* Is it natural or manmade?
* How do we use energy?
* Are all types of energy good?
* How can we study it?

It may be useful to type the questions for students on a handout or either on a separate slide. Once they watch the video clip, give them time to brainstorm the questions. This may be done in small groups or as individuals, followed by a grouping activity, such as “think-pair-share.” The idea is to get students thinking about a broad definition of energy with many examples and viewpoints. For example, some students will only think of electricity as energy, while another will initially think of the food we eat. This activity can lead to a class discussion on the following topics, depending on what the teacher wants to include in the unit. There are some weblinks for these topics at the end of the lesson plan.* Sources of energy
* Forms of energy
* Conservation of energy
* Heat, temperature, catalyst, calorimetry
* Renewable and nonrenewable resources
* Advantages and disadvantages of various forms of energy
* Current research on energy
* Careers associated with energy and fuel

Students are not likely to list biofuel or biodiesel as a form of energy during this discussion. The teacher will introduce it with a few 30-second public service/commercial clips from the National Biodiesel Board’s video library. The links are <http://bcove.me/r6k4gt36> and <http://bcove.me/rwararju>. For other appropriate video links, use the National Biodiesel Board website at [www.biodiesel.org](http://www.biodiesel.org). The video links are under the “News” tab in a video library. It is interesting to ask students “How did researchers figure out this technology?” or “Why are these products being used?” The idea, again, is to broaden their thinking about energy and the issues we face by using petroleum-based products.Students will begin learning how energy is studied. Using their knowledge of prefixes, students can infer that thermochemistry is the study of heat changes associated with a chemical reaction. A power point and class demonstration will show students that some chemical reactions release energy while some absorb it. A picture of a hot pack and a cold pack allows them to predict the differences between the two products. The first reaction is calcium oxide and water, which is exothermic and releases enough energy to cook an egg. The second reaction is barium hydroxide and ammonium chloride, which is endothermic and absorbs enough energy to freeze a beaker to a wet balsa board. Students will predict the products of the demonstration reactions. If the chemicals used in the power point file are not available, the teacher may use a hot pack and a cold pack purchased at any local drug store. Another low-cost option is to use rubbing alcohol on students’ hands to demonstrate an endothermic process and steel wool soaked in vinegar closed in a jar with a thermometer to demonstrate an exothermic process. The demonstration shows how an exothermic reaction releases heat to its surroundings and an endothermic reaction absorbs heat. Students can then check their predictions and include heat in both balanced equations. The teacher needs to explain the reaction diagram to students. Point out the location of products, reactants, activation energy and the change in energy between products and reactants. Make sure students recognize that the graphs are opposites of one another. Encourage students to think of other examples of endothermic and exothermic processes.Finally, heat and temperature are compared and the equation Q = CmT is developed with teacher instruction. Students typically understand that matter and the temperature change affects the amount of heat energy involved in a process, but most will not understand specific heat. A power point file is included. The experimental set up for calorimetry can be introduced as well as conservation of energy and heat lost = heat gained. Explain that this is the process scientists use to determine heat content of the foods we eat and the fuel we burn. Use this to preview the lab procedure that will be completed in Activity 2. For the remainder of the period or for homework, ask students to reflect and begin filling out a modified KWL chart for the unit. As the unit continues, they may continue to add and answer questions they think of. The entire class will create a KWL study guide at the end of the unit. |
| **Assessment (Required)** | Teachers can use a variety of formative assessments that are not graded, but will inform instruction after each activity. The following are some suggestions for these informal assessments.* Entrance/exit tickets – each student fills out a small ticket. The teacher can ask a content question, such as “Name two things you have learned about energy” or an open-ended question, such as “Write one question that you still have about calorimetry.” The teacher can then use the responses to guide future instruction.
* Starter question – The teacher can make a quick power point slide with a heat problem for students to work out.
* Thumbs up/thumbs down – A quick poll of understanding by a show of “thumbs up” or “thumbs down” can let the teacher know if students are confused. If students are not likely to give responses in this way, polleverywhere.com or gosoapbox.com are websites that have similar functions.
* Whiteboarding – students may work in small groups. The teacher assigns one problem from the homework sheet and the group puts the solution on the board and explains it to the rest of the class. This provides an easy way to uncover misconceptions.
* Electronic feedback – padlet.com allows teachers to build a wall and students to post comments. In this unit, a padlet could be created to post student questions or student feedback from each activity. Gosoapbox.com is a student management site where students can post questions, teachers can give quizzes or polls, and students can post discussion comments during class.

Summative assessments are more formal and are graded. A number of suggested assessments are listed below. Teachers may select work that is appropriate for their classes.* Heat Practice Problems – a power point with four heat problems with answers worked out on the last slide. Can be used as a quiz after Activity 2.
* Quiz – a short quiz can be given after Activity 3.
* Class summary – the entire class can create a KWL-type chart once the activity is complete. Padlet.com is one option to do this electronically. A low-tech option is to create whiteboards. Students can use this as a study guide before the test.
* Written test – a test with multiple choice, heat problems, graphs and short answer questions has been included. This test is best given once the entire unit has been completed.
* Lab report – students can write up formal lab reports for Activity 3 and 4.
* Student presentations – students can create a presentation to support or oppose biodiesel production in the United States. Options for formats include: power point; prezi.com; piktochart.com. This will be most effective after Activity 5.
* Class debate – students can be assigned roles (environmentalist, farmer, scientist, congressman, etc.) to help them focus research for the debate. The debate will be most productive if it is held after the completion of the unit.
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| **Community Engagement (Required)** | In North Carolina, there are several sites involved in biofuel production or research. These operations offer education outreach by offering tours or guest speakers to school groups. Teachers should brainstorm* Piedmont Biofuels – Pittsboro, NC – free public tours on Sunday afternoons and the first Friday of each month
* Patriot Biofuels – Greensboro, NC
* Biofuels Center of North Carolina – Oxford, NC – tours are available or guest speakers can visit schools
* Catawba County landfill site – Newton, NC – free tours can be scheduled
* Guest speakers – North Carolina A&T bioenergy center, Greensboro; North Carolina Biotechnology Center, Research Triangle Park.
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| **Websites (Optional)** | **Introductory Articles** – these have basic information that you will want to read before you start looking at other aspectsA list of common FAQs* http://biodiesel.org/what-is-biodiesel/biodiesel-faq's
* http://www.patriotbiodiesel.com/category\_s/1820.htm

A great introduction to biodiesel* <http://biodiesel.org/what-is-biodiesel/biodiesel-basics>

History of Biofuels* <http://blog.hemmings.com/index.php/2013/07/10/a-brief-history-of-biofuels-from-the-civil-war-to-today/>

A basic dictionary of terms* http://www1.eere.energy.gov/bioenergy/glossary\_full\_text.html

NC State Energy report 2010 – overview of policies, regulations and energy statistics for NC* http://www.energync.net/Portals/14/Documents/Publications/ANNUAL%20NC%20ENERGY%20REPORT%20final%20feb%202010%20v2-1.pdf

**Biodiesel Production**A one-page schematic of how biodiesel is produced* http://biodiesel.org/docs/ffs-production/production-fact-sheet.pdf?sfvrsn=4

US Dept of Energy data – current prices of fuel in different areas of the country* http://www.eia.gov/petroleum/gasdiesel/

**Advantages and Disadvantages**Biodiesel Myths v. Facts brochure (pro-biodiesel)* http://biodiesel.org/docs/default-source/ffs-basics/biodiesel-myths-vs-facts.pdf?sfvrsn=10

Alternative Fuels Data Center – you can compare various types of fuel* http://www.afdc.energy.gov/

Create your own comparison chart for various fuels* http://www.afdc.energy.gov/fuels/fuel\_properties.php

A short article on renewable v. nonrenewable sources of energy* http://www.ecology.com/2011/09/06/fossil-fuels-vs-renewable-energy-resources/

Crunching the Numbers on Alternative Fuels – Popular Mechanics articles* http://www.popularmechanics.com/cars/alternative-fuel/news/2690341
* http://www.popularmechanics.com/cars/how-to/4314657?click=main\_sr

Ending the Food vs. Fuel Debate* http://www.renewableenergyworld.com/rea/news/article/2012/10/ending-the-food-v-fueldebate-researchers-define-surplus-land

Food vs. Fuel Debate – CNBC article* http://www.cnbc.com/id/48477352

**Video Resources –** Each video clip has the time listed at the end of the titleInvention Nation: Biodiesel video (3:38)* http://videos.howstuffworks.com/science-channel/5044-invention-nation-biodiesel-video.htm

Public service announcement – introduces the use of fuel from organic materials (0:30)* http://bcove.me/r6k4gt36

“Here, Now” commercial – use of biodiesel in Dallas (0:37)* http://bcove.me/rwararju

“Fast Track” commercial – a biodiesel truck breaks a land speed record (0:37)* http://bcove.me/9cdwh71s

Jay Leno’s Garage – Jay talks to a scientist about using biodiesel in some of his cars (1:31)* http://bcove.me/316xk1ki

Motorweek segment – interviews farmers and various industries using biodiesel (7:55)* http://bcove.me/3yzusjn6

Biofuel lesson from National Defense Education Program – brief description of how organic materials are being developed into gasoline, biodiesel, and jet fuel* http://www.ndep.us/Biofuel

CNN Story on the Catawba County landfill site* http://www.cnn.com/video/?/video/tech/2009/08/20/wolf.green.town.cnn

**Careers in Biofuels**A US Bureau of Labor Statistics report on biofuel associated careers with salaries and credentials* <http://www.bls.gov/green/biofuels/biofuels.pdf>

Biofuel and Biodiesel product development careers – lists job outlook, salaries, personality traits and has links to other related careers* <http://myfootpath.com/careers/science-careers/biofuel-and-biodiesel-product-developer-careers/>

Green Career Guide – basic information about school and expectations for various biofuel jobs* <http://www.greencareersguide.com/Cellulosic-Biofuels.html>
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| **Author Info (Required)** | Marci Harvey is a chemistry and physics teacher at West Forsyth High School in Clemmons, NC. She has been teaching in NC for 17 years. She has a BS in chemistry from the College of Charleston and a MS in chemistry from the University of South Carolina. Marci earned National Board certification in 2008. This lesson is part of a Kenan Fellowship “Pump New Life into the Classroom with Biofuels.” completed at North Carolina A&T University. |