**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 2 – Heat problems and Calorimetry** |
| **Introduction (Required)** | In this activity, students will perform a virtual calorimetry experiment and apply data from the experiment to thermochemical problems. Students will use the equation Q = CmT as well as the concept of heat lost = heat gained.There is an optional calorimetry lab for students to create a procedure and use a basic calorimeter to determine heat transfer between a metal and water. This will provide the same data as the virtual activity. |
| **Learning Outcomes (Required)** | **Students will*** Practice solving thermochemical problems.
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| **Curriculum Alignment (Required)** | From the Next Generation Science Standards (<http://www.nextgenscience.org/>):

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| 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-PS3-4. | 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). |

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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| **Classroom Time Required (Required)** | **Activity 2** - one 90 minute block.  |
| **Materials Needed (Required)** | **Activity 2 Materials:**Teacher: computer with internet access, class monitor, power point software, virtual calorimetry activity answer key, thermochemistry problem set answer keyStudents: computer with internet access, virtual calorimetry lab handout, Thermochemistry problem set worksheet |
| **Pre-activities (Required)** | **Activity 2 – Heat problems and Calorimetry**The teacher needs to arrange computer access for students prior to this activity. If a bench calorimetry lab is to be conducted, the chemicals and equipment need to be set up before class begins. |
| **Activities (Required)** | **Activity 2 – Heat problems and Calorimetry**In this activity, students will perform a virtual calorimetry experiment and practice using Q = CmT to calculate amounts of heat in various situations.Begin this class by discussing the KWL charts the students worked on during Activity 1. The teacher can assess if there are any questions about heat and temperature or biofuels before beginning Activity 2.Students will perform the activity “Heat Transfer between a Metal and Water” using the Iowa State University simulation (<http://group.chem.iastate.edu/Greenbowe/sections/projectfolder/flashfiles/thermochem/heat_metal.html>). If the classroom has equipment, students may perform a lab using Styrofoam cups as calorimeters and various metal objects with hot water. If there is not enough equipment for students to perform this lab, it can be completed as a whole class with the teacher. A handout is included where students write their own procedure. If students are having trouble writing their own procedure, it can be filled in for them or the teacher can remind them about the calorimetry set up from the notes in Activity 1. Alternatively, there are many online videos and procedures for various reactions involving calorimetry.Students will complete the Thermochemistry Problem set questions. These problems may be completed during class and shared on whiteboards or for homework, depending on what the teacher determines is best for their students. If there are students who need more explanation, The Physics Classroom website has a good review with some sample problems. The link is <http://www.physicsclassroom.com/Class/thermalP/u18l2c.cfm>.Complete this activity by once again reviewing the KWL chart and adding to it. |
| **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. Students can also make videos, posters or skits. 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. |