**Lesson Plan: Lecture 19**

**Green Chemistry and Energy**

**Description**

In this lecture students will learn about the current state of energy production and consumption. Traditional sources of energy include non-renewable sources such as coal and oil. Renewable energy sources will be explored such as biofuels, solar cells and fuel cells. Students will learn how energy is used within the laboratory to heat, cool and for processing, along with alternative energy sources for performing synthetic reactions. The next generation of energy applications will also be discussed.

**Prior to Lecture**

Optional/ Supplemental Readings:

* Energy Independence, Transcript of the Testimony of Richard E. Smalley to the Senate Committee on Energy and Natural Resources —April 27, 2004: http://www.americanenergyindependence.com/energychallenge.aspx
* For more information about biodiesel and fact sheets see BDI Biodiesel: Biodiesel Fact Sheets: https://www.biodiesel.org/what-is-biodiesel/biodiesel-fact-sheets
* Open-access article on dye-sensitized solar cells: Efficient Dye-Sensitized Solar Cells for Direct Conversion of Sunlight to Electricity, Gratzel, M., Kalyanasundaram, K., Material Matters, 2009, 4.4, 88, https://www.sigmaaldrich.com/technical-documents/articles/material-matters/efficient-dye-sensitized.html
* For more information about microwave synthesis: Nuchter, M., Ondruschka, B., Bonrath, W., Gum, A., [Green Chem.](https://doi.org/10.1039/1463-9270/1999), 2004, **6**, 128-141https://pubs.rsc.org/en/content/articlehtml/2004/gc/b310502d - DOI: [10.1039/B310502D](https://doi.org/10.1039/B310502D)
* For more information on Smart Grids and systems: Smarter planet: Energy and Utilities, Slideshare, IBM, 2011,https://www.slideshare.net/gmattathil/smarter-planet-energy-and-utilities

**Topics to Cover**

* Current state of energy consumption: Globally
* Source of energy:
	+ Power plant – coal, oil, natural gas
	+ Renewable – Biofuels, solar cell, Fuel cells, hydro, etc.
* Energy in the Laboratory
	+ Thermal
	+ Cooling
	+ Distillation
	+ Equipment
	+ Synthesis
* New Modern Applications

**Class Exercise (Optional)**

* For a lab-based activity: Synthesis of Biodiesel, <https://www.beyondbenign.org/lessons/synthesis-of-biodiesel/>
	+ In this multi-lesson module students consider the physical properties of different oils used to make biodiesel and then make their own fuel. Students will then analyze the enthalpy of combustion of the biodiesel they have made.
* For a lab-based hands-on activity: Dye-Sensitized Blackberry Solar Cell, <https://www.beyondbenign.org/lessons/dye-sensitized-blackberry-solar-cell/>
	+ Students build their own dye-sensitized solar cell using blackberry fruit as the dye. This lab highlights how current photovoltaic solar cells are manufactured and the green chemistry research towards greener solar energy.