General Education Foundations of Scientific Inquiry (FSI) Course Information Sheet

Please submit this sheet for each proposed course along with 1) a syllabus describing the key components of the course that will be taught regardless of the instructor and 2) assignment guidelines.

Department, Course Number, and Title Chemistry 98T

Indicate when the department anticipates offering this course in 2018-19 and give anticipated enrollment:

Fall: ☐ Enrollment____ Winter: ■ Enrollment 16 Spring: ☐ Enrollment____ Summer: ☐ Enrollment ____

As stated in the guidelines regarding courses in the Foundations of Scientific Inquiry (FSI), the aim of these course offerings is:

> *To ensure that students gain a fundamental understanding of how scientists formulate and answer questions about the operation of both the physical and biological world. These courses also deal with some of the most important issues, developments, and methodologies in contemporary science, addressing such topics as the origin of the universe, environmental degradation, and the decoding of the human genome. Through lectures, experiential learning opportunities such as laboratories, writing, and intensive discussions, students consider the important roles fields such as physics, genetics, chemistry, biology, earth and environmental sciences, evolution, astrophysics, ecology, and planetary and space sciences play in modern society.*

General Education FSI Student Goals: Courses fulfilling the GE FSI will provide a minimum of five units and should align with some (not necessarily all) of the following seven general goals:

1. Students will acquire an informed appreciation of scientists, scientific research, and technology.
2. Students will experience the interdisciplinary nature of science.
3. Students will develop information literacy.
4. Students will actively engage in the scientific process of inquiry, analysis, problem-solving, and quantitative reasoning.
5. Students will make evidence-based decisions in a wide array of science and non-science contexts.
6. Students will develop scientific literacy by addressing current, critical issues and topics in science that are personally meaningful in daily life and/or connected to the needs of society.
7. Students will recognize fundamental scientific principles and the connections between different domains of science.

General Education FSI Student Learning Outcomes: Each course should have student learning outcomes listed in the syllabus. These outcomes may be tied to a specific discipline but should be associated with the seven broad categories listed above (please see **Appendix I** for a sample list of possible learning outcomes supporting each goal).

General Guidelines for GE FSI Courses: GE Courses may be upper or lower division, but they should have no prerequisites. Any student should be able to take them and understand the material with the background expected from all UCLA students. While the course may include material related to the history of science and the social and cultural implications of scientific research, **at least half** of the course should be devoted to students actively engaging in the scientific process of inquiry, analysis, problem-solving, and quantitative reasoning (Goal #4).

Please indicate the area/s which you believe this course should satisfy.

Life Science: ☐ Physical Science: ■ Life Science Lab*: ☐ Physical Science Lab*: ☐

**Please see the additional student learning outcomes and expectations for courses approved as GE FSI Labs.*

Please present a concise explanation of how your course satisfies these criteria.

Which of the seven student learning goals listed on page 1 are you addressing in your course?	Student learning goals 1-6 will be included in the syllabus with a particular emphasis on developing scientific literacy by addressing the critical issue of the current global energy crisis.
What fundamental scientific principles does your class address? Are you making intentional connections between life and physical science disciplines in your course? Does your course explore any current, critical societal issues? If so, what are they?	The main scientific concepts that will be explored in this class are energy conversion in many forms, renewable and non-renewable. In addition to reading the fundamental science research literature, students will be constantly exploring the broader impacts of this energy on society. They will also be studying the affects of funding and public policy on this area of scientific research which should help students become more informed voters on these critical issues in the future.
What class activities (e.g. homework problems, quizzes, clicker questions, projects, etc.) have you designed to help students actively engage in the process of scientific inquiry, analysis, problem solving, and quantitative reasoning throughout the course?	The main basis of scientific inquiry is asking questions about the information provided through experiments, research and discussion. In order to help teach the students to be constantly inquisitive about information given, each student will lead the class discussion one during the quarter in which they provide discussion questions about the reading for the week. Students will also gain the skill of distilling many sources from the scientific literature, popular culture, news and their own calculations into a simple argument. They will have multiple assignments in which they have to present oral arguments synthesized from many sources both in an informal presentation and an end of quarter formal debate. Students will be required to use quantitative reasoning to evaluate many figures of merit applied to different energy sources (energy density, cost in research and production, etc) in order to successfully defend their arguments both in informal class discussion and formal presentations.
For each course goal listed above, what are the student learning outcomes you will list in your syllabus? In addition, what types of assignments will be given to determine whether students achieve the learning outcomes? (Please provide a sample assignment, term paper/exam, essay prompt, or other form of assessment)	1: a) b) c) This class is intended for anyone with an inquisitive mind but particularly those who may not have been exposed to the ideas about renewable energy presented in this class. The goal for this class is for the students to use the knowledge they have gained to be able to hold discussion, read news articles with a critical eye and become informed voters on the topic of renewable energy. 2: a) b) c) The field of energy research is by nature highly interdisciplinary and students will be expected to read and understand the connections between sources from chemists, physicists, engineers, environmental scientists and others and explain how they relate to one another. 3: a) b) Students will read peer-reviewed journal articles and the news stories that accompanied them to understand the different ways in which information is given to the public. They will also be required to research their own sources for the final project. 4: a) f) Students will become familiar with units of measurement and scale when they are learning about the scope of the current energy crisis in terms of how much energy we use and require on a daily basis. 5: a) b) c) Much work in comparing sources from peer reviewed journals versus popular news sources will be done to help students better understand various sources of information 6): a) b) c) d) This learning objective is the one that will be most heavily stressed throughout the class. The overall goal of this class to understand how the work that scientists do in research clean energy relates to the broader impact on our country and the world. Every class will revolve around discussing science and its impacts on the economy, public policy and society. Sample Assignments: 1) Reflection on nuclear energy: Without googling or reading anything each student will write a paragraph on what they know about nuclear energy as a possible form of clean energy. Then, after reading a variety of sources including non-partisan and opinion pieces they will respond to these readings and discuss how it did or did not change their views 2) Final project: In groups of 4 students will research all of the pros and cons to a promising form of energy and engage in a formal debate with another group imagining they are trying to convince a funding agency to provide money to perform research and eventually form a company

Additional Student Learning Outcomes for experiential learning courses approved as "GE FSI Labs"

GE FSI Lab Definition and Expectations: A hands-on laboratory, computer simulation, demonstration, or field experience that involves active participation in experimental observation, data generation and collection using the techniques, methodologies, and approaches of modern-day scientists. Any lab should be conducted under sufficient supervision by the instructor or a Teaching Assistant (TA). Furthermore, the instructor and TAs should meet regularly outside of class time (minimum weekly or biweekly) to practice performing the lab procedures and/or to review the experimental results. Courses fulfilling the GE FSI Lab requirement will provide a minimum of four units and should align with some (not necessarily all) of the following eight general goals:

1. Students will design, implement, and evaluate an experimental strategy for answering scientific questions, testing a hypothesis, or solving a problem.
2. When possible, students will replicate experiments to allow testing for and interpretation of statistical significance.
3. Students will apply commonly used mathematical concepts and statistical methods (e.g., basic addition, subtraction, multiplication, division, averages, standard deviation, t-test for significance) in their analysis of different types of scientific data they collect.
4. Students will visually depict a quantitative dataset as a chart, graph, table, or mathematical equation.
5. Students will concisely summarize trends and patterns deduced from quantitative and qualitative data to make informed conclusions about their experimental results.
6. When interpreting their results, students will distinguish between the most important and extraneous findings (i.e. identify those that are critical to addressing a question, solving a problem, or supporting/refuting a hypothesis).
7. When interpreting their results, students will infer relationships between controls and experimental variables as well as assess causality and correlation among variables.
8. Students will troubleshoot experimental procedures or methods of analysis to develop a sound scientific rationale for deducing what went wrong and why.

Please present a concise explanation of how your course satisfies these criteria.

How will students in this course actively experiment and engage in the hands-on process of gathering, analyzing, and interpreting data? How will progress towards meeting the student learning outcomes for "labs" be measured/assessed? In other words, what types of assignments will be given to determine whether students are achieving the learning outcomes?	

Clean Energy from the Ground Up

Instructor

K.J. Winchell

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Email: kjwinchell@ucla.edu

Seminar Description:

What is the state of renewable energy progress in the world today? This question will be answered as we learn about the state of the art in clean and renewable energy research and what it will takes for basic research to have a meaningful global impact.

Learning Objectives:

1. Be familiar with the state of the art and research techniques in the most promising forms of renewable and clean energy including solar, wind, biofuel/biomass and nuclear.

2. Know the criteria by which various energy sources are evaluated included energy density, cost, scalability etc. and be able to use these to evaluate all energy sources, renewable and non, including those not explicitly discussed in class

3. Be able to read both news articles and some scientific literature with a critical eye in order to stay up to date on future advances in energy research.

4. Be able to explain the steps and challenges associated with each step required to get from basic research to consumer goods and how these affect the future possibilities for various forms of energy.

5. Understand the role the EPA, congress and the president have in affecting the success of large scale implementation of new forms of energy.

6. Construct a scientific argument in both spoken and written form to be discussed with peers and/or those unfamiliar with the topic.

Class structure:

- The core of the class will be centered on critical discussion and close reading of texts about renewable and clean energy from a variety of sources including written news sources, opinion papers, textbooks, scientific journal articles, US government resources and digital media sources such as videos.
- Every Tuesday a group of two people will lead class discussion on the readings over the weekend. They will come prepared with thought questions to which the rest of the class will respond. These prompts may include counter arguments to what was presented in the reading, questions about parts they did not understand or questions to gather class opinion on the reading.
- Thursdays classes will vary depending on the week's topic but will include activities such as small group discussion, presentations, facilities tours and full class discussions lead by the instructor.
- The last week of the class will be structured around the final project rather than typical class activities.

Readings

DeGunther, R. "**Alternative Energy for Dummies**" *Wiley Publishing Inc.* (2009)

Peake, S. "**Renewable Energy: Power for a Sustainable Future**" *Oxford University* (2018)

News articles from sources including *The New York Times*, *Chemistry and Engineering News* and others

Selected relevant journal articles

Assignments and Grading

In Class Participation (15%)

Every week a series of reading assignments will be given and all students are expected to come to class ready to engage in discussion based on these readings

Class discussion lead (5%)

Once during the quarter each student, in a team of two, will be assigned to lead the Tuesday discussion by preparing questions and idea relating to the readings.

Weekly reading summaries (15%)

Each week students will write an informal response to the reading assignment of a page or less outlining any questions, thoughts or points on which they disagreed with the text.

Bi weekly assignments: (30%)

Every other week a larger assignment will be given in order to practice various form of critical thinking and scientific communication. These assignments will include:

- Elevator pitch: Each student will choose a form of energy and in 2 minutes with one PowerPoint slide, give an oral presentation on why that form is the energy of the future. *Due Week 3*
- Reflection on nuclear energy: Without googling or reading anything each student will write a paragraph on what they know about nuclear energy as a possible form of clean energy. Then, after reading a variety of sources including non-partisan and opinion pieces they will respond to these readings and discuss how it did or did not change their views. *Due Week 5*
- Start-up company evaluation: Students will choose from a list of renewable energy related start-ups and research their impact, business model and underlying science in order to evaluate the company's effectiveness. *Due Week 7*
- Political impact evaluation: Students will research a clean energy-related bill passed in the US or in another country and discuss what changes positive or negative occurred as a direct effect of the political measure. *Due Week 9*

Final Project, Renewable energy debate (35%)

In groups of 4 students will research all of the pros and cons to a promising form of energy and engage in a formal debate with another group imagining they are trying to convince a funding agency to provide money to perform research and eventually form a company. This project will have three components factoring into the total grade:

- An outline of their arguments and sources to be turned in during Week 7 and revised before the final debate (5%)
- In class debate during week 10 (15%)
- A final paper, written individually, due during finals week written in the style of a journal article (15%)

Weekly Schedule

Week 1: The Scope of the energy Problem

- DeGunther, R. "**Alternative Energy for Dummies**" *Wiley Publishing Inc.* (2009) Chapter 1

- Höök, M. and Tang, X. "**Depletion of Fossil Fuels and Anthropogenic Climate Change-A Review**" *Energy Policy* 52, (2013): 797–809. doi:10.1016/j.enpol.2012.10.046

Week 2: Wind and hydroelectric energy

- Peake, S. "**Renewable Energy: Power for a Sustainable Future**" *Oxford University* (2018) Chapters 6 and 8
- Joselin Herbert, G. M., Iniyan, S., Sreevalsan, E., and Rajapandian, S. "**A Review of Wind Energy Technologies**" *Renewable and Sustainable Energy Reviews* 11, no. 6 (2007): 1117–1145. doi:10.1016/j.rser.2005.08.004
- Kaunda, C. S., Kimambo, C. Z., and Nielsen, T. K. "**Hydropower in the Context of Sustainable Energy Supply: A Review of Technologies and Challenges**" *ISRN Renewable Energy* 2012, (2012): 1–15. doi:10.5402/2012/730631, Available at http://www.hindawi.com/journals/isrn/2012/730631/

Week 3: Solar Cells and Biofuel

- Peake, S. "**Renewable Energy: Power for a Sustainable Future**" *Oxford University* (2018) Chapters 4 and 5
- Lee, T. D. and Ebong, A. U. "**A Review of Thin Film Solar Cell Technologies and Challenges**" *Renewable and Sustainable Energy Reviews* 70, no. December 2016 (2017): 1286–1297. doi:10.1016/j.rser.2016.12.028, Available at http://dx.doi.org/10.1016/j.rser.2016.12.028
- Hassan, M. H. and Kalam, M. A. "**An Overview of Biofuel as a Renewable Energy Source: Development and Challenges**" *Procedia Engineering* 56, (2013): 39–53. doi:10.1016/j.proeng.2013.03.087, Available at http://dx.doi.org/10.1016/j.proeng.2013.03.087

Week 4: Not so renewable: nuclear, coal and fossil fuels

- DeGunther, R. "**Alternative Energy for Dummies**" *Wiley Publishing Inc.* (2009) Chapter 4, 5 and 8
- Plumer, B. "**How Retiring Nuclear Power Plants May Undercut U.S. Climate Goals**" *The New York Times* (2017): Available at https://www.nytimes.com/2017/06/13/climate/nuclear-power-retirements-us-climate-goals.html?_r=0
- Pate, B. Z. T. and Jr, W. E. W. "**The Nuclear Showdown in Georgia**" *The New York Times* (2017): 2–5. Available at https://www.nytimes.com/2017/12/20/opinion/nuclear-showdown-georgia.html
- Dong, D. J. and Eyester, H. "**The Future of Nuclear Energy**" *Harvard College Review of Environment & Society* no. 2 (2015):
- "**North American Energy Inventory**" *Insitute for Energy Research* no. December (2011): 49.
- Plumer, B. B. "**What 'Clean Coal' Is — and Isn't**" *The New York Times* (2018): 2017–

2019.

Week 5: Scientific communication

- Gebel, E., "**Solar Cells from a Paintbrush**", *Chemical and Engineering* News, (2011)
- Genovese, M. P., Lightcap, I. V., and Kamat, P. V. "**Sun-Believable Solar Paint. A Transformative One-Step Approach for Designing Nanocrystalline Solar Cells**" *ACS Nano* 6, no. 1 (2012): 865–872. doi:10.1021/nn204381g
- Moran, B. "**Truths and Half-truths"**, *Boston University*, (2015)
- Weatherall, J. O., O'Connor, C., and Bruner, J. "**How to Beat Science and Influence People: Policy Makers and Propaganda in Epistemic Networks**" (2018): 1–24. Available at http://arxiv.org/abs/1801.01239

Week 6: Funding and how a research lab works

- Mervis, J., "**Data Check: UC government share of basic research funding falls below 50%",** *Science*, (2017)
- Jahnke, A. "**Who Picks Up the Tab for Science?"**, *Boston University*, (2015)
- Moran, B. "**Cracking the NIH code",** *Boston University*, (2015)
- Zuber, M. "**Falling Short on Science"**, *The New York Times* (2018
- Kennedy, J. V. "**The Sources and Uses of U.S. Science Funding**" *The New Atlantis* no. 36 (2012): 3–22.

Week 7: Start-ups and small companies

- DeGunther, R. "**Alternative Energy for Dummies**" *Wiley Publishing Inc.* (2009) Chapter 16, 17 and 20
- Chen, Y. and Perez, Y. "**Business Model Design: Lessons Learned from Tesla Motors**" no. June (2015)
- Hardman, S., Shiu, E., and Steinberger-Wilckens, R. "**Changing the Fate of Fuel Cell Vehicles: Can Lessons Be Learnt from Tesla Motors?**" *International Journal of Hydrogen Energy* 40, no. 4 (2015): 1625–1638. doi:10.1016/j.ijhydene.2014.11.149, Available at http://dx.doi.org/10.1016/j.ijhydene.2014.11.149
- Kempton, W. and Tomić, J. "**Vehicle-to-Grid Power Implementation: From Stabilizing the Grid to Supporting Large-Scale Renewable Energy**" *Journal of Power Sources* 144, no. 1 (2005): 280–294. doi:10.1016/j.jpowsour.2004.12.022
- Lund, H. "**Large-Scale Integration of Wind Power into Different Energy Systems**" *Energy* 30, no. 13 (2005): 2402–2412. doi:10.1016/j.energy.2004.11.001

Week 8: Public Policy and government

- DeGunther, R. "**Alternative Energy for Dummies**" *Wiley Publishing Inc.* (2009) Chapter 2
- Webber, M. "**Energy 101: Energy Technology and Policy"** *Disco Learning Media, Inc.* Chapter 25 (2017)

- Jacobsson, S. and Lauber, V. "**The Politics and Policy of Energy System Transformation - Explaining the German Diffusion of Renewable Energy Technology**" *Energy Policy* 34, no. 3 (2006): 256–276. doi:10.1016/j.enpol.2004.08.029
- Blanchet, T. "**Struggle over Energy Transition in Berlin: How Do Grassroots Initiatives Affect Local Energy Policy-Making?**" *Energy Policy* 78, (2015): 246–254. doi:10.1016/j.enpol.2014.11.001, Available at http://dx.doi.org/10.1016/j.enpol.2014.11.001

Week 9: Tying it back to the grid: Energy storage

- DeGunther, R. "**Alternative Energy for Dummies**" *Wiley Publishing Inc.* (2009) Chapter 23
- Akinyele, D. O. and Rayudu, R. K. "**Review of Energy Storage Technologies for Sustainable Power Networks**" *Sustainable Energy Technologies and Assessments* 8, (2014): 74–91. doi:10.1016/j.seta.2014.07.004, Available at http://dx.doi.org/10.1016/j.seta.2014.07.004
- Schmalensee, R. "**The Future of the US Electric Grid**" *Perspectives on Complex Global Challenges: Education, Energy, Healthcare, and Security Resilience* (2015): doi:10.1002/9781118984123.ch8

Week 10: Final project debate

- No Reading

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New Course Proposal

Chemistry & Biochemistry 98T
Clean Energy from Ground Up

Course Number	**Chemistry & Biochemistry 98T**
Title	**Clean Energy from Ground Up**
Short Title	**CLEAN ENERGY**
Units	Fixed: **5**
Grading Basis	**Letter grade only**
Instructional Format	**Seminar - 3 hours per week**
TIE Code	**SEMT - Seminar (Topical) [T]**
GE Requirement	**Yes**
Requisites	**Enforced: Satisfaction of entry-level Writing requirement. Freshmen and sophomores preferred.**
Course Description	**Seminar, three hours. Requisite: satisfaction of Entry-Level Writing requirement. Freshmen/sophomores preferred. What is state of renewable energy today? Study of state-of-art clean and renewable energy research, and what it takes for basic research to have meaningful global impact. Letter grading.**
Justification	**Part of the series of seminars offered through the Collegium of University Teaching Fellows**
Syllabus	File *CHEM 98T_Winchell_Syllabus.pdf* was previously uploaded. You may view the file by clicking on the file name.
Supplemental Information	**Instructor (Katharine Winchell) UID: 004680877** **Professor Sarah Tolbert is the faculty mentor for this course. UID: 802745947**
Grading Structure	**In Class Participation - 15%** **Class discussion lead - 5%** **Weekly reading summaries - 15%** **Bi weekly assignments - 30%** **Final Project - 35%**
Effective Date	**Winter 2019**
Discontinue Date	**Summer 1 2019**
Instructor	Name: **Katharine Winchell** — Title: **Teaching Fellow**
Quarters Taught	☐ Fall ☑ Winter ☐ Spring ☐ Summer
Department	**Chemistry**
Contact	Name: **MICHELLE CHEN** — E-mail: **mchen@oid.ucla.edu**
Routing Help	

ROUTING STATUS

Role: Registrar's Office

Status: Processing Completed

Role: Registrar's Publications Office - Livesay, Blake Cary (BLIVESAY@REGISTRAR.UCLA.EDU) - 61590

Status: Added to SRS on 8/17/2018 9:25:33 AM
Changes: Title, Description
Comments: Course description edited into official version.

Role: Registrar's Scheduling Office - Lin, Jessica (JLIN@REGISTRAR.UCLA.EDU) - 58253
Status: Added to SRS on 8/3/2018 3:21:49 PM
Changes: Short Title
Comments: Within e-mail thread from Mary Ries and Aaron Tornell, FEC Chair Aaron Tornell approved course proposal on 08/03/2018.

Role: FEC Chair or Designee - Ries, Mary Elizabeth (MRIES@COLLEGE.UCLA.EDU) - 61225
Status: Returned for Additional Info on 8/1/2018 3:26:44 PM
Changes: No Changes Made
Comments: Per 8/01/2018 e-mail from Michelle L. Chen, course proposal was approved by CUTF FAC on 5/08/2018. Copy of approval letter was attached to Michelle's e-mail.

Role: Initiator/Submitter - Chen, Michelle L. (MCHEN@OID.UCLA.EDU) - 53042
Status: Submitted on 8/1/2018 2:34:28 PM
Comments: Initiated a New Course Proposal

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