

## *Is your refrigerator running ... efficiently? An integrated STEM approach to understanding energy efficiency*

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**Saturday, October 26, 2019 (9:00 a.m. – 3:00 p.m.)**

**121 Chambers Building, Penn State**

Refrigerators consume more electricity than any other type of appliance or electronic in U.S. homes. When you shop for a refrigerator, you may see labels like EPA Energy Star, but what does that mean? Can we really trust ratings? This workshop will provide flexible modules to introduce your students to energy use in the USA and at homes and the physics and chemistry of how refrigerators and air conditioners work. Your students will have an opportunity to participate in an authentic research project to understand how home refrigerators work in the real world, and whether manufacturer and government ratings actually mean energy and cost savings at home. All teachers are welcome, but content is most applicable to physics, chemistry, general science, math and computer science teachers, particularly those teaching about heat and energy or statistics and interpretation of data.

**Target Audience: Teachers of students in grades 6-12**

**This workshop is FREE to all educators with ACT 48 (6 hours) provided free of charge and aligns with the PA Science and Technology standards, and Next Generation Science standards.**

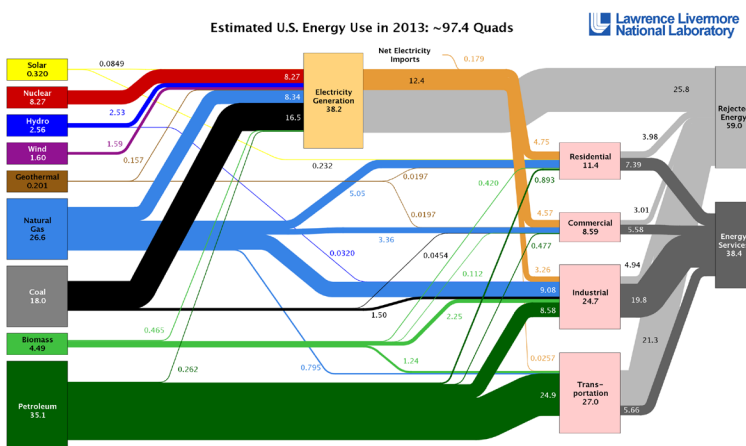
**Continental breakfast and lunch are provided.**

**Maximum enrollment is 24. [Register online now](#) to reserve a spot online today.**

**For more information email Matt Johnson at [mjohnson@psu.edu](mailto:mjohnson@psu.edu) or call 814-863-6607.**

**Sponsored by:**

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How do we use energy in the US?  
Where does it come from and where does it go?



How does refrigeration work?  
(Phase change, energy transformations, properties of liquids and gases...)



Participate in an authentic research project to measure energy use in US homes

## **Pennsylvania Science, Technology, and Engineering Standards**

### Grades 6-12

- 3.2.7.A3: Explain how energy transfer can affect the chemical and physical properties of matter.
- 3.2.6.B3: Give examples of how heat moves in predictable ways, normally flowing from warmer objects to cooler ones until they reach the same temperature.
- 3.2.7.B2: Describe how energy can be changed from one form to another as it moves through a system or transferred from one system to another.
- 3.2.7.B6: Demonstrate that heat is often produced as energy is transformed through a system
- 3.4.8.A1: Analyze the development of technology based on affordability
- 3.4.7.E3: Investigate that power is the rate at which energy is converted from one form to another.
- 3.4.7.E3: Examine the efficiency of energy use in our environment.
- 3.2.10.B3: Explain how the overall energy flowing through a system remains constant. Describe the work-energy theorem. Explain the relationship between work and power.
- 3.2.10.B7: Identify questions and concepts that guide scientific investigations.
- 3.4.10.D2: Synthesize data, analyze trends, and draw conclusions regarding the effect of technology on the individual, society, and environment.
- 3.4.12.B1: Illustrate how, with the aid of technology, various aspects of the environment can be monitored to provide information for decision making.
- 3.2.12.B3: Describe the relationship between the average kinetic molecular energy, temperature, and phase changes.

## **Common Core Math Standards**

### Grades 6-12

- CC.2.2.6.B.3: Represent and analyze quantitative relationships between dependent and independent variables.
- CC.2.2.7.B.3: Model and solve real-world and mathematical problems by using and connecting numerical, algebraic, and/or graphical representations.
- CC.2.2.8.B.2: Understand the connections between proportional relationships, lines, and linear equations.
- CC.2.4.6.B.1: Analyze and/or interpret bivariate data displayed in multiple representations.
- CC.2.1.HS.F.3: Apply quantitative reasoning to choose and interpret units and scales in formulas, graphs, and data displays.
- CC.2.1.HS.F.5: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.
- CC.2.2.HS.D.7: Create and graph equations or inequalities to describe numbers or relationships
- CC.2.4.HS.B.2: Summarize, represent, and interpret data on two categorical and quantitative variables.

## **Computer Science Standards**

### Grades 6-12

- 2.CS.02: Design projects that combine hardware and software components to collect and exchange data.
- 2.DA.08: Collect data using computational tools and transform the data to make it more useful and reliable.
- 3A.DA.12: Create computational models that represent the relationships among different elements of data collected from a phenomenon or process.
- 3B.DA.05: Use data analysis tools and techniques to identify patterns in data representing complex systems
- 3B.DA.06: Select data collection tools and techniques to generate data sets that support a claim or communicate information.