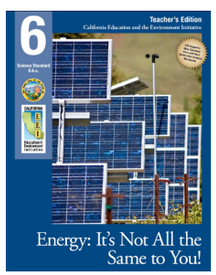
California Education and the Environment Initiative

The EEI Curriculum cohesively integrates science and engineering practices (SEPs), content (disciplinary core ideas/DCIs), and crosscutting concepts (CCs) within its lesson procedures. This preliminary analysis intentionally teases apart the individual SEPs, DCIs, and CCs as a means of correlating the EEI unit with specific performance expectations; however, the EEI lessons weave these components back together to provide three-dimensional learning for students.

Middle School (Grades 6, 7, and 8 in the Integrated Course Model)

6.6.a. Energy: It's Not All the Same to You!

"Energy: It's Not All the Same to You!" draws students' attention to the importance of various forms of energy and the processes of energy conversion by exploring California's statewide system of power generation. They examine the variety of energy sources used to generate electricity, looking at the availability of these sources and considering how these resources are limited and typically nonrenewable, as well as assessing how the distribution of different fuels influences their use in California. Students use power plants as models to study the release of energy during the conversion of fuels from one state to another, for example, the conversions that occur during the burning of coal and the operation of hydroelectric power plants. They examine California's electricity generation systems as they assess which kinds of design and engineering solutions are feasible. The students then consider which designs might minimize the influence of power generation on natural systems. Since the role of petroleum-based energy is so substantial in California's transportation systems, there is a supplemental lesson that explores this specific topic.



Next Generation Science Standards* Correlation with the California Education and the Environment Initiative (EEI) Curriculum

The EEI Curriculum is a great choice for transitioning to NGSS and contributes toward achievement of the performance expectations for the standards reflected in the Summary Chart below: MS-PS1: Matter and Its Interactions, MS-PS3: Energy, MS-ESS3: Earth and Human Activity, and MS ETS1: Engineering Design. Each EEI unit highlights a small number of performance expectations, science and engineering practices, disciplinary core ideas, and crosscutting concepts. Therefore, the EEI units contribute to students' overall achievement of the performance expectations by the end of a school year, where they will have had multiple opportunities to engage in all appropriate science and engineering practices, disciplinary core ideas, and crosscutting concepts. While EEI was designed to teach the 1998 California science standards to mastery, it reflects the real world interconnections in science and already incorporates many of the paradigm shifts reflected in the NGSS. To learn more about how EEI supports NGSS, visit http://californiaeei.org/NGSSGuides/.

	Next Generation Science Standards											
	MS-PS1			MS-PS3			MS-ESS3			MS-ETS1		
California Connection					✓			✓	✓		✓	
Lesson 1 –– Graph energy sources and analyze the mix of resources used in California and the U.S.	✓				✓			✓	✓	✓		
Lesson 2 – Examine electricity generation and the byproducts of energy conversions.					✓		✓	✓	✓	✓		
Lesson 3 – Chart data about byproducts and effects of generating California's power.	✓			✓	✓		✓	✓	✓	✓		
Lesson 4 – Analyze California's energy consumption and discuss how it affects natural systems.				✓	✓		✓	✓	✓	✓	✓	
Lesson 5 –Weigh costs and benefits of energy sources and discuss related choices.	✓			✓	✓		✓	✓	✓	✓	✓	
Supplemental Lesson				✓	✓		✓	✓	✓	✓	✓	
Traditional Unit Assessment	✓			✓	✓		✓	✓	✓	✓	✓	
Alternative Unit Assessment	✓			✓	✓		✓	✓	✓	✓	✓	
	SEP	DCI	CC	SEP	DCI	CC	SEP	DCI	CC	SEP	DCI	CC

Correlation Chart Key

SEP (Science and Engineering Practices)
DCI (Disciplinary Core Ideas)
CC (Crosscutting Concepts)

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EEI Unit 6.6.a. Energy: It's Not All the Same to You!

Disciplinary Core Ideas Supported by this EEI Unit

MS-PS1 Matter and Its Interactions
MS-PS3 Energy
MS-ESS3 Earth and Human Activity
MS ETS1 Engineering Design

Performance Expectations	Suggestions for Using the EEI Unit to Support NGSS
MS-PS1-4 *(Grade 7 in the Integrated Course Model):* Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.	Use the unit to have students examine how the release of energy during the conversion of fuels from one state to another affects the kinetic energy in power generation systems, such as coal burning and hydroelectric power plants.
MS-PS3- 5 *(Grade 6 in the Integrated Course Model):* Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.	Use the unit to have students create an argument about the transfer of kinetic energy that occurs in power plants and including the different forms that energy can take.
MS-ESS3-1 *(Grade 7 in the Integrated Course Model):* Construct a scientific explanation based on evidence for how the uneven distribution of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes.	Use the unit to have students consider, using energy sources as an example, how resources are limited and typically nonrenewable, and how their distribution influences the use of different fuel sources for the generation of California's electricity.
MS-ESS3-3 *(Grade 6 in the Integrated Course Model):* Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.	Use the unit to have students consider California's electricity generation systems as an example of the design process, while examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce the influences of power generation on natural systems.
MS-ESS3-4 *(Grade 8 in the Integrated Course Model):* Construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impacts Earth's systems.	Use the unit to have students interpret data and models as the basis for constructing an argument that increasing energy consumption and the use of various energy sources have different impacts on the environment.
MS-ESS3-5 *(Grade 6 in the Integrated Course Model):* Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.	Use the unit to have students respond to questions as they evaluate information that correlates an increase in population, energy use, and atmospheric greenhouse gases, and consider evidence that supports how these increases affect global warming.
MS-ETS1-1 *(Grades 6, 7, and 8 in the Integrated Course Model):* Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.	Use the unit to have students evaluate the impact different types of energy use have on natural systems by analyzing the costs and benefits of each. Have them consider how science can help predict the potential impacts on natural systems.

Science and Engineering Practices (SEPs)	Suggestions for Using EEI to Support SEPs	Disciplinary Core Ideas (DCIs)	Suggestions for Using EEI to Support DCIs	Crosscutting Concepts (CCs)	Suggestions for Using EEI to Support CCs
Asking questions and defining problems (MS-ESS3-5, MS-ETS1-1)	Use the unit to have students create and analyze charts, graphs, and other evidence to clarify the impacts California's power mix has on increasing greenhouse gases into the atmosphere, and how	**PS3.A.: Definitions of Energy:** - The term "heat" as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that	Use the unit to have students consider how heat is released when various fuels, such as coal and petroleum, are burned to generate electricity or to power motor vehicles (Lessons 1, 2, and Supplemental Lesson).	**Cause and Effect (MS-ESS3-1, MS-ESS3-3, MS-ESS3-4)**	Use the unit to have students evaluate the cause and effect relationship between the rise in energy demand, the increasing release of greenhouse gases, and the overall rise in mean global temperature.

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	that increase relates to a rise in global temperatures (Lessons 2, 3, and 4). Have students engage in a town-hall discussion about the costs and benefits of energy source options, and ask questions about how each energy source might impact their community (Lesson 5).	thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. (secondary to MS-PS1-4) - The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system's material)… (secondary to MS-PS1-4)			Have them analyze the cause and effect relationship between the extraction and use of energy sources and the loss of habitat, rise in water temperature, and release of pollutants into the atmosphere (Lessons 1-6, Supplemental Lesson).
Engaging in argument from evidence (MS-PS3-5, MS-ESS3-4)	Use the unit to have students collect and evaluate evidence showing the byproducts of different types of energy used in California and their potential impacts to the land, air, and water (Lesson 3). Have them compare and analyze graphs on electrical consumption in California and the United States (Lesson 4). Have students prepare and argue the impacts energy use has on communities (Lesson 5 and Supplemental Lesson).	**PS3.B.: Conservation of Energy and Energy Transfer:** When the motion energy of an object changes, there is inevitably some other change in energy at the same time (MS-PS3-5)	Use the unit the unit to have students examine how energy conversions take place inside a power plant. Have them explore how the generation of electricity in a power plant involves the transfer of energy (chemical to heat; heat to motion; and motion to electricity) (Lessons 1 and 2).	**Influence of Engineering, Technology, and Science on Society and the Natural World (MS-ESS3-1, MS-ESS3-3, MS-ESS3-4, and MS-ETS1-1)**	Use the unit to have students study how humans have used science and technology to extract energy to meet human needs, how some technologies have significant consequences to the environment, and how humans are using science and technology to create more efficient and less harmful ways to meet their demands for energy.
Developing and Using Models (MS-PS1-4)	Use the unit to have students use models to study how the conversion of energy from potential to kinetic (burning fossils to create motion energy or electricity) includes changes of state and changes in temperature and involves the movement of particles throughout the process (Lessons 1,3, and 5).	**ESS3.A: Natural Resources:** Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, freshwater, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes. (MS-ESS3-1)	Use the unit to have students explore the concepts of limited resources, and realize that many are not renewable or replaceable over a human lifetime (Lessons 1 and 2). Have them investigate the byproducts of using natural resources to create electricity (Lesson 3). Have students realize that the supply of petroleum humans extract and use for transportation is a nonrenewable resource that will only be available until Earth's supply is exhausted (Supplemental Lesson).	**Science Addresses Questions About the Natural and Material World (MS-ESS3-4)**	Use the unit to have students participate in a focused discussion, based on the example of generating and using electricity to meet human demands, to consider the various processes and scientific information that are involved in making energy-related decisions, and consider how science helps inform policy decisions and societal action.

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Constructing Explanations and Designing Solutions (MS-ESS3-1, MS-ESS3-3)	Use the unit to have students design and/or construct a solution and explain how their designed solution will either reduce or increase the transfer of thermal energy (Lesson 5).	**ESS3.C: Human Impacts on Earth's Systems:** - Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. (MS-ESS3-3) - Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise (MS-ESS3-4) **ESS3.D: Global Climate Change:** Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to	Use the unit to have students study the impacts different types of energy use have on natural systems (Lessons 2 and 3). Have them consider that California's efforts toward conservation and new technologies have changed the rates of per-capita energy consumption (Lessons 3 and 4). Have students determine that factors involved in meeting energy demand can have widespread consequences, such as habitat loss and the release of pollutants into the atmosphere (Lessons 4 and 5). Have them consider the consequences to natural systems as humans extract, refine, transport, and use petroleum products, as well as other "costs" associated with their use (Supplemental Lesson). Use the unit to have students analyze how the burning of fossil fuels to meet energy demands results in the release of greenhouse gases that can cause global climate change (Lessons 3, 4 and Supplemental Lesson). Have them analyze how humans can have a positive effect through efforts to mitigate the		

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		whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities. (MS-ESS3-5)	amount and types of energy they use, and that making wise decisions based on climate science and engineering capabilities can have a significant effect on our future (Lesson 5 and Supplemental Lesson).		
		ETS1.A: Defining and Delimiting Engineering Problems: The more precisely a design task's crieteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1)	Use the unit to have students consider the impacts each energy source has on people and the natural environment, and to use that information in evaluating the costs and benefits for each type of fuel (Lessons 4, 5, and Supplemental Lesson).		