Learning that works for Colorado CTE™

Colorado CTE Course – Scope and Sequence

Course Name	**Introduction of Energy**	**Course Details** **Course = 0.50 Carnegie Unit Credit**	First course in the secondary course sequence for the Energy Pathway under the Energy cluster.
Course Description	Competencies taken from the US Department of Energy - Energy Literacy- Essential Principles and Fundamental Concepts for Energy Education. This course offers basic units of the physical and biological process of energy. It also covers how energy can affect our daily lives.		
Note:	This is a suggested scope and sequence for the course content. The content will work with any textbook or instructional resource. If locally adapted, make sure all essential knowledge and skills are covered.		
SCED Identification #	18506	Schedule calculation based on 60 calendar days of a 90-day semester. Scope and sequence allows for additional time for guest speakers, student presentations, field trips, remediation, or other content topics.	

All courses taught in an approved CTE program must include Essential Skills embedded into the course content. The Essential Skills Framework for this course can be found at **https://www.cde.state.co.us/standardsandinstruction/essentialskills**

Instructional Unit Topic	CTE or Academic Standard Alignment	Competency / Performance Indicator	Outcome / Measurement	CTSO Integration
Unit 1: Physical Quantity	1.0 Energy is a physical quantity that follows precise natural laws. *SCIENCE: SC.HS.1.6* *SC.HS.1.7* *SC.HS.1.9*	1.1 Energy is a quantity that is transferred from system to system.	List characteristics of transferrable energy.	
		1.2 The energy of a system of object that results in its temperature is called thermal energy.	Define Convention, conduction, radiation	
		1.3 Energy is neither created nor destroyed.	Change in the total amount of energy is always equal to the difference between the amount of energy transferred in and the amount transferred.	
		1.4 Energy available to do useful work decreases as it is transferred from system to system.	During all transfers of energy between two systems, some energy is lost to the surroundings. In a practical sense, this lost energy has been “used up,” even though it is still around somewhere. A more efficient system will lose less energy, up to a theoretical limit.	
		1.5 Energy comes in different forms and can be divided into categories.	Kinetic and potential energy/light energy, elastic energy, chemical energy, etc.	
		1.6 Chemical and nuclear reactions involve the transfer and transformation of energy.	The energy associated with nuclear reactions is much larger than that associated with chemical reactions for a	

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			given amount of mass. Nuclear reactions take place at the centers of stars, in nuclear bombs, and in both fission- and fusion based nuclear reactors. Chemical reactions are pervasive in both living and non-living Earth systems.	
		1.7 Many different units are used to quantify energy.	Joules, calories, ergs, kilowatt-hours, BTU's – 1 calorie =4,186 joules.	
		1.8 Power is a measure of energy transfer rate	Rate of Power, 1joule/second = 1 watt.	
Unit 2: Physical Processes	2.0 Physical processes on Earth are the result of energy flow through the Earth's system. *SCIENCE: SC.HS.3.6 SC.HS.3.7*	2.1 Energy is constantly changing as energy flows through the system.	Geological, fossil, and ice records provide evidence of significant changes throughout Earth's history. These changes are always associated with changes in the flow of energy through the Earth's system. Both living and non-living processes have contributed to this change.	
		2.2 Sunlight, gravitational potential, decay of radioactive isotopes, and rotation of the Earth are the major sources of energy driving physical processes on Earth.	Radioactive isotopes, gravitational potential, tidal energy, geothermal energy, etc.	
		2.3 Earth's weather and climate are mostly driven by energy from the sun.	Unequal warming of Earth's surface and atmosphere by the Sun drives convention within the atmosphere, producing winds and influencing ocean currents.	
		2.4 Water plays a major role in the storage and transfer of energy in the Earth's systems.	Identify energy roles in storage and transfer.	
		2.5 Movement of matter between reservoirs is driven by Earth's	These movements are often accompanied by a change in the physical and chemical	

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		internal and external sources of energy.	properties of the matter. Understand the influence of carbon in the atmosphere.	
		2.6 Greenhouse gases affect energy flow through the Earth's system.	Explain how greenhouse gases affect energy flow.	
		2.7 The effects of changes in Earth's energy system are often not immediately apparent.	Understand responses to inputs vs. outputs.	
Unit 3: Biological Processes	3.0 Biological processes depend on energy flow through the Earth's system.	3.1 The sun is the major source of energy for organisms and the ecosystem of which they are a part.	Describe the role of the sun on energy production.	
		3.2 Food is biofuel used by organisms to acquire energy for internal living processes.	Food is composed of molecules that serve as fuel and building materials for all organisms as energy stored in the molecules is released and used. The breakdown of food molecules enables cells to store energy in new molecules that are used to carry out the many functions of the cell and thus the organism.	
		3.3 Energy is available to do useful work decreases as it is transferred from organism to organism.	The chemical elements that make up the molecules of living things are passed through food chains and are combined and recombined in different ways. At each level in the food chain, some energy is stored in newly made chemical structures, but most is dissipated into the environment. Continual input of energy, mostly of sunlight, keeps the process going.	
		3.4 Energy flows through food webs in one direction, from producers to consumers, and decomposers.	An organism that eats lower on the food chain is more energy efficient than one eating higher on the food chain. Eating producers is the lowest, and thus the most energy-efficient, level at which an animal can eat.	

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		3.5 Ecosystems are affected by changes in the availability of energy and matter.	The amount and kind of energy and matter available constrains the distribution and abundance of organisms in an ecosystem and the ability of the ecosystem to recycle materials.	
		3.6 Humans are part of Earth's ecosystems and influence energy flow through these systems.	Humans are modifying the energy balance of Earth's ecosystems at an increasing rate. Shifts occur, for example, because of changes in agriculture and food processing technology, consumer habits, and human population size.	
Unit 4: Energy for Human Activities	4.0 Various sources of energy can be used to power human activities, and often this energy must be transferred from source to destination.	4.1 Humans transfer and transform energy from the environment into forms useful for human endeavors.	The primary sources of energy in the environment include fuels like coal, oil, natural gas, uranium, and biomass. All primary source fuels except biomass are non-renewable. Primary sources also include renewable sources like sunlight, wind, moving water, and geothermal.	
		4.2 Humans use energy is subject to limits and constraints.	Industry, transportation, urban development, agriculture, and most other human activities are closely tied to the amount and kind of energy available. The availability of energy resources is constrained by the distribution of natural resources, availability of affordable technology, socioeconomic policies, and socioeconomic status.	
		4.3 Fossil Fuels and biofuels are organic matter that contain energy captured from sunlight.	The energy in fossil fuels such as oil, natural gas, and coal comes from energy that producers like plants, algae, and cyanobacteria captured from sunlight long ago. The energy in biofuels such as food, wood, and ethanol come from energy that producers captured from sunlight recently.	

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			Energy stored in these fuels is released during chemical reactions such as combustion, respiration, which also release carbon dioxide into the atmosphere.	
		4.4 Humans transport Energy from place to place	Fuels are often not used at their source but are transported, sometimes over long distances. Fuels are transported primarily by pipelines, trucks, ships, and trains. Electrical energy can be generated from a variety of energy resources and can be transformed into almost any other form of energy. Electric circuits are used to distribute energy to distant locations. Electricity is not a primary source of energy, but an energy carrier.	
		4.5 Humans generate electricity in multiple ways.	When a magnet moves or magnetic field changes relative to a coil of wire, electrons are induced to flow in the wire. Most human generation of electricity happens in this way. Electrons can also be induced to flow through direct interaction with light particles, this is the basis upon which a solar cell operation. Other means of generating electricity, include electrochemical, piezoelectric, and thermoelectric.	
		4.6 Humans Intentionally store energy for later use in several different ways.	Examples include batteries, water reservoirs, compressed air, hydrogen, and thermal storage. Storage of energy involves many technological environment and social challenges.	
		4.7 Different sources of energy and the different ways energy can be transformed, transported, and stored	A given energy system, from source to sink, will have an inherent level of energy efficiency, monetary cost, and environmental risk. Each system will also	

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		each have different benefits and drawbacks.	have national security, access, and equity implications.	
Unit 5: Economic, political, environmental, and social factors	5.0 Energy decisions are influenced by economic, political, environmental, and social factors. *SCIENCE: SC.HS.3.9*	5.1 Decisions concerning the use of energy resources are mad at many levels.	Identify individual, community, national, and international energy decisions.	
		5.2 Energy infrastructure has inertia.	Explain the impact governments, corporations, and individuals have made towards the energy industry.	
		5.3 Energy decisions can be made using a system-based approach.	Define a systems-based approval decision making strategy in regards to the energy industry.	
		5.4 Energy decisions are influenced by economic factors	Describe how the monetary costs of energy affect energy decisions.	
		5.5 Energy decisions are influenced by political factors.	Governmental structure, power balances, and self-serving actions taken by individuals and groups effect energy decisions.	
		5.6 Energy decisions are influences by environmental factors.	Environmental costs of energy decisions effect energy decision making at all levels.	
		5.7 Energy decisions are influenced by social factors.	Questions of ethics, morality, and social norms affecting energy decisions making at all levels.	
Unit 6: Factors that affect Energy	6.0 The amount of energy used by human society depends on many factors.	6.1 Conservation of energy has two very different meanings.	Differentiate between the two different meanings of energy.	
		6.2 One way to manage energy resources is through conservation.	Conservation includes reducing wasteful energy use, using energy for a given purpose more efficiently, making strategic choices as to sources of energy and reducing energy use altogether.	
		6.3 Human demand for energy is increasing.	Infer how population growth, industrialization, and socioeconomic development have resulted in an increase demand for energy.	

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		6.4 Earth has limited energy resources.	How is human energy consumption putting stresses on the natural processes that renew some energy resources?	
		6.5 Social and technological innovation affects the amount of energy used by human society.	Connect social and technological innovations with the amount of energy used in society.	
		6.6 Behavior and design affect the amount of energy used by human society.	Propose changes in behavior or changes I the design of technology and infrastructure to benefit the conservation of energy.	
		6.7 Products and services carry with them embedded energy.	The energy needed for the entire life cycles of a product or service is called “embedded” or “embodied” energy. An account of the embedded energy in a product or service, along with knowledge of the source(s) of the energy is essential when calculating the amount of energy used and in assessing impacts and consequences.	
		6.8 The amount of energy used can be calculated and monitored.	Understand utility costs, knowing where consumer goods and food come from and energy efficiency in relation to home, work, and transportation processes.	
Unit 7: Quality of life affected through Energy Choices	7.0 The quality of life of individuals and society is affected by energy choices.	7.1 Economic security is impacted by energy choices.	Individuals and society continually make energy choices that have economic consequences. The consequences come in the form of monetary cost in general and in the form of price in fluctuation and instability specifically.	
		7.2 National Security is impacted by energy choices.	The security of a nation is dependent, in part, on the sources of that nation’s energy supplies. For example, a nation that has diverse sources of energy that come mostly from within its borders is more secure than a nation largely dependent on foreign energy supplies.	

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		7.3 Environmental quality is impacted by energy choices	Identify the environmental consequences.	
		7.4 Increasing demand for and limited supplies of fossil fuels affect quality of life.	Fossil fuels provide most of the world's energy. Fossil fuels supplies are limited. If society has not transitioned to sources of energy that are renewable before depleting Earth's fossil fuel supplies, it will find itself in a situation where energy demand far exceeds energy supply. This situation will have many social and economic consequences.	
		7.5 Access to energy resources affects quality of life.	How does access to energy affect human health, access to education, socioeconomic status, gender, equality, global partnerships, and the environment?	
		7.6 Some populations are more vulnerable to impacts of energy choices than others.	Identify the environmental consequences that energy decisions have on economic, social, and environmental consequences.	
Unit 8: Electricity Basics	Understand the basics of electrical charges	Explain 3 ways charge can be transferred. Understand the importance of grounding a system. List the 3 subatomic particles, their charges, and where they are located in an atom. Describe the 3 "rules" of charge. Draw a picture and use it to explain how charge can be induced on an object.	Define the following vocabulary: • Electrons • Protons • Neutrons • Nucleus • Grounding • Static Electricity • Charge • Induction/induced • Polarization • Friction • Law of conservation of charge • Electroscope • Conductor • Insulator	

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	Understand the basics of electrical current.	Explain the relationship between voltage, current, and resistance in a circuit. Calculate the voltage in a circuit if given the current and resistance. Test different materials for conductance Know how to use a voltmeter/multimeter. Understand the difference between an insulator and a conductor. Explain how a battery works. Describe the four factors that affect resistance.	Define the following vocabulary: • Electricity • Current • Amperes • Voltage Difference • Volts • Resistance • Ohms • V=IR (and the triangle of glory) • Circuit • Battery	
	Understand the basics of electrical circuits	Design circuits in parallel and series. Calculate the amount of resistance needed in a circuit to protect the components added. Make a lightbulb illuminate in a series circuit and a parallel circuit. Draw parallel and series circuits Name examples of parallel and series circuits in the world. Compare and contrast parallel and series circuits	Define the following vocabulary: • Parallel Circuit • Series Circuit • Switch • Resistor • Ammeter • Voltmeter • Fuse • Circuit Breaker	

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	Understand the basics of electrical magnetism.	Know the symbols for drawing components in a circuit. Explain the relationship between electricity and magnetism. Describe the force that exists between magnetic objects, including where it is the strongest, and how this force acts similarly to other forces we've learned about (such as electrical force and gravitational force.) Differentiate between the magnetic domains of magnetic elements vs. nonmagnetic elements. I can compare and contrast these by drawing them. Understand how magnets are used to generate electricity in a generator. Make a generator and test the voltage produced with a voltmeter. Test the electricity generated from a model wind turbine. Build an electromagnet and understand two ways to increase the strength of an electromagnet. Build a simple AC Generator.	Define the following vocabulary: • Magnetism • Magnetic / Electric field • Magnetic Poles • Domains • Ferromagnetism • Electromagnet • Generator • Electric Motor	

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		Design an experiment to test the voltage produced by a generator, altering one variable at a time.		

Academic Standards Alignment

Colorado CTE courses are required to integrate academic and essential skills into course content. The following academic standards have been identified as aligned to this course and should be integrated throughout instruction.

CO CTE Academic Standards Resources **(Rubrics, integration strategies, etc)**

CDE Colorado Academic Standards Online **(Online standards lookup tool)**

Standard 1: Oral Expression and Listening

- Prepared Graduate 1: Collaborate effectively as group members or leaders who listen actively and respectfully; pose thoughtful questions, acknowledge the ideas of others; and contribute ideas to further the group's attainment of an objective.
    - Students collaborate to analyze energy production and consumption systems, evaluate energy choices and their societal impacts, investigate conservation strategies, and design solutions related to energy generation and efficiency.

Standard 2: Reading for All Purposes

- Prepared Graduate 4: Read a wide range of informational texts to build knowledge and to better understand the human experience.
    - Students analyze scientific, technical, environmental, economic, and social information related to energy resources, energy transfer, electricity generation, conservation, sustainability, energy policy, and the impacts of energy choices on society and the environment.
- Prepared Graduate 5: Understand how language functions in different contexts, command a variety of word-learning strategies to assist comprehension, and make effective choices for meaning or style when writing and speaking.

- Students develop and apply specialized vocabulary related to energy systems, electricity, circuits, magnetism, energy conservation, energy transfer, environmental impacts, and energy policy to communicate scientific and technical concepts effectively.

Standard 3: Writing and Composition

- Prepared Graduate 6: Craft arguments using techniques specific to the genre.
  - Students evaluate and defend positions regarding energy conservation, renewable and nonrenewable energy sources, environmental impacts, energy policy, and societal energy choices using scientific evidence and systems-based reasoning.
- Prepared Graduate 7: Craft informational/explanatory texts using techniques specific to the genre.
  - Students develop scientific explanations, technical descriptions, systems analyses, and energy evaluations to communicate how energy is generated, transferred, stored, conserved, and used within human and environmental systems.

Standard 4: Research Inquiry and Design

- Prepared Graduate 10: Gather information from a variety of sources; analyze and evaluate its quality and relevance; and use it ethically to answer complex questions.
  - Students investigate energy resources, energy systems, environmental impacts, energy conservation strategies, economic and political influences on energy decisions, electrical systems, and energy technologies by gathering and analyzing scientific data, technical information, and societal factors to address complex energy challenges.

***Note**: Mathematics and Science standards will be added in the future. Visit the Colorado Academic Standards page for the most current version.*