WTCS Repository

10-806-169 Energy in Nature, Tech & Soc

Course Outcome Summary

Course Information

Description This course provides an introduction to the essential roles of energy in Nature and human activity. It is an interdisciplinary general education course intended for all students who desire basic understanding of the forms and applications of energy and their influence on the development of civilization, geopolitics, economics and our environment. In addition to traditional sources of energy, special emphasis is given to renewable energy. Field trips may be arranged.

Total Credits 3

Course History

Last Revision Date 8/28/2013

Pre/Corequisites

Prerequisite Each Wisconsin Technical College determines the General Education course prerequisites used by their academic institution. If prerequisites for a course are determined to be appropriate, the final Course Outcome Summary must identify the prerequisites approved for use by the individual Technical College.

Course Competencies

1. Describe the process of scientific discovery

Assessment Strategies

1.1. in recitations, in quizzing, in term papers and portfolios, and in correct responses to examination items

Criteria

Performance will be successful when:

1.1. Learner describes the scientific method as it relates to observing objects or events
1.2. Learner describes the scientific method as it relates to describing objects or events
1.3. Learner describes the scientific method as it relates to developing a hypothesis
1.4. Learner describes the scientific method as it relates to testing the hypothesis

2. Observe and perceive the concepts of energy, potential energy, power, and work

Assessment Strategies

2.1. in recitations, in quizzing, in term papers and portfolios, and in correct responses to examination items

Criteria

Performance will be successful when:

2.1. Learner lists and analyzes various forms of energy, including kinetic, gravitational, elastic, thermal and latent heat, electrical, waves, chemical, nuclear, etc.
2.2. Learner defines the concept of work
2.3. Learner defines and converts between units involved -- 1) energy (joules, BTU, foot-pounds, kilowatt-hours; and 2) power (horsepower, watts)
2.4. Learner describes the laws of thermodynamics -- 1) First Law (conservation of energy); and 2) Second Law (energy transfer and entropy)
2.5. Learner perceives the interplay between mass and energy (E=Mc2) and how it relates to our universe (Big Bang, star formation and evolution, formation of elements in supernovae, and formation of planetary systems)

3. Describe how energy is used as a tool

Assessment Strategies

3.1. in recitations, in quizzing, in term papers and portfolios, and in correct responses to examination items

Criteria

Performance will be successful when:

3.1. Learner describes early uses of energy, including fire; Stone Age tools (e.g., bows, kilns); the wheel; beasts of burden; slaves; metallurgy; wind (sailing)
3.2. Learner perceives how these tools, systems and events changed society: weaponry (including fire, explosives, nuclear weapons, etc.); agriculture; social systems; Industrial Revolution; a century of electricity
3.3. Learner analyzes mechanical advantage as it relates to simple machines, such as levers, ramps, wedges, screws, pulleys, wheel and axle, hydraulics (learner lists several common examples of each machine)

4. Identify and describe the types and uses of electricity

Assessment Strategies

4.1. in recitations, in quizzing, in term papers and portfolios, and in correct responses to examination items

Criteria

Performance will be successful when:

4.1. Learner identifies types of fuels involved (coal, nuclear, hydroelectric)
4.2. Learner describes conventional means of producing and transporting electricity (the grid) including: 1) Amperage, voltage and electrical resistance (Ohm's law); 2) Turbines and dynamos (converting kinetic energy to electricity); 3) AC v. DC current (Tesla v. Edison); 4) Transformers; and 5) Percent by coal/nuclear/hydroelectric
4.3. Learner describes other methods of generating electricity (e.g., batteries, thermocouples, photovoltaic cells)
4.4. Learner identifies common uses of electricity, including: 1) Back to heat (toasters, baseboard heaters, incandescent light bulbs); 2) Make things move (electric motors, piezoelectric crystals, etc.); 3) Generate magnetic fields (solenoids, relays, etc.); and 4) Electronics and computers
4.5. Learner describes and analyzes the use of coal and uranium as the current fuels driving the electric grid
4.6. Learner describes and analyzes the formation of coal and uranium

5. Investigate the use of energy as it relates to the transportation system

Assessment Strategies

5.1. in recitations, in quizzing, in term papers and portfolios, and in correct responses to examination items

Criteria

Performance will be successful when:

5.1. Learner lists and analyzes the 4-stroke engine, diesel engines, and 2-stroke engines
5.2. Learner lists and analyzes other types of engines (i.e., sterling and rotary)
5.3. Learner lists and analyzes advantages, limitations (practical and thermodynamic) and problems related to each type of engine
5.4. Learner describes and analyzes the use of petroleum as the current fossil fuel driving the transportation system
5.5. Learner describes and analyzes the formation of petroleum and history of petroleum production, uses,

and costs
5.6. Learner describes and analyzes world reserves of petroleum
5.7. Learner describes and analyzes exploration of, drilling for, refining and transporting petroleum, and problems related to extracting and using petroleum
5.8. Learner describes and analyzes industrial vs. residential use of petroleum
5.9. Learner describes and analyzes other byproducts of petroleum
5.10. Learner describes and analyzes political and economic aspects of a petroleum-based society
5.11. Learner describes and analyzes environmental issues related to petroleum, including short-term (smog/ozone alerts), long-term (global warming/health issues), and classic environmental and/or political disasters

6. Identify and describe sources and uses of heat and the role of natural gas in creating heat energy

Assessment Strategies

6.1. in recitations, in quizzing, in term papers and portfolios, and in correct responses to examination items

Criteria

Performance will be successful when:

6.1. Learner lists types of fossil fuels involved in heating (i.e., natural gas and LP gas)
6.2. Learner identifies characteristics of gas furnaces, gas stoves, and gas water heaters (including high-efficiency models)
6.3. Learner identifies ways heat is lost (home and hot water systems)
6.4. Learner identifies Newton's law of cooling (rate of heat flow related to temperature difference)
6.5. Learner identifies and analyzes heat conduction: the need for insulation; "R" values
6.6. Learner identifies and analyzes heat convection: hot air up the chimney; need for caulk and weather stripping
6.7. Learner identifies and analyzes heat transfer via radiation: using infra-red images of homes to show areas of greatest heat loss
6.8. Learner identifies need for proper ventilation for health risks (e.g., mold problems and radon)
6.9. Learner describes and analyzes the use of natural gas as the current fossil fuel driving the heating system
6.10. Learner identifies how natural gas is used in industry and agriculture
6.11. Learner describes and analyzes the formation of natural gas and the history of natural gas production, its uses, and costs
6.12. Learner describes and analyzes world reserves of natural gas
6.13. Learner describes and analyzes drilling for, refining, and transporting natural gas, as well as problems related to its extraction and use
6.14. Learner describes and analyzes industrial vs. residential use of natural gas
6.15. Learner describes and analyzes other byproducts of natural gas
6.16. Learner describes and analyzes political and economic aspects of a natural gas-based society
6.17. Learner describes and analyzes environmental issues related to natural gas, including short-term (smog/ozone alerts), long-term (global warming/health issues), and classic environmental and/or political disasters

7. Descrtibe how electricity is generated and used

Assessment Strategies

7.1. in recitations, in quizzing, in term papers and portfolios, and in correct responses to examination items

Criteria

Performance will be successful when:

7.1. Learner identifies types of fuels involved (coal, uranium/nuclear, water/hydroelectric)
7.2. Learner describes conventional means of producing and transporting electricity (the grid) including: 1) Amperage, voltage, and electrical resistance (Ohm's law); 2) Turbines and dynamos (converting kinetic energy to electricity); 3) AC v. DC current (Tesla v. Edison); 4) Transformers; 5) Percent of electricity generated by coal, nuclear, and hydroelectric
7.3. Learner describes other methods of generating electricity (batteries, thermocouples, photovoltaic cells, etc.)
7.4. Learner identifies common uses of electricity, including: 1) conversions back to heat (toasters, baseboard heaters, incandescent light bulbs); 2) making things move (electric motors, piezoelectric

crystals, etc.); 3) generating magnetic fields (solenoids, relays, etc.); and 4) electronics and computers
7.5. Learner describes and analyzes the use of coal and uranium as the current fuels driving the electric grid
7.6. Learner describes and analyzes the formation of coal and uranium and the history of their production, use, and costs
7.7. Learner describes and analyzes world reserves of coal and uranium
7.8. Learner describes and analyzes the mining, refining, and transportation of coal and uranium, and the problems related to extracting and using coal and uranium, and problems related to using hydroelectric power
7.9. Learner describes and analyzes industrial vs. residential use of coal, nuclear, and hydroelectric power
7.10. Learner describes and analyzes other byproducts of using coal, nuclear, and hydroelectric power, including disposal of nuclear wastes
7.11. Learner describes and analyzes the political and economic aspects of a coal-based industry
7.12. Learner describes and analyzes short- and long-term environmental issues, including classic environmental and/or political disasters related to the use of coal, nuclear and hydroelectric power

8. Investigate alternatives to present standards

Assessment Strategies

8.1. in recitations, in quizzing, in term papers and portfolios, and in correct responses to examination items

Criteria

Performance will be successful when:

8.1. Learner describes methods to conserve energy created from petroleum, natural gas, coal, uranium, and hydroelectric power in both the home and in industry
8.2. Learner describes costs of use for common items such as: 1) How much does it cost to run a television for 8 hours?; 2) What is the payback if you buy better windows?; and 3) Is it a good time to purchase a hybrid car?
8.3. Learner describes and analyzes the environmental impact of common items such as: 1) How much carbon dioxide enters the atmosphere for every gallon of gasoline used?; 2) What are the trade-offs of coal-fired v. nuclear power plants?; and 3) What effect does a hydroelectric dam have on the ecosystem?
8.4. Learner identifies and understands the energy ratings on appliances (EER, SEER ratings)
8.5. Learner describes the differences between renewable and nonrenewable sources of energy. What are the realistic goals? What are the limits to current nonrewable fuels?
8.6. Learner investigates alternatives to petroleum-based fuels (e.g., oil shale, tar sands, coal oil, hydrogen (fuel cells), natural gas, E85, hybrid cars) and the economic, political, and environmental problems each presents
8.7. Learner investigates alternatives to natural gas (e.g., solar heating, heat pumps (geothermal), wood, biogas) and the economic, political, and environmental problems each presents
8.8. Learner investigates alternatives to electricity (e.g., fuel cells, photovoltaics, wind, tidal and wave power, breeder reactors, nuclear fusion) and the economic, political, and environmental problems each presents
8.9. Learner investigates what drives the change to use alternative forms of energy and who drives the change (Government? Private businesses? Individuals?)