



## Fundamentals of Energy

Designed for Grades 6–8, *Fundamentals of Energy* is a 150-hour course designed to assist students in making informed decisions regarding their future academic and occupational goals and to provide information regarding careers in the energy career cluster. The content includes but is not limited to careers in the energy industry; various energy sources; and electrical power generation, transmission, and distribution.

Divided into seven modules with both Teacher and Student Guides, *Fundamentals of Energy* is correlated to the Next Generation Science Standards, the Common Core, as well as STEM connections. The program was piloted in Florida middle schools during the 2015-2016 school year.

### Module 1 Energy Basics

Understand conventional electric power generation--The student will be able to:

- Explain the conventional electric power generation systems and process (coal, petroleum, hydroelectric, and nuclear).

Discuss the value of alternative and renewable energy sources--The student will be able to:

- Investigate the reasons for seeking alternatives to fossil fuels.

Investigate energy consumption and identify ways to use energy wisely--The student will be able to:

- Describe energy efficiency and conservation.

### Module 2 Conventional Energy Resources

Understand conventional electric power generation--The student will be able to:

- Explain the conventional electric power generation systems and process (coal, petroleum, hydroelectric, and nuclear).

- Identify various conventional electric power generation fuel sources and the cost, efficiency, and environmental advantages and disadvantages of each.
- Draw and label diagrams of conventional electrical power generation systems.

Investigate the use of nuclear power--The student will be able to:

- Explain the process of nuclear fission.
- Define radio-isotopes and half-life.
- Evaluate the advantages and disadvantages of nuclear power.
- Draw and label a diagram of a Light-Water Reactor (LWR) (e.g. control rods, coolant, containment vessel, dry casks, turbine, etc.).
- Describe nuclear energy and how it is harnessed.
- Research and map appropriate locations ideal for nuclear applications.

### **Module 3 Renewable Energy Resources**

Discuss the value of alternative and renewable energy sources--The student will be able to:

- Investigate the reasons for seeking alternatives to fossil fuels.
- Explain the difference between alternative energy and renewable energy.

Investigate the viability of wind energy--The student will be able to:

- Describe wind energy and the way it is harnessed.
- Evaluate the advantages and disadvantages to wind technology.
- Draw and label a diagram of a wind turbine.
- Research and map appropriate locations ideal for wind energy applications.

Investigate the viability of solar energy--The student will be able to:

- Describe solar energy and how it is harnessed.
- Explain the difference between passive solar and active solar.
- Draw and label a diagram of PV cells (e.g. array, panel, module, boron-enriched silicon).
- Describe a central receiver system.
- Draw and label a diagram of a solar thermal plant.
- Evaluate the advantages and disadvantages of using solar energy.
- Research and map appropriate locations ideal for solar energy applications.

Investigate the use of hydroelectricity--The student will be able to:

- Describe hydroelectric energy and how it is produced.
- Draw and label a diagram of a hydroelectric plant.
- Evaluate the advantages and disadvantages of using hydroelectricity energy.
- Research and map appropriate locations ideal for hydroelectricity applications.

Investigate the viability of bioenergy (biomass and biofuel)--The student will be able to:

- Discuss the major sources of biomass.
- Define biofuels (e.g. ethanol, biodiesel, and methanol).
- Outline the pyramid energy flow including the different trophic levels.
- Describe the major sources, scale, and impacts of biomass energy.
- Draw and label a diagram of an electric energy producing biomass plant.
- List the advantages and disadvantages of using biomass for energy (e.g. CO<sub>2</sub> emissions, photosynthetic efficiency, cost, etc.).
- Research and map appropriate locations ideal for biomass and biofuel applications.

Investigate the viability of geothermal energy--The student will be able to:

- Describe geothermal energy and the way it is harnessed.
- Evaluate the advantages and disadvantages of using geothermal energy.
- Draw and label a diagram of a geothermal power plant.

## **Module 4 Electricity – Conventional and Renewable Power Plants**

Understand conventional electric power generation--The student will be able to:

- Explain the conventional electric power generation systems and process (coal, petroleum, hydroelectric, and nuclear).
- Identify various conventional electric power generation fuel sources and the cost, efficiency, and environmental advantages and disadvantages of each.
- Draw and label diagrams of conventional electrical power generation systems.

Discuss the value of alternative and renewable energy sources--The student will be able to:

- Investigate the reasons for seeking alternatives to fossil fuels.
- Explain the difference between alternative energy and renewable energy.

## Module 5 Electrical Generation in Your State

Understand conventional electric power generation--The student will be able to:

- Explain the conventional electric power generation systems and process (coal, petroleum, hydroelectric, and nuclear).
- Identify various conventional electric power generation fuel sources and the cost, efficiency, and environmental advantages and disadvantages of each.
- Draw and label diagrams of conventional electrical power generation systems.

Discuss the value of alternative and renewable energy sources--The student will be able to:

- Investigate the reasons for seeking alternatives to fossil fuels.
- Explain the difference between alternative energy and renewable energy.

Calculate greenhouse gas emissions based on local fuel mixture and energy consumption--The student will be able to:

- Plan ways to conserve energy at home and at school.
- Plan ways to improve energy efficiency at home and at school.

## Module 6 Electrical Transmission, Distribution, and Safety

Understand electric power transmission and distribution--The student will be able to:

- Explain the electric power transmission process.
- Discuss the application of different electric power transmission principles (including AC vs. DC).
- Explain the electric power distribution process.
- Discuss the need for electric distribution systems and how they are designed to operate.
- Discuss the emerging technologies in electric power transmission and distribution, including distribution automation, SmartGrid systems, Supervisory Control and Data Acquisition (SCADA), Advanced Metering Infrastructure (AMI), automated transfer system, and fuel cells.

## **Module 7 Energy Consumption and Efficiency**

Investigate energy consumption and identify ways to use energy wisely--The student will be able to:

- Describe energy efficiency and conservation.
- Read and interpret a residential utility bill.
- Learn how to measure energy use of various equipment.
- Learn how to measure light output.
- Graph temperature and humidity levels in classrooms.