U.S. DEPARTMENT OF ENERGY | Office of Science

Integrating a Holistic View of Energy Principles into High School Physics

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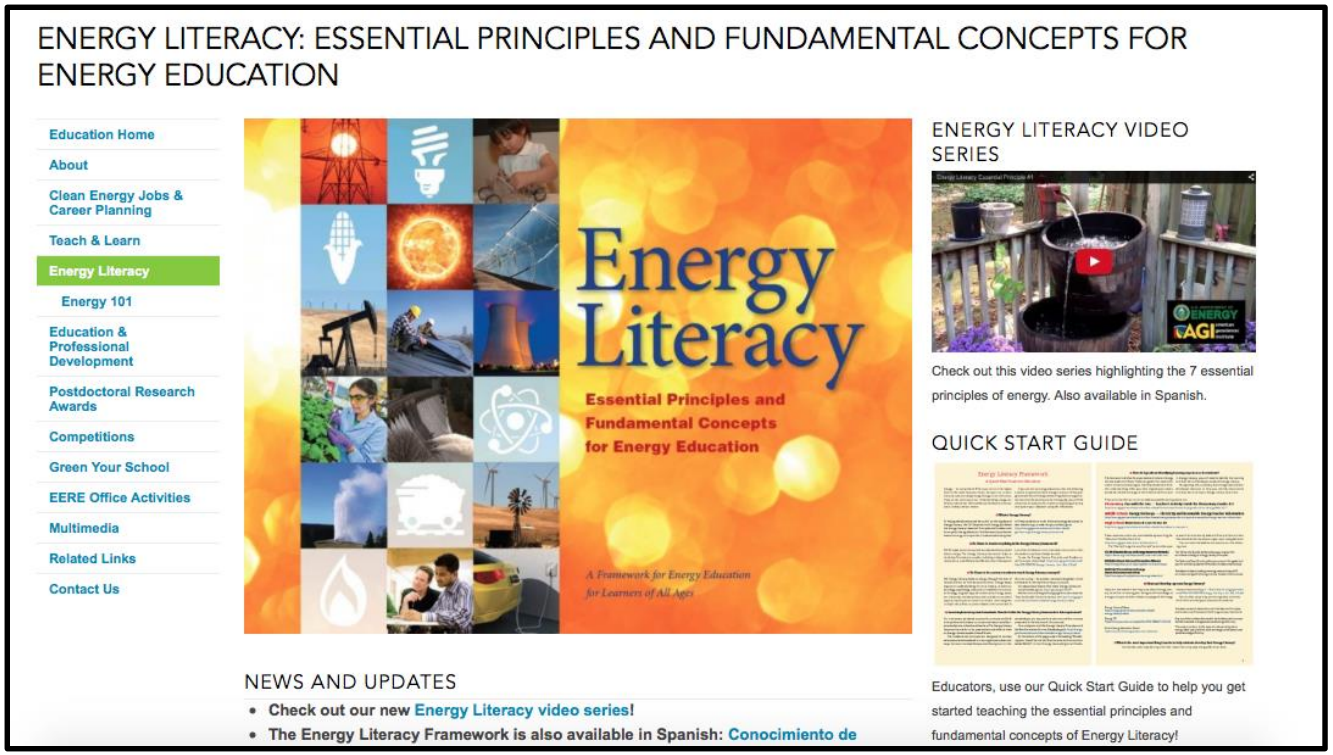
Summer Meeting 2015

DOE Energy Literacy Framework



- **Energy Literacy Framework is a guide to help energy educators teach energy from the natural to the social sciences. Also available in Spanish.**

  http://energy.gov/eere/education/energy-literacy-essential-principles-and-fundamental-concepts-energy-education

- **Video series addressing each of the 7 literacy principles:**
  http://www.energy.gov/eere/education/downloads/energy-literacy-videos

Energy Literacy Principles

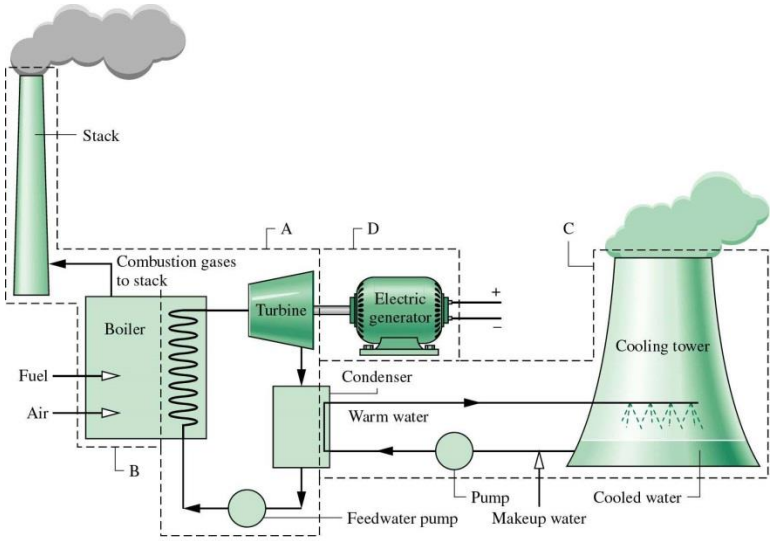
1. Energy is a physical quantity that follows precise natural laws.
2. Physical processes on Earth are the result of energy flow through the Earth system
3. Biological Processes depend on energy flow through the Earth System
4. Various sources of energy can be used to power human activities, and often this energy must be transferred from source to destination.
5. Energy decisions are influenced by economic, political, environmental, and social factors.
6. The amount of energy used by human society depends on many factors.
7. The quality of life of individuals and societies is affected by energy choices.

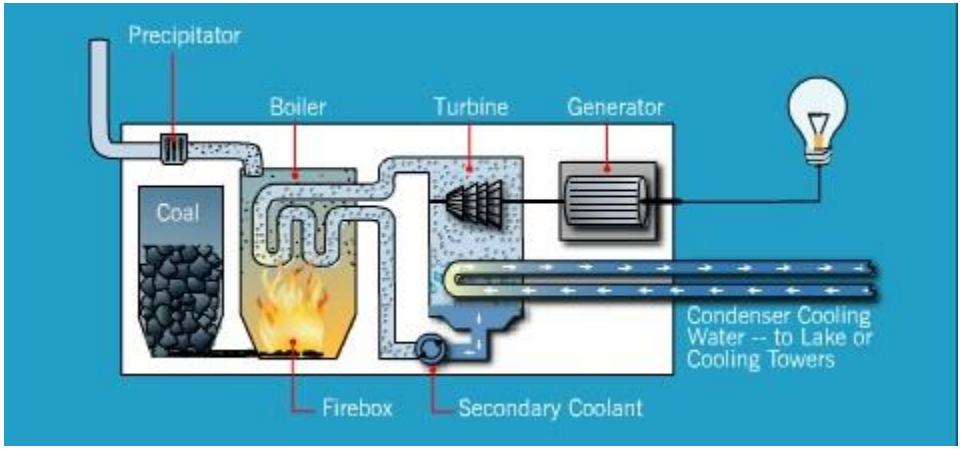
Energy Literacy: Essential Principles and Fundamental Concepts for Energy Education, (2013). U.S. Department of Energy. www.eere.energy.gov/education/energy_literacy.html

Literacy Principles 1 and 2

NGSS HP-PS2-5 “Plan and conduct an investigation to provide evidence that an electrical current can produce a magnetic field and that a changing magnetic field can produce an electrical current.”

- **Changing magnetic field -> electric current is what a generator does**
- **Ask students to trace the energy flow / conversion**





http://mae.wvu.edu/~smirnov/mae320/figs/F8-1.jpg
https://www.duke-energy.com/about-energy/generating-electricity/coal-fired-how.asp

Literacy Principle 4

- **Nice 3:15 minute video tracing energy through a turbine**

  https://www.youtube.com/watch?v=5kFOq9_10kc

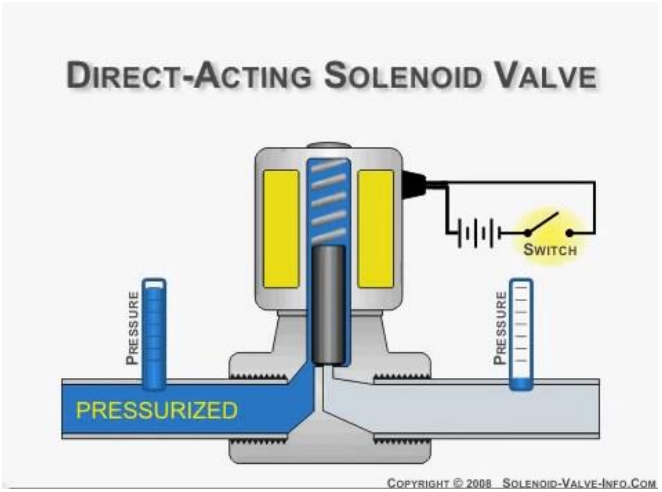
- **Ask students to distinguish between fuels that use a turbine generator to make electricity and those that experience direct conversion.**

solar, geothermal, wind, biomass waste,
biomass fuel, wood, hydropower,
petroleum fuels, coal, nuclear, natural gas

Backwards

- **Think about opposite flow of energy**
- **Electric current -> changing magnetic field -> motion of a solid mass is what a motor does**
- **Ask students to trace the energy flow / conversion**

Junkyard Heavy Electric Magnet Machine Picking Up Scrap In Our Truck Fun For Kids



https://www.youtube.com/watch?v=XBWy9gzGGd4

https://www.youtube.com/watch?v=SwqM8zpmAD8

Literacy Principles 1 and 5

NGSS HS-PS4-4 “Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter.”

Class Debate:

Claim against:
Never buy a house near high voltage power lines.

Claim for:
It’s fine to buy a house near high voltage power lines.

- The mechanism of electromagnetic radiation that causes / does not cause cell damage (the energy flow)
- Economic considerations
- The sociological, psychological, religious factors that underlie people’s beliefs when faced with scientific data

Debate Resources

- **Reliable sources**
  - NIH http://www.niehs.nih.gov/health/topics/agents/emf/
  - NIH http://www.cancer.gov/about-cancer/causes-prevention/risk/radiation/magnetic-fields-fact-sheet
  - National Geographic http://ngm.nationalgeographic.com/2015/03/science-doubters/achenbach-text
- **Company selling shielding** safespace

  http://www.safespaceprotection.com/electrostress-from-power-lines.aspx
- **Blog of the people considering buying homes:**

  http://www.trulia.com/voices/Home_Buying/Is_it_safe_to_buy_a_home_with_power_lines_in_near_-478241

Literacy Principles 2 and 5

NGSS HP-PS3-3 “Design, build and refine a device that works within given constraints to convert one form of energy into another form of energy.

- **Rube Goldberg devices, wind turbines, solar cells, solar ovens, generators.**
- **Require:**
  - Energy flow back to original source
  - Efficiency measurements and/or constraints
  - Optimization problem once groups is finished – need to generate a certain amount of energy, weight correlates to costs to build, political/social constraints on number of each type.

Literacy Principle 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.

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Questions

- **Email us at energyliteracy@ee.doe.gov**