Unit 03B: Energy (Thermodynamics) NJ NGSS

Content Area: **Science**
Course(s): **Generic Course**
Time Period: **Marking Period 2**
Length: **3 weeks**
Status: **Published**

Standards

- Energy is a quantitative property of a system that depends on the motion and interactions of matter and radiation within that system. That there is a single quantity called energy is due to the fact that a system's total energy is conserved, even as, within the system, energy is continually transferred from one object to another and between its various possible forms. (HS-PS3-1),(HS-PS3-2)
- These relationships are better understood at the microscopic scale, at which all of the different manifestations of energy can be modeled as a combination of energy associated with the motion of particles and energy associated with the configuration (relative position of the particles). In some cases the relative position energy can be thought of as stored in fields (which mediate interactions between particles). This last concept includes radiation, a phenomenon in which energy stored in fields moves across space. (HS-PS3-2)
- Uncontrolled systems always evolve toward more stable states—that is, toward more uniform energy distribution (e.g., water flows downhill, objects hotter than their surrounding environment cool down). (HS-PS3-4)

http://www.state.nj.us/education/modelcurriculum/sci/physicsu3.shtml

SCI.9-12.HS-PS3-2	Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motion of particles (objects) and energy associated with the relative position of particles (objects).
SCI.9-12.HS-PS3-4	Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).
SCI.9-12.HS-PS3-3	Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.
SCI.9-12.HS-PS3-1	Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

Essential Questions

- What are some ways to increase or decrease the temperature of a room?
- If you have one object consisting of material A, and a second object consisting of material B, why does object A "feel" colder than object B. (IE: steel and wood)
- When two objects collide, what happens to the energy? (IE: two cars)

Content / Skills

- Explain that Thermodynamics is the study of heat as a form of mechanical energy. (Accelerated & CP: *Additional Topic when Time Permits*)
- Know that all particles are in constant vibrational motion. (Accelerated & CP: *Additional Topic when Time Permits*)
- Heat is measured in energy units. (Accelerated & CP: *Additional Topic when Time Permits*)
- Temperature is a measure of how hot a material is. (Accelerated & CP: *Additional Topic when Time Permits*)
- Temperature is related to the average translational kinetic energy of a particle. (Accelerated & CP: *Additional Topic when Time Permits*)
- Temperature can be measures in celcius, degrees or Kelvin scale. (Accelerated & CP: *Additional Topic when Time Permits*)
- Absolute Zero Kelvin and -273 degrees Celcius is the lower limit of temperature. (Accelerated & CP: *Additional Topic when Time Permits*)
- Describe and calculate heat transfer through thermal collisions. (Accelerated & CP: *Additional Topic when Time Permits*)
- Heat flows when there is a temperature difference. (Accelerated & CP: *Additional Topic when Time Permits*)
- Calculate and model temperature and heat changes using the specific heat capacity of a material. (Accelerated & CP: *Additional Topic when Time Permits*)
- Explain why materials expand when heated. (Accelerated & CP: *Additional Topic when Time Permits*)
- Discuss the consequences of water at 4 degrees being more dense than 0 degrees. (Accelerated & CP: *Additional Topic when Time Permits*)
- Explain how heat conducts through a material. (Accelerated & CP: *Additional Topic when Time Permits*)
- Explain the process of convenction on the molecular scale. (Accelerated & CP: *Additional Topic when Time Permits*)
- Describe how heat is transmitted by radiation. (Accelerated & CP: *Additional Topic when Time Permits*)
- Explain how radiant energy is absorbed and emitted. (Accelerated & CP: *Additional Topic when Time Permits*)
- Explain the meaning of The Greenhouse effect. (Accelerated & CP: *Additional Topic when Time Permits*)
- Descibe how solar radiation is converted to heat by greenhouse gasses. (Accelerated & CP: *Additional Topic when Time Permits*)
- Model the absorption and transmission of radiation in the atmosphere. (Accelerated & CP: *Additional Topic when Time Permits*)
- State the first law of thermodynamics and explain how it relates to conservation of energy. (Accelerated & CP: *Additional Topic when Time Permits*)
- Define and give examples of an adiabatic process.(Accelerated & CP: *Additional Topic when Time Permits*)
- State the second law of thermodynamics and how it applies to heat engines. (Accelerated & CP: *Additional Topic when Time Permits*)
- Calculate the efficiency of a heat engine. (Accelerated & CP: *Additional Topic when Time Permits*)
- Define entropy and why it increases in an open system. (Accelerated & CP: *Additional Topic when Time Permits*)