



Physics

Connections to Other Sciences

Here are some examples of how the concepts you studied in this chapter relate to other sciences.

Electric Charges

Biology An isotonic solution contains a balance of charged particles identical to blood and therefore, can be safely used in the transfusions of liquid.

Chemistry The electrostatic forces between oppositely charged ions (cations and anions) bind crystals together, as in sodium chloride.

Earth Science Certain mineral crystals under pressure form an electric discharge.

Electric Energy

Biology Electric eels store energy in their organs in a configuration similar to an electric battery. This configuration allows larger eels to deliver powerful shocks of up to 600 volts, or five times the voltage of a wall socket.

Chemistry The electron affinity difference between two dissimilar metals in solution is the source of electric energy found in a cell or battery.

Earth Science The potential energy of the separated charges in a thunderstorm is the source of tremendous amounts of electric energy released in a lightning bolt.

Heat and Thermodynamics

Biology Life on Earth is water-based. The high specific heat of water is one factor that allows organisms to function in below-freezing temperatures for significant periods of time without damage.

Chemistry The position on the periodic table of an element is one factor that determines its specific heat. The specific heat is inversely proportional to an element's atomic mass: the higher the atomic mass, the lower the specific heat. This relationship for solids is known as the law of DuLong-Petit.

Earth Science The heat absorbed in the tropics is distributed to higher latitudes by convection of ocean and air currents. The high specific heat of the warm water from the Gulf Stream is responsible for the relatively mild climate of northern Europe.

Electric Currents

Biology A pacemaker is designed to analyze the function of the heart's own electrical system and when needed, to stimulate the heart by delivering small, precisely timed electric pulses via a current.

Chemistry The flow of electric charge through a solution is used to deposit a layer of material on a surface in a process called electroplating. The bright finish on car parts is produced by electroplating.

Earth Science A typical lightning bolt in a thunderstorm can transfer current at the rate of thousands of amperes with a potential difference of billions of volts.

Series and Parallel Connections

Biology When an electric pulse flows from one nerve to the next through a synapse along a long nerve fiber, the connection is analogous to a series circuit. The connections between nerve cells in the brain form a parallel connection.

Chemistry Monitoring systems for industrial chemical processes are connected either in series or in parallel. Pressure meters are connected in parallel to prevent interference with the process, while flow meters are connected in series.

Earth Science A river with only one channel transports water along a single path. A braided stream carries water in parallel channels. The water flowing in these various water courses follows the same patterns as series and parallel electric circuits.

Entropy

Biology Although entropy indicates that natural systems should always go to states of greater disorder, living organisms can violate this process locally with an input of energy, decreasing their entropy. This implies an increase in entropy in the systems that support life.

Chemistry Entropy dictates that naturally occurring chemical processes are not reversible without the input of energy.

Earth Science The erosion of landforms is a consequence of entropy, as differences in altitude are gradually reduced. The input of energy from inside Earth, evidenced by the creation of mountains, is necessary to reverse this process.

