


Physics Connections to Other Sciences

This section explains the connections between physics and other sciences and provides a deeper understanding of natural phenomena. Brief descriptions of scientific phenomena demonstrate how energy is the battery of life and how different scientific disciplines interact with each other.

Students can explore how physics concepts relate to other scientific fields by extending their inquiry through the research of the information presented in *Physics Connection to Other Sciences*. You could ask students to go to the school library or the Internet for more resources that connect physics concepts to biology, chemistry, and Earth science. Emphasize the growing interdisciplinary approach to science and the need for scientists to understand the fundamentals of electricity, including electric charges such as the forces between electric charges and the energy related to them, the relationship between constructs in parallel and series, the laws of thermodynamics, including heat energy, how it is transferred, and the concept of entropy. Discuss the relevance of scientific concepts in everyday life and encourage students to relate physics concepts they have learned in this section to other sciences familiar to them. Reiterate that science concepts discussed in this chapter also provide scientists in other fields with new insights when they conduct research pertaining to a topic of their


Chapter 6 Electricity for Everyone

Physics
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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.

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interest. Emphasize that because of interdisciplinary scientific research, cross-disciplinary fields have emerged, such as nuclear medicine, radiology, biochemistry, and biophysics. If students are unfamiliar with the scientific terms discussed in the examples, explain them and ask them to take down notes in their *Active Physics* log books.