

Physics Connections to Other Sciences

Physics Connections to Other Sciences is fundamental to how science operates in the real world. This section provides a glimpse of the interconnectedness of different scientific disciplines. The brief descriptions relate students' study of physics concepts to biology, chemistry, and Earth science. Each description deals with an aspect of how various physics principles are intrinsic to the behavior of living beings, chemical substances, and geological phenomena (Earth science).

Discuss the science connections and encourage students to draw analogies with science connections they are familiar with. Students will gain a deep understanding of interdisciplinary interactions if they are actively engaged in the process of thinking about connections between different scientific disciplines. Encourage students to appreciate physics in relation to a broader framework of scientific interactions that are gaining ground as major areas of study—such as geophysics, biochemistry, and biophysics.

If students are unfamiliar with the content of the other branches of science discussed in the examples in their textbooks, explain scientific terms they don't know and ask them to take down notes in their *Active Physics* logs.



Chapter 1 Driving the Roads

Physics

Connections to Other Sciences



The fundamental ideas you have studied in this chapter are also basic to many other sciences that you will study in the future. Appreciating the connections among science disciplines helps scientists achieve a richer understanding of nature. Science research in the twenty-first century depends heavily upon the way these different disciplines interact, with areas such as biophysics and geophysics becoming major areas of study.

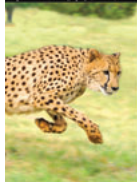
Here are some examples of how the concepts you studied in this chapter relate to other sciences.

Response Time

Biology An animal's response time may be critical for its survival. A bird that responds too slowly to a hawk, or a fly that fails to evade a frog's tongue, will not survive long.

Chemistry The time it takes a chemical to respond to light, and then bond with other chemicals, is one of the criteria for determining film speed for cameras.

Earth Science The response of the polar ice caps due to global warming may take hundreds of years to become completely visible.



Circular Motion

Biology Many birds will soar in circles on thermals—rising columns of warm air. The birds bank their wings to provide a centripetal force toward the center of the thermal and the lifting force of the rising air.

Chemistry Magnetic fields cause charged molecular fragments to travel in a circle. The larger the circle, the more massive the charged fragments must be, giving chemists an idea of what the composition of these parts may be.

Earth Science Most of the weather systems on Earth are examples of large masses of air that circle around a central position due to the Coriolis force that is experienced by air masses moving on a rotating Earth. This force is part of the reason for Earth's global winds and ocean currents.



Speed and Velocity

Biology The speeds obtainable by living organisms vary, from that of a diving peregrine falcon (almost 200 mph or 322 km/h) to that of a slime mold (1 mm/hr or 0.04 in./hr).

Chemistry The high speed gained by molecules in a chemical explosion is responsible for the damage they do.

Earth Science The speed of advance of a glacier may be as much as several feet per day.

Acceleration

Biology The fastest land animal, the cheetah, is able to accelerate from rest to a speed of 60 mph in only 3 seconds, or almost 9 m/s^2 (30 ft/s^2)!

Chemistry Electrons are accelerated to a very high speed and collide with molecules in a device known as a mass spectrometer, which is used in forensics for solving crimes.

Earth Science An earthquake may accelerate the floor of the ocean upward for a very short time, causing a tsunami that is capable of damaging large sections of a coastline.

Doppler Effect

Biology The velocity measurement of blood flow in arteries and veins, based on the Doppler effect, is an effective tool for diagnosis of vascular problems.

Chemistry The random motion of atoms of a gas due to their kinetic energy results in a shift in the frequency of the light emitted by the atoms due to the Doppler effect. Thus, the light emitted by a gas has a wider range of frequencies than that of a single atom.

Earth Science The expansion rate of the universe is determined by astronomers who use the Doppler effect to calculate the speed of moving galaxies.

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This will give you the opportunity to model how you are comfortable explaining scientific phenomena studied in biology, chemistry, or Earth science.