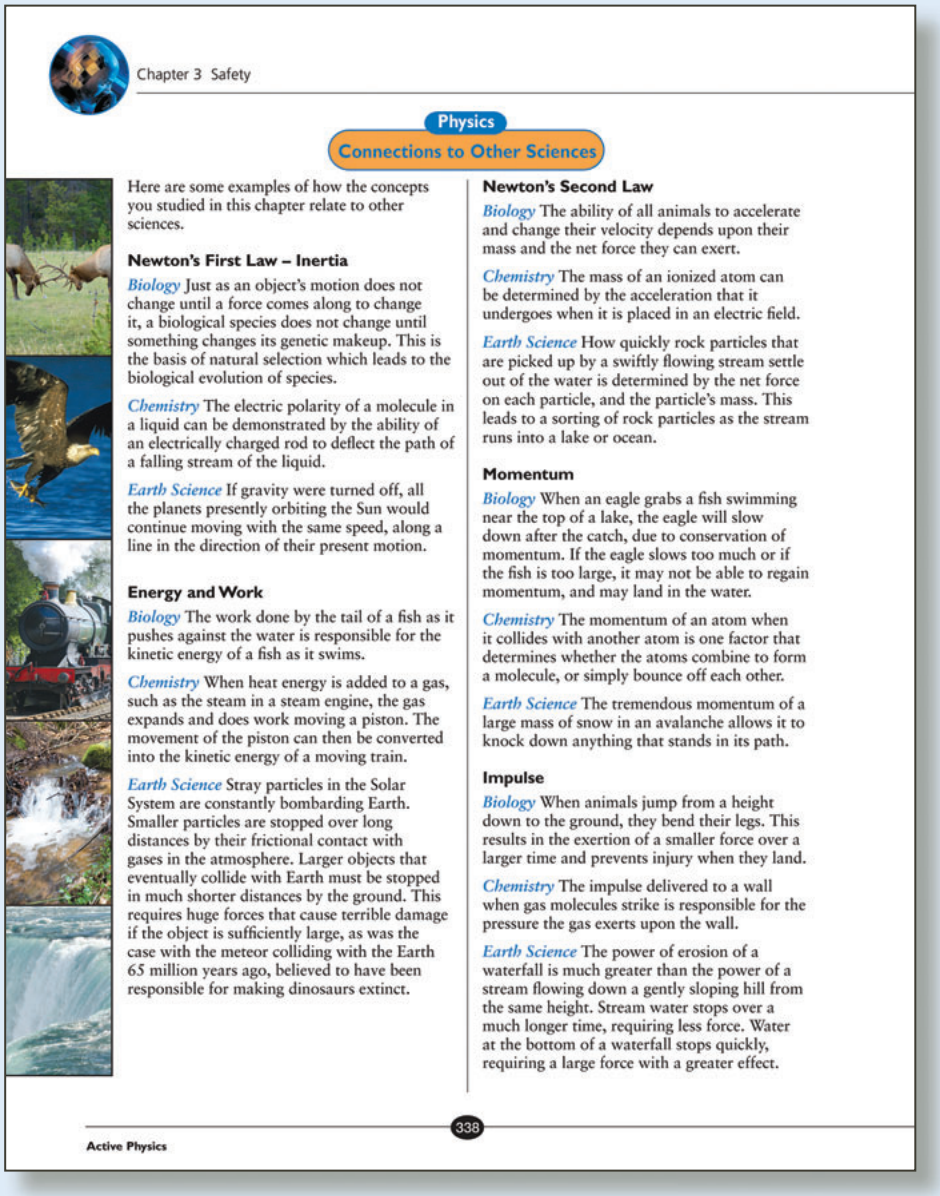
Physics Connections to Other Sciences

Students gain understanding of interdisciplinary interactions when they are actively engaged in thinking about connections between scientific disciplines. This section provides a glimpse of the interconnectedness between the physics concepts presented in this chapter and the scientific disciplines of biology, chemistry, and Earth science. Brief sketches relate students' study of physics concepts to biology, chemistry, and Earth science.

Encourage students to draw analogies with science connections they are familiar with while discussing the science connections. The science concepts discussed in this chapter must hold true for every branch of science, and can provide scientists in other fields with new insights. Emphasize the growing interdisciplinary approach to science and the need for scientists to understand the fundamentals of forces, momentum, and energy. Discuss how scientists try to understand phenomena by studying interactions using either a force approach and applying ideas such as the conservation of momentum law that involve vector quantities, or an energy approach which involves scalar quantities. Encourage appreciation for physics in relation to the broader framework of science by describing the increase in demand for scientists with interdisciplinary backgrounds. (For example, geophysics, biochemistry, and biophysics.)



Chapter 3 Safety

Physics

Connections to Other Sciences

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

Newton's First Law – Inertia

Biology Just as an object's motion does not change until a force comes along to change it, a biological species does not change until something changes its genetic makeup. This is the basis of natural selection which leads to the biological evolution of species.

Chemistry The electric polarity of a molecule in a liquid can be demonstrated by the ability of an electrically charged rod to deflect the path of a falling stream of the liquid.

Earth Science If gravity were turned off, all the planets presently orbiting the Sun would continue moving with the same speed, along a line in the direction of their present motion.

Energy and Work

Biology The work done by the tail of a fish as it pushes against the water is responsible for the kinetic energy of a fish as it swims.

Chemistry When heat energy is added to a gas, such as the steam in a steam engine, the gas expands and does work moving a piston. The movement of the piston can then be converted into the kinetic energy of a moving train.

Earth Science Stray particles in the Solar System are constantly bombarding Earth. Smaller particles are stopped over long distances by their frictional contact with gases in the atmosphere. Larger objects that eventually collide with Earth must be stopped in much shorter distances by the ground. This requires huge forces that cause terrible damage if the object is sufficiently large, as was the case with the meteor colliding with the Earth 65 million years ago, believed to have been responsible for making dinosaurs extinct.

Newton's Second Law

Biology The ability of all animals to accelerate and change their velocity depends upon their mass and the net force they can exert.

Chemistry The mass of an ionized atom can be determined by the acceleration that it undergoes when it is placed in an electric field.

Earth Science How quickly rock particles that are picked up by a swiftly flowing stream settle out of the water is determined by the net force on each particle, and the particle's mass. This leads to a sorting of rock particles as the stream runs into a lake or ocean.

Momentum

Biology When an eagle grabs a fish swimming near the top of a lake, the eagle will slow down after the catch, due to conservation of momentum. If the eagle slows too much or if the fish is too large, it may not be able to regain momentum, and may land in the water.

Chemistry The momentum of an atom when it collides with another atom is one factor that determines whether the atoms combine to form a molecule, or simply bounce off each other.

Earth Science The tremendous momentum of a large mass of snow in an avalanche allows it to knock down anything that stands in its path.

Impulse

Biology When animals jump from a height down to the ground, they bend their legs. This results in the exertion of a smaller force over a larger time and prevents injury when they land.

Chemistry The impulse delivered to a wall when gas molecules strike is responsible for the pressure the gas exerts upon the wall.

Earth Science The power of erosion of a waterfall is much greater than the power of a stream flowing down a gently sloping hill from the same height. Stream water stops over a much longer time, requiring less force. Water at the bottom of a waterfall stops quickly, requiring a large force with a greater effect.

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Active Physics

Consider developing an interdisciplinary lesson plan that investigates how these *Key Physics Concepts* of force, momentum, and energy are applied in different sciences. Groups could select an object and determine how it relates to biology, chemistry, and Earth science based on their reading of *Physics Connections to Other Sciences*, and how it relates to the *Key Physics Concepts* of force, momentum, and energy. A set of questions could be constructed for students to focus on to build a constructive inquiry. Each group member could write down the highlights of their discussion. Once students have recorded the focal points of their discussion, bring the whole class together and have a student volunteer from each group to share their knowledge of important science connections.