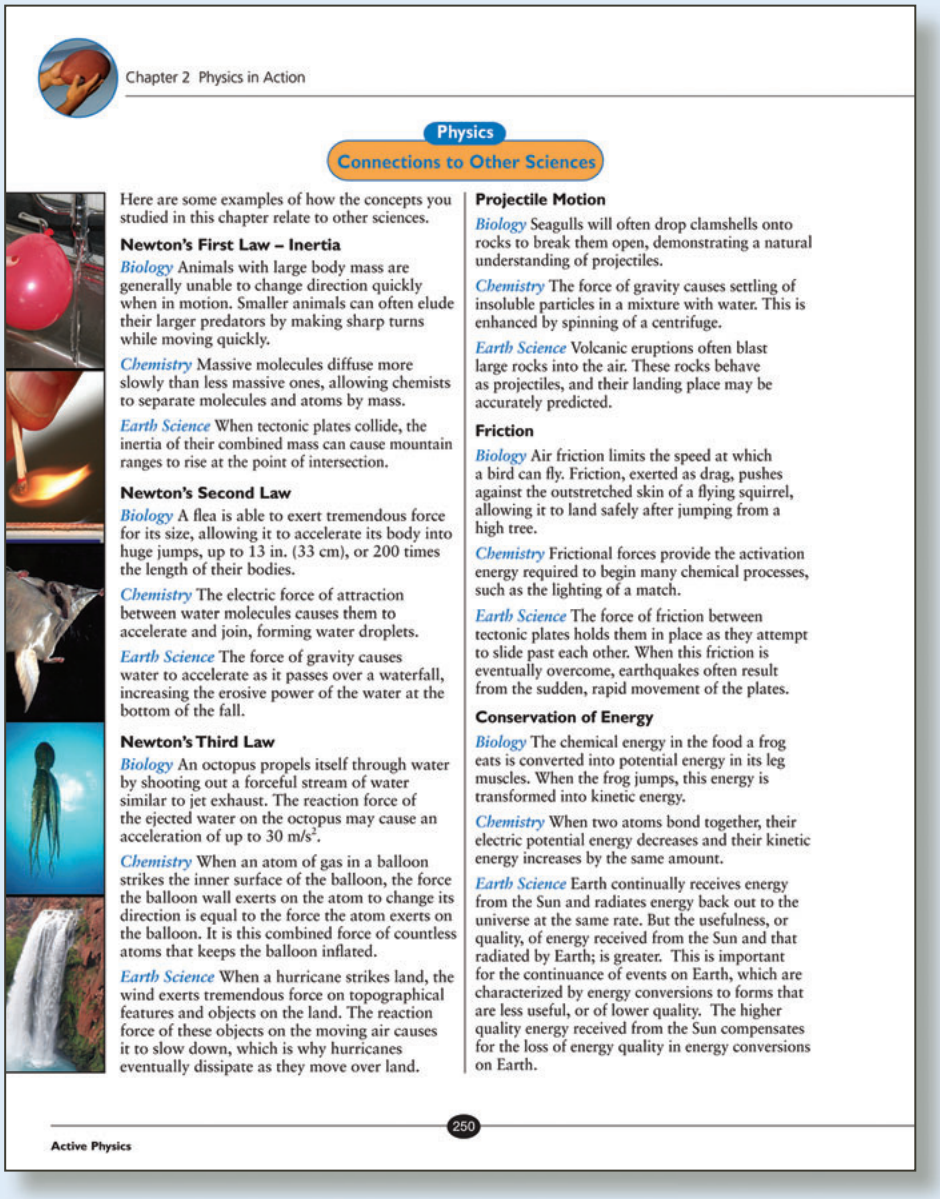
Physics Connections to Other Sciences

This section shows how intrinsic the laws of motion are to understanding natural phenomena that are studied under different scientific disciplines. Body mass becomes an impediment to animals with large bodies, massive molecules diffuse more slowly, and the combined mass of mountain ranges have so much inertia that it causes them to rise at the point of intersection when tectonic plates collide. These examples, among others, point to the significance of the connections physics makes with other sciences. To have a thorough understanding of any scientific process, it is essential to approach it from multiple-scientific perspectives. Students should, therefore, look for instances of a scientific concepts in other branches of science with which they are familiar. Encourage them to follow an interdisciplinary approach to learning.

Ask students to read the information provided in their student text on the connections of physics to biology, chemistry, and Earth science. Consider dividing students into groups of four and assign each group biology, chemistry, or Earth science connections. Ask each group to read the information given in the text, discuss, and paraphrase their understanding of each connection. For example, you could assign a group two biology connections, two chemistry, or two Earth science connections. Then ask student volunteers from each group to present their information in a whole-class discussion.



Chapter 2 Physics in Action

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 Animals with large body mass are generally unable to change direction quickly when in motion. Smaller animals can often elude their larger predators by making sharp turns while moving quickly.

Chemistry Massive molecules diffuse more slowly than less massive ones, allowing chemists to separate molecules and atoms by mass.

Earth Science When tectonic plates collide, the inertia of their combined mass can cause mountain ranges to rise at the point of intersection.

Newton's Second Law

Biology A flea is able to exert tremendous force for its size, allowing it to accelerate its body into huge jumps, up to 13 in. (33 cm), or 200 times the length of their bodies.

Chemistry The electric force of attraction between water molecules causes them to accelerate and join, forming water droplets.

Earth Science The force of gravity causes water to accelerate as it passes over a waterfall, increasing the erosive power of the water at the bottom of the fall.

Newton's Third Law

Biology An octopus propels itself through water by shooting out a forceful stream of water similar to jet exhaust. The reaction force of the ejected water on the octopus may cause an acceleration of up to 30 m/s^2.

Chemistry When an atom of gas in a balloon strikes the inner surface of the balloon, the force the balloon wall exerts on the atom to change its direction is equal to the force the atom exerts on the balloon. It is this combined force of countless atoms that keeps the balloon inflated.

Earth Science When a hurricane strikes land, the wind exerts tremendous force on topographical features and objects on the land. The reaction force of these objects on the moving air causes it to slow down, which is why hurricanes eventually dissipate as they move over land.

Projectile Motion

Biology Seagulls will often drop clamshells onto rocks to break them open, demonstrating a natural understanding of projectiles.

Chemistry The force of gravity causes settling of insoluble particles in a mixture with water. This is enhanced by spinning of a centrifuge.

Earth Science Volcanic eruptions often blast large rocks into the air. These rocks behave as projectiles, and their landing place may be accurately predicted.

Friction

Biology Air friction limits the speed at which a bird can fly. Friction, exerted as drag, pushes against the outstretched skin of a flying squirrel, allowing it to land safely after jumping from a high tree.

Chemistry Frictional forces provide the activation energy required to begin many chemical processes, such as the lighting of a match.

Earth Science The force of friction between tectonic plates holds them in place as they attempt to slide past each other. When this friction is eventually overcome, earthquakes often result from the sudden, rapid movement of the plates.

Conservation of Energy

Biology The chemical energy in the food a frog eats is converted into potential energy in its leg muscles. When the frog jumps, this energy is transformed into kinetic energy.

Chemistry When two atoms bond together, their electric potential energy decreases and their kinetic energy increases by the same amount.

Earth Science Earth continually receives energy from the Sun and radiates energy back out to the universe at the same rate. But the usefulness, or quality, of energy received from the Sun and that radiated by Earth; is greater. This is important for the continuance of events on Earth, which are characterized by energy conversions to forms that are less useful, or of lower quality. The higher quality energy received from the Sun compensates for the loss of energy quality in energy conversions on Earth.

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