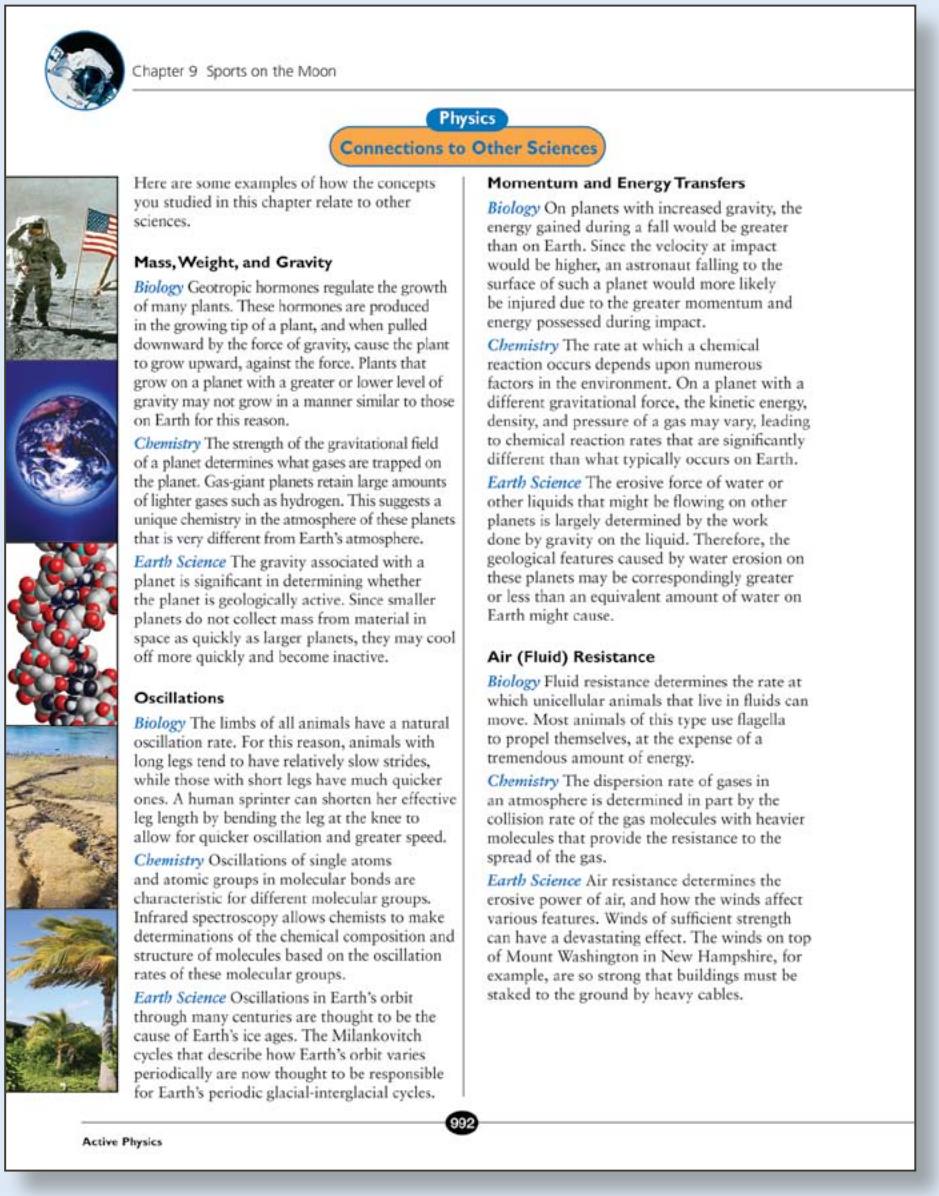
Physics Connections to Other Sciences

Students discover how familiar physics concepts relate to other sciences. For example, the growth of plants studied in biology is related to the downward force of gravity; in physics the strength of the gravitational field determines which gases are trapped on a planet, and for the Earth sciences gravity plays a role in determining whether the planet is geologically active. Similar connections are established through other examples that demonstrate the deep connections among the different scientific disciplines. Scientists, in fact, rarely study concepts in isolation. They often have to cross the boundaries of individual disciplines and have a sound knowledge of other sciences to make sense of their experiments and prove their theories.

For students to appreciate the connections that exist among different sciences, ask them to write brief descriptions of examples given in the student texts. Divide them into groups and have them share their information. Ask them to highlight the information that is essential to making these connections, and have them draw a concept map showing how the same concept is linked to different sciences. Students can then interact to consider these connections in a whole-class discussion.



Chapter 9 Sports on the Moon

Physics

Connections to Other Sciences

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

Mass, Weight, and Gravity

Biology Geotropic hormones regulate the growth of many plants. These hormones are produced in the growing tip of a plant, and when pulled downward by the force of gravity, cause the plant to grow upward, against the force. Plants that grow on a planet with a greater or lower level of gravity may not grow in a manner similar to those on Earth for this reason.

Chemistry The strength of the gravitational field of a planet determines what gases are trapped on the planet. Gas-giant planets retain large amounts of lighter gases such as hydrogen. This suggests a unique chemistry in the atmosphere of these planets that is very different from Earth's atmosphere.

Earth Science The gravity associated with a planet is significant in determining whether the planet is geologically active. Since smaller planets do not collect mass from material in space as quickly as larger planets, they may cool off more quickly and become inactive.

Oscillations

Biology The limbs of all animals have a natural oscillation rate. For this reason, animals with long legs tend to have relatively slow strides, while those with short legs have much quicker ones. A human sprinter can shorten her effective leg length by bending the leg at the knee to allow for quicker oscillation and greater speed.

Chemistry Oscillations of single atoms and atomic groups in molecular bonds are characteristic for different molecular groups. Infrared spectroscopy allows chemists to make determinations of the chemical composition and structure of molecules based on the oscillation rates of these molecular groups.

Earth Science Oscillations in Earth's orbit through many centuries are thought to be the cause of Earth's ice ages. The Milankovitch cycles that describe how Earth's orbit varies periodically are now thought to be responsible for Earth's periodic glacial-interglacial cycles.

Momentum and Energy Transfers

Biology On planets with increased gravity, the energy gained during a fall would be greater than on Earth. Since the velocity at impact would be higher, an astronaut falling to the surface of such a planet would more likely be injured due to the greater momentum and energy possessed during impact.

Chemistry The rate at which a chemical reaction occurs depends upon numerous factors in the environment. On a planet with a different gravitational force, the kinetic energy, density, and pressure of a gas may vary, leading to chemical reaction rates that are significantly different than what typically occurs on Earth.

Earth Science The erosive force of water or other liquids that might be flowing on other planets is largely determined by the work done by gravity on the liquid. Therefore, the geological features caused by water erosion on these planets may be correspondingly greater or less than an equivalent amount of water on Earth might cause.

Air (Fluid) Resistance

Biology Fluid resistance determines the rate at which unicellular animals that live in fluids can move. Most animals of this type use flagella to propel themselves, at the expense of a tremendous amount of energy.

Chemistry The dispersion rate of gases in an atmosphere is determined in part by the collision rate of the gas molecules with heavier molecules that provide the resistance to the spread of the gas.

Earth Science Air resistance determines the erosive power of air, and how the winds affect various features. Winds of sufficient strength can have a devastating effect. The winds on top of Mount Washington in New Hampshire, for example, are so strong that buildings must be staked to the ground by heavy cables.

992

Active Physics