

THE LIVING ENVIRONMENT

INTERDEPENDENCE OF LIFE (5D)

Every species is linked, directly or indirectly, with a multitude of others in an ecosystem. Ecosystems are shaped by both the nonliving environment and by its inhabitants, including humans. Hence, benchmarks on this map are closely related to benchmarks on the **FLOW OF MATTER IN ECOSYSTEMS** map in *Atlas 1* and to benchmarks on the **USE OF EARTH'S RESOURCES** map.

The map is organized around four strands—*interactions among organisms, dynamic nature of ecosystems, dependence of organisms on their environment, and human impact*. The learning progression begins in the elementary grades with an emphasis on the needs of organisms and how they are met in different environments. In middle school, the emphasis is on understanding how organisms (including humans) interact with one another and with the environment in a wide variety of ecosystems. In high school, students' knowledge about the interdependence of organisms in ecosystems and the environment is linked to more abstract ideas about stability and change in systems.

NOTES

Students may not regard food as a scarce resource for animals and, hence, may not consider competition among species for food resources. Therefore, the grades 6-8 benchmark "In all environments, organisms with similar needs..." was modified to include the idea that resources for which animals compete are limited. A new benchmark (5D/M3) was added to the map to extend students' understanding of the implications of finite resources for populations of organisms.

Students' knowledge of the variety of environments and changes in environmental conditions on Earth needs to be integrated with their growing understanding of earth science, in particular with benchmarks related to climate in the **WEATHER AND CLIMATE** map. As students become more familiar with the characteristics of systems in general, they can begin to recognize some of those characteristics—such as interdependence of parts, stability, and change—as they appear in ecosystems.

Ethical choices and the implications of various uses of the environment are not explicitly addressed in this map. However, the map can provide contexts for learning about the effects of science on society, ethics in research, and the incompleteness of scientific answers as presented on the **SCIENCE AND SOCIETY** map and the **SCIENTIFIC WORLD VIEW** map.

RESEARCH IN BENCHMARKS

Lower elementary-school students can understand simple food links involving two organisms. Yet they often think of organisms as independent of each other but dependent on people to supply them with food and shelter. Upper elementary-school students may not believe food is a scarce resource in ecosystems, thinking that organisms can change their food at will according to the availability of particular sources (Leach et al., 1992). Students of all ages think that some populations of organisms are numerous in order to fulfill a demand for food by another population (Leach et al., 1992).

Middle-school and high-school students may believe that organisms are able to effect changes in bodily structure to exploit particular habitats or that they respond to a changed environment by seeking a more favorable environment (Jungwirth, 1975; Clough & Wood-Robinson, 1985a). It has been suggested that the language about adaptation used by teachers or textbooks to make biology more accessible to students may cause or reinforce these beliefs (Jungwirth, 1975).

Some middle-school students think dead organisms simply rot away. They do not realize that the matter from the dead organism is converted into other materials in the environment. Some middle-school students see decay as a gradual, inevitable consequence of time without need of decomposing agents (Smith & Anderson, 1986). Some high-school students believe that matter is conserved during decay, but do not know where it goes (Leach et al., 1992).

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