

environment. Keystone species, predators, and essential abiotic and biotic factors contribute to maintaining the diversity of an ecosystem. For example, the removal of sea otters or mollusks can drastically affect a marine ecosystem, and the introduction of an exotic plant or animal species can likewise affect the stability of a terrestrial ecosystem.

Essential knowledge 4.C.1: Variation in molecular units provides cells with a wider range of functions.

- a. Variations within molecular classes provide cells and organisms with a wider range of functions. [See also 2.B.1, 3.A.1, 4.A.1, 4.A.2]

*To foster student understanding of this concept, instructors can choose an illustrative example such as:*

- Different types of phospholipids in cell membranes
- Different types of hemoglobin
- MHC proteins
- Chlorophylls
- Molecular diversity of antibodies in response to an antigen

- b. Multiple copies of alleles or genes (gene duplication) may provide new phenotypes. [See also 3.A.4, 3.C.1]

*Evidence of student learning is a demonstrated understanding of each of the following:*

1. A heterozygote may be a more advantageous genotype than a homozygote under particular conditions, since with two different alleles, the organism has two forms of proteins that may provide functional resilience in response to environmental stresses.
2. Gene duplication creates a situation in which one copy of the gene maintains its original function, while the duplicate may evolve a new function.

*To foster student understanding of this concept, instructors can choose an illustrative example such as:*

- The antifreeze gene in fish

Learning Objective:

**LO 4.22** The student is able to construct explanations based on evidence of how variation in molecular units provides cells with a wider range of functions. [See **SP 6.2**]

Essential knowledge 4.C.2: Environmental factors influence the expression of the genotype in an organism.

- a. Environmental factors influence many traits both directly and indirectly. [See also 3.B.2, 3.C.1]