45.5B: Predation, Herbivory, and the Competitive Exclusion Principle

Predation and herbivory are two methods animals use to obtain energy; many species have developed defenses against them.

Learning Objectives

- Distinguish between predation and herbivory and describe defense mechanisms against each

Key Points

- Predation, the hunting and consuming of animals by other animals, often shows cyclical patterns of predator/prey population sizes; predators increase in numbers when prey species are plentiful.
- Herbivory is the eating of plant material for energy and can assist the plants with seed distribution.
- Plants have evolved spines and toxins to defend against being eaten by herbivores.
- Animals use bright colors to advertise that they are toxic; mimicry to hide from predators; or have spines, shells, and scales to protect themselves.
- Batesian mimicry is when a non-toxic species looks similar to a poisonous one, which deters predator attacks.

Key Terms

- **camouflage**: resemblance of an organism to its surroundings for avoiding detection
- **herbivory**: the consumption of living plant tissue by animals
- **Batesian mimicry**: the resemblance of one or more non-poisonous species to a poisonous species, for example, the
Predation and Herbivory

Most animals fall into one of two major categories when it comes to obtaining the energy they need to survive in the environment: predation or herbivory. An animal that hunts, kills, and eats other animals is called a predator. Examples of predators include tigers, snakes, and hawks. Herbivory, on the other hand, refers to animals that eat plant matter. Deer, mice, and most song birds are examples. To protect themselves against these feeding mechanisms, many organisms have developed methods that keep them from being eaten.

Predation is the hunting of prey by its predator. Populations of predators and prey in a community are not constant over time; in most cases, they vary in cycles that appear to be related. The most-often-cited example of predator-prey dynamics is seen in the cycling of the lynx (predator) and the snowshoe hare (prey), which is based on nearly 200-year-old trapping data from North American forests. This cycle of predator and prey lasts approximately 10 years, with the predator population lagging 1–2 years behind that of the prey population. As the hare numbers increase, there is more food available for the lynx, allowing the lynx population to increase as well. When the lynx population grows to a threshold level, they kill so many hares that the hare population begins to decline. This is followed by a decline in the lynx population because of scarcity of food. When the lynx population is low, the hare population size begins to increase due, at least in part, to low predation pressure, starting the cycle anew.

**Predator and prey population cycling**: The cycling of lynx and snowshoe hare populations in Northern Ontario is an example of predator-prey dynamics. As hare populations increase, the lynx populations also increase due to increased food supplies. Many lynx eating many hares causes a decline in the hare population size. This results in a decrease in the lynx population. Then the cycle begins again.

Herbivory describes the consumption of plants by insects and other animals. Unlike animals, plants cannot outrun predators or use mimicry to hide from hungry animals. Some plants have developed mechanisms to defend against herbivory. Other species have developed mutualistic relationships; for example, herbivory provides a mechanism of seed distribution that aids in plant reproduction.

Defense Mechanisms against Predation and Herbivory

The study of communities must consider evolutionary forces that act on the members of the various populations
Species are not static, but slowly changing and adapting to their environment by natural selection and other evolutionary forces. Species have evolved numerous mechanisms to escape predation and herbivory. These defenses may be mechanical, chemical, physical, or behavioral.

Mechanical defenses, such as the presence of thorns on plants or the hard shell on turtles, discourage animal predation and herbivory by causing physical pain to the predator or by physically preventing the predator from being able to eat the prey. Chemical defenses are produced by many animals as well as plants, such as the foxglove which is extremely toxic when eaten.

Defenses against predation and herbivory: The (a) honey locust tree (*Gleditsia triacanthos*) uses thorns, a mechanical defense, against herbivores, while the (b) Florida red-bellied turtle (*Pseudemys nelsoni*) uses its shell as a mechanical defense against predators. (c) Foxglove (*Digitalis* sp.) uses a chemical defense: toxins produced by the plant can cause nausea, vomiting, hallucinations, convulsions, or death when consumed. (d) The North American millipede (*Narceus americanus*) uses both mechanical and chemical defenses: when threatened, the millipede curls into a defensive ball, producing a noxious substance that irritates eyes and skin.

Many species use their body shape and coloration to avoid being detected by predators. The tropical walking stick is an insect with the coloration and body shape of a twig, which makes it very hard to see when stationary against a background of real twigs. In another example, the chameleon can change its color to match its surroundings. Both of these are examples of camouflage: avoiding detection by blending in with the background.

Some species use coloration as a way of warning predators they are not good to eat. For example, the cinnabar moth caterpillar, the fire-bellied toad, and many species of beetle have bright colors that warn of a foul taste, the presence of toxic chemical, and/or the ability to sting or bite, respectively. Predators that ignore this coloration and eat the organisms will experience their unpleasant taste or presence of toxic chemicals and learn not to eat them in the future. This type of defensive mechanism is called aposmotic coloration, or warning coloration.
Examples of aposmotic coloration: (a) The strawberry poison dart frog (*Oophaga pumilio*) uses aposmatic coloration to warn predators that it is toxic, while the (b) striped skunk (*Mephitis mephitis*) uses aposmatic coloration to warn predators of the unpleasant odor it produces.

While some predators learn to avoid eating certain potential prey because of their coloration, other species have evolved mechanisms to mimic this coloration to avoid being eaten, even though they themselves may not be unpleasant to eat or contain toxic chemicals. In Batesian mimicry, a harmless species imitates the warning coloration of a harmful one. Assuming they share the same predators, this coloration then protects the harmless ones, even though they do not have the same level of physical or chemical defenses against predation as the organism they mimic. Many insect species mimic the coloration of wasps or bees, which are stinging, venomous insects, thereby discouraging predation.