Social Interactions

FIGURE 7: When a predator is near, individuals in a group will move in unison for protection.

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Similar to flocking of birds, schooling in fish is a group activity that benefits the individual members. Fish school for several reasons, including foraging for food, defending themselves from predators, and reproducing. Swimming in a group also may improve hydrodynamics, or the dynamics of fluids, and reduce the energy cost associated with traveling through water. In the absence of predators, schools will often break apart, or the fish will take cover when in danger.

Analyze How do you think schooling behavior evolved over time? How does it increase the fitness of individuals in the school?

FIGURE 8: Springbok Pronking

Living in a Group

Sometimes, springboks hop on all four legs rather than run away when they spot a predator. This behavior, called *pronking*, alarms the rest of the herd but makes the individual visible to predators. Pronking gives the herd enough time to escape and signals to the predator that the herd already spotted it. Social behaviors include any and all interactions between individuals of the same species. Social groups interact in many ways, such as through communication, mate selection, and defense.

Explain Pronking carries with it a high energy costs and high risk costs. Why would an individual put itself at risk to alert and protect the rest of the group? What are the potential benefits?

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FIGURE 9: Chimpanzee Pant-hooting

Communication

Communication is the sharing or exchange of information and is critical to the survival of individuals and groups, as well as for the species itself. Vocalizations, plumage, songs, mutual grooming, and pheromone trails are all forms of animal communication.

Chimpanzees live in dense tropical rain forests where it is easy to lose sight of others. They use a variety of vocalizations to stay in touch and let each other know where they are located. Other vocalizations are used to show excitement, greet group members, and alert the group to predators. Chimpanzees also communicate through facial expressions and body postures.

Mate Selection

Courtship displays are behaviors most often used by male members of a species to attract females. Scientists theorize that females use courtship displays to judge the condition of their potential mate or the quality of his genes. For example, as shown in Figure 10, blue-footed boobies high step and strut to show off their blue feet to potential partners. The pigment that gives the blue-footed booby its bright blue feet comes from its food. So an individual that is more successful at finding food will have brighter feet. The courtship "dance" helps females find the most fit partner.

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FIGURE 10: Blue-Footed Booby

Defense

Defensive behaviors are responses to threatening stimuli from the environment. These various behaviors are meant to reduce harm to the individual. Animals will often put themselves in harm's way to protect their young as well. For example, the adult penguins in Figure 11 put themselves between their young and a petrel, who will eat young penguins. Groups of animals also will warn each other of danger with different vocalizations. Vervet monkeys, for example, use one call to indicate that a predator is a snake and another to indicate that it is a large cat or bird. This tells group members where to look and where to escape.

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FIGURE 11: Penguins protecting their young from a petrel.

Model Make a model that explains how different types of behavior benefit the individual, and thereby the group. For each type of behavior, include elements that explain how this trait evolved over time.

Cooperation

Lions hunt together in packs, called *prides*, to increase their chances of success. Most prey can outrun a single lion but not an entire hunting group. The group works together to stalk the prey and make a barrier to prevent its escape. They then pounce together to take down the prey. This behavior is an example of *cooperation*, which involves behaviors that improve the fitness of the individuals involved.

Reciprocity

Vampire bats live together in tightly knit communities, providing protection and warmth to each other. A female vampire bat will donate food that she has collected from her hunt to a bat that is unable to hunt for its own food, voluntarily regurgitating and sharing part of its meal. This comes at a cost to the donor bat, because it has used energy to gather the food and is losing some energy by sharing.

FIGURE 12: Vampire bats share food with other bats.

Vampire bats keep track of which bats share food and, in turn, will share food with those bats. This is an example of reciprocity, another form of cooperative behavior among animals. The idea is that one action, such as sharing food, will result in a future beneficial response, such as being the recipient of shared food. Research has shown that bats in need of food received more donations if they had previously shared food with other bats.

Gather Evidence Which individuals within a larger community of bats would be most beneficial to feed after missing a meal or two?

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FIGURE 13: Meerkats show altruistic behaviors.

Altruism

Meerkats, such as those shown in Figure 13, stand and watch for predators. When an individual sees a predator, it raises an alarm to the group. This signaling brings attention to itself and increases its own risk of being attacked but may save other individuals. This type of behavior is known as *altruism*. Altruism is a kind of behavior in which an animal reduces its own fitness to help other members of its social group. In other words, the animal appears to sacrifice itself for the good of the group.

Model Explain how you could model the cost-benefit relationship exhibited in altruistic behaviors.

How can we explain the evolution of altruism if behavior is supposed to increase fitness? British evolutionary biologist William Hamilton realized that alleles can be transmitted and therefore spread in a population in two ways, either directly from an individual to its offspring or indirectly by helping close relatives survive.

When an animal reproduces, its offspring gets half of its alleles. But its relatives also share some of the same alleles, in the following proportions:

- Parents and siblings share 50 percent of the animal's alleles.
- Nephews and nieces share 25 percent of its alleles.
- First cousins share 12.5 percent of its alleles.

The total number of genes an animal and its relatives contribute to the next generation is called inclusive fitness. It includes both direct fitness from reproduction and indirect fitness from helping kin survive. When natural selection acts on alleles that favor the survival of close relatives, it is called kin selection.

Eusocial Behavior

FIGURE 14: Weaver ants work together in eusocial colonies.

Analyze How is it possible for a behavior to evolve when there is only one reproductive female and the rest of the colony never reproduces?

Among colonies of insects, such as wasps, bees, and ants, only a small number of reproductive females exist. In honeybee colonies, one queen produces a few male offspring along with thousands of sterile female workers. These worker bees are incapable of reproduction and spend their short lives maintaining and protecting the hive, gathering food, producing wax and honey, and feeding the young. The workers live for about six weeks during the summer, while the queen can live for several years. Female offspring that will one day take the queen's place are raised in a separate cell and are fed a special diet.

If you were to look across many eusocial colonies, you would find that they share a common feature, haplodiploidy. This means their sex is determined by the number of chromosome sets in an individual. Males are haploid and females are diploid. Female social insects produce daughters through eggs fertilized by sperm. Unfertilized eggs produce sons. In these animals, daughters share half of their mother's alleles but all of their father's alleles. Sisters therefore share up to 75 percent of their alleles overall with one another, compared with 50 percent in humans and most other animals. The close relationship between sisters in a colony may influence the evolution of eusociality.

Explain Compare and contrast individual behaviors and group behaviors. What requirements are there for these behaviors to evolve?