Altruism and Inclusive Fitness

Animal behavior is altruistic when it is aimed at supporting kin and the population rather than the self.

Ants defend their nest. Ants are well known for their complex social structures that include individual sacrifice for the good of the ant colony. These African Platthyrea conradti guard the entrance to their nest fiercely. They will attack other members of their species who do not come from the same nest. Patrick Landmann/Science Source.

Topics Covered in this Module
- The Genetic Basis of Behavior
- Behaviors of One Individual that Benefit Other Individuals

Major Objectives of this Module
- Give examples of studies showing that behavior is heritable and can evolve.
- Explain what altruism is and give examples of organisms that exhibit it.
- Describe kin selection and its relationship to Hamilton's rule and the coefficient of relatedness.
Genes, environment, and behavior are inseparable. All behavior patterns, or behavior phenotypes, are based on genetic information acting in concert with the environment; there are no purely environmentally based behaviors. Conversely, there are no purely genetic behaviors — ones that do not require any environmental input. This blending is a fascinating topic at the heart of animal behavior. Biologists attempt to measure and explain the relative contribution of genes and environment to animal behavior, as these interactions lie at the heart of biological evolution. Parsing these differences can be tricky, but it starts with very basic questions. What is the evidence for the genetic basis of behavior? What behaviors seem to contradict an individual's survival, and thus tend to prevent its genes from being passed on? Given that these behaviors do not promote an individual's reproductive success, why have they persisted through evolutionary time?

**The Genetic Basis of Behavior**

A great deal of evidence suggests that genes have an important influence on an organism's behavior. But other environmental and experiential factors are known to intervene in the expression of an organism's genotype in its phenotype. Together, environment, experience, and genetics act in concert to influence behavior.

**How have researchers determined the genetics of behavior?**

For more than a century, scientists have known that some forms of behavior have a genetic basis. In the 1870s, an amateur English biologist, Douglas Spalding, first reported one such behavior, now called imprinting. Spalding discovered that baby chicks follow the first moving object they see. Since this behavior exhibited immediately after hatching, Spalding speculated that it was inherited. A half-century later, the Austrian zoologist and ethnologist Konrad Lorenz brought Spalding's research to fruition. In a classic series of experiments with geese and jackdaws, Lorenz demonstrated the tendency of young animals to mimic the behavior of older animals with which they are raised (Figure 1). This behavior occurs in young animals at early stages during a sensitive period, and is usually associated with basic survival skills, such as feeding or following a mother; however, a specific genetic basis for the behavior has not yet been formally established.
Early behavioral research on geese found that they imprint on objects they see in the first 12–18 hours of their lives, whether that object is a parent, a cardboard cutout resembling a parent, or even a human. 

**Figure 1: Imprinting among Canada geese (Branta canadensis).** Courtesy of Donna Dewhurst/USFWS. Some rights reserved.

One clearer example of genetically based behavior is pair bonding, the strong affinity that develops between two members of a species. Pair bonding in nature is usually — but not always — between a male and a female (Figure 2). It is most often associated with nesting and reproductive behavior, but also extends to hunting and raising offspring. Pair bonding can take a number of forms, from short-term bonds that survive only a single season, to long-term bonds that last for life. Studies have shown that pair bonding is related to various types of biochemical changes within an organism. For example, pair-bonded members of a species may have different blood concentrations of the hormones oxytocin and vasopressin than members of the same species who are not pair bonded.

**Figure 2: A pair of female Laysan albatrosses (Phoebastria immutabilis).**
In some colonies, up to a third of bonded pairs consist of two females, some of whom remain together for up to 20 years.

**Courtesy of David Patte/USFWS.**

For decades, scientists have studied the migration of the monarch butterfly as a form of genetically based behavior. This butterfly spends summers in the northern United States and southern Canada, but cannot survive the cold winter season. As fall approaches, monarchs begin a journey that extends up to 5,000 kilometers from their summer homes to Mexico or California. The journey itself is an extraordinary accomplishment for these fragile animals. More remarkably, the butterflies that make their "return" trip to Mexico or California are not the same ones that flew from their southern homes to their northern habitats a year earlier. In fact, since the life span of the butterfly is only about two months, these butterflies are three generations removed from the original group of butterflies (Figure 3). Researchers are still trying to unravel the complex processes that make it possible for monarchs to make this return trip to the south, often to the very same group of trees in which their ancestors lived.

**Figure 3: Monarch butterflies.**
Through a still-unknown process, monarch butterflies travel to destinations visited by ancestors three generations removed.

**Courtesy of Gene Nieminen/USFWS.**

**Test Yourself**

What possible explanation can be given for a monarch butterfly's ability to follow a path identical to that of an ancestor several generations removed?

Submit

**The evolution of behavior.**

Plants and animals have evolved physical properties, including color, size and shape, that aid their survival and reproduction. Animal behavior serves
the same purpose — behavior is an animal’s ability to rapidly respond to the external environment in such a way as to increase its own survival and/or reproduction (i.e., its evolutionary fitness). Finding food and water, avoiding predators, avoiding environmental stress, finding mates and caring for young are all examples of behaviors that are clearly under evolutionary control because they influence an organism’s fitness. In 2007, researchers from the University of California at Davis discovered an example of a set of behaviors that evolved as a means to avoid predators. The California ground squirrel (Spermophilus beecheyi) evolved an arsenal of defenses against two of its most dangerous predators, the rattlesnake (Crotalus oreganus) and the gopher snake (Pituophis melanoleucus). The ground squirrel stands in an upright position and wags its tail furiously back and forth (Figure 4). Though it might seem that the squirrel has no chance against such a large predator, surprisingly, this assertive stance often changes a snake’s aggressive behavior into one of hesitancy and even defensiveness.

How does this tail-wagging behavior actually deter a snake from attacking? In addition to the tail wagging, a squirrel also emits a burst of infrared radiation (radiant heat) from its tail. To a rattlesnake, an animal with sensitivity to infrared radiation, this is analogous to shining a flashlight in a person’s eyes. As a result, the rattlesnake is confronted with a double warning signal consisting of a wagging tail and a flash of infrared radiation. By contrast, the gopher snake cannot detect infrared radiation. In a confrontation with a gopher snake, the squirrel does not deploy the burst of radiation and instead relies on its tail-wagging behavior for defense. These results suggest that the ground squirrel displays defensive behaviors tailored to different predators.

Evidence about the evolution of behavioral characteristics also comes from the study of hybrids, organisms whose parents are of different species. Scientists have recognized that hybrids display certain physical properties intermediate between those of its parents. Interestingly, the behavior of
hybrid animals has also been observed as a mix of those inherited from their parents. In one of the earliest studies on this topic, Keith Evans, then of the U.S. Department of Agriculture, detailed the behavioral characteristics of a hybrid offspring of a sharp-tailed grouse (*Tympanuchus phasianellus*) and a greater prairie chicken (*Tympanuchus cupido*). The hybrid held its wings during territorial displays in a position midway between those of its two parents, stamped its feet faster and for a longer period than the prairie chicken, but less than the grouse, and controlled a mating territory with an area intermediate in size between the areas controlled by its parents. Other behavioral patterns provide additional support that some hybrids demonstrate behaviors intermediate between those of their parents. Hybrids of the two main species of lizards on Trinidad Island, *Anolis trinitatis* and *A. aeneus*, in addition to exhibiting intermediate traits at the molecular and cellular level, demonstrate territorial behaviors that are intermediate between those of their parents. Based on acoustical analysis, auditory signals used by hybrids of Richardson's ground squirrel (*Spermophilus richardsonii*) and the Wyoming ground squirrel (*S. elegans*), consisting of chirps, squeals, teeth-chatter and growls, are intermediate between those of the parent species. Even the frequencies of echolocation sounds produced by the hybrids of Eastern bats (*Rhinolophus philippinensis*) and large-eared bats (*R. megaphyllus*) are an average of the parent species. Where the Eastern bats transmit at a frequency of 28 kHz and the large-eared bats at 66 kHz, their hybrids produce sounds at 40 kHz.

**Test Yourself**

Propose an alternative hypothesis for the observation that a hybrid offspring often display behaviors intermediate between those of its parents.
Behaviors of One Individual that Benefit Other Individuals

Most organisms behave in a manner that maximizes the likelihood that they will survive to reproduce and transmit their own genes to the next generation. But not all behavior by an animal benefits only itself. Under what circumstances will an organism behave in such a way that its own interests are reduced to benefit another?

The evolution of altruism.

The clearest and most obvious way that one individual's behavior benefits another individual is behaviors associated with reproduction. Even the simple act of a female turtle leaving the water to lay its eggs in a hole on land and never seeing its offspring again is a behavior that is costly to the female turtle but beneficial to the developing offspring. Of course, in this case, we call this reproductive behavior and assume it provides a direct benefit to the female through fitness. But the fitness benefits of particular behaviors are not always so obvious as the direct fitness benefit the female turtle gets from laying her eggs in a nest on land. Sometimes, an organism's behavior has less of a direct and obvious influence on its fitness but can indirectly influence it just the same. This is often the case when we think of behaviors that would seem to be "altruistic" — that is, behaviors performed by one individual that would seem to benefit other individuals at the expense of the individual doing the behavior.

Worker bees in a hive would appear to not have much of a future. They spend their lives collecting food to feed the queen, building and repairing the hive, and defending the colony against attackers. In addition, they are sterile, so their genes will die with them. If behavior is genetically based, how can these seemingly altruistic behaviors be reconciled with evolution?

While altruistic behavior may not advance the reproductive prospects for the individual, it may allow for the survival and reproduction of the genes of that individual. Thus, the fitness benefit is indirect rather than direct, but the outcome is the same — movement of the individual's genes from one generation to the next. Among honey bees, for example, the activities of a single worker bee guarantee that it will not directly pass on its genes to future generations, but these activities also ensure that the colony as a whole will survive, thrive and reproduce. Importantly, the honey bee, and many of its relatives, has a unique genetic pattern called "haplodiploidy." Most sexual animals are diploid, meaning that they have two copies of each gene and pass half of those on to their offspring, which then share half of their genes with each parent. In bees, however, males only have one set of chromosomes (haploid), while females have two. The significance of this is that females receive 100% of their father's genes and 50% of their mother's genes, and then sisters are 75% related to one another. As a result, it is actually more beneficial for a female to help care for her sisters, to which she is 75% related, than it would be to care for her own offspring, to which should would be 50% related (Figure 5). In the end, the situation is a bit more complicated than this, and some animals that have typical diploid mating systems also have highly altruistic behaviors like bees, where only some females reproduce and others never do — a cooperative organization of the species called eusociality. But the evolutionary explanation for many cases that seem altruistic on the surface is that the animal performing the behavior often receives a benefit indirectly either through indirectly passing on some
Altruistic behaviors are also common among higher animals like the meerkat (*Suricata suricatta*). Meerkats live in highly structured communities in which all individuals are involved in the raising, feeding and protecting of the community. In a typical meerkat community, about 80% of all offspring come from a single dominant female. Yet every member of the community is involved in feeding these unrelated young. Individual meerkats sometimes leave to found a new community, a risky venture for the pioneer animal, but one that protects its home community from becoming overcrowded. The sentinel behavior of meerkats has been carefully studied. Meerkats take turns standing guard at exposed sites outside the community den (Figure 6). If a sentinel senses danger, it sends out a high-pitched warning signal for members of the community to return to the den. While this act protects the community as a whole, it exposes the sentinel to detection and attack by predators, and possibly death. In this way, a sentinel meerkat risks its life to protect its community.

**Test Yourself**

Why do you think the sentinel meerkat would risk its life to benefit the colony?
A meerkat shows sentinel behavior, keeping watch for dangers that might threaten the communal den of other meerkats below ground.

**Gregory G. Dimijian, M.D./Science Source.**

Biologists have classified one form of altruistic behavior as **reciprocal altruism**, in which a beneficial act is performed by one animal for another with the expectation that this kindness will be returned later. Reciprocal altruism is enshrined in the familiar adage, "You scratch my back, and I'll scratch yours." The saying is actually true for some social animals like many species of primates (Figure 7). Scientists have found that such animals tend to groom those who have returned the favor in the past more often than those who have not.
Early debates about the genetic basis of behavior were lively.

The question of whether, how, and to what extent behavior is determined by genes was the subject of intense study by biologists during the 1960s and 1970s. In 1975, Harvard biologist E. O. Wilson summarized this research in a now-classic book, *Sociobiology: The New Synthesis*. Wilson defined sociobiology as the study of the biological basis of behavior in humans and other animals. He pointed to compelling evidence that some, if not all, of the social behaviors exhibited by an organism are defined by its genes.

Wilson's book was not the first study of the genetic basis of behavior in animals. In fact, the question of "nature versus nurture" can be traced at least as far back as the 13th century. Those who support the "nature" side of this argument claim that most animal behavior can be explained using the same scientific principles that explain physical characteristics. If there are genes for physical traits such as brown eyes or curly hair, proponents say, then there are also genes for behavioral traits, such as assertiveness or sexual orientation. Those who support the "nurture" side of the argument claim that the "nature" view is too simplistic, at least for humans, and ignores the impact of the mind and culture on human behavior.

The publication of *Sociobiology* also set off a rabid debate among the general public about its significance for social institutions in the modern world. Suppose, for example, that biologists find a genetic basis for aggression in males. Would that mean that male aggressiveness is natural and, therefore, should be more socially accepted? The problem is that it is extremely difficult to trace a specific human behavior back to a single gene, or even a set of genes, in the human genome. A behavior cannot be readily categorized as predetermined by one's genes or learned through social networks; more likely, the behavior is some combination of the two.

In the 21st century, the dispute over nature versus nurture in human behavior still continues, although hardly with the virulence it once provoked. Sociobiology ignited research in the adaptive and evolutionary nature of social behavior; clearly, however, the interplay between social and genetic factors that influence behavior is quite complex, particularly in humans, but also in many other animals. Our broad behavioral repertoires most certainly are the product of millions of years of evolution. However, our more specific day-to-day behaviors among individuals are certainly much more complex, and social context certainly plays a large role. Whether you choose to be more of a "team player" or act in your own self-interest; whether you respond aggressively to a threat or are passive in the face of it; whom you choose as a mate; these and many other questions cannot be answered with simple evolutionary answers because they are so heavily influenced by psychological and sociological components of behavior as well.

**What is inclusive fitness?**

How can altruism evolve? The case of the honey bee that shares three-quarters of her genes with her sisters clearly illustrates the role of genetic relatedness in altruistic behaviors (Figure 5). This is an extreme form of *kin selection*. In kin selection, behaviors can evolve through standard evolutionary pathways if the behavior increases the reproductive success of an organism's relatives, even if those behaviors come at a cost to the organism itself, including death. This represents genetic selection at the population level and is the most common explanation for the evolutionary survival of altruism.

Fitness is usually thought of at the individual level. The number of offspring that survive to produce offspring of their own defines an individual's fitness. The bird known as the killdeer feigns a broken wing for predators to observe (Figure 8). This behavior draws a predator away from a killdeer's nest,
increasing the likelihood of her offspring's survival, while decreasing her own. By doing this, the killdeer demonstrates classical fitness by promoting the survival of its young to reach reproductive age. However, in reality, it is the bird's genes that are being selected for or against, not the bird itself. The product of evolution is the transmission of genes through the generations.

**Figure 8: Killdeer (Charadrius vociferus) displaying a "broken" wing.**

The broken-wing defense by a kildeer draws a predator away from her nest, increasing the chance of her chicks' survival but increasing the likelihood of her own demise.

_Jeffrey Lepore/Science Source._

Kin selection also promotes the survival of an organism's genes via its relatives and its relatives' offspring, thus increasing the indirect fitness of the individual. Thus, the otherwise seemingly mysterious behavior of honey bees makes much more sense. And in many other cases where it would appear as though organisms are acting completely selflessly, such as when a meerkat guards the communal den, the animals' behavior can instead be seen as selfish once one considers that these animals share some portion of the genetic makeup of those who benefit from their seemingly altruistic behaviors.

Together, classical fitness and indirect fitness define inclusive fitness, a measure of total genetic success. A key element of inclusive fitness is the degree of relatedness between an organism performing seemingly altruistic behavior and the organisms that benefit from its actions. A meerkat who dies while its parents or siblings survive increases the likelihood that many of its own genes will be transmitted. The meerkat's behavior increases the likelihood that a smaller number of its own genes will be transmitted if aunts, uncles and cousins survive, and even fewer genes if second- and third-cousins survive. British geneticist J. B. S. Haldane summarized this view in one of the classic remarks in genetics. When asked if he would lay down his life to save a drowning brother, he said, “No, but I would to save two brothers or eight cousins.” Haldane was suggesting that either of these actions would result in the possible transmission of comparable numbers of his own genes.

In 1964, British evolutionary biologist William D. Hamilton attempted to quantify the relative cost and benefit of an altruistic act. He assumed that three factors were of primary significance: the cost to the organism that commits an altruistic act in terms of lost classical fitness (which he called $c$), the genetic relationship between the altruistic organism and the organisms that benefit from the act (which he called the coefficient of relatedness, $r$), and the ultimate benefit to the recipient ($b$). Thus, the product of $r$ and $b$ represents the indirect fitness gained by helping a relative. In the resulting
equation, an act of altruistic behavior can be selected for when \( rB > C \), known as Hamilton's rule. In other words, an organism will risk its own fitness to support the fitness of another organism if the recipient is closely related enough and the evolutionary benefit to the recipient is great enough.

Now let's see how Hamilton's rule works in practice. Suppose that two cousins of reproductive age have gone rock climbing, and one has slipped off an edge. She is clinging to her rope with desperation. Her cousin estimates that she has a 50% chance of saving her cousin and surviving if she attempts the rescue. Should she take the risk? To use Hamilton's rule, first estimate the number of offspring that could benefit from this act of altruism. The average human female produces two offspring during her lifetime, so let's assume that both cousins will produce two children if they survive. Now one can determine the value of the three variables in the rule. First, the fitness benefit \( (B) \) to the cousin in trouble is the two offspring that she can anticipate: \( B = 2 \). Next, the cost \( (C) \) to the cousin who would risk the rescue is the product of the probability that she doesn't survive the rescue attempt (0.50) and the number of children she could expect to have, 2. So \( C = 0.50 \times 2 = 1 \). Finally, the coefficient of relationship \( r \), or genetic similarity, between two cousins is about 1/8, or 0.125. Substituting these values into Hamilton's rule results in the following calculations:

\[
(benefit \ to \ A) \times rB > C (cost \ to \ B)
\]

\[
0.125 \times 2 > 1
\]

\[
0.25 > 1
\]

Based on Hamilton's rule, the benefit to the cousin who would have to perform the rescue, in terms of her inclusive fitness, is less than the cost of the rescue; thus, in this case, the cousin, following Hamilton's rule, would not attempt the rescue.

**Test Yourself**

What factors could change in this scenario for the person to take the risk of the rescue?

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**BIOSKILL**

**Estimating the Coefficient of Relationship**

Using Hamilton's rule requires a calculation of the coefficient of relationship between an altruistic organism and the beneficiary of its altruism. Punnett squares provide a method for finding this value. For example, the coefficient of relationship can be easily calculated between a mother and a father and one of their children. Remember that the coefficient of relationship is the likelihood that two related individuals will have exactly the same alleles for some given trait. Assume that both parents are heterozygous for a gene (Figure 9).
What letters would you fill in for offspring 1 and 2? What percentage of alleles is shared between each parent and their offspring? This value, expressed as a decimal, is the coefficient of relationship. See Figure 10 to check your work.

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Each parent randomly gives only one of their two alleles to their offspring. Overall, each parent will only give one-half of their alleles to any one of their offspring. The coefficient of relationship between parents and offspring, and vice versa, is therefore 0.50.

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BIOSKILL

IN THIS MODULE
- The Genetic Basis of Behavior
- Behaviors of One Individual that Benefit Other Individuals
- Summary
PRIMARY LITERATURE

Red squirrels are altruistic toward kin

SCIENCE ON THE WEB

Challenging Kin Selection Theory
A mathematical model bucks conventional thinking.
**Summary**

OBJECTIVE Give examples of studies showing that behavior is heritable and can evolve.

Most forms of animal behavior have a genetic basis. One example is imprinting, in which very young animals mimic the behavior of older animals they observe. Another form of behavior for which there appears to be a genetic basis is pair bonding, in which two members of a species become attached for the purpose of producing and raising offspring. Migration patterns followed by organisms such as the monarch butterfly also appear to have a genetic basis. The hypothesis that some animal behaviors have a genetic basis is supported by a great deal of evidence, including the behavior of hybrid organisms. Hybrid behavior often (but not always) presents as an intermediate form between the behaviors of the two parental species.

OBJECTIVE Explain what altruism is and give examples of organisms that exhibit it.

Altruism has been the focus of research on the genetic basis of behavior. Altruism describes an organism’s behavior when it experiences a cost (including possible death) to increase the fitness of another organism. A primary reason for the evolution of many seemingly altruistic behaviors in the face of natural selection is that even if the animal performing the behavior puts its life at risk, its genes will survive in those relatives who have benefited from the altruistic act. Reciprocal altruism is a form of altruism in which a beneficial act is performed by one animal with the expectation that this same behavior will be returned later.

OBJECTIVE Describe kin selection and its relationship to Hamilton’s rule and the coefficient of relatedness.

Classical fitness is measured by the ability of an organism to reproduce and transmit its own genes to the next generation. However, inclusive fitness also includes the fitness of those genes as they pass through close relatives, influencing the strength of kin selection. Thus, behaviors can evolve that provide benefits to relatives even if they come at a cost to the primary individual — as long as the benefits outweigh the costs. Hamilton’s rule is a mathematical inequality that uses the benefit expected for the recipient of an altruistic act, the cost to the altruist, and the genetic relatedness of the altruist and the recipient to calculate the likelihood that an act of altruism will be evolutionarily beneficial.

**Key Terms**

altruism  
Selfless behavior; an organism putting itself at risk for the benefit of other, related individuals.

classical fitness  
Reproductive success measured as the number of offspring that an organism produces.

coefficient of relatedness  
Genetic relationship between the altruistic individual and the organism that benefits from the action.

eusociality  
Level of social organization in which cooperative breeding is extreme. Some individuals (queens) reproduce for the entire colony, while others, such as
workers, spend their lives helping raise the colony's young, gather food, etcetera.

**Hamilton's rule**
Natural evolution always benefits an act of altruism.

**inclusive fitness**
Reproductive success measured as the number of offspring produced plus any individuals born as a result of altruistic actions.

**indirect fitness**
Reproductive success measured as the number of equivalents of its own offspring that an organism adds to the population by supporting others.

**kin selection**
Behaviors that favor the reproduction of an organism's relatives, even to the detriment of the individual.

**reciprocal altruism**
Beneficial act performed by one individual with expectation that the other will do the same in the future.

### References


Principles of Biology

Test Your Knowledge

1. A duck's egg is removed from its nest prior to hatching, and the baby duck is cared for by a wildlife specialist for a few days before being returned to its parents. Which individual is the duckling's behavior most likely to resemble?
   - the mother duck
   - the father duck
   - both the father duck and mother duck
   - the wildlife specialist
   - None of the answers are correct.

2. Monarch butterflies from northern Maine that winter in Mexico are which of the following?
   - descendants several generations removed from butterflies that flew from Mexico to Maine the previous spring
   - the offspring of butterflies that flew from Mexico to Maine the previous spring
   - genetically unrelated to butterflies that flew from Mexico to Maine the previous spring
   - lost, because they should be migrating between Mexico and California
   - the same butterflies that flew from Mexico to Maine the previous spring

3. Why doesn't the California ground squirrel emit infrared radiation as a defense mechanism against gopher snakes?
   - Gopher snakes and rattlesnakes do not approach California ground squirrels at the same time.
   - Gopher snakes do not prey on California ground squirrels.
   - Gopher snakes are not sensitive to infrared radiation.
   - California ground squirrels retreat as a defense mechanism against gopher snakes.
   - Gopher snakes are sufficiently deterred by tail wagging, so infrared signals are not needed as a defense mechanism.

4. If an organism is confronted with performing a behavior that enhances the likelihood of survival of any of these family members, which choice would increase its inclusive fitness the least?
   - a first cousin
   - a sibling
   - a parent
   - a second cousin
   - a grandparent

5. In some species of birds, offspring may choose to stay in their parents' territory and help raise their younger full siblings (relatedness is 0.5) rather than setting off on their own to produce their own offspring. Which of the following satisfies Hamilton's rule in this system?
   - The benefits of helping to raise the 2 siblings produced by the offspring's parents exceed the costs from not producing the one offspring it could produce if it went out alone.
   - The benefits of helping to raise the 5 siblings produced by the offspring's parents exceed the costs from not producing the 3 offspring it could produce if it went out alone.
The benefits of helping to raise the 3 siblings produced by its parents exceed the costs from not producing the 1 offspring it could produce if it went out alone.
- All answers are correct.
- None of the answers are correct.

6. There are many examples from nature where one species is sometimes seen to engage in exceptionally unusual behaviors that benefit another species. For example, there are countless examples of females of one species raising offspring of other species. Which of the following best explains this apparently altruistic behavior?
- kin selection
- reciprocal altruism
- aberrant behavior
- All answers are correct.
- None of the answers are correct.