



Diversity of Life:
Introduction to
Animal Behavior

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Image References

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Animal Behavior

- The way an organism reacts to changes in its external or internal environment
- Influenced by genetics and environment
- Asks “how” (the behavior is triggered, controlled, performed)
- Asks “why” (the behavior exists)



A blue orchard bee pollinates a zinnia.



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Animal Behavior

Behavior encompasses anything that an organism does, including voluntary actions and responses to stimulation (internal or external). The study of animal behavior involves investigating the relationships animals have with their physical environments and with other organisms. Examples of animal behavior studies could include research to determine how animals find and defend resources, communicate, avoid predators, choose mates, reproduce and care for their young.

Animal behavior has both genetic (polygenic in many cases) and environmental components. Some behaviors develop similarly, regardless of the environment, while others develop differently in different environments.

When studying behavior, it is important to identify both the behavior and the related stimulus (internal or external) that initiates or controls it. Ultimately, this leads us to ask why the behavior exists, and what evolutionary significance it might have (for example, how did it influence the species' survival and reproductive success?).

Ethology, the study of the evolution and functional significance of behavior, originated in the 1800s with C.O. Whitman, who studied display patterns in pigeons. Much of the work of early ethologists was unified by two Nobel Laureates, Niko Tinbergen (identified four areas of study: the behavior itself, along with its cause, development and evolution) and Konrad Lorenz (who conducted studies on imprinting). A third Nobel Laureate, Karl von Frisch, pioneered studies in bee communication and foraging. The ethological approach typified by the research of Lorenz, Tinbergen and von Frisch was largely concerned with the behavior of organisms as it is expressed in their natural environments.

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Innate Animal Behavior

- Instinctive or inborn
- Fully functional first time performed
- Some improve with performance or maturation
- Examples:
 - Nest building
 - Suckling
 - Weaving a web



Sow with piglet



Female orb weaver
with prey



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Innate Animal Behavior

Even though it is useful to think of behavior as being strictly genetic (inborn) or strictly learned, the line between these two types of behavior is blurred. Even a rigidly automatic behavior depends on the environmental factors for which it evolved, and most learning is guided by internal neural programs.

In general, instinct is considered to consist of heritable, genetically specified behavior organized and guided by circuits in the nervous system. In other words, innate or instinctive traits are those existing in, belonging to, or determined by factors present in an individual from birth. In the 1800s, C.O. Whitman coined the term “instinct” to describe behaviors he observed in pigeons. Innate behavior is that which appears to be developmentally fixed, meaning a particular behavior occurs in all members of a species, regardless of environmental influences. Innate behaviors are present at birth and do not require experience or practice, but do require a stimulus. Many of these behaviors improve with practice or physical maturation. Examples of innate behavior include hibernation in black and brown bears, nest building in birds, web weaving in spiders, and mating in all animals.

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Berger, J. *Orb weaver, Female with prey* *Img #1368049*. USDA Forest Service. Retrieved 12-20-2006 from <http://www.forestryimages.org/>

Learned Animal Behavior

- Acquired/modified by experience
- Types
 - Habituation
 - Association
 - Classical conditioning
 - Operant conditioning (trial and error)
 - Insight (reasoning)
 - Imprinting



Classical conditioning of dogs



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Learned Animal Behavior

Learning is modification of a behavior as a result of specific experiences. Learned behaviors allow an animal to adjust to changing environmental and social conditions. An organism's behavior is related to its environment and can be influenced by the presence or absence of other organisms, availability of food and other resources, and physical characteristics of the environment. When the environment changes, an organism's behavior patterns also may change in response.

Studies have shown that there are several ways in which animals learn.

• **Habituation** is a simple kind of learning involving loss of responsiveness to repetitive stimuli that do not reward or harm the animal. This allows an animal to concentrate energy on signals that are important to survival and reproduction.

• **Associative** learning involves the linking of one kind of stimulus with another, or with a behavior. In general, an animal learns to associate stimuli that are relevant for survival. In **classical conditioning**, an involuntary or innate response becomes associated positively or negatively with a stimulus that did not originally elicit that response. Ivan Pavlov (1900s) experimented with a dog's innate behavior of salivating. He conditioned a dog to associate the ringing of a bell with feeding (which caused salivation) so that even with the absence of food, the ringing of a bell would cause the dog to salivate. **Operant conditioning** (trial and error) involves learning to associate a behavior with a reward or stimulus and modifying later behavior accordingly. This type of learning was described by B.F. Skinner in the 1930s using the "Skinner box," which rewards an animal with food when the correct colored button or lever is pressed.

• **Insight or reasoning** occurs when an animal applies past experiences to solve new problems without a period of trial and error. This is the most complicated form of learning.

• **Imprinting** is a specialized type of learning that is limited to a critical time early in the life of an animal. It appears to be irreversible. Konrad Lorenz discovered that by artificially incubating duck and goose eggs, he was able to observe the newly hatched goslings and ducklings. Because the hatchlings spent the first few hours with him, they formed a social bond with him instead of with their mothers. The ducklings and goslings "imprinted" on him, the first moving object they saw following hatching. Lorenz was impressed by the fact that a young bird does not instinctively recognize adult members of its own species but requires this special type of learning.

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Patterns of Behavior in Animals

- Courtship
- Parental care
- Defensive
- Foraging
- Territorial
- Periodic or Cyclic
- Migration



Black Swan nesting,
Cygnus atratus



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Patterns of Behavior in Animals

Behavior in animals can be related to courtship and mating, caring for young, defense, obtaining food, establishing or maintaining territory or periodic cycles. Successful behaviors promote survival of the individual animal and its future generations.

•**Courtship** consists of behaviors that help members of the same species identify and select potential mates. Sexual selection is an evolutionary mechanism in which some traits increase an individual's chance of mating and passing along its genetic information.

•**Parental care**, if present, is usually provided by the female. This may allow successful and perhaps healthier males to maximize their reproductive output. Reproduction and care of offspring requires a great deal of energy, and the number of offspring produced at any one time is usually inversely proportional to the amount of energy invested in parental care.

•**Defensive** behaviors involve protection of the individual. In some animals, it also involves protection of offspring, mates and territory.

•**Foraging** behaviors relate to the ability of the animal to locate, obtain and consume food.

•**Territorial** behavior typically relates to feeding, mating and/or caring for offspring. A territory can vary widely from species to species. While the location is generally static, the size of the territory varies depending on the species and available resources.

•Many animals respond to **periodic** changes in the environment with daily or seasonal cycles of behavior. Daily patterns, such as sleep cycles, are referred to as circadian rhythms and are related to the Earth's 24 hour day-night cycles. Other periodic behavior can be linked to changes in the length of day and night, or of temperature.

•**Migration** is the regular, recurrent, seasonal movement of populations from one geographic location to another and back again. Many species of fish, mammals, and even insects take amazing migratory journeys, but birds, as a group, are the most mobile creatures on Earth. In general, migrating animals use one or more of three mechanisms: piloting, orientation and navigation. Piloting involves use of familiar landmarks and usually is used to locate nearby destinations. In orientation, an animal detects compass directions and travels in straight-line pathways. Navigation, which is the most complex mechanism, involves being able to determine the present location, and then the use of compass direction to travel in the desired direction. Some animals use the Earth's magnetic field, the sun, or the stars for navigation.

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Animal Communication

- Transmission, reception of, and response to signals constitutes communication
- Signals cause changes in behavior
 - Visual, auditory, tactile, chemical
- Examples
 - Pheromones
 - Dance of the honeybee
 - Bird songs
 - Feigning of injury
 - Visual display of stickleback fish



A bee, *Osmia ribifloris*, on a barberry flower



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Animal Communication

Communication occurs when one organism passes along some type of information (signal) to another, generating a response. Animals may use visual, auditory (sound), tactile (touch), chemical or electrical signals to communicate with one another. Transmitting and receiving these signals generates an external or internal response in the organism. Some examples are:

- Pheromones, chemical signals used for communication, are especially common in mammals and insects. Bees use pheromones to determine social rank and to initiate reproduction. The context of the signal is important. For example, male honeybees will respond to the pheromones of the queen while they are outside the hive (where they can mate), but are unaffected by the pheromones while inside the hive. Ants also use pheromones to mark a trails to food sources.
- Karl von Frisch was awarded the Nobel Prize for physiology and medicine in 1973 for his theory that honey bees communicate by a dance language. This theory was presented first by von Frisch in the 1940s. He suggested that worker bees are able to communicate direction and distance to a food source through movements described as “round dances and waggle dances.”
- Birds use song to recognize and attract other members of their species, to warn of predators and to defend their territories.
- Some birds, such as killdeer, will leave the nest and perform an elaborate “broken wing” display to attract a predator away from its nest.
- Niko Tinbergren demonstrated in his research that visual displays of stickleback fish initiate reproduction. The red belly of the male stickleback attracts a female, who adopts a head up posture. In response, the male makes a series of zigzag motions, leading the female to his nest where she deposits her eggs. Finally, the male enters the nest and fertilizes the eggs.

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Cognition in Animals

- Cognitive ethology
- Awareness or consciousness
- Mental experiences of animals as they:
 - Find food and mates
 - Rear young
 - Avoid predators
 - Create shelters
 - Communicate and socialize



Spinner Dolphins



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Cognition in Animals

Cognitive ethology is the comparative, evolutionary and ecological study of the mental experiences of animals, particularly in their natural environment, in the course of their daily lives. Cognitive ethologists use the term “mental experiences” because ethologists remain open to the idea that animals may have a conscious awareness of themselves and the world around them.

This would mean that animals have sensory experiences such as pleasure and pain, the use of mental imagery, and at least simple intentional states, such as wanting and trusting.

Cognitive ethologists use both field and laboratory experiments to study the mental experiences animals face as they find food and mates, rear their young, avoid predators, create shelters and communicate and engage in social interactions.

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Thank You

- This concludes a brief review of animal behavior.
- You may find additional information on this section in the expanded content talks, and in the notes attached to each slide within the library.

