What Is Behavior?

- **Behavior**: change in activity in response to stimuli
  - Is what an animal does and how it does it
  - Includes muscular and non-muscular activity
- **Cognition**: the ability of an animal's nervous system to perceive, store, process, and use information gathered by sensory receptors
- **Signal**: a behavior that causes a change in another animal's behavior
  - Visual, auditory, chemical, [pheromones] electromagnetic
- **Communication**: the reception of and response to signals
- **Learning**: the modification of behavior based on specific experiences

Behavioral Biology: Ethology

- Studying behavior in the natural setting.

Alan Rabinowitz radio-tagging jaguars for behavioral study in Belize.

Behavioral Biology: Experimental

- Isolating and manipulating specific behaviors.

Using artificial star patterns to study stellar navigation in indigo buntings

Behavioral Ecology

- Evaluating how behavior relates to niche.

Optimal foraging strategies: Natural selection favors feeding behavior that maximizes energy gain and minimizes the expenditure of time and energy. Tapirs have 40x more meat, but are much harder to find and catch. So jaguars prefer armadillos.

Nature vs. Nurture

Analyzing the roles of inherited characteristics (**innate behaviors**) and environmental conditioning (**learned behaviors**) on the overall behavior of a particular organism.

- Innate behaviors: no need to risk failures; correct from the first time.
- Learned behaviors: more dynamic, complex, and able to adapt to various situations.
  - Capacity for learning best developed in animals with complex nervous systems (sensory and memory), long life-spans, and parental care.
    - ✓mammals, birds, sharks & rays, cephalopod mollusks

Innate Behavior

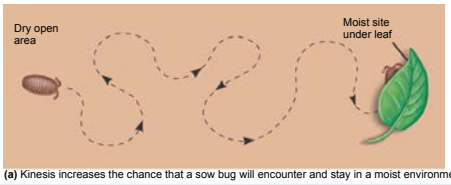
Stimulus ➠ response.

- Reflex
- Directed Movements: kinesis and taxis
- Fixed action pattern (FAP)
- Instinct

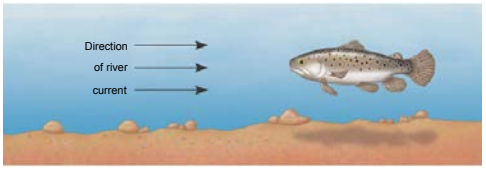
Directed Movements

- Kinesis: increased general activity (movement) in response to stimulus.
  - Photokinesis: turn on light ➠ run around randomly until encounter dark place ➠ stop moving
  - Hydrokinesis: increase activity when wet
- Taxis: movement directed toward (positive taxis) or away from (negative taxis) a specific stimulus.
  - Positive chemotaxis: move toward chemical cue
  - Positive phototaxis: move (or grow) toward the light
  - Positive rheotaxis: swim into the current
  - Negative geotaxis: crawl away from the earth (up wall)

Directed Movements



(a) Kinesis increases the chance that a sow bug will encounter and stay in a moist environment.

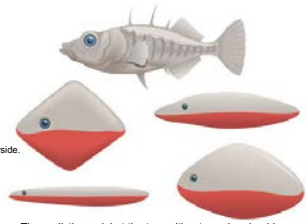


(b) Positive rheotaxis keeps trout facing into the current, the direction from which most food comes.

Sign stimulus

- An external stimulus that elicits a specific behavior.

(a) A male three-spined stickleback fish shows its red underside.



(b) The realistic model at the top, without a red underside, produces no aggressive response in a male three-spined stickleback fish. The other models, with red undersides, produce strong responses.

BEHAVIOR: A male stickleback fish attacks other male sticklebacks that invade its nesting territory.

Figure 51.3

Fixed Action Patterns (FAP)

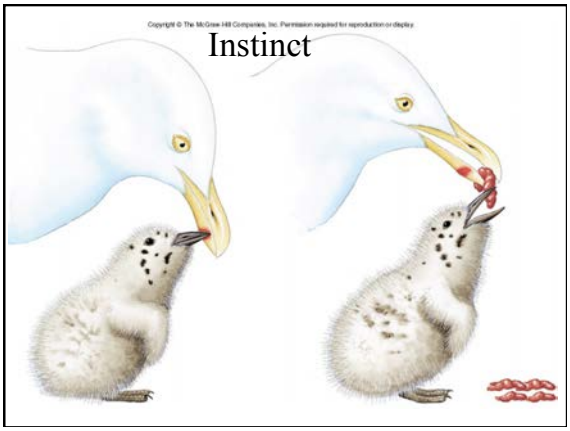
1. Sign stimulus initiates a distinct series of behavioral steps.
2. Once the series is initiated, all the steps proceed to completion even if the stimulus is removed.

Egg retrieval by the graylag goose.

FAPs in a nest parasite and its host

- FAP#1: European cuckoo chick responds to presence of host bird eggs by pushing them out of the nest.
- FAP#2: Cuckoo chick displays (gape/fluff) to host bird.
- FAP#3: Host bird responds to display by feeding chick.

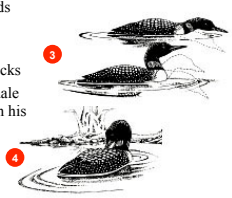
Instinct



Complex Instincts

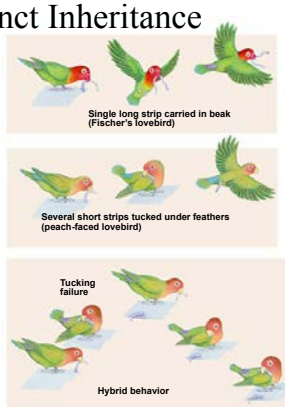
- The courtship and mating of the common loon involves the male and female loons swimming side by side while performing a series of displays

1. The courting birds frequently turn their heads away from each other
2. The birds then dip their beaks in the water
3. The loons then submerge their heads and necks
4. Prior to copulation, the male invites the female onto land by turning his head backward with his beak held downward
5. The loons then copulate



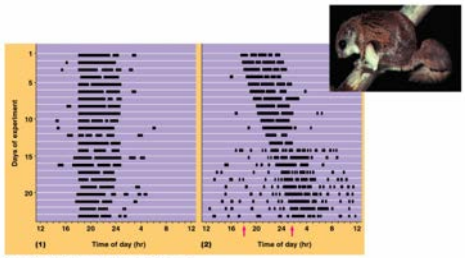
Instinct Inheritance

- Hybrids display intermediate behavior.



Many behaviors have both innate and environmental components

- Biological rhythms and circadian cycles [*circa-*: about; *-dia*: a day]
- Innate cycles entrain to the environment. I.e., in the absence of environmental cues, these rhythms continue — But they become out of phase with the environment.



Human Circadian Rhythms

- Long-term isolation has been used to study human circadian rhythms
- Body rhythms affect our general well-being, work efficiency, and decision-making ability

Learning: change in behavior in response to experience

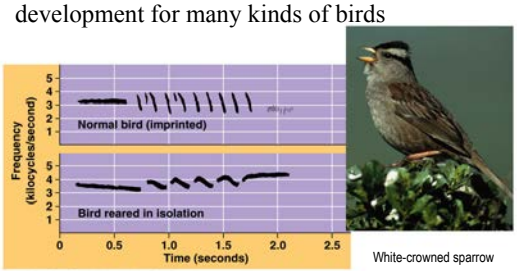
TYPES OF LEARNING

Learning Type	Defining Characteristic
Habituation	Loss of a response to a stimulus after repeated exposure
Imprinting	Learning that is irreversible and limited to a sensitive time period in an animal's life; often results in a strong bond between new offspring and parents
Association	Behavioral change resulting from a link between a behavior and a reward or punishment; trial-and-error learning
Imitation	Learning by observing and mimicking others
Problem solving	Inventive behavior that arises in response to a new situation

Imprinting: identification of self, con-specifics, mates, or home dependent upon exposure to specific stimulus during a specific **critical period** in development

- In famous study by Konrad Lorenz, graylag goslings exposed to him at time of hatching behaved toward him as their mother.
- Other examples: maternal imprinting on newborns; salmon imprinting on home stream

- Imprinting plays an important role in song development for many kinds of birds



White-crowned sparrow

- Young bird exposed to song learns appropriate song to attract mates.
- Bird raised in isolation has innate song, but insufficiently developed.
- Innate song pattern is sufficient though to prevent imprinting upon wrong species!

Social environment & behavioral development

- Male California deermice are monogamous, aggressively territorial, social, and demonstrate strong parental care
- Male white-footed deermice are polygamous, non-territorial, non-social, and demonstrate poor parental care
- Cross-fostered males exhibit many behavioral and neuroendocrine characters of their foster fathers

Table 51.1 Influence of Cross-Fostering on Male Mice*

Species	Aggression Toward an Intruder	Aggression in Neutral Situation	Paternal Behavior	Arginine-Vasopressin (AVP) Content in Brain
California mice fostered by white-footed mice	Reduced	No difference	Reduced	Reduced
White-footed mice fostered by California mice	No difference	Increased	No difference	No difference

*Comparisons are with mice raised by parents of their own species.

Data from J. K. Bester-Meredith and C. A. Marler, Vasopressin and the transmission of paternal behavior across generations in mated, cross-fostered *Peromyscus* mice. *Behavioral Neuroscience* 117(2003):455–463.

Many animals learn by association

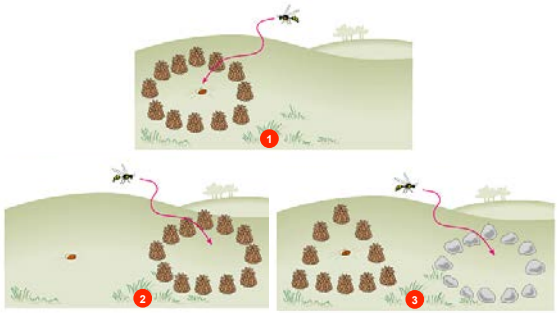
- Associative learning is learning that a particular stimulus or response is linked to a reward or punishment
  - These ducks have learned to associate humans with food handouts
  - They congregate rapidly whenever a person approaches the shoreline

Associative Learning: Classical Conditioning

The natural response to a natural stimulus is transferred to be the response (conditioned response) to a new, associated stimulus.

- Pavlov's dogs: a bell is rung when food is presented. Soon dogs start salivating at sound of bell even without food.

Associative Learning: Pattern Recognition & Mapping Behavior



Associative Learning: Operant Conditioning

Make an **association** between a particular behavior and its **consequence** (operant).

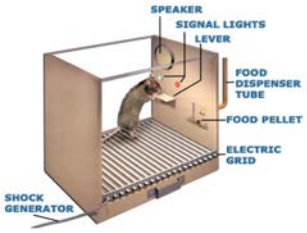
Trial-and-error learning: New responses to a new stimulus are tried and **reinforced**.

- **Positive** reinforcement: the response results in a (perceived) reward
- **Negative** reinforcement: the response removes a (perceived) punishment

→ the association of the stimulus with that response is strengthened. (↑ probability that response will be repeated)

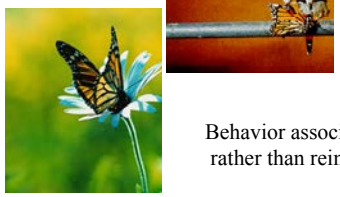
Associative Learning: Operant Conditioning

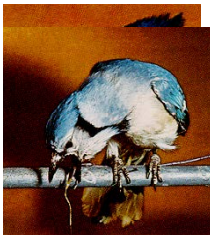
Operant Conditioning: The Skinner Box



- **Positive reinforcement: Push lever → food pellet**
- **Negative reinforcement: Push lever → stop shocks**
- **Classical conditioning + Negative reinforcement:**
  - **Associate red light with start of shocks**
  - **Push lever when light comes on → prevent shocks**

Operant Conditioning & Aversion Learning





Behavior associates with **punisher**, rather than reinforcer.

The problem with reliance upon learned behaviors is living with your mistakes!

- Trial-and-error learning is a common form of associative learning
  - An animal learns to associate one of its own behavioral acts with a positive or negative effect

Social Immitation & Learning

- Infant vervet monkeys give undiscriminating alarm calls at the sign of any approaching bird.
- If bird is actually a monkey-eating eagle, the rest of the troop echoes the calls. If the bird is harmless, troop stays quiet.
- Young monkey learns to sound alarm only when eagles approach.

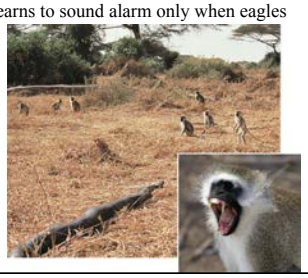


Figure 51.37

Cognition, insight, and problem-solving behavior

- Applying old responses to new stimuli
- Predicting new responses based upon previous experience or observation
- Some animals exhibit problem-solving
  - Examples: chimpanzees and ravens

Sociobiology
— applying ethology to human behavior

- Human behavior, like that of other species is the result of interactions between genes and environment.
- *However*, our social and cultural institutions may provide the only feature in which there is no continuum between humans and other animals.
- No other species comes close to matching the social learning and cultural transmission that occurs among humans.

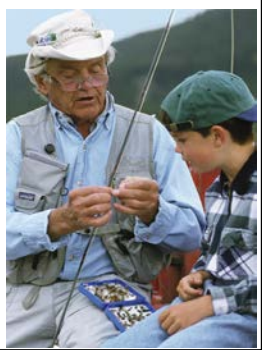


Figure 51.38