Ethology
- scientific study of animal behavior
  - particularly in natural environments
Behavior helps an animal
- Obtain food
  - Bird of Paradise
- Find a partner for sexual reproduction
  - Bowerbird
- Maintain homeostasis
- Behavior is subject to natural selection

Sensory inputs stimulate simple/complex behaviors
An animal’s behavior
- is its response to external and internal stimuli
According to early ethologist Niko Tinbergen, four questions should be asked about behavior:

1. What stimulus elicits the behavior, and what physiological mechanisms mediate the response?
2. How does the animal’s experience during growth and development influence the response mechanisms?
3. How does the behavior aid survival and reproduction?
4. What is the behavior’s evolutionary history?

**Proximate causation**
- “how” explanations, focus on
  - Environmental stimuli that trigger a behavior
  - Genetic, physiological, and anatomical mechanisms underlying a behavior

**Ultimate causation**
- “why” explanations, focus on
  - Evolutionary significance of a behavior

**Behavioral ecology**
- Study of the ecological and evolutionary basis for animal behavior
- Integrates proximate and ultimate explanations for animal behavior

**Sensory inputs stimulate simple/complex behaviors**
- Sensory inputs stimulate simple/complex behaviors
- Proximate causation
- Ultimate causation
- Behavioral ecology
Fixed action pattern

- a sequence of unlearned, innate behaviors
  - unchangeable
- Once initiated, it is usually carried to completion
- Triggered by an external cue
  - sign stimulus

Male stickleback fish

- Stimulus for attack behavior
  - is the red underside of an intruder
- When presented with unrealistic models
  - as long as some red is present
    - attack behavior occurs
**Oriented Movement**

- Environmental cues
  - can trigger movement in a particular direction

**Kinesis and Taxis**

- kinesis
  - simple change in activity or turning rate
  - in response to a stimulus
  - sow bugs become more active in dry areas
    - and less active in humid areas
- Though sow bug behavior varies with humidity
  - sow bugs do not move toward or away from specific moisture levels

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Fig. 51-4

Dry open area
Sow bug

Moist site under leaf

Sow bug
**Taxis**
- more or less automatic, oriented movement
  - toward or away from a stimulus
- Many stream fish exhibit a positive taxis
  - automatically swim in an upstream direction
    - prevents them from being swept away
    - keeps them facing the direction from which food will come

**Migration**
- regular, long-distance change in location
- Animals can orient themselves using
  - Position of the sun
    - and their circadian clock
      - an internal 24-hour clock that is an integral part of their nervous system
  - Position of the North Star
  - Earth’s magnetic field
Behavioral Rhythms

- Some animal behavior
  - is affected by the animal’s circadian rhythm
  - daily cycle of rest and activity
- Behaviors such as migration and reproduction
  - linked to changing seasons
    - circannual rhythm
- Some behaviors are linked to lunar cycles
  - Courtship in fiddler crabs occurs during the new and full moon

Animal Signals and Communication

- signal
  - a behavior that causes a change in another animal’s behavior
- Communication
  - transmission and reception of signals
- Animals communicate
  - using visual, chemical, tactile, and auditory signals
Honeybees
- show complex communication with symbolic language
- A bee returning from the field
  - performs a dance to communicate information
    - about the position of a food source
    - Waggle dance
Pheromones

- Many animals that communicate through odors emit chemical substances
  - called pheromones
    - effective at very low concentrations
- When a minnow or catfish is injured
  - an alarm substance in the fish’s skin disperses in the water
  - inducing a fright response among fish in the area

Learning creates links between experience/behavior

- Innate behavior
  - developmentally fixed and under strong genetic influence
- Learning
  - modification of behavior based on specific experiences
**Habituation**
- simple form of learning
- involves loss of responsiveness to stimuli
  - that convey little or no information
- birds will stop responding to alarm calls from their species
  - if these are not followed by an actual attack

**Imprinting**
- a behavior that includes learning and innate components
  - generally irreversible
- Sensitive period
  - a limited developmental phase
    - that is the only time when certain behaviors can be learned
  - Distinguishes imprinting from other modes of learning

**Example**
- young geese following their mother
- Konrad Lorenz
  - showed that when baby geese spent the first few hours of their life with him
    - they imprinted on him as their parent
• Conservation biologists
  • have taken advantage of imprinting
    • in programs to save the whooping crane from extinction
  • Young whooping cranes can imprint on humans in “crane suits”
    • who then lead crane migrations using ultralight aircraft

• Spatial learning
  a more complex modification of behavior
  based on experience with the spatial structure of the environment
• Niko Tinbergen
  • showed how digger wasps use landmarks to find nest entrances
Cognitive Maps

- Cognitive map
  - an internal representation of spatial relationships
    - between objects in an animal’s surroundings
  - Example
    - Clark’s nutcrackers can find food hidden in caches
      - located halfway between particular landmarks

Associative Learning

- Associative learning
  - animals associate one feature of their environment with another
  - Example
    - a white-footed mouse will avoid eating caterpillars with specific colors
      - after a bad experience with a distasteful monarch butterfly caterpillar
Classical conditioning

- a type of associative learning
  - in which an arbitrary stimulus is associated with a reward or punishment
- Example
  - Pavlov's dog
    - repeatedly hears a bell before being fed will salivate
    - in anticipation at the bell's sound

Operant conditioning

- a type of associative learning
  - in which an animal learns to associate one of its behaviors with a reward or punishment
- It is also called trial-and-error learning
- Example
  - a rat that is fed after pushing a lever
    - will learn to push the lever in order to receive food
- Example
  - a predator may learn to avoid a specific type of prey
    - associated with a painful experience
Cognition

- a process of knowing
  - that may include awareness, reasoning, recollection, and judgment
- Example
  - honeybees can distinguish "same" from "different"

Problem solving

- The process of devising a strategy to overcome an obstacle
- Example
  - Chimpanzees can stack boxes in order to reach suspended food
- Some animals learn to solve problems
  - by observing other individuals
- Example
  - Young chimpanzees learn to crack palm nuts with stones by copying older chimpanzees
Experience and Behavior

- Animal behavior
  - Is governed by complex interactions
    - between genetic and environmental factors
- Cross-fostering studies
  - help behavioral ecologists to identify the contribution of environment
    - to an animal’s behavior
  - Places the young from one species
    - in the care of adults from another species

- Studies of California mice and white-footed mice
  - have uncovered an influence of social environment
    - on aggressive and parental behaviors
- Cross-fostered mice
  - developed some behaviors that were consistent with their foster parents