

Understanding Bee Behavior

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Key concepts, typical patterns, and the ecological significance of bees

1. Overview

Bees are social insects (most species) that exhibit complex behaviors essential for colony survival, pollination, and ecosystem health. Their actions are driven by genetics, environmental cues, and communication systems.

2. Social Structure

Cast	Role	Typical Lifespan	Main Tasks
Queen	Reproductive leader	2–5?years (sometimes longer)	Lays all eggs; releases pheromones that regulate colony cohesion
Worker (female, sterile)	Foragers, nurses, builders	5–6?weeks (summer) / up to 6?months (winter)	Brood care, hive maintenance, food storage, defense
Drone (male)	Mating	8?weeks (summer)	Leaves hive to mate with virgin queens; dies after mating

Note: In solitary bee species (e.g., mason bees), only the female performs all tasks—nest building, provisioning, and egg laying.

3. Life Cycle

- Egg** – Laid by the queen in a wax cell (?3?days).
 - Larva** – Fed a diet of royal jelly (first 3?days) ? worker/queen diet (subsequent days).
 - Pupa** – Encased in a capped cell; metamorphosis lasts 12–14?days.
 - Adult** – Emerges with specific duties determined by age (age?polyethism).
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Understanding Bee Behavior

4. Age?Polyethism (Task Allocation by Age)

Age (Days)	Primary Activity	Behavioral Traits
0–3	Nursing – feed larvae	High brood?care pheromone response
4–10	Hive maintenance – comb building, cleaning	Increased wax production
11–20	Guarding – monitor hive entrance	Aggressive response to intruders
21+	Foraging – collect nectar, pollen, water	Strong orientation to sun & landmarks; use of waggle dance

Transition is flexible; colony needs can accelerate or delay task shifts.

5. Communication Systems

5.1. Pheromonal Signals

- **Queen mandibular pheromone (QMP):** Inhibits worker ovary development, maintains social order.
- **Alarm pheromone (isopentyl acetate):** Released when a bee is threatened; triggers defensive stinging.
- **Nasonov pheromone:** Used by foragers to guide nestmates to food sources or new nest sites.

5.2. Waggle Dance (*Apis mellifera*)

- **Purpose:** Convey distance and direction to a food source.
- **Components:**
 - **Waggle run:** Straight segment; duration encodes distance (?1?s ? 1?km).
 - **Return loops:** Indicate direction relative to the sun (angle of the waggle run).
- **Interpretation:** Receiver bees decode the vector and fly to the advertised location.

5.3. Tactile & Vibrational Cues

- **Antennal contacts:** Exchange information about colony status.

Understanding Bee Behavior

- **Vibrations:** Signal queen presence, brood health, or alarm.
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6. Foraging Behavior

Factor	Influence on Foraging
Flower color & pattern	Bees see UV patterns; preference for blue & yellow.