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## COMMUNICATION CHEMICAL TERMINOLOGY

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- **Semiochemicals** are communication chemicals.
- **Pheromones** are chemicals used for communication among members of a species.
- Pheromones are the principal form of communication of honey bees.
- Regulate activities such as colony defense, swarming, and foraging.
- Communicate individual bee sex, caste, and age.
- Communicates nestmate identity, i.e. indicates if an individual lives in a particular colony or not.

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## CLASSIFICATION OF SOCIAL INSECT PHEROMONES

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- Pheromones are classified as **releaser** and/or **primer** pheromones.
- **Releaser pheromones** release a behavioral response that is mediated by the nervous system. Releaser pheromones elicit an immediate behavioral response.
- **Primer pheromones** alter endocrine, reproductive and neurological systems. Changes are not immediate but occur in hours to days.
- Many social insect pheromones are releaser and primer pheromones that are a blend of many components.

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## PHEROMONES

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- Chemicals are the principal form of communication among insects.
- A simple understanding of the role of pheromones in regulating colony activities such as defense and swarming can help a great deal in understanding beekeeping practices.
- Among solitary insects pheromones are primarily used in mate attraction and comprised of one or two components.
- Among the social insects pheromones are used in mate attraction and much more. Social insect pheromones are often a complex blend of chemicals that have different functions in different social contexts. Pheromone biology is where communication, neurobiology, and physiology interact.

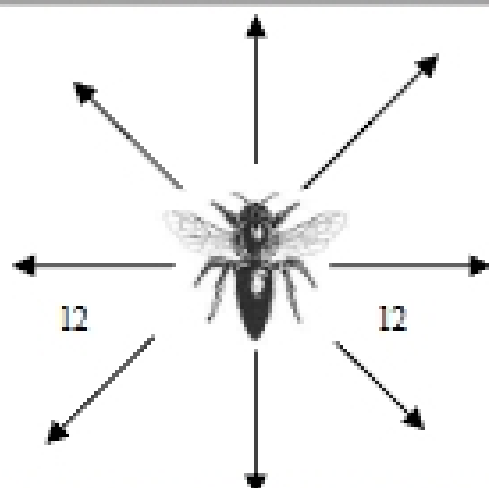
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## VOLATILE PHEROMONES

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- Volatile chemicals usually serve as sex pheromones or mass-action pheromones (defensive).
- Form an odor plume that can be followed along a concentration gradient.
- Majority of social insect pheromones are relatively non-volatile.

NON-VOLATILE PHEROMONES



- Non-volatile pheromones have no or short volatile spaces as shown here.
- These pheromones are detected by direct contact with chemoreceptors on the antennae or feet.

Volatile space of queen mandibular gland pheromone.

RELEASER PHEROMONES

PRIMER PHEROMONES

Pheromone	Source	Behavioral Response
2-heptanone	Mandibular gland	Alarm (aggression)
isopentyl acetate	Venom	Defensive (stinging)
Queen mandibular pheromone (QMP)	Mandibular gland	Retinue behavior

Pheromone	Source	Behavioral Response
Queen mandibular pheromone	Mandibular gland	Partial inhibition of worker ovary development
Brood pheromone	Larvae	Partial inhibition of worker ovary development
Brood pheromone	Larvae	Stimulate hypopharyngeal gland development

HONEY BEE SEMIOCHEMICALS

OUTLINE

**I. Queen Mandibular Pheromone (QMP)**

- Queen mandibular gland
- Component blend of QMP
- Mate attraction
- Species specific blend
- Racial blends
- Communicates reproductive status
- Retinue behavior
- Pheromone transmission
- Regulation of colony-level reproduction (swarming)

**II. Adult worker bee pheromones**

- Mandibular gland –alarm pheromones
- Membranes associated with the stinger – defensive pheromones
- Nasonov gland – orientation pheromones

**III. Nestmate recognition/discrimination**

- Adults learn the odors of nestmates either as individuals, or as a group (i.e. mixture) of familiar odors and accept individuals that “smell” like nestmates and reject others.

**IV. Brood pheromone(s)**

- a) Cuticular hydrocarbons (fatty acid esters)
- b) Communicates caste
- c) Communicates stage of development
- d) Stimulates hypopharyngeal gland development
- e) Releases pollen foraging
- f) Dose dependent effects on behavioral ontogeny (affects foraging age of adults)

**QUEEN MANDIBULAR PHEROMONE (QMP)**



- a) Produced by the mandibular glands of queens.
- b) **5-component blend of 3 acids and 2 aromatics.**
  - i. ODA; 9-keto 2 (*E*)-decenoic acid (200 µg) .
  - ii. 9-HDA; *R*- isomer of 9-hydroxy-2 (*E*)-decenoic acid (64 µg).
  - iii. 9-HDA; *S*- isomer of 9-hydroxy-2 (*E*)-decenoic acid (16 µg).
  - iv. HOB; methyl *p*-hydroxybenzoate (20 µg).
  - v. HVA; 4-hydroxy-3-methoxyphenyl ethanol (2 µg) .

• All 5 components in the correct proportions and within a range of amounts are necessary to elicit a retinue response equivalent to whole gland extracts in the proportions and amounts found on the body of a queen.

c) **Mate Attraction**

- 1) The most abundant component extractable from the mandibular glands of queens (ODA) attracts drones.
- 2) Mating takes place in the air and is very difficult to see.
- 3) Virgin queen blend of ODA is attractive to drones.
- 4) No bioassays have been conducted to determine what is most attractive to drones.

**QUANTITY AND QUALITY OF QMP**

