

Insects and People -- Entomology 101

How Insects Perceive Their Environment

Sensory Physiology

- response to changes in the environment
- changes perceived as sound, touch, chemical signals, humidity, vibrations, etc.
- Sensilla (sensillum) sensory apparatus (apparatus)

A. Sound

- vibrations - waves of kinetic energy in a solid medium
- sound - waves of kinetic energy in a fluid medium

1. Sound Production by Insects

- as a by-product of some other activity
e.g., wing movement, body movements
- by banging body parts against a substrate
e.g., stoneflies thumping ground
deathwatch beetle in burrow
- by means of specialized sound producing structures
 - air movement - expelling air - hissing cockroaches
 - stridulation - friction of body surfaces
e.g., file and scraper
crickets and katydids
grasshoppers
 - vibrating membrane - contracting of muscles attached to a membrane - tympanum

2. Sound Reception by Insects

- tympanum - "ear-drum"
e.g., moths and katydids
- Johnston's organ - base of antennae
e.g., male mosquitoes

3. Factors Controlling Sound Production

- external factors
e.g., light and dark and weather
- internal factors
e.g., sexual maturity, gender

4. Functions of Sound (produced by insects)

- interspecific - disturbance/alarm; mimicry; host location
e.g., grasshopper "clicking"
e.g., wasps and bees

- b. intraspecific
 - e.g., attract mates and courtship

B. Tastes and Smells

Chemical Ecology - Chemical abound in the environment

Chemeoreception - the perception and interpretation of chemicals

smell - olfaction (olfactory) - a distance source

taste - gustation (gustatory) - a close or local source

Basic Components of Chemical Communication

<u>sender (source)</u>	□ □ □ □ □ □ □ □ □ □ □ □	<u>signal</u>	□ □ □ □ □ □ □ □ □ □	<u>receiver</u>
host plant		olfactory or gustatory		insect
burger		olfactory or gustatory		Zack
female with perfume		olfactory		male in love

Advantages of Using Chemical Signals

1. visual cues unnecessary
2. effective range flexible
3. persistent
4. can be highly specific

Disadvantages of Using Chemical Signals

1. can be slow
2. cannot be modulated once released
3. can be copied

Chemical Signals

1. hormones - internal
2. semiochemicals - external

Semiochemicals

1. Allomone - acts interspecifically; signal benefits the sender
 - insect/animal
 - stink bugs - stench and foul taste
 - ants - formic acid
 - caterpillars - foul smelling secretions - osmeteria
 - insect/plant
 - pollination
 - turning the tables
 - orb weaver spider and moths
 - “synomones”
 - oviposition deterrents in fruit flies
 - pollination

2. Kairomone - acts interspecifically; signal benefits the receiver
 - carbon dioxide and biting flies (arthropods)
 - cucurbitacins

3. Pheromone - acts intraspecifically; signal benefits sender and receiver
 1. alarm pheromones
 - aphids
 - africanized bees and yellowjackets
 2. trail pheromones
 - ants
 3. aggregation pheromones
 - ladybird beetles
 - bark beetles
 4. sex pheromones
 - moths (notice antennae)
 5. oviposition deterrent pheromones
 - fruit flies
 6. aphrodisiac pheromones

How does a Chemosensillum Work

How Does a Male Moth Find a Female Moth

- plumes and zig zag flight patterns

The Practical use of Knowledge

- trap crops
- pheromone traps
- disruptive mating
- allomones to repel insects

C. Sight

Light and the Electromagnetic Spectrum

What Information does "Light" Provide

- light vs. dark
- movement
- forms
- patterns (within forms)
- intensity
- duration of light (or dark)
- distance (from triangulation)
- color
- polarization plant of light

Visual Receptors

1. Compound Eyes (see handout)
 - major photoreceptors (not found in larvae)
 - sometimes reduced
 - morphology
 - ommatidia (ommatidium)
 - lens and receptor portions
 - what do compound eyes “see”
 - movement
 - complex forms
 - form and background
 - distance
 - polarized light
 - color
2. Dorsal Ocelli
 - one to three small, single lenses, as many as 1000 retinal cells/lens
 - light intensity and length
3. Stemmata
 - larvae
 - forms - “scan”

Color Vision

- wider than in humans; infrared to UV (depending on species); not good with reds
- nectar guides (UV light perception)

Communicating with “Light”

- Bioluminescence
- lightening bugs and turning the tables