Communication

Goals:
1. Learn how and why animals communicate
2. Learn types of chemical communication: pheromones, kairomones & allomones
3. Compare methods of animal communication to human behavior
4. Understand the purpose and mechanisms of visual communication
   • See examples of the varied uses of coloration in insect communication
5. Understand the benefits and disadvantages of using various methods of communication

Web Reading:

Fireflies:
http://life.ku.edu/~biosteam/forum/seeonefirefly.html
http://life.ku.edu/~biosteam/oldsite/leonard/Fly/164F.htm
http://www.colostate.edu/Depts/Biology/zoology/papers/07papers/1066matthews.htm
http://www.news.cornell.edu/Chronicle/97/9.4.97/firefly.html
http://www.vnhb.com.cornell.edu/entomology/journals/jns/glossary.htm

Insects and Sound
http://hrbms.unl.edu/HRBM/HRBM.htm
http://hrbms.unl.edu/HRBM/insectails/i335faunaref/Michigan_Cicadas/Michigan/index.html

Social Behavior
http://cogprints.soton.ac.uk/documents/disk0/00/00/01/56/cog00000156-00/199709001.html
http://www.naturereview.com/nr/Environmen/EWEB/monarch.html
http://www.insects.unr.edu/Boom/Abalone/Abalone.html
http://www.nbb.cornell.edu/neurobio/eisner/poguna.html
http://www.beyonddiscovery.org/content/view/article.asp?i=2702

The Four (4) Key Elements of Communication

1. Sender
2. Message
3. Receiver
4. Medium

Other Communication Terms:
• Signal • Noise • Mimicry •

Uses of Communication

• Provide Information
• Provide Stimulus
• Benefit one or both participants

Intra & Interspecific Communication

• Mating
• Predation
Types of stimuli

1. Visual
2. Acoustic
3. Chemical
4. Tactile
5. Combination

Visual Communications

Disadvantages
- May be visible to predators
- Only works over short distances

Advantages
- Little risk of noise (misinterpretation)
- Wider range of expression than odor

Firefly Communication

1. Mate Finding
   Some females use their light to attract males of her own species for mating.

2. Prey Attraction
   Other females use their light to attract males of other species, which she devours

3. Warning
   Fireflies are toxic to many types of birds, and spiders and birds exhibit oral deterrence. Fireflies are known to contain lucibufagins, which are related structurally to toxins such as the bufodienolides of toads and the cardenolides of plants

4. Intimidation of Predators
   A bright flash of light in the face of a predator causes confusion and allows time for escape

Animal Coloration

1. Concealment
2. Distraction
3. Advertisement
4. False Advertisement = Mimicry

The Tiger Swallowtail: Master of Disguise!

Bird-dropping = larva
Three molts later...

Pupa looks like a broken twig

Mimicry

Poisonous
Non-poisonous

Mullerian mimics:
imitate other poisonous individuals, creating a recognizable "distasteful type"

Batesian mimics:
look like distasteful organisms, even though they, themselves are harmless

Aggressive mimics: Whereas Batesian mimics just want to be left alone, aggressive mimics want something else—food for example

The zone-tailed hawk mimics the flight silhouette of a turkey vulture (which does not eat rodents) in order to trick prey into false security
**Types of stimuli**

1. Visual
2. Acoustic
3. Chemical
4. Tactile
5. Combination

**Acoustic**

**Advantages**
- A large sound can be generated by a small creature.
- You don’t have to be seen to be heard.
- Can be used over and over again.

**Disadvantages**
- Signal is broadcast to intended and unintended receivers.
- Noise creates issues.

**Purpose of Sounds**

**Aggression:** The hippo's voice can be heard for over 3 miles both above and below water and is used to claim territory.

**Aggregation:** Hyenas "giggle" and "whoop" to call clan members to aid the hunt.

**Courtship signal:** Cicadas are the loudest insects, and the males use their calls to attract mates.

**Alarm:** Hissing cockroaches hiss when disturbed, in an attempt to warn off attackers.

**Copulation:** Tortoises (and other animals) usually vocalize during copulation in order to enhance the possibility of fertilization.

**Sound Generation**

**Stridulation:** Rubbing rough part of body against another such as wings or legs.

**Tymbal organs:** Buckle inwards causing pressure changes in the abdominal cavity, from which sound is radiated.

**Vocal cords or larynx:** Long, smoothly rounded bands of muscle tissue that may be lengthened or shortened, tensed or relaxed, and opened or closed. Opening and closing of the vocal folds periodically interrupts the air stream to produce a tone within the cranial cavities.

**Auditory Communication Among Insects**

**Most vocal group:** Orthoptera (grasshoppers, crickets and katydids).

**Loudest Group:** Cicadas - 106 db!
Types of stimuli

1. Visual
2. Acoustic
3. Chemical
4. Tactile
5. Combination

Causes of song/sound differences

1. Seasonal
   Mating season
2. Geographic distribution
   Japan Michigan
3. Habitat selection
4. The Environment
   72 degrees
   93 degrees

Chemical Communication

Advantages
- Sender need not be exposed
- Better for long distance than visual or acoustic
- Large variety of signals
- Reduced risk of interception

Disadvantages
- Lag Time
- Time to dissipate
- Limited Information Content, Highly context-sensitive

Pheromones

Chemical released by an individual of a species to elicit a response from another (usually of the opposite sex) of the same species: benefits both sender and receiver.

Flehmen: behavior that gathers chemicals towards the vomeronasal organ (Jacobson’s organ) in the roof of the mouth
- Partially open mouth, raised upper lip, curled tongue
- Baring the teeth: threat behavior
- Found in snakes, felines, horses, goats, cattle, deer and antelope

Chemical

Semiochemicals: Chemicals used in communication

Classification of communication chemicals

Time scale | Primer | Long term Changes
---|---|---
Releaser: Immediate RESPONSE
(or)
Who Benefits?
The Sender or The Receiver

Pheromones
Kairomones
Allomones
Honey bee
· Queen’s mandibular salivary gland
· Inhibits ovary development in all worker females

- Lower concentration workers ovaries develop, unfertilized, unmated = drones

**Gland or Source and Chemical Behavior reactions in colonies**

**Mandibular:**
- 9-oxodecenoic acid Recognition of queen and reduction of egg laying by workers.
- 10-hydroxydecenoic acid Recognition of queen and reduction of egg laying by workers.
- 9-oxodec-trans-2-enoic acid Mating attractant

**Stinger:**
- 3-isopentyl acetate Alarm pheromone (more on this later)

**Queen Substance:**
- a PRIMER pheromone
- \[ \text{Chemical} \]

**Aphrodisiac pheromones**

- Male butterflies release on female antennas in flight
  - Inhibits flight
  - Copulation of “grounded” female

**Anti-aphrodisiacs**

- Bombardier beetle *Pterostichus*
  - Male attempts to mate with female
  - Female unresponsive = shoots male
  - Male paralyzed for 1-3 hours

**Alarm Pheromone**

- Aphids - trans-ß-farnasene = many species
- Released from aphid cornicles when disturbed
- Cause others to fall off or move away

**Dispersion Pheromone**

- Fruit flies & oviposition deterrence

**Kairomones:**

- Chemicals Released by one species that elicit a response in individuals of another species which favors the receiver

- A. Bark Beetles
- B. Aphids
- C. Parasitoids
Allomones (Allo = other)

Chemicals released by one species that elicit response in an individual of another species which favors the sender

**Defense Secretions**
- Toxins - ants, bees, wasps, stinkbugs

**Secondary Plant Compounds**
- Cardenolides (cardiac glycosides) = milkweed
  - Poisonous to vertebrates, affects heart rate
  - Monarchs eat it to gain defensive toxin
- Crucifers (horseradish, wasabi, broccoli, Brussels sprouts, Kohlrabi, radishes, cauliflower, turnips-the mustard family)
- Sinigrin = allomones to most organisms but... stimulus to cabbage aphids, diamondback moths

**Clever uses of Chemistry**

**Crop protection (911 for plants)**

The Bola Spider

HELP!!

**Types of stimuli**
1. Visual
2. Acoustic
3. Chemical
4. Tactile
5. Combination

Much unhappiness has come into the world because of bewilderment and things left unsaid.

--Fyodor Dostoyevsky (1821-1881) Russian novelist

Happy the cicadas live, since they all have voiceless wives.

--Xenarchus, (lived around 60-20 BC) ancient Grecian poet and philosopher

Use what language you will, you can never say anything but what you are.

--Ralph Waldo Emerson (1803-1882) American essayist