Insect cuticle with a composite of various types of sensilla

- Trichoid (mechano-)
- Campaniform (stretch)
- Placoid (pressure)
- Two types of uniporous (chemo-)

Proprioreception

- Sensilla (trichoid or campaniform) surround joints or margins of sclerites
- Movement is sensed; informs insect of position of appendage or of itself

Olfaction

- Insects use odor for what purposes?
  - Sensory discrimination
  - Sensory control of motor behavior

Antennae

- Distance chemoreceptors
- Some contact chemoreceptors
- Many mechanoreceptors
- Sensilla on antennae act as tactile, olfaction, carbon dioxide, temperature, wind, humidity, and sound receptors

Types of antennae

- Setaceous (dragonfly)
- Filiform (ground beetle)
- Moniliform (termites)
- Serrate (click beetle)
- Clavate (carrion beetle)
- Lamellate (scarab beetle)
- Geniculate (ants, weevils)
- Pectinate (fire-colored beetle)
- Plumose (mosquito)
- Plumose (mosquito)
- Aristate (house fly)

Behaviour

- Detection
- Transduction
- Processing

Multiporous sensilla

- Micrograph Hallers organ, on the first leg tarsi of ticks showing olfactory sensillae. Numerous pores and slits; scale bar 2 µm.

Schematic of olfactory sensillum. Branched dendrites (yellow and orange) bathed in sensillum lymph (blue) increase sensory cell surface and molecular receptors so very low numbers of odor molecules are converted into action potentials
Moth Behavior

Female releases a chemical
Attracts male and guides him toward her over long distance

Moth Behavior
Odor triggers:
1. Flight upwind: determines direction and velocity from air currents and visual clues
2. A motor pattern in which the moth flies in a zigzag pattern

Cockroach Behavior
Periplanen - mixture of 2 substances

Structure of Olfactory Receptors

Receptors are modified sensilla

Transduction of odor signal

Olfactory Sensillum
Transduction of an Odor Signal

1. Molecule binds to, activates receptor
2. Activated receptor binds to G protein, phosphorylates GDP
3. Adenylate cyclase converts ATP to cAMP
4. cAMP acts as internal 2nd messenger
5. Na channel opens in membrane, Na enters
6. Sensory neuron depolarized

Central nervous system of an insect

Processing of Odor Signals

Processing in a glomerulus

Olfactory pathways in the cockroach

<table>
<thead>
<tr>
<th>Antennal Receptors</th>
<th>Brain</th>
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</thead>
<tbody>
<tr>
<td>Number</td>
<td>Type</td>
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<tr>
<td>18,000</td>
<td>Mechano</td>
</tr>
<tr>
<td>72,000</td>
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<tr>
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<tr>
<td>2,000</td>
<td>Hygro</td>
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<tr>
<td>100</td>
<td>Thermo</td>
</tr>
<tr>
<td>80,000</td>
<td>Female pheromones</td>
</tr>
</tbody>
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Insect eyes

- Compound eyes: large, located dorsolaterally
  - Many ommatidia create mosaic view
  - Perceive movement quickly
  - Vary in resolving power and light sensitivity

Frontal view of the inside of a moth head to show brain and antennal nerves

Glomeruli
125 in Cockroach
43 in Drosophila
The compound eyes of the house fly, each containing ~ 4,000 image-forming ommatidia. All surrounded by pigment cells. Retinula cells connected to neurons.

Animal pollinators: Bees
- Bees feed on nectar and pollen
- Bees are guided by sight and smell
- See yellow and blue colors, also UV light (not red)
- Flowers have “honey guides” and bee landing platforms.
Butterflies and moths

- Also guided by sight and smell
- Butterflies see red and orange flowers
- Moth-pollinated flowers are usually white or pale, with sweet, strong odor – for night pollination
- Usually shaped as a long tube; proboscis used to extract nectar

For Wednesday:

Become an expert on one arthropod-related disease

Choices:
- dengue fever
- West Nile virus
- Lyme disease
- Chagas' disease
- bubonic plague
- typhus
- yellow fever
- African trypanosomiasis
- filariasis
- Japanese encephalitis
- Onchocerciasis (river blindness)
- Rocky mtn spotted fever