

### Insect Respiratory System

- Some aquatic insects breathe through gills



### Insect Respiratory System

- Mosquitoes larvae breathe through siphons



### Respiratory Video

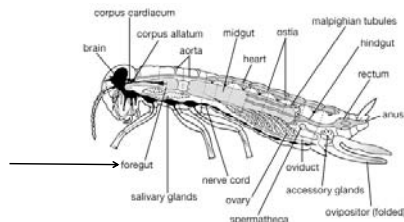
### Digestive System

The digestive system is a tube that is divided basically into three sections:

- Foregut
- Midgut
- Hindgut

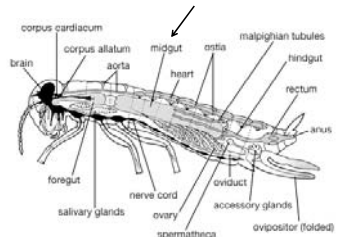
### Digestive System

Foregut – mostly used for temporary storage, mixing and grinding.



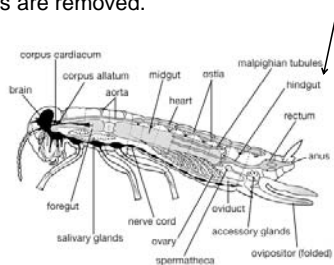
### Digestive System

Midgut - where most digestion and absorption of food occurs

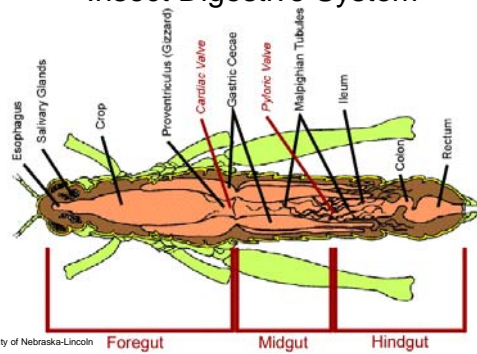


### Digestive System

Hindgut - where wastes are removed.



### Insect Digestive System



### Insect Digestion of Food

Most insects digest carbohydrates, proteins and fats.

Some insects, such as termites, have microorganisms called "symbionts" in their gut that digest cellulose or other materials for them to use as nutrients.

15

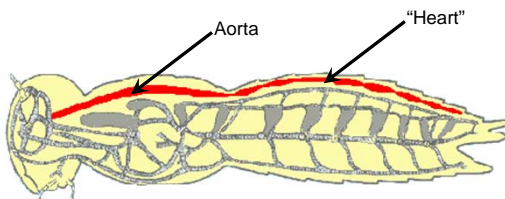
### Insect Circulatory System

Insects have an "open" circulatory system.

- Their blood is about 90% liquid (plasma)
- Blood travels through some blood vessels, then dumps into an open cavity.
- Insects have a dorsal blood vessel that serves as their "heart".
- Accessory pulsating organs help push the blood through the legs, wings and antennae

16

### Dorsal Blood Vessel



17

### Circulatory Video

### The Insect Circulatory System

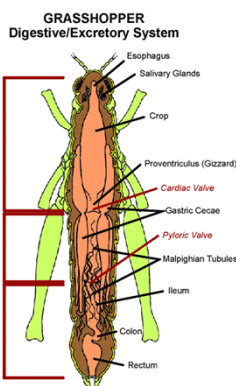
- With most insects, blood is not used to transport oxygen
- Bloodworms - Hemoglobin binds and holds a reserve supply of oxygen for times when oxygen in water is low.



### The Insect Circulatory System

- Transports nutrients and waste products
- Transports chemicals that are important for insect growth and development (hormones).
- Certain cells in the blood heal wounds and also dispose of bacteria and other organisms
- Maintains or changes the pressure inside the body

20



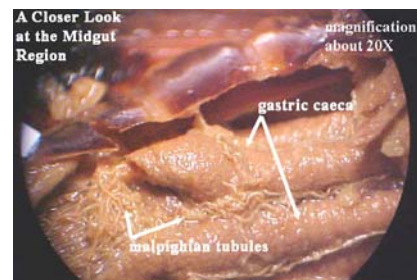
### Insect Excretory System

Malpighian tubules – insect “kidneys” located at the junction of the midgut and hindgut

- Purpose - similar to our kidneys
- Remove wastes from the blood and digestive systems.
  - Filter out water for recycling through the body.

21

### Insect Excretory System



22

### Reproductive System

Most insect species have two genders (sexes) - male and female

Some insects can control the gender of their offspring. For example - bees

- unfertilized eggs produce males (drones)
- fertilized eggs produce females
- they may produce males at certain times of the year only

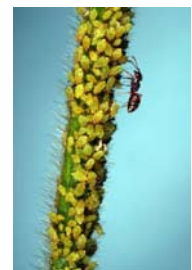
23

### Reproductive System

Parthenogenesis - reproduction without mating

All offspring from one female are genetically identical to her. (Example – aphids and whiteflies)

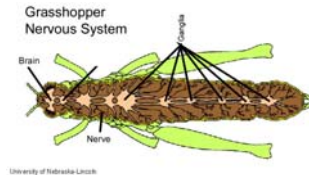
Can increase the likelihood of pesticide resistance developing.



■

### Nervous System

- Insects have a ventral nerve cord (the opposite of mammals and other vertebrates)
- They have a collection of nerve cells that compose a "brain"
- They have a pair of nerve centers in each body segment, called ganglia

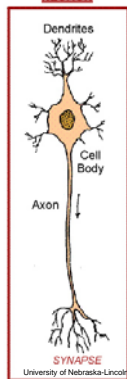


### Nervous System

Role of the nervous system:

- Collect and transmit sensory information such as:
  - Temperature, light, chemicals, etc.
- Control responses (movement, molting, eating, etc.)

### NEURON



### How the Nervous System Works

1. Nerves control the muscles
2. A nerve impulse moves along the nerve cell (neuron).
3. The impulse then travels across a gap (synapse) between the neuron and the muscle that it controls

### How the Nervous System Works

1. Acetylcholine acts as "chemical bridge" across the gap.
2. Acetylcholinesterase - resets the synapse

### How the Nervous System Works

Organophosphate pesticides (e.g. Dursban and diazinon, Orthene) inhibit or interfere with acetylcholinesterase and prevent the nerves from resetting.

Result:

- nerve keeps sending signals (doesn't reset)
- muscles keep twitching
- insect dies

Same affect on human nervous systems

### Hormone Production

HORMONE - a chemical formed in an organ or body tissue that travels through the body and causes some effect on another body part.

Some hormones control

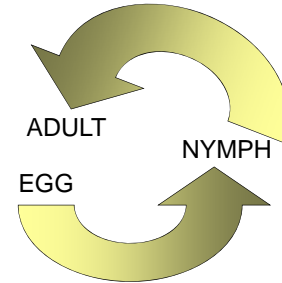
- Molting
- Growth and maturation to adulthood

### Hormone Production

Some insecticides mimic these hormones - prevent the insect from molting or maturing or cause it to become an adult too quickly.



### INSECT GROWTH & METAMORPHOSIS



32

Questions?