

BSCI 120
ARMSTRONG

8/31/10.

• What is an insect?

- An arthropod.
- arthro - means jointed.
- pods - refers to feet or appendages.
- 3 distinct body regions: head, thorax, abdomen
- have 2 pairs of wings.
- has 1 pair of antennae
- 3 pairs of legs.

Entomology = Study of insects

Why study? b/c we encounter them daily; more kinds of insect than any other kinds of animals.



- over 1,000,000 species described
- maybe up to 10,000,000 species undiscovered.
- insects are everywhere.
 - occupy every terrestrial + aquatic habitat except:
- greatest ^(of insects) # occur in the tropics
- highly variable size.
- Insect Richness
- insects have been used in diff. cultures

Benefits of Insects:

- important pollinators
- one of nature's efficient "sanitation workers"
- serve as food for other animals.

- provide commercial products.
 - silk from silkworms)
 - honey + beeswax from honey bees.
 - cosmetics from royal jelly.
- perform services such as scavengers.
- help keep harmful animals + plants in check on crops, forests, + other human-managed resources
 - ladybugs, praying mantis.
- replenish nutrients to + aerate soil
- useful in medicine + scientific research
 - bee stings for arthritis
 - bio-terrorism
 - models for genetic + molecular studies.
 - models for understanding biological processes.
 - ... to develop robots.
- used as religious items or symbolic in many cult
- interesting
- provide jobs
 - Academia • fed. + state govt.

Harmful Effects of Arthropods.

- Some are responsible for enormous economic losses in agricultural store products.
- conflict w/ humans.
- many transmit disease causing agents to man/animals.

disease vectors:

- kissing/assassin bug - transfers protozoa.
- female mosquitoes (suck blood, males don't)
- tick
- soft tick

terrible diseases:

- malaria
- yellow fever
- plague

* Historically, during war times

Entomology includes:

- physiology
- morphology
- forensic entomology
- taxonomy
- integrated pest management
- medical + veterinary
- Genetics
- Ecology
- biological control

Hierarchical Classification

9/2/10.

- Kingdom
- Phylum
- Class
- Order
- Family
- Genus
- Species

Classification: Kingdoms.

- Animalia - animals
- Monera
-
-
-

Kingdom Animalia

- consists of ~30 phyla.

Some familiar phyla: Chordata - vertebrates

Arthropoda, arthropods. Nematoda - roundworms, etc.

- Trilobites (extinct)
- Horseshoe crabs.
- Arachnids.
- Crustacea.
- millipedes.
- centipedes

Arthropod characteristics:

- exoskeleton
- jointed appendages
 - legs, mouthparts.
- show bilateral symmetry
- dorsal blood vessel; circulatory system found on top.
- ventral nerve chord.
- no vertebrae present
- well developed sensory systems.
- Striated muscles present

Classes of Arthropods.

- Class Arachnida (spiders, ticks, mites, scorpions).
- " Chilopoda. (centipedes)
- " Diplopoda. (millipedes)
- " Crustacea. (crabs, shrimps, etc)
- " Insecta. (Hexapoda)

Characteristics used to separate Arthropod classes.

- # of body regions
- legs
- antennae

evolution of arthropods.

- Annelids or segmented worms. (e.g. Marine worms, etc...)

Early Annelids

- mostly marine w/ segmented bodies.
- segment had fleshy, paddle-like appendage.

Modern Annelids:

• earthworms & leeches habitats range from soil to water; no fleshy paddle-like appendages on segments.

Phylum Onychophora.

Onychophorans are "linking ancestors" b/w annelids & arthropods.

Annelids

Arthropods.

Onychophorans

Velvet Worms

Habitats: mostly tropical in dark or damp areas. (f.e. Central + South America, Africa.)

Food source: omnivores.

Phylum Arthropoda

Subphylum Trilobita

Subphylum Chelicerata

Subphylum Mandibulata

extinct

Sea scorpions, horse shoe crabs,
arachnids.

crustaceans, millipedes
centipedes, insects.

Arthropoda: from arthro. and poda.

phylum of invertebrate animals that have insects.

Trilobites: the 1st arthropods.

- appeared in the Cambrian Period & dominated many habitats during the Paleozoic Era.
- All were extinct before Dinosaurs appeared on Earth.
- Oldest form of arthropods.
- lived > 500 million years ago (fossils).
- Scavengers on organic material.

Subphylum Chelicerata. Characteristics:

- two body sections.
 - cephalothorax (=Prosoma): the head & thorax fused together
 - abdomen (=Opisthoma)
- Six pairs of appendages on the cephalothorax:
 - 1st pair: chelicerae
 - 2nd " : pedipalps
 - 3rd thru 6th pairs: legs.

Examples of chelicerates:

- Sea Scorpions.
 - extinct - large 6-8ft. - Flourished in Devonian period (360 r year)
- Horseshoe Crabs.
 - found along eastern coast of Atlantic ocean + Orient
 - eat marine worms - Breathe via gills. - forked

importance:

- \$100 million/yr tourism industry
- \$50 million/yr biomedical industry: federal law requires intravenous be tested w/ horseshoe crab bi impurities.
- eggs are vital link in shorebirds migration from South America to arctic breeding grounds.

Arthropods -

- Brown reese spiders.

- Wolf Spiders.

- nocturnal carnivores.
- found in litter.
- spiderlings on back.

- Tarantulas.

- tarantula wasp.

- lays eggs on the inside of tarantulas.

- Trap-door spiders.

- Found in Southern + Western U.S.

- Crab Spiders.

- Crab-like in appearance
- common on litter or vegetation
- camouflage.
- pounce on prey + suck up predigested liquid.

- Jumping Spider.

- doesn't produce spider webs.

- Daddy long-legs.

- Arachnids
- always mating
- feed on decaying plant material

Arachnids Courtship Behavior.

- Male so small, he clambers ignored over body of female
- approach "direct," male pounces female w/ his pedipalps + legs, causing her to lose consciousness.
- some males vibrate strands of webbing, producing vibrations detected by female.
- dance in front of female.
- black widow spider courtship.

9/13/10 Discussion / Lab .

- Domain-species

- Kingdoms:

Plantae Animalia Fungi

Protista.

(multicellular, eukaryotic.)

eukaryotic, unicellular + multi

Eubacteria

Archaeobacteria.

(unicellular, prokaryotic.)

* harvestmen: "daddy-long leg"

Animalia

• multicellular • require food from outside source

• nervous system • ex: sponges, worms, mollusks, mammals, and arthropods.

Arthropods:

• have exoskeleton • jointed appendages.

• growth by molting. • Tagmose and Segmentation
"body regions" ↳ helps in movement

Arthropod Groups: ON ELMS.

hexapod: 6 legs.

Sub-Phylum: Trilobita.

- oldest + extinct arthropod.

Sub-phylum: Chelicerata.

" : Myriapoda.

Discussion/Lab.

9/20/10.

Dorsal: Top

Ventral: bottom / underside

Anterior: front

Posterior: back

Lateral: side

Tagmosis. - structure

head

thorax: 2nd body region: Prothorax, Mesothorax, + Metathorax

abdomen: spiracles for breathing. sternites, tergum

Grasshopper

head:

Antenna

Ocellus (ocelli)

Compound Eye

head:

Labrum

Mandible

Maxilla

Labium

Legs:

Femur (femora)

Tibia(e)

Tarsus (tarsi)

Females have an ovipositor

9/23/10. Lecture.

Exam 1: September 28, 2010

- Lectures in Packet
- Arthropods (pgs 2-9, 17-19)
- Diversity + Evolution (pgs 1, 20, 25-28)
- External Anatomy (pgs 32-34)
- **Internal Anatomy (pgs 35-40)**
 - Digestive, respiratory, circulatory, excretory, and reproductive systems.

Digestive Tract.

- Regions of digestive tract.
 - Foregut
 - Midgut
 - Hindgut

Midgut: (Ventriculus)

- Region of digestion and absorption
- Peritrophic membrane
 - Functions:
 - ~ Passage of nutrients
 - ~ Protects delicate epithelial cells
 - ~ Keep harmful microorganisms from entering epithelial cells

Hindgut

- ileum, - colon - rectum - anus

Nutrients:

Dietary Requirements: vitamins, amino acids, {steroids, lipids, carbohydrates,} salts & other substances to grow & develop.

Circulatory System

Plaphet

open vs closed.

- lab book * insects have open systems. *
- Open: blood not confined w/in arteries, veins, etc.
- Closed: blood confined w/in arteries, veins, etc...

Dorsal vessel ; ventral nerve cord.
 various hearts.
 aorta; hearts.
 aorta, ostium, heart, hemocoel.

- Insectect hemolymph (blood) doesnt carry oxygen since tracheal systems do that; blood not red + bathes the tissues/organs.



alary muscles (insect body; dorsal view)

Accessary pulsatile organs: wings, legs, antennae.

- These organs (small "hearts") pump blood to wings, legs, antennae.

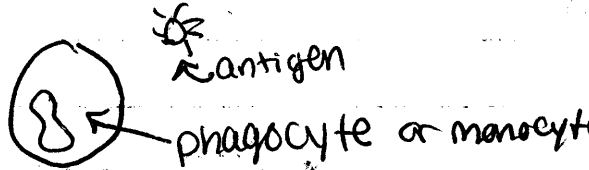

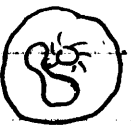

Blood Components

- Blood = hemolymph
- hemocytes
- water
- inorganic ions
- other organic molecules

Functions of blood:

- Nutrient transport
- Storage
- hydraulic pressure
- coagulation
- phagocytosis
- encapsulation
- wound healing

Phagocytosis

- ① phagocyte/monocyte approaches antigen 
- ② Engulfing 
- ③ Digesting 
- ④ Phagocytosis completed 

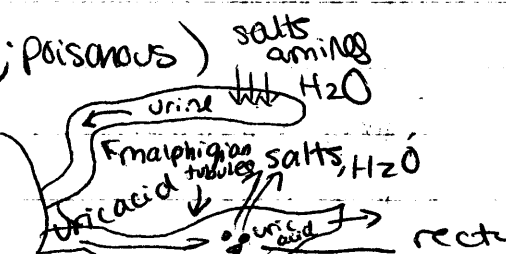
What's the difference between phagocytosis and encapsulation?
 encapsulation: covers & completely surrounds it
 phagocytosis:

NO hemoglobin present, so won't be red.

Excretory System

Function: remove metabolic waste products from the body

Forms of waste products:

- | | | |
|------------------|---|---|
| insects < | 1. ammonia (aquatic animals; poisonous) | salts
amino acids
H ₂ O |
| mammals/humans < | 2. uric acid (land, terrestrial) |  |
| | 3. urea | |

Malpighian tubules (tubes found @ junction of mid & hind area)

• remove nitrogenous (poisonous) wastes from the body
 They function like the kidney in our body.

Principle Waste Organs.

• Malpighian tubules:

- vary in # & found at midgut & hindgut junctions.

- Cryptophry

• Other waste product structures.

- fat bodies, urate cells and nephrocytes

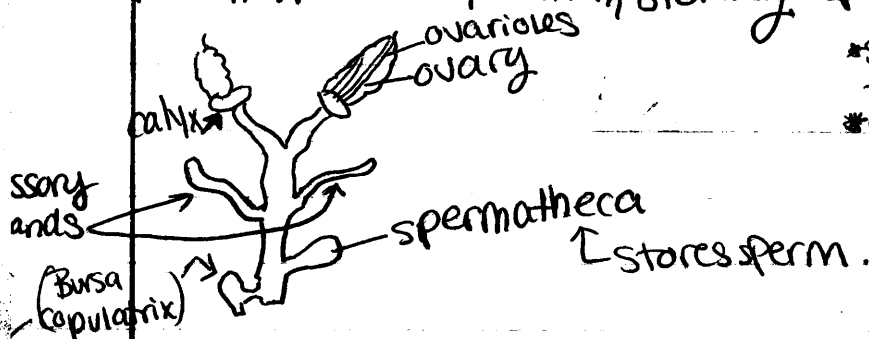
Reproductive System of Insects. (NOT on exam)

Function: perpetuation of species.

- mayflies: mate & die in day.

Female reproductive system.

Function: copulation, storing sperm, producing eggs.



* Some females reproduce once or multiple times
* can choose the sex

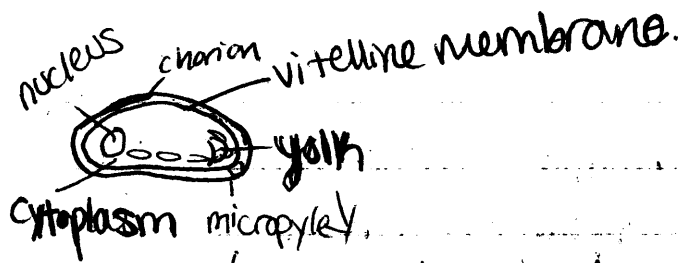
→ produce chorion & glue-like materials to adhere eggs to matrix in the environment.

→ temporarily stores sperm

Ovipositor: used to lay eggs in soil, trees, plants, & other materials. In stinging insects

Reproductive System

Insect egg cell
Chorion: egg shell



nucleus: contains the genetics

provide nutrients, spread throughout the egg
allows sperm to enter the egg

~~oocyte~~ aeropyle: allows oxygen to penetrate the egg
series of openings.

Oviparity: egg placed in environment

(e.g. hissing cockroach) →

Ovoviviparity: eggs retained w/in female's body but offspring received nutrients from yolk sacs of egg

Viviparity: eggs retained w/in female's body & receive nutrients from uterine device (e.g. tsetse fly, sheep ked); gives birth to live offspring

Male Reproductive System

- produce sperms

- produce spermatophores

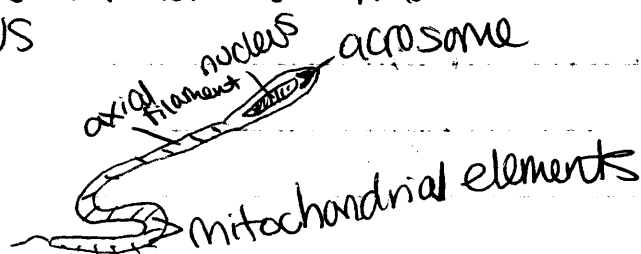
pair of testis, which contain sperm tubes.

once they're mature, they pass through vas deferens and into seminal vesicle where sperm is stored

accessory gland: provides nutrients & fluids for sperm

ejaculatory duct:

claspers: function is to hold female when not receptive to aedeagus



Sperm Transfer

Mr.

- Seminal Fluid
- spermatophores

nood

Are insects monoecious, dioecious, other?

Monoecious: both reproductive systems found in same sex.

Dioecious: males + females have individual reproductive system; copulation must occur to produce offspring

Asexual Reproduction:

- eggs)
- Polyembryony: single egg gives rise to multiple offspring
 - Parthenogenesis: offspring develops from unfertilized eggs.
 - Neoteny: immature insects having babies.

Muscular System

Functions: locomotion, maintaining posture, movement of organs.

Two Types of muscles: skeletal and visceral

Skeletal

- head
- legs
- wings

> associated with locomotion

visceral muscles.



Nervous System

Central

Peripheral

Stomodaei

brain,

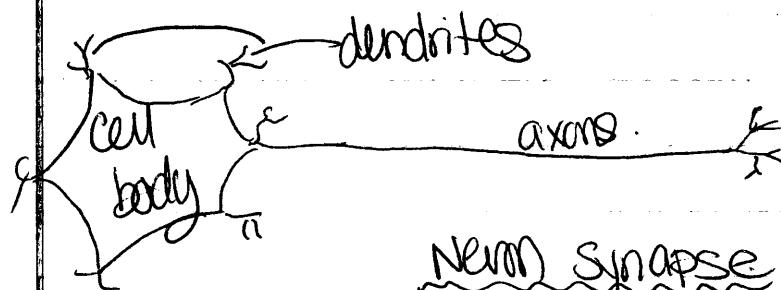
niraa

Peripheral: radiates from ventral nerve cord and makes connection with many of the internal organs. Thoracic ganglion are important in movement.

Stomodaei: Makes connections with innermost visceral organs (e.g. digestive tract).

Types of neurons ^(nerve cells) in insects:

Sensory neurons • Motor neurons • Association neuron



contains nucleus.

Neuro Synapse

axon dendrite



acetylcholine = transmitter substance

insects possess a variety of auditory, olfactory, tactile structures, and other

Internal Anatomy

Endocrine system

Functions:

- secretion of hormones
 - transported by nerves and circulatory system
- control and regulate insects development
- Reproduction (as adults)
- * gland or tissue produces and secretes hormones, "chemical messages" ... hormone stimulates or inhibits "target tissues".

Important glands:

- corpus cardiacum

- protocerebrum

- neurosecretory cells:

- neurosecretory substance (brain hormone)

brain has these produce a (brain hormone) associated with growth + development of the insect

Corpora cardiaca (Found in thorax)

prothoracic gland; molting fluid cells, exoskeleton, integument, epidermal cell
ecdysone (molting hormone)

ecdysial sutures → exuvium → instar II

Corpus allatum = produce juvenile hormone

10/4/10.

Discussion. Practical: week after 2nd exam.

Insect Respiration

Gas Exchange:

- oxygen taken up from the environment
- CO₂ released.

Insect "blood" (hemolymph) does not carry oxygen.

- What does it lack?

- It lacks respiratory pigments and therefore carries little oxygen.

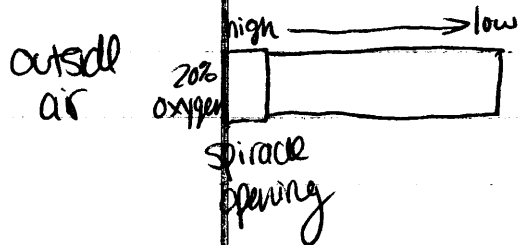
Spiracles

↓
Trachea

↓
Tracheole

↓
Tissues & organs.

Diffusion: movement of molecules from high to low concentration.



How does oxygen move through tracheal system
pumping of thorax + abdomen