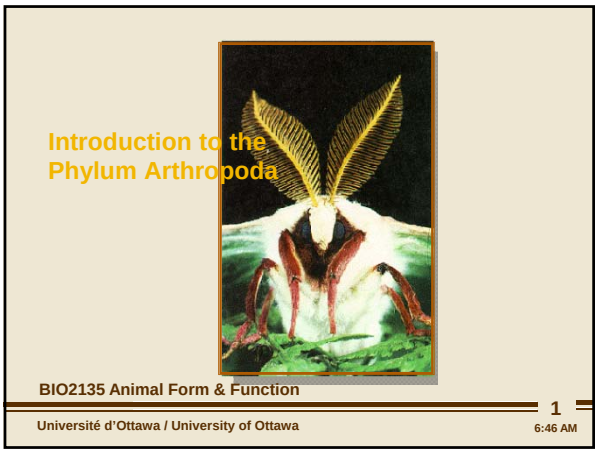
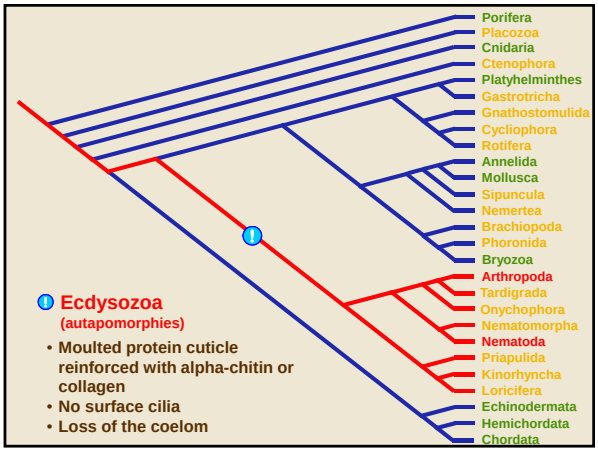
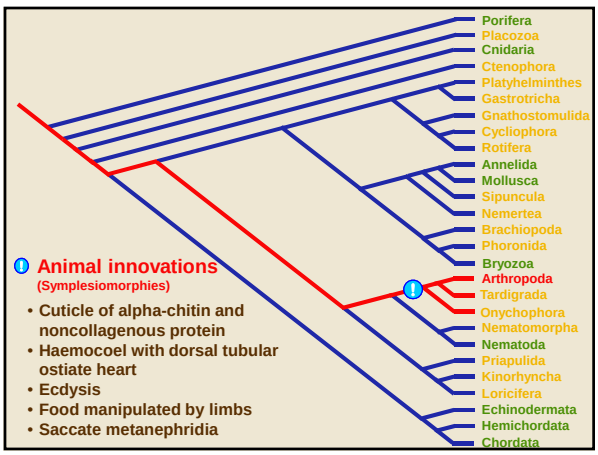
Arthropoda

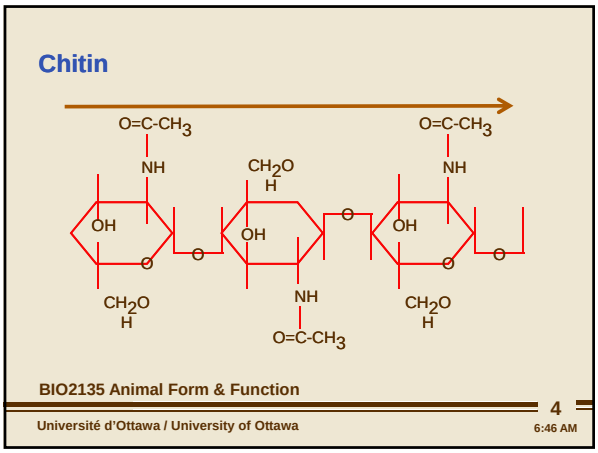


single largest group

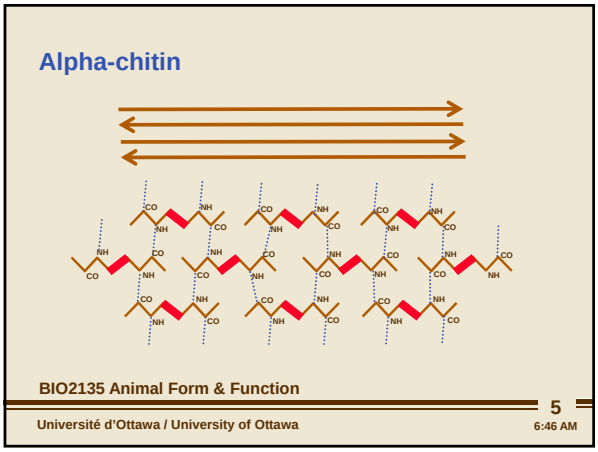


reinforced with chitin or collagen
-diff - alpha chitin as reinforcing cuticle
-have open circulatory system
-remenents of coelum
-ostiate heart- the way they pump blood
-drowned in blood
-molt a number of time in the life system- way to gets out of cuticle because it becomes constricting as it gets bigger
-every organism consumes substrates that is is in, first group that takes food and manipulates it with its limbs -before consumption
-saccate metanepgridia
-funnel like struction inside a coelomic space
-paraphenium- lines coelomic area - also put space around the metanephridiam -hemoceal - for main body cavity - the only coelom that rests is the opening of the metaniphridia

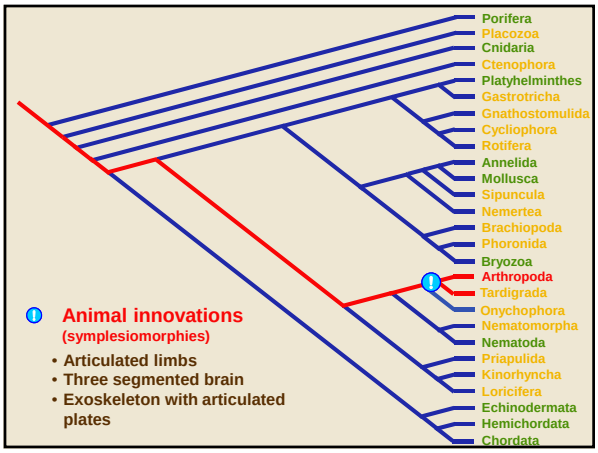




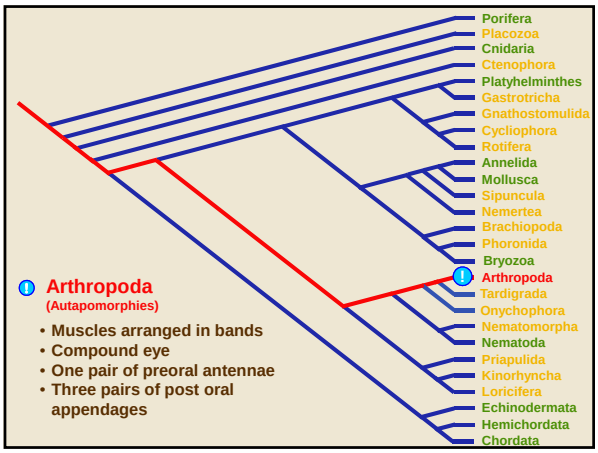
cuticle - annelides had cutticle- had the structure lined in the same polarity
-lines in a anti-parrele pattern



nitrogen reacts with the carboxyl - end up with strong ionic bonds between the molecultes in the alpha pattern
-give group strong exoskeleton
-surronds it with protein- makes it hard to rip or tear cuticle



~~3 segmented brain~~
-1 all of the visual info
2 and 3 - for antenna
~~3 componetnst are associated with the brain~~



autapomorphies

-muscles arranged in bands- depends on the structure of the cuticle

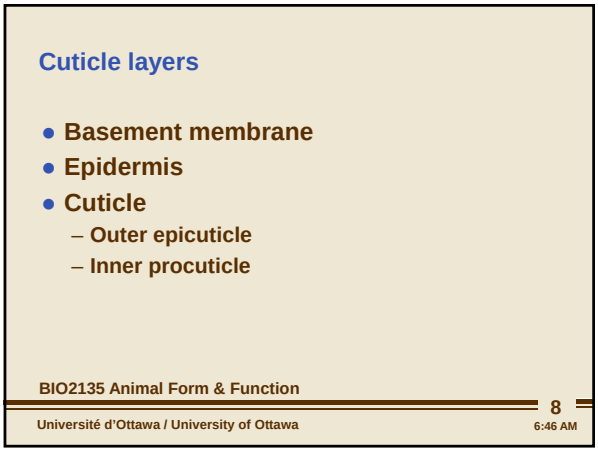
-compound eye- composed of little optic units that fuse together a image

-head has 3 segments

-vision, and antennae (sometimes 2 sets)

-behind mouth there are 3 other segments

-



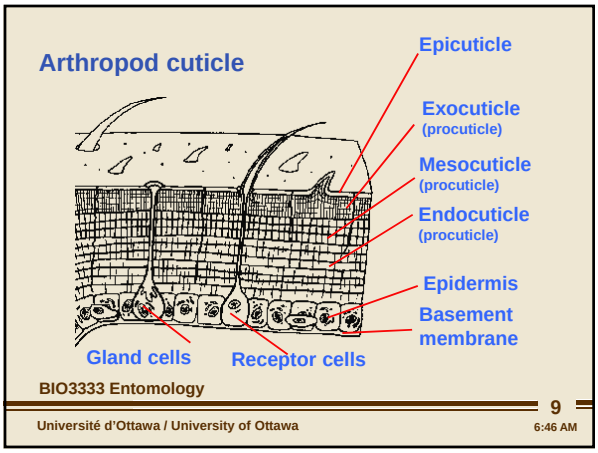
-amoung all groups

-cuticles - cement layer that holds all of the cells together

-underneath epidiumis that builds the cuticle

-cuticle is non living that sits outside

-when it molds, tries to recove as much nutrients as possible???



2 major components

~~-epi and pro cuticle~~

-pro: strenght - where most of rigidity comes from

-epi: layer that give cuticle its waterproffing

~~-first animals to move on land where they dont dry out~~

-divided into 2 or 3 components

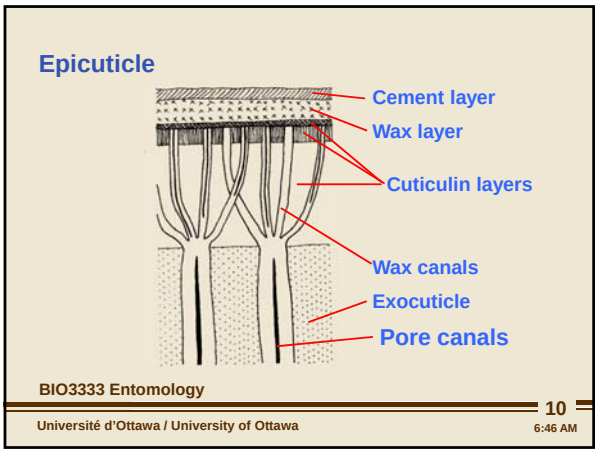
-exo and endo cuticle

~~-endo - protein matrix enbedded are cross linked together~~ - proteins are higher strenghtens

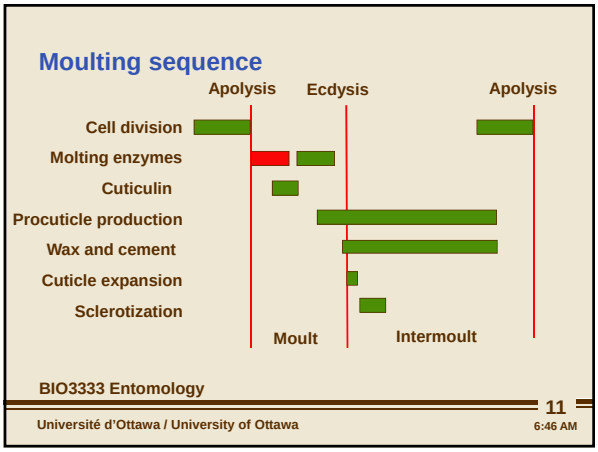
-underneath- no cross linking- less rigitity- able to change and shift position for flexible ~~cutible~~

-depending on proportion- dependmines flexibitlity

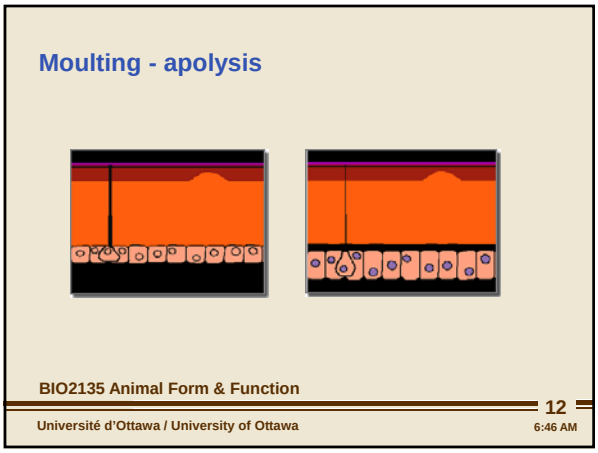
-mesocutilcle- crustration - calcium - extra set of rigedity



2 componests
-no cuticle- just makes a protenateous layers
-wax give waterproffing- soft and easily degraded
-to protect it, cement layer is placed on tope of that - high protein mix that lays on top so it is protected
procuticle- give strenth and rigidity



animal is putting on mass - skeleton restrict its growth
echdysozoans - molt
-chemical signal that causes
apolysis- seperate cell membrane from cuticle
-digest old cuticle to make new cuticle



digestion of cutilcle- old and not new
protease break down proteins
chitenases to break down chitin
-enzymes are release in inactive state- put is a space
-secreat cutifulum layer - proten mesh - semi permeal- lets small molecules pass through- end up activating enzymes

Moulting - new epicuticle

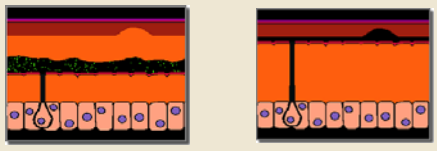
BIO2135 Animal Form & Function
Université d'Ottawa / University of Ottawa
13
6:46 AM

Moulting - digestion of old cuticle

BIO2135 Animal Form & Function
Université d'Ottawa / University of Ottawa
14
6:46 AM

can only get to the old cuticle
-chewing away at the old chitin so it can be used again
-make new procuticle until it reaches the epi cuticle
- stops because cant break it down
-when they produce that cuticle

Moulting - undigested exocuticle



BIO2135 Animal Form & Function
Université d'Ottawa / University of Ottawa
15
6:46 AM

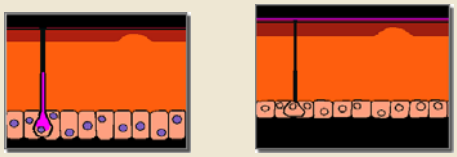
~~gulp ans solweingw water, swells up~~
-shatters and old cuticle braeks
-crawls out of out cuticle and become larger animals

Moulting - ecdysis

BIO2135 Animal Form & Function

Université d'Ottawa / University of Ottawa 16 6:46 AM

Moulting - outer waxy layer



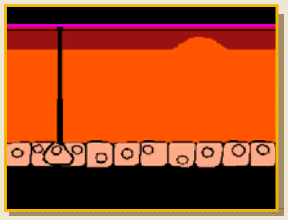
BIO2135 Animal Form & Function

Université d'Ottawa / University of Ottawa 17 6:46 AM

when it leave -homogeneous procuticle
-hardens and tehe secreates hard layer
-gives new space of organism to grow

digidiv videos

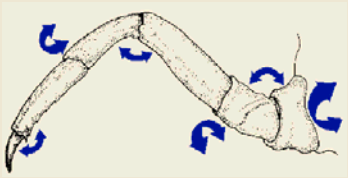
Moulting



BIO2135 Animal Form & Function

Université d'Ottawa / University of Ottawa 18 6:46 AM

Arthropod articulating limbs

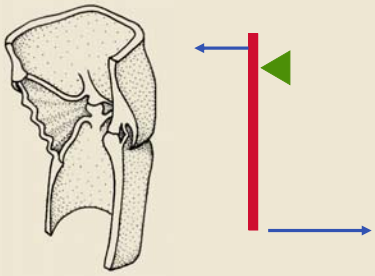


BIO2135 Animal Form & Function

Université d'Ottawa / University of Ottawa 19 6:46 AM

hindge joints that move in one plane
~~arthoped needs many limbs to be abel to move in multiple directions~~

Arthropod joints



BIO2135 Animal Form & Function

Université d'Ottawa / University of Ottawa 20 6:46 AM

requires articulations that has cuticles that compresses and expense

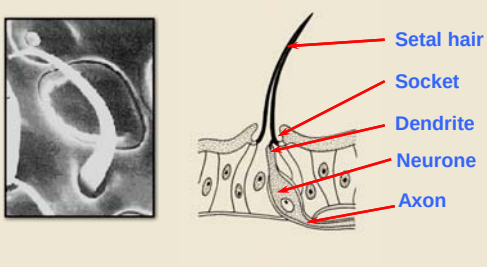
Muscle organisation

BIO2135 Animal Form & Function

Université d'Ottawa / University of Ottawa 21 6:46 AM

needs muscles on either side of the skeleton
-arrange ment of muscles that are bands that cross across the articulations
-have pulleys and levers to moves the apendages

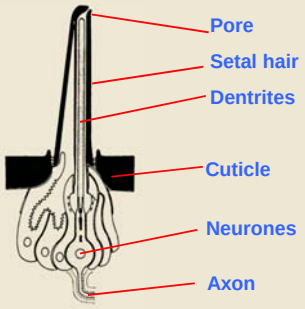
Mechanoreceptive setal hairs



BIO2135 Animal Form & Function
22
Université d'Ottawa / University of Ottawa
6:46 AM

sensory neuron
-setal hairs - sits in a socket (made from another cell) (all cuticle from epidermis)
socket is anchors in the rest of the cuticle
when it bends- tugs sesory cell that is attached toit
-opens atp channel, creats action potiential - sends signle htat it has touched soemthing
-

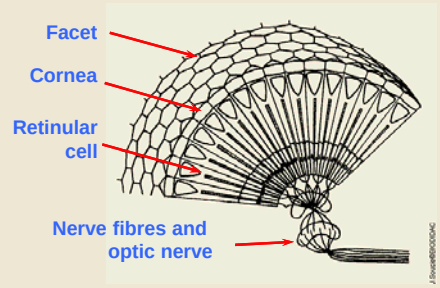
Chemoreceptive setal hairs



BIO3333 Entomology
23
Université d'Ottawa / University of Ottawa
6:46 AM

take same setal hairs
-small opening- pore- if it touches food
-detechs chemical
-dilute chemicalts in air for scent, have more pores

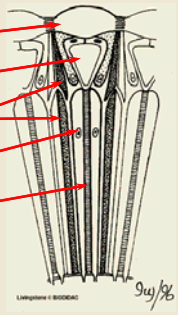
Compound eye



BIO2135 Animal Form & Function
24
Université d'Ottawa / University of Ottawa
6:46 AM

vision through massive cuticle?
-compound eyes - series of optic units

Ommatidium



BIO2135 Animal Form & Function

Université d'Ottawa / University of Ottawa

25

6:46 AM

light is gathered from visual field - as it pasese thourgh the corea
-concentratied into one little dot- visual picture has dissapeard
-certien intensity- just a dot with mixtrure of coluurs
-dont see picture
-light pushed to rhadome, has microvilli that concentrates the light -creats action potential
-cell that are resitive to diffrent colours
-more ommatidium more resolution can see more

Mosaic model of insect vision

26

6:46 AM

Extant Animalia

~1,300,000 species

- Parazoa (1.2%)
- Radiata (0.9%)
- Protostomia (3.9%)
  - Platyzoa (2.2%)
    - Platyhelminthes (1.9%)
    - Others (0.3%)
  - Lophotrochozoa (9.8%)
    - Mollusca (8.5%)
    - Annelida (0.9%)
    - Others (0.5%)
  - Ecdysozoa (82.0%)
    - Crustecea (3.1%)
    - Chelicerata (7.6%)
    - Atelocerata(70.3%)
    - Others (1.1%)
- Deuterostomia (4.0%)
  - Chordata (3.5%)
  - Others (0.4%)

32

6:46 AM

most abundant because they move up on land and to survive

Arthropod taxa

- Subphylum Trilobita
- Subphylum Crustacea
- Subphylum Chelicerata
- Subphylum Atelocerata

BIO2135 Animal Form & Function
Université d'Ottawa / University of Ottawa
33
6:46 AM

Trilobita

BIO2135 Animal Form & Function
Université d'Ottawa / University of Ottawa
34
6:46 AM

big arthopodes

Crustacea

BIO2135 Animal Form & Function
Université d'Ottawa / University of Ottawa
35
6:46 AM

Crustacea

BIO2135 Animal Form & Function

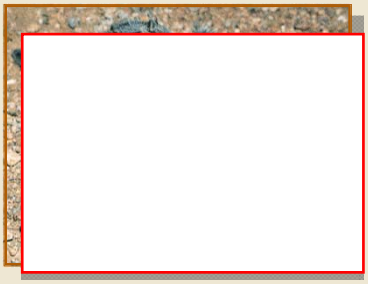
Université d'Ottawa / University of Ottawa

36

6:46 AM

herbiboises in the marine land

Chelicerata



BIO2135 Animal Form & Function

Université d'Ottawa / University of Ottawa

37

6:46 AM

Chelicerata

BIO2135 Animal Form & Function

Université d'Ottawa / University of Ottawa

38

6:46 AM

Chelicerata (scorpions)

BIO2135 Animal Form & Function

Université d'Ottawa / University of Ottawa 39 6:46 AM

Uniramia

BIO2135 Animal Form & Function

Université d'Ottawa / University of Ottawa 40 6:46 AM

Uniramia

BIO2135 Animal Form & Function

Université d'Ottawa / University of Ottawa 41 6:46 AM

Arthropod success (importance)

- Numbers of species
- Distribution
- Evolutionary history
- (Impact on man)

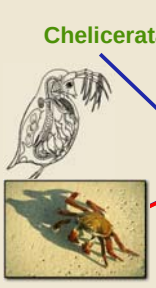
BIO2135 Animal Form & Function
Université d'Ottawa / University of Ottawa
42
6:46 AM

most sucessful- largest number, distributed everywhere on earth

Subphylum Crustacea

BIO2135 Animal Form & Function
Université d'Ottawa / University of Ottawa
43
6:46 AM

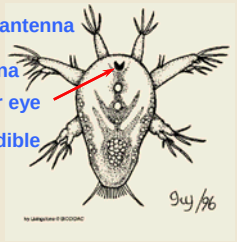
Arthropoda



BIO2135 Animal Form & Function
Université d'Ottawa / University of Ottawa
44
6:46 AM

mandibles for feeding right before the head
-saccate metanephridiate- have open circulartoy sysmtem, there is not reason to have one because there is filtering that happens already
- in 2 section - maxilary gland or anterary gland
-have unique larval stage -
-apendages are unusual - made from two branches - biramous -
-nature of the manidible- gnathobasic : mandible that is goign to grind food
-use the base to bring food to the mouth
articulation is still there from previous structure

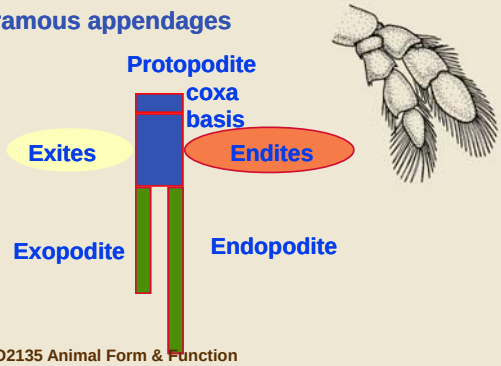
Nauplius larva



BIO2135 Animal Form & Function
45
Université d'Ottawa / University of Ottawa
6:46 AM

cyclopic, has 2 eyes that are fused at the top of the head,
apendages at the top of the head, in deuterocebrebrum
-2 pairs of antenae
- as it grows, more appendages will grow

Biramous appendages



BIO2135 Animal Form & Function
46
Université d'Ottawa / University of Ottawa
6:46 AM

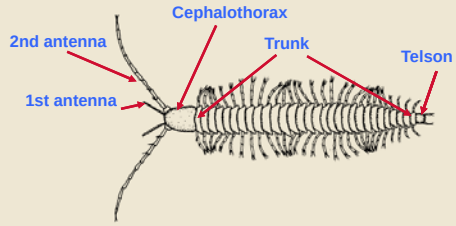
have 2 branches- 2 pieces that attache teh apendage to the base - coxa and basis
-inside- endo, outside- exo
exites and endites form gills - basic achitecture of the leg
-limbs is goign to be modified to become uniramous
-endo is goign to dissapear exo is closest to the floor

Feeding and digestion

BIO2135 Animal Form & Function
47
Université d'Ottawa / University of Ottawa
6:46 AM

micro herbivores
not typical

Crustacean limb and serial homology



BIO3334 Invertebrate Zoology

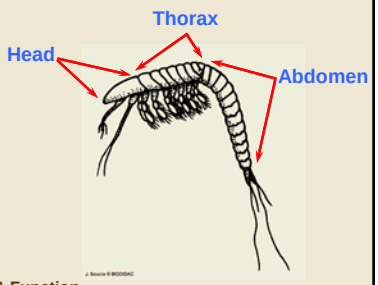
48

Université d'Ottawa / University of Ottawa 06:46

had a head that was fused with trunk - cepholophorax,
all apprendages attached to the body was the same

Crustacean limb and serial homology

- Locomotion
- Feeding
- Respiration
- Sensory



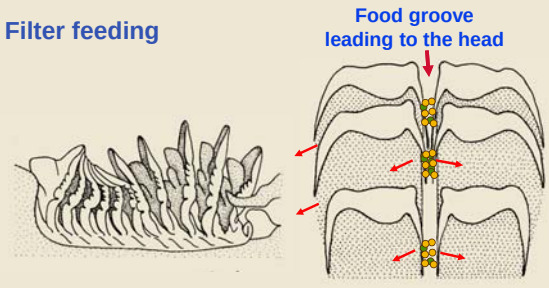
BIO2135 Animal Form & Function

49

Université d'Ottawa / University of Ottawa 6:46 AM

became part of the trunk-large and fleshy , able to arate and oxygenate the hemoglogin
-surface si ccovered in setal hairs so it can detec the type of water that is in

Filter feeding



BIO3334 Invertebrate Zoology

50

Université d'Ottawa / University of Ottawa 06:46

tap into organic materials of the water via filter feeding
- appendages are built in a way so it can paddle back and forth to make a swimming motion
-one aparendage flows into the other - makes a metachromal wave as it moves
-unidirectional flow of water - water is flowed out of the side- give propusive force
-water flows from the midline into the midle of the box - repeaded
-hairs on the side that trap any algae material that will be trapped- filter feed particulate food
-bases of appendages are sqeezing together- base pulls forward
-pushes food to the front of the mouth
-traps primary productivity of the water
only done by crustacean zooplankton

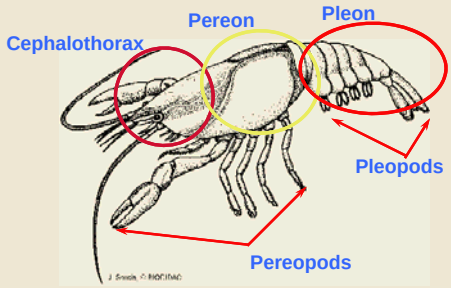
Large crustacea

BIO3334 Invertebrate Zoology

51

Université d'Ottawa / University of Ottawa 06:46

Tagmosis - (Crustacea)



BIO2135 Animal Form & Function

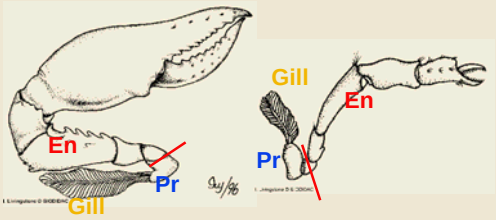
52

Université d'Ottawa / University of Ottawa 6:46 AM

are altered from ancestor
~~walking apendages are moved forward and incorporated to the head to assits with eating~~
cephalothorax- maxillipeds
no longer a thorax because it doesnt have legs there any more- not called pereon
~~and then "adomend" with appendages~~ - pleon

Modified limbs (thorax)

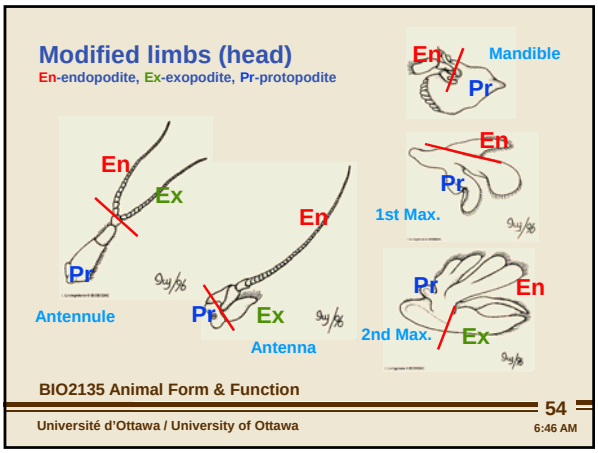
En-endopodite, Ex-exopodite, Pr-protopodite

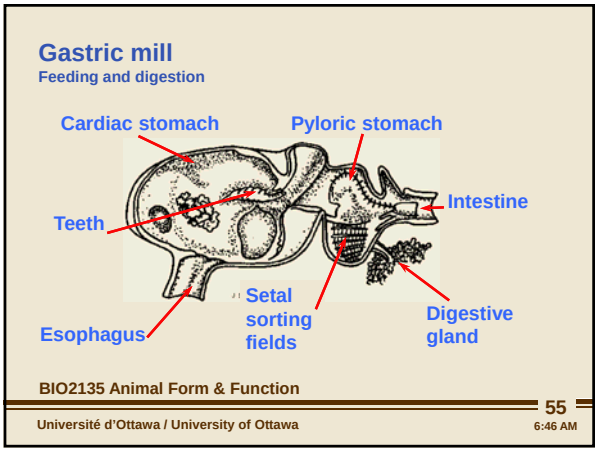


BIO2135 Animal Form & Function

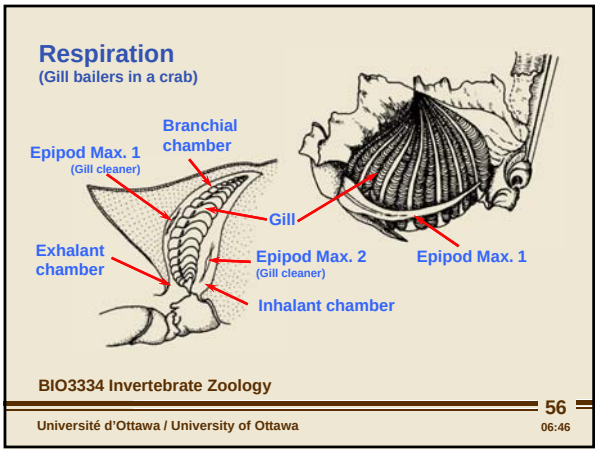
53

Université d'Ottawa / University of Ottawa 6:46 AM



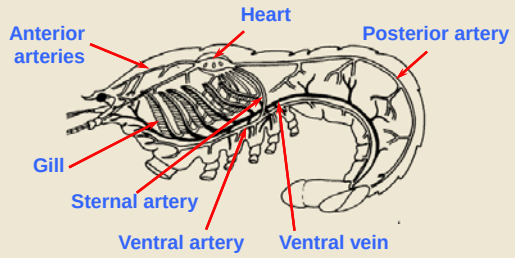


unique stomach- bottem feeder - put anything in their mouth to eat
~~-still made out of chitin~~
-little chitin structures - 3 massive teeth that are inside of the stomach , where grinding occurs
filering system that is made from the setal hairs that are present - if particle are small enough to eat
~~if too big~~
***DONT CONFUSE CILIARY SORTING FIELDS WITH SETAL SORTING FIELDS



also needs to airates it gills

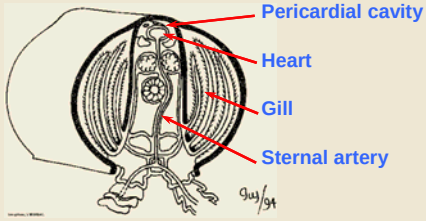
Circulatory system



BIO2135 Animal Form & Function
57
Université d'Ottawa / University of Ottawa
6:46 AM

open
3 majorty arteries that
-anterion, prosterios and steral - goes to stomach and braches out

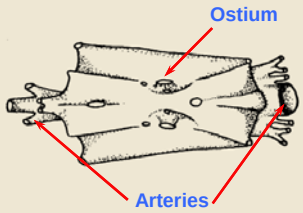
Circulatory system



BIO2135 Animal Form & Function
58
Université d'Ottawa / University of Ottawa
6:46 AM

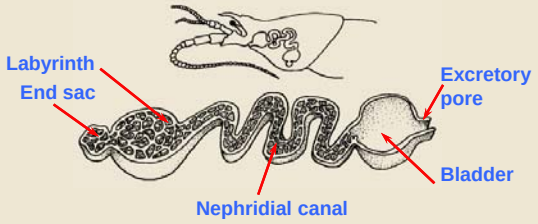
all are associated with passing throughout the body
-no capillaries

Circulatory system

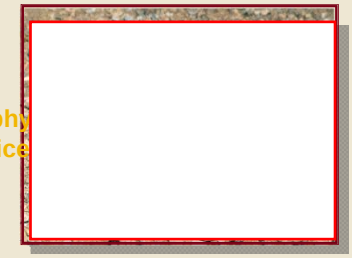


BIO2135 Animal Form & Function
59
Université d'Ottawa / University of Ottawa
6:46 AM

Antennal gland



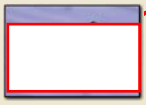
BIO2135 Animal Form & Function
60
Université d'Ottawa / University of Ottawa
6:46 AM



BIO2135 Animal Form & Function
61
Université d'Ottawa / University of Ottawa
6:46 AM

Arthropoda

Chelicerata
Crustacea
Atelocerata
(Uniramia, Tracheata)

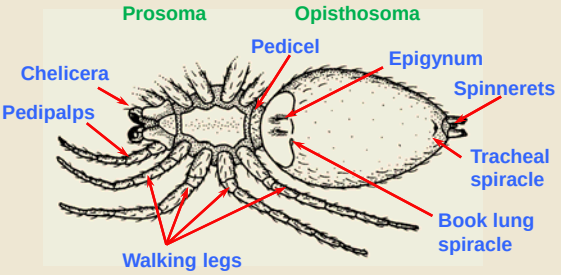


1 Chelicerata
(autapomorphies)
- Two tagma: prosoma and opisthosoma
- Prosoma with six pairs of appendages
- Chelicera, first pair of appendages
- Loss of antenna and deuterocerebrum

BIO2135 Animal Form & Function
62
Université d'Ottawa / University of Ottawa
6:46 AM

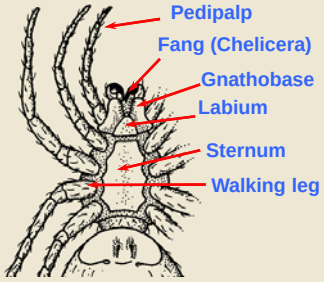
chelicerate- insects
has 2 tagmas- front and back piece of the body, sixe
one pair of preoral antenne- thre is none in chelicetates
-no antenea on spiders

Tagmosis (chelicerates)



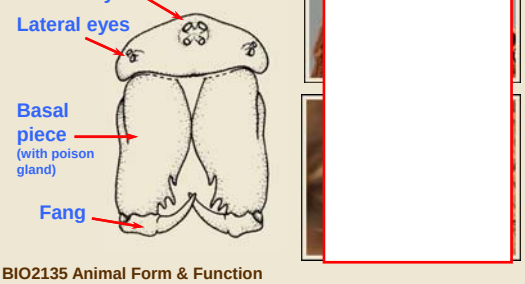
BIO2135 Animal Form & Function
63
Université d'Ottawa / University of Ottawa
6:46 AM

Tagmosis (chelicerates)



BIO2135 Animal Form & Function
64
Université d'Ottawa / University of Ottawa
6:46 AM

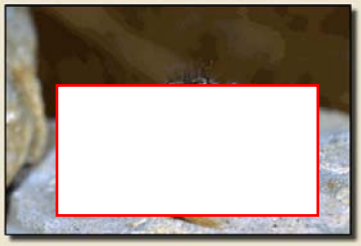
Chelicera and simple eyes



BIO2135 Animal Form & Function
65
Université d'Ottawa / University of Ottawa
6:46 AM

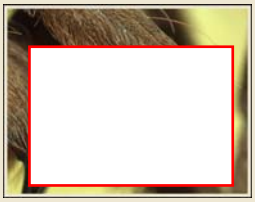
detect vibrrations - set up trap line and fell wherne soemthing gets caught
~~embeedded in the exoskeleton~~

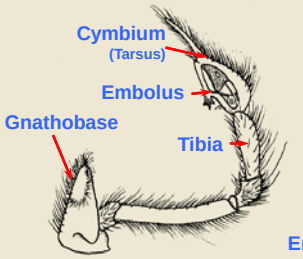
Sensory – simple eyes

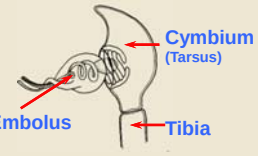


BIO2135 Animal Form & Function
Université d'Ottawa / University of Ottawa
66
6:46 AM

Male spider's pedipalp



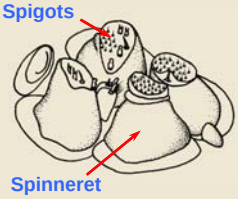




BIO2135 Animal Form & Function
Université d'Ottawa / University of Ottawa
67
6:46 AM

silk- detect and captire flight
-catch flying protein, spiders - blind predator- problem for male, male and female cant mate
-

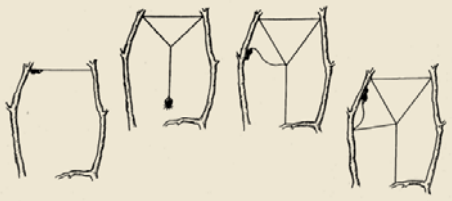
Silk and spider webs



BIO2135 Animal Form & Function
Université d'Ottawa / University of Ottawa
68
6:46 AM

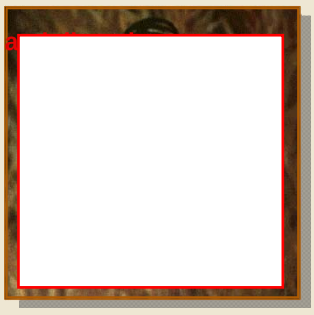
orb web- classic web

Orb webs

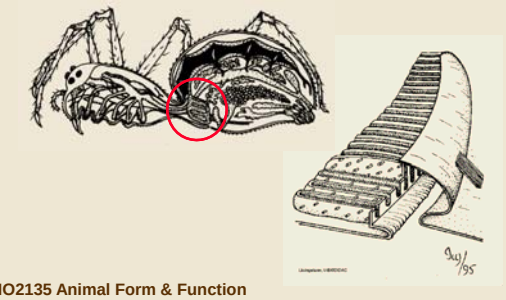


Orb webs

Feeding a



Book lung



BIO2135 Animal Form & Function

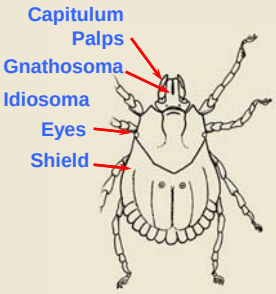
Université d'Ottawa / University of Ottawa 72 6:46 AM

Ticks and mites

BIO2135 Animal Form & Function

Université d'Ottawa / University of Ottawa 73 6:46 AM

Tick



BIO2135 Animal Form & Function

Université d'Ottawa / University of Ottawa 74 6:46 AM

Tick, ventral surface

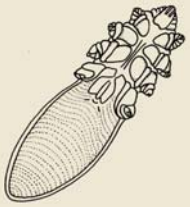
BIO2135 Animal Form & Function

75

Université d'Ottawa / University of Ottawa

6:46 AM

Mites



BIO2135 Animal Form & Function

76

Université d'Ottawa / University of Ottawa

6:46 AM

Subphylum Atelocerata (Tracheata)

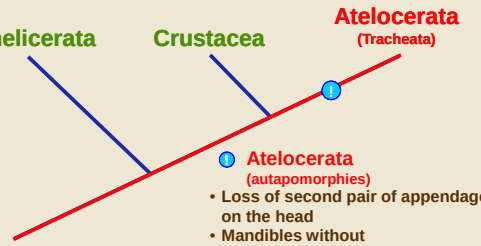
BIO2135 Animal Form & Function

77

Université d'Ottawa / University of Ottawa

6:46 AM

Arthropoda



Atelocerata
(autapomorphies)

- Loss of second pair of appendages on the head
- Mandibles without articulation
- Malpighian tubules
- Paired segmental tracheal system

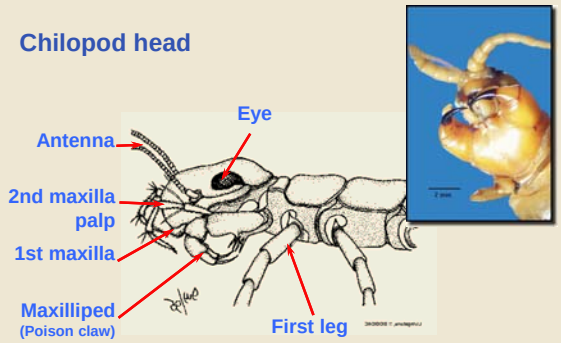
BIO2135 Animal Form & Function

78

Université d'Ottawa / University of Ottawa 6:46 AM

at one time thought it should have been tracheata
group have lose of the antena
-3 segenst, eyes, antenea, and large coordinatiton of brain
grinding surface at along the mandible
unique excretory system - terestiral organims
-tubules deals with water balance in the diff environment

Chilopod head



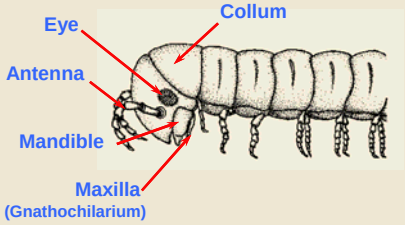
BIO3334 Invertebrate Zoology

79

Université d'Ottawa / University of Ottawa 06:46

part of group in amereolopodat- many legs, centi and milipede
cene- vicious predator, lives in dark (neears dark moist environment)
mgrcapaod
-poisin fangs, digs them into the prey
lost one of the mouth parts - remainding one
--structure allows them to bend their head into their body
diplosegments- two fused together in the appendages

Diplopod head



BIO3334 Invertebrate Zoology

80

Université d'Ottawa / University of Ottawa 06:46

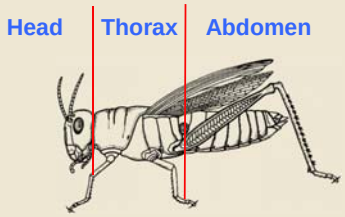
Reasons for insect success

- Small size
- Water proof exoskeleton
- Metamorphosis
- Reproductive potential
- Co-evolution with plants
- Evolution of flight (Not an ancestral character.)

BIO2135 Animal Form & Function
81
Université d'Ottawa / University of Ottawa
6:46 AM

not lose water out of their structure
2 major type of metaphornasis

Insect - Tagma



BIO2135 Animal Form & Function
82
Université d'Ottawa / University of Ottawa
6:46 AM

6, 3, 11

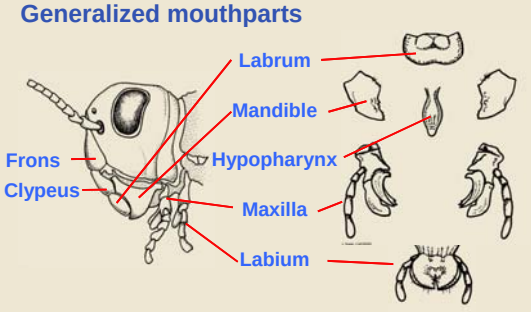
Insect tagma

- Head
  - sensory and food acquisition
- Thorax
  - Locomotion
- Abdomen
  - Reproduction and general function

BIO2135 Animal Form & Function
83
Université d'Ottawa / University of Ottawa
6:46 AM

tagma that can englargen and retract

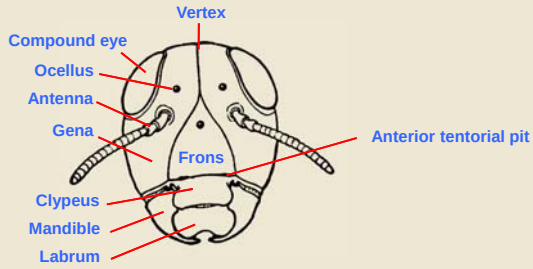
Generalized mouthparts



BIO2135 Animal Form & Function
84
Université d'Ottawa / University of Ottawa
6:46 AM

head is the first tagma
-mount, mandible, maxilla
in insect fused to form labium
have cavity inforont o fthe mouth- articulate the food with their limbs,

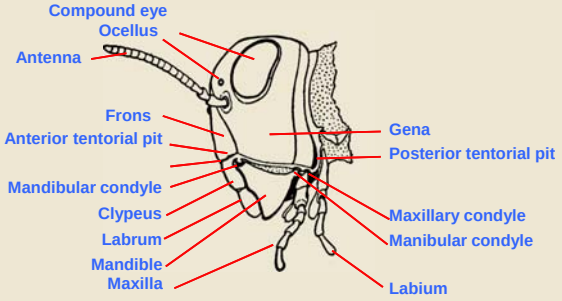
Head – lines and landmarks



BIO2135 Animal Form & Function
85
Université d'Ottawa / University of Ottawa
6:46 AM

flap of tissue clypeus

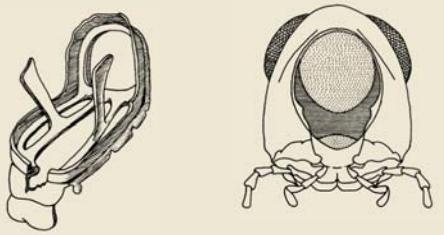
Head – lines and landmarks



BIO2135 Animal Form & Function
86
Université d'Ottawa / University of Ottawa
6:46 AM

pits and divits, leads to cutticles infectiosn that strenghten it

Reinforcing the head - tentorium



BIO2135 Animal Form & Function

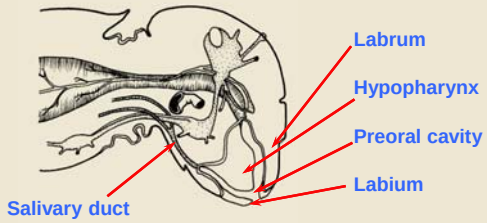
Université d'Ottawa / University of Ottawa

87

6:46 AM

if no reinforcemnet- would not be strong

Insect mouth



BIO2135 Animal Form & Function

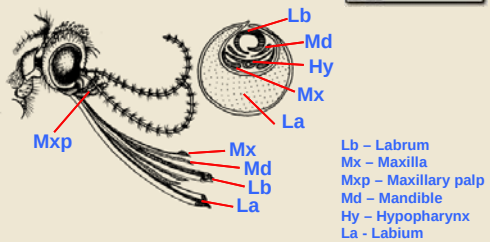
Université d'Ottawa / University of Ottawa

88

6:46 AM

hypo=tongue
-above- digestive tract
-below- salivary glands

Piercing mouthparts



Lb – Labrum
Mx – Maxilla
Mxp – Maxillary palp
Md – Mandible
Hy – Hypopharynx
La - Labium

BIO2135 Animal Form & Function

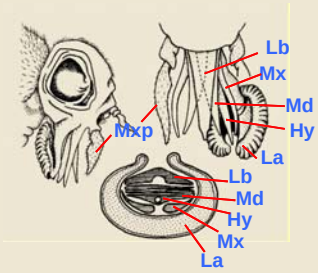
Université d'Ottawa / University of Ottawa

89

6:46 AM

mx and lb that is blade like
-blood is going to clot, hypo curls on its self so that salivila can mix with the anticoagulant

Combination - Horsefly



Lb – Labrum
Mx – Maxilla
Mxp – Maxillary palp
Md – Mandible
Hy – Hypopharynx
La - Labium

BIO2135 Animal Form & Function

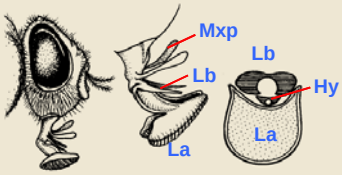
90

Université d'Ottawa / University of Ottawa

6:46 AM

work like scissors- slashes your skin to make a puddle of blood

Sponging mouthparts



Lb – Labrum
Mx – Maxilla
Mxp – Maxillary palp
Md – Mandible
Hy – Hypopharynx
La - Labium

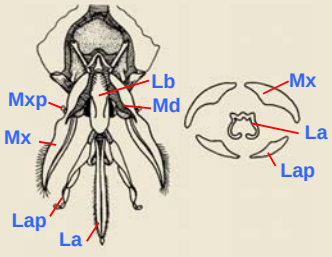
BIO2135 Animal Form & Function

91

Université d'Ottawa / University of Ottawa

6:46 AM

Combination – honey bee



Lb – Labrum
Mx – Maxilla
Mxp – Maxillary palp
Md – Mandible
Hy – Hypopharynx
La – Labium
Lap – Labial palp

BIO3333 Entomology

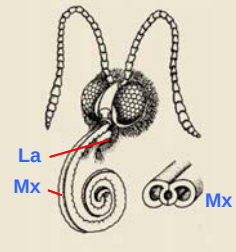
92

Université d'Ottawa / University of Ottawa

6:46 AM

unusual - worker collects nectar and pollen for the nest
manipulates the wax
-mx, lap, la is fuzzy- wickes sugar solution and squeeze solution and digested - do that until ful
-put enzymes in the sugars to break it down to- throwes up in the cell so that the sugar can evaoprae- 80% sugar
becomes stellze, bacteria cant grow there
and honey is sold- still needs to builds cells- uses manibles
-swings down mandibles to make the next- related to what is in grasshoppers

Butterfly



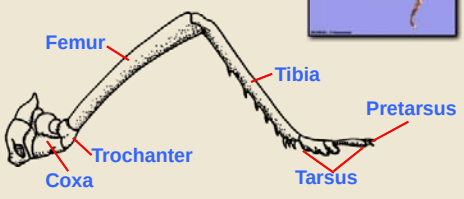
Lb – Labrum
Mx – Maxilla
Mxp – Maxillary palp
Md – Mandible
Hy – Hypopharynx
La - Labium

only thing that is left is the maxilla
-inflates it suck up the nector

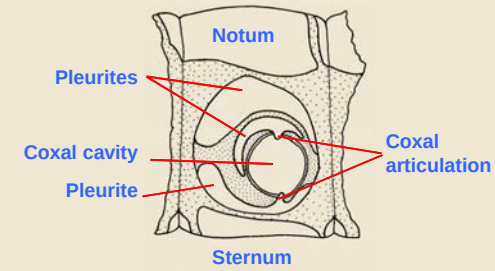
Thorax

- Prothorax
- Mesothorax
- Metathorax

Insect leg



Pronotum and leg articulation



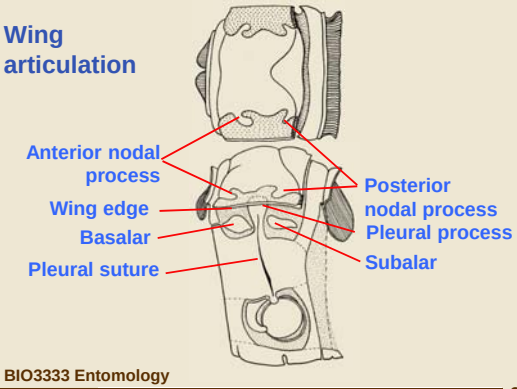
BIO2135 Animal Form & Function
96
Université d'Ottawa / University of Ottawa
6:46 AM

leg articulates into the cuticle

Insect flight - Pterothorax

BIO2135 Animal Form & Function
97
Université d'Ottawa / University of Ottawa
6:46 AM

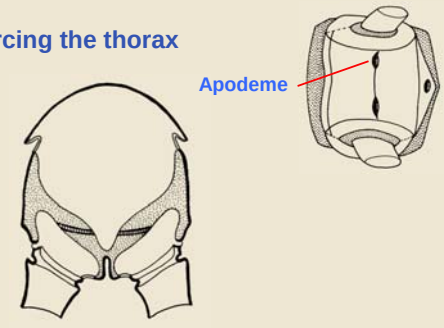
Wing articulation



BIO3333 Entomology
98
Université d'Ottawa / University of Ottawa
6:46 AM

have two extensions of the cuticle that allow the wing to pivot on the side of the throracic box
have a extremely rigid cuticular box and at the very top it is hinged - can move up and down
only motion that is associated with the box
the wing is positioned on the side of the box - when the box gets pushed down, also pushes down on the wing and forces it to go up
- when the wing goes up, there is a piece of cuticle that is soft - stretches to its maximum width
set of sclerites (pieces of cuticle - basalar and subalar) to get the wing to come back down, muscles extend to those pieces of cuticle - muscles pull on them and pulls the wing back down and forces the box to go back up

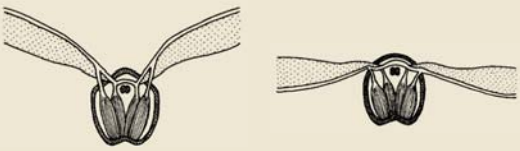
Reinforcing the thorax



BIO3333 Entomology
99
Université d'Ottawa / University of Ottawa
6:46 AM

the cuticle bends inward to create flying buttresses of cuticle that give the reinforcing structure with flight
nodes that push against the wing to make it go up, stretches the sclerites, muscles that are attached to make them go back to normal, wind goes back down

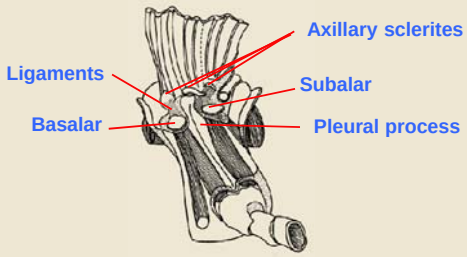
Direct flight musculature



BIO2135 Animal Form & Function
100
Université d'Ottawa / University of Ottawa
6:46 AM

called direct flight because the musculature to bring the wing back down to original position is attached to the wing
have two pair of wings that are working asynchronously, not in beat with each other
movement of the first wing would cause turbulence, laminar flow against the second pair of wings would force dragonfly to just drop
the propulsive force forward of the first wing beat would bring the animal far enough so that the next wing beat would pass the pocket of turbulence
issue of having wings to the sides - need to have a mechanism to fold the wings in

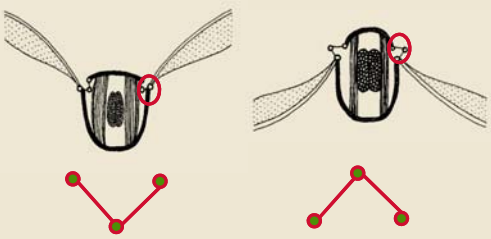
Direct flight musculature



BIO3333 Entomology
101
Université d'Ottawa / University of Ottawa
6:46 AM

the movement for the muscles that are pulling the nodal down, are a set of dorsal ventral muscles
when they contract not affecting the wing, just brings the top piece down, forcing the two cuticle pieces to push against the wing so it can pivot up
have the lowering of the wings occurring by the action of a muscle to bring the sclerites back to its original state
synchronization of wings is done in a nervous impulse
dragonflies use this type of flight muscle

Indirect flight muscles



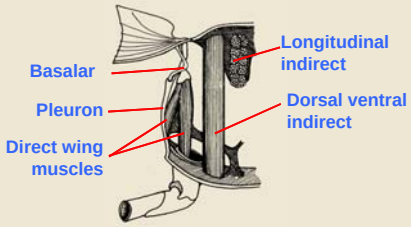
BIO2135 Animal Form & Function

Université d'Ottawa / University of Ottawa 102 6:46 AM

end up with indirect flight
-have new set of muscles that are running from the anterior to the posterior
sit in the middle
still have muscles that are attached to the sides but not positioned on the wing
by pull on the muscles on the side can now tilt the wing, get a paddling motion for how they will fly
whole mechanism for flight changes biochemically
wings now beat at frequencies that are faster then the single nervous impulse
-if you have small wings compared to organism, need to be beat it faster
get asynchronous flight with the indirect flight
myosin arms grab onto the actin fibers, where there is atp and calcium re-absorption cycle - causes the arm to move along the length to get contractions
-have a click mechanism - as wing is moving up and down, there is a block of cuticle between the wing and thorax, there is elastic (resalin) compress the energy from the muscles into the spring and as the wing goes past the spring point, it releases and the wing pops
pop is going to stretch the antagonistic muscle mechanically
myesin attaches but gets ripped back to the top by the muscle that is moving in the other direction - calcium re-absorption cycle is broken - makes crazy wing beats (myosin is walking on actin fibres extremely fast)

beetles take their front wings and make it into a protective body cover and have delicate wings that are folded underneath

Indirect flight mechanism

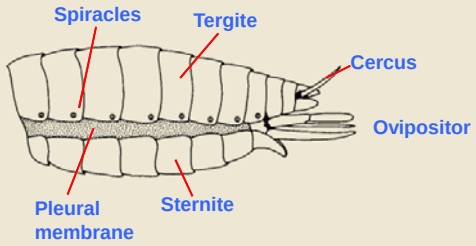


BIO2135 Animal Form & Function

Université d'Ottawa / University of Ottawa 103 6:46 AM

still have dorsal ventral muscles that pull the top down
to bring the wings back down, have anterior and posterior muscles that will distract the cuticle box thorax so it pops back up on its own
no muscles that are attached to the wings

Insect abdomen



BIO2135 Animal Form & Function

Université d'Ottawa / University of Ottawa 104 6:46 AM

abdomen is the main visceral mass - where all of the organs are
- membrane on the side of the organism that allows it to stretch
important for females because they need to have space for the eggs to grow/feeing on a large meal
abdomen allow flexibility for growth

Reproduction and development

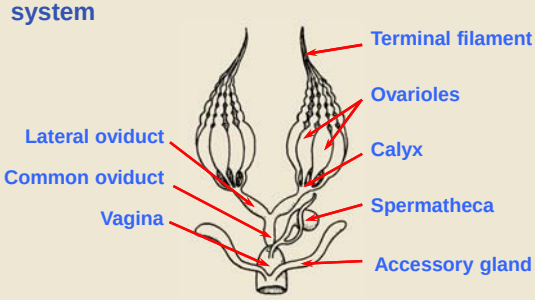
- Spermatophores
- Eggs

BIO2135 Animal Form & Function

Université d'Ottawa / University of Ottawa 105 6:46 AM

other reason for insect success is their reproductive potential
-eggs will have to be waterproof so they dont dessicate
when they mate, going to pass sperm to each other in waterproof packages called spermatophores

Female reproductive system

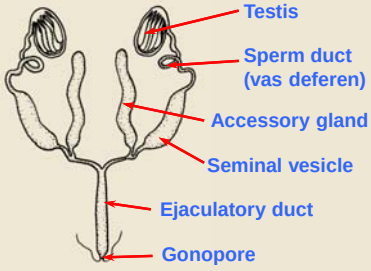


BIO2135 Animal Form & Function

Université d'Ottawa / University of Ottawa 106 6:46 AM

each ovary is composed of a series of ovarioles
in female, there is always an egg that is sitting at the bottom of the reproductive system waiting to be fertilized
behind it there is already a partially developed eggs - get a whole string of eggs
once one if fertilized/ovaposited the next layer is made (vitelline etc)
-very modular
when egg is ready, gets passed in front of the spermatheca (seminal receptical)
-sperm reserve

Male reproductive system



BIO2135 Animal Form & Function

Université d'Ottawa / University of Ottawa 107 6:46 AM

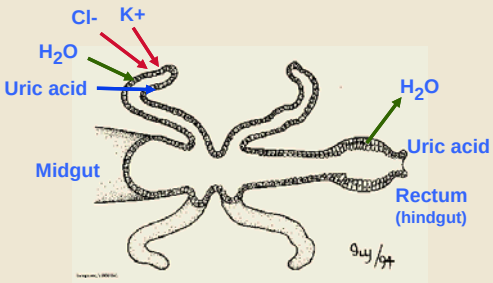
similar system, testis with multiple follicles that produce large amounts of sperm
have accessory glands to make the spermatophore to pass to the female
-vertebrates dont put the shell on their eggs until after they are fertilized

Insect eggs

BIO2135 Animal Form & Function
Université d'Ottawa / University of Ottawa
108
6:46 AM

insects pull the protective shell on first - need to have a special opening in the shell for the sperm to enter
-micropyle, when the egg passes in front of the seminal receptacle (spermatheca) - the hole lines up exactly so that the sperm gets pass directly

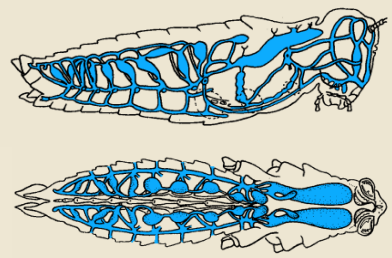
Malpighian tubules



BIO2135 Animal Form & Function
Université d'Ottawa / University of Ottawa
109
6:46 AM

need to retain as much water as possible
there is the waxy cuticle but now it is combined with - malpighian tubules as the main excretory mechanism
-tubules extend into the hemolymph
-have a potassium pump that burns atp
-as potassium levels rise, changes the charge of the tubule relative to the outside (more positive)
-creates an electrochemical gradient - brings in chloride ions to fix positive charge
membrane of the tubule is semipermeable to ions/small molecules
-make tube inside more salty to the hemolymph - water and uric acid gets pasts to the tubule
-make and ultrafiltrate of the hemolymph
flows down the tubule and into the digestive tract
when it reaches the rectum , rectum pumps potassium as well to extract any last bits of water
hind gut is lined with cuticle, prevents uric acid from getting back inside

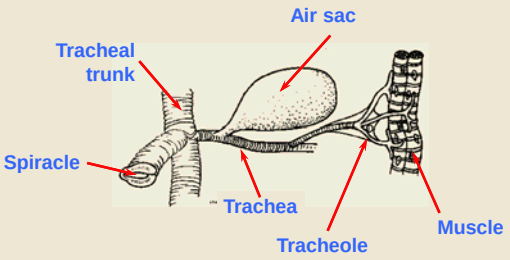
Tracheal system



BIO2135 Animal Form & Function
Université d'Ottawa / University of Ottawa
110
6:46 AM

have tracheal system for respiration
their blood does not contain any oxygen binding proteins - transmit air directly to the tissues
branches are connected to the spiracles

Tracheal system

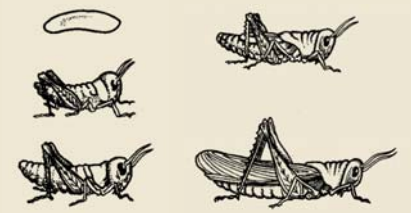


BIO2135 Animal Form & Function
111
Université d'Ottawa / University of Ottawa
6:46 AM

inside reflects an opening that can be controlled and a series of pipes that get continuously smaller until it reaches a muscle
when it reaches the muscle, the tracheole is in contact with the mitochondria
- there is air in the tracheole, instead of putting oxygen in a fluid environment and pumping it to where it is needed, tracheole transmits air throughout entire body
to prevent water loss, same epicuticle that waterproofs the surface of the insect surrounds the tracheal just up to the tracheole where the exchange occurs
at 21% oxygen, the spiracle opens - diffuses all the way to the tubule
spiracle closes and as muscle is contracting, use up the oxygen, percentage starts to drop
air diffuses fast so as it is being used up at the tracheole there is still air in the air sac that can be passed
can drop as low at 4% before having problems, when low the spiracle is going to open and entire system gets replenished
-never have anaerobic metabolism, no lactic acid build up

Incomplete metamorphosis

Hemimetabolous metamorphosis



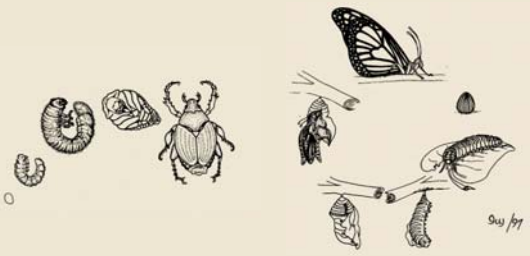
BIO2135 Animal Form & Function
112
Université d'Ottawa / University of Ottawa
6:46 AM

have good metabolism - metamorphosis
2 basic strategies for insect development
incomplete/hemimetabolous metamorphosis
-immature insect looks just like the adult, but doesnt have wings and is not reproductively capable
-feeds and moults and when it comes out of the water, reaches a sized where it is big enough, turns into an adult and stays that way

when you go one step back, can see ovaries are starting to grow, turn the food reserves into the organ systems for the adult

Complete metamorphosis

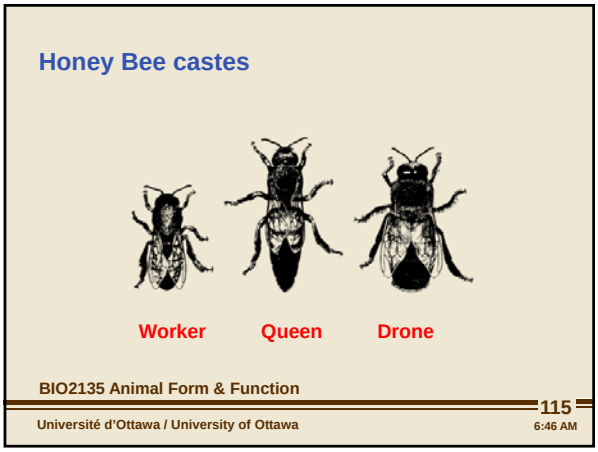
Holometabolous metamorphosis



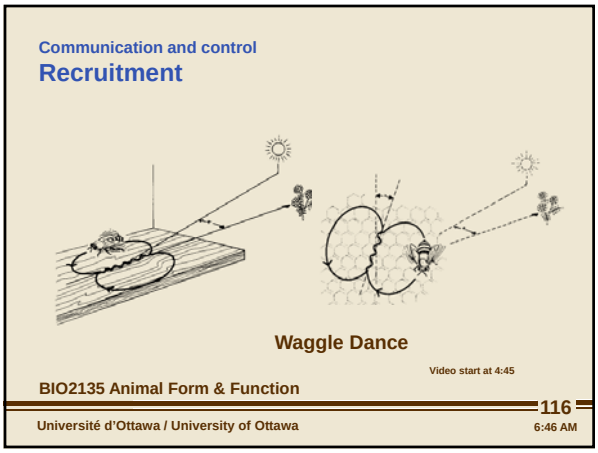
BIO2135 Animal Form & Function
113
Université d'Ottawa / University of Ottawa
6:46 AM

complete/holometabolous metamorphosis - ex beetles and butterflies
-insect has a very distinct larval stage - caterpillar like
-goes into a resting stage - pupa, where reorganization occurs internally
-then emerges into an adult
have imaginal disc, sets of cells that have been programmed to make adult tissues but they are sitting dormant
takes the food that it consumes and transforms it into fat and protein reserves to be used later
in pupal stage, imaginal discs get turn on, in the cocoon, liquefy and destroy previous stage of life cycle and then discs rebuild inside to make the adult
-partitioning the life cycle
-first stage to collect food
-adult with wings - reproductive

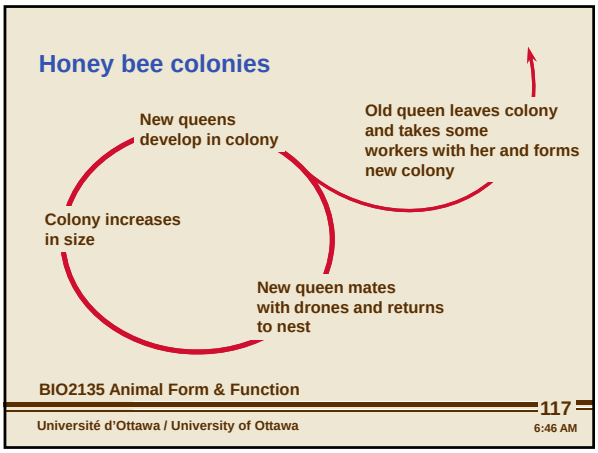
insects make societies ex. termites, wasps



in society with bees - any haploid egg that manages to hatch was an unfertilized egg is a male/ drone
female normal have fertilized eggs and are diploid - emerge as new female
worker are kept inactive - reproductive organs never develop
when colony gets big, queen is unable to kept it in control, so the egg that comes out is a male
-gives signal that colony has gotten big enough so they disperse



waggle dance - way for bees to communicate
-when workers come back from collecting sugar source, on vertical hives make a figure eight, depending on the tilt, tells other bees where the sugar source is located
-frequency eventually dies out because they use up all of the sugar
want to get pollen to feed the young and to collect nectar to make honey
-take disaccharides nectar into their stomachs to mix with enzymes to break it down into monosaccharides, vomit it out into the combes, beat their wings to get rid of the bee vomit
-make it so that it is 80 % sugar - bacteria cannot survive in 80 %



drones make their appears

queen has workers that are under her control, leaves the colony with them to find a new colony

queen will mate with a lot of males and make more males

and cycle repeats