

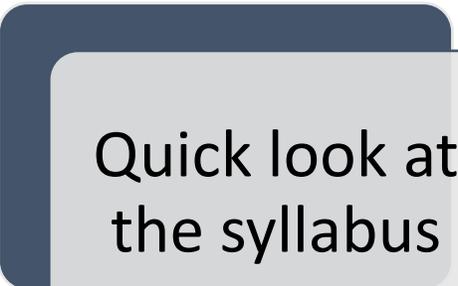


Introduction to Module 5 Honey Bee Anatomy

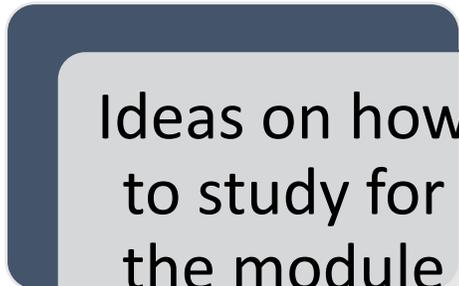
Sean Stephenson



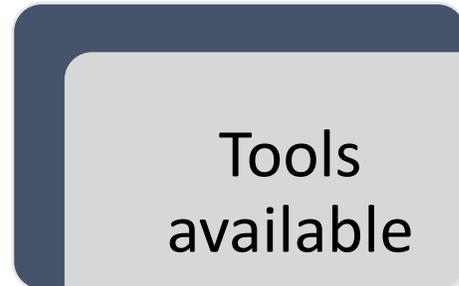
Plan for the workshop



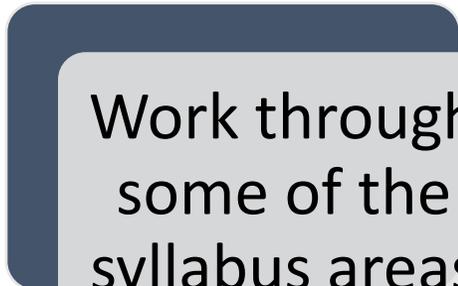
Quick look at
the syllabus



Ideas on how
to study for
the module



Tools
available



Work through
some of the
syllabus areas

The Candidate shall be able to give a detailed account of, referring to histological features as necessary:

- 5.1 the contributions of R.E. Snodgrass and H.A. Dade to the understanding of honey bee biology.
- 5.2 the alimentary system of the adult honey bee including the process of digestion by enzymes and the absorption and assimilation of the products of digestion.
- 5.3 the excretory system of the adult honey bee and the substances excreted.
- 5.4 the respiratory system of the adult honey bee, including the muscular ventilation of the air sacs, the structure and operation of the spiracles and the exchange of respiratory gases, both at rest and during active flight.
- 5.5 the circulatory system of the adult honey bee, including the heart, dorsal and ventral diaphragms and the composition and functions of haemolymph.
- 5.6 the exocrine glands of both castes and sexes of adult honey bees and larvae, their location, the functions and main compositions of their secretions including pheromones; hypopharyngeal, mandibular, post-genal, Nasonov, poison gland, Koshevnikov, Dufour, Arnhart, post cerebral, thoracic salivary, wax glands, silk glands and tergite glands of the queen (Renner-Baumann).
- 5.7 the different structures of the exocrine glands for the queen, worker and drone.
- 5.8 the structure and function of the nervous system and sense organs of the adult honey bee including the compound eyes, ocelli, organ of Johnston and the sensilla.
- 5.9 the endocrine glands and the functions of their secretions particularly the neurosecretory cells, the corpora allata, corpora cardiaca and the prothoracic glands.
- 5.10 the composition, location and function of the fat body throughout the life cycle of the honey bee.
- 5.11 the reproductive system of the queen and drone and the production of sperm and eggs.
- 5.12 the structure of the egg, development of the embryo within the egg and the hatching of the larva.
- 5.13 the external and internal structure of the honey bee larva.
- 5.14 the metamorphosis of the larva with outline accounts of ecdysis, apolysis, larval defaecation, cocoon spinning, the external anatomy of the pro-pupa, its change to a pupa and then to an imago.
- 5.15 the effect of feeding and other factors on caste determination and the differences between brood food and royal jelly.
- 5.16 the physiological and structural differences between laying workers and normal workers and the role of pheromones in bringing about these differences.
- 5.17 the differences between summer and winter worker honey bees including the role of vitellogenin, juvenile hormone and the fat body.
- 5.18 the structure and main constituents of the cuticle, of the larva and the adult honey bee, with an outline account of its invagination within the body to form linings of the gut and tracheae.
- 5.19 the external anatomy of the queen, worker and drone.
- 5.20 the function and structure of the wings, legs, feet, antennae, mouth parts and setae (hairs).
- 5.21 the structure of the sting mechanism and how this mechanism operates to penetrate human skin and deliver the venom.
- 5.22 the role of the direct and indirect muscles in flight and in the colony.
- 5.23 the structure and function of the exoskeleton of the bee.

The Syllabus

Resources

- <https://learning.bbka.org.uk/>
 - Practice questions
 - Paid for correspondence course
- Study Group material
- Reading list Picture of my books
- Local microscopy group
- Online resources
 - Tinyurl.com/honeybeeanatomy

Main systems of the honey bee

Alimentary, Excretory,
Nervous, Respiratory,
Circulatory

Internal and external glands

Exocrine and endocrine

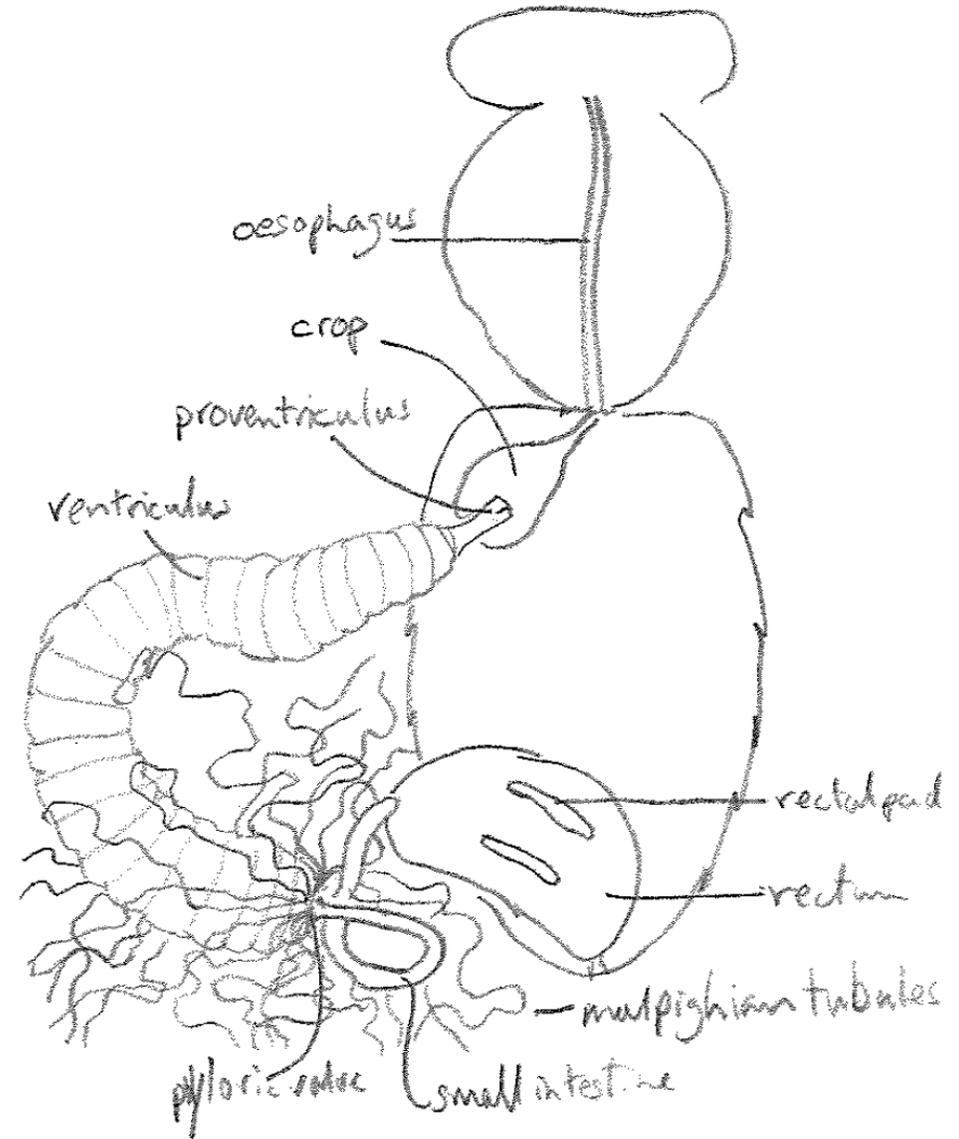
Development of a honey bee from egg to adulthood

Reproduction, sex
determination, caste
determination, complete
metamorphosis

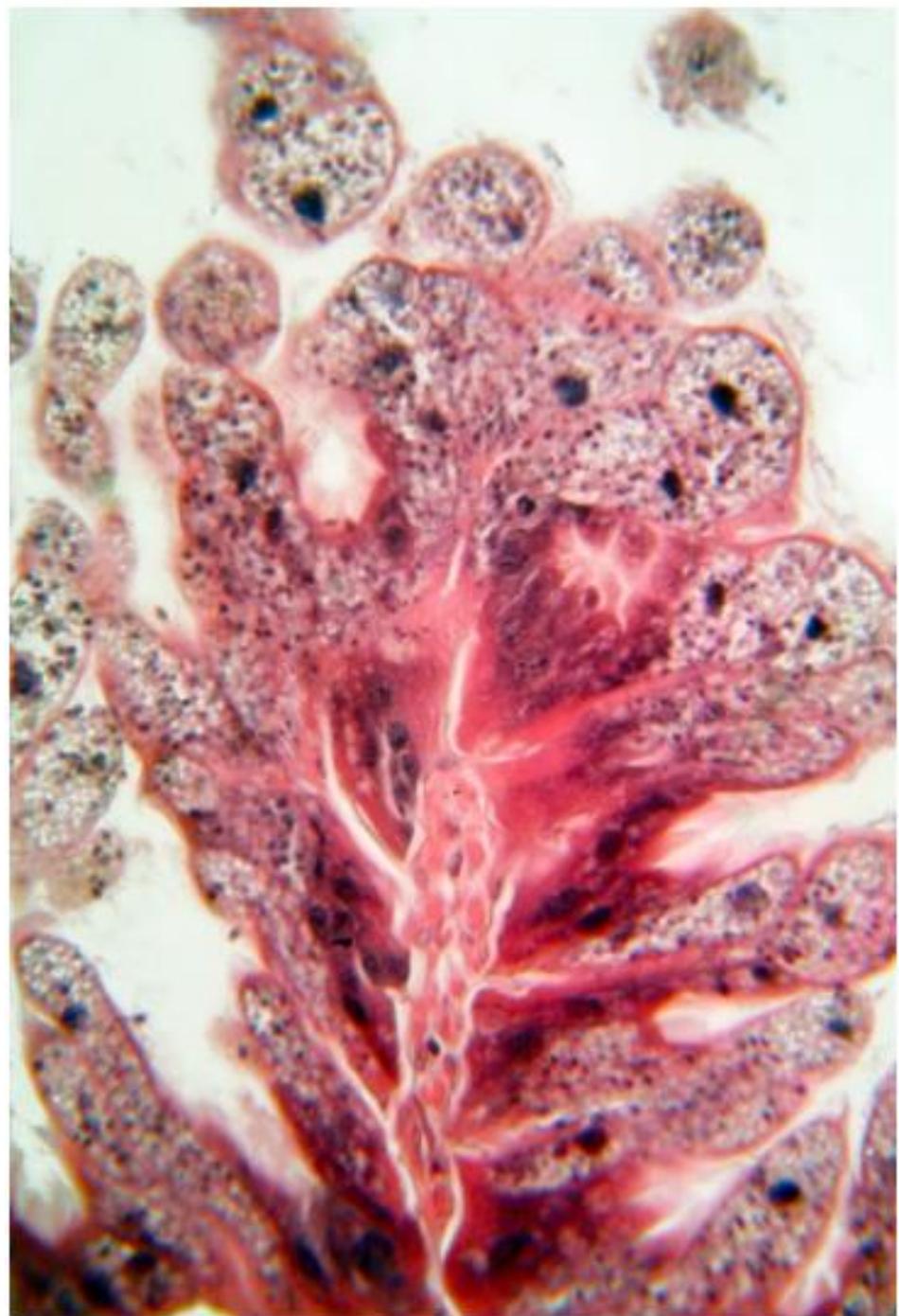
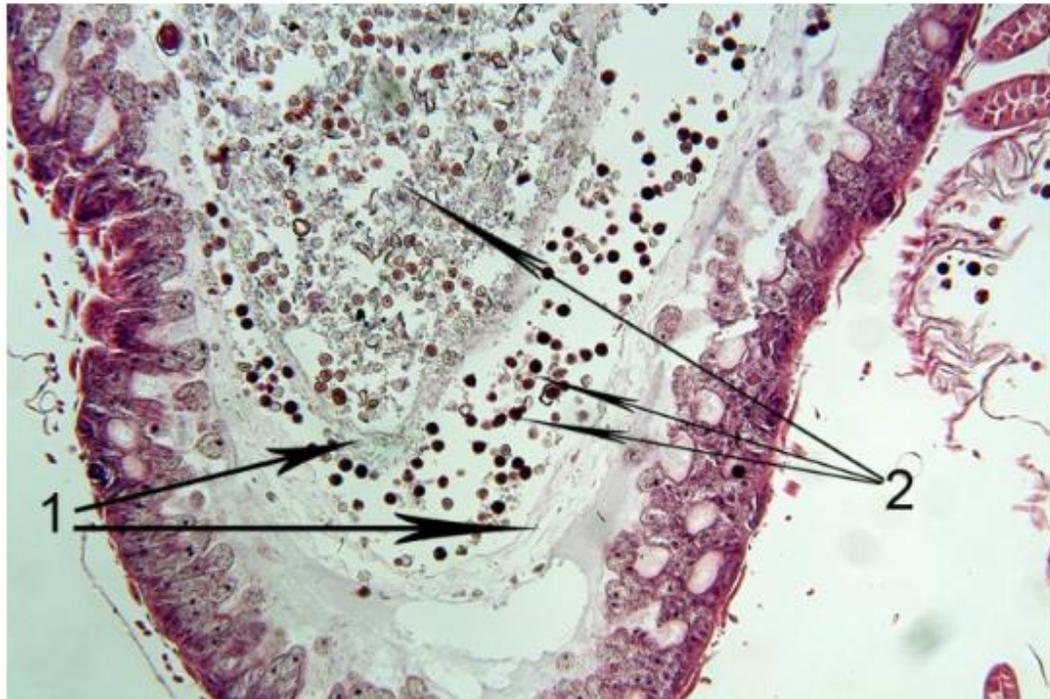
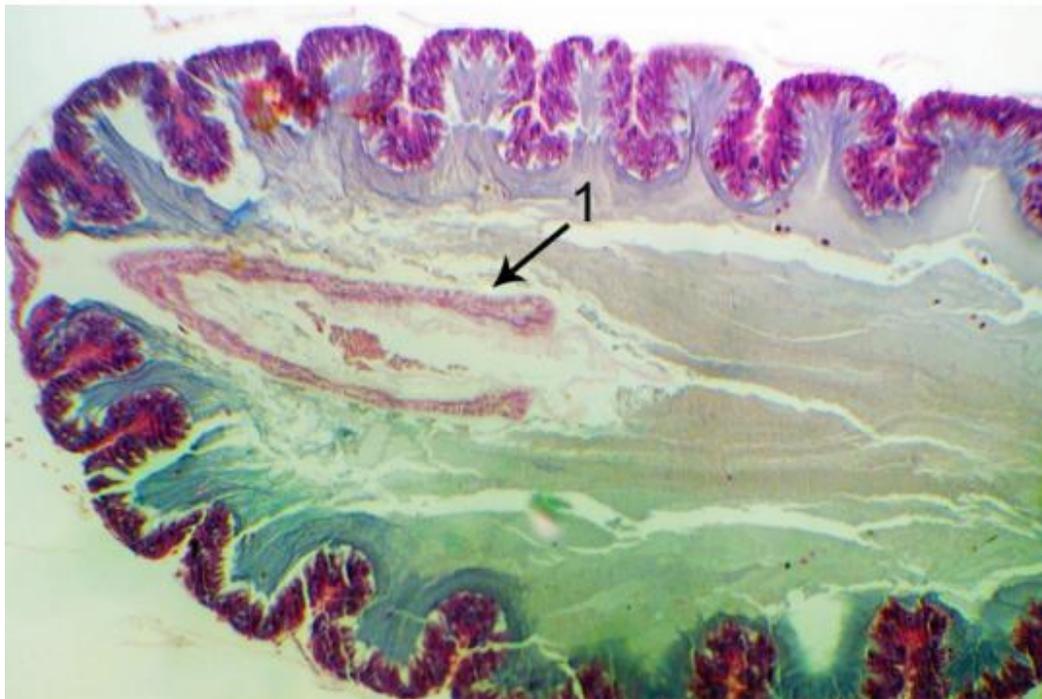
Body Structures

Invaginations, appendages,
differences between castes
and sexes, fat bodies,
winter/summer bees

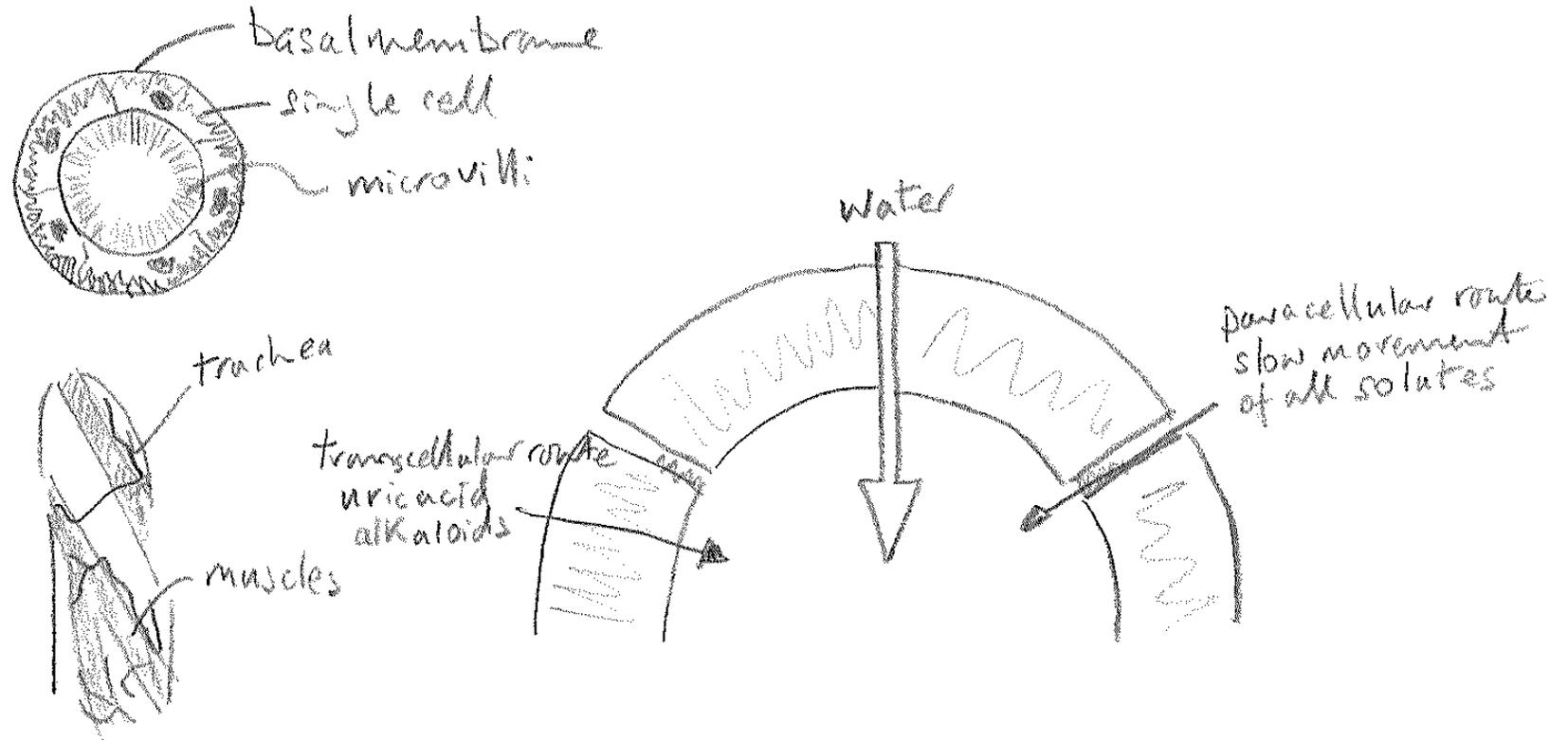
Alimentary/Excretory



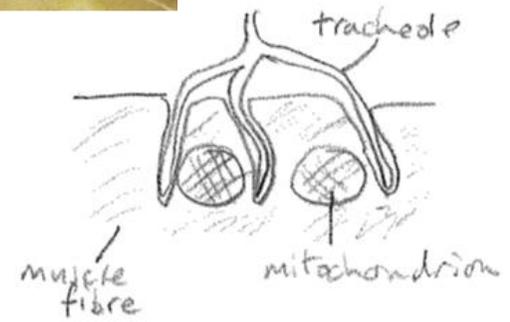
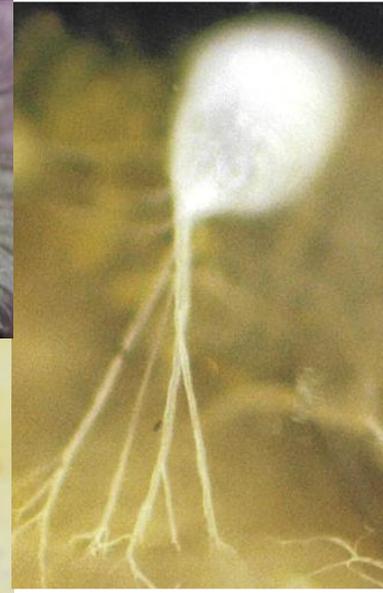
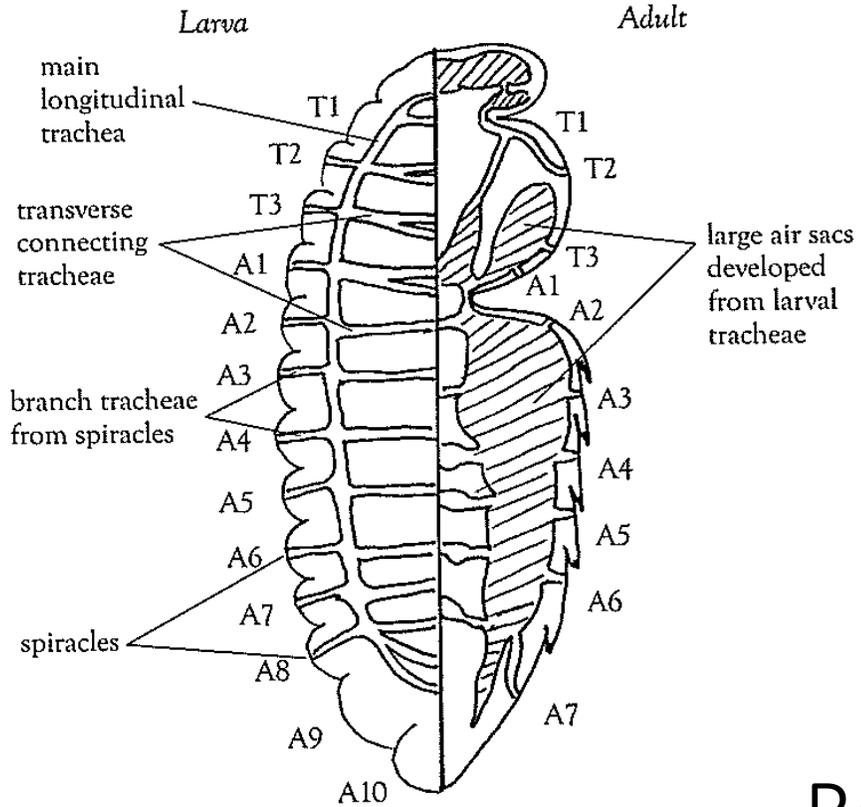




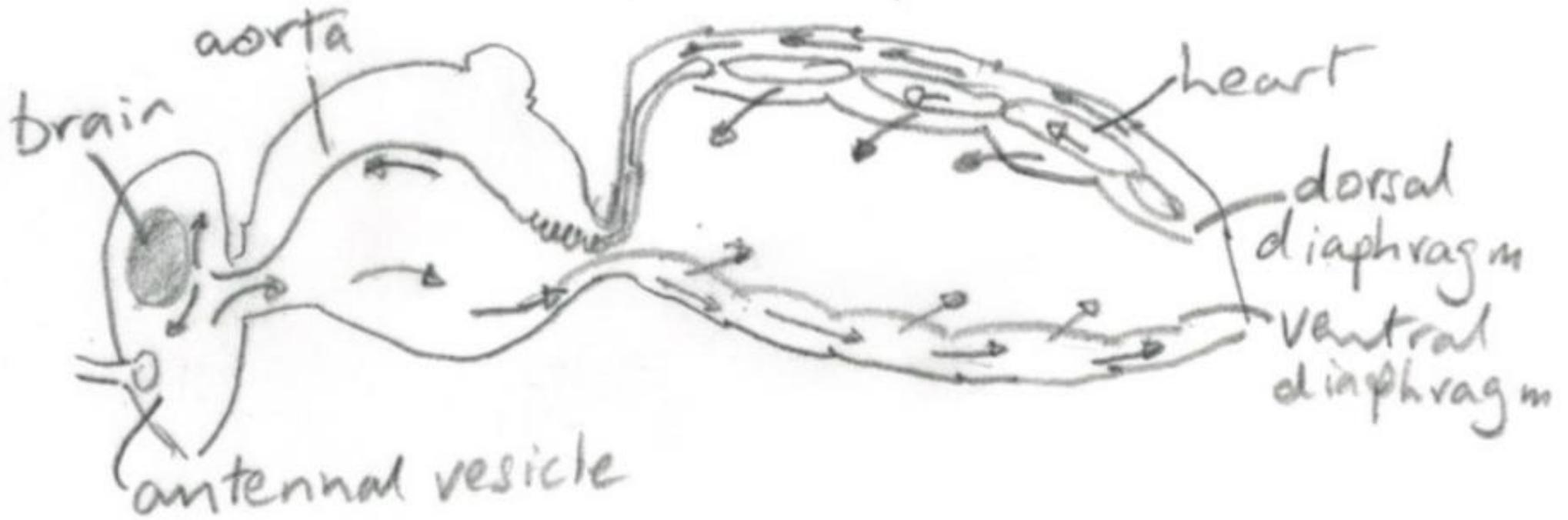
Malpighian Tubules







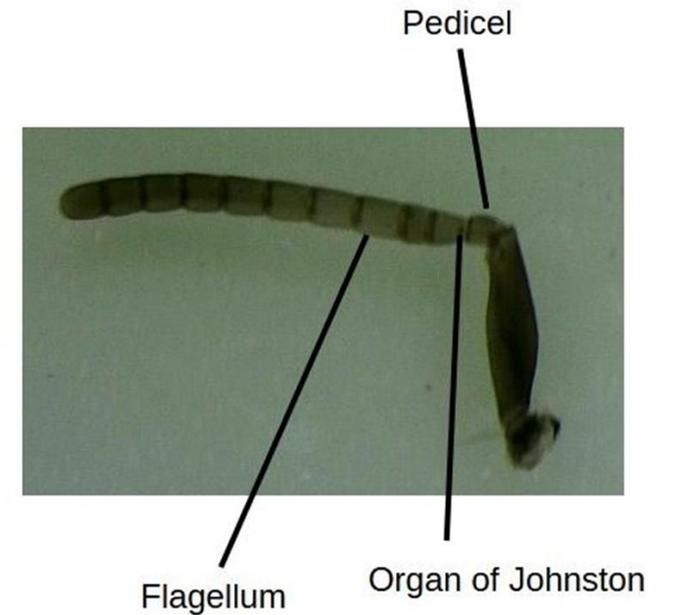
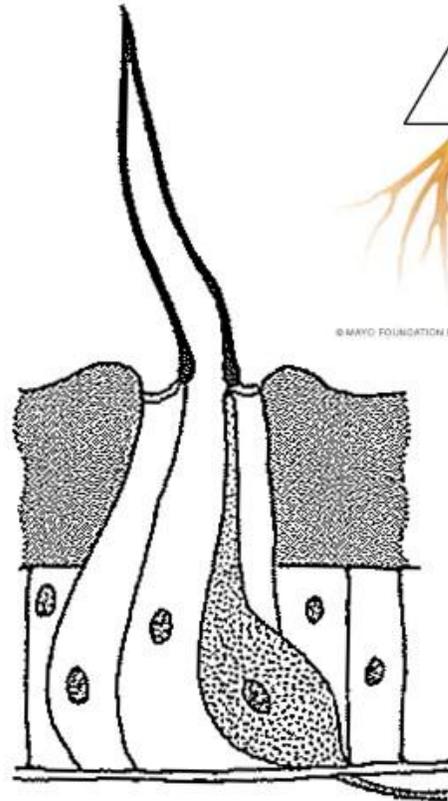
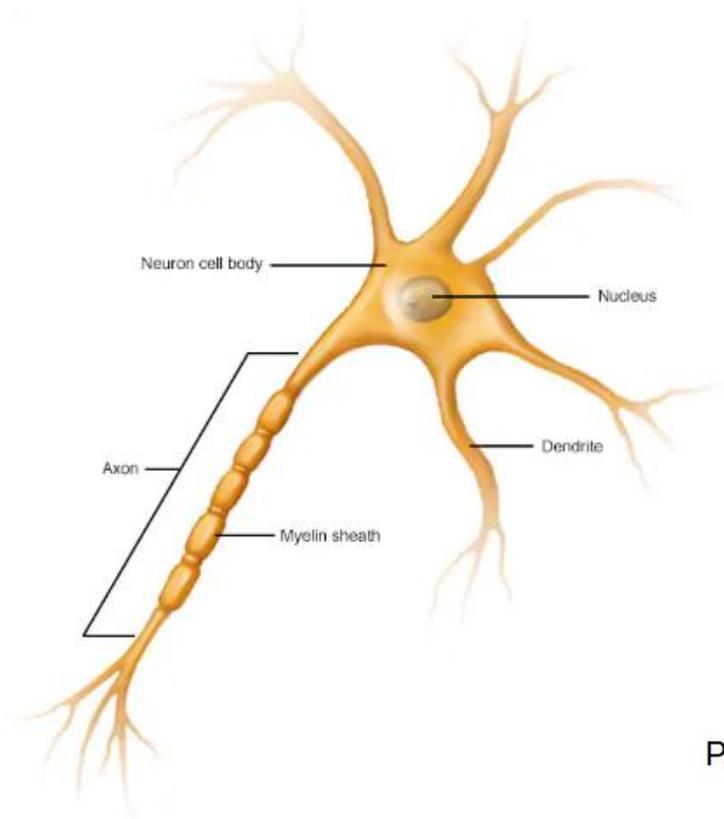
Respiratory system



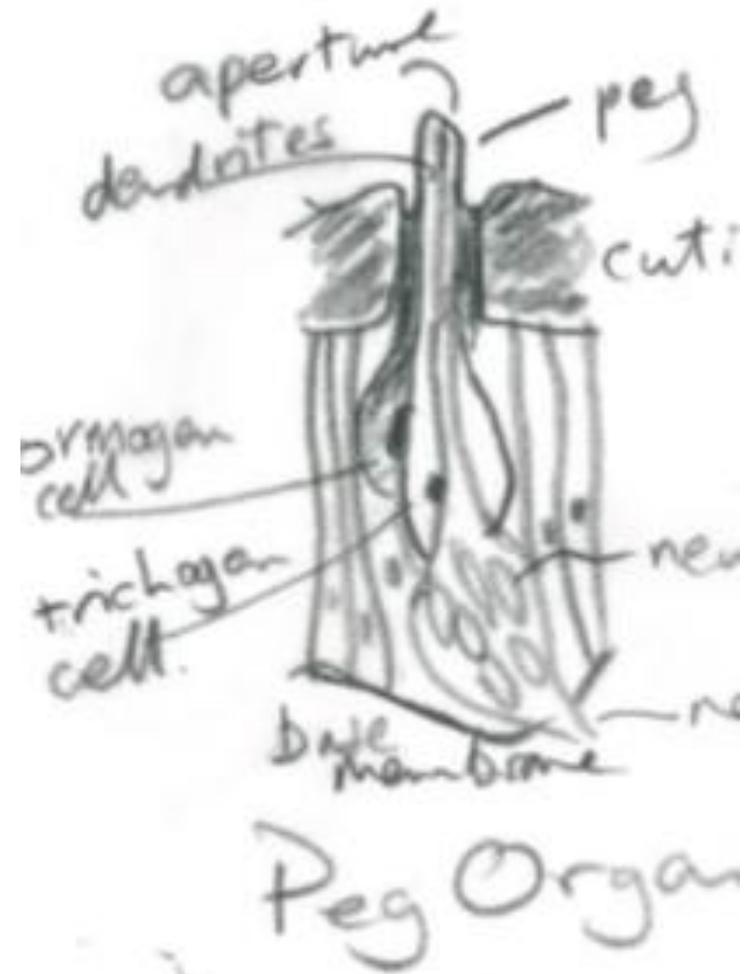
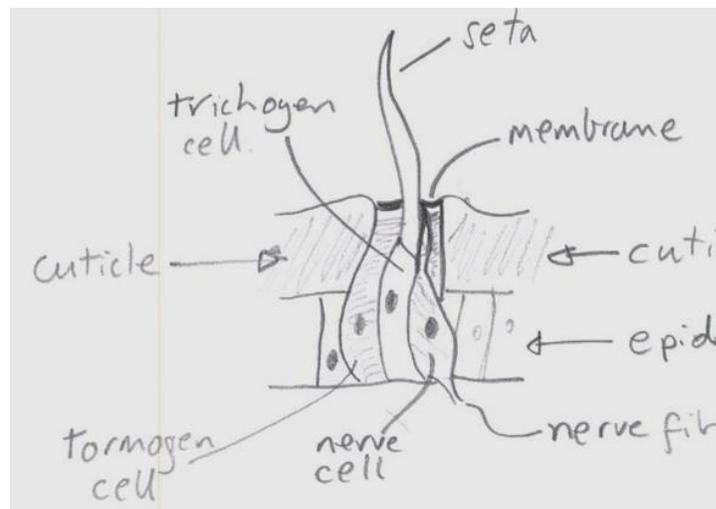
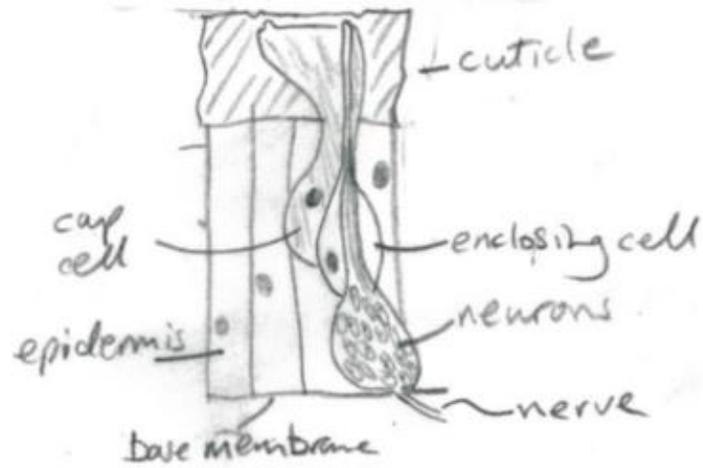
Circulatory system

Nervous system

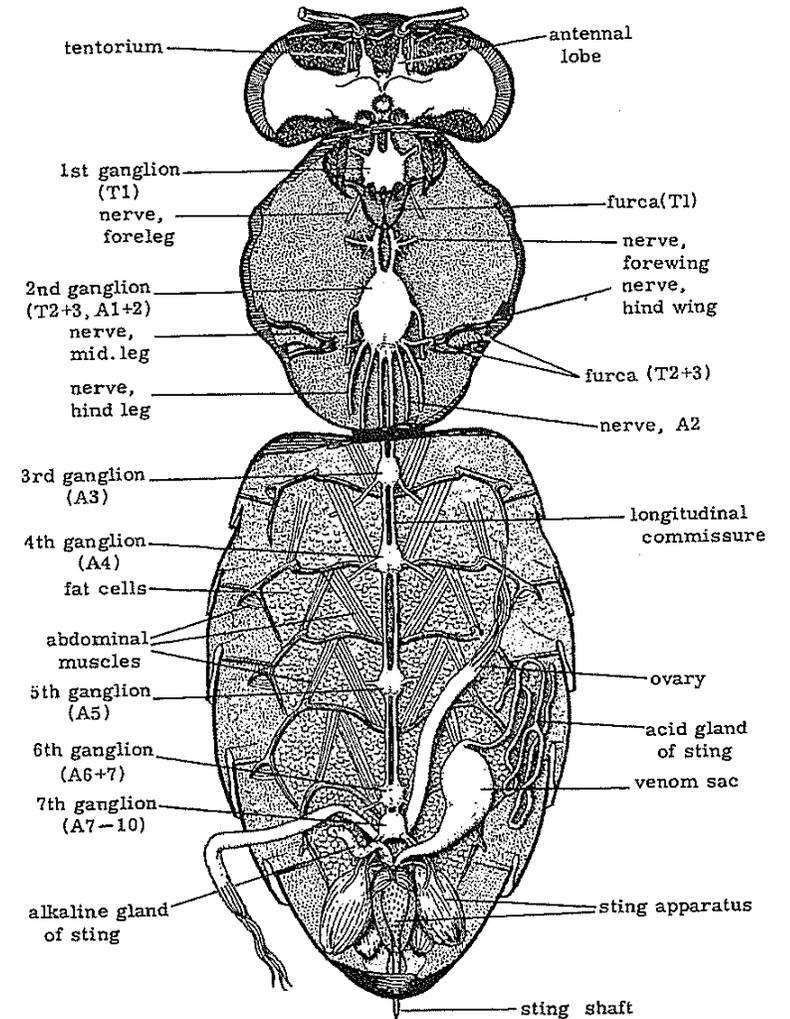
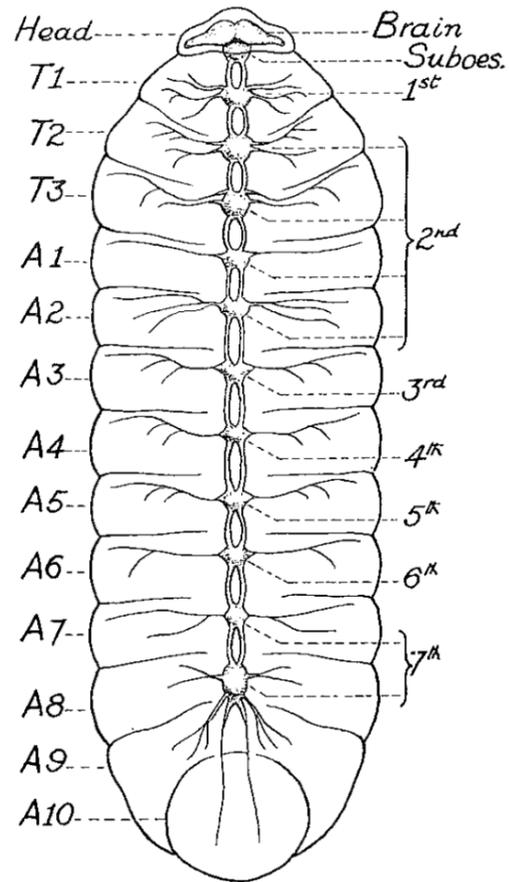
- Nerves
- Sense Organs

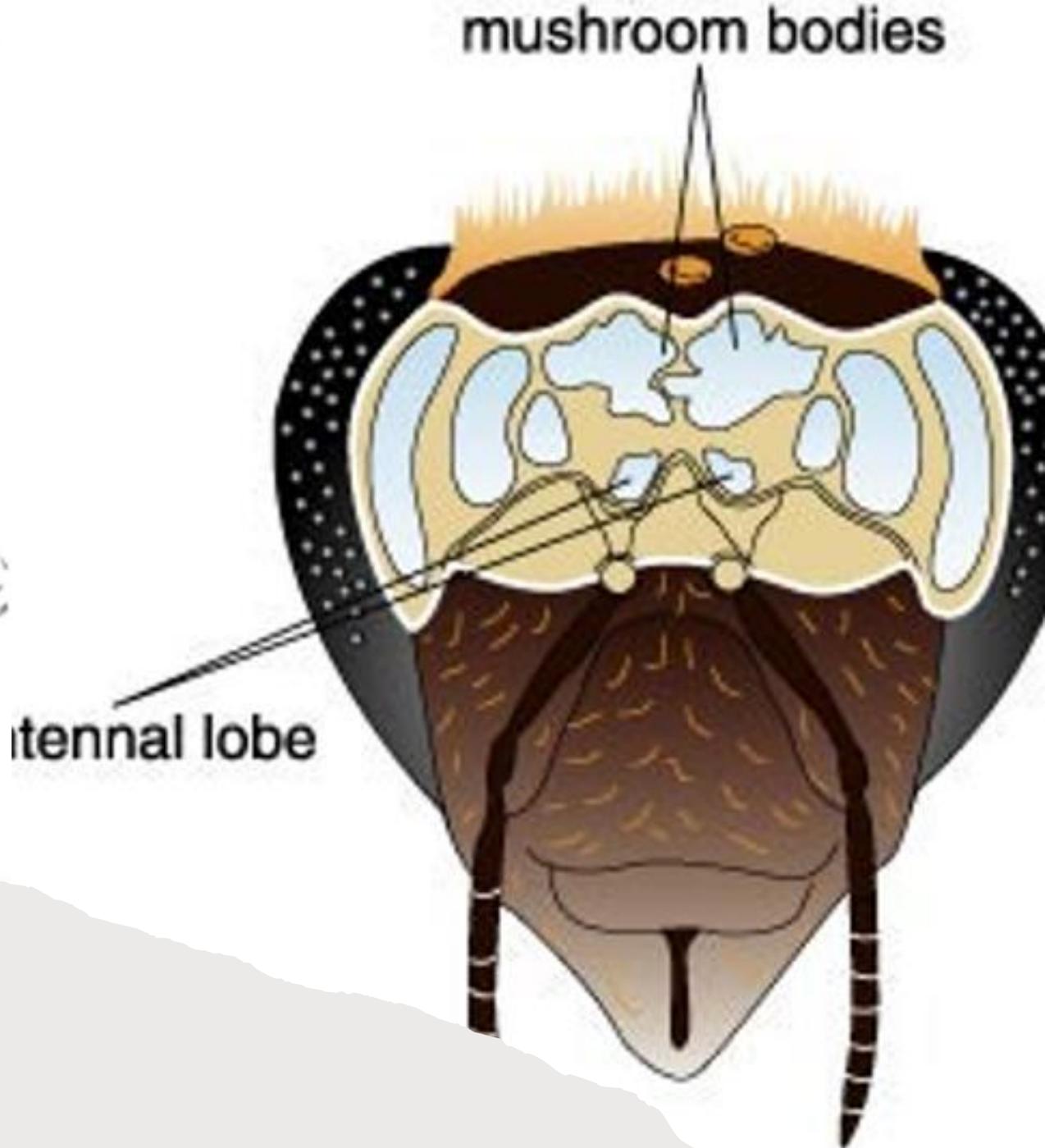
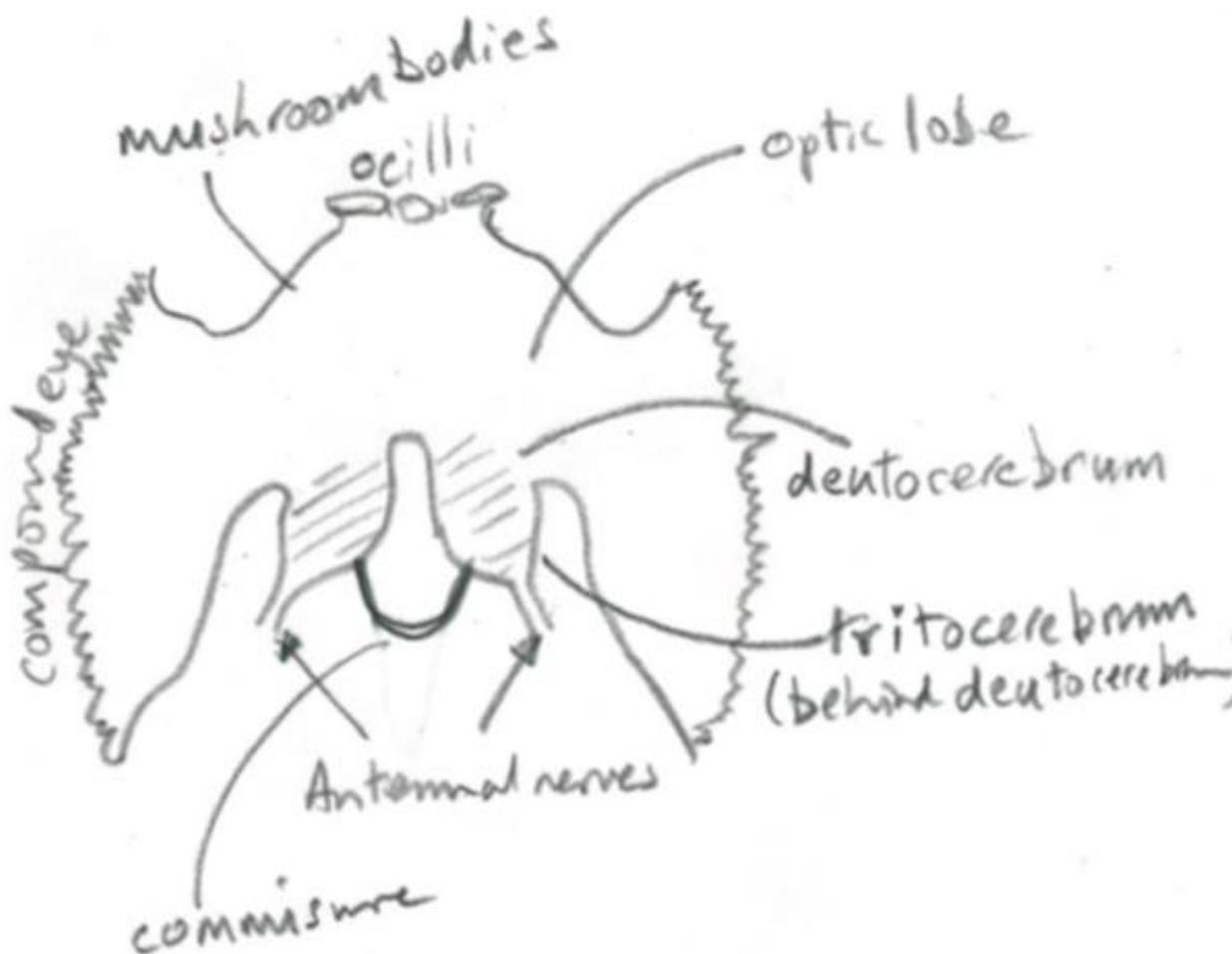


Sense organs



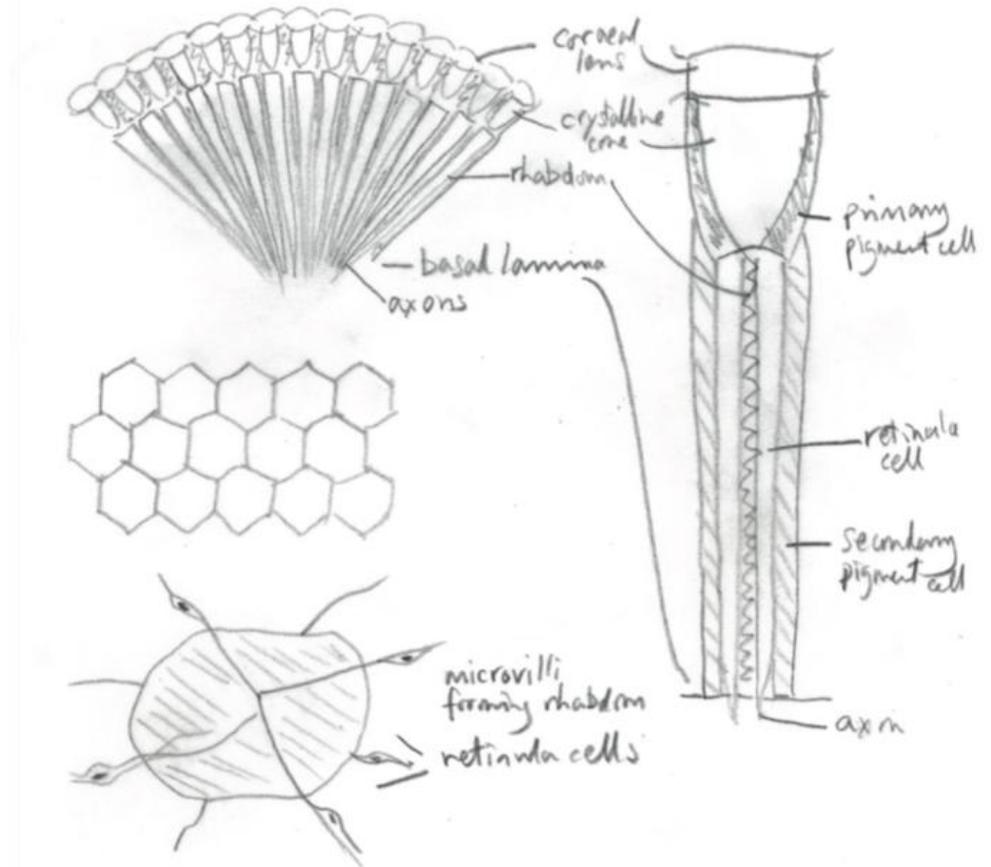
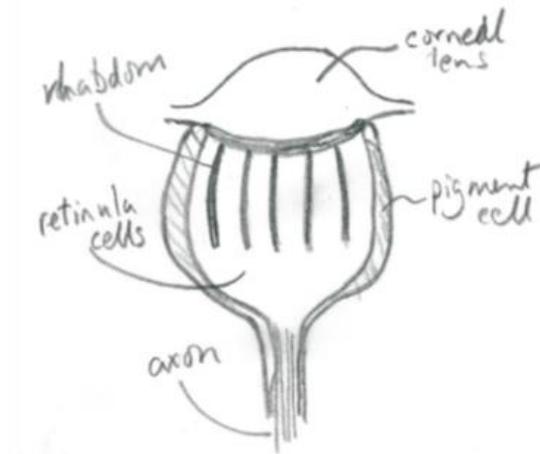
Central Nervous System

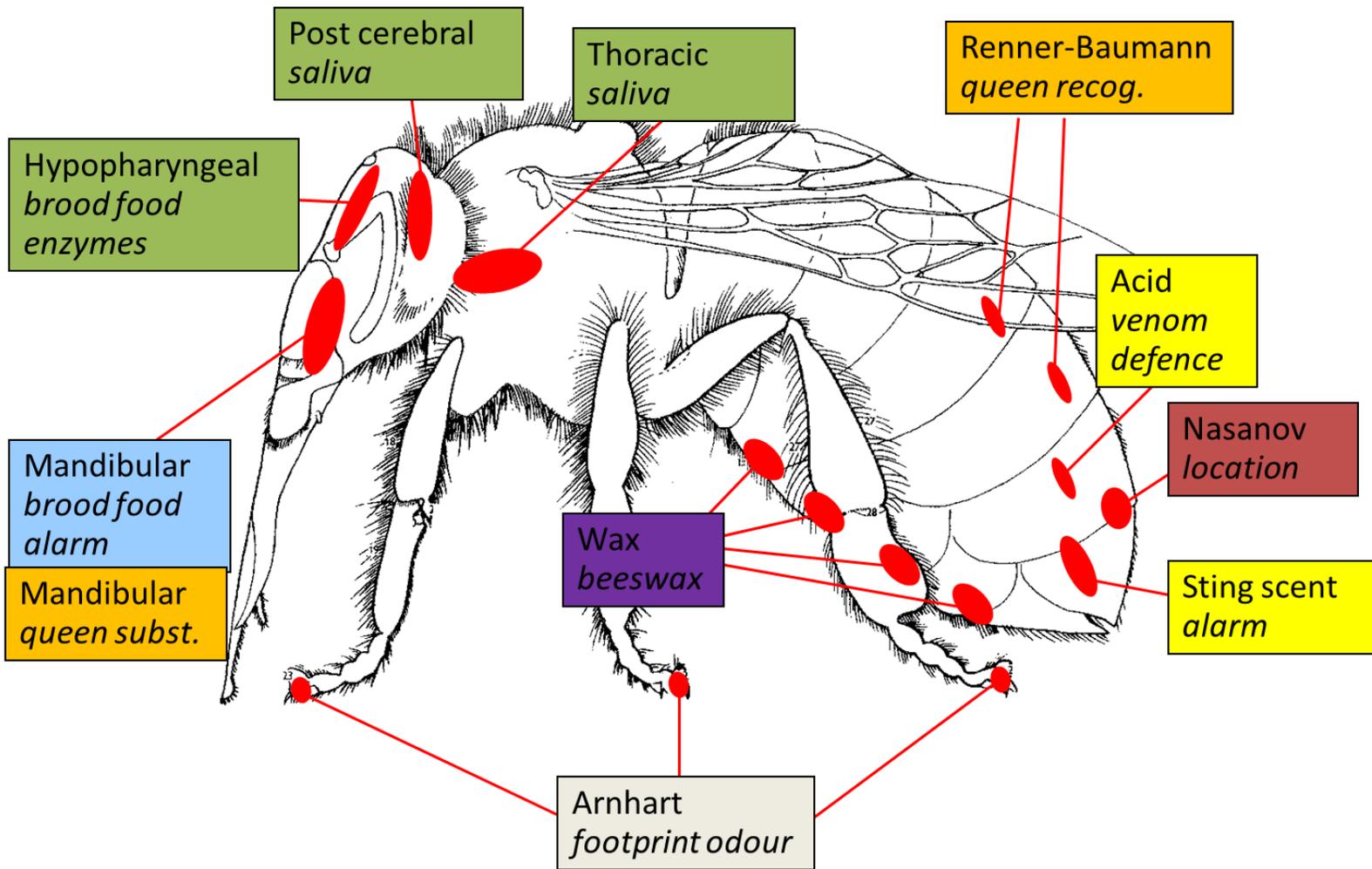




Brain

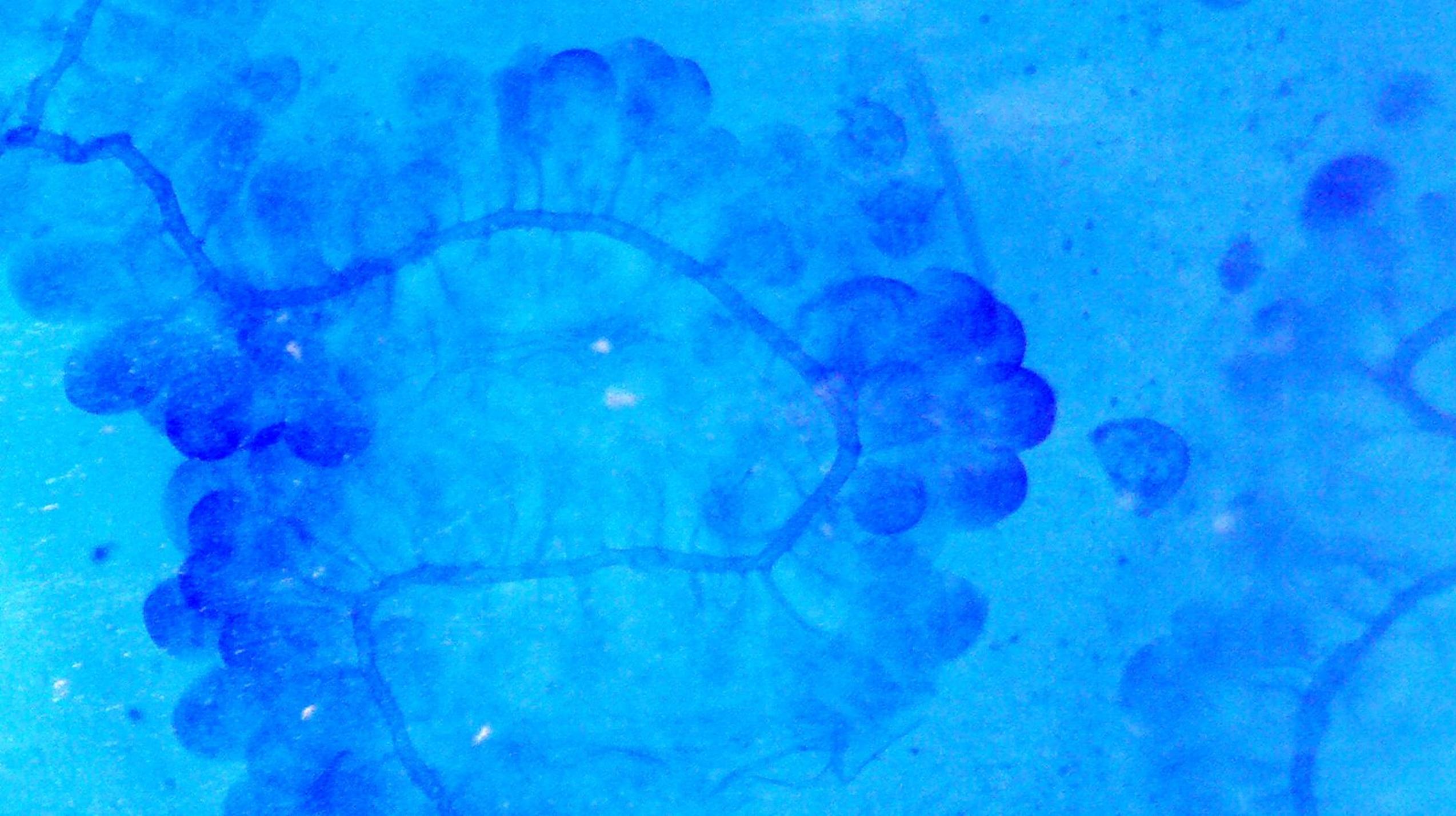
Optical cells





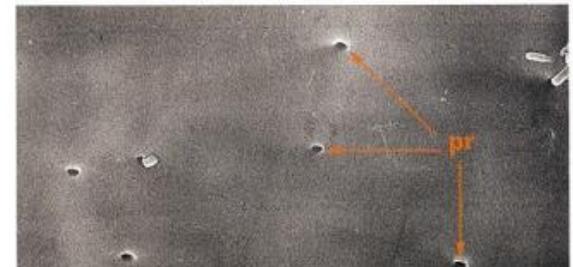
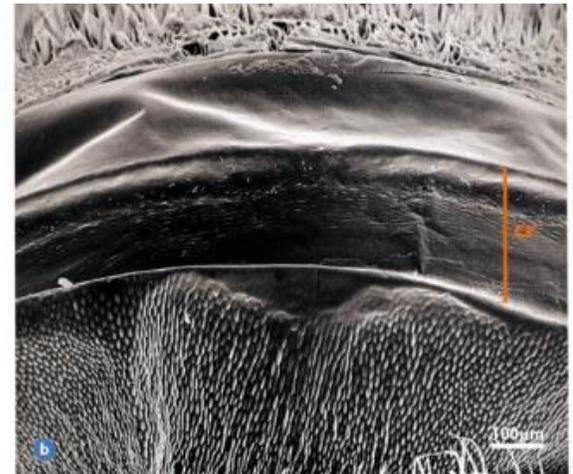
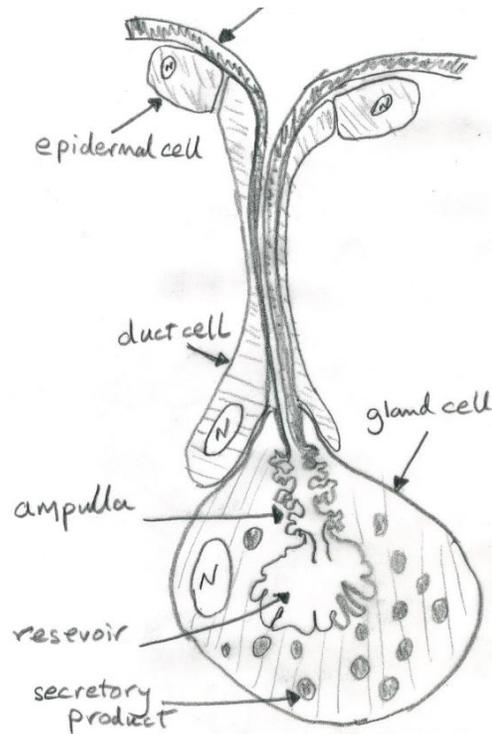
Exocrine glands





Nasonov Gland

- Invagination
- Single glandular cell

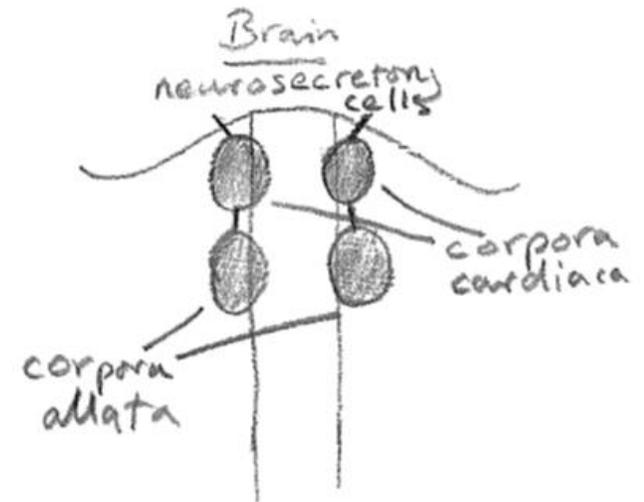
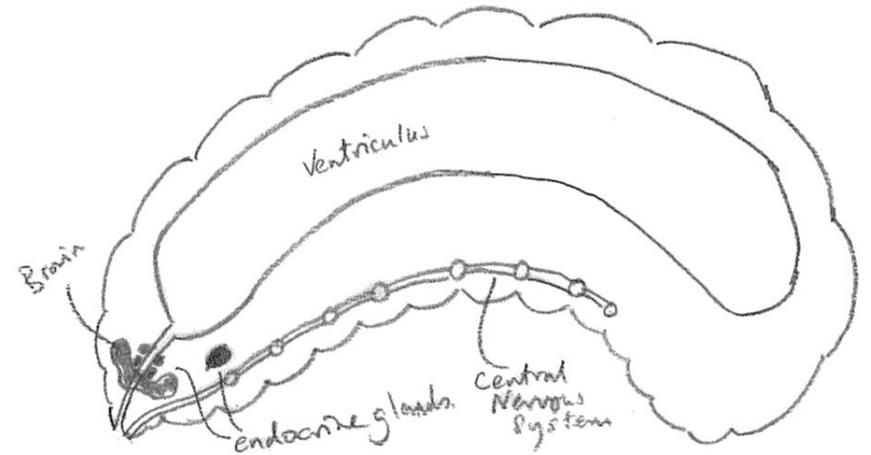


Poison
gland



Endocrine glands

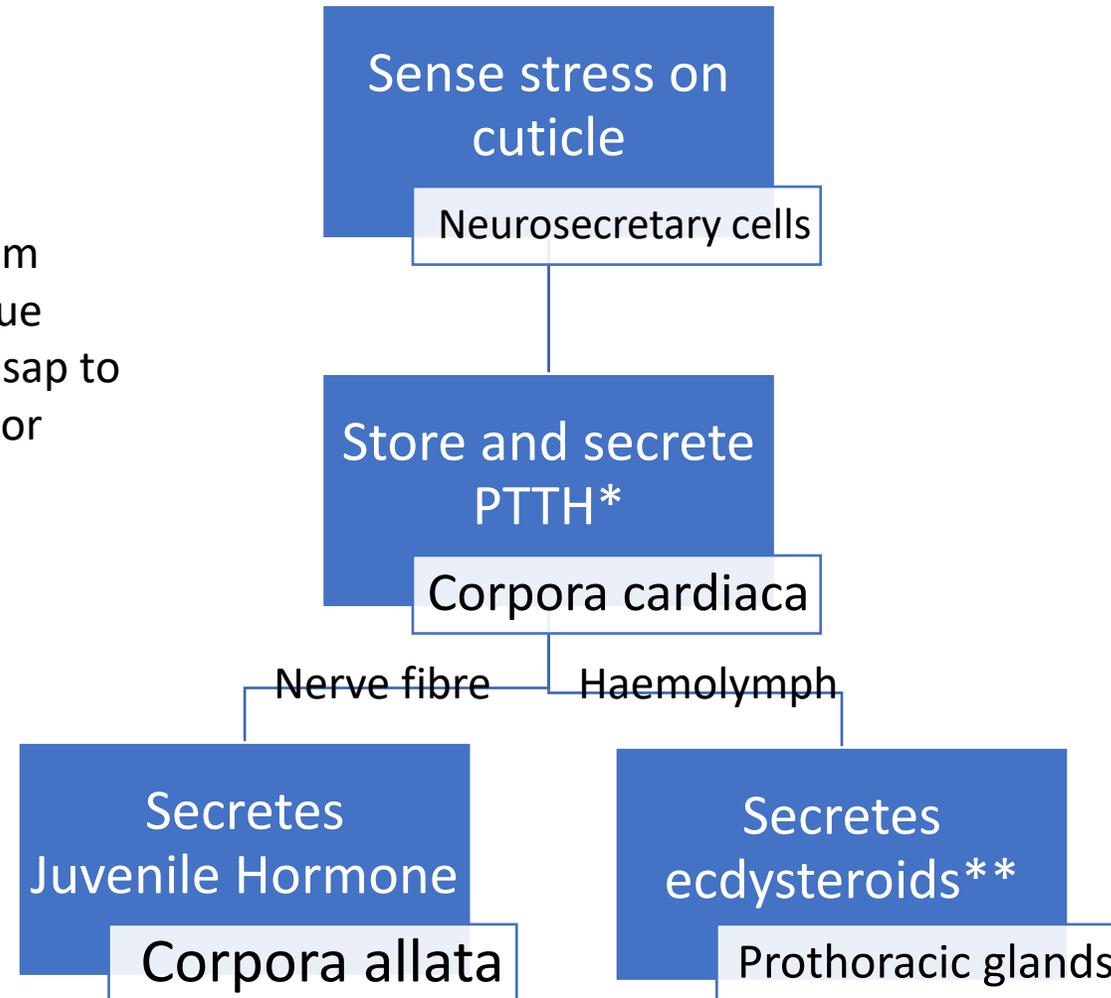
- Neurosecretory cells
- Corpora cardiaca
- Corpora allata
- Prothoracic gland



Hormone pathway

Hormone:

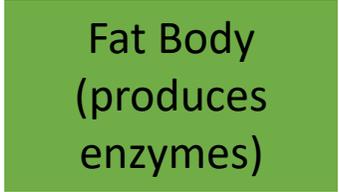
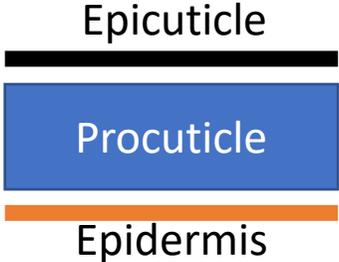
a regulatory substance produced in an organism and transported in tissue fluids such as blood or sap to stimulate specific cells or tissues into action.



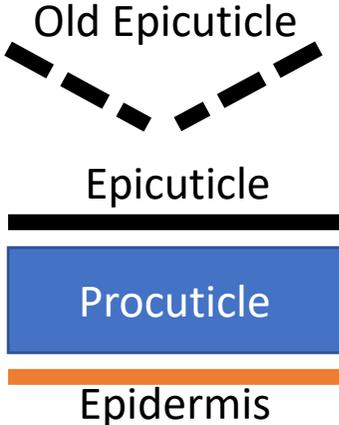
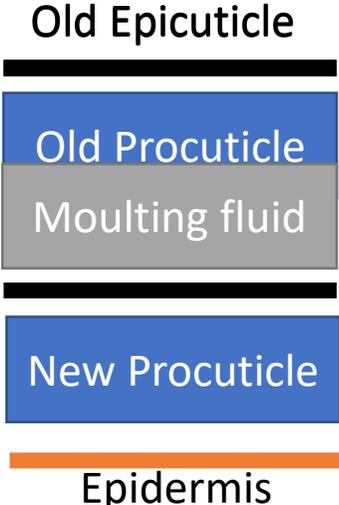
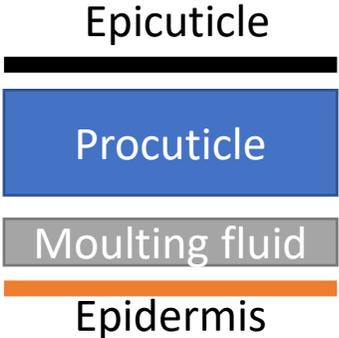
*prothoracicotropic hormone

** including ecdysone

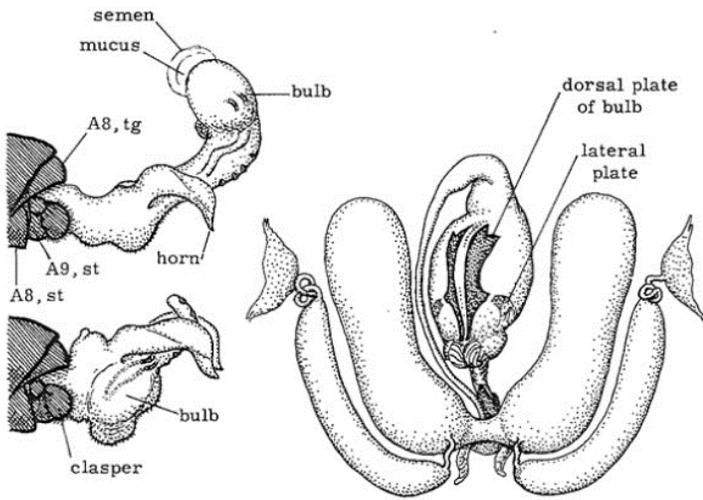
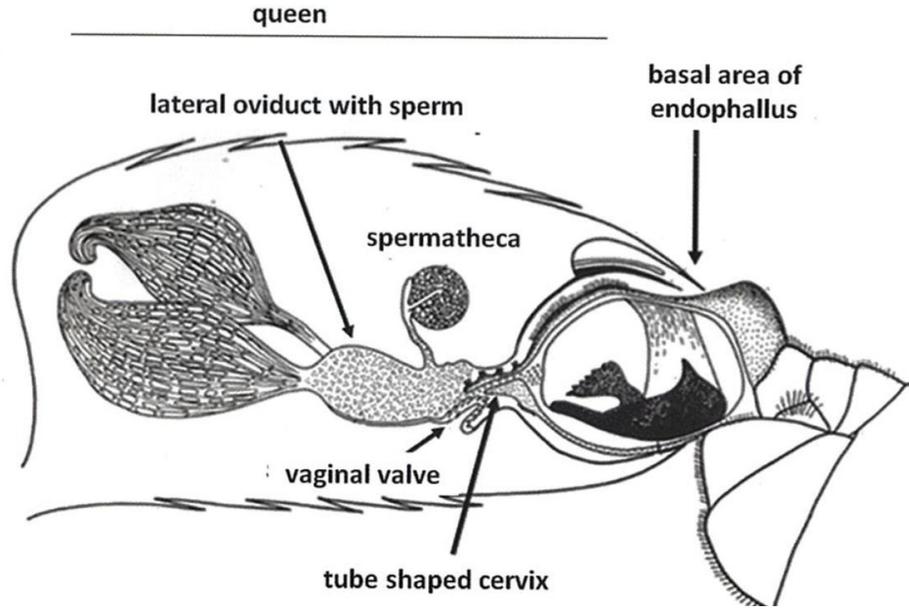
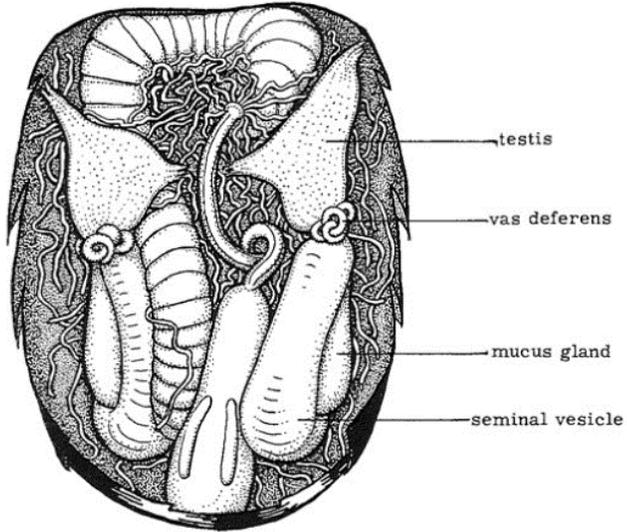
Apolysis



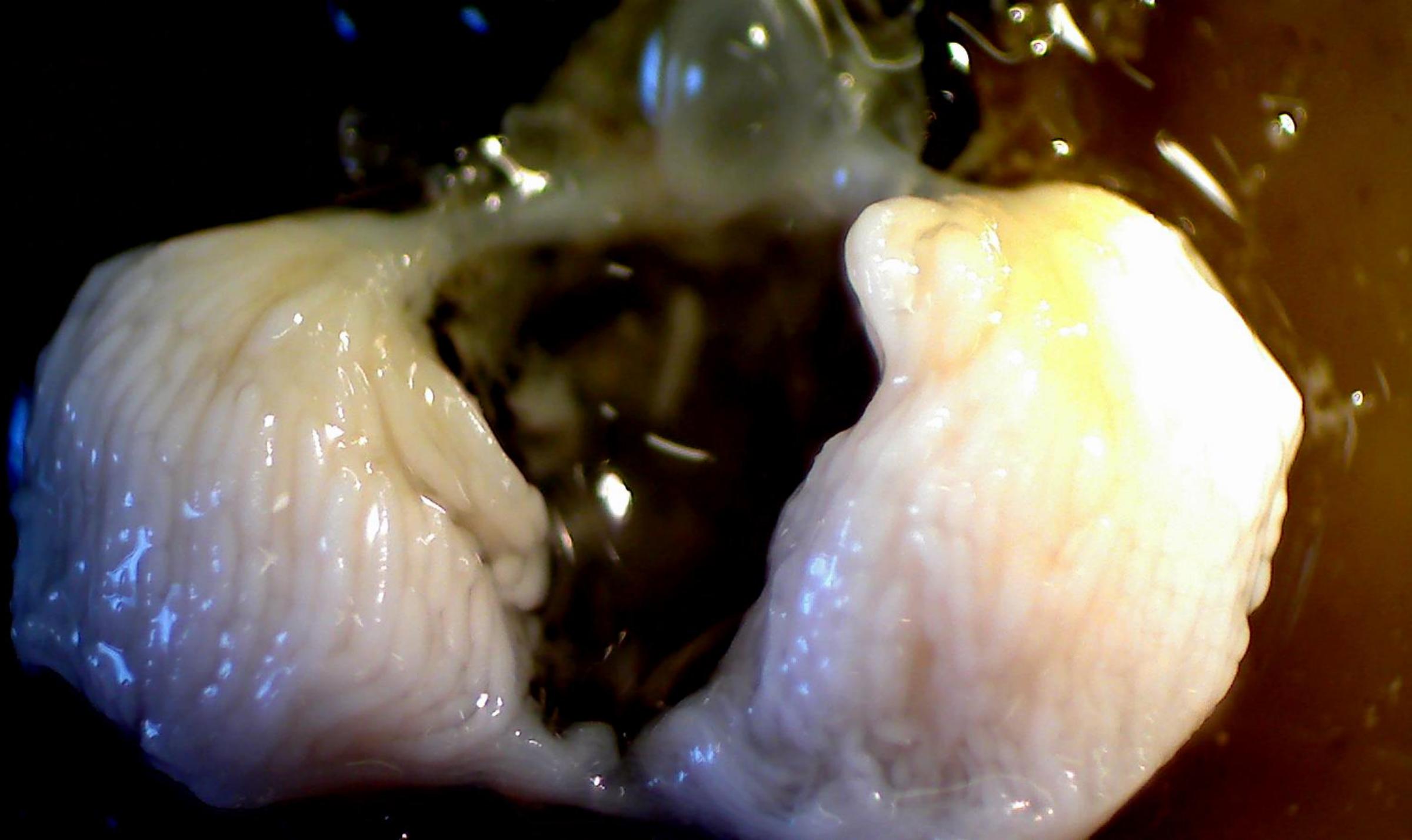
Hormone (ecdysone)



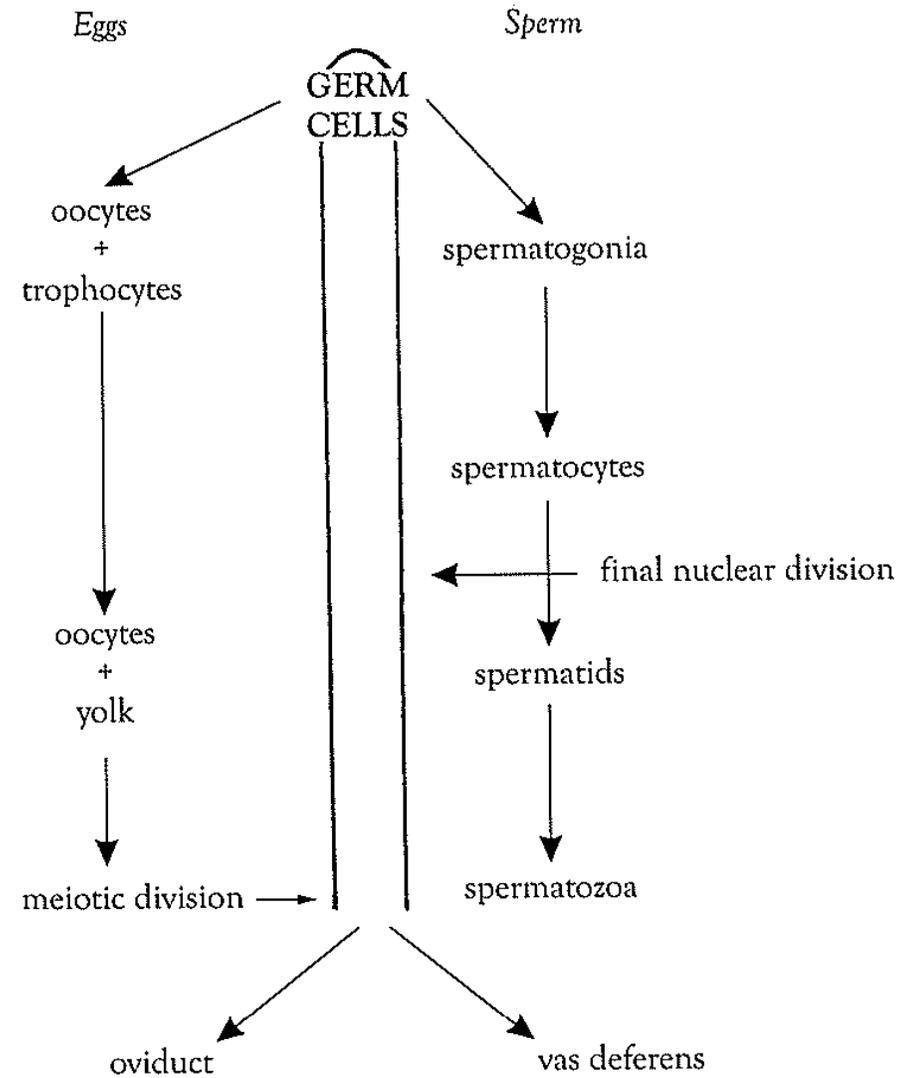
Ecdysis

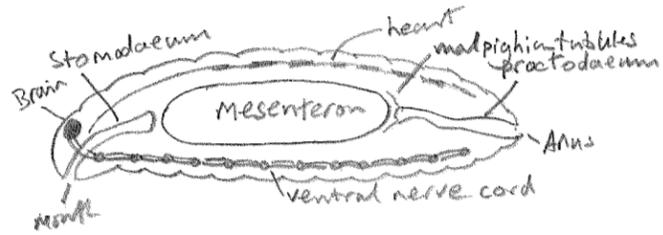


Reproductive organs

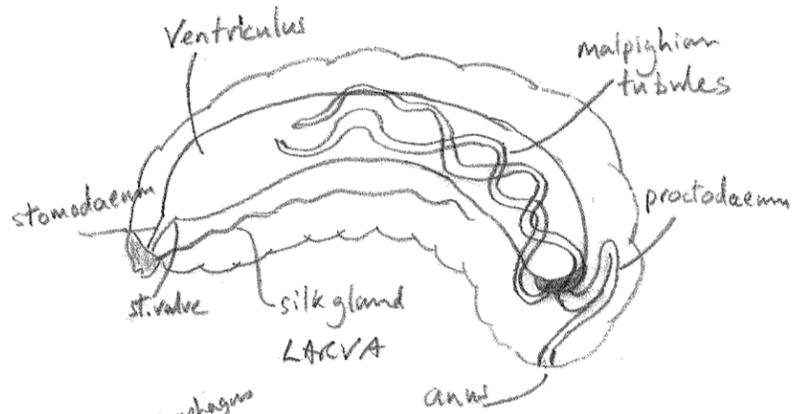


Gamete production

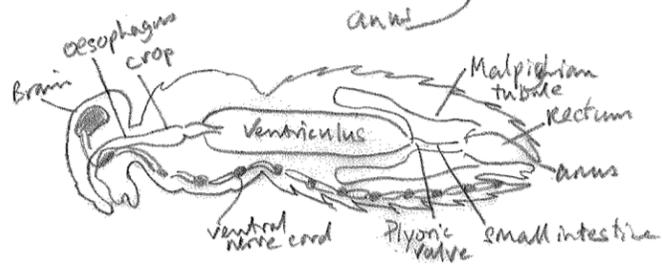




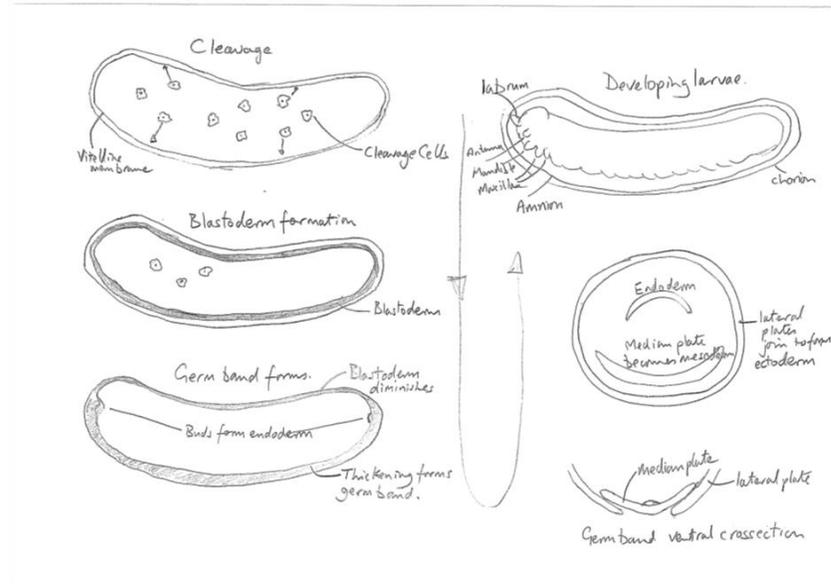
EMBRYO



LARVA



ADULT



Metamorphosis

Castes and sexes

honeybee
(*Apis mellifera*)

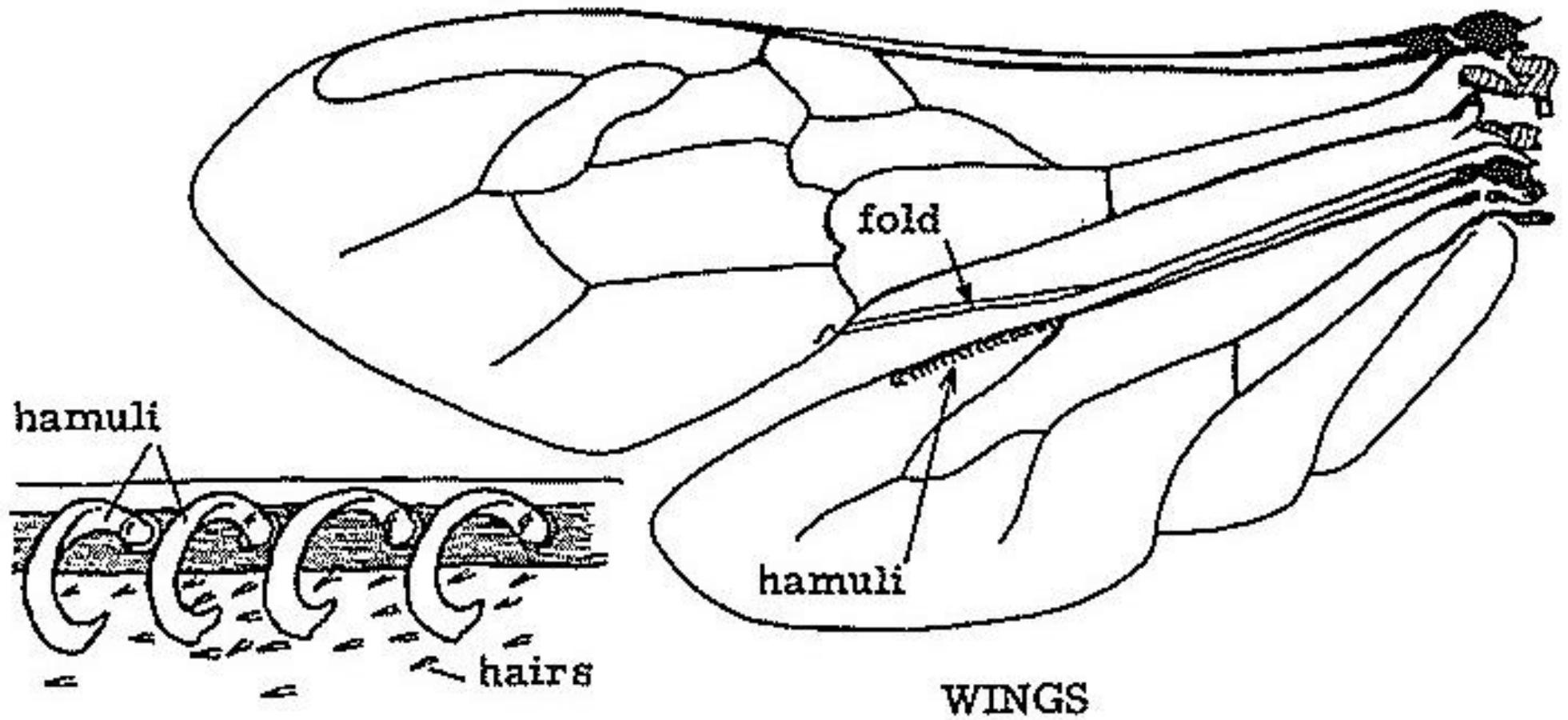


worker

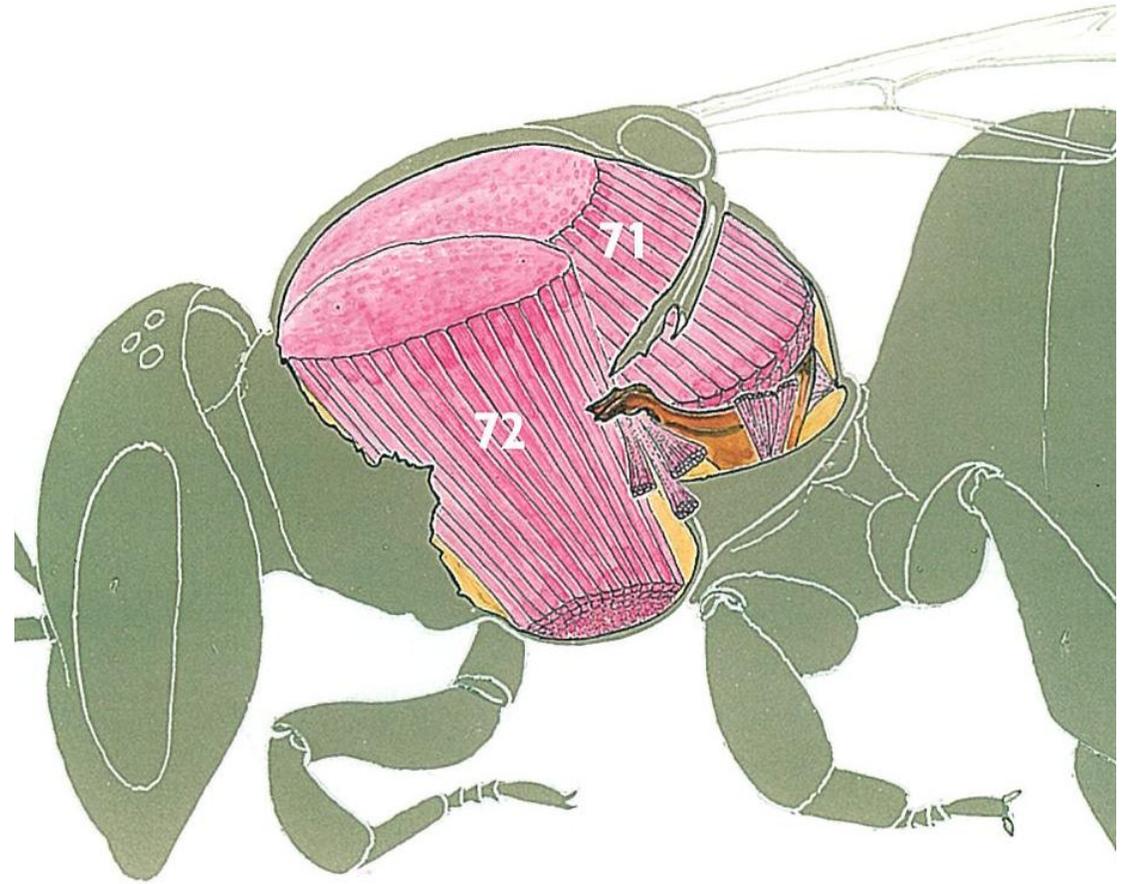
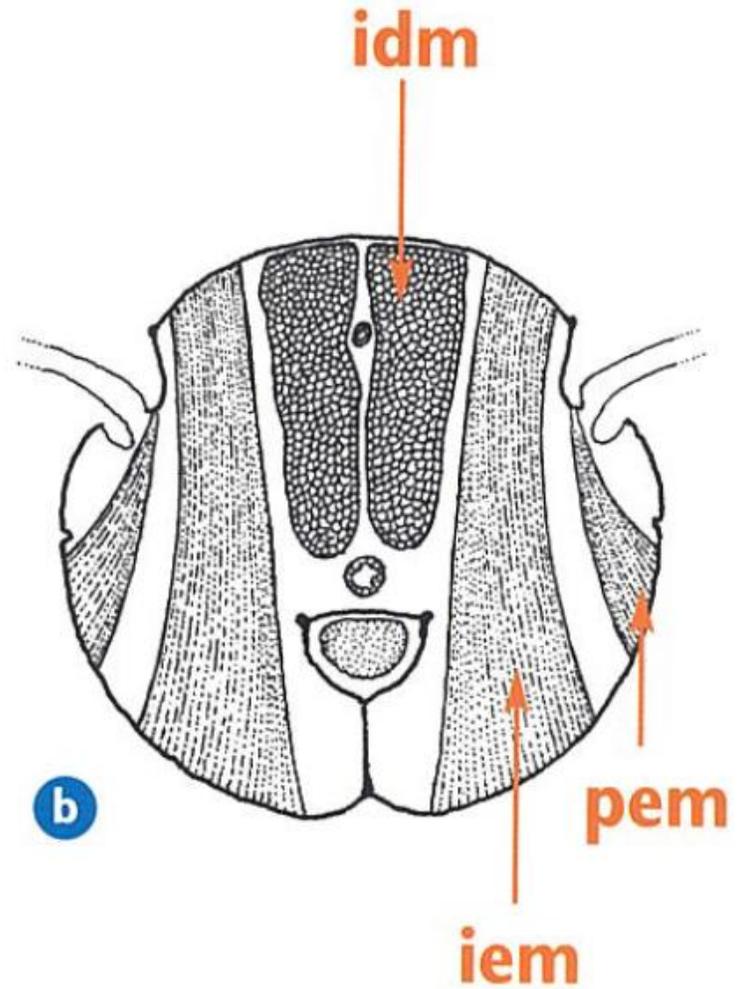
queen

drone

© 2006 Encyclopædia Britannica, Inc.

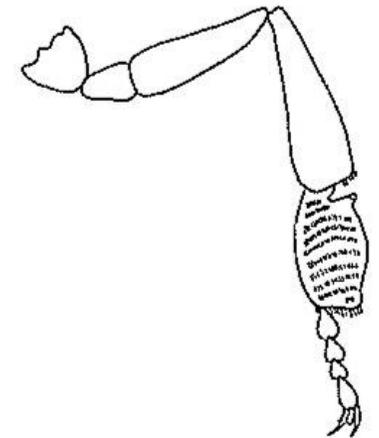
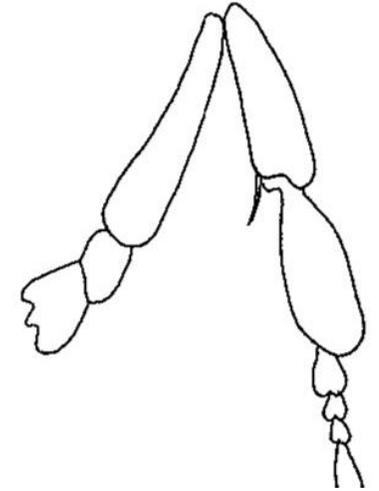
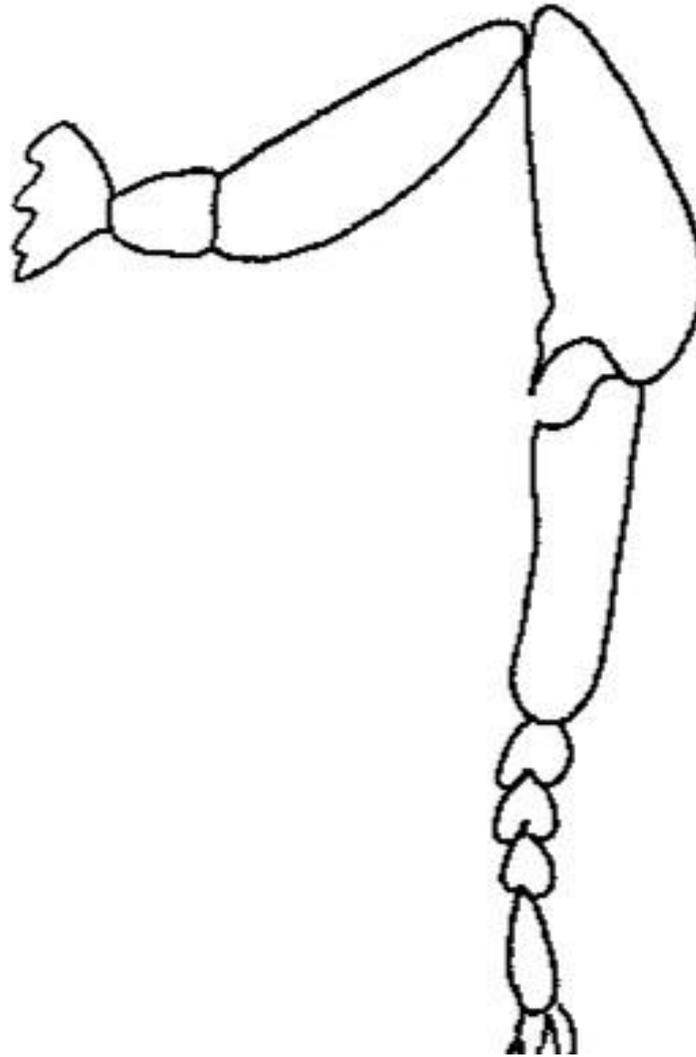


Direct and indirect muscles

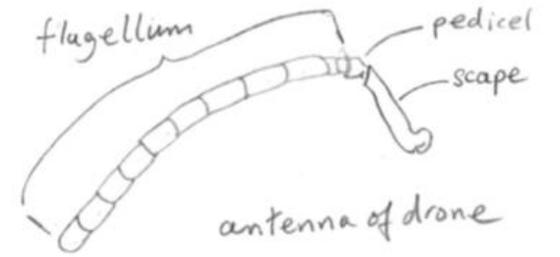
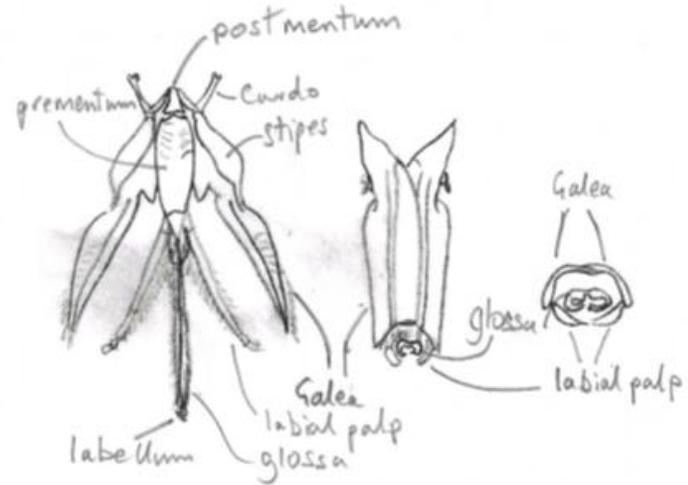
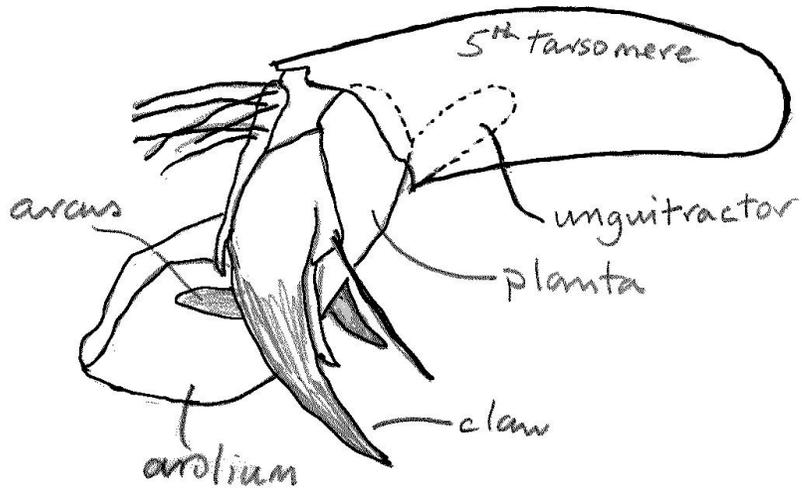


Can trains follow time-tables perfectly?

- Coxa
- Trochanter
- Femur
- Tibia
- Tarsus
- Pretarsus



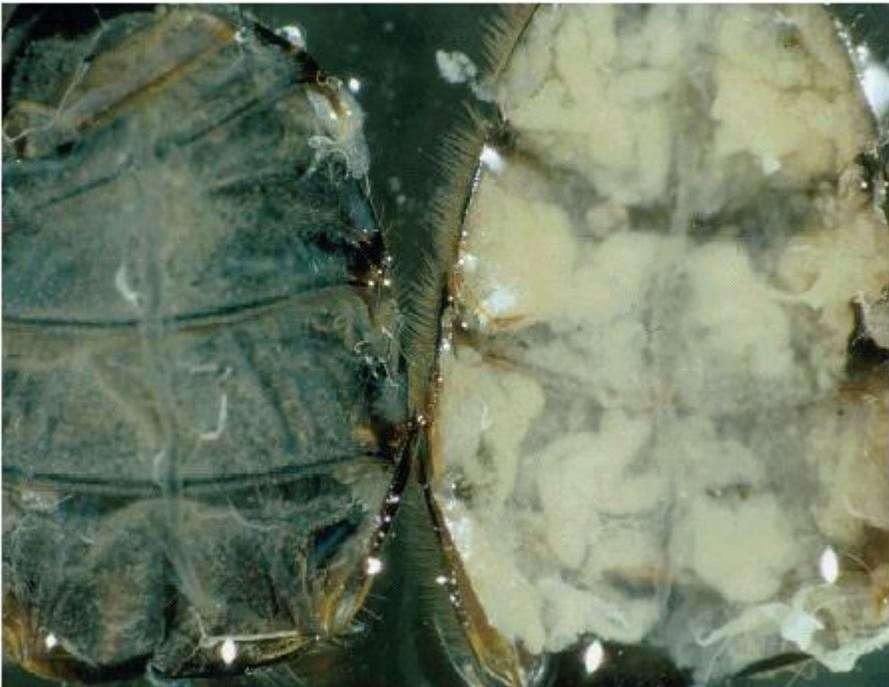
Appendages



Differences

Characteristic	Worker	Queen	Drone
Sensory			
No. facets of compound eye	4,000-9,000	3,000-4,000	7,000-8,600
Optic lobe of brain	Medium	Small	Large
No. antennal plate organs	3,000	1,600	30,000
Relative ratio of antennal surface	2	1	3
Glandular			
Hypopharyngeal	Present	Vestigial	Absent
Mandibular	Large	Very large	Small
Head salivary	Large	Large	Vestigial
Thoracic salivary	Large	Large	Small
Wax	Present	Absent	Absent
Nasonov	Present	Absent	Absent
Alkaline (dufour)	Reduced	Present	Absent
Koshevnikov	Reduced/absent	Present	Absent
Reproductive and sting			
Ovaries or testes	Reduced ovaries	Enlarged ovaries	Testes
No. ovarioles	2-12	150-180	None
Spermathica	Rudimentary	Large	None
Sting barbs	Strong	Minute	No sting
Sting plates	Loosely attached	Strongly attached	None
Mouthparts			
Mandibles	Slender	Robust	Small
Mandibular groove	Present	Absent	Absent
Proboscis	Long	Short	Short
Leg and wing			
Pollen press and combs	Present	Absent	Absent
Pollen basket	Present	Absent	Absent
Wing sensilla	Medium	Fewest	Most

Fat bodies



Stage	Cells Present	State of cells
Hatched larva	Trophocyte, Oenocyte, Urate	Oil globules, very few
Growing larva	As above	Cells increase in number and size
Larva 4 th moult	As above	White colour of larva fat body Body cavity full of fat body Contain oil globules and glycogen
Prepupa	As above	Fat body in haemolymph Protein increases in cells
Pupa	Disappear	Cells disintegrate releasing carbohydrate and proteins into the haemolymph
Adult	Trophocytes, oenocytes	New fat bodies built, see above for content

Vitellogenin

- Generally associated with egg production (yolk)
- Protein produced in the fat body
- Used in brood food production
- Young bees
 - JH low
 - Vitellogenin high (winter bees)
- Foragers
 - JH high
 - Vitellogenin low



Anatomy of the Honey Bee	Snodgrass (1956)
The Honey Bee Inside Out	Celia F Davis, 3 rd Edition
The Honey Bee Around and About	Celia F Davis, 3 rd Edition
The Biology of the Honey Bee	Mark L Winston
Anatomy and Dissection of the Honeybee	H.A. Dade
Understanding Bee Anatomy	Ian Stell
The Insects Structure and Function	R.F. Chapman, 5 th edition
Form and Function in the Honey Bee	Lesely Goodman

- Reference Documents



Any Questions?