

# Physiology of Excretion

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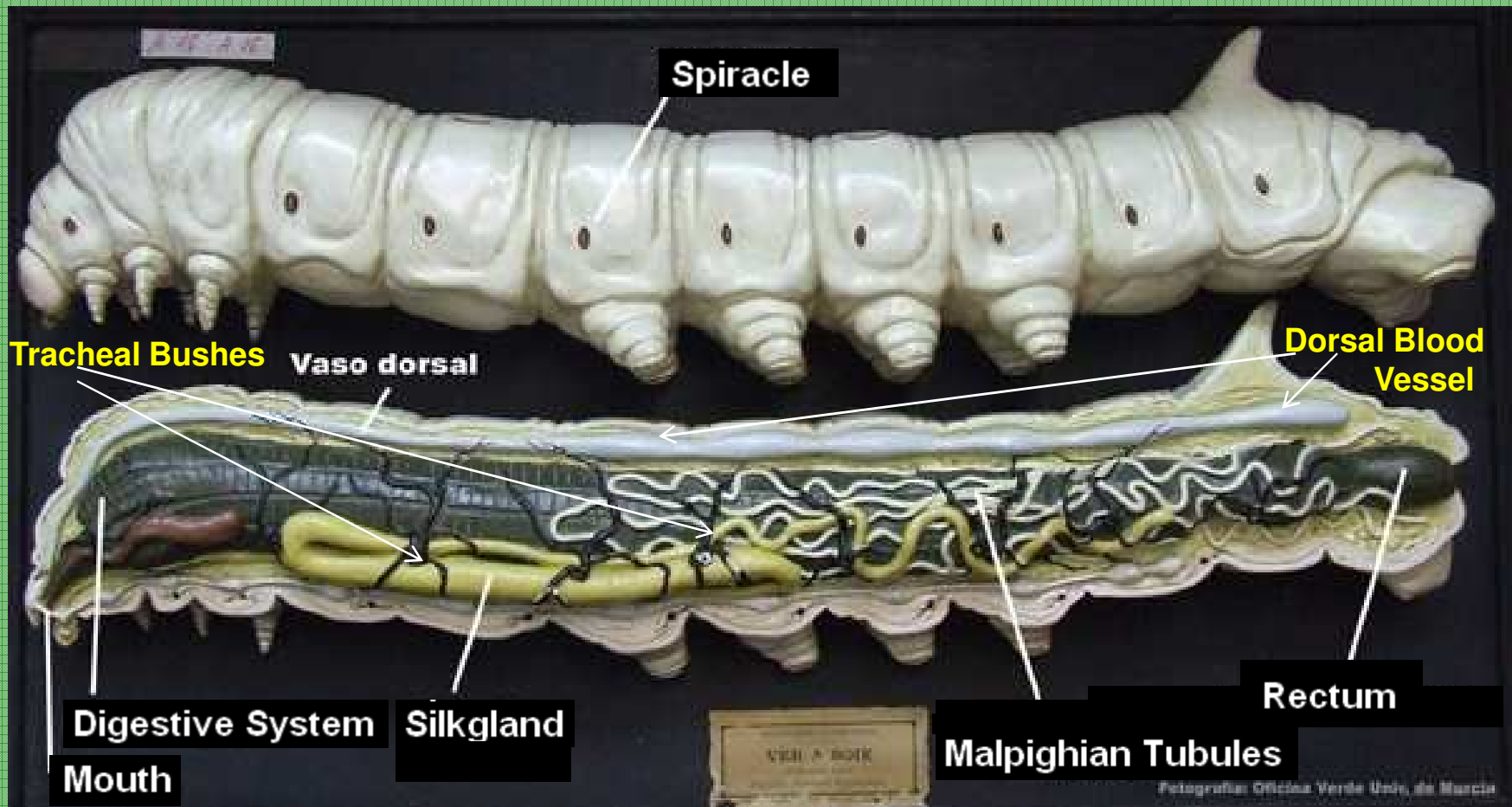
**Physiology:** The branch of biology that deals with the normal functions of living organisms and their parts.

or

The way in which a living organism or bodily part functions.

**Excretion:** The removal of waste products of metabolism from the body of insects.

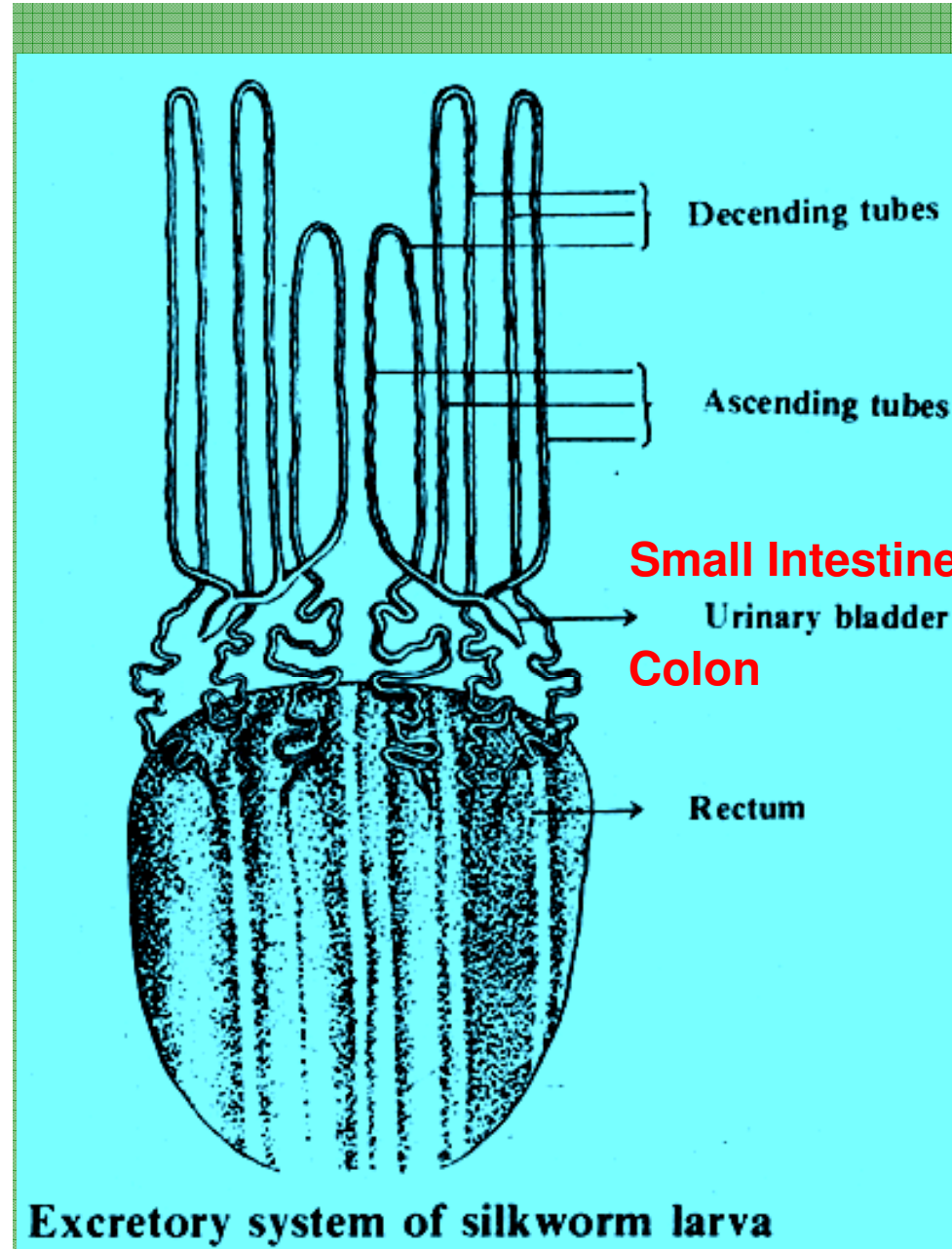
## Overall Morphology and Anatomy of Silkworm Larva



# EXCRETORY SYSTEM



EXCRETORY SYSTEM  
Malpighian Tubules (white colour)



**EXCRETORY SYSTEM continued**

**Malpighian Tubules picks up ammonium ions from haemolymph and converts as uric acid; releases in to rectum**

**The function of the excretory system is to maintain a constant internal environment in the body, by the elimination or segregation of unwanted substances present in the blood and by there tension or re-absorption of constituents needful to the organism.**



**In silkworm Malpighian tubules perform this function. They are attached to the alimentary canal at the junction between small intestine and colon.**

**Paired Malpighian tubules arise from each side of the hind gut. The two branches are further divided into three tubes. Each Malpighian tube (one group) emerges from the intestine is emerged into a sac called excretory chamber or urinary bladder. From which two branches arise. One of them situated on the dorsal side branches further into 2 tubes. Thus total three tubes are get arise in one side.**

**Thus there are 3 pairs of Malpighian tubules in the silkworm body, which stick to the midgut and run towards the anterior side.**

**One tube in one group runs along the dorsal wall of the midgut towards the anterior side and turns backwards at the 4<sup>th</sup> abdominal segment.**

**2<sup>nd</sup> tube runs along the midgut to laterally and turns backwards at the point of center of 4<sup>th</sup> and 3<sup>rd</sup> abdominal segments.**

**3<sup>rd</sup> remaining one tubule pass along ventral wall of the mid gut and turns backwards at the 3<sup>rd</sup> abdominal segments.**

**Then all three tubes are ultimately open into the rectum. The tubes passing to wards the anterior side from the urinary bladder are referred as ascending limbs and the same tubes turns back and passing towards rectum are called descending limbs.**



**The waste products of metabolism are mainly excreted as urine together with faeces.**

**The amount of excreted uric acid in adult urine is 5 to 15 mg per individual.**

**The winding tips of the Malpighian Tubules which are bound to the rectum by a membrane have an active absorption function. Therefore water and some excreta diffused from the rectum are accumulated in the winding tips.**

**Next, the winding long portion of the Malpighian tubules in the body cavity directly absorb uric acid, riboflavin, oxalic acid and other substances from the blood and then these substances are crystallized in the tubule.**

**When the larval ecdysis occurs all the substances thus accumulated in the Malpighian tubules are discharged between the new and old cuticle through the urinary bladder of the tubule.**

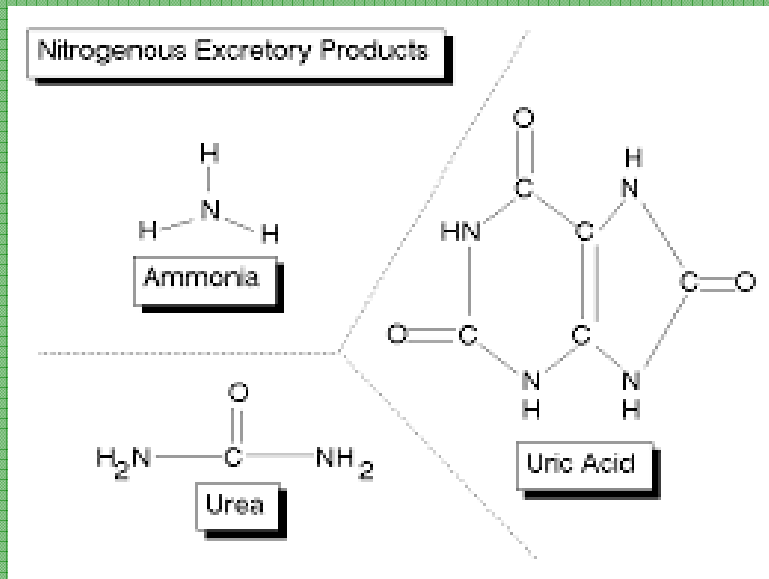
**In conclusion, The pyloric valve serves as a point of origin for Malpighian Tubules.**

**These long, spaghetti-like structures serve as excretory organs, removing nitrogenous wastes (principally ammonium ions,  $\text{NH}_4^+$ ) from the hemolymph.**

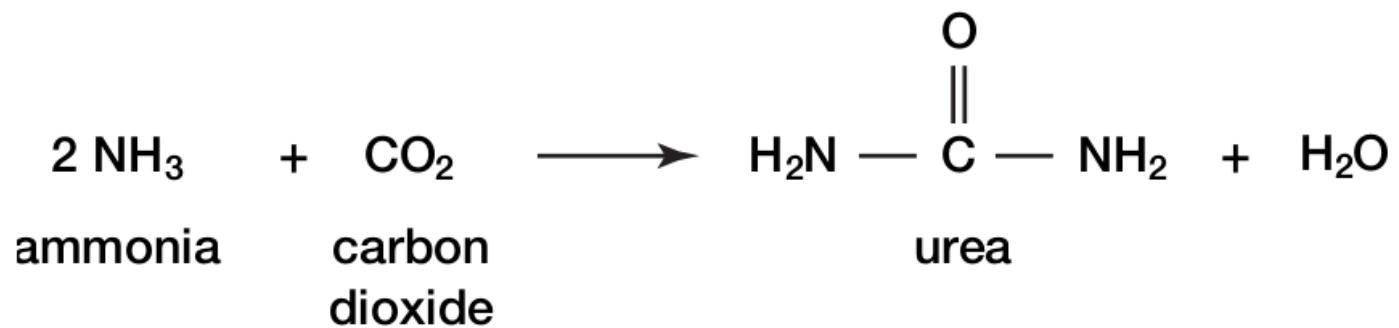
**The toxic  $\text{NH}_4^+$  is quickly converted to urea and then to uric acid by a series of chemical reactions within the Malpighian Tubules.**

**The uric acid, a semi-solid, accumulates inside each tubule and is eventually emptied into the hindgut for elimination as part of the fecal pellet.**

# Nitrogenous Excretory Products:



## Chemical Reactions:



**Acknowledgements**  
to

- 1. Sericulture Manual II, FAO, Rome, 1987.**
- 2. The Principles of Insect Physiology by V B Wiggelesworth 1972.**
- 3. The silkworm – A Laboratory Tool by Y Tazima 1979.**
- 4. Internet.**