Exocrine Glands

Post- cerebral and thoracic glands
Know collectively as the salivary gland. The post cerebral is located behind the brain where as the thoracic is located in the thorax. They produce a liquid passing from the glands into tubes that joins in the head passing under the pharynx and opening in the salivarium from where the secretions are used via the proboscis or in the pharynx to moisten solid food.
Secretion is mainly H_2O but slightly alkaline. The thoracic glands are developed from the silk glands of the larva and have a reservoir preceding the outlet duct. They are present in Q.W.D. The post cerebral glands have no reservoir. They are equally developed in the Q and W but not in the D.
Post cerebral acini are more translucent than the creamy bodies of the hypopharyngeal gland and have a different characteristic shape. The acini are arranged in small bunches on a branching system of tubes which run into a median duct under the pharynx.
The thoracic glands are rather compact bunches of short cylindrical bodies arranged on branches of the main ducts and their secretions is stored in two small sacs from which main ducts pass to the median duct in the heads.

The mandibular glands
The glands are in all three castes, the largest in the Q and the smallest in the D. Located one gland each side of the head above the mandibles.
The lumen of the gland acts as a reservoir under pressure and the outlet can be opened and closed allowing the secretion to be released as required.
The secretion runs down a groove in the mandible.
Function in the worker produces a white secretion containing 2- heptanone which acts as an alarm pheromone and 10 hydroxyl- 2 deconic acid (10 HDA) which is the principal fatty acid in brood food and royal jelly and acts as a preservative. The function of the gland changes with the age of the bee and the duties it is undertaking. 2- heptanone is not found in the secretion of very young bees. Only as they start foraging does the pheromone appear i.e. after nurse duties.
Function in the Q: produces queen substance, the main components being

1. 9-oxo-2-deconic acid (attracts drone for mating)
2. 9-hydroxyl-2-deconic acid (hols swarms together)

Inside the hive Q. substance inhibits the building of Q. cell inhibits the development of the workers ovaries and the workers are attracted to the queen.

The Hypopharyngeal glands
The glands one on each side, of the workers head, each having it own duct and connected to the hypopharyngeal plate. The two connections are on the underside of the plate and the secretions runs down the upper side and collects in the labial base.
The secretion is led to the larvae the bees using its mandibles to direct the brood food into the cell. Each gland consists of 100's of pear shaped acinis each with a short duct connecting to the main axial duct. They are no apparent opening or closing valves on these glands but it is being suggested that the movement of the hypopharyngeal plate could kink the duct and stop the flow. The size of the gland depends on the duties and it is at its largest where the bee is a few days old working as a nurse bee. The glands produce a clear liquid (protein) which combines with secretions from the mandibular glands and is known as brood food or royal jelly.
Later these glands shrink and are the source of invertase in the foraging bee.
It is possible for a foraging bee to reactivate its food gland by consuming large quantities of pollen. Nosema tends to atrophy the glands prematurely.
Viruses causing ABPV and Sacbrood are both to be found in the hypopharyngeal glands. Sacbrood virus is probably fed to the larvae by the infected nurse bees. Brood food is made up of proteins, several vitamins of the B group, vitamins C and D but not E, 10HDA from the mandibular.

The Renner Baumann glands
Located on the free edges of the abdominal tergites A3, A4 and A5 of the queen.
The court bees pay particular attention to the queen's abdominal.
The Q. grooms herself 3-4 times every hour spreading a combination of her pheromones over her exocuticle.
The pheromones from the tergite glands and the mandibular inhibit ovary developments in worked bees, inhibit the building of Q cells and stabilise the court of bees.

The Nasonov gland
Discovered by Nasonov (Russia) 1883. Known as the "come and join us" scent
Easily observed when a worker bee flexes the top of its abdomen downwards. The Nasonov gland is then exposed on the dorsal surface of the 7th abdominal segment. It consists of glandular cells which secrete pheromone through c. 600 ducts into a groove between the 6th and 7th tergite.

Honeybees release pheromone from this gland when:
- Flying in a swarm to attract other bees
- Marking the entrance to the hive
- Marking a source of H_20 or when they are foraging for water or syrup (odourless)

Components in the pheromone are terpenic alcohols, aldehydes and acids.A synthetically produced Nasonov pheromone can be used to attract a honey bee swarm to an unoccupied hive or a swarm-catching box also to attract bees to crops for pollination. Synthetically produced Nasonov consists of citral and geraniol in a 2:1 ratio.

The sting scent gland
The glands are believed to be located on the inner surface of the quadrate plates. The pheromone is a powerful alarm pheromone the main chemical being isophentyl acetate which inhibits foraging and scenting.
This alarm pheromone elicits a stinging response in other bees and recruits other workers to act as guard bees. It should be noted that bee venom does not elicit a stinging response, only the alarm pheromones do this i.e. isophentyl acetate and 2- heptanone.

Arnhart gland
Found on the 5th tarsomere of each leg of Q and W. Produce foot print odour. Essential for surpressing q cell production (cells above q excluder).
Foragers leave a foot print odour on flowers they visit. Lasting for 4 hours at 25°C and 4 days at 5°C

The sting glands (acid and alkaline)
The main glands associated with the sting normally the acid gland (venom) and the alkaline gland (Dufour). The acid gland lies in the posterior part of the abdomen at the end of each long tubule. At the end of each tubule a glandular enlargement secretes venom which passes into the tubules. Before entering the poison sac these tubules combine into a common duct. This duct joins the anterior end of the poison sac, where the venom is stored until required. The poison sac tapering in shape at posterior end discharges directly into the bulb of the sting shaft. There are no valves or closing mechanisms. Venom is expelled by the action of the bufferfly valves associated with the bulb.
The alkaline gland is a short thick convoluted tube which opens ventrally at the base of the sting. White in colour and the secretion is alkaline in nature. Acts as a lubricant for the sting mechanism. Neutralising any remaining acid after the sting has been used, in the Q as a protective coating for the eggs or as an adhesive to stick the eggs to the cell floor.

The venom gland starts to produce venom just prior to emergence and reaches a maximum in about 12 days. It ceases secreting at about 20 days just before it becomes a forager. In total about 300mg of venom is produced and old bees cannot replenish it. Winter bees retain their ability to produce venom until the following spring. About 50-100mg is used in a sting.
The main constituents are as follows

Phospholipose A	Mellitin
Hyaluronidase	Mellitin-F
Acid phosphatase	Apamin
Allergen C	Most cell degranulators (peptide, secopin and tertins)

Wax glands

Wax is secreted from four pairs of wax glands located inside the exoskeleton on sternites A4-A7 inclusive. These are the last visible segments on the ventral side of the bee's abdomen.

Internally, lying over each gland is a large cellular mass composed of oenocytes and fat cells. There are two glands on each sternite making 4 pairs in all.

The glands secrete a liquid which passes through the mirrors and oxidises as a flake of wax in the wax pockets. The glands, mirrors and pockets are known collectively as the "waistcoat pockets"

Wax is secreted at relatively high temp 33-36^{o}C after consumption of large amounts of honey 1lb honey to 5-8 lbs wax.

Wax glands are best developed in worker bees 12-18 days old. When building combs bees hang in festoons near the building site after gorging themselves with honey, waiting for the wax to form.

The wax glands inside the exoskeleton are covered with far bodies.

The main constituents of wax are

Monohydric alcohols	31%	S.G-0.95
Fatty acids	31%	Melting at-64^{o}C
Hydrocarbons	16%	Solidify-63^{o}C
Hydroxyl acids	13%	Colour- white translucent
Other substances	6%	Insoluble in H_20
Diols	3%	slightly soluble in cold alcohol
		Soluble in Chloroforms ethers or benzene

Wax is normally white in colour but can be tinted with a yellow hue caused by pigments that originate in pollen (dandelion new comb is coloured yellow)

In new emerged workers the wax gland consists of flat epithelial cells

By day 14 these cells have enlarged longitudinally and are richly supplied with trachea from which the tracholoes branch out to penetrate into the cells and into the intercellular spaces.

Young and old bees cannot produce wax.

Queenlessness inhibits wax production

12-18 day best aged for wax production