
Dissection Guide: The Crayfish

This handout is a stepwise description of how to dissect a crayfish. The accompanying set of figures will help you identify its anatomy. It has been our experience that manuals typically illustrate some anatomical structures very well and others, not so well. You may wish to consult other materials available in the laboratory to get a better mental picture of what you're looking for on the pickled crayfish in hand. You should be concerned primarily with the following external and internal features and their functions:

External Anatomy and Appendages

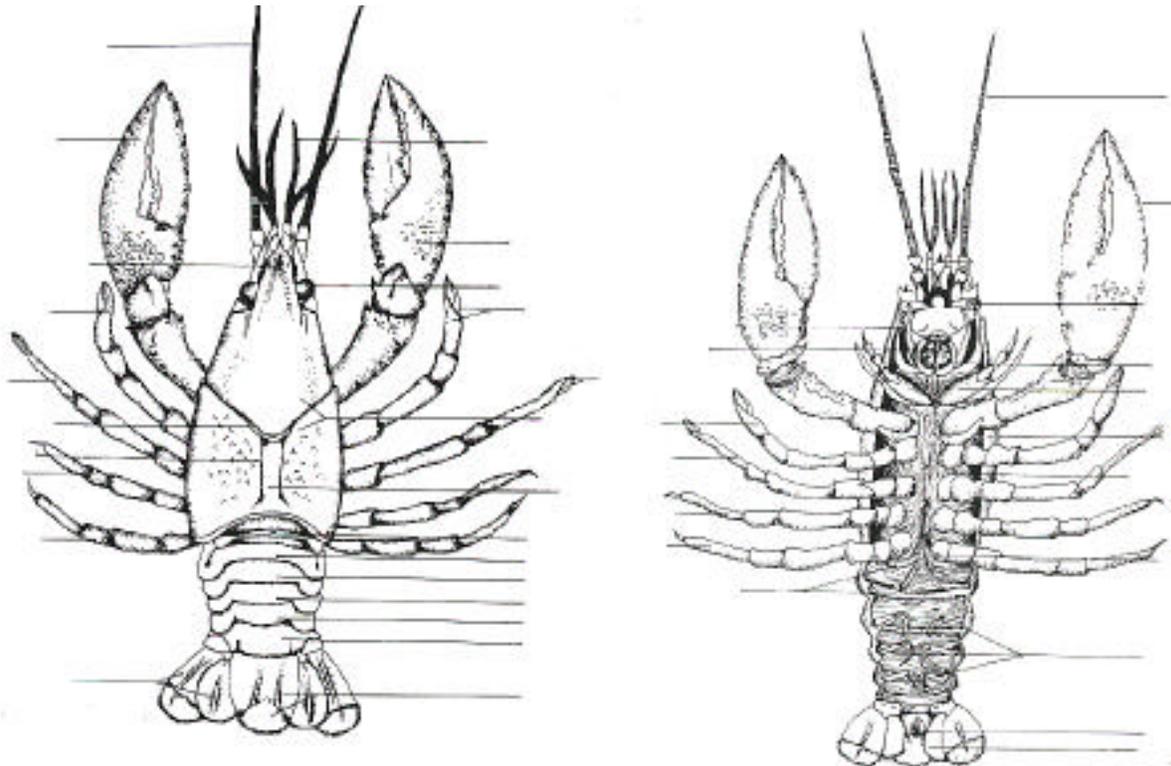
Obtain a preserved specimen and a dissecting pan. The body consists of two regions, the anterior **cephalothorax** covered by a continuous exoskeleton, the **carapace** and the posterior **abdomen** composed of a number of independently movable segments. The cephalothorax consists of the fused head and thorax distinguished by the **cervical groove** of the carapace. Posterior to that groove, the sides of the carapace form the right and left **branchiostegites**, which are free along their ventral margins and cover the gill chambers to be observed later. On the dorsal side of the carapace and extending posteriorly from the cervical groove are right and left branchiocardiac grooves that mark the branchiostegites attachments to the body underlying the carapace. The **heart** lies immediately below the dorsal carapace between those grooves. That region may bear a small hole made by a needle used to inject the circulatory system with colored latex.

The anterior prolongation of the carapace is the **rostrum**. Projecting from beneath each side of the rostrum is the stalked **compound eye**. With a sharp scalpel, cut off the tip of the right eye, mount in a drop of water, and examine with the microscope. Note the many **facets**. What is their shape? Each facet is the external surface of an **ommatidium**, the visual unit of which arthropod compound eyes are composed. By pressing on the coverglass, the ommatidia can be separated and individual ones observed. What is their shape and how do they fit into the eye?

The second segment of the crustacean head bears a pair of sensory **antennules**, and the third segment bears the **antennae**. Examine the crayfish and locate the antennules, antennae, and the **mandibles**. The larger, paired mandibles are chewing mouth parts on the ventral side of the cephalothorax. Closely associated with the mandibles are two pairs of accessory feeding appendages, the **first** and **second maxillae**. They may be difficult to see without dissection, as they are obstructed by the most anterior thoracic appendages (the **first, second, and third maxillipeds**).

Next, study the abdomen in which segments are not fused and the appendages retain their generalized structure. The exoskeleton of each segment consists of a dorsal **tergum**, each side of which is fused a lateral **pleuron**. The pleura extend ventrally beyond their attachment to the **sternum**, the ventral plate of the exoskeleton. The abdomen ends with the **telson**, bearing the anus on its ventral surface. The telson is flanked by a pair of flattened appendages, the **uropods**, which are attached to the segment immediately anterior to the telson. Most other abdominal segments bear less specialized appendages, the **swimmerets**. Examine one attached to a segment at about the abdomen's midlength. This appendage consists of a basal portion, the **protopodite** to which is attached a lateral **exopodite** and a median **endopodite**, the basic pattern of crustacean appendages.

FIGURE 59. Dorsal and ventral views of the crayfish.



The thoracic and abdominal limbs of Crustacea, function in locomotion, feeding, and respiration. Identify the first three pairs of thoracic appendages (**maxillipeds**), the paired **chelipeds**, and the four pairs of **walking legs**. The chelipeds and walking legs have lost the exopodite, and the chelipeds and first two pair of walking legs have their distal joints modified to form chelae for gripping and tearing food. Turn the animal so the ventral surface faces you. In the abdominal region, **genital openings** are on the base of the fifth pair of thoracic walking legs, if your specimen is male, or on the base of the third pair of walking legs, if it is female. Notice structural modifications on the first and second pairs of abdominal pleopods of a male specimen; these are important in copulation. The uropods and the telson form the tail fan used in making rapid backward swimming movements.

Remove the left branchiostegite by inserting scissors beneath its posterior edge and cutting in an arc just below the branchiocardiac groove towards the cervical groove, then along the groove to its ventral end. Be careful not to injure underlying structures. Removing the branchiostegite exposes the **gills**, some of which are attached to the bases of appendages and are removed with them; others are attached to the inner wall of the **gill chamber**.

Internal Anatomy

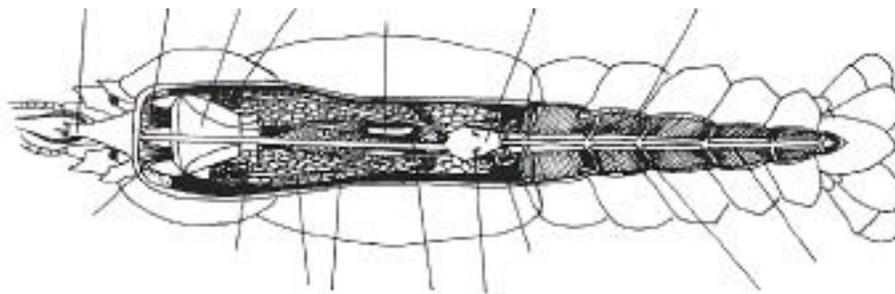
Insert scissors under the posterior edge of the carapace, about midway between its dorsal and ventral margins, and carefully cut horizontally through the exoskeleton from that point towards the rostrum. Repeat on the opposite side of the body. Connect those incisions by cutting across the rostrum and through the thin membrane connecting the cephalothorax and abdomen. Then carefully remove the loosened carapace, using the scalpel to separate it from underlying tissues.

Continue the incision posteriorly on each side just above the abdominal pleura with the cuts meeting at the back of the telson. Carefully remove the loosened dorsal abdominal exoskeleton. Beneath it is a pair of longitudinal muscles, the **abdominal extensors**, which may remain attached so that the intestine is exposed when the piece is removed. The intestine is flanked by **abdominal flexor** muscles. Which of the two sets of muscles is more massive and more powerful? What is their function?

With fine forceps remove any membranous tissue covering internal structures of the cephalothorax. Be careful not to damage the heart and blood vessels. The heart is surrounded by a **pericardial sinus**. Because of its position, delicacy, and interference with observing other structures, study the circulatory system first. The injection mass should have filled not only the pericardial sinus, but also the efferent branchial vessels which leave the sinus and diverge as they extend ventrally and terminate along the edges of the gills. Remove the remaining gills on the left side of the body and carefully pick the injection mass away from the sinus to expose the heart. It has one dorsal and two lateral pairs of openings, the **ostia**. In life, the heart is bathed by blood that fills the sinus, thereby closing the ostia and forcing blood from the heart into the arteries. Three dorsal arteries leave the heart at its anterior end: the small median ophthalmic artery (anterior aorta) and the lateral pair of antennary (lateral cephalic) arteries. Below them, right and left hepatic arteries leave the heart and pass directly to a pair of large digestive glands that occupy most of the body cavity and hide many structures. Other anterior arteries supply blood to the dorsal region of the cephalothorax.

Two arteries leave the heart's posterior region: 1) the dorsal abdominal artery (posterior aorta), which can be seen extending the length of the intestine on its dorsal side, and 2) the sternal artery, which passes ventrally and branches into the ventral thoracic artery extending anteriorly and ventral abdominal artery with a similar relationship to the abdomen. The sternal artery and its branches cannot be seen well at this time without destroying structures yet to be studied. Blood reaches all parts of the body from the heart through the arteries and collects in the ventral sinus which extends through the cephalothorax and abdomen. From the sinus it passes through afferent branchial vessels to the gills and then to the pericardial sinus as already observed. The injection mass does not reach the ventral sinus and afferent brachial vessels, which as a result, are difficult to see. In crustaceans, as well as other arthropods, the circulatory system is of the open type in which blood is not confined to tubular vessels but enters expanded sinuses comprising the hemocoel which largely replaces the coelom.

FIGURE 60. Internal anatomy of the crayfish



The anterior end of the cephalothorax is occupied largely by the stomach. Its dorsal surface bears a transverse thickening from which muscles extend anteriorly into the rostrum and posteriorly to attach on the removed carapace. Flanking the

posterior ones is a pair of powerful muscles that extend ventrally to insert on the mandibles. To reveal the extent of the stomach, remove the muscles attached to it and separate the lobes of the **digestive glands** anterior to the heart. Observe the larger, **gastric stomach** and the smaller, posterior **pyloric stomach** joined by the intestine. The gastric stomach is connected ventrally with the mouth by a short esophagus and contains the gastric mill which grinds ingested food. Slit open the gastric stomach, remove the contained food and observe the hard teeth of the mill. The pair of large digestive glands already observed join the anterior end of the intestine and evidently not only produce digestive enzymes but also absorb the products of the digestion of food that enters them from the intestine.

To study the reproductive system, it is necessary to remove the heart and distinguish the gonads from the much more conspicuous digestive gland. That is easier in the female because the ovaries are pink and the eggs can be seen. The posterior ends of the two ovaries are fused so that they form a Y-shaped structure mostly between the right and left digestive glands. At the junction of the stem and arms of the Y, the oviduct, a delicate, band-like tube leaves each side of the ovary and extends ventrally to open on the base of the third walking leg. Remove the body wall of the left gill chamber to see the oviduct and other parts better. In the male, the testes are similar in form but are smaller than the ovary and resemble the digestive glands. The vas deferens on each side is a convoluted tube extending over the surface of the digestive gland to pass ventrally and open on the base of the fifth walking leg. With care, it can be traced to its connection with the testes and the lobes of the Y separated from the digestive glands.

Begin study of the nervous system by pressing the stomach posteriorly to reveal the circumesophageal connectives between which the esophagus passes downward to the mouth. Beneath the connective on each side is a small, rounded structure, the green gland, which is excretory in function. Its opening to the outside on the basal segment of the antenna has already been observed. The gland is complex in structure, in part tubular and with a bladder-like portion that is a coelomic sac. Returning to the nervous system, trace the circumesophageal connectives anteriorly and find the at the anterior end of the body cavity. If necessary, pick away the roof of the rostrum to see the brain clearly and nerves extending from it. Again pressing the stomach posteriorly, cut the esophagus close to the connectives without injuring them and remove the digestive and reproductive systems so that further dissection will reveal the ventral nerve cord. In that process, it is necessary to remove internal skeletal plates and their attached muscles in the thorax and most of the flexor muscle mass in the abdomen. Trace the circumesophageal connectives posteriorly to their junction with the subesophageal ganglia at the anterior end of the nerve cord, which contains six thoracic ganglia and one ganglionic mass for each segment of the abdomen. Observe the delicate nerves leaving the ganglia. What evidence is there that the nerve cord is a double structure? What is the relationship of the sternal artery and its branches to the nerve cord?

Acknowledgements

This guide was written by Dr. Howard Hagerman and drawings by Dr. Jane Kaminski, D.D.S.