**Phylum Arthropoda - Crustacea**

Branchiopoda

The class Branchiopoda includes a number of small Crustaceans including *Daphnia*, brine shrimp and fairy shrimp. Even though there are only about 800 species in the class it’s difficult to make generalizations about them and some taxonomists feel that the Anostraca - the fairy shrimp and the Phyllopoda which include *Daphnia* form a polyphyletic group. Part of the problem is that the Anostraca are adapted to living in temporary aquatic environments where there are no vertebrate fish to prey upon them. Although most phyllopods are found in these environments they are also found in the permanent freshwater and only a few species are marine. The phyllopods retain and enlarge the ancestral carapace of the Crustacea while the anostraca have neither a carapace or cephalic shield. While we wait for the decision on just how these groups are related to each other we’ll combine them in the Class Branchiopoda.

Fairy shrimp (*Eubranchipus* or *Artemesia*)

You may have already heard of these little crustaceans under a different name; the sea monkeys advertised in children’s comics and magazines. Like magic they spring to life by adding water to what appears to be dust. But that dust contains their eggs, a part of their unique life cycle that allows them to survive in vernal bodies of water or other temporary aquatic environments without vertebrate predators. Their desiccated eggs can survive for as long as a few years and once wet, embryogenesis begins and the typical nauplius larva emerges from the egg. **What is a vernal pool and what time of year would you expect to find one?** Fairy shrimp aren’t restricted to freshwater environments, they are also found in salt water ponds, another problematic habitat. As the saline pools heat up the water evaporates and as salinity increases and some species of fairy shrimp can survive salt concentrations more than three times that of the oceans.

**External anatomy**

Prepared slides and live specimens immobilized under a coverslip in a wet mount can be used to explore the external anatomy of a fairy shrimp. The body resembles the primitive crustacean body plan and consists of only three tagma: the head a trunk divided into the thorax with appendages and an abdomen without.

*Fig. 1.* Anatomy of a female fairy shrimp, *Artemesia*. © BIODIDAC

**Head**

Like all crustaceans the head tagma is a fusion of the five segments and includes the stalked compound and naupliar eye that are crustacean hallmarks. The first pair of appendages are the uniramous antenules followed, by the second pair of antennae, which are sexually dimorphic and considerably larger than the first pair. In the males the antenna have two segments and on the inner surface of the second is a cuticular hook that helps the male hold onto the female during mating. The female antennae aren’t as long but are still thicker than the antennules. **What is the sex of the specimen you are looking at?** The large upper lip is the labrum and isn’t an appendage. Underneath it are the large, paired and lobe-shaped mandibles that touch each other along the midline. Underneath is the mouth. The remaining two head appendages are hard to see. The first pair of maxilla have a triangular shape and a set of setal...
hairs and the second pair of maxilla have been reduced to a set of bristles. There is one more structure you may be able to see - the maxillary glands which form small bulges on the side of the head near the dorsal surface. The maxillary glands are the excretory organs.

**Trunk**  The thorax has eleven segments and none are fused with the head. This is the reason there is no cephalothorax in these animals. They have phyllopodous legs and like the ancestral crustacean they are important for locomotion, feeding and respiration. Fairy shrimp swim on their backs, and at the base of the legs is a food groove used in combination with the movements of the legs to propel food towards the mouth. Secretion from the labrum and movement of the mandibles consolidate food in mucous and push it into the mouth.

Two segments behind the thorax are the genital segments. There is some disagreement in the literature with some authors including the two genital segments as a part of the thoracic tagma, others as the first two abdominal appendages. In females the appendages of the two segments have fused to form the egg sac (ovisac), in males the segments are separate and form a pair of eversible penes extended using hydrostatic pressure. When they mate the male clasps the female with its modified antenna, bend its abdomen underneath and inserts the penes into the ovisac and deposits sperm to fertilize the eggs inside. In both males and females the remaining six segments of the abdomen terminate in a telson, which isn’t a segment, and the paired caudal rami that are attached to it. The anal opening is located at the base of the ramii.

After you complete your observations of the internal anatomy remove one of the phyllopods from the body of a live specimen and prepare a wet mount of the appendage. Locate the three main parts of the biramous crustacean limb. The large basal segment that was attached to the body is the protopodite with endites extending from the inside surface or medial side, and exites from the outer lateral sides. The most basal lobe, with its large setae is the gnathobase and the setae are used to filter particulate food from the water before it passes forward to the mouth. The large lobed exite has a joint between it and the protopodite forms the exopodite with setae used for swimming. The apparent endite opposite it is assumed to be the endopodite.

**Internal anatomy**

Internal anatomy can be observed through the transparent cuticle of the fairy shrimp.

As we’ve already mentioned, particulate food is filtered from the water by setae on the legs and passed along the food groove to the mouth and into the digestive system. The short esophagus is part of the foregut and its connection to the sac-like stomach located just behind the mouth identifies the junction of the foregut and midgut. Two caeca extend from the stomach that connects to the intestine running the length of the trunk. Near the tip of the abdomen is the junction between the midgut and hindgut with the rectum and anal opening.

The most visible structure in the circulatory system is the contractile, tubular heart found dorsal to the intestine and running the length of the trunk. Blood enters the heart at the posterior end through segmentally arranged ostia. At the anterior end blood pours out into the haemocoel of the head and then percolates back to the rest of the body.
With the exception of the compound and naupliar eyes the nervous system is difficult to see. The excretory system is represented by maxillary glands and the external reproductive structures are easier to see than the internal gonads. In most cases the sexes are separate, but there are species of fairy shrimp where males have never been seen. Parthenogenesis is not uncommon in the type of environment where these crustaceans live. What other parthenogenetic animals might you find in these vernal ponds?

**Daphnia**

*Daphnia* is common in freshwater puddles, ponds and lakes. It filters food from the water using its thoracic appendages. Like many freshwater invertebrates the females reproduce **parthenogenetically** during favorable conditions. When conditions start to deteriorate parthenogenetic males appear in the population and mate with the females. Fertilized **winter eggs** are provisioned with more nutrients than **summer eggs** and are shed in the protective covering of the female’s old cuticle. After overwintering, and with the return to favorable conditions, the fertilized eggs hatch into parthenogenetic females and the cycle repeats itself. There are no free-swimming larval stages in these freshwater animals and development is direct.

Live and prepared slides are available for you to look at and you will be able to identify most of the internal and external features using either. To immobilize a live specimen prepare a wet mount with an extra thick Vaseline rim, or place the specimen in a depression slide with the glass coverslip on top.

**External anatomy**

*Daphnia* doesn’t have the segmented look that other Crustacea have because the body is covered with a folded carapace that covers the legs. There is also no clear division between the head and the rest of the body, the trunk, or abdomen. The carapace has two roles, one is protection for the animal inside, the second is as part of the feeding mechanism forming the sides of a water filled box through which water flows.

**Head**

The head is bent forward and down, the result is that the mouth is directed ventrally and a rostrum extends out and above it with the compound eye located above the rostrum. *Daphnia* swim using their antennae and this results in the characteristic jumpy motion that gives them their common name of water fleas. The long biramous antennae are covered in setal hairs and are on the second segment of the head. The smaller antennules are located on the posterior surface of the rostrum. Although it looks like there is only one compound eye, its...
actually formed from the fusion of two and is composed of a couple of dozen facets. In the live specimen you’ll notice that the eye rotates as it and moves. An optic nerve runs from the eye to the **supraesophagial ganglion**. You may be able to see a smaller nerve that runs back to a small dark pigmented area near the base of the antennae. This pigment spot is a **simple eye**, and all that remains of the **naupliar eye**.

Locate the opening to the mouth underneath the rostrum. The **mandibles** are large and grind at food as it enters the mouth. The **first maxilla** are small and difficult to see, the **second maxilla** have disappeared.

**Abdomen (trunk)** Five thoracic appendages are visible underneath the carapace. In the prepared slides the first thoracic appendage is the smallest and hardest to find. Adjust the focal plane to find the base of thoracic legs two through five. Carefully move the focal plane through the specimen and you’ll see the delicate setal hairs that are used to trap food.

Watch the abdominal appendages as they move in the live preparation and you’ll see that they aren’t moving synchronously. Instead, they are out of step with each other which is related to how *Daphnia* feeds. The limbs are **phyllodinous** and their edges covered with setal hairs. The movement of the legs creates a series of expanding and contracting water filled boxes. As this occurs the setal hairs trap food that is passed to the base of the leg and then forward to the mouth. To see *Daphnia* feed place a small blob of Vaseline in the center of a watch glass. Use a pair of forceps to capture a *Daphnia* from the specimen container and place it on a kimwipe to gently dry it off. Lift the animal from the towelling using fine forceps and immobilize it by placing the dorsal surface in the Vaseline. Don’t let any of the legs touch the Vaseline since this will interfere with their movement. Once the animal has been secured cover it with fresh water taken from the culture. Do not use tap water. Add a very small drop of congo red stained yeast suspension into the surrounding water and observe currents created by the feeding appendages. If you watch the animal for a while you’ll see the red stained yeast pass into the alimentary tract and ultimately eliminated through the anus.

The remaining trunk segments have fused to form a **postabdomen** bent forward underneath the body. There are two large spines, or **claws**. As you watch *Daphnia* you’ll notice that the postabdomen occasionally flexes, and when it does it removes any accumulating debris from inside the carapace.

**Internal anatomy**

We’ve already seen the compound and maybe simple eye on the head. Nerves from them connect to the supraesophagial ganglia. A ventral nerve cord with seven ganglia runs the length of the body on the ventral surface. The digestive system starts with the **mouth** and extending forward before bending back on itself and running the length of the body to the **anus** near the base of the postabdomen. There is very little to distinguish differences along the length of the gut except for a pair of **digestive ceca** at the anterior end of the digestive tract. The mid-dorsally positioned **heart** is easy to see in the live specimens as it beats. Locate the single pair of **ostia**. As in all arthropods the circulatory system is open and blood flows through the **haemocoel**. Below the heart and embedded in the wall of the carapace are **shell glands** presumed to be involved in excretion. **Where is the respiratory system in Daphnia?** The female reproductive system consists of paired **ovaries** surrounding the middle portion of the digestive tract, the **midgut**. This is the only part of the gut that isn’t lined with cuticle and it’s where absorption of nutrients occurs. Dorsal to the gut is the **brood pouch** connected to the ovaries by **oviducts**. Males are usually smaller and the genital opening is near the anus in the postabdomen. The **testes** are next to the midgut and a **sperm duct** connects the gonad with the genital opening.

**Maxillopoda**

Maxillopoda are the major primary planktonic herbivores in marine environments. These are small species and again have a variety of different forms. The abdomen is usually reduced and legs are missing on some of the segments. They include a variety of interesting subclasses that illustrate the modification of the crustacean body plan.
**Cyclops - Copepod**

Copepods are found in all aquatic environments and are an important link between the single celled autotrophs and larger animals that feed on them. *Cyclops* is a freshwater species and they’re commonly found creeping along vegetation and the bottoms of ponds and lakes. *Cyclops* is unusual being a predator feeding on protozoans and other small crustacea.

**External anatomy**

Copepods don’t have a carapace and their body is divided into three tagmata. The most anterior segment is the cephalothorax formed from the fusion of the first two thoracic segments with the head. The next four segments, thoracic segments three through six, all have limbs. The seventh segment has no obvious limbs and forms the jointed waist that connects the thorax to the abdomen. In females, the first two are fused giving the impression that the thorax is formed from three segments. The abdomen has four segments, although like the thorax the first two are fused in the female. At the end of the abdomen two long rami form the furca. Because their cuticle is transparent you use either live specimens in a wet mount or prepared slides to see the internal and external anatomy.

The largest appendages on the head are the two pairs of antennae. The antennule is the longer of the two and used for swimming. In males it’s modified with a bend that forms a hook to hold onto the female while mating. The antennae are smaller and have only four segments compared to the seventeen of the antennule. Between the antennae, and near the tip of the rostrum, is the single medial eye that gives the genus its name from the one-eyed monster of greek myth. The eye is the larval naupliar eye that has been retained in the adult. The mandibles are small and the two pairs of maxilla behind them are covered in setal hairs used in feeding. The inner surfaces of the mandible and first maxilla have grinding gnathobases. The thoracic appendages that have fused with the head are maxillipeds.

The four thoracic appendages are all biramous with three segmented endopodites and exopodites covered in setal hairs. The thoracic legs are important in locomotion and for creating water currents that bring food to the filtering appendages on the head. The sixth pair of thoracic legs are small, uniramous and have only two segments. The seventh pair of legs has been reduced to cuticular flaps. When present, eggs are found inside the ovisac attached to the last thoracic segment. The abdomen has no appendages and the long furca forms the most posterior part of the body. Two muscle bands should also be visible running from the front of the cephalothorax to the end of the thorax.
**Internal anatomy**

The **mouth** is surrounded by the **labrum** above and the mouthparts to the sides. The **stomach** is located in the cephalothorax and behind it the **intestine** which has large cells often filled with granular material. The midgut narrows and the **rectum** opens through the **anus** on the dorsal, posterior surface. In live specimens you may be able to see the pumping action of the anus as water is moved in and out. The circulatory system is open and lacks a heart, body movements, especially those of the intestine, propel the blood through the body. The excretory system consists of a pair of **shell glands** at the front of the cephalothorax. The coiled tubule opens at the base of the maxilla. In females the reproductive system consists of a single **ovary** on the dorsal midline above the gut. The **oviducts** are paired, have numerous **ceca**, and may be filled with eggs. The oviducts open to the ovisacs on the seventh thoracic segment. A **semenal receptacle** is also located in the seventh segment. In males the single medial **testis** is located above the intestine and is connected by the **sperm duct** to the genital opening on the last thoracic segment. Sperm is passed to the female in a **spermatophore** glued next to the opening of the female’s seminal receptacle. Depending on the stage of the reproductive cycle some parts of the reproductive system may be reduced and not visible.

**Lepas - Barnacle**

Adult barnacles were once thought to be related to bivalve clams because of their sessile existence and body incased in what appeared to be a modified bivalve shell. These are sessile crustacea and they’re commonly found attached to just about anything that floats in the ocean. They’re **monoeious**, as you might expect with a sessile organism, and they filter feed by extending their thoracic limbs from the shell.

![Barnacle diagram](image)

**External anatomy**

The barnacle is anchored to the substrate by the fleshy **peduncle** that was originally the anterior end of the animal. Barnacles are essentially standing on the tip of their heads! The rest of the body, the **capitulum**, is contained inside the **carapace** formed from five calcareous plates, two of which are paired; the **scuta** and **terga**. The single dorsal **carina** is unpaired. The carapace surrounds a **mantle cavity**, a term that reflects the once thought of mollusc link. The mantle cavity opens along the ventral surface. The **mantle** is a fold of the external body wall and inside, it is lined with a thin chitinous cuticle. To see the rest of the external anatomy you’ll have to remove the right half of the carapace and cut through the **scutal adductor muscle** that connects the two sides of the carapace.
The first segment of the head has formed the peduncle and you may still be able to see what remains of the antennules as disc-shaped structures. There are no appendages on the second segment where the antennae would normally be located. The remaining three head appendages are all visible. A fleshy labrum, which is not an appendage, is in front of the mouth. On either side are the mandibles, with two teeth on the inner surface and a palp on the outer surface. Behind the mandibles are two pairs of maxilla covered in setal hairs.

The thorax is composed of six segments, each with a pair of biramous cirri. Other than being longer towards the posterior, each of the cirri are the same, with a protopodite that anchors it to the body, a multijointed endopodite ramus and a slightly longer outer exopodite ramus. The rami are curved and when the barnacle feeds it extends them from the shell and traps food on the bristles that cover the surface of the rami. Between the last pair of cirri is the long penis used to place sperm in the mantle cavity of a neighboring barnacle. Just behind the penis is the anus with a pair of caudal rami on either side of it, all that remains of the abdomen.

Malacostraca

Class Malacostraca is the largest, and certainly the tastiest, class of Crustacea, and includes three quarters of the known species in the subphylum. The head is composed of 5 segments, a thorax with 8 segments and the abdomen is six segmented with a terminal telson to make up the 14 post cephalic segments. Compound eyes are also present. This is an extremely large group and we will only look at a couple examples from the Decapoda. The decapods, ten legged crustacean, include the shrimp, lobster and crabs. The first three thoracic legs have been modified to assist in feeding and are referred to as maxillipeds; the remaining five are involved in locomotion.

Homarus or Cambarus

External Anatomy

Examine your specimen and identify the key arthropod characteristics, such as the hardened outer cuticle, jointed appendages and compound eyes. The body is arranged in a linear series of metameres which have undergone tagmosis into distinct body regions. The two principle regions, or tagma, in the decapods are the cephalothorax and abdomen (pleon). The cephalothorax is covered dorsally by the carapace and the division between the head and thorax (pereon) is represented by the cervical groove in the carapace. Three of the eight thoracopods have fused with the head and are now referred to as maxillipeds. This leaves five pairs of appendages on the thorax. Posterior to the cervical groove and running parallel to the body axis are two branchial grooves, which identify the underlying branchial or gill chambers. The structural organisation of the abdomen is simple, with overlapping curved dorsal tergites and ventral sternites connected by articulating membranes.

Fig. 6. External anatomy of a crayfish or lobster.© BIODIDAC
In the ancestral Crustacea, all appendages on each segment would have been similar in appearance and when you look at the ventral surface of your specimen you can see the serially homologous appendages. All the appendages are built on a biramous plan consisting of a protopodite, exopodite and endopodite, but each of these parts of the basic limb has been modified in a variety of different ways. Pieces may be lost, enlarged, added or fused as appendages become specialised for the different roles of food gathering, locomotion or respiration. Each function requires different modifications and as a consequence the appearance of the appendages changes, although serial homology is maintained. How are the basic elements of the biramous appendage modified? Try and keep track of what is what using diagrams.

Examine the specimen and identify appendages starting from the anterior most antennules, antennae, followed by mandibles and the two maxillae. These five cephalic appendages are found in all Crustacea and are one of the defining characteristics of the subphylum. Three maxillipeds follow and mark the division between the head and thorax (pereon). The first of five walking legs or pereopods is modified as a prehensile organ and referred to as a cheliped and it is followed by the four pairs of walking legs. Originally the walking legs were biramous but only the endopodite remains. The tip of the legs are chelate and you should be careful that you don’t confuse this chelate condition with being biramous. The difference here is that the second to last segment extends a lateral process forward. It gives a branched appearance but in fact the segments that make up the leg are still in a linear sequence. Behind the walking legs are six pairs of abdominal appendages, five swimmerets (pleopods) and the last set of modified legs the uropod, which when combined with the telson, forms the rudder like posterior end of the animal. The first two swimmerets are sexually dimorphic and are modified as copulatory organs in the male. Most of the mouth parts will not be apparent until later in the exercise when you actually remove them.

Before dissecting the animal cut away the carapace to expose the gills contained in the branchial chamber. Are all the gill elements attached only to the legs? Carefully remove the appendages from the side of the body where the gills have been exposed. Using your forceps, carefully grab the base of the leg, near the articulating membrane where it is attached to the body and remove...
it. As you remove each appendage, identify its three principle components and how they relate to the general biramous plan. When comparing endopodites and exopodites the endopodite is usually larger and may be divided into a maximum of five segments.

The antennule protopodite is composed of a single coxopodite and a basopodite divided into two segments. The dorsal surface of the coxopodite contains the statocyst which can be seen externally as a small depression. Remove the exoskeleton from the side and examine the statocyst under the microscope. Carefully remove the antennae insuring that the coxopodite remains attached. The opening from the the antennal gland, a part of the excretory system, is located on the coxopodite.

Orient your specimen under the dissecting microscope to provide a clear view of the mouth parts and carefully remove the oral appendages beginning from the third maxilliped and working forward. As you remove the maxillipeds, be sure to record which is first, second and third. The maxillipeds not only function in the manipulation of food, but are also involved in respiratory processes and gills are attached to maxillipeds two and three. Maxilliped three best demonstrates the structure of the crustacean limb with obvious exopodites, endopodites and the epipodite which is in part modified into a gill. Unlike the first maxillae the second maxillae has an exopodite fused with the coxal epipodite to form the gill bailer. The grinding and tearing surfaces of the mandible are the modified coxopodite and the finger like projection is the basipodite and endopodite.

The walking legs, pereopods, are the largest appendages and the cheliped the most prominent. All lack exopodites and gills are located on each. The second and third legs are also chelate with pincer-like structures. The pereopods are the last of the thoracic appendages. The remaining appendages are abdominal and all but the terminal uropod are referred to as pleopods and each closely resembles the biramous plan. The first two in males are modified.

What sex is your specimen?

Internal anatomy

Open the lobster or crayfish by making a lateral cut on each side of the carapace, through the branchial chamber and forward to the rostrum. Do not cut too deep otherwise you will destroy the musculature and underlying organs. Extend the cut along the lateral edges of the abdomen towards the telson.

Circulatory system

These animals have an open circulatory system, which means there are no capillaries connecting the blood vessels leading to and away from the heart. An open circulatory system does not preclude veins and arteries; both lobsters and crayfish have a complex set of blood vessels that supply the different organs and collect the blood to be passed over the gills and returned to the heart.

Locate the heart and principle blood vessels which extend from it. The heart lies in a pericardial cavity in which blood from the gills collects before it passes into the heart through ostia. In latex injected specimens the latex is often forced in and some of these features may be damaged. In particular the delicate pericardial sinus may burst and the latex may spill into the haemocoel. If
this has happened the heart can still be found embedded in the latex. To find it you will have to carefully remove the surplus latex. **How do the ostia work and how are they related to the pumping of blood?**

You will be able to see most of the major circulatory vessels, which includes the anterior and posterior aortas. The anterior aorta branches to form the optic artery. The anterior lateral artery divides to form the antennal artery and hepatic artery. The posterior aorta branches into abdominal segmental arteries. The sternal artery leaves the heart to supply the ventral surface of the animal. These arteries are used to direct the blood to different parts of the body where it is released into the haemocoel. Blood from the haemocoel is drawn into the gills and after passing through them it leaves to enter the pericardial sinus.

**Reproductive system** The reproductive organs are found in close association with the digestive gland, and testes or ovaries are located in front and slightly below the heart. The male genital opening is found on the base of the fifth per cepod and the female’s on the third. The pleopods in the male are modified for spermatophore transfer.

Eggs hatch and pass through a variety of larval stages. The nauplius larva with its naupliar eye is a characteristic of all crustacea. The zoea stage is also available to give you an idea of the larval transformation that occurs.

**Digestive system** An esophagus leads from the mouth to the stomach which is located just behind the rostrum. The digestive gland or hepatopancreas are paired gut diverticula connected to the midgut region. To expose the underlying digestive tract carefully remove the digestive gland. Identify the large stomach, or gastric mill, that is divided into a cardiac and pyloric region. In the anterior area the large muscles that are associated with the stomach are visible. Remove the stomach by cutting the intestine and oesophagus. Submerge it under water in a dissecting dish and make a cut through the middle. Spread the two sides apart and identify the lateral and medial chitinous teeth as well as other chitinous setae that act as strainers. All are composed of chitin since this region is part of the foregut and lined with cuticle.

**Excretory system** The green glands are excretory organs located in the ventral region of the head near the mouth. One difference between lobsters and crayfish is the structure of the convoluted tube. Remove the glands and try and identify the components. **What is the difference?**

**Nervous system** Remove the stomach and other viscera and locate the sub- and supraesophageal ganglia and circumesophageal connectives. Identify the segmentally arranged nerve cord. **Are the ganglionic masses all of a uniform size? Why might they differ?** Examine a compound eye under the dissecting microscope.
**Callinectes**

Unlike the awkward walk the lobster has as it moves across the ocean bottom performing a balancing act between the weight of the abdomen behind with the cheliped in front, the crab has modified its body in a different way that allows a different way of movement. The abdomen is reduced and tucked under the body and they move sideways instead of directly ahead. It's an unusual solution to preventing the walking legs from getting entangled in each other, but it works! The large tail of the lobster was essentially a muscular structure designed for escape from predation. **How do crabs protect themselves from being prey?**

**External anatomy**

The body of these animals is divided into two tagma in much the same way as the lobster that you just looked at. Most of the body is cephalothorax with a six segmented abdomen that is tucked up underneath it. Turn your specimen over to see the abdomen. Males of the species have a longer and narrower abdomen than the much broader and rounded female's abdomen. What appears to be the seventh segment is the telson and unlike the lobster, crabs do not have uropods. If you pull the abdomen back from the ventral surface of the cephalothorax you will be able to see the pleopod appendages that are attached to it. There not as many as in the lobster but in the female they are still used to carry eggs. Just as with the lobster, the pleopods are sexually dimorphic in their appearance and in the males only the first two pleopods are present and used in mating. For the female the first is lost and the ones on the second through fifth segment of the abdomen are present. **What sex is your specimen?**

---

**Fig. 10.** External anatomy of the ventral surface of the crab. © BIODIDAC
At the most anterior end you'll notice that the first two pairs of antennae, a crustacean character, are much smaller than those of the lobster. The antennules can be hard to find, try using your dissecting microscope and look for them in the small groove under the carapace near the midline. The antennae are easier to see and outside of these are the stalked compound eyes. Just as you did with the lobster remove the different mouth parts starting with the 3rd maxilliped and work forward. Compare the ones from the crab with those of the lobster.

Internal anatomy

The easiest way to see inside the crab is to remove the dorsal part of the carapace covering the cephalothorax. Using scissors, and starting at a posterior edge cut forward along the outer edge. Continue up both sides and then across the anterior and posterior regions. Gently lift the carapace. As you do this there will be a few muscles that remain attached to the inner surface and you will have to cut them with your scalpel. As you lift the carapace, you may be able to see attached to it or to the underlying organs, the thin hypodermis which covers the organs. You'll need to gently cut and pull this back to be able to see the underlying structures.

Circulatory and Respiratory system

One of the most obvious structures you see, once you pull back the hypodermis is the heart with the three pairs of large ostia. By removing the hypodermis you have also opened up the pericardial cavity in which blood pools before entering into the heart. You should be able to see the heart and the ostia, as well as blood and some of the seven blood vessels attached to the heart, although they are hard to see because they are not muscular. Five major arteries lead anteriorly to supply the gonads, digestive gland and other structures in the anterior part of the body. Two leave the heart from the posterior side. A single large artery leaves from the underside of the heart and supplies the ventral surface.

To the left and the right of the heart you can see the gills that are attached to the underlying legs and body wall. Lying on top or underneath the gills is the enlarged epipodite of the first maxilliped. Just as was the case in the lobster the movement of this structure helps to circulate water through the branchial chamber to keep the gills well aerated.
Digestive system  In front of the heart is the stomach with the anterior cardiac region and behind it the pyloric region. Surrounding the stomach on the two sides are the digestive glands. Just like the crayfish, the cardiac stomach contains three large teeth that are used to grind up consumed food. The cardiac stomach sorts the food and sends the digestible food to the digestive gland, while the remainder passes out and into the intestine. Gently lift any of the remaining hypodermis in this area to expose the musculature of the stomach.

Reproductive System  In the female, two branches of the ovary extend towards the anterior and then branch in front of the digestive gland and run for the whole length of the gland. Two other branches of the ovary lead posteriorly. In the central region you may be able to see the sac-like seminal receptacles that connect to the ovary and the oviduct which opens to the outside of the animal on the sixth abdominal sternite. Just as was the case with the female, the testes of the male are found in close association with the digestive gland. They are connected by sperm ducts to the accessory glands, which in turn open to the outside on the coxa of the last pair of walking legs.

Nervous system  The nervous system is compressed considerably and there are two ganglionic masses. One above and the other below the esophagus. The most anterior is the brain, or supraesophageal ganglion; it may be harder to see than the large subesophageal ganglion.