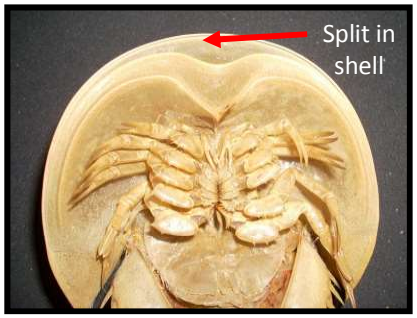
Horseshoe Crab Molt Anatomy Lab – basic structures

1. MEET YOUR MOLT: *To grow bigger, HSCs must shed their old shell and grow a new one underneath. They do this 16-18 times from the time they hatch out of the egg until adulthood.*
So how can we tell a molted (shed shell) from a dead HSCs?
HSC molts show a split along the front rim of the shell. This is where the old shell separated as the new shell beneath expanded. Find that split on your molt specimen.



2. AGE YOUR MOLT: *The size of a molt can be used to estimate the age of the HSC at the time it molted. This is done by turning the molt over on its back and using a ruler to measure the distance (in cm) across the widest part of the shell.*

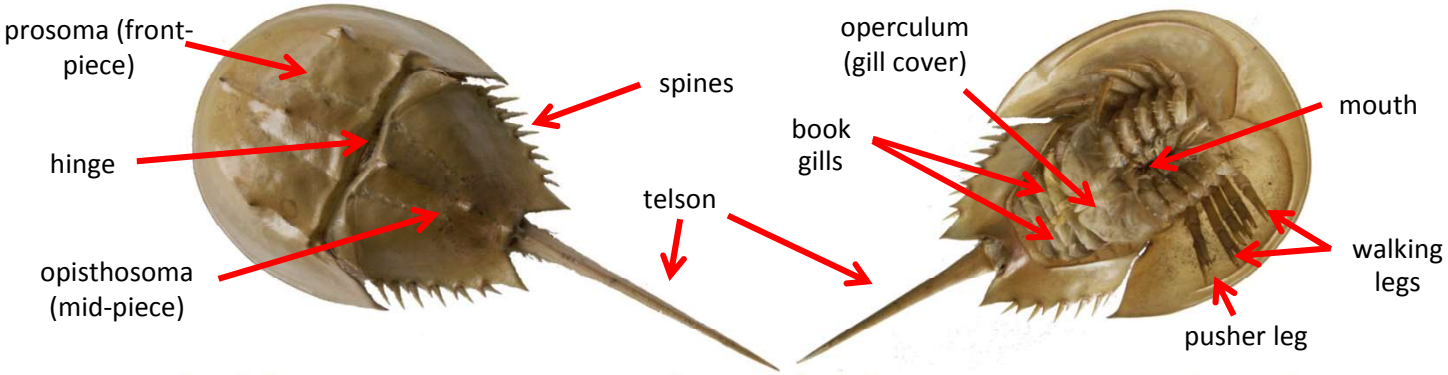
Molt number	Year since hatching	Average Prosomal Width (cm)
6	1	1.7
7	1.5	2.2
8	2	3.0
9	2.5	4.1
10	3	4.9
11	4	6.3
12	5	7.7
13	6	9.1
14	7	10.3
15	8	11.5
16	9	13.4
17	10	16.0

*This measurement is called Prosomal Width (PW). The chart at left shows average PW of HSC molts from a population on Cape Cod.**
Using the chart at right and the ruler provided, determine the PW, molt number and estimated age of one of your molts. Record this data on your answer sheet..

- Size with age of HSCs varies with geographic location.

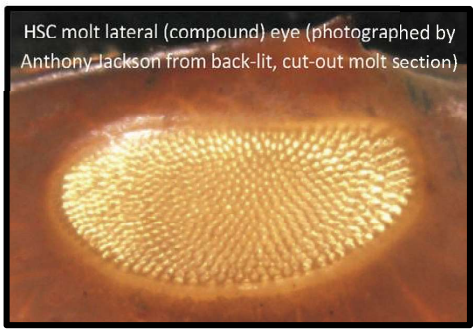
Data in chart from: RH Carmichael, D Rutecki and J Valiela. 2003. Marine Ecology Progress Series 246: 225-239.

3. HSC ANATOMY BASICS: *The drawings below show the basic external HSC body plan.*



Find each of these structures on your molt and label them on your answer sheet drawings.

4. EYES: *Find the **lateral (compound) eyes** on your molt. Label them on your answer sheet drawing. These are like the eyes of a fly – each having hundreds of lenses that work together to help the HSC see. Use the penlight to shine light up through the eye while viewing with the hand lens.*
What do you observe about the design of the lateral eye?


HSC molt lateral (compound) eye (photographed by Anthony Jackson from back-lit, cut-out molt section)

*Now locate and label the small pair of **median eyes** located next to the front-most spine on the top of your molt. Use the penlight to shine light up through these eyes. These eyes detect ultraviolet light reflected from the moon & stars. How could this help the HSC?*

Horseshoe Crab Molt Anatomy Lab – finer details

5. MOUTH: *One of the HSCs most unique features is its between-the-legs located mouth. Observe the many bristles on the leg bases that surround your molt's mouth. These are the* ***gnathobases****. Considering their location and structure, what purpose do you think they serve?*

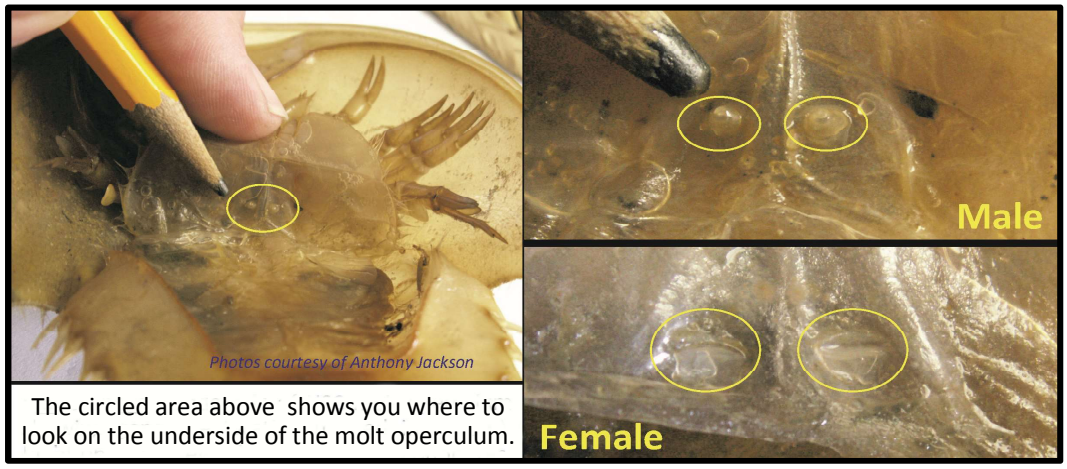
Now find the small, leg-like ***chelicerae****. just above the mouth,and the two paddle-like* ***chilaria*** *at the lower end of the mouth. Both structures serve to direct food to the mouth. Label these parts on your answer sheet drawing.*

6. PUSHER LEGS: *Observe the hind legs of your molt. This is called the* ***pusher leg****. What do you see that's different about these legs (compared to the other legs)? Follow the pusher leg down to where it meets the mouth, and look for a strong spine there (in area at right arrow). These spines are used to open up clams for eating. How do you think the HSC does that?*

Find the part on your molt that's labeled ***F*** *in the photo at left. This is the* ***flabellum****. It holds hundreds of thousands of sensory receptors. Considering its location, what do you think the function of these sensors might be?*

7. SEXING YOUR MOLT: *The underside of the HSC operculum (gill cover) holds the pores through which eggs (in adult females) and sperm (in males) come out in spawning. Observing the shape and feel of these pores can tell us the sex of a molt. This is the only way of telling the boys from the girls in young HSCs.*

Find the ***operculum*** *(plate that covers gills) on your molt. Gently lift it up & run your fingers along its underside (in the area at the pencil tip in the photo at right) Can you tell which kind of HSC you have?*



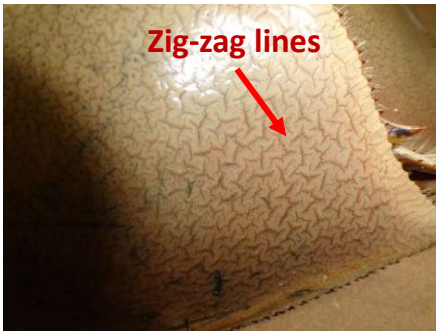
Photos courtesy of Anthony Jackson

The circled area above shows you where to look on the underside of the molt operculum.

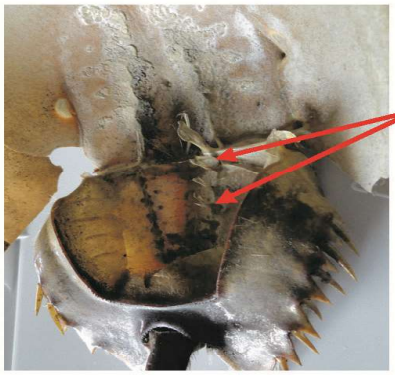
In male HSCs, the pores will stick out like little bumps and feel hard to the touch. When you run your hand along a female's operculum, it will feel soft and smooth.

Horseshoe Crab Molt Anatomy Lab – Bonus challenge

MORE on MOLTING: *Replacing a shell isn't easy. Using its old shell as a mold, the HSC grows a larger one underneath. This new shell is soft and wrinkled. As it takes in water and expands, the new shell pushes against the old, causing it to split around the front. The crab crawls out leaving its old shell behind. The photo at right shows a series of fine zig-zag lines that can be found on the side of an HSC shell. Use the hand lens to look for these lines on the front side of your molt. What do you think caused them?*



MOLTING THEIR GUTS OUT: *When HSCs molt, along with forming new external shell parts, they also re-form certain chitinous parts of their digestive system, including the lining of the esophagus, crop-gizzard and rectum. Observe the molt specimen in your kit that has the top shell separated from the bottom so you can see what its under-side looks like (as in photo at right). Use that photo to help you find the structure pointed to on your molt. Thinking about where this structure is located (including what sits above it), what do you think it might be used for?*



Now look at the bottom part of the underside of the top of your dissected molt (as shown in photo at left). Notice the deeply vaulted space inside the bottom of the shell. If you look carefully inside that space, you'll see two lines (one on each side, running from the hinge down) each with 6 thin protruding structures (see arrows at left). Using the underside of one of your whole molts as reference, figure out what key HSC body parts lie above these ridges, and describe how they could help those body parts work.

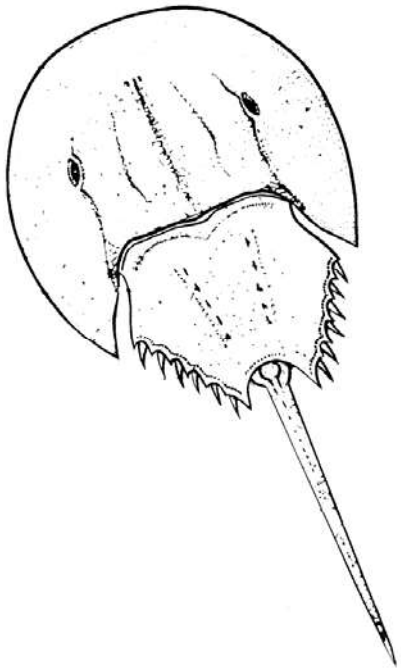
Use this sheet to answer the questions on the big Horseshoe Crab Molt Anatomy Lab instruction sheets.

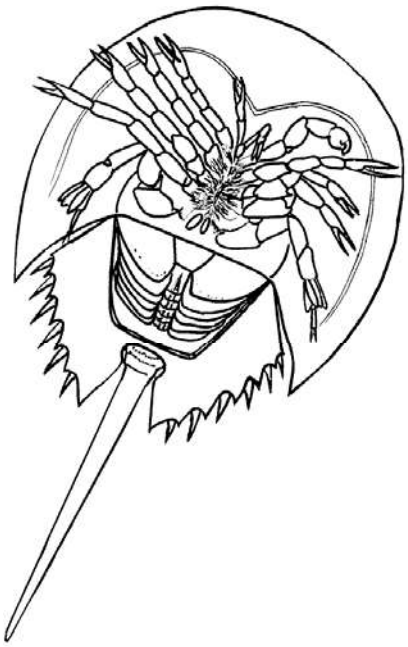
1. **MEET YOUR MOLT:** If you found an HSC shell on the beach, how would you know if it's a molt?

2. **AGE YOUR MOLT:** Write down the data in the spaces below pertaining to the aging of your molt.

_____ prosomal width (cm) _____ molt number _____ age (years)

3. **HSC ANATOMY BASICS:** Label all of the HSC body parts that you can in the drawings below.





4. **EYES:** Label the eyes in the drawing above. What did you observe about the HSC's lateral eyes?

How do you think the ability of the median eyes to detect ultraviolet light could help the HSC?

5. **MOUTH:** Label the HSC mouth structure in the drawing at right corresponding to what you observed in your molt. Considering the location of the **gnathobases** in relation to the mouth, what purpose do you think they serve?

6. **PUSHER LEGS:** How does the pusher leg appear different than the other (walking) legs of the HSC?

How do you think the HSC uses the strong spine on the base of its pusher leg for eating clams?

Given their location, what do you think the function might be of the sensors on the HSC's flabellum?

7. **SEXING YOUR MOLT:** Use what you learned to identify the sex of the molt specimens in your kit.

sex of specimen A: _____ Why you think so: _____

sex of specimen B: _____ Why you think so: _____

sex of mystery molt specimen: _____

Bonus #1 **MORE on MOLTING:** What do you think caused those zig-zag lines on the molt shell?

Bonus #2 **MOLTING THEIR GUTS OUT:** To what HSC part does the pointed-to structure connect with? Given its placement, what would you think its purpose is?

What key HSC body parts would be located above the 6 ridges that are pointed to in the photo at the very bottom of the bonus sheet? How do you think these ridges help those body parts work?

Bonus #3 **SIMPLY IMPOSSIBLE:** Look carefully at the two drawings on the front side of this sheet. There is something wrong about one part of those drawings. Tell what that is and why you'd never find an HSC like that in the wild.