Hawaii's Rocky Shore

Concepts
Students will be introduced to animals that live on the rocky shore. They will be able to make live observations about these animals and learn how to study organisms in detail, as scientists do.

HCPS III Benchmarks
SC.1.1.1
SC.1.4.1
SC.1.5.2

Duration
45 minutes

Source Material
PRISM

Vocabulary
Adapted
Anatomy
Data
Foraging
Observation

Rocky Shore Critters in the Classroom

Summary

Students will be broken into groups and will rotate around the room to each of 6 stations. At each station there will be a different live animal from the rocky shore. Digital microscopes will be present at some of the stations for a more detailed view. Students will make drawings of each organism and write one sentence describing their observations of each animal at each station. The class will end with a group discussion and share what they learned and observed about these animals.

Objectives

- Students will learn which animals live on the rocky shore.
- Students will form questions and make observations about these animals and record their **data**.
- Students will compare and contrast the parts of each organism.
- Students will discuss how the anatomy of each animal is adapted for living on the rocky shore.

Materials (for each station):

Enough salt water to submerge animals in each bin
A 5-gallon bucket for transport of animals
An air pump for transporting animals to the classroom
One bin or petri dish (depending on how large animal is) to keep animal in.
Rocks for animals that attach themselves to or hide under
Digital microscopes (or hand-lenses)
One laptop computer per digital microscope
One worksheet per student
Large photographs or drawings of each focal animal or plant (see "Critter Anatomy Posters" folder)
The animals: (ʻopihi/limpet, aʻama/rock crab, hermit crab, helmet urchin, ʻina/rock-boring urchin, pipipi/black nerite snail
A plant sample: (collect at least one type of limu)

Making Connections

Students have probably seen the rocky shore and explored tidepools and animals found in them during trips to the beach in Hawaii. They will have a chance to see some of these familiar animals up close and make observations about their behavior. They will also be able to see how animals have adapted to life on the rocky shore.

Teacher Prep for Activity

Prepare a "Rocky Shores Vocabulary List" on chart paper. Print and laminate photographs of the animals. Print enlarged copies of the Critter Anatomy Posters and cut the labels from the Critter Anatomy Parts file. Collect animals and materials for each station (see Advice for Collection of Animals sheet below). Copy a worksheet for each student. Obtain digital microscopes or hand-lenses.

Background

Tidepools contain a variety of organisms such as crabs, urchins, limpets, small fish, snails, and many types of algae or *limu*. The organisms that reside in a tidepool may be subjected to drastic salinity changes because of evaporation or precipitation, changes in temperature from sunlight or precipitation, and desiccation (drying out) when the available water evaporates. The organisms found in the intertidal zone are, therefore, uniquely **adapted** to survive under the harsh conditions of this habitat. Their shells, outer-body coverings are designed to protect them from this harsh environment and from predators. Some are equipped with muscular feet or tube feet, which provide suction so as not to be removed from their optimal zone. They are equipped with adaptive eye stalks and antennae for seeing a feeling without completely exposing themselves during **foraging**. In this lesson we will focus on mollusks such as pipipi, which lives in the splash zone and opihi ,which live in the high-tide zone. Hermit crabs and a'ama crabs also live in the splash zone in tidepools. Brittlestars are found in tidepools (high-tide zone). Loli are found in the middle-tide zone and ina are found in the low-tide zone, usually completely submerged. By making **observations** of each of these organisms' **anatomy**, we see the forms reflect the microhabitat in which they live.

Species Background:

Taken from Hear.org (http://www.hear.org/hoike/pdfs/marine_unit3_act1.pdf)

Rotate Image Right

Pipipi or Black Nerite

Nerita picea

Where in the Intertidal Zone?

- Abundant on rocky shores in the splash zone
- Live closer to the water than the *pipipi kōlea*

What They Eat

- Feed on algae film on wet rocks

Behaviors, Characteristics, and Adaptations

- Breathe air through wet gills
- When rocks are dry, shut shell doors to retain moisture

Photo: John P. Hoover, Hawai'i's Sea Creatures, Mutual Publishing

'Ina Kea or Rock-Boring Urchin

Echinometra mathaei

Where in the Intertidal Zone?

- Found in tidepools and deeper, often anchoring themselves under branching finger coral
- Found on shallow, rocky shores exposed to constant wave action, down low in the lower intertidal or upper subtidal zones
- Almost always submerged

What They Eat

- Feed on algae

Behaviors, Characteristics, and Adaptations

- Use spines and teeth to bore hollows into soft rock where they lives
- Protect their soft undersides from predators by burrowing
- Have tube feet for attaching to rocks

Photo: Philip Thomas

Hāʻukeʻuke Kaupali or Shingle or Helmet Urchin

Colobocentrotus atratus

Where in the Intertidal Zone?

- Live low in the intertidal zone where the waves pound
- Cling to exposed, rocky shores, where few other animals survive

What They Eat

- Feed on algae

Behaviors, Characteristics, and Adaptations

- Have little tolerance to drying
- Clamp onto rocks with many strong tube feet (suction cups)
- Have flat spines, allowing water to flow over them easily

Photo: John P. Hoover, Hawai'i's Sea Creatures, Mutual Publishing

ʻIna or Oblong Urchin

Echinometra oblonga

Where in the Intertidal Zone?

- Found on shallow, rocky shores exposed to constant wave action, way down in the lower intertidal or upper subtidal zones
- Often the dominant urchins in these areas
- Also found on reef flats, at less than ten feet in depth

What They Eat

- Feed on algae

Behaviors, Characteristics, and Adaptations

- Use spines and teeth to bore hollows into soft rock where they live
- Protect their soft undersides from predator by burrowing and create depressions that hold water when exposed at low tide
- Have tube feet for attaching to rocks

Photo: John P. Hoover, Hawai'i's Sea Creatures, Mutual Publishing

Seurat's Hermit Crab

Calcinus seurati

Where in the Intertidal Zone?

- Live in rocky tidepools in the splash zone, amongst the periwinkles and nerites
- Common in rocky areas with strong surf

What They Eat

- Scavenge and eat algae

Behaviors, Characteristics, and Adaptations

- Can tolerate warm stagnant water
- Live in discarded periwinkle and nerite shells
- Use their left claws to block openings when they withdraw into their shells

Photo: John P. Hoover, Hawai'i's Sea Creatures, Mutual Publishing

'A'ama or Thin-Shelled Rock Crab

Grapsus tenuicrustatus

Where in the Intertidal Zone?

- Live on rocky shores with strong waves
- Forage for algae in the splash zone
- Cast molted shells, which are red and found high on the rocks above the intertidal zone

What They Eat

- Feed on algae

Behaviors, Characteristics, and Adaptations

- Have long legs and spines on legs, which are used for gripping rocks
- Retreat to water or crevices when approached

Photo: John P. Hoover, Hawai'i's Sea Creatures, Mutual Publishing

ʻOpihi Makaiaūli or Black-Foot *ʻOpihi*

Cellana exarata

Where in the Intertidal Zone?

- Live in the mid-intertidal zone in areas where the waves pound
- Live higher on the rocks than the other types of *ʻopihi*

What They Eat

- Graze on algae

Behaviors, Characteristics, and Adaptations

- Clamp tightly to the rock with a muscular foot
- Sometimes, on warm, sunny days, lift their shells off the rock, perhaps to cool down
- Have "home scars" to which they return after feeding

Photo: John P. Hoover, Hawai'i's Sea Creatures, Mutual Publishing

Limu Pālahalaha or Sea Lettuce

Ulva fasciata

Where in the Intertidal Zone?

- Commonly grows on lava rock and old coral in the middle part of the intertidal zone
- Uncovered at low tide

Behaviors, Characteristics, and Adaptations

- Its base resembles a lettuce leaf, with ribbon-like blades that can grow longer than 75 centimeters (30 inches).

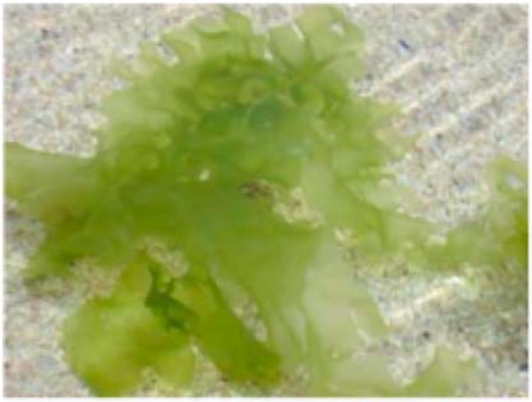


Photo: Kim Martz and Forest Starr

Limu 'Aki'aki

Ahnfeltia concinna

Where in the Intertidal Zone?

- Grows on *pāhoehoe* lava boulders in the upper intertidal zone, higher than the other kinds of *limu*

Behaviors, Characteristics, and Adaptations

- Grows upright to .3 meters (one foot) tall
- Has tough, rubbery branches that grow close together in dense bunches

Photo: Kim Martz and Forest Starr

Bubble Algae

Dictyosphaeria spp.

Where in the Intertidal Zone?

- Found in tidepools and on shallow reefs

Behaviors, Characteristics, and Adaptations

- Is a green seaweed composed of tiny, round cells

Photo: Ed Robinson ©1984

Procedure

Vocabulary:

First, introduce new vocabulary and write words on your ongoing Rocky Shores vocabulary list (chart paper).

Critter Observations:

1. Once all stations are set up, break the class into groups with no more than 4 students per group.
2. Tell the students they are allowed to touch the animals in the presence of the teacher or fellow. Go over the importance of careful handling and the fact that the animals are sensitive to stress. Therefore, animals should not be handled for too long and should never be harassed.
3. At each station, have the group observe the organism. For smaller organisms, have them use digital microscopes to look at the details of the organisms.
4. Students should make a drawing of the animal at the station on their worksheet. Also have them label the animal with the animal's name (e.g.. "'OPIHI"). Also have students try to write one sentence about what they saw the animal doing. Ask probing questions like:
   - Is the animal moving? How does it move?
   - Is the animal eating? What is it eating? Can you see it's mouth?
   - Does it have eyes? How many arms?
   - Is the animal interacting with another animal (if there is more than one in the bin)?
5. Allow 5 minutes at each station and have groups move clockwise around the room until they have observed at all 5 stations.
6. Have students gather on the carpet with their observation worksheets. Facilitate a discussion about their observations. Show large pictures of the animals. Ask students to tell you about the parts of each animal. How does the animal move? How does it eat? What does it eat? Etc.
7. Label the parts of the animal posters together as a class using the labels found in the Animal Labels folder. If students don't know the specific names of the parts, ask probing questions like :What do you think the part is used for? Why is it on this part of the body? When does the animal use this part? To guide them to naming the parts.
8. Briefly talk about how animals on the rocky shore are adapted to life in this ever-changing environment. Remind them about their experiments on tides (Intertidal Zones) and substrates (Hidden Animals). Open the floor to more discussion about adaptations of these animals.

Assessments

Worksheets completed
Group discussion

Resources

PRISM Sandy Shores (Hermit Crabs in the Classroom lesson)
Arkive.org for photos
www.enchantedleanring.com

Literature Connections

Iki, the Littlest Opihi by Tammy Yee

Iki, the opihi lives in the rough surge zone of Hawai'i's rocky shore. Like the other 'opihi, Iki must learn to cling tightly to the rocks, or risk being swept away by the waves. But Iki wants to see the world. Will this tiny limpet settle down and learn to "stick to it?"

Supplemental Materials

See below.

Subzones Species Key

Splash Zone

- *Pipipī Kōlea* or Dotted Periwinkle
- *Pipipī* or Black Nerite
- Seurat's Hermit Crab
- *'A'ama* or Thin-Shelled Rock Crab

Upper Intertidal

- *'Opihi 'Awa* or False *'Opihi*
- *'Opihi Makaiaāli* or Black-Foot *'Opihi*
- *Nahawele* or *Pāpaua* or Black Purse Shells
- *Maka'awa* or Granular Drupe
- *Limu 'Aki'aki*
- *Limu Pālahalaha* or Sea Lettuce
- *Limu Kala* or *'Akala*

Lower Intertidal

- *Limu Kala* or *'Akala*
- *Hā'uke'uke* or Shingle or Helmet Urchin
- *'Opihi 'Ālinalina* or Yellowfoot *'Opihi*
- *'Ina Kea* or Rock-Boring Urchin
- *Loli* or White-spotted Sea Cucumber
- *'Ina* or Oblong Urchin
- *Kauna'oa* or Variable Worm Snail

Subtidal

- *Loli* or White-spotted Sea Cucumber
- *'Ina* or Oblong Urchin
- *'Ina Kea* or Rock-Boring Urchin
- *Kūpīpī* or Blackspot Sergeant
- *Āholehole* or Hawaiian Flagtail

Tidepools

- *Pāo'o* or Zebra Blenny
- *'O'opu Ohune* or Cocos Frill Goby
- Juvenile *Kūpīpī* or Blackspot Sergeant
- Juvenile *Āholehole* or Hawaiian Flagtail
- *Loli Okuhi Kuhi* or Black Sea Cucumber
- Spiny Brittle Star
- *'Ina Kea* or Rock-Boring Urchin
- Bubble Algae
- Seurat's Hermit Crab
- *Kauna'oa* or Variable Worm Snail

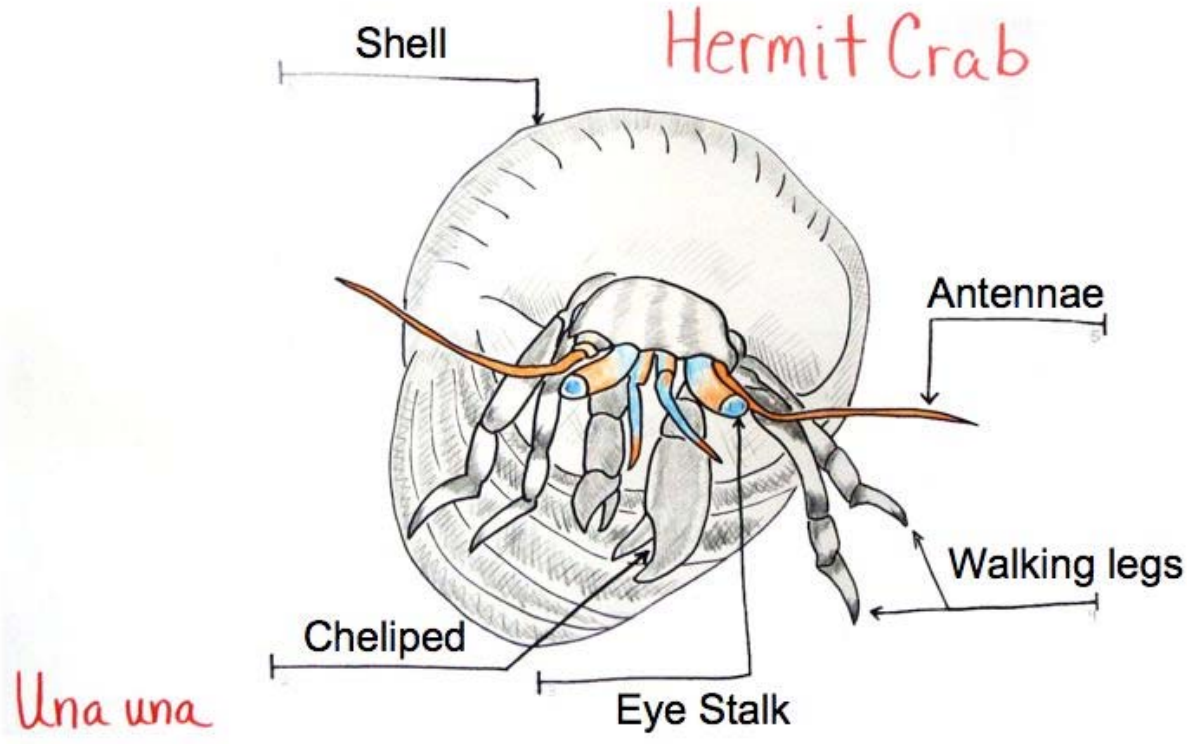
Advice for the collection of animals

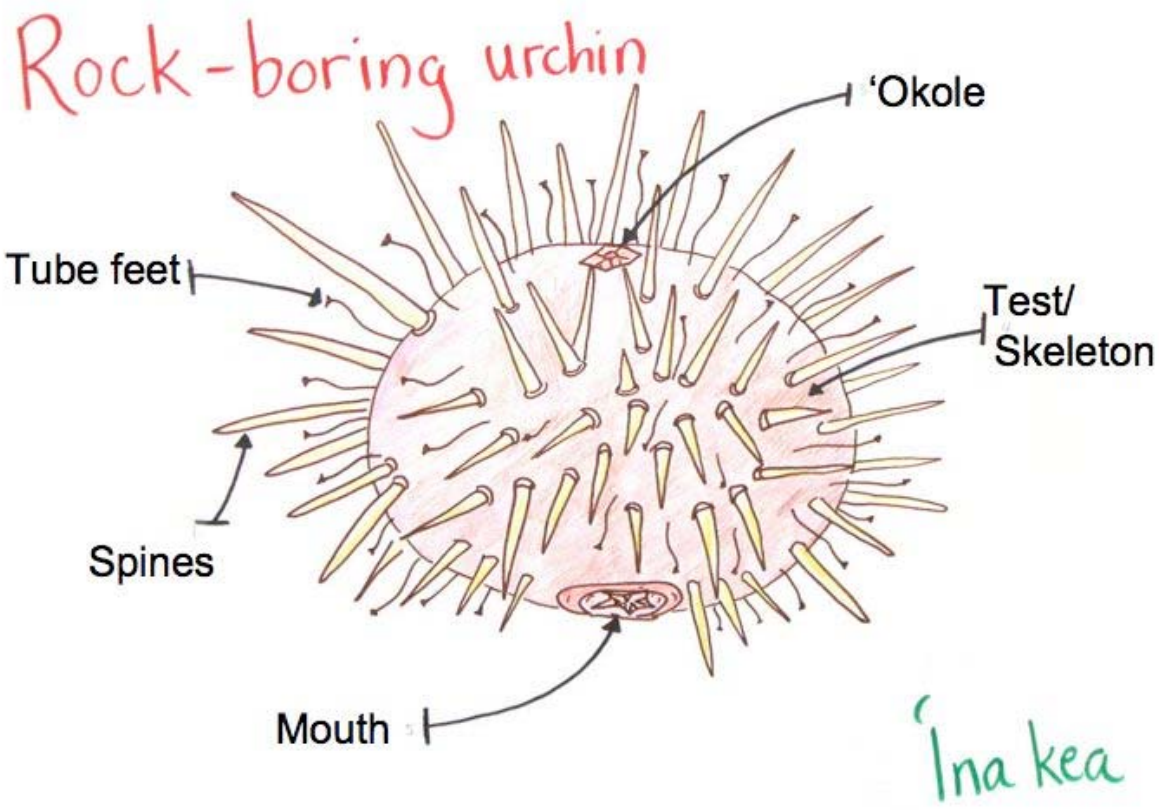
- **Go during low tide. Check your local tide chart in the newspaper or go to : http://www.freetidetables.com**
- **Collect only what you NEED, not extra.**
- **Bring plastic bins, an a bucket with salt water**
- **Bring a small net for catching a'ama crabs.**
- **Bring the air pump and extra D batteries!!**
- **Make plenty of room in your trunk. Bungee cords or boxes work well for securing bins and buckets during travel.**
- **Check all regulation for the state of Hawaii below on the size of animals you all legally allowed to collect, especially opihi.**
- **Do NOT collect rocks with limu growing on them, only limu itself can be collected.**

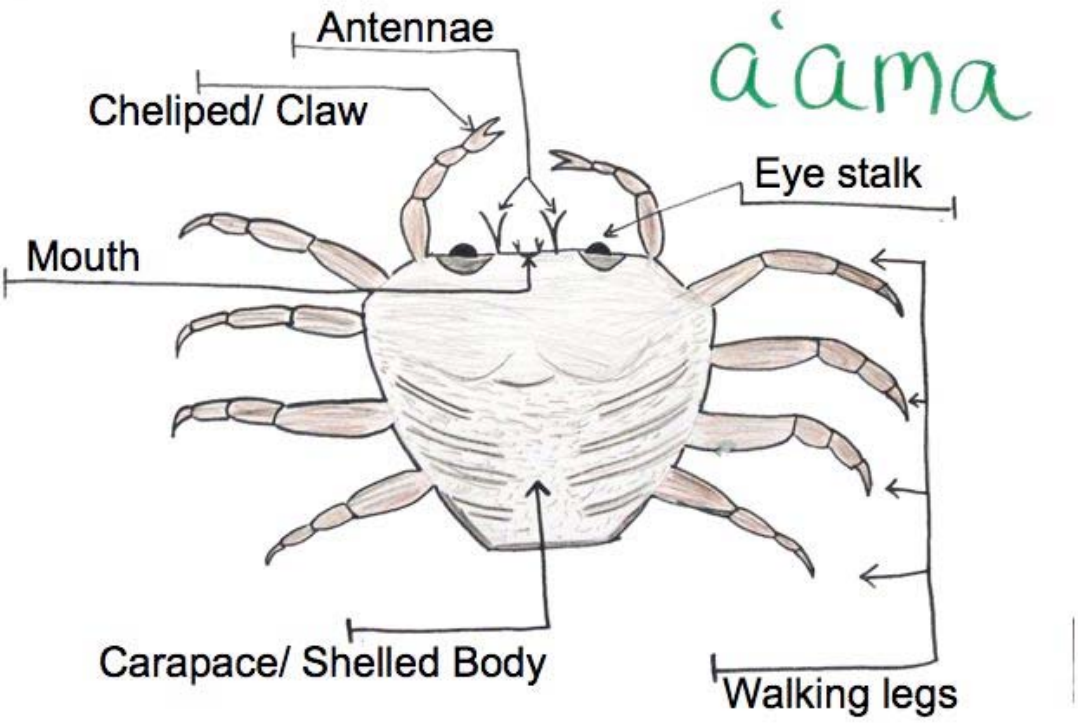
OPIHI REGULATIONS according to DLNR/DAR HAWAII

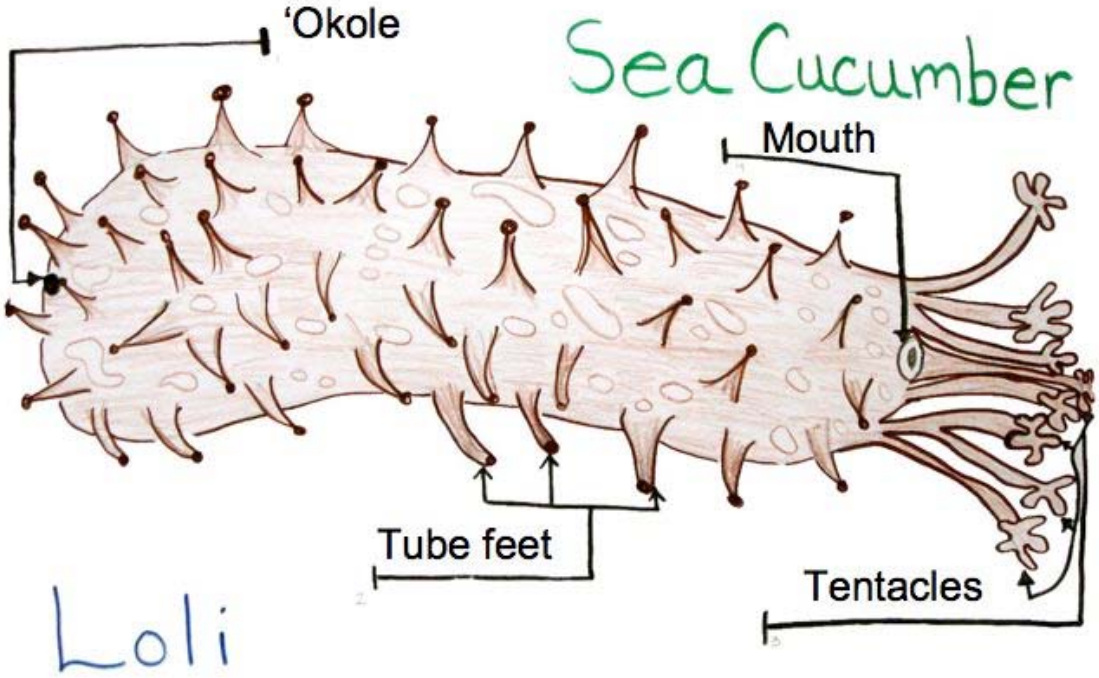
§73-92-l Prohibited activities. (a) No person shall within the State, except as provided in §13-92-2: (1) Take, possess, sell, or offer for sale any opihi (Cellana spp.) shell (with meat attached) which is **less than one and one- fourth inches (3.18 centimeters) in diameter;** (2) Take, possess, sell, or offer for sale any opihi (Cellana spp.) meat (without shell) less than one-half inch (1.27 centimeters) in diameter; or (3) Sell, or offer for sale any curio or jewelry made from an opihi (Cellana spp.) shell less than one and one-fourth inches (3.18 centimeters) in diameter. (b) Nothing in subsection a shall be construed as making it unlawful for any person to possess for purposes other than sale, opihi meat or shell of any size or products therefrom taken or in possession prior to August 4, 1978. [Eff: 5/26/81; am and comp SEP 16 1989] (Auth: HRS §187A-5) (Imp: HRS §187A-5)

Posters with labels filled in (See "Critter Anatomy Posters" file for originals without labels):

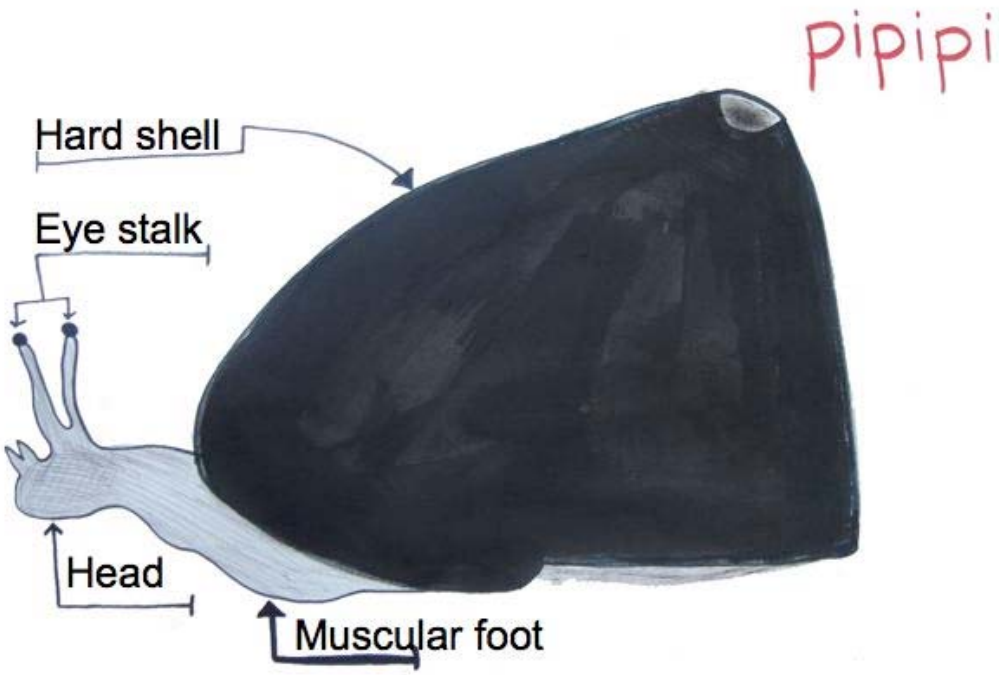



Rock-boring urchin
'Okole
Tube feet
Test/
Skeleton
Spines
Mouth
'Ina kea


Antennae
Cheliped/ Claw
Eye stalk
Mouth
Carapace/ Shelled Body
Walking legs


'Okole
Sea Cucumber
Mouth
Tube feet
Tentacles
Loli


`opihi
Shell
Eye stalk
Head
Muscular foot


pipipi
Hard shell
Eye stalk
Head
Muscular foot

Critters in the Classroom

Hawaii's Rocky Shores

Name_____

Station 1.

I saw _____

_____

Station 2.

I saw _____

_____

Critters in the Classroom

Hawaii's Rocky Shores

Name_____

Station 3.

I saw _____

_____

Station 4.

I saw _____

_____

Critters in the Classroom
Hawaii's Rocky Shores

Name_____

Station 5.

I saw

_____

_____

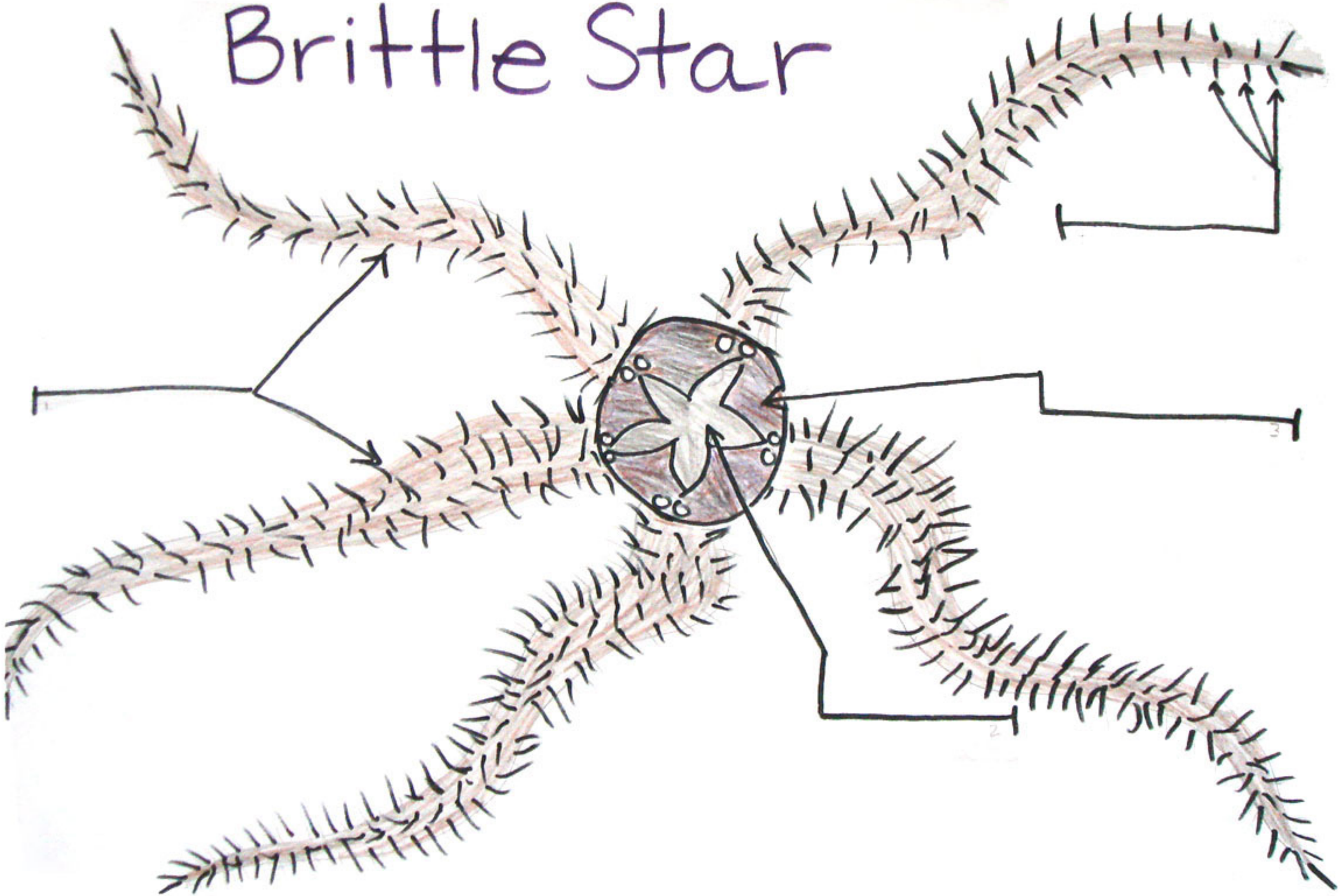
Station 6.

I saw

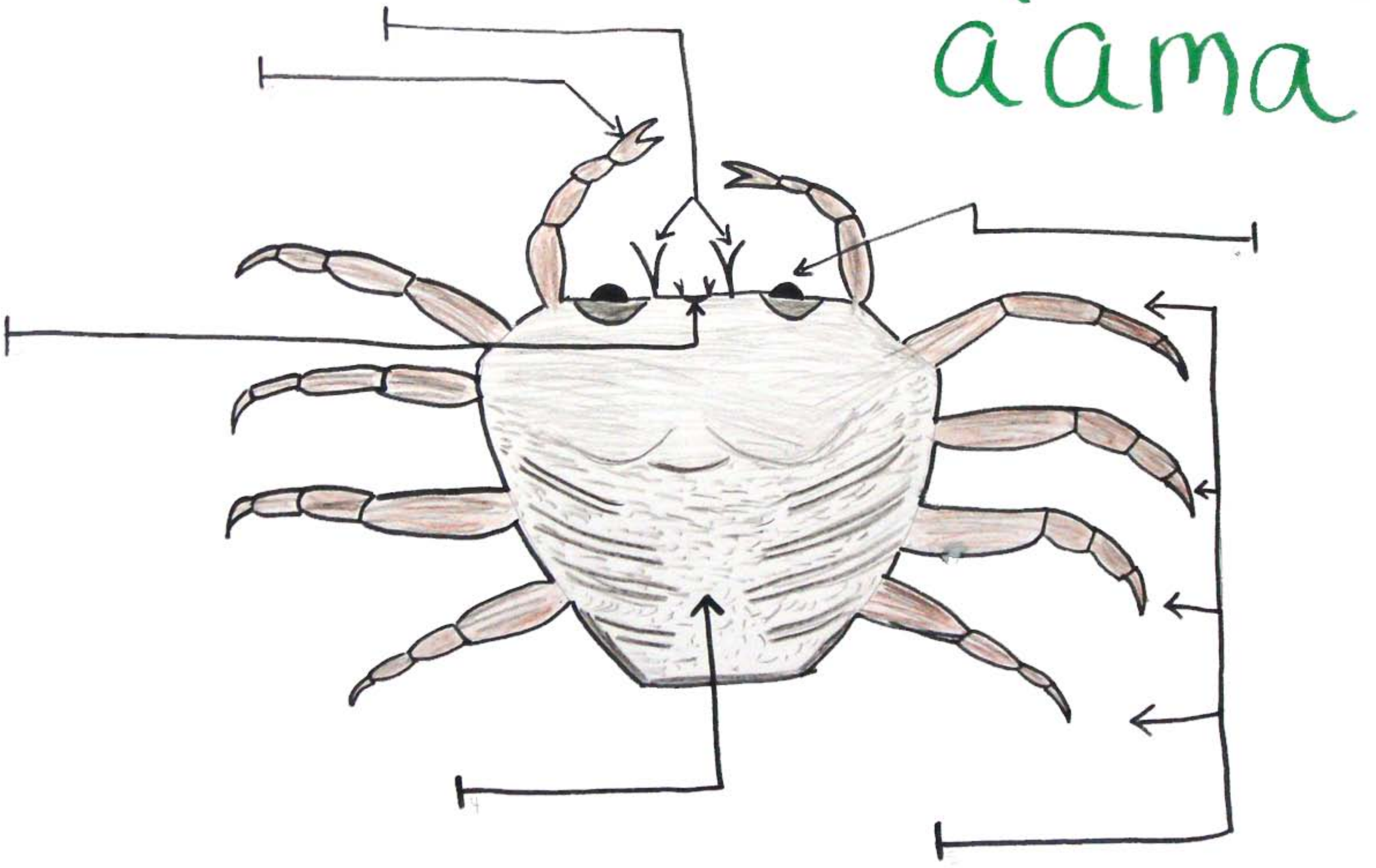
_____

_____

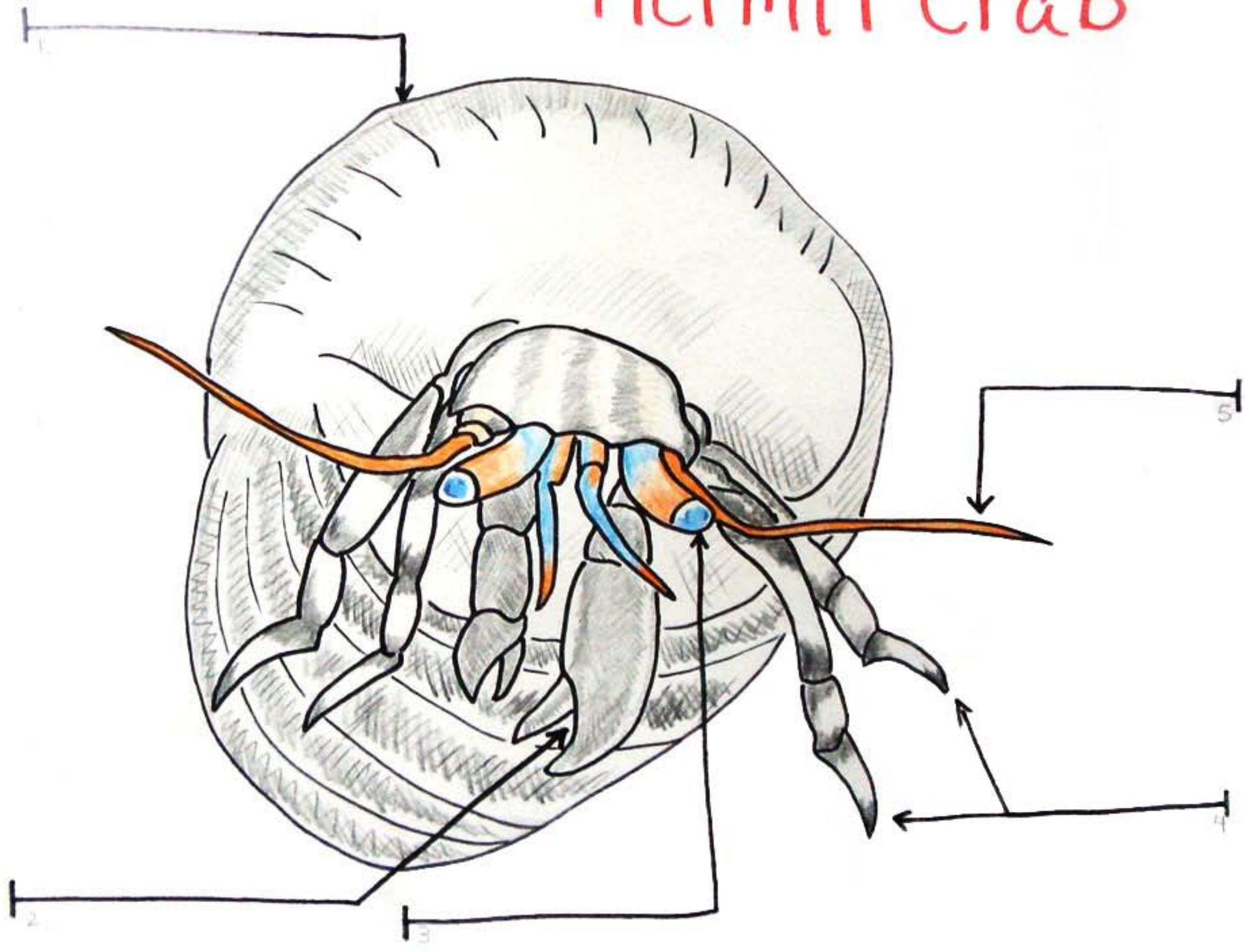
Brittle Star



a'ama



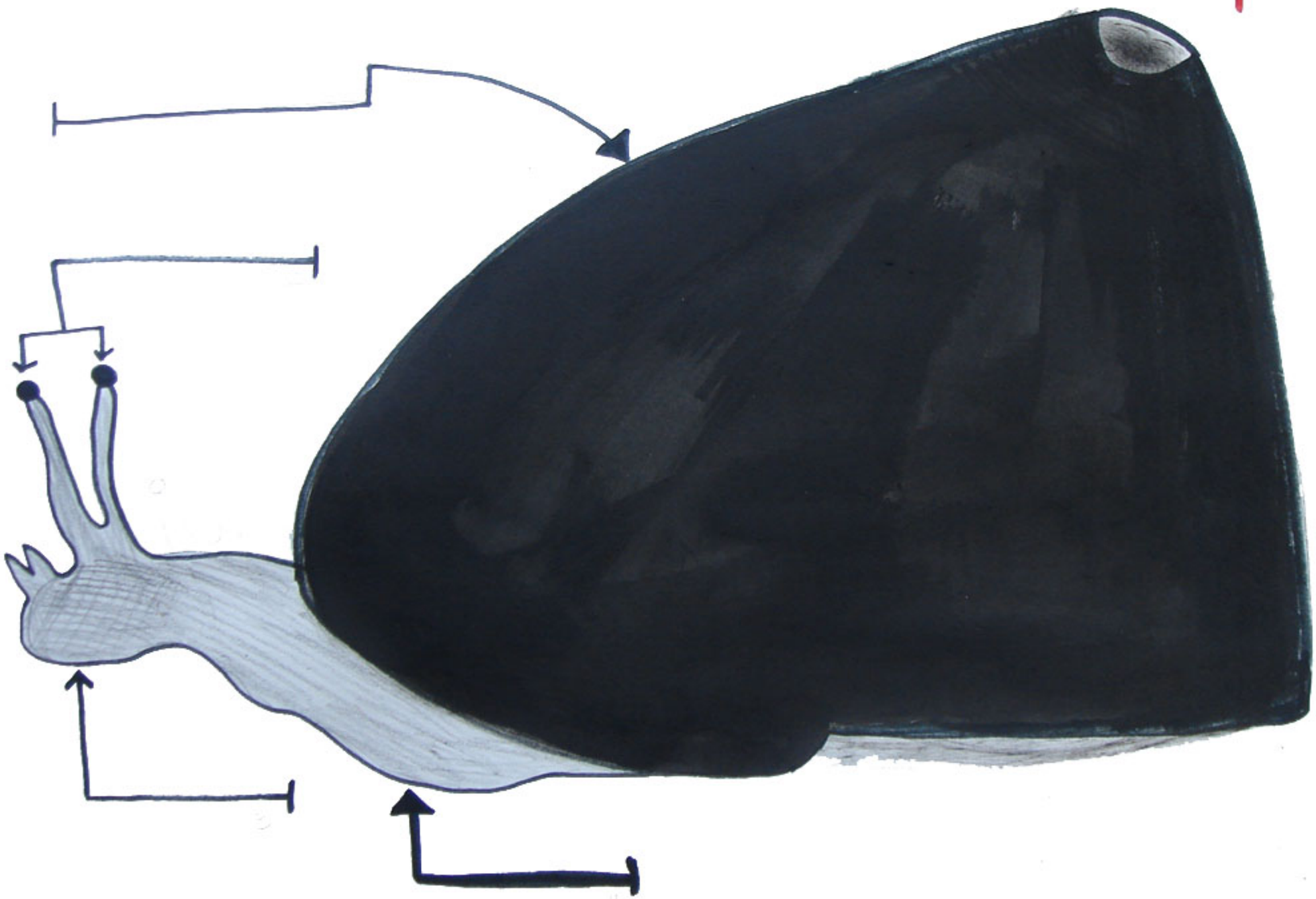
Hermit Crab



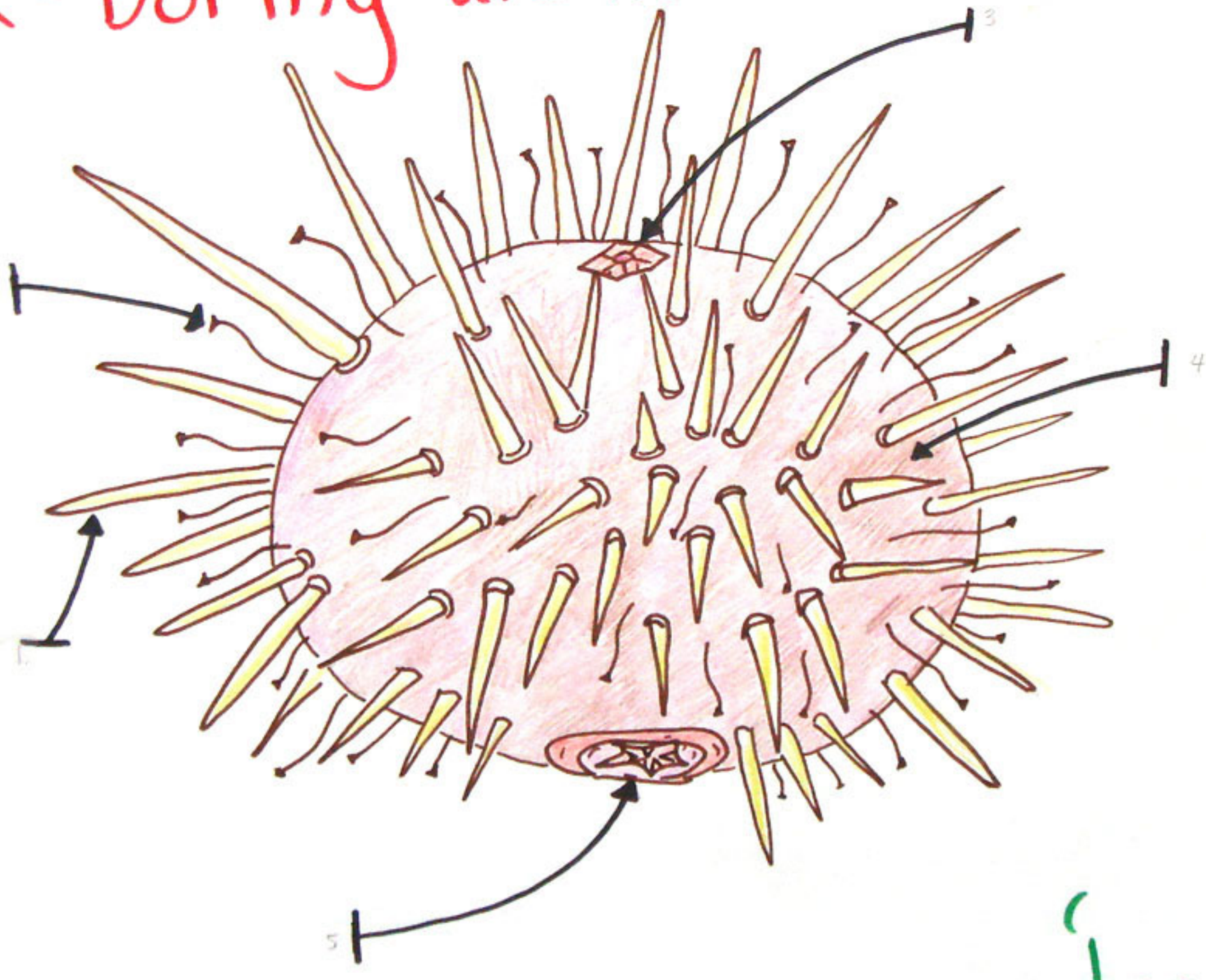
Una una

`opihi

pipipi

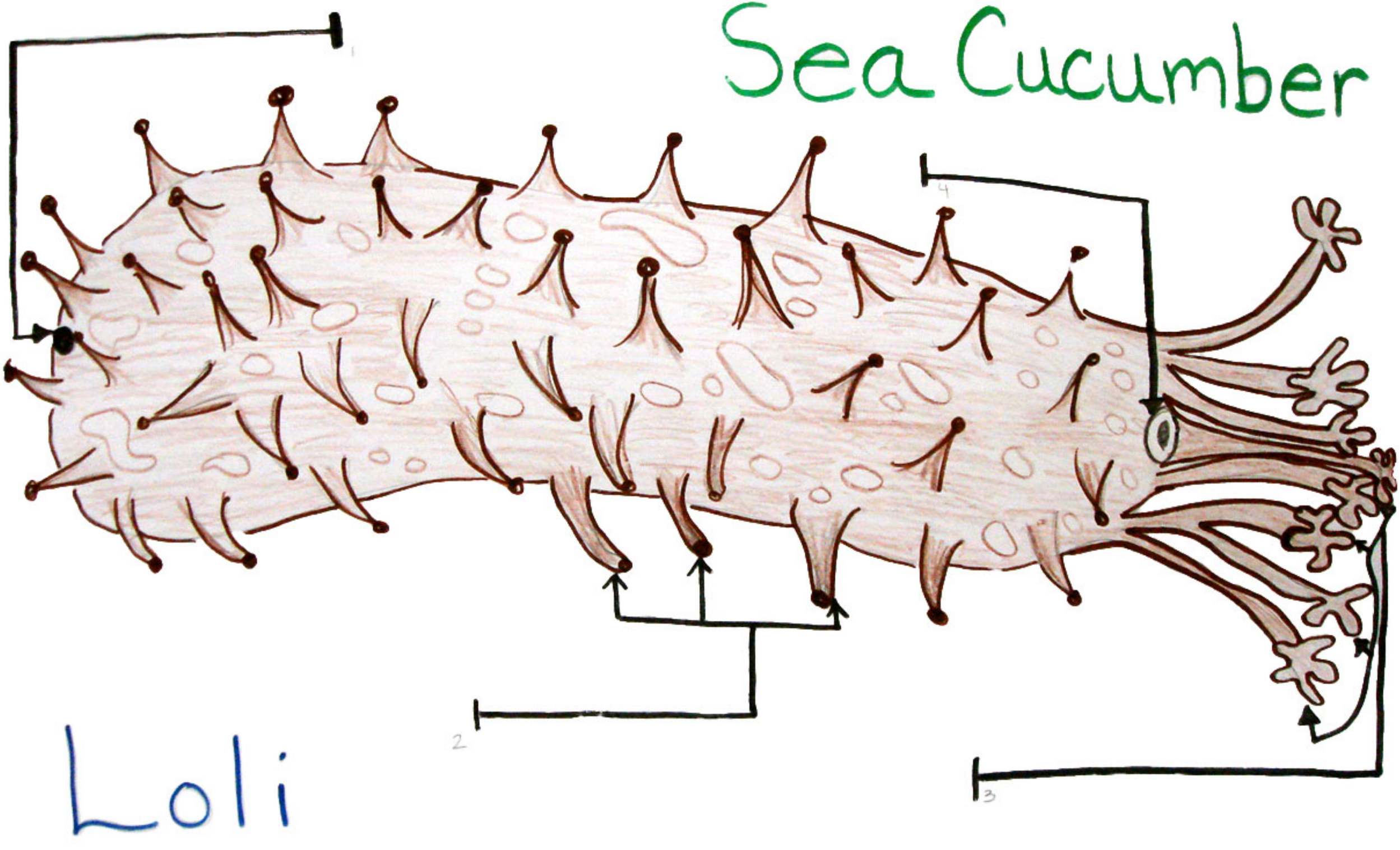


Rock-boring urchin



'Ina kea

Sea Cucumber



Loli

SEA CUCUMBER:

‘Okole	Tentacles
Tube feet	Mouth

A’AMA CRAB:

Antennae	
	Walking Legs
Cheliped/Claw	
	Eye Stalk
Carapace/Shelled Body	Mouth

PIPIPI:

Hard shell

Head

Muscular foot

Eye stalk

ROCK-BORING URCHIN:

Spine

Test/ Skeleton

Tube feet

Mouth

ʻOkole

OPIHI:

Shell

Head

Eye stalk

Muscular foot

BRITTLE STAR:

Arms

Disk/ Shield

Mouth plate

Spines

HERMIT CRAB:

Antennae

Cheliped/ Claw

Eye stalk

Shell

Walking legs