Ocean Adventures Curriculum

Platform: Invertebrates are Everywhere!

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Ocean Adventurers Camp Curriculum

Overview

Science Discovery Focus: Explore and Wonder

Ocean Discovery Unit

Next Generation Science Standards:

3-LS4-3 Biological Evolution: Unity and Diversity: Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

- DCI: For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.

Overarching Responsibilities of Lead Instructor:

- Classroom management & timing of lesson
- Execution of all lesson material in this curriculum
  - Regular – content that should be covered using language of your choice
  - (Parenthesis) – Teaching notes and actions
  - *Adaptation* – Way curriculum can be adapted for different grade levels
- Adapting curriculum up or down for grade level audience
- When transitioning from activity-to-activity use attention getters
- Lead discussions & ask guiding questions to get students thinking about science
- Use Belief and Science Discovery Process language during lesson
- Encourage participation from all students to create an inclusive environment
- Determine floor management with team BEFORE the start of the lesson
- **Always be thinking about ASC – Accountability-Safety-Communication**

Overarching Responsibilities of Fellows:

- Remind students of mantra early and often:
  - Wear your Mask, Wash your Hands, Watch your Distance!
- Mentor students during and in between activities
- Participate in any kinesthetic movements and/or writing or lab activities
- Ask students questions that help them to make their own discoveries
- Sit with students and model good listening behavior
- Sit or stand near any students struggling to pay attention
- **Always be thinking about ASC – Accountability-Safety-Communication.**

Academic Year Camp Schedule and Locations

Monday and Friday Schedule:

Regular Start	Late Start	Activity
3:00p-3:30p	3:30p-4:00p	Check-In / Snack Time (30)
3:30p-3:45p	4:00p – 4:15p	Community Building (15)
3:45p-4:40p	4:15p – 5:10p	Science Lab (55)
4:40p-4:50p	5:10p - 5:20p	Snack Break (10)
4:50p-5:20p	5:20p – 5:50p	Reflection / Believe Survey (Fridays) (30)
5:20p-5:30p	5:50p – 6:00p	Clean-up or awards (10)

Tuesday, Wednesday and Thursday Schedule:

Regular Start	Late Start	Activity
3:00p-3:30p	3:30p-4:00p	Check-In / Snack Time (30)
3:30p-3:45p	4:00p – 4:15p	Community Building (15)
3:45p-4:05p	4:15p – 4:35p	Science Leader-Student Connection (20)
4:05p-4:50p	4:35p – 5:20p	Science Lab (45)
4:50p-5:00p	5:20p - 5:30p	Snack Break (10)
5:00p-5:15p	5:30p – 5:45p	Reflection (15)
5:15p-5:30p	5:45p – 6:00p	Clean-up (15)

Group Locations & Activity Schedule:

	Monday	Tuesday	Wednesday	Thursday	Friday
Green	Eco-Lab	Eco-Lab: Dissection	Leadership Alcove: Invertebrates	Sci-Tech Lab: DNA and Plankton	Eco-Lab
Orange	Sci-Tech Lab	Sci-Tech Lab: DNA and Plankton	Eco-Lab: Dissection	Leadership Alcove: Invertebrates	Sci-Tech Lab
Yellow	Leadership Alcove	Leadership Alcove: Invertebrates	Sci-Tech Lab: DNA and Plankton	Eco-Lab: Dissection	Leadership Alcove

Invertebrates Are Everywhere Story

Internal – Staff and Teachers

During Ocean Adventurers, students investigate the world of invertebrates. They learn that invertebrates are found everywhere, from canyons to the deep ocean, and that there are many ways to study these unique and interesting organisms. Throughout the week, students improve their understanding of these scientific

Invertebrates Are Everywhere Story

External – Students

I am excited to continue my journey with Ocean Discovery Institute this summer by joining the Invertebrates are Everywhere camp. Over the years, Ocean Discovery has helped me believe that science is something I can do, and a scientist is someone I can be.

On our first day, I meet the Ocean Discovery staff and other student scientists. I learn that I am on the pathway to becoming a science and conservation leader - awesome! We watch a video of other kids who participate in Ocean Discovery programs and I get excited about all the ways I can get involved with Ocean Discovery in the future. I think I might want to be an Ocean Leader someday. After that, we play a game of bingo where we race around the canyon looking for invertebrates – I wasn't even 100% sure I knew what an invertebrate was yet, but I had an idea. Once we find something on our bingo card, we form a circle and share things about ourselves. I learn that I have a lot in common with my fellow student scientists and the Ocean Discovery staff. I also find out that we will be focusing on invertebrates this week and thanks to our exploring, I know exactly what an invertebrate is! Pretty cool!

Over the next few days, I learn that invertebrates can be found everywhere on the earth and there are lots of ways to study them including – experiments, dissections, and genetics. We observe living marine invertebrates and I even get to touch a few of them! We then build our own invertebrate out of clay and splash them with a wave from a bucket! The survivors help me understand which body types are most useful for living in an environment where you are constantly getting hit with waves. On another day, we dissect a squid and observe the outside and inside anatomy. I learn about lots of cool adaptations squid have for living in the deep ocean. We even cook calamari after the dissection- I thought it would taste slimy and gross, but it was yummy! Another day we use cool scientific tools to look at the DNA of different kinds of plankton. Did you know that some plankton look really different when they are young versus when they are adults? Kind of like me- I look really different now than I did when I was a baby! I learn that since our DNA never changes, we can use it to match up the juvenile plankton to their adult forms even if they look really different.

On the last day we work to remove invasive plants from the canyon so that more native plants can grow. I learn that invasive plants don't belong in the canyon and take up space that the native plants which should live in the canyon need. We all agree this is important because we want to help protect our new invertebrate friends who need the native plants for food and protection. I really like making a difference in the world and knowing I helped my invertebrate friends. All in all, it was an awesome week!

Pathway of an Ocean Leader/Canyon Invertebrates & Observation

Day 1

Goal: Students become familiar with the Seed to Tree pathway of an Ocean Leader while sharing about themselves and learning about other students and Ocean Discovery alumni and staff.

Technology:

- Large Smart Board with "CI Inverts Are Everywhere Camp" PPT loaded to desktop
    - If a guest speaker joins - connect a speaker, microphone, microphone stand, and camera.
    - If a video will be shown - connect the speaker.
    - *PLAZA DEL SOL LAB ONLY* - connect the lavalier to speaker for instructor.

Supplies: (For one group of 10 students)

Visual Materials:

- Community Agreements stand
- Invertebrates Are Everywhere Poster (will be used every day of the program)
    - Made from a large piece of butcher paper with a drawing including the canyons, rocky seashore, open ocean and deep ocean.
- Labels for "Invertebrates Are Everywhere" Poster
    - Laminated in a large font "Invertebrates Are Everywhere"
    - Laminated in a slightly smaller font "Canyon", "Rocky Seashore", "Open Ocean", "Deep Ocean" "Observe", "Experiment", "Genetics", and "Dissection"
- Word Wall (will be used every day of the program)
    - A poster made from a large piece of butcher paper
    - "Word Wall" written in large letters
    - Laminated words in a large font:
        - Invertebrates – an animal without a backbone
        - Family – a group of people that care for you.
        - Science and Conservation Leader – a person who uses science to make our world a better place.

Supplies:

- Painters Tape
- Seed to Tree Ocean Discovery Alumni video
    - Papi/Curriculum/CI New

Ocean Discovery Challenge – Bingo supplies:

- Each Color Group can divide into two groups.

Green Team

- Supplies for Instructor Pack (a small canvas drawstring pack) (2/ group):
    - Fill with these supplies:

- Hand sanitizer (1)
- Yellow disposable fabric headbands (1/student)
- Laminated Bingo Card for Green Team (1)
- Black dry erase marker (1)
- Bug box (1/student)
- Bug stickers for prizes (10)

Orange Team

- Supplies for Instructor Pack (a small canvas drawstring pack) (2/ group):
  - Fill with these supplies:
    - Hand sanitizer (1)
    - Yellow disposable fabric headbands (1/student)
    - Laminated Bingo Card for Orange Team (1)
    - Black dry erase marker (1)
    - Bug box (1/student)
    - Bug stickers for prizes (10)

Yellow Team

- Supplies for Instructor Pack (a small canvas drawstring pack) (2/ group):
  - Fill with these supplies:
    - Hand sanitizer (1)
    - Yellow disposable fabric headbands (1/student)
    - Laminated Bingo Card for Yellow Team (1)
    - Black dry erase marker (1)
    - Bug box (1/student)
    - Bug stickers for prizes (10)

Blue Team

- Supplies for Instructor Pack (a small canvas drawstring pack) (2/ group):
  - Fill with these supplies:
    - Hand sanitizer (1)
    - Yellow disposable fabric headbands (1/student)
    - Laminated Bingo Card for Blue Team (1)
    - Black dry erase marker (1)
    - Bug box (1/student)
    - Bug stickers for prizes (10)

Timing:

Regular Time	Late Start	Activity	Learning Cycle
3:45p – 3:55p	4:15p – 4:25p	Introduction (10)	Engagement
3:55p – 4:25p	4:25p – 4:55p	Ocean Discovery Challenge – Bingo (30)	Exploration & Guided Analysis
4:25p – 4:40p	4:55p – 5:10p	Process Reflection (15)	Reflection

Set up

- Write daily agenda on white board and set on white board stand
- Set up technology & visuals:
  - Open "CI Inverts Are Everywhere Camp" PPT slides and test links for the day.
    - Be sure to move past commercials for any videos.
  - Put up Word Wall Poster and set words for the day at instructor station.
  - Put up Inverts are Everywhere Poster.
  - Check sounds Student Pathway Video
- Create Instructor Packs for Yellow, Blue, Orange and Green Teams
- Write daily agenda on SMART board

Fellow Teaching Notes

- Help students to place words on the Word Wall.
- During Ocean Leader Challenge:
  - The lead instructor will be at the front of the group
  - The fellow will be at the back of the group to make sure all students stay accounted for
  - Help students maintain social distancing while playing bingo and creating circles for sharing
  - Encourage students who are quiet to participate
  - Help to maintain respectful silence of other students when one student is sharing
  - Participate by sharing about yourself during share out circles
- During the process reflection you have a **Mentoring opportunity**. Potential questions include:
  - Do you think learning about invertebrates is important? Why?
  - What did you enjoy about being out in the canyon today?
  - Do you think you might want to become an Ocean Leader?
- **Always be thinking about ASC – Accountability-Safety-Communication.**

Introduction (10 minutes)

- Review daily agenda on the white board.
- Orient students to the space.
    - Water fountain, bathrooms, mask break area
    - UPSTAIRS ONLY:
        - Highlight the Solar Trees. Be sure to cover:
            - Connection to name Plaza Del Sol
            - How sunlight is used to power the Living Lab which is a net-zero energy building.
- Introduce Ocean Discovery Family.
    - (Ask student to place "Family" on word wall)
    - Some of you may already be a part of the Ocean Discovery Family and some of you are new to the Ocean Discovery Family.
    - Today everyone is a part of the Ocean Discovery family.
    - You will be getting to know each other, staff, and other Ocean Discovery students as you learn about becoming a science and conservation leader.
- Introduce Science and Conservation Leader Pathway.
    - We believe that all students are science and conservation leaders.
    - Importance of science and conservation leaders who come from City Heights to create diversity and bring new ideas, perspectives and experiences to our science and conservation workforce.
    - How you can be leaders today:
        - Share what you learn
        - Raise your hand to answer questions
        - Make good decisions
    - How you can be leaders in the future - mentor others, go to college, and even have a career in science and conservation.
- Introduce Science and Conservation Leader Pathway video which highlights Ocean Discovery students in different places along their pathway to becoming science and conservation leaders.
- (Show Science and Conservation Leader Pathway video.)
- Debrief Science and Conservation Leader Pathway video.
    - (Ask student to place "Science and Conservation Leader" on the word wall.)
    - Potential questions include:
        - How would you describe a science and conservation leader?
        - What questions do you have about becoming a science and conservation leader?
        - What did you see in the video that gets you excited?

Ocean Discovery Challenge – Bingo (35 min)

Teaching Note: Be sure to slow students down for the sharing circles. This is the most important part of the activity.

- As a family, we are going to embark on an Ocean Discovery Challenge!
- Introduce Bingo.
    - (Utilize Ocean Discovery Challenge Slide on "CI Inverts are Everywhere Camp" PPT.)
    - Goal: Get to know your Ocean Discovery Family

- Ask students if they have ever played Bingo. If they have let them explain to the other students how the game works.
- We will be in around the Living Lab and in the canyon looking for things on the Bingo board.
- When we find something on the board – there will be a question we need to answer as a group that your leader will read to you.
- Remember part of today is getting to know our new Ocean Discovery family so you will be asked to share things about yourself so your team members can get to know you better.
- Once your team has answered the question you can cross that box off and move on to find something else on the board.
- The goal is to be the first team to get a bingo (three boxes in a row vertical, horizontal or diagonal).
- There are two (four) teams: Blue Team and Yellow Team
  - PLAZA DEL SOL LAB:
    - Your two teams are: Orange Team and Green Team
- This challenge requires your skills, speed and teamwork.
- First team to get a bingo, return here and say "Go Awesome!" wins a prize.

- (Divide students into two (four) teams.)
- (Before beginning the game, the team lead will):
  - Give colored fabric ribbons to each student to wear.
    - The ribbons make us a team!
  - **BE SURE BOTH TEAMS HAVE COMPLETED THE ABOVE ACTION BEFORE BEGINNING THE BINGO GAME.**
- (Team Lead takes out Bingo Card.)
  - Let students hold the card and read some of the things they are looking for.
  - Ask students where they want to look for these things, around the outside of the Living Lab, the canyon, etc.
- (During the game allow the students to choose to look for whichever box they want to – there is no correct order.)
- (Think ASC)
  - (Count the number of students throughout to ensure accountability and safety.)
  - (Instructor in the front of the group and fellow in the back for safety.)
  - (Encourage students to be competitive and have fun but ensure that they stay together as a group for collaboration.)
- (Play Bingo.)
- (Team Lead: If you are the first team back, say Go Awesome! And hand out prize to your team. Congrats, you won!)
- (Have students wash hands.)

<u>Process Reflection</u> (12 min)

- (Both teams return to shared space and sit near Invertebrates Are Everywhere poster.)
- Debrief the experience using a think-pair-share:
  - (Utilize Debrief Slide on "CI Inverts are Everywhere Camp" PPT.)
  - What is something you learned about someone on your team?
- Debrief further (if time allows) either whole group or pair-shares:

    - Who is someone on your team that you would like to call out for being a leader? In what way did they show leadership?
- Introduce the theme of the week – Invertebrates are Everywhere.
    - See if students can identify the group of organisms they were studying today. – Invertebrates.
        - Define Invertebrate – an animal without a backbone.
        - Have students compare themselves to invertebrates.
    - (Ask a student to place "Invertebrate" on the word wall.)
    - Ask students where they found invertebrates today – everywhere in the canyon!
    - (Ask a student to add the laminated word "canyon" to the poster.)
    - Ask students how we studied those invertebrates today.
    - (Ask a student to add the laminated word "observation" to the poster.)
    - Share the roadmap of the week with students.
        - Today we grew as part of the Ocean Discovery Family and we investigated invertebrates that live in the canyon by observing them.
        - Tomorrow you will investigate invertebrates that live at the rocky seashore.
        - Wednesday and Thursday, we will travel deeper in the ocean to explore invertebrates that live in the open ocean and the deep ocean.
        - Friday, we learn how we can make a difference and protect invertebrates!
        - Each day we will learn another way to study invertebrates.
    - (Add the "Invertebrates are Everywhere", "Rocky Seashore", "Open Ocean" and "Deep Ocean" labels to the poster.)

Ocean Leader Challenge Bingo Questions
(*same for each group*)

Directions: Each time the students find something on the bingo board, stop the group, make a sharing circle **while being socially distant** and read the question out loud to the group. It doesn't matter which box the students are in, whichever thing they find first – ask the first question. Whatever the students find second – ask the second question, etc. until they are able to complete a bingo. Be sure to slow the students down and take time to do the sharing circles respectfully because this is the main point of the day – creating a sense of belonging and getting to know your Ocean Discovery Family.

1) Share two words that describe you.
2) Share a place you like to go outdoors and who you like to go there with.
3) Who is someone you look up to? Why do you look up to them?
4) Share a job or career you are excited about doing in the future.
5) Who is someone you would want to bring to the Living Lab with you? Why do you think they would enjoy it?
6) Take a picture with the whole team where everyone is trying to jump at the same time.
7) Where do you see yourself in five years?
8) Create the world "TEAM" with your bodies and take a picture.
9) Run back to the lab!

Bingo Card YELLOW Team

Find an animal with six legs. Gently place the animal in a bug box and let everyone take a look at it.	*Find a bug with wings.*	*Find an animal with no legs.*
Find an animal living under a rock that is smaller than a quarter.	*Find a bug that is living on a plant.*	*Find an animal with at least six legs that has a minimum of two different colors on its body. Gently place it in a bug box and let everyone look.*
Find some water and find an animal who makes their home in or on top of the water.	*Find an animal with eight legs.*	*Find an animal smaller than a dime that is using camouflage to protect itself.*

Bingo Card BLUE Team

Find a bug that is living on a plant.	*Find a bug with wings.*	*Find an animal smaller than a dime that is using camouflage to protect itself.*
Find some water and find an animal who makes their home in or on top of the water.	*Find an animal with six legs. Gently place the animal in a bug box and let everyone take a look at it.*	*Find an animal with no legs.*
Find an animal living under a rock that is smaller than a quarter.	*Find an animal with eight legs.*	*Find an animal with at least six legs that has a minimum of two different colors on its body. Gently place it in a bug box and let everyone look.*

Bingo Card ORANGE Team

Find an animal with at least six legs that has a minimum of two different colors on its body. Gently place it in a bug box and let everyone look.	*Find an animal with no legs.*	*Find an animal living under a rock that is smaller than a quarter.*
Find some water and find an animal who makes their home in or on top of the water.	*Find an animal with six legs. Gently place the animal in a bug box and let everyone take a look at it.*	*Find an animal smaller than a dime that is using camouflage to protect itself.*
Find a bug with wings.	*Find an animal with eight legs.*	*Find a bug that is living on a plant.*

Bingo Card GREEN Team

Find an animal living under a rock that is smaller than a quarter.	*Find an animal with no legs.*	*Find a bug that is living on a plant*
Find some water and find an animal who makes their home in or on top of the water.	*Find an animal with at least six legs that has a minimum of two different colors on its body. Gently place it in a bug box and let everyone look.*	*Find a bug with wings.*
Find an animal smaller than a dime that is using camouflage to protect itself.	*Find an animal with eight legs.*	*Find an animal with six legs. Gently place the animal in a bug box and let everyone take a look at it.*

Rocky Seashore Invertebrates & Experimentation

Day 2, 3, or 4

Goal: Students will learn that invertebrates live at the rocky seashore and perform an experiment to learn more about these rocky seashore invertebrates.

Technology:

- Large Smart Board with "CI Inverts Are Everywhere Camp" PPT loaded to desktop
- If a guest speaker joins - connect a speaker, microphone, microphone stand, and camera.
- If a video will be shown - connect the speaker.
- *PLAZA DEL SOL LAB ONLY* - connect the lavalier to speaker for instructor.

Supplies:

Visual Materials:

- Community Agreements stand
- Invertebrates Are Everywhere Poster
-
- Laminated words: "Rocky Seashore" and "Experiment"
- Word Wall
  - Word Wall Poster
  - Laminated words:
    - Experimentation – to test something
    - Adaptation – something that helps an animal survive

Lab Materials:

- Painters tape (1)
- Live Invertebrates (1/student)
  - Each student should have the chance to interact with two animals. There can be multiples of a species, no one species should make up more than 50% of the organisms and greater diversity overall is optimal.
  - Best invertebrates for this lesson: Giant Keyhole Limpets, Ochre Sea Star, Chiton, Snails (the larger the better)
  - Invertebrates not to use for this lesson: Hermit crabs
- Small aquaria w/ lids (1/student)
- Dry rags (4)
- Dry towels (4)
- Large plastic bin (2)
- Bucket of clay (2)
- Laminated "Survivor" sign (2)
- Laminated "Non-survivor" sign (2)
- Acrylic panel (2)
- Large white board (2)
- White board stand (2)
- Dry erase marker (2)
- Outlines of rocky seashore invertebrates(pre-cut) (1/student)
- Small art supply plastic bins filled with colored pencils, crayons, and markers (4)

- Scotch tape rolls (4)
- Orange Home Depot buckets (12)
- Prizes (1-6)
  - Check with CI Program Manager about what to use for prizes
- *6th – 10th ONLY*: Curiosity Cards
- *OCEAN DISCOVERY COURTYARD LAB ONLY*: Coolers to transport small aquaria
- White board (1)
- White board stand (1)
- Dry erase marker (2)
- Dry erase eraser or rag (1)
- Large digital timer (2)

Timing:

Time	Activity	Learning Cycle
3:45p – 3:55p	Introduction	Engagement
3:55p – 4:05p	Science Leader Student Connection	Engagement
4:05p – 4:30p	Invertebrate Experimentation	Exploration and Guided Analysis
4:30p – 4:42p	Process Reflection	Reflection

Set Up

- Write daily agenda on white board and set on white board stand
- Set up technology and test for Zoom call with scientist.
- Set up visual materials:
  - Open "CI Inverts Are Everywhere Camp" PPT slides and test links for the day.
    - Be sure to move past commercials for any videos.
  - Put up Word Wall Poster and set words for the day at instructor station.
  - Put up Inverts are Everywhere Poster.
- Ensure there are diverse invertebrates and enough for each student to have one.
  - Place each invertebrate in a small aquarium and place a lid on top.
- Place all aquaria back in the tank so that they stay chilled and aerated until they are needed for the lab.
- Place acrylic panel at an angle inside the large plastic tub (to create a "rocky seashore").
- Fill home depot bucket with water about 2/3 full.
- Divide clay into equal pieces (about 1in balls) one per student + 2 additional/adult and place back in the clay bucket.
- Wet two wash clothes and place off to the side with a dry towels and hand sanitizer (for students to clean clay off hands).
  - Enter student names randomly into first set of brackets.
- Set up a spot where you can lay out both the "Survivor" and "Non-Survivor" laminated cards with enough space to lay survivor and non-survivor clay invertebrates out after experiment.
- Prep small plastic art supply bins with pre-cut outlines of rocky seashore invertebrates, crayons, colored pencils and markers.

Fellow Teaching Notes

- Connect the zoom link(s).
  - Check sound.
  - Check that the camera shows as many students as possible.
- Help students to place words on the Word Wall.
- During Invertebrate Experimentation Intro place an invertebrate in front of each student.
- During the Invertebrate Experimentation Activity:
  - Help students maintain social distancing while they rotate to the next living invertebrate when the instructor says it's time to switch.
  - Help students who are struggling to build an invertebrate out of clay.
  - Build your own clay invertebrate.
  - Help to place "Survivor" and "Non-Survivor" clay invertebrates behind the correct sign after the "wave".
- During the Invertebrate Experimentation Activity you have a **Mentoring opportunity**. Potential questions include:
  - What do you notice?
  - What do you think helps this animals survive at the rocky seashore?
  - How does this animal avoid being knocked over by waves?
  - How do you think that (point to a specific body part) could help (name of animal) survive at the rocky seashore?
- During the process reflection you have a **Mentoring opportunity**. Potential questions include:
  - Do you think learning about invertebrates and their adaptations is important? Why?
  - Do you think learning about invertebrates and their adaptations is important? Why or why not?
  - What did you like about doing science today?
  - Can you think of a time today when you were doing science? What were you doing?
- Help students to tape their rocky seashore invertebrate to the Invertebrates Are Everywhere Poster.
- **Always be thinking about ASC – Accountability-Safety-Communication.**

Intro (10 min):

- Review daily agenda on the white board.
- Review the previous day using the Word Wall and Invertebrates Are Everywhere poster. Potential questions include:
  - What kinds of organisms are we studying this week?
  - Where did we find invertebrates yesterday?
  - What method did we use to study invertebrates yesterday?
- Introduce Rocky Seashore.
  - Today we will move closer to the ocean and explore invertebrates at the rocky seashore.
    - (Show picture of rocky seashore in PPT.)
    - Ask students what they already know about the rocky seashore.
    - Ask students to try to define rocky seashore.
      - Rocky seashore: a coastal area made of rocks.

- There are rocky seashores all over the world. Today we will explore a rocky seashore close to home, in La Jolla.
    - Describe location of La Jolla rocky seashore.
    - Ask students if anyone has been there before.
    - (Show Google Map on PPT.)
        - 30 minutes – car; 60 minutes by trolley and bus
        - You can visit with your family- free!
- Introduce the harsh physical environment of the rocky seashore.
    - (Play 1-2 minutes of a rocky seashore video in PPT.)
    - Ask students to describe what they see.
    - Focus on the physical environment at the rocky seashore – rocky, wavy, pools of water, etc.
    - The rocky seashore is a harsh environment and the invertebrates that live there must be adapted to survive in those conditions.
        - Invertebrates do not want to get washed away, knocked over or crushed by waves or rocks, etc.
- Introduce adaptation.
    - Ask students to define adaptation.
        - Adaptation: something that helps an animal to survive.
        - (Give a student the word "adaptation" to place on the Word Wall.)
    - Have students come up with examples of adaptations for animals they are more familiar with.
        - (Show picture of polar bear in PPT.)
- Today we will be exploring how invertebrates at the rocky seashore are adapted to survive in this harsh environment.

Science Leader Student Connection (10 min):

- Provide an overview of the Science Leader Student Connection portion of the program.
    - Each day will meet virtually with a science and conservation leader.
    - Will hear about their passion for the ocean and marine protected areas.
    - Wil learn about their pathway to becoming a science and conservation leader and what they do in their work.
    - You will have the opportunity to come to the microphone and ask the scientist directly any questions you have.
        - K – 5th adaptation: Brainstorm questions they could ask the scientists ahead of time.
        - 6th – 10th adaptation: Give students curiosity cards. They can ask one of these questions or their own question.
- Introduce Science and Conservation Leader.
    - Tell the students who they are about to meet (scientist's name) a scientist who (describe what they do in 1-2 sentences).
    - (Connect Zoom Call).
    - (Welcome the Science and Conservation Leader.)
    - (Conduct the interaction as one would an interview.)
        - Interview tips:
            - You may change the order or modify the questions based on the Science Leader's responses.

- If a Science Leader is answering a question that may need to be wrapped up, you can move to the microphone which will signal them that you want to speak.
- After the Science Leader answers a question, in a sentence or two, reaffirm the point they are making or acknowledge how it ties to the students' experience.

- Potential interview questions (you do not need to use all):
  - Can you start by sharing more about yourself and how you came be the Science and Conservation Leader you are today?
  - We'd love to hear more about your work. Can you describe your work in 4-5 sentences?
  - Can you share one thing that you do or your organization does that is really cool?
  - Today we are studying invertebrates at the rocky seashore. Are these topics of interest to you and if so, why?
  - I know you shared a bit about your job as a scientist, but were curious to learn 2 things you love about your job?
  - What is one piece of advice you have for these young scientists?
- Student questions:
  - Give one or two students the chance to ask questions.
  - If needed, remind them about the questions they came up with earlier (K – 5th) or their Curiosity Cards (6th – 12th).

- (Have students say "Thank you!" and all clap for the science leader.)
- (Disconnect Zoom call.)

Invertebrate Experimentation (25 min)

- Introduction (5 min):
  - Introduce new way of studying invertebrates – Experimentation.
    - Define: Experimentation means to test something.
    - (Give a student the laminated word "experimentation" to place on the Word Wall.)
    - Today we are going to test what kind of body shapes are the best adaptations for living at the rocky seashore.
  - Introduce activity:
    - (Utilize Invertebrate Experimentation slide in PPT.)
    - Goal: To build an invertebrate out of clay that you think could survive at the rocky seashore.
      - You will have 10 minutes to study living rocky seashore invertebrates and think about how they are adapted to survive at the rocky seashore.
      - You will then be given a piece of clay to build an invertebrate that you think would be adapted to survive at the rocky seashore.
      - You will then place your clay invertebrate on our "rocky seashore".
        - (Show the plexiglass angled in the plastic tub.)
      - I will then create a "wave" using this bucket of water.
        - (Hold up an orange home depot bucket.)

- Any invertebrate that survives and stays stuck to the rocky seashore will win a prize.
- Questions?

- Living Invertebrates (10 min)
  - Goal: Observe living rocky seashore invertebrates and make observations about what adaptations they have to help them to survive at the rocky seashore.
    - You will have time to visit two different invertebrates before building your own.
    - Focus on what adaptations might help these invertebrates survive the waves and rocks at the rocky seashore.
    - (Have students open to page xx in their science notebook.)
    - Show them space in science notebook to write down any notes or sketch a protype invertebrate they might like to build.
    - When you are observing an invertebrate remember:
      - You may hold it gently and/or touch it with two fingers.
      - Be respectful of the invertebrates. Don't squeeze or pull them.
      - Be brave, as this your chance to learn more!
  - (Instructor and fellow to place an invertebrate in a small aquaria in front of each student.)
    - (Let students observe the invertebrate in front of them for 3 minutes.)
    - Give students one minute to make notes and draw pictures in their science notebook.
  - (Have students rotate in a circle to the next invertebrate and repeat above sequence.)
  - (Fellows: return invertebrates to tank.)

- Build an Invertebrate (5 min):
  - Goal: Remind students their goal is to build an invertebrate out of clay that will survive at the rocky seashore.
    - You will have five minutes to work. Use your notes/drawings in your science notebook to help.
    - (Give each student a piece of clay.)
    - (Set digital timer for five minutes.)
    - (Start timer.)
    - Give students a two-minute and one-minute warning.
  - (Have student stop working and bring clay invertebrates up to plexiglass in the bucket).

- Competition (5 min)
  - Once all invertebrates are attached to the acrylic panel, have students step backwards out of the "splash zone.
  - (Take the bucket and create a "wave" by dumping the water over the entire panel. BE CAREFUL not to create too strong of a wave that knocks everything off!)
  - (Take the clay invertebrates that fell off and place next to the "non-survivor" laminated card.)
  - (Take the clay invertebrates that stayed attached and place next to the "survivor" laminated card.)
  - Congratulate all winners-invertebrates that survived and give them their prize.

Process Reflection (15 min)

K – 5th Adaptation*: Utilize kinesthetic movements to represent these three body types:*

Flat body: Stand up straight with legs together and arms at sides.

Round body: Make a circle with both hands and move it them in a circle.

Large sticking area: Have students hold all their fingers up and spread out like tube feet.

- Analyze data from experiment to determine what kinds of adaptations can help invertebrates survive at the rocky seashore.
    - o
    - Ask students to look at "survivors" to find similarities that helped them stay attached to rocky seashore after the wave. Potential questions include:
        - What similarities do you notice about the survivors?
        - What do you think helped these invertebrates stay stuck to the rocky seashore?
- Rocky seashore adaptations: (Write these on the board.)
    - Flat body (students may use words such as: short, low, etc.)
        - Less impact from waves = less chance to get knocked off
    - Large sticking area (clarify that size of the sticking part is most important not simply a large size animal.)
        - Larger surface area to stay stuck to rocks.
    - **o** Round body shape – versus a blocky or more square shape.
        - Allows water to flow around you more easily.
- Great job using experimentation today to figure out adaptations for invertebrates living at the rocky seashore.
- Return to Invertebrates are Everywhere Poster
    - Ask students where they found invertebrates today – rocky seashore!
        - (Ask a student to add the laminated word "rocky seashore" to the poster.)
    - Ask students how we studied those invertebrates today.
        - (Ask a student to add the laminated word "experiment" to the poster.)
    - **o** Each day we will add invertebrates that we have studied to our poster.
        - Today we will add invertebrates to the rocky seashore.
        - Choose an invertebrate in your bin to color and then it will be added to the poster.
    - **o** (Give students a time limit to work.)
    - o (Provide students with time reminders.)
    - o (When a student is finished help them tape it to the Invertebrates Are Everywhere Poster.)
    - o Review the rest of the roadmap for the week using the Invertebrates Are Everywhere poster.

- (Have students wash hands.)
- Great job today scientists!

Deep Ocean Invertebrates & Dissection

Day 2, 3, or 4

Goal: Students will learn that invertebrates live in the deep ocean and perform a dissection to learn more about these deep-water invertebrates.

Technology:

- Large Smart Board with "CI Inverts Are Everywhere Camp" PPT loaded to desktop
  - If a guest speaker joins - connect a speaker, microphone, microphone stand, and camera.
  - If a video will be shown - connect the speaker.
  - *PLAZA DEL SOL LAB ONLY* - connect the lavalier to speaker for instructor.

Supplies:

Visual Materials:

- Community Agreements stand
- Invertebrates Are Everywhere Poster
  - Laminated words: "Deep Ocean" and "Dissection"
- Word Wall
  - Word Wall Poster
- Laminated words:
  - Dissection – to cut open a plant or animal to study its internal body parts
  - Explore – to investigate in order to learn more

Lab Materials:

- Giant Squid (1)
  - **Alert Program Manager** to reach out to xx about procuring a giant squid for squid dissection.
- Painters tape (1)
- White board (1)
- White board stand (1)
- Dry erase marker (2)
- Dry erase eraser or rag (1)
- *6th – 12th GRADE ONLY*: Curiosity Cards (3/student)
- Butcher paper or other to cover tables
- Trash bags (2)
  - To dispose of squid parts
- Squid for dissection (1/student)
- Calamari Grade squid for calamari (1/3 students)
- Box gloves (1)
  - Size small for K – 5th
  - Size medium for 6th – 12th
- Dissection tools (1 of each item/student):
  - Tweezers
  - Scissors
- Instructors' dissection tools (1/Instructor and Fellows)

- Pointer, scissors, Tweezers
- Outlines of squid (pre-cut) (1/student)
- Small art supply plastic bins filled with colored pencils, crayons, and markers (4)
- Scotch tape rolls (4)

Calamari Materials:

- Electric Wok (2)
- Oil
- Plastic containers for buttermilk and flour (4)
- Buttermilk
- Seasoned flour
- Mallet (2)
- Wax Paper
- Tongs (2)
- Small napkins (1/student + 2 additional plates)
- Roll of paper towels (2)
- Disposable gloves (2 pairs)
- Sharp knife (1)
- Cutting board (1)

Timing:

Regular Time	Activity	Learning Cycle
3:45p – 3:55p	Introduction	Engagement
3:55p – 4:05p	Science Leader Student Connection	Engagement
4:05p – 4:30p	Squid Dissection	Exploration and Guided Analysis
4:30p – 4:45p	Process Reflection	Process Reflection

Set Up

- Write daily agenda on white board and set on white board stand
- Set up technology and test for Zoom call with scientist.
- Set up visual materials:
  - Open "CI Inverts Are Everywhere Camp" PPT slides for the day.
  - Put up Word Wall Poster and set words for the day at instructor station.
  - Put up Invertebrates are Everywhere poster.
- Cover all tables with butcher paper for dissection.
- Place squid, dissection tools, and trash bags in the back of the lab.
- Place 1 pair of gloves into each students' bin.
- Precut calamari grade squid into strips and place in a bowl in the refrigerator.
- Place buttermilk in one bowl and flour in another bowl and place in refrigerator.
- Place oil, tongs, and small napkins next to wok.
- While wearing disposable gloves, clean and pre-cut all squid mantle into calamari strips, then refrigerate.
- Prep small plastic art supply bins with pre-cut outlines of squid, crayons, colored pencils and markers.

Fellow Teaching Notes

- Connect the zoom link(s).
  - Check sound.
  - Check that the camera shows as many students as possible.
- Help students to place words on the Word Wall.
- During the Dissection:
  - Pass out and collect animals
- During the Dissection you have a **Mentoring Opportunity**. Potential questions:
  - What do you notice?
  - What do you think that is? (Point to a specific body part and have students look at list of anatomy and try and figure out what the part is.)
  - What do you think that part is used for?
  - How do you think that (point to a specific body part) could help the squid survive in the deep ocean?
- During Dissection Clean-Up:
  - Place oil in electric wok.
  - Heat oil to 375°F.
  - Get pre-cut calamari, bowl of buttermilk and bowl of flour from refrigerator and bring back to wok station.
- During the Process Reflection you have a **Mentoring opportunity**: Potential questions:
  - Which part of the squid did you think was the coolest? Why?
  - Do you think learning about squid and their adaptations is important? Why?
  - Did you feel like you were doing science today? When?
- ~~Help students place their drawing on the Invertebrates are Everywhere Poster during process reflection.~~
- **Always be thinking about ASC – Accountability-Safety-Communication.**
  - During the Process Reflection beware of hot oil in electric wok bubbling.

Instructor Note: There are teaching resources for squid dissection below in Instructor Supplement.

Intro (10 min):

- Review daily agenda on the white board.
- Review the previous day using the Word Wall and Invertebrates Are Everywhere poster. Potential questions include:
  - What type of animals were we studying yesterday?
  - Where did we find invertebrates yesterday?
  - What method did we use to study invertebrates yesterday?
- Introduce squid.
  - (Utilize Squid Intro Slides on PPT.)
  - Invertebrates are everywhere including the deep ocean. Today we will spend time learning more about squid an invertebrate that lives in the deep ocean.
  - Ask students what they know about squid.
  - Squid are invertebrates and come in many shapes and sizes:

- Smallest: Thai Bobtail Squid - 0.5 inch
- Largest: Giant Squid – 49 feet
- Can be found in oceans all over the world – warm tropical water and cold seas, shallow water to deep ocean trenches.

- Show squid video. **STOP video at 1:20**.
  - https://www.youtube.com/watch?v=UxvzjrDE1Kk
  - Explain that Humboldt squid are not man-eaters.
- Today you will learn more about squid through dissection.

Science Leader Student Connection (10 min):

- Acknowledge the students who asked questions the day prior.
- Tell the students who they are meeting (their name and what they do in 1-2 sentences.)
- (Connect Zoom Call).
- (Welcome the Science and Conservation Leader.)
- (Conduct the interaction as one would an interview.)
  - Interview tips:
    - You may change the order or modify the questions based on the Science Leader's responses.
    - If a Science Leader is answering a question that may need to be wrapped up, you can move to the microphone which will signal them that you want to speak.
    - After the Science Leader answers a question, in a sentence or two, reaffirm the point they are making or acknowledge how it ties to the students' experience.
  - Potential interview questions (you do not need to use all):
    - Can you start by sharing more about yourself and how you came be the Science and Conservation Leader you are today?
    - We'd love to hear more about your work. Can you describe your work in 4-5 sentences?
    - Can you share one thing that you do or your organization does that is really cool?
    - Today we are studying squid in the deep ocean. Are these topics of interest to you and if so, why?
    - I know you shared a bit about your job as a scientist, but were curious to learn 2 things you love about your job?
    - What is one piece of advice you have for these young scientists?
  - Student questions:
    - Give one or two students the chance to ask questions.
    - If needed, remind them about the questions they came up with earlier (K – 5th) or their Curiosity Cards (6th – 12th).
- (Have students say "Thank you!" and all clap for the Science Leader.)
- (Disconnect Zoom call.)

Squid Dissection (25 min):

- Introduction (5 min)
  - Introduce dissection:
    - Today we will learn about another way to study invertebrates – through dissection.
    - Ask students to try to define dissection.
      - Dissection: to cut open a plant or animal to study its internal body parts.

- (Give a student the laminated word "dissection" to place on the Word Wall.)
- Why would we do a dissection?
  - We are want to learn more about a plant or animal.
- Today we will be doing a squid dissection to learn more about how squid are adapted for life in the deep ocean.
- Respect the squid you are dissecting as they are helping us to learn more about how the world works and to become better scientists.
- Review potential reactions to dissection:
  - Whatever you feel is appropriate.
  - Excited, nervous, etc.
  - Students can take a quick break if they need to step away but should hurry back so they don't miss too much exploring.
  - Review mantra:
    - We never say "gross!", instead we day "Ooooohh science!"

- (Pass out gloves)
- Remind students not to touch themselves after they have touched the squid even with gloves on.

- <u>External Anatomy</u> (10 min):
  - Explain external squid exploration – outside of squid.

***K – 2nd Adaptation**: Choose 2 or 3 external anatomy features to focus on. Suggested:*
- *Tentacles vs. Arms*
- *Siphon*
- *Chromatophores*

  - (Show slide of the external anatomy of the squid from "CI Inverts Are Everywhere Camp" PPT.)
  - Students will have three minutes to explore the outside of the squid.
    - They can look at it, touch it and make some observations, like what do you think each of the different parts are and what do they do?
    - Direct student's attention to the list of body parts and diagram on the SMART board students should try to figure out which parts are which.
  - (Pass out one squid for each student.)
  - (Give students 5 minutes to explore the squid.)
  - Debrief external squid exploration
  - (Fill in the external diagram on the SMART board as you go.)
  - Ask students to help you label each part of the squid and use these to lead into
  - discussion and stories about the following external anatomy features:
    - Eyes
    - Tentacles vs. Arms
      - Suction cups
    - Siphon
    - Fins
    - Mantle
    - Chromatophores

- Internal Anatomy (10 min):
  - Explain internal squid exploration – inside squid.
  - (Show slide of the external anatomy of the squid from "CI Inverts Are Everywhere Camp" PPT.)
    - Students will have three minutes to explore the inside of the squid.
      - They can look at it, touch it and make some observations, like what do you think each of the different parts are and what do they do?
      - Direct student's attention to the list of body parts and diagram on the SMART board students should try to figure out which parts are which.
  - (Explain how to use dissection tools.)
  - (Pass out dissection scissors and tweezers.)
  - (Help students to cut open squid.)
    - K – 2nd: open for them

***K – 2nd Adaptation**: Choose 2 or 3 external anatomy features to focus on. Suggested:*
- *Gills*
- *Ink Sac*
- *Beak*

    - 3rd – 10th: instruct them how to use scissors
  - (Give students 3 minutes to explore the squid.)
  - Debrief internal squid exploration with fun stories
    - (Fill in the external diagram on the SMART board as you go.)
    - Ask students to help you label each part of the squid and use these to lead into
    - discussion and stories about the following internal anatomy features:
      - Gills
      - Ink Sac
      - Heart (can be difficult to see)
      - Gonads
      - Beak
  - (Demonstrate how to remove the ink sack).
  - (Have students remove the ink sac using tweezers and place to the side.)
  - (Demonstrate how to remove all internal organs by grasping the arms and tentacles and holding the mantle down so the organs can be removed in once piece.)
  - (Have students carefully remove internal organs.)
  - (Have students locate the pen.)
  - Explain that the pen is not a backbone but an internalized shell which acts to stiffen the squid and provide a point for muscle attachment.
  - (Show students how to remove the pen.)
  - (Have students remove the pen.)
  - (Show students how to break open the ink sac and give themselves a squid ink tattoo.)
  - (Allow students to give themselves a squid ink tattoo.)
  - (Remove all squid from tables.)
    - (Place all squid into a trash bag.)
  - (Fellow should go to turn on electric wok and get pre-cut calamari from refrigerator.)

- (Have all students remove and dispose of gloves.)
- (Have students wash hands.)

Process Reflection (12 min):

- Great job today scientists! While we debrief what we learned today Chef (fellow's name) is going to prepare us calamari!
  - Explain calamari.
    - Who here has eaten calamari before? What was your experience like?
    - The mantle, arms and tentacles of squid are edible.
    - Squid fishery is one of the most important fisheries in the United States and California.
    - Squid is the fifth-largest fishery in the United States by weight.
    - The majority is frozen and exported to China where it is processed and sold throughout the world.
    - Squid has been harvested in the California since the 1860's.
    - Squid is the biggest commercial fishery by weight in California.
    - Squid can be eaten many ways, seared, grilled, eaten raw as sashimi or breaded and fried as calamari to name a few. Today you will have a chance to taste squid when our fell chef xx takes out dissected squid and makes us some calamari!
- Return to Invertebrates are Everywhere Poster
  - Ask students where they found invertebrates today – deep ocean!
    - (Ask a student to add the laminated word "deep ocean" to the poster.)
  - Ask students how we studied those invertebrates today.
    - (Ask a student to add the laminated word "dissection" to the poster.)
  - Each day we will add invertebrates that we have studied to our poster.
    - Today we will add squid.
    - Take a squid from your bin to color and when you finished add it to the poster.
  - (Give students a time limit to work.)
  - (Provide students with time reminders.)
  - (When a student is finished help them tape their squid to the Invertebrates Are Everywhere poster.)
  - Review the rest of the roadmap for the week using the Invertebrates Are Everywhere poster.
- (Have students wash hands.)
- (Students pick up a napkin with calamari and head to their snack spot.)
  - (Have students wash hands.)
- Great job today scientists!
-

Open Ocean Invertebrates & Genetics

Day 2, 3, or 4

Goal: Students learn that invertebrates live in the open ocean and use genetics to learn more about these open ocean invertebrates.

Technology:

- Large Smart Board with "CI Inverts Are Everywhere Camp" PPT loaded to desktop
  - Virtual guest speaker - connect a speaker, microphone, mic stand, and camera.
  - If a video will be shown - connect the speaker.
  - *PLAZA DEL SOL LAB ONLY* - connect the lavalier to speaker for instructor.

Supplies: (For one group of 10 students)

Visual Materials:

- Community Agreements stand
- Invertebrates Are Everywhere Poster
  - Laminated words: "Open Ocean" and "Genetics"
- Word Wall
  - Word Wall Poster
  - Laminated words:
    - Microscopic – something you need a microscope to see
    - Genetics – the study of DNA

Lab Materials:

- Painters tape (1)
- *6th-12th GRADE ONLY*: Curiosity Cards (3/student)
- E-Gel iBase Power System (1/ 2 students)
- E-Gel Safe Imager Real-time Transilluminator (1/2 students)
- E-Gel (1/2 students)
- Pipettes locked to 8ul (1/2 students)
- Disposable pipette tips (1/2 students)
- 5 types of DNA
- Outlines of plankton (pre-cut) (1/student)
- Small art supply plastic bins filled with colored pencils, crayons, and markers (4)
- Compound Microscopes (5)
- Plankton Slides Case (there are 2 cases – one with 5 slides, the other with 25 slides)

Timing:

Time	Activity	Learning Cycle
3:45p – 3:55p	Introduction	Engagement
3:55p – 4:05p	Science Leader Student Connection	Engagement

4:05p – 4:30p	DNA Analysis Lab	Exploration and Guided Analysis
4:30p – 4:42p	Process Reflection	Reflection

Set Up

- Write daily agenda on white board and set on white board stand
- Set up technology and test for Zoom call with scientist.
- Set up visual materials:
  - Open "CI Inverts Are Everywhere Camp" PPT slides for the day.
  - Put up Word Wall Poster and set words for the day at instructor station.
  - Put up Invertebrates are Everywhere poster.
- Set up gel electrophoresis machines (see below).
- Set up and plug-in microscopes along the sides of the lab.
  - Place a concave glass slide under each microscope
- Retrieve plankton jar from aquarium and check to make sure plankton is living.*
  - *If there is no living plankton place plankton slides next to microscopes.
- **Make sure there is one good "sample" e-gel with all the plankton DNA run clearly so that students can look at that sample if theirs is not clear.***
  - * This sample gel can be kept for as long as it is clearly readable. You will not need to create one every day.
- Prep small art supply bins with pre-cut outlines of plankton, crayons, colored pencils and markers.

Fellow Teaching Notes

- Connect the zoom link(s).
  - Check sound.
  - Check that the camera shows as many students as possible.
- Help students to place words on the Word Wall.
- During the DNA Analysis Lab:
  - Help students to use micropipettes and load DNA into e-gels
  - Be sure students are loading the correct DNA into each well.
  - Be sure all students are taking a turn using the micropipette.
- During the Plankton Activity:
  - Help pass out plankton sample.
  - Help students focus microscopes and identify plankton.
  - Collect plankton samples from microscopes and return to larger sample bottle.
  - Take the large plankton sample bottle back to the area where it is being stored.
- During the process reflection, you have a **Mentoring opportunity**: Potential questions:
  - What would you tell a friend about genetics?
  - Did you feel like you were doing science at any point today? When?
  - Was there any time today that you were doing something difficult and it frustrated you? What did you do when that happened?
  - Can you think of a reason it would be important to know what juvenile invertebrates will become as adults?
- Help students tape their plankton to the Invertebrates Are Everywhere Poster.
- **Always be thinking about ASC – Accountability-Safety-Communication**.

Gel Electrophoresis Instructions

Using the E-Gel iBase Power System and Transilluminator

Materials: E-Gel iBase Power System
E-Gel Safe Imager Real-time Transilluminator
E-Gel
Pipettes locked to 2uL (total 4uL in each well – can use more than 4 uL if you have more students)
Disposable pipette tips
5 types of DNA

Set Up

Before Students arrive

1. Remove plastic on e-gel and slide the E-Gel into the designated spot on the iBase. (put in right side first then left)
2. Close the light protector
3. Plug the device but don't turn on until after you have loaded the gels with the students (switch can be found in the back of the machine).

With the Students

1. Once the students have learned how to use the pipettes, they may pipette the DNA into the wells, using a new disposable tip for each sample. Each student can micropipette 2uL of DNA. You want the total of each sample in each well to be a max of 4 uL.
2. Once all the wells are full close the door and plug in the device and turn to "on" position (switch in the back)
3. Now it is safe to plug in the machine and 'run the gel'
4. Click "set up run" and select "E-gel 0.8%-2%" to match the type of gels that we have.
5. Select the timing. You can choose 15 minutes but if running low on time, you can choose down to 10 minutes.
6. Press the "Go" button to start the gel
7. To watch the gels run or check on their progress press the "back light" button on the transilluminator. (CAUTION: make sure lid is closed before turning on the light)

Clean up

1. Disconnect the power cord.
2. Remove the gel from the iBase by simply sliding the gel out the opposite way it was put in.
3. These gels are non-toxic and can be thrown away in the trash.
4. Store machines and tools in their appropriate places and store all left over gels and equipment at room temperature.

***6th - 10th Adaptation**: Use the word Planktonic – organisms that can not swim against the current and;*

Nektonic: organisms that can swim against the current.

Intro (10 min):

- Review daily agenda on the white board.
- Review the previous day using the Word Wall and Invertebrates Are Everywhere poster. Potential questions include:
    - What type of animals were we studying yesterday?
    - Where did we find invertebrates yesterday?
    - What method did we use to study invertebrates yesterday?

***Fun fact**:*
Not all plankton grows up to be something else!

Holoplankton: are plankton that remain as plankton their whole life

Meroplankton: are plankton that only spend the beginning of their life as plankton and then grow up to become nekton (organisms that can move against the current).

- Introduce plankton.
    - Invertebrates are everywhere including the open ocean. Today we will study one group of invertebrates that live in the open ocean – plankton.
    - Ask students what they know about plankton.
    - Define plankton: organisms that cannot swim against the current.
        - Example: Jelly
        - (Show picture of jellies slide in PPT.)
    - (Give a student the laminated word “plankton” to place on the Word Wall.)
    - Plankton come in many different shapes and sizes.
        - (Show example of plankton slide in PPT.)
    - The interesting thing is that some of these plankton will grow up to become invertebrates we are familiar with like snails, crabs, mussels, etc.
        - (Show example of juvenile plankton that grows up to be a barnacle on PowerPoint.)
        - Explain that while the barnacle is young it is plankton- floating along in the ocean wherever the currents take it until it becomes an adult barnacle and settles down on

***6th - 10th Adaptation**: When talking about DNA add the following information:*
<u>The more closely related you are the more similar your DNA:</u>

Do you think your DNA looks more like your classmates' or more like a fish? *Your classmates because you are both human.*

Would your DNA look more similar to your classmates' or to your sibling? *Your sibling because you are related.*

        - a rock, piling, etc.
- Introduce new way of studying invertebrates – Genetics
    - As a scientist, it would be very interesting to know what these plankton will grow up to be, but how can we know that when they look so different between their planktonic and adult stage?
        - Ask students if there is any way they can think of to do this?
        - Hint: Is there anything about you that doesn't change your whole life even though you look very different from the time you are a baby to a teenager to an adult?
    - Define: Genetics is the study of DNA.
    - (Give a student the laminated word "Genetics" to place on the Word Wall.)
- Introduce DNA.
    - One way we could match baby plankton forms to their adult form is through their DNA.
    - Every living thing has DNA.
    - (Use DNA slide on PPT.)
    - <u>Every living thing has different DNA</u>: Like a fingerprint; it can be used for identification.
        - DNA never changes even though a living thing might change appearance.
        - A caterpillar which turns into a butterfly has the same DNA even though it looks very different at different stages of its life.
            - (Show caterpillar to butterfly slide in PPT.)
    - That means we could use DNA to match baby plankton to its adult form because even though some plankton changes its DNA does not.

<u>Science Leader Student Connection</u> (10 min):
- Acknowledge the students who asked questions the day prior.
- Tell the students who they are meeting (their name and what they do in 1-2 sentences.)
- (Connect Zoom Call).
- (Welcome the Science and Conservation Leader.)
- (Conduct the interaction as one would an interview.)
    - <u>Interview tips</u>:
        - You may change the order or modify the questions based on the Science Leader's responses.

        - If a Science Leader is answering a question that may need to be wrapped up, you can move to the microphone which will signal them that you want to speak.
        - After the Science Leader answers a question, in a sentence or two, reaffirm the point they are making or acknowledge how it ties to the students' experience.
    - Potential interview questions (you do not need to use all):
        - Can you start by sharing more about yourself and how you came be the Science and Conservation Leader you are today?
        - We'd love to hear more about your work. Can you describe your work in 4-5 sentences?
        - Can you share one thing that you do or your organization does that is really cool?
        - Today we are using genetics to studying plankton. Are these topics of interest to you and if so, why?
        - I know you shared a bit about your job as a scientist, but were curious to learn 2 things you love about your job?
        - What is one piece of advice you have for these young scientists?
    - Student questions:
        - Give one or two students the chance to ask questions.
        - If needed, remind them about the questions they came up with earlier (K – 5th) or their Curiosity Cards (6th – 12th).
- (Have students say "Thank you!" and all clap for the Science Leader.)
- (Disconnect Zoom call.)

DNA Analysis Lab (25 min)

- Introduction: (3 min):
    - Your job today is to determine what this plankton is going to be when it grows up.
        - (Show Mystery Plankton slide in PPT.)
    - We have a sample of this plankton's DNA.
        - (Show DNA vial.)
    - We suspect this plankton may become one of these five adult organisms.

6th - 10th Adaptation:
- *Refer to machines as gel electrophoresis machines throughout the lab.*

        - (Show Potential Adult Plankton slide in PPT.)
    - We also have DNA samples from these five adult organisms.
        - (Show other vials of DNA.)
    - Your job is to figure out which adult organism this plankton is going to grow up to be using DNA.
    - Can we tell which is which just by looking at these vials of DNA?

- *6th - 10thAdaptation: Explain how gel electrophoresis works:*
- *After you load the DNA into the wells when you turn the machine on it creates an electrical current which pulls the DNA through the gel. DNA is*

negatively charged so it moves toward the positive end (the end furthest away from the wells). The heavier the piece of DNA the less quickly it will travel- therefore the pieces closest to the wells are the heaviest and the pieces furthest away are the lightest.

- DNA is microscopic. We need a special machine to take the DNA and convert it to a visible code we can look at.

- Gel Electrophoresis machines & E-gels: (7 min)
  - These machines will help us to do that.
    - (Show gel electrophoresis machines.)
  - Place a small sample of each adult organism's DNA and the mystery plankton's DNA onto a gel so we can compare them and find a match.
    - (Show e-gel.)
    - (Show a blow-up of e-gel slide on PPT.)
  - Make sure you put only one organism's DNA into each hole so you can see each adult organism's DNA and the plankton's DNA separately.
    - There are 12 holes, but we only need to use the first six.
    - Load the adult DNA samples into wells 1-5 and the mystery plankton's DNA into well 6.
      - (Show Loading E-gel slide in PPT.)
  - The holes in the gel are really tiny and we only need a very small amount of DNA so we will use micropipettes.
  - (Hold up micropipette and demonstrate how to use it.)
  - Be sure everyone gets a turn using the micropipette and loading DNA into at least one hole.
  - Once your gel is loaded, we will turn the machines on and let them process the DNA and turn it into a something visible we can compare.
  - (Walk around and help students load gels. Help them place the tips into the wells. This can be difficult at it requires strong motor coordination.)
  - (Once a gel is loaded choose the e-Gel program to run and place the Safe Imager Real-time Transilluminator cover over the machine.)
  - (**Make sure the electrophoresis machine is set to the correct program: xx**)
  - (Have the student's push the button to start the program.)
  - (Tell students not to take the cover off while the machine is running- the light can damage their eyes.)
  - (Show them where the light it so they can see the gel beginning to run with the cover on.)
  - (**Collect all DNA samples and place in refrigerator**.)
  - (Let machine's run while having students move to next activity.)

- Plankton Activity (15 minutes)
  - Tell students they are going to get a sample of living plankton to look at under the microscope.*
    - *If there is no living plankton use plankton slides instead.
  - (Show students how to use microscopes.)
    - Turn on light

        - How to use eye pieces
        - Course and fine focus knobs
    - Show student the Plankton ID cards next to the microscopes. Explain they can be used to identify some the plankton they might see.
    - (Hand out samples of plankton.)
    - When two minutes of time remain, call group together.
        - Ask students to turn off microscope lights
        - Collect plankton samples
    - Ask students to say which of the plankton from their ID card they saw.

<u>Process Reflection</u> (12 min):

- **Teaching note: The mystery plankton will grow up to be the adult whose DNA looks almost the same as the DNA in hole 6, because it will be from the same organism.**
- **Not all gels will be easy to read because students will over or underfill the wells in their e-gel. Allow students to look at the sample e-gel or another group's e-gel if theirs is unclear or to streaky to read.**
- Return to e-gels.
- (Ask students to turn on light and look through Safe Imager Real-time Transilluminator cover and see their completed gels.)
    - Remind students that they are trying to figure out which adult their plankton in hole six will grow up to be.
    - (Give students 2-3 minutes to consider the question and talk with mentors or their partner.)
- Bring the group together again and have them share out their responses. Ask them what scientific evidence they are using to make their decision.
    - DNA can be used to identify organisms.
    - You can see the barnacle's DNA is the same from when they were a plankton and is still the same when they are an adult.
    - You could do the same for any plankton to figure out what it will become as an adult!
- Return to Invertebrates are Everywhere Poster (5 min).
    - Ask students where they found invertebrates today – open ocean!
        - (Ask a student to add the laminated word "open ocean" to the poster.)
    - Ask students how we studied those invertebrates today.
        - (Ask a student to add the laminated word "genetics" to the poster.)
    - Each day we will add invertebrates that we have studied to our poster.
        - Today we will add plankton.
        - Take a plankton from your bin to color and when you finished add it to the poster.
    - (Give students a time limit to work.)
    - (Provide students with time reminders.)
    - (When a student is finished help them tape their plankton to the Invertebrates Are Everywhere poster.)
    - Review the rest of the roadmap for the week using the Invertebrates Are Everywhere poster.
- (Have students wash hands.)

Making a Difference

Day 5

Goal: Students will learn how they can help protect invertebrates that live in their local canyon by removing invasive plants which take the place of native species that provide habitat for local invertebrates.

Technology:

- Large Smart Board with "CI Inverts Are Everywhere Camp" PPT loaded to desktop
    - If a guest speaker joins - connect a speaker, microphone, microphone stand, and camera.
    - If a video will be shown - connect the speaker.
    - *PLAZA DEL SOL LAB ONLY* - connect the lavalier to speaker for instructor.

Supplies: (For one group of 10 students)

Visual Materials:

- Community Agreements stand
- Inverts are Everywhere Poster
- Painters Tape
- Word Wall
    - Word Wall Poster
    - Laminated words
        - Invasive - a species that is not normally found in that area
        - Make a Difference – work scientists do to take information and help the world

Lab Supplies

- White board (1)
- White board stand (1)
- Dry erase marker (2)
- Dry erase eraser or rag (1)
- Gloves (20)
- Shovels (20)
- Invasive and Native Plant ID cards w/ lanyard (20)
- Blue Buckets (20)
- Spring scale (2)
- Rope – to hang the spring scale from (1)
- Calculator (1)
- Thought bubble cut outs (10)
- Prize (1)
    - Could be a "going to college" t-shirt

Timing:

Time	Activity	Learning Cycle
3:45p – 4:00p	Introduction	Engagement
4:00p – 4:35p	Invasive Plant Removal	Exploration

4:35p – 4:45p	Process Reflection	Guided Analysis & Reflection

Set Up

- Write daily agenda on white board and set on white board stand
- Set up visual materials:
  - Open "CI Inverts Are Everywhere Camp" PPT slides for the day.
  - Put up Word Wall Poster and set words for the day at instructor station.
  - Put up Invertebrates Are Everywhere Poster.

Fellow Teaching Notes

- Help students to place words on the Word Wall.
- During Intro:
  - Hand out supplies.
- During Invasive Plant Removal:
  - Help students use Plant ID cards to identify invasive plants.
  - Okay plants for removal.
  - Watch out for students removing native species.
- During the Invasive Plant Removal you have a **Mentoring opportunity**: Potential questions:
  - Why do you think it's important for us to be removing some of these plants in the canyon?
  - Is there anything else you think we could do to help protect the invertebrates we've studied this week?
- During Analyze Invasive Plants:
  - Help the students with the calculator add up the total amount of trash that you find.
  - Support students measuring at the spring scale.
- Help students tape thought bubbles to the Invertebrates are Everywhere Poster.
- **Always be thinking about ASC – Accountability-Safety-Communication.**

Intro (15 min):

- Review daily agenda on the white board.
- Review the previous day(s) using the Word Wall and Invertebrates Are Everywhere poster. Potential questions include:
    - What type of animals were we studying yesterday? Previous days?
    - Where did we find invertebrates yesterday? Previous days?
    - What method did we use to study invertebrates yesterday? Previous days?
- This week we have learned invertebrates can be found everywhere.
    - We have discovered invertebrates in the canyon, at the rocky seashore, in the open and deep oceans.
    - We have also learned that there are many ways to study invertebrates, this week we used observation, experimentation, genetics and dissection to learn more about them.
- Introduce Making a Difference.
    - As scientists it is important that we not only learn about science, but we also take that information and try to make a difference in the world.
    - Reference any Science Leaders they met throughout the week that are making a difference. (i.e. Remember (scientist's name)who we talked to on Zoom? They are studying xx and helping to make a difference by xx. Also we met xx who….)
    - (Give a student the laminated words "Make a Difference" to place on the Word Wall.)
    - Today YOU will work to make a difference in the world.
    - Will return to the canyon where we started our week.
        - Ask students to name some the invertebrates that they saw in the canyon.
    - Today we will return to the canyon to help those invertebrates.
    - Introduce invasive.
        - All of the plants that we saw in the canyon are not actually supposed to be there – they are called invasive species.
        - Definition: a species that is not normally found in that area
        - (Give a student the laminated words "Invasive" to place on the Word Wall.)
        - These invasive plants are not naturally found in the canyon and should not be there. Invasive plants are bad because they take up space that native plants – plants that belong in the canyon – would normally use.
        - Native plants provide habitat for the invertebrates that live in the canyon.
        - (Give a student the laminated words "Invasive" to place on the Word Wall.)
        - Ask students if they think it would be better for invertebrates to have more invasive or more native plants in the canyon. Why?
            - We want more native plants because they provide food, places to hide and homes for the invertebrates.
        - Today we will help make a difference in our canyons by removing some invasive plants.
    - (Pass out plant id cards.)
    - Show students both sides of the plant id cards.
        - Native side and invasive side.
    - When you are in the canyon today and you think you have found an invasive plant- call over a staff member to confirm.
    - Then you can work with your hands and a shovel to remove the invasive plant.

        - It is best to remove as much of the root structure as possible so the invasive plant does not grow back.
    - Place the invasive plant into your blue bucket.
    - At the end of the day we will weigh the trash bags to see how many pound of invasive plants are removed today!
    - (Hand each student a pair of blue bucket, gloves, and a trowel.)

Invasive Plant Removal (20 min):

- (Walk students out into canyon.)
- Explain physical boundaries that students can work within.
    - (Post an adult at each boundary and make sure all students are within the sight of at least one adult.)
- (Give five and two-minute warnings.)
- (Count students and walk back to lab.)

Analyze Invasive Plants (15 min):

- (Utilize Student Expert Roles slide in PPT.)
- Create/assign student expert roles:
    - Data scribe (1): Will write invasive plant weights on the smartboard
    - Mathematician (1): Will use the calculator to add total amount of pounds of invasive plants
    - Lab technician (1): Will gather all the invasive species from the buckets into a large trash bag to be disposed of.

- Weigh Invasive Plants:
    - Have **each student** place their blue bucket on the spring scale and share the weight in pounds to group.
    - (**Data scribe** will record all the answers)
    - Have **each student** place the invasive from their blue bucket into the trash bag the **Lab technician** has**.**
    - Have **each student** place their blue bucket in a pile to the side.
    - (Repeat the above until all blue buckets have been weighed.)
    - **Mathematician** will add the total pounds of invasive plants removed and announce the total to the group.

Process Reflection (10 min):

- Debrief the invasive plant removal. Potential questions include:
    - What surprised you about the amount of invasive plants in the canyon?
    - How does removing invasive plants help invertebrates?
    - What could be a next step to help the invertebrates in the canyon?
- Great job making a difference today scientists!
- Together you cleaned up xx pounds of invasive plants from the canyon. Together OS Camp students have cleaned up xx pound of invasive plants this summer! That's amazing!
- You have helped the invertebrates that live in the canyon by removing invasive plants and making room for native plants that provide food and housing for invertebrates.

- As scientists this week we have learned about many different invertebrates that live in different places.
    - (Point to poster.)
- Have students brainstorm other ways humans can protect invertebrates from the land to the rocky seashore to the ocean.
    - What other ways could we make a difference for other invertebrates?
    - (Try to get students to think of ways to help invertebrates in each of the areas they explored.)
- (Give each student a thought bubble)
    - Ask each student to share how people can make a difference to protect the invertebrates that live there and to write than in the thoughts bubble.
- Have each student come up and place their thought bubble on one of the invertebrates on the poster that their statement would be helping.

Science and Conservation Leader: Virtual Meeting

Program Overview: The students you will be talking to are part of our Community Initiative, which is our most encompassing initiative, and serves all young people and their families. The Community Initiative focuses on exposing members of the community to the breadth of STEM fields as well as the process of science.

Students are participating in a week-long after school science camp to explore their pathway as science and conservation leaders. They are learning about how invertebrates can be found everywhere, from canyons to the deep ocean, and there are many ways to study them (see full story on the reverse side). In addition to growing their marine science knowledge, they also take concrete steps to make our world a better place.

Virtual Meeting Focus: Expose our students to a diversity of local science and conservation leaders. Students want to hear about you, your career path and your current job.

Virtual Meeting Details:

- Your meeting will last 10 minutes.
- It will be conducted like an interview by one of our staff.
- Students will also have an opportunity to ask questions.

Things to Talk about with Students:

- Where did you grow up?
- Where did you go to college/graduate school? Major?
- What got you interested in your field?
- Describe (in student friendly terms) what your job is.
- Something "cool" or interesting you or your company does.
- What you like best about your job.
- If you are an Ocean Leader alumni:
    - *o* 1-2 favorite memories of Ocean Discovery Institute programs.
- Why you care about invertebrates (plankton, squid, insects, rocky seashore invertebrates, etc.)
    - o This does not need to be a direct connection to your job, it can be of a more personal nature.

Ocean Discovery will provide:

- A list of student names + grade levels
- List of virtual teaching tips (see other side)
- Reminder email the day before Virtual Program
- Start and end to Virtual Meeting on Zoom

We are so excited to have you interact with our students! Thank you so much for your participation. If you have questions, please contact Joanna Vance at 619-795-8365 ext. 123 or at jvance@oceandi.org.

Teaching Tips

Scale Your Language – The age of the students you are talking to will vary. Consider the types of words you would use for the age level you are speaking with.

Use Student Names – Ocean Discovery staff will provide student names whenever possible. Feel free to ask a student their name and then use it.

Ask Questions - Questions are a great way to engage your audience. Students love to participate.

- Example: Does anyone here know what a Chemist does?
- Example: I study plankton in the ocean. Who knows what plankton is?

Incorporate Physical Movement – Whenever possible have students get up and join you in a movement to help them understand a concept.

- Example: "I collect samples during low tide." Have students stand up and then bend down close to the floor, extend their arms and say "low tide"! Repeat a few times.

Invertebrates Are Everywhere Story

During Ocean Adventurers, students investigate the world of invertebrates. They learn that invertebrates are found everywhere, from canyons to the deep ocean, and that there are many ways to study these unique and interesting organisms. Throughout the week, students improve their understanding of these scientific concepts and build their belief that science is something they can do, and a scientist is someone they can become.

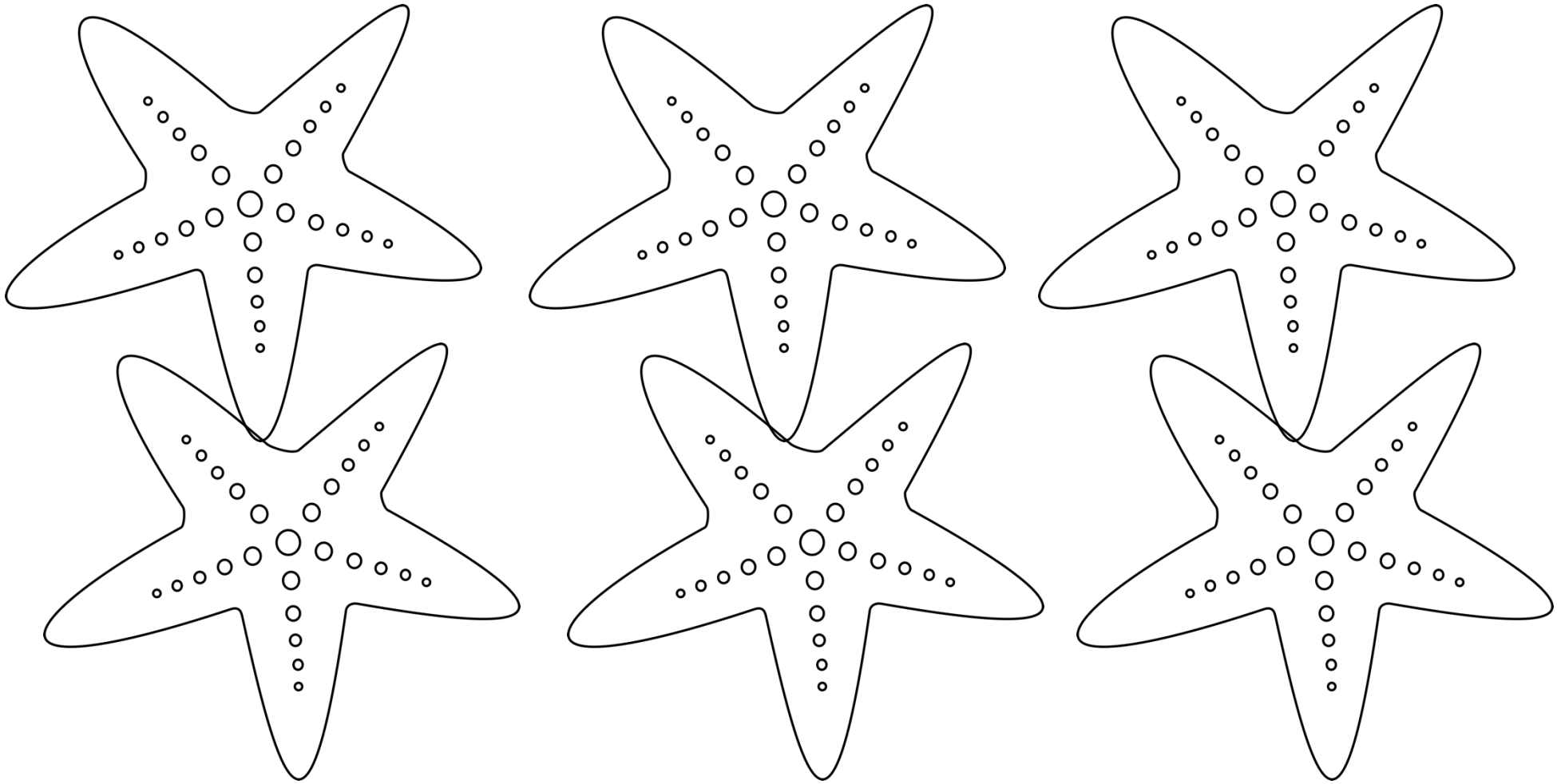
On day one, students build their sense of belonging by learning that they are part of the Ocean Discovery family and getting to know some of the staff and the facility where they will be meeting each day. Students learn that they are on the pathway to becoming a science and conservation leader and watch a video of Ocean Discovery alumni discussing their experiences at different stages along the pathway. Students participate in an Ocean Discovery Challenge, racing other teams around the canyon to collect invertebrates and share information about themselves and their experiences with their fellow scientists. By the end of the day the theme of the week- invertebrates is revealed.

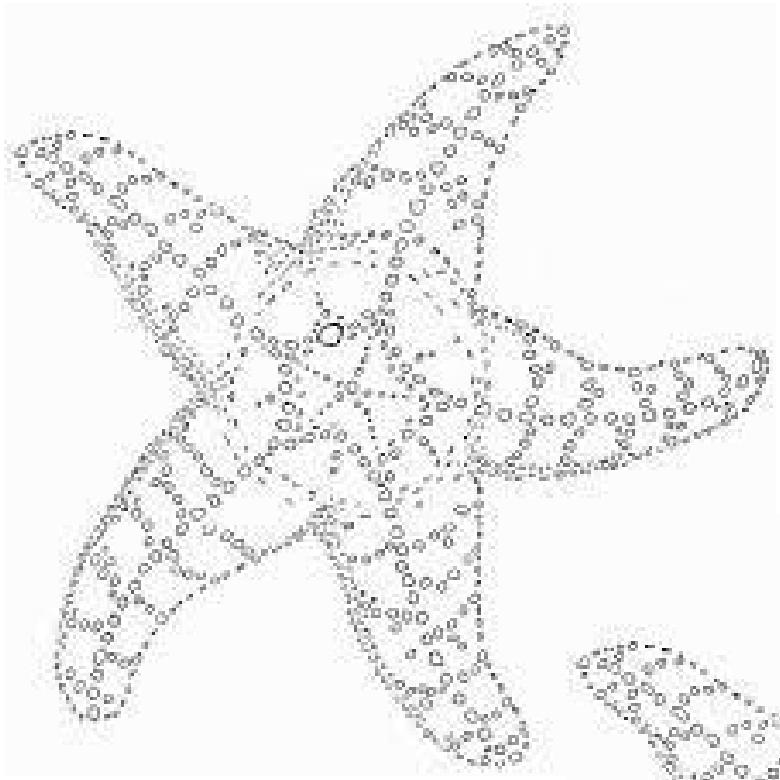
Over the next three days students discover some of the fascinating ways to study invertebrates that live throughout the world. On one of the days, they dissect a squid and explore its internal and external anatomy to discover some of the unique adaptations these intelligent invertebrates have for survival in the deep ocean. After the dissection, calamari is prepared and cooked, while students learn about the multi-million-dollar squid fishery in their home state of California. On another day, students perform an experiment to study how invertebrates are adapted to the harsh physical conditions of the rocky seashore. Students observe living rocky seashore invertebrates with the goal of preparing to build their own invertebrate they believe will have the physical adaptations necessary to survive at the rocky seashore. A competition follows where students test the survivability of their invertebrate by placing it on a "rocky seashore" and subjecting it to a "wave". Students then analyze the "survivors" to discover which adaptations work best for surviving at the rocky seashore. On another day, students use genetics to learn about plankton – an invertebrate that lives part or all of its life in the open ocean. Students discover that many plankton have wildly different juvenile and adult forms which can make it difficult for scientists to know what the juvenile invertebrates will grow up to be. Students explore how DNA can be used to "solve this mystery" using scientific tools such as, micropipettes and gel electrophoresis.

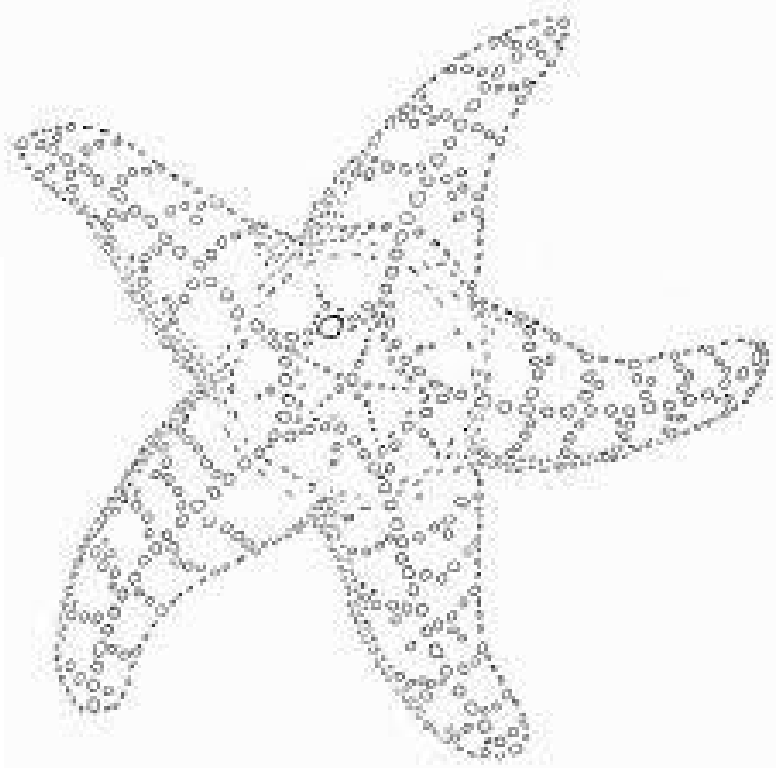
On their final day of the program, students return to the canyon and apply their new scientific knowledge to make a difference by removing invasive plants species to create more space for native plant species that act as habitat for local invertebrates.

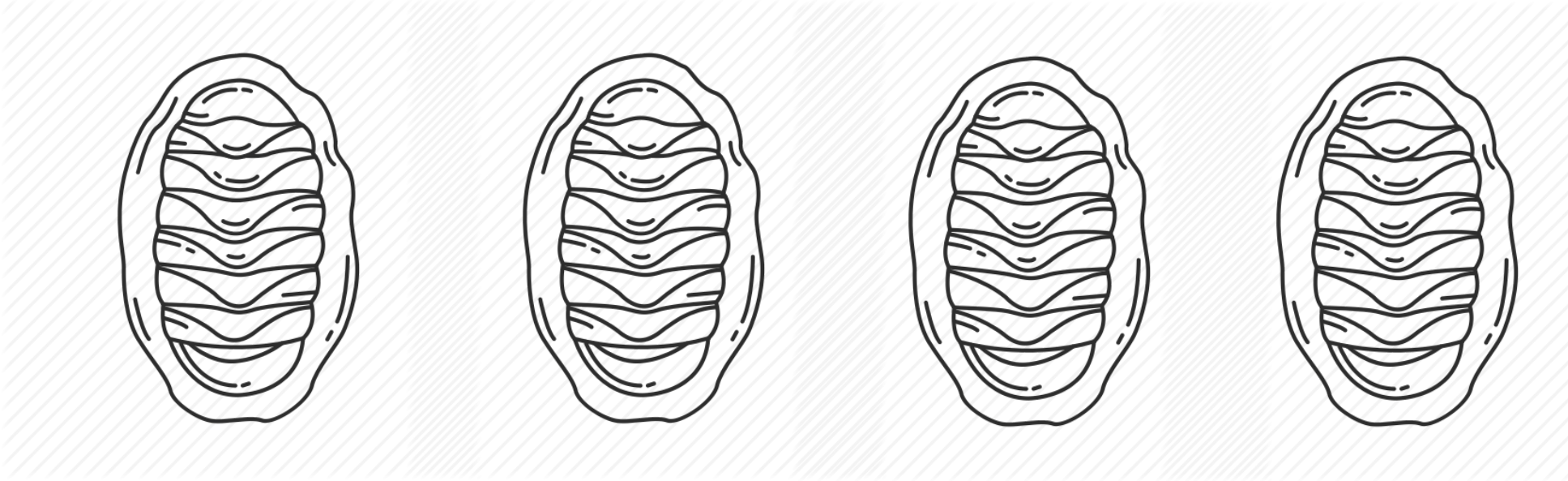
MATERIALS FOR LESSON

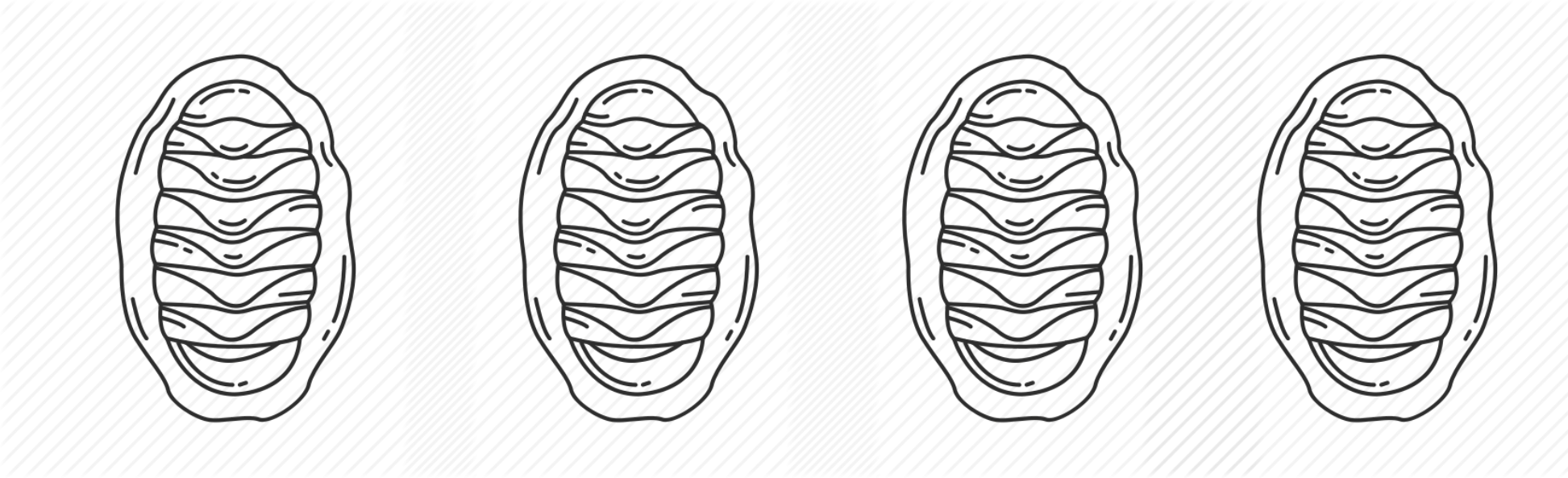
OUTLINES ROCKY SEASHORE INVERTEBRATES

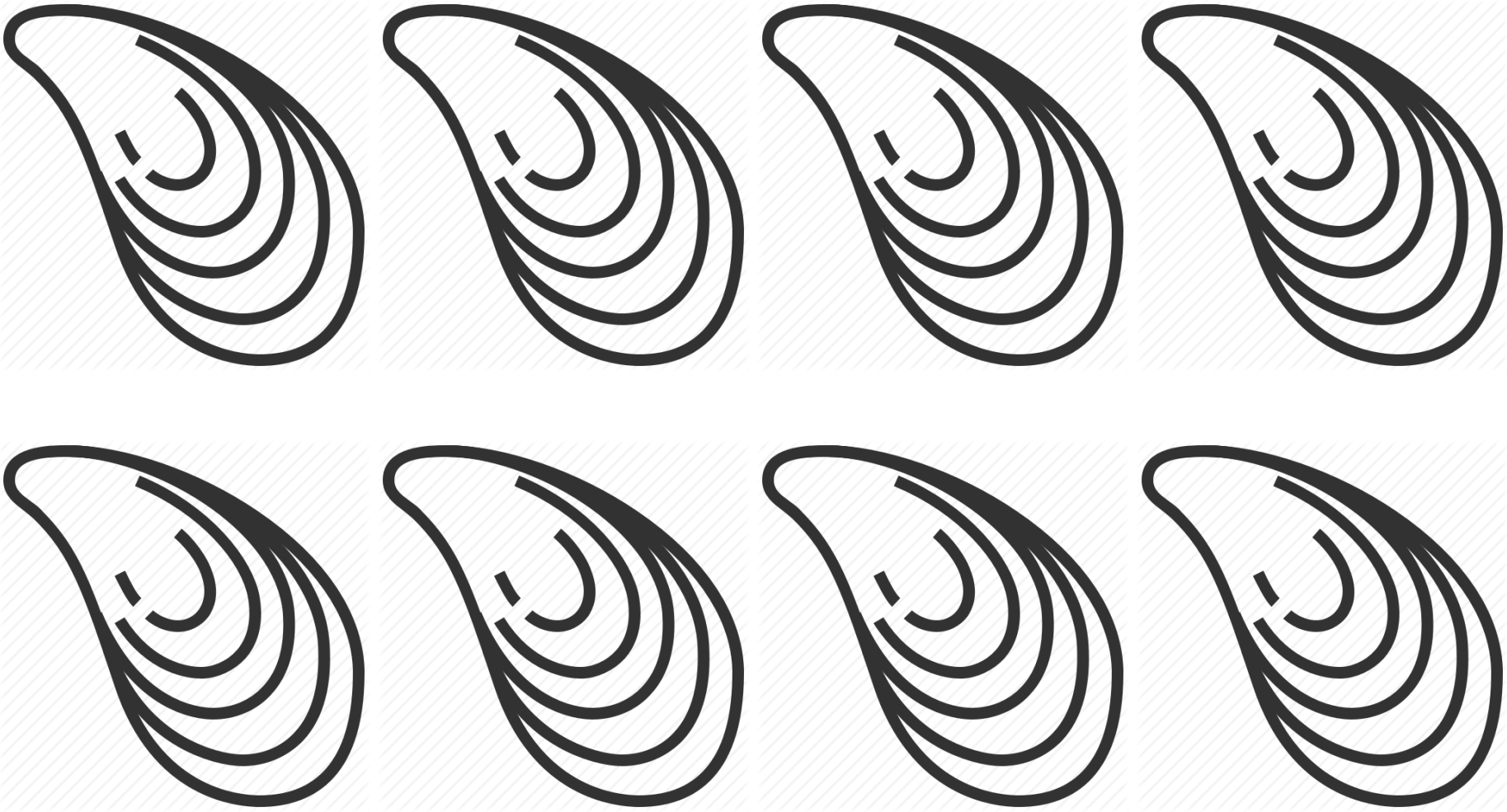


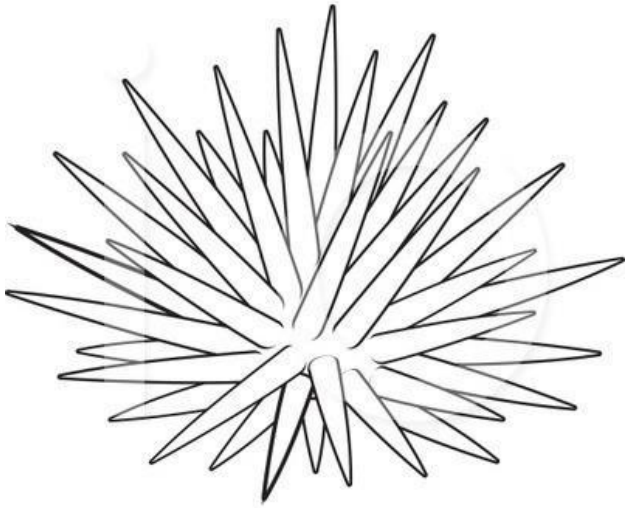
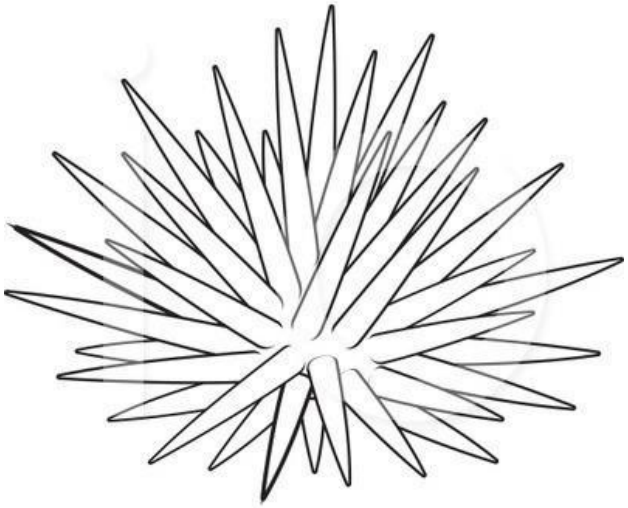
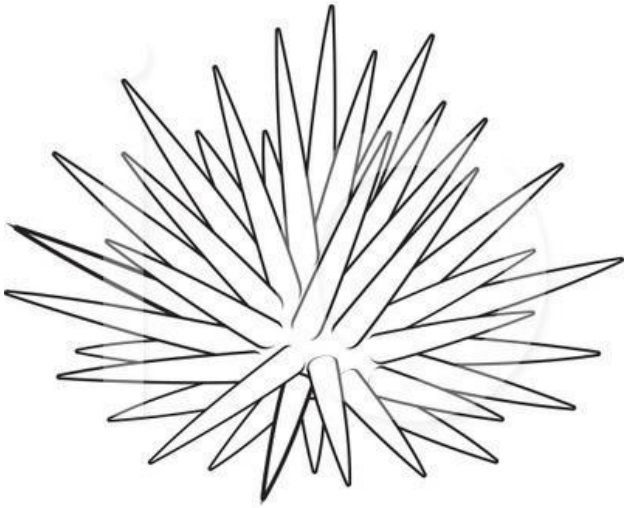
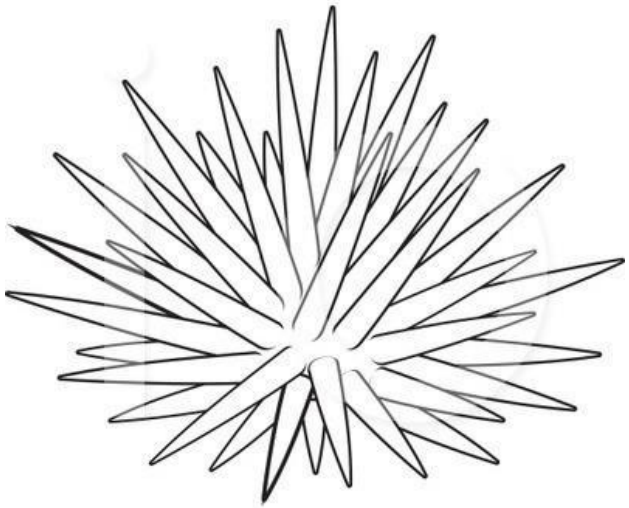
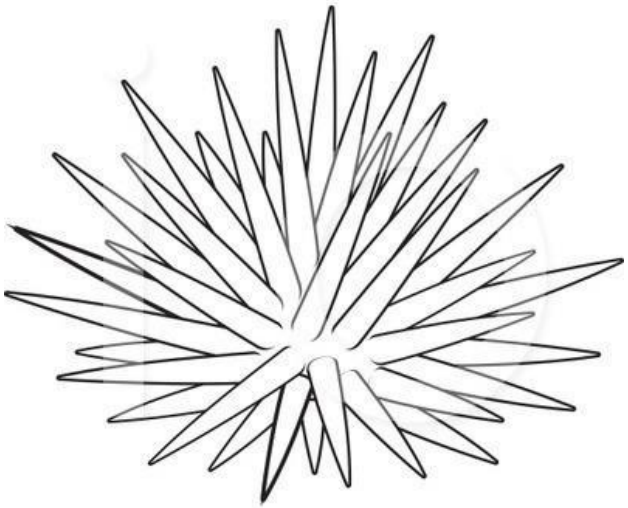
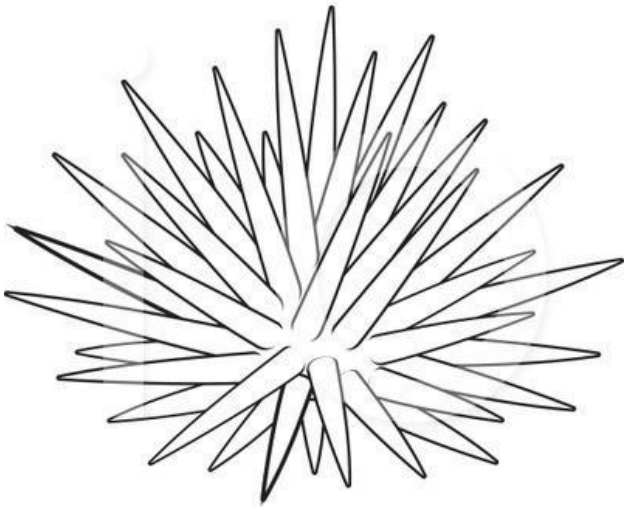


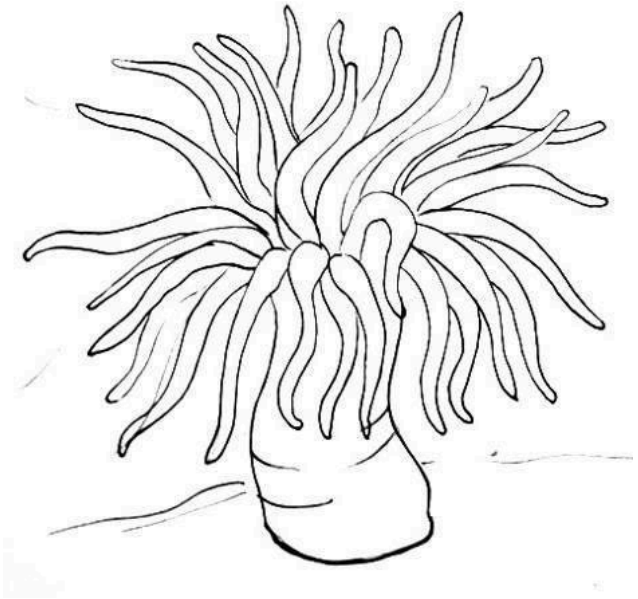


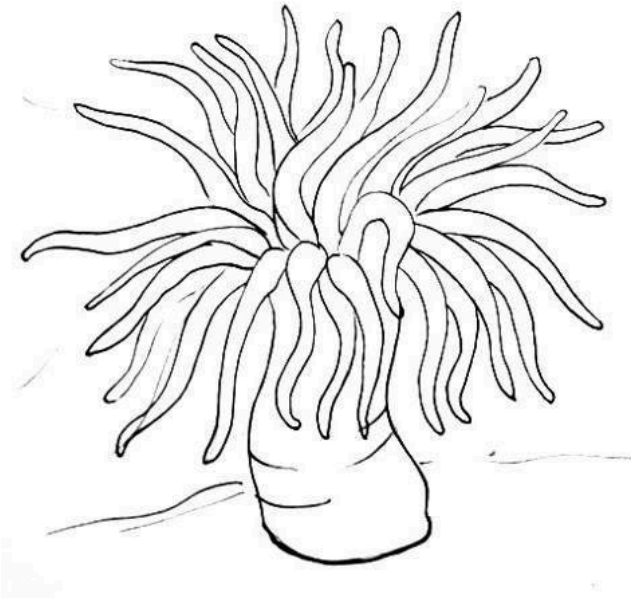


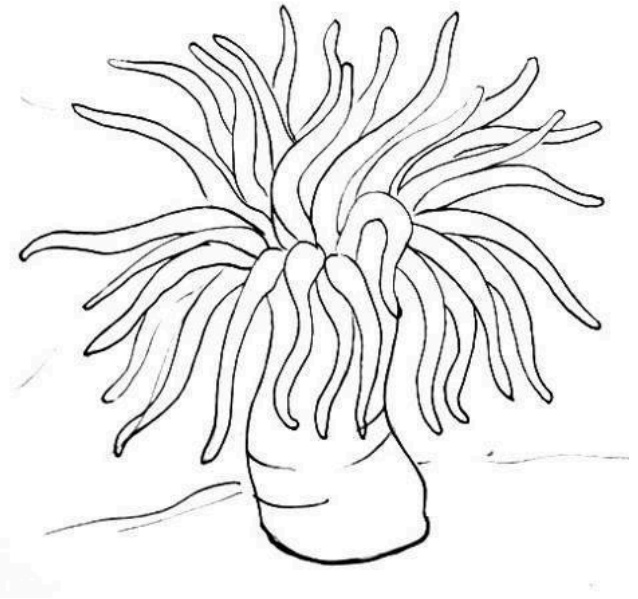


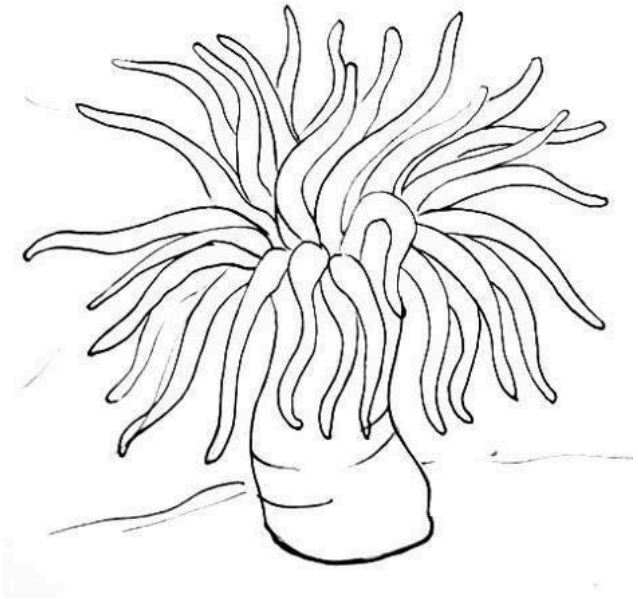


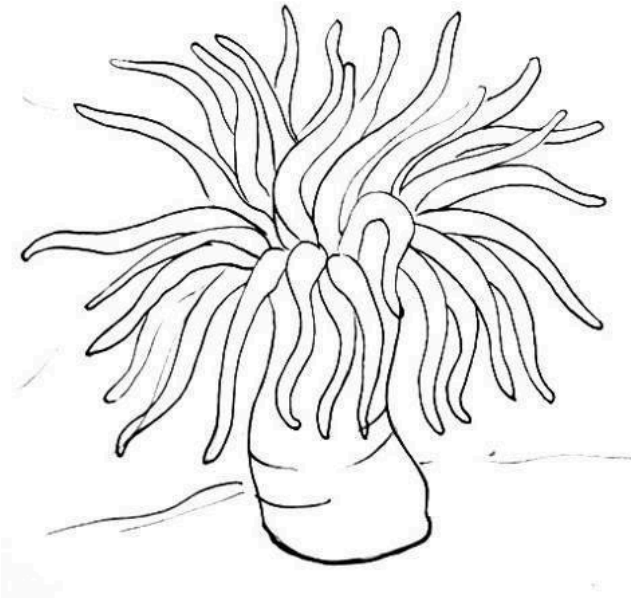







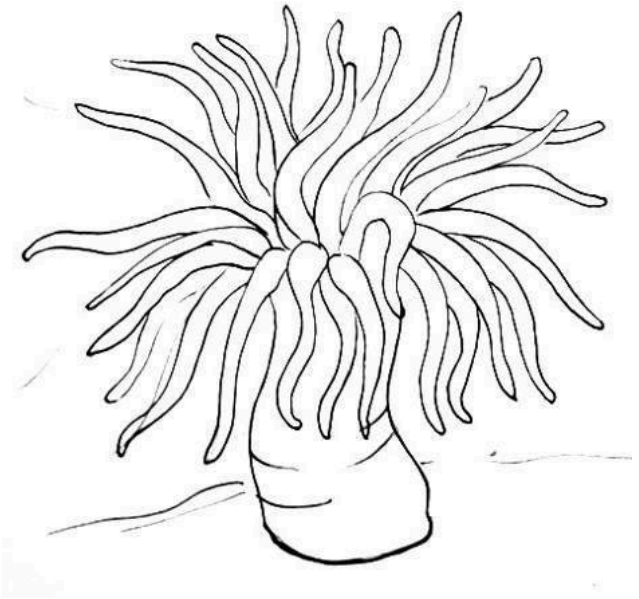


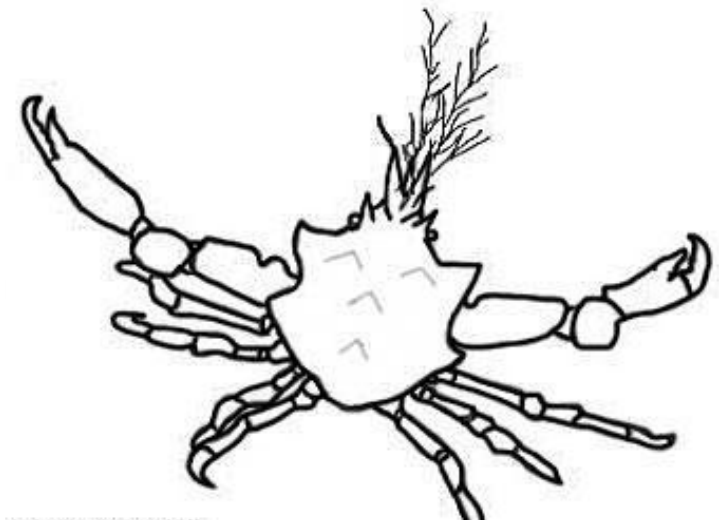


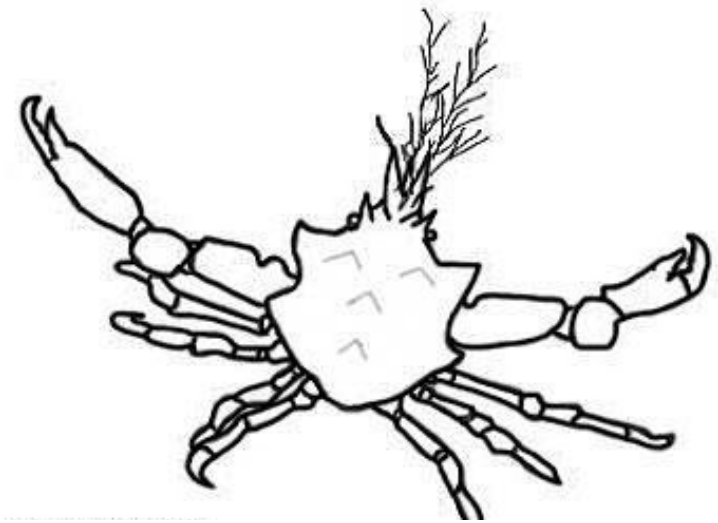


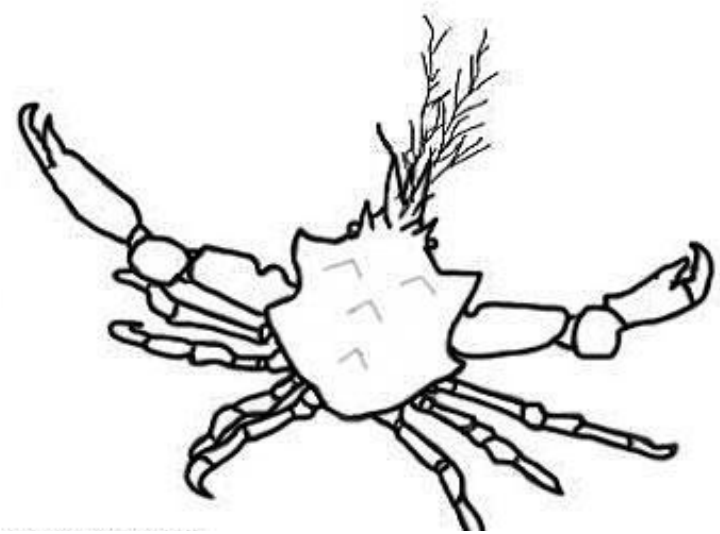


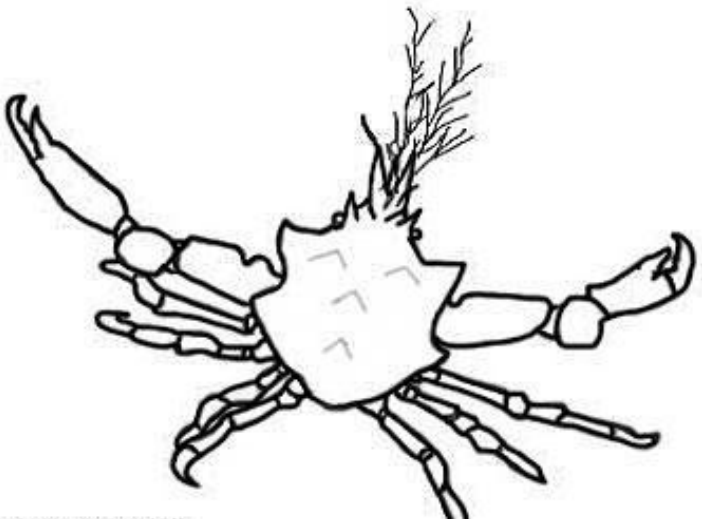


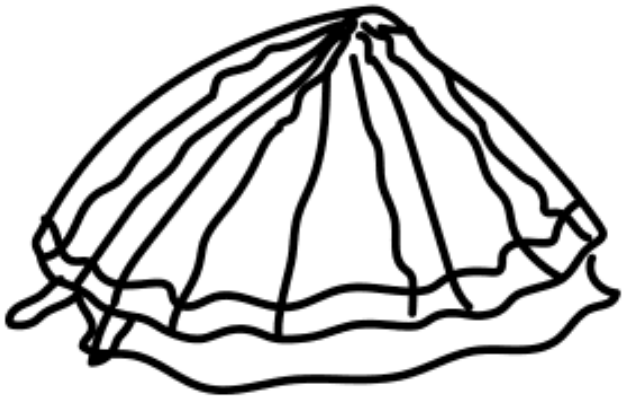
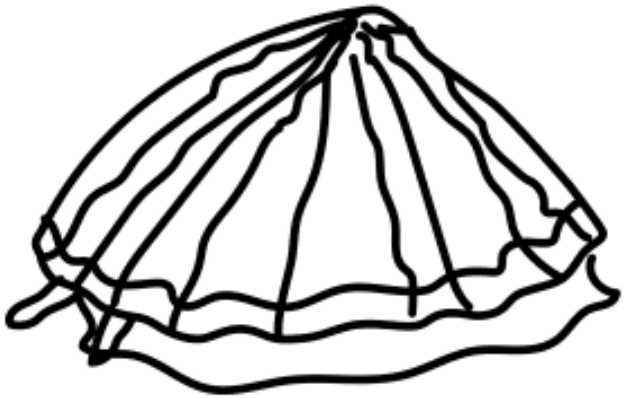
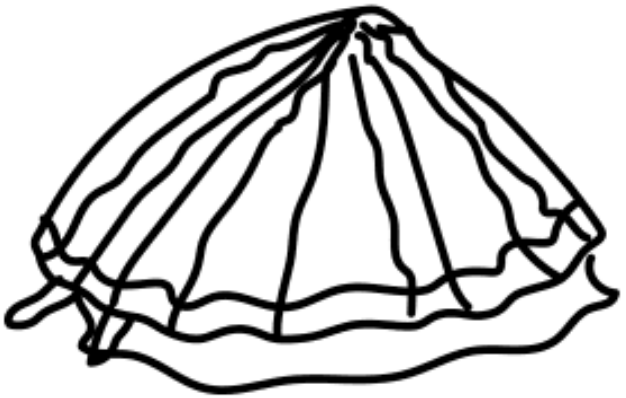
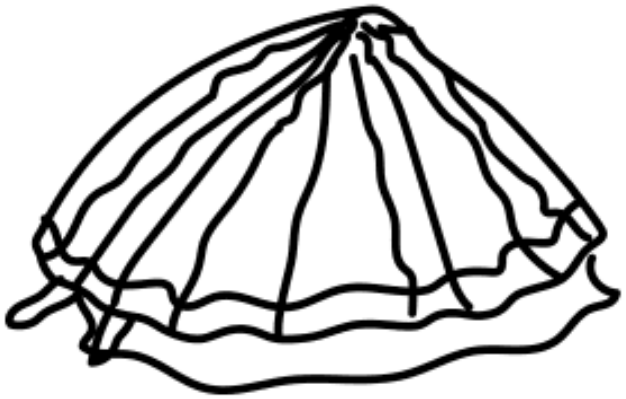
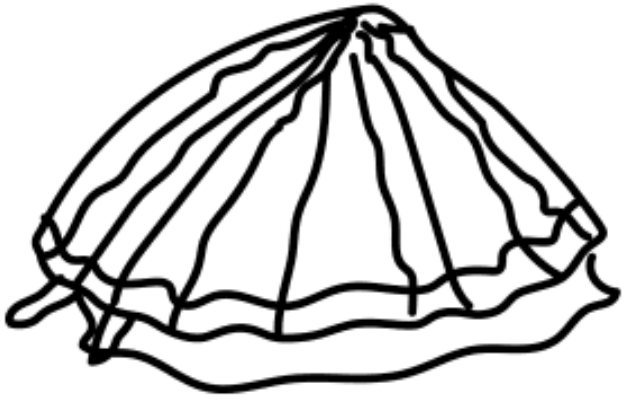
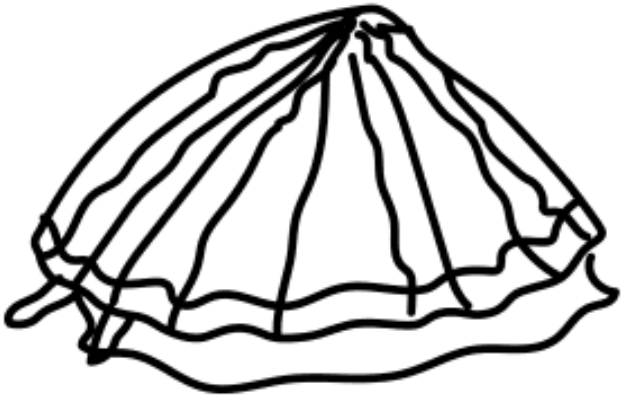


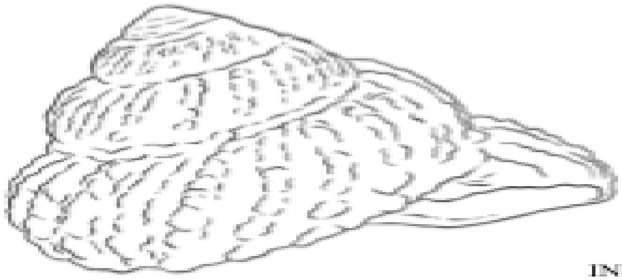










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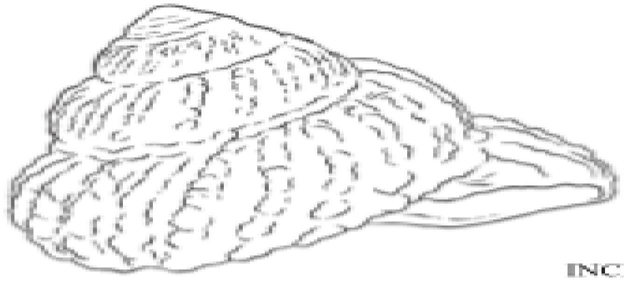

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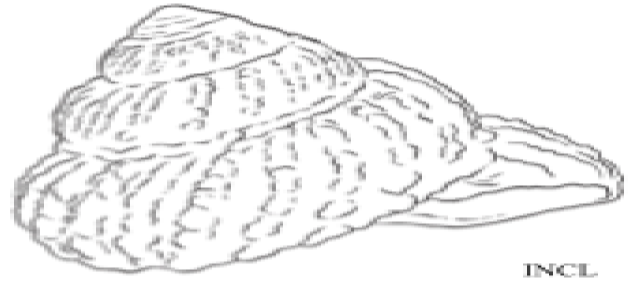

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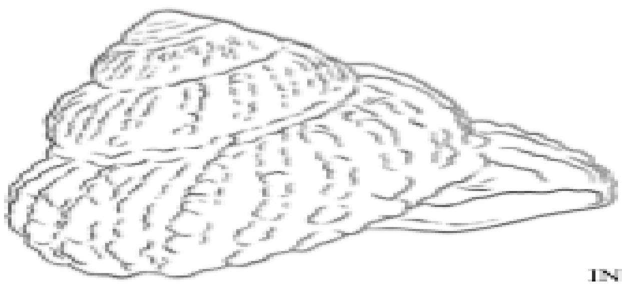

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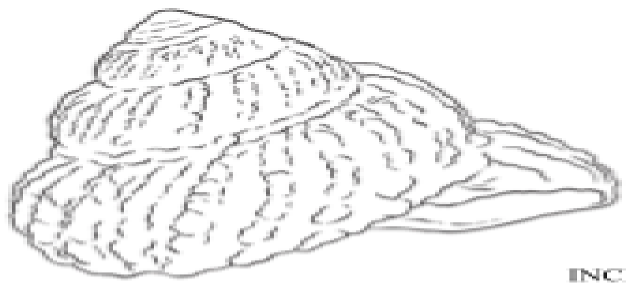

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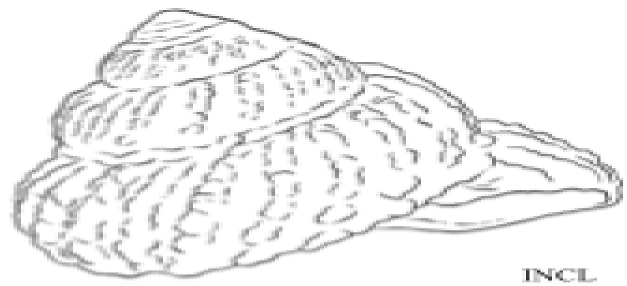

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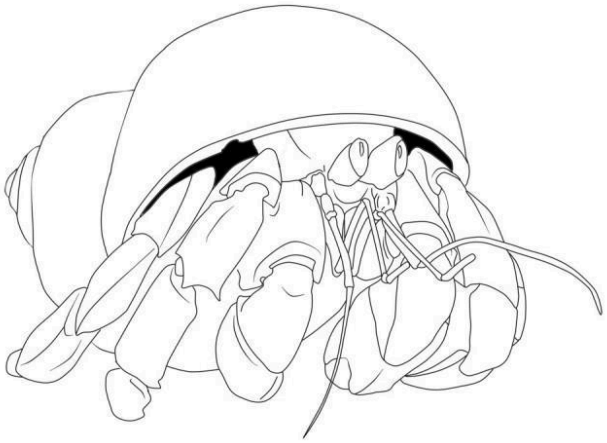

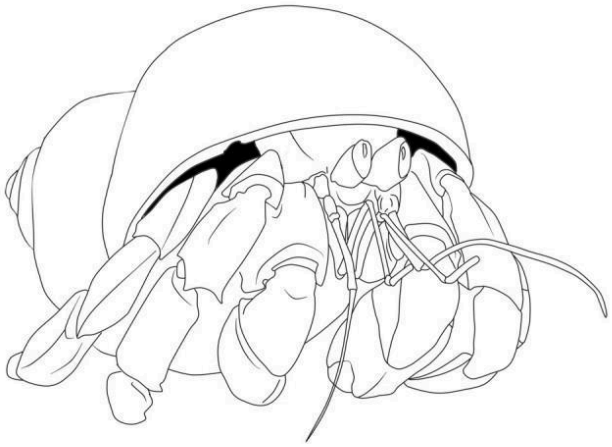

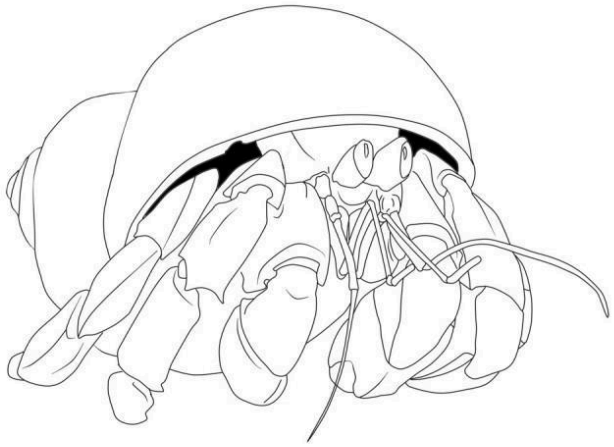

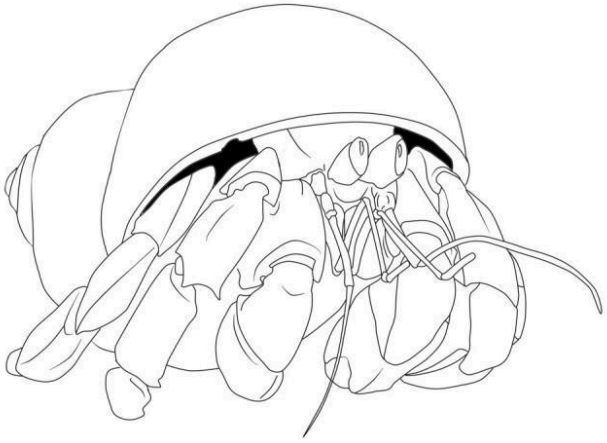

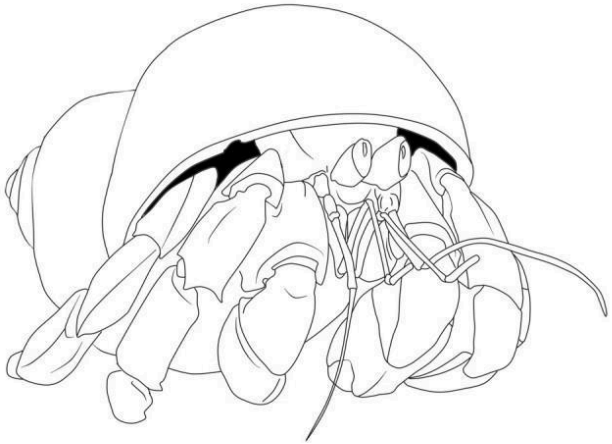

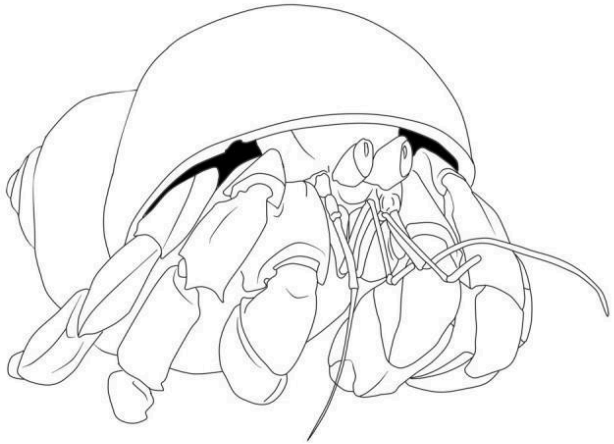

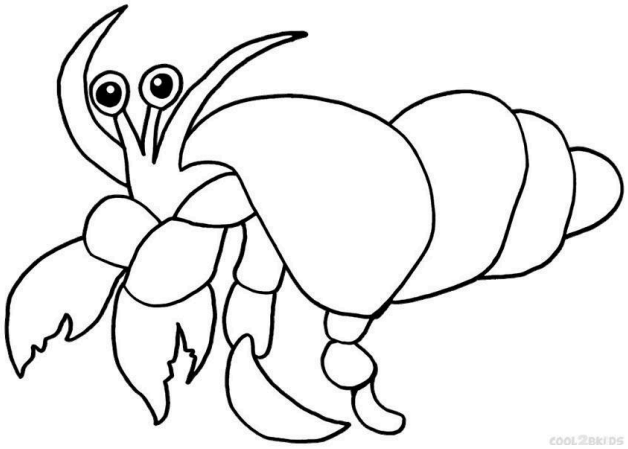
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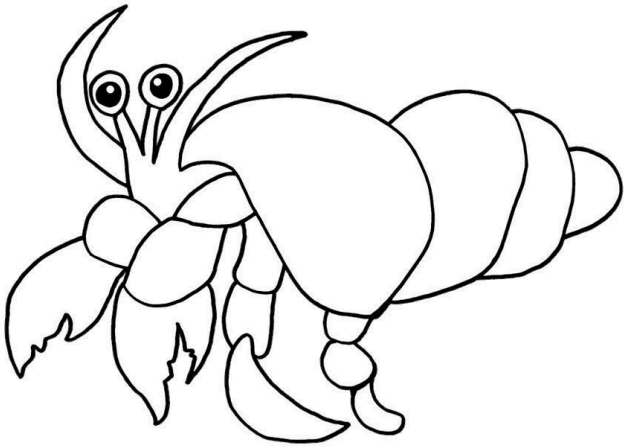
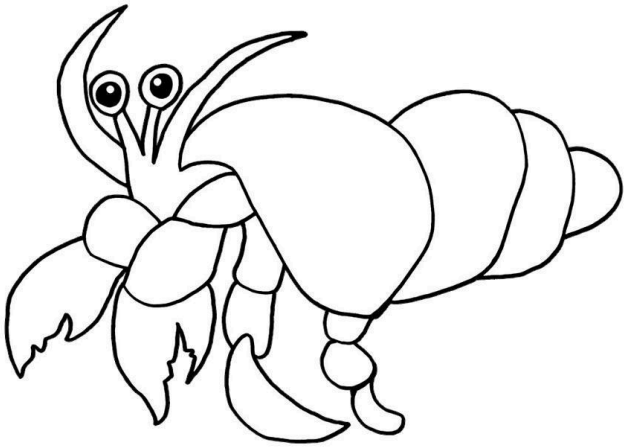
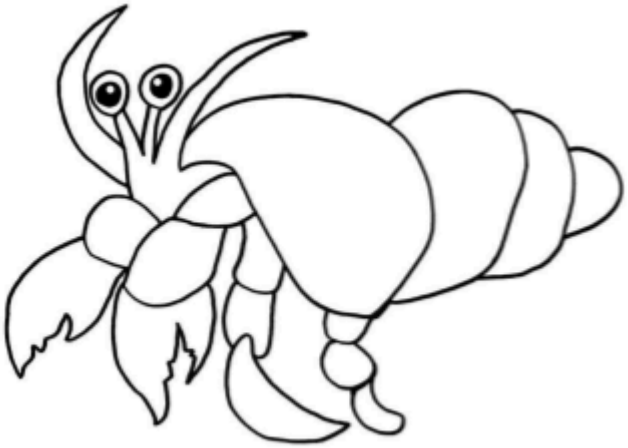
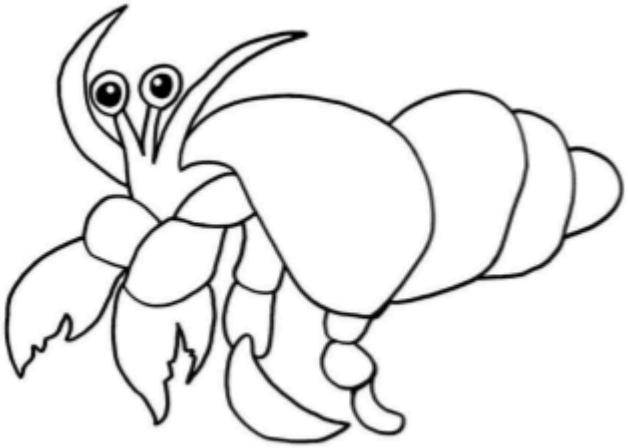
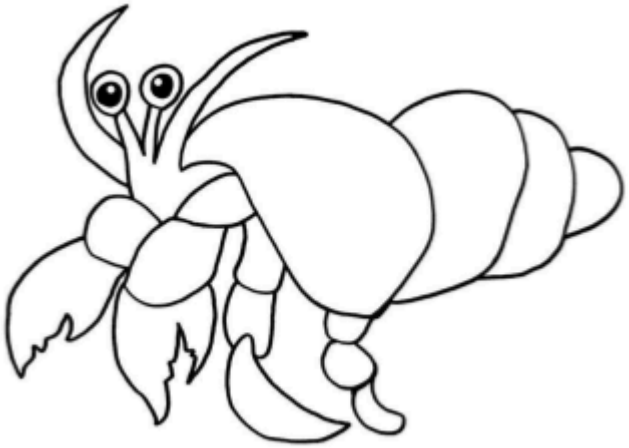
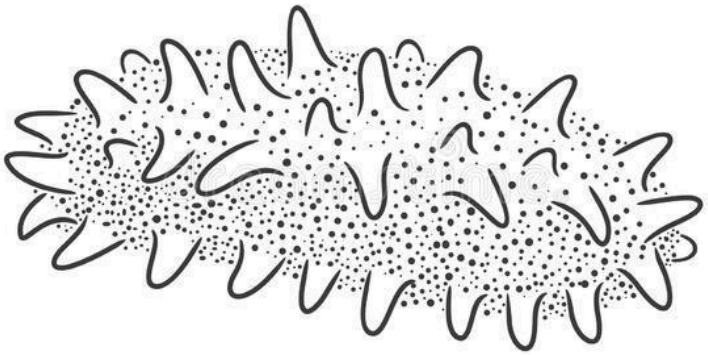


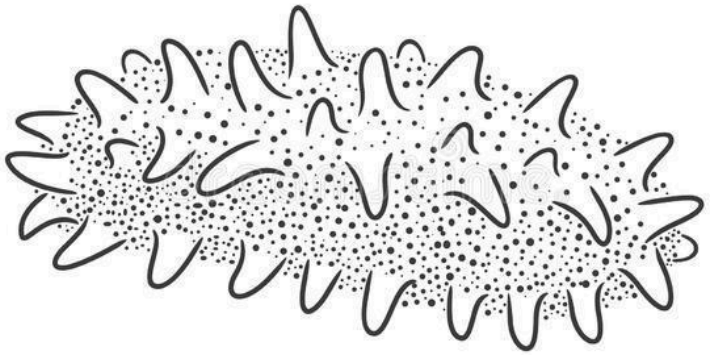


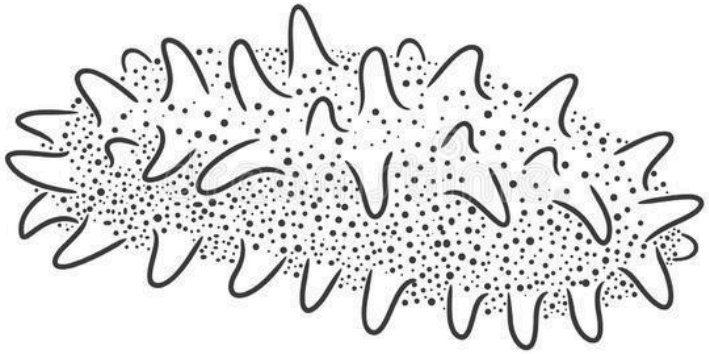


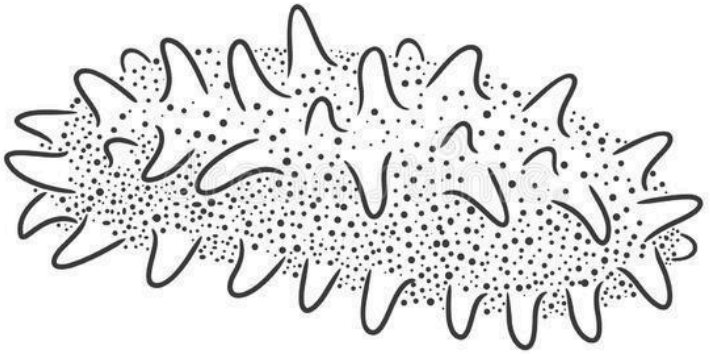


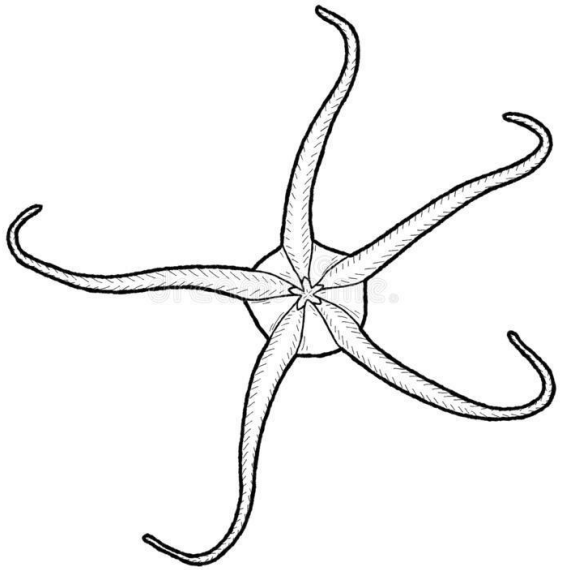


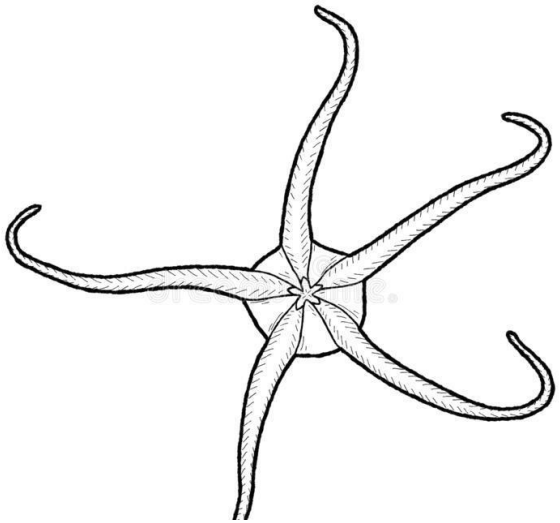


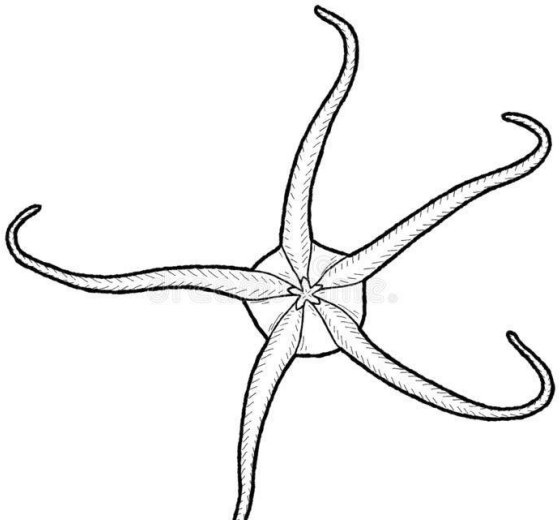


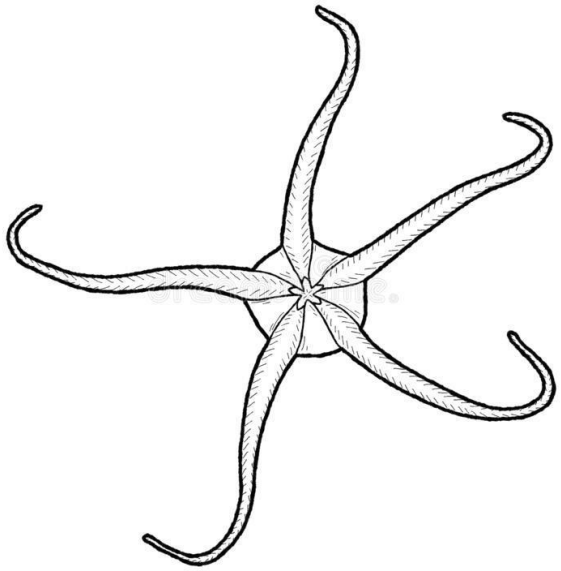


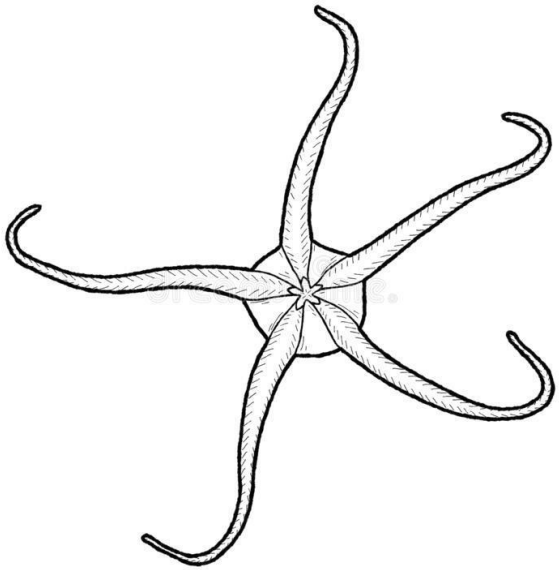


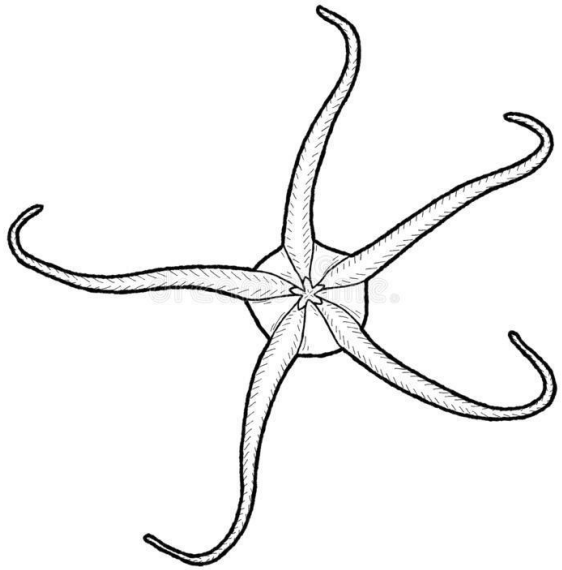




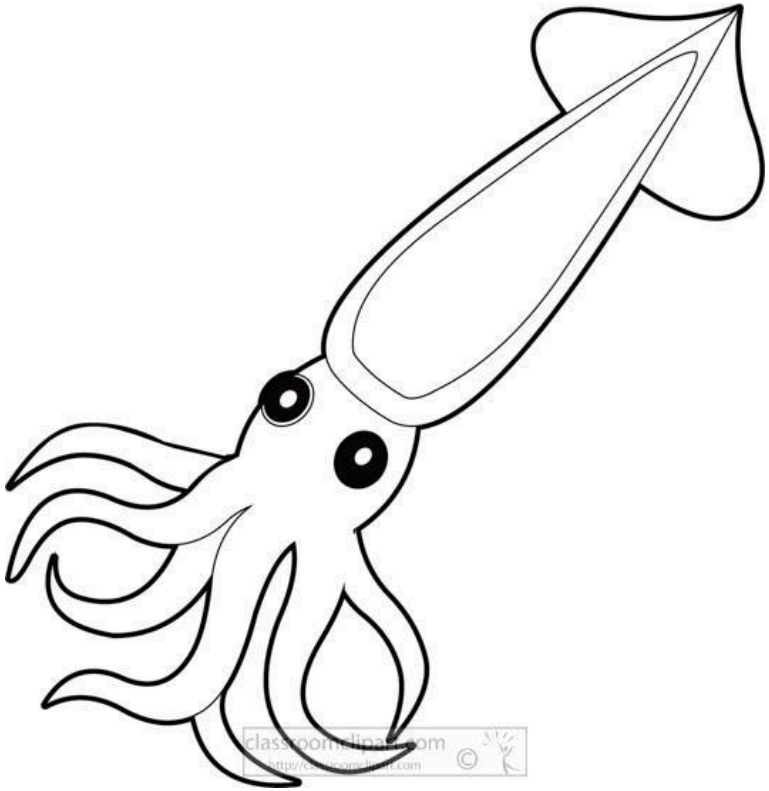


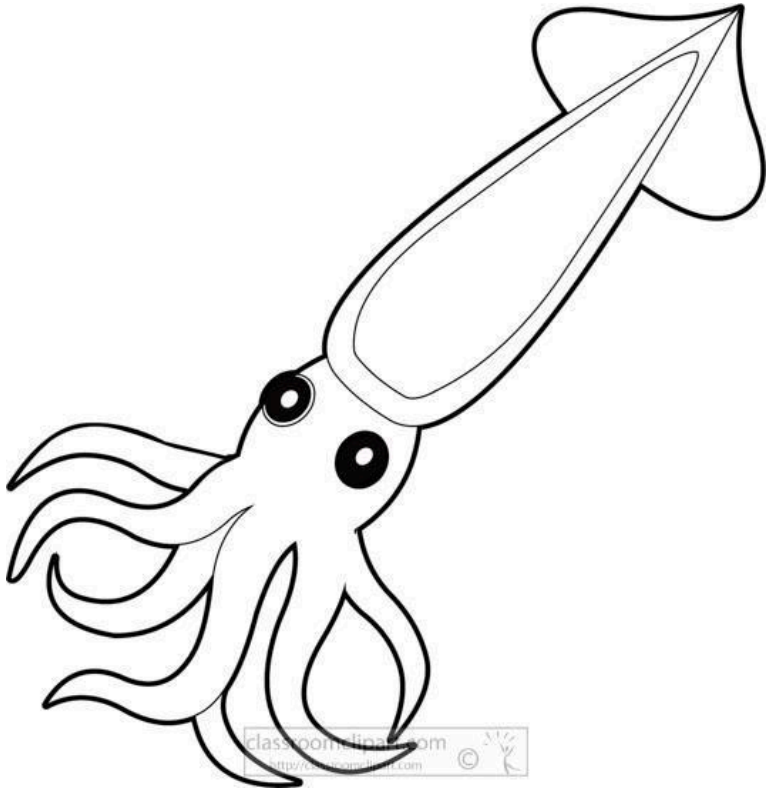




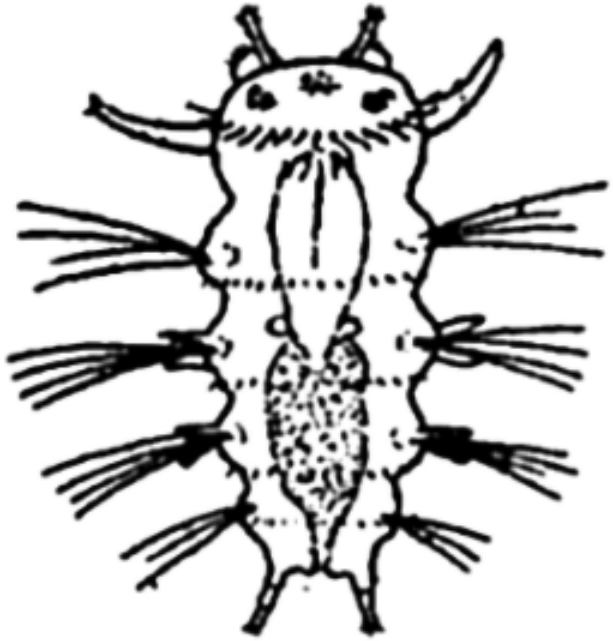


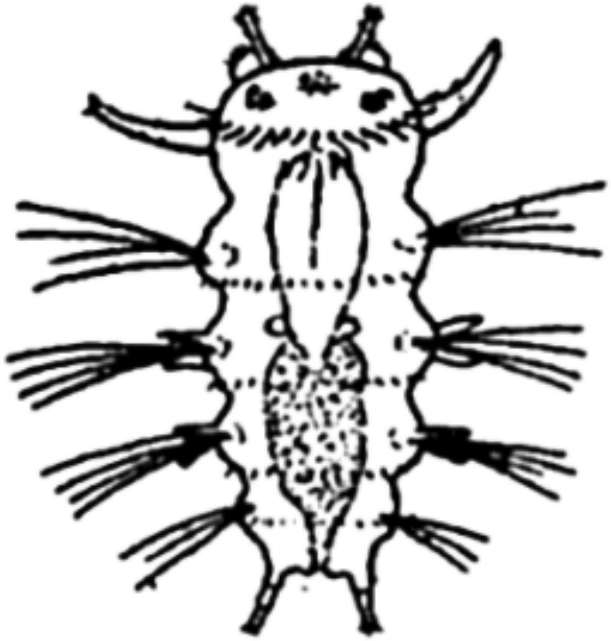
OUTLINE OF SQUID

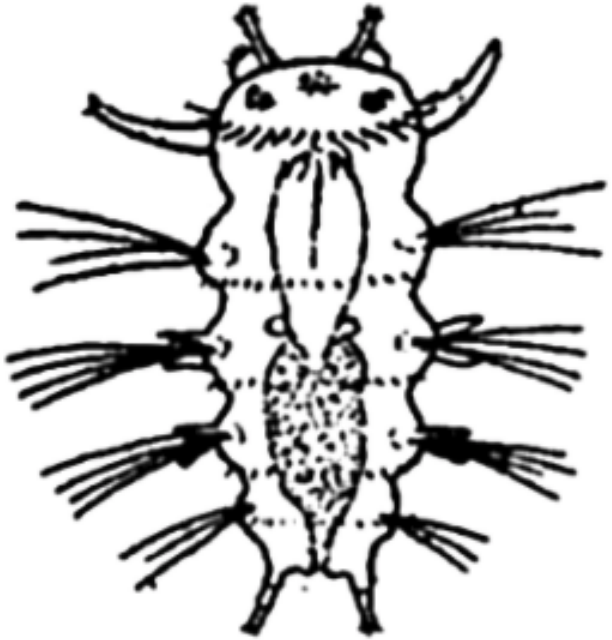


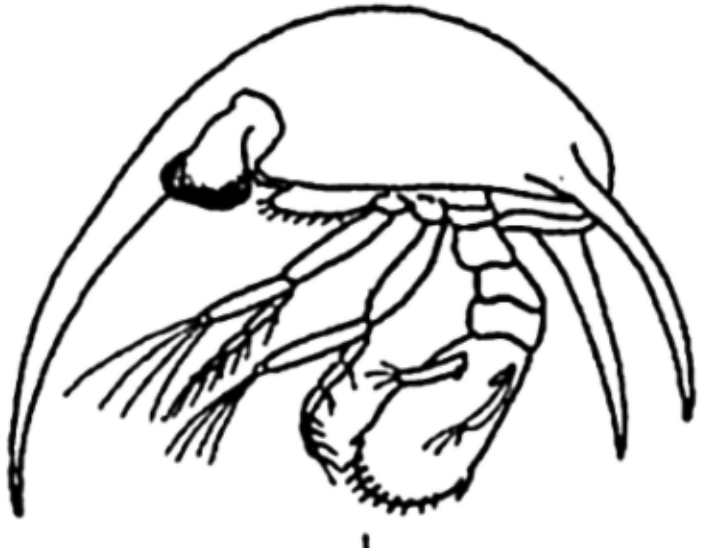


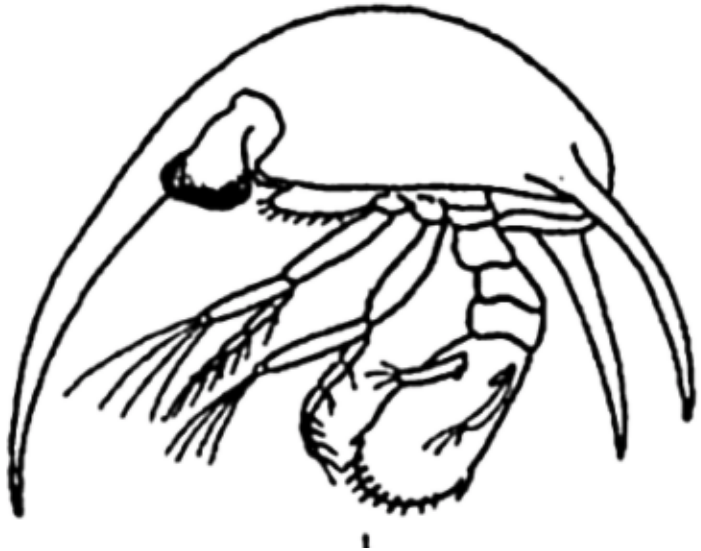
OUTLINES OF PLANKTON

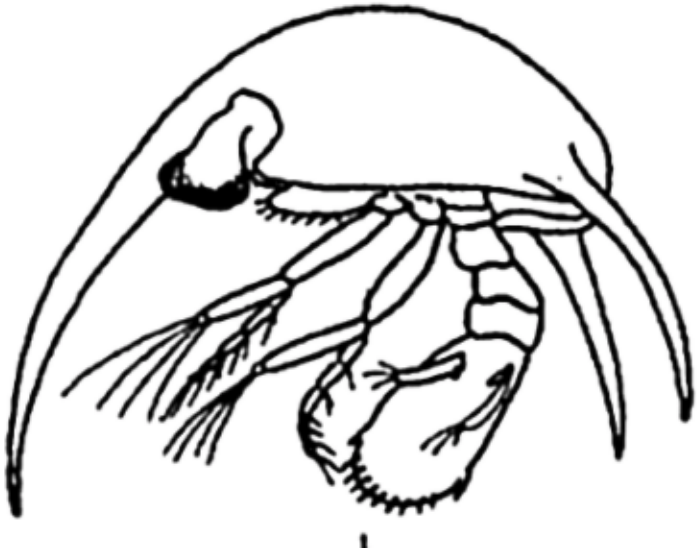


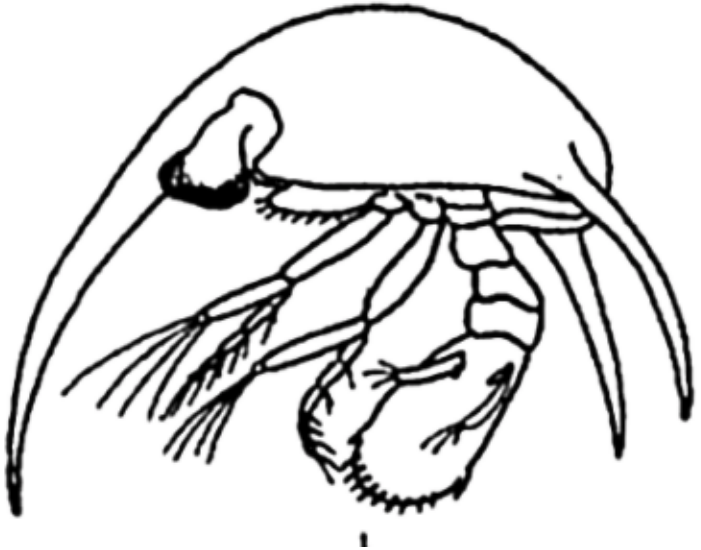


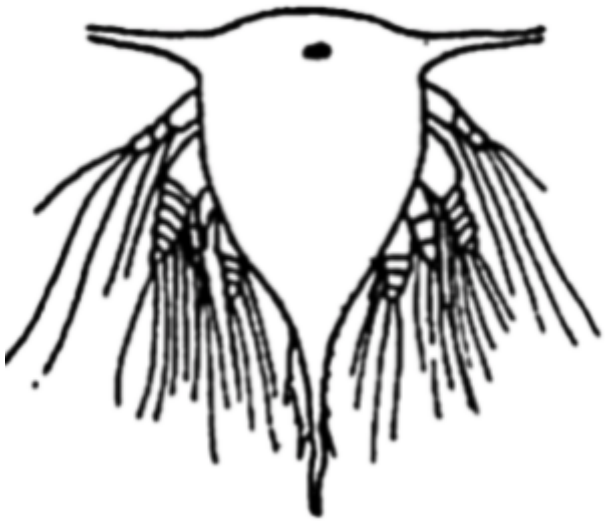
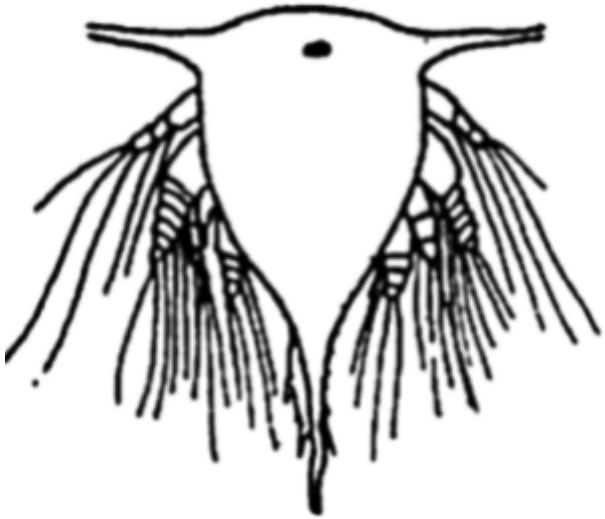


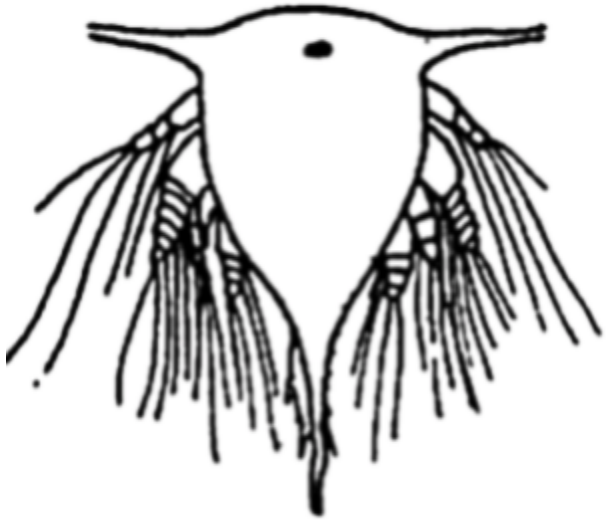
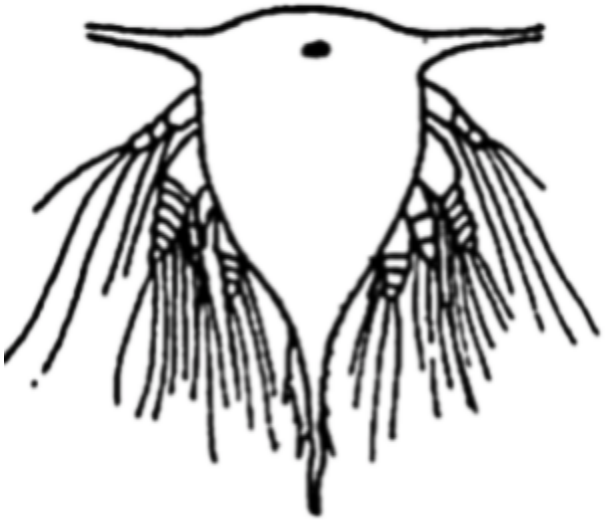
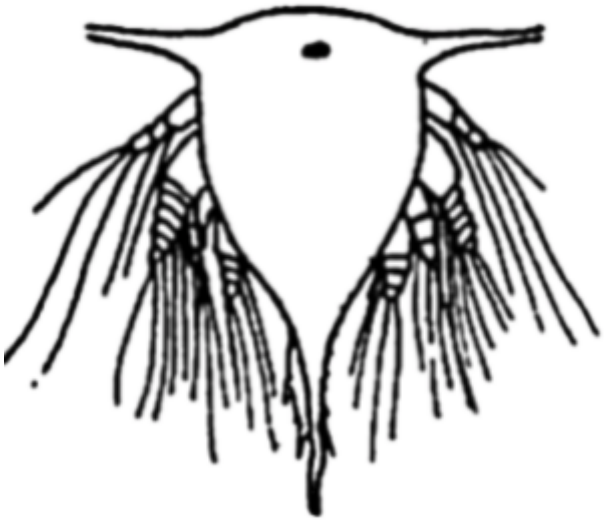








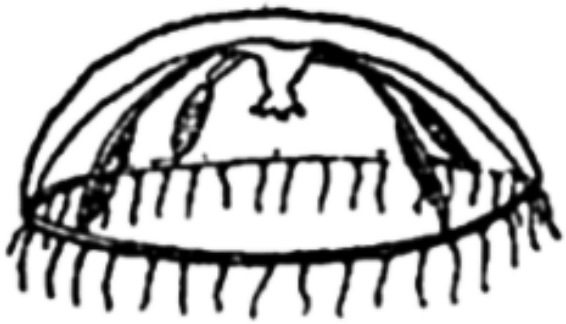
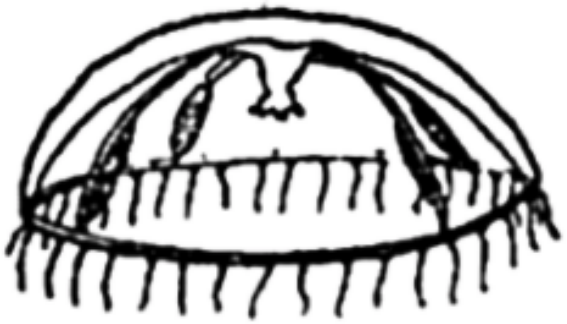
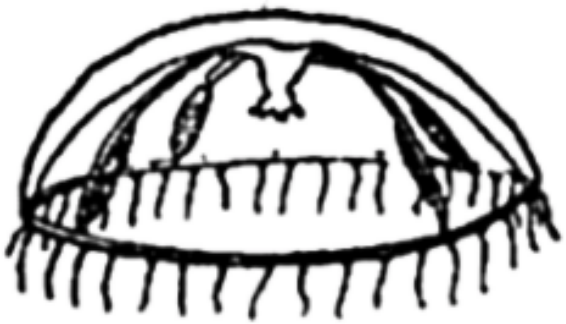



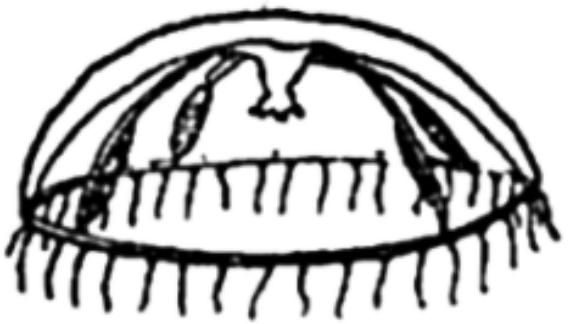










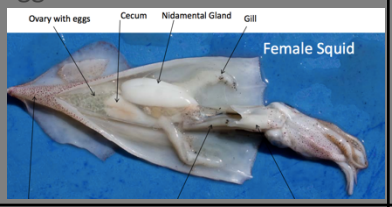


Instructor Supplement: Squid Dissection Information

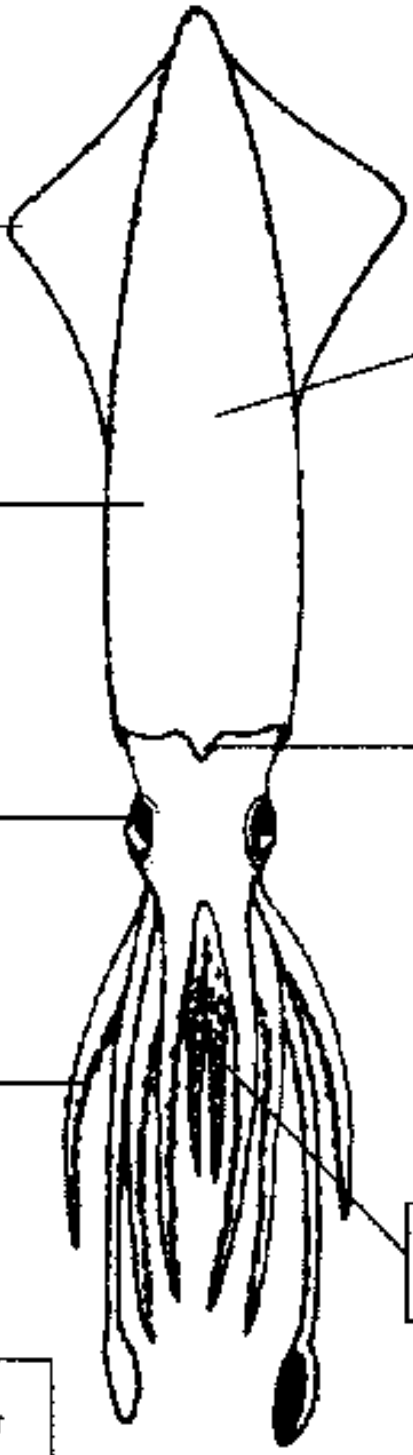
Squid External Anatomy

Anatomical Feature	Student Action	Fun Facts	6th-10th Grade*
Mantle	Let students touch the mantle and feel how smooth and flexible it is.	The mantle opens to take water in, then muscles will close off the opening to push water through the siphon for propulsion.	The squid has a hydrodynamic body shape -it can move through the water at high speeds because water passes over its body easily without any blockages.
Chromatophores	Have students rub their thumb or scratch along the chromatophores- they may be able to "break" some of the cells open to see the	Squid use chromatophores to change color and communicate.	Muscles controlled by the nervous system surround each chromatophore. Muscles expand or contract to revel the color of the pigment inside the chromatophore.
Arms	Let students count the arms (they are the shorter appendages) - 8	There are suction cups down the whole length of the arms. Used to hold onto prey and bring food to its mouth. Some squid have barbs in each suction cup which help to catch larger prey.	
Tentacles	Let students count how many tentacles (longer appendages) -2	Used to strike out and grab prey. Only have suction cups at the end.	
Siphon	Let students move the siphon around and see how flexible it is	The siphon is how squid move. They take water in through their mantle and then squeeze it out the small siphon – like jet propulsion. (Can be compared to placing your thumb over a garden hose and creating a strong steam of water.) Squid generally move backwards because of the direction of the siphon.	Squid are one of the fastest moving animals in the ocean.
Eye	Have students observe.	Eye is large. Giant squid have the largest eye in the animal kingdom. No eyelid	Squid can see in black and white but not color. Larger eyes are necessary because many squid live in the deep ocean where there is very little light. The larger the eye the more light they can let in-therefore allowing them to see even in the darkness of the deep ocean.
Fins		Used for steering and stabilization.	Fins can be used to propel squid at slow speeds.

Squid Internal Anatomy

Anatomical Feature	Student Action	Fun Facts	6th-10th Grade*
Gills	Have students cut out one gill and place in a shallow plastic tub with some water and see how they are feather like.	Gills bring oxygen into the squid from the ocean water.	Gills are "feathery" to allow maximum surface area which allows them to absorb more oxygen from the ocean water.
Ink Sac	Have students observe the dark color and remove the ink sac and place to the side.	Used to limit vision and confuse and escape from predators. Squid ink is used in cooking – often squid ink pasta.	Over the centuries squid ink and ink sacs have been used in a variety of human applications including anti-microbial, immune response enhancing, anti-retroviral and potential anticancer drugs as well as ink for writing and painting.
Gonads	Male squid – gonads are a large white sac.  Female squid – gonads have eggs 	Female squid can have up to 700 eggs.	
Hearts	Can be difficult to see.	Squid actually have 3 hearts! Two branchial and one systemic heart. Used to pump oxygenated blood around the body.	
Beak	Have students hold the squid head in one hand and spread out the tentacles and arms like a flower. Use a tweezer to reach into the center of the mouth and feel around for something hard- this is the beak. It can be removed in two pieces.	Beak is used to tear food into smaller pieces before eating.	High school students may be able to remove the entire buccal mass (round springing ball in center of arms and tentacles). If they do so carefully and a long thing thread also comes out this is the esophagus which connects to the stomach!
Pen	Have students take the whole head/arms/tentacles and peel upward while holding down on the mantle to remove all the internal organs and revel the pen (a plastic looking piece).	Remnants of a shell. Supports squid shape but allows the squid to be flexible.	

Squid: External Anatomy



FIN
These help squid change direction when swimming.

MANTLE
This is the main part of the squid's body--all the organs are inside.

CHROMATOPHORES
These spots change size to change the squid's color for camouflage or possibly communication.

PEN
The squid is related to other "shelled" animals like clams and snails. The pen is all that is left of the shell the squid's ancestors once had.

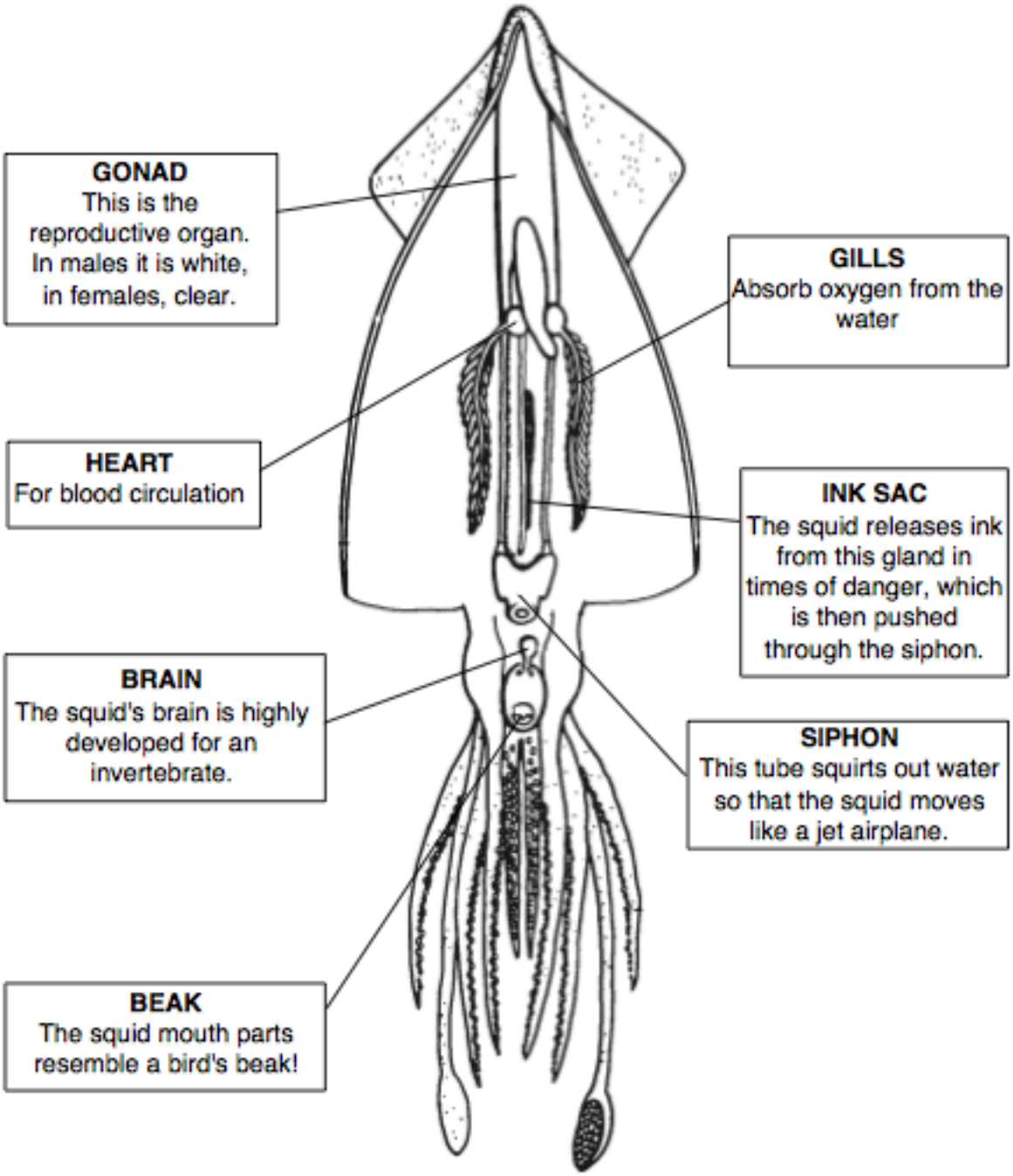
EYE
Squids have a well developed eye that allows them to see about as well as people!

ARM
Squid have 8 arms covered suction cups.

SUCTION CUPS
The suction cups help the squid to hold onto food.

TENTACLE
The tentacles are longer than the arms and have suction cups only at the tips. These are used to pass food to the shorter arms and then to the mouth.

Squid: Internal Anatomy



Great Online Resource: https://www.instructables.com/Squid-Dissection

- Full squid dissection with photos

Fun Facts about Squid

- The squid is one of the most highly developed invertebrates. Some of the animal's structures explored in this lesson illustrate the ways in which the squid has adapted to life in the ocean. Its streamlined body and "jet propulsion" which occurs as the squid squeezes water out of its body through its siphon, make the squid a fast, active predator. This animal also has a very good defense mechanism.
- All mollusks have a soft body with a special covering called the mantle, which encloses all of the body organs such as heart, stomach and gills.
- Squid can be as small as a thumbnail, or as large as a house. The giant squid, Architeuthis, can measure 60 ft. in length and weigh three tons!
- Squid have ten arms, which are wrapped around the head. Eight are short and heavy, and lined with suction cups. The ninth and tenth are twice the length of the others, and are called tentacles. Suction cups are only on the flat pads at the end of the tentacles.
- Squid feed on small crustaceans, fish, marine worms, and even their own kind! They use their tentacles to quickly catch their prey, which is pulled in by the arms and down to the radula, or beak, which uses a tongue-like action to get food to the mouth so it can be swallowed whole.
- Squid are a major food source for many fishes, birds and marine mammals.
- Squid produce a dark ink that they use to escape from predators. When a squid is startled, the ink is released through the anus, and the cloud of inky water confuses the predator while the squid swims away.
- After mating, a female squid will produce 10-50 elongated egg strings, which contain hundreds of eggs each. In many species, the parents will soon die after leaving the spawning ground. The egg strings are attached to the ocean floor, are left to develop on their own, and hatch approximately ten days later.
- Squid are an important part of the ocean food web. Squid are gaining popularity as a food source for humans around the world. Overfishing is a growing concern because there are no regulations on squid harvesting.
- Southern California squid populations spawn mainly in the winter (December to March).
- Squid are seined commercially at their spawning grounds. About 6,000 metric tons are taken yearly for human food and bait.