**MARINE MYSTERY: A WATERY WHO-DUNNIT!**

**Grade Level:** This kit is appropriate for students in grades 3–8.

**Overview:** Students learn about the causes of coral reef destruction by assuming various character roles in this marine murder-mystery. As they determine who killed Seymour Coral, students learn the basics of DNA testing. Suspects include global warming, sedimentation, and other threats facing coral reefs today. This activity is designed for 15 students, but can be modified for 12–24 students. A narrated PowerPoint that provides background information on coral reefs can be shared in advance in a separate lesson. The total class time for both the PowerPoint and skit is about 90 minutes.

**Suggestions for Curriculum Placement:** This activity can be used as part of a marine, life, or environmental science unit. Two key concepts are addressed: the interdependence of coral polyps and zooxanthellae (the symbiotic algae that lives inside – and provides food for – the coral), and the decline of coral reefs worldwide.

**Materials Included in this Kit:**

1. Coral Reef (3 pieces)
2. Orange Cones (4)
3. Ziploc Bag with Crime Scene Tape
4. Mailboxes (4)
5. Zooxanthellae in cage
6. Speakers
7. Teacher Packet (contains shark hat, evidence bag & clue bag)
8. Student Packets (15 different packets, each containing a different character’s ID, script, costume or mask and related items)
9. Extra Costumes packet
10. Binder (Paper materials contained in binder are shown in **BOLD CAPS**)
   a. CD, containing Video, Narrated PowerPoint, and electronic versions of everything in binder (front pocket)
   b. C-MORE Key Concepts in Microbial Oceanography brochure (front pocket)
   c. TEACHER MATERIALS (TEACHER GUIDE, CHARACTER LIST, TEACHER SCRIPT, and TEACHER VERSION OF 3 SCRIPTS)
   d. HANDOUTS (ENVIRONMENTAL SUSPECTS and WORDS TO KNOW)
   e. REWARD SIGNS (3)
   f. SCENE SIGNS (5)
   g. HOUSE SIGNS (4)
   h. DNA KEYS FOR EVIDENCE AND SUSPECTS (for reference only)
   i. EVALUATION (for teacher to complete)
   j. SUPPLY CHECKLIST

**Materials NOT Included in this Kit:**

1. Computer
2. Projector
3. Scotch Tape

**Note:** Items in **BOLD CAPS** are paper materials found in the binder

**Hawaii Content & Performance Standards (HCPS III):** The following science standards and benchmarks can be addressed through these lessons:

**Science Standard 1:** The Scientific Process: SCIENTIFIC INVESTIGATION: Discover, invent and investigate using the skills necessary to engage in the scientific process.

**Grades 3–8 Benchmarks for Science:**

SC.3.1.2 Safely collect and analyze data to answer a question.
SC.5.1.2 Formulate and defend conclusions based on evidence.
SC.7.1.3 Explain the need to revise conclusions and explanations based on new scientific evidence.
SC.8.1.1 Determine the link(s) between evidence and the conclusion(s) of an investigation.
SC.8.1.2 Communicate the significant components of the experimental design and results of a scientific investigation.

Science Standard 3: Life and Environmental Sciences: ORGANISMS AND THE ENVIRONMENT: Understand the unity, diversity, and interrelationships of organisms, including their relationship to cycles of matter and energy in the environment.

Grades 3–8 Benchmarks for Science:
SC.3.3.1 Describe how plants depend on animals.
SC.4.3.1 Explain how simple food chains and food webs can be traced back to plants.
SC.4.3.2 Describe how an organism's behavior is determined by its environment.
SC.5.3.1 Describe the cycle of energy among producers, consumers, and decomposers.
SC.5.3.2 Describe the interdependent relationships among producers, consumers, and decomposers in an ecosystem in terms of the cycles of matter.
SC.6.3.1 Describe how matter and energy are transferred within and among living systems and their physical environment.
SC.7.3.1 Explain how energy moves through food webs, including the roles of photosynthesis and cellular respiration.
SC.7.3.2 Explain the interaction and dependence of organisms on one another.
SC.7.3.3 Explain how biotic and abiotic factors affect the carrying capacity and sustainability of an ecosystem.

Science Standard 4: Life and Environmental Sciences: STRUCTURE AND FUNCTION IN ORGANISMS: Understand the structures and functions of living organisms and how organisms can be compared scientifically.

Grades 3–8 Benchmarks for Science:
SC.3.4.1 Compare distinct structures of living things that help them to survive.
SC.7.4.1 Describe the cell theory.


Grades 3–8 Benchmarks for Science:
SC.4.5.2 Describe the roles of various organisms in the same environment.
SC.4.5.3 Describe how different organisms need specific environmental conditions to survive.
SC.8.5.1 Describe how changes in the physical environment affect the survival of organisms.

Ocean Literacy Principles: The following ocean literacy principles can be addressed through these lessons:

Ocean Literacy Principle 1: The Earth has one big ocean with many features.

a. The ocean is connected to major lakes, watersheds and waterways because all major watersheds on Earth drain to the ocean. Rivers and streams transport nutrients, salts, sediments and pollutants from watersheds to estuaries and to the ocean.

Ocean Literacy Principle 2: The ocean and life in the ocean shape the features of the Earth.

d. Sand consists of tiny bits of animals, plants, rocks and minerals. Most beach sand is eroded from land sources and carried to the coast by rivers, but sand is also eroded from coastal sources by surf. Sand is redistributed by waves and coastal currents seasonally.

Ocean Literacy Principle 5: The ocean supports a great diversity of life and ecosystems.

d. Ocean biology provides many unique examples of life cycles, adaptations and important relationships among organisms (symbiosis, predator-prey dynamics and energy transfer) that do not occur on land.

f. Ocean habitats are defined by environmental factors. Due to interactions of abiotic factors such as salinity, temperature, oxygen, pH, light, nutrients, pressure, substrate and circulation, ocean life is not evenly distributed temporally or spatially, e.g., it is “patchy”. Some regions of the ocean support more diverse and abundant life than anywhere on Earth, while much of the ocean is considered a desert.
Ocean Literacy Principle 6: The ocean and humans are inextricably interconnected.

e. Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution (point source, non-point source, and noise pollution) and physical modifications (changes to beaches, shores and rivers). In addition, humans have removed most of the large vertebrates from the ocean.

g. Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean. Individual and collective actions are needed to effectively manage ocean resources for all.
TEACHER GUIDE

Time Required: 1.5 hours (not including advance preparation)

Advance Preparation:

1. Using the SUPPLY CHECKLIST as a reference, look through the kit to identify all supplies. It is highly recommended that you do this now, even before you continue reading this TEACHER GUIDE, in order to familiarize yourself with all of the supplies. This will help you follow the guide more easily.

2. Familiarize yourself with the structure of the activity by reviewing the Crime Scene Bulletin Board (below) and the CHARACTER LIST, reading the TEACHER SCRIPT, and watching the 6 minute Marine Mystery Video (included on the CD). The video was created from photos taken at a previous marine mystery event, and provides a quick overview of the storyline. The culprit is revealed at the end of the video, so do not share this video with your students. There are two versions of the Marine Mystery Video (one for PCs and one for Macs).

3. The PowerPoint Presentation on the CD is narrated. We suggest you preview the presentation with the speakers to ensure that everything works properly. Set up the speakers by plugging the speaker wire into the headphone jack on your computer and orient the speakers to face the class. Ensure the speakers are turned on.

4. Photocopy the ENVIRONMENTAL SUSPECTS and WORDS TO KNOW handouts (1 per student), the SUPPLY CHECKLIST (1 copy), and the TEACHER EVALUATION (1 copy). Or you may print these items from the CD.

5. Hang up the REWARD SIGNS around your classroom.
Characters:
This kit is designed for 1 teacher and 15 students (see the CHARACTER LIST). However, you can easily modify the roles to accommodate 12–24 students:

- 12 students – Eliminate the jury and simply review the case as a group.
- 13 students – Consolidate the jury down to a single judge and combine the jurors’ speaking lines into a single, coherent review by the 13th student.
- 14 students – Have Juror 1 (Butterflyfish) say Juror 3’s (Seahorse) line, and have Juror 2 (Tiger Cowry) finish with “Police Commissioner, lock him/her up!”
- 15 students – No alterations necessary.
- 16–24 students
  - Students #16 and #17 can wear the Crime Scene Cleaners IDs (provided in extra costumes bag) and help with the removal of signs around the classroom and the packing of supplies back into the box.
  - Student #18 can act as a crime scene photographer, and wears the Crime Scene and Evidence Photography ID (provided in extra costumes bag).
  - Students #19–24 can take turns holding up the SCENE SIGNS at the beginning of each scene.

An example of how to run the marine mystery is described below and summarized in Table 1. The items in red are suggested locations with corresponding clues that are commonly found in a classroom, however these can be modified as needed. Use this example to familiarize yourself with the format of the marine mystery. Later, you can make any modifications to the items in red to adapt the scenario to your classroom or outside.

**Example of How to Run the Marine Mystery:**
1. The investigation will start at Location 1 (Crime Scene) where students will find the 1st set of DNA samples and Clue 1 (dry erase marker). The students will use the DNA samples to eliminate one of the suspects. Then, Clue 1 will lead the students to Location 2 (whiteboard).
2. At Location 2, students will find Clue 2 (phone card), which will lead them to Location 3 (phone).
3. At Location 3, students will find Clue 3 (printer cartridge) and the 2nd set of DNA samples. The 2nd set of DNA samples will eliminate another suspect and Clue 3 will lead the students to Location 4 (printer).
4. At Location 4, students will find a key. At this point, the suspects will be asked to pull out their key chains. The only suspect whose key chain has no key is All-gal Bloom. The students should go to Location 5 (All-gal Bloom’s house), where they will find the zooxanthellae being held captive. It looks like All-gal Bloom is guilty because the missing zooxanthellae are found at his/her house.
5. But wait! A 3rd set of DNA samples that matches Glowball Warming’s DNA (but doesn’t match All-gal Bloom) is also found at Location 5. Thus, Glowball Warming is guilty. Glowball Warming was trying to frame All-gal Bloom!

**Table 1: Suggested Scenario for your Marine Mystery**

<table>
<thead>
<tr>
<th>Location</th>
<th>Evidence (found in Teacher Packet)</th>
<th>Clues (found in Teacher Packet)</th>
<th>Acquitted Suspect</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Crime Scene</td>
<td>Hide all 3 of the 1st DNA samples</td>
<td>Hide dry erase marker</td>
<td>Industrial Plant</td>
</tr>
<tr>
<td>2 Whiteboard</td>
<td>-</td>
<td>Hide phone card</td>
<td>-</td>
</tr>
<tr>
<td>3 Phone</td>
<td>Hide all 3 of the 2nd DNA samples</td>
<td>Hide printer cartridge</td>
<td>Seddi Mentation</td>
</tr>
<tr>
<td>4 Printer</td>
<td>-</td>
<td>Hide Key</td>
<td>-</td>
</tr>
<tr>
<td>5 All-gal Bloom’s House</td>
<td>Hide 1 of the 3rd DNA samples in the cage with zooxanthellae + hide the other 2 pieces nearby.</td>
<td>--</td>
<td>All-gal Bloom</td>
</tr>
</tbody>
</table>

**Set up the crime scene:**
In an open space, place the 3 pieces of coral together to create a coral reef. The white bleached coral is the late Seymour Coral. Surround the coral reef with orange cones and yellow caution tape to indicate that this is the crime scene. Use Scotch tape (not provided) to secure the caution
tape to the cones. Make the crime scene as large as possible (e.g., a corner of a classroom), as students will be searching this area for evidence (DNA samples) and clues that you will hide for them. Note: The crime scene photo is for illustration purposes only, and is not to scale.

Set up Scene 4 (scavenger hunt component):

1. According to the scenario outlined in Table 1, your students will visit five different locations in your classroom (crime scene, whiteboard, area with phone, area with printer, and All-gal Bloom’s house). You will need to hide the specified items (evidence and clues) at these locations, as described below. First, take out the evidence bag and the clue bag from the Teacher Packet.
   a) Location 1 set-up (crime scene): From the evidence bag, pull out all three DNA strands labeled “1st DNA samples” and hide them around Location 1. Similarly, from the clue bag, remove the dry erase marker and hide it in Location 1.
   b) Location 2 set-up (whiteboard). From the clue bag, remove the phone card and hide it around Location 2. Note: there is no evidence at this location.
   c) Location 3 set-up (phone). From the evidence bag, pull out all three DNA strands labeled “2nd DNA samples” and hide them around Location 3. Similarly, from the clue bag, remove the printer cartridge and hide it around Location 3.
   d) Location 4 set-up (printer). From the clue bag, remove the key and hide it around Location 4.
   e) Location 5 set-up (All-gal Bloom’s house). From the evidence bag, pull out all three DNA strands labeled “3rd DNA samples” and hide them around Location 5. Hide 1 of the 3rd DNA samples inside the cage with zooxanthellae, and hide the other 2 pieces nearby.

2. Place the four mailboxes with their corresponding HOUSE SIGNS at four separate areas in the classroom to represent the suspects’ residences. The residences should be outside of the crime scene.

3. Students begin at the crime scene, where they will find all three of the identical 1st DNA samples and the dry erase marker. Before using the clue to determine the next location, students must first complete a DNA analysis to determine which suspect’s DNA did not match the DNA evidence found at the crime site.

4. The students who play the scientists will have already collected a DNA sample from each suspect during Scene 3. To complete a DNA analysis, the class needs to compare the DNA evidence found at each location to each suspect’s DNA sample. The short DNA strands found at Location 1 are consistent with all of the suspects except one (Industrial Plant); thus Industrial Plant is the first suspect to be acquitted. At each subsequent location, the strands of DNA become more complete (i.e., have longer strands of beads) and thus reduce the number of potential suspects with matching DNA. Ultimately the DNA evidence will only match one suspect – the guilty Glowball Warming. To compare the crime scene and suspect DNA samples, we recommend the students lay the DNA samples out on the ground (or table), so that they can look for matches by lining up the evidence and the suspect DNA samples side by side, as shown in the photo below.

DNA Analysis
Students compare the DNA evidence with the DNA of each suspect.

Students play the scientists by comparing DNA evidence to samples from each suspect to determine which suspect committed the crime.
5. After a suspect has been acquitted, the whole class may then examine the clue for that site, and discuss the implications of the clue. The class should proceed to the next location together. For example, at Location 1, after acquitting Industrial Plant, the class examines the dry erase marker, which leads them to the whiteboard. (The students may need some prompting at first, until they get the hang of it.) According to Table 1, you have hidden a clue but no evidence at the whiteboard location, so the students can immediately analyze the clue (phone card) once it is found and move on to the next location (near the phone). This scavenger hunt continues until the students find the key at Location 4.

Note: the students have no way of knowing whether a location has DNA evidence or a clue, or both. They just have to keep on searching for both, until they’re convinced they’ve found everything at that location.

6. Once the key is found, all the suspects must pull out their key chains, which are in their student packets. The students will discover that everyone has a key on their key chain, except for All-gal Bloom. At this point, most will suspect that All-gal Bloom is guilty. Students will rush to the area that you have designated as All-gal Bloom’s house (Location 5) by looking for the corresponding HOUSE SIGN and mailbox that you have displayed for them. Students will analyze the DNA evidence found here (both inside and near the zooxanthellae cage), and they will realize that it matches the DNA of Glowball Warming – not All-gal Bloom, as they had suspected! What does this mean? Glowball Warming is guilty! Glowball Warming was trying to frame All-gal Bloom for stealing the zooxanthellae, but the DNA evidence tells the real story.

7. The above scenario works well, as long as you have a whiteboard, phone, and printer in your classroom. The necessary clues for this scenario are included in the clue bag in the teacher packet. However, if these locations do not exist in your classroom, the scenario can be modified. Ultimately, you just need to choose a location that all or most of your participants are familiar with, and a clue that is associated with that location. You may substitute any clue written in red with a clue that will then send the students to your new location. However, do NOT change anything written in black on the table! It’s imperative that you hide the DNA samples, cage with zooxanthellae, and the key at the correct locations or you will not get the desired outcome.

8. The marine mystery can also be successfully implemented outside. It may even provide you with more options for hiding evidence and clues, as things are more spread out. Here are some possible clue/location combinations that may work well outside depending on your environment: bike lock/bike rack, candy wrapper/vending machine, petal/flowers, phone card/pay phone.

9. Now that you are familiar with the format of the marine mystery, locate the teacher packet. Inside you will find an evidence bag and a clue bag. Decide on your clues and locations, and hide the necessary items at the specified locations – or just use the locations and clues provided in Table 1.

**Instructional Procedures:**
1. Once the students arrive, play the **PowerPoint Presentation** on the threats to coral reefs. Have students review the **WORDS TO KNOW** list and the **ENVIRONMENTAL SUSPECTS** handouts, and discuss as a class.

2. Review rules:
   a. Listen when someone else is talking; raise your hand to ask a question.
   b. Each student is only allowed to find one clue or piece of evidence; this allows more people to get involved.
   c. Everyone must circle up and share the evidence before proceeding to the next location.

3. Distribute the character packets, and have everyone practice their lines. The student scripts show the line of the preceding character as a prompt to notify them that their turn is coming up. (Note: Three characters will not receive all of their lines ahead of time because it would give away the ending – these lines are provided on the **TEACHER VERSION** of these three scripts, which can be found following the **TEACHER SCRIPT** in the binder. These scripts should be distributed to Glowball Warming, Tiger Cowry, and Seahorse at the beginning of Scene 5.

4. Check that the students understand and can pronounce all their words. This activity also works well when younger students are paired with older students. The younger students get excited to wear the costumes, while the older students enjoy assisting with the lines.

5. Have everyone dress up in their costumes and learn about their organisms by reading their ID cards.

[Link to more science kits](https://cmore.soest.hawaii.edu/education.htm)
6. Grab the **TEACHER SCRIPT** and shark hat, and you are ready to begin. Good luck!

**Assessment & Clean-up:**

1. After the activity, repack the teachers packet.

2. Ask students to neatly pack all items into their student packets. Ask them to check that all items listed on the label are included.

3. Please double check that all items are included – and neatly packed – in each packet by going through the **SUPPLY CHECKLIST**. To ensure that the supplies will fit back into the original container, please remove any excess air from the character packets while closing the bags.

4. Collect all the miscellaneous supplies that were used throughout the activity. Please remove any tape from the signs and the caution scene tape before packing. Use the **SUPPLY CHECKLIST** to check off each item as you pack everything in the original container. To ensure that the binder is reassembled properly, please refer to the **SUPPLY CHECKLIST** as you arrange the items in sequential order. Don’t forget to eject the CD with the **PowerPoint Presentation**, and to place it in the front pocket of the binder.

5. Please make a note of missing, broken, or damaged items so that they can be replaced.

6. If you have time, we would be grateful if you would complete the **TEACHER EVALUATION**. All comments, corrections, and suggestions are very welcome.

*Mahalo!*
CHARACTER LIST

This kit is designed for 1 teacher and 15 students. However, you can easily modify the roles to accommodate more or fewer participants. For ideas on how to modify the roles for the number of students in your class, please refer to the TEACHER GUIDE.

Lead characters: 2

Police Commissioner Sharkey: This role is designed for the teacher.
Deputy Moray Eel: Select a good reader for this role as there are lots of lines.

Witnesses: 4

Pinchy Crab
Dr. Simba Lionfish
Pearl Sea Star
Perky Clownfish

Suspects: 4

Industrial Plant
Glowball Warming: This character is the culprit! Boys seem to do better as the guilty party.
Seddi Mentation
All-gal Bloom: This character has a feather boa for a costume. Girls prefer this role.

Scientists: 3

Dr. Moo Cowfish
Bacon Hogfish
Skippy Sea Hare

Jurors: 3

Rocky Racoon Butterflyfish
Tony Tiger Cowry
Scout Seahorse

Other Potential Roles (8) – No lines, with minimal or no costume provided

Crime Scene Cleaners: 2
Scene Sign Holders: 5
Crime Scene Photographer: 1
**TEACHER SCRIPT**

**Who are you?**

You are Sharky the shark, and you are the police commissioner! Your job is to lead the investigation, and make careful observations about the evidence and suspects.

The teacher script contains everyone’s lines, with your lines written in red. *Notes to the teacher are italicized throughout the script.*

**Marine Mystery Outline**

**Scene 1: Interviewing witnesses**

*Deputy Moray and you should be at the front of the classroom.*

- **Police Commissioner:** “Good evening, I am Police Commissioner Sharky and this is Deputy Moray. I have invited you all here tonight to share the news of a tragic loss in our community. Mr. Seymour Coral was found dead in his garden early this morning. His zooxanthellae (zoh – zan – thell – lay) are also missing. We have not yet concluded whether they are still alive. I know that this is a terrible shock, but I need your help to find and collect evidence.”

- Deputy Moray: “We have a handful of witnesses that saw our wanted poster and have courageously come here to report information. Please state your name and position and what you saw or heard. Let’s start with the crab.”

*Witnesses will share information that implicates different suspects. Have the 4 witnesses (Crab, Lionfish, Sea Star, and Clownfish) stand up or come to the front of the classroom for their lines.*

- Crab: “Hi, my name is Pinchy and I’m the local gardener. Last week, while I was trimming my limu, I smelled weird chemicals coming out of the Industrial Plant. They looked kind of greasy and shiny. I think they may have been toxic.”

- Deputy Moray: “Hmmm…that’s rather strange. We’ll certainly need to follow up on that. What does the Lionfish have to share?”

- Lionfish: “Hello, my name is Dr. Simba, and I was the victim’s doctor. Last month, he complained of fevers and low blood sugar. As you know, this often happens when ocean temperatures rise and I recently saw Glowball Warming turning up the thermostat on the reef. But when I followed up the next week, Seymour seemed fine so I didn’t think anything of it.”

- Deputy Moray: “That seems reasonable. And what did the Sea see?”

- Sea Star: “My name is Pearl, and I am, well I was (*choke*, *sob*) Seymour’s neighbor. He was such a friendly coral head.”
Deputy Moray (sympathetically): “Yes, yes. Please continue.”

Sea Star: “Well, I saw Seymour fighting with Seddi Mentation a few days ago. Seddi was trying to smother Seymour and wouldn’t leave him alone. Now I feel like I should have done something!”

Deputy Moray: “Well, don’t you worry about that now. Let’s hear from our last witness, the Clownfish.”

Clownfish: “My name is Perky, and I deliver the mail. I was taking a package to Polly Polyp when I saw a cloud pass overhead. But this cloud hung around for a while. I then realized that it wasn’t a cloud, it was All-gal Bloom casting a shadow on us. Brrr…. All-gal Bloom gives me the shivers!”

At this point, stop to recap the witnesses’ information and have everyone identify the four suspects. Use the written prompts in the following line to encourage the discussion.

Police Commissioner: “Alright, let’s review and have the suspects come up to the front. Who did Pinchy think was responsible? Who did Dr. Simba suggest was guilty? That’s right, and what did Pokey witness? And finally, who did Perky say s/he saw? OK, Deputy Moray, let’s hear what our suspects have to say.”

Scene 2: Interviewing suspects

Deputy Moray and you will provide potential motives/methods and ask for alibis from the suspects in this scene. Have the 4 suspects (Industrial Plant, Glowball Warming, Seddi Mentation, and All-gal Bloom) stand up or come to the front of the classroom for their lines.

Deputy Moray: “Industrial Plant, let’s start with you. Please explain why strange chemicals were coming off of your property last week.”

Industrial Plant: “No problem. I care a lot about the environment and I have very strict rules about my waste products. While they may not smell very good, all of my waste has been treated and breaks down naturally in the environment. I promise that these chemicals were not toxic.”

Police Commissioner: “Hmmm…that doesn’t sound so bad, but depending on how our investigation goes, we might want to test those so-called safe chemicals anyway. And how about you, Glowball Warming? Dr. Simba said that Seymour was suffering from fevers and low blood sugar. You know that warming up the oceans can cause zooxanthellae to leave their coral home. This means the coral gets less food, and it slowly starves?”

Glowball Warming: “No way! Dr. Simba said that Seymour looked just fine after his first visit. Besides, Seymour’s zooxanthellae are missing. So you have no one to ask about it. You’ve got no evidence against me!”

Police Commissioner: “I’m not so sure about your story, but why don’t we hear from Seddi Mentation. Seddi, you can smother the reef with soil particles and were seen bullying Seymour. What do you have to say for yourself?”

Seddi Mentation: “I only really cause trouble when dirt gets washed off land during big storms, and there hasn’t been any for weeks. I didn’t do it!”
- **Police Commissioner**: “That’s true, hmmm. OK, what about All-gal Bloom? You can multiply quickly and block out light that zooxanthellae need for photosynthesis. How do we know you didn’t starve them of light and cause Seymour’s death?”

- All-gal Bloom: “The currents have been strong and washed me right off the reef. I didn’t hang around long enough to cause that much trouble."

- **Police Commissioner**: “All of you have decent alibis, but let’s review the facts.”

*Now, take a moment to review the facts with your students.*

- Deputy Moray: “We now need our scientific team to sample your DNA before we release you.”

### Scene 3: Scientists collect DNA from suspects

*Have each of the three scientists (Cowfish, Hogfish, and Sea Hare) collect a DNA sample from each of the suspects and then come to the front of the classroom. (Have the scientists place the DNA strands into their small plastic baggie that was supplied in their character packet, and have suspects put their empty DNA baggie back into their character packet).*

- **Police Commissioner**: “Will the crime scene scientists please introduce themselves and explain what they will be doing today?”

- Cowfish: “Hello, everyone. I am Dr. Moo, and these are my assistants, Skippy and Bacon. We are collecting DNA, which is the microscopic genetic material found in every living thing.”

- Hogfish: “DNA is very delicate, so you have to be careful when handling it.”

- Sea Hare: “Even though two individuals may be from the same species, some of their DNA is different enough to be able to tell them apart, just like a fingerprint.”

- Cowfish: “But DNA is even better than a fingerprint, because it’s found in almost everything: blood, saliva, bones, hair, and even fish scales!”

- Hogfish: “So if we find even a little bit of DNA at a crime scene, we can figure out who was responsible by matching it to a sample we collect from a suspect.”

- Sea Hare: “I’ll pass my samples around so that everyone can see that no two individuals have exactly the same DNA.”

*Wait for everyone to check out the samples.*

- **Police Commissioner**: “OK, does everyone understand what DNA is?”

*Review what DNA is with the students (i.e., genetic material found in every living organism, everyone’s DNA is different, and it can be used to identify who was at crime scene if evidence such as hair or blood is left behind).*

- **Police Commissioner**: “Alright everyone, it’s time to start the investigation. Let’s begin at the crime scene. DNA is very fragile and can break apart easily. Therefore, let’s try to find at least three pieces of DNA at the crime scene.”

C•MORE SCIENCE KITS • cmore.soest.hawaii.edu/education.htm
Scene 4: Search for clues

Have everyone leave their scripts aside. The scientists need to bring their suspect DNA samples with them, which they should have in a small baggie. The suspects need to bring the key chains included in their student packets with them.

1) The investigation will start at the crime scene! An outline of the investigation is shown in the table below to assist you with this section (Note: If you would like to change the clues/locations that are in red, please refer back to the TEACHER GUIDE.) Remember to tell the kids that the bleached white coral is the late Seymour Coral. The hunt for clues and DNA analysis should require little teacher involvement – unless they are really struggling to find a clue, allow them to work things out.

2) Tell the students that each location has DNA evidence or a clue, or both. They need to keep on searching for both, until they’re convinced they’ve found everything at that location. For locations at which students find both evidence and clues, make sure they first analyze the evidence to determine which suspect can be acquitted. Then they can work on figuring out the clue and where to go next.

3) Once the students have found the key, ask the suspects to pull out their key chains. The only suspect missing a key is All-gal Bloom. The group should go to All-gal Bloom’s house, where they will find the zooxanthellae being held captive.

4) But wait! A 3rd set of DNA samples that matches Glowball Warming’s DNA is found and incriminates him/her. Glowball Warming was trying to frame All-gal Bloom, but forgot about DNA evidence.

<table>
<thead>
<tr>
<th>Location</th>
<th>Evidence (found in Teacher Packet)</th>
<th>Clues (found in Teacher Packet)</th>
<th>Acquitted Suspect</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Crime Scene</td>
<td>3 of the 1st DNA samples</td>
<td>Dry erase marker</td>
</tr>
<tr>
<td>2</td>
<td>Whiteboard</td>
<td>-</td>
<td>Phone card</td>
</tr>
<tr>
<td>3</td>
<td>Phone</td>
<td>3 of the 2nd DNA samples</td>
<td>Printer cartridge</td>
</tr>
<tr>
<td>4</td>
<td>Printer</td>
<td>-</td>
<td>Key</td>
</tr>
<tr>
<td>5</td>
<td>All-gal Bloom’s House</td>
<td>1 of the 3rd DNA samples is in the cage with zooxanthellae; the other 2 pieces are nearby.</td>
<td>Students will find Glowball Warming’s DNA in the zooxanthellae cage ... and will find him/her GUILTY!</td>
</tr>
</tbody>
</table>

Scene 5: Court hearing and verdict

Have the jurors and Glowball Warming come to the front of the classroom. Give Glowball Warming, Tiger Cowry, and Scout Seahorse the teacher versions of their scripts.

- Police Commissioner: “Will the jury please take a few moments to discuss the case and report the verdict?”

- Butterflyfish: “With 4 different suspects and many pieces of information from witnesses, it was difficult to figure out who was responsible.”

- Tiger Cowry: “But then we found Glowball Warming’s DNA at All-gal Bloom’s house with the missing zooxanthellae, and it became clear who did it.”

- Seahorse: “Therefore, we have decided that Glowball Warming was responsible for driving the zooxanthellae away from Seymour, which resulted in his death!”

- Butterflyfish: “Police Commissioner, lock him (or her) up!”

- Glowball Warming: “This isn’t fair! Those darn zooxanthellae were stealing my greenhouse gases!”

C MORE SCIENCE KITS • cmore.soest.hawaii.edu/education.htm
Who are you?

You are “Glowball Warming” and you are a major suspect in the crime! When carbon dioxide and other greenhouse gases are put into the air, you cause the surface of the earth’s land and oceans to warm up. When this happens, zooxanthellae can’t survive and they abandon the corals, which causes the coral to turn white and sometimes die. Human beings are responsible for putting most of the heat-trapping gases in the air in the first place though, so how can you be blamed for Seymour Coral’s death?!

Please follow the conversation closely so that you know when to speak and to whom. Your lines are written in red, and you speak in two scenes. In Scene 2, you will be the second suspect to defend him/herself. In Scene 5, you are the last person to speak.

Marine Mystery Outline

Scene 1: Interviewing witnesses

Scene 2: Interviewing suspects

Scene 3: Scientists collect DNA from suspects

Scene 4: Search for clues

Scene 5: Court hearing and verdict

- Police Commissioner
- Butterflyfish (juror #1)
- Tiger Cowry (juror #2)
- Seahorse (juror #3)
- Butterflyfish (juror #1): “Police Commission, lock him up!”
- Glowball Warming: “This isn’t fair! Those darn zooxanthellae (zoh – zan – thell – lay) were stealing my greenhouse gases!”
You are Scout, a yellow seahorse, and you are a member of the jury! Your job is to pay close attention to the progress of the investigation, making careful observations about the evidence and suspects. After all, you and your fellow jurors will be deciding who is responsible for Seymour Coral’s death!

Please follow the conversation closely so that you know when to speak and to whom. Your lines are written in red, and you will be the third juror to speak during the court hearing in Scene 5.

**Marine Mystery Outline**

**Scene 1:** Interviewing witnesses

**Scene 2:** Interviewing suspects

**Scene 3:** Scientists collect DNA from suspects

**Scene 4:** Search for clues

**Scene 5:** Court hearing and verdict

- Police Commissioner
- Butterflyfish (Juror #1)
- Tiger Cowry (Juror #2): “But then we found Glowball Warming’s DNA at All-gal Bloom’s house with the missing zooxanthellae, and it became clear who did it.”
- Seahorse: “Therefore, we have decided that Glowball Warming was responsible for driving the zooxanthellae (zoh – zan – thell – lay) away from Seymour, which resulted in his death!”
Tiger Cowry’s Script

Who are you?

You are Tony, the tiger cowry, and you are a member of the jury! Your job is to pay close attention to the progress of the investigation, making careful observations about the evidence and suspects. After all, you and your fellow jurors will be deciding who is responsible for Seymour Coral’s death!

Please follow the conversation closely so that you know when to speak and to whom. Your lines are written in red, and you will be the second juror to speak during the court hearing in Scene 5.

Marine Mystery Outline

Scene 1: Interviewing witnesses

Scene 2: Interviewing suspects

Scene 3: Scientists collect DNA from suspects

Scene 4: Search for clues

Scene 5: Court hearing and verdict

- Police Commissioner
- Butterflyfish (Juror #1): “With 4 different suspects and many pieces of information from witnesses, it was difficult to figure out who was responsible.”
- Tiger Cowry: “But then we found Glowball Warming’s DNA at All-gal Bloom’s house with the missing zooxanthellae (zoh – zan – thell – lay), and it became clear who did it.”
Environmental Suspects!
(Bold terms are defined in the “Words to Know” list)

1. **Glowball Warming** *(global warming):*
   - Coral reefs can only live in waters between 23–29°C.
   - Many corals have tiny plant-like cells called *zooxanthellae* that live in their tissues and provide food for the coral by *photosynthesis*.
   - If water temperature increases, *zooxanthellae* are unable to produce food for the coral.
   - When water temperature continues to rise, corals often lose their *zooxanthellae* through a process known as coral bleaching.
   - If the coral does not acquire more *zooxanthellae*, the coral can starve and die.

2. **Seddi Mentation** *(sedimentation):*
   - Mining, building, farming, and other human activities loosen soil (sediment).
   - When it rains, loose soil can get washed off the land and carry nutrients and toxic chemicals into rivers and streams, and eventually into the ocean.
   - Corals grow best in clear, blue water so that their *zooxanthellae* can get plenty of sunlight to produce food.
   - Soil and other particles that are suspended in the water reduce the amount of light reaching a coral, making it difficult for *zooxanthellae* to produce food.
   - As the sediment settles out of the water, it can bury corals or cause them to use a large amount of energy to keep clean.

3. **All-gal Bloom** *(algae bloom):*
   - The runoff from agricultural areas is rich in nutrients, such as nitrogen and phosphorus.
   - These nutrients can cause tiny marine algae to grow into vast numbers, which is called an algal bloom.
   - Similar to the process of sedimentation, these algal blooms can block sunlight and thus reduce coral growth.
   - The change in ocean color (to red) on the left is due to a pigment produced by the algae.

4. **Industrial Plant** *(pollution):*
   - Industrial pollution includes the dumping of heavy metals and other toxins into the oceans and rivers, and the release of heated water from the cooling systems of power plants.
   - Pollution affects a coral’s ability to feed and reproduce (the toxins interfere with proper egg development).
   - The pollution enters the coral through the polyps, and the heavy metals from the pollution can kill the animals. When the polyps are killed, no new coral layers can be produced.
Words to Know!

Algae – plant-like organisms that are able to capture sunlight and change it into food through a process called photosynthesis (see below).

Algal Bloom – a rapid increase in the population size of one or more species of algae. Algal blooms can occur in freshwater or marine environments.

Coral – a marine invertebrate animal that is related to sea anemones. Some types of coral build a hard skeleton that forms reefs. Many serve as a habitat for symbiotic algae called zooxanthellae (see below).

DNA – a molecule that contains the genetic instructions for the development of all living things. DNA is short for deoxyribonucleic (dee-oxy-rye-bow-new-clay-ick) acid.

Global Warming – the gradual increase in the average temperature of the Earth’s air and oceans. While the global temperature does change naturally, the steady increase in temperature over the past century is mostly caused by human activity.

Limu – the generic Hawaiian name for seaweed.

Photosynthesis – Plants make food by converting light energy from the sun into chemical energy. This process (called photosynthesis) requires carbon dioxide and water, and produces sugar and oxygen.

Pollution – the introduction of chemical substances or energy (such as noise, heat, or light) into the environment that harm humans, other living organisms, or the environment.

Sedimentation – the settling of particles that were suspended in water onto a surface such as the ocean floor or a reef. Particles are usually very small – for example, the size of sand grains.

Symbiosis (sim-bye-oh-sis) – Symbiosis describes when two or more species live in close association with each other (e.g., clownfish and anemone).

Zooxanthellae (zoh – zan – thell – lay) – single-celled algae that live in symbiosis within corals. These cells provide food for corals through photosynthesis and also give corals their bright colors.
MISSING!

ZOOXANTHELLAE

LAST SEEN ON TUESDAY

SEYMOUR CORAL WAS FOUND DEAD AT HIS HOME
AND HIS SYMBIOTIC ALGAE ARE MISSING

REWARD

WILL BE GIVEN FOR INFORMATION THAT LEADS TO AN ARREST. IF YOU HAVE SEEN ANY SUSPICIOUS BEHAVIOR OR HAVE ANY INFORMATION, PLEASE CALL 555-REEF!
MISSING!

ZOOXANTHELAE

LAST SEEN ON TUESDAY

SEYMOUR CORAL WAS FOUND DEAD AT HIS HOME
AND HIS SYMBIOTIC ALGAE ARE MISSING

REWARD

Will be Given For Information that leads to an arrest.

If you have seen
any suspicious behavior or have any information, please
Call 555-REEF!
MISSING!

LAST SEEN ON TUESDAY

Seymour Coral was found dead at his home and his symbiotic algae are missing

REWARD

Will be given for information that leads to an arrest. If you have seen any suspicious behavior or have any information, please call 555-REEF!
SCENE 1:
Interviewing Witnesses
SCENE 2:
Interviewing Suspects
SCENE 3:
Scientists Collect DNA From Suspects
SCENE 4: Search for Clues
SCENE 5:
Court Hearing and Verdict
Industrial Plant’s House
Glowball Warming’s House
All-gal Bloom’s House
Seddi Mentation’s House
DNA EVIDENCE KEY

1\textsuperscript{st} DNA Sample
☆ Hide at Crime Scene

2\textsuperscript{nd} DNA Sample
☆ Hide at 3\textsuperscript{rd} location

3\textsuperscript{rd} DNA Sample
☆ Hide at All-gal Bloom’s house
SUSPECT DNA KEY

- Industrial Pollution
- Sedgi Mentation
- Glowball Warming
- All-gal Bloom
TEACHER EVALUATION
Marine Mystery

1. Was this C-MORE Science Kit easy to use?

2. What do you think are the appropriate grade levels for this Science Kit?

3. Did your students enjoy using this Science Kit?

4. Would you borrow this Science Kit in the future? Would you recommend it to other teachers?
5. Please suggest two things that could be improved.

6. Any other comments?

7. Please tell us about your students. As we are committed to serving underrepresented populations, please estimate the number of your students in the following categories:

___ Total number of students
___ Eligible for free or reduced lunch
___ Native Hawaiian or Pacific Islander
___ Filipino
___ Hispanic
___ African American
___ Native American
___ Physically disabled
___ Learning disabled
___ Neither parent attended college

Thank you for your feedback.
SUPPLY CHECKLIST for the C-MORE Marine Mystery Science Kit
Use the boxes to check off each item as you reassemble this kit!

Contents of Binder:
1. Front pocket
   - CD (contains Video, PowerPoint, and electronic versions of everything in binder)
   - C-MORE Key Concepts in Microbial Oceanography brochure
2. Front Material
   - General Overview & Standards
3. Teacher Materials Tab
   - Teacher Guide
   - Character List
   - Teacher Script
   - Glowball Warming (Teacher Version)
   - Seahorse’s Script (Teacher Version)
   - Tiger Cowry’s Script (Teacher Version)
4. Handouts Tab
   - Environmental Suspects
   - Words to Know!
5. Reward Signs Tab
   - Reward signs (3)
6. Scene Signs Tab
   - SCENE 1: Interviewing Witnesses Sign
   - SCENE 2: Interviewing Suspects Sign
   - SCENE 3: Scientists Collect DNA From Suspects Sign
   - SCENE 4: Search for Clues Sign
   - SCENE 5: Court Hearing and Verdict Sign
7. House Signs Tab
   - Industrial Plant’s House Sign
   - Glowball Warming’s House Sign
   - All-gal Bloom’s House Sign
   - Seddi Mentation’s House Sign
8. DNA Keys Tab
   - DNA Evidence Key
   - Suspect DNA Key
9. Evaluation Tab
   - Teacher Evaluation
10. Supply Checklist Tab
    - Supply Checklist For Kit

Teacher Packet:
Shark (Police Commissioner)
- Shark hat
- Evidence Bag
  - Ziploc bag with 1st DNA Sample (3 DNA Strands with 8 Beads)
  - Ziploc bag with 2nd DNA Sample (3 DNA Strands with 9 Beads)
  - Ziploc bag with 3rd DNA Sample (3 DNA Strands with 11 Beads)
- Clue Bag
  - Dry erase marker
  - Phone card
  - Printer cartridge
  - Ziploc bag with 1 Key
Student Packets:

1. Moray Eel (Deputy Sheriff)
   - Deputy Moray ID
   - Moray Eel script
   - Zebra mask
   - Deputy sheriff badge

2. Industrial Plant (Suspect 1)
   - Industrial Plant ID
   - Industrial Plant script
   - Yellow hard hat
   - Key on key ring
   - Industrial Plant DNA (3 strands in Ziploc bag)

3. Glowball Warming (Suspect 2)
   - Glowball Warming ID
   - Glowball Warming script
   - Black cape
   - Key on key ring
   - Glowball Warming DNA (3 strands in Ziploc bag)

4. Seddi Mentation (Suspect 3)
   - Seddi Mentation ID
   - Seddi Mentation script
   - Red dirt t-shirt
   - Key on key ring
   - Seddi Mentation DNA (3 strands in Ziploc bag)

5. All-gal Bloom (Suspect 4)
   - All-gal Bloom ID
   - All-gal Bloom script
   - Green feather boa
   - Key ring (no key!)
   - All-gal Bloom DNA (3 strands in Ziploc bag)

6. Crab (Witness 1)
   - Crab ID
   - Crab script
   - Crab hat

7. Lionfish (Witness 2)
   - Lionfish ID
   - Lionfish script
   - Lion mask
   - Lab coat
   - Stethoscope

8. Sea Star (Witness 3)
   - Sea Star ID
   - Sea Star script
   - Star headband

9. Clownfish (Witness 4)
   - Clownfish ID
   - Clownfish script
   - Rainbow Clown wig
   - Red nose
Student Packets (Continued):
10. Cowfish (Scientist 1)
   - Cowfish ID
   - Cowfish script
   - Cow mask
   - Lab coat
   - Ziploc bag with Forceps (labeled “Cowfish”)

11. Sea hare (Scientist 2)
   - Sea hare ID
   - Sea hare script
   - Lab coat
   - Rabbit mask
   - Ziploc bag with Forceps (labeled “sea hare”)

12. Hogfish (Scientist 3)
   - Hogfish ID
   - Hogfish script
   - Lab coat
   - Pig mask
   - Ziploc bag with Forceps (labeled “hogfish”)

13. Butterflyfish (Juror 1)
   - Butterflyfish ID
   - Butterflyfish script
   - Raccoon mask

14. Tiger Cowry (Juror 2)
   - Tiger Cowry ID
   - Tiger Cowry script
   - Tiger mask

15. Seahorse (Juror 3)
   - Seahorse ID
   - Seahorse script
   - Horse mask

16. Extra costumes
   - IDs for Crime Scene Cleaners (2)
   - ID for Crime Scene and Evidence Photography

Other Supplies:
- Speakers
- Ziploc bag with Crime Scene Tape
- Industrial Plant mailbox
- Glowball Warming mailbox
- Seddi Mentation mailbox
- All-gal Bloom mailbox
- Orange cones (4)
- Coral reef (3 pieces)
- Zooxanthellae in cage
Dr. Simba. I’m a lionfish.

Diet: The lionfish is beautiful but dangerous! It is an ambush predator that homes in quickly and consumes its prey whole. If it senses a fish or shrimp or small crab in its vicinity, it strikes with its venomous spines.

Size: The lionfish is no shrimp! It can grow up to 8.5 in (22 cm) long.

Distribution: This species of lionfish is found only in Hawaii, but close relatives are also found in the Indo-Pacific.
Hi, my name is Pinchy. I'm a sleepy sponge crab.

Photos credit: Jennifer Maloney/WikiMedia Commons-Kibo Molina

The Sleepy Sponge Crab

Size: Up to 8 inches in width.

Habitat: This unusual crab lives off a piece of sponge (see the yellow sponge in the photo) and attaches its back with its curved hind legs. Over time, the sponge grows and provides camouflage and shelter for the crab.

Distribution: The sleepy sponge crab is found in the Pacific Ocean, Red Sea, and Indian Ocean.

It is slow moving and non-aggressive.

What's in a Name: The "sleepy" part of this crab's name comes from the fact that Pinchy is a bit of a daytime sleeper.
Hi
my name is:

Skippy. I’m a sea hare.

Photo credit: https://www.pollinators.org/ story/look-for-sea-hares/
HI
my name is:

Dr. Moo. I’m a honeycomb cowfish.

Photo credit: https://www.flickr.com/photos/michelew(Constructoris/12482669723)

I hail from a box!

Holy cow! Rather than a skeleton, cowfish have a body of exterior bony plates.

Individuals are only half this size.

Size: The honeycomb cowfish grows up to 20 inches (50 cm) in length, but most are smaller.

Sea squirts, and shrimps.

Diet: Despite their name, cowfish don’t eat grass. They eat sponges, soft corals, corral teeth in shallow (10-260 ft) water from New Jersey to Brazil.

Distribution: This fish is only found in the western Atlantic Ocean and lives around mangroves.

What’s in a name? The cowfish earned its name because of its bony skin! Species name: Acanthochromis polyacanthus.
I'm a zebra moray eel.

Size: Zebra morays grow up to 5 feet (1.5m), but you rarely see their full length.

Diet: This predatory critic cannot see or hear very well, but it does have an excellent sense of smell. It uses its close-set, pebble-like teeth to feed on hard-shelled prey such as crabs, molluscs, and sea urchins.

Distribution: The zebra moray eel is a bony fish that is found in the Pacific Ocean, Red Sea, and Indian Ocean.

Species name: Gymnomuraena zebra.

Photo credit: Julie Lý/www.grandanimalphotography.com
My name is: All-gal Bloom

Why do we care? Algal blooms can block sunlight and prevent zooplankton and other marine invertebrates from becoming able to photosynthesize and make food for corals. The change in ocean color is due to the pigment produced by the algae.

What does it happen? Just like plants on land, plants in the ocean need nutrients rich in nutrients and can cause hypoxic algae to grow into vast numbers. The runoff from agricultural areas is such as nitrogen and phosphorus to grow. Why does it happen? An algal bloom is a rapid increase in the population size of one or two species of single-celled algae.
Industrial Plant (pollution)

Pollution can kill the animals. When the poplars are killed, no new coral layers can be produced.

The pollution enters the coral through the polyps, and the heavy metals from the plants affect a coral’s ability to feed and reproduce (the toxins interfere with proper development).

Pollution affects a coral’s ability to feed and reproduce; the toxins interfere with the coral’s ability to feed and reproduce (the toxins interfere with the coral’s ability to feed and reproduce).

Power plants, oceans and rivers, and the release of heated water from the cooling systems of industrial pollution includes dumping heavy metals and other toxins into the environment, becoming harmful to human health, other living organisms, or the environment as noise, heat, or light into the environment to such a point that it affects such systems.
HI
my name is:

Seddi Mentation

Photo credit: https://www.usgs.gov/centers/erstn/projects/coastal-water

use a large amount of energy to keep clean.

also, as the sediment (dirt particles) settles, it can bury corals or cause them to

die. When soil and other particles get suspended in the water, less light can reach

corals. Like to live in clear, blue water so that their zooxanthellae can get plenty

of sunlight to produce food.

Why do we care?

Oceans.

loose chemicals and nutrients into rivers and streams and eventually into the

Why does it happen? Mining, building, farming, and other human activities

and can be made of dirt, debris, or sand.

What is it? Sedimentation is the settling of particles that are suspended in water.
Glowball Warming

Why do we care?

What is it? Global warming is the gradual increase in the average temperature of the Earth due to the accumulation of greenhouse gases in the atmosphere. These gases trap heat from the sun, leading to a gradual rise in global temperatures.

Why does it happen? Global warming is mostly caused by human activity, such as burning fossil fuels, deforestation, and farming practices. These activities release large amounts of greenhouse gases into the atmosphere, contributing to the warming trend.

The Earth's air and oceans

Many corals have tiny plant-like cells called zooxanthellae that live in their tissues and provide food for the coral through photosynthesis. If water temperature increases, zooxanthellae stop being able to produce food and the coral can lose their zooxanthellae in a process known as coral bleaching.

If water temperature keeps increasing, corals lose their zooxanthellae and die. Coral reefs can only live in waters between 23° C - 29° C. Why do we care?

Because they trap heat near the Earth's surface and cause temperatures to rise, greenhouse gases are called greenhouse gases. These gases are also known as carbon dioxide and methane. In the past century, the concentration of these gases in the atmosphere has increased significantly, leading to a gradual increase in global temperature.
Hi, my name is: Scout. I’m a yellow seahorse.

Photo and information credit: https://animals.nationalgeographic.com/animals/three-seahorse/hi-three-seahorse.html

Easy die of exhaustion when canned in storm seas.

Billions up to 35 times per second! They are such poor swimmers that they can barely move. Seahorses prop themselves by using a small fin on their back that quickly they must eat almost constantly to stay alive.

In small crustaceans that drift by. Food passes through their digestive systems so Diet: Seahorses have no teeth and no stomach. They use their long mouths to suck

Species: Hippocampus kuda

Distribution: Indo-Pacific.
My name is Bacon. I’m a hogfish.

Photo credit: https://www.flickr.com/photos/40360335@N06/4803666434

Hogfish, c. David Fleetham/David Fleetham/Alamy

Extral, external Opposite to crownfish, all hogfish are born female. After a few years, dominant females can transform into fully functional males.

Hogfish has a long spout and an extendable jaw with strong canine teeth.

Distribution: These attractive fish are popular to eat and are caught in the Western Atlantic, from North Carolina to Brazil.

Species name: Lachnolaimus maximus

Such as plants,utchins, and snails.

This jaw structure allows the hogfish to consume a range of organisms on the reef.

Size: Hogfish grow up to 3 feet (91cm) in length.
Tony, the tiger cowry.

Photo credit: https://www.flickr.com/photos/leonfree/
Roc
terck
ock
raccoon butterflyfish.

Photo credit: https://www.zeitlosfische.com (Image: 220x170)

When breeding, females of this species produce up to 20,000 eggs!

Diet: Raccoon butterflyfish are carnivores that feed on planktonic invertebrates.

Size: These attractive fish grow to about 5 cm (20cm) in length.

Distribution: The raccoon butterflyfish has a broad range that extends throughout the tropical and subtropical waters of the Pacific and Indian Oceans.

Species name: Chelidon hynma
My name is Perky. I’m an orange clownfish.
Hi my name is:

Pearl. I’m a necklace sea star.
All-gal Bloom’s Script

Who are you?

You are “All-gal Bloom” and you are a prime suspect in the case! As an algal bloom, your individual sizes are microscopic, but you overwhelm the reef with your sheer numbers! For some, you’re a blessing, providing a rich-source of food. But for corals, you can block out light and starve them of the food produced by their zooxanthellae. You are tough and bossy, but that doesn’t necessarily make you guilty!

Please follow the conversation closely so that you know when to speak and to whom. Your lines are written in red, and you speak in Scene 2. You will be the fourth and last suspect to defend him/herself.

Marine Mystery Outline

Scene 1: Interviewing witnesses

Scene 2: Interviewing suspects

- Deputy Moray
- Industrial Plant (suspect #1)
- Police Commissioner
- Glowball Warming (suspect #2)
- Police Commissioner
- Seddi Mentation (suspect #3)
- Police Commissioner: “That’s true, hmmm. OK, what about All-gal Bloom? You can multiply quickly and block out light that zooxanthellae need for photosynthesis. How do we know you didn’t starve them of light and cause Seymour’s death?”
- All-gal Bloom: “The currents have been strong and washed me right off the reef. I didn’t hang around long enough to cause that much trouble.”

Scene 3: Scientists collect DNA from suspects

Scene 4: Search for clues

Scene 5: Court hearing and verdict
Butterflyfish’s Script

Who are you?

You are Rocky, a raccoon butterflyfish, and you are a member of the jury! Your job is to pay close attention to the progress of the investigation, making careful observations about the evidence and suspects. After all, you and your fellow jurors will be deciding who was responsible for Seymour Coral’s death!

Please follow the conversation closely so that you know when to speak and to whom. Your lines are written in red, and you speak during the court hearing in Scene 5.

Marine Mystery Outline

Scene 1: Interviewing witnesses

Scene 2: Interviewing suspects

Scene 3: Scientists collect DNA from suspects

Scene 4: Search for clues

Scene 5: Court hearing and verdict

- Police Commissioner: “Will the jury please take a few moments to discuss the case and report the verdict?”
- **Butterflyfish:** “With 4 different suspects and many pieces of information from witnesses, it was difficult to figure out who was responsible.”
- Tiger Cowry (juror #2)
- Sea Horse (juror #3): “Therefore, we have decided that … was responsible for driving the zooxanthellae away from Seymour, which resulted in his death!”
- Butterflyfish: “Police Commissioner, lock him (or her) up!”
Clownfish’s Script

Who are you?

You are Perky, the clownfish, and you are the last key witness of the investigation! You are generally very happy and positive; however, Seymour’s unexpected death has you worried.

Please follow the conversation closely so that you know when to speak and to whom. Your lines are written in red, and you speak in Scene 1. You will make your formal statement to the police after Deputy Moray has heard from the sea star (witness #3).

Marine Mystery Outline

Scene 1: Interviewing witnesses

- Police Commissioner
- Deputy Moray
- Crab (witness #1)
- Deputy Moray
- Lionfish (witness #2)
- Deputy Moray
- Sea Star (witness #3)
- Deputy Moray
- Sea Star (witness #3)
- Deputy Moray: “Well, don’t you worry about that now. Let’s hear from our last witness, the clownfish.”
- Clownfish: “My name is Perky, and I deliver the mail. I was taking a package to Polly Polyp when I saw a cloud pass overhead. But this cloud hung around for a while. I then realized that it wasn’t a cloud, it was All-gal Bloom casting a shadow on us. Brrr.... All-gal Bloom gives me the shivers!”

Scene 2: Interviewing suspects

Scene 3: Scientists collect DNA from suspects

Scene 4: Search for clues

Scene 5: Court hearing and verdict
Who are you?

You are Dr. Moo, a cowfish. You are the lead crime scene investigator - a specially trained scientist who collects information to solve cases! You take your work seriously and this case is no exception. You work well in a team, and your fellow scientists respect you.

Please follow the conversation closely so that you know when to speak and to whom. Your lines are written in red, and you speak in Scene 3. At the beginning of Scene 3, you will use your forceps to carefully collect one DNA sample from each of the suspects. Place the DNA samples into the small Ziploc baggie that was provided in your character packet.

Marine Mystery Outline

Scene 1: Interviewing witnesses

Scene 2: Interviewing suspects

Scene 3: Scientists collect DNA from suspects

- Police Commissioner: Will the crime scene scientists please introduce themselves and explain what they will be doing today?”
- Cowfish: “Hello, everyone. I am Dr. Moo, and these are my assistants, Skippy and Bacon. We are collecting DNA, which is the microscopic genetic material found in every living thing.”
- Hogfish (scientist #2)
- Sea Hare (scientist #3): “Even though two individuals may be from the same species, some of their DNA is different enough to be able to tell them apart, just like a fingerprint.”
- Cowfish: “But DNA is even better than a fingerprint, because it’s found in almost everything: blood, saliva, bones, hair, and even fish scales!”

Scene 4: Search for clues

Scene 5: Court hearing and verdict
Crab’s Script

Who are you?

You are Pinchy, the crab, and you are the first key witness in the investigation! You are a relaxed and confident member of the community, and you are standing up to share what you feel is important information.

Please follow the conversation closely so that you know when to speak and to whom. Your lines are written in red, and you speak in Scene 1. You will make your formal statement to the police after Deputy Moray asks for witnesses to share what they know.

Marine Mystery Outline

Scene 1: Interviewing witnesses

- Police Commissioner
- Deputy Moray: “We have a handful of witnesses that saw our wanted poster and have courageously come here to report information. Please state your name and position and what you saw or heard. Let’s start with the crab.”
- Crab: “Hi, my name is Pinchy and I’m the local gardener. Last week, while I was trimming my limu, I smelled weird chemicals coming out of the Industrial Plant. They looked kind of greasy and shiny. I think they may have been toxic.”

Scene 2: Interviewing suspects

Scene 3: Scientists collect DNA from suspects

Scene 4: Search for clues

Scene 5: Court hearing and verdict
Who are you?

You are “Glowball Warming” and you are a major suspect in the crime! When carbon dioxide and other greenhouse gases are put into the air, you cause the surface of the earth’s land and oceans to warm up. When this happens, zooxanthellae can’t survive and they abandon the corals, which causes the coral to turn white and sometimes die. Human beings are responsible for putting most of the heat-trapping gases in the air in the first place though, so how can you be blamed for Seymour Coral’s death?!

Please follow the conversation closely so that you know when to speak and to whom. Your lines are written in red, and you speak in two scenes. In Scene 2, you will be the second suspect to defend him/herself. Since your lines in the last scene may identify the culprit, your teacher will give you those lines at the beginning of Scene 5.

Marine Mystery Outline

Scene 1: Interviewing witnesses

Scene 2: Interviewing suspects

- Deputy Moray
- Industrial Plant (suspect #1)
- Police Commissioner: “Hmmm…that doesn’t sound so bad, but depending on how our investigation goes, we might want to test those so-called safe chemicals anyway. And how about you, Glowball Warming? Dr. Simba said that Seymour was suffering from fevers and low blood sugar. You know that warming up the oceans can cause zooxanthellae to leave their coral home. This means the coral gets less food, and it slowly starves?”

- Glowball Warming: “No way! Dr. Simba said that Seymour looked just fine after his first visit. Besides, Seymour’s zooxanthellae (zoh – zan – thell – lay) are missing. So you have no one to ask about it. You’ve got no evidence against me!”

Scene 3: Scientists collect DNA from suspects

Scene 4: Search for clues

Scene 5: Court hearing and verdict

Suspect, Scenes 2 & 5
**Hogfish’s Script**

**Who are you?**

You are Bacon, a hogfish. You are a crime scene investigator, which is a specially trained scientist who collects information to solve cases!

Please follow the conversation closely so that you know when to speak and to whom. Your lines are written in red, and you speak in Scene 3. At the beginning of Scene 3, you will use your forceps to carefully collect one DNA sample from each of the suspects. Place the DNA samples into the small Ziploc baggie that was provided in your character packet.

**Marine Mystery Outline**

**Scene 1: Interviewing witnesses**

**Scene 2: Interviewing suspects**

**Scene 3: Scientists collect DNA from suspects**

- Police Commissioner
- Cowfish (scientist #1): “Hello, everyone. I am Dr. Moo, and these are my assistants, Skippy and Bacon. We are collecting DNA, which is the microscopic genetic material found in every living thing.”
- Hogfish: “DNA is very delicate, so you have to be careful when handling it.”
- Sea Hare (scientist #3)
- Cowfish (scientist #1): “But DNA is even better than a fingerprint, because it’s found in almost everything: blood, saliva, bones, hair, and even fish scales!”
- Hogfish: “So if we find even a little bit of DNA at a crime scene, we can figure out who was responsible by matching it to a sample we collect from a suspect.”

**Scene 4: Search for clues**

**Scene 5: Court hearing and verdict**
**Industrial Plant’s Script**

**Who are you?**

You are the “Industrial Plant” and you are a prime suspect in the crime! You produce pollution that is thought to harm the reef, but you feel that you have been a responsible member of the community who has been wrongly accused.

Please follow the conversation closely so that you know when to speak and to whom. Your lines are written in **red**, and you speak in Scene 2. You will be the first suspect to defend him/herself.

**Marine Mystery Outline**

**Scene 1:** Interviewing witnesses

**Scene 2:** Interviewing suspects

- Deputy Moray: “Industrial Plant, let’s start with you. Please explain why strange chemicals were coming off of your property last week.”

- Industrial Plant: “No problem. I care a lot about the environment and I have very strict rules about my waste products. While they may not smell very good, all of my waste has been treated and breaks down naturally in the environment. I promise that these chemicals were not toxic.”

**Scene 3:** Scientists collect DNA from suspects

**Scene 4:** Search for clues

**Scene 5:** Court hearing and verdict
Who are you?

You are Dr. Simba, the lionfish! You are Seymour’s doctor and the second key witness in the investigation. You are a respected member of the community and have come to share your knowledge of Seymour’s health before his death.

Please follow the conversation closely so that you know when to speak and to whom. Your lines are written in red, and you speak in Scene 1. You will make your formal statement to the police after Deputy Moray has heard from the crab (witness #1).

**Scene 1: Interviewing witnesses**

- Police Commissioner
- Deputy Moray
- Crab (witness #1)
- Deputy Moray: “Hmmm…that’s rather strange. We’ll certainly need to follow up on that. What does the Lionfish have to share?”
- Lionfish: “Hello, my name is Dr. Simba, and I was the victim’s doctor. Last month, he complained of fevers and low blood sugar. As you know, this often happens when ocean temperatures rise and I recently saw Glowball Warming turning up the thermostat on the reef. But when I followed up the next week, Seymour seemed fine so I didn’t think anything of it.”

**Scene 2: Interviewing suspects**

**Scene 3: Scientists collect DNA from suspects**

**Scene 4: Search for clues**

**Scene 5: Court hearing and verdict**
Who are you?

You are a zebra moray eel. You’re the Police Deputy on the reef, which explains why everyone calls you Deputy Moray. You take your job seriously and are very organized. You are proud to have such an important job. You not only assist the Police Commissioner with their job, but you also get to interview key witnesses!

Please follow the conversation closely, as you have several lines to read. Your lines are written in red, and you speak during Scenes 1 and 2. In Scene 1, you will begin interviewing witnesses right after the Police Commissioner begins the Town Hall Meeting. In Scene 2, you will start the discussion with witnesses, and then the Police Commissioner will question them.

Marine Mystery Outline

Scene 1: Interviewing witnesses

- Police Commissioner: “Good evening, I am Police Commissioner Sharky and this is Deputy Moray. I have invited you all here tonight to share the news of a tragic loss in our community. Mr. Seymour Coral was found dead in his garden early this morning. His zooxanthellae are also missing. We have not yet concluded whether they are still alive. I know that this is a terrible shock, but I need your help to find and collect evidence.”

- Deputy Moray: “We have a handful of witnesses that saw our wanted poster and have courageously come here to report information. Please state your name and position and what you saw or heard. Let’s start with the crab.”

- Crab (witness #1): “Hi, my name is Pinchy and I’m the local gardener. Last week, while I was trimming my limu, I smelled weird chemicals coming out of the Industrial Plant. They looked kind of greasy and shiny. I think they may have been toxic.”

- Deputy Moray: “Hmmm... that’s rather strange. We’ll certainly need to follow up on that. What does the Lionfish have to share?”

- Lionfish (witness #2): “Hello, my name is Dr. Simba, and I was the victim’s doctor. Last month, he complained of fevers and low blood sugar. As you know, this often happens when ocean temperatures rise and I recently saw Glowball Warming turning up the thermostat on the reef. But when I followed up the next week, Seymour seemed fine so I didn’t think anything of it.”

- Deputy Moray: “That seems reasonable. And what did the sea star see?”

- Sea star (witness #3): “My name is Pearl, and I am, well I was (*choke*, *sob*) Seymour’s neighbor. He was such a friendly coral head.”

- Deputy Moray (sympathetically): “Yes, yes. Please continue.”
- Sea star (witness #3): “Well, I saw Seymour fighting with Seddi Mentation a few days ago. Seddi was trying to smother Seymour and wouldn’t leave him alone. Now I feel like I should have done something!”
- Deputy Moray: “Well, don’t you worry about that now. Let’s hear from our last witness, the clownfish.”

Scene 2: Interviewing suspects

- Deputy Moray: “Industrial Plant, let’s start with you. Please explain why strange chemicals were coming off of your property last week.”
- Industrial Plant (suspect #1)
- Police Commissioner
- Glowball Warming (suspect #2)
- Police Commissioner
- Seddi Mentation (suspect #3)
- Police Commissioner
- All-gal Bloom (suspect #4)
- Police Commissioner: “All of you have decent alibis, but let’s review the facts.”
- Deputy Moray: “We now need our scientific team to sample your DNA before we release you.”

Scene 3: Scientists collect DNA from suspects

Scene 4: Search for clues

Scene 5: Court hearing and verdict
Who are you?

You are Skippy, a sea hare (a type of sea slug). You are a crime scene investigator, which is a specially trained scientist who collects information to solve cases!

Please follow the conversation closely so that you know when to speak and to whom. Your lines are written in red, and you speak in Scene 3. At the beginning of Scene 3, you will use your forceps to carefully collect one DNA sample from each of the suspects. Place the DNA samples into the small Ziploc baggie that was provided in your character packet.

Scene 1: Interviewing witnesses

Scene 2: Interviewing suspects

Scene 3: Scientists collect DNA from suspects

- Police Commissioner
- Cowfish (Scientist #1)
- Hogfish (Scientist #2): “DNA is very delicate, so you have to be careful when handling it.”
- Sea Hare: “Even though two individuals may be from the same species, some of their DNA is different enough to be able to tell them apart, just like a fingerprint.”
- Cowfish (Scientist #1)
- Hogfish (Scientist #2): “So if we find even a little bit of DNA at a crime scene, we can figure out who was responsible by matching it to a sample we collect from a suspect.”
- Sea Hare: “I’ll pass my samples around so that everyone can see that no two individuals have exactly the same DNA.”

Scene 4: Search for clues

Scene 5: Court hearing and verdict
Sea Star’s Script

Who are you?

You are Pearl, a necklace sea star, who was Seymour’s neighbor. You are the third key witness in the investigation! You and Seymour were good buddies and you are terribly upset about his death. You get very emotional about the issue, but you have important information that you need to share.

Please follow the conversation closely so that you know when to speak and to whom. Your lines are written in red, and you speak in Scene 1. You will make your formal statement to the police after Deputy Moray has heard from the lionfish (witness #2).

Marine Mystery Outline

Scene 1: Interviewing witnesses
- Police Commissioner
- Deputy Moray
- Crab (witness #1)
- Deputy Moray
- Lionfish (witness #2)
- Deputy Moray: “That seems reasonable. And what did the sea star see?”
- Sea Star (in a shaky voice): “My name is Pearl, and I am, well I was (choke, sob) Seymour’s neighbor. He was such a friendly coral head.”
- Deputy Moray: “Yes, yes. Please continue.”
- Sea Star: “Well, I saw Seymour fighting with Seddi Mentation a few days ago. Seddi was trying to smother Seymour and wouldn’t leave him alone. Now I feel like I should have done something!”

Scene 2: Interviewing suspects

Scene 3: Scientists collect DNA from suspects

Scene 4: Search for clues

Scene 5: Court hearing and verdict
You are Scout, a yellow seahorse, and you are a member of the jury! Your job is to pay close attention to the progress of the investigation, making careful observations about the evidence and suspects. After all, you and your fellow jurors will be deciding who is responsible for Seymour Coral’s death!

Please follow the conversation closely so that you know when to speak and to whom. Your lines are written in red, and you will be the third juror to speak during the court hearing in Scene 5. Since your lines may identify the culprit, your teacher will give you your lines at the beginning of Scene 5.

**Marine Mystery Outline**

**Scene 1:** Interviewing witnesses

**Scene 2:** Interviewing suspects

**Scene 3:** Scientists collect DNA from suspects

**Scene 4:** Search for clues

**Scene 5:** Court hearing and verdict

Your teacher will give you your lines at the beginning of Scene 5.
You are “Seddi Mentation” and you are a main suspect in the case! You don’t usually hang out around the reef, but after a storm, you can cause big-time damage when rivers carry tons of soil particles out into the ocean. You can starve zooxanthellae of light by making the water murky and even smother the coral in dirt when it settles on the reef. You are messy and clumsy, but you don’t really mean to cause trouble!

Please follow the conversation closely so that you know when to speak and to whom. Your lines are written in red, and you speak in Scene 2. You will be the third suspect to defend him/herself.

**Scene 2:** Interviewing suspects

- Deputy Moray
- Industrial Plant (suspect #1)
- Police Commissioner
- Glowball Warming (suspect #2)

- Police Commissioner: “I’m not so sure about your story, but why don’t we hear from Seddi Mentation. Seddi, you can smother the reef with soil particles and were seen bullying Seymour. What do you have to say for yourself?”
- Seddi Mentation: “I only really cause trouble when dirt gets washed off land during big storms, and there haven’t been any for weeks. I didn’t do it!”

**Scene 3:** Scientists collect DNA from suspects

**Scene 4:** Search for clues

**Scene 5:** Court hearing and verdict
Who are you?

You are Tony, the tiger cowry, and you are a member of the jury! Your job is to pay close attention to the progress of the investigation, making careful observations about the evidence and suspects. After all, you and your fellow jurors will be deciding who is responsible for Seymour Coral’s death!

Please follow the conversation closely so that you know when to speak and to whom. Your lines are written in red, and you will be the second juror to speak during the court hearing in Scene 5. Since your lines may identify the culprit, your teacher will give you your lines at the beginning of Scene 5.

Marine Mystery Outline

Scene 1: Interviewing witnesses

Scene 2: Interviewing suspects

Scene 3: Scientists collect DNA from suspects

Scene 4: Search for clues

Scene 5: Court hearing and verdict

Your teacher will give you your lines at the beginning of Scene 5.