

MARINE MYSTERY: A WATERY WHO-DUNNIT!

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

Standards: This kit is aligned with state science content standards for Hawai'i, California and Oregon, as well as national Ocean Literacy Principles.

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 the PowerPoint, skit, and pre- and post-surveys is about 100 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: (Paper materials contained in binder are shown in **BOLD CAPS**)

Front Binder Materials

1. CD, containing Video, PowerPoint, and electronic versions of everything in binder
2. C-MORE *Key Concepts in Microbial Oceanography* brochure
3. C-MORE *Microbial Oceanography: Resources for Teachers* brochure

Marine Mystery Activity

4. Coral Reef (3 pieces)
5. Orange Cones (4)
6. Ziploc Bag with Crime Scene Tape
7. Mailboxes (4)
8. Zooxanthellae in cage
9. Teacher Packet (contains shark hat, evidence bag & clue bag)
10. Student Packets (15 different packets, each containing a different character's ID, script, costume or mask and related items)
11. Extra Costumes packet
12. **TEACHER GUIDE**
13. **POWERPOINT SCRIPT**
14. **CHARACTER LIST**
15. **TEACHER SCRIPT**
16. **TEACHER VERSION OF 3 SCRIPTS**
17. **TEACHER ANSWER KEY to MARINE MYSTERY SURVEY**
18. **HANDOUTS (MARINE MYSTERY SURVEY, ENVIRONMENTAL SUSPECTS and GLOSSARY – WORDS TO KNOW)**
19. **REWARD SIGNS (3)**
20. **SCENE SIGNS (5)**
21. **HOUSE SIGNS (4)**
22. **DNA KEYS FOR EVIDENCE AND SUSPECTS** (for reference only)



Other Materials

23. TEACHER EVALUATION
24. SUPPLY CHECKLIST
25. Speakers

Materials NOT Included in this Kit:

26. Computer
27. Projector
28. Scotch Tape

State Standards for Hawai'i, California and Oregon. The following science standards and benchmarks can be addressed through this C-MORE science kit:

Hawai'i Content & Performance Standards (HCPS III):

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.

Science Standard 5: Life and Environmental Sciences: DIVERSITY, GENETICS, AND EVOLUTION: Understand genetics and biological evolution and their impact on the unity and diversity of organisms.

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.

Content Standards for California Public Schools:

Physical Sciences

Grade 3 – Standard 1a. Students know energy comes from the Sun to Earth in the form of light.

Life Sciences

Grade 3 – Standard 3d. Students know when the environment changes, some plants and animals survive and reproduce; others die or move to new locations.

Grade 4 – Standard 3b. Students know that in any particular environment, some kinds of plants and animals survive well, some survive less well, and some cannot survive at all.

Investigation and Experimentation

Grade 3 – Standard 5b. Differentiate evidence from opinion and know that scientists do not rely on claims or conclusions unless they are backed by observations that can be confirmed.

Grade 3 – Standard 5e. Collect data in an investigation and analyze those data to develop a logical conclusion.

Grade 4 – Standard 6a. Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.

Grade 6 – Standard 6h. Draw conclusions from scientific evidence and indicate whether further information is needed to support a specific conclusion.

Grade 7 – Standard 7a. Select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data.

Grade 7 – Standard 7e. Communicate the steps and results from an investigation in written reports and oral presentations.

Grade 8 – Standard 9a. Plan and conduct a scientific investigation to test a hypothesis.

State of Oregon Standards by Design:

Scientific Inquiry

3.3S.2 Use the data collected from a scientific investigation to explain the results and draw conclusions.

4.3S.2 Summarize the results from a scientific investigation and use the results to respond to the question being tested.

6.3S.2 Organize and display relevant data, construct an evidence-based explanation of the results of an investigation, and communicate the conclusions.

7.3S.2 Organize, display, and analyze relevant data, construct an evidence-based explanation of the results of an investigation, and communicate the conclusions including possible sources of error.

8.3S.2 Organize, display, and analyze relevant data, construct an evidence-based explanation of the results of a scientific investigation, and communicate the conclusions including possible sources of error. Suggest new investigations based on analysis of results.

8.3S.3 Explain how scientific explanations and theories evolve as new information becomes available.

Interaction and Change

4.2L.1 Describe the interactions of organisms and the environment where they live.

5.2L.1 Explain the interdependence of plants, animals, and environment, and how adaptation influences survival.

5.2E.1 Explain how the energy from the sun affects Earth's weather and climate.

7.2E.3 Evaluate natural processes and human activities that affect global environmental change and suggest and evaluate possible solutions to problems.

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: ~ 100 minutes (not including advance preparation)

Structure: This science kit is a marine mystery: Who killed Seymour Coral? Students assume various characters and play an active role in solving the mystery. In the process, students learn about environmental threats to coral reef ecosystems. A pre- and post- survey is included. This kit is designed for one teacher and 12–24 students.

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 this 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). There are two versions of the **Marine Mystery Video** (one for PCs and one for Macs). Load the appropriate version onto your computer by dragging the file from the CD onto the computer desktop. Eject the CD and return it to the binder. 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.

The Crime Scene Bulletin Board



3. The CD contains a narrated **PowerPoint Presentation**. Speakers are included in the kit for playing the narrated presentation. Refer to the laminated manual attached to the speaker storage case for set-up instructions. We suggest you preview the presentation with the speakers to ensure that everything works properly.

- If you prefer to present the information yourself using the non-narrated version of the PowerPoint presentation, a **POWERPOINT SCRIPT** is included as a guide.
- Photocopy or print the **ENVIRONMENTAL SUSPECTS** and **GLOSSARY – WORDS TO KNOW** handouts (1 per student), the **SUPPLY CHECKLIST** (1 copy), and the **TEACHER EVALUATION** (1 copy).
- Photocopy or print **MARINE MYSTERY SURVEY** (two per student). This is given as a pre-survey at the beginning of this lesson and a post-survey at the end of the lesson.
- Hang up the **REWARD SIGNS** around your classroom.
- Set up the crime scene. In an open space (such as a corner of your classroom), 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, as students will be searching this area for evidence (DNA samples) and the clue that you will hide for them. Note: The crime scene photo is for illustration purposes only, and is not to scale.

The Crime Scene



- Read through **Table 1** and the **Table 1 Explanation** below to learn how the marine mystery works. Basically, students visit various locations to gather clues and evidence to solve a mystery. At each location, students find three identical DNA samples and a clue, all of which you've previously hidden. Students examine the DNA samples to see if they can acquit any suspects. The clues direct them to the next location, where they again find three DNA samples and another clue. The items in red below are suggested locations with corresponding clues that are commonly found in a classroom. Use this scenario 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.

Table 1. Suggested Scenario for your Marine Mystery (see below for detailed instructions)

	Location	Evidence (found in Teacher Packet)	Clues (found in Teacher Packet)	Any Suspect Acquitted?
1	Crime Scene	Hide all 3 of the 1 st DNA samples	Hide dry erase marker	No
2	Whiteboard	Hide all 3 of the 2 nd DNA samples	Hide phone card	Yes (Industrial Plant)
3	Phone	Hide all 3 of the 3 rd DNA samples	Hide printer cartridge	No
4	Printer	Hide all 3 of the 4 th DNA samples	Hide key	Yes (Seddi Mentation)
5	All-gal Bloom's House	Hide 1 of the 5 th DNA samples in the cage with zooxanthellae. Hide the 2 remaining 5 th DNA samples nearby.	--	Yes (All-gal Bloom)

Table 1 Explanation

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 DNA samples at this location will not eliminate a suspect. Then, Clue 1 will lead the students to Location 2 (whiteboard).

At Location 2, students will find the 2nd set of DNA samples and eliminate one of the suspects. They will also find Clue 2 (phone card), which will lead them to Location 3 (phone).

At Location 3, students will find the 3rd set of DNA samples. The DNA samples at this location will not eliminate a suspect. Students will also find Clue 3 (printer cartridge), which will lead them to Location 4 (printer).

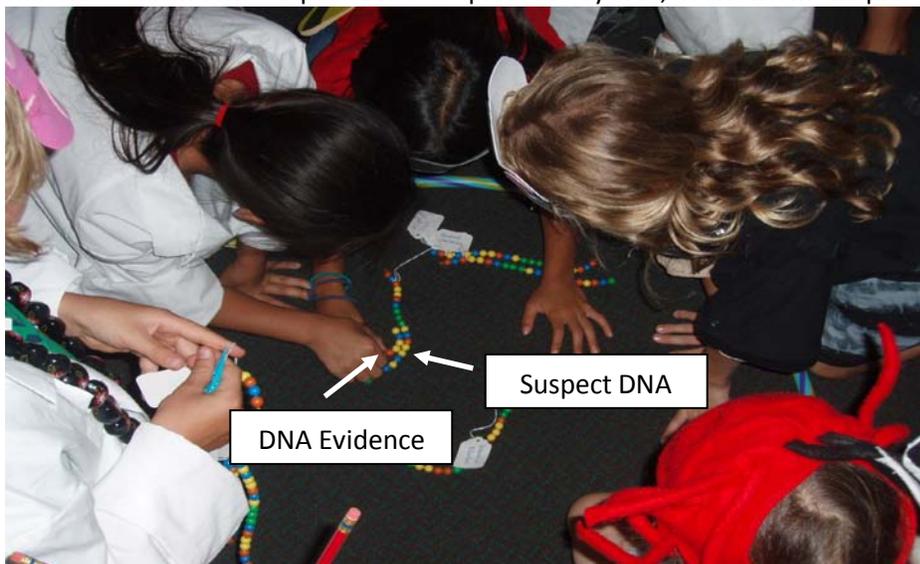
At Location 4, students will find a 4th set of DNA samples and eliminate another suspect. The students will also find Clue 4 (a key). At this point, the suspects will be asked to pull out their key chains. The only suspect whose key chain has no key is All-gal Bloom. The students should go to Location 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.

But wait! A 5th 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!

10. You are now ready to hide the evidence and clues at the five locations outlined in **Table 1**. 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. From the evidence bag, pull out all three DNA strands labeled "2nd DNA samples" and hide them around Location 2.
 - c) Location 3 set-up (phone). From the evidence bag, pull out all three DNA strands labeled "3rd 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 evidence bag, pull out all three DNA strands labeled "4th DNA samples" and hide them around Location 4. 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 "5th DNA samples" and hide them around Location 5. Hide 1 of the 5th DNA samples inside the cage with zooxanthellae, and hide the 2 remaining 5th DNA samples nearby.
11. 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.

Additional Information to Run the Marine Mystery

1. How to use the DNA samples to eliminate suspects: The Marine Mystery scavenger hunt occurs during Scene 4 (see **TEACHER SCRIPT**). 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 and therefore no suspect is eliminated. 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.

2. After the class analyzes the DNA samples at each location, the teacher should collect the DNA samples and return them to the appropriate evidence bag to eliminate evidence confusion or mix up. 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 next location (whiteboard). (The students may need some prompting at first, until they get the hang of it.) This scavenger hunt continues until the students find the key at Location 4.

3. Every location has 3 pieces of DNA evidence and 1 clue (exception: Location 5 does not have a clue because the mystery is solved here). The students should not begin analyzing the DNA until all four items have been found.
4. Once the key is found (Location 4), 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. 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.
5. 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 send the students to your new location. However, do NOT change anything written in black on the table! It's essential that you hide the DNA samples, cage with zooxanthellae, and the key at the correct locations in order to get the desired outcome.
6. 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.
7. 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**.

Character roles based on numbers of students

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.

Instructional Procedures:

1. Pass out **MARINE MYSTERY SURVEY** (one per student). Have students check the pre-survey box and answer the questions (allow 5–10 minutes). At the end of this lesson, the students will answer these same questions as a post-survey.
2. Once the students arrive, play the PowerPoint Presentation on the threats to coral reefs. Have students review the **GLOSSARY – WORDS TO KNOW** and the **ENVIRONMENTAL SUSPECTS** handouts, and discuss as a class.
3. 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.
4. 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 the students 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.
5. 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 like to wear the costumes, while the older students enjoy assisting with the lines.
6. Have everyone dress up in their costumes and learn about their organisms by reading their ID cards.
7. Grab the **TEACHER SCRIPT** and shark hat, and you are ready to begin. Good luck!

Assessment & Clean-up:

1. After the activity, administer the post-survey. Pass out **MARINE MYSTERY SURVEY** (one per student). Have students check the post-survey box and answer the questions (allow 5–10 minutes). A **TEACHER ANSWER KEY** is provided for your convenience. As the students are completing their surveys, we would be grateful if you would complete the **TEACHER EVALUATION** in this kit. All comments, corrections, and suggestions are very welcome. If you prefer, you can complete the evaluation online (see **TEACHER EVALUATION** for website address).
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. 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.
3. Repack the Teacher Packet and 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.
4. Re-pack the kit for return to C-MORE. Please pack the kit so that the materials are stored as they were when you received them. Please also include a copy of the students' pre- and post-surveys.
5. 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.
6. Please make a note of missing, broken, or damaged items so that they can be replaced.

Mahalo!

POWERPOINT SCRIPT

Slide 1

Welcome to the marine mystery - a watery who-dunnit! Before we dive into the case, we're going to review some basic coral reef biology and discuss threats to coral health. (CLICK)

Slide 2

Most of the earth's surface is covered by ocean. (CLICK)

Slide 3

Coral reefs only make up 1% of the Earth's surface, yet they are home to over 25% of all marine life! Corals are important indeed, but what exactly are they? (CLICK)

Slide 4

A coral is an animal that has single-celled plants that live in its tissues. These plant cells are called zooxanthellae. (CLICK)

In exchange for a place to live, the zooxanthellae produce food for the coral. (CLICK)

Slide 5

Just like plants on land, plants in the ocean need (CLICK)

Carbon dioxide, water and sunlight (CLICK) to produce food and oxygen. How much food do the cells living inside of corals provide? In fact, up to 98% of the coral's diet! Corals with zooxanthellae grow 3 times faster than those without them! So, keeping zooxanthellae happy is a top priority for corals. Unfortunately, that isn't always an easy task. (CLICK)

Slide 6

You may have heard of coral bleaching. (CLICK)

Coral reefs are one of the most fragile ecosystems on earth, and when they are put under stress, they can bleach, or lose their symbiotic algae. (CLICK)

These stresses include increased temperature, changes to sunlight, sedimentation, and chemical pollution.

The coral can replace their zooxanthellae and recover if the environmental stress doesn't last long. But if any of these conditions persist, the coral will die. Let's look at each of these threats. (CLICK)

Slide 7

You can think of global warming like sitting in a car on a sunny day with the windows rolled up. Sunlight comes in through the windows and heat gets trapped in the car. Carbon dioxide acts like the windows in the car.

Burning fossil fuels, like coal and gas, increases the amount of carbon dioxide, or CO₂, in the air and oceans. (CLICK)

CO₂ keeps solar heat trapped near the Earth's surface, and this slowly warms up the land and oceans. (CLICK)

Zooxanthellae can't photosynthesize in very warm water and they abandon the coral. (CLICK)

Slide 8

Humans use land (CLICK) for activities such as farming, mining, and housing. (CLICK)

These activities loosen the soil and increase erosion so that when it rains, dirt gets washed into rivers and streams, where it is carried to the ocean. You can see this in this picture of the west coast of Maui where dirt has been

washed off the hills and colored the ocean orange. If the zooxanthellae don't get enough light, they may abandon the corals. (CLICK)

Slide 9

Much like dirt, fertilizers that are used to grow food can also get washed off the land and into the ocean. (CLICK) These nutrients can cause algal cells to reproduce rapidly, and they can block out light too. In this picture, the orange water is due to billions and billions of single-celled plants that have grown in response to the addition of fertilizers in the ocean. (CLICK)

Slide 10

Nearly everything that we eat, wear, work with and play with was made in a factory, and the production of these items creates waste. (CLICK)

When this type of pollution enters the oceans, it can either poison the coral or keep it from being able to eat and reproduce effectively. (CLICK)

Slide 11

If you hadn't guessed it, we've been learning about the four suspects in our case! Let's review who they are. (CLICK)

Global warming increases ocean temperature and in this condition zooxanthellae can't photosynthesize. (CLICK)

With sedimentation, soil particles get washed off the land and block out light and can even smother the coral. (CLICK)

In an algal bloom, there are so many algal cells that grow in the ocean that they block out light and keep the corals from being able to photosynthesize. (CLICK)

With industrial pollution, toxic compounds can get washed into the ocean and poison the coral. (CLICK)

Slide 12

So here we have it: four witnesses who will identify the four suspects. A crime scene and several important pieces of evidence. (CLICK)

Slide 13

The investigation hinges on a few critical rules. (CLICK)

It is very important to listen when someone else is talking – everyone's scripts will reveal vital clues that will guide the investigation (CLICK) so please only speak when it is your turn and speak loudly and clearly so that everyone hears the information that you have to share. (CLICK)

So that everyone can participate equally, each person is only allowed to find one clue. (CLICK)

Tell your instructor as soon as you have found a clue so that everyone can gather around and get a chance to decipher it. (CLICK) Work together to decide the next step to take.

Good luck and have fun on your mission – the corals are depending on it!

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 details 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! Some sensitive children do not enjoy being the guilty party.

Seddi Mentation

All-gal Bloom: This character has a feather boa for a costume. Girls tend to prefer this role.

Scientists: 3

Dr. Moo Cowfish

Bacon Hogfish

Skippy Sea Hare

Jurors: 3

Rocky Raccoon 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 to say 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 Star 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 many things: 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.”**

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 **Table 2** 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 3 pieces of DNA evidence and a clue. They need to keep on searching until they’ve found all four items. Once all four items have been found, students should work together to analyze the DNA and 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. At this point, most will suspect that All-gal Bloom is guilty. The group should go to All-gal Bloom's house, where they will find the zooxanthellae being held captive.
- 4) But wait! **A 5th 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 for stealing the zooxanthellae, but forgot about DNA evidence.

Table 2. Outline of the Investigation (assuming clues were hidden according to Table 1)

	Location	Evidence (found in Teacher Packet)	Clues (found in Teacher Packet)	Any Suspect Acquitted?
1	Crime Scene	3 of the 1 st DNA samples	Dry erase marker	No
2	Whiteboard	3 of the 2 nd DNA samples	Phone card	Yes (Industrial Plant)
3	Phone	3 of the 3 rd DNA samples	Printer cartridge	No
4	Printer	3 of the 4 th DNA samples	Key	Yes (Seddi Mentation)
5	All-gal Bloom's House	1 of the 5 th DNA samples in the cage with zooxanthellae. The 2 other 5 th DNA samples nearby.	Students will find Glowball Warming's DNA in the zooxanthellae cage ... and will find him/her GUILTY!	Yes (All-gal Bloom)

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!"

TEACHER VERSION
Glowball Warming's Script

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!”**

TEACHER VERSION
Seahorse's Script

Who are you?



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!"**

TEACHER VERSION
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."**

TEACHER ANSWER KEY
MARINE MYSTERY SURVEY

Check one:

- Pre-survey
 Post-survey

Email kits@soest.hawaii.edu to request a completed teacher answer key. Please include name, school and grade(s) taught in your request. Mahalo!

Name: _____

Directions:

This survey is both a pre- and post- survey. Put a check mark at the top of this paper next to the survey you are doing (pre- or post- survey). Please answer each question to the best of your ability. Circle the most correct answer.

1. Many corals have tiny, plant-like cells called _____ that live in their tissues and provide food for the coral by photosynthesis.
 - a. limu
 - b. zooxanthellae
 - c. polyps
 - d. plankton

2. Sedimentation and _____ can block sunlight and either reduce coral growth or kill the coral.
 - a. algal blooms
 - b. symbiosis
 - c. competition
 - d. boats

3. DNA is _____.
 - a. genetic material
 - b. inherited
 - c. unique to each individual
 - d. all of the above

4. Coral reefs _____.
 - a. are mostly found in the deep ocean
 - b. are rocks
 - c. prefer to live in cloudy water
 - d. provide many marine organisms with a place to live

5. _____ is when corals turn white because they lose their tiny plant-like cells.
 - a. Global warming
 - b. Pollution
 - c. Coral bleaching
 - d. Photosynthesis

MARINE MYSTERY SURVEY

Check one:

- Pre-survey
 Post-survey

Name: _____

Directions:

This survey is both a pre- and post- survey. Put a check mark at the top of this paper next to the survey you are doing (pre- or post- survey). Please answer each question to the best of your ability. Circle the most correct answer.

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 - zooxanthellae
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 - boats
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 - inherited
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 - all of the above
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 - are rocks
 - prefer to live in cloudy water
 - provide many marine organisms with a place to live
- _____ is when corals turn white because they lose their tiny plant-like cells.
 - Global warming
 - Pollution
 - Coral bleaching
 - Photosynthesis

ENVIRONMENTAL SUSPECTS

(Bold terms are defined in the **GLOSSARY – WORDS TO KNOW**)

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.



Aerial photo of the west coast of Maui.

3. All-gal Bloom (algal 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.



GLOSSARY – WORDS TO KNOW

algae	(al-jee); Plant-like organisms in the ocean. Example: seaweed.
algal bloom	(al-gull bloom); A fast increase in the numbers of one or more kinds of algae . Algal blooms can occur in freshwater or marine environments. ("All-gal Bloom" is one of the suspects in the death of Seymour Coral.)
coral	A marine invertebrate animal. Some types of coral build a hard skeleton that forms reefs.
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 warming of the Earth's air and oceans due to the steady increase of greenhouse gases in the Earth's atmosphere. ("Glowball Warming" is one of the suspects in the death of Seymour Coral.)
greenhouse gases	Gases in the Earth's atmosphere that trap heat (they act like the glass in a greenhouse). The increase in these gases since the 1800's is mostly due to human activities, such as driving cars. Example: carbon dioxide.
industrial pollution	Harmful chemical substances introduced to the environment by factories.
limu	(lee-moo); The Hawaiian name for seaweeds.
photosynthesis	(foe-toe-sinth-uh-sis); The way that plants make food. Photosynthesis requires sunlight, carbon dioxide and water, and produces sugar and oxygen.
polyp	(pah-lip); An individual coral animal.
sedimentation	The settling of particles onto a surface such as the ocean floor or a coral reef. ("Seddi Mentation" is one of the suspects in the death of Seymour Coral.)
symbiosis	(sim-by-oh-sis); A type of relationship between two or more species that live closely together, for example, coral and zooxanthellae . Zooxanthellae provide food for corals and corals provide a habitat for zooxanthellae.
zooxanthellae	(zoh – zan – thell – lay); Single-celled algae that live within corals .

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!



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
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MISSING!



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AND HIS SYMBIOTIC ALGAE ARE MISSING!**

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ANY SUSPICIOUS BEHAVIOR OR HAVE ANY INFORMATION,
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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



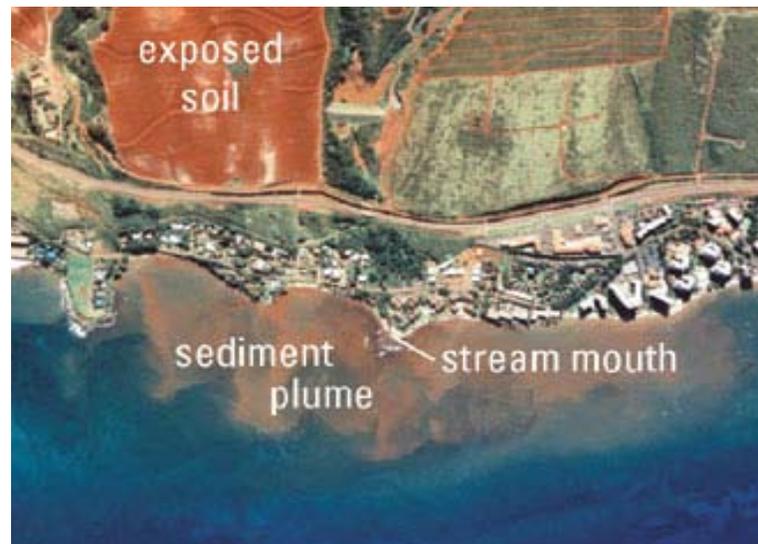
Glowball Warming's House



All-gal Bloom's House



Sedimentation's House



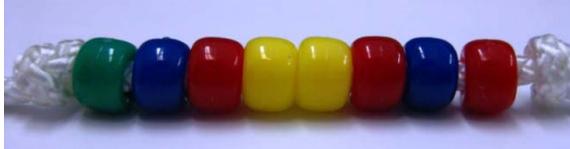
DNA EVIDENCE KEY

1st DNA Sample
★ Hide at Location 1



4 Beads

2nd DNA Sample
★ Hide at Location 2



8 Beads

3rd DNA Sample
★ Hide at Location 3



9 Beads

4th DNA Sample
★ Hide at Location 4

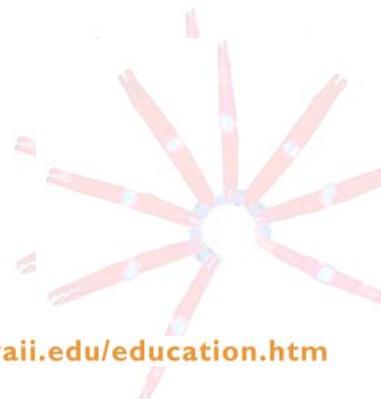


10 Beads

5th DNA Sample
★ Hide at All-gal Bloom's house



11 Beads



SUSPECT DNA KEY



TEACHER EVALUATION

<http://www.surveymonkey.com/s/CMORE-kit-evaluation>

1. Please circle the C-MORE science kit used:

Marine Debris

Ocean Acidification

Plankton

Marine Mystery

Ocean Conveyor Belt

Random Sampling

Nautical Knots and Maritime Careers

2. I borrowed this science kit from _____.

3. Please rate how strongly you agree or disagree with each of the following statements.

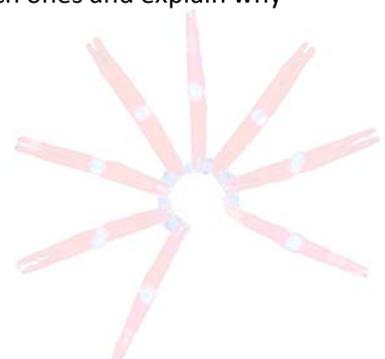
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Online kit reservation was easy.	1	2	3	4	5
Picking up this science kit was difficult.	1	2	3	4	5
This science kit was easy to use.	1	2	3	4	5
The Teacher Guide was difficult to follow.	1	2	3	4	5
My students enjoyed using this science kit.	1	2	3	4	5
I would not borrow this science kit in the future.	1	2	3	4	5
I will borrow other C-MORE science kits.	1	2	3	4	5

Comments:

4. Are the time estimates given for each lesson reasonable? If not, please explain.

5. How did you use this science kit? (Example: in a 6th grade public school classroom to introduce a unit on...)

6. Did you use the entire science kit? If you omitted any lessons or activities, please list which ones and explain why you skipped them.



7. Were your students involved and interested in the science kit activities?

8. Please suggest two things that could be improved.

9. Any other comments?

10. 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:

School (optional): _____

Grade(s) kit was used with: _____

___ **Total number of students**

___ African American

___ Filipino

___ Hispanic

___ Native American

___ Native Hawaiian or Pacific Islander

___ Other (please specify)

___ Learning disabled

___ Eligible for free or reduced lunch

___ Neither parent attended college

___ Physically disabled

11. Please fill out the following information if you would like to be notified of other C-MORE programs (workshops, GEMS grants, teachers aboard research ships, etc).

Name _____

City/Town _____

State _____

Zip _____

Email Address _____

Thank you for your feedback.

SUPPLY CHECKLIST

Marine Mystery

Use the boxes to check off each item as you reassemble this kit!

Note: This checklist is four pages.

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
 - C-MORE *Microbial Oceanography: Resources for Teachers* brochure
2. Front Material
 - MARINE MYSTERY: A WATERY WHO-DUNNIT!** (provides a general overview & standards addressed)
3. Teacher Materials Tab
 - TEACHER GUIDE**
 - POWERPOINT SCRIPT**
 - CHARACTER LIST**
 - TEACHER SCRIPT**
 - TEACHER VERSION – Glowball Warming Script**
 - TEACHER VERSION – Seahorse’s Script**
 - TEACHER VERSION – Tiger Cowry’s Script**
 - TEACHER ANSWER KEY to MARINE MYSTERY SURVEY**
4. Handouts Tab
 - MARINE MYSTERY SURVEY**
 - ENVIRONMENTAL SUSPECTS**
 - GLOSSARY – WORDS TO KNOW**
5. Reward Signs Tab
 - REWARD SIGNS (3)**
6. Scene Signs Tab
 - 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**
7. House Signs Tab
 - Industrial Plant’s House**
 - Glowball Warming’s House**
 - All-Gal Bloom’s House**
 - Seddi Mentation’s House**
8. DNA Keys Tab
 - DNA EVIDENCE KEY**
 - SUSPECT DNA KEY**
9. Teacher Evaluation Tab
 - Completed **TEACHER EVALUATION**
10. Supply Checklist Tab
 - Completed **SUPPLY CHECKLIST**

Teacher Packet:

Shark (Police Commissioner)

- Shark hat
- Evidence Bag
 - Ziploc bag with 1st DNA Sample (3 DNA Strands with 4 Beads)
 - Ziploc bag with 2nd DNA Sample (3 DNA Strands with 8 Beads)
 - Ziploc bag with 3rd DNA Sample (3 DNA Strands with 9 Beads)
 - Ziploc bag with 4th DNA Sample (3 DNA Strands with 10 Beads)
 - Ziploc bag with 5th 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
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:

- Coral reef (3 pieces)
- Orange cones (4)
- Ziploc bag with Crime Scene Tape
- Industrial Plant mailbox
- Glowball Warming mailbox
- Seddi Mentation mailbox
- All-gal Bloom mailbox
- Zooxanthellae in cage
- Speakers

HI
my name is:

Deputy Moray.
I'm a zebra moray
eel.



Species name: *Gymnomuraena zebra*

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

Diet: This predatory critter 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.

Size: Zebra morays grow up to 5 feet (1.5m), but you rarely see their full length because these animals are shy and secretive.

Photo credit <http://www.grandpoohbah.net/hawaii.htm>

HI
my name is:

Dr. Moo. I'm a
honeycomb
cowfish.



Species name: *Acanthostracion polygonus*

What's in a name?: The cowfish earned its name because of its horns!

Distribution: This fish is only found in the western Atlantic Ocean and lives around coral reefs in shallow (10-260 ft) water from New Jersey to Brazil.

Diet: Despite their name, cowfish don't eat grass! They eat sponges, soft corals, sea squirts, and shrimps.

Size: The honeycomb cowfish grows up to 20 inches (50 cm) in length, but most individuals are only half this size.

Holy cow!: Rather than a skeleton, cowfish have a body of exterior fused plates that form a box!

Photo credit <http://www.reefnews.com/reefnews/news/v05n12/ncpucker.html>

HI
my name is:

Skippy. I'm a
sea hare.



Species name: *Aplysia californica*

What's in a name?: The sea hare gets its name from the way its projections on top of its head resemble rabbit ears.

Distribution: Sea hares are found in almost every region of the world, but this species is only found in the northeast Pacific.

Diet: Sea hares are herbivores, and their different colors match the color of the seaweed that they graze on! In this way, they are camouflaged from predators.

That's not all!: Ever wondered how something soft and shell-less, like a sea hare, could defend itself from predators? In addition to camouflage, sea hares produce a toxin in their skin that makes them inedible.

Photo credit http://www.tekhelet.com/kitrossky/tekhelet_images/image019.jpg

HI
my name is:

Pinchy.
I'm a sleepy
sponge crab.



Species name: *Dromidiopsis dormia*

What's in a name?: The 'sleepy' part of this crab's name comes from the fact that it is slow moving and non-aggressive.

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

Size: Up to 8 inches in width.

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

Photo credit: <http://www.scubapost.net/fieldguide/sponge-crab>

HI
my name is:

Dr. Simba. I'm
a lionfish.



Species name: *Pterois sphex*

Distribution: This species of lionfish is found only in Hawaii, but close relatives are also found in the Indo-Pacific.

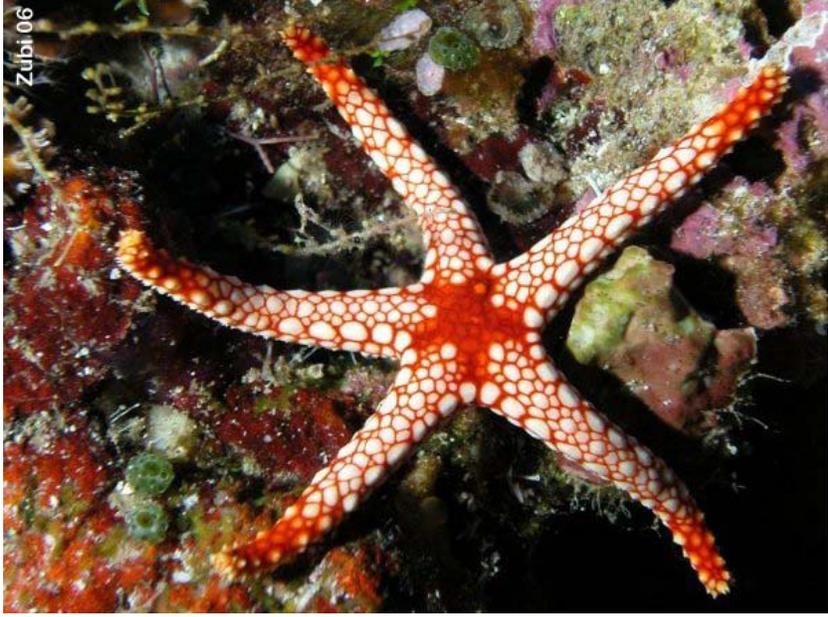
Size: The lionfish is no shrimp! It can grow up to ~8.5 in (22 cm) long.

Diet: The lionfish is beautiful but dangerous! It is an ambush predator that forms a cage around shrimp or small crabs using its long, venomous spines. It then strikes quickly and consumes its prey whole!

Photo credit: <http://animalpicturearchive.com/>

HI
my name is:

Pearl. I'm a
necklace sea star.



Species name: *Fromia monilis*

Distribution: This striking animal is found in shallow, tropical waters around Australia, Indonesia, the Philippines, and various islands in the western Pacific Ocean.

Size: Necklace sea stars grow to a maximum of 5.5 in (14 cm) in width.

Diet: The undersides of sea star arms are lined with numerous tube feet (not shown in photo), which are used as suction cups to pry open shellfish prey, such as clams and mussels. Once the prey is exposed, the sea star extends its stomach into the prey and partially digests its food externally!

Photo credit <http://www.starfish.ch/otos/echinoderms-Stachelhaute/starfish-Seeesterne/Fromia-monilis5.jpg>

HI
my name is:

Perky. I'm an
orange clownfish.



Species: *Amphiprion percula*

What's in a name? Clownfish earned their name because their markings resemble the grease paint worn by circus clowns.

Distribution: It inhabits the warm waters of the tropical western Pacific, including Australia, New Guinea, and Vanuatu.

Size: No joke! Clownfish only grow to be a few inches (~8 cm) long.

Diet: Clownfish live symbiotically amid anemone tentacles where they feed on small floating organisms, called plankton, or on algae.

Extra, extra! All clownfish are born male; however, individuals can switch sex to maintain a balance in the community.

Photo credit <http://www.waterlife.co.uk/seaquariums/images/clownfish.jpg>

HI
my name is:

Rocky. I'm a
raccoon
butterflyfish.



Species name: *Chaetodon lunula*

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

Size: These attractive fish grow to about 8in (20cm) in length.

Diet: Raccoon butterflyfish are carnivores that feed at night on sea slugs, tubeworms, coral, and other bottom-dwelling invertebrates.

Whoa nelly!: Females of this species produce up to 20,000 eggs!

Photo credit: http://calphotos.berkeley.edu/browse_imgs/fish.com_22.html

HI
my name is:

Tony, the
tiger cowry.



Species name: *Cypraea tigris*

Distribution: This beautiful snail is common in the Indo-Pacific and Hawaii.

Size: 4-6 in (10-15cm)

Diet: Tiger cowries inhabit rocky and coral areas where they graze on algae by rasping it off of surfaces.

Extra extra!: The tiger cowry, like all gastropods, has a thick fold of tissue called the mantle. Inside the shell, the mantle surrounds the animal's organs, but it is also responsible for producing and cleaning the shell. In the photo, you can see the special folds of mantle tissue that extend outside the shell and that are covered with frilly, branched projections called papillae.

Photo credit: http://www.divergallery.com/cowry_tiger.htm

HI
my name is:

Bacon. I'm
a hogfish.



Species name: *Lachnolaimus maximus*

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

Size: Hogfish grow up to 3 feet (91cm) in length.

Diet: The hogfish has a long snout and an extendable jaw with strong canine teeth. This jaw structure allows the hogfish to consume a range of organisms on the reef, such as clams, urchins, and snails.

Extra, extra!: Opposite to clownfish, all hogfish are born female! After a few years, dominant females can transform into fully functional males.

Photo credit <http://www.flmnh.ufl.edu/fish/Gallery/Description/hogfish/hogfish.html>

HI
my name is:

Scout. I'm a
yellow seahorse.



Species name: *Hippocampus kuda*

What's in a name?: The genus name *Hippocampus* has nothing to do with hippos but is actually based on the Greek words *hippos* (= horse) and *kampos* (= sea monster). Though who could mistake a seahorse for a monster?!

Distribution: Indo-Pacific.

Size: Up to 12 inches (30.5 cm).

Diet: Seahorses have no teeth and no stomach! They use their long snouts to suck in small crustaceans that drift by. Food passes through their digestive systems so quickly, they must eat almost constantly to stay alive!

Wacky facts: Seahorses propel themselves by using a small fin on their back that flutters up to 35 times per second! They are such poor swimmers that they can easily die of exhaustion when caught in stormy seas.

Photo and information credit: <http://animals.nationalgeographic.com/animals/fish/sea-horse.html>

HI
my name is:

Glowball Warming



What is it?: Global warming is the gradual increase in the average temperature of the Earth's air and oceans.

Why does it happen?: Global temperatures change naturally, but the steady increase in temperature over the past century is mostly caused by humans adding gases (such as carbon dioxide) to the atmosphere. These gases are called greenhouse gases because they trap heat near the Earth's surface and cause temperatures to rise.

Why do we care?:

- Coral reefs can only live in waters between 23° C - 29° C
- 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.
- If water temperature keeps increasing, corals lose their zooxanthellae in a process known as coral bleaching.
- If the zooxanthellae don't return to the coral, the coral can starve and die.

HI
my name is:

Sedimentation



What is it?: Sedimentation is the settling of particles that are suspended in water, on to a surface such as the ocean floor or a reef. Particles are usually very small and can be made of dirt, debris, or sand.

Why does it happen?: Mining, building, farming, and other human activities loosen soil. When it rains, the loose soil can get washed off the land and carry toxic chemicals and nutrients into rivers and streams and eventually into the ocean.

Why do we care?:

- Corals like to live in clear, blue water so that their zooxanthellae can get plenty of sunlight to produce food.
- When soil and other particles get suspended in the water, less light can reach the corals and they don't get enough food from the zooxanthellae.
- Also, as the sediment (dirt particles) settles it can bury corals or cause them to use a large amount of energy to keep clean.

Photo credit: <http://walrus.wr.usgs.gov/research/projects/coralreefs.html>

HI
my name is:

Industrial Plant (pollution)



What is it? Pollution is the introduction of chemical substances or energy (such as noise, heat, or light) into the environment to such a point that its effects become harmful to human health, other living organisms, or the environment. Industrial pollution includes dumping heavy metals and other toxins into the oceans and rivers, and the release of heated water from the cooling systems of power plants.

Why do we care?:
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.

HI
my name is:

All-gal Bloom



What is it?: An algal bloom is a rapid increase in the population size of one or two species of single-celled algae. Algal blooms can occur in freshwater or marine environments.

Why does it happen?: Just like plants on land, plants in the ocean need nutrients such as nitrogen and phosphorus to grow. The runoff from agricultural areas is rich in nutrients and can cause tiny marine algae to grow into vast numbers.

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

Photo credit: <http://serc.carleton.edu/microbelife/topics/redtide/general.html>

<http://www.crimescencleaners.com/home.html>



<http://www.crime-scene-investigator.net/csi-photo.html>



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

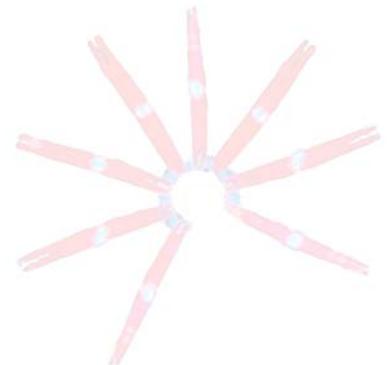
Scene 2: Interviewing suspects

- 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



Cowfish's Script

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



Glowball Warming's Script

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



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

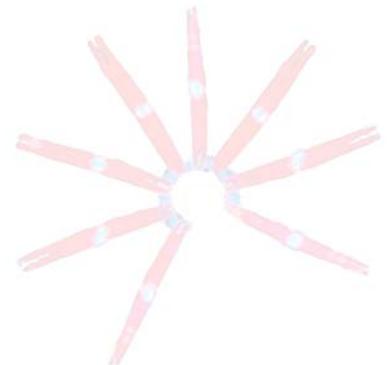
Scene 2: Interviewing suspects

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



Lionfish's Script

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).

Marine Mystery Outline

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



Moray Eel's Script

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



Sea Hare's Script

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.

Marine Mystery Outline

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

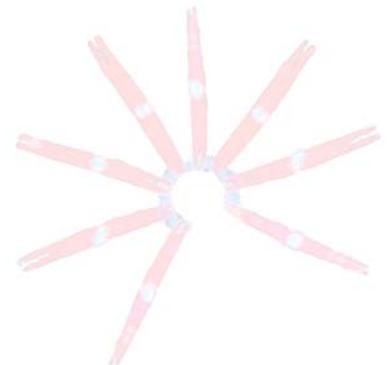
- Police Commissioner
- Deputy Moray
- Crab (witness #1)
- Deputy Moray
- Lionfish (witness #2)
- Deputy Moray: "That seems reasonable. And what did the sea star see?"
- Sea Star (*in a shaky voice*): **"My name is Pearl, and I am, well I was (*choke, sob*) Seymour's neighbor. He was such a friendly 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



Seahorse's Script

Who are you?



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

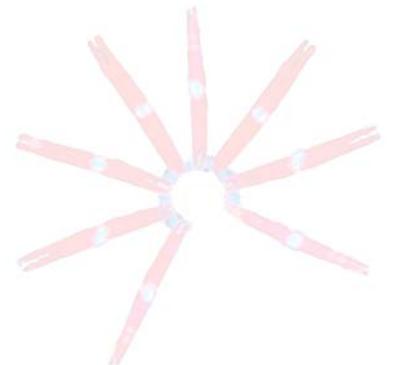
Scene 2: Interviewing suspects

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.



Seddi Mentation's Script

Who are you?



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.

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: “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



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. 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.

