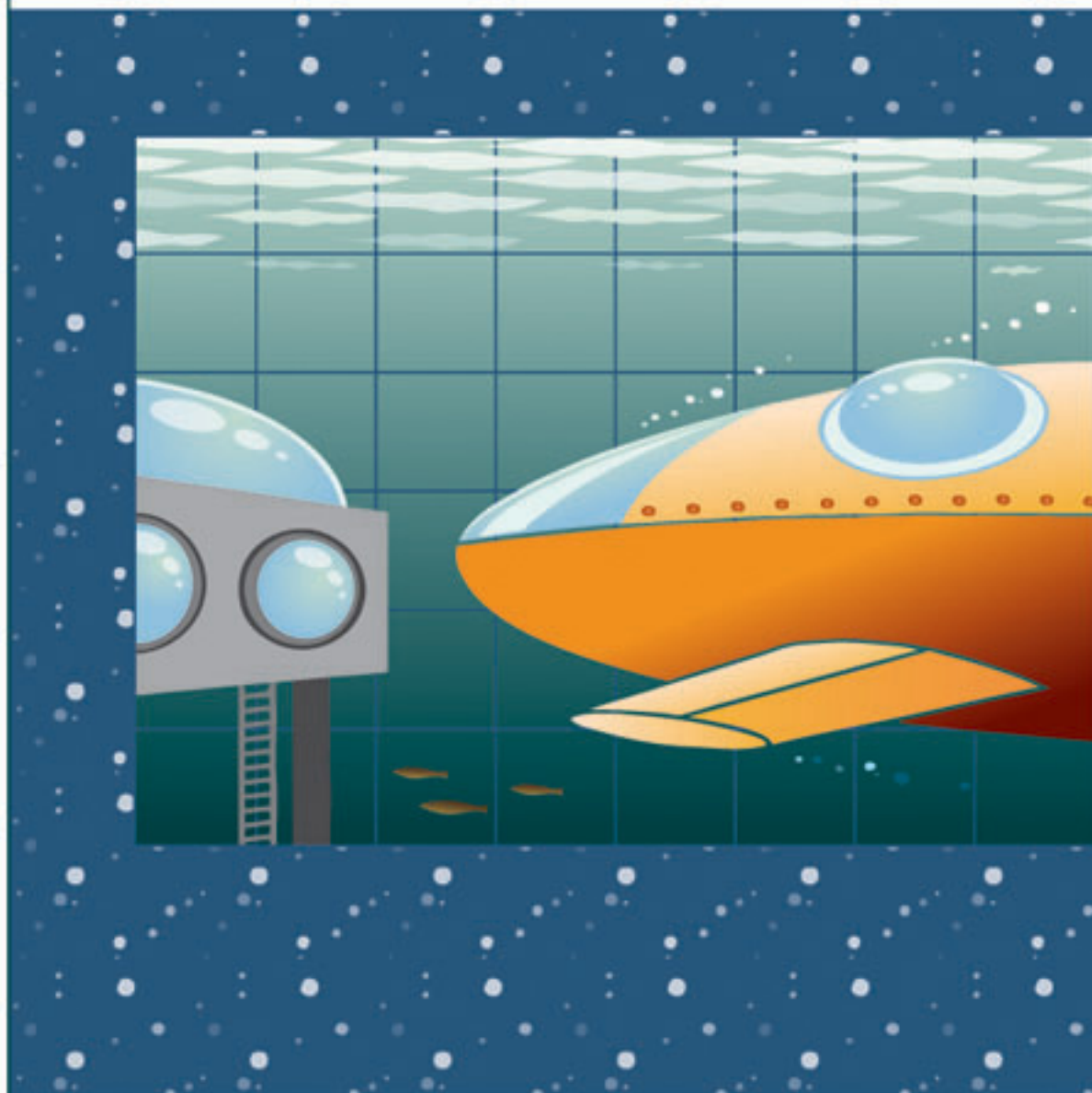


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NEW ATLANTIS



A Math Simulation of Ocean Mysteries and Problem Solving

NEW ATLANTIS

A simulation of scientific teams wisely using the Ocean Planet's inner-space habitats

BONNIE PETTIFOR VREEMAN, the author of NEW ATLANTIS, is a former elementary teacher in both American and overseas public and private schools. Currently she is a freelance writer and editor residing in Illinois.

Bonnie wishes to acknowledge the fourth grade students of pilot teachers Judy Zindar and Eric Hillman at Lincoln Elementary School in Monticello, Illinois, who so capably completed the first research missions of the New Atlantis project.

Bonnie dedicates NEW ATLANTIS to Dr. Sylvia A. Earle, world record holder for the deepest untethered dive.

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PURPOSE

While role-playing interesting identities in NEW ATLANTIS' underseas habitats, students explore, preserve, restore, and wisely use the resources of our planet's oceans (often called "inner space"). They first research, analyze, and evaluate data; they then invent their own creative futuristic solutions. This thematic unit helps students study individually and cooperatively in these content areas: science, geography, language arts, physics, and health. Specifically, your students will experience the following:

● Knowledge

- Relationship between a safe water supply and waste disposal
- Potential environmental hazards of undersea colonization
- Strategic difficulties of undersea colonization
- Food webs and how pollution affects them
- Oceans' potential resources: minerals, medicines, food, oil
- Biological/ecological impact of the lack of sunlight at ocean depths
- Basic features of undersea geography

● Attitudes

- Appreciating the value of each aspect of the ocean
- Recognizing the need to protect our oceans' ecosystems before it is too late to save them
- Appreciating the value of cooperation in problem solving
- Appreciating that creativity is essential to saving the oceans
- Desiring to balance the different missions' goals carefully

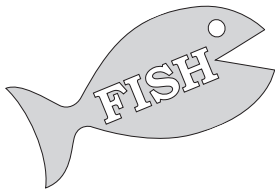
● Skills

- Developing a problem-solving outline cooperatively with other students working in the same area and then presenting it to one's own team
- Writing a problem-solving essay involving research and projections
- Brainstorming construction methods of undersea workplaces and submersibles
- Using map skills to choose a work station site
- Finding useful research sources
- Taking useful research notes
- Speaking publicly to present ideas clearly

“
... recognizing
the need
to protect ...

”

OVERVIEW - 1



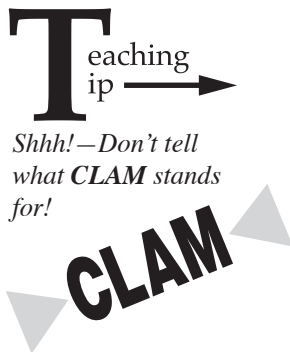
Organizing teams: After students are divided into groups of four to six, each group becomes an international scientific team working for the **Federation for Inner Space Habitats (FISH)**. Roles are assigned, or members choose roles: Chief Administrator, Chief Engineer, Chief Marine Biologist, Chief Marine Geologist, Chief Medical Officer, and Chief Oceanographer. (If some groups are smaller than six, one member plays two roles.)

Beginning the simulation: The simulation begins when the FISH Commander in Chief (you) introduces students to the New Atlantis project as they convene at FISH headquarters on New Atlantis Island (a newly charted island in the Pacific). The students are briefed on their missions and sworn in as commissioned officers of FISH. They are then issued their official FISH ID tag and given their first assignment: solving a specific survival problem that all teams will face. Each specific mission specialist role is assigned a different problem, and problem-solving articles and instructions are included in the Student Guides. Teams send their specialists to meet with other teams' specialists. Brainstorming sessions flow into developing problem-solving outlines. Individual specialists return to their teams and, using these outlines, brief their respective teams on how to solve the various basic survival problems. The FISH Commander offers guidance as needed.

Developing work stations and submersibles: Using the results of the brainstorming and team discussions, each team designs its own undersea work station (small laboratory with dorm) to install at a site the team chooses on the ocean floor. Then teams design submersibles to use for their future missions.

FATE EVENTS: To add an element of chance, the first of many FATE EVENTS is read during Day 4. Teams soon learn that they must watch out for **CLAM (Coalition for Legalizing All Mining)**, a radical group opposed to FISH's mission. CLAM members fear that successful completion of the New Atlantis project will lead to banning all undersea mining operations being done for profit. Teams decipher clues as to what the CLAM acronym stands for in order to stop CLAM's sabotage.

Specific missions: The teams receive their six specific missions. They focus on saving coral reefs, searching for the giant squid, cleaning up ocean pollution, saving the sharks, exploring hydrothermal vents, and saving the whales. Each team experiences a simulated journey to its chosen site where they work to accomplish the team's mission.



OVERVIEW - 2



Accumulating the most points will not guarantee that a team wins the FISH Neptune Award. The teams must use their earned Sand Dollars to invest in Scientific Breakthroughs. To successfully win a Scientific Breakthrough, the team members must submit a creative and original written and/or illustrated composition.

“

... a
competitive
or a

?

cooperative
experience ...

”

Problem-solving essay: To accomplish their team’s mission, students aid one another in doing research and taking research notes. Individual students write a problem-solving essay that is focused on the problem each mission specialist must solve for his or her team.

Scoring: New Atlantis teams earn points daily for completed assignments. Points are multiplied by a **synergy factor**—the increase in productivity created by the combined efforts of all FISH teams—to yield “Sand Dollars.” Each team begins the simulation with a synergy factor of 10. The FATE EVENTS provide a random element that can add to or subtract from a team’s synergy factor. By earning points, teams can purchase a chance at a scientific breakthrough that, in turn, is determined by chance (rolling dice, number selection, or coin toss). A successful scientific breakthrough adds two synergy points to that team and one to each of the other teams. At the simulation’s culminating event, scoring is based on the number of breakthroughs achieved and a scoring rubric filled out by the FISH Prize Committee.

NEW ATLANTIS concludes as teams present their work to the FISH Prize Committee (teacher, principal, etc.) to earn FISH Neptune Awards for Excellence in Science. Individual students may earn FISH Peace Prizes for their outstanding work within the team framework in making the world a better place for all humankind. You may also wish to invite other classes to tour the teams’ displays and to ask questions of the “aquanauts.”

Final Note: As teacher you must decide whether you want to make the NEW ATLANTIS simulation a competitive or cooperative experience.: As written, it is a cooperative effort in which all teams may win the FISH Neptune Award for Excellence in Science if they meet the minimum standard you set, but you may choose to offer a special top award to any team that does the most outstanding work. For more information see #7 “Understanding Scoring” in the Set Up Directions on page 4 of this Teacher Guide.

SETUP DIRECTIONS - 1

1. **Before beginning:** Carefully read the NEW ATLANTIS Teacher Guide and Student Guide. Decide which parts of the simulation you would like to include. Keep in mind that the more parts you use, the more complex the scenario will become and the longer the simulation will probably take to complete. Perhaps using fewer facets will work better for the class you have this year while next year's class will benefit from doing all simulation activities—or vice versa. You may tailor NEW ATLANTIS in several ways to fit your situation, students, time limitations, and interests. (See the Options for Shortening NEW ATLANTIS in the Set Up Directions on page 6.)
2. **Materials:** Collect or have students collect supplies for illustrating work stations based on whether you will have students do a two or three dimensional design. Recycled junk materials (e.g., plastic bottles, small boxes, etc.) work well for 3-D along with a sturdy cardboard base; white or light blue butcher paper and markers (drawn in pencil first) work well for 2-D.
3. **References:** Collect books as listed in the BIBLIOGRAPHY following these directions. Enlist the help of your school and/or city librarian to locate these and additional sources.
4. **Other sources:** If desired, write to sources listed in the RESOURCES GUIDE following the BIBLIOGRAPHY. Allow at least a month for information to arrive. If desired, locate videos that may be of interest during this simulation.
5. **Maps:** Besides the two page map in the Student Guide, you may wish to find other ocean floor maps in the National Geographic magazine or other sources.
6. **Judges:** Arrange for three judges for the culminating activity. You may be one if you wish. Your principal, a high school or college science teacher, or a local scientist are all good choices for judges. Set a date and time for the culminating activity that will ensure you and your students have plenty of time to complete the simulation.
7. **Understanding Scoring:** A point tracking chart is provided on page 40. Study the following carefully in order to understand how scoring takes place in NEW ATLANTIS.
 - a. Teams earn points for completing individual and group assignments. These points are added to team accounts after being multiplied by a synergy factor. (Points x Synergy Factor = Sand Dollars.)
 - b. FATE EVENTS can reduce or add to a team's synergy factor and points, thereby ultimately affecting the team's total Sand Dollars.



To save time, have capable students write the letters for you.

SETUP DIRECTIONS - 2



c: Feel free to raise or lower the standard.

Be sure to subtract each team's Sand Dollars investment from their team totals when they agree to begin the Scientific Breakthrough project.

d: If you run out of breakthroughs, simply create more.

e: IMPORTANT

Keep up with scoring for it motivates teams to work towards discoveries and breakthroughs.

f: As teacher you may choose to award an additional prize to the team which does the best work of all.

Individuals who excel (by your definition) in simulation assignments and quality extra credit work earn FISH PEACE PRIZES.

- c. After earning a set number of Sand Dollars, teams can purchase a chance at a Scientific Breakthrough. Teams must invest 100 Sand Dollars per team member for the opportunity to work on a Scientific Breakthrough. (See Student Guide, page 22.) Explain to your students that actually getting a breakthrough often depends on subjective factors prevalent in society (in this case, on your judgment as a teacher). In real life hard work doesn't necessarily mean one will be successful, especially in science.
- d. For a team to actually earn a Scientific Breakthrough after spending the required Sand Dollars, you must judge whether or not they have turned in an acceptable paragraph. You also have the option of approving a project that does not appear on the list in the Student Guide.
- e. A team that accomplishes a breakthrough earns two synergy points and all other teams earn one synergy point. This rule is used because in real life one scientific breakthrough may help solve another critical problem.
- f. Be sure to keep track of the number of Breakthroughs each team wins. Final scoring is based on number of breakthroughs won plus a scoring rubric filled out by the FISH Prize Committee at the culminating activity. This rubric takes into account the final oral and visual presentations teams make. (See **M21**, page 59.)
- g. Use the information below for each assignment's maximum value—**all to be multiplied by the team's synergy factor**:

● **Required assignments:**

Problem-Solving Outline:	5 points per student
Undersea work station:	100 points per team
Submersible:	50 points per team
Problem-Solving Essay:	25 points per student
Oral Presentation	25 points per team

● **Optional activities:** (maximum values):

Vocabulary Challenge 1:	5 points per student
Vocabulary Test 1:	10 points per student
Email to friend:	5 points per student
Vocabulary Challenge 2:	5 points per student
Vocabulary Test 2:	10 points per student

- h. At the end of each day's work multiply points by the team's current **synergy factor**. Remember that each team starts with a synergy factor of 10, but can gain or lose synergy factor points during the simulation.

SETUP DIRECTIONS - 3



Read thoroughly both the Teacher Guide and Student Guide before using any of these options as you might leave out something you really want your students to experience.

8. **Options for shortening NEW ATLANTIS:** You may choose to do all the exercises as described in the Daily Directions or, if you wish, you can do a shortened version. Options:
- a. Instead of having each role specialist solve a survival problem to integrate into a two- or three-dimensional model of each team's undersea work station, simply state that teams will take a prefabricated work station to the site of their choice.
 - b. Do not have students construct a model of or otherwise illustrate their work stations; have them write problem-solving outlines only.
 - c. Instead of using the survival problem research articles found in the Student Guides and having students brainstorm solutions with other specialists in the same role, give teams a list of survival problems to address when they design their work stations. Require that teams simply label their solutions to the survival problems on their model rather than write a problem-solving outline on each problem.
 - d. Have all the teams work on the same mission.
 - e. Do not use the FATE EVENTS and/or CLAM BULLETINS (Remember, however, both of these items not only add to the learning; they also add "spice.")
 - f. Rather than an essay, require a problem-solving outline for the mission assignment.
 - g. Allow students to explain their mission solutions with artwork or music rather than with an essay.
 - h. To simplify the scoring, just give points for completed assignments and don't figure in a synergy factor. Decide how many points it takes to earn a chance at a scientific breakthrough or discovery (10 multiplied by the number of people on a team works well). See #7 "Understanding Scoring" in Set Up Directions on page 4 for more information on how to score.
 - i. For FATE EVENTS that require specialists to write a paragraph, substitute an easier activity, such as calling a coin toss.
 - j. Rather than using a panel of judges and having teams make presentations, limit the culminating activity to a presentation of awards based on work already done. Have younger students tour teams' work stations, asking questions of the "aquanauts."

SETUP DIRECTIONS - 4

Obviously, you can tailor NEW ATLANTIS any way you wish to fit your needs.



The bold ink **M** and # stand for “Master” and “number.” Thus, **M1** = Master 1.

9. **Duplication:** Use this list below to ensure you have duplicated enough of each master. I recommend that you place each master’s copies in separate manila folders in a NEW ATLANTIS file box. The **Daily Directions** beginning on page 15 tell you which items you need each day.

- **(M1)** TEAM CHART, *1 for your records*
- **(M2)** POINT-TRACKING CHART, *1 per team, 6 total*
- **(M3)** POINT-TRACKING CHART SAMPLE, *display copy only*
- **(M4)** FISH IDENTITY BADGE SHEET, *class set*
- **(M5)** VOCABULARY CHALLENGE 1, *class set*
- **(M6)** PROBLEM-SOLVING OUTLINE, *display copy+Student Guide page 24*
- **(M7)** ACRONYM WORKSHEET, *1 per team, 6 total*
- **(M8)** CLAM 1: Clue #1, *1 per team, 6 total*
- **(M9)** UNDERSEA WORK STATION RUBRIC, *1 per team, 6 total*
- **(M10)** SUBMERSIBLE RUBRIC, *1 per team, 6 total*
- **(M11)** VOCABULARY TEST 1, *class set*
- **(M12)** VOCABULARY CHALLENGE 2, *class set*
- **(M13)** DUFFEL BAG SHEET, *class set*
- **(M14)** E-MAIL MESSAGE FORM, *class set*
- **(M15)** CLAM 2: Clue #2, *1 per team, 6 total*
- **(M16)** PROBLEM-SOLVING ESSAY MODEL *display copy only*
- **(M17)** RESEARCH CARD *display copy only*
- **(M18)** PROBLEM-SOLVING ESSAY RUBRIC, *1 per student pair, 18 total*
- **(M19)** CLAM 3: Clue #3, *1 per team, 6 total*
- **(M20)** VOCABULARY TEST 2, *class set*
- **(M21)** TEAM ORAL PRESENTATION RUBRIC, *1 per team, 3 for judges, 1 for you, 10 total*
- **(M22)** CLAM 4: Clue #4, *1 per team, 6 total*
- **(M23)** CLAM NEWS BULLETIN, *1 per team, 6 total*
- **(M24)** FISH JUDGE ID BADGE, *1 sheet, cut into 3 badges*
- **(M25)** FISH NEPTUNE AWARD, *depends on how many you want to give out*
- **(M26)** FISH PEACE PRIZE, *depends on how many you want to give out*

10. **Student folders:** Have folders available for each team in which students can keep all their work, including their Student Guides, outlines, essays, CLAM Clues, etc.



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- Littlefield, C.A. 2006. *Awesome Ocean Science*. Williamson Books.

RESOURCES - 1

All of these organizations have resources for teachers. Some offer chances to “adopt” wildlife. Consider making it a class project to support one of these organizations.

Ocean Conservancy

202-429-5609

Email: dccmc@ix.netcom.com

National Aquarium in Baltimore

410-576-3800

Website: <http://www.aqua.org>

National Geographic Society

(Ocean maps, videos, puzzles, and books)

800-447-0647

Website: <http://www.nationalgeographic.com>

National Wildlife Federation

202-797-6800

Website: <http://www.nwf.org>

New England Aquarium

617-973-5200

Website: <http://www.neaq.org>

Email: kids.ed@neaq.org



Project Aware Foundation

866-80-AWARE

Website: <http://www.projectaware.org>

Email: info@projectaware.org

Reef Relief

305-294-3100

Website: <http://www.reefrelief.org>

Email: info@reefrelief.org

Sea Turtle Survival League

(800) 678-7853

Website: <http://www.cccturtle.org>

Email: ccc@cccturtle.org



NEW ATLANTIS AND THE INTERNET

If you keep the following tips in mind, the Internet can be a valuable tool for students to use while experiencing NEW ATLANTIS:

- Since websites come and go, be sure to check out the sites published in NEW ATLANTIS before asking students to “search the web.”
- Search the following words on to see what current sites you can locate.
 - oceanography
 - whale
 - shark
 - submersible
 - squid

Review all of the sites you find for appropriateness before suggesting them to your students.

- Discourage surfing, which can be frustrating and confusing; instead, guide students by providing reliable “starter” sites to check out.
- Use the Internet as a tool, not a toy used just for the sake of using. While your students may find valuable information on the net, don’t overlook more traditional sources of information such as library books, which may be more valuable and appropriate, depending on the situation.
- Stress to your students that the Internet is not an encyclopedia. You should teach students to recognize and discard information that is incorrect, unimportant, or otherwise misleading.
- Use email or listservs to encourage students to network with students at other schools as well as with adult experts to discuss ideas for solving mission problems.

● Two sites to get you started:

- **<http://www.si.edu>** (Smithsonian Institution; look for “Ocean Planet” in particular)
- **<http://www.whoi.edu>** (Woods Hole Oceanographic Institute; home of Bob Ballard, the finder of the Titanic, and Alvin, the famous submersible)

“

... as a
tool, not
a toy ...

”

UNIT TIME CHART

Monday	Tuesday	Wednesday	Thursday	Friday
Organize Mission Teams Outline Missions Introduce and assign roles (Optional) Vocabulary Challenge 1 1	Introduce team survival problems Role specialist brainstorming and research sessions 2	Problem-Solving Outline Role Specialists report to teams Teams decide on solutions to survival problems, and outline workstation design 3	Underwater Work Station Rubric Teams continue design and illustration of workstations Fate Event 1 4	Fate Event 1 due Research site selection Teams continue workstations Fate Event 2 5
Fate Event 2 due Teams continue design and illustration of workstations Fate Event 3 6	Fate Event 3 due Submersible Rubric, begin submersibles Fate Event 4 Vocabulary Test 1 Vocabulary Challenge 2 7	Fate Event 4 due Duffel bag, email handouts Continue design of workstations and submersibles Fate Event 5 8	Fate Event 5 due Introduce Mission Orders, Team brainstorming sessions Teams finalize workstations Fate Events 6, 7 9	Research Card and Outline, Problem-Solving Essay Model and Rubric Teams begin research, finish workstations and submersibles 10
Fate Events 8, 9 Teams continue research, note-taking, and brainstorming (option for role specialists to brainstorm) Work on Outlines 11	Complete Problem-Solving Outlines and begin Problem-Solving Essays Fate Events 10, 11 12	Fate Event 11 due Complete Problem Solving Essays Fate Events 12, 13 Vocabulary Test 2 13	Fate Event 13 due Oral Presentation Rubric, Teams prepare Oral Presentations from all research data Fate Events 14, 15 14	Teams return to FISH headquarters Teams finalize oral presentations Fate Event 16 15
Fate Event 16 due Team Oral Presentations Awards Ceremony (Optional) Debriefing 16	This UNIT TIME CHART is an example. Alter as desired.			



*For your first day of New Atlantis, consider donning an official “uniform” with cap, medals, and a FISH ID Tag which identifies you as the **FISH Commander in Chief**. Read or tell your scripted parts with great authority and dignity.*

*Group your students prior to Day 1 according to your decisions or allow the students to select their own groups. (See **Two Options** in #3 on the right.) In either case, place their names on your **TEAM CHART** only after it is decided who is to play each role.*

Materials needed:

- Student Guides (Introduction and Section 1)
- TEAM CHART (**M1**, page 39) *1 for your records*
- POINT-TRACKING CHART (**M2**, page 40) *1 per team*
- FISH IDENTITY BADGE (**M4**, page 42) *class set + 1 for you*
Be sure you have cut them apart in advance. You should also have tag board and glue available for student use.
- VOCABULARY CHALLENGE 1 word list (**M5**, page 43) class set—Optional

1. Students arrive at FISH Headquarters on New Atlantis Island in the Pacific Region of the Ocean.
2. Have students join their mission teams and sit in a permanent classroom area.
 - a. If you do not wish to have groups of six, choose a lower number of roles to offer to students and do not use the other role(s) at all.
 - b. If you have a group that is one person short, ask a more capable student to play two roles.
 - c. Fill in blanks on the TEAM CHART to keep track of who is playing which mission specialist role on each team.
3. **Two options:**
 - Assign specialist roles to students within each mission team.
 - Allow students to choose their own roles.
4. Tell each team what its general mission will be, but do not go into detail. Tell students they will receive detailed directions later.
5. Give students their Student Guides and direct them to read silently while you read aloud the “Introduction” and “Roles” sections. Assume an authoritative stance and use a dramatic voice.
6. As FISH Commander in Chief, read the following memo:

FISH Headquarters Briefing Memo

“Welcome to New Atlantis, headquarters of the Federation for Inner Space Habitats, known as FISH. As commissioned officers of FISH, today you shall embark on a journey to the ocean depths of inner space to create a better world for all humankind. Your mission is to explore, preserve, restore, and wisely use the Ocean Planet’s inner space habitats.



DAILY DIRECTIONS - 2

“You will work in international teams, each of which will strive to solve one of the many ecological problems the inner space of the oceans present. Should your team excel in your endeavors, you will win the **FISH Neptune Award for Excellence in Science**.

“This, however, is not a race or a contest. One of FISH’s main goals is to promote international cooperation. Therefore, the separate teams will work together to help each other in our quest to save the Ocean Planet from ecological doom.”

Read

Once again—passion and dignity. This is an important occasion.

7. Have students stand and raise their right hands to take the **Oath of Office**. Have them repeat the oath as you read it, line by line. (**Note:** *This oath also appears in the Student Guide.*)

“I solemnly swear
that I will explore, preserve,
restore, and wisely use
the Ocean Planet’s inner space habitats
as deemed appropriate
by the Federation for Inner Space Habitats;
that I will obey the orders
of the FISH Commander in Chief;
that I will faithfully discharge
the duties of this office;
and that I take this oath
without any reservation.”

T

Have students mount ID tags on tag board (or you can laminate them), then punch two holes at the top to thread yarn through so they can wear their ID tags whenever working in NEW ATLANTIS.

8. Issue official FISH ID TAGS and have students fill in their names, mission specialist roles, and team numbers.
9. Read the rest of the Student Guide’s Section 1 with the class.
10. If you are using the vocabulary challenge option, distribute the VOCABULARY CHALLENGE 1 word list as an assignment. Point out the **GLOSSARY** list in the Student Guide as an aid for study. Consider requiring more capable students to use other sources to find definitions for the vocabulary words. For less capable or younger students, you may want to have them define only the 10 words that appear on VOCABULARY CHALLENGE TEST 1.



Materials needed:

- Student Guides (Section 2 through “Specialists Meetings,” page 6)

1. Have students refer to their Survival Problems in their Student Guides. Use the chart below as a quick reminder of what survival problem each mission specialist is to study.

Mission Specialist	Phase 1 Survival Problem
Chief Engineers	Fresh water supply
Chief Medical Officers	Oxygen supply
Chief Administrators	Communication
Chief Marine Biologists	Food supply
Chief Marine Geologists	Earthquakers
Chief Oceanographers	Power supply

Team # and Name	Phase 2 Mission
1 Reefers	Saving the coral reefs
2 Squid Eyes	Finding the giant squid
3 Surf’s Up	Saving the ocean from pollution
4 Sharks	Saving the sharks
5 Hot Shots	Preserving hydrothermal areas
6 Blue Peace	Saving the whales

2. As the FISH Commander in Chief, read the following:

“We of FISH’s High Command hope you are finding your quarters comfortable here on New Atlantis Island. We encourage you to get to know your teammates because you will soon be living together in the tight quarters of your undersea work station.



#3: *Emphasize to students that throughout NEW ATLANTIS scientific cooperation should be their goal and that therefore, they should continually share ideas.*

#4: *You must model or role play courteous behavior in responding to the brainstorming ideas of others.*

“Now it is time to begin researching and brainstorming how to deal with the many survival problems you will face under the sea. You must use research to help you design a safe undersea work station for your team. Examine your **Survival Problem Data Sheets** given you in Section 2 in your Student Guide. *Note that each mission specialist role has a different data sheet covering a different survival problem.* Your task is to meet with the FISH officers from the other teams who are assigned the same role as you are. In this meeting, you are to read and discuss your Survival Problem Data Sheet and then brainstorm creative ideas to take back to your own team. Your team will then use the problem-solving process to choose what will be the best design elements for your team’s undersea work station.”

3. Now have all the students fulfilling similar roles meet together: the Chief Administrators meet in one circle, the Chief Engineers in another circle, and so on. Emphasize that in brainstorming, all ideas are acceptable and that their task is primarily to list what the others have to say and to contribute their own ideas.
4. After specialists have developed brainstorming lists, have them examine whatever additional resource materials you have available. They should share new information with one another. They should also add to their brainstorming lists any new ideas they have come across.

DAY 3

Materials needed

- Student Guides, page 24
 - PROBLEM-SOLVING OUTLINE (**M6**, page 44) *display copy*
 - 4"x6" note cards—*several for each mission specialist role*
1. Introduce the PROBLEM-SOLVING OUTLINE and instruct students in its use.
 2. Mission specialists return to their own teams with their survival problem brainstorming lists. The specialists then take turns reporting to their teams the results of their brainstorming meetings with the specialists from the other teams.

DAILY DIRECTIONS - 5

- Each specialist should lead his/her team through the problem-solving process and fill out the PROBLEM-SOLVING OUTLINE form as it relates to her/his survival problem. Each team will produce a total of 6 outlines, one for each survival problem, after all discussions are completed. (The idea here, of course, is to encourage peer teaching and group discussion.)
- Have teams make final decisions as to which solutions they will apply in order to solve each survival problem. Instruct specialists to produce sketches of their plans on 4"x6" note cards which their team can use to guide them as they design their undersea work stations.

DAY 4

Materials needed:

- Student Guides (Section 2: Site Selection, page 6)
- ACRONYM WORKSHEET (**M7**, page 45) *1 per team*
- CLAM 1: Clue #1 (**M8**, page 46) *1 per team*



Of course, feel free to modify the rubric as you see fit.

If allowing 3-D, limit size of finished product to something your classroom can handle. One of our test pilots had to travel to a student's home to score an oversized 3-D model that one team produced!

Have teams sketch an overall plan before offering them art supplies.

- Explain that two important tasks remain before they focus on their team research mission: finding a suitable site for their work station and building a submersible that they can use as an exploratory vessel outside of their work station.
- To help students find a suitable site, hold a discussion about the MAP OF THE OCEAN included with this set. Point out that NEW ATLANTIS refers to the "Ocean" not the Pacific Ocean or the Atlantic Ocean—or any other ocean—because they are really all one large, interconnected body of water. Discuss how the Ocean floor has many geographical features similar to land features (e.g., mountains, valleys, fissures, volcanoes, and so on).
- Have the students consider the facts given in their Student Guides under Site Selection on page 6. Explain that this information is intended merely for suggestions, not directions.
- Encourage teams to discuss possible sites based on their individual missions.
- Allow teams to choose their own site even if it is not, in your opinion, the best they could choose for their mission.
- Have each team construct a small flag with its team name on it to mark its team's site on the classroom map.
- Before beginning to use FATE EVENTS, read and be familiar with these general directions:

HOW TO USE FATE EVENTS



Note well: When planning a lesson, be sure to check for any items required by the FATE EVENT(S) for that day (straws, coins, dice, etc.)

- If you are not using synergy factors in your scoring, you will have to modify the FATE EVENT scoring. Just be sure to treat each team equally.
- For the fates that allow each member of a team to try to score, allow teams that are one person short to choose one person to try to score a second time.
- As written, there is one FATE EVENT per mission specialist, each of which requires writing a research paragraph; one FATE EVENT per mission team; and four others that apply to all teams. Modify fates that involve a mission or a role you have chosen not to use so that they involve another mission or role, or do not use those particular fates. Just be sure to distribute fates equally among teams.
- Feel free to modify fates or not use them as you see fit.
- If a FATE EVENT calls for having a specialist write a paragraph to avoid a fate, and you feel that a particular student needs help, it is acceptable to have a teammate work with that specialist.

6. Read **FATE EVENT 1.**

*(Note: This fate applies to **all teams**. Now is a good time to hand out the clue tracking sheet ACRONYM WORKSHEET. At the completion of the activity, have the Chief Marine Geologists read their paragraphs aloud to their teams or the entire class so that all may learn.)*

“A radical group called CLAM threatens to dynamite FISH Headquarters (where you are staying while you get ready for your mission). They claim to have first rights to the Ocean floor. No one knows what CLAM stands for. The only clue you have is a message left on your team’s answering machine from the office of the FISH Commander in Chief:



*Consider having a colleague record an audio message including the information at the right but expanding upon it with dramatic details. Students will listen to it **very carefully**.*

“Some group named CLAM, which means Coalition for something or other, called to tell your team to stay off of the Ocean floor or they’ll blow up FISH Headquarters. They’re not going to let you spoil their chances to make millions of bucks. They said they’d be in touch again soon if you don’t go home and get your fish at the supermarket from now on.”

DAILY DIRECTIONS - 7

“To avoid a security problem, your team’s Chief Marine Geologist must write a paragraph about what might be valuable to CLAM on or under the Ocean floor. Due _____. (Put in when you want the paragraphs completed. We usually use the next day.)

“If your Geologist completes an acceptable paragraph on time, your team gets a clue from CLAM and 1 synergy factor. If the Geologist fails, your team loses 1 synergy factor because you waste so much time and energy on extra security.”



*Shhh!—CLAM 1:
Clue #1 reveals
what the letter
C stands for, but
don’t tell students
what letter they’re
looking for.*

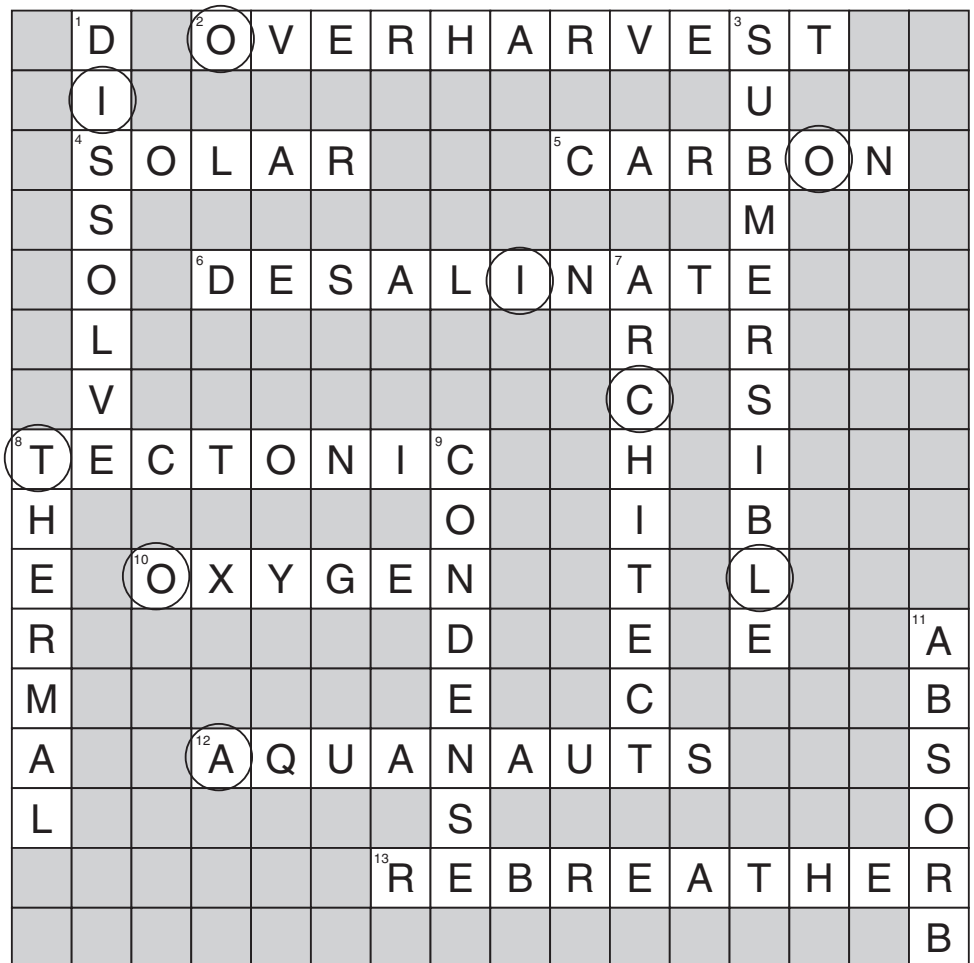
*Unscrambling the
circled letters will
spell “coalition,”
the first letter in the
CLAM acronym. If
teams have trouble
unscrambling, first
ensure that their
crossword work
is correct. Then
reread the answering
machine message.*

Note well: For future
reference, have
students file this
CLAM clue and all
other CLAM clues in
their NEW ATLANTIS
folders.

8. Distribute **CLAM 1: Clue #1**

Note that the answer is mentioned in the answering machine message. See crossword answer below.

Answer to CLAM 1: Clue #1



Materials needed:

- Student Guides (Section 3 through Task 1, page 7)
- Work station art materials (See Set Up Directions #2 on page 4.)
- UNDERSEA WORK STATION RUBRIC (**M9**, page 47) *1 per team*



It is very helpful at this point to use one of the several excellent audiovisual aids available.

Do not worry if teams ignore the site information; the process of “exploring” the Ocean floor is the most important aspect of this exercise.



1. You read aloud from the Student Guide, “Orders From FISH Headquarters: Undersea Work Station” while students read silently.
 - a. If you eliminate a role to keep group size smaller, you may want to add that role’s survival problem to the extra credit list.
 - b. You may wish to limit teams to either a two-dimensional or a three-dimensional model as you see fit.
2. Answer any questions students may have.
3. Distribute and review the UNDERSEA WORK STATION RUBRIC. Emphasize that the design and illustration of the undersea work station is a team effort that will significantly impact their overall scoring. When the discussion is finished, explain that you will now collect the rubrics to use when scoring the team’s work. You may wish to post one for student reference.
4. Have teams begin discussing and designing their undersea work stations. Suggest that groups’ rough plans be ready by Day 6.
5. Read **FATE EVENT 2**.
 (**Note:** *This fate applies to all teams. At the completion of the activity, have the Chief Oceanographers read their paragraphs aloud to their teams or the entire class so that all may learn.*)

“A hurricane threatens New Atlantis Island and the headquarters of FISH. If it hits the island, it will delay the building of your team’s work station.”

“To avoid this fate, your team’s Chief Oceanographer must write a paragraph about what a hurricane is and where they are most likely to occur. Due: _____.

“If your Oceanographer completes an acceptable paragraph on time, your team avoids the hurricane and gains one synergy factor. If he or she fails, your team loses one synergy factor because you lose so much time and energy preparing for and living through the hurricane.”

Materials needed:

- Student Guides (Section 3: Task 1)
1. Have teams continue to work on designing and illustrating their work stations and adjusting them to fit their sites. If possible, allow extra time for this lesson so that teams may make substantial progress on their work stations. Remind them to review the directions on page 7 in the Student Guide.

Teaching tip →

*This is an exciting FATE EVENT. You may wish to audio record it in order to build in its loud, powerful **Beeeeeeeeeeep!** sound announcing its dangerous contents. (As mentioned before, students love such dramatic moments.)*

Read ►

2. Read **FATE EVENT 3**.

(Note: This fate applies to **all teams**. If possible, this is a great time to have your school’s secretary or principal read the FATE EVENT over your classroom intercom—at a prearranged time so that you surprise your students. At the completion of this activity, have the Chief Engineers read their paragraphs aloud to their own team or to the entire class, so that all may learn.)

“Beeeeeeeeeeeeeeeeeeeeeeep! Warning from FISH Weather Command! A tsunami, a tidal wave, is heading toward New Atlantis. You survived the hurricane, but can you survive this?

“To avoid damage, the Chief Engineer on your team must write a paragraph telling what a tsunami is and the damage a tsunami can cause on land. Due: _____. If your Engineer completes an acceptable paragraph on time, your team gains one synergy factor. If he or she fails, your team loses one synergy factor because of the time and energy it takes to repair the damage.”

DAY 7

Materials needed:

- Student Guides (Section 3: Task 2)
- Art and construction materials for submersibles
- SUBMERSIBLE RUBRIC (**M10**, page 48) **1 per team**
- VOCABULARY TEST 1 (**M11**, page 49) **class set**
- VOCABULARY CHALLENGE 2 word list (**M12**, page 50) **class set**—Optional

Teaching tip →

For easy storage between lessons, make sure boxes can be flattened without harming artwork.

DAILY DIRECTIONS - 10



Of course, feel free to modify the rubric as you see fit. If having students design smaller illustrations or models, you may wish to have each student design his or her own, rather than using this as a team project. The teams would then have to pick the best design to use. You could, however, award up to 5 points per student to the team for each completed design.



1. Read and discuss the article in the Student Guide (page 8) entitled “**Scientific Subs.**” You may wish to have teams design a submersible using a large appliance (refrigerator?) box in which they will “ride” during their simulated journey to the Ocean floor.
2. Instead of using appliance boxes, you may wish to have the teams produce a smaller 3-D model or a 2-D illustration. Distribute and discuss the SUBMERSIBLE RUBRIC. Explain that you will use this rubric to judge a team-produced submersible, and then you will collect and evaluate the rubrics. Consider posting one for student reference.
3. Give teams/students time to begin designing their submersibles. It may be helpful to have teams sketch their plans before offering them art supplies and tools. **Note well:** *In such a case, after school, secretly photocopy sketches to use for FATE EVENT 5 in Lesson 8.*
4. Read **FATE EVENT 4.**
(Note: This fate applies to all teams. At the completion of this activity have the Chief Marine Biologists read their paragraphs aloud to their own teams or to the entire class so that all may learn.)

“While testing the various systems in your undersea work station, your team discovers that too much oxygen is being added by the fresh air system. You all suspect that CLAM is responsible for the problem, but you do not receive a message from them. Knowing that too much oxygen can be as harmful as too little, your team must work overtime correcting the problem.

“To avoid this fate, your team’s Chief Marine Biologist must write a paragraph about how plants produce oxygen through photosynthesis. Due: _____.

“If your Marine Biologist completes an acceptable paragraph on time, your team gains one synergy factor. If he/she fails, your team loses one synergy factor while working to fix the problem.”

5. If you are using the VOCABULARY CHALLENGE 1 materials, distribute and give VOCABULARY TEST 1.

VOCABULARY TEST 1 ANSWERS: 1, c; 2, b; 3, b; 4, b; 5, a; 6, c; 7, a; 8, b; 9, c; 10, a.

DAILY DIRECTIONS - 11



After this activity, feel free to move on to Day 8, even if teams have not completed their work station and submersible art work.

Shhh!—Neither warn nor even hint about items students might or might not need to solve certain FATE EVENT problems.



6. If you are using the vocabulary challenge option, distribute the VOCABULARY CHALLENGE 2 materials. Remind students of the **Glossary** in their Student Guides. For more capable students, you may require students to use other sources to find the definitions of the vocabulary words. For less capable or younger students, you may want to have them define only the 10 words that appear on VOCABULARY CHALLENGE TEST 2.

DAY 8

Materials needed:

- Student Guides (Section 3: Tasks 1 and 2)
 - DUFFEL BAG (**M13**, page 51) *class set*
 - EMAIL MESSAGE FORM (**M14**, page 52) *class set*—Optional
 - CLAM 2—Clue #2 (**M15**, page 53) *1 per team*
1. Have each student write a list of 10 items he/she would like to take or thinks he or she may need on the mission (not including food) to “pack” in a duffel bag. Use the reproducible **M11** DUFFEL BAG handouts. Collect these in team bundles and save them to use with FATE EVENT 11 in Lesson 10. Do not warn students that they might need the items that they have packed to solve any problems.
 2. Read the simulated journey to the work site:

“You are standing on the shore of New Atlantis Island in the Pacific Region of the Ocean, waiting to enter your work station. You feel nervous, yet excited, about beginning your mission as a commissioned officer of the Federation for Inner Space Habitats. Your fellow team members crowd around, joking about everything being a little FISHy.

“Your team’s work station rests on the deck of a transport ship, waiting to be lowered by a crane into the water for a government transport submarine to tow to your work site. You check quickly to make sure your team’s submersible is securely attached to the side of the work station.

(continue to read other side ...)

DAILY DIRECTIONS - 12



This “journey” to enter their work stations is an exciting one. Therefore, **read certain portions dramatically** to make students aware of this moment’s drama.

“As you enter the work station, you step carefully over the cables that will connect the work station to the submarine. At the last moment, you turn and wave good-bye to the TV cameras lining the beach, knowing that your friends and family along with the rest of the world are watching your departure. You strap yourself into the chair in your sleeping quarters and wait for your trip to begin.

“In a short while, the ship sails out of the harbor to rendezvous with the submarine. Soon you feel the work station shake and toss as the crane lowers it into the water. Through the window you see divers gather around to bolt the towing cables onto the bottom of the submarine. Once the divers finish, your team establishes contact with the captain of the submarine, who welcomes you and wishes you a good trip and successful mission.

“Knowing you’re in for a rather rough ride, someone on your team begins playing a CD to help everyone relax. You wish you could ride inside the submarine, but going between it and your work station would be too tricky, if not impossible. So you sit back and watch the sea life slide past the window and think about the mission lying ahead.”

*If possible, you may wish to have students actually send their email messages. **Note:** To preserve the messages’ spontaneity, mark scores based on creativity only.*

3. At this point, if desired, assign the optional EMAIL MESSAGE FORM to all students. You may find it helpful to brainstorm with students about how they might be feeling under the circumstances, especially considering they don’t really know what they’re getting into. Encourage students to take the points of view of their adult roles. It may also be helpful to show them the EMAIL MESSAGE FORM before reading about the simulated journey, telling them, “Please don’t write until after hearing what I am going to read to you.”

Read

4. Read **FATE EVENT 5**.

*(Note: This fate applies to **all teams**. See answer on the next page)*

“You receive word that the vice president of a leading manufacturer of submersibles has visited FISH Headquarters and has offered to buy your blueprint(s) for one million dollars. You’ll all be rich! But what if it’s a CLAM action aimed at sabotaging your team’s mission?

“While arguing among yourselves about whether or not you should sell your plans, you receive a mysterious FAX, which indicates that CLAM has a photocopy of your plans. The FAX states:

“We know who you are, but we don’t think you can ever figure out who we are. Just go ahead and try! —CLAM.”

“The FAX also contains a clue to help you figure out what CLAM stands for. You work feverishly to try to solve the mystery and stop CLAM from destroying your mission.

“Your team has until _____ to figure out the clue. If you succeed, your team gains one synergy factor because you all feel more confident that you will be able to squelch the activities of CLAM. If you fail, you lose one synergy factor while cowering in fear.”

Teaching
tip 

*Shhh!—CLAM 2: Clue #2 reveals what the letter **A** stands for, but don’t tell students what letter they’re looking for.*

*CLAM 2: Clue #2 provides one letter more than is needed to get the right answer. If a team uses the **W** from whale shark to come up with the word **LAW**, don’t say anything. Allow them to put the **L** for **LAW** on their **ACRONYM** sheet. Students will have an opportunity to correct their response later.*

Answers for CLAM 2: Clue #2

L for **limpets** (a snail-type animal, not a survival problem); **A** for **anemones** (an animal, not a geographical feature of the ocean); **whale sharks** (a shark, not a marine mammal); **L** for **legs** (not part of a fish’s body).

5. Have teams continue to work on their work stations and submersibles. Remind them they must show evidence of survival problem solutions in the designs of **both** the work station and the submersible.

Materials needed:

- Student Guides (Section 4: Team Mission Orders)
- Coin for coin toss

Read

Teaching Tip

Consider asking a school secretary or the principal to read the FISH Commander's message over your classroom intercom to simulate that the you are not actually present on the Ocean floor but are still back at FISH Headquarters on New Atlantis Island.

1. As the FISH Commander in Chief, say:

"I am well-pleased with the excellent designs of your work stations and submersibles. I am also pleased to see the cooperative and efficient way you are working together as teams and your valiant struggle to find and defeat the evil forces of CLAM. You have done well to settle into your new homes quickly.

"It is now time to read your team's Official **Mission Orders** from FISH Headquarters. We of FISH High Command on New Atlantis Island wish you well as you strive to explore, preserve, restore, and wisely use the Ocean Planet's inner space habitats."

2. Have teams carefully read their **Mission Orders** (Student Guide).
3. Have teams discuss their mission data, brainstorming answers to the question posed.
4. If necessary, have teams continue to work on their work stations and submersibles.
5. Read **FATE EVENT 6**.
(**Note: This fate applies only to Team 5: Hot Shots; however, read it aloud to the entire class.**)

Read

"Your team is traveling in a submersible, when suddenly, you see a new vent open up before your very eyes! You see the geyser shoot up for the first time, and as the sea water cools, the sediments settles on the ocean floor, creating the beginnings of a new black smoker.

"To win this discovery, at least two people on your team must be able to call a coin toss correctly. Every person who succeeds scores 5 points to add to your team's total (multiplied by current synergy factor). But if only one person succeeds, your team scores nothing."

Read

This is another good time to surprise the class by having the FATE EVENT message read by someone else over the intercom.

T eaching ip

***Note:** Students should not work cooperatively on this challenge. It may be helpful to assign a different word to each team or to each role specialist to reduce the chances of students collaborating.*

6. Read **FATE EVENT 7.**

(Note: This fate applies to **all teams**. Choose a word to define that you think the students will have a reasonable chance of knowing at this point in the simulation.)

“Wooooooooonk! Wooooooooonk! Wooooooooonk!”

Your work station’s seismograph senses that an earthquake is about to happen close enough to your work station to cause at least some damage. The Chief Marine Geologist on your team is worried about a volcanic eruption happening along with the earthquake, possibly causing more damage.

“To avoid these problems, at least two people on your team must write down the correct definition of (*your word choice*)—without help. If you fail, your work station does not suffer damage, but several of the instruments inside do. Your team will lose 10 points, multiplied by the number of team members who got the definition wrong. This total will be deducted from your team’s total because you must wait for replacement instruments.”

DAY 10

Materials needed:

- Student Guide (Section 5, pages 15, 24)
- PROBLEM-SOLVING OUTLINE (**M6**, page 44) *display copy*
- RESEARCH CARD (**M16**, page 54) *display copy*
- PROBLEM-SOLVING ESSAY MODEL (**M17**, page 55) *display copy*
- PROBLEM-SOLVING ESSAY RUBRIC (**M18**, page 56) *1 per student pair and display copy*
- 4"x6" note cards—**several for each student**

1. Review the PROBLEM-SOLVING OUTLINE.
2. Depending on your class’ age/ability level, assign as much research as your class warrants. Display the RESEARCH CARD and explain how research notes are taken. (*These directions are also in their Student Guides.*)
3. Now display the PROBLEM-SOLVING ESSAY MODEL. Go through how it is constructed from the outline. Call students’ attention to the model (Student Guide, page 17).
4. Explain that they will be working in pairs, but that each member will have to write an essay of his/her own.



*These essay composition materials are adapted from Interact's **FIRST STEPS** or **STEPS** writing programs—grades 3–6 and 7–12 respectively. You may wish to purchase either program for in-depth training of your students, although enough is given here to act as an excellent introduction to the process.*

5. Referring again to the PROBLEM-SOLVING OUTLINE and ESSAY, show how the research card material is “fed” into each.
6. Explain that the essay each member produces will be combined with other members’ essays to develop their team’s Oral Presentation to the FISH Neptune Award Prize Committee.
7. Distribute and review the PROBLEM-SOLVING ESSAY RUBRIC. Emphasize that team pairs must work together to brainstorm ideas, but the actual essays will be individual efforts with each student allowed to write about his/her own opinions. Explain that each essay will be scored individually. Collect rubrics to use when scoring essays. You may wish to post one for student reference.
8. Have team pairs start their research, taking notes from whatever sources they can find.
9. Have students finalize their work stations and submersibles if they haven’t already done so.

DAY 11

Materials needed:

- Student Guides (Section 5)
- Research notes taken previously
- 3 dice
- Squares of paper numbered 1 through 12
- Container for paper squares

1. Before beginning additional research, read **FATE EVENT 8**.
(**Note:** This fate applies **only to Team 6: Blue Peace**; however, read it aloud to the entire class.)



“Your team discovers a new species of whale that appears to be doing very well. From studying this new whale, you learn how to help other whale species.

“To win this discovery, at least two team members must roll three dice and get 12 or better. Every person who succeeds scores five points (multiplied by current synergy factor) to add to your team’s total. However, if only one person succeeds, your team scores nothing.”

Read

2. Read **FATE EVENT 9**.

(Note: This fate applies to **all teams**. To prepare for this fate, write the numbers one through twelve—each on its own small slip of paper. Fold the slips so that the number cannot be read, and place all twelve into a paper bag, hat, or other container. Have **one team at a time** draw a number. Note each team’s selection, and then put each number back in the container as you proceed so that all teams have an equal chance to draw any number.)

“Your team discovers that Cookie Cutter Sharks are taking bites out of the rubber parts of your submersible. Normally, these creatures take bites out of whales. They must think your submersible is a small whale! Or maybe CLAM is committing sabotage! At any rate, the damage to your submersible could endanger your team’s mission.

“To avoid this fate, your team must draw a number seven or larger out of the container. If you draw a number less than seven, this fate is yours, and your team loses 10 points (multiplied by current synergy factor) from your team total.”

Teaching

Of course, substitute other directions as needed.

3. Allow more time for research, note-taking, and brainstorming. It is permissible to allow team member pairs to meet with other team members as a sounding board, but we have found that in assignments of this sort, pairs get the most individual work done.

4. You can, if desired, have fellow specialists from the various teams jigsaw to discuss each team’s mission; then they take their brainstorming notes back to their own teams. Consider having fellow specialists “travel” by submersible to each other’s work stations.

Read

5. If using #4 above, as the FISH Commander read the following:

“I advise you to travel in your submersibles to each other’s work stations to discuss your missions with your fellow specialists. Take your team’s Mission Orders and a pencil and paper for taking notes. While meeting with your fellow specialists, you will take turns briefly sharing—in your own words—what your team’s mission is and what your team has discussed as possible solutions. I encourage you to work with your fellow specialists to brainstorm additional ideas. Write new ideas down to take back to your own team.

Read

“At 1400 hours (substitute a time that works for you) all Chief Administrators will meet at Team 1’s work station, all Chief Engineers will meet at Team 2’s work station, all Chief Marine Biologists will meet at Team 3’s work station, all Chief Marine Geologists will meet at Team 4’s work station, all Chief Medical Officers will meet at Team 5’s work station, and all Chief Oceanographers will meet at Team 6’s work station.”

DAY 12

Materials needed:

- Student Guides (Section 5)
- Research notes and outlines
- 1 die
- DUFFEL BAG sheets from Day 8

Read

1. Read **FATE EVENT 10.**

*(Note: This fate applies **only to Team 1: Corals**; however, read it aloud to the entire class.)*

“Your team discovers a way to quickly help coral that has bleached white because the temperature of the water has changed too much. When you add this chemical to the water around a coral reef, it turns the coral back to their healthy colors without hurting other living things.

“To win this discovery, at least two team members must roll a die and get a four or higher. If they succeed, your team scores five points (multiplied by current synergy factor) for each roll of the die that is four or higher. If only one member gets a four or higher, your team scores nothing.”

Read

2. Read **FATE EVENT 11**.

(Note: This fate applies to **all teams**. Return the list of items packed in the DUFFEL BAGS during the Day 8 lesson.)

“You wake up this morning to the unexpected sound of running water. Sleepily, you walk out of your sleeping quarters and discover that your team’s work station is flooding! You shout to wake everyone else up, and soon a teammate discovers that a pipe is leaking heavily in the galley (kitchen). Water is pouring steadily across the floor. Before the entire station floods, your team must work together to fix the pipe. You all grab your duffel bags and search for items that will help you stop the leak in time. One of you radios FISH headquarters to send a rescue party just in case, but you all know that will probably take too much time. Muttering “CLAM” under your breath, you get to work.



Monitor students’ work to ensure that no one changes what she/he packed.

You decide what is acceptable for paragraphs. Look for creativity and clear explanations.

“First, you must work together to discuss and choose a solution, using only the items in your duffel bags. Then your team’s Chief Administrator must write a paragraph describing how you will use the items in your duffel bags to stop the leak. Due: _____.

“If your Chief Administrator completes an acceptable paragraph on time, your team stops the water in time to save your lives, and gains one synergy factor because now you feel confident that you can handle anything. If he or she fails, FISH headquarters must mount a rescue mission and your team loses one synergy factor while waiting for repairs to be completed on your work station.”

3. Have student pairs help one another finish filling out their PROBLEM-SOLVING OUTLINES and, if not already done, begin their essays.
4. Try to have all outlines completed by the end of this period.
5. Once the outlines are completed, students can begin writing their problem-solving essays. Circulate among the team pairs, helping whenever necessary.

Materials needed:

- Student Guides (Section 5)
- CLAM 3: Clue #3 (**M19**, page 57) *1 per team*
- 1 short straw and 1 long straw
- VOCABULARY TEST 2 (**M20**, page 58) *class set*—Optional

1. Read **FATE EVENT 12**.

*(Note: This fate applies **only to Team 2: Squid-eyes**; however, read it aloud to the entire class. Be sure you have two straws—one straw slightly longer than the other.)*

“Your team is able to make friends with a sperm whale. It allows you to follow it, studying how it lives. Because squid is one of the sperm whale’s favorite meals, following this whale will give you a better chance of finding the giant squid.

“To win this fate, at least two people on your team must draw the long straw. If you succeed, your team scores five points (multiplied by current synergy factor) for everyone who selects the long straw. If only one person chooses the long straw, your team scores nothing.”

2. Read **FATE EVENT 13**.

*(Note: This fate applies to **all teams**. Each team which completes an acceptable paragraph on the problem stated below will receive a copy of CLAM 3: Clue #3. Have the Chief Medical Officers read their paragraphs aloud so that all may learn.)*

“**Ding, ding, ding, ding, ding!** Your fresh water sensor sounds off! **Ding, ding, ding!** Too many bacteria have gotten into your fresh water supply. You think that your waste water recycler is malfunctioning. Could it be CLAM again? Regardless, since these bacteria can make people very sick, you all must stop working on your team’s mission and figure out what is wrong with the special water filter.

“To solve the problem before anyone gets sick, your team’s Chief Medical Officer must write a paragraph explaining how waste water is recycled into safe, drinkable water.
Due: _____.

Read 

Teaching
tip 

Shhh!—CLAM 3: Clue #3 reveals what the letter M stands for, but don’t tell students what letter they’re looking for.

This is another good time for someone other than you to read over the intercom.

“If your Chief Medical Officer completes an acceptable paragraph on time, no one gets sick, your team discovers another clue to help figure out who CLAM is, and you gain one synergy factor. If he or she fails, two members of your team become ill before your team figures out what is wrong with the water filter and your team loses 10 points per team member.”

Answers for CLAM 3: Clue #3

“Get out! The ocean floor is ours for mining.”

- If you are using the VOCABULARY TEST 2 materials, distribute and give VOCABULARY TEST 2—Optional.

VOCABULARY TEST 2 ANSWERS: 1, c; 2, b; 3, a; 4, a; 5, c; 6, a; 7, c; 8, a; 9, b; 10, b.

- Have students finish writing their problem-solving essays.

DAY 14

Materials needed:

- Student Guides (as reference material)
- PROBLEM-SOLVING ESSAYS
- PROBLEM-SOLVING OUTLINES
- ORAL PRESENTATION RUBRIC (**M21**, page 59) *1 for each team*
- Coin for coin toss
- 1 set of dice

- Give a copy of the ORAL PRESENTATION RUBRIC to each team for guidance.
- Allow time for teams to organize their presentations to the FISH Prize Committee. They should use all of their problem-solving work as a data base for this presentation. **Note:** *Emphasize that each team member must speak during the presentation.*
- Read **FATE EVENT 14**.
(**Note:** *This fate applies only to Team 4: Sharks; however, read it aloud to the entire class.*)

“Your team discovers how to cure the flu using teeth that have naturally fallen out of the great white shark. You just know you will all be millionaires as soon as you can start selling it!



Tailor this culminating activity to your situation using the ORAL PRESENTATION RUBRIC.

“To win this discovery, at least two people on your team must call a coin toss two out of three tries. If you succeed, your team gains five points (multiplied by current synergy factor) for every person who succeeds two out of three times. But if only one person succeeds, your team scores nothing.”

4. Read **FATE EVENT 15.**

*(Note: This fate applies **only to Team 3: Surf’s Up**; however, read it aloud to the entire class.)*

“Your team figures out a way to make cheap but effective pollution shields to hang around marine sanctuaries. These shields protect ocean life by filtering out pollutants before they can harm the life inside the sanctuary.

“To win this invention, at least two people on your team must roll a pair of dice and get an eight or better. If you succeed, you score five points (multiplied by current synergy factor) for every person who gets an eight or better. If only one person succeeds, your team scores nothing.”

DAY 15

Materials needed:

- Student Guides (as reference material)
- CLAM 4: Clue #4 (**M22**, page 60) **1 per team**
- CLAM NEWS BULLETIN (**M23**, page 61) **1 per team**

1. Read this message about the journey back to FISH Headquarters on New Atlantis Island:

“It is now time to repack your duffel bag and prepare for your journey back to FISH Headquarters on New Atlantis Island. There all teams will make presentations to the FISH Prize Committee.

“You are tired but happy, satisfied that you have done your best to fulfill the Federation for Inner Space Habitats’ mission to explore, preserve, restore, and wisely use the Ocean Planet’s inner space habitats. I praise you for having worked cooperatively with people of all origins in the quest to save the Ocean Planet from ecological

Read



Read



doom.



Shhh!—CLAM 4; Clue #4 reveals what the letter L stands for, but don't tell students what letter they're looking for.

If a group used the word LAW as their answer for CLAM 2; Clue #2, suggest that they reexamine all other clues to find their mistake.



“As you strap yourself into your seat for your return journey, you think about your family and friends, whom you haven’t seen for a year! The government transport submarine arrives and divers surround your work station as they bolt it to the bottom of the sub. The captain of the sub establishes contact with your team and congratulates you all on a job well done. Soon you and your work station are being towed back to New Atlantis Island. You think about the presentation your team will make to the FISH Prize Committee, confident that you will win **The FISH Neptune Award for Excellence in Science**.

2. Read **FATE EVENT 16**.

(Note: This fate applies to *all teams*. Then distribute CLAM 4: Clue #4. Offer to your successful teams the CLAM NEWS BULLETIN.)

“Halfway back to FISH Headquarters on New Atlantis Island you feel your team’s work station jolt violently. You realize that something or someone is releasing the bolts that connect the towing cables to the bottom of the FISH transport submarine. If the bolts release, you, your team, and your work station will crash-land on the Ocean floor. You’ve come so far and now this! ***It has to be CLAM!*** Sure enough another clue comes over your FAX machine.

“To avoid crash-landing on the Ocean floor, missing the big welcome at FISH Headquarters, and having your little brother inherit your CD collection, your team must decipher the clue by _____. If you succeed, you make it to New Atlantis Island just in time to make your presentation to the FISH Prize Committee.

● **Answers for CLAM 4: Clue #4**

1. Antibiotic;
2. New Zealand;
3. Geyser;
4. Pollutant.

Answer: Legalizing

DAILY DIRECTIONS - 24

(The final letter is L, which stands for Legalizing)

DAY 16

Materials needed:

- TEAM ORAL PRESENTATION RUBRIC (**M21**, page 59) *1 per judge*
- FISH JUDGE ID BADGE (**M24**, page 62) *1 per judge*
- THE FISH NEPTUNE AWARD (**M25**, page 63) *1 for each honored student*
- THE FISH Peace Prize (**M26**, page 64) *1 for each honored student*

Read



“Welcome back to FISH Headquarters. I trust your stay here on New Atlantis Island will once again be a pleasant one.

“Today the entire world welcomes you as heroes and heroines of the deep, as brave and victorious soldiers in the battle to save the Ocean Planet from ecological doom and from CLAM. As FISH Commander in Chief, I congratulate you on behalf of both the Federation for Inner Space Habitats and the people of the Ocean Planet. We extend to you our deepest gratitude and humblest thanks.

“We wish you all the best as you make your presentations to the FISH Prize Committee.”

1. Greet teams as the FISH Commander in Chief:
2. Have teams make their presentations to the FISH Prize Committee.
3. Hold the awards ceremony and present the FISH AWARDS. Have the chairperson of the FISH Prize Committee offer congratulations to winners.

4. Debriefing

We recommend that you hold a debriefing. Ask students either to write out answers to the following questions, or to answer them orally and have one student record the answers:

- What did you enjoy about this method of learning? How does “simulation learning” differ from other methods of learning?
- What was not enjoyable in your NEW ATLANTIS experience?
- Would you recommend that your teacher use this simulation again next year? Why or why not?
- If you recommend that students play this simulation next year, what specific changes can you suggest to improve it, and what items in it would you suggest not be changed in any way?
- Did taking part in this simulation excite you about a career in oceanography?



Have the three judges wear their ID tags identifying them as either chairperson or member of the FISH Prize Committee.

TEAM CHART

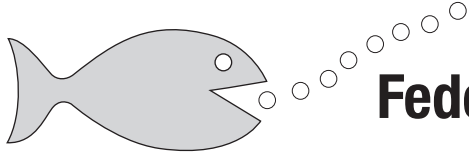
	Administrator	Engineer	Marine Biologist	Marine Geologist	Medical Officer	Oceanographer
Team 1: CORALS Coral Reef						
Team 2: SQUID EYES Giant Squid						
Team 3: SURF'S UP Pollution						
Team 4: SHARKS Sharks						
Team 5: HOT SHOTS Hydrothermal Vents						
Team 6: BLUE PEACE Whales						

POINT TRACKING CHART

Team Name																			
Number of members																			
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12	Day 13	Day 14	Day 15	Day 16			
Problem-Solving Outline																			
Undersea Work Station																			
Submersible																			
Problem-Solving Essay																			
Oral Presentation																			
Vocabulary Challenge 1																			
Vocabulary Test 1																			
Email to Friend																			
Vocabulary Challenge 2																			
Vocabulary Test 2																			
	x																		
Synergy Factor																			
	-																		
Scientific Breakthrough Purchase																			
	=																		
Sand Dollars (Total at end of day																			

[illegible]

FISH IDENTITY BADGE SHEET

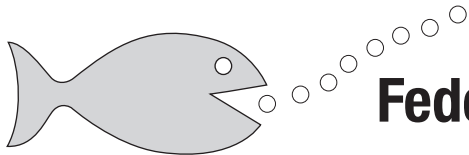


Federation for Inner Space Habitats

Name:

Position:

Team:

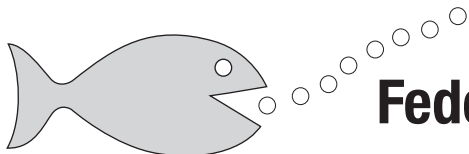


Federation for Inner Space Habitats

Name:

Position:

Team:



Federation for Inner Space Habitats

Name:

Position:

Team:

VOCABULARY CHALLENGE 1

- **Directions:** Use the glossary in the Student Guide to make sure everyone on your team knows the following words and terms. *Your survival may depend on it!*

1. Aquanaut
2. Submersible
3. Remotely operated vehicle (ROV)
4. Autonomous underwater vehicle (AUV)
5. Maneuver
6. Oxygen
7. Carbon dioxide
8. Photosynthesis
9. Hydrogen
10. Marine
11. Rebreather system
12. Desalinate
13. Condense
14. Membrane
15. Dehydrate
16. Overharvest
17. Supplement
18. Architect
19. Absorb
20. Masonry
21. Tectonic plate
22. Dissolve
23. Solar
24. Thermal
25. By-product
26. Nutrient-rich

PROBLEM-SOLVING OUTLINE

Directions: Your task is to write a problem-solving outline, explaining how you will adapt the ideas listed in your category for use in the design of your team's underwater work station. (Follow the outline below, but use your own paper.)

I. Introduction

I am going to solve the problem of _____ by defining it; by offering at least two solutions; by evaluating these solutions; and by selecting the best solution.

II. Define the problem (at least two specific details):

A. Detail 1:

B. Detail 2:

C. Other detail (if more):

III. Offer at least two possible solutions

A. Solution 1:

B. Solution 2:

IV. Evaluate your solutions

A. Solution 1:

1. Good points:

2. Bad points:

B. Solution 2:

1. Good points:

2. Bad points:

C. Why solution _____ is best: (Give at least two reasons why.)

1.

2.

V. Summary (Restate the problem, give the best solution, and tell how it will help.)

In summary, I have defined the problem of _____, I have suggested _____ solutions, and I have evaluated them. I believe my _____ solution is best for us today in our situation because _____.

ACRONYM WORKSHEET

An acronym is a word formed by using the first letter of each word in a group of words. **FISH** is an acronym for **F**ederation for **I**nnner **S**pace **H**abitats.

Note that it is okay for small, unimportant words such as “for,” “to,” and “of,” to be left out of the acronym:

Federation for

Innner

Space

Habitats

CLAM is an acronym for a group trying to sabotage, or harm, FISH’s mission. Your job is to figure out what CLAM stands for in order to catch them. You can use this sheet to keep track of clues you come across. Place ideas beginning with the letter right after the letter. For example, if a clue suggested that the **C** in **CLAM** stood for *hidden* or *secret*, you might print the word **clandestine** after the large **C**.

C

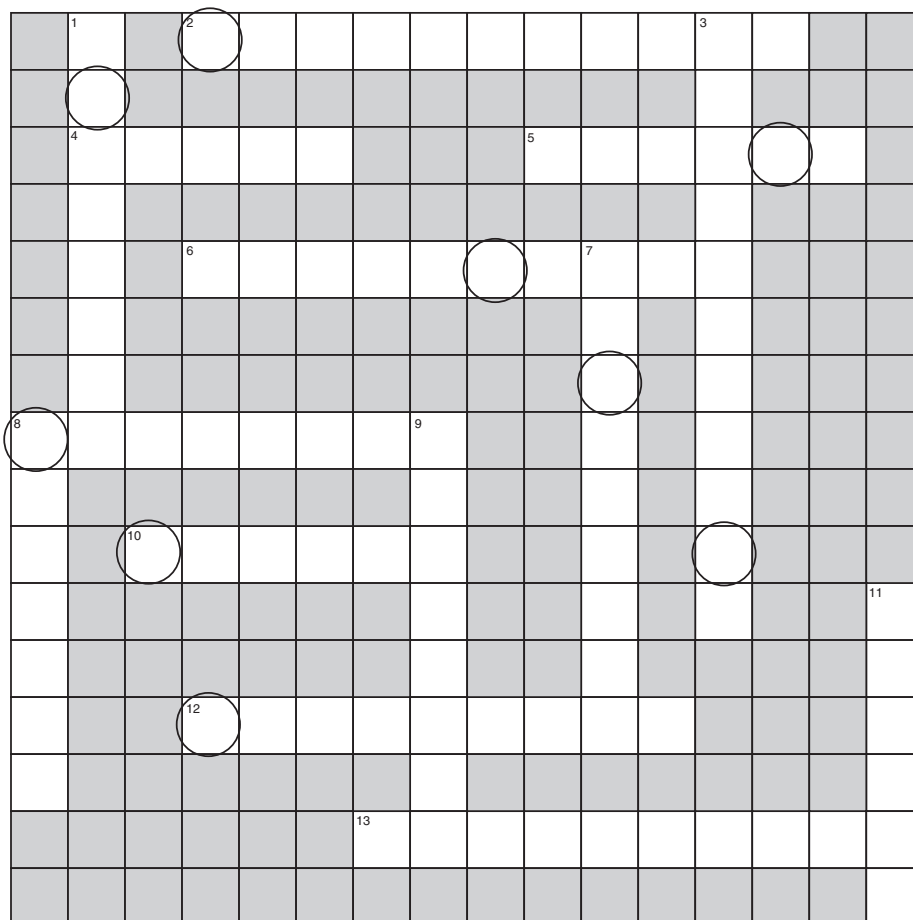
L

A

M

CLAM 1

Re: FATE EVENT 1: Ha! We know who you are, but you'll never find out who we are. Just to keep you hopping, we'll give you a clue. But you're going to have to work for it!



Across clues:

2. To take too many plants or animals out of nature
4. From the sun
5. Compound breathed out by animals:
_____ dioxide
6. To take the salt out of
8. One of the many pieces of the Earth's crust: _____ plate
10. An element breathed in by animals
12. People who explore the ocean depths
13. Recycles a diver's air supply:
_____ system

Down clues:

1. To cause to pass into a solution
3. Undersea vessel used for science
7. A person who designs buildings
8. Caused by heat
9. To undergo condensation, changing a gas to a liquid
11. To take in and make part of an existing whole

Hmmmm... So you haven't figured anything out yet? You have more work to do.

Take the letters that are **circled** in the crossword puzzle and unscramble them to find the meaning of one of the letters in CLAM. ***Just go ahead and try!***

UNDERSEA WORK STATION RUBRIC

(100 points for entire team—Teacher may score between given numbers if appropriate.)

Team Name: _____ Total: _____

● **Quality of work** (25 points possible)

- 25:** Demonstrates excellent artwork; no spelling errors; all neat handwriting
- 20:** Demonstrates good artwork; few spelling errors; mostly neat handwriting
- 15:** Demonstrates fair artwork; several spelling errors; legible handwriting
- 10:** Demonstrates fair artwork; many spelling errors; poor handwriting
- 5:** Demonstrates poor artwork; many spelling errors; illegible handwriting

● **Evidence that each member did fair share of work** (25 points possible)

- 25:** Always worked cooperatively as a group; paragraph contains at least one sentence per group member describing what each member contributed to the project; method used to decide how to divide the work equally and why they divided it as such.
- 20:** Usually worked cooperatively as a group; paragraph contains at least one sentence per group member describing what each member contributed to the project and the method used to decide how to divide the work equally or why they divided the work as such
- 15:** Sometimes worked cooperatively as a group; paragraph contains at least one sentence per group member describing what each member contributed to the project
- 10:** Rarely worked cooperatively as a group; paragraph describes what each member contributed in fewer sentences than group members or reveals that not all group members contributed equally
- 5:** Never worked cooperatively as a group; paragraph does not describe what each member did or reveals that not all group members contributed equally

● **Accuracy in following directions** (25 points possible)

- 25:** All details of direction handout clearly and carefully followed
- 20:** Most details of direction handout clearly and carefully followed
- 15:** Details of direction handout generally followed
- 10:** Many details of direction handout missing
- 5:** Does not follow direction handout

● **Creativity** (25 points possible)

- 25:** All solutions to problems original and detailed; much thought put into unique presentation of ideas
- 20:** Many solutions to problems are original and detailed; much thought put into unique presentation of ideas.
- 15:** Some solutions to problems are original and detailed, attempts to convey ideas creatively.
- 10:** Contains few original ideas; reveals little thought put into presentation of ideas
- 5:** Reveals that no thought was put into being original or creative

SUBMERSIBLE RUBRIC

(50 points for entire team—Teacher may score between given numbers if appropriate.)

Team Name: _____ Total: _____



Evaluation principles

- 50:** Always discussed ideas and worked cooperatively as a group; followed all directions carefully; all creative and original ideas; excellent artwork; all labels spelled correctly; neat handwriting; evidence that all members did fair share of work
- 40:** Usually discussed ideas and worked cooperatively as a group; followed all directions carefully; many creative and original ideas; good artwork; few spelling errors; mostly neat handwriting; evidence that all members did fair share of work
- 30:** Sometimes discussed ideas and worked cooperatively as a group; followed most directions; few creative or original ideas; fair artwork; several spelling errors; legible handwriting; evidence that all members did fair share of work
- 20:** Rarely discussed ideas or worked cooperatively as a group; did not follow directions closely; no creative or original ideas; fair artwork; several spelling errors; illegible handwriting; little evidence that all members did fair share of work
- 10:** Never discussed ideas or worked cooperatively as a group; did not follow directions at all; no creative or original ideas; poor artwork; several spelling errors; illegible handwriting; no evidence that all members did fair share of work

VOCABULARY TEST 1

Name: _____ Score: _____

Team's name: _____

- Your team members must score an average of 9 or better on this test to avoid this fate: Your team's **Chief Medical Officer** suddenly becomes very ill. Since no one else has the medical knowledge to help this team member, you must spend valuable time reading the Chief Medical Officer's medical books to find out how to help him/her. Your team loses one synergy point because of the discouragement and the lost time.

If you score an average of nine or better as a team, your **Chief Medical Officer** does not become ill and you gain one **synergy point**.

- **Directions:** Circle the letter of the definition that **best** fits the word or term.

1. **Solar**

- a. Of the moon
- b. Belongs to water
- c. From the sun

2. **Tectonic plate**

- a. An island
- b. A piece of Earth's crust
- c. A steel building reinforcement

3. **Carbon dioxide**

- a. An unimportant substance
- b. A compound breathed out by animals and absorbed by plants
- c. The lightest and simplest element

4. **Desalinate**

- a. To squeeze through
- b. To take the salt out of
- c. A submersible

5. **Architect**

- a. A person who designs buildings
- b. To guide skillfully
- c. A person who lives underwater

6. **Submersible**

- a. A military submarine
- b. An undersea work station
- c. A small, mobile undersea vessel used for science

7. **Oxygen**

- a. An element breathed in by animals and given off by plants
- b. A tank
- c. A poison

8. **Absorb**

- a. Produced by chemistry
- b. To take in and make part of an existing whole
- c. To remove water from

9. **Thermal**

- a. Of, related to, or caused by cold
- b. A type of thermometer
- c. Of, related to, or caused by heat

10. **Aquanaut**

- a. A person who explores ocean depths
- b. A person who explores outer space
- c. A water walnut

VOCABULARY CHALLENGE 2

● **Directions:** Use the glossary to make sure everyone on your team knows the following words and terms. Your survival may depend on it!

1. Ecosystem
2. Species
3. Erosion
4. Sediment
5. Isolate
6. Tentacle
7. Prey
8. Habitat
9. Specimen
10. Pollutant
11. Toxin
12. Pesticide
13. Sewage
14. Marine sanctuary
15. Monitor
16. Antibiotic
17. Geyser
18. Mineral
19. Probe
20. Chemosynthesis
21. Extinction
22. Cetacean
23. Migration
24. Scavenger
25. Tissues
26. Chemical
27. Tempered

DUFFEL BAG

- **Directions:** Decide on 10 items, other than food, that you want to take with you in your duffel bag while you are on your team's mission. List these items in the **Duffel Bag** below:



EMAIL MESSAGE FORM: GOING UNDER

Directions: Use the form below to send an email to your best friend. Tell him or her what you are thinking, feeling, and planning as you begin your journey to your team's work site. Then explain why you joined FISH and what your job will be. Finally, describe what you think your life undersea will be like.

To:

Copy to (your teacher):

Regarding: **Going Under**

[illegible]

CLAM 2

Re: FATE EVENT 5: For each group of words below, circle the one thing that does not belong with the others. **Hmmmm** ... You probably will have to use library books to figure out this challenge.

Oxygen

Food

Power

Limpets

Volcanoes

Anemones

Valleys

Mountain ranges

Dolphins

Whale sharks

Seals

Porpoises

Gills

Scales

Legs

Eyes

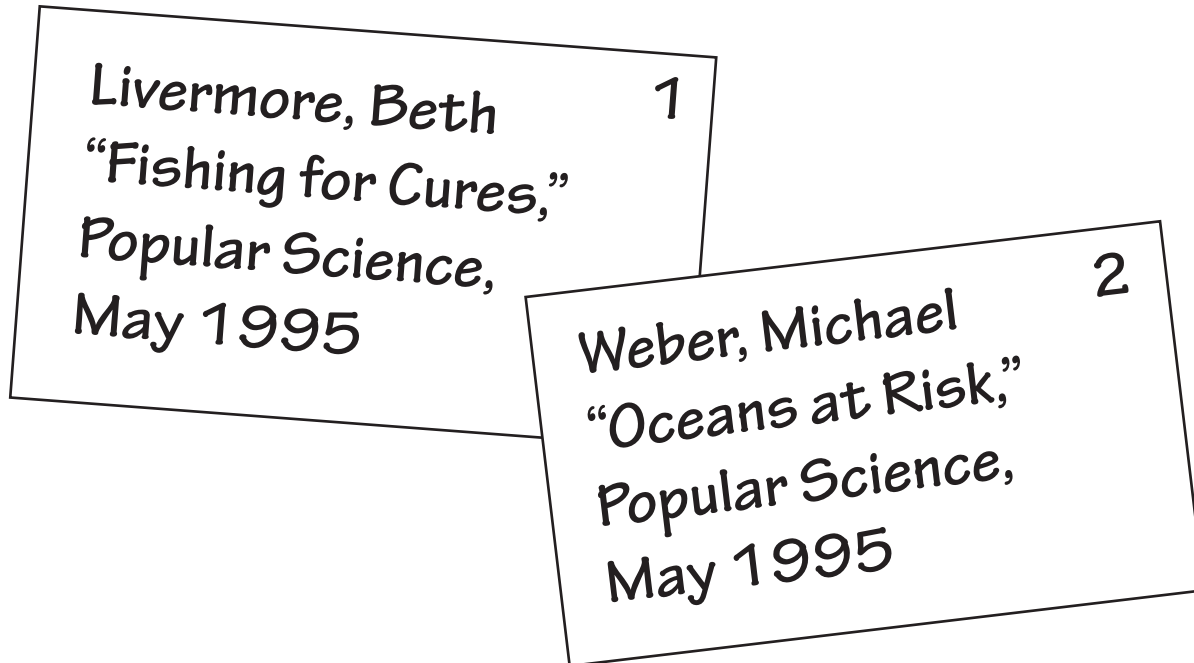
Now take the first letter of each word that you circled. Use these letters to form another word in CLAM.

Hint: You will need to use only three of the letters.

RESEARCH CARD/BIBLIOGRAPHY PREPARATION

Bibliography preparation and use

1. Sort **Source Cards** alphabetically by author's last name, numbering them 1,2,3, and so on.



2. Then in your text, immediately following where you place the note, put the source number, followed by the page number where that note can be found. Note how this is done below. Also, note Source #2. Although it is not used in this portion of the essay, it will be used somewhere else.

Like humans, Atlantic squid have nervous systems. A squid's nerve cells are about a hundred times bigger than those of humans—making them easier to study. Squid also have a giant, pencil-lead-size axon, the "telephone wire" connecting nerve cells. Most of what is currently known about the human nervous system has come from studies of squid during the past several decades. (1:62)

Dogfish sharks have yielded squalamine, a potent antibiotic. Because squalamine works differently from today's antibiotics, it may also combat diseases that have become drug-resistant. (1:64)

Bibliography

1. Livermore, Beth, "Fishing for Cures," *Popular Science*, May 1995.
2. Weber, Michael, "Oceans at Risk," *Popular Science*, May 1995.

PROBLEM-SOLVING ESSAY MODEL

This essay follows the Problem-Solving Outline that you used earlier and has references to sources you have practiced using.

Using Marine Plants and Animals for Medicine Without Harming the Ocean

1. Set up the essay by introducing what it is about.

Scientists have found medicines for people in marine plants and animals (1:64), but how can we use these plants and animals without harming the ocean? I will define the problem, explain two solutions, and then show why one solution is better than the other.

2. Define the problem.

The problem is that if we take too many of one type of plant or animal, we will harm the ocean's food web. For example, if we harvest too much kelp to help with human immune system problems, many creatures, including the sea otter, will lose their habitat. We have to find a way to "farm" the plants and animals we need as we do corn and chickens (2:42).

3. Offer at least two solutions.

One way to solve this problem is to take just a few plants or animals and breed them in large pools of seawater. However, making the pools exactly the same as the ocean so that the plants or animals multiply is difficult.

Another solution is to take just enough of the plant or animal life to study how to make the chemical we want in a laboratory. I believe this second solution is better than the first.

4. State which solution is better and why.

The second solution is better for two reasons. First, we would have to take fewer plants and animals out of nature to get started. Second, once we are able to make the medicine in a laboratory, we can make all we want without worrying about how we are affecting nature.

5. Restate what you have said and relate your theme to today.

In conclusion, I have explained that the difficulty of using ocean plants and animals for human good without harming the ocean habitat. Next, I have evaluated two solutions to the problem. Finally, I have clearly shown why learning how to make the medicines in a laboratory is the best solution. My solution will allow us to have all the medicines we need from the ocean without harming it.

Bibliography

1. Livermore, Beth, "Fishing for Cures," *Popular Science*, May 1995
2. Weber, Michael, "Oceans at Risk," *Popular Science*, May 1995

PROBLEM-SOLVING ESSAY RUBRIC

(25 points for each team member—Teacher may score between given numbers if appropriate.)

Team Name: _____ Score: _____

- 25:** Worked well in group discussions; followed all directions closely; included creative and original ideas; no spelling errors; neat handwriting

- 20:** Worked well in group discussions; followed most directions closely; included creative or original ideas; few spelling errors; neat handwriting

- 15:** Usually worked well in group discussions; generally followed directions; ideas lack creativity; many spelling errors; legible handwriting

- 10:** Sometimes worked well in group discussions; did not follow all directions; ideas lack creativity; many spelling errors; illegible handwriting

- 5:** Did not work well in group discussions; did not follow directions; ideas lack creativity; many spelling errors; illegible handwriting

CLAM 3

Re: FATE EVENT 13: Just try to figure out who we are! Use the code box below to receive our message!

	A	B	C	D	E
1	A	B	C	D	E
2	F	G	H	I	J
3	K	L	M	N	O
4	P	R	S	T	U
5	V	W	X	Y	Z

Code Box

B2 E1 D4 E3 E4 D4! D4 C2 E1 E3 C1 E1 A1 D3 A2 B3 E3

E3 B4

D2 C4 E3 E4 B4 C4 A2 E3 B4 C3 D2 D3 D2 D3 B2!

One word in the message stands for one letter in “**CLAM.**”

VOCABULARY TEST 2

Your name: _____ Your score: _____

Your team's name: _____

While cruising in your submersible, your team discovers a drift net, discarded by fishermen, that has trapped several dolphins. Your team must score an average of eight or better on this test to free the dolphins in time to save their lives. If your team averages nine or better, your team will earn a bonus 100 points in addition to the points earned by correct answers. If you score less than an average of eight, the dolphins die and you lose 50 points off your current team total.

 **Directions:** Circle the letter of the definition that **best** fits the word or term.

1. **Scavenger**

- a. Of or relating to the land
- b. A captain
- c. A living thing that eats dead or dying animals

2. **Prey**

- a. A stream that sprays heated water
- b. An animal taken by a predator (animal hunter) for food
- c. Talking to a divine being

3. **Species**

- a. Populations or individuals with common traits
- b. An individual typical of the group
- c. The spaces between different fish eyes

4. **Sewage**

- a. Waste water and matter carried off by sewers
- b. Sewing for science
- c. Storage space on a submarine

5. **Ecosystem**

- a. A way to save money
- b. A group of bankers working together on a system of providing money
- c. A community of living things and their environment functioning as a unit in nature

6. **Toxin**

- a. A poison
- b. The brain
- c. A medicine

7. **Mineral**

- a. A vitamin
- b. A female miner
- c. Something neither animal nor vegetable

8. **Tentacle**

- a. A flexible arm
- b. A special tent
- c. A kind of eye

9. **Cetacean**

- a. A squid or octopus
- b. A whale, dolphin, or porpoise
- c. A fish with 100 eyes

10. **Migration**

- a. A movement along a special underwater grate
- b. The regular passage of a group of animals from one place to another for feeding or breeding purposes
- c. A severe headache

TEAM ORAL PRESENTATION RUBRIC

Directions: During the final event of NEW ATLANTIS, each mission team will make an oral (spoken) presentation to the **FISH Prize Committee**, trying to win a **FISH Neptune Award for Excellence in Science**. Your presentation must include the following five parts, with each part presented by a different team member. (If there are six members, then the sixth member will introduce and summarize the presentation; otherwise, the first speaker must introduce the presentation, and the last speaker must summarize.)

1. A description of your team's work station and how you solved the survival problems
2. Description(s) of your team's submersible(s) and how you solved the survival problems
3. Where you located your work station and why
4. What your mission was and the ways you decided to solve the problem
5. Descriptions of the scientific breakthroughs you won, including any illustrations you made of them

All of you must practice so that your team presents all five parts clearly and smoothly in just five to seven minutes. The committee will judge how well you reach the following standards:

ORAL PRESENTATION SCORING FORM

Team: _____

Committee members: _____ Please circle the number that best describes the following:

	poor	fair	average	good	excellent
1. Each team member had a speaking part.	1	2	3	4	5
2. The team briefly discussed all five parts.	1	2	3	4	5
3. The presentation made the team's mission and decisions clear.	2	4	6	8	10
4. We could hear your speakers from the back of the classroom.	1	2	3	4	5

Total Score:

--

Other comments:

CLAM 4

Re: FATE EVENT 16: Can you break the code? We know what it means, but you probably think it's nonsense! —**CLAM**.

1. Medicine that kills infection:



2. The best place to find the giant squid may be near here:



3. Stream that sprays water:



4. Something that pollutes:



Have you broken the code? We doubt it, but go ahead and just try to figure out another word in **CLAM**!



CLAM NEWS BULLETIN

CLAM Caught! Students Help the FBI!

The elusive members of the terrorist group **CLAM** have been caught—thanks to the hard work and persistence of the students in _____’s class in the _____ School.

The FBI believes that **CLAM** has been responsible for dozens of acts of sabotage against **FISH**, the Federation for Inner Space Habitats.

The students determined that **CLAM** stood for **C**oalition for **L**egalizing **A**ll **M**ining, making it possible for the FBI to locate **CLAM** headquarters, a dirty little apartment in Seattle. Found plotting their next act of sabotage against **FISH** were three unemployed strip miners from Idaho, who claimed in their own defense that **FISH** was infringing on their right to mine the Ocean floor.

The FBI found evidence of plans to sell everything valuable **CLAM** could dig up from under the Ocean floor. The **FISH** Commander in Chief commented, “They had no regard for the environmental damage they would cause. We’re relieved that they are at last behind bars. Thanks to the work of the **FISH** mission teams, future missions will be safer and even more productive. These fine students are today’s heroes and heroines.”

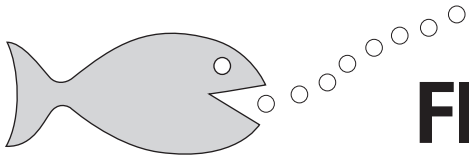
FBI Special Agent Edgar Holmes said that the evidence against 21-year-old Danny Pearl and his two 20-year-old cohorts Christine Mollusk and Bruce Bivalve, is overwhelming. “We found six digital alarm clocks, twelve sticks of dynamite, and two well-used copies of the book *Terrorism for Complete Fools*.”

The Elliott Bay Three’s attorney denied all the government accusations. Andrew Lundquist of Windstrom and Crusher said, “My clients didn’t do it, and there is no way you could ever prove it.”

Special Agent Holmes, who worked closely with the students, continued, “We couldn’t have done it without them. Their diligence made all the difference in capturing these dastardly criminals. On behalf of the FBI, I thank them for their hard work and courage.”

The **FISH** mission teams plan to celebrate soon in an awards ceremony.

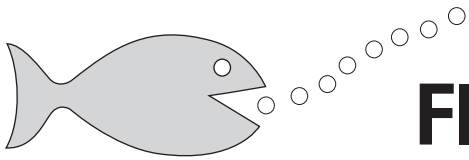
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FISH JUDGE I.D. BADGE

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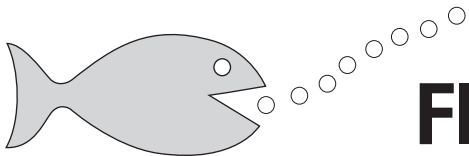
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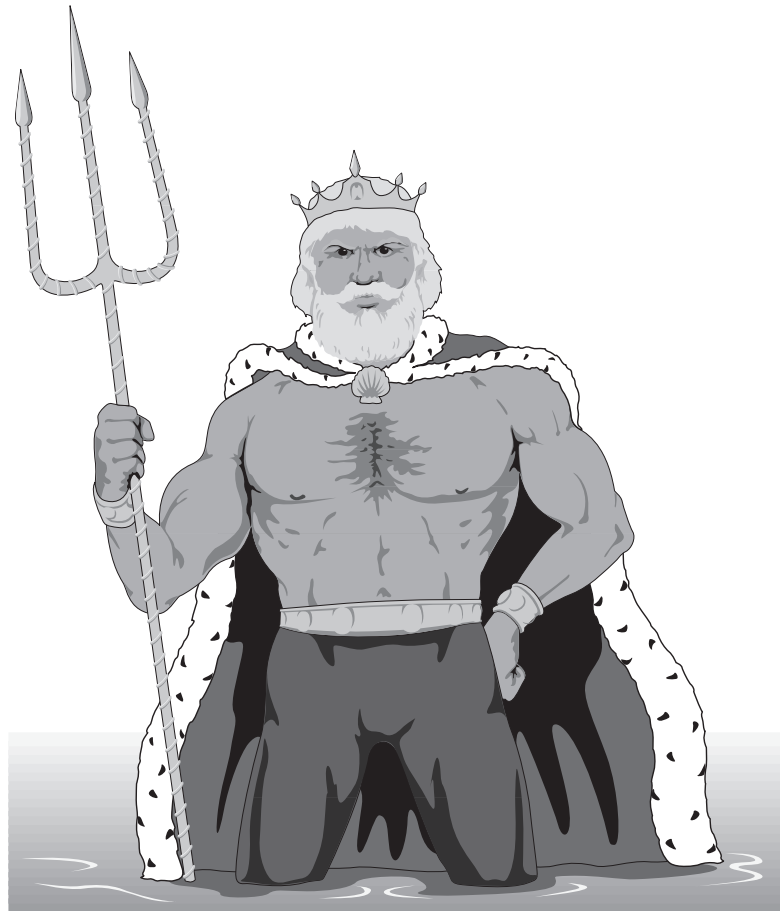


FISH JUDGE I.D. BADGE

Name:

Position:

THE FISH NEPTUNE AWARD



For Excellence in Science

Honoring

For Contributing To Your Team's
Successful Mission To The Ocean Floor

Date

THE FISH PEACE PRIZE



For Excellence in Human Understanding

Honoring

For Contributing To Peace On
Our Planet Earth And Its Oceans

Date

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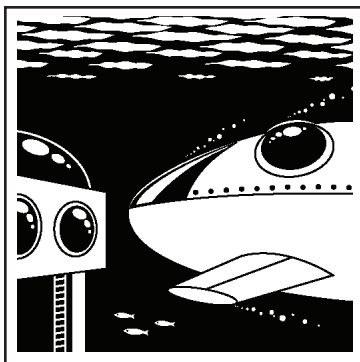
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NEW ATLANTIS

A simulation of scientific teams wisely using the Ocean Planet's inner-space habitats

Student Guide

INTRODUCTION

Greetings! The **F**ederation for **I**nnner **S**pace **H**abitats (called **FISH**) congratulates you for being chosen as a specialist on an international team seeking to explore, preserve, restore, and wisely use the Ocean Planet's inner space habitats. You will first report to FISH headquarters on New Atlantis, a newly discovered island in the Pacific region of the ocean. There you will experience a short briefing on your team's mission. Before embarking into the sea on this mission, however, you will work with other specialists in your field from other teams and with your own team members to solve one of several survival problems facing FISH as it seeks to colonize inner space for scientific purposes.

When the survival problems have been solved, your team will design its own work station and a submersible tailored to your mission's needs. A FISH transport submarine will then tow your work station to your work site, and there you will begin your mission in earnest. Later you will receive your detailed mission orders. They will outline what your team must do for the betterment of the ocean and humankind.

SECTION 1: ORGANIZATION

Mission Specialist Roles

Chief Administrator You will be responsible for ensuring that your team members work well together and complete mission assignments promptly. You will also work with administrators from other teams to develop a way to communicate with FISH Headquarters and with your team's submersible.

Chief Engineer You will be responsible for meeting all mechanical needs of your team's mission. You will also work with engineers from other teams to decide how best to provide fresh water for your team.

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Chief Marine Biologist: You will be responsible for ensuring that sea life is helped, not damaged, by your team's efforts. You will also work with marine biologists from other teams to determine how best to meet your team's food needs.

Chief Marine Geologist: You will be responsible for making sure that the land-forms undersea are not damaged by your team's efforts. You will also work with geologists from other teams to decide how best to deal with the problem of earthquakes.

Chief Medical Officer: You will be responsible for the medical and psychological welfare of your team. You will also work with medical officers from other teams to decide the best way to provide a steady supply of oxygen for your team.

Chief Oceanographer: You will be responsible for making sure your team's decisions do not interfere with another team's efforts. You will also work with oceanographers from other teams to determine how best to provide power for your undersea station.

■ Oath of Office

The FISH Commander will administer the oath of office that you must take to become commissioned officers of FISH. When the commander asks you to rise for this oath, please raise your right hand and repeat:



"I solemnly swear that I will explore, preserve, restore, and wisely use the Ocean Planet's inner space habitats as deemed appropriate by the Federation for Inner Space Habitats; that I will obey the orders of the FISH Commander in Chief; that I will faithfully discharge the duties of this office; and that I take this oath without any reservation."

Identity tags: Your teacher will give you a special FISH identity tag. Neatly fill in your name and role specialist assignment. Wear this official document with pride throughout this simulation!

Scoring: Throughout this simulation, you will work to complete assignments to earn points for your team. These points will be multiplied by a synergy factor of 10. Synergy is the increase in productivity created by the combined efforts of FISH teams. Your total points are called Sand Dollars, which your team should spend to buy chances to work on Scientific Breakthrough Challenge Projects. Should your team excel in its efforts, your team will win **The FISH Neptune Award for Excellence in Science.**

“ ... I solemnly swear ... ”

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... forces
beyond
FATE
EVENTS
your
control ...
”

Fate Events: Affecting your scoring, however, will be forces beyond your control—**Fate Events** which your teacher will read from time to time. These events simulate the reality that life is often unfair, a problem with which we must always cope. These Fate Events usually present problems that one of your team experts can solve if he/she can learn to work under pressure of a deadline.

CLAM: As if adverse Fate Events were not enough, you must also be aware of the evil forces of CLAM, an organization bent on destroying your important work. You must seek to squelch these saboteurs, making it safer for future officers of FISH to save the ocean. Your FISH commander will help you solve this problem by providing clues as to what you can do, but in order to survive, your group members must make wise decisions in response to this threat.

“
... must
make
wise
decisions
regarding
this threat ...
CLAM
”

SECTION 2: SURVIVAL PROBLEM DATA SHEETS

Each mission specialist has a different survival problem to solve for his or her team in order to make their workstation and/or submersible habitable. The officers of a particular profession from each team will meet to help one another solve the problems described on the data sheets below:

Chief Administrators' Survival Problem: Communication

While you are living in your undersea work station, you will need to be able to communicate with FISH Headquarters and any team member who leaves the station in a submersible. Consider the following ways of communicating. Then invent your own, using these and/or your own ideas.

- Whales, dolphins, and porpoises communicate by making sounds which can travel for miles through water.
- Military submarines use long wave radio signals to communicate with each other and with those on land.
- Light can be used to flash signals.
- A telephone line to a telegraph link floating on the surface or to an undersea telephone cable can be used.

Task: Each of these methods has good and bad aspects. You must write a problem-solving outline describing the solution, a combination of solutions, or a solution of your own that will work best for your team's undersea work station and submersible.

Chief Engineers' Survival Problem: Fresh Water

Did you know that you could die of thirst in the middle of the ocean? The human body cannot handle the salt in sea water. Because 97 percent of the world's water is saltwater, scientists have developed two main ways to **desalinate** water, to make it drinkable.

“
... whales,
dolphins,

and
porpoises
communicate
...
”

“
... fresh
water for
your team to
drink, cook
with, and
bathe in ...
”

Distillation desalters boil saltwater, then **condense** the steam back into water, leaving the salt behind. The process takes a large amount of energy to boil the water, making it very costly to operate. The fuel also burns precious oxygen.

Reverse osmosis desalters strain sea water through **membranes** that allow water through, but not salt. This process uses only half the energy of a distillation desalter, but the membranes fall apart easily and are not very reliable. Valves often become blocked and pumps often fail. One scientist has developed computer software to run his private island's power plant more dependably. Although scientists are experimenting with new materials, the membranes through which the sea water is pumped still often fall apart.

Task: You must write a problem-solving outline describing how you will turn saltwater into fresh water for your team to drink, cook with, and bathe in.

■ Chief Marine Biologists' Survival Problem: Food

Astronauts eat **dehydrated** food. Dehydrated food is a good choice for astronauts because it weighs less than fresh or canned food (which is very important in space travel), takes little storage space, and lasts for months. Unfortunately, it neither tastes very good nor looks very appetizing.

“
... What
should

?

aquanauts
eat ...
”

What should **aquanauts** eat? Teams living underwater have eaten frozen meals, stored in their work station's freezer. Unfortunately, frozen meals take more space than dehydrated meals, and you must supply electricity to run the freezer. You have space and energy for a freezer that can store only two weeks' worth of food, but your mission will last at least a year. *FISH will be able to deliver food every four weeks. Note well: You will not be permitted to use your submersible to go back to any land source for food, for doing so would waste valuable research time.*

The ocean itself is a good source of food for humans. Unfortunately, people have not been very careful to use this resource wisely and many popular species of marine animals have been **overharvested**. Keep in mind that people who do not eat fresh fruits and vegetables regularly must take vitamin **supplements** to stay healthy. In addition, people who do not get enough sunlight need to take vitamin D supplements.

Task: Write a problem-solving outline describing how your team will meet your food needs.

■ Chief Marine Geologists' Survival Problem: Earthquakes

Earthquakes happen underwater as well as on dry land. Shaking and quaking take place because the Earth's crust is made up of many pieces—like the pieces of a jigsaw puzzle. These pieces are called **tectonic plates**. An earthquake occurs when the pressure between two tectonic plates becomes so great that the plates shift suddenly, causing the earth to shake. Earthquakes cause millions of dollars of damage and, often, many deaths. Engineers and **architects**

“
... the
plates shift
suddenly,
causing the
earth to ...
”

have developed ways to construct buildings so that they can better withstand earthquakes. The following is a list of construction ideas you might consider while designing your undersea work station:

- Make walls of more than one section with two inches of air space between sections so that the sections can move in different directions to **absorb** the force of the earthquake better.
- Use **tempered** glass in all windows and glass doors.
- Bolt all large items of furniture to the floor.
- Set foundations on rollers or shock absorbers so that the building moves with the ground.
- Build structural skeletons to be flexible, particularly for taller buildings.
- Make smaller buildings of reinforced **masonry** or flexible wood frames.

Task: Use these ideas to stimulate your own creativity as you build an underwater structure that will withstand earthquakes. Then write a problem-solving outline describing your solution.

■ Chief Medical Officers' Survival Problem: Fresh Air

As you know, animals must breathe in **oxygen** (O_2) to survive. You may also know that animals breathe out **carbon dioxide** (CO_2). But did you know that plants do the opposite? They breathe in carbon dioxide and breathe out oxygen. This oxygen-carbon dioxide cycle is vital to all life as we know it.

Marine plants make oxygen, too. If you have ever looked closely at a live plant in an aquarium, you may have noticed bubbles on it. These oxygen bubbles are formed by **photosynthesis**.

Water itself is made of two things: **hydrogen** and oxygen. Fish and other creatures **absorb** oxygen that is dissolved in the water. Your team could choose to design a system that would take oxygen out of the water as fish do.

Because we do breathe out some oxygen that our bodies don't need, divers use **rebreather systems** to recycle the air they breathe. These systems clean out most of the carbon dioxide a diver breathes out, adding oxygen as needed. Your team could design a system for your station that would recycle air, but you would still need to find a way to add some oxygen.

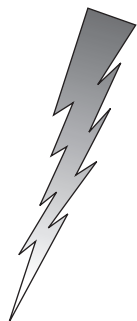
FISH will supply tanks of oxygen for any diving you do, but you must develop a way to supply your team's work station and submersible with a steady supply of safe air to breathe.

Task: Write a problem-solving outline clearly explaining how you will provide your team work station with plenty of safe air to breathe.





... come up
with your own
creative way
to supply



your under-
water station
with power...



... in most
parts of



the ocean ...



Chief Oceanographers' Survival Problem: Oceans of Energy

Scientists are experimenting with several ways to harness the ocean's energy. One kind of generator captures wave and current power. A polarized plastic panel tied between a float and an anchor generates electricity when moving water stretches it. Batteries store the power. This generator is relatively cheap to build, but waves and currents are not always strong enough.

Tropical waters collect considerable **solar** energy. To use the sun's energy, scientists have invented open cycle ocean **thermal** energy conversion, simply called OTEC. This system creates cool (72°F) steam when cold water, pumped up from 2,500 feet down, **condenses** the warmer surface water in a vacuum chamber. The steam turns a turbine which produces electricity. A **by-product** of this process is **desalinated** water.

However, OTEC wastes a considerable amount of the energy it makes while pumping up the cold water. It could also damage the environment by raising the water temperature by as much as 6 F. On the other hand, the **nutrient-rich** cold water pumped up from the deep could help marine life thrive.

Task: Use these two ideas to come up with your own creative way to supply your undersea station with power. Then you must write a problem-solving outline describing your solution.

Final directions for Section 2: Survival Problems Data Sheets

Specialists meetings Work with your fellow specialists to fill out your outlines. Then return to your team, discuss these ideas with your team, and make decisions about how to solve each problem. *(Remember, however, that your decisions must not interfere with any other team's mission.)*

Site selection Now your team must select a suitable site for your undersea work station, your team's base of operations while you conduct your mission. With the FISH Commander (your teacher), study the ocean map on pages 12–13 showing all the world's oceans. You will discover that our Earth has really just one large body of water. Consider these facts before selecting your site:

- Coral reefs are always in clear, warm, sunlit, tropical ocean areas, with the largest in the world being the Great Barrier Reef off the northeast coast of Australia.
- Hydrothermal (hot-water) vents are found where tectonic plates are moving apart, forming volcanic systems of mid-ocean ridges. For example, there are several along the East Pacific Rise.
- A squid expert claims that the largest concentrations of giant squid beaks in sperm whale stomachs are found near New Zealand.
- Whales and pollution can be found in all areas of the ocean.
- Sharks are found in most parts of the ocean, but they are concentrated in tropical waters.

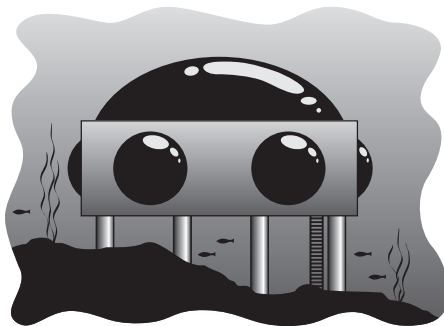
Two group tasks: After all survival problems have been solved, FISH headquarters has ordered your team to complete two tasks: First, you must design your own **undersea work station** based on your decisions. Second, you must design a **submersible** tailored to your team's mission needs. You will then be ready to begin working on your team's mission in earnest. Remember, however, at all times *you must be on the lookout for the evil forces of CLAM*. We of FISH wish you well. The Ocean Planet's future depends on you!

Task 1: FISH Headquarters Orders: Undersea Work Station

For Your Information

*The illustration on the right of the exterior of an imaginary undersea work station is not meant to be a model for you to follow. Its only purpose in being here is to stimulate your thinking. **Note well:** You should build your work station from "the inside out." Ensure that form follows function.*

Your team is to design your undersea work station based on the survival problem information you have been studying and discussing. Illustrate your work station either by drawing it on a large piece of paper or by building a model of it with common items such as plastic bottles and cardboard boxes. Your illustration or model must include each of the following parts:



- Clearly labeled solutions to the survival problems we have discussed.
- A poster that has each of the survival problem outlines neatly written by each of your team members so that everyone can read about your decisions.
- Evidence that all team members did their fair share of work will be provided by your team Chief Administrator, who will write a paragraph describing who did what to create your illustration or model.
- For extra credit, include solutions to any or all of the following additional survival problems: waste disposal, entertainment, strong currents, lack of sunlight at greater depths, corrosion, intense water pressure.

Remember All your solutions must be realistic yet creative, and they may not be harmful to the environment.

Scoring Your team's work station will be scored based on the following areas with each area being worth 25 points:

- Quality of work
- Evidence that each member did his or her fair share of work
- How accurately your team followed directions
- Creativity

Task 2: FISH Headquarters Orders: Submersibles

Your team's second task is to **design a submersible** that meets your mission's needs. It must have a manipulator arm with which you will perform tasks, and you must explain how you will deal with the survival problems you addressed while designing your undersea work station. Decide what other features will best serve your mission and label them in your design. State how many of these submersibles your team will need. Read the article on page 8 for more information.

Scientific Subs

Three basic types of **submersibles** have been developed: the **manned submersible vehicle (MSV)** controlled by humans riding inside, the **remotely operated vehicle (ROV)** controlled from the surface by a tether, and the **autonomous underwater vehicle (AUV)**, which uses powerful on-board computers to run predetermined missions (1:42).

MSV

The first type of submersible, the manned submersible, puts humans on the scene. As one researcher says, “Human eyes are connected to the best portable computer there is [the brain] A person can often fix [problems] faster than a robot” (2:60). A manned submersible, however, has many limits. It needs to refuel often, it must maintain systems such as an **oxygen** supply to support human life, and its pilots get tired. The best manned submersibles today can dive to about 6,000 meters (20,000 feet), and they can reach 97 percent of the ocean floor (1:40).

ROV

An ROV, the second type of submersible, has unlimited power and can handle continuous hard work without taking a break. Scientists can see and hear what the ROV films as a video without being distracted by human concerns. Bob Ballard, finder of the *Titanic*, points out, “(with an ROV) you’re not thinking ‘Is there enough oxygen in here?’” (2:60). Unfortunately, an ROV’s tether is difficult to **maneuver**.

AUV

The final submersible type, the AUV, is cheaper to build and run than manned submersibles and can work for long stretches under the most dangerous conditions. Free of the troublesome tether of the ROV, an AUV can comb the depths of the ocean for months at a time, patiently collecting data. These robots cannot yet send pictures as they are taken, but they can efficiently gather information and periodically surface to send their data to earthbound researchers. Both ROVs and AUVs can reach the deepest part of the ocean, called “Challenger Deep,” which is 10,915 meters (35,810 feet) down.

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SECTION 4: TEAM MISSION ORDERS

FISH headquarters has informed you that once you have both your workstation and your submersible(s) designed and built, you must begin working on your Team Mission.

Hold a team meeting to discuss your mission data and the task that follows this data. Then, *plan your mission activities carefully*. Remember: CLAM is watching every move you make. If necessary, be prepared to take action. **Good luck!**

“
... are home to
as much as
25%
of all marine
species ...
”

Team 1's Mission: Saving the Coral Reefs

Although coral reefs cover less than one percent of the ocean floor, scientists believe that these **ecosystems** are home to as many as 25 percent of all marine **species** (2:28). In addition, coral reefs protect coasts from **erosion**, provide 10 percent of the fish people eat, and produce chemicals useful for medical research (2:28).

Sediments from farming, logging, mining, and other human activities run off the land and damage coral reef health. Oil spills, shipping, overfishing, tourists, and the selling of coral all threaten the survival of coral reefs around the world (1:50-1:51).

Water that becomes too warm or too cold (either because of Mother Nature or pollution) can cause bleaching, turning the colorful coral white (1:51). Unless the water quickly returns to normal temperature, the entire reef dies. In addition, storms can cover coral with sand, smothering the coral polyps, the tiny animal that makes the coral (1:51).

Only reefs **isolated** from human activities are in fairly good shape. For damaged reefs, the good news is that scientists see signs of recovery within one year after harmful practices and conditions end. But larger corals need centuries to rebuild (2:32-2:33).

Team 1 Mission Orders: Your team's task is for each of you to write a problem-solving essay answering the following Problem Solving Focus Question: ***How can we save the coral reefs from destruction?***

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1. Fritz, Sandy, "The Living Reef," *Popular Science*, May 1995.
2. Weber, Peter K., "Saving the Coral Reefs," *The Futurist*, July-August 1993.

Team 2's Mission: Searching for the Giant Squid

The giant squid has eight sucker-lined arms, two long **tentacles** with clubs that shoot out and snatch **prey**, a powerful beak located in the center of its arms, eyes as big as hubcaps, and a body that can grow to be sixty feet long.

But no one has ever seen a giant squid alive, let alone in its natural **habitat**. Everything scientists know about the giant squid comes from studying dead **specimens** washed up on beaches or found in the stomachs of sperm whales.

Squid can help humans. The large nerve cells of squid enable scientists to study how nerve cells may work in humans—a big help when it comes to finding cures for diseases of the nervous system (2:133). The livers of smaller squid collect **pollutants**, helping scientists keep track of pollution levels (4:5).

“
... no one
has ever
seen a
giant squid
alive ...
”

Experts figure that if you follow the sperm whale, you'll find the giant squid—the sperm whale's favorite meal. While the giant squid is probably slow (2:136), it has excellent eyesight (3:29), is highly intelligent (3:29), and may even be able to sense a submersible coming its way (1:50).

Team 2 Mission Orders: Your team's task is for each of you to write a problem-solving essay to answer the following Problem-Solving Focus Question: ***How can we film a live giant squid in its natural habitat without harming it?***

Bibliography

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3. Fisher, Arthur, "He Seeks the Giant Squid," *Popular Science*, May 1996.
4. Umezu, Takeshi, "Squid Watch," *The Futurist*, March/April 1994.

“

... Where
did all



the pollution
come from ...

”

■ Team 3's Mission: Cleaning up Ocean Pollution

The **tissues** of Beluga whales in Canada are loaded with **toxins** (2:234). One plastic fishing net found in Alaskan waters was 20 miles wide and held 350 dead seabirds and hundreds of dead salmon (2:256). Plastic garbage threatens to choke marine mammals and smother corals worldwide. Where did all the pollution come from?

Three-quarters of the ocean's **pollutants** come from land (3:89), including oil, **pesticides**, **sewage** flowing untreated into the sea, and trash, especially plastics. Rain washes much of these pollutants into the ocean, and people dump more. Sailing vessels of all kinds dump billions of pounds of garbage into the ocean every year, and some of it never goes away. For example, many six-pack rings, which choke thousands of seabirds and sea mammals every year, are tough enough to last for 450 years (2:256)!

What can be done? Peter K. Weber states, "Preserve the areas of the ocean that are still in good shape, clean up the ones that aren't, and prevent further pollution from taking place" (4:33). Pollution cannot even be fenced out of **marine sanctuaries**. Scientists, however, have developed a **probe** that sits on the ocean floor, "watching" for pollution. When it senses pollution, it surfaces and sends signals to a satellite, making it easier to **monitor** pollution troublespots (1:24).

Team 3 Mission Orders: Your team's task is for each of you to write a problem-solving essay, answering the following Problem-Solving Focus Question: ***How can we clean up the ocean?***

Bibliography

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100
million
sharks killed
by people each
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... form more
than a mile
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ocean's
surface ...

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Team 4's Mission: Saving the Sharks

Most people think that all sharks are bloodthirsty killers. But only 10 to 15 people a year die of shark wounds worldwide, compared to 100 million sharks killed by people every year, usually for the fin only (2:17). Often the fin is cut off while the shark is still alive, and the shark is thrown back into the water to die a slow, painful death (2:18). Why? To make shark-fin soup in Asia.

Some shark populations are now endangered because of overfishing or **habitat** destruction. Fishermen kill the harmless basking shark because of the damage it can do to salmon nets (1:34). Because people are destroying the mangrove swamps in Florida to make way for expensive seafront buildings, the lemon shark is quickly losing nurseries for its pups (1:62).

Sharks generally “attack” only in self-defense, and most sharks are too small to harm humans. Sharks can be helpful as well. Without these **scavengers**, the ocean would be full of dead or dying fish.

Team 4 Mission Orders: Your team's task is for each of you to write a problem-solving essay, answering the Problem Solving Focus Question: **How can we save the sharks?**

Bibliography

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Team 5's Mission: Exploring Hydrothermal Vents

Hydrothermal vents form more than a mile below the ocean's surface where the seafloor is spreading apart, spraying heated seawater much like the **geysers** found in Yellowstone National Park (1:200).

When the water (up to 400 C) remixes with cold seawater, **mineral** particles pile up, forming black smokers, chimney-like structures several meters tall (1:201). They are so hot that, if bumped, they can melt the side of a submersible.

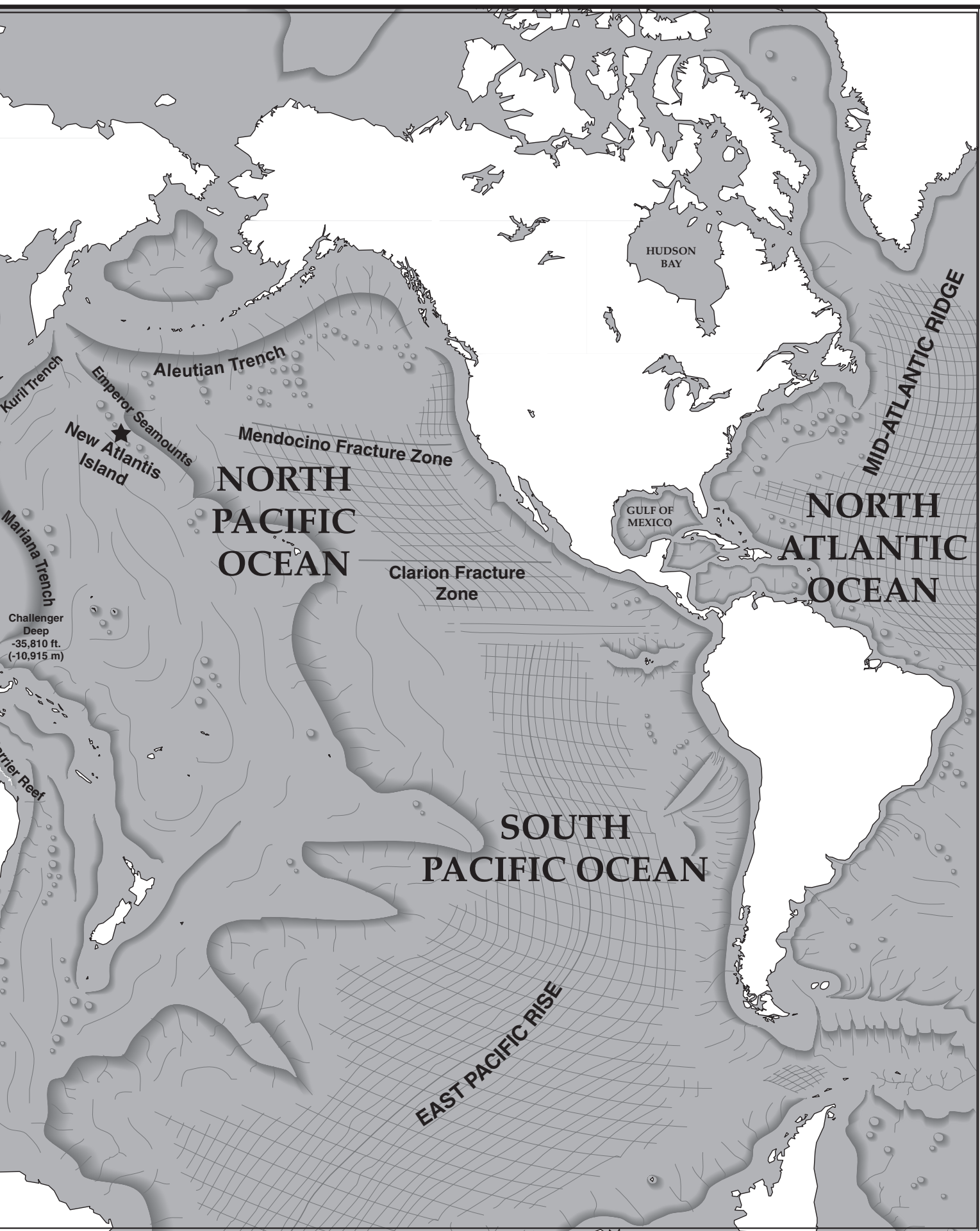
Only a few millimeters away from a black smoker, the seawater temperature is only 2 C to 40 C (3:55). Despite the lack of sunlight and the harsh **chemicals** brought up from the earth's subsurface, these cooler areas create an underwater oasis of sorts.

Scientists have discovered more than 300 new life forms around hydrothermal vents (2:56). These include types of mussels, shrimp, crabs, and clams which have adapted to living in the harsh conditions.

Hydrogen sulfide, which smells like rotten eggs, is abundant in vent water. The blood of the giant tube worm combines with the hydrogen sulfide forming a mixture that nourishes the bacteria that fill its tube. The bacteria then change the

(Team 5 and Team 6 Missions are concluded on page 14.) ►►►►►







hydrogen sulfide into food for the giant tube worm, keeping other chemicals as food for themselves (2:56). Scientists call this process **chemosynthesis**. Many other creatures of hydrothermal vents have a similar relationship with bacteria (2:56).

Team 5 Mission Orders: Your team’s mission is for each of you to write a problem-solving essay, answering the following Problem Solving Focus Question:
How can we make it safer to explore a hydrothermal vent?

Bibliography

1. Erickson, Jon, “Marine Geology: Undersea Landforms and Life Forms,” *Facts on File*, New York, 1996.
2. Stover, Dawn, “Creatures of the Thermal Vents,” *Popular Science*, May 1995.
3. Van Dover, Cindy, *The Octopus’s Garden*, Addison-Wesley, Reading, MA, 1996.

Team 6’s Mission: Saving the Whales

“
... Many
species
are in
danger of
extinction ...
”

Most whale populations are lower today than they were before man started whaling for profit in the nineteenth century and before the ocean became so polluted in the twentieth century. Many **species** are in danger of **extinction** (2:217). A worldwide ban on commercial whaling was agreed upon in 1986, but some countries openly ignore it or say that they are killing whales for “scientific research”—something the 1986 law allows (1:20). The 1986 law also allows the killing of smaller species of whale and of their **cetacean** cousins, the dolphins and porpoises. In fact, the ban on the killing of large whales has meant that smaller species have suffered greater losses (2:209).

Whale populations also suffer from accidental capture in fishing nets, competition with fisheries for food, destruction of their habitats, and other human activities disturbing them (1:217).

“
... One way
to help
whales is to
understand
them better ...
”

One way to help whales is to understand them better. Unfortunately, because many species live far out at sea and spend much of their time underwater, whales are especially difficult to study. Scientists, however, have developed techniques for collecting information about whales. For example, some whales are tagged to help keep track of them (1:19). Some tags even have transmitters that send signals to a satellite orbiting the earth to help scientists collect data about whale **migration**.

Team 6 Mission Orders: Your team’s mission is for each of you to write a problem-solving essay, answering the following Problem-Solving Focus Question:
How can we save the whales from extinction?

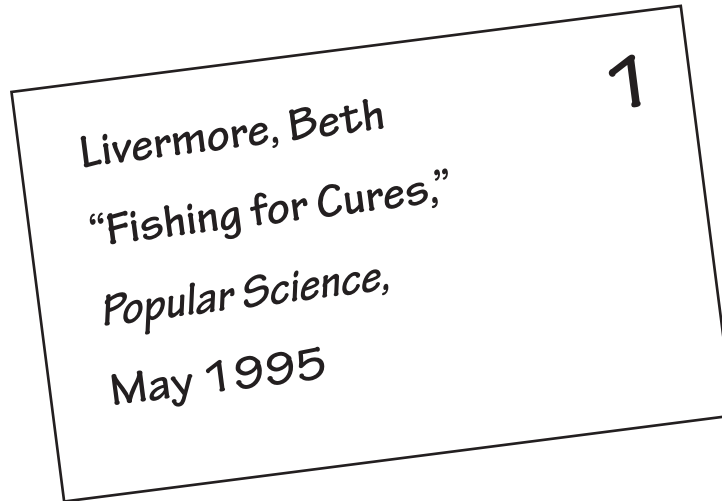
Bibliography

1. Carwardine, Mark, *Whales, Dolphins, and Porpoises*, Dorling Kindersley, New York, 1995.
2. Connor, Richard, *The Lives of Whales and Dolphins*, Henry Holt, New York, 1994.

SECTION 5: SOURCE CARD AND BIBLIOGRAPHY PREPERATION

Source Card Preparation

The author's last name is written first, the article's name is enclosed in quotation marks, and the publication's name appears in italics. (If the student had not been able to use italics, she/he would have underlined *Ms. Livermore's source* (e.g., Popular Science.)



List author, title of article or book, publisher's name, place of publication, date of publication. Use only one source on each card.

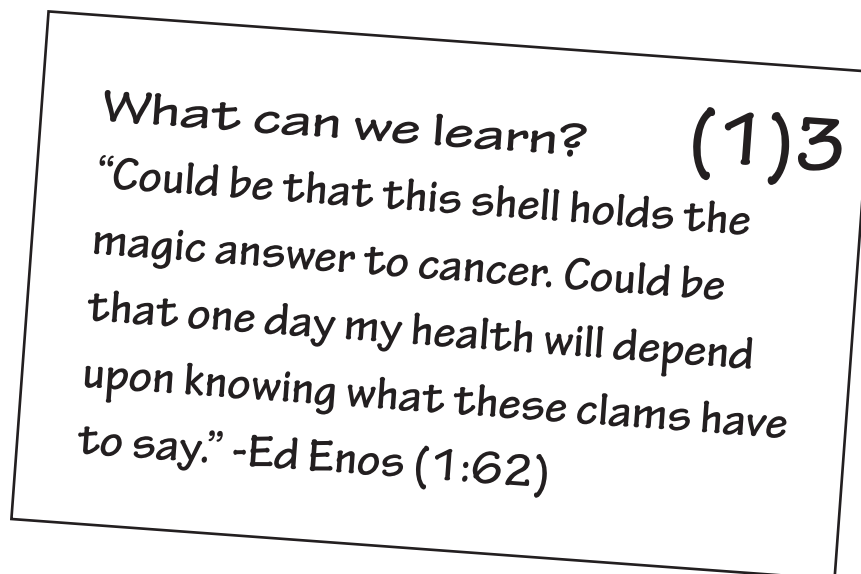
Here is an example of a Research card for Beth Livermore's *Popular Science* article.

Note Card Preparation

1. Under an appropriate heading, write notes from one source consisting of a fact, incident, example, or quotation. List source number and page number in parentheses.
2. If the notes are a direct quotation, surround them with quotation marks and place the speaker's name after the source number and page number, both of which are in parentheses.
3. Number your note cards. (Note this example is the third note taken from Source #1.

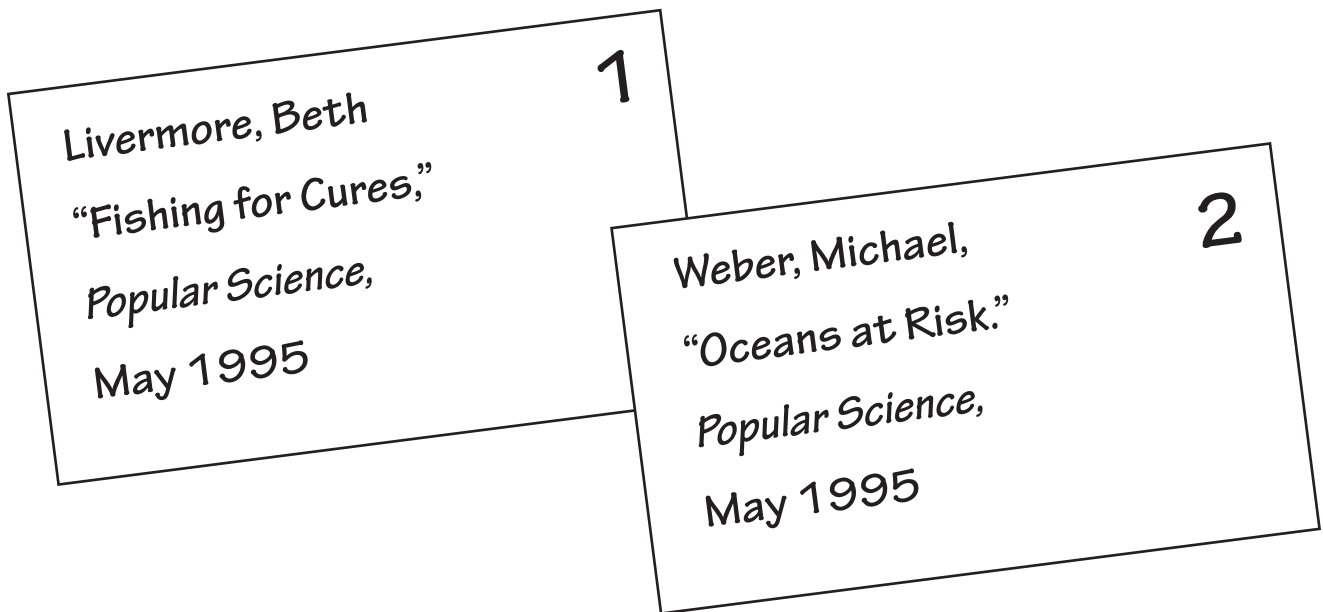
This note card example is from Beth Livermore's article.

The heading appears at the top; the notes in the middle are surrounded by quotation marks because the notes are a direct quotation, and the source at the bottom lists the speaker's name, then gives the source reference numbers in parentheses.



Bibliography preparation and use

1. Sort **Source Cards** alphabetically by author's last name, numbering them 1, 2, 3, and so on.



2. Then in your text, immediately following where you place the note, put the source number, followed by the page number where that note can be found. Note how this is done below. Also, note source #2. Although it is not used in this portion of the essay, it will be used somewhere else.

Like humans, Atlantic squid have nervous systems. A squid's nerve cells are about a hundred times bigger than those of humans—making them easier to study. Squid also have a giant, pencil-lead-size axon, the “telephone wire” connecting nerve cells. Most of what is currently known about the human nervous system has come from studies of squid during the past several decades. (1:62)

Dogfish sharks have yielded squalamine, a potent antibiotic. Because squalamine works differently from today's antibiotics, it may also combat diseases that have become drug-resistant. (1:64)

Bibliography

1. Livermore, Beth, “Fishing for Cures,” *Popular Science*, May 1995.
2. Weber, Michael, “Oceans at Risk,” *Popular Science*, May 1995.

*This essay follows the Problem-Solving Outline (page 24) that you used earlier.
Note that it also includes Source notes.*

Using Marine Plants and Animals for Medicine Without Harming the Ocean

1. Set up the essay by introducing what it is about.

Scientists have found medicines for people in marine plants and animals (1:64), but how can we use these plants and animals without harming the ocean? I will define the problem, explain two solutions, and then show why one solution is better than the other.

2. Define the problem.

The problem is that if we take too many of one type of plant or animal, we will harm the ocean's food web. For example, if we harvest too much kelp to help with human immune system problems, many creatures, including the sea otter, will lose their habitat. We have to find a way to "farm" the plants and animals we need as we do corn and chickens (2:42).

3. Offer at least two solutions.

One way to solve this problem is to take just a few plants or animals and breed them in large pools of seawater. However, making the pools exactly the same as the ocean so that the plants or animals multiply is difficult.

Another solution is to take just enough of the plant or animal life to study how to make the chemical we want in a laboratory. I believe this second solution is better than the first.

4. State which solution is better and why.

The second solution is better for two reasons. First, we would have to take fewer plants and animals out of nature to get started. Second, once we are able to make the medicine in a laboratory, we can make all we want without worrying about how we are affecting nature.

5. Restate what you have said and relate your theme to today.

In conclusion, I have explained that the difficulty of using ocean plants and animals for human good without harming the ocean habitat. Next, I have evaluated two solutions to the problem. Finally, I have clearly shown why learning how to make the medicines in a laboratory is the best solution. My solution will allow us to have all the medicines we need from the ocean without harming it.

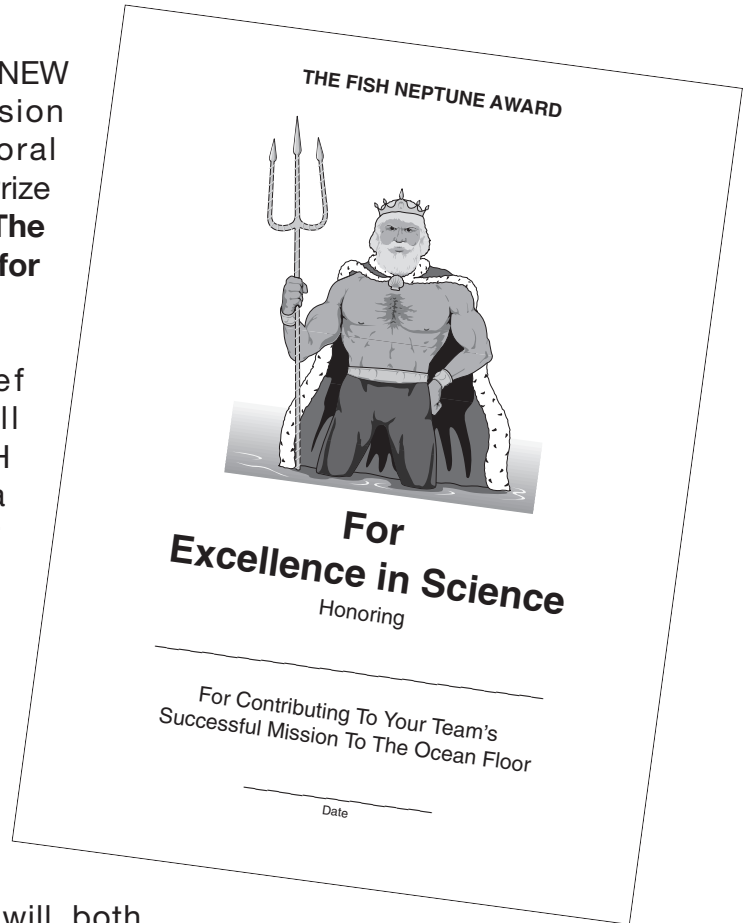
Bibliography

1. Livermore, Beth, "Fishing for Cures," *Popular Science*, May 1995.
2. Weber, Michael, "Oceans at Risk," *Popular Science*, May 1995.

Directions:

During the final event of NEW ATLANTIS, each mission team will make an oral presentation to the FISH Prize Committee, trying to win **The FISH Neptune Award for Excellence in Science**.

1. Your Team Chief Administrator will supply the FISH Commander with a written outline of your team's presentation that includes the five parts listed below. Each part will be presented by a different member of your team. (If there are six members on your team, then the sixth member will both introduce and summarize the team presentation; otherwise, the first speaker must introduce the presentation and the last speaker must summarize the presentation.)
 - I. A description of your team's work station and how you solved the survival problems
 - II. Description(s) of your team's submersible(s) and how you solved the survival problems
 - III. Where you located your work station and why
 - IV. What your mission was and the ways you decided to solve the problem
 - V. Descriptions of the scientific breakthroughs you achieved, including any illustrations you made of them
2. Practice so that your team can include all five parts clearly and smoothly in just five to seven minutes.
3. Also examine the TEAM ORAL PRESENTATION RUBRIC given each team by the FISH Commander.



“
... include
all

5

parts ...

”

- absorb** (v.)—to take in and make part of an existing whole, like a sponge soaking up water
- aquanaut** (n.)—a person who explores the ocean depths
- architect** (n.)—a person who designs buildings
- autonomous underwater vehicle** (AUV; n.)—an unmanned submersible that roams freely using powerful onboard computers to run preset missions
- by-product** (n.)—something produced in a process in addition to the main product
- carbon dioxide** (n.)—a compound breathed out by animals and absorbed by plants
- condense** (v.)—to undergo condensation (changing a gas to a liquid), like steam forming drops of water on the lid of a pot of boiling water
- dehydrate** (v.)—to remove water from, to dry out: a raisin is a dehydrated grape
- desalinate** (v.)—to take the salt out of
- dissolve** (v.)—to cause to pass into a solution, like cocoa in milk
- hydrogen** (n.)—the lightest and simplest element
- maneuver** (n.)—to guide skillfully
- manned submersible vehicle** (ROV; n.)—a manned submersible controlled by a human pilot ... needs oxygen and regular refueling
- marine** (adj.)—from or relating to the sea
- masonry** (n.)—building materials made of concrete or rock
- membrane** (n.)—a thin, soft, pliable (bendable) sheet
- nutrient-rich** (adj.)—full of nutrition
- overharvest** (v.)—to take too many plants or animals out of nature
- oxygen** (n.)—an element breathed in by animals and given off by plants, found in air and water
- photosynthesis** (n.)—the process by which plants use sunlight, water, and carbon dioxide to make their own food and give off oxygen

“

... a diver's
air supply



is recycled ...

”

rebreather system (*n.*)—a system through which a diver’s air supply is recycled; it removes carbon dioxide and adds oxygen as needed

remotely operated vehicle (ROV; *n.*)—an unmanned submersible controlled from the surface by a tether (cable)

solar (*adj.*)—from the sun

submersible (*n.*)—a small, mobile undersea vessel used for science

supplement (*n.*)—something that completes or makes an addition to, like a vitamin supplement to add to an incomplete diet

tectonic plate (*n.*)—one of the many pieces of the Earth’s crust

tempered (*adj.*)—glass that has been treated so that it is stronger than normal glass and will break into pellets instead of sharp pieces

thermal (*adj.*)—of, related to, or caused by heat

GLOSSARY: PART 2

antibiotic (*n.*)—a medicine the kills infection

cetacean (*n.*)—a whale, dolphin, or porpoise

chemical (*n.*)—something produced by chemistry

chemosynthesis (*n.*)—the chemical process by which living creatures make their own food without benefit of sunlight

ecosystem (*n.*)—a community of living things and their environment functioning as a unit in nature

erosion (*n.*)—the state of being worn away slowly, like waves wearing away a sand castle

extinction (*n.*)—the process of becoming extinct (no longer existing)

geyser (*n.*)—a stream that sprays heated water

habitat (*n.*)—the place or environment where an animal or plant lives and grows

isolate (*v.*)—to separate

marine sanctuary (*n.*)—an area in which sea life is protected from some, but not all, threats

migration (*n.*)—the regular passage of a group of animals from one place to another for feeding or breeding purposes

mineral (*n.*)—something that is neither animal nor vegetable

monitor (*v.*)—to watch or keep track of

pesticide (*n.*)—a substance used to kill pests

pollutant (*n.*)—something that pollutes

prey (*n.*)—an animal taken by a predator (animal hunter) for food

probe (*n.*)—a small object inserted into something to test conditions

scavenger (*n.*)—a living thing that eats dead or dying animals

sediment (*n.*)—the matter that settles to the bottom of a liquid, like the sugar you put on cereal that ends up on the bottom of the bowl

sewage (*n.*)—waste water and matter carried off by sewers

species (*n.*)—related populations or individuals with common traits

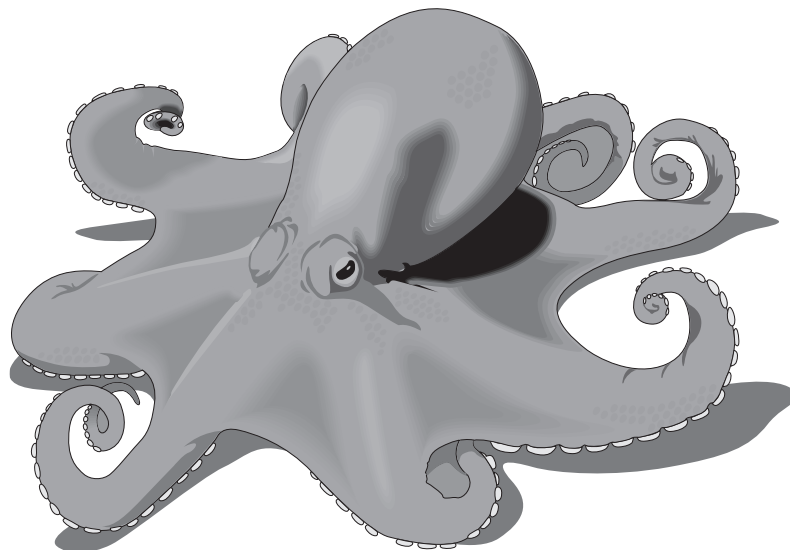
specimen (*n.*)—an individual considered typical of a group

tentacle (*n.*)—flexible arm, usually on animals without backbones, such as an octopus or a squid

tissues (*n.*)—structural material of a plant or animal

toxin (*n.*)—poison

“
... a flexible
arm, usually
on animals
without
backbones ...
”



Breakthrough Projects



Why should your team spend its Sand Dollars to win “breakthrough ideas”? **For this reason:** Final scoring adds the number of breakthroughs you have won to your team’s final presentation score. *(These breakthrough ideas are listed for each team below.)*

To be eligible to win these points, your team must do two things:

1. Invest 100 Sand Dollars for every member of your team; and
2. Assign a member to write a detailed paragraph about the idea your team has selected. Use your imagination to create a descriptive paragraph. Illustrate your idea if you wish.

If the member’s paragraph is approved by the FISH Commander, your team may add two synergy points to your team’s synergy factor. One synergy point will be added to all other teams’ synergy points totals. This mutual “reward” takes place because in the real world all scientists gain from one another’s successes.

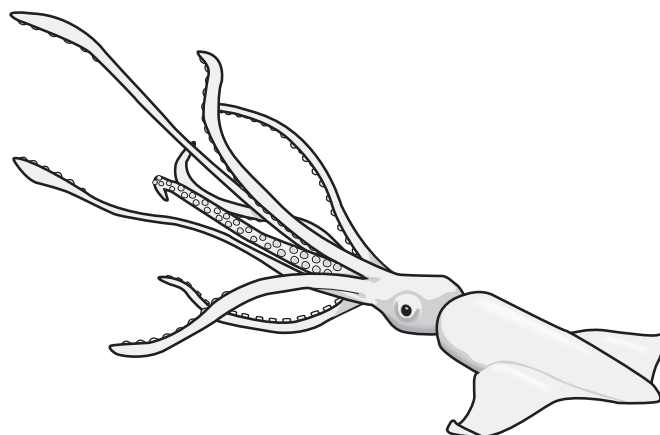
If your Commander decides a breakthrough has not taken place, your team loses the Sand Dollars spent trying for the breakthrough, but your team does not lose any synergy points. *(The Sand Dollar loss happens because in the real world high effort does not necessarily equal success. Sometimes you just have to keep working hard and hope for a lucky break.)*

■ Team 1 — Coral Reef “Breakthrough Ideas”:

- discovering how to breed coral faster in order to speed up reef restoration
- finding a new species of tiny fish
- discovering a new form of coral
- making better glues after studying how coral sticks to things
- finding a new species of eel
- *(The Commander must approve other related ideas.)*

■ Team 2 — Giant Squid “Breakthrough Ideas”:

- finding a cure for Alzheimer’s disease through studying squid nerve cells
- discovering the sperm whale’s breeding area
- finding a new species of squid
- building better robots after studying how squid coordinate their tentacles
- building a better submersible propulsion after studying how squid move
- *(The Commander must approve other related ideas.)*



Team 3—Ocean Pollution “Breakthrough Ideas”:

- a new species of bacteria that will aid human life while at the same time its removal will aid the ocean environment
- a chemical that soaks up spilled oil without harming sea life
- a pesticide that does not pollute water
- a process that will somehow turn trash into energy
- an understanding of how pollution affects the environment and then applying this understanding in a way that helps stop global warming
- *(The Commander must approve other related ideas.)*

Team 4—Sharks “Breakthrough Ideas”:

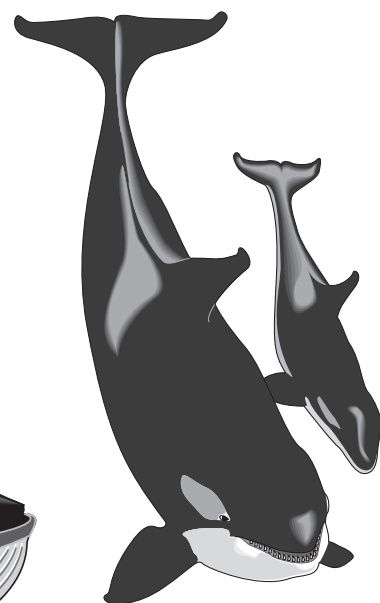
- a way to communicate with sharks
- a better diving suit so that divers can walk on the sea bottom deeper than ever before
- a discovery resulting from studying sharks that demonstrates how people can also grow replacement teeth
- a new method to detect poisons in air discovered from studying sharks’ sense of smell
- a cure for osteoporosis found while studying sharks’ cartilage
- *(The Commander must approve other related ideas.)*

Team 5—Hydrothermal Vents “Breakthrough Ideas”:

- a new fish never seen before
- a way to harness the thermal energy of vent water
- a new source of titanium
- a new way to predict volcanoes and earthquakes
- a cure for ulcers found while studying tube worms
- *(The Commander must approve other related ideas.)*

Team 6—Whales “Breakthrough Ideas”:

- finding the meaning in one pod’s song
- communicating with whales
- cleaning the pollution from whales’ bodies without hurting them
- finding a cure for autism by studying how whales communicate
- creating better artificial human lungs by studying how whales breathe
- *(The Commander must approve other related ideas.)*



PROBLEM-SOLVING OUTLINE

Directions:

Your task is to write a problem-solving outline, explaining how you will adapt the ideas listed in your category for use in the design of your team's underwater work station. *(Follow the outline below, but use your own paper.)*

I. Introduction:

I am going to solve the problem of _____ by defining it; by offering at least two solutions; by evaluating these solutions; and by selecting the better solution.

II. Define the problem. *(Give at least two specific details.)*

A. Detail 1: _____

B. Detail 2: _____

C. Other detail (if more): _____

III. Offer at least two possible solutions.

A. Solution 1: _____

B. Solution 2: _____

IV. Evaluate your solutions.

A. Solution 1: _____

1. Good points: _____

2. Bad points: _____

B. Solution 2: _____

1. Good points: _____

2. Bad points: _____

C. Why solution _____ is superior: *(Give at least two reasons why this is the best solution.)*

1. _____

2. _____

V. Summary *(Restate the problem, the better solution, and how it will help.)*

_____ In summary, I have defined the problem of _____, I have suggested solutions, and I have evaluated them. I believe this solution _____ is better for us today in our situation because _____