Underwater Naturalist

PADI

Specialty Course Instructor Guide

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PADI Underwater Naturalist Specialty Course Instructor Guide

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Introduction

This section includes suggestions on how to use this guide, an overview of course philosophy and goals, a flow chart to show you how course components and materials work together for success, and ways you can organize and integrate student diver learning.

How to Use this Guide

This guide speaks to *you*, the PADI Underwater Naturalist Specialty Instructor. The guide contains three sections – the first contains standards specific to this course, the second contains knowledge development presentations, the third considers optional confined water and/or surface training and details the open water dives. All required standards, learning objectives, activities, and performance requirements specific to the PADI Underwater Naturalist course appear in **boldface** print. **The boldface assists you in easily identifying those requirements that you *must* adhere to when you conduct the course**. Items not in boldface print are recommendations for your information and consideration. General course standards applicable to *all* PADI courses are located in the General Standards and Procedures section of your PADI *Instructor Manual*.

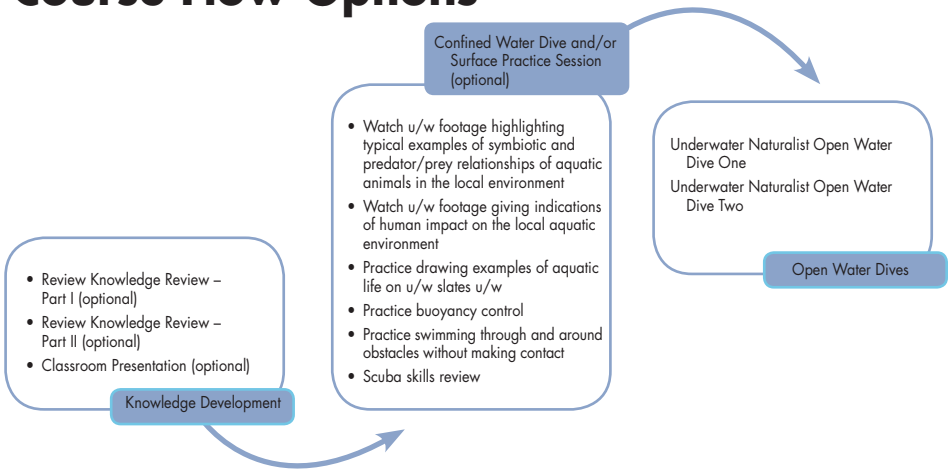
Course Philosophy and Goals

The PADI Underwater Naturalist course is designed to help student divers to interact with the living underwater world based on objective assessments and observations. Thus, the *goal* of this course is to teach student divers to view the aquatic ecosystems scientifically, without biases based on misconceptions and myths. Student divers learn basic organism groupings and identification, but the emphasis is placed on student diver understandings of the relationships between organisms, their environment and humans, as well as on the application of environmentally friendly dive techniques.

While the Underwater Naturalist course has a significant amount of knowledge development, as with other PADI programs, the course philosophy is to apply this

knowledge and practice related techniques actually diving. With this in mind, the philosophy of this course is to focus on *demonstrating responsible interactions with the living environment*. This course *philosophy* therefore, involves student divers in the planning, organization, procedures, techniques and problems of diving in different aquatic environments. Student divers apply the knowledge they gain by reading the PADI *Underwater Naturalist Manual* and by completing at least two open water dives practicing and demonstrating the practical aspects of being an underwater naturalist.

Course Flow Options



Course Flow Options provides a visual representation of how knowledge development and confined water and/or surface practice sessions support open water dives. When possible, it's preferable to have student divers complete and review Knowledge Reviews from the PADI *Underwater Naturalist Manual* before participating in the open water dives. Knowledge Review – Part I is the same Knowledge Review that appears in the Underwater Naturalist section of *Adventures in Diving*. If you have the first part of the Knowledge Review on file, you may at your discretion, have student divers complete only Knowledge Review – Part II.

Confined water and/or surface practice sessions are not required for the PADI Underwater Naturalist course; however, you may choose to hold practical sessions to allow student divers to practice skills such as buoyancy control to stay off the bottom, swimming through and around obstacles without making contact, and drawing on slates.

There are two dives to complete. **You may rearrange skill sequences within each dive; however, the sequence of dives must stay intact**. You may add more dives as necessary to meet student divers' needs. Organize your course to incorporate environment friendly techniques throughout each dive, to accommodate student diver learning style, logistical needs, and your sequencing preferences. You may choose from one of the approaches from Program Options, or develop your own.

Program Options

Step	Independent Study	Adventure Dive Integration	Instructor-Led
1	Independent study with manual (optional)	Independent study with manual (optional)	Knowledge Development Classroom Presentation (optional)
2	Review Knowledge Review - Part I and Part II (optional)	Give credit for the Underwater Naturalist Adventure Dive and collect Knowledge Review - Part I (optional)	Review Knowledge Review – Part I and Part II (optional)
3	Confined Water Dive and/ or Surface Practice Session (optional)	Confined Water Dive and/ or Surface Practice Session (optional)	Confined Water Dive and/ or Surface Practice Session (optional)
4	Open Water Dive One	Review Knowledge Review - Part II (optional)	Open Water Dive One
5	Open Water Dive Two	Open Water Dive Two	Open Water Dive Two

Section One
Course Standards

This section includes the course standards, recommendations, and suggestions for conducting the PADI Underwater Naturalist course.

Standards at a Glance

Topic	Course Standards	
Minimum Instructor Rating	**PADI Underwater Naturalist Specialty Instructor**	
Prerequisites **Minimum Age**	**PADI (Junior) Open Water Diver** **10 years**	
Ratios	**Open Water 8:1**	
Site, Depths, and Hours	Depth: 9-18 metres/20-60 feet recommended Hours Recommended: 12 **Minimum Open Water Dives: 2**	
Materials and Equipment	Instructor: • **PADI *Underwater Naturalist Instructor Guide*** • **Aquatic life identification slates and guides for the local area** • **Underwater slate with pencil**	Student Diver: • **Underwater slate with pencil**

Instructor Prerequisites

To qualify to teach the PADI Underwater Naturalist course, an individual must be a Teaching status PADI Open Water Scuba Instructor or higher. **PADI Instructors may apply for the Underwater Naturalist Instructor rating after completing a Specialty Instructor Training course with a PADI Course Director, or by providing proof of experience and applying directly to PADI**. For further detail, reference Membership Standards in the General Standards and Procedures section of your PADI *Instructor Manual.*

Student Diver Prerequisites

By the start of the course, a diver must be:

1. **Certified as a PADI (Junior) Open Water Diver or have a qualifying certification from another training organization**. In this case, a qualifying certification is defined as proof of entry-level scuba certification with a minimum of four open water training dives. Verify student diver prerequisite skills and provide remediation as necessary.
2. **At least 10 years**.

Supervision and Ratios

Open Water Dives

A Teaching status PADI Underwater Naturalist Specialty Instructor must be present and in control of all activities. If Dive One is conducted deeper than 18 metres/60 feet, the Specialty Instructor must directly supervise at a ratio of no greater than 8 student divers per instructor (8:1). Otherwise, the Specialty Instructor may *indirectly supervise* all dives. **The Specialty Instructor must ensure that all performance requirements are met**.

The ratio for open water dives is 8 student divers per instructor (8:1), with 4 additional student divers allowed per certified assistant (4:1).

Children

For dives that include 10-11 year olds, direct supervision is required at a maximum ratio of four student divers per instructor (4:1). No more than two of the four divers may be 10 or 11. You may not increase this ratio with the use of certified assistants.

Site, Depths, and Hours

Site

Choose sites with conditions and environments suitable for completing requirements. Ideally, select sites familiar to student divers. Shallower dives will provide student

divers with more experience. If possible, use different open water dive sites to allow student divers to explore a diversity of aquatic animals while incorporating environmentally friendly techniques throughout each dive. Different dive sites will also let student divers practice in dealing with logistical challenges. Practice skills in confined water sessions first to better prepare divers to apply skills in open water later.

Depths

18 metres/60 feet maximum for certified Open Water Divers

Children

12 metres/40 feet limit for 10-11 year olds
21 metres/70 feet limit for 12-14 year olds if they have taken the Deep Adventure Dive

Hours

The PADI Underwater Naturalist course includes two open water dives, which may be conducted in one day. Dives may be conducted at night for divers who have completed the Night Adventure Dive or the first dive of the PADI Night Diver specialty course, or have qualifying night diving experience. The minimum number of recommended hours is 12.

Materials and Equipment

Instructor Materials and Equipment

Use the PADI Underwater Naturalist course materials prescriptively to accommodate various sequencing preferences and teaching and learning styles.

Required

- **PADI *Underwater Naturalist Course Instructor Guide***
- **Specialty equipment needed for student divers to perform naturalist dives in the local environment**
  - **Underwater slate with pencil**
  - **Aquatic life identification slates and guides for the local area**

Recommended

- PADI *Underwater Naturalist Manual.* Use the student diver manual for detailed content explanations.
- *The Encyclopedia of Recreational Diving*
- *Adventures in Diving* Manual
- *A.W.A.R.E. Our World, Our Water*
- *Life on an Ocean Planet*
- *AWARE Ten Ways a Diver can Protect Underwater Environment*
- *AWARE Ten Tips for Underwater Photographers*
- As needed: underwater lights, underwater slates with pencils, aquatic life identification slates and guides, etc. for student diver use.

Student Diver Materials and Equipment

Required

- **Underwater slate with pencil**

Recommended

- PADI *Underwater Naturalist Manual*
- *The Encyclopedia of Recreational Diving*
- *Adventures in Diving* Manual
- *A.W.A.R.E. Our World, Our Water*
- *Life on an Ocean Planet*
- Access to support equipment as necessary, including but not limited to: aquatic life identification slates and guides and underwater lights.

Assessment Standards

To assess knowledge you may review the Knowledge Reviews from the student diver's manual with the diver. **The student diver must demonstrate accurate and adequate knowledge during the open water dives and must perform all skills (procedures and motor skills) fluidly, with little difficulty, in a manner that demonstrates minimal or no stress.**

Certification Requirements and Procedures

Document student diver training by completing the PADI *Specialty Training Record* for Underwater Naturalist (see Appendix). **To qualify for certification, by completion of the course, student divers must complete *all* performance requirements for Underwater Naturalist Open Water Dives One and Two.**

The instructor certifying the student diver must ensure that all certification requirements have been met. Encourage divers to choose a Project AWARE version certification card and to support conservation activities through the Project AWARE Foundation. Reference Administrative Procedures of the General Standards and Procedures section of your PADI *Instructor Manual* for detailed information on Referral.

Links to Other Courses

The Underwater Naturalist Adventure Dive conducted during the PADI Adventures in Diving program may count as the *first dive* toward this specialty at your discretion.

Similarly, divers who successfully complete Underwater Naturalist Open Water Dive One and Knowledge Review Part 1 may receive credit as an Adventure Dive toward the PADI Adventure Diver and the PADI Advanced Open Water Diver certifications. They may also credit the specialty certification toward the PADI Master Scuba Diver rating.

Section Two:
Knowledge Development
Conduct

The philosophy of this course is to focus on *demonstrating responsible interactions with the living environment*. This means to expand student diver knowledge of aquatic life and to emphasize passive observation as a responsible interaction with the environment. Student divers study independently by reading the PADI *Underwater Naturalist Manual* and apply this knowledge development on open water dives. Use the student diver manual to clarify and address prescriptively any student diver misconceptions and to enhance student learning tailored to the local dive environment and individual student interest. If there is a need for instructor-led presentations, use the following teaching outline, which appears in point form, as a road map of the conduct, content, sequence and structure for the PADI Underwater Naturalist course.

In the end, you should have equipped student divers with knowledge and experience needed to adapt what they've learned in this course to their future explorations as an underwater naturalist. **Regardless of how you conduct knowledge development (independent study, instructor-led or a combination of these instructional approaches), student divers will be able to explain the following learning objectives**.

Knowledge Development

Learning Objectives

By the end of knowledge development, student divers will be able to explain:

Introduction to the aquatic realm

- **What is *ecology*? What is an *ecosystem*?**
- **What is a *community*? What is a *habitat*?**
- **What are at least three physical and structural differences between terrestrial and aquatic ecosystems?**
- **What is *symbiosis*? What are examples of *mutualism*, *commensalism* and *parasitism* in the aquatic environment?**

The Linnaeus Classification System

- **What are three reasons scientists have for classifying organisms?**
- **What are the seven main *taxa* into which scientists classify organisms?**
- **What two taxa does an organism's scientific name represent?**
- **How do taxonomists determine into which taxon to classify an organism?**
- **What common problem do taxonomists have in classifying organisms and how do they solve it?**
- **What are the six-kingdom and three-domain systems of classification?**

Overview of Aquatic Life

- **What are the three types of aquatic *photosynthesizers*?**
- **What is the difference between an *invertebrate* and a *vertebrate*?**
- **What characterizes the aquatic animals in each major invertebrate and vertebrate phylum?**

Aquatic organisms: Myths and human misperceptions

- **What does the label *hazardous* mean when applied to an organism?**
- **What is the most common cause of aquatic animal "attacks"?**
- **What is the difference between an *offensive* and a *defensive* action by an organism?**
- **What is an accurate and objective view of hazardous aquatic animal "attacks"?**
- **What are four misperceptions people may have about aquatic organisms?**

Human interactions with aquatic life

- **How do you passively interact with aquatic organisms?**
- **Can you responsibly touch or handle aquatic life?**
- **Why should you not ride aquatic animals?**
- **Can you hunt and take aquatic life responsibly?**
- **Why should you avoid feeding aquatic animals and fish?**
- **What diving techniques should you use to preserve bottom dwelling organisms and to minimize disturbing aquatic life?**

Project AWARE Foundation

- **Why are divers and snorkelers the natural ambassadors for the aquatic environment?**
- **What is the Project AWARE Foundation?**
- **What is Project AWARE Foundation's mission and purpose?**
- **What steps is the Project AWARE Foundation taking to protect the aquatic world in partnership with PADI?**

Specialty activities and aquatic life

- **What should you do to minimize your effects on aquatic life while taking underwater photos or video?**
- **How do you use a diver propulsion vehicle (DPV) so that you interact responsibly with the underwater environment?**
- **How does your experience in night diving improve your ability to interact responsibly with aquatic life, as well as your awareness of it?**
- **How does your participation in aquatic life monitoring activities increase your knowledge and contribute to conservation?**

Knowledge Development Teaching Outline

Suggestions to *you*, the PADI Underwater Naturalist Specialty Course Instructor, *appear in note boxes*.

A. Course Introduction

1. Staff and student diver introductions

Note:
Introduce yourself and assistants. Explain your background with the underwater world and your role as a naturalist in it if your student divers are not familiar with you.

Have divers introduce themselves and explain why they are interested in this course. Break the ice and encourage a relaxed atmosphere.

Give times, dates and locations as appropriate for classroom presentations, confined water and/or surface practice sessions, and open water dives.

Review with student divers knowledge and other skills useful to a PADI Underwater Naturalists. These may include, but are not limited to: PADI Night Diver, *PADI* Deep Diver, PADI Digital Underwater Photographer and/or Videographer, *PADI* Peak Performance Buoyancy Diver, *AWARE Fish Identification, and PADI* Dry Suit Diver *etc.*

2. Course goals -this course will help you:
   a. Develop your knowledge and familiarity with aquatic plants and animals.
   b. Dispel myths and misinformation about potentially hazardous organisms.
   c. Develop your ability to interact responsibly and safely with aquatic life as a knowledgeable observer.
   d. Develop a personal conservation ethic with respect to the underwater world.

3. Course overview
   a. Outline classroom presentations and confined water and/or surface practice sessions.
   b. Discuss open water dives. There will be two open water dives.

4. Certification
    a. Upon successfully completing the course, you will receive the PADI Underwater Naturalist Specialty certification.
    b. Certification means that you will be qualified to:
        1. Plan, organize, make, and log open water underwater naturalist dives in conditions generally comparable to or better than, those in which you are trained.
        2. Apply for the Master Scuba Diver rating if you are a PADI Advanced Open Water Diver and a PADI Rescue Diver (or qualifying certification from another training organization) with certification in four other PADI Specialty ratings, and you have 50-logged dives.

Note:
Use the PADI Student Record File. *Explain all course costs and materials, and what the costs do and do not include, including equipment use, dive site fees, etc. Explain what equipment student divers must have for the course, and what you will provide. Cover and review points about scheduling and attendance.*

5. Class requirements
    a. Complete paperwork.
    b. Course costs.
    c. Equipment needs.
    d. Schedule and attendance.

B. Introduction to the Aquatic Realm

- ***What is ecology? What is an ecosystem?***

1. Loosely, *ecology* is the study of living things and their interrelations with each other and their environment.
    a. The environment of an organism includes both physical properties, which consist of the non-living chemical and physical factors of the environment such as water, sunlight, atmospheric gases (oxygen, carbon dioxide, and nitrogen), temperature, soil and climate and structural properties, which consist of other organisms that share its habitat.
        1. The non-living chemical and physical factors in the environment are referred to as *abiotic* components (physical characteristics).
        2. Factors in the environment produced by, or caused by living organisms are referred to as *biotic* components (structural characteristics).

2. An *ecosystem* (also called *biome*) is a natural system consisting of all plants and living things (animals and microorganisms) in an area functioning together with all the non-living physical factors of the environment. Each ecosystem is a region that has its own unique climate and life. Each ecosystem is filled with plants and animals that have adapted to that region.
    a. There are eight main ecosystems in the world - each one different from the other. Terrestrial (land) ecosystems include tundra, taiga, grassland, temperate forest, desert, tropical rain forest, and chaparral. Aquatic (water) ecosystems include the ocean (marine and freshwater). The ocean ecosystem is the largest biome.
    b. How you define an ecosystem can be broad or specific depending upon what you're studying.
    c. Ecosystems exist within ecosystems. The entire earth is an ecosystem. The ocean is an ecosystem within it, and a coral reef is an ecosystem within the ocean.

- ***What is a* community? *What is a* habitat?**

3. A *community* is a collection of different organisms living and interacting in an ecosystem. This includes all species and types of organisms.
    a. A *population* is a group of the same species living and interacting within a community. This interaction is part of the definition because sometimes two populations of the same species live in a single community.
    b. An example of this exists off Vancouver Island, Canada. In these waters, orca pods live relatively closely together, yet maintain separate populations that rarely interact. These pods don't even interbreed as far as scientists can tell. Therefore, separate pods would be considered separate populations within a community.

4. A *habitat* includes the area and conditions in which you find an organism. Some species are adapted to or occur in very specific habitats, whereas others range over a variety of habitats.
    a. Chitons, for example, live in the rocky intertidal zone, whereas octopuses live in a wide depth range and in many different parts of the reef. The chiton has a narrowly defined habitat compared to the octopus.
    b. A *microhabitat* exists on a very small scale. For example, tiny crustaceans and worms live in the spaces between sand grains on the sea floor.
    c. An organism's role in its habitat is called its *niche*. Very different species can occupy the same niche. On coral reefs, for example, cleaner-shrimp and cleaner-fish both survive by feeding on the parasites and dead or injured skin of reef fish. To avoid confusing habitat and niche, think of the habitat is an organism's address, and the niche as its job.

Note:
Once you have defined ecology, ecosystem, community and habitats help your student divers understand the differences between terrestrial (land) and aquatic (marine and freshwater) ecosystems by asking them the question "How do land and water environments differ?"

Note up-to-date information for your local area in the instructor outline below. Depending upon course requirements, you may also consider having student divers research local land and water environments for a home-study assignment.

Facilitate this discussion by listing your student divers' responses on a blackboard or overhead. This exercise will help your student divers to think about the aquatic environment (what they know, what they don't know, and what they'd like to know), by comparing it to the land environment that they are familiar with.

Regardless of your instructional approach, review with student divers the physical and structural differences between terrestrial and aquatic ecosystems.

- ***What are at least three physical and structural differences between terrestrial and aquatic ecosystems?***

5. Terrestrial (land) physical characteristics
    a. Air density (fluid) - air is about 800 times less dense than water.
    b. Air movement (fluid)
        1. Relatively few organisms distribute their spores/pollen and seeds via air/wind currents.
        2. Long distance travel by air is restricted to a very small number of species. This encourages relatively restricted, geographically isolated and distinct organism populations.
    c. Light penetration - excepting caves, sunlight reaches every terrestrial environment with sufficient energy to support some type of plant life. Areas without plant life are that way because something other than light is lacking.
    d. Light absorption - air does not significantly change the spectral qualities of light. Its primary role is to absorb ultraviolet light, which protects life.

e. Gravity

1. All terrestrial organisms deal with the effects of gravity.
2. Because of this, all terrestrial organisms must have rigid support structures such as fiber, wood, bone, cartilage, etc. The larger the organism, the more structure it needs.
3. Terrestrial organisms must overcome gravity in moving themselves. The larger the organism, the more energy this requires.

f. Biochemical makeup - terrestrial organisms tend to be higher in fat and carbohydrates than aquatic organisms, which reflects the higher energy demands of terrestrial existence. (Fat and carbohydrates are primary energy sources in living systems.)

g. Oxygen - oxygen is relatively evenly distributed (approximately 21 percent) throughout the atmosphere. Organisms that adapt to lower oxygen concentrations do so primarily due to the lower pressure at altitude, not due to a lower percentage of oxygen.

Note:
If time permits, take this opportunity to review with student divers Dalton's Law of Partial Pressures to explain why lower pressure at altitude has required organisms at that altitude to adapt to low oxygen concentrations. Dalton's Law of Partial Pressure states that the total pressure exerted by a gaseous mixture is equal to the sum of the partial pressures of each individual component in a gas mixture. For more information on this concept, refer to The Chemistry and Physics of Diving section in The Encyclopedia of Recreational Diving.

h. Notable local terrestrial (land) physical characteristics:

_____

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6. Terrestrial (land) structural characteristics

a. Role of dominant plants

1. Dominant plants are large, long-lived flowering plants.
2. Because of their large size and need for massive structure to remain erect (tree trunks), dominant plants are not easy to remove from the environment. This makes terrestrial ecosystem plants dominant and relatively stable.

3. Long-lived plant communities control relatively short-lived animal communities.
4. Because they are dominant, we refer to a terrestrial ecosystem by plant dominance: redwood forests, grass prairies, oak woodlands, etc.

b. Food chains, food webs, and/or food networks - networks describe the feeding relationships between species to another within an ecosystem. A map of what eats what.

1. A basic food chain, where each link is a source of food (energy) for the next link, begins with a *primary producer* or *autotrophs* (plants or other photosynthesizing organism) that harnesses energy from then sun and ends with an animal. Since most organisms are part of more than one food chain, the interconnected food chains form a food web.
2. Organisms in a food chain are grouped into *trophic* (nourishment) levels based on how many links they are removed from the primary producers. Terrestrial food chains tend to be short because it takes large animals to eat large plants. For example: grass eaten by an antelope, which in turn is eaten by a lion. This is a food chain with three links.

c. Notable local terrestrial (land) structural characteristics:

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7. Aquatic (water) physical characteristics

a. Water density (fluid) - medium-high. Water is about 800 times denser than air.

1. This allows many organisms of all sizes to exist suspended for extended periods.
2. Some species live their entire lives in the water column. This is particularly true of the *plankton* (from the Greek word meaning *wanderers*) community. There is no terrestrial equivalent to plankton.

b. Water movement (fluid) - Water movement plays a significant role in both feeding and reproduction.

1. Many species feed off plankton drifting in the water currents.
2. Water currents distribute *larvae* (young) over a wide area.

c. Light penetration

1. In the clearest water, light only penetrates to a maximum of about 180 metres/600 feet (the photic zone).

2. This restricts plant growth to the upper-lit areas of the world's aquatic system. Where the water is turbid, plant growth may be limited to the first metre/three feet or less.
3. Some deep-water communities, such as those surrounding hydrothermal vents, depend on chemosynthesis (chemical energy sources by bacteria) instead of photosynthesis (light energy) by plants and algae.

d. Light absorption
   1. Water absorbs light asymmetrically, taking up red, orange, yellow, green and blue in that order. This is why greens and blues penetrate the deepest.

Note:
For more information on light absorption, refer to The Chemistry and Physics of Diving section in The Encyclopedia of Recreational Diving. *The ocean is blue for the same reason the sky is blue. Wavelengths of blue light are scattered by water molecules. Particles in water such as sand and silt re-suspended from the bottom by tides can change the color of the ocean near the coasts. However, for most of the world's oceans, the amount of phytoplankton (autotrophic component of plankton) determines their color.*

   2. Different plants use different parts of the light spectrum for photosynthesis. In water, this may determine the vertical distribution of plants.

e. Gravity
   1. In water, buoyancy substantially offsets gravity.
   2. Organisms can become very large without rigid skeletons for support. Organisms with such skeletons have their structures primarily so they can move quickly.
   3. Vertical motion is relatively easy for aquatic organisms.
   4. Most aquatic organisms nonetheless rely on gravity for up and down orientation.

f. Biochemical makeup - Compared to terrestrial organisms, aquatic organisms are high in protein and low in fat and carbohydrates, reflecting a low energy existence. Exceptions include aquatic mammals and cold-water fish like salmon.

g. Oxygen - Oxygen is unevenly distributed in water, varying with depth and conditions. A wave swept shore may be high in oxygen, and a stagnant mud flat low in oxygen. Different species may have different gill adaptations for extracting oxygen depending upon their environment.

h. Notable local aquatic (water) physical characteristics:

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8. Aquatic (water) structural characteristics
   a. The role of aquatic plants and photosynthetic organisms
      1. Most aquatic plants and photosynthetic organisms are small (many are microscopic) and exist in huge numbers on a seasonal (sunlight) basis.
      2. The small size of these organisms makes them available for food to very small animals. Copepods are tiny shrimp-like animals, which are important links in the marine ecosystem food web because they convert plant energy to animal energy.
      3. Long-lived animal populations control short-lived plant/photosynthetic organisms by eating them rapidly.
      4. Animals are the dominant life in aquatic ecosystems and we refer to them accordingly: coral reefs, oyster banks, clam beds, mussel beds etc.
      5. A notable exception is the kelp forest.
   b. Food chains, food webs, and/or food networks
      1. In aquatic ecosystems, the food chains are longer and the food webs are more complex because small animals consume small plants and photosynthesizers.
      2. An example of an aquatic food chain might be phytoplankton (photosynthetic plankton) eaten by a copepod, which is then eaten by herring, then the herring is eaten by a squid, and finally the squid is eaten by a shark. This is a five-link food chain.
   c. Notable local aquatic (water) structural characteristics:

_____

_____

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- ***What is* symbiosis? *What are examples of* mutualism, commensalism *and* parasitism *in the aquatic environment?***

Note:
Inform student divers that the information covered in this section relates directly to the tasks they are to perform on their second open water dive. Note up-to-date information for your local area in the instructor outline below. Depending upon course requirements, you may also consider having student divers research local examples of mutualism, commensalism, and parasitism for a home-study assignment.

9. Relationships among aquatic animals

   a. Predator/prey relationships - one animal eats another for food. Examples: seals feeding on fish, parrotfish feeding on algae or freshwater crawdads feeding on bottom debris. This is the most common way energy moves through aquatic food webs (as opposed to large animals eating photosynthesizers, as is common in terrestrial ecosystems).

   b. Types of symbiosis - *Symbiosis* is the relationship of animals of different species living together in close association. The outcome for each organism is highly dependent upon the other. There are different forms of symbiosis depending upon how the association benefits, fails to benefit, or harms the organisms in the association.

      1. *Mutualism* - both species living together benefit from the association. Examples: the relationship between *Ocellaris* clownfish living in the stinging tentacles of *Ritteri* sea anemones. The territorial fish protects the anemone from anemone-eating fish, and in turn, the stinging tentacles of the anemone shelter the clownfish from its predators. The clownfish has developed a special mucus coating to protect itself from the stinging tentacles of its host. A local area example of mutualism is:

         _____

         _____

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         _____

      2. *Commensalism* - one species clearly benefits from the association while the other neither benefits nor is harmed. Example: pilot fish following sharks. Pilot fish feed on morsels of food falling from a feeding shark, while the shark neither benefits nor is harmed. A more indirect dependency (an organism uses something another organism created and discards) is the hermit crab that uses a gastropod shell to protect its body. Although only one species benefits and the other isn't harmed directly,

this isn't commensalism because the species don't live in association with each other. A local area example of commensalism is:

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3. *Parasitism* - the parasite (one species) benefits at the expense of the host (the other species). Most commonly, the parasite obtains food benefits, while the host experiences reduced food reserves, lowered resistance to disease and general loss of vigor. The host may die due to infection, starvation or predation but not directly due to the parasite. Examples: parasitic copepods that live on the skin of fish. A local area example of parasitism is:

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C. The Linnaeus Classification System

- ***What are the three reasons scientists have for classifying organisms?***

1. The Need for Classification
    a. There are at least three reasons why scientists classify organisms:
        1. Classification helps to identify the relationships between organisms. Through classification, it's easier to see how organisms are both similar and different. It creates a relationship theme that gives order to millions of life forms.
        2. Classification requires scientists to identify key characteristics of each organism clearly. This process avoids two of the same organism being mistaken for two different organisms because of minor individual differences. It also tells scientists which organisms are related but different.
        3. Classification helps avoid confusion. The common names of many organisms differ with culture, language, and location. The same common name may apply to two different organisms. For example, the common name "dolphin" can mean a marine mammal or it can be the food fish also called dolphin fish, mahi-mahi, or el dorado. The classification system avoids this issue by assigning every species a unique Latin name. When a scientist hears that name, there's no question as to the species.

- ***What are the seven main taxa into which scientists classify organisms?***

2. Classification Taxa

   a. The Linnaeus classification system (developed in 1758 by Carolus Linnaeus, a Swedish botanist) divides organisms into *taxa* (singular taxon), which are groupings of organisms with subdivisions. From the most specific taxon (species) to the most general (kingdom) there are seven subdivision levels used by taxonomists (scientists who study the relationships between organisms and who classify them). The seven taxa are:

      1. Species – the most specific of the taxa is *species*, the Latin name for an individual organism. A species is a group of organisms that can reproduce together to produce fertile offspring.

Note:

Refer student divers to the side bar "Does it have to be Latin?" This is an interesting history of why scientific names originate from the Latin language. This side bar is an important piece of information for student divers to understand as it helps to take the mystery out of the science behind the name.

Does it have to be Latin?

Newcomers to science sometimes wonder why scientific names are all derived from Latin. How did it start? Is it important?

Scientific names were originally Latin because in Linnaeus' time, scholars used Latin. It was the common language used by all scientists, much as English is today.

Latin has remained as the basis for scientific names for at least two apparent reasons. The first is tradition. The world has grown accustomed to it, so that when scientists see a binomial (two part) Latin name, they recognize it as the scientific name. A second reason is that since all organisms have only one scientific name, Latin provides a neutral language. Today, Latin is no one's native language so no one from any culture need feel slighted because scientific names are in somebody else's native language.

It's worth noting that while scientific names are in Latin form, *not all scientific names originate from the Latin language. Sometimes a species takes the name of the discoverer of that species or in honor of someone. For instance, you might call a new species of penguin discovered by Dr. Smith* Spheniscus smithus. *It's also common for the name of a classification to borrow from Greek. For example the phylum Arthropoda (it includes crustaceans and insects) gets its name from the Greek* arthro *meaning* jointed *and* podos *meaning* foot.

2. Genus (plural genera) – The taxon above species is *genus*. The species grouped in a genus are considered to be very closely related. For example, there are 34 species of reef shark all belonging to the genus *Carcharnus*.
3. Family – Genera that share characteristics are grouped in a *family*. For example, *Carcharhinus* and several other genera of large sharks make up the family *Carcharhinidae*. There are 51 species in this family.
4. Order – Related families are grouped together into *orders*. For example, family Carcharhinidae is in order Carcharhiniformes, along with family Sphynidae (hammerhead sharks), family Scyliorhinidae (catsharks), and others. About 260 species make up this order.
5. Class – Related orders make up a *class*. Class Chondrichthyes includes order Carcharhiniformes and several other orders of shark, ray, and their close relatives. This class includes more than 1,000 species.
6. Phylum/Division – Classes are grouped together by *phylum* or *division* (division is usually used by botanists to classify plants). Phyla (plural of phylum) can be thought of as grouping animals based on a general body plan. Thus despite seemingly different *external* appearances of organisms, they are classified into phyla based on their *internal* organization.
    a. For example, Chondrichthyes, along with the classes for mammals, birds, reptiles, amphibians, and bony fish, belong to phylum Chordata. Taxonomists define phylum Chordata as all the classes of animals that are chordates, meaning they possess a notochord and a dorsal nerve cord, either during development or for their entire lives.
    b. The seven animal phyla discussed in this course are the Porifera, Cnidaria, Annelida, Mollusca, Arthropoda, Echinodermata, and Chordata, the phylum to which humans belong. Although there are approximately 35 phyla, these seven phyla include the majority of the species you'll encounter underwater.
7. Kingdom - Phyla are grouped together into *kingdoms*. For example, Phylum Chordata along with 32 other phyla makes up kingdom Animalia.

Note:
Reference the following table for phylum, meaning, group, distinguishing characteristics, and number of species identified.

Phylum	Meaning	Group	Distinguishing Characteristics	Species Identified
Porifera	Pore bearer	Sponges	Perforated interior wall	more than 5,000
Cnidaria	Stinging nettle	Coelenterates	Nematocysts (stinging cells)	about 11,000
Annelida	Little ring	Segmented worms	Multiple circular segments	about 15,000
Mollusca	Thin shell	Mollusks/ Mollusca	Muscular foot and mantle round shell	about 112,000
Arthropoda	Jointed foot	Arthropods	Chitin exoskeleton	1,134,000+
Echinodermata	Spiny skin	Echinoderms	Five-fold radial symmetry, mesodermal calcified spines	about 7000 living species and 13,000 extinct ones
Chordata	Cord	Chordates	Hollow dorsal nervous chord	about 100,000+

- ***What two taxa does an organism's scientific name represent?***
    a. You identify each species by referring to *both* the genus and the species, with the genus capitalized and the species name in lower case. This is the species' scientific name.
    b. This scientific name is unique to one organism. For example, when a scientist in the United States talks to another in Australia about *Carcharhinus leucas*, they both know they're discussing a bull shark.

- ***How do taxonomists determine into which taxon to classify an organism?***
3. Determining Taxa
    a. There are two methods to classify organisms.
        1. Most taxonomists classify multicellular, complex organisms based on their anatomical features. This usually works well and it shows possible relationships between organisms.
        2. More recently, taxonomists find the study of genetics especially useful when classifying unicellular, one-cell organisms that differ very little anatomically.

- ***What common problem do taxonomists have in classifying organisms and how do they solve it?***

    b. A common problem taxonomists have is that some organisms don't fit neatly into defined classifications. Some organisms have some characteristic that define a classification and others, that separate them from it. Yet, they don't belong in the classification above or below.

        1. A good example of this is the relationship between sharks and rays. Both belong to the class Chondrichthyes. However, rays and sharks are clearly different enough to be in two distinct groups. Instances like this taxonomists assign super- or sublevels to create new higher or lower divisions, respectively, within a classification. For example, class Chondrichthyes consists of two subclasses; Holocephali and Elasmobranchii. Subclass Holocephali consists of one order of chimaeras. Subclass Elasmobranchii consists of superorder Selachimorpha (orders of sharks) and superorder Batdoidimorpha (orders of rays).

Note:
Explain to student divers that as early biologists learned more about the world around them, they broadened their classification of living organisms. For many years, all living things were classified as either plant or animal. As new information was discovered, taxonomists developed a visual representation of how organisms fit with one another. This visual representation is often called the tree of life *or* taxa tree. *Make clear to divers that although there are many versions of this representation, the illustration in their student manual is a complete yet simple view of how living organisms can be organized taxonomically. Point out to divers that the taxa tree drawn in their student manual highlights not only the kingdom but also the domain classification systems. The bottom of the tree begins with the most simple of all life forms. Complex organisms are organized at the top of the tree.*

- ***What are the six-kingdom and three-domain systems of classification?***

    4. Six-Kingdom and Three-Domain System

        a. The six-kingdom system divides all life into six broad classifications: kingdom Eubacteria, kingdom Archaebacteria, kingdom Protista, kingdom Fungi, kingdom Plantae, and kingdom Anamalia. In this course, we focus on kingdom Animalia. Some countries however, use a system of five classification domains: kingdom Animalia, kingdom Plantae, kingdom Fungi, kingdom Protista, and kingdom Prokaryota or Monera.

b. Many taxonomists use genetic and biochemical research to organize kingdoms into higher domains. In the three-domain system consists of domain Archea, domain Bacteria and domain Eukarya. Kingdom Animalea is in the domain Eukarya.

D. Overview of Aquatic Life

Note:
Inform your student divers that, in biology, taxonomy focuses on the classifying of organisms in an ordered system that indicates natural relationships. A lifetime can be spent on learning the taxonomy of all the species in just one fish family, so a comprehensive study of all aquatic animals is clearly beyond the scope of this course. To learn more about the classification of aquatic animals, refer student divers to a marine biology/marine science reference such as Life on an Ocean Planet *published by from Current Publishing Corp. To order a copy or to find more information about* Life on an Ocean Planet *visit www.currentpublishingcorp.com*

- ***What are the three types of aquatic photosynthesizers?***

1. Aquatic photosynthesizers. Phytoplankton, algae and aquatic plants are the primary producers that combine sunlight and carbon to create the base of the food web. Through these organisms, light from the sun powers virtually all life on earth (a small amount of energy comes from chemical processes by bacteria, such as those around thermal vents in the deep oceans discussed earlier).
    a. Phytoplankton
        1. A plantlike community of mostly single celled, microscopic organisms.
        2. Usually found drifting in the surface layers of most bodies of water.
        3. This is the most important source of energy for the aquatic realm. Without phytoplankton, the aquatic realm as we know it would be lifeless.
        4. A primary producer of atmospheric oxygen.
    b. Algae
        1. Commonly called "seaweed," there are many algae in both fresh and salt water.
        2. Algae have no true roots, stems, leaves or flowers.
        3. Many algae have holdfasts (root-like structures) that hold them to the reef.

4. Some, including many kelp species, are held erect by natural gas bladders from depths of 30 metres/100 feet or more.
5. Three major groups of larger, attached algae: red algae, brown algae and green algae.
6. Reproduction by spores and the production of eggs and sperm.
7. Grazed upon by animals as a food source.

c. Aquatic plants

1. Aquatic plants such as eelgrass, surf grass, turtle grass.
2. Sometimes called "seaweed," these are true flowering plants.
3. Typically found in shallow water growing out of sandy bottoms; some species live entirely underwater; others live partially submerged.
4. Grazed upon by animals as a food source, but are also important for other reasons. Mangrove swamps, for example, are vital for coral health because they act as nurseries where juvenile species can grow large enough before joining the reef community and they absorb wave energy that would otherwise erode the coastline.

- ***What is the difference between an invertebrate and a vertebrate?***

2. Aquatic animals. Animal groups are arranged in phyla (singular: phylum) - that is, they are presented in an order that reflects how the groups relate to each other in terms of the theory of evolution. As discussed earlier, a phylum is a major division or grouping of animals having certain similar characteristics. *Invertebrates* are animals without backbones and *vertebrates* do have backbones.

Note:
It is important to take your time to explain to student divers that you will be covering the simplest organisms first followed by organisms that are more complex. Remind student divers once again, that the review is by no means comprehensive; it does not include every group. It is important for divers to understand that you will examine each phylum by describing its body plan and form, its life history, and its feeding and defense tactics. Suggest to divers that they refer to Current Publishing Corp's Life on an Ocean Planet *for further detailed information on aquatic life and relationships between aquatic animals.*

- ***What characterizes the aquatic animals in each major invertebrate and vertebrate phylum?***

a. Phylum Porifera (pronounced *pore-if-er-a*, meaning "pore-bearing").

Sponges

1. *Body plan and form:* Body nonsymmetrical (no right or left sides - no identifiable symmetry), perforated by pores and canals; soft tissue supported by spicules (small needlelike structures or stringy threads). No identifiable organ system.
2. Life history: Reproduction by eggs and sperm and by budding (outgrowths of small pieces of sponge, which simply break off, drift in the water and perhaps settle on a suitable bottom to grow into a new sponge). Some sponges that release eggs and sperm into the water look like they're smoking.
3. Feeding and defense: Filter water feeding on microscopic plankton. As a primary defense, the spicules make them inedible to most other animals.

b. Phylum Cnidaria (pronounced *Nye-dar-ia* [the c is silent], refers to unique stinging cells called *cnidoblasts*).

Corals, anemone-type animals, jellyfish

1. *Body plan and form:* Radially symmetrical (means their bodies look like the spokes of a wheel), two main body plans; the polyp (like sea anemones) and the medusa (like jellyfish). One-opening digestive tract, mouth/anus ringed with tentacles bearing stinging cells. Anemones adopt the polyp form as adults. Corals are colonies of anemones with an added external calcified (hard) skeleton. Jellyfish adopt the medusa form as adults. Organ systems are very simple.
2. *Life history:* Reproduce by budding and fission (the animal divides in two). Sexually, males release sperm into the water that are taken in by females, fertilizing eggs that are then released into the water as microscopic larvae. These settle to the seafloor and attach (for those that take the polyp form as adults), or change into adult jellyfish (those that take the medusa form as adults).
3. *Feeding and defense:* All are carnivores (animal eaters). They capture prey with stinging tentacles. Smaller species feed on plankton; larger species, such as some jellyfish, feed on prey such as fish. Primary defense also involves stinging cells on the tentacles and body.

c. Phylum Annelida (pronounced *an-ella- da*. Annelida means *ringed* - these worms have rings around their bodies where their segments begin and end).

Segmented worms

1. *Body plan and form:* This phylum includes worms such as Christmas

tree and fire worms. All are bilaterally symmetrical (meaning their form is symmetrical to either side of a line, like humans). Aquatic worms have bodies that are divided into regularly repeating segments, and they usually have specialized head and feeding parts. Organ systems are present.

2. *Life history:* There are two main lifestyles found in this group - those that live attached to the seafloor usually building some kind of tube or burrow, and those that are free-living, crawling about. Reproduction can occur in several ways: 1) an adult can divide in half, 2) a small part of an adult worm's body can break off becoming a new individual, or 3) worms can release sperm and eggs into the water (usually by the thousands). Fertilization is external in the open water. The resulting microscopic larvae go through several stages before settling down to the seafloor as adults.
3. *Feeding and defense:* Practically all segmented worms are predators of one kind or another. The attached tube-dwelling forms feed mainly by filtering plankton prey from the water. Free-living forms actively search for small prey such as other worms, small shrimp and crabs, and even small snails. Some graze on sponges and corals. Tube-dwelling forms retreat into their tubes and burrows for defense; free-living forms use spines, jaws and their ability to burrow quickly as defense mechanisms.

d. Phylum Mollusca (pronounced *mole-us-ka*. The word means *head-foot* - like snails, they literally have their *head on their foot*).

Snails, slugs, clams, octopus and squid

1. *Body plan and form:* There are five main body plans to this phylum. All are bilaterally symmetrical, have a large, fleshy foot as a prominent part of their bodies, and a hard shell in the form of a single, spiral form (snails), a series of overlapping plates (chitons), or a symmetrical pair of shells (clams). Organ systems are present and well developed. The five body plans are: 1) snails and slugs, which have a large foot and mostly spiral shells, 2) chitons, which have a large foot and eight over-lapping plates as a shell, 3) clams and oysters, which have a large digging foot and a paired shell, 4) octopus and squid, in which the foot has developed into eight or more sucker-lined arms and the shell is greatly reduced or absent and 5) tusk shells, which have elongated tubular tapered shells which are open at both ends. The conical foot at one end protrudes and can be used for burrowing only.
2. *Life history:* The life histories vary greatly for each of these five groups, but for the most part reproduction is sexual, involving the release of eggs and sperm into the water where external fertilization occurs, the laying of internally fertilized eggs through copulation, or the brooding (protec-

tion) of internally fertilized eggs by adults such as in octopus. Larvae resulting from any one of these methods become part of the plankton for a time before settling down to the seafloor to become adults.

3. *Feeding and defense:* Again, this varies greatly with each group. Most snails are grazers (feed on plants) or prey on sedentary (attached) animals such as sponges and corals. Nearly all clams and their kin are filter feeders of plankton, while octopus and squid are active predators of fish, crabs and clams. Defense mechanisms range from color changing ability in octopus to the graceful undulations of a swimming nudibranch (slug) escaping an attacking crab.

e. Phylum Arthropoda (pronounced *are-throw-poe-da*, meaning *jointed foot*).

Lobsters, hermit crabs, crabs, crawdads and shrimp

1. *Body plan and form:* The aquatic members of this large phylum (which also includes insects) are in the class Crustacea (*crust-a-see-a*). All are *bilaterally symmetrical* and are covered with a hard outer body covering resembling jointed armor (thus the name *jointed foot*). There are two main body forms: the shrimp type and the crab type (basically a shrimp with its tail tucked up underneath the main body). Organ systems are present with a simple circulatory system.
2. *Life history:* All crustaceans go through a series of stages developing from tiny microscopic larvae to an adult. Reproduction is sexual, usually involving copulation. Females may release thousands of fertilized eggs or they may carry them until they hatch. The larvae may go through as many as 12 intermediate stages before assuming the adult form. Growth occurs through a periodic (but regular) molting of the hard shell.
3. *Feeding and defense:* Most crustaceans are scavengers, feeding on almost anything. Some are more specialized and feed only on plants; others such as large crabs, capture prey such as snails, crushing their shells with massive claws. Their primary defense is the hard outer body covering, well-developed sense organs and keeping a low profile.

f. Phylum Echinodermata (pronounced *e-kine-a-derm-a-ta*, meaning *spiny-skinned*).

Sea stars, urchins, cucumbers, lilies, brittlestars

1. *Body plan and form:* This phylum is represented by four main classes (groups) - all live in the ocean. They all exhibit some form of *radial symmetry* as adults even though the larvae are all *bilaterally symmetrical*. All classes have *tube feet* - unique structures that help them move across the bottom. Most have some type of spines embedded in their flesh that provide structural support or, as in sea urchins, defense mechanisms.

2. *Life history:* Echinoderms reproduce primarily sexually. Males and females shed eggs and sperm into the water by the millions; fertilization occurs externally in the water. The microscopic larvae go through a series of changes before they settle to the seafloor.
3. *Feeding and defense:* Most are animal eaters. Sea stars feed on clams and other slow-moving or attached prey. Sea urchins are herbivores, grazing on marine plants. Sea cucumbers are either filter feeders or bottom scavengers. Most rely on their tough, spiny outer bodies for defense. The entire phylum exhibits great powers of regeneration (for example, if a piece of a sea star breaks off, it may become a completely new individual - in other words, it is doubtful you will kill one by breaking it in two).

g. Subphylum of phylum Chordata - Urochordata (pronounced *you-rocore-data*).

Sea squirts and salps

1. *Body plan and form:* Sea squirts are a group between the true invertebrates (animals without backbones) and the vertebrates (animals with backbones). As larvae (juveniles), they resemble tiny tadpoles, with the beginnings of a backbone in their tails. As they develop, the tail disappears and the larvae settle to the ocean floor, attach and take on the adult form – looking like a nonsymmetrical sponge-like sac with two projecting siphons. There are both individual and colonial forms (which look even more like sponges).
2. *Life history:* Reproduction is by budding or through release of sperm into the water, which is taken in by the females fertilizing eggs. Eggs develop into tiny tadpole larvae, which eventually make their way to the seafloor where they attach, absorb the tail and take on the adult form. Salps live their entire lives drifting in the water column, much like a jellyfish.
3. *Feeding and defense:* All sea squirts are filter feeders as adults. They defend themselves primarily by having a tough tunic (outer covering).

h. Phylum Chordata, subphylum Vertebrata (pronounced *ver-tay-bra-ta* and includes all vertebrates, terrestrial and aquatic), class Chondrichthys (pronounced *con-dry-ich-these* meaning *cartilage fish*).

Skates, rays and sharks

1. *Body plan and form:* This group of fish is characterized by having an internal skeleton made of cartilage, not bone. They also have unique scales, gill structures and teeth. Two main body forms exist: skates and rays, which are flattened *dorsoventrally* (flattened on the top and bottom); and sharks, which have retained a streamlined, tubular body shape.

2. *Life history:* Rays and sharks reproduce sexually. Copulation takes place and either an egg case is released containing several fertilized eggs (as in most skates and rays), or several dozen live young are born (as in most sharks).
3. *Feeding and defense:* All skates, rays, and sharks are carnivores preying on everything from clams (rays) to other fish and even mammals (primarily seals and sea lions). Prey is located through extremely keen senses of smell, mechanical senses (including electrical stimuli) and vision. Prey is captured and consumed through attacks by repeated biting with the well-armed mouth and jaws. Defense strategies include escape by rapid swimming and hiding (as in rays).

i. Phylum Chordata, subphylum Vertebrata, class Osteichthyes (pronounced *os-tie-ich-these* meaning *bony fish*).

Bony reef fish

1. *Body plan and form:* Bony fish are characterized by having internal skeletons composed of true bone. All fish can be defined as aquatic, cold-blooded vertebrates that have gills throughout life and limbs in the shape of fins (this definition includes sharks and rays). All fish are *bilaterally symmetrical* and have complete organ systems. The outer body covering is composed of scales (there are several types). Fish exhibit tremendous diversity in body shape, size and color.
2. *Life history:* All fish reproduce sexually. Some fertilize their eggs internally through copulation; others are *broadcast* spawners, releasing eggs and sperm into the water leading to external fertilization. Larval fish may or may not hatch out with a yolk sac attached. Most go through several developmental stages before reaching adulthood. Some fish undergo long migrations from both fresh to salt and salt to fresh water. Many species occupy different places in the ecosystem as they grow.
3. *Feeding and defense:* Fish feed on a variety of things from plants to other fish. Head, jaw shape and dentition (the type, number and arrangement of a set of teeth) generally reflect the kinds of food a fish eats. Defense mechanisms are also varied from camouflage to flight.

j. Phylum Chordata, subphylum Vertebrata, class Reptilia (pronounced *rep-tile-i-a*).

Aquatic turtles

1. *Body plan and form:* Aquatic turtles vary from land turtles by having a streamlined shell and the inability to pull the head back into the shell; the forelimbs are modified as rigid flippers and hind limbs as paddles.
2. *Life history:* Aquatic turtles reproduce sexually. Internal fertilization occurs when males copulate with females. Marine female turtles leave the water, usually at night, to dig a nest on a beach, deposit several hun-

dred leathery eggs and return to the sea. Several weeks later, the eggs hatch and the young return to the sea. Adults make long migrations to return to the exact beach where they were born to lay their eggs.

3. *Feeding and defense:* Aquatic turtles feed on a variety of organisms and plants - jellyfish to hard corals - which they bite off with their hard beaks. They defend themselves with their hard shells and by escaping detection. The greatest predation of sea turtles occurs when the young leave the nest and race to the water, at which time they are small and exposed to predators such as birds, crabs and shore mammals.

k. Phylum Chordata, subphylum Vertebrata, class Reptilia.

Crocodiles, alligators and aquatic snakes

1. *Body plan and form:* Varies with type. Most aquatic reptiles are equipped with specially flattened tails for swimming.
2. *Life history:* Reproduction is sexual and fertilization is internal. Crocodiles and alligators lay eggs in nests of decaying vegetation. Sea snakes retain the eggs within their bodies until hatching - bear live young.
3. *Feeding and defense:* Crocodiles, alligators and sea snakes feed on fish. All bite defensively, and some species of freshwater sea snakes are venomous.

l. Phylum Chordata, subphylum Vertebrata, class Mammalia, order Sirenia (pronounced *sie-ree-nee-a*)

Manatees

1. *Body plan and form:* Manatees are mammals, which mean they are warm-blooded, breathe air, have hair, bear live young, and suckle their young (some mammals lack hair and some lay eggs). They are large (up to twelve feet long), have small eyes, no hind limbs (replaced by a single large paddle) and paddle-like flippers as forelimbs.
2. *Life history:* Manatees reproduce sexually, copulating to ensure internal fertilization. Usually a single calf is born.
3. *Feeding and defense:* Manatees are exclusively herbivorous (plant eating), feeding on aquatic plants such as water hyacinth. Their large size is their primary defense, as well as simply living in habitats where few large predators exist (mangrove swamps, shallow inland waterways).

m. Phylum Chordata, subphylum Vertebrata, class Mammalia, order Pinnipedia (pronounced *pin-nee-pay-dia*)

Seals, sea lions and walrus

1. *Body plan and form:* Pinnipeds all share a sleek, elongated and streamlined body that's clearly adapted to aquatic life, but also to life out of but near the water. Seals, sea lions and walrus differ in key anatomical details. Seals have no earflaps and their hind limbs point backwards, whereas sea lions have external ear flaps and their rear hind limbs can

rotate forward, which gives them more mobility out of water. Walrus have no earflaps, yet can rotate their hind limbs forward like sea lions.

2. *Life history:* Seals, sea lions and walrus reproduce sexually. Internal fertilization occurs through copulation. Most species are social animals that live in large herds dominated by one or a few larger, older males.
3. *Feeding and defense:* Pinnipeds are predators that eat primarily fish. Most species are fast and agile, so their primary defense is fleeing, which can include into the water to escape threats on land, or from the water to escape threats in the sea. Sea lions and seals are prey for great white sharks and orcas, and part of their defense strategy includes group living. Groups provide many individuals to detect a threat, and allow most animals to escape at the cost of a single member.

n. Phylum Chordata, subphylum Vertebrata, class Mammalia, order Cetacea (pronounced *see-tay-see-a*)

Dolphins, porpoises and whales

1. *Body plan and form:* Dolphins, whales and porpoises are air-breathing mammals. Their hind limbs have been replaced with a *fluke* (horizontally flattened tail); the forelimbs have become stiff flippers. They breathe through a blowhole located at the top of the head. They are essentially hairless and have a thick fat layer that insulates them from cold.
2. *Life history:* Dolphins, whales and porpoises reproduce sexually. Internal fertilization occurs through copulation. Usually a single calf is born after a long gestation period (11 months for most dolphins). There is a strong bond between the cow and the calf. Most dolphins, whales and porpoises form small to large (several hundred) social groups called pods.
3. *Feeding and defense:* Dolphins, porpoises and many whales feed primarily on squid and fish, which they catch with their mouths. Some collective hunting occurs, including orcas, which may collectively feed on larger whales. They defend themselves by schooling and their ability to travel at high speeds. They can also detect potential danger at a distance using their sophisticated sense organs, particularly using sound for echolocation.

E. Aquatic Organisms: Myths and Human Misperceptions

- ***What does the label* hazardous *mean when applied to an organism?***

1. Potentially hazardous aquatic animals.

Note:
Start a discussion with your student divers by asking what aquatic organisms they consider hazardous. The list will likely range from mobile organisms such as sharks, through relatively immobile organisms like sea urchins, to the sedentary fire coral. Note your divers' answers on a blackboard or overhead. After your discussion of this section return to this list and re-evaluate the list – ask student divers if they still consider the entries on the list as hazardous?

a. Potentially hazardous organisms are integral parts of their ecosystems and often play an important role in ecosystem health. For example, sharks are the top predators that keep populations of fish and mammals in check to help maintain the stability of various food webs.

b. The label *hazardous* simply means that the organism can cause injury to human beings. It is not a value judgment, nor does it indicate that an organism is "good" or "bad."

- ***What is the most common cause of aquatic animal "attacks"?***

c. Potential hazardous organisms (terrestrial or aquatic) behave according to instinct; there is no malice or intent in an "attack."

d. The most common cause of aquatic animal "attacks" is defensive behavior on the part of the animal.

- ***What is the difference between an offensive and a defensive action by an organism?***

1. An *offensive* action is one in which the organism initiates the action. This is typically linked to feeding behavior. Humans are not natural prey for any aquatic animal, so all offensive actions are caused by the victim resembling food in some way. For example, sharks accustomed to being hand fed may bite a diver's extended hand if they mistake the hand for food.

2. A *defensive* action is one in which the organism defends itself, a mate, its young or its territory.

a. Sedentary organisms like fire coral protect themselves by stinging. We don't think of this as an attack, but the sting is a defense mechanism.

b. Mobile organisms like a moray eel may protect themselves by biting. We may perceive this as an "attack," but it's a defensive action by an animal that feels threatened.

c. Either way, both injuries result from the same response: an organism trying to protect itself, a mate, young or territory.

- ***What is an accurate and objective view of hazardous aquatic animal "attacks"?***

e. Potentially hazardous aquatic animals cause injury either due to mistaking a diver for food or a threat. Therefore, an accurate (objective) view of their "attacks" is that they result from human behaviors that cause animals to perceive the human is food or a threat.

1. We fear underwater attacks by animals like sharks because we are in the wild and more vulnerable than out of the water.
2. Nonetheless, an organism "attacks" out of hunger or because it thinks it needs to defend itself, a mate, young or territory - whether a terrestrial or aquatic organism.

f. This means that you can reduce the risk of aquatic organism injuries by taking these steps:

1. Learn to recognize potentially hazardous aquatic life on sight; it's your responsibility to be aware of local creatures that may be hazardous
2. Understand the nature of the hazard and potential severity. For example, a sea urchin is a hazard only if you put your hand, foot or knee on it, and in most cases, while painful, it is not deadly or life threatening. On the other hand, snorkeling in a black wet suit in areas known for sea lions may make you appear to be prey to a great white shark. In this case, the hazard is much greater (the shark can out swim you) and far more deadly.
3. Modify your behavior to avoid and substantially reduce the risk so that you don't trigger a defensive or unintentional offensive (feeding) behavior. Examples: To avoid the sea urchin, watch where you put your hands, wear thick soled wet boots, etc. To avoid being bitten by a moray, don't reach into holes where they may live.
4. With respect to mobile, higher intelligence animals like sharks, eels, seals, etc., it's what the organism perceives, not what you intend, that determines their behavior. To avoid an attack by a great white don't dive near areas that are known feeding grounds and get out of the water if someone spots a great white.

- ***What are four misperceptions people may have about aquatic organisms?***

2. Misperceptions and myths about aquatic organisms. There are four inaccurate perceptions we can have about aquatic life:
    a. As dangerous and harmful. This relates directly to what you just learned about hazardous organisms.
        1. Uninformed or misinformed people may view sharks or other species as dangerous and bad. On the other hand, they may have a general misperception, such that there are "things" in the lake that will get you.
        2. These views may be exaggerated through the excitement of retelling the story. A two metre/six foot shark becomes a 5 metre/15 foot monster.
        3. Misunderstandings lead to misperceptions. For example, a shark landed by an angler flops around on the boat and happens to writhe toward the angler. This becomes "It came after me in the boat!" because the person doesn't realize the movement was happenstance.
        4. Portrayals in cinema and television play up and perpetuate misconceptions for entertainment purposes. The *Jaws* movies are a noted example.
        5. As you already learned, just because an organism can potentially injure people doesn't make it dangerous or harmful. Rather, people can cause a dangerous situation by intentionally or unintentionally disregarding behaviors and mechanisms that can lead to injury.
    b. As harmless animals similar to domestic/friendly animals.
        1. Some people misperceive animals as being unrealistically harmless instead of dangerous. All animals in the wild are unpredictable and should be treated as such.
        2. This is especially true of animals like hermit crabs, dolphins and whales that have two eyes and exhibit higher order complex behaviors to which you can relate, perhaps as you would to a dog or cat.
        3. Such perceptions at best lead you to misunderstand the animal in question. At worst, they can lead to injury if a diver fails to recognize potential defensive or feed behavior triggers. For example, if after seeing a trainer pet a sea lion at a zoo you were to attempt to pet a wild sea lion, you could be severely bitten.
        4. As a way to deal with the unknown, it is a normal mental mechanism to relate something unfamiliar to something familiar. With respect to aquatic organisms, we must be wary and interact with aquatic organisms based on education and observations rather than on comparisons with domesticated animals.

c. As non-living, inanimate objects.

   1. Animals that lack eyes and mobility may be perceived as inanimate. These include animals like coral, sea urchins, sea fans, sea stars and sea cucumbers.

   2. This may be due to ignorance, such as not realizing that coral is a living creature, not a pretty rock. Alternatively, it may be due to emotional detachment, such as playing with an inflated puffer fish as though it were a balloon instead of a living creature.

   3. Sometimes it's easy to perceive that such animals are less important or valuable than animals with eyes and complex behaviors. As an underwater naturalist, however, you must realize that these characteristics have nothing to do with an animal's value in an ecosystem. Corals are the basis for entire ecosystems in which, sea urchins play a critical role feeding on algae that would otherwise overrun and kill coral.

d. As having human characteristics.

   1. Some perceptions arise from attributing human characteristics to animals (particularly animals with two eyes that exhibit complex behaviors).

   2. These perceptions may be fostered by attempts to entertain, such as having dolphins wear sunglasses or chimpanzees wearing human clothes. Simpler examples include trained animals that nod "yes" when a trainer asks a question.

   3. Television and cinema have portrayed all manners with animals in human or near human qualities. Interestingly, extreme portrayals create less misperception: no one seriously expects a dog to talk just because they do in a movie. Portrayals more likely to create misperception are subtle, such as those that show dolphins, dogs or other animals as able to recognize when humans are in trouble and run for help.

   4. Portraying animals as imperfect humans impedes recognizing them for what they really are. It can lead to value judgments based on whether an organism has or lacks human characteristics instead of based on its role in the ecosystem.

F. Human Interactions with Aquatic Life

Note:
Inform your student divers that this section of the course introduces them to the various ways people (particularly snorkelers and scuba divers) can interact with aquatic life in the natural environment. Explain to divers that the goal of this discussion is for them to develop a conservation ethic with respect to how they view aquatic life and the aquatic environment. Make clear to divers that adopting such a view focuses on making the conservation of aquatic environments a top priority - protecting the aquatic environment for the present and future generations, and for the balance of the entire earth ecosystem. To illustrate your points, use Project AWARE short video clips, such as Protect the Living Reef or Protect the Sharks as well as brochures and other materials available on www.projectaware.org.

1. Student diver discussion: Human activities in and around water

Note:
Ask student divers to consider activities that take place in and around the water. Ask divers to call out activities, list them on the board or on an overhead. Note up-to-date information for your local area in the instructor outline below.

a. Typical responses may include:

1. Spearfishing
2. Searching for shipwrecks
3. Photography
4. Collecting tropical fish
5. Sightseeing
6. Recovering artifacts
7. Night diving
8. Deep diving
9. Fish-watching
10. Shell-collecting
11. Commercial diving
12. Boat repairs
13. Scientific research diving
14. Fish-feeding

_____
_____
_____
_____
_____
_____

2. Student diver discussion: Human interaction with aquatic organisms

Note:
Now ask student divers to identify how each activity affects aquatic organisms, listing their answers on the board or overhead. Through the discussion, divers should notice that all human activities affect aquatic organisms to some degree. Some activities have a significant effect, others have no significant long-term effect and yet others may or may not have significant effects depending upon how they're conducted. Note up-to-date information for your local area in the instructor outline below. This discussion leads into the next topic.

Activity	Significant Effect	No Long-Term Effect	Effect Dependent Upon Conduct
1. Spearfishing			
2. Searching for shipwrecks			
3. Photography			
4. Collecting tropical fish			
5. Sightseeing			
6. Recovering artifacts			
7. Night diving			
8. Deep diving			
9. Fish-watching			
10. Shell-collecting			
11. Commercial diving			
12. Boat repairs			
13. Scientific research diving			
14. Fish-feeding			

3. Types of diver interactions with aquatic life – three types of interactions that can be classified as either *passive* interaction, *active* interaction or "it depends."
    a. Passive interaction is limited to observation only – interactions in which you do not touch, chase or otherwise affect aquatic life beyond the effects you have just by being there (remember, many organisms will be wary of you as a potential predator just due to your size). It means primarily watching and looking.
        1. Passive interactions have the least effect on the environment and its inhabitants.
        2. Given the wide diversity of underwater life, passive observation is very rewarding because it increases your chances of observing natural behaviors.

b. Active interactions are those that directly affect aquatic organisms and affect their environment.

   1. An example of unintentional active interaction could be disturbing bottom sediments and the organisms that live in them while recovering an object from the bottom.

c. "It depends" interactions are those that may be passive, clearly active or in between depending upon how you conduct them.

   1. For example, you can shoot underwater photos or video in a manner that's relatively passive, or in ways that significantly disrupt natural behaviors.

- ***How do you passively interact with aquatic organisms?***

d. As an underwater naturalist, you have a unique opportunity to observe animals' behavior in their natural environment. You can passively interact (make observations) with aquatic organisms in four ways:

   1. Observations of one individual animal. Such observations may include watching it move, feed, build a home or nest, or some other behavior unique to that organism.
   2. Observations of a group of individuals of the same species. Such observations may include watching a school of fish feed, move, defend territories, courtship rituals and other behaviors unique to that species.
   3. Observations involving two or more individuals of different species interacting. Such observations may include cooperative feeding, symbiotic relationships between different species, territorial defense of an area, predator/prey interactions and other behaviors displayed when two or more species interact.
   4. Observations involving interactions between divers and aquatic life. These may include territorial displays by fish when a diver enters its area (as with damselfish), an animal's response to a diver disturbing the environment (i.e., the feeding response exhibited by most fish when a diver kicks up the bottom), or watching a barracuda check out a diver as a potential threat.

- ***Can you responsibly touch or handle aquatic life?***

e. Touching and handling aquatic life is not a passive interaction, though it may be done responsibly.

   1. Touching/handling aquatic life should only be done by people with the education/experience necessary to do so safely for both the diver and the organism.
   2. Touching/handling should not cause a significant disruption to the organism's normal behavior.

3. You (obviously) can't touch or handle all animals safely. Some can harm you, and you can harm most of them. Touching live coral can lead to blisters on your skin while even your slightest touch can tear the living coral tissue against its own sharp skeleton leaving it vulnerable to disease and damage. Even gentle handling of fish, which have a mucus coating that protect them from infection and parasites, can damage this protective barrier and make them vulnerable.
4. Touching/handling should only be done to provide a meaningful learning experience about the organism without compromising the organism's well being in any way.

- ***Why should you not ride aquatic animals?***

f. Riding aquatic animals

1. In the 1960s and 1970s, you could have seen divers riding aquatic animals (turtles in particular) in the media. As our understanding has grown, this is no longer considered an acceptable practice.
2. There are no circumstances in which riding an aquatic animal benefits the animal.
3. There are two reasons why you should not ride aquatic animals.
   a. There are many circumstances in which riding an aquatic animal harms it or may harm you. Riding an animal may terrify it and, in the cases of air breathing animals, riding can drown it.
   b. Some seemingly harmless and gentle animals may react defensively, raising the possibility that you will be injured.

- ***Can you hunt and take aquatic life responsibly?***

g. Underwater hunting and taking of aquatic life

1. There is no benefit to the aquatic environment from underwater hunting or other taking of aquatic organisms. Humans are not natural predators and are not necessary for the health of the ecosystem.
2. Aquatic resources today are under tremendous pressures and laws governing taking of aquatic life are designed to assure availability of aquatic resources now and in the future.
   a. Always follow all game laws, *and follow them conservatively,* when spearfishing or taking any aquatic life for human consumption.
   b. These laws regulate the seasons, sizes, genders, species and quantities of when and what you may take.
   c. These laws are often a compromise between those seeking to protect a species and those who want to take it, meaning that the limits may be more liberal than what is optimum.
   d. In many areas where diving is popular, taking game in any form is entirely prohibited.

3. Measure any potential game before removing it from the environment or otherwise disrupting its normal behavior.
4. Capturing animals for an aquarium, for a personal shell collection or other purpose is no different from underwater hunting in that you must be responsible and follow all laws. Only purchase such organisms from dealers who are appropriately licensed and who practice legal, responsible methods of collection or breeding.
5. Always remember that removing any organism from the environment affects the local ecosystem, even if the effects are not immediately obvious.
    a. If in doubt, do without. You will not starve if you don't take a fish. The environment will always be better off if you don't take an organism.
    b. When buying seafood, aquarium fish, shells or other product derived from aquatic organisms, only purchase from distributors who follow all laws and use responsible practices.

Note:

For up-to-date information on sustainable fisheries and seafood choices, refer student divers to the Project AWARE website www.projectaware.org. Review with student divers the following 10 things that they can do to ensure sustainable fisheries.

1. *Make informed decisions while selecting seafood. Support fisheries that are better for the environment and relieve pressure on those that aren't doing as well. Many organizations inform consumers about which seafood can be selected and which to avoid to reduce overfishing and damage to the underwater environment. Visit www.projectaware.org to download or request copies of current seafood guides.*
2. *When buying seafood, look for eco-labels. The Marine Stewardship Council (MSC) has developed an environmental standard for sustainable and well-managed fisheries. This designation rewards environmentally responsible fishery management practices. The label ensures consumers that the product has not contributed to overfishing. For an international directory of where to buy MSC labeled products visit http://eng.msc.org/.*
3. *Ask your local supermarkets and restaurants if they stock seafood with sustainable labels. If not, encourage them to add sustainable species to their product line. Your consumer power can influence local businesses.*

4. *Don't assume that farmed seafood is always an environmentally friendly alternative. Depending on the species, farms can introduce or increase waste, toxins, disease and chemicals into the natural environment. Carnivorous species like salmon and shrimp require an unsustainable amount of wild caught fish in order to reach marketable size. This means that the increase in farmed carnivorous fish still put pressure on fished species as they are caught to produce feed. For example, to produce one pound of farmed salmon, requires from 1-2 kilograms/2-5 pounds of ocean fish as food. By knowing your seafood source you can use sustainable seafood guides and eco-labels to guide your decisions.*
5. *Eat lower down on the food chain. Fish species that are higher on the food chain such as tuna, swordfish and shark, tend to be larger in size and fewer in number than those at lower levels. Occasionally eating seafood lower on the food chain can reduce pressure on higher species and make better use of protein sources. For example, it takes approximately 10,000 kilograms of sardines to produce one kilogram of farm-raised tuna. Consider eating sardines, anchovies - fish that live off algae or plants.*
6. *Stay tuned in to fisheries management issues and support initiatives that improve fisheries through responsible management, conservation, fishing practices and fishing gear. Turtle Excluder Devices (TEDs), for example, are a fishing gear modification that allows larger animals like sea turtles and sharks to pass through shrimp trawl nets.*
7. *Be sure your country has implemented the United Nations (UN) Code of Conduct for Responsible Fisheries and related International Plans of Action (IPOA). These voluntary measures aim to ensure the effective conservation and management of living aquatic resources. A major focus of these actions is to halt illegal, unreported and unregulated (IUU) fishing, which can cause problems for international fisheries management. If your country hasn't implemented the Code and a national action plan, encourage the government to do so. For more information, visit the UN Food and Agriculture Organization (FAO) website at http://www.fao.org/fi/agreem/codecond/codecon.asp.*
8. *Support the establishment of Marine Protected Areas (MPAs). Research indicates that properly designed MPAs preserve biodiversity while providing refuge and nursery grounds for fish species. These MPAs also have the potential to increase fish stocks, and therefore fishing, outside MPA boundaries.*

9. *Think twice before starting an aquarium hobby. Unless aquarium or ornamental fisheries are carefully and responsibly managed, collection of these species for captive display often damages coral reefs and marine species. Serious concerns include destructive capture methods, overexploitation and high mortality rates during transportation. Project AWARE Foundation supports publication of the Responsible Marine Aquarist book by the Marine Conservation Society. This book addresses concerns, raises awareness of conservation and management issues and summarizes ways that these fisheries are monitored and regulated. For more information visit www.mcsuk.org.*
10. *Educate your family, friends and coworkers. Give them the seafood guides and tell them why you support sustainable fisheries and how they can help make a difference. Consumers, through their voices and pocketbooks, have the power to make positive change - but only if they make the effort.*

- ***Why should you avoid feeding aquatic animals and fish?***

Note:
Inform your student divers that this section discusses why feeding aquatic animals and fish is generally considered an inappropriate activity for underwater naturalists. Explain to divers that the goal of this discussion is for them to understand the reasons why feeding aquatic life can be detrimental to both the animal and the ecosystem. Make clear to student divers that following the discussion, they should be able to speak to the concerns surrounding feeding in an effort to protect the aquatic environment for present and future generations, and for the balance of the entire earth ecosystem. Inform divers that in some countries fish feeding is strictly prohibited, while in other countries, shark feeding by experienced professionals has lead to species conservation. Refer student divers to www.projectaware.org for more details on Protect the Sharks. If possible, view the "Protect the Sharks "and "Attacking the Shark Myth" public service announcements.

h. Feeding aquatic animals and fish
    1. Feeding aquatic animals may seem like a positive interaction, but it is generally detrimental to the animals involved and the local ecosystem.
    2. In many protected areas, feeding fish or other aquatic animals is *strictly prohibited,* because doing so disrupts their normal behavior and feeding patterns.

a. The animals will come to associate humans with food. This can present a hazard, such as when sharks come to associate divers with food.

b. The animals may stop feeding on their natural food, which can cause a local over population of what they would otherwise feed on.

c. Animals fed by people may aggregate in large numbers in areas they would not normally visit. A large concentration of animals in one area can reduce local populations of their natural prey as well as negatively affect their competitors.

d. Animals that normally hide may come out for feeding and become vulnerable to predation. They may lose their natural fear of humans, an important survival mechanism.

e. Animals may get sick from eating foods they're not capable of digesting. For example, many fish do not digest carbohydrates.

f. Animals may die from eating plastic bags or other packaging used to carry food.

3. Feeding predators like sharks or rays provides opportunities to see creatures that you rarely see otherwise, but has risks associated with it. This practice should only be carried out by professionals trained and experienced in predator feeding who understand the complexities of the local ecosystem and foods that can be used safely.

- ***What diving techniques should you use to preserve bottom dwelling organisms and to minimize disturbing aquatic life?***

i. Proper diving techniques will reduce the effect you have on aquatic organisms, especially those that live on the bottom.

1. Secure all your gear to your BCD (never to a weight belt) so nothing dangles. Dangling gear damages the environment and the gear itself. Unsecured alternate second stages may fill with sand and may be hard to locate.

2. Stay neutrally buoyant and in the water column, well off the bottom, with your body horizontal and legs parallel to the bottom or angled slightly upward.

3. Avoid diving with too much weight. Your BCD may offset the weight, but the extra weight tends to shift your center of gravity so your feet are low.

4. When descending, reorient from feet first to horizontal well above the bottom.

5. Avoid kicking up sand or silt. Not only is this bad for visibility, sand and silt can damage coral and other organisms by settling on them.
6. Be cautious with what you touch with your fins, knees and hands. Stay high enough that you don't kick things. If you need to touch the bottom, do so carefully to avoid damaging or stirring it up. Sand and mud are still a home to countless creatures.
7. Swim slowly and calmly, as if you're a natural part of the environment. This reduces how much you disrupt behaviors and allows you to see more natural behaviors.
8. For up-to-date information on sustainable fisheries and seafood choices go to the Project AWARE website www.projectaware.org. Review the 10 things that can be done to ensure sustainable fisheries.

G. Project AWARE Foundation

- ***Why are divers and snorkelers the natural ambassadors for the aquatic environment?***

1. Noticing both short and long term changes in the aquatic realm, be it marine or freshwater, is unavoidable for people who regularly put on masks and venture underwater.
    a. Because of intimate familiarity with the underwater world, divers and snorkelers are the natural ambassadors for the aquatic environment. Today they are some of the strongest supporters of programs and initiatives such as:
        1. Volunteer monitoring.
            a. Participating in monitoring and assessing aquatic life increases your knowledge and understanding of the underwater environment because every time you dive you are bound to encounter new organisms and behaviors.
            b. Your observations can inform science and management decisions by providing vital information on the local, regional and international status of threatened or endangered species. For example, participating in Project AWARE's CoralWatch monitoring provides vital information on the bleaching trends of coral reefs worldwide.
        2. Underwater and beach cleanups.
        3 Marine parks and protected areas.
        4. Legislative actions to support sustainable fisheries and protect endangered habitats and species.
    b. To harness each diver's potential as an advocate and protector of the aquatic environment, PADI introduced Project AWARE (Aquatic World Awareness, Responsibility and Education) in 1989.

- ***What is the Project AWARE Foundation?***

2. What began as an environmental ethic quickly formed into the Project AWARE Foundation, a nonprofit organization that involves divers and water enthusiasts in projects and activities to conserve underwater environments. The Foundation also supports research, education and conservation projects through its established grant program.
    a. Since the nonprofit designation in 1992, Project AWARE has created an international presence with offices in the United Kingdom, Australia, Switzerland and Japan.
    b. You can join the team of environmental divers and contribute to conservation by becoming a Project AWARE Patron.
        1. Project AWARE Patrons take action for the underwater environment and their donations support conservation and data collection initiatives.
        2. All patrons receive a subscription to Project AWARE's email newsletter containing information about conservation activities and action alerts from around the world related to the underwater environment.
    c. Through Project AWARE, each year nearly a million people worldwide are exposed to environmental awareness through interactions with PADI Professionals. For up-to-date information, visit Project AWARE Foundation online at projectaware.org.

- ***What is Project AWARE Foundation's mission and purpose?***

3. Project AWARE is dedicated to conserving underwater environments through education, advocacy and action.
    a. Project AWARE partners with divers and water enthusiasts to protect aquatic environments around the world.
    b. Project AWARE involves divers in environmental projects, activities and campaigns working toward global conservation solutions.

- ***What steps is the Project AWARE Foundation taking to protect the aquatic world in partnership with PADI?***

4. Emphasizing environmentally sound approaches to dive practices, dive operations and dive skills. These include:
    a. Mooring buoy use, responsible boating practices, buoyancy control, proper techniques and equipment placement for underwater photography, responsible wreck diving guidelines and dive training programs including this course.
    b. Implementing initiatives to expand diver participation in conservation activities and data collection including global underwater cleanups, coral reef monitoring, shark sightings and identification, environmental education and advocacy.

c. Empowering children to get involved in environmental solutions through its AWARE Kids program.

d. Increasing implementation of sustainable business practices and expanding financial support for the aquatic environment.

H. Specialty Activities and Aquatic Life

- ***What should you do to minimize your effects on aquatic life while taking underwater photos or video?***

1. Learning dive specialties gives you new opportunities for underwater adventures.
2. Underwater photography and videography
   a. Underwater photography and videography are very rewarding. However, they have to be carried out properly to have minimal effect on aquatic organisms. A few techniques help minimize the possibility of accidentally damaging aquatic life while shooting pictures or video.
      1. Remember you're a diver before you're a photographer/videographer. This means making sure you continue to use proper diving techniques, even while shooting.
      2. Never capture, move, harass or otherwise damage organisms for the sake of creating images.
      3. Be cautious when leading a subject by swimming ahead of it, especially when shooting video.

Note:
Encourage student divers interested in underwater imaging to take your PADI Digital Underwater Photographer and/or Underwater Videographer courses. Inform student divers to consult the Project AWARE Foundation brochure "10 Tips for Underwater Photographers" before taking underwater photos. Remind divers that they can download a pdf of this information from http://www.projectaware.org.

10 Tips for Underwater Photographers

1. *Photograph with Care*
   Dive carefully as many aquatic creatures are fragile regardless of size. Improper techniques while taking or editing photos underwater can damage sensitive aquatic life and harm fragile organisms with the bump of a camera or cylinder, swipe of a fin or even the touch of a hand.

2. *Dive Neutral*
   Camera systems may add weight or be buoyant. Make sure to secure photo and dive equipment and be properly weighted to avoid contact with reefs or other vital habitat. Practice buoyancy control and photography skills in a pool before swimming near sensitive and fragile environments.
3. *Resist Temptation*
   Avoid touching, handling, feeding, chasing or riding aquatic life. Avoid altering an organism's location to get the perfect shot. Many aquatic creatures are shy and easily stressed. These actions may interrupt feeding, disturb mating or provoke aggression in a normally nonaggressive species.
4. *Easy Does It*
   While diving, move slowly and deliberately through the water. Be patient and still while photographing – allow organisms to show their natural behavior for a more significant and meaningful shot.
5. *Sharpen Your Skills*
   Make sure the difficulty of the dive and the environmental conditions are appropriate for your current skills and comfort level. Avoid stabilizing underwater by grabbing onto the reef for a better photo. Enroll in PADI's Underwater Photographer, Digital Underwater Photography and Peak Performance Buoyancy Specialty courses to become a more skilled and successful photographer.
6. *Be Informed*
   Be aware of local regulations and protocols regarding behavior around marine mammals and other species before entering the water. These regulations protect creatures and aim to assure their preservation for future generations.
7. *Be an AWARE Diver*
   Consider enrolling in an AWARE - Coral Reef Conservation, Project AWARE Specialty or Underwater Naturalist course to learn sustainable dive techniques and increase knowledge about the environment you're photographing.
8. *Take Only Pictures, Leave Only Bubbles*
   Avoid souvenir collection. Nearly everything found in the aquatic realm is alive or will be used by a living creature. Removing specimens such as corals and shells can disturb the delicate balance and quickly deplete dive sites of both their resources and their beauty. The wonderful thing about photography is that you can capture this beauty and take it with you without disturbing it.

9. *Share Your Images*
   Use images for conservation by reporting environmental disturbances or destruction using your photographs as evidence. Assist scientific research and improve resource management by contributing your photos to The Whale Shark Project and other monitoring programs. You may also submit your photos to Project AWARE. Your images have the power to change perspectives and influence conservation.
10. *Conserve the Adventure*
    Join Project AWARE Foundation, the dive industry's leading nonprofit environmental organization. Your support helps conserve underwater environments through education, advocacy and action.

b. UW photo/video allows you to study organisms more closely after a dive, confirm identification of species, document behaviors and share your discoveries and observations with others:

1. A photo can help you see the characteristics of an animal that you might have missed during the dive and a video camera might document changes in behavior that might have gone unnoticed.
2. A captured image of an unknown animal can be referenced with guides and materials following your dive to confirmed species identity.
3. If you're lucky and patient, you may be fortunate to document rarely seen behaviors.
4. You can share your discoveries and observations with scientists and your photos and video can be used to inform conservation efforts. For example, by submitting your photos to the Whale Shark Project at Project AWARE's website (www.projectaware.org) you help monitor this endangered largest living fish.

- ***How do you use a diver propulsion vehicle (DPV) so that you interact responsibly with the underwater environment?***

3. Diver propulsion vehicles (DPVs)

Note:
Encourage student divers who have DPVs or who are interested in using them to complete your PADI Diver Propulsion Vehicle course.

a. Diver propulsion vehicles (DPVs) allow you to observe more aquatic life over a wider area.

b. Used responsibly, they help reduce risk to aquatic organisms because you don't kick and you travel smoothly well above the bottom. Improper use, however, can cause damage.

   1. Keep the prop wash directed away from the bottom so it doesn't stir up silt or sand.
   2. When parking your DPV on the bottom, rest it where it will only make contact with insensitive parts of the environment (sandy, barren areas) and where it will not make contact with aquatic life.
   3. DPVs give you a lot of speed and can break coral or cause other damage on impact. Be careful not to run into anything, and stop with ample room to slow down.
   4. Don't let aquatic vegetation get sucked into the DPV propeller.
   5. DPVs make noise and move fast, and can therefore frighten fish and other animals. Try to maintain enough distance that animals don't feel threatened by you.

- ***How does your experience in night diving improve your ability to interact responsibly with aquatic life, as well as your awareness of it?***

4. Night diving

Note:
Encourage student divers who are interested in night diving to complete your PADI Night Diver course.

a. Night diving can improve your ability to interact responsibly with aquatic life as well as your awareness of it.

b. Because you're diving after dark, you don't go as far on a night dive and instead observe a smaller area in more detail. When you use a light, you pay more attention to specific areas so you see more detail.

c. Because it's easier to bump into things in the dark, night diving teaches you to be more aware of your body position and more cautious about touching things by accident.

d. At night, nocturnal organisms become active, and familiar animals display different behaviors. As an underwater naturalist, when diving at night you have an opportunity to witness processes and behaviors that you can't see during the day.

- ***How does your participation in aquatic life monitoring activities increase your knowledge and contribute to conservation?***

5. Conservation activities

> *Note:*
> *Explain to student divers the types of aquatic life monitoring activities available in your area. Visit www.projectaware.org for activities available in your local area or your travel destinations.*

a. Participating in monitoring and assessing aquatic life increases your knowledge and understanding of the underwater environment because every time you dive you are bound to encounter new organisms and behaviors.

b. Your observations can inform science and management decisions by providing vital information on the local, regional and international status of threatened or endangered species. For example, participating in Project AWARE's CoralWatch monitoring provides vital information on the bleaching trends of coral reefs world wide.

Section Three
Open Water Dives
Conduct

There are no required confined water or surface practice sessions for the PADI Underwater Naturalist Specialty course, however, it is sound instruction to develop student diver abilities in conditions that don't add complexity to learning new skills. For example, you may want to review Project AWARE information relevant to diving skills and have student divers practice environment-friendly skills in a pool or other insensitive confined water environment. You may add confined water and/or surface practice sessions at your discretion, and you may want to include using videos, photos, guidebooks, the internet, etc., to show your student divers some of the organisms they can expect to see during their dives. The confined water session may also include a scuba skills review.

Both dives in the course emphasize environmentally friendly diving techniques and passive interaction with aquatic life. The first dive focuses on finding, recognizing and identifying organisms from each of the broad groups. The second dive focuses on studying the interrelationships of organisms and the effects of humans on the environment.

Bottom time on each dive should not exceed the no decompression limits of the Recreational Dive Planner or each diver's computer, if used. **Regardless of how you conduct the open water dives, student divers must demonstrate the following performance requirements to qualify for certification.**

Open Water Dives

Performance Requirements

By the end of the open water dives, student divers will be able to:

Underwater Naturalist Open Water Dive One

- **Passively observe aquatic life.**
- **Demonstrate and apply diving techniques that preserve bottom dwelling organisms and minimize disturbing aquatic life.**
- **Locate and identify, by common or scientific name, at least two local aquatic plants (one for fresh water).**
- **Locate and identify, by common or scientific name, at least four local aquatic invertebrates (one for fresh water).**
- **Locate and identify, by common or scientific name, at least five local aquatic vertebrates (two for fresh water).**

Underwater Naturalist Open Water Dive Two

- **Passively observe aquatic life.**
- **Demonstrate and apply diving techniques that preserve bottom dwelling organisms and minimize disturbing aquatic life.**
- **Find and identify as many symbiotic relationships and predator/prey relationships as you can.**
- **Find and identify as many human effects on the environment as you can.**

Open Water Guidelines for U/W Naturalist Dives

A. General Open Water Considerations

1. Involve student divers in dive-planning activities. Prepare student divers with descriptions of the underwater ecosystems, organisms to expect (provide pictures if possible), relationships and other details they can look for.
2. Encourage student divers to use aquatic life identification slates, if available, and to carry slates for writing and recording their observations. You can also allow student divers to document what they find with still or video imaging.
3. Conduct a thorough briefing. The better the briefing, the more smoothly the dives will proceed. Besides discussing the profiles, conditions and the facilities at the dive site, predive briefings should include the recommended entry and exit techniques, buddy contact recommendations and basic emergency considerations. Remind divers to use environmentally friendly techniques throughout the dive, including maintaining neutral buoyancy, staying off the bottom, securing gear and passively observing the animals they encounter.
4. Dive Two tasks require student divers to identify and observe symbiotic and predator/prey relationships. Discuss examples they're likely to see in the local area to give divers ideas of what to look for.
5. Dive Two tasks also require student divers to look for human effects on the local aquatic environment. This may be difficult in pristine environments, but you can usually provide some examples that prepare student divers to think beyond obvious physical damage from anchors or other contact. Examples: Fish come unnaturally close to divers (due to feeding) or appear unnaturally fearful (due to spear fishing). In some areas, litter and pollution will (unfortunately) be obvious, and you'll want to guide student divers to think beyond the obvious, such as nothing rocks turned over by divers (looking for game). Doing this disrupts habitats and therefore effects the environment.

B. Underwater Naturalist Open Water Dives

Dive One

- ***Passively observe aquatic life.***
- ***Demonstrate and apply diving techniques that preserve bottom dwelling organisms and minimize disturbing aquatic life.***
- ***Locate and identify, by common or scientific name, at least two local aquatic plants (one for fresh water).***
- ***Locate and identify, by common or scientific name, at least four local aquatic invertebrates (one for fresh water).***
- ***Locate and identify, by common or scientific name, at least five local aquatic vertebrates (two for fresh water).***

a. Briefing

1. Dive sequence – review Dive One tasks

b. Predive procedures

c. Dive One Tasks

1. Apply diving techniques used to preserve bottom-dwelling organisms and minimize disturbance of all aquatic life; dive streamlined, neutrally buoyant, watching your hands and fins. Passively observe aquatic life.
2. Locate and identify at least two local aquatic plants (one for fresh water); for the purposes of this dive, algae may be considered plants, as well as true flowering plants.
3. Locate and identify at least four local aquatic invertebrate animals (one for fresh water). These animals may be from any of these groupings:
   a. Sponges
   b. Corals, anemones, jellyfish
   c. Segments worms
   d. Snails, clams, octopus, squid
   e. Lobsters, crab, shrimps, freshwater crawfish
   f. Sea stars, urchins, cucumbers, brittle stars
   g. Sea squirts

4. Locate and identify at least five local aquatic vertebrate animals (two for fresh water). These animals may be from any of these groupings:
    a. Skates, rays and sharks
    b. Bony fish
    c. Sea turtles, amphibians, reptiles
    d. Manatees
    e. Whales, dolphins, porpoise
    f. Seals, sea lions

d. Post-dive procedures

e. Debriefing

1. Compare student diver findings, identification, and observations of the local aquatic plants and animals (invertebrates and vertebrates). Discuss diving techniques used to preserve bottom-dwelling organisms and ask student divers to describe the techniques they used to minimize disturbing aquatic life while on the tour portion of their dive. Guide discussions to address what worked, what didn't work, and how things may be done differently the next time. Specifically focus the discussion on responsible interactions with the living environment and environmentally friendly diving techniques.

f. Log dive (instructor signs log)

Dive Two

- ***Passively observe aquatic life.***
- ***Demonstrate and apply diving techniques that preserve bottom dwelling organisms and minimize disturbing aquatic life.***
- ***Find and identify as many symbiotic relationships and predator/prey relationships as you can.***
- ***Find and identify as many human effects on the environment as you can.***

a. Briefing

1. Dive sequence – review Dive Two tasks

b. Predive procedures

c. Dive Two Tasks

1. Apply diving techniques used to preserve bottom-dwelling organisms and minimize disturbance of all aquatic life; dive streamlined, neutrally buoyant, watching your hands and fins. Passively observe aquatic life.

2. Find and identify as many symbiotic relationships and predator/prey relationships as possible.
    a. Review symbiotic relationships: mutualism, commensalism and parasitism.
    b. Recommend that student divers record these on a slate, and/or use photography or videography.
3. Find and identify as many human effects on the environment as possible.
    a. Review human effects on the local aquatic environment.
    b. Recommend that student divers record these on a slate, and/or use photography or videography.

d. Post-dive procedures

e. Debriefing

1. Compare student diver findings of symbiotic and predator/prey relationships. Ask student divers to share with the group any human effects on the environment they found on their dive. Discuss diving techniques used to preserve bottom-dwelling organisms and ask student divers to describe the techniques they used to minimize disturbing aquatic life while on the tour portion of their dive. Guide discussions to address what worked, what didn't work, and how things may be done differently the next time. Specifically focus the discussion on responsible interactions with the living environment and environmentally friendly diving techniques.

f. Log dive (instructor signs log)

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Underwater Naturalist
Knowledge Review Part I Answer Key

Note:
To assess knowledge you may review the Knowledge Review from the student diver's manual with the diver, ideally prior to participating in skill practice. Prescriptively teach answers to questions student divers may have missed or have answered incorrectly or incompletely. Ensure student divers understand what they have missed.

1. Define the terms *ecology* and *ecosystem*.
   Ecology: *Study of the interrelationship of living things and their environment.*
   Ecosystem: *The complex of living things and their environment functioning as a unit.*

2. List three physical/structural differences between aquatic ecosystems and terrestrial ecosystems.
   (Answers may vary.)

3. Identify the most common cause of aquatic animal "attacks."
   The animal attacks to defend itself, its mate, its territory or its young.

4. Describe an accurate view of potentially dangerous aquatic animals.
   Aquatic animals rarely attack unprovoked. An accurate, objective view is that "attacks" result from human behaviors that cause an animal to believe a human is food or a threat.

5. List four inaccurate ways people may perceive aquatic animals.
   1. *As dangerous and harmful.*
   2. *As harmless like a domestic dog or cat.*
   3. *As inanimate objects.*
   4. *As having human characteristics.*

6. Explain how to interact passively with aquatic organisms.
   Interacting passively means primarily watching and looking, and diving in ways that minimizes disrupting the natural behaviors of aquatic life.

7. Explain how and when you can responsibly touch or handle aquatic animals.
   Should only be done by people with the education/experience necessary to do so safely for both the diver and the organism. Touching/handling should not cause a significant disruption of the organism's normal behavior, and should only be done when doing so provides a meaningful learning experience without compromising the organism's well being in any way.

8. Explain why divers should not ride aquatic animals.
   There are no circumstances in which doing so benefits the animal. In most instances, it can harm the animal, or the animal may react defensively and harm you.

9. Why should divers avoid feeding aquatic animals?
   Feeding aquatic animals disrupts normal behaviors. It causes them to associate humans with food, and they may stop feeding on natural prey. It can cause the fed species to overpopulate, and to lose their natural fears. Animals can get sick from eating unnatural foods, or suffer internal blockages by eating plastic containers.

10. Describe the diving techniques that you should use to preserve bottom dwelling organisms and to minimize disturbing all aquatic life.
    Secure all your gear so it doesn't dangle. Stay neutrally buoyant, well off the bottom in a horizontal position with your legs parallel to the bottom or angled upward slightly. Don't overweight. Avoid kicking up sand and be cautious what you touch with your fins, knees and hands. Don't grasp anything living.

Adventure Dive: Underwater Naturalist

Skills Overview

- Knowledge Review
- Briefing
- Suiting Up
- Predive Safety Check (BWRAF)
- Entry
- Descent
- Identification of Aquatic Plant Life
- Identification and Observation of Aquatic Invertebrate Animals
- Identification and Observation of Aquatic Vertebrate Animals
- Ascent – Safety Stop
- Exit
- Debrief
- Log Dive Complete Adventure Dive Training Record

Underwater Naturalist
Knowledge Review Part II Answer Key

Note:
To assess knowledge you may review the Knowledge Review from the student diver's manual with the diver, ideally prior to participating in skill practice. Prescriptively teach answers to questions student divers may have missed or have answered incorrectly or incompletely. Ensure student divers understand what they have missed.

11. Why do scientists classify organisms and what two taxa does an organism's scientific name represent?

    Classification helps identify the relationships between organisms. This process avoids two of the same organism being mistaken for two different organisms because of minor individual differences. It also tells scientists which organisms are related but different. Classification helps avoid confusion. You identify each species by referring to both the genus and the species. This is the species' scientific name.

12. What do taxonomists base their classification on and what are the seven taxa into which organisms are classified?

    There are two methods to classify organisms. Most taxonomists classify macro-organisms based on anatomical features. This usually works well and it shows possible relationships between organisms. More recently, taxonomists find the study of genetics especially useful when classifying single-celled organism that differ very little anatomically. The Linnaeus classification system divides organisms into taxa, which are divisions of organisms with subdivisions. The seven taxa are species, genus, family, order, class, phylum, and kingdom.

13. What is the most common problem when classifying organisms into different categories?

    A common problem taxonomists have is that some organisms don't fit neatly into defined classifications. Some organisms have the characteristic that define a classification, along with other characteristics that separate them from it. Yet, they don't belong in the classification above or below.

14. What are the six-kingdom and three-domain systems of classification?

    The six-kingdom system divides kingdom into six broad classifications: kingdom Eubacteria, kingdom Archaebacteria, kingdom Protista, kingdom Fungi, kingdom Plante, and kingdom Animalia. Many taxonomists use genetic and biochemical research to organize kingdoms into domains. The three-domain system consists of domain Archea, domain Bacteria and domain Eukarya.

15. What is *symbiosis*?

    Symbiosis is the relationship of animals of different species living together in close association.

16. Define the terms *mutualism, commensalism* and *parasitism* and give an example of each in the aquatic environment.

    Mutualism: *Symbiosis in which both species benefit from the association. [Examples may vary.]*

    Commensalism: *Symbiosis in which one species benefits and other neither benefits nor is harmed. [Examples may vary.]*

    Parasitism: *Symbiosis in which the parasite (one species) benefits at the expense of the host (other species). [Examples may vary.]*

17. What is Project AWARE Foundation's purpose and mission? Give an example of what Project AWARE and PADI are doing in partnership to protect the aquatic world.

    Project AWARE is dedicated to conserving underwater environments through education, advocacy and action. Project AWARE partners with divers and water enthusiasts to protect aquatic environments around the world. The Project AWARE Foundation involves divers in environmental projects, activities and campaigns working toward global conservation solutions. The Project AWARE Foundation, in partnership with PADI, strives to protect the aquatic world by emphasizing environmentally sound approaches to dive practices, dive operations and dive skills.

18. What should you do to minimize your effects on aquatic life while taking underwater photos or video?

    Use proper diving techniques, especially while shooting. Never capture, move harass or damage organism for the sake of images. Be cautious when leading a subject by swimming because it's easy to run into things; have your buddy watch ahead if necessary.

19. How do you use a DPV so that you interact responsibly with the underwater environment?

    Travel well above the bottom. Keep your prop wash directed away from the bottom so it doesn't stir up silt. When parking your DPV, be sure to place it so it only makes contact with insensitive parts of the environment. Be careful not to run into anything, and be cautious not to let aquatic plants get sucked into the propeller. Maintain enough distance from animals that you don't frighten them.

20. How does experience in night diving improve your ability to interact responsibility with aquatic life, as well as your awareness of it?

    You don't go as far on a night dive so you observe smaller areas in detail. Lights force you to pay attention to specific areas. Night diving teaches you to be more aware of body position and to be cautious about touching things by accident. At night, you see nocturnal behaviors and other aspects of the ecosystem that you don't see during the day.

PADI Adventure Dive Training Record
Adventure Dive:
Underwater Naturalist Dive

Skills Overview

- Knowledge Review
- Briefing
- Suiting Up
- Predive Safety Check (BWRAF)
- Entry
- Descent
- Identification of Aquatic Plant Life
- Identification and Observation of Aquatic Invertebrate Animals
- Identification and Observation of Aquatic Vertebrate Animals
- Ascent – Safety Stop
- Exit
- Debrief
- Log Dive – Complete Adventure Dive Training Record

Instructor Statement

"I verify that this student diver has satisfactorily completed the Knowledge Review and Performance Requirements (as described in PADI's Adventures in Diving Program Instructor Guide) for this PADI Adventure Dive. I am a renewed, Teaching status PADI Instructor for the current year."

Instructor Name: _____

Instructor Signature: _____

PADI #: _____ Completion Date: _____
Day/Month/Year

Instructor Contact Information (Please Print)

Instructor Mailing Address: _____

City: _____ State/Province: _____

Country: _____ Zip/Postal Code: _____

Phone/Fax/email: _____

Student Diver Statement

"I verify that I have completed all of the Performance Requirements for this Adventure Dive. I realize that there is more to learn about the aquatic environment and that completion of a PADI Underwater Naturalist course is highly recommended. I also agree to abide by PADI Standard Safe Diving Practices."

Student Diver Signature: _____ Completion Date: _____
Day/Month/Year

PADI Specialty Training Record Underwater Naturalist

Instructor Statement

"I verify that this student diver has satisfactorily completed all academic and/or any confined water training sessions as outlined in the PADI Specialty Course Instructor Guide for Underwater Naturalist. I am a renewed, Teaching status PADI Instructor in this specialty."

Instructor Name: _____ PADI #: _____

Instructor Signature: _____ Completion Date: _____
Day/Month/Year

Open Water Dives

Dive One

I verify that this student diver has satisfactorily completed Dive One as outlined in the PADI standardized guide for Underwater Naturalist, including:

- Demonstrating diving techniques that preserve bottom-dwelling organisms and minimize disturbing aquatic life
- Identifying aquatic plants
- Identifying and observing aquatic invertebrates
- Identifying and observing aquatic vertebrates

I am a renewed, Teaching status PADI Instructor in this specialty.

Instructor Name: _____ PADI #: _____

Instructor Signature: _____ Completion Date: _____
Day/Month/Year

Dive Two

I verify that this student diver has satisfactorily completed Dive Two as outlined in the PADI standardized guide for Underwater Naturalist including:

- Demonstrating diving techniques that preserve bottom-dwelling organisms and minimize disturbing aquatic life
- Finding and identifying symbiotic relationships and predator/prey relationships
- Finding and identifying human effects on the environment

I am a renewed, Teaching status PADI Instructor in this specialty.

Instructor Name: _____ PADI #: _____

Instructor Signature: _____ Completion Date: _____
Day/Month/Year

Student Diver Statement

"I verify that I have completed all performance requirements for the PADI Underwater Naturalist Specialty course. I am adequately prepared to dive in areas and under conditions similar to those in which I was trained. I agree to abide by PADI Standard Safe Diving Practices."

Student Diver Name: _____

Student Diver Signature: _____ Date: _____
Day/Month/Year