

MANTA

Marine science And
Nautical Training Academy

Marine Science and Nautical Field Studies

Course Description

This two week summer course will provide students a unique opportunity to learn about the marine environment, while instilling in them leadership and teamwork skills. The program is based aboard a 45 foot catamaran that students will live-aboard and sail through the British Virgin Islands. This floating classroom, laboratory, and research platform will carry students through the diverse suite of tropical marine habitats, with a new environment and anchorage to explore each day. Students will be challenged with an intensive, experienced-based field studies course offering instruction in fundamental and applied marine science and the principles and practices of the nautical sciences. Marine science curriculum will be aligned to the Ocean Literacy standards. The course will introduce a broad range of topics to students, exposing them to the diversity of subdisciplines that are available within the general discipline of marine science. These topics will include coral reef ecology, ichthyology, invertebrate zoology, animal behavior, oceanography, fisheries science, aquatic toxicology, and conservation biology. Classroom instruction will be accompanied by direct observation of these concepts through laboratory exercises onboard and using scuba. Lab activities will include earning a PADI open water scuba certification (PADI Advanced Open Water certification is provided for applicants who are already certified), fish and invertebrate identification and taxonomy, anatomy and physiology labs employing gross dissections, observation of anatomical structures through microscopes, an introduction to the techniques and methods used in marine biology field studies, and other topics. Students will become familiar with and observe the indigenous fishes, sea turtles, and diverse array of invertebrates present in tropical marine habitats. Teams of students will then work to finalize the design and execution of a short field experiment using the scientific method to test a hypothesis they have developed based on their own observations. This course also provides students with instruction on fundamental nautical concepts such as sailing, seamanship, and both modern and celestial navigation. On alternate days, each team of students will be responsible for planning and executing the day's navigation route and other onboard duties including cooking and swabbing. This complete approach creates an understanding and appreciation of the ocean from the perspective of a scientist, a diver, and a mariner.

Prerequisites: Physical Science & Biology (Biology I, Honors/Pre-IB Biology I or Applied Biology II)

Appropriate Grade Level: Rising 11th & 12th graders, or recent graduate

Marine Science and Nautical Field Studies Course

Syllabus & Lesson Objectives

Instructors: Rusty Day, M.S. and Jennifer Keller, Ph.D.
and Michelle Lee, M.S.

High School Student Course Duration: 15 days, July 14 – 28, 2010

Assessments: 30% - Participation (sailing, diving, & science project: human surveys, *E. coli*, nutrients, coral health, fish survey)

30% - Practicals (knots, plotting, dinghy pilot, navigation, celestial navigation, fish ID, invert ID)

20% - Team Experimental Summary & Presentation

20% - Written Final Exam

Prior to the two-week study abroad course, students are required to enroll in and complete the classroom portion of PADI's Open Water Diver Course online (www.padi.com). It is highly recommended that students complete this online portion of the course during the two week period before the departure date.

Approximate online course time is 10-12 hours.

Saturday, July 18th-Day 1:

- Soper's Hole, Tortola
- Welcome & Introductions
 - Unpacking, cabin assignments and storage, hammocks and sleeping arrangements
- Program & Vessel Orientation
 - Locate safety equipment, marine heads, electronics, man overboard, become familiar with boating safety procedures
 - Use appropriate nautical terminology for regions and components of the boat
 - Identify functions of components of the vessel and how they interact for its successful operation
 - rope clutches, winches, cleats
- SCUBA Assessment
 - Collect PADI paperwork (online certificate, medical statement, understanding of risk)

Sunday, July 19th-Day 2:

- Sail to White Bay, Jost van Dyke; Sailing I & Anchoring
 - Understand and apply the principles of physics to sail propulsion using the proper execution of basic sailing manoeuvres
 - Demonstrate steps for raising mainsail, unfurling jib, setting sail
 - Once underway, discuss the principles of sail propulsion and points of sail
 - Brief and demonstrate jibing, anchoring
 - Discuss points of sail
- SCUBA confined water training dives & Advanced navigation dives
 - Demonstrate mastery of SCUBA skills in confined water dives (training dives #1-2)
 - proper assembly and disassembly of gear, safety check, alternate air source use, regulator recovery, & clearing, and flooding/clearing of mask
 - Advanced students conduct navigation training dive
- Science Experiment Introduction; Human Impacts
 - Experimental Design
 - Student Teams
 - Team Expertise & Responsibilities

Monday, July 20th-Day 3:

- White Bay, Jost van Dyke; Navigation I
 - Interpret nautical charts, determine/plot position, measure distance, differentiate between true north and magnetic north, apply concepts of compass deviation and variation, and plot a course
 - Determine bearings using compass rose
- SCUBA confined water training dives (Divemaster-skin diver instruction)
 - Continue developing mastery of SCUBA skills in confined water dives (training dives #3,4 & 5)
 - removal and replacement of mask, underwater navigation, buddy breathing, controlled emergency swimming ascent
 - Advanced students perform trial coral and fish survey
- Science: Perform first E. coli and nutrient testing
- Fish Diversity & Identification
 - Understand fish systematics, species diversity, fish anatomy and evolutionary adaptations
 - Identify indigenous reef fishes using field guides

Tuesday, July 21st-Day 4:

- Sail to The Bight, Norman Island; Sailing II & Marine Electronics; [Plotting Practical](#)
 - Brief and demonstrate tacking; picking up a mooring ball
 - Become proficient in the use of GPS navigation, compass, depth finder, sonar, radar, VHF radio, vessel machinery (generators, inverters), auto-pilot, anemometers
- SCUBA Checkout Dives (Indians, Pelican Reef)
 - Demonstrate mastery of PADI skills for SCUBA certification (check out Dive 1 & 2) in an open-water environment
 - Sample sea urchins for reproductive and developmental lab
- Invertebrate Diversity & Identification
 - Explain reef invertebrate systematics, species diversity, anatomy and evolutionary adaptations
 - Identify indigenous reef invertebrates using field guides

Wednesday, July 22nd-Day 5:

- Sail to Deadman's Bay; Sailing Rules of the Road & Docking
 - Understand and interpret aids to navigation, right of way, safety equipment and regulations, lighting configurations, ship-to-ship radio communication
 - Brief and demonstrate docking
- SCUBA Checkout Dives (Caves, Painted Walls)
 - Perform remaining PADI skills to complete SCUBA certification (check out Dive 3 & 4) in an open-water environment
 - Identify indigenous reef invertebrates while SCUBA diving and examine selected invertebrates onboard using dissecting microscope (coral, sponges, sea urchins, etc.)
 - Assess coral health using NOAA coral disease field guide during our dive
- Coral Reef Ecology
 - Examine aspects of coral reef ecosystems, including coral anatomy, interactions, reef zonation, coral bleaching and disease
 - Assess benthic foraminifera samples collected from dive

Thursday, July 23rd-Day 6:

- Sail to Cooper Island; Sailing III
 - True vs apparent wind, stability, theoretical hull speed, being a good helmsman, sail shape
- Dive Rhone & Wreck
 - Explore a shipwreck while SCUBA diving
 - Identify indigenous reef fishes while SCUBA diving and perform a gross dissection of a fish specimen
 - Make initial observations of fish abundance, species composition, and behaviour on a protected reef relative to a fished reef
 - Practice roving diver technique fish abundance and diversity survey
- [Fish ID Practical](#)
- Possible water quality sampling in Road Town, opportunity for [human surveys](#)
- Hike Salt Island
- Population Biology
 - Examine factors affecting population growth and distribution, density-dependent factors (competition, predator-prey interactions, carrying capacity), symbiotic relationships, dispersion patterns (founders theory, bottleneck effect), and life history strategies

Friday, July 24th-Day 7:

- Sail to Spanish Town, Virgin Gorda; Types of Sailing Rigs
 - Distinguish between different sailing vessels and their strengths & weaknesses, based on marine architecture and design, evolution of ship building (structures and functions specific to vessel types), and criteria for classification
- Dive Alice in Wonderland (all science facets performed)
 - Roving diver fish survey-Adventure Underwater Naturalist
 - Coral survey—transects, quadrats
 - Fish herbivory experiment
 - Foram sampling and water quality
- [Invertebrate ID Practical](#)
- Trip ashore in Spanish Town for dinner and grocery shopping
- Assess water quality in Spanish Town, opportunity for human surveys
- Fisheries Management & Fish Aging/Growth Techniques
 - Classify fishing gear, understand types and effects of overfishing, explain stock assessment techniques (including age and growth, spawning stock biomass), and compare sustainable use, marine protected areas, and other management strategies
 - Demonstrate fish ageing technique by removing otoliths from fish specimens and reading otolith growth bands

Saturday, July 25th-Day 8:

- Sail to Savannah Bay, Virgin Gorda; Seamanship; [Dinghy Pilot Practical](#)
 - Heavy weather tactics, anchor, dock, tie basic knots, vessel stability
- Dive Chimneys; Adventure Night Dive
- Science at Savannah Bay: water quality and possible coral and fish surveys
- Biological Oceanography
 - Discuss how physical processes regulate life in the ocean
 - Primary and secondary production (phytoplankton and zooplankton, zooxanthellae, macroalgae, seagrass), zones of nutrient upwelling, and compare and contrast tropical and temperate environments

Sunday, July 26th-Day 9:

- Sail to North Sound, Virgin Gorda; Navigation II; [Navigation Practical](#)
 - Calculate headings with compensation for current set and drift and triangulate position using visual references
 - Obtaining a fix using lines of position from visual references
- Dive Dogs and then Coral Garden
 - Explore an artificial reef while SCUBA diving
 - At Coral Gardens, perform all science facets
- Trip ashore for shopping, opportunity for human surveys
- Physiology
- Homeostasis, respiration, temperature regulation, locomotion, osmoregulation

Monday, July 27th-Day 10:

- Sail to Anegada; Celestial Navigation I
 - Identify constellations in the celestial sphere, understand the celestial clock and sun and moon events
- Science progress reports Snorkel barrier reef-Loblolly Bay, opportunity for human surveys
- Larval Dispersal & Recruitment, Artificial Reefs
 - Discuss larval life history strategies in the marine environment and implications for evolution, population connectivity, and stock management (traditional and marine protected areas)
 - Examine current research techniques for assessing larval dispersal patterns

Tuesday, July 28th-Day 11:

- Sail to Muskmelon, Guana Island; Celestial Navigation II; [Celestial Navigation Practical](#)
 - Take sun and moon sights for latitude, star sights, and solve the spherical triangle
- Continue science progress reports Dive Chikuzen & Night dive at Muskmelon
 - Fish survey on Chikuzen
 - Experience a large offshore wreck dive
 - Contrast species presence during a night dive versus day dive, including bioluminescent organisms
- Hike to point
- Oceanography & Climate Change
 - Examine how the oceans function to influence weather and climate
 - Coriolis effect, ocean gyres, upwelling, thermohaline circulation, global climate change

Wednesday, July 29th-Day 12:

- Sail to Great Harbour, Jost van Dyke; [Knots Practical](#)
 - Continue to learn mastery of nautical knots
- Dive Brewers Bay Caves
- perform all science facets Kayaking in Brewers Bay
- Opportunity for human surveys with boaters
- Human Impacts & Conservation Biology
 - Describe conservation status of sea turtles, marine mammals, and other marine species of concern
 - Examine case studies and identify human threats (including marine pollution, habitat degradation, and fishery by-catch)
 - Discuss aspects of aquatic toxicology, including identification of human pollutants that pose a risk to the marine environment, types of toxicity, examining case studies for marine mammals and sea turtles

Thursday, July 30th-Day 13:

- Sail to Cane Garden Bay, Tortola—students take over!
 - Student sail teams independently direct the operation and sailing of the vessel
- Dive Twin Towers
- perform all science facets: coral and fish survey, fish herbivory experiment, foram sampling and water quality [Student Experiment Presentations](#)
- [Dinner ashore with Dr. Lianna Jarecki](#), opportunity for human surveys

Friday, July 31st-Day 14:

- Sail to Sandy Spit, Jost van Dyke—students take over!
 - Student sail teams independently direct the operation and sailing of the vessel
- Dive Playgrounds
- [Final Exam II: Written](#)
- Course Evaluation
- Beach party on Sandy Spit
- Pack

Saturday, August 1st-Day 15:

- Sail to Soper's Hole
- Say farewells...depart for home!

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MANTA Day # & Site Location

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