COURSE OUTLINE

Natural History of Palau
Course Title

SC 239
Dept. & Course No.

I. **Course Description:**

This course is about the natural environment of Belau. It introduces the student to the geological formation of the islands of Palau, the significance of oceanic distance between Palau islands and its neighboring islands and continents, and how it influences migration and immigration of terrestrial and marine organisms between islands. Students will better understand and develop appreciation of the importance of the major terrestrial and marine ecosystems to Palau's environment and culture. Students become aware of how island ecosystems function, and more importantly, how they are all interconnected. Through field observations, students gain knowledge and skills in identifying, by their scientific names, of some of the common terrestrial and marine flora and fauna of Palau. Students become aware of the richness of Palau's biodiversity by participating in simple field surveys and monitoring techniques. Through library research, online searches using search engines, and interviews with local experts, students increase their knowledge of some of Palau's indigenous, introduced, and endemic species. Students construct public education awareness power point presentations on selected flora and fauna of Palau, proposing practical solutions to conserve and protect Palau's biodiversity, and present to their peers.

II. **Semester Credits**: 4

III. **Contact hours Per Week:** 3 Lecture 3 Lab 6 Total

IV. **Prerequisite:** EN109, and CS100

V. **Student Learning Outcomes**

Upon completion of this course the student will be able, with a minimum of 65% accuracy, to:

1. Describe the different properties of water
2. Express relationships between different water properties
3. Calibrate and use meters to measure and analyze water quality in different bodies of water (lake, stream, estuary, and reef)
4. Describe the Theory of Plate Tectonics and evidences that support theory
5. Describe the three general motions of the

VI. **Course Content**

A. Seawater

1. Properties
   - a) Density
   - b) Salinity
   - c) Temperature
   - d) pH
   - e) Dissolved oxygen
   - f) Conductivity
   - g) Turbidity
2. Water Quality Meters
   - a) Hydrometer
   - b) pH meter
   - c) dissolved oxygen meter
   - d) Refractometer
   - e) Thermometer

B. Theory of Plate Tectonics

1. Plate motions and

tectonic plates and geological activities resulting from these motions
6. Identify on a topographic map of the world areas of subduction, major trenches, and seafloor spreading

7. Identify and locate on a world map the Oceania region and the three ethno-geographical groups of islands
8. Describe the geography of Micronesia
9. Identify and locate on a world map the major islands within geographical Micronesia region

10. Provide a scientific explanation (based on the Theory of Plate Tectonics) of how the islands of Palau were formed; compare and contrast the scientific explanation to the indigenous legend of island formation
11. Describe and give examples of the three major classes of islands found in Palau based on how they were formed and altitude

12. Describe the geographic location of the Palau islands and its weather and climate
13. Provide and locate them on a map of Palau the indigenous names of the main islands
14. Identify by their present and "old" names the 16 states of Palau and locate them on a map of Palau and describe unique features of each state
15. Provide the indigenous names of the major limestone islands in the southern lagoon of Koror and locate them on a map
16. Name and locate on a map of Palau the channels used as major navigation routes for sea vessels and important conservation areas

boundaries
2. Major tectonic plates

C. Oceania
1. Polynesia
2. Melanesia
3. Micronesia
   a. Republic of Palau
   b. Commonwealth of the Northern Marianas
   c. US Territory of Guam
   d. Federated States of Micronesia
   e. Republic of the Marshall Islands
   f. Nauru
   g. Kiribati

D. Geology of Palau
1. Formation
2. Classification of Islands
   a) Volcanic
   b) Limestone
   c) Compound

E. Geography of Palau
1. Geographical Coordinates
2. Weather & Climate
3. Main Islands
   a) Babeldaob
   b) Oreor
   c) Beliliou
   d) Ngeaur
4. 16 States of Palau & Features
5. Major Limestone Island
   a) Ngeruktabel
   b) Ullebsechel
   c) Ngeteklou
   d) Ngermeuangel
   e) Ngeruktabel
   f) Mecharchar
6. Major Channels
   a) Touachel Mlengui
   b) Touachel Mid
   c) Ngel
   d) Kesebekuu
   e) Llebuchel
   f) Ngerumekaol

17. Define *ecology*
18. Explain the interconnectedness and relationship between organisms and other organisms, and to their environment using food webs and special relationships that result when resources become scarce.
19. Define *ecosystem* and *habitat* and give local examples of each
20. Define *species* and describe how species populations may have been established on isolated islands such as Palau
21. Differentiate between *indigenous, endemic, introduced,* and *invasive species* and give local examples of each
22. Explain how introduced species become invasive species on islands and give local examples of invasive flora and fauna in Palau

23. Compare and contrast soil structure on limestone and volcanic islands
24. Explain the ecological, cultural, economical, and educational significance of soil and forest resources in Palau
25. Describe the major types of vegetation in Palau and identify by their scientific and indigenous names ten common plants from each type of vegetation

26. Define *watershed*, identify components of a watershed on an island
27. Identify and label on a map of Palau the major watershed areas in Babeldaob
28. Define a *lake* and its water properties
29. Identify by their indigenous names, and locate on a map of Palau the two major freshwater lakes in Palau
30. Explain the ecological, economical, cultural, and educational significance of lakes and streams in Palau
31. Compare and contrast *stream* and *river*
32. Identify by their indigenous names and

F. Island Ecology

1. Ecology
2. Ecosystems
3. Food Web & Trophic levels
   a) Primary Producers
   b) Consumers: herbivore, carnivore, & omnivore
   c) Decomposers
4. Relationships
   a) Mutualism
   b) Commensalism
   c) Parasitism
5. Establishment of different species populations on islands

G. Terrestrial Ecosystems

1. Soil Ecosystem
   a) Soil resources: phosphate, bauxite, coal, manganese, clay, sand,
2. Forests or Vegetation Types of Palau
   a) Strand
   b) Coastal Plain
   c) Secondary
   d) Upland
   e) Savannah
   f) Raised limestone forest
   g) Atoll & Low coral islands
   h) Mangrove

H. Watershed

1. Lakes
   a) Ngardok
   b) Ngarngall
2. Streams, & Waterfalls
   a) Ngermeskang
   b) Ngerdorch
   c) Ngerikiil
   d) Tabecheding
   e) Medalaiechad
3. Estuary
   a) Types

locate on a map of Palau the major streams and falls in Palau

33. Define *estuary* and explain its ecological, economical, cultural, and educational importance to Palau environment and Palauans.

b) Ecological Importance

34. Explain the ecological, cultural, economical, and educational significance of mangroves in Palau
35. Identify by their scientific names 15 plants that are commonly associated with mangrove forests in Palau, including true mangroves
36. Identify by their scientific names some of the common organisms that inhabit the mangroves and state their global and local conservation status

I. Mangrove Ecosystem

1. Importance & Conservation
2. Mangrove Trees
3. Mangrove fauna

37. Describe a coral reef and identify the global distribution of most coral reefs
38. Summarize Darwin's Theory of Atoll formation.
39. Differentiate the major types of reefs and provide local examples of each
40. Sketch a profile of a typical reef in Palau and identify the zones on the reef by their indigenous and common names.
41. Describe the ecological, economical, cultural, and educational significance of coral reefs

J. Coral Reef Ecosystem

1. Global Distribution
2. Evolution of a Reef
   a) Fringing
   b) Barrier
   c) Atoll
   d) Patch
3. Reef Zones
   a) L'lemau (tidepool)
   b) Debeaot (inner reef lagoon)
   c) Rsaol
   d) Ngeraol (inner reef crest)
   e) Oreall (surf zone)
   f) Merek (reef flat)
   g) Uis (outer reef slope)
4. Importance

42. Sketch a diagram of a coral polyp, label and describe the main functions of the following structures: tentacles, mouth, mesenterial filaments, digestive tract, zooxanthellae, nematocysts, and cnydoblast
43. Describe abiotic and biotic conditions necessary for the healthy growth of a coral polyp
44. Explain the relationship between a coral polyp and a zooxanthellae and how both organisms benefit
45. Describe the different sexual and asexual forms of reproduction for coral polyps; describe coral spawning events in Palau and how it differs from other neighboring

K. Coral Biology

1. Structure
2. Growth Requirements
3. Reproduction
   a) Sexual
   b) Asexual

islands in the Pacific

46. Explain the importance of classification in science
47. Define the groups used in biological classification: species, population, community, ecosystem, biosphere
48. Describe the science of *taxonomy*
49. List and describe each taxa in the hierarchy of taxonomy: kingdom, phylum, class, order, family, genus, species
50. Describe how organisms get their scientific names
51. Explain the important of using scientific names when identifying organisms

L. Classification & Taxonomy of Species

1. Biological Classification
2. Hierarchy of Taxonomy
3. Scientific Name

52. Describe the common traits shared by organisms classified in each phylum and class
53. Identify common representatives from each phylum by their scientific and indigenous names (if any)

M. Classification of Common Marine Invertebrates and Vertebrates:

1. Porifera
2. Cnidaria
   a) Hydrozoa
   b) Anthozoa
   c) Scyphozoan
3. Platyhelminthes
   a) Turbellaria
4. Mollusca
   a) Amphineura
   b) Gastropoda
   c) Bivalvia
   d) Cephalopoda
5. Annelida
   a) Polychaeta
6. Arthropoda
   a) Crustacea
7. Echinodermata
   a) Echinoidea
   b) Asteroidea
   c) Ophiuroidea
   d) Crinoidea
   e) Holothuroidea
8. Chordata

54. Explain the differences between seagrasses and seaweeds
55. Describe the abiotic and biotic conditions necessary to maintain healthy seagrass beds
56. Describe the ecological, economical, cultural, and educational importance of seagrass beds, seagrass, and algae
57. Identify and describe the characteristics of the three major divisions of algae
58. Identify, by their scientific names, ten algae from the chlorophyta division, three

N. Marine Plants

1. Seagrass
2. Seaweed
   a) Chlorophyta
   b) Rhodophyta
   c) Phaeophyta
3. Structures & Functions

from the phaeophyta division, and two from the rhodophyta division found in Palau

59. Identify by their scientific names the ten species of seagrass found in Palau
60. Sketch a diagram of a seagrass and label the following parts: roots, rhizome, leaf, leaf sheath, stem, marginal veins, and ligules (if present)
61. Sketch a diagram of an algae and label the following structures: blade, pneumatocysts (if present), stipe, holdfast, and haptera

62. Compare and contrast western-based and indigenous-based methods of conserving resources and explain importance of surveying and monitoring terrestrial and marine resources
63. Describe different monitoring techniques and which works best when
64. Use the "Reef Check" method to survey a shallow fringing reef for the following: substrate type, fish count, invertebrate, marine plants, and indications of anthropogenic threats to the reef
65. Describe the impacts of natural and anthropogenic threats to Palau islands' terrestrial and marine resources
66. Identify by their scientific and indigenous names, terrestrial and marine organisms that are threatened, endangered, and protected by law in Palau
67. Summarize most recent amendments to Palau's Marine Protection Act of 1994
68. Visit a conservation or protected area and describe the follow: history of the site; the type of ecosystem being protected; its ecological, cultural, economical, and educational significance; how it was selected to be a conservation area; whether or not it is a success story and why
69. Locate on a map of Palau and name conservation areas or protected areas of each state in Palau

70. Identify and locate marine lakes on a map of Palau
71. Describe the compositions of the different marine lakes in Palau: water properties, organisms that populate the lakes, and other unique features

72. Write concise profiles designed for use in public education and awareness of four

O. Conservation & Protection

1. Natural & Anthropogenic Threats to Resources
2. Survey and monitoring methods
   a) Transects
   b) Quadrants
   c) Video
   d) Timed swim
   e) Rapid visual survey
3. Conservation methods
4. Threatened, endangered, and protected species in Palau

P. Marine Lakes of Palau

1. Characteristics
   a) Geology
   b) Ecology
   c) Chemistry

Q. Research & Symposium

different flora and fauna found in Palau—one each terrestrial flora and fauna, and one each marine flora and fauna

73. Construct PowerPoint presentations and present the four species profiles to peers and instructors

1. Species Profiles
2. Symposium

EQUIPMENT AND MATERIALS:

a. Internet Access
b. Laptop
c. LCD Projector
d. Computer Printer
e. Copy Machine
f. TV set
g. VCR Player
h. DVD Player
i. Boat
j. Snorkeling Gear Set per student: Mask, snorkel, & swimming fins
k. Bus or Van

VIII. TEXT AND REFERENCES:

a. Required field guides for Student

Gosliner, Terrence, David W. Behrens, and Gary C. Williams. Coral Reef Animals of the Indo-Pacific. Monterey, CA: Sea Challengers, 1996.

Kitalong, Ann H., Robin Ann DeMeo, and Tarita Holm. Native Trees of Palau: A Field Guide, 2nd Edition. Koror, Palau: The Environment Inc., 2013

Pratt, H. Douglas and Mandy Etpison. The Birds & Bats of Palau. Honolulu, HI: Mutual Publishing, 2008

IX. Methods of Instruction:

A. Traditional classroom and lab lectures and demonstrations
B. Use of supplemental audio-visuals (DVDs and VCR tapes)
C. Instructor-made supplemental readings and reinforcement exercises
D. Reinforcement Activities
E. Field Trips
F. Internet Resources
G. Symposium

X. Method of Evaluation:

Semester grade is weighted based on the following components:

Grade Components	*Weigh (%)*
Participation in class discussion, lab demonstrations, and field work	10%
Assignments	10%
Quizzes & Tests	20%
Research Papers (4 Species Profiles)	20%
Laboratory/Field Works	20%
Final Exam	20%

The computation of the letter grade is as follows:

Percentage	Letter grade
90% to 100%	A

80% to 89%	B
70% to 79%	C
65% to 69%	D
64% and below	F

TASK LISTING SHEET

SC 239 Natural History of Palau — **Credits: 3 1 48**
Course No. & Title — **Lec. Lab Total Lab Hrs.**

Identify each laboratory SLO only (from course outline) and list its accompanying tasks. Use numbers for SLO and small letters for tasks — **Total hours for each SLO**

1. SLO 72 & 73: PROVIDE AND INTERPRET WRITING GUIDELINES FOR CONSTRUCTING SPECIES PROFILE and PRESENTATION — 6
   a. Specify guidelines required for constructing written species profiles for use in public education and awareness
   b. Specify guidelines for constructing a powerpoint presentation of species profiles for public education & awareness
   c. Search for information on species using search engines on the internet
   d. Conduct personal interview with local experts on Palau's flora and fauna

2. SLO 73: STUDENT PRESENTATIONS — 12
   a. Conduct symposium during the week before and week of mid-terms where students present profiles of two terrestrial species found in Palau
   b. Conduct a symposium during the last two weeks of instructions where students present profiles of two marine species found in Palau

3. SLO 12 →15: PROVIDE OVERVIEW OF PALAU ISLANDS GEOGRAPHY — 3
   a. Label the major volcanic and limestone islands of the Palau archipelago on a map
   b. Recognize the unique geological and/or man-made structural features of the 16 states of Palau on a map of Palau

4. SLO 11, 15, 16, 25: COMPARATIVE STUDY OF LIMESTONE AND VOLCANIC ISLANDS — 3
   a. Identify islands and channels, and label them on a map of Palau
   b. Compare the following features about Ngemelachel, Metuker ra Bisech and Ngarchelngael: geological formation, soil quality, forest make-up, and water availability
   c. Recognize, by their scientific names, some of the common plants found on limestone island and describe their unique adaptations
   d. Recognize, by their scientific names, the birds and other animals commonly observed in area during field observations

5. SLO 11, 25, 65: IDENTIFICATION OF PLANTS ON A VOLCANIC ISLAND — 3
   a. Distinguish the various types of vegetations observed on Ngarkebesang: strand, secondary, upland, and savannah
   b. Recognize, by their scientific names, some of the common plants of the different vegetations along the PPR Nature Trail
   c. Recognize, by their scientific names, common animals that inhabit the forest floor and canopies
   d. Describe the impacts of human activities and natural events on forest ecosystems and their composition

6. SLO 35, 36, 53, 65, 66: IDENTIFICATION OF TREES AND PLANTS IN MANGROVE FOREST — 3
   a. Recognize, by their scientific names, common plants associated with mangrove forests in Palau, including true mangrove trees
   b. Recognize, by their scientific names, common animals that inhabit the mangrove mud, water, and forest
   c. Describe the impacts of human activities and natural events to mangroves

7. SLO 25, 28, 53, 65, 66, 68: OBSERVE THE ECOLOGICAL, ECONOMICAL, AND CULTURAL SIGNIFICANCE OF NGARDOK NATURE RESERVE — 3
   a. Distinguish the various types of vegetations observed along the road to Ngardok Lake
   b. Recognize, by their scientific names, common plants of the different vegetation types
   c. Recognize, by their scientific names, common animals that make their home in Ngardok Nature Reserve and observed along the hiking trail to the lake
   d. Describe the impacts of human activities and natural events to the Ngardok Nature Reserve

8. SLO 2, 3, 37, 65, 66, 68: COMPARING WATER PROPERTIES FROM THE RIVER TO THE REEFS — 3
   a. Examine the formation of the bay and the physical features surrounding it
   b. Conduct water quality test at different locations (Ngermeskang river, Ngermeskang and Yamato rivers Y-junction, Ngermeskang river mouth, Ngermeduu Bay, fringing reef, and Ngaremlengui channel) and compare the following bottom and surface properties: temperature, pH, salinity, dissolved oxygen, conductivity, turbidity
   c. Observe and relate the changing water properties to the mangrovet distribution along the banks of the river
   d. Review the scientific names of mangrove plants along the banks of Ngermeskang river
   e. Describe the impacts of human activities and natural events on Ngermeskang river and Ngermeduu Bay

9. SLO 54, 57, 58, 60, 61, 65, 66: FIELD IDENTIFICATION OF ALGAE AND SEAGRASS — 3
   a. Observe and describe natural habitats of algae and seagrass
   b. Identify, by their scientific names, the following marine algae found in Palau: 10 chlorophyta, three phaeophyta, and two rhodophyta
   c. Identify, by their scientific names, the 10 species of seagrass found in Palau
   d. Describe the impacts of human activities and natural events to the habitats of algae and seagrass

10. SLO 10, 11, 35, 36, 38, 40, 53, 57, 58: CLASSIFY MARINE FLORA AND FAUNA (PALAU AQUARIUM) — 3
   a. Review the geological formation of the Palau Archipelago
   b. Review the scientific names of mangroves and marine plants observed inside the aquaria
   c. Diagram a typical reef profile in Palau and label the different zones on the reef

d. Identify by their scientific names, and classify into appropriate phyla and class, the various marine organisms displayed at the Palau Aquarium

11. SLO 18, 25, 53, 65, 68, 71: DESCRIBE A SIMPLE ECOSYSTEM (ONGEIM L'TKETAU aka TOURIST JELLYFISH LAKE) AND ITS VULNERABILITY TO ANTHROPOGENIC AND NATURAL THREATS — 3
    a. Integrate knowledge of ecology and describe how a simple ecosystem such as a marine lake functions
    b. Identify by their scientific names and classify to appropriate phyla and classes the different organisms that live inside the marine lake
    c. Diagram the food web in the marine lake to show interrelatedness of the organisms to each other, the environment inside the lake and the surrounding areas.
    d. Recite the scientific names of plants along the hiking trail to the marine lake
    e. Recite the scientific names and classify to appropriate phyla and class the animals observed on the hike to the lake
    f. Describe the impacts of human activities to the marine lake and its inhabitants

12. SLO 64, 65, 69: SURVEY AND DISCUSS SOLUTIONS TO PROTECT AND CONSERVE LOCAL RESOURCES — 3
    a. Apply a survey method or reef monitoring techniques to survey the reef: substrate, invertebrates, fish, algal coverage, seagrass coverage, coral damage, exploitation of resources
    b. Isolate indication(s) of human pollution from natural threats to coral reefs
    c. Discuss protection and conservation of marine resources in the area

COURSE LEARNING OUTCOMES
SC239 Natural History of Palau
PALAU COMMUNITY COLLEGE

During the course experience, the **course learning outcomes (CLOs)** will be assessed through the use of signature assignments. A rating scale will be used to determine the students' proficiency level of each CLO using specifically aligned assignments. The numerical ratings of 4, 3, 2, and 1 are not intended to represent the traditional school grading system of A, B, C, D, and F. The descriptions associated with each of the numbers focus on the level of student performance for each of the course learning outcomes listed below.

Rating Scale:
4—Accomplished 3—Competent 2—Developing 1—Beginning

CLO #1 – KNOWLEDGE OF THE NATURAL ENVIRONMENT OF PALAU: Student is literate and demonstrates familiarity of the natural environment of Palau, its geological formation, ecosystems, and indigenous, endemic, endangered, and invasive flora and fauna that inhabits the islands.

4	Complete all of the following tasks with 90% accuracy or better: • Provides concise geographical location and description of the Palau archipelago in reference to its neighboring islands in Oceania region and major continents; • Scientifically explains the formation of the Palau Islands; • Identifies on a map of Palau the major volcanic and limestone islands and describes their major physical features including vegetation types, rivers, lakes, and other special features; • Recognize by their scientific names some of the common terrestrial and marine flora and fauna of Palau, and classify them into appropriate taxa; • Explain the ecological, economical, educational, and cultural significance of the following major ecosystems in Palau: forest, lakes, rivers, estuaries, and coral reefs; • Recognize by their scientific names terrestrial and marine flora and fauna that are threatened, endangered, endemic, and/or invasive; • Apply proper techniques in collecting, preserving, and labeling terrestrial and marine specimens for herbarium and/or museum collection; • Apply simple ecological field surveying techniques to gather quantitative data for the purpose of short- and long-term monitoring of a threatened species, habitat, or an ecosystem; • Construct and present to peers concise profiles of four different species found in Palau for use in public education and awareness
3	Complete all of the above tasks with an accuracy of 70-89%
2	Complete all of the above tasks with an accuracy of 65-69%
1	Complete all of the above tasks with an accuracy of less than 65%

CLO #2 – RESEARCH SKILLS: Student actively learns outside of the classroom through library research, local interviews, and search using different internet search engines.

4	Complete all of the following tasks with 90% accuracy or better: • Exhibits ability to locate, select, and prioritize appropriate literature and other sources outside of the classroom to construct species profiles; • Demonstrates knowledge of species by prioritizing and selecting convincing facts and information about a species that can convince audience of its ecological, economical, and cultural significances; • Correctly interprets information; • Creatively propose original and practical solutions to promote the conservation and protection of species; • Defends facts by providing references used to construct species profiles
3	Complete all of the above with an accuracy of 70-89%
2	Complete all of the above with an accuracy of 65-69%
1	Complete all of the above with an accuracy of less than 65%

CLO #3 – KNOWLEDGE SHARING: Student shares knowledge to diverse audience by preparing and presenting a community awareness presentation of a local environmental issue to a local audience; student engages in community activities to experience possible solutions to local and global problems

4	Complete all of the following tasks with 90% accuracy or better: • Capable of putting together a PowerPoint presentation that highlights important facts about species of Palau; • Presentation is concise yet covers all of the required contents with details;

	• Presentation information is well organized in a logical and clear way; • Presentation includes basic information that audience gain a comfortable understanding of the topic; • Presentation demonstrates creativeness, inventiveness, and resourcefulness of student
3	Complete all of the above with an accuracy of 70-89%
2	Complete all of the above with an accuracy of 65-69%
1	Complete all of the above with an accuracy of less than 65%