COURSE TITLE

Marine Biology

LENGTH

One Semester

DEPARTMENT

STEM Department

SCHOOL

Rutherford High School

DATE

September 10, 2018

Initial BOE Approval Date (Born on): 6/15/2015

Marine Biology

I. Introduction/Overview/Philosophy

Marine Biology is the scientific study of the plants, animals, and other organisms that live in the ocean. The ocean is a vast realm that contains many strange and wonderful creatures. It is often the beauty, mystery, and variety of life in the sea that attracts students to a course in marine biology. Even professional marine biologists feel a sense of adventure and wonder in their studies. It is therefore the goal of this course to instill in our students the belief that marine biology is an exciting, relevant, human activity that can be enjoyable to study. To this end, the extensive use of laboratory experimentation, demonstrations and other hands-on and field activities are an integral part of this course.

II. Objectives

Course Outline:

1. Appreciate the marine environment and its inhabitants by:
    a. Investigating the geography of the oceans.
    b. Investigating the geomorphology of the oceans.
    c. Comparing and contrasting the pelagic environment and the benthic environments.
2. Develop an understanding of man's effect on the balance of nature in the marine environment by:
    a. Examining the physical, chemical, and biological factors of ecology.
    b. Determining the food potential of the marine environment.
    c. Investigating farming of marine life.
3. Identify and classify marine plants and animals by:
    a. Discussing the criteria for classification of marine microscopic plants and animals.
    b. Classifying and examining phytoplankton.
    c. Classifying and examining Zooplankton.
    d. Investigating planktonic communities.
    e. Collecting plankton.
    f. Classifying and examining nektonic organisms.
    g. Describing nektonic communities.
    h. Collecting nektonic organisms.
    i. Classifying and examining primitive fish.
    j. Classifying and examining bony fish.
    k. Classifying and examining marine reptiles.
    l. Classifying and examining marine mammals.
    m. Identifying and classifying plants and animals of the benthos community.
    n. Collecting benthos organisms.

Student Outcomes:

After successfully completing this course, the student will:

- Understand how the interacting components of a system combine to produce the overall behavior of the system.

- Apply problem-solving skills to develop and test hypotheses by planning experiments where they conduct observations, gather and analyze data, draw conclusions and communicate results.
- Appreciate the many people and cultures that have contributed to the advancement of science and the individuals that have made major discoveries.
- Apply scientific discoveries to technology.
- Relate mathematical concepts in scientific problem solving as a means of expressing scientific theories.
- Develop models to explore the nature of matter and energy in order to understand the physical universe.
- Defend the need to care for, respect, and protect living things and their habitats.

New Jersey Student Learning Standards

CAREER READY PRACTICES

CRP1 Act as a responsible and contributing citizen and employee.

Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.

CRP2 Apply appropriate academic and technical skills.

Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation

CRP4 Communicate clearly and effectively and with reason.

Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.

CRP5. Consider the environmental, social and economic impacts of decisions.

Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact and/or mitigate negative impact on other people, organization, and the environment. They are aware of and utilize new technologies, understandings, procedures, materials, and regulations affecting the nature of their work as it relates to the impact on the social condition, the environment and the profitability of the organization.

CRP6. Demonstrate creativity and innovation.

Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and suggestions will add greatest value. They seek new methods, practices, and ideas from a variety of sources and

seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.

CRP7. Employ valid and reliable research strategies.
Career-ready individuals are discerning in accepting and using new information to make decisions, change practices or inform strategies. They use reliable research process to search for new information. They evaluate the validity of sources when considering the use and adoption of external information or practices in their workplace situation.

CRP11. Use technology to enhance productivity.
Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring new technology. They are proficient with ubiquitous technology applications. They understand the inherent risks-personal and organizational-of technology applications, and they take actions to prevent or mitigate these risks.

CRP12. Work productively in teams while using cultural global competence.
Career-ready individuals positively contribute to every team, whether formal or informal. They apply an awareness of cultural difference to avoid barriers to productive and positive interaction. They find ways to increase the engagement and contribution of all team members. They plan and facilitate effective team meetings.

TECHNOLOGY

Standard 8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
Strand E: Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.
8.1.12.E.1- Produce a position statement about a real world problem by developing a systematic plan of investigation with peers and experts synthesizing information from multiple sources.
Standard 8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.
Strand C. Design: The design process is a systematic approach to solving problems.
8.2.12.C.4- Explain and identify interdependent systems and their functions.
8.2.12.C.7- Use a design process to devise a technological product or system that addresses a global problem, provide research, identify trade-offs and constraints, and document the process through drawings that include data and materials.

21ST CENTURY LIFE AND CAREERS
9.1 Personal Financial Literacy
Strand F: Civic Financial Responsibility
9.1.12.F.5 Compare and contrast the role of philanthropy, volunteer service, and charities in community development and quality of life in a variety of cultures.
9.2 Career Awareness, Exploration, and Preparation
Strand C: Career Preparation

9.2.12.C.1 Review career goals and determine steps necessary for attainment.

COMPANION STANDARDS FOR SCIENCE AND TECHNICAL SUBJECTS

RST.11-12.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
RST.11-12.4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.
RST.11-12.7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
RST.11-12.9. Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
WHST.11-12.2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
WHST.11-12.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
WHST.11-12.5. Develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on addressing what is most significant for a specific purpose and audience.
WHST.11-12.7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

NEW JERSEY STUDENT LEARNING STANDARDS- SCIENCE

HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.
HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
HS-LS4-4. Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

III. Proficiency Levels

Marine Biology is available to junior and senior level students who have completed Biology.

IV. Methods of Assessment

Student Assessment
The teacher will provide a variety of assessments, among them are: homework, teacher-made tests and quizzes, projects, research reports, laboratory reports, and presentations.

Curriculum/Teacher Assessment
The teacher will provide the subject area supervisor with suggestions for changes on an ongoing basis.

V. Grouping

Marine Biology is a heterogeneously grouped junior/senior level course.

VI. Articulation/Scope & Sequence/Time Frame

Course length is one semester.

VII. Resources

Texts/Supplemental Reading/References
Resources include but are not limited to:

1. Text
    a. Marine Biology, 6th Edition. McGraw-Hill, 2007.
2. References
    a. Marine Biology, McGraw-Hill, 2000.
    b. Various Websites
    c. Various Videos

VIII. Suggested Activities

Appropriate activities are listed on the curriculum map.

IX. Methodologies

Marine Biology is a laboratory science with lessons focused on laboratory experiments and hands-on activities. Group instruction, cooperative learning and individual projects are also utilized.

X. Interdisciplinary Connections

Connections are made to mathematics in the form of analysis of data and graphs. Discussions as to the historical significance and background of scientific experiments and discoveries strengthen the connection to history. Nutrition analysis makes a connection with Foods (Family and Consumer Science). Topics from other science areas such as chemistry and earth science play an important part in the study of marine biology.

XI. Differentiating Instruction for Students with Special Needs: Students with Disabilities, Students at Risk, English Language Learners, and Gifted & Talented Students

Differentiating instruction is a flexible process that includes the planning and design of instruction, how that instruction is delivered, and how student progress is measured. Teachers recognize that students can learn in multiple ways as they celebrate students' prior knowledge. By providing appropriately challenging learning, teachers can maximize success for all students.

Differentiating in this course includes but is not limited to:

Differentiation for Support (ELL, Special Education, Students at Risk)

- Peer mentoring on problems
- Differentiated teacher feedback on assignments
- Modeling out problems on whiteboard
- Visual aids as we project problems on whiteboard
- Study guides
- Tiered assignments
- Scaffolding of materials and assignments
- Re-teaching and review
- Guided note taking
- Exemplars of varied performance levels
- Multi-media approach to accommodating various learning styles

Differentiation for Enrichment

- Supplemental reading material for independent study
- Flexible grouping
- Tiered assignments
- Topic selection by interest
- Enhanced expectations for independent study
- Elevated questioning techniques using Webb's Depth of Knowledge matrix

XII. Professional Development

The teacher will continue to improve expertise through participation in a variety of professional development opportunities.

XII. Curriculum Map/Pacing Guide

Unit Topic	Time Allocated	Differentiating Instruction for Students with Disabilities, Students at Risk, English Language Learners, & Gifted & Talented Students	Standards	Assessments
Oceanography ● Tides ● Surface currents ● Sedimentation ● Sand formation ● Seafloor spreading and plate movement	5 weeks	*For Support:* ● Use of visual and multi-sensory formats ● Modified assessments ● Guided notes ● Pre-teaching of vocabulary and concepts *For Enhancement:* ● Interest-based content ● Student-driven projects ● Real-world problems and scenarios	HS-ETS1-1 HS-ETS1-2 HS-ETS1-3 HS-ETS1-4 HS-PS4-1 CRP1,2,4,6,7,8,9,11,12 RST.11-12.3,4,7,9 WHST.11-12.2,4,5,7 8.2.12.C.4	*Formative Assessment:* ● Homework ● Classwork ● Questioning ● Entry/exit Tickets *Summative Assessment:* ● Test-The ocean floor and surface ● Lab- Mapping the ocean today
Plankton ● The life cycle of plankton ● Ecology of plankton	1 week	*For Support:* ● Use of visual and multi-sensory formats ● Use of assisted technology ● Modification of content and student products *For Enhancement:* ● Provide extension activities ● Adjusting the pace of lessons	HS-LS1-2 HS-LS4-3 HS-LS4-4 CRP1,2,4,6,7,8,9,11,12 RST.11-12.3,4,7,9 WHST.11-12.2,4,5,7	*Formative Assessment:* ● Classwork ● Questioning ● Homework *Summative Assessment:* ● Food web lab ● Test on plankton ecology and life cycle
Echinoderms ● Life cycle of echinoderms ● Unique echinoderm anatomy	2 weeks	*For Support:* ● Guided notes ● Pre-teaching of vocabulary and concepts ● Visual learning, including graphic	HS-LS1-2 HS-LS4-3 HS-LS4-4 CRP1,2,4,6,7,8,9,11,12 RST.11-12.3,4,7,9 WHST.11-12.2,4,5,7	*Formative Assessment:* ● Entry/exit tickets ● Classwork ● Homework ● Group and Cooperative Work

Unit Topic	Time Allocated	Differentiating Instruction for Students with Disabilities, Students at Risk, English Language Learners, & Gifted & Talented Students	Standards	Assessments
		organizers *For Enhancement:* ● Higher-order thinking skills ● Interest-based content ● Inquiry-based instruction		*Summative Assessment:* ● Quiz on anatomy ● Test on echinoderms ● Lab on the structures of echinoderms
Cnidarians • The life cycle of jellies and anemones • Radial and bilateral symmetry • Impact on humans	2 weeks	*For Support:* ● Pre-teaching of vocabulary and concepts ● Visual learning, including graphic organizers ● Testing accommodations *For Enhancement:* ● Inquiry-based instruction ● Student-driven projects ● Real-world problems and scenarios	HS-LS1-2 HS-LS4-3 HS-LS4-4 CRP1,2,4,6,7,8,9,11,12	*Formative Assessment:* ● Homework ● Questioning ● Entry/Exit Tickets ● Classwork *Summative Assessment:* ● Quizzes on cnidarian anatomy ● Tests on cnidarian life cycles and impacts on ecosystems. ● Benchmark Assessments
Coral Reefs • Anatomy • Interdependent relationships • Global climate change and reef destruction	3 weeks	*For Support:* ● Cooperative learning groups ● Guided notes ● Visual learning, including graphic organizers ● Modified assessments *For Enhancement:* ● Higher-order thinking skills ● Interest-based content ● Student-driven projects ● Real-world problems and scenarios	HS-LS1-2 HS-LS4-3 HS-LS4-4 HS-ESS2-2 CRP1,2,4,6,7,8,9,11,12 RST.11-12.3,4,7,9 WHST.11-12.2,4,5,7 8.2.12.C.4 8.2.12.C.7 8.1.12.E.1	*Formative Assessment:* ● Questioning ● Entry/Exit Tickets ● Classwork ● Group and Cooperative Work *Summative Assessment:* ● Benchmark Assessments ● Projects on the disappearance of coral reefs ● Quizzes on coral reef formation
Sharks • Anatomy • Sharks as a keystone species	2 weeks	*For Support:* ● Cooperative learning groups ● Authentic assessments ● Guided notes	HS-LS1-2 HS-LS4-3 HS-LS4-4 CRP1,2,4,6,7,8,9,11,12 RST.11-12.3,4,7,9	*Formative Assessment:* ● Classwork ● Group and Cooperative Work ● Homework

Unit Topic	Time Allocated	Differentiating Instruction for Students with Disabilities, Students at Risk, English Language Learners, & Gifted & Talented Students	Standards	Assessments
• Geography		*For Enhancement:* ● Provide extension activities ● Inquiry-based instruction ● Independent study	WHST.11-12.2,4,5,7	*Summative Assessment:* ● Test on shark anatomy ● Benchmark Assessments ● Projects on shark conservation
Marine Mammals • Anatomy • Evolution • Adaptations	2 weeks	*For Support:* ● Use of visual and multi-sensory formats ● Use of assisted technology ● Use of prompts ● Rephrase questions, directions, and explanations *For Enhancement:* ● Real-world problems and scenarios ● Inquiry-based instruction	HS-LS1-2 HS-LS4-3 HS-LS4-4 CRP1,2,4,6,7,8,9,11,12 RST.11-12.3,4,7,9 WHST.11-12.2,4,5,7	*Formative Assessment:* ● Classwork ● Entry/exit tickets ● Homework ● Questioning *Summative Assessment:* ● Quizzes on mammal anatomy and evolution ● Benchmark Assessments ● Projects on the evolution of whales
Marine Conservation ● Conservation efforts ● Citizen science ● Global climate change/water pollution	2 weeks	*For Support:* ● Rephrase questions, directions, and explanations ● Modification of content and student products ● Teacher modeling ● Think-pair-share *For Enhancement:* ● Interest-based content ● Student-driven projects ● Real-world problems and scenarios ● Critical/Analytical thinking tasks	HS-LS1-2 HS-LS4-3 HS-LS4-4 CRP1,2,4,6,7,8,9,11,12 RST.11-12.3,4,7,9 WHST.11-12.2,4,5,7 8.1.12.E.1 8.2.12.C.7 9.1.12.F.5 9.2.12.C.1	*Formative Assessment:* ● Homework ● Questioning ● Classwork ● Group and Cooperative Work *Summative Assessment:* ● Project on marine conservation efforts and citizen science ● Benchmark assessment