Randolph Township Schools
Randolph High School

Marine Biology Honors Curriculum

"The world's finest wilderness lies beneath the waves…"
~Wyland, Marine Life Artist

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Randolph Township Schools
Department of Science, Technology, Engineering, & Mathematics
Marine Biology Honors

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Randolph Township Schools

Mission Statement

We commit to inspiring and empowering all students in Randolph schools to reach their full potential as unique, responsible and educated members of a global society.

Randolph Township Schools
Affirmative Action Statement

Equality and Equity in Curriculum

The Randolph Township School district ensures that the district's curriculum and instruction are aligned to the State's Standards. The curriculum addresses the elimination of discrimination and the achievement gap, as identified by underperforming school-level AYP reports for state assessment. The Curriculum provides equity in instruction, educational programs and provides all students the opportunity to interact positively with others regardless of race, creed, color, national origin, ancestry, age, marital status, affectional or sexual orientation, gender, religion, disability or socioeconomic status.

N.J.A.C. 6A:7-1.7(b): Section 504, Rehabilitation Act of 1973; N.J.S.A. 10:5; Title IX, Education Amendments of 1972

RANDOLPH TOWNSHIP BOARD OF EDUCATION
EDUCATIONAL GOALS
VALUES IN EDUCATION

The statements represent the beliefs and values regarding our educational system. Education is the key to self-actualization, which is realized through achievement and self-respect. We believe our entire system must not only represent these values, but also demonstrate them in all that we do as a school system.

We believe:

- The needs of the child come first
- Mutual respect and trust are the cornerstones of a learning community
- The learning community consists of students, educators, parents, administrators, educational support personnel, the community and Board of Education members
- A successful learning community communicates honestly and openly in a non-threatening environment
- Members of our learning community have different needs at different times. There is openness to the challenge of meeting those needs in professional and supportive ways
- Assessment of professionals (i.e., educators, administrators and educational support personnel) is a dynamic process that requires review and revision based on evolving research, practices and experiences
- Development of desired capabilities comes in stages and is achieved through hard work, reflection and ongoing growth

Randolph Township Schools
Department of Science, Technology, Engineering, & Mathematics

Introduction

Randolph Township Schools is committed to excellence. We believe that all children are entitled to an education that will equip them to become productive citizens of the 21st century. We believe that an education grounded in the fundamental principles of science, technology, engineering, and math (STEM) will provide students with the skills and content necessary to become future leaders and lifelong learners.

A sound STEM education is grounded in the principles of inquiry, rigor, and relevance. Students will be actively engaged in learning as they use real-world STEM skills to construct knowledge. They will have ample opportunities to manipulate materials and solve problems in ways that are developmentally appropriate to their age. They will work in an environment that encourages them to take risks, think critically, build models, observe patterns, and recognize anomalies in those patterns. Students will be encouraged to ask questions, not just the "how" and the "what" of observed phenomena, but also the "why". They will develop the ability, confidence, and motivation to succeed academically and personally.

STEM literacy requires understandings and habits of mind that enable students to make sense of how our world works. As described in Project 2061's *Benchmarks in Science Literacy, The Standards for Technological Literacy,* and *Professional Standards for Teaching Mathematics,* literacy in these subject areas enables people to think critically and independently. Scientifically and technologically literate citizens deal sensibly with problems that involve mathematics, evidence, patterns, logical arguments, uncertainty, and problem-solving.

Marine Biology Honors

Introduction

Marine Biology Honors is an elective course in the STEM department for students who have completed honors biology. It introduces students to the major concepts in marine biology and provides them with a unique opportunity to conduct self-designed scientific investigation in the context of marine systems. Students will become familiar with the diversity of marine ecosystems, biotic and abiotic processes within the systems, marine phyla, and marine and coastal conservation. Through this course, students will hone their inquiry skills as they design, conduct, and analyze a series of scientific investigations focused on a variety of marine phyla.

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Curriculum Pacing Chart
Marine Biology Honors

SUGGESTED TIME ALLOTMENT	UNIT NUMBER	CONTENT - UNIT OF STUDY
2 weeks	**I**	**Introduction to Marine Biology**
2 weeks	**II**	**Scientific Method and Experimental Design**
13 weeks	**III**	**Marine Phyla and Biodiversity**
1 week	**IV**	**Marine Conservation**

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Marine Biology Honors
UNIT I: Introduction to Marine Biology

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
The environment is a complex assemblage of interacting and evolving chemical, physical and biological processes; changes in these processes will impact the species diversity and distribution within the environment.	• How could the environment—including the distribution and abundance of species—be changed by physical, chemical, and biological factors?
Evolution is change in the genetic makeup of a population over time and results from the process of natural selection.	• How can various types of selective pressure change populations? • How can interspecific interactions lead to coevolution?
Seawater is composed of water, dissolved solid material, and dissolved gases; composition varies depending on geography and depth; and composition influences the distribution of marine organisms.	• Why and where does variation exist in the composition of seawater? • How can seawater variation affect the distribution and abundance of marine communities?

KNOWLEDGE	SKILLS	CC/NJCCCS
Students will know:	**Students will be able to:**	5.1.A.12.1 5.1.A.12.2
Biogeochemical cycles and their relationships to the marine environment.	Analyze changes and/or situations in marine systems relative to or as a result of changes in biogeochemical cycles (e.g. nitrogen, carbon, or water).	5.1.A.12.3 5.1.12.B.1 5.1.12.B.2 5.1.12.B.3
How natural selection leads to differential reproduction and consequential changes in the genetic makeup of a population.	Analyze a situation involving selective pressure (e.g. predator/prey, competition, or resource shortage), identify traits that might be selected for or against, and predict the outcome of the pressure on a given population.	5.1.12.B.4 5.1.12.C.1 5.1.12.C.2 5.1.12.C.3 5.1.12.D.1
Origin, quantities, and patterns of variation of dissolved solid and gas material in seawater.	Analyze and evaluate seawater in terms of salinity, dissolved oxygen, and dissolved carbon dioxide.	5.1.12.D.2 5.1.12.D.3 5.2.12.A.2
Categories and defining characteristics of marine ecosystems.	Evaluate and classify marine ecosystems based on biotic and abiotic characteristics.	5.2.12.A.5 5.2.12.A.6 5.2.12.B.1 5.2.12.B.4 5.2.12.B.5 5.2.12.B.6 5.3.12.C.1

		5.3.12.C.2 5.3.12.D.1 5.3.12.D.2 5.3.12.E.1 5.3.12.E.3 5.3.12.E.4 5.4.12.E.1 5.4.12.F.2 5.4.12.F.3 5.4.12.G.1 5.4.12.G.2 5.4.12.G.3 5.4.12.G.4 5.4.12.G.5 5.4.12.G.6 5.4.12.G.7 RST.11-12.7 RST.11-12.9

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Unit I - Curriculum Pacing Chart
Marine Biology Honors

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
2 weeks	**Unit I – Introduction to Marine Biology** o Biogeochemical cycles o Evolution and natural selection o Seawater o Marine ecosystems	Textbook: Karleskint, Turner, and Small, *Introduction to Marine Biology*, 2006. Online Evolution and Natural Selection Simulation Lab: http://biologyinmotion.com/evol/ Make your own hydrometer (modified): www.msc.ucla.edu/oceanglobe/pdf/densitysalinity/density4.pdf

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Marine Biology Honors
Unit II: Scientific Method and Experimental Design

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
Scientific inquiry is a purposeful and controlled attempt to describe, predict, and explain natural phenomena through a continuous process of questioning, data collection, analysis and interpretation.	• What does it mean to observe and ask questions in science? • How do scientists design experiments in order to demonstrate a quantifiable relationship between two variables?
Scientific literacy includes the ability to search for and assess the relevance and credibility of scientific information found in various print and electronic media, in addition to the ability to read, write, discuss, and present coherent ideas about science.	• Why is it important to determine the validity of experimental design and credibility of scientific claims?
Scientific inquiry requires the sharing of findings and ideas for critical review by colleagues and other scientists.	• Why is it necessary to support scientific claims with experimental evidence?

KNOWLEDGE	SKILLS	CC/NJCCCS
Students will know:	**Students will be able to:**	5.1.12.A.1 5.1.12.A.2
Observation and questioning are the basis for beginning a scientific study.	Objectively record observations and develop questions regarding phenomena.	5.1.12.A.3 5.1.12.B.1 5.1.12.B.2
Conducting a literature review is necessary in order to be well-informed on the most current research in the field and to inform the experimental design.	Evaluate electronic and print resources in multiple formats such as scientific journals.	5.1.12.B.3 5.1.12.B.4 5.1.12.C.1
	Select appropriate resources that inform experimental design.	5.1.12.C.2 5.1.12.C.3
Designing a scientific experiment requires identifying and isolating independent and dependent variables, in addition to levels of the independent variable. When writing a hypothesis it should demonstrate a predicted relationship between these two variables.	Formulate a testable hypothesis, in the "If..., then..." format, which demonstrates a predicted relationship between two variables.	5.1.12.D.1 5.1.12.D.2 5.1.12.D.3
	Design a controlled experiment where the independent and dependent variables are accurately identified.	HSS-ID.A.1 HSS-ID.A.3
In advance of the experiment, a data collection method must be selected that is appropriate for the topic of study.	Select and implement methodologies and equipment that are appropriate for the design of the experiment.	HSS-ID.B.6 HSS-IC.B.6
	Record data in the appropriate units of measure, and apply both precision and accuracy in recording experimental data.	RST.11-12.1 RST.11-12.2 RST.11-12.3

Once data is collected, it must be analyzed and presented in the form of charts or graphs. In order to draw conclusions and share findings that demonstrate whether there is a relationship between the variables studied, experimental evidence must be used to support scientific claims. Peer review and presentation of research allows scientists to critically evaluate the current body of scientific knowledge.	Select and use mathematical operations to analyze and interpret data, and present relationships between variables in appropriate formats such as charts or graphs. Develop logical conclusions, using supporting evidence, that are based on the analysis of experimental data. Formulate a report that communicates the results of a scientific experiment.	RST.11-12.4 RST.11-12.5 RST.11-12.6 RST.11-12.7 RST.11-12.8 RST.11-12.9 RST.11-12.10

RANDOLPH TOWNSHIP SCHOOL DISTRICT
Unit II - Curriculum Pacing Chart
Marine Biology Honors

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
2 weeks	**Unit II – Scientific Method and Experimental Design** ○ Scientific inquiry ○ Observation ○ Literature review ○ Experimental design ○ Data collection ○ Data analysis ○ Presentation of findings	Textbook: Karleskint, Turner, and Small. *Introduction to Marine Biology*, 2006. Handbook: Ambrose, et al. *A Handbook of Biological Investigation*, 2002. Course Documents: • Experimental Design Practice Worksheet • Instructions For Self-Designed Research • Guide to Writing a Scientific Report • Peer Review Checklist • Experimental Design Grading Rubric Online Resource: Experimental Design and Data Analysis for Biologists: http://www.lacbiosafety.org/wp-content/uploads/2011/09/experimental-design-and-data-analysis-for-biologists1.pdf

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Marine Biology Honors
Unit III: Marine Phyla and Biodiversity

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
As a result of natural selection and environmental pressures, organisms within each phylum of marine animals share common adaptations such as body structure, movement, and feeding behavior.	• What are some of the potential factors responsible for the variation in structure and function among different marine phyla? • How do observations of the behavior of a species inform scientists about its niche in an ecosystem?
By designing controlled experiments based on observations, marine biologists are able to draw evidence-based conclusions regarding organisms within each marine phylum.	• How does experimental evidence inform our understanding of the diversity of marine life?

KNOWLEDGE	SKILLS	CC/NJCCCS
Students will know: Marine phyla are defined by distinct common characteristics and adaptations. The species diversity that exists within the following selected marine phyla: Arthropoda, Echinodermata, Cnidaria, Mollusca, and Chordata. The diversity of ecological roles that exist within and among the selected marine phyla.	**Students will be able to:** Record and diagram observational data about the body plan and major defining structures of organisms in each selected marine phylum. Collect appropriate background research regarding the selected topic of study by conducting a literature review using multiple forms of electronic and print resources. Design a collaborative, independent research experiment based on an original question relative to the selected marine phyla by using scientific inquiry. Evaluate experimental results and draw evidence-based conclusions relative to the original question for each selected marine phylum. Summarize experimental findings in the form of a research report that includes relationship of experimental conclusions to ecology, evolution, and/or conservation of the phylum. Revise and construct new understandings of the characteristics of each marine phylum by participating in a review of peer research reports.	5.1.12.A.1 5.1.12.A.2 5.1.12.A.3 5.1.12.B.1 5.1.12.B.2 5.1.12.B.3 5.1.12.B.4 5.1.12.C.1 5.1.12.C.2 5.1.12.C.3 5.1.12.D.1 5.1.12.D.2 5.1.12.D.3 5.3.12.A.3 5.3.12.A.4 5.2.12.B.3 5.2.12.B.5 5.3.12.C.1 5.3.12.D.3 5.3.12.E.1 5.3.12.E.2 5.3.12.E.3 5.3.12.E.4

		HSS-ID.A.1 HSS-ID.A.3 HSS-ID.B.6 HSS-IC.B.6 RST.11-12.1 RST.11-12.2 RST.11-12.3 RST.11-12.4 RST.11-12.5 RST.11-12.6 RST.11-12.7 RST.11-12.8 RST.11-12.9 RST.11-12.10

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Unit III - Curriculum Pacing Chart
Marine Biology Honors

SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
13 weeks	**Unit III – Scientific Method and Experimental Design** o Defining characteristics of marine phyla o Species diversity of marine phyla o Ecological roles of marine phyla	Textbook: Karleskint, Turner, and Small. *Introduction to Marine Biology*, 2006. PBS Video Series: Shape of Life Suggested Lab Exercises: Sea Star Dissection Sea Urchin Reproduction Lab Squid Dissection Fish Buoyancy Lab

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Marine Biology Honors
UNIT IV: Marine Conservation

ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
Changes in any of the interacting biotic and abiotic processes will impact the current state of the marine environment.	• What are the potential consequences of environmental changes that result from variations in physical, chemical, and biological factors?
Pollution, development, and over-harvesting have all significantly degraded the biodiversity and environmental, economic, and recreational value of the marine environment.	• What are the consequences of pollution, development, and over-harvesting on the marine environment? • How do synergistic effects associated with various forms of environmental degradation exacerbate the consequences?

KNOWLEDGE	SKILLS	CC/NJCCCS
Students will know: Types and consequences of marine habitat modification and interference in natural processes. Categories, sources, and environmental consequences of major types of marine pollution. Status of commercial fishing and environmental and economic consequences of overfishing.	**Students will be able to:** Evaluate marine habitat modifications and/or interferences in natural processes and then predict possible environmental consequences. Identify and categorize major types of marine pollution, describe their possible sources, and discuss their possible consequences. Analyze commercial fishing harvest and techniques in terms of species population levels, by-catch, environmental consequences, and economic consequences.	5.1.A.12.1 5.1.A.12.2 5.1.A.12.3 5.1.12.B.3 5.1.12.B.4 5.1.12.C.1 5.1.12.C.2 5.1.12.C.3 5.1.12.D.1 5.1.12.D.2 5.1.12.D.3 5.2.12.A.2 5.2.12.A.5 5.2.12.B.1 5.2.12.B.4 5.2.12.B.5 5.2.12.B.6 5.3.12.C.1 5.3.12.C.2 5.4.12.E.1 5.4.12.F.2 5.4.12.F.3

		5.4.12.G.1 5.4.12.G.2 5.4.12.G.3 5.4.12.G.4 5.4.12.G.5 5.4.12.G.6 5.4.12.G.7 RST.11-12.1 RST.11-12.2 RST.11-12.3 RST.11-12.4 RST.11-12.5 RST.11-12.6 RST.11-12.7 RST.11-12.8 RST.11-12.9 RST.11-12.10

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Unit IV - Curriculum Pacing Chart
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SUGGESTED TIME ALLOTMENT	CONTENT-UNIT OF STUDY	SUPPLEMENTAL UNIT RESOURCES
1 week	**Unit IV – Marine Conservation** o Habitat modification and natural process interference o Marine pollution o Commercial fishing impacts	Textbook: Karleskint, Turner, and Small, *Introduction to Marine Biology*, 2006. BBC Documentary: The Death of Oceans

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APPENDIX A

RESOURCES:

Textbook:

Introduction to Marine Biology
Authors: Karleskint, Turner, and Small
ISBN13: 9780534420727
Copyright 2006 Thomson Brooks/Cole

Technology:

- Spreadsheet software such as Excel
- Word processor software such as Word
- Presentation software such as Powerpoint

Web addresses:

Online Evolution and Natural Selection Simulation Lab:
http://biologyinmotion.com/evol/

Make your own hydrometer (modified):
www.msc.ucla.edu/oceanglobe/pdf/densitysalinity/density4.pdf

Course Documents:

- Experimental Design Practice Worksheet
- Instructions For Self-Designed Research
- Guide to Writing a Scientific Report
- Peer Review Checklist
- Experimental Design Grading Rubric

PBS Video Series: Shape of Life

Suggested Lab Exercises:

Saltwater tank and filter setup and maintenance
Sea Star Dissection
Sea Urchin Reproduction Lab
Squid Dissection
Fish Buoyancy Lab
Self-designed Labs on selected Phyla

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APPENDIX B

ASSESSMENT:

- Quiz
- Test
- Individual Projects
- Group Projects
- Lab Reports
- Homework

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APPENDIX C

Opportunities exist for interdisciplinary units with courses such as Statistics, Animal Behavior, Environmental Science, and Genetics.

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APPENDIX D

It is assumed that the student has successfully completed Biology.

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APPENDIX E

Lesson plans to follow as curriculum is implemented.