

CURRICULUM

FOR

MARINE SCIENCE

GRADES 11-12

This curriculum is part of the Educational Program of Studies of the Rahway Public Schools.

ACKNOWLEDGMENTS

Dr. Susan Dube, Supervisor of Science, Technology Education, Business, and World Languages

The Board acknowledges the following who contributed to the preparation of this curriculum.

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Subject/Course Title:
Marine Science
Grades 11-12

Date of Board Adoptions:
September 15, 2020

RAHWAY PUBLIC SCHOOLS CURRICULUM
Marine Science
Grades 11-12

PACING GUIDE

Unit	Title	Pacing
1	Introduction to Marine Science	2 weeks
2	The Ocean Seafloor	3 weeks
3	Properties and Chemistry of the Ocean	3 weeks
4	Marine Physics and Energy	3 weeks
5	Biodiversity of Ocean Ecosystems	5 weeks
6	Human Impact on Oceans and Climate Change	4 weeks

ACCOMMODATIONS

<p>504 Accommodations:</p> <ul style="list-style-type: none"> ● Provide scaffolded vocabulary and vocabulary lists. ● Provide extra visual and verbal cues and prompts. ● Provide adapted/alternate/excerpted versions of the text and/or modified supplementary materials. ● Provide links to audio files and utilize video clips. ● Provide graphic organizers and/or checklists. ● Provide modified rubrics. ● Provide a copy of teaching notes, especially any key terms, in advance. ● Allow additional time to complete assignments and/or assessments. ● Provide shorter writing assignments. ● Provide sentence starters. ● Utilize small group instruction. ● Utilize Think-Pair-Share structure. ● Check for understanding frequently. ● Have student restate information. ● Support auditory presentations with visuals. ● Weekly home-school communication tools (notebook, daily log, phone calls or email messages). ● Provide study sheets and teacher outlines prior to assessments. ● Quiet corner or room to calm down and relax when anxious. ● Reduction of distractions. ● Permit answers to be dictated. ● Hands-on activities. ● Use of manipulatives. ● Assign preferential seating. ● No penalty for spelling errors or sloppy handwriting. ● Follow a routine/schedule. ● Provide student with rest breaks. ● Use verbal and visual cues regarding directions and staying on task. ● Assist in maintaining agenda book. 	<p>IEP Accommodations:</p> <ul style="list-style-type: none"> ● Provide scaffolded vocabulary and vocabulary lists. ● Differentiate reading levels of texts (e.g., Newsela). ● Provide adapted/alternate/excerpted versions of the text and/or modified supplementary materials. ● Provide extra visual and verbal cues and prompts. ● Provide links to audio files and utilize video clips. ● Provide graphic organizers and/or checklists. ● Provide modified rubrics. ● Provide a copy of teaching notes, especially any key terms, in advance. ● Provide students with additional information to supplement notes. ● Modify questioning techniques and provide a reduced number of questions or items on tests. ● Allow additional time to complete assignments and/or assessments. ● Provide shorter writing assignments. ● Provide sentence starters. ● Utilize small group instruction. ● Utilize Think-Pair-Share structure. ● Check for understanding frequently. ● Have student restate information. ● Support auditory presentations with visuals. ● Provide study sheets and teacher outlines prior to assessments. ● Use of manipulatives. ● Have students work with partners or in groups for reading, presentations, assignments, and analyses. ● Assign appropriate roles in collaborative work. ● Assign preferential seating. ● Follow a routine/schedule.
<p>Gifted and Talented Accommodations:</p> <ul style="list-style-type: none"> ● Differentiate reading levels of texts (e.g., Newsela). ● Offer students additional texts with higher lexile levels. ● Provide more challenging and/or more supplemental readings and/or activities to deepen understanding. ● Allow for independent reading, research, and projects. ● Accelerate or compact the curriculum. ● Offer higher-level thinking questions for deeper analysis. ● Offer more rigorous materials/tasks/prompts. ● Increase number and complexity of sources. ● Assign group research and presentations to teach the class. ● Assign/allow for leadership roles during collaborative work and in other learning activities. 	<p>ELL Accommodations:</p> <ul style="list-style-type: none"> ● Provide extended time. ● Assign preferential seating. ● Assign peer buddy who the student can work with. ● Check for understanding frequently. ● Provide language feedback often (such as grammar errors, tenses, subject-verb agreements, etc...). ● Have student repeat directions. ● Make vocabulary words available during classwork and exams. ● Use study guides/checklists to organize information. ● Repeat directions. ● Increase one-on-one conferencing. ● Allow student to listen to an audio version of the text. ● Give directions in small, distinct steps. ● Allow copying from paper/book. ● Give student a copy of the class notes. ● Provide written and oral instructions. ● Differentiate reading levels of texts (e.g., Newsela).

- Shorten assignments.
- Read directions aloud to student.
- Give oral clues or prompts.
- Record or type assignments.
- Adapt worksheets/packets.
- Create alternate assignments.
- Have student enter written assignments in criterion, where they can use the planning maps to help get them started and receive feedback after it is submitted.
- Allow student to resubmit assignments.
- Use small group instruction.
- Simplify language.
- Provide scaffolded vocabulary and vocabulary lists.
- Demonstrate concepts possibly through the use of visuals.
- Use manipulatives.
- Emphasize critical information by highlighting it for the student.
- Use graphic organizers.
- Pre-teach or pre-view vocabulary.
- Provide student with a list of prompts or sentence starters that they can use when completing a written assignment.
- Provide audio versions of the textbooks.
- Highlight textbooks/study guides.
- Use supplementary materials.
- Give assistance in note taking
- Use adapted/modified textbooks.
- Allow use of computer/word processor.
- Allow student to answer orally, give extended time (time-and-a-half).
- Allow tests to be given in a separate location (with the ESL teacher).
- Allow additional time to complete assignments and/or assessments.
- Read question to student to clarify.
- Provide a definition or synonym for words on a test that do not impact the validity of the exam.
- Modify the format of assessments.
- Shorten test length or require only selected test items.
- Create alternative assessments.
- On an exam other than a spelling test, don't take points off for spelling errors.

RAHWAY PUBLIC SCHOOLS CURRICULUM

UNIT OVERVIEW

Content Area: Marine Science

Unit Title: Unit 1: Introduction to Marine Science

Target Course/Grade Level: 11th & 12th grade

Unit Summary: The first two weeks of this course will be dedicated to students activating their prior knowledge of ecology and biology. With this knowledge, we will discuss how marine science is a very specific branch of ecology, biology, geology, chemistry, and other aspects of environmental science coming together in our oceans and waterways. This is extremely important because the oceans connect the entire Earth. Students will also evaluate and explore different ways that humans rely on the oceans. To further engage students, we will discuss our local waterways and their importance (Atlantic Ocean, Rahway River, and the Hudson River). This unit is meant to get the students engaged in the course, activate prior knowledge, and bring the importance of marine science into their everyday lives.

Approximate Length of Unit: 2 weeks

LEARNING TARGETS

NJ Student Learning Standards:

Science:

HS- LS2- 6. Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

HS- ESS1-6 Apply scientific reasoning and evidence from ancient Earth materials, meteorites, and other planetary surfaces to construct an account of Earth's formation and early history.

HS- ESS2-7 Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.

Career Readiness, Life Literacies, and Key Skills:

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.IML.8: Evaluate media sources for point of view, bias, and motivations (e.g., NJSLSA.R6, 7.1.AL.IPRET.6).

9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRET.8)

Interdisciplinary Connections and Standards:

Mathematics:

A.CED.1 Create equations and inequalities in one variable and use them to solve problems.

A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations

English Language Arts:

W.11-12.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

W.11-12.6. Use technology, including the Internet, to produce, share, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

NJ SLS Companion Standards: Reading and Writing Standards for History, Social Studies, Science, and Technical Subjects:

NJSLSA.R1. Read closely to determine what the text says explicitly and to make logical inferences and relevant connections from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text.

NJSLSA.R7. Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.

NJSLSA.R8. Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.

NJSLSA.R10. Read and comprehend complex literary and informational texts independently and proficiently with scaffolding as needed.

RST.9-10.1. Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.

RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

RST.9-10.7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

NJSLSA.W1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

NJSLSA.W2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

NJSLSA.W8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.

NJSLSA.W9. Draw evidence from literary or informational texts to support analysis, reflection, and research.

WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.

Unit Understandings:

Students will understand that...

- The ocean is changing throughout time naturally and with human impact.
- Different events throughout time have changed Earth's oceans.
- Marine ecosystems are different from each other depending on where they are located on Earth.
- Marine science is a collection of different sciences focused on the ocean.

Unit Essential Questions:

- What is marine science?
- How has the ocean changed throughout time?
- Which events have changed the Earth's oceans?
- Where are different marine ecosystems located on Earth?
- How are marine ecosystems different from each other?

Knowledge and Skills:

Students will know.....

- Where the oceans are on Earth.
- Where different marine ecosystems are located on Earth.
- The timeline of events that have happened on Earth and how they impacted the oceans.
- How humans use the ocean.
- Which sciences are involved in marine science.
- The history behind the Rahway River and the Hudson River.

Students will be able to ...

- Activate prior knowledge about ecosystems (biotic and abiotic factors)
- Ask questions about marine science.
- Research information about a marine ecosystem.
- Locate marine ecosystems on a global map.
- Explain why marine ecosystems are important.
- Evaluate how humans use and impact the ocean.
- Construct a timeline of the history of Earth's oceans.
- Explain the importance of our local waterways to our lives.

EVIDENCE OF LEARNING

Assessment:

What evidence will be collected and deemed acceptable to show that students truly “understand”?

- **End of Unit 1 assessment**
 - Combination of multiple choice and open ended questions
- Do Now questions
- Exit ticket questions
- Claim, Evidence, Reasoning Activities
- Prior knowledge pre-assessment
- Students collaboration with each other
- Marine ecosystem research and project
- Locating different ecosystems on a world map
- Ocean Timeline Activity
- Map and history of located waterways
- Review questions

Learning Activities:

What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Individual research with teacher feedback
- Class and individual diagramming
- Peer to peer presentations
- Using maps as a class and individually
- Experiments and analysis of data

RESOURCES

Teacher Resources:

- Marine Science- The Dynamic Ocean by Meghan E. Marrero, Ed.D. and Glen Schuster, M.S.
- Teacher designed worksheets and notes

Equipment Needed:

- Large world map
- Classroom computer and projector
- Student chrome books
- Local waterways map

RAHWAY PUBLIC SCHOOLS CURRICULUM

UNIT OVERVIEW

Content Area: Marine Science

Unit Title: Unit 2: Exploring the Seafloor

Target Course/Grade Level: 11th and 12th grade

Unit Summary: Within this unit students will explore different topographical features of the ocean floor. Students will create and evaluate models of the seafloor and learn how scientists figure out these features with measurements and sonar technology. The geological aspects of the ocean will be investigated with learning in depth about the different boundaries of Earth's crust and how plate tectonics plays a role in the past and future of Earth's oceans. Evidence for plate tectonics will also be used to make diagrams and predict movement of these plates throughout time. Students will also begin to see how different aspects of the ocean interconnect by looking at how populations respond to the seafloor formations to guide migration patterns.

Approximate Length of Unit: 3 weeks

LEARNING TARGETS

NJ Student Learning Standards:

Science:

HS- ESS1-5 Evaluate evidence of the past and current movements of continental and oceanic crust and the theory of plate tectonics to explain the ages of crustal rocks.

HS- ESS2-1 Develop a model to illustrate how Earth's internal and surface processes operate at different spatial and temporal scales to form continental and ocean-floor features.

HS- ESS2-3 Analyze geoscience data to make the claim that one change to Earth's surface can create feedback that causes changes to other Earth systems.

Career Readiness, Life Literacies, and Key Skills:

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.IML.8: Evaluate media sources for point of view, bias, and motivations (e.g., NJSLSA.R6, 7.1.AL.IPRET.6).

9.4.12.IML.3: Analyze data using tools and models to make valid and reliable claims, or to determine optimal design solutions (e.g., S-ID.B.6a., 8.1.12.DA.5, 7.1.IH.IPRE)

Interdisciplinary Connections and Standards:

Mathematics:

A.CED.1 Create equations and inequalities in one variable and use them to solve problems.

A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations

English Language Arts:

W.11-12.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

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NJSLSA.R7. Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.

NJSLSA.R8. Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.

NJSLSA.R10. Read and comprehend complex literary and informational texts independently and proficiently with scaffolding as needed.

RST.9-10.1. Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.

RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

RST.9-10.7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

NJSLSA.W1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

NJSLSA.W2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

NJSLSA.W8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.

NJSLSA.W9. Draw evidence from literary or informational texts to support analysis, reflection, and research.

WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.

Unit Understandings:

Students will understand that...

- The Earth is made up of different layers.
- The crust of the Earth is made up of different separate plates which move toward each other, away from each other, and slide against each other.
- How to read an oceanic topographic map called a bathymetry.
- Plate tectonics is forever changing the geology of the Earth's land and oceans.
- The ocean floor is made up of different geological features just like the land is.
- Scientists can estimate the sizes and shapes of these features by using different technologies.
- We can estimate how far certain areas of land are going to move by observing plate tectonics.
- Different populations rely on the features of the seafloor for survival.

Unit Essential Questions:

- How do the Earth's layers interact with each other?
- What is the evidence for plate tectonics?
- What happens when two different plates move toward or away from each other?
- How does plate tectonics change the Earth's land and oceans?
- How do the different features of the seafloor influence marine life?
- How do scientists measure and observe the features of the seafloor?

Knowledge and Skills:

Students will know.....

- Different features of the seafloor like trenches, ridges, and shelves.
- How to model the features of the seafloor.
- How scientists use sonar to measure the seafloor.
- The different plates of the Earth crust and where they are located on Earth.
- The three boundaries of plates (transform, divergent, and convergent).
- Which plates are moving toward or away from each other.
- Seals, penguins, and whales are some of the populations that use the seafloor for survival.

Students will be able to ...

- Evaluate topographical maps.
- Explain different features of the seafloor and how scientists view these features.
- Differentiate between the features of the seafloor.
- Model different features of the seafloor.
- Use evidence from measurements to conclude different features of a seafloor.
- Graph seafloor features.
- Explain how sonar is used to measure various features about the ocean.
- Use evidence to explain plate tectonics.
- Explain the three different plate boundaries and the consequences of these interactions.
- Compare how marine populations use the seafloor for survival.

EVIDENCE OF LEARNING

Assessment:

What evidence will be collected and deemed acceptable to show that students truly “understand”?

- **End of Unit Assessment**
 - Comprehensive end of unit assessment
- Do Now questions
- Discussion questions
- Claim, Evidence, Reasoning Activities
- Maps and diagramming
- Measuring and graphing seafloor features
- Models of the seafloor
- Sonar calculations
- Seafloor Quiz
- Calculating rates of movements of plates
- Marine mammal diving diagramming questions
- Review questions

Learning Activities:

What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Notes and diagrams of the seafloor features
- Modeling seafloor features with peers
- Using evidence from models with peers
- Using equations
- Experiments and analysis of data
- Full class discussions and small group discussions
- Analyzing data from graphs

RESOURCES

Teacher Resources:

Marine Science- The Dynamic Ocean by Meghan E. Marrero, Ed.D. and Glen Schuster, M.S.

- Teacher designed worksheets and notes

Equipment Needed:

- Classroom computer and projector
- Student chrome books

RAHWAY PUBLIC SCHOOLS CURRICULUM

UNIT OVERVIEW

Content Area: Marine Science

Unit Title: Unit 3: The Properties and Chemistry of the Ocean

Target Course/Grade Level: 11th and 12th grade

Unit Summary: Within this unit students will explore the different properties of the ocean, specifically salinity, temperature, transparency, density, and pressure. They will begin by investigating the structure and chemistry of the water molecule. Students will then begin to question what else do we find in the oceans' water besides just water? Salts and salinity of the ocean has a relationship with the life within those ecosystems as well as the density of salt water versus fresh water. We find many other elements within the ocean that help sustain life like oxygen, carbon, nitrogen, and phosphorus. Students will experiment with different concentrations of dissolved oxygen and carbon within salt water, and analyze how those amounts affect life. We will begin to delve into ocean acidification and human impacts on the oceans.

LEARNING TARGETS

Approximate Length of Unit: 3 weeks

**NJ Student Learning Standards:
Science:**

HS- LS1-6 Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy.

HS-LS2-5: Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

HS- ESS2-4 Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.

HS- ESS2-5 Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes.

HS-ESS2-6: Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere.

HS-PS1-6: Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

HS-PS2-6: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

Career Readiness, Life Literacies, and Key Skills::

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.IML.8: Evaluate media sources for point of view, bias, and motivations (e.g., NJSLSA.R6, 7.1.AL.IPRET.6).

Interdisciplinary Connections and Standards:

Mathematics:

A.CED.1 Create equations and inequalities in one variable and use them to solve problems.

A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations

English Language Arts:

W.11-12.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

W.11-12.6. Use technology, including the Internet, to produce, share, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

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NJSLSA.R8. Delineate and evaluate the argument and specific claims in a text, including the validity of the reasoning as well as the relevance and sufficiency of the evidence.

NJSLSA.R10. Read and comprehend complex literary and informational texts independently and proficiently with scaffolding as needed.

RST.9-10.1. Accurately cite strong and thorough evidence from the text to support analysis of science and technical texts, attending to precise details for explanations or descriptions.

RST.9-10.3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

RST.9-10.7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

NJSLSA.W1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

NJSLSA.W2. Write informative/explanatory texts to examine and convey complex ideas and information clearly and accurately through the effective selection, organization, and analysis of content.

NJSLSA.W8. Gather relevant information from multiple print and digital sources, assess the credibility and accuracy of each source, and integrate the information while avoiding plagiarism.

NJSLSA.W9. Draw evidence from literary or informational texts to support analysis, reflection, and research.

WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.

Unit Understandings:

Students will understand that ...

- The properties of a water molecule.
- Other elements are commonly found within the ocean.
- Water has different densities at different phases.
- Salt impact density of water.
- The ocean is the lowest point on the Earth, therefore salt in the ocean comes from the land.
- Salt water impacts the temperature of the ocean.
- Dissolved oxygen in the ocean is essential for life.
- The ocean is a carbon sink and high amounts of carbon dioxide in the ocean leads to ocean acidification.

Unit Essential Questions:

- What is in ocean water?
- What are the different properties of the ocean?
- Where does the salt come from?
- Which elements are mostly found in oceans to support life?
- How do organisms breathe underwater?
- How is salinity and temperature related?
- How much dissolved oxygen do different ocean ecosystems need to sustain life?
- What makes the ocean more acid?
- How does ocean acidification affect life and the properties of the ocean?

Knowledge and Skills:

Students will know

- The ocean is not just water molecules, it contains salts, oxygen, carbon, and many other elements to support life.
- Scientists study salinity, density, temperature, and other factors of the ocean.
- Salt comes from the land, and the deeper the ocean is, the saltier it is.
- Organisms that breathe underwater most have a certain amount of dissolved oxygen in the water to live. Not all organisms metabolize oxygen.
- The ocean is a carbon sink and as the levels of carbon dioxide increase in the atmosphere, they increase in the oceans causing ocean acidification which is negatively affecting many ecosystems.

Students will be able to ...

- Compare and contrast the heating and cooling of freshwater and saltwater.
- Determine whether substances will float or sink in water, based on their densities.
- Analyze the different properties of the ocean and explain how they impact each other and marine organisms.
- Describe the relationship between water temperature, and dissolved oxygen.
- Analyze evidence about amounts of dissolved oxygen and marine life.
- Observe how carbon dioxide sinks into the ocean from the atmosphere.
- Explain how carbon dioxide in water impacts the pH of water (ocean acidification).

EVIDENCE OF LEARNING

- Collect and analyze data to explain ocean acidification.

Assessment:

What evidence will be collected and deemed acceptable to show that students truly “understand”?

- Do Now questions
- Discussion questions
- Claim, Evidence, Reasoning Activities
- Temperature experiment data collected and analysis
- Density experiment data collection and analysis
- Dissolved oxygen experiment data collection and analysis
- Ocean Acidification experiment data collection and analysis
- Review questions
- **End of Unit 3 assessment**
 - Combination of multiple choice and open ended questions

Learning Activities:

What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Notes and diagrams
- Using evidence from models with peers
- Using equations
- Experiments and analysis of data
- Full class discussions and small group discussions
- Analyzing data from experimentation & graphs

RESOURCES

Teacher Resources:

- Marine Science- The Dynamic Ocean by Meghan E. Marrero, Ed.D. and Glen Schuster, M.S.
- Teacher designed worksheets and notes

Equipment Needed:

- Classroom computer and projector
- Student chrome books

RAHWAY PUBLIC SCHOOLS CURRICULUM

UNIT OVERVIEW

Content Area: Marine Science

Unit Title: Unit 4: Marine Physics and Energy

Target Course/Grade Level: 11th and 12th grade

Unit Summary: This unit will focus on the different types of energy that deal with the ocean and marine ecosystems. Students will begin by exploring the sun and how solar radiation makes its way to the Earth to give this planet energy. The energy from the sun is distributed unequally due to the tilt of the Earth which creates differences in sea surface temperatures. Ocean currents move different temperature water around the Earth which could explain the movement of marine animals. Students will consider their own experiences with water's high heat capacity and compare heat capacities of land and the water through experimentation. Students will also learn about the conservation of energy and analyze the transfer of energy within a system. Waves are another aspect of the ocean that has to do with energy. Students will explore the physics behind waves, and use their knowledge to predict tsunamis.

Approximate Length of Unit: 3 weeks

LEARNING TARGETS

NJ Student Learning Standards:

Science:

HS- PS3-1 Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

HS- PS4-1 Use mathematical representation to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media.

HS- ESS 1-1 Develop a model based on evidence to illustrate the life span of the sun and the role of nuclear fusion in the sun's core to release energy that eventually reaches Earth in the form of radiation.

Career Readiness, Life Literacies, and Key Skills::

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.IML.8: Evaluate media sources for point of view, bias, and motivations (e.g., NJSLSA.R6, 7.1.AL.IPRET.6).

Interdisciplinary Connections and Standards:

Mathematics:

A.CED.1 Create equations and inequalities in one variable and use them to solve problems.

A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations

W.11-12.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

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NJSLSA.W9. Draw evidence from literary or informational texts to support analysis, reflection, and research.

WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.

Unit Understandings:

Students will understand that...

- There are many different forms of energy and they all allow things to happen (do work).
- The polar regions receive less solar radiation than the equator region of the Earth due to the tilt of the Earth, which is called differential heating.
- The electromagnetic spectrum includes many different types of waves from the sun.
- Marine mammals base their lives around differential heating of the oceans.
- Warm water is less dense than cold water.
- Currents in the ocean cause different temperatures of water to move around the Earth.
- It takes a lot more energy to heat up the ocean than it does the land, but once the ocean is heated, it takes a long time to lose its energy.
- The major parts of a wave.
- The ratio of a wave's height to wavelength can tell us information about a wave, like when it's going to break.
- There are different types of waves.
- A tsunami is a shallow water wave triggered by displacements of a large amount of water.
- Wave physics can help scientists predict tsunamis and the location of them.

Unit Essential Questions:

- What different types of energy come from the sun?
- Which sections of the Earth receive the most sun?
- How do the different types of energy from the electromagnetic spectrum compare to each other?
- How do marine animals use the ocean's heat for survival?
- How do currents impact the temperature of the ocean in different locations?
- What are the different features of a wave?
- How do scientists predict tsunamis?

Knowledge and Skills:

Students will know.....

- Warmer water is at the equator and cooler water is at the poles due to the tilt of the Earth and how the sun hits it.
- The Sun's radiation travels to Earth through Space in the form of waves.

- The electromagnetic spectrum includes Gamma Rays, X-rays, UV, Visible light, Infrared Red, Microwaves, and Radio waves.
- The major parts of a wave are the crest, trough, height, wavelength, and period.
- The ratio of a wave's height to wavelength can tell us information about a wave, like when it's going to break.
- There are shallow and deep water waves.
- A tsunami is a shallow water wave triggered by displacements of a large amount of water.
- Wave physics can help scientists predict tsunamis and the location of them.

Students will be able to ...

- Model how the angle of isolation from the sun relates to differential heating of the Earth's surface
- Differentiate between types of incoming solar radiation
- Give examples of how marine animals respond to seasonal cures.
- Indicate that energy in the ocean is distributed through currents.
- Identify sea surface temperature (SST) and ocean currents from satellite imagery
- Explain the concept of heat capacity and the role of the ocean in moderating Earth's climate.
- Demonstrate the Law of Conservation of Energy in various scenarios of energy transformation.
- Define a wave and the terminology commonly used to describe the anatomy and movement of a wave.
- Differentiate between shallow and deep water waves.

EVIDENCE OF LEARNING

- Predict when tsunamis originating at specific locations will affect nearby areas.

Assessment:

What evidence will be collected and deemed acceptable to show that students truly "understand"?

- Do Now questions
- Discussion questions
- Claim, Evidence, Reasoning Activities
- Solar radiation chart
- Sea surface temperature maps
- Investigating Warm and Cold water experiment & analysis
- The Ocean Helps Earth Support Life experiment and analysis
- Wavelength Calculations
- Can you Outrun a Tsunami? Activity data and questions
- Review questions
- **End of Unit Assessment:**
 - Unit 3 & 4 Exam
 - Combination of multiple choice and open ended questions

Learning Activities:

What differentiated learning experiences and instruction will enable all students to achieve the desired

results?

- Notes and diagrams
- Using evidence from models with peers
- Using equations
- Experiments and analysis of data
- Full class discussions and small group discussions
- Analyzing data from experimentation & graphs

RESOURCES

Teacher Resources:

- Marine Science- The Dynamic Ocean by Meghan E. Marrero, Ed.D. and Glen Schuster, M.S.
- Teacher designed worksheets and notes

Equipment Needed:

- Classroom computer and projector
- Student chrome books

RAHWAY PUBLIC SCHOOLS CURRICULUM

UNIT OVERVIEW

Content Area: Marine Science

Unit Title: Unit 5: Biodiversity of Marine Ecosystems

Target Course/Grade Level: 11th and 12th grade

Unit Summary: The biodiversity of organisms in ecosystems is the key for a healthy environment. Populations naturally change over time, but we are seeing more and more evidence that humans are impacting populations as well. Organisms have specialized adaptation to survive in these changing environments. Due to these changing environments, organisms with the best adaptations survive to reproduce. These organisms also rely on the abiotic and biotic factors within their habitat. The base of these ecosystems are the producers, specifically phytoplankton in oceans. The health of the ecosystems rely on these microscopic organisms. Students will use Earth imagery to predict where marine animals will feed, and if algal blooms are becoming dangerous. Students will also explore the invertebrates of the ocean which consist of 97% of the animal species on Earth. Students will begin to work on their final projects during this unit which will entail a presentation component during their final exam. For their final projects, students will identify a problem within marine science they would like to investigate.

Approximate Length of Unit: 5 weeks

LEARNING TARGETS

NJ Student Learning Standards:
Science:

HS- LS1-5 Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

HS- LS2.1 Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.

HS- LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

HS- LS2-4. Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.

HS- LS2- 6. Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

HS- LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

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. (Final project)

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. (Final project)

Career Readiness, Life Literacies, and Key Skills:

9.1.12.CFR.2: Summarize causes important to you and compare organizations you seek to support to other organizations with similar missions.

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.IML.8: Evaluate media sources for point of view, bias, and motivations (e.g., NJSLSA.R6, 7.1.AL.IPRET.6).

9.4.12.IML.5: Evaluate, synthesize, and apply information on climate change from various sources appropriately (e.g., 2.1.12.CHSS.6, S.IC.B.4, S.IC.B.6, 8.1.12.DA.1, 6.1.12.GeoHE.14.a, 7.1.AL.PRSNT.2). •

9.4.12.IML.6: Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender, and age diversity (e.g., NJSLSA.SL5).

Interdisciplinary Connections and Standards:

English Language Arts:

W.11-12.4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

W.11-12.6. Use technology, including the Internet, to produce, share, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.

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NJSLSA.W9. Draw evidence from literary or informational texts to support analysis, reflection, and research.

WHST.9-10.1. Write arguments to support claims in an analysis of substantive topics or texts, using valid reasoning and relevant sufficient textual and non-textual evidence.

Unit Understandings:

Students will understand that...

- Producers and consumers have a relationship within food webs.
- Phytoplankton is the base of marine food webs.
- Different populations have different trends of growth depending on environmental factors.
- Certain populations need human protection.
- Abiotic and biotic factors could influence population size.
- Populations change over time as their environment changes.
- Only individuals with favorable adaptations will survive to reproduce passing on those favorable traits to offspring.
- Different marine ecosystems cater to different adaptations of organisms.
- Invertebrates are an important part of every marine ecosystem
- Invertebrates are extremely diverse consisting of 97% of animals on Earth.

Unit Essential Questions:

- Which factors impact marine populations?
- What is the Endangered Species Act?
- How do populations change with a changing environment?
- Which adaptations are best for which marine ecosystems?
- In which ways is phytoplankton important to ocean life?
- How can scientists look at chlorophyll maps to predict marine life feedings?
- How does structure relate to function in invertebrates?

Knowledge and Skills:

Students will know.....

- Factors like food availability, reproduction rate, protection, predation, etc. influence marine populations.
- The Endangered Species Act protects biodiversity in the oceans and the land.
- Marine populations have unique adaptations through natural selection based on which marine ecosystem they live in.
- Invasive species tend to outcompete native species leading to loss of biodiversity.
- Phytoplankton populations have to be healthy in order for the rest of the food web to be healthy.
- Marine life follows phytoplankton populations.
- Marine invertebrates have specialized internal and external structures to support hunting and transportation.

Students will be able to ...

- Identify the factors that increase or decrease population sizes and analyze changes in animal populations.
- Describe the importance of the Endangered Species Act and give examples of species that are listed under the Act.
- Explain how the process of natural selection influences the evolution of species.
- Determine how invasive species can result in biodiversity loss.
- Give examples of adaptations in diverse marine ecosystems.
- Construct a marine food web.
- Describe how phytoplankton influence marine food webs.
- Model how nutrient cycling is essential to the ocean system.
- Identify organisms classified into the major invertebrate phyla.

EVIDENCE OF LEARNING

- Explain how the structure of marine invertebrates relates to their function.

Assessment:

What evidence will be collected and deemed acceptable to show that students truly “understand”?

- Do Now questions
- Discussion questions
- Claim, Evidence, Reasoning Activities
- Food web analysis
- Photosynthesis and carbon cycle activity
- Virtual plankton lab activity
- Local plankton field & lab experiment
- Marine population analysis
- Endangered Species project
- Formative assessment quizzes
- Review questions
- **End of Unit 5 Assessment**
 - Combination of multiple choice and open ended questions

Learning Activities:

What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Notes and diagrams
- Using evidence from models with peers
- Using equations
- Experiments and analysis of data
- Full class discussions and small group discussions
- Analyzing data from experimentation & graphs

<i>RESOURCES</i>

Teacher Resources:

Marine Science- The Dynamic Ocean by Meghan E. Marrero, Ed.D. and Glen Schuster, M.S.

- Teacher designed worksheets and notes

Equipment Needed:

- Classroom computer and projector
- Student chrome books

RAHWAY PUBLIC SCHOOLS CURRICULUM

UNIT OVERVIEW

Content Area: Marine Science

Unit Title: Unit 6: Human Impact on the Ocean and Climate Change

Target Course/Grade Level: 11th & 12th grade

Unit Summary: Students will begin this unit by exploring what happens to a marine ecosystem when too much nutrients get into the water from the land. Phytoplankton blooms are common at the mouth of the Mississippi which leads to dead zones directly related to nutrients coming off farm land in the midwest. Students will analyze these problems along with being introduced to other marine nonpoint and point pollution. Polluting our waters is not the only way humans are impacting oceans. We are also directly impacting coast lines, marine ecosystems and biodiversity, populations by overfishing, and changing the climate. Scientists have the technology to predict how a hurricane will impact the coastline, how much land will be underwater in the next 50 years with rising sea levels, and the future of biodiversity for these marine ecosystems.

Approximate Length of Unit: 4 weeks

LEARNING TARGETS

NJ Student Learning Standards:
Science:

HS- LS2-7 Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

HS- ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

HS- ESS3-5 Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth's systems.

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. (Final project)

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. (Final project)

Career Readiness, Life Literacies, and Key Skills:

9.1.12.CFR.2: Summarize causes important to you and compare organizations you seek to support to other organizations with similar missions.

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12.prof.CR3a).

9.4.12.GCA.1: Collaborate with individuals to analyze a variety of potential solutions to climate change effects and determine why some solutions (e.g., political, economic, cultural) may work better than others (e.g., SL.11-12.1., HS-ETS1-1, HS-ETS1-2, HS-ETS1-4, 6.3.12.GeoGI.1, 7.1.IH.IPERS.6, 7.1.IL.IPERS.7, 8.2.12.ETW.3).

9.4.12.IML.5: Evaluate, synthesize, and apply information on climate change from various sources appropriately (e.g., 2.1.12.CHSS.6, S.IC.B.4, S.IC.B.6, 8.1.12.DA.1, 6.1.12.GeoHE.14.a, 7.1.AL.PRSNT.2).

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9.4.12.IML.6: Use various types of media to produce and store information on climate change for different purposes and audiences with sensitivity to cultural, gender, and age diversity (e.g., NJSLSA.SL5).

Interdisciplinary Connections and Standards:

Social Studies:

6.1.12.GeoHE16.a: Explain why natural resources (i.e., fossil fuels, food, and water) continue to be a source of conflict and analyze how the United States and other nations have addressed issues concerning the distribution and sustainability of natural resources and climate change.

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Unit Understandings:

Students will understand that...

- Extra nutrients in the ocean from human activity disrupts ecosystems.
- There is a difference between nonpoint and point pollutants.
- Oil spills in oceans can be cleaned up with innovative engineering.
- Using renewable energy sources eliminates oil spills.
- Wetlands provide natural benefits for the oceans and land.
- Fisheries can be more sustainable if policies followed the tragedy of the commons.
- Climate change impacts marine ecosystems negatively.
- Communities and governments are protecting marine ecosystems around the world.

Unit Essential Questions:

- Why does extra nutrients in the water negatively affect marine ecosystems?

- What is the difference between nonpoint and point pollutants?
- How do scientists use satellite imagery to identify algal blooms?
- How do we clean up oil spills?
- How do oil spills affect marine organisms? (specifically sea turtles, birds, seals, whales, and dolphins)
- What benefits do wetlands provide?
- How can fisheries be more sustainable?
- What evidence do we have for climate change impacting marine ecosystems?
- How are humans protecting marine ecosystems?

Knowledge and Skills:

Students will know.....

- Phytoplankton require carbon dioxide, water, nutrients (nitrogen), sunlight, and oxygen for survival, but too much nutrients causes blooms which wind up depleting the water of oxygen through eutrophication.
- Nonpoint pollutants are things that cannot be directly identified, like how we may use fertilizers on our lawns, but these fertilizers wind up in our waterways far away from the source.
- Point pollutants are harmful pollutants where we know exactly where they come from like an oil spill or sewage leaks.
- Wetlands provide natural filters for pollutants, habitats for diverse organisms, and reduce flooding.
- If policies were put in place to allow fisheries to make money and leave fish to reproduce in a healthy way, the fishing industry could be sustainable.
- Factors of climate change like rising sea levels, ocean acidification, and harsher storms are impacting marine ecosystems.
- Scientists work with communities, companies, and governments to establish policies to protect marine ecosystems.

Students will be able to ...

- Explain human impacts on the ocean and how they are detected by satellite imagery.
- Illustrate the process of eutrophication and its influences on marine ecosystems, relating to human activities.
- Identify sources of marine pollution and its impacts on marine organisms.
- Make connections between local pollution and marine pollution.
- Identify examples of nonpoint and point pollutants.
- Compare and contrast methods of cleaning up oil spills.
- Explain the impacts of point pollutants on ecosystems.
- Identify the properties of wetland ecosystems.
- Explain the function of wetlands for the community.
- Analyze the costs and benefits associated with coastal development.
- Give examples of ways in which fisheries can be more sustainable.
- Use evidence to support climate change.
- Analyze the impacts of climate change on marine ecosystems.
- Describe the functions of Marine Protected Areas (MPAs)

<i>EVIDENCE OF LEARNING</i>

- Use scientific evidence to design new MPAs.

Assessment:

What evidence will be collected and deemed acceptable to show that students truly “understand”?

- Do Now questions
- Discussion questions
- Claim, Evidence, Reasoning Activities
- Light and nutrients experiment and analysis
- Oil Spill Engineering Activity
- Modeling Wetlands Activity
- Global Climate Change evidence analysis
- New Marine Protected Areas design
- Formative assessment quizzes
- Review questions
- **End of Unit Assessment for Unit 6**
 - Combination of multiple choice and open ended questions
- **Final summative assessment project**
 - Students will be working on this for the last 9-10 weeks of the course. The last couple of classes will consist of students presenting their projects.

Learning Activities:

What differentiated learning experiences and instruction will enable all students to achieve the desired results?

- Notes and diagrams
- Using evidence from models with peers
- Modeling ecosystems
- Experiments and analysis of data
- Full class discussions and small group discussions
- Analyzing data from experimentation & graphs

<i>RESOURCES</i>

Teacher Resources:

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Equipment Needed:

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