



Ocean and Sustainability for 8th Grade Science

Unit Summary:

This unit aims to provide students with an opportunity to learn about the importance of oceans to humans' sustainability, some sustainability issues related to ocean: unsustainable fishing, ocean and climate change, as well as ocean pollution.

Key words: sustainability, three pillars of sustainability, ocean, unsustainable fishing, climate change, ocean pollution, hypoxia, dead zone

Michigan Content Expectations:

E1.1B Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions.

E1.1D Identify patterns in data and relate them to theoretical models.

E1.2C Develop an understanding of a scientific concept by accessing information from multiple sources. Evaluate the scientific accuracy and significance of the information.

E1.2D Evaluate scientific explanations in a peer review process or discussion format.

E2.1C Explain, using specific examples, how a change in one system affects other Earth systems.

E4.1C Explain how water quality in both groundwater and surface systems is impacted by land use decisions.

E2.4B Explain how the impact of human activities on the environment (e.g., deforestation, air pollution, coral reef destruction) can be understood through the analysis of interactions between the four Earth systems.

E4.2A Describe the major causes for the ocean's surface and deep water currents, including the prevailing winds, the coriolis effect, unequal heating of the earth, changes in water temperature and salinity in high latitudes, and basin shape.

E4.2B Explain how interactions between the oceans and the atmosphere influence global and regional climate. Include the major concepts of heat transfer by ocean currents, thermohaline circulation, boundary currents, evaporation, precipitation, climatic zones, and the ocean as a major CO₂ reservoir.

E5.4D Based on evidence of observable changes in recent history and climate change models, explain the consequences of warmer oceans (including the results of increased evaporation, shoreline and estuarine impacts, oceanic algae growth, and coral bleaching) and changing climatic zones (including the adaptive capacity of the biosphere).

B3.1D Explain how living organisms gain and use mass through the processes of photosynthesis and respiration.

B3.4B Recognize and describe that a great diversity of species increases the chance that at least some living organisms will survive in the face of cataclysmic changes in the environment.

B3.4C Examine the negative impact of human activities.

B3.5A Graph changes in population growth, given a data table.

B3.5B Explain the influences that affect population growth.

C3.4B Explain why chemical reactions will either release or absorb energy.

Learning Objectives:

- Summarize important points from a United Nations Conference on Sustainable Development (UNCSD) article.
- Describe the importance of oceans to humans.
- Categorize sustainability issues oceans are facing today into the three pillars of sustainability: environment, society and economy.
- Conclude what impacts these sustainability issues can cause on human.
- Describe global fish population status.
- Compare sustainable and unsustainable fishing methods.
- Investigate in their local grocery store to discover the type of seafood available there, whether they are wild or farmed and where they are from.
- Conclude whether the seafood available in their local grocery stores are sustainable or not and why.
- Conclude what connections are there between their local community and global unsustainable fishing.
- Conclude what environmental, social and economic impacts unsustainable fishing can cause globally.
- Observe a figure and describe their observation.
- Make inference about the trend of the data from their observation.
- Compare information from multiple figures and conclude whether they are consistent with each other or not.
- Conclude whether the ocean is getting warmer or not based on information from multiple figures.
- Describe the reasons that the ocean is getting warmer.
- Describe the impacts of climate change on oceans.
- Describe the impacts of warmer oceans on the three pillars of sustainability: environment, society, and economy.
- Describe what is “Dead Zone” or hypoxia.
- Describe factors needed for algal growth.
- Describe what will be consumed and released when algae grow and die in water.
- Conclude how algae growth will impact marine environment.
- Conclude how human activities are connected to hypoxia.

Table of Lessons:

Lesson Title- Brief Description	Learning Objectives	NGSS Addressed	Materials
<p>1. Ocean and Sustainability – This lesson will give students a general introduction about sustainability issues related oceans. Students will read a UN conference document and conclude from the document what are the sustainability issues the oceans are facing now and how they impact on global sustainability.</p>	<p><u>Students will be able to:</u></p> <ul style="list-style-type: none"> • Summarize important points from a United Nations Conference on Sustainable Development (UNCSD) article. • Describe the importance of oceans to humans. • Categorize sustainability issues oceans are facing today into the three pillars of sustainability: environment, society and economy. • Conclude what impacts these sustainability issues can cause on human. 	<p>E4.1C Explain how water quality in both groundwater and surface systems is impacted by land use decisions.</p> <p>E4.2A Describe the major causes for the ocean’s surface and deep water currents, including the prevailing winds, the coriolis effect, unequal heating of the earth, changes in water temperature and salinity in high latitudes, and basin shape.</p> <p>E4.2B Explain how interactions between the oceans and the atmosphere influence global and regional climate. Include the major concepts of heat transfer by ocean currents, thermohaline circulation, boundary currents, evaporation, precipitation, climatic zones, and the ocean as a major CO2 reservoir.</p>	<ul style="list-style-type: none"> • Computer with Microsoft PowerPoint, internet access, audio and projector • Ocean and Sustainability Student Worksheet • Ocean and Sustainability PowerPoints
<p>2. Unsustainable Fishing – This</p>	<p><u>Students will be able to:</u></p> <ul style="list-style-type: none"> • Describe global 	<p>B3.4B Recognize and describe that a</p>	<ul style="list-style-type: none"> • Computer with

<p>lesson aims to introduce to students one of the sustainability issues the oceans are facing today – unsustainable fishing. Students will conduct a field trip to their local grocery store to find out what fishes are available in their community and whether they are sustainable or not.</p>	<p>fish population status.</p> <ul style="list-style-type: none"> • Compare sustainable and unsustainable fishing methods. • Investigate in their local grocery store to discover the type of seafood available there, whether they are wild or farmed and where they are from. • Conclude whether the seafood available in their local grocery stores are sustainable or not and why. • Conclude what connections are there between their local community and global unsustainable fishing. • Conclude what environmental, social and economic impacts unsustainable fishing can cause globally. 	<p>great diversity of species increases the chance that at least some living organisms will survive in the face of cataclysmic changes in the environment. B3.4C Examine the negative impact of human activities. B3.5A Graph changes in population growth, given a data table. B3.5B Explain the influences that affect population growth.</p>	<p>Microsoft PowerPoint, internet access, audio and projector.</p> <ul style="list-style-type: none"> • Unsustainable fishing Student Worksheet • Unsustainable fishing PowerPoints • Documentary: Empty Ocean, Empty Nets.
<p>3. Ocean and Climate Change – In this lesson, students will discover the connection between ocean and climate change. They will be given</p>	<p><u>Students will be able to:</u></p> <ul style="list-style-type: none"> • Observe a figure and describe their observation. • Make inference about the trend of the data from their observation. 	<p>E1.1D Identify patterns in data and relate them to theoretical models. E1.2C Develop an understanding of a scientific concept by accessing</p>	<ul style="list-style-type: none"> • Computer with Microsoft PowerPoint, internet access, audio and projector. • Ocean and Climate Change Student

<p>four figures to study and conclude whether climate change is affecting the oceans or not.</p>	<ul style="list-style-type: none"> • Compare information from multiple figures and conclude whether they are consistent with each other or not. • Conclude whether the ocean is getting warmer or not based on information from multiple figures. • Describe the reasons that the ocean is getting warmer. • Describe the impacts of climate change on oceans. • Describe the impacts of warmer oceans on the three pillars of sustainability: environment, society, and economy. 	<p>information from multiple sources. Evaluate the scientific accuracy and significance of the information.</p> <p>E2.1C Explain, using specific examples, how a change in one system affects other Earth systems.</p> <p>E4.2B Explain how interactions between the oceans and the atmosphere influence global and regional climate. Include the major concepts of heat transfer by ocean currents, thermohaline circulation, boundary currents, evaporation, precipitation, climatic zones, and the ocean as a major CO₂ reservoir.</p> <p>E5.4D Based on evidence of observable changes in recent history and climate change models, explain the consequences of warmer oceans (including the results of increased evaporation, shoreline and estuarine impacts, oceanic algae growth, and coral bleaching) and</p>	<p>Worksheet</p> <ul style="list-style-type: none"> • Ocean and Climate Change PowerPoints • Video clip: The Ocean: A Driving Force for Weather and Climate
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		<p>changing climatic zones (including the adaptive capacity of the biosphere).</p>	
<p>4. Ocean Pollution – This lesson aims to introduce to students ocean pollution issue, especially Dead Zone or hypoxia issue caused by excess nutrients discharged into oceans. Students will learn how human activities affect the environment of marine animals.</p>	<p><u>Students will be able to:</u></p> <ul style="list-style-type: none"> • Describe what is “Dead Zone” or hypoxia. • Describe factors needed for algal growth. • Describe what will be consumed and released when algae grow and die in water. • Conclude how algae growth will impact marine environment. • Conclude how human activities are connected to hypoxia. 	<p>E1.1B Evaluate the uncertainties or validity of scientific conclusions using an understanding of sources of measurement error, the challenges of controlling variables, accuracy of data analysis, logic of argument, logic of experimental design, and/or the dependence on underlying assumptions.</p> <p>E1.2C Develop an understanding of a scientific concept by accessing information from multiple sources. Evaluate the scientific accuracy and significance of the information.</p> <p>E1.2D Evaluate scientific explanations in a peer review process or discussion format.</p> <p>E2.4B Explain how the impact of human activities on the environment (e.g., deforestation,</p>	<ul style="list-style-type: none"> • Computer with Microsoft PowerPoint, internet access, audio and projector • Ocean Pollution Student Worksheet • Ocean Pollution PowerPoints • Video clip: The Earth’s Green Machine • Video clip: Algal growth

		<p>air pollution, coral reef destruction) can be understood through the analysis of interactions between the four Earth systems.</p> <p>E4.1C Explain how water quality in both groundwater and surface systems is impacted by land use decisions.</p> <p>B3.1D Explain how living organisms gain and use mass through the processes of photosynthesis and respiration.</p> <p>B3.4C Examine the negative impact of human activities.</p> <p>C3.4B Explain why chemical reactions will either release or absorb energy.</p>	
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Safety Considerations:

None

Evaluation Plan:

In order to assess students’ understanding to the new concepts and tools, one worksheet will be given to students for each lesson. Students will answer questions on the worksheet and share with their partner or the whole class.

Resources (websites):

1. <http://www.uncsd2012.org/rio20issuesbriefs.html>

This is a website of the United Nations Conference on Sustainable Development. Totally sixteen Rio+20 Issues Briefs were prepared by the UNCSD Secretariat, in order to provide policymakers and other stakeholders with reviews of topics and themes of the conference.

2. <http://online.wsj.com/news/interactive/SALMONFISHING0311?ref=SB10001424052748704615504576172292781589156>

An article contains detailed introduction about sustainable and unsustainable fishing methods with pictures. This will help students to better understand fishing methods adopted by fishing industries.

3. http://www.seafoodwatch.org/cr/cr_seafoodwatch/sfw_gear.aspx

Another website that describes sustainable and unsustainable fishing methods with videos.

4. http://www.seafoodwatch.org/cr/cr_seafoodwatch/sfw_recommendations.aspx

A nice website for information about the sustainability of various kinds of seafoods.

5. <http://www.epa.gov/climatechange/science/indicators/oceans/index.html>

This website from EPA contains climate change indicators in the United States. For oceans, they use four indicators: ocean heat, sea surface temperature, sea level and ocean acidity. Data and figures are available on the website.

6. <http://water.epa.gov/type/watersheds/named/msbasin/hypoxia101.cfm>

This webpage from EPA has some basic information about hypoxia including what it is and what causes it.

7. http://www.nwfsc.noaa.gov/hab/habs_toxins/phytoplankton/images/AlgalGrowth_Revised2.swf

This webpage contains a little video that describe what are needed for algae growth. This will help student to understand what cause hypoxia and generate some discussion about what will happen when algae dies.

Brief description of how this unit relates to your graduate research:

This is a unit that aims to further students' understanding about sustainability and the three pillars of sustainability by putting sustainability into the context of ocean.

My graduate research is about China's land acquisition in Africa for biofuels. The replacement of petroleum-based transportation fuels with renewable biofuels has become a common imperative among most countries, commonly to achieve energy independence (self-sufficiency) goals, reduce carbon dioxide emissions, and encourage domestic industry development (Gomiero et al. 2010, Buyx and Tait 2011, Greene 2011). However, due to biofuel development's large spatial and temporal scale, it can have big impact on the sustainability of local community where biofuel crops are planted and produced. Media reports and academic studies about global land acquisition have reported substantial negative environmental and social impacts including severe deforestation, land rights and human rights violations, reduced food security and increased pollution of water and soil. The focus of my study is more on the environmental and social impacts due to China's biofuel development in Africa, since

these impacts are often ignored when more attention is being given to the economic benefit of biofuel development.

Therefore, in this unit I would like to help students to understand that ocean issues we are facing today are also the result of humans focusing on economy while ignoring environmental and social pillars, and as a result, these ocean sustainability issues will impact on the environment, society and economy of affected communities even the whole earth. I believe the ability to analyze an issue from the perspectives of the three pillars of sustainability will provide students a more holistic view to understand many issues we are facing today. In this unit, I focus on three major sustainability issues oceans are facing today: unsustainable fishing, climate change and pollution. In each lesson, in addition to help student understand the status and cause of these issues, I always have students make connections between the issues and specific impacts on the three pillars of sustainability: environment, society and economy.