

LESSON 4: The Gulf of Mexico Ecosystem

Teacher's Guide

Objective: In this lesson, students will learn about the physical features, species distribution, and human impacts on the Gulf of Mexico system. In reviewing maps and plotting positions, students will analyze the potential impacts of oil spills or other events on the members of this system.

Inquiry question:

How is the Gulf of Mexico a system?

Time Required: One class period

Science Standards Addressed:

6th Grade: SC.6.E.7.3, SC.6.E.7.4

7th Grade: SC.7.N.1.3, SC.7.N.1.5, SC.7.L.17.3

8th Grade: SC.8.N.1.5, SC.8.N.1.6, SC.8.E.5.10

Middle School Computer Science: SC.68.CS-PC.3.1, SC.68.CS-CS.2.2, SC.68.CS-CP.3.1, SC.68.CS-CS.2.4, SC.68.CS-CS.6.3

Materials:

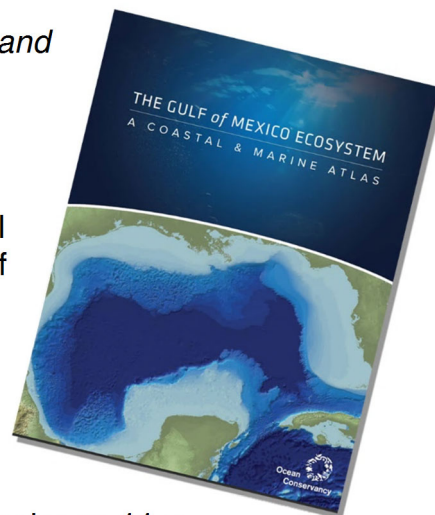
- [The Gulf of Mexico Ecosystem: A Coastal and Marine Atlas](#)
- Color copies of select maps from the Atlas (one of each unless noted below)
 - Project Area Map (p. 11) - 10 copies
 - Bathymetry Map (p. 15)
 - Sea Surface Currents Map (p. 26)
 - Seagrasses Map (p. 44)
 - Hydrocarbon Seeps & Communities Map (p. 63) - 2 copies
 - Whale Shark Map (p. 86)
 - Red Snapper Map (p. 98)
 - Kemp's Ridley Sea Turtle Map (p. 140)
 - Atlantic Bottlenose Dolphin Map (p. 148)
 - Hazardous Materials Spills Map (p. 187)
 - Oil and Gas Drilling Platforms & Boreholes Map (p. 200) - 3 copies
 - Selected Oil and Gas Pipelines Map (p. 201) - 2 copies
- Individual copies of the Lesson 4 Student Guide (pages 32-33 of this curriculum)
- One set of the correspondence items for distribution to the student teams
- One poster-sized whiteboard or a piece of chart paper per group, with markers

PROCEDURES

Step 1

Introduce students to *The Gulf of Mexico Ecosystem: A Coastal and Marine Atlas* published by the Ocean Conservancy (a pdf can be downloaded here - <https://oceanconservancy.org/wp-content/uploads/2017/05/gulf-atlas.pdf>). This document is a compilation of many different data sets and provides an overall picture of the Gulf of Mexico ecosystem. The Atlas includes physical features, habitats, animals, stressors, and human uses in the Gulf of Mexico. The maps and brief summaries make a good jumping off point for understanding the Gulf ecosystem.

The Ocean Conservancy Atlas provides many maps that could be used in classrooms. However, only 13 mapped features are used for this lesson. To print **only the maps used in this lesson**, go to: <https://csomio.org/education-and-outreach/modeling-the-gulf-middle-school-curriculum>. Ideally, you will want to print the maps in color on 11 x 17 inch paper for the group work, and laminate them for repeated use.



Step 2

Use a projector or digital whiteboard to display the Atlas. Show the “project area” map or provide a copy for individuals or pairs of students. Have students tell you what they observe on this map (land and water geographical areas, states and countries, lines of latitude and longitude, shading differences, a key, etc.). Be certain to note the scale of the map and let students know that all other maps used in this activity will show the same area at the same scale. Ask students how they think scientists obtained this data- examples may include satellite imagery, sonar, human observers, commercial fisheries, and research expeditions taking samples of water,

plankton, and vegetation. If covering standard SC.8.E.5.10, this would be a logical place to introduce Geographic Information Systems (GIS) and the use of computers, satellites, and location-tagged data to produce the maps.

Step 3

Begin the lesson by sharing the “U.S. Gulf of Mexico Marine Ecosystem” video from NOAA Fisheries (see web address at right).

Have your students share to develop a definition for the Gulf of Mexico ecosystem. Be certain they understand that this system includes non-living components (abiotic features) and that it is influenced by things that happen outside the ecosystem. Ask students to share the types of people who are involved in the system.



Students will work in groups of four to complete an analysis of the ecosystem. They will take on the role of a research team from the National Oceanic and Atmospheric Administration, the federal scientific agency that focuses on areas such as the Gulf ecosystem. Specific roles will be assigned to them after they have answered the initial questions.


Before investigating a specific issue, each research team will collaborate to find answers to questions about the system. This activity should familiarize students with the Atlas and some main features of the Gulf.






Step 4



After submitting their responses to the initial questions, each group will receive a correspondence from someone expressing a concern about the Gulf. Each indicates a specific location (longitude and latitude) and the nature of the writer’s concern.

Correspondence Items Addressed to the NOAA Ecosystem Science Team

(letters, tweets, emails, a ship-to-shore radio transcription, and a telegram)

Longitude	Latitude	Correspondence item assigned to the research team	Map(s) needed to address the correspondence
91.1°W	28.4°N	 <p><i>Greetings from Alabama,</i></p> <p><i>I was out on a fishing trip this weekend and saw 2 whale sharks. What an amazing experience that was! I've spent my whole life of 67 years on the water and never seen a single whale shark. The fishing spot is at 91.1°W 28.4°N.</i></p> <p><i>The reason for my letter is to let you know that I'm very concerned about the oil platforms in that area. What would happen if these whale sharks are exposed to oil? Will that interrupt any part of their life history? I know that your team has lots of data available from years of study. Should I be concerned about this very special species?</i></p> <p><i>Also, I'm wondering about the reproduction of whale sharks. Do they have egg cases like those I've seen washed up on the beach from other species of sharks and rays?</i></p>	<ul style="list-style-type: none"> • Project Area Map • Whale Shark Map • Oil & Gas Drilling Platforms and Boreholes Map • Hazardous Materials Spills Map • Oil & Gas Pipelines Map

Longitude	Latitude	Correspondence item assigned to the research team	Map(s) needed to address the correspondence
81.3°W	24.8°N	 <p><i>Distressed now due to the Tampa Bay red tide. Will this impact my favorite seagrass bed for snorkeling and fishing? #redtide #seagrass4life 81.3°W 24.8°N</i></p>	<ul style="list-style-type: none"> • Project Area Map • Seagrasses Map • Surface Currents Map <p>Note: For ecosystem level analysis, you may want to also introduce this team to the Sea Surface Temperature Map (p. 22) and the Salinity and Riverflow Map (p. 23), but these are optional.</p>
93.7°W	24.4°N	 <p><i>I regret that I must inform you that our cargo ship has lost a container of wholesale shampoo bottles. These bottles with sealed caps are packaged in cardboard boxes. There were 144 boxes each containing 200 bottles. The accident happened at 93.7°W 24.4°N.</i></p> <p><i>My shipping company has access to 4 large workboats with crews. Can you please help me know where I should send each crew so that we can collect as many of these bottles as possible? The cargo was lost yesterday. The crews can be on-site in 3 days.</i></p> <p><i>How far do you think these bottles could travel in the next month?</i></p>	<ul style="list-style-type: none"> • Project Area Map • Surface Currents Map
97.8°W	22.2°N	 <p><i>Hola, I went to the beach this week with my class. We noticed lots of plastic and are concerned. Should the government do something about the litter that washes up onshore? 97.8°W 22.2°N are the longitude and latitude of the beach we visited.</i></p>	<ul style="list-style-type: none"> • Project Area Map • Surface Currents Map • Kemp's Ridley Turtles Map
82.4°W	26.3°N	 <p><i>I just read an article on Huffingtonpost.com. I know that I need to be careful about checking facts online, so I wanted to ask the experts.</i></p> <p><i>The military has a need for sonar devices to help protect the country during times of war. Since they need to train the sailors, they do testing in the ocean. These tests involve very loud soundwaves that are much higher than what's healthy for humans.</i></p> <p><i>The article I read said that tests will be happening at these coordinates: 82.4°W 26.3°N. Do you think that there are any marine mammals who might be impacted by the tests? When and where would be best for these testing events?</i></p>	<ul style="list-style-type: none"> • Project Area Map • Bottlenose Dolphin Map
86.1°W	23.6°N	 <p><i>Cheers science team,</i></p> <p><i>I'm an investor from Fiji. My fellow investors and I have developed a new technology that uses recycled materials to make floating "islands" in large shallow bodies of water. There is an area off the Yucatan Peninsula that we think would be a great spot for a new floating resort. The coordinates are 86.1°W 23.6°N.</i></p> <p><i>Our resorts are completely solar-powered and self-sufficient. We only use biodegradable materials (except for the "island") and have containment systems that compost all waste.</i></p> <p><i>Water quality is a very important consideration for our resort. The construction material for the "island" can breakdown when exposed to petroleum products like oil. As you might imagine, siting will be very critical. We would like to water depth to be less than 100 feet for scuba divers to safely access the bottom. If neither of these sites will work for our criteria, where do you suggest we locate the resort?</i></p> <p><i>I hope you will be able to travel to the new Sun-stainable Gulf Resort once it opens. Thanks for your assistance.</i></p>	<ul style="list-style-type: none"> • Project Area Map • Hydrocarbon Seeps & Communities Map • Bathymetry Map

Longitude	Latitude	Correspondence item assigned to the research team	Map(s) needed to address the correspondence
88.9°W	29.5°N	 <p>Science team,</p> <p>My friends and I were on a scuba diving trip to an abandoned oil drilling platform at 88.9°W longitude 29.5°N latitude. While we were there, we think we found an invasive species of algae, <i>Caulerpa taxifolia</i>.</p> <p>I know that this species can reproduce from just fragments that float to a new location. I've also heard that this algae produces a poison that is toxic to fish.</p> <p>I hope your team will be able to make a plan to investigate and control the spread if you find it is actually an invasive species. We dive on old platforms all over the Northern Gulf. Where can we expect to see this algae in the future? What would happen to the recreational red snapper fishery?</p> <p>Could you also let me know how much of the United States' oil and gas supply comes from the Gulf? Thanks</p>	<ul style="list-style-type: none"> • Project Area Map • Surface Currents Map • Red Snapper Map • Oil & Gas Drilling Platforms and Boreholes Map
84.1°W	28.0° N	 <p>FROM W J JACKSON-(STOP)-WATER SHEEN EIGHTY FOUR POINT ONE DEGREES WEST TWENTY EIGHT POINT ZERO DEGREES NORTH -(STOP)- DEAD FISH FLOATING-(STOP)- PLEASE ADVISE-(STOP)</p>	<ul style="list-style-type: none"> • Hydrocarbon Seeps & Communities Map • Selected Oil and Gas Pipelines Maps • Oil & Gas Drilling Platforms and Boreholes Map • Surface Currents Map

NOTE: Printable versions of these correspondence examples are provided on pages 28-31 of this curriculum. Print and assign one to each of your student teams.

Step 5

The team will investigate the issue presented in their correspondence item using the maps from the Atlas. Once the work is completed, each team will complete (as a team) the **Claim-Evidence-Reasoning (CER)** chart (page 35) and present to the class. Poster-sized whiteboards, chart paper, or a whiteboard or projector can be used to display the appropriate information to the class.

Step 6

The presentation is the reply to original query. Presenters must include a claim (state whether the team thinks there may be an issue of concern or not), evidence (actual data that supports this claim), and reasoning (a scientific explanation of the scientific principles that justify using this data to make the claim). **Claim-Evidence-Reasoning** is a framework for constructing a scientific argument and can be used in any and all content areas that involve empiricism and qualitative or quantitative data. It involves an initial question, with the claim being a proposed answer to that question. If this is not familiar to the students, it may be helpful to go over an example, science-based or not, before independent or group work. The CER structure is as follows:

Question: What do you want to know?	
CLAIM: A statement that answers your question	
EVIDENCE for the claim: <ul style="list-style-type: none"> • Scientific data that support the claim • Data need to be appropriate (pictures, graphs, table) • Observation 	REASONING (How the evidence justifies the claim): <ul style="list-style-type: none"> • Based on scientific principles • Each piece of evidence may have a different justification for why it supports the claim
Teams should also answer any other questions posed in the correspondence . The answers can be found in the text description that precedes each map in the Atlas.	

Step 7

In closing the lesson, emphasize that the members of the Gulf ecosystem can all have effects on other parts of the system.



Letter

To: NOAA Ecosystem Science Team

From: Kathryn Williams

Greetings from Alabama,

I was out on a fishing trip this weekend and saw 2 whale sharks. What an amazing experience that was! I've spent my whole life of 67 years on the water and never seen a single whale shark. The fishing spot is at 91.1° W 28.4°N.

The reason for my letter is to let you know that I'm very concerned about the oil platforms in that area. What would happen if these whale sharks are exposed to oil? Will that interrupt any part of their life history? I know that your team has lots of data available from years of study. Should I be concerned about this very special species?

Also, I'm wondering about the reproduction of whale sharks. Do they have egg cases like those I've seen washed up on the beach from other species of sharks and rays?

Thank you,

Kathryn Williams



Tweet



Seagrass4Life ✓
@Thalassia_Testudinum

Follow



Distressed now due to the Tampa Bay red tide. Will this impact my favorite seagrass bed for snorkeling and fishing?
#redtide #seagrass4life 81.3 W 24.8 N
@NOAA

2:48 PM - 6 May 2018

1.5k Retweets 8.9k Likes



200



1.5k



8900



85



Ship-to-Shore Radio Transmission

SHIP-TO-SHORE RADIO TRANSMISSION FROM MV HALOPHILA
TRANSCRIBED MAY 20 7:22PM

HALOPHILA: COME IN COAST GUARD

COAST GUARD: GO AHEAD

HALOPHILA: I REGRET THAT I MUST INFORM YOU THAT OUR CARGO SHIP HAS LOST A CONTAINER OF WHOLESALE SHAMPOO BOTTLES. THESE BOTTLES WITH SEALED CAPS ARE PACKAGED IN CARDBOARD BOXES. THERE WERE 144 BOXES EACH CONTAINING 200 BOTTLES. THE ACCIDENT HAPPENED AT 93.7°W 24.4°N .

MY SHIPPING COMPANY HAS ACCESS TO 4 LARGE WORKBOATS WITH CREWS. CAN YOU PLEASE HELP ME KNOW WHERE I SHOULD SEND EACH CREW SO THAT WE CAN COLLECT AS MANY OF THESE BOTTLES AS POSSIBLE? THE CARGO WAS LOST YESTERDAY. THE CREWS CAN BE ON-SITE IN 3 DAYS.

HOW FAR DO YOU THINK THESE BOTTLES COULD TRAVEL IN THE NEXT MONTH?

OVER



Tweet



ScienceTeacher ✓
@EarthScienceRocks

Follow



Hola, I went to the beach this week with my class. We noticed lots of plastic and are concerned. Should the government do something about the litter that washes up onshore? 97.8 W 22.2 N are the longitude and latitude of the beach we visited. #plasticocean @NOAA

2:48 PM - 6 May 2018

1.2k Retweets 2.3k Likes



12



1.2k



4353



24



Email

From: jacoblee2012@gmail.com
Subject: Sonar testing and marine mammals
To: ecosystemscienceteam@noaa.gov

I just read an article on the Internet. I know that I need to be careful about checking facts online, so I wanted to ask the experts.

The military has a need for sonar devices to help protect the country during times of war. Since they need to train the sailors, they do testing in the ocean. These tests involve very loud soundwaves that are much higher than what's healthy for humans.

The article I read said that tests will be happening at these coordinates: 82.4°W 26.3°N. Do you think that there are any marine mammals who might be impacted by the tests? When and where would be best for these testing events?

Thank you,

Jake Lee



Letter

Elenoa Katalou
14 Viria St
Vatuwaqa, Fiji
(679)-272-3858
Ekatalou@sunstainableislands.com.fj

Cheers science team,

I'm an investor from Fiji. My fellow investors and I have developed a new technology that uses recycled materials to make floating "islands" in large shallow bodies of water. There is an area off the Yucatan Peninsula that we think would be a great spot for a new floating resort. The coordinates are 86.1°W 23.6°N.

Our resorts are completely solar-powered and self-sufficient. We only use biodegradable materials (except for the "island") and have containment systems that compost all waste.

Water quality is a very important consideration for our resort. The construction material for the "island" can breakdown when exposed to petroleum products like oil. As you might imagine, siting will be very critical. We would like to water depth to be less than 100 feet for scuba divers to safely access the bottom. If neither of these sites will work for our criteria, where do you suggest we locate the resort?

I hope you will be able to travel to the new Sun-stainable Gulf Resort once it opens. Thanks for your assistance.

Elenoa Katalou
Sun-stainable Islands, Inc.



Email

From: prodiver850@outlook.com
Subject: Oil and gas supply from the Gulf of Mexico?
To: ecosystemscienceteam@noaa.gov

Science team,

My friends and I was on a scuba diving trip to an abandoned oil drilling platform at 88.9° W longitude 29.5°N latitude. While we were there, we think we found an invasive species of algae, *Caulerpa taxifolia*.

I know that this species can reproduce from just fragments that float to a new location. I've also heard that this algae produces a poison that is toxic to fish.

I hope your team will be able to make a plan to investigate and control the spread if you find it is actually an invasive species. We dive on old platforms all over the Northern Gulf. Where can we expect to see this algae in the future? What would happen to the recreational red snapper fishery?

Could you also let me know how much of the United States' oil and gas supply comes from the Gulf? Thanks

Earl Johnson



Telegram

TELEGRAM

TO: NOAA ECOSYSTEM SCIENCE TEAM
FROM: W.J. JACKSON

FROM W J JACKSON-(STOP)-WATER SHEEN EIGHTY FOUR POINT ONE DEGREES WEST TWENTY EIGHT POINT ZERO DEGREES NORTH -(STOP)-DEAD FISH FLOATING-(STOP)-PLEASE ADVISE-(STOP)

TIME RECEIVED: 4:13AM

NAME _____ Class _____ Period _____

QUESTION: How is the Gulf of Mexico a system?

For this activity, you will use information from *Gulf of Mexico Ecosystem: A Coastal and Marine Atlas*. This document used a variety of scientific sources to compile data about many parts of the Gulf of Mexico ecosystem.

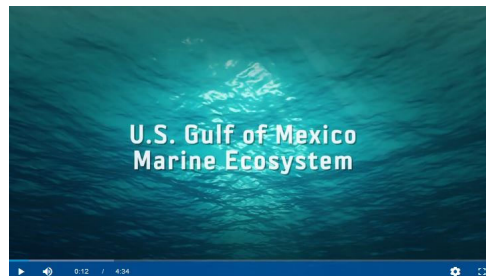
Activity 1

Look at the cover of the Atlas and note who created it and when. It was produced by the Ocean Conservancy after the Deepwater Horizon oil disaster to be a resource for people interested in restoring the Gulf of Mexico. Before beginning your task, look at the project area map in the Atlas.

1. Write down five things you observe:
 - 1.
 - 2.
 - 3.
 - 4.
 - 5.
2. Approximately how far does one centimeter on this map represent?
3. What kinds of data do you think will be shown in the Atlas?

Activity 2

Define the Gulf of Mexico ecosystem. Watch the video “U.S. Gulf of Mexico Marine Ecosystem.” Your teacher will pass out some maps for you and your classmates to look at. Examine each map and be ready to share something that you notice.

**Activity 3**

Now that you are familiar with the area, you will be working in a team to conduct an analysis of the ecosystem. Your group is a research team from universities around the Gulf of Mexico coast. The team includes a physical oceanographer, marine biologist, resource manager, and communications coordinator. Groups like this are *interdisciplinary*. By having a team with expertise in many areas, your group can get the big picture about what is happening in a system. Your teacher will assign your team and role.

Physical oceanographers are experts in the physical properties and changes in the ocean. They may study currents, salinity, dissolved oxygen and carbon dioxide, or other chemicals.

Marine biologists study the living things in the ocean. This can include the very largest fish or the tiniest bacterium and everything in between.

Resource managers have the job of assessing the abundance of all the types of resources in the ocean and advising lawmakers and other agencies. They plan for the long-term sustainability of ocean resources.

Communications coordinators help scientists share information with the public in a way that they can understand. Communications coordinators help us understand why scientific research is relevant to our lives.

Your team has received correspondence from a member of the public. It is your job to investigate, using data from the Atlas, so you can respond to the inquiry. Your team should use the maps and accompanying text related to different parts of the ecosystem. Once your team has come to a conclusion, you will prepare a response to the person. This will be presented to the class as a poster or single slide using the format below. Presenters must include:

1. A summary of **the problem**.
2. **A claim** (state whether your team thinks there may be an issue of concern or not) and what should be done about it.
3. **Evidence** (scientific data that support your claim).
4. **Reasoning** (a scientific explanation of the principles that justify using this data to make the claim).

You and your team should also answer any other questions posed in the correspondence. Answers to these can be found in the text description that comes before each map in the Atlas. Below is a space for your notes. Your team submission will include all member ideas.

Team Submission Form

1. The Problem	2. Group Members and Assigned Roles
3. Our Claim	
4. Evidence	5. Reasoning
Other Information to Answer the Person's Question or Problem	