

## **Sustaining Our Oceans – Summative Assessment**

### **Module Summative Assessment:**

As a culminating assignment, students will create a fact sheet that addresses the 3 main learning goals of this module.

**Learning goal 1:** Describe physical, chemical, and biological aspects of ocean systems, their importance, and how human activities influence these aspects.

**Learning goal 2:** Predict oceanographic changes that will result from modern climate change.

**Learning goal 3:** Discuss long-term strategies to protect ocean resources and preserve the state of the ocean.

To accomplish this, students will demonstrate their integrated understanding of the physical, chemical and biological aspects of ocean systems and describe how human activities influence these aspects. The fact sheets will also predict oceanographic changes that will result from modern climate change and conclude with proposing and supporting long term strategies designed to protect ocean resource and preserve the state of the ocean.

Students will be assigned the role of scientist, and communicate to the general public, through a mock fact sheet in support of policy action on the grand challenge of climate change.

### **Context for Use**

This activity is intended for use as a summative assessment for the entire module and gives students the opportunity to apply knowledge gained in the other units. The overall structure of this activity can be adapted for use with a wide variety of other topics with societal implications. It can be used as a group or individual assessment and could be heavily structured by the instructor (by providing a template, for example) or assigned as a more open-ended, student-driven project.

Prior knowledge gained from completion of the activities in Units 1-6 of this module is required for students to successfully complete this summative assessment. Before beginning this activity, students should be able to:

- describe how oceans moderate climate on Earth.
- describe the process by which oceans buffer rapid changes in atmospheric carbon dioxide and the effect of ocean acidification on calcifying organisms.

- describe the ecological role that organisms play within a community and ecosystem and how biodiversity is linked with ecosystem function and resilience.
- predict how climate change could alter ocean currents and chemistry.
- Students will be able to predict how climate change will impact marine organisms, communities, and ecosystems.
- define ocean sustainability and assess lifestyle choices related to ocean health.
- discuss contributions of marine protected reserves to ocean sustainability on multiple scales.
- evaluate and discuss the potential outcomes and long-term consequences of geoengineering.

This activity is designed as a homework assignment, and students may need 1-2 weeks outside of class to complete this assignment; the final due date should be determined by the instructor based on their instructional setting.

## **Description and Teaching Materials**

This activity is motivated by the long-standing tradition of the [United States Geological Survey](#) of providing research-based information to producers, consumers, and other community members. In this activity, students will work independently (individually or in groups) to create a fact sheet ([example from the USGS](#)) describing the use of carbon sequestration to mitigate climate change. They will use what they have learned about the factors that contribute to oceanic changes as described in modeled impact of climate change and to recommend changes in practice that might mitigate the effects of climate change.

The instructor will introduce the assignment by assigning the Fact Sheet Student Handout and Fact Sheet Grading Rubric. The instructor will then prompt students to consider the aspect of oceans (circulation, chemistry, ecosystems, pressures, protected areas, geoengineering, etc.) that they will focus their fact sheet on.

The instructor should also introduce this prompt;

"Describe the issue of ocean sustainability, including why oceans are vulnerable to climate change and how human interaction can help or hurt ocean systems".

Guidelines for format are intentionally left loose so students have a chance to be creative and consider how it might be best to present their information to the intended audience. Examples of "good" balance and "poor" balance are provided for students to consider. If desired, the instructor can project each example and have the students identify good and bad qualities of each.

- [Good example 1: USGS Coral Calcification In A Changing Ocean](#)

- Good content, informative and robust information
- Engaging photos

Problem with URL? Google Search –USGS Fact Sheet)

- [Good Example 2– USGS Response of Florida Shelf Ecosystems to Climate Change: from Macro to Micro Scales](#)
  - Good coverage of three scales; regional, estuary and organism level response

Problem with URL? Google Search –USGS Fact Sheet)

- [Fair Example – Coral Reefs](#)
  - Good content, not enough detail or factual information for this assignment
  - Engaging photos, visually appealing layout

Problem with URL? Google Search – Waitt Institute, Coral Reef Fact Sheet)

- [Poor Example 1 – “Coral Reefs – Ecosystem in Crisis”](#)
  - Balance is too text-heavy , people may not read the whole thing unless really interested
  - Only 1 page

Problem with URL? Google Search – Curriculum Press, Geofact Sheet, Coral Reef)

- [Poor Example 2 - Grass Carp](#)
  - All text, pretty small font, no headings. This format is fine for an academic audience already interested in the topic, but will not encourage laypersons to read it

Problem with URL? Google Search - Oklahoma Cooperative Extension Fact Sheets, Carp

## References

### Sample Fact Sheets

Information Fact Sheet on Ocean Sciences from UNESCO

[http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/pdf/info\\_sheet\\_IOC\\_EN\\_2013.pdf](http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/pdf/info_sheet_IOC_EN_2013.pdf)

Information Fact Sheets on Science Practices for Sustainable Development

[http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/pdf/sc\\_psd\\_EN.pdf](http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/pdf/sc_psd_EN.pdf)

The Ocean and Climate Change – IUCN Brochure

<http://bluesolutions.info/images/Oceans-and-CC-brochure-IUCN.pdf>

Changing Arctic Ecosystems – USGS Fact Sheet

<http://pubs.usgs.gov/fs/2012/3131/pdf/fs20123131.pdf>

Coral Calcification In A Changing Ocean – USGS Fact Sheet

<https://pubs.er.usgs.gov/publication/fs20103098>

Response of Florida shelf ecosystems to climate change: from macro to micro scales

<https://pubs.er.usgs.gov/publication/fs20103065>

Carbon Sequestration to Mitigate Climate Change

<https://pubs.er.usgs.gov/publication/fs20083097>

### **Sources for Images, Diagrams, Maps**

Infographics on Ocean Acidification

<https://ocean-acidification.net/2014/03/20/infographics-on-ocean-acidification/>

Ocean Acidification for Policy Makers

<https://ocean-acidification.net/category/for-policymakers/>

Ocean Acidification - Bringing information on ocean acidification to scientists, policymakers and the public

<https://ocean-acidification.net/category/by-the-numbers/>

Marine Protected Areas

<http://marineprotectedareas.noaa.gov/resources/publications/factsheets/>

Google Search “Images for Coral Reef Fact Sheets”

[https://www.google.com/search?q=coral+reefs+fact+sheet&rlz=1T4GGLS\\_enUS558US558&tbm=isch&bo=u&source=univ&sa=X&ved=0ahUKEwjW1a2czP3NAhVBLyYKHVZ6AUMQsAQIew&biw=1366&bih=612#imgrc=](https://www.google.com/search?q=coral+reefs+fact+sheet&rlz=1T4GGLS_enUS558US558&tbm=isch&bo=u&source=univ&sa=X&ved=0ahUKEwjW1a2czP3NAhVBLyYKHVZ6AUMQsAQIew&biw=1366&bih=612#imgrc=)