Lesson Plan: Teaching about Hazards and Disasters through Climate-related Examples (Sea-Level Rise and Flooding due to Melting of Polar Ice)

As a **high school** or **undergraduate Geography** or **Earth Sciences** teacher, you can use this set of computer-based tools to help you in teaching topics such as **Hazards, and Disasters: Natural and Man-made**.

This lesson plan allows students to understand how the melting of polar ice due to climate change can result in an increase in sea levels globally. The activity will also allow students to examine real data on sea-level rise, determine the reasons for climate change-related flooding, and visualize the effects of such flooding on vulnerable coastal regions.

Thus, the use of this lesson plan allows you to integrate the teaching of a climate science topic with a core topic in Geography or Earth Sciences.

Use this lesson plan to help your students find answers to:

- *Name the largest glaciers (in terms of volume) in the world.*
- *What would be the impact of the melting of large glaciers on coastal locations across the world?*
- *What are the factors that determine the vulnerability of a coastline to flooding caused by rising sea levels?*
- *What is the likely impact of a sea-level rise of 100 cm on San Francisco and Los Angeles?*

About the Lesson Plan

Grade Level	High school, Undergraduate
Discipline	Geography, Earth Sciences

Topic(s) in Discipline	Hazards, Disasters: Natural and Man-made, Sea-level Rise, Floods, Melting of Polar Ice due to Climate Change
Climate Topic	Disasters and Hazards
Location	United States, California
Access	Online
Language(s)	English
Approximate Time Required	140 – 200 min

1 Contents

1. Classroom/Laboratory Activity (60 – 90 min)	A classroom/laboratory activity that introduces the relationship between climate and the cryosphere, explains how sea-level rise can be predicted (based on average global temperature change), and triggers a discussion on the potential impacts of sea-level rise. https://serc.carleton.edu/eslabs/cryosphere/6b.html
2. Video (~7 min)	A video to discuss the social and economic impacts of rising sea levels. http://www.nbclearn.com/changingplanet/cuecard/53460

3. Classroom/Laboratory Activity (undergraduate level) (~90 min) **OR** **Visualization (high-school level) (60 – 90 min)**	For undergraduate level: A classroom/laboratory activity to examine and analyze sea-level change data and shoreline response for the coast of California. https://serc.carleton.edu/sp/ssac/national_parks/examples/35176.html OR For high-school level: An interactive visualization to visualize the effect of different amounts of sea-level rise and various storm scenarios on the coast of California. http://data.pointblue.org/apps/ocof/cms/ http://data.pointblue.org/apps/ocof/cms/index.php?page=flood-map
4. Suggested questions/assignments for learning evaluation	• Name the largest glaciers (in terms of volume) in the world. • What would be the impact of the melting of large glaciers on coastal locations across the world? • What are the factors that determine the vulnerability of a coastline to flooding caused by rising sea levels? • What is the likely impact of a sea-level rise of 100 cm on San Francisco and Los Angeles?

2 Step-by-step User Guide

Here is a step-by-step guide to using this lesson plan in the classroom/laboratory. We have suggested these steps as a possible plan of action. You may customize the lesson plan according to your preferences and requirements.

1. Introduce the topic through a classroom/laboratory activity

- Introduce the relationship between climate and the cryosphere, and the effect of increasing average global temperature on sea levels by conducting the classroom/laboratory activity, "Future of the Cryosphere: Sea Level Rise", from EarthLabs at SERC, Carleton.

  The activity can be accessed at https://serc.carleton.edu/eslabs/cryosphere/6b.html.

- Discuss the impact of rising sea levels for a specific location.

2. Play a video

Now, play the video "Rising Sea Levels", from NBC Learn's Changing Planet, to discuss how coastal communities are likely to be impacted by an increase in sea levels worldwide.

The video is available at http://www.nbclearn.com/changingplanet/cuecard/53460.

3. Conduct a classroom/laboratory activity (undergraduate level)	For undergraduate level: Next, explore the topic through a hands-on classroom/laboratory activity, "Mapping Coastal Vulnerability to Sea-Level Rise at Point Reyes National Seashore", developed by Len Vacher, University of South Florida. In this activity, students will examine actual data for sea-level change, and will perform data analysis and calculations in MS Excel to determine coastal vulnerability and shoreline response to sea-level rise. • Download the teaching material (module) available at https://serc.carleton.edu/sp/ssac/national_parks/examples/35176.html. • Conduct the activity described in the PowerPoint presentation (module).
OR **Conduct an activity based on an interactive visualization (high-school level)**	OR For high-school level: Next, explore the topic in an interactive and engaging manner by using the visualization (maps and tools), "OCOF Our Coast Our Future Flood Map", developed by the CoSMoS project team. • Access the visualization at http://data.pointblue.org/apps/ocof/cms/index.php?page=flood-map. • Facilitate an activity in which students can change the amounts of sea-level rise and storm scenario frequency, and observe the corresponding effects for specific locations on the coast of California. • Compare and discuss various flooding scenarios and the vulnerability of different locations.
4. Questions/Assignments	Use the tools and the concepts learned so far to discuss and determine answers to the following questions: • *Name the largest glaciers (in terms of volume) in the world.* • *What would be the impact of the melting of large glaciers on coastal locations across the world?*

- *What are the factors that determine the vulnerability of a coastline to flooding caused by rising sea levels?*
- *What is the likely impact of a sea-level rise of 100 cm on San Francisco and Los Angeles?*

3 Learning Outcomes

The tools in this lesson plan will enable students to:

- describe the relationship between climate and the cryosphere, and the possible impact of an increase in average global temperature on sea levels
- explain sea-level rise and the reasons for the rise
- discuss the factors that determine the vulnerability of coastal regions to inundation caused by rising sea-levels

4 Additional Resources

If you or your students would like to explore the topic further, these additional resources will be useful.

1. **Mobile App**

A mobile app, “Polar Explorer: Sea Level”, from Columbia University:

https://itunes.apple.com/us/app/polar-explorer-sea-level/id1056414420

5 Credits/Copyrights

All the teaching tools in our collated list are owned by the corresponding creators/authors/organizations as listed on their websites. Please view the individual copyright and ownership details for each tool by following the individual links provided.
We have selected and analyzed the tools that align with the overall objective of our project and have provided the corresponding links. We do not claim ownership of or responsibility/liability for any of the listed tools.

1. **Classroom/Laboratory activity, "Future of the Cryosphere: Sea Level Rise"**	EarthLabs at Science Education Resource Center (SERC), Carleton College
2. **Video, "Rising Sea Levels"**	NBC Learn's Changing Planet
3. **Classroom/Laboratory activity, "Mapping Coastal Vulnerability to Sea-Level Rise at Point Reyes National Seashore"**	Len Vacher, University of South Florida; available at SERC Carleton
4. **Visualization, "OCOF Our Coast Our Future Flood Map"**	Our Coast Our Future (OCOF)
5. **Additional Resources**	Columbia University