Crystal Cove® CONSERVANCY

Session 5: Monitoring Ocean Water Chemistry

Focus: Ocean Water Chemistry
Grade Level: *6-12*
Session Length: 125-170 minutes (Sessions can be done in class or assigned as homework)

Driving Questions

- Does data from a Crystal Cove State Marine Conservation Area (SMCA) monitoring project indicate whether the water chemistry (temperature, salinity, and pH) of ocean water is changing over time?

NGSS Links

- Analyzing and Interpreting Data
- Constructing Explanations and Designing Solutions
- Engaging in Argument from Evidence
- Obtaining, Evaluating, and Communicating Information

California Common Core State Standards Mathematics Links

- Statistics and Probability
- Interpreting Categorical and Quantitative Data
- Making Inferences and Justifying Conclusions

Computer Science Standards Links

- Data and Analysis

In this Environmental Challenge, students will analyze water quality data collected aboard our Marine Protected Area Science Cruise.

In 2012, California established a system of Marine Protected Areas, or MPAs for short. MPAs are underwater protected areas that are similar to state parks and forests on land. They help to protect and restore ocean habitats by putting regulations in place that limit what kinds of activities can take place there, such as fishing. These regulations increase the health, productivity, and resilience of ocean ecosystems.

The MPA Science Cruise is a field trip we've run in collaboration with a whale watching and fishing company, Newport Whales, since 2012. Junior high and high school students join us aboard the *Western Pride* to help us study Crystal Cove's State Marine Conservation Area. During the cruise, one of the studies that students help us with involves using sampling equipment to collect water samples and measure the temperature, salinity, and pH. For this environmental challenge, we are hoping to get your students' help in analyzing the water chemistry date from the last several years to look at trends.

During the environmental challenge, students will...

1. ***Learn*** about the Crystal Cove State Marine Conservation Area.
2. ***Learn*** about the ocean's water chemistry and ocean acidification.
3. ***Develop*** hypotheses about whether temperature, salinity, and pH change over time.
4. ***Collect data*** virtually on temperature, salinity, and pH to gain a better understanding of data collection methods.
5. ***Analyze*** and graph the data that have been collected on the MPA Science Cruise since 2015.
6. ***Share*** their findings about any trends they saw in the water chemistry data with their classmates and Crystal Cove State Park.
7. ***Reflect*** on the experience of analyzing data.
8. ***Connect*** with STEM professionals and like-minded peers to explore STEM content and careers in more depth.

Session Overview

By the end of this module, students will be able to...	*You can assess this using...*
1. ***Value*** the environment and understand that it is under threat and should be protected from human impacts.	Student notebook page; class discussions
2. ***Describe*** the ocean's water chemistry and how scientists measure temperature, salinity, and pH to monitor changes in those abiotic factors.	Student notebook page
3. ***Develop*** a hypothesis for a monitoring question.	Student notebook page
4. ***Use*** Use Google Sheets or Microsoft Excel to analyze and visualize data sets.	Student notebook page; class discussions
5. ***Describe*** patterns and trends in water chemistry data and share their findings with Crystal Cove State Park.	Student notebook page; class discussions
6. ***Reflect*** on why they care about protecting the Crystal Cove SMCA.	Student notebook page; class discussions
7. ***Participate*** in class discussions and discover shared areas of interest with classmates and explore those areas of interest together.	Class discussions
8. ***List*** other opportunities to engage with other interested students.	Student notebook reflection
9. ***Connect*** with STEM professionals during and/or after the environmental challenge to learn more about STEM disciplines and careers.	Questions posted to Padlet

Learning Outcomes and Assessments

Section	Description	Length	Format
Launch	Students learn about MPAs, water chemistry, and ocean acidification through a slideshow and online resources. They develop hypotheses about whether the temperature, salinity, and pH are changing over time in the Crystal Cove SMCA.	30-45 minutes	Individual or Whole class
Explore	Students virtually collect water chemistry data and then analyze the raw data collected during MPA Science Cruises.	25 minutes for ThingLink and virtual data collection; 45-60 minutes for data analysis and visualization	Individual
Share	Students share their findings with Crystal Cove State Park through Google Forms and with their classmates through a class discussion.	15-30 minutes	Individual and Whole Class
Reflect	In their student notebook, students reflect on whether they think it is important to monitor water chemistry trends and the impact of those trends on the Crystal Cove SMCA. Students also reflect on their role in this project.	10 minutes	Individual and Whole Class

Virtual Materials

- Online Environmental Challenge from Crystal Cove Conservancy's website: ***https://bit.ly/3gBLrBs***
- Introduction to the Water Chemistry Monitoring Project: ***https://bit.ly/3vGkRvi***
- Resources About MPAs and Ocean Acidification:
  - Souther California Marine Protected Areas: ***https://bit.ly/3wAalHb***
  - California Marine Protected Areas: ***https://bit.ly/3xzGjn3***
  - Crystal Cove State Marine Conservation Area: ***https://bit.ly/3cKljSv***
  - Safeguarding an Underwater Wilderness: ***https://bit.ly/2VAJxWq***
  - NOAA's Ocean Acidification Education Page: ***https://bit.ly/2SyLAMR***
  - NOAA's Ocean Acidification Program Page: ***https://bit.ly/3q2yOT1***
- Google forms for Sharing a Hypothesis: ***https://bit.ly/3vu5xBK***
- Vitual Data Collection ThingLink: ***https://bit.ly/3gAOBFo***
- Water Chemistry Measurements: ***https://bit.ly/2U5ktJq***
- Google Form for Sharing Data: ***https://bit.ly/3vv4Gk5***
- Water Chemistry Raw Data: ***https://bit.ly/35tVD8H***
- Data Analysis Crash Course YouTube Video: ***https://bit.ly/3aPQV8p***
- Padlet Question board: ***https://bit.ly/35wHRCk***
- Google form for Sharing Findings: ***https://bit.ly/2U5bl7A***
- Reflection Video: ***https://bit.ly/2Ufb1Dx***
- Student notebook pages: ***https://bit.ly/3gB01cs***

Each student will need...

- A device with internet access (a computer, smartphone, or tablet will all work!)

Before You Start Teaching

- Decide if you want your students to use the student notebook pages. This can be a good option if you want to collect student's work at the end of the project.
- Decide if you want to do the challenge during class time, assign it as homework, or a combination of both.
- This challenge can be done during class as a whole group or it can be assigned for students to work on independently in class or at home. The following instructions in the Learning Sequence describe how to lead students through the challenge as an in-class activity.
- Decide if you want students to work individually or in small groups

Learning Sequence

Launch

Getting Started (15-30 minutes)

1. Open the ***Introductory Voicethread Slideshow*** and play the video on Slide 2 for your class. In this video, students will meet Kaitlin, who will introduce you to the ocean water chemistry monitoring project and how it is connected to the Crystal Cove SMCA.

2. After you've finished the video, reiterate to students that your class has been asked to help protect the Crystal Cove SMCA by analyzing water chemistry data and sharing their findings with Crystal Cove State Park.

3. Continue to advance through the slideshow as a class or ask students to continue on their own.

A. ***Slide 3*** gives information about Marine Protected Areas.
B. ***Slide 4*** gives information about Crystal Cove State Marine Conservation Area.
C. ***Slide 5*** describes the importance of monitoring water chemistry.
D. ***Slide 6*** describes the MPA Science Cruise.
E. ***Slide 7*** describes the water chemistry station during the MPA Science Cruise.
F. ***Slide 8*** describes how students can analyze water chemistry data and help Crystal Cove State Park resource managers by sharing their findings.
G. ***Slide 9*** includes includes links to additional resources about MPAs and ocean acidification.

4. Next, students can learn more about MPAs and ocean acidification by exploring the resources posted in ***Step 1*** on the website.

5. After students explore the resources, ask them to share what they learned about water chemistry by answering the questions on the first page in the science notebook and facilitating a class discussion if you have the time.

6. Next, students consider a monitoring question in order to develop a hypothesis. Direct students to ***Step 2*** on the website to read the monitoring question:

A. **Monitoring Question:** Have there been annual or seasonal trends in the water chemistry measurements of temperature, salinity, and pH since 2015?

7. Ask students to predict what they will find when they analyze the butterfly data set and make a hypothesis for each monitoring question. Ask them to complete the ***Google Form*** on the website and write their hypotheses in their student notebook page.

Explore

Virtually Collect Data and Analyze Raw Data (30-35 minutes)

1. Show the students the ***ThingLink*** of the virtual trip aboard the Western Pride to the Crystal Cove SMCA with Kaitlin to see how she collects water samples and the equipment she uses to collect data on water chemistry, or ask them to watch it individually. Students will practice recording water chemistry measurements by watching the video, reviewing this ***equipment guide***, and looking at the images of the equipment showing measurements from water samples ***here***. They can then submit their data from the virtual data collection through this ***Google Form***.

2. After students have completed the virtual data collection, ask them to ***analyze the data*** in Google Sheets or Microsoft Excel from ***Step 4*** on the website and create data visualizations to answer the monitoring question. Students will learn about and record data on dissolved oxygen during the virtual data collection, but that abiotic factor isn't included in the data set that they will analyze because we don't have enough data for that abiotic factor yet.

3. If students need some assistance with analyzing and visualizing the data in SageModeler, ask them to watch the ***Data Analysis Crash Course Slideshow*** in ***Step 4*** on the website.

4. If students are working on this during class, circulate throughout the class to monitor the progress of students and assist them if necessary.

5. If students have questions about the data that need to be answered by a Crystal Cove Conservancy staff member or a scientist, collect questions and submit them as a class to the ***Padlet Questions Board*** or allow students to individually submit questions.

Share

Share Your Findings (15 minutes)

1. After the students have analyzed the data, they will share their findings with Crystal Cove State Park through the ***Google Form*** in ***Step 5*** on the website. If possible, facilitate a class discussion about their findings before students submit their information to Crystal Cove State Park.

A class discussion will give students an opportunity to explain their findings and make any necessary revisions based on new information that comes to light during the discussion. Encourage students to share the evidence from their data that supports their findings.

2. Remind students to include any data visualizations that they created in the Google Form. If you had students use the student notebook page, remind them to record their findings on the student notebook page and return it to you at the end of the project if you wish to see their work.

3. If students are interested in communicating with other students who have analyzed the data, they can submit thoughts, comments, and questions to the ***Padlet***.

Reflect

Reflecting on Butterfly Monitoring (10 minutes)

1. Tell students that they have one last task. Remind them that it's important for scientists to take time to reflect on how our thinking is changing. Show the ***video*** on the website page of Kaitlin talking about reflection and about the ocean water chemistry monitoring project.

2. Ask students to spend five to ten minutes reflecting on their experiences by answering the following questions in their student notebook or in another document if you aren't using the student notebooks. If possible, facilitate a class discussion to allow students to share their thoughts with each other.

- ***A.*** What did you do during this environmental challenge?
- ***B.*** What did you learn? How did your thinking change?
- ***C.*** Do you think it is important to monitor water quality in the Crystal Cove SMCA over time? Why or why not?
- ***D.*** Did you enjoy analyzing data and sharing your findings to help protect the MPA? What did or didn't you like about the experience?
- ***E.*** Would you like to learn more about the ocean ecosystem or how scientists monitor water chemistry? If so, what topics interest you? Do you have ideas of how you could learn more about them?

3. If students are interested in exploring other community science activities or marine science careers, encourage them to explore the links to the following websites in ***Step 6*** on the Environmental Challenge website.

- ***A. iNaturalist Project List***
  - ***A. Snapshot Crystal Cove 2021***
- ***B. SciStarter Project Finder***
- ***C. Zooniverse***
- ***D. Marine Careers***