

Focus: Analyzing Data & Constructing Explanations

Grade Level: 7-12

Session Length: 75-90 minutes

Driving Questions

- Is the Crystal Cove SMCA changing over time?
- What recommendations do we want to make to Crystal Cove State Park?

NGSS Links

- Analyzing Questions
- Using Mathematics & Computational Thinking
- Constructing Explanations

Systems Thinking Characteristics

- Identifying Hidden Dimensions of the System
- Proposing Explanations Based on Data
- Thinking Temporally & Making Predictions

In the seventh session of the MPA Exploration, student research teams analyze data and make a recommendation to Crystal Cove State Park.

Research teams revisit the data set for the three monitoring projects. They use an online platform to create a scatterplot of each dataset, work with their teammates to identify any patterns or correlations, and test the assumptions in their model. Finally, they construct a scientific explanation about whether the Crystal Cove SMCA's ecosystem is changing over time and draft a recommendation to Crystal Cove State Park.

Learning Outcomes & Assessments

<i>By the end of this module, students will be able to...</i>	<i>You can assess this using...</i>
1. Construct a scatter plot with a trend line.	Student-created graphs
2. Make inferences about the data based on their scatter plot, including determining the slope of the trend line and identifying patterns in their data.	Field notebooks
3. Use data to validate their system model from Session 3.	Field notebooks; Updates to research team models'
4. Develop an explanation that is supported by evidence about how the Crystal Cove SMCA's ecosystem is changing over time.	Research team recommendations
5. Make a Recommendation about whether or not it is necessary to make alterations to existing MPA regulations.	Research team recommendations

Session Overview

Section	Description	Length	Format
Launch	Erick introduces students to the task for the day: they will be analyzing their data to see if the Crystal Cove SMCA's ecosystem is changing over time and constructing a recommendation to share with Crystal Cove State Park about the MPA regulations.	5 minutes	Whole class
Explore	<p>Students work independently to graph the full data set from their monitoring project using SageModeler or Google Sheets. After, they share their scatter plot with their research team, look for correlations in the trend lines, and use it to validate their models.</p> <p>Research teams develop an explanation on how the Crystal Cove SMCA is changing over time, and then make a recommendation to Crystal Cove State Park about their findings.</p>	<p>30-40 minutes</p> <p>25-30 minutes</p>	Individual
Share	Students share their explanations with the entire class.	5-10 minutes	Research teams
Reflect	Students reflect on their experience during Session 7.	5 minutes	Individual

Choosing a Data Analysis Platform

In Session 7, student research teams work together to analyze the data set from each of the three monitoring projects.

As the lead educator, you can choose which online platform you want your class to use while building their model. We recommend choosing between *SageModeler* or *Google Sheets*, but you could also use Microsoft Excel or another platform.

The pros and cons of our two recommended platforms are listed below.

Platform	Pros	Cons
<p><i>SageModeler</i></p> <p>Cost: Free</p>	<p>Specifically designed to support student modeling and data analysis.</p> <p>Using the platform is very intuitive, making it ideal for younger students.</p> <p>If students created their model using SageModeler in Session 3, it is easy to test the model using the new data.</p>	<p>Only one person can manipulate the platform at a time (meaning one student will need to make a graph and then take a screenshot or share their screen with others).</p> <p>Teacher can only view the contents when the link was shared, so it is hard to see thinking in real time.</p> <p>It is not a platform that would be used by practicing scientists.</p>
<p><i>Google Sheets</i></p> <p>Cost: Free</p>	<p>Students can work collaboratively in the same document or share links to their graphs directly.</p> <p>Teacher can see thinking in real time.</p> <p>It is similar to platforms like Microsoft Excel, which are used by professionals working in scientific fields.</p> <p>It is capable of analyzing a larger and more detailed data set making the results more accurate.</p>	<p>Creating graphs is not as intuitive as SageModeler, so students will need to focus on the step-by-step process, possibly taking away from their conceptual understanding.</p>

Virtual Materials

- Session 7 Google Slides Presentation:
 - Sage Modeler: <http://bit.ly/3myQ5Qk>
 - Google Sheets: <http://bit.ly/3oUmyCe>
- MPA Exploration Dataset:
 - Sage Modeler: <http://bit.ly/2M1wkEB>
 - Google Sheets: <http://bit.ly/3awHDI4>
- Session 7 Field Notebook template (optional): <http://bit.ly/3az65PJ>
- Creating a Scatter Plot Instructions:
 - Sage Modeler: <http://bit.ly/3mGXjBE>
 - Google Sheets: <http://bit.ly/3ay2bXq>
- Research Team Recommendation Template: <http://bit.ly/3nHfLLQ>
- Final Recommendation Submission:
 - Google Form: <http://bit.ly/3pi99DZ>
 - Flipgrid: <http://bit.ly/38wasZt>

Each student will need...

- A device with internet access (a computer, smartphone, or tablet will all work!)
- Field notebook and pencil
- Access to their research team models from Session 3

Before You Start Teaching

- Decide how to structure the session. Since it may require more time than you might have in a single class meeting, you may decide to reduce or eliminate sections, split the tasks up over multiple meetings, or assign some of the collaborative work to take place outside of class.
- Decide whether you want students to use SageModeler or Google Sheets to analyze their data.
- Copy over the appropriate [Session 7 Slideshow](#) for your chosen platform to your own Google Drive account. Test to make sure that the videos work. (If not, you may have to check the permissions on the Crystal Cove Conservancy Youtube Account.)
- If you have chosen [Google Sheets](#) for data analysis, copy over the [Google Sheets data file](#) to your own Google Drive account. Decide how you will give students access to the file. You can have them make their own copy as they open it, or create a copy for each student or research team.
- Copy over the [Creating a Scatter Plot](#) instructions to your own Google Drive account. If you are using Google Sheets, add the link to your class's [Google Sheets data file](#) to the document.
- Set up a version of the Research Team Recommendation template for each group to complete. Decide how you will give students access to their team's template.

Learning Sequence

Launch

Preparing to Analyze Data (5 minutes)

1. Open the [Session 7 Slideshow](#) and play the video on [Slide 2](#) for your class. In this video, Erick will introduce the tasks for Session 7: analyzing data, developing an explanation of how the Crystal Cove SMCA ecosystem is changing, and then making a recommendation to Crystal Cove State Park.
2. After watching the video, move on to [Slide 3](#), which gives an overview of what students will do and learn during Session 7.

Explore

Part 1: Analyzing Data (20-25 minutes)

1. Advance to [Slide 4](#) and play the video. Kaitlin, one of Crystal Cove Conservancy's Education Coordinators, will introduce students to the online platform (SageModeler or Google Sheets) that they'll use to analyze data. During a screencast, she will demonstrate how to create a scatter plot and add a line of best fit.
2. Move on to [Slide 5](#), which includes links to the three different data sets for the three monitoring projects. Ask students to open the link for their specialized monitoring project and follow Kaitlin's instructions to create a scatter plot of their data. Remind them that they will need to share their graphs with their research team, so they should be ready to either share their screen or take a screenshot.

If you'd like, distribute the [Creating a Scatter Plot Instructions PDF](#) to students. Give them about 10 minutes to create the scatter plot and insert a line of best fit. Note that the Water Quality group may take a little longer -- they have three graphs to create, rather than just one.

3. When students are ready, advance to [Slide 6](#). There, in a video, Kaitlin will invite students to reflect on their graph and think about the distribution of their data.
4. After watching the video, move on again to [Slide 7](#). Have students respond to the questions in their field notebook and prepare to share their graphs with their teammates.

5. Once students have had a chance to reflect on their graphs, move on to *Slide 8*. Ask students to return to their research teams and share their findings with their teammates. In addition to describing trends, encourage them to look for any correlations between the different factors!

Remind students to respond to the questions in *Slide 8* in their field notebook. Give them 5-10 minutes to share their findings.

Part 2: Testing the Assumptions on Our Model (15-20 minutes)

6. Once students have finished sharing their graphs with each other, bring the group back together. Open *Slide 9* in the presentation, where Erick will ask students to use their findings to test the assumptions in the model that they created back in Session 3.

7. Move on to *Slide 10* and reiterate the instructions to students: Each research team should identify at least three relationships in their data that they had also included in their model and describe that relationship, based on the data. Next, they should compare those three relationships to the assumptions that they included in their model. They should determine if their original assumptions were supported, disproven, or inconclusive based on the data, and then make any necessary changes to their model.

Ask each research team to take notes in their field notebook as they work. As you can, move between the teams as they make updates to their models to listen in on their thinking.

8. If there is time, invite students to briefly share with the whole class whether or not the data supported the original assumptions in their model.

Part 3: Developing a Recommendation (25-30 minutes)

9. Tell students that now that they have had a chance to analyze the data and make updates to their models, it is time to answer one of our original driving questions: How is the Crystal Cove SMCA changing over time?

Open [Slide 11](#) and play the video. Erick will frame the task for students: first, they will create an explanation of how the Crystal Cove SMCA's ecosystem is changing over time, using their graphs as evidence. Afterwards, they'll use that explanation to support a recommendation to Crystal Cove State Park, giving the State Park input on whether the current SMCA regulations should be altered.

10. Once you've finished the video, move on to [Slide 12](#). Give each research team access to the Research Team Recommendation document. Ask them to work together to complete the first half, using their graphs as evidence to support an explanation as to how the marine ecosystem is changing over time.

Give students about ten minutes to work. As possible, move between the different groups. Encourage them to be very clear about the evidence and reasoning that supports their claim about how the ecosystem is changing over time.

11. When the research teams are done, move on to [Slide 13](#) and play the video. Erick will now frame the second half of the task: Students will now decide on what they want to recommend to Crystal Cove State Park. Should the current MPA regulations stay in place? Do they want to recommend changes?

12. Move on to [Slide 14](#), which gives students written instructions on the task. Ask students to complete the second half of the Research Team Recommendation document.

As the research teams wrap up the process, they can also share their recommendation with Crystal Cove Conservancy and Crystal Cove State Park through our Google Form.

Share

Sharing Our Recommendations (Optional) (5-10 minutes)

1. If there is time, bring the whole class back together. Move on to [Slide 15](#) and ask students to share their research team's recommendation to Crystal Cove State Park.

As different groups share, encourage them to explain their reasoning and ask questions of each other. You can structure this as a debate, with different students supporting different sides, or use it as an opportunity to seek input from different points of view.

2. As the discussion wraps up, invite students to reflect on the fact that a large part of the challenge with turning science into policy is that there are many different groups with different interests. Some, like the Acjachemen and Tongva tribal nations, have long been excluded from political processes like this. Others, like our local fishing groups, are rightfully concerned that science decisions could affect their ability to earn a living.

Even if we're taking the point of view of scientists right now, part of our task as future environmental leaders will be building an understanding and compassion for these different views so that we can figure out how to justly balance different needs and perspectives.

Reflect

Reflecting on Session 7 (5 minutes)

1. At the end of the discussion, advance to [Slide 16](#) in the slideshow and play the video, where Erick will ask students to spend a few minutes reflecting on their experiences today.

2. Advance to [Slide 17](#), which will share reflection questions. Ask students to spend five minutes reflecting on their experiences today in their field notebook.

3. Finally, thank the class for their time today.

- If this is the end of the MPA Exploration program for you, tell the students thank you for going on this journey with us!
- If you are continuing on with the extension Science Communication project, let students know that during the next session, they will use what we've learned so far as we return to our original question: How can we help protect the Crystal Cove SMCA?