

Topic: Marine Ecosystems

Grade Level: 7-12

Unit Length: 10 sessions

Unit Overview

Student research teams investigate how best to protect the marine ecosystem in the Crystal Cove State Marine Conservation Area. As they explore how MPA regulations protect coastal marine ecosystems, students design a model, process data during a virtual monitoring cruise, analyze the data, and share their findings with Crystal Cove State Park.

At the end of the unit, in an optional culminating project, students use science communication strategies to create social media pieces that promote the protection of places like the Crystal Cove SMCA.

Essential Questions:

- How can we protect the Crystal Cove State Marine Conservation Area?
- How is the Crystal Cove State Marine Conservation Area changing over time?

NGSS Performance Expectations

MS-LS2-1

MS-LS2-3

HS-LS2-2

HS-ESS3-3

NGSS Crosscutting Concept
Systems & System Models

Welcome to Crystal Cove Conservancy's Marine

Protected Area Exploration! As you and your students take part in real marine monitoring in Crystal Cove State Park's underwater park, you'll help researchers and natural resource managers understand whether regulations in the Crystal Cove State Marine Conservation Area are working.

The MPA Exploration is the result of a unique partnership between Crystal Cove Conservancy, Crystal Cove State Park, Newport Landing Sportfishing, UC Irvine researchers, and local educators. During this extended program, student research teams are introduced to California's Marine Protected Area network and how it helps to protect places like Crystal Cove's underwater park. By engaging in the practices of science, students develop a deep understanding of how environmental systems operate over time and build skills to engage in environmental research and science communication, preparing them to become informed stakeholders in the future.

Normally, the MPA Exploration involves an integrated curriculum that links classroom learning to a field trip aboard a fishing vessel owned and operated by Newport Landing Sportfishing. During the 2020-2021 school year, as a result of COVID-19, we have adapted the MPA Exploration so that students can participate virtually without the field experience.

The virtual version of the MPA Exploration is free for participating teachers and students, and was made possible thanks to support from the **Ocean Protection Council** and **Coastal Quest**. For more information on the grant award, [click here!](#)

If you would like more information on the program or would like to officially join, please contact Holly Fletcher, Crystal Cove Conservancy Education Manager, by emailing holly@crystalcove.org.

If you have taken part in the MPA Exploration, we would love to hear from you! Please **fill out this participation form** if you have used any of the modules or would like to leave feedback.

Our Park

Located on the coast in the area that is today known as Orange County, Crystal Cove State Park is located on the traditional lands and waters of the Acjachemen and Tongva tribal nations. We are deeply indebted to these tribal nations for their continuing role as the caretakers of these lands and waters, and are committed to uplifting their voices and perspectives through our work.

Crystal Cove State Park today is a green enclave within suburban Orange County. It consists of 3.2 miles of protected coastline, 2,400 acres of backcountry in Moro Canyon, and a 1,150-acre offshore underwater park, designated as the Crystal Cove State Marine Conservation Area in 2012.

The park features the federally-listed Historic District, which includes an enclave of forty-five vintage coastal cottages originally built as a seaside colony in the 1930s and 1940s and a preserved Japanese school house, which was built by the area's Japanese farming community before they were deported by the federal government to internment camps during World War Two.

Who We Are

Crystal Cove Conservancy is the nonprofit public benefit partner to Crystal Cove State Park, supporting important preservation, education, and conservation initiatives to cultivate our planet's next generation of environmental stewards ensuring that Crystal Cove, and places like it, live on for generations.

The Conservancy's unique STEM (Science, Technology, Engineering, Mathematics) education programs use community science to immerse students and the public in becoming good stewards of our environment. During our programs, students take part in real scientific investigations, working alongside researchers and land managers to investigate challenges faced by Crystal Cove State Park. Student findings inform real land management decisions, and past student data has even been included in *academic publications*, furthering our understanding of how best to protect wild places like Crystal Cove State Park.

For questions regarding MPA Exploration curriculum, logistics, and field trip scholarships, please contact:

Holly Fletcher
Crystal Cove Conservancy Education Manager
(949) 607-8709
holly@crystalcove.org

For questions regarding booking MPA Cruise field trips, please contact:

Jessica Roame
Newport Landing Education Coordinator
(949) 675-0550 x 118
jessica@newportwhales.org

Our Philosophical Approach to Science Learning

Crystal Cove Conservancy's STEM education programs are anchored in the idea of science-as-practice: that the best way to learn science is to do science. All of our programs integrate a three-dimensional approach to learning that aligns with the Next Generation Science Standards.

Our commitment to science-as-practice means that your students will really be helping to advance scientific knowledge as they participate in our STEM education programs. The research that they take part in is real, addressing real questions from scientists and land managers. Every year, we go into our program season unsure of what they'll find. Student data has even been included in scientific journal articles, like *Dr. Peter Bryant's article* on DNA barcoding techniques for plankton that was published in PLoS.

We also ground our work in sociocultural approaches to learning. We believe that people learn best by engaging in conversation with each other. Explaining reasoning out loud, asking questions of our peers, and responding to critique allows us to develop and test our ideas about how the world works. It also mirrors how professional scientists work by engaging in discussion and challenging ideas together.

Our Approach to Equity & Access

We believe in an assets-based approach to environmental education. The environmental movement has a long history of systematically excluding Black, Indigenous, and People of Color from both the movement itself and from parks and other outdoor spaces. Through programs like the MPA Exploration, we aim to empower youth so that they know that they can make a meaningful contribution to conservation.

We also recognize that all learners are natural scientists who possess an innate curiosity about the world. When students take part in the MPA Exploration, they are not learning to do science from scratch, but are practicing and refining the scientific skills that they already possess.

We are deeply committed to improving accessibility to our programs. Videos are close-captioned, and we've provided family-oriented materials in Spanish and English. If you need a different language or other technology to make the program more accessible for your students, please let us know.

Introduction to the Ecological Problem

Our ocean is one of California's greatest treasures, and it plays an important role in both our everyday lives and our economy. As our population has grown, human activity has put more and more pressure on our coastal and marine ecosystem. Overfishing has stressed not only many of the fish and marine species that we rely on for food, but also the marine ecosystems as a whole.

To prevent overfishing, governments can put regulations into effect that limit specific types of take. Marine protected areas are underwater parks where a government puts limits on specific human activities within defined boundaries. Scientific evidence has shown that these marine protected areas, commonly called MPAs, help to preserve biodiversity in marine ecosystems because they create a safe space where threatened species can breed and reproduce without pressure from people. As the fish or other marine populations grow within an MPA, they eventually spill over into unprotected waters, thus benefiting fishermen and others who rely on them for sustenance or economic value.

California has long had marine protected areas, but for much of our state's history, these parks were set up ad hoc without clear goals or objectives. A 1997 study found that they were giving little conservation value. To remedy this, in 1999, California's Legislature passed the Marine Life Protection Act (MLPA), which directed the state to review California's existing marine parks and redesign them as a coherent system grounded in science. This would allow the newly-designed MPA system to function as a network, helping to protect the state's marine life, marine ecosystems, and marine natural heritage. This historic law was the very first effort in the United States to set up such a statewide network of marine parks.

In June 2012, the new MPA network for California's South Coast was implemented. This included the establishment of the Crystal Cove State Marine Conservation Area (SMCA), the underwater offshoot of Crystal Cove State Park. However, at the time, there was no funding and no guidance on how the State Park should monitor the newly-established Crystal Cove SMCA to determine whether it was working or not.

That was how the Crystal Cove MPA Exploration was born. Crystal Cove Conservancy, the park's nonprofit partner, entered into a new partnership with Newport Landing Sportfishing, a nearby fishing company. At the time, the partnership was particularly notable because environmentalists and the fishing industry had been at loggerheads for so long during the MPA implementation process. The Conservancy then partnered with Crystal Cove State Park's natural resource managers and UC Irvine researchers to set up a series of monitoring projects, which we continue to this day.

The Intersection Between Science, Community Interests, and Policy

California's MPA Network also offers a unique opportunity for students to explore the intersection between policy, government regulations, community interests, and science. Early attempts to implement the MLPA and plan a statewide network of underwater parks stalled due to budget challenges and vocal opposition from several different groups. California's tribal nations possess unceded rights to access and care for California's coastal lands and waters, and they feared that those rights were being ignored by policymakers. In addition, fishing groups were vocally opposed to the proposed limits on fishing.

In 2004, a nonprofit organization called Resource Legacy Fund stepped in and signed an agreement with the State of California to start a new initiative to implement the act. From 2004-2012, RLF oversaw an extensive planning process, setting up scientific task forces and holding stakeholder meetings across the state to collect public input and expert ideas. The process became highly contentious. California's tribal nations, who frequently face racism and other systemic barriers that exclude them from California's governmental processes, feel strongly that their rightful interests were ignored during the review process. Fishing groups were also strongly opposed to the proposed reduction in permitted fishing areas.

Although California's new statewide system of marine protected areas is remarkable and historic from the perspective of science policy, there are still stakeholders today who feel as if their interests have been ignored or dismissed by the state. Most notably for Crystal Cove, this includes the Acjachemen and the Tongva, the two tribal nations whose historic lands and waters include the area that is now designated as Crystal Cove SMCA. Members of the local fishing community also remain frustrated by the regulations. If our goal is to protect and preserve our marine ecosystem, we need to find ways to include those who have been historically excluded from the political process.

The Challenge for Students

During the MPA Exploration, your students will have the chance to explore this intersection between science, policy, and stakeholder perspectives. Participating students will process and analyze real environmental data for three monitoring projects, helping us to better understand how the Crystal Cove SMCA is changing over time so that we can assess whether the regulations are working.

This year, in a new extension, students can also help us test new methods to build public awareness of the Crystal Cove SMCA by developing social media pieces aimed at specific audiences. Their creations will really be shared and evaluated through Crystal Cove Conservancy's social media platforms, helping us to build a better understanding of how best to promote awareness of MPA regulations among different audiences. By doing so, we will continue to ensure that Crystal Cove's underwater park, and other remarkable places like it, remain protected for future generations to enjoy.

Our Monitoring Projects

Since 2015, Crystal Cove Conservancy has partnered with Crystal Cove State Park and UC Irvine to run three monitoring projects in the Crystal Cove SMCA: using underwater cameras to survey the fish population in the kelp forest, conducting plankton tows and identifying plankton under a microscope, and collecting and testing water samples at different depths.

These monitoring projects are intended to help us understand how the ecosystem in the SMCA is changing over time. This will allow Crystal Cove State Park to make informed decisions about resource management and provide input on the MPA regulations when they come up for review in 2022.

Normally, the data for these three monitoring projects are collected by students during MPA Cruise field trips. Due to COVID-19 restrictions, in 2021, Crystal Cove Conservancy and Newport Landing will conduct monthly monitoring cruises to collect the data ourselves -- but although we've taken up the burden of collecting field samples, we still need help from students to record and analyze that data. During the MPA Exploration program, students will be responsible for processing the data during a virtual field expedition in Session 6, and then will analyze the full multi-year data set to look for trends in Session 7.

Driving Questions

How can we protect the Crystal Cove State Marine Conservation Area?
How Crystal Cove SMCA's ecosystem changing over time?
Are MPA regulations working?

Testable Monitoring Questions

- **Monitoring Question (1): Fish.** How is the presence of our target fish species changing over time in the Crystal Cove SMCA?
- **Monitoring Question (2): Plankton.** How is the presence of our target plankton species changing over time in the Crystal Cove SMCA?
- **Monitoring Question (3): Water quality.** How is the water quality in the Crystal Cove SMCA changing over time?

Learning Outcomes

During the MPA Exploration, students will be immersed in the practices and processes of scientific research as they take part in marine ecosystem monitoring in the Crystal Cove State Marine Conservation Area. By participating in the full program, they will build a broad understanding of marine ecology, MPA management, science communication, and how professional and community scientists can use science ideas and build public awareness to protect places like Crystal Cove's underwater park.

<i>By the end of the program, your students will be able to...</i>	<i>You can assess this using...</i>
1. Participate productively in scientific practices and the discourse of science.	Observations of student discussions throughout the program
2. Explain how MPA regulations can help to protect coastal marine ecosystems.	Observations of student discussions and science journals in Module 1
3. Use lateral search techniques to analyze sources and answer student-generated questions.	Research team presentations in Session 2 and Session 4
4. Construct a visual model of a marine ecosystem that shows how different factors and processes affect fish populations.	Research team models, created in Session 3 and revised in Session 4
5. Use their model to analyze how MPA regulations and changes to the environment may affect fish populations in a coastal marine ecosystem.	Research team discussions and field notebooks in Session 3
6. Reflect on why natural resource managers want to monitor ecosystems and collect and analyze data over time.	Field notebook reflections in Session 6
7. Use ideas about statistics to create mathematical representations and graphs showing changes in fish population, plankton population, and water quality data over time.	Research team products in Session 7
8. Construct evidence-based explanations about how the Crystal Cove State Marine Conservation Area is changing over time.	Research team products in Session 7
9. Apply science communication strategies to design a social media piece that communicates key science ideas related to Marine Protected Areas.	Final social media presentation in Session 10
10. Reflect on how we can use science ideas to protect places like the Crystal Cove SMCA.	Field notebook reflections in Session 7 and Session 10

Next Generation Science Standards Alignment

The MPA Exploration program is aligned with the three-dimensional approach of the Next Generation Science Standards. As students engage in community science research that focuses on a specific disciplinary core idea, they utilize science practices to plan and carry out investigations. Our programs frame science investigation through the crosscutting concept lens of Systems & Systems Models, challenging students to think about the visible and invisible interactions that affect environmental systems at Crystal Cove State Park.

By taking part in the ten sessions, students will be able to demonstrate understanding in the following areas:

Performance Expectations

Middle School

- **5-LS1-1.** Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- **5-LS2-1.** Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

High School

- **HS-LS2-2:** Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
- **HS-ESS3-3:** Create a computational simulation to illustrate the relationships among management of natural resources, the sustainability of human populations, and biodiversity.

Science Practices

1. Asking questions
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Crosscutting Concept

- Systems and System Models

Session	Overview	Length
1 <i>Exploring Crystal Cove's SMCA!</i>	In this initial session, students are introduced to the MPA Exploration program. After learning about the project, they are divided into research teams and start their field notebooks. After, they explore a Thinglink of Crystal Cove's beach to meet different stakeholders and investigate why people care about protecting the Crystal Cove SMCA.	45-60 minutes
2 <i>Asking Questions About MPAs</i>	Research teams generate questions about Marine Protected Areas and then use lateral search techniques to assess sources and research information online.	75-120 minutes
3 <i>Designing a Model</i>	Research teams collaborate to design a model showing how different components and processes affect the fish population in the Crystal Cove State Marine Conservation Area.	90-120 minutes
4 <i>Diving Deeper (optional)</i>	Research teams identify questions about their model, and then conduct background research to answer their questions and refine their model.	45-60 minutes or longer
5 <i>Preparing to Collect Data</i>	Research team members are assigned to specialize and learn more about one of the three monitoring projects in the Crystal Cove SMCA.	45-60 minutes
6 <i>Collecting Data</i>	Via Thinglink, research teams take part in a virtual monitoring cruise. They learn about the data collection process via video and help record data for their specialized monitoring project.	45-60 minutes
7 <i>Analyzing Data</i>	Research teams are tasked with analyzing data and determining how the Crystal Cove SMCA is changing over time.	75-90 minutes
8 <i>Choosing a Message (optional)</i>	After determining how the Crystal Cove SMCA is changing over time, team members are tasked with developing a social media piece to increase community awareness of MPAs. After learning about the basics of science communication, they choose a message, an audience, and a platform and begin drafting an evaluation plan.	45-60 minutes
9 <i>Refining Your Plan (optional)</i>	Team members refine their messaging and begin developing their social media piece.	90-120 minutes
10 <i>Executing Your Plan (optional)</i>	Finally, team members finalize their social media piece and evaluation plan, and then share it on their chosen platform.	45-60 minutes

Required Student Assessment

Crystal Cove Conservancy has pre- and post-assessments to help us evaluate the program's effectiveness, measure its impact on students, and report back on student learning outcome to our funders.

Before you start the MPA Exploration program, please ask students to complete the pre-program assessment. After completing your last session of the program, please have them fill out the post-program assessment. You can assure students that their responses to these two assessments will not be graded or scored -- they're simply to help us assess the program itself.

Student Pre-Program Assessment: <https://forms.gle/eiGNwAGRY9RESTqs9>

Student Post-Program Assessment: <https://forms.gle/GjM3GjkYMiiScZev9>

Basic Session Structure

Each session within the MPA Exploration is broken down into four sections. These sections align with the five elements of the BSCS 5E Instructional Model (although we use slightly different names).

Launch (or Engage)

At the start of every session, a short video introduces students to the day's driving question and invites them to share their initial ideas.

Explore

Next, students take part in short investigations related to the module's driving question. These investigations are designed to be flexible, and can take place during scheduled class time or independently outside of class.

Share (or Explain & Expand)

Students come back together to share their observations and discuss their ideas with their peers. These discussions may take place in student research teams or as a whole class. In the Session 1 slideshow, we've included slides with suggested science discussion norms, sentence starters, and suggested questions to get you started! You can adapt these for your class.

Reflect (or Evaluate)

At the end of each session, students watch a video prompt and reflect on what they've learned so far in their field notebook.

Technological Platforms

Throughout the MPA Exploration, we use a few different technological platforms to support student learning.

Sharing Information

Most of the program's presentations are hosted on **Google Slides**, with videos embedded from our **Crystal Cove Conservancy Education Youtube** account. Due to school permissions, you will likely need to make a copy of each Google Slides presentation on your school Google account so that students can access it.

Exploring Places Virtually

Thinglink is an easy-to-use platform that allows organizations to create interactive photo maps that users can click on and explore -- including 360-degree photos. During the MPA Exploration, students will use Thinglink **to take a virtual tour** of the Crystal Cove SMCA in Session 1, and then visit another Thinglink later in Session 6 to participate in a virtual monitoring cruise. (You will not need to know how to use it, other than demonstrating how to access virtual explorations and click through it!)

Creating Models

You can choose between two different options for students to use when they create a model in Session 3. The Session 3 lesson guide has more specific information on the advantages and disadvantages of the two platforms.

- **Padlet** is a collaboration platform similar to an online bulletin board, which will let multiple students collaborate and build a model at the same time. Free accounts (which students can sign up for) can create up to three Padlet boards. Pro accounts, which let a user create unlimited boards, start at \$8/month. If you don't have access to Padlet but prefer a collaborative option for modeling, you might consider using **Google Jamboard** or another **online collaborative whiteboard** instead.
- **SageModeler** is a free, online modeling tool that can be used to build computer simulations of systems. Although it is challenging to collaborate on SageModeler because only one person can manipulate the model, this platform will also allow students to easily define computational relationships between different factors in their models and simulate how environmental change will affect them.

Analyzing Data

SageModeler has the ability to create graphs and display data using visualizations that are deliberately designed to help students think about data distribution and outliers. This can help students to build a conceptual understanding of ideas like statistical significance. It is also easy to use, which makes it ideal for younger students. However, it is challenging to collaborate on SageModeler because only one person at a time can manipulate it, and it is not a platform that would be used by practicing researchers.

Google Sheets is a more traditional data analysis platform that is very similar to Microsoft Excel. It allows students greater freedom in creating graphs and performing calculations, and it can also be accessed collaboratively, with multiple students working on the same document in real time. However, using Google Sheets requires students to be more attentive to the step-by-step process involved in creating graphs and performing calculations, which can detract from conceptual understanding.

Designing Communications

In Sessions 8-10, students are tasked with creating a social media piece to communicate ideas about the Crystal Cove SMCA to specific audiences. During Session 8, they're asked to pick a platform to reach their audience. Recommended options include **Youtube**, **Facebook**, **Twitter**, **Instagram**, and **Medium**.

Later on, in Session 10, students will need to design and produce their social media piece. You can use whatever graphic design or video editing programs you have access to at your school site. If you are not familiar with any programs, easy-to-use free Mac & PC options include **Krita** for graphic design and **Da Vinci Resolve** for video editing. Mobile options include **Adobe Lightroom** for image editing and design, and **InShot** for video editing.

If you prefer another platform that serves a similar purpose, please feel free to substitute it in. If you or your students have any trouble accessing the slideshows or videos, please contact Holly at holly@crystalcove.org!

Decisions to Make

Before beginning the MPA Exploration, it will be helpful to think through how you want to integrate and support a few key aspects of the program. Below, you'll find more information on four key decisions that you may want to make.

Supporting Collaboration

We often learn science best by engaging in discussions and collaboration, but COVID-19 restrictions and time limitations make it challenging to support collaboration. As a result, it's worth thinking ahead about ways that you can intentionally support student collaboration.

We recommend dividing students into research teams early in Session 1. Students will continue to work in these same teams throughout the program. If you are teaching in a fully online or hybrid environment, you might consider dividing into small discussion groups on Zoom or giving students options to meet in their research teams independently.

Integrating Field Notebooks

Throughout the MPA Exploration, students are encouraged to use field notebooks to take notes, record observations, plan investigations, and reflect on their own thinking. This is intended as a teaching tool to support metacognition. Before beginning the program, we recommend thinking through the logistics of the field notebooks.

- **What kind of journal do you want students to use?** If you want to give students an opportunity to get off of their computers, you may ask them to use a physical field notebook, like a notebook, notepad, or paper stapled together. Individual Google Docs work for a digital option, which may be easier to review and assess.
- **How much scaffolding do you want to give students?** There is benefit to letting students use a free-form notebook, since it will force them to think through how to structure their thinking. However, some students may need more support which can come from pre-designed pages. If you would like to provide students with more scaffolding, we have provided scaffolded field notebook pages for each lesson.
- **How will you assess the field notebooks?** Consider whether you want to collect the journals, or if it's better to ask students to share photos of their entries so that you can assess their learning.

Assessing Student Work

Assessment can be challenging during COVID restrictions, so it is worth thinking ahead about how you will monitor and assess student learning. In the module lesson guides, we've identified learning outcomes for each module, along with suggestions for assessments.

- **For formative assessments**, you can observe student science journals and other student-created work, monitor students during discussions, and have students share a personal reflection at the end of each module.
- **For summative assessments**, you might decide to use our pre- and post-program learning assessments or have students or grade research team's final product using a rubric.

Focus: Human Impact on Ecosystems
Grade Level: 7-12
Session Length: 45-60 minutes

Driving Questions

- How has the Crystal Cove SMCA changed over time?
- Why do we care about protecting the Crystal Cove SMCA?

NGSS Links

- Asking Questions

Systems Thinking Characteristics

- Identifying System Components & Processes

In the first session of the MPA Exploration, students are introduced to the Crystal Cove State Marine Conservation Area and the threats it is currently facing.

Students divide into their research teams and set up their field notebooks for the unit. Then, research teams are tasked with exploring the Crystal Cove SMCA virtually. As they meet some of the people who work and recreate in this space, they reflect on the threats that it faces and why we care about protecting it.

Learning Outcomes & Assessments

<i>By the end of this module, students will be able to...</i>	<i>You can assess this using...</i>
1. Explain the goals of the Marine Protected Area Exploration project.	Field notebook reflection
2. Describe some of the challenges that the Crystal Cove SMCA is currently facing.	Research team and whole class discussions; Field notebook entry
3. Reflect how on why we care about protecting the Crystal Cove SMCA.	Research team and whole class discussions; Field notebook entry

Session Overview

<i>Section</i>	<i>Description</i>	<i>Length</i>	<i>Format</i>
Launch	Students watch a short video of Holly, who introduces them to the MPA Exploration project. They then divide into their research teams and set up their field notebooks, which they'll use throughout the project to take notes and track their thinking.	10-20 minutes	Whole class
Explore	Students explore the Crystal Cove SMCA virtually using Thinglink and meet some of the people who work and recreate in this space.	20 minutes	Research teams or individual
Share	Students share their reflections on the Thinglink with their research team members.	10 minutes	Research teams
Reflect	In their field notebook, students reflect on whether they think it is important to protect the Crystal Cove SMCA and begin to generate questions that they need to know.	5-10 minutes	Individual

Virtual Materials

- Session 1 Google Slides Presentation: <https://bit.ly/2JNdsaU>
- Session 1 Thinglink: <https://bit.ly/3mxSVWx>
- Session 1 Field Notebook Template (optional): <https://bit.ly/3qsl02y>

Each student will need...

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

Before You Start Teaching

- Copy over the *Session 1 Slideshow* 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.)
- In your copy of the Session 1 Slideshow, update *Slide 3* so that it reflects the sessions you plan to run with your class.
- Decide how you want to divide your class into research teams. In your copy of the Session 1 Slideshow, update *Slide 6* with your chosen directions.
- Decide how you want your class to set up their field notebooks. In your copy of the Session 1 Slideshow, update *Slide 8* with your chosen directions.
- Decide how you will host the Share Discussion for the session. In your copy of the Session 1 Slideshow, update *Slide 11* with any specific guidelines you have for science discussions.

Learning Sequence

Launch

Getting Started (10-20 minutes)

1. Open the *Session 1 Slideshow* and play the video on *Slide 2* for your class. In this video, students will meet Holly, who will introduce them to the MPA Exploration project and give a brief overview of what they'll do throughout the unit.
2. After you've finished the video, reiterated to students that your class has been asked to help protect the Crystal Cove State Marine Conservation Area. Continue to *Slide 3*, which gives an overview of the entire unit, and *Slide 4*, which describes what students can expect to do today.
3. Next, it is time to divide your class into their research teams, which they'll work in throughout the project. In *Slide 5*, Holly will introduce the concept of why scientists often collaborate together in research teams. Play the video for students, and then move onto *Slide 6* to divide them into their teams.
4. Finally, students will need to set up their field notebooks for the project. The video in *Slide 7* introduces the concept of a field notebook. Play the video for students, and then move on to *Slide 8* to share instructions with students.

Explore

Exploring the Crystal Cove SMCA Virtually (20 minutes)

1. Now that students have divided into their research teams and set up their field notebooks, tell them it's time to start exploring the Crystal Cove SMCA. Advance to *Slide 9* and play the video of Holly, who will describe the Thinglink and their task.
2. Move on to *Slide 10*, which will give students directions on using the Thinglink.

Reiterate the directions for students: They are to explore the Thinglink individually and take notes in their field notebook as they go. As they click on the points of interest, they'll hear different perspectives from some of the stakeholders and community members who live and work in this space. Students should make sure to record anything that might be important to our work protecting the Crystal Cove SMCA, such as threats that it is currently facing, as well as any perspectives that you find interesting.

If you feel that it would be helpful open the Thinglink and demonstrate how to move around it using your mouse. Click on the icons to pull up short videos from different stakeholders.

3. Give students 15-20 minutes to explore the Thinglink individually.

Share

Thinking About Perspectives (10 minutes)

1. After the students have had a chance to explore the Thinglink, have the class come back together. Review any guidelines for science discussions on [Slide 11](#), and then break the class into their research teams. Move onto [Slide 12](#) and ask each team to discuss the questions and record their thoughts in their science journals.
2. Give students about 10 minutes to talk in their research teams. If there is time, bring the class back together so teams can share their initial thoughts with the whole group.

Reflect

Reflecting on Session 1 (5-10 minutes)

1. Tell students that they have one last task. In the slideshow, advance to [Slide 13](#) and play the video, where Holly will introduce why it's important for scientists to take time to reflect on how our thinking is changing.
2. Move on to [Slide 14](#), which will share reflection questions. Ask students to spend five minutes reflecting on their experiences today in their field notebook.
3. Finally, if you are able, thank the class for their time today. Tell them that when you gather again, they will start diving deeper into Marine Protected Areas to learn more about them.

Session 2: Asking Questions

Focus: Obtaining & Evaluating Information

Grade Level: 7-12

Session Length: 45-60 minutes, with an additional 30-45 minute independent assignment

Driving Questions

- What do we need to know about California's MPA system?
- How can we determine if an information source is reliable?

NGSS Links

- Asking Questions
- Obtaining, Evaluating, & Communicating Information

Systems Thinking Characteristics

- Identifying System Components & Processes

In the second session of the MPA Exploration, students develop questions with their research team and conduct background research to learn more about California's MPA system and the Marine Life Protection Act.

Students are introduced to the idea of why California needs Marine Protected Areas. Next, research teams identify what they want to learn about MPAs. Students are introduced to the idea of lateral reading while looking for background resources, practice conducting a lateral search, and then independently apply the lateral search technique to find resources to answer their questions. Finally, they share their findings with their research team.

Learning Outcomes & Assessments

<i>By the end of this module, students will be able to...</i>	<i>You can assess this using...</i>
1. Describe the role that Marine Protected Areas and the Marine Life Protection Act play in protecting California's marine ecosystems.	Whole class discussion; Field notebook reflection
2. Use lateral search techniques to evaluate media sources while conducting background research.	Field notebook entry; Research team discussion
3. Communicate the results of their background research to their research team.	Research team discussion
4. Reflect on why it is important to evaluate the source of information while conducting background research.	Whole class discussion; Field notebook reflection

Session Overview

Section	Description	Length	Format
Launch	Students examine graphics related to the historic crash of the sardine fishing industry and reflect on how the Marine Life Protection Act helps to protect California’s marine ecosystems.	15-20 minutes	Whole class
Explore	Research teams brainstorm questions that they have about MPAs. They are introduced to the concept of lateral reading and practice conducting a lateral search using provided resources.	20 minutes	Research teams or individual
	Afterwards, students work independently to find resources to answer their questions.	30-45 minutes	Individual
Share	Students share their findings with their research teammates.	15 minutes	Research teams
Reflect	Students reflect on why it is important to evaluate information sources and what questions they still have about MPAs.	5-10 minutes	Individual

Virtual Materials

- Session 2 Google Slides Presentation: <https://bit.ly/2VEUG8I>
- Session 1 Field Notebook Template (optional): <https://bit.ly/3g4rp0g>

Each student will need...

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

Before You Start Teaching

- Copy over the [Session 2 Slideshow](#) 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.)
- Decide how you will structure the session. The first part (Launch and the first half of Explore) will be helpful to do during class time, but the second half of Explore can be assigned as independent work.
- Review the links in [Slide 9](#) and decide the best way to get them to students.

Background Information Resources

If you'd like to learn more about the topics covered today, check out the following resources!

Marine Protected Areas

- [California's MPA Network on Youtube](#)
- [Southern California MPA Maps & Regulations](#) from the California Department of Fish and Wildlife
- [California MPAs](#)

Lateral Reading Technique

- [How to Read News like a Fact Checker](#)
- [Check Yourself with Lateral Reading](#)

Learning Sequence

Launch

Why do we need MPAs? (15-20 minutes)

1. Open the [Session 2 Slideshow](#) and play the video on [Slide 2](#) for your class. In this video, Holly will briefly introduce Session 2. After watching the video, move on to [Slide 3](#), which gives an overview of what students will do and learn during Session 2.
2. Continue to [Slide 4](#) and play the video, where Holly poses the question: Why do we need a statewide system of MPAs in California?
3. Show [Slide 5](#) to students and ask them to spend five minutes reflecting on the graph and photo that they see there. In their field notebook, ask them to respond to the following questions:
 - What does the graph show?
 - What is the connection between the graph and the photos?
4. Once students have had a few minutes to think, move on to [Slide 6](#) and invite them to share their ideas about the graph and photo. You can use the questions on the slide as a starting point for the discussion:
 - How do you think California's sardine population crashed in the 1960s?
 - How might this have affected people who worked on fishing boats or in the canning industry? The price of sardines? The marine ecosystem?
 - What could we do to prevent this from happening?

As students share their thoughts about possible solutions, encourage them to think about different viewpoints. How can they balance the competing interests of consumers and concerns about the environment? Are there places where the fishing industry and environmentalists might agree? Where might they disagree? How would the average low-income worker in a sardine factory feel about all this? How about a low-income family who relies on sardines for food?

Highlight for students that this is really the challenge of protecting marine ecosystems: we need to find a way to balance our serious concerns about protecting the environment with our very real reliance on the ocean for sustenance and jobs.

Explore

Explore Part 1: Asking Questions (15-20 minutes)

1. Move on to *Slide 7* and play the video, which will give students an overview of California's Marine Life Protection Act and introduce them to the system of MPAs that were established as a result. The video will also introduce the task for the session: Students will work in their research teams to brainstorm questions they they have about the MPA system as a whole, and then use lateral reading techniques to find and evaluate resources to answer their questions.
2. Once the video is done, move on to *Slide 8* and reiterate the task for students: They will work in their research teams to brainstorm questions about California's MPA system, recording their questions in their field notebook. When they are done brainstorming all of their questions, they should go back through their list and identify the 4-5 questions that they think are most important.
3. Break students into their research teams and give them 5-10 minutes to brainstorm their questions. If possible, give them a 2 minute reminder before the end of the brainstorming time to identify which questions are most important.

If there is time, ask the research teams to share their questions with the whole class.

Explore Part 2: Introduction to Lateral Reading (15-20 minutes)

4. Move on to *Slide 9* and play the video for students, which will introduce them to the idea of reading laterally.

After playing the video, advance to *Slide 10*, which includes an initial question -- "What is the history of California's MPA system?" -- along with a few example resources. Ask students to pick one of the resources to practice performing a lateral search and open it in their browser.

Once the class is ready, move on to *Slide 11*, which will give them a screencast demonstration of how to perform a lateral search.

5. Advance to *Slide 12* and use it to review the steps of a lateral search: After each student chooses an article, they should open three separate windows and perform three web searches: for the author or creator (if known), for the organization or publication that published the article, and for 1-2 experts quoted in the text. They can keep track of what they find in their field notebook.

After reviewing the results of their lateral search, each student should determine what they should keep in mind about the author or publishing organization’s perspective while interpreting the source. They should also take notes on what they learn from it.

6. Give students 10 minutes to work individually so they can practice performing a lateral search.

7. After students finish their initial lateral search, bring the class back together. Invite 3-4 students to share what they found about the different sources.

Some highlights of the different sources include:

<i>Source</i>	<i>Description</i>
<i>The California MPA Network: Safeguarding an Underwater Wilderness</i> (Video)	This video was created by California’s Department of Fish and Wildlife in 2018. CDFW oversees the implementation of the MLPA in California. The video presents perspectives of stakeholders who believe the MPA system is a success six years after it was established.
<i>California’s Tribes Peacefully Take Control of the MLPA Taskforce Meeting</i> (Article)	This 2010 article was published by Intercontinental Cry, an independent newsroom that focuses on Indigenous issues. It includes a media contact from the Coastal Justice Coalition, a tribal-led activist group. Stories involving historically-excluded groups like California’s tribal nations are often not covered in traditional media. (For instance, the tribal perspective isn’t mentioned in the other three sources in this exercise.) Although the creators of this piece have a clear point-of-view, their work still provides insight into the perspective of the represented tribes, which may be impossible to find in other places.
<i>Go Fish? Not in No-Fishing Zones on California’s Pacific</i> (Video)	This 2011 video was created by PBS. In it, reporter Spencer Michels presents the perspectives of fishermen and environmentalists on the MLPA, which was in the process of being implemented at the time. This piece is an example of what we might think of as “traditional” journalism. It attempts to present different sides of a contentious issue.
<i>Overview: What is the Marine Life Protection Act (MLPA)?</i> (Article)	This Beachpedia wiki article was created by Surfrider, an environmental organization that was a strong proponent of the MLPA. This piece is an example of why it is important to perform lateral searches. Sometimes, it is not clear which author or organization is responsible for a particular resource. Lateral reading can help you to learn more about the creator so that you are able to judge whether the information presented is reliable or not. (In this case, we do consider Surfrider reliable, but they also have a clear opinion on the MLPA that may not be obvious at first!)

Move on to *Slide 13* and ask students to spend a few minutes reflecting on the process of lateral reading. Why is it important to evaluate sources of information, especially when you're looking for information about a politically-tricky topic like MPAs?

Explore Part 3: Using Lateral Search Techniques to Answer Questions about MPAs (30-45 minutes)

8. Depending on time, move on to *Slide 14* and play the video for students. (If there is not time, you can assign the next few slides to watch independently or in their research teams). This short video will introduce students' next task: to come up with a plan and use lateral search techniques to answer their research team's questions about MPAs.

Advance to *Slide 15*, and ask students to break into their research teams. They should review their questions about MPAs and decide who will research each question.

9. Give students time to work independently to find the answers to their questions. They should keep track of all of the resources they find in their field notebook, along with the results of the lateral searches they use to evaluate each resource.

Make sure they have a clear plan to regroup and share their findings with their research team, whether this will be done during your next class session or independently!

Share

What did you find? (15 minutes)

1. Open *Slide 16* in the *Session 2 slideshow*. Have students return to their research teams and share the results of their background research. Each student should take two minutes to informally present the following:

- What was your question?
- What sources did you look at to help answer your question?
- Were the sources reliable, or was there anything you needed to keep in mind while reading and interpreting them?
- What new information did you learn?

As students share, move between groups and listen to their conversations. Encourage them to reflect on the process of evaluating their resources. Did they find any authors with a particular point of view that needed to be taken into account? Did they find any resources that didn't seem reliable?

2. If there is time, gather the entire class for a group discussion. Invite them to share any interesting or surprising information that they learned about MPAs, or ways that the lateral searching helped them to understand an author's perspective.



Reflecting on Session 2 (5 minutes)

1. Tell students that they have one last task. In the slideshow, advance to *Slide 17* and play the video, where Holly will invite them to spend a few minutes reflecting.
2. Move on to *Slide 18*, which will share reflection questions. Ask students to spend five minutes reflecting on their experiences today in their field notebook.
3. Finally, if you are able, thank the class for their time today. Tell them that when you gather again, they will return to thinking specifically about the Crystal Cove SMCA and start building a model of the ecosystem there.

Session 3: Designing a Model

Focus: Designing & Using Models

Grade Level: 7-12

Session Length: 90-120 minutes

Driving Questions

- What might affect the fish population in the Crystal Cove SMCA?
- How can we create a model that shows how components and processes in the Crystal Cove SMCA's ecosystem interact with each other?

NGSS Links

- Designing and Using Models
- Using Mathematics and Computational Thinking
- MS-LS2-3
- HS-LS2-2
- HS-ESS3-3

Systems Thinking Characteristics

- Identifying System Components & Processes
- Identifying Simple Relationships Between System Components
- Organizing System Components & Processes within a Framework of Relationships
- Identifying Hidden Dimensions of the System

In the third session of the MPA Exploration, students work with their research teams to design a model that shows their initial ideas about how different components and processes with the Crystal Cove SMCA marine ecosystem might affect the fish population.

During the first half of the session, student research teams work together to brainstorm a list of biotic components, abiotic components, and processes that might impact the number and biodiversity of fish in the Crystal Cove SMCA. Students then work independently and draft a model in their field notebooks. During the second half of the session, research teams come back together to collaboratively design a model using an online platform.

Learning Outcomes & Assessments

<i>By the end of this module, students will be able to...</i>	<i>You can assess this using...</i>
1. Generate a list of biotic components, abiotic components, and processes that affect fish populations in the Crystal Cove SMCA.	Field notebook entry or shared Google Doc
2. Create a model that shows how biotic components, abiotic components, and processes might affect the fish populations in the Crystal Cove SMCA.	Research team models
3. Use computational thinking to predict environment will impact the fish populations in the Crystal Cove SMCA.	Field notebook entry or shared Google Doc
4. Reflect on why scientists use models to make predictions about real-world systems.	Whole class discussion

Session Overview

Section	Description	Length	Format
Launch	Students watch a video that introduces them to the idea of creating a model.	5 minutes	Whole class
Explore	Research teams generate a list of components and processes that might affect fish populations in the Crystal Cove SMCA. Students then work independently to create a draft model in their field notebook.	20 minutes	Research teams & individual
	Research teams then come back together to create a collaborative model using Padlet, SageModeler, or another online platform of the teacher's choice.	30-45 minutes	Research teams
	Optionally, research teams can also use their models to make predictions about how changes to the ecosystem will affect the fish population.	15-20 minutes	Research teams
	Finally, research teams identify what questions they still have about their model.	5 minutes	Research teams
Share	If there is time, students share their models with the whole class.	15 minutes	Whole class
Reflect	Students reflect on what they've learned from their model and what their next steps might be.	5-10 minutes	Individual

Choosing a Modeling Platform

In Session 3, student research teams work together to build a model that shows how different biotic components, abiotic components, and processes impact the fish population within the Crystal Cove SMCA.

As the lead educator, you can choose which platform you want your class to use while building their model. Unfortunately, while online modeling platforms exist, no one platform is perfect. We recommend choosing between Padlet or SageModeler, but you could also use Google Jamboard, another online whiteboard, or another platform entirely.

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

Platform	Pros	Cons
<p>Padlet</p> <p>Cost: Free for first three boards; requires \$10/month subscription for additional boards</p>	<p>Modeling can be done collaboratively with multiple students using one online workspace at the same time.</p> <p>Teacher can see thinking in real time.</p> <p>Students can import videos, links, and images within the posts.</p>	<p>More difficult to show links and explain computational relationships.</p> <p>A free account can only create three Padlets (meaning students will need to sign up for their own account).</p> <p>Cannot import data and use it to test the assumptions in the model.</p>
<p>SageModeler</p> <p>Cost: Free</p>	<p>Specifically designed to support student modeling.</p> <p>Has a clear way to define computational relationships between components and processes.</p> <p>Can run simulations to see the effects of one component on another.</p> <p>Can import data to test the model and make graphs (which can be used to analyze data in Session 7).</p>	<p>One person can manipulate the model at a time (meaning one student will need to manipulate the model and share their screen with others).</p> <p>Teacher can only view the contents when the link is shared, so it is hard to see thinking in real time.</p>

Virtual Materials

- Session 3 Google Slides Presentation:
 - If you're using Padlet: <https://bit.ly/39GCpA6>
 - If you're using SageModeler: <https://bit.ly/33K1bLA>
- Session 3 Field Notebook template (optional): <https://bit.ly/33JGrnr>
- Template for your chosen modeling platform:
 - Padlet Template: <https://bit.ly/2VQrewu>
 - SageModeler Template: <https://bit.ly/3mFuHtl>

Each student will need...

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

Before You Start Teaching

- Decide which platform you want students to use when building their research team model: Padlet, SageModeler, or another platform of your choice.
- Copy over the [Session 3 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.)
- Review the lesson plan and decide how you will structure the session in terms of timing. Students will likely need about two hours to complete the session, so you may want to break it over two class meetings or assign some collaborative work outside of class.
- Decide how you want students to collaborate and share their ideas as they are brainstorming a list of components and processes and reflecting on their models. If you want them to use a shared Google Doc (instead of using their field notebooks), copy over the Research Team Brainstorming template and set up a document for each research team.

If you want students to use a shared Google Doc, update [Slide 5](#) with links to the Research Team Brainstorming documents for each team.

Learning Sequence

Launch

Getting Started with Modeling (5 minutes)

1. Open the [Session 3 Slideshow](#) and play the video on [Slide 2](#) for your class. In this video, Erick will briefly introduce Session 3 and the fact that students will work in their research teams to build a model of the Crystal Cove SMCA marine ecosystem.
2. After watching the video, move on to [Slide 3](#), which gives an overview of what students will do and learn during Session 3.

Explore

Explore Part 1: Brainstorming Components & Processes (20-25 minutes)

1. Advance to [Slide 4](#) and play the video. Erick will introduce students to the first task in creating their model: they will need to work in their research team to brainstorm a list of abiotic components, biotic components, and processes that could affect the fish population in the Crystal Cove SMCA.
2. Once the video is done, move on to [Slide 5](#) and reiterate the task for students: They will work in their research teams to brainstorm abiotic components, biotic components, and processes that could affect the fish population in the Crystal Cove SMCA.

Let students know how you want them to record their list (in a shared Google doc, in their field notebook, etc.).

Some tips to share with students:

- What was your question?
- What sources did you look at to help answer your question?
- Were the sources reliable, or was there anything you needed to keep in mind while reading and interpreting them?
- What new information did you learn?

3. Break students into their research teams and give them 10-15 minutes to brainstorm their list. If possible, give them a two-minute reminder before the end of the brainstorming time.

4. When the research teams are done brainstorming, play the video on [Slide 6](#). In this video, Erick will challenge students to pick the 10-12 items from their list that have the biggest effect on fish populations.

5. Move on to [Slide 7](#) and ask students to break back into their research teams. Give them two minutes to choose the 10-12 items on their shared list that they think will be most important to include in their team model.

If there is time, ask the research teams to share some of the final components and processes on their list with the whole class.

Explore Part 2: Drafting a Model Individually (15-20 minutes)

6. Move on to [Slide 8](#) and play the video for students, which will challenge them to now work independently to begin building a model. There are written directions on [Slide 9](#), which you can use to review the task again.

Give students time to begin drafting their models individually in their field notebooks. You can have them do this individually in class or assign it as individual work outside of class.

Explore Part 3: Building a Team Model (30-45 minutes)

7. Once students have finished drafting their individual models, move on to [Slide 10](#) and play the video for the whole class. This will introduce them to the modeling platform that they will be using to build their team models.

- If you are using Padlet, the model-building instructions are broken in two. There is one video on how to register for an account and set up a Padlet for their research team ([Slide 10](#)), written instructions on how to set up the Padlet ([Slide 11](#)), and a second video and written instructions on how to use Padlet to build a model ([Slide 12-13](#)).

Note that as students set up their model, they are asked to use conditional statements to describe the relationship between different components of the model. They will use these conditional statements to construct logical proofs later on so that they can use their model to make predictions about how changes to the ecosystem may impact the fish population.

- If you are using SageModeler, there is one video on how to use SageModeler ([Slide 10](#)) and a second with written instructions ([Slide 11](#)).

8. Give students research teams to build their models. If it is possible, visit each group (whether virtually and in person) to check in on their progress. As you do so, encourage them to think about parts of the ecosystem and processes that they can't see, as well as those that are visible.

Explore Part 4: Using the Model to Simulate Change (Optional) (20 minutes)

- 9.** Once there is time, you can also ask student research teams to use their model to think about how changes to the ecosystem will impact the fish population.
- If you are using Padlet, the video on [Slide 14](#) introduced the idea of how to use student models to think about change.
 - If you are using SageModeler, students can use the slider bars within SageModeler to simulate change within their model. The screencast video on [Slide 12](#) will introduce how to do this.

10. After introducing the task, give students ten minutes to explore their model and determine how changes to the ecosystem will impact the fish population.

Explore Part 5: Identifying Questions (5 minutes)

11. Finally, move on to [Slide 16](#) (in the Padlet slideshow) or [Slide 14](#) (in the SageModeler slideshow), which will ask students to identify any remaining questions that they have about their models.

Move on to the next slide, which has written instructions, and give research teams a few minutes to finalize their questions.

Share

Sharing Our Models (Optional) (10-15 minutes)

1. If there is time, gather the entire class for a group discussion. Invite the research teams to share their models and their predictions about how changes to the ecosystem will impact the fish population.



Reflect

Reflecting on Session 3 (5 minutes)

1. Tell students that they have one last task. In the slideshow, advance to Padlet [Slide 19](#) or SageModeler [Slide 17](#) and play the video, where Erick will invite them to spend a few minutes reflecting.
2. Move on to the final slide, which will share reflection questions. Ask students to spend five minutes reflecting on their experiences today in their field notebook.
3. Finally, if you are able, thank the class for their time today. Tell them that when you gather again, they will dive deeper into their models to refine them and start thinking about how we can use our ideas about the Crystal Cove SMCA's marine ecosystem to monitor how it is changing.

Focus: Building Background Knowledge
Grade Level: 7-12
Session Length: 45-60 minutes or longer

Driving Questions

- What else do we need to know to refine our model of the Crystal Cove SMCA

NGSS Links

- Designing and Using Models

Systems Thinking Characteristics

- Identifying System Components & Processes
- Identifying Simple Relationships Between System Components
- Organizing System Components & Processes within a Framework of Relationships
- Identifying Hidden Dimensions of the System

In the fourth and optional session of the MPA Exploration, students identify the questions that they have about their model and conduct background investigations to learn more about different parts of the system.

At the start of the session, research teams return to the models that they created in Session 3 and identify any questions that they need to answer. Based on the questions that students identify, they set up a chart to track what they learn and use lateral search techniques to research the answers online. The teacher can also choose to have students take part in other related labs or investigations outside of the MPA Exploration program.

Learning Outcomes & Assessments

<i>By the end of this module, students will be able to...</i>	<i>You can assess this using...</i>
1. Identify questions that they have about the marine ecosystem in the Crystal Cove SMCA.	Field notebook entry
2. Plan and conduct background research or investigations to answer their questions.	Research team discussions
3. Develop and carry out a plan to refine their model of the Crystal Cove SMCA.	Research team models; Field notebook reflections

Session Overview

Section	Description	Length	Format
Launch	Students watch a video of Erick, who introduces the task for Session 4: they will be asked to identify and answer questions about their model so that they can refine it.	5 minutes	Whole class
Explore	<p>Research teams generate a list of questions that they still have about their model and come up with a plan to answer them.</p> <p>The latter part of the session is flexible. Students can research the answers to their questions online using the lateral search technique that they practiced in Session 2. The teacher can also choose to insert other scientific investigations to explore specific topics related to their models.</p>	<p>20 minutes</p> <p>30 minutes and up</p>	<p>Research teams & individual</p> <p>Individual or Research teams</p>
Share	Student research teams share what they've learned and make updates to their model.	20-25 minutes	Whole class
Reflect	Students reflect on what they've learned from their model and what their next steps might be.	5 minutes	Individual

Virtual Materials

- Session 4 Google Slides Presentation: <https://bit.ly/3IRISuk>
- Session 4 Field Notebook template (optional): <https://bit.ly/33YaKXE>

Each student will need...

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

Before You Start Teaching

- Review research teams' models from Session 3 and take note of any common misunderstandings or questions that they identified.
- Decide how you want students to conduct background research. You can let them look for information online, or you can integrate other investigations (such as *an ocean acidification lab* to learn more about how ocean acidification affects pH and fish or *building a food web* of a marine ecosystem).
- Copy over the *Session 4 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.)
- Review the lesson plan and decide how you will structure the session in terms of timing. Depending on how you want to have students conduct their research and refine their model, you may want to break the Explore section over multiple class sessions or assign it as independent work.
- If there are specific extension investigations that you want to add into the lesson, update *Slide 5* with any information that may be unique to your class.

Learning Sequence

Launch

Getting Started with Modeling (5 minutes)

1. Open the [Session 4 Slideshow](#) and play the video on [Slide 2](#) for your class. In this video, Erick will briefly introduce introduce Session 4 and the idea that research teams will want to refine their models.
2. After watching the video, move on to [Slide 3](#), which gives an overview of what students will do and learn during Session 4.

Explore

Digging Deeper (75+ minutes)

Part 1: Identifying Questions (20-25 minutes)

1. Advance to [Slide 4](#) and play the video. Erick will ask research teams to review their model, identify any questions that they have, and come up with a plan to answer those questions.
2. Once the video is done, move on to [Slide 5](#) and reiterate the task for students: They will review their models and identify at least 3-5 questions that they still have and then come up with a plan to answer those questions.

Let students know how you want them to record their list (in a shared Google doc, in their field notebook, etc.). If there are specific questions that you want to tackle as a class through extension investigations, make sure to note these.

3. Break students into their research teams and give them 15 minutes to identify their questions and come up with a plan to answer them. If possible, give them a two-minute reminder before the end of the brainstorming time.

Part 2: Conducting Background Research (30+ minutes)

4. When the research teams are done brainstorming, play the video on [Slide 6](#). Move on to [Slide 7](#) and ask students to begin working on their background research.

As students work, they should keep track of what they learn in a Digging Deeper chart.

Question	What I Did	What I Learned	Clues for Our Model
What question are you trying to answer?	How did you find the answer to the question?	What did you learn that answered the question?	What do you plan to add to your model as a result?

5. Give students time to conduct their background research. You can have them do this individually in class or assign it as individual work outside of class.

Share

Sharing Our Findings & Revising Our Model (Optional) (20-25 minutes)

1. Open *Slide 8* and play the video, where Erick will invite them to share their findings with their research team.
2. Move on to *Slide 9*. Ask students to return to their research teams and share their findings with their teammates. When they're ready, they can begin refining the collaborative model that they created in Session 3.
3. Give students time to work. If possible, move between the discussions. Invite students to share how their thinking and understanding changed as they conducted the background research.

Reflect

Reflecting on Session 4 (5 minutes)

1. When the research teams are done updating their models, tell students that they have one last task, as always. In the slideshow, advance to *Slide 10* and play the video, where Erick will invite them to spend a few minutes reflecting.
2. Move on to the final slide, 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. Tell them that when you gather again, they will learn about the different monitoring processes that Crystal Cove Conservancy, Crystal Cove State Park, and UC Irvine are using to study the Crystal Cove SMCA, and will prepare to help with data collection.

Session 5: Preparing to Collect Data

Focus: Planning an Investigation
Grade Level: 7-12
Session Length: 45-60 minutes

Driving Questions

- What can we monitor to see if the Crystal Cove SMCA ecosystem is changing over time?
- What do we need to know to collect data?

NGSS Links

- Planning and Carrying Out Investigations

Systems Thinking Characteristics

- Identifying Hidden Dimensions of the System

In the the fifth session of the MPA Exploration, students prepare to collect data for Crystal Cove Conservancy's three monitoring projects!

Research teams use their models to identify what data they could collect to see how the marine ecosystem is changing. They're then introduced to the three monitoring projects for which they will be responsible for collecting and analyzing data during their virtual field trip. Research teams then assign their members to one of the three specialities -- fish monitoring, plankton monitoring, or water quality monitoring -- and explore a Voicethread to train and learn more about their specialized topic.

Learning Outcomes & Assessments

<i>By the end of this module, students will be able to...</i>	<i>You can assess this using...</i>
1. Describe how Crystal Cove Conservancy monitors the Crystal Cove State Marine Conservation Area.	Whole class discussion
2. Describe what they will do during their specialized monitoring project.	Field notebook reflection

Session Overview

Section	Description	Length	Format
Launch	Students watch a video that introduces the topic of the day: learning more about the monitoring projects that they'll be asked to help with during their virtual field trips.	5 minutes	Whole class
Explore	Research teams use their models to reflect on what data they might want to gather.	10 minutes	Research teams
	Afterwards, students learn about the three monitoring projects and are assigned to specialize in one of three monitoring projects. They explore a Voicethread to learn more about their speciality.	20-30 minutes and up	Individual or Research teams
Share	Students share details about the three projects and reflect on why we need to monitor the Crystal Cove SMCA over time.	5-10 minutes	Whole class
Reflect	Students reflect on their experience during Session 5.	5 minutes	Individual

Virtual Materials

- Session 5 Google Slides Presentation: <https://bit.ly/3qDGNWo>
- Session 5 Field Notebook template (optional): <http://bit.ly/34B199r>
- Monitoring Project Voicethreads:
 - Fish Monitoring: <https://bit.ly/3qBFreO>
 - Plankton Monitoring: <https://bit.ly/2K2eTTa>
 - Water Quality Monitoring: <https://bit.ly/2LkClf6>

Each student will need...

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

Before You Start Teaching

- Copy over the *Session 5 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.)
- Decide whether you want to let students choose their own monitoring project or if you'd rather assign them to a speciality. Update *Slide 7* with any specific instructions for your class.

Learning Sequence

Launch

Getting Started with Modeling (5 minutes)

1. Open the [Session 5 Slideshow](#) and play the video on [Slide 2](#) for your class. In this video, Erick will briefly introduce Session 5 and the fact that research teams need to prepare to collect data so that we can see how Crystal Cove's SMCA is changing over time.
2. After watching the video, move on to [Slide 3](#), which gives an overview of what students will do and learn during Session 5.

Explore

Preparing to Collect Data (75+ minutes)

Part 1: What Can We Monitor (10 minutes)

1. Advance to [Slide 4](#) and play the video. Erick will ask research teams to review their model and brainstorm 3-4 things that they might be able to monitor over time to see how the Crystal Cove SMCA is changing.
2. Once the video is done advance to [Slide 5](#) and reiterate the task for students: They will need to look back at their model and think about what they could monitor over time.
3. Break students into their research teams and give them 5 minutes to brainstorm ideas. If there is time, bring them back together and ask teams to briefly share their plan.

Part 2: Preparing to Collect Data (20-30 minutes)

4. Move on on to [Slide 6](#) and play the video for students. Erick will introduce the three monitoring projects: monitoring fish using underwater cameras, collecting plankton samples and identifying plankton, and measuring different aspects of water quality. Students will specialize in one of these three monitoring projects, which they'll help to collect data for during the virtual field trip in Session 6.

5. Advance to *Slide 7*, and break students into their research teams. Ask them to assign at least one member to specialize in each of the three monitoring projects. (Alternatively, you can make these assignments for them!)

Once students have made their assignments, they can open the Voicethread for their monitoring project and begin exploring it.

- **Fish Monitoring:** Specialists will need to be able to identify fish in videos recorded using an underwater camera. During the Voicethread, they'll learn about the different fish species in the Crystal Cove SMCA and practice identifying them using a field guide.
- **Plankton Monitoring:** Specialists will need to be able to identify plankton from a sample collected in the Crystal Cove SMCA. During the Voicethread, they'll learn more about common plankton species and practice identifying them using a field guide.
- **Water Quality Monitoring:** Specialists will need to record and interpret data on pH, dissolved oxygen, temperature, and salinity. During the Voicethread, they'll be introduced to the equipment that will help them collect this data and learn about typical ranges.

6. Give students 20 minutes to explore the Voicethread and learn more about their assigned specialities.

Share

Sharing Our Monitoring Projects (5-10 minutes)

1. Open *Slide 8* and bring the class back together. Ask students to briefly describe each of the three monitoring projects.

- What will they be monitoring?
- Why is this important to monitor?
- What will they need to do?

2. After students have described the projects, invite them to spend a few minutes reflecting on why we want to collect monitoring data over time. How will data help us understand how the Crystal Cove SMCA is changing? How does this help us to protect it?



Reflect

Reflecting on Session 5 (5 minutes)

1. At the end of the discussion, advance to **Slide 9** in the slideshow and play the video, where Erick will invite them to spend a few minutes reflecting.
2. Move on to the final slide, 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. Tell them that when you gather again, they will go on a virtual field expedition aboard one of Newport Landing's fishing vessels to collect data for their specialized monitoring project in the Crystal Cove SMCA!

Focus: Collecting Data
Grade Level: 7-12
Session Length: 45-60 minutes

Driving Questions

- How can we collect data to see if the Crystal Cove SMCA is changing over time?

NGSS Links

- Planning and Carrying Out Investigations

Systems Thinking Characteristics

- Identifying Hidden Dimensions of the System

In the sixth session of the MPA Exploration, student research teams take part in a virtual expedition to the Crystal Cove SMCA and help to record data for the three monitoring projects.

After a short introduction to the virtual expedition, research teams explore Newport Landing’s fishing vessel, Western Pride, through an interactive Thinglink. As they move around the vessel, they meet the research team members and observe the process of collecting data. Each specialist then breaks off to help record and process data for the fish monitoring, plankton monitoring, and water quality monitoring projects.

Learning Outcomes & Assessments

<i>By the end of this module, students will be able to...</i>	<i>You can assess this using...</i>
1. Describe the process of collecting scientific data for the three monitoring projects.	Field notebook reflection
2. Record and process data for their assigned monitoring project.	Field notebook notes

Session Overview

Section	Description	Length	Format
Launch	Holly welcomes research teams to the virtual field expedition during a short video.	5 minutes	Whole class
Explore	Students explore <i>Western Pride</i> virtually through a Thinglink as they observe data collection and then help to process samples for their specialized research project.	30-40 minutes	Individual
Share	Students debrief on their experiences with their research team.	5-10 minutes	Research teams
Reflect	Students reflect on their experience during Session 6.	5 minutes	Individual

Virtual Materials

- Session 6 Google Slides Presentation: <https://bit.ly/375GnjS>
- Session 6 Field Notebook template (optional): <http://bit.ly/2LNmcPx>
- Field Expedition Thinglink: <http://bit.ly/2Wohr0G>
- Data Processing Resources
 - Fish Data Processing: <http://bit.ly/3nILfRW>
 - Plankton Data Processing: <http://bit.ly/2WDg5iV>
 - Water Quality Data Processing: <http://bit.ly/2WGxirE>

Each student will need...

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

Before You Start Teaching

- Copy over the [Session 6 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.)
- Take a few minutes to explore the Thinglink and the Data Processing resources for each project. Most of the session should be self-guided for students, but you can check to see if there are any parts where you may need to offer specific assistance.

Learning Sequence

Launch

Getting Ready to Collect Data! (5 minutes)

1. Open the [Session 6 Slideshow](#) and play the video on [Slide 2](#) for your class. In this video, Holly will introduce the virtual field expedition that students will take part in during Session 6.
2. After watching the video, move on to [Slide 3](#), which gives an overview of what students will do and learn during Session 6.

Explore

Virtual Field Expedition (30-40 minutes)

1. Advance [to Slide 4](#) and play the video. Holly will give the research teams specific instructions for what to expect as they explore the virtual field expedition: As they move through the Thinglink, they can click on the various people and pieces of equipment to see each monitoring project in action. When they get to their specialized project (fish monitoring, plankton monitoring, or water quality monitoring), they will find a link that will take them to Crystal Cove Conservancy's website where they can help record and process data from our most recent monitoring cruise.
2. Once the video is done, move on to [Slide 5](#). Give students any additional instructions and let them access the Thinglink link to begin exploring!
3. Give students 25-35 minutes to explore the Thinglink and assist with their assigned data collection project. This can take place during class time or independently outside of class.

Share

Sharing Our Monitoring Projects (5-10 minutes)

1. Open [Slide 6](#) and ask students to regroup with their research teams. Ask them to describe what they found during their monitoring project.
 - What kind of data did you process?
 - What did you notice? Was there anything that surprised you?
 - What will you need to do next to see if the Crystal Cove SMCA is changing over time??

2. If there is time, bring the whole class back together. Ask students to briefly recap their experience on the virtual monitoring cruise.

Remind students that our goal is to understand whether and how the Crystal Cove SMCA is changing over time, so that we can get a sense as to whether the MPA regulations are starting to work. Invite students to share their thoughts on possible next steps. Elevate ideas that today's data is only one snapshot -- we'll have to look at the extended data set, which has been tracking these same indicators for years, to really see how the SMCA's ecosystem is changing over time.



Reflect

Reflecting on Session 6 (5 minutes)

1. At the end of the discussion, advance to **Slide 6** in the slideshow and play the video, where we will recap the experience on the virtual field expedition and then ask students to spend a few minutes reflecting.
2. Move on to the final slide, 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. Tell them that when you gather again, they will get a chance to analyze the full data sets to determine whether the Crystal Cove SMCA's ecosystem is changing over time!

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?

Focus: Communicating Science Ideas

Grade Level: 7-12

Session Length: 45-60 minutes

Driving Questions

- How can we protect the Crystal Cove SMCA?
- How can we start planning a social media piece to communicate about the Crystal Cove SMCA with a specific audience?

NGSS Links

- Communicating, Evaluating, & Sharing Information

In the eighth session of the MPA Exploration, student research teams begin planning a social media piece to help raise awareness of challenges related to the Crystal Cove SMCA.

Research teams are introduced to the basics of science communication, where science ideas are shared with other audiences. They revisit some of the challenges that threaten the Crystal Cove SMCA and pick a specific challenge to help solve, decide on an audience, and begin planning a social media post, blog post, or video that will help raise awareness and address that challenge.

Learning Outcomes & Assessments

<i>By the end of this module, students will be able to...</i>	<i>You can assess this using...</i>
1. Describe one challenge that is threatening the Crystal Cove SMCA.	Whole class discussion
2. Apply science communication strategies to begin framing science ideas for a particular audience.	Research team products
3. Select a challenge, an audience, and begin drafting a call to action.	Research team products

Session Overview

<i>Section</i>	<i>Description</i>	<i>Length</i>	<i>Format</i>
Launch	Holly introduces students to the idea of science communication and how we can use it to help protect Crystal Cove State Park.	5 minutes	Whole class
Explore	Research teams choose a challenge to address and decide what audience they need to reach. After, they begin framing a science idea and drafting a call to action.	35-40 minutes	Research teams
Share	Optionally, research teams share their progress with the entire class.	5-10 minutes	Whole class
Reflect	Students reflect on their experience during Session 8.	5 minutes	Individual

Overview of the Social Media Final Product

During the final three sessions of the MPA Exploration, student research teams help to create a social media piece that raises awareness about some of the challenges that threaten the Crystal Cove State Marine Conservation Area. During this process, students will choose a challenge to address and identify the audience they need to reach, draft a call to action, choose a social media platform, create a pitch packet, draft an evaluation plan, swap feedback with another group, and execute their final product.

Before starting these last three sessions, we strongly recommend reviewing the *project rubric* and deciding on how you want to structure the project for your class. You may want to put limits on what platforms or approaches students use based on the time available.

Just like always, the work that students are doing on this project is real, and their creations can help us to really raise awareness about some of the challenges that put our underwater park at risk. If possible, Crystal Cove Conservancy and our partners at Newport Landing would love to be able to share students' final products on our social media.

If you'd like to share final products or have questions about this process, please contact Holly Fletcher by emailing holly@crystalcove.org.

Session 8		Session 9			Session 10
<i>Choosing a Challenge and an Audience</i>	<i>Drafting a Call to Action</i>	<i>Choosing a Platform & Creating a Pitch Packet</i>	<i>Drafting an Audience Engagement Plan</i>	<i>Giving & Getting Feedback</i>	<i>Executing the Final Product</i>

You are here!

Virtual Materials

- Session 8 Google Slides Presentation: <http://bit.ly/3hgzgsk>
- MPA Social Media Project Rubric: <http://bit.ly/34I7cJm>
- Session 8 Field Notebook Template (optional): <http://bit.ly/3prP5iR>

Each student will need...

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

Before You Start Teaching

- Briefly skim *Sessions 8, 9, and 10* and review the *project rubric*. Decide how to structure the project based on the time that you have available.
- Copy over the *Session 8 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.)
- Update the project rubric with any specifics relevant to your class. Make any adjustments to *Slide 5*.
- Decide how you want to structure the session as a class. Will you move through everything together, or will you allow research teams to work independently and move at their own pace? If it is the latter, each research team will need access to the slideshow.

Learning Sequence

Launch

Getting Started (5 minutes)

1. Open the [Session 8 Slideshow](#) and play the video on [Slide 2](#) for your class. In this video, Holly will introduce the final project for the MPA Exploration: Student research teams will be tasked with creating a social media piece to help address a challenge that threatens the Crystal Cove SMCA.
2. After watching the video, move on to [Slide 3](#), which gives an overview of what students will do and learn during Session 8.

Explore

Launching the Project & Choosing a Message (35-40 minutes)

1. Move on to [Slide 4](#) and play the video. Holly will introduce the students to the idea of science communication.
2. Advance to [Slide 5](#), which gives students an overview of the final project. Depending on the time you have available, you can visit the link to review the project rubric with students.
3. After you've answered any questions about the overall project, move on to [Slide 6](#). Holly will frame the first step of the process for students: They'll get a chance to meet some of the Crystal Cove SMCA's stakeholders via video and hear about some of the challenges threatening the underwater park. Afterwards, each research team will need to pick a challenge to address.

You can let students move through [Slides 7-11](#) at their own pace, or go through them as a group. Remind students that they need to pick a challenge threatening the Crystal Cove SMCA to address via a social media piece. They can choose something mentioned in the videos or pick something else -- but, if they pick something on their own that wasn't mentioned, they'll need to justify and explain why it's a problem.

Give the research teams time to discuss and choose their challenge, and then move on to the next step.

4. Once students are ready, move on to *Slide 12*. Here, students will be challenged to decide which audience they want to target with their social media piece.

Advance to *Slide 13*, and give research teams time to discuss and pick the audience for their project.

5. Advance to *Slide 14*, where Holly will introduce students to the basics of framing a science idea and tailoring it to their specific audience.

Move on to *Slide 15*, and give students time to talk. This will likely take a bit more time, as students need to decide what science information their audience will need to understand, and then begin to frame it in relatable terms. It is okay if research teams don't entirely finish this discussion -- they will have more time to refine their framing when they create their pitch packet in Session 9.

6. When the time is up, move on to *Slide 16*, where Holly will challenge students to draft a call to action.

Advance to *Slide 17* and give the research teams time to work. Each team will need to make a decision about what they want their audience to do as a result of their social media piece. This could be participating in a beach clean-up, following the rules when they visit the Crystal Cove SMCA, responding to the post on social media, or something else.



Share

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

1. If there is time, bring the whole class back together. Move on to *Slide 18* and ask students to share their progress so far.

- What challenge did you choose?
- Which audience do you intend to reach?
- How are you framing the science idea?
- What is your call to action?



Reflect

Reflecting on Session 8 (5 minutes)

1. At the end of the discussion, advance to **Slide 19** in the slideshow and play the video, where Holly will ask students to spend a few minutes reflecting on their progress so far
2. Advance to **Slide 20**, 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. Remind them that they will continue working on their social media project in Session 9 , where they'll begin fleshing out their plan by developing a pitch packet.

Focus: Communicating Science Ideas

Grade Level: 7-12

Session Length: 90-120 minutes

Driving Questions

- How can we protect the Crystal Cove SMCA?
- What do we need to plan in order to create a social media piece that will raise awareness about challenges that threaten the Crystal Cove SMCA?

NGSS Links

- Communicating, Evaluating, & Sharing Information

In the ninth session of the MPA Exploration, student research teams continue planning a social media piece to help raise awareness of challenges related to the Crystal Cove SMCA.

Research teams begin refining their materials from Session 8 as they create a pitch packet. During the process, they meet Crystal Cove Conservancy's Communications Manager, who introduces them to different social media platforms and assessment metrics.

During this session, student teams select a platform, create a rough draft of their script or written text, and draft an evaluation plan. Finally, they pitch their plan to another team and swap feedback.

Learning Outcomes & Assessments

<i>By the end of this module, students will be able to...</i>	<i>You can assess this using...</i>
1. Evaluate the pros and cons of different social media platforms and select one to reach their chosen audience.	Research team pitch packets
2. Create a rough draft of their social media piece.	Research team pitch packets
3. Draft an audience engagement plan that includes at least 2 metrics to assess the effectiveness of their social media piece.	Research team pitch packets
4. Give feedback to another team on their pitch packet	Research team discussions

Session Overview

Section	Description	Length	Format
Launch	Holly frames the task for the day, as student research teams begin working on their pitch packet.	5 minutes	Whole class
Explore	Research teams begin working on their pitch packets, including selecting a social media platform and creating a rough draft of their text.	45-70 minutes	Research teams
	Research teams draft an audience engagement plan.	20-25 minutes	Research teams
Share	Research teams present their pitch packet to another team and swap feedback.	15-20 minutes	Paired research teams
Reflect	Students reflect on their experience during Session 9.	5 minutes	Individual

Overview of the Social Media Final Product

During the final three sessions of the MPA Exploration, student research teams help to create a social media piece that raises awareness about some of the challenges that threaten the Crystal Cove State Marine Conservation Area. During this process, students will choose a challenge to address and identify the audience they need to reach, draft a call to action, choose a social media platform, create a pitch packet, draft an evaluation plan, swap feedback with another group, and execute their final product.

Before starting these last three sessions, we strongly recommend reviewing the *project rubric* and deciding on how you want to structure the project for your class. You may want to put limits on what platforms or approaches students use based on the time available.

Just like always, the work that students are doing on this project is real, and their creations can help us to really raise awareness about some of the challenges that put our underwater park at risk. If possible, Crystal Cove Conservancy and our partners at Newport Landing would love to be able to share students' final products on our social media.

If you'd like to share final products or have questions about this process, please contact Holly Fletcher by emailing holly@crystalcove.org.

Session 8		Session 9			Session 10
<i>Choosing a Challenge and an Audience</i>	<i>Drafting a Call to Action</i>	<i>Choosing a Platform & Creating a Pitch Packet</i>	<i>Drafting an Audience Engagement Plan</i>	<i>Giving & Getting Feedback</i>	<i>Executing the Final Product</i>

You are here!

Virtual Materials

- Session 9 Google Slides Presentation: <http://bit.ly/3mLNORR>
- MPA Social Media Project Rubric: <http://bit.ly/34I7cJm>
- Session 9 Pitch Packet Template: <http://bit.ly/2WK0XR2>
- Session 9 Field Notebook Template (optional): <http://bit.ly/3nOZXa6>

Each student will need...

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

Before You Start Teaching

- Copy over the [Session 9 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.)
- Decide how you want to structure the session as a class. The session can be split over 2-3 class meetings or research teams can be given time to work independently outside of class.

If you need to reduce the length of the session, you can cut out the creation of an evaluation plan or the Share step when research teams trade feedback.

- Decide how you want student research teams to get and give feedback on each others' pitch packet. Update [Slide 11](#) with any instructions that are specific to your class.

Learning Sequence

Launch

Getting Started (5 minutes)

1. Open the [Session 9 Slideshow](#) and play the video on [Slide 2](#) for your class. In this video, Holly will welcome students back and explain their task for today, as they will move on to creating a pitch packet to help them plan their social media piece.
2. After watching the video, move on to [Slide 3](#), which gives an overview of what students will do and learn during Session 9.

Explore

Part 1: Creating a Pitch Packet (45-70 minutes)

1. Move on to [Slide 4](#) and play the video. Holly will introduce Kian, Crystal Cove Conservancy's social media manager.

[Slide 5](#) includes a link to a Voicethread, where students will get to meet Kian and find out more about some of the different social media platforms. Together as a research team, they'll need to choose a platform (such as Facebook, Instagram, Youtube, Medium, or Twitter) and a medium (infographic or other image, video, or blog post) for their social media post.

2. Give students time to choose a platform and begin working on their pitch packet. Much of the information can be moved over from [Session 8](#), such as the challenge they want to solve, the audience they want to reach, and their strategies for framing a science idea and structuring a call to action.

In addition, they now need to choose a social media platform and medium for their final post.

3. Once it seems like most of the teams have chosen a platform, move on to [Slide 6](#). In the video, Holly will give some more tips on using science communication strategies to design their social media piece.

Afterwards, move on to [slides 7 and 8](#) which will provide additional resources that students may want to use to complete their task. Again, give students time to work. Students will be responsible for completing their pitch packet and creating a rough draft of their social media piece, including any scripts, storyboards, or draft text.

This will likely be the longest stretch of time in the process. If you are dividing this session over multiple class meetings, you might consider breaking here.

Part 2: Drafting an Audience Engagement Plan (20-25 minutes)

4. As research teams begin to reach the end of their pitch packet, bring the class together again. Move on to *Slide 9*, where Holly will describe the importance of having a plan to evaluate the audience engagement and success of the social media piece.

Slide 10 includes a link to another Voicethread, where Kian will describe some of the metrics that he uses to assess engagement on different social media platforms.

5. Let students break back into their research teams. Remind them that they will need to create a draft audience engagement plan, including choosing at least 2-3 metrics to help them measure engagement.

Give them more time to work and finish drafting their pitch packet.

Share

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

1. Advance to *Slide 11* in the slideshow and play the video. Here, Holly will frame the importance of making a pitch and getting feedback on one's plan.

2. Move on to *Slide 12* and divide the research teams into pairs. Go over the expectations for getting and giving feedback.

We recommend using the *3-2-1 Format*:

- **First**, Team A spends three minutes making their initial pitch.
- **Next**, Team B spends two minutes giving feedback, highlighting parts they liked and parts that could be improved. While receiving feedback, Team A must listen silently in order to take it in and is not allowed to speak, aside from answering clarifying questions.
- **At the end**, Team A spends one minute describing the changes they want to make as a result of the feedback.
- **Finally**, the two teams switch places and repeat the process.

This process works best if the teacher is extremely strict with timing, and encourages students to fill out the entire time available.

3. Once teams have had a chance to give and get feedback, if there is time, give them a few minutes to regroup with their original research team and make a plan to update their pitch packet based on the feedback they received.



Reflect

Reflecting on Session 9 (5 minutes)

1. At the end of the discussion, advance to **Slide 13** in the slideshow and play the video, where Holly will ask students to spend a few minutes reflecting on their progress so far
2. Advance to **Slide 14**, 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. Remind them that they will continue working on their social media project in Session 10, they'll create their final social media piece and will have a chance to share it with Crystal Cove Conservancy to promote on our social media platforms!

Focus: Communicating Science Ideas
Grade Level: 7-12
Session Length: 45-60 minutes or longer

Driving Questions

- How can we protect the Crystal Cove SMCA?
- How can we create our final social media piece that will raise awareness about the challenges that threaten the Crystal Cove SMCA

NGSS Links

- Communicating, Evaluating, & Sharing Information

In the tenth and final session of the MPA Exploration, student research teams execute their plan to create a social media piece that will help raise awareness of challenges related to the Crystal Cove SMCA.

Research teams use the pitch packet that they created in Session 9 to create their final social media piece, which can take the form of a post, video, or blog post.

Unlike previous sessions, this session is largely self-guided, giving students time to finalize their project. You can decide how much time to give students, and whether to give students another opportunity to give and get feedback on their final product.

Learning Outcomes & Assessments

<i>By the end of this module, students will be able to...</i>	<i>You can assess this using...</i>
1. Create the final draft of a social media piece that will address a challenge threatening the Crystal Cove SMCA.	Final social media pieces
2. Share their social media piece with Crystal Cove Conservancy.	Screenshots or reports of research team submissions
3. Reflect on the role that science communication plays in helping to protect places like the Crystal Cove State Marine Conservation Area.	Student reflections

Session Overview

Section	Description	Length	Format
Launch	Holly welcomes students to the final session of the MPA Exploration, where they will execute their plan to create a social media piece.	5 minutes	Whole class
Explore	<p>Research teams are given time to work on their final product.</p> <p>Optionally, if there is time, you can break halfway through to give students another opportunity to give and get feedback on their final product.</p>	<p>30+ minutes</p> <p>15-20 minutes</p>	<p>Research teams</p> <p>Research teams</p>
Share	Research teams present their final products to the class.	15-20 minutes	Whole class
Reflect	Students reflect on their experience during the MPA Exploration program.	5 minutes	Individual

Overview of the Social Media Final Product

During the final three sessions of the MPA Exploration, student research teams help to create a social media piece that raises awareness about some of the challenges that threaten the Crystal Cove State Marine Conservation Area. During this process, students will choose a challenge to address and identify the audience they need to reach, draft a call to action, choose a social media platform, create a pitch packet, draft an evaluation plan, swap feedback with another group, and execute their final product.

Before starting these last three sessions, we strongly recommend reviewing the *project rubric* and deciding on how you want to structure the project for your class. You may want to put limits on what platforms or approaches students use based on the time available.

Just like always, the work that students are doing on this project is real, and their creations can help us to really raise awareness about some of the challenges that put our underwater park at risk. If possible, Crystal Cove Conservancy and our partners at Newport Landing would love to be able to share students' final products on our social media.

If you'd like to share final products or have questions about this process, please contact Holly Fletcher by emailing holly@crystalcove.org.

Session 8		Session 9			Session 10
<i>Choosing a Challenge and an Audience</i>	<i>Drafting a Call to Action</i>	<i>Choosing a Platform & Creating a Pitch Packet</i>	<i>Drafting an Audience Engagement Plan</i>	<i>Giving & Getting Feedback</i>	<i>Executing the Final Product</i>

You are here!

Virtual Materials

- Session 10 Google Slides Presentation: <http://bit.ly/3rsFVo8>
- MPA Social Media Project Rubric: <http://bit.ly/34I7cJm>
- Session 10 Field Notebook Template (optional): <http://bit.ly/37MKOR9>
- Student Learning Post-Assessment: <http://bit.ly/2WWxNOJ>
- Share Final Products with Crystal Cove Conservancy: <http://bit.ly/34Lftwe>

Each student will need...

- A device with internet access (a computer, smartphone, or tablet will all work!)
- Field notebook and pencil
- Their pitch packet from Session 9
- Any other supplies or programs they listed in their pitch packet to create their final social media piece
- Social media stock photo gallery (optional): <http://bit.ly/2PDWbnT>

Before You Start Teaching

- Copy over the [Session 10 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.)
- Decide how you want to structure the session as a class. Students will likely need time to complete their final products, so you may want to give them 1-2 class meetings.

Halfway through, if there is time, it is recommended that research teams have a chance to give and receive feedback with another team. If you will not have time for this, you can delete [Slide 5](#) from your slideshow.

At the end, we recommend hosting a final Share discussion so each research team can share their final project with the class, but if time does not allow, you can choose to do a gallery walk or cut this entirely.

- Decide how you want student research teams to share their final creations with Crystal Cove Conservancy. You can gather the posts and email them directly to Holly at holly@crystalcove.org or students can submit their projects online at <http://bit.ly/34Lftwe>.

Make sure to update [Slide 7](#) with any special instructions. If you decide to have students submit their own projects, decide what you will accept as evidence that they have completed this final step.

Learning Sequence

Launch

Getting Started (5 minutes)

1. Open the [Session 10 Slideshow](#) and play the video on [Slide 2](#) for your class, where Holly will introduce the last session of the MPA Exploration. During Session 10, students will complete their social media piece and share it with Crystal Cove Conservancy.
2. After watching the video, move on to [Slide 3](#), which gives an overview of what students will do and learn during Session 10.

Explore

Executing Your Plan (30+ minutes)

1. Open up [Slide 4](#), which will outline the task for the day. Session 10 is entirely self-driven, with research teams executing their plan to create a social media piece. The teams should largely be able to work independently, with you checking in on their progress.

If students need any stock photo or video materials for their project, you can provide them with a link to our social media content gallery on [Slide 5](#).

2. If here is time, move on to [Slide 6](#), break the research teams halfway through, and give them an opportunity to pair up with another team to share feedback. We recommend following the same process as you did in Session 9.

We recommend using the [3-2-1 Format](#):

- **First**, Team A spends three minutes making their initial pitch.
- **Next**, Team B spends two minutes giving feedback, highlighting parts they liked and parts that could be improved. While receiving feedback, Team A must listen silently in order to take it in and is not allowed to speak, aside from answering clarifying questions.
- **At the end**, Team A spends one minute describing the changes they want to make as a result of the feedback.
- **Finally**, the two teams switch places and repeat the process.

3. Give students additional time to continue adjusting and finalizing their social media pieces. At the end of the project time, ask them to submit their pitch packet and final piece to you for grading.

If possible, it would also be great to have students submit their final projects to Crystal Cove Conservancy so that we can share them on our social media, with optional instructions on [Slide 8!](#)

Share

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

1. Once students have completed their projects, as time allows, give them a chance to share their work with the whole class. If you don't have time to do presentations, you might use Google Slides to set up a virtual gallery walk, where each research team adds their creation to a different slide.
2. If there is time, we also recommend hosting one final class discussion to reflect on the project and the role that science communication plays in protecting places like the Crystal Cove State Marine Conservation Area. You can use the questions on [Slide 7](#) as a starting point for your discussion.

Reflect

Reflecting on the MPA Exploration (5 minutes)

1. At the end of the discussion, advance to [Slide 9](#) in the slideshow. Holly will thank the students for taking part in the program and frame one last moment of reflection for them.
2. Advance to [Slide 10](#), which will share reflection questions. Ask students to spend five minutes reflecting on their experiences throughout the program in their field notebook.
3. If possible, please end with having students complete the final post-assessment online!