Crystal Cove® CONSERVANCY

PROJECT CRYSTAL TEACHER GUIDE

Topic: Plants & Water
Grade Level: 5
Unit Length: Six modules

Unit Overview
Fifth grade scientists investigate how the types of plants used in restoration affect the insects and birds in Moro Canyon. Throughout this unit, they identify how the environment has changed, design a model to show ecosystem interactions, create a hypothesis, collect data in the field, analyze the data, and share their findings back with Crystal Cove State Park.

Essential Questions:
- How has Moro Canyon's landscape changed over time?
- What is the best way to restore Moro Canyon's coastal sage scrub ecosystem?

NGSS Performance Expectations
5-LS2-1
5-ESS3-1

NGSS Crosscutting Concept
Systems & System Models

Welcome to Crystal Cove Conservancy's Project Crystal!

As you and your students take part in real restoration ecology research at Crystal Cove State Park, you'll help researchers and land managers learn how best to restore degraded habitat in Southern California.

Project Crystal is the result of a unique partnership between Crystal Cove Conservancy, UC Irvine's Center for Environmental Biology, UC Irvine's School of Education, Crystal Cove State Park, and local educators. During this multi-week program, fifth grade scientists are introduced to the concept of ecological restoration and how communities are using it to protect places like Crystal Cove's Moro Canyon. 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 that can inform land management decisions.

Project Crystal involves an integrated curriculum that links classroom learning to two field trips to Crystal Cove State Park. During the 2021-2022 school year, as a result of COVID-19, we have adapted Project Crystal so that students can also participate from your schools, if field trips are not possible. Video Field Trips and other technology-supported investigations can take the place of in-person visits to the park.

The Project Crystal curriculum is provided free to participating fifth grade teachers and students.

If you would like more information on the program or would like to officially join, please contact Kaitlin Magliano, Crystal Cove Conservancy Education Manager, by emailing ***kaitlin@crystalcove.org***.

Land Acknowledgement

The place that we call Crystal Cove State Park today 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 as leaders in the fight to ensure that places like Crystal Cove remain protected.

Through our collaborative work, we are together committed to uplifting the voices of everyone dedicated to protecting this important place.

About Crystal Cove State 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.

Today, Crystal Cove State Park 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 also includes 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 Japanese language schoolhouse, which was built by Crystal Cove's Japanese American farming community in the early 1930s.

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 Project Crystal curriculum, program booking, and logistics, please contact:

Kaitlin Magliano
Crystal Cove Conservancy Education Manager
(949) 415-8493
kaitlin@crystalcove.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. Kimball's article*** that was published in *Conservation Science and Practice.*

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 Project Crystal, 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 Project Crystal, they are not learning to do science from scratch, but are practicing and refining the scientific skills that they already possess. We want to honor the fact that all of our participants have had prior meaningful experiences with nature. Through the Explore at Home extensions, we want to offer opportunities for students to connect learning about the park to their own families, homes, neighborhoods, and communities.

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 by contacting Kaitlin at ***kaitlin@crystalcove.org***.

Introduction to the Ecological Problem

Southern California's coastal sage scrub (CSS) plant community is an incredibly diverse ecosystem, but it has been incredibly impacted by development and human activity. As invasive plants such as black mustard dominate its original range, CSS has also come to be threatened by drought and other pressures created by climate change. Today, only 20% of our original coastal sage scrub range remains. Land managers in Crystal Cove State Park aim to take degraded areas of the park that are dominated by black mustard, and turn them back into coastal sage scrub through ecological restoration.

Crystal Cove State Park's Moro Canyon offers an ideal laboratory to study how best to restore coastal sage scrub and help our native CSS plants thrive. During the 2021-2022 school year, our project will investigate how the type of native plant species used in restoration impacts the presence of insects and birds.

In 2017, Crystal Cove State Park and the Center for Environmental Biology at UC Irvine began restoring a degraded area of the park that was dominated by black mustard back to native coastal sage scrub. As part of the restoration, they set up an experiment to determine if certain mixes of plant species would be more successful than others. To investigate this, they tested different seed mixes in different plots. Each seed mix contained seeds from native plant species with different traits. For Project Crystal, our study will compare three of these different seed mixes: plants with high water use efficiency, plants with low water use efficiency, and an equal mix of plants.

To test the effectiveness of each of these seed mixes, researchers at the Center for Environmental Biology have collected data on each of the experimental plots to determine which one yielded the most diverse plant community. Now that the seed mixes have had time to grow and establish themselves, we can start assessing the quality of the habitat that has grown from each seed mix. In order to start investigating which seed mix provides the best habitat for other species in the park, we want to know if there are any differences in insect abundance or bird activity between the different experimental plots.

That's where your fifth grade students can help! We need their help to decide the best types of plants to use in future restoration projects by collecting data on bird activity and insect abundance in each of the different seed mixes. For Project Crystal, we specifically want students to compare the high water use efficiency plants (what we'll call *water-savers*) to the low water use efficiency plants (*water-spenders*) and to an equal mix of both (*equal mix*). Students will investigate whether the type of plants used in restoration affects the number of insects and birds at The Bowl experiment.

Driving Question

How does the type of native plants used in restoration affect the presence of insects and birds?

Testable Research Questions

Research Question (1): Insect Abundance. Which plant mix has the highest number of insects present and which has the lowest number of insects present: water-saver plants, water-spender plants, or an equal mix of both?

Research Question (2): Bird Activity. Where will we find the highest number of bird attacks on clay caterpillars and where will we find the lowest number of bird attacks on clay caterpillars: water-saver plants, water-spender plants, or an equal mix of both?

Learning Outcomes

During Project Crystal, students will be immersed in the practices and processes of scientific research as they take part in an ecological experiment at Crystal Cove State Park. By participating in the full program, they will build a broad understanding of plant ecology, the water cycle, and how professional and community scientists can use science ideas to protect wild places like Crystal Cove State Park.

By the end of the program, your students will be able to…	*You can assess this using…*
1. ***Participate*** productively in scientific practices and the discourse of science.	Observations of student discussions throughout the program
2. ***Compare*** coastal sage scrub plant community landscape to a degraded landscape, and reflect on what might have caused these changes.	Observations of student discussions and science journals in Module 1
3. ***Construct*** a visual model of a coastal sage scrub plant community that shows how system components interact to impact the population of insects and insect-eating birds.	Student models, created in Module 2 and revised in Module 4
4. ***Use*** their model to make hypotheses about the effects of different plant mixes on insect and bird activity.	Hypotheses in Module 4
5. ***Describe*** why scientists must test their hypotheses by designing an experiment, collecting data, and using that data as evidence to support their claims.	Science journals and reflections in Module 5
6. ***Use*** ideas about statistics to compare insect and bird activity data across different treatments, both verbally and in the form of a graph.	Final presentation and/or science journals and observations of student discussions in Module 6
7. ***Construct*** evidence-based explanations about the impacts of different plant mixes on insect and bird activity.	Final presentations and/or science journals and reflections in Module 6
8. ***Communicate*** findings of the investigation with their teachers, parents, and environmental researchers using appropriate representations of data.	Final presentations in Module 6
9. ***Reflect*** on how individual communities can use science ideas to protect places like Crystal Cove State Park.	Reflections in Module 6

Next Generation Science Standards Alignment

The Project Crystal 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 six modules, students will be able to demonstrate understanding in the following areas:

Performance Expectations

- ***5-LS2-1.*** Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

- ***5-ESS3-1.*** Obtain and combine information about the ways individual communities use science ideas to protect the Earth's resources and environment.

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

Module Overview

1 Welcome to Moro Canyon!	During a field trip to Crystal Cove State Park, students are introduced to the initial phenomenon of how Moro Canyon's landscape has changed over time. As they reflect on these changes, they begin asking questions about how they might help, and whether they think Moro Canyon is a place worth protecting
2 Introduction to Our Research Project	Students meet Dr. Mooney, the team ecologist, and are introduced to the research topic for the year. They develop a representational model showing how they believe high water use plants vs. low water use plants might affect insect populations at The Bowl.
3 Digging Deeper (optional)	In this optional session, students dig deeper into the science behind Project Crystal as they participate in short investigations focused on how plants use water, and the food web of Moro Canyon.
4 Preparing to Collect Data	Drawing on what they've learned from Module 3, students update their model and use it to make a hypothesis and design an experiment.
5 Collecting Our Data	During a field trip to Crystal Cove State Park, students help Crystal Cove Conservancy staff collect data at the research site, and then reflect on their initial ideas.
6 Analyzing Our Data	In this final session, students analyze their data using an online platform called Sage Modeler, and then use their data as evidence to make a recommendation to Crystal Cove State Park.
7 Designing an experiment at Your School Site (optional)	In this optional extension, students can develop a research question and design an experiment at their school site related to the study at Crystal Cove.

Basic Module Structure

Each module within Project Crystal is broken down into 5-6 learning activities, which generally take between 20-30 minutes each. 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 module, a Google Slides presentation introduces students to that section's driving question. Students watch an introduction video and then take part in a short activity that sets the stage for what they will be exploring. They generally take **20-30 minutes.**

Explore

Next, students take part in short investigations related to the module's driving question. Each investigation takes **30-45 minutes.**

During two of the six modules, students can take part in an in person field trip or video field trip**.** You can choose to schedule both in-person or virtual field trips by contacting ***kaitlin@crystalcove.org***.

Share *(or Explain)*

Students share their observations and discuss their ideas with their peers. These discussions can be run as a whole class or in small research teams. For each ***Share*** section, we've included a Google Slides presentation with suggested science discussion norms, sentence starters, and suggested questions to get you started! They typically take **20-30 minutes.**

Extend

During an optional Explore at Home investigation, students connect their experiences in Moro Canyon to their community at home. These investigations include outdoor options for exploring in their backyard, on their balcony, or in their neighborhood, along with indoor options that students can use to safely explore inside their apartment or house. Family-friendly instructions are provided in English and Spanish. They generally take about **30 minutes.**

Reflect *(or Evaluate)*

At the end of each module, students watch a video prompt and reflect on what they've learned so far. You can have students respond on our public Padlet or Flipgrid for each session, or set up a private discussion board or other platform that is unique for your class. We suggest choosing one consistent format to use for your class's responses throughout the entire program. These should take **15-20 minutes.**

Technological Platforms

Throughout Project Crystal, we use a few different technological platforms to support student learning. If you prefer another platform that serves a similar purpose, please feel free to substitute it in!

Google Slides

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.

Padlet

Padlet is a collaboration platform similar to an online bulletin board. Throughout Project Crystal, we use Padlet ***as an online discussion board*** where students can ask questions or share their thoughts.

If you'd like to start your own padlet for your class, free accounts can create up to three Padlet boards. Pro accounts, which let you create unlimited boards, start at $8/month. If you don't have access to Padlet, you might consider using ***Google Jamboard*** or another ***online collaborative whiteboard*** instead.

Flipgrid

Flipgrid is a free online platform for sharing short videos. We recommend using it as a platform for students ***to share their reflections***. If you prefer, you can choose another method instead, including writing a reflection in their science journal or posting on a class discussion board.

Zoom *(with Mentimeter)*

Crystal Cove Conservancy uses ***Zoom*** as our regular platform ***for Video Field Trips***. During live programs, we may ask students to visit the ***Mentimeter*** website so they can share their ideas with us live.

Thinglink

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. In place of Project Crystal field trips, students can use Thinglink ***to take a virtual hike*** through Moro Canyon. (You will not need to know how to use it, other than demonstrating how to access the virtual hike!)

Sage Modeler

SageModeler is a free, online modeling tool that can be used to create data visualizations and to build computer simulations of systems. In Project Crystal, we'll use a special pre-programmed model ***to create graphs of our data***, which students can use to make inferences about their findings.

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 Kaitlin at ***kaitlin@crystalcove.org***!

Decisions to Make

Before beginning Project Crystal, 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. We recommend dividing students into research teams of about four students at the start of Module 1. Students will continue to work in these same teams throughout the program.

Assessing Student Work

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 student research teams create a final presentation that you can grade with a rubric.

Integrating Science Journals

Throughout Project Crystal, students are encouraged to use science journals to make observations, respond to questions, and reflect on their own thinking. This is intended as a teaching tool to support metacognition and as a support to get students away from computers and into the real world for at least a portion of the program. Before beginning the program, we recommend thinking through the logistics of the science journals.

- ***What kind of journal do you want students to use?*** We suggest using a physical science journal, like a notebook, notepad, or paper stapled together. Individual Google Docs also work for a digital option. If you would like to provide students with more scaffolding or want to give everyone printed pages, you will find a complete set of scaffolded science notebook pages ***here***.

- ***What guidelines will you give students?*** Update the ***Module 1 Launch slideshow*** to include any details that may be specific to your class.

- ***How will you assess the science journals?*** 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.

If you are at a Title 1 school in Orange County, Crystal Cove Conservancy does have some funding to provide simple notebooks for your students. Please contact Kaitlin Magliano by emailing ***kaitlin@crystalcove.org*** if you would like to request this!

Choosing a Format for Discussions & Reflections

In each of the six modules, students will have the opportunity to participate in a discussion to share their ideas with their peers, and to reflect on what they've learned by responding to a provided prompt. Before starting the program, we recommend deciding what format you would like your class to use for these discussions or reflections.

- ***Where will you host group discussions?*** Although you may choose to run discussions in different formats throughout the program, we recommend establishing a set of science conversation norms in Session 1 and sticking to them throughout each module.

- ***How will you have students share their reflections?*** We recommend choosing one consistent format for reflections to use throughout the entire program. You can have students share their reflections on our public Padlet site or Flipgrid site, or host the video prompt on your own platform of choice.