Crystal Cove® CONSERVANCY

Session 7: The Bowl Restoration

Focus: Native Plant Restoration
Grade Level: *6-12*
Session Length: 2-4 hours (Sessions can be done in class or assigned as homework)

Driving Questions

- Which seed mix would be best for land managers to use to restore the native coastal sage scrub community at The Bowl in Crystal Cove State Park?

NGSS Links

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

Computer Science Standards Links

- Data and Analysis

In this Environmental Challenge, students are introduced to a native plant restoration project at "The Bowl" in Crystal Cove State Park, and analyze data to make a recommendation on the best seed mic to use to restore the native coastal sage scrub.

2018, the State Park has been working to bring back the native plant community to a site in Crystal Cove. The Conservancy and University of California, Irvine have worked together to restore an area in Crystal Cove called "The Bowl" that has changed over time from native coastal sage scrub to an invaded grassland dominated by non-native species. Crystal Cove staff and volunteers worked to create an experiment to see what combination of plants would best restore "The Bowl." We need the help of your students to analyze our data set and create visualizations and graphs that show which seed mix is the most effective for the restoration process.

During the environmental challenge, students will...

1. ***Describe*** the history and changes of "The Bowl's" environment over time.
2. ***Reflect*** on how returning "The Bowl" to a similar native habitat would be beneficial in terms of ecological services to the region.
3. ***Develop*** hypotheses for three research questions.
4. ***Collect*** data virtually.
5. ***Compare*** data on the effectiveness of different kinds of seed mixes and how different treatments affect restoration outcomes.
6. ***Weigh*** the effectiveness vs. the cost of each seed mix to make a recommendation about the best seed mix to use in restoration.
7. ***Reflect*** on the experience of data collection and analysis.
8. ***Connect*** with STEM professionals and like-minded peers to explore STEM content and careers in more depth.

Session Overview

By the end of this module, students will be able to...	You can assess this using...
1. ***Describe*** the history and changes of "The Bowl's" environment over time.	Student notebook page; Class discussions
2. ***Reflect*** on how returning "The Bowl" to a similar native habitat would be beneficial in terms of ecological services to the region.	Student notebook page; Class discussions
3. ***Develop*** hypotheses for three research questions.	Student notebook page
4. ***Identify*** and record plants and record soil moisture readings while virtually collecting data for each treatment block in one replicate plot.	Student notebook page; Class discussions
5. ***Compare*** data on the effectiveness of different kinds of seed mixes and how different treatments affect restoration outcomes.	Student notebook page; Class discussions
6. ***Weigh*** the effectiveness vs. the cost of each seed mix to make a recommendation about the best seed mix to use in restoration.	Student notebook page; Class discussions
7. ***Participate*** in class discussions and discover shared areas of interest with classmates and explore those areas of interest together.	Class discussions
8. ***Engage*** with other interested students and list other opportunities to engage with other interested students.	Posts on Padlet; Science notebook (reflect section)
9. ***Connect*** with STEM professionals during and/or after the environmental challenge to learn more about STEM disciplines and careers.	Questions posted to Padlet

Learning Outcomes and Assessments

Section	Description	Length	Format
Launch	Students learn about "The Bowl" restoration project through a slideshow and online resources. They make hypotheses for three research questions.	25-35 minutes	Individual or Whole class
Explore	Students virtually collect data by identifying and recording plants and recording soil moisture readings and then analyzing raw data to determine the best seed mix to use for the restoration project.	30-40 minutes for virtual data collection; 1-2 hours for data analysis and visualization	Individual
Share	Students share their findings with Crystal Cove State Park through Google Forms and with their classmates through a class discussion.	15 minutes	Individual and Whole Class
Reflect	In their student notebook, students reflect on their experience analyzing data for a restoration project.	10 minutes	Individual and Whole Class

Virtual Materials

- Online Environmental Challenge from Crystal Cove Conservancy's website
  - *Introduction to the Bowl Restoration Experiment Voicethread Presentation*
- Resources related to The Bowl Restoration Experiment:
  - *Natural Resources Management at Crystal Cove*
  - *Crystal Cove's Beautiful Coastal Sage Scrub*
  - *Coastal Sage Scrub Habitat*
  - *Audubon Blog Post about Coastal Sage Scrub Habitat*
  - *Restoration Ecology*
- *Google Form for Sharing a Hypothesis*
- *Virtual Data Collection Voicethread Slideshow*
- *Raw data from The Bowl site*
- *Data Analysis Crash Course YouTube Video*
- *The Bowl Question Board*
- *Google Form for Sharing Data from Virtual Data Collection*
- *Google Form for Sharing Findings*
- *Student Notebook Pages*

Each student will need...

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

Before You Start Teaching

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

Learning Sequence

Launch

Getting Started (15-30 minutes)

1. Open the ***Introductory Voicethread Slideshow*** and play the video on ***Slide 2*** for your class. In this video, students will meet undergraduate interns from UC Irvine's Center For Environmental Biology, Hunter and Amanda, who will introduce you to the project.

2. After you've finished the video, reiterate to students that your class has been asked to help with the restoration efforts at "The Bowl" by analyzing data and sharing their findings with Crystal Cove State Park.

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

A. ***Slide 3*** gives information about coastal sage scrub.
B. ***Slide 4*** describes historical land use at Crystal Cove State Park.
C. ***Slide 5*** describes the ecosystem services of coastal sage scrub.
D. ***Slide 6*** describes the Bowl Experiment.
E. ***Slide 7*** describes the five different seed mixes.
F. ***Slide 8*** describes how students can help analyze data and share their findings with land managers at Crystal Cove State Park.
G. ***Slide 9*** provides links to additional resources that are helpful for students.

4. Next, students can learn more about The Bowl, coastal sage scrub habitat, and habitat restoration by exploring the resources posted in ***Step 1*** on the website.

5. Next, students consider three research questions in order to develop hypotheses. Direct students to Step 2 on the website to read the three research questions:

A. ***Research Question (1):*** Does the amount of water in the soil vary between the different seed mixes?
B. ***Research Question (2):*** Does the number of native plants that germinate vary between the different seed mixes?
C. ***Research Question (3):*** Does the number of non-native plants that germinate vary between the different seed mixes?

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

Explore

Virtually Collect Data and Analyze Raw Data
(30-40 minutes for virtual data collection; 1-2 hours for data analysis and visualization)

1. Students will use a VoiceThread slideshow to virtually collect data. You can have them go through this on their own or you can do it as a class activity. If you decide to do it as a class activity, the following steps will guide you through the process.

2. Open the virtual data collection VoiceThread slide show and play the video on ***Slide 1***, which introduces the students to the virtual data collection process.

3. Advance to ***Slide 2***, which provides photos and narration that describe the research site set-up.

4. Advance to ***Slide 3***, which provides more information about how seeds were planted in the plots.

5. Advance to to ***Slide 4***, which is a video of Amanda showing how to use a quadrat to measure plant diversity.

6. Move to ***Slide 5***, which is a video of Hunter demonstrating how to use a soil moisture meter.

7. Move to ***Slide 6***, which shows the students how to use what they just learned to virtually collect data for each treatment block for one of the replicate plots.

8. Move to ***Slide 7***, which shows an example of a data sheet. Ask students to copy the data sheet into their student notebook.

9. Once everyone has copied the data sheet, ask the students to describe to you what they will do to virtually collect the data so that you can check for their understanding of the process. If there is any confusion about what they will do, explain the process to them.

10. Move to ***Slide 8***, which shows a photo of a quadrat and a link to a plant field guide. Tell students that they will use the field guide to identify plants. Give them time to look through the pages of the field guide to familiarize themselves with the plants.

11. Once students are familiar with the field guide, advance to ***Slide 9***. This slide shows a close-up photo of a plant. Ask students to use the field guide to identify the plant. (This plant is California Sagebrush.) Once students have identified the plant, ask them to share which plant they think it is. If the students all agree on the name of the plant, ask students to record the information on the data sheet. If there is disagreement on the name of the plant, talk about the defining characteristics of the plant in the photo and assist students with using the field guide to identify it correctly. Once everyone has identified it correctly, ask students to record their data in their notebooks.

12. Advance to ***Slide 10***, which shows a close-up photo of another plant in the quadrat. Ask students to use the field guide to identify the plant. (This plant is Black Sage.) Ask students to share their observations with the class to see if everyone correctly identified the plant. Discuss any differences in responses and clear up any confusion about how to identify the plant. If necessary, go through this process again as a group to ensure that everyone accurately identifies the plant. Once everyone agrees on the correct identification, ask students to record the name of the plant on their data sheet.

13. Advance to ***Slide 11***, which shows the soil moisture meter. Ask students to read the soil moisture, which is the percentage in the upper left corner of the display. Make sure that everyone agrees on the same number (3.9%), and ask them to record the number on their data sheet.

14. Move to ***Slide 12***, explain that they will go through the same process to collect data using Slides 12-28. You may want to go through the process as a class one more time for Slide 13 (California Sagebrush) if you feel like your students need some more support with collecting data before they can do it on their own. Discuss their observations for the set of slides for the second quadrat to ensure everyone has collected accurate data. When you are satisfied with their observations, proceed through the rest of the slides and allow students to collect data on their own. Support any students who have questions about how to collect data as you go through the slides.

15. When you get to ***Slide 29***, your students will have an opportunity to share their data with Crystal Cove Conservancy through a ***Google Form***. Explain whether you will submit it as a class or if each student will submit their data on their own.

16. After virtually collecting data, ask students to look at the raw data in SageModeler from ***Step 4*** on the website so that they can analyze the data that was collected.

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

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

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

Share

Share Your Findings (15 minutes)

1. After the students have analyzed the data, they will share their findings with Crystal Cove State Park through the ***Google Form*** in ***Step 5*** on the website. If possible, facilitate a class discussion about their findings before students submit their information to Crystal Cove State Park. A class discussion will give students an opportunity to explain their findings and make any necessary revisions based on new information that comes to light during the discussion. Encourage students to share the evidence from their data that supports their findings.

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

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

Reflect

Reflecting on The Bowl Experiment

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

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

- ***A.*** What did you do during this environmental challenge?
- ***B.*** What did you learn? How did your thinking change?

C. Do you think it is important to restore a native plant community in a habitat that has changed over time? Why or why not?
D. Did you enjoy analyzing data and sharing your findings to help establish native plants? What did or didn't you like about the experience?
E. Would you like to learn more about plant cover or restoration techniques? If so, what topics interest you? Do you have ideas of how you could learn more about them?

3. If students are interested in exploring other community science activities or restoration ecology careers, encourage them to explore the links on the website.

A. ***iNaturalist Project List***
B. ***SciStarter Project Finder***
C. ***Zooniverse***
D. ***More than Planting Trees: Career Opportunities in Ecological Restoration***
E. ***What is a Habitat Engineer?***