

Session 4: Making Our Hypothesis

Focus: Developing a Hypothesis and Designing an Experiment

Grade Level: 7

Session Length: 45-70 minutes

Driving Questions

- What are our hypotheses for the Project Crystal Code research questions?
- How can we design an experiment to test our Project Crystal Code research questions?

NGSS Links

- Engaging in Argument from Evidence
- Planning Investigations

Systems Thinking Characteristics

- Making Predictions Based on Understanding System Mechanics
- Thinking Temporally & Predicting Change Over Time

In the fourth session of Project Crystal Code, students develop hypotheses to three research questions, then use their hypotheses to design an experiment in Moro Canyon.

At the start of the session, research teams learn how to format their predictions about the ecosystem into a hypothesis, and develop a hypothesis for each of our three research questions about decomposition and soil moisture. Then, in an optional extension, students will learn about replication, randomization, and control, and use those ideas to design an experiment to test one of the research questions for this year.

Learning Outcomes & Assessments

<i>By the end of this module, students will be able to...</i>	<i>You can assess this using...</i>
1. Use their understanding of the Moro Canyon Ecosystem to develop three hypotheses about how water saving, water spending and non-native plants affect soil moisture and decomposition rates.	Field notebook entry; Research team discussions
2. Design an experiment to test one of our three research questions for Project Crystal Code.	Field notebook entry; Research team discussions

Session Overview

Section	Description	Length	Format
Launch	Students watch a video of Georges, who introduces the task for Session 4: they will be asked to use their models of the ecosystem to develop hypotheses for the three research questions.	5 minutes	Whole class
Explore	Students explore the hypothesis format using an example from a previous experiment, then work in their research teams to develop their own hypothesis for each of the three research questions. Optionally, students are then introduced to the components of experimental design, and then choose one research question to try designing an experiment to answer.	20-25 minutes 15-20 minutes	Research teams Research teams
Share	Student research teams share their hypotheses with the rest of the class, as well as their experimental design if applicable.	10-25 minutes	Whole class
Reflect	Students reflect on what they've learned and why scientists use models to develop hypotheses.	5 minutes	Individual

Virtual Materials

- *Session 4 Google Slides Presentation*
- *Session 4 Field Notebook Template (optional)*

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 4 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.)
- Review the lesson plan and decide how you will structure the session in terms of timing. Depending on the time you have available, you can decide to skip the experimental design slides, split it into another session, or assign it as homework.

Learning Sequence

Launch

Getting Started with Developing a Hypothesis (5 minutes)

1. Before starting, review the format for the hypothesis. The sentence structure is likely different from what you have used in the past, and it may feel awkward to use when formulating a hypothesis. We recommend using this sentence structure because it incorporates the idea of experimental design (i.e., rather than just saying what they predict will happen, students state what they will manipulate as part of the experiment).

If you think the sentence frame will be too confusing for your class, you are welcome to adjust it, but we encourage you to give it a try!

2. Open the the [Session 4 Slideshow](#) and play the video on [Slide 2](#) for your class. In this video, Georges will briefly introduce Session 4 and the idea that research teams will work to develop hypotheses for 3 research questions today.

3. After watching the video, move on to [Slide 3](#), which gives an overview of what students will do and learn during Session 4.

Explore

Part 1: Developing Our Hypotheses (20-25 minutes)

1. Play the video on [Slide 4](#). Georges will share the format that scientists use when writing a hypothesis to make sure we're directly addressing our research question, and share an example using a research question from a previous year of Project Crystal. Then you can move on to [Slide 5](#) to see the example hypothesis written out.

2. Then, advance to [Slide 6](#) where Georges will share the next step in generating a hypothesis, where students will draw their thinking and show how they think the experimental treatments will change over time.

3. Next, move onto [Slide 7](#) where Georges will explain the task for each research team: they will generate a hypothesis for each research question this year in our Project Crystal Code experiment, and should use their models from Session 3 as they work to make their predictions.

4. Move on to **Slide 8**, which shows all three research questions and reiterates the task to the students, where they will work in research teams to make a prediction about water saver, water spender and non-native plant decomposition rate, the effect of water saver, water spender and non-native plants on soil moisture, and the effects of site location, restored or unrestored, on decomposition rates.
5. Break students into their research teams and give the teams about 5 minutes to work on their hypotheses for each research question, advancing through **Slides 9-14** for each step of the process.

Share

Part 1: Sharing Our Hypothesis (10-15 minutes)

1. Open **Slide 15** and play the video, where Georges will invite them to share their hypotheses with their research team.
2. Move through **Slides 16-18** with each research question, and ask the research teams to share their hypotheses with the class. During the discussion, make sure to highlight any places where students have differing ideas. Emphasize that some students might have the same hypotheses, and some might differ, and that's okay! This is an opportunity for students to share their reasoning and explain their thinking with each other. Since we don't know the answer to our research questions yet, there are no wrong answers as long as we can support our ideas.

Explore

Part 2: Designing the Experiment (Optional) (15-20 minutes)

1. If you have time and want students to learn more about the process of designing an experiment in Moro Canyon, advance to **Slide 19**, where Georges introduces some of the questions that the Project Crystal Code team kept in mind when designing the experiment.

After the video ends, move on to **Slide 20** and give the students a moment to think about the following question and share some initial ideas: If you were designing this experiment, what would you want to do to make sure that the data was reliable? For instance, how could you make sure that something strange didn't happen to one of your bags that affected your results?

If there is time, ask them to share their initial ideas out loud.

2. Move on to *Slide 21* to hear Georges introduce the ideas of randomization, replication, and control, and explains how those ideas were used to set up an experiment for the first research question about decomposition rate. Then advance to *Slide 22* where Georges introduces their task: to design a study for one of the two other research questions.
3. Split the students back into their research teams and have them pick a question on *Slide 23*.
4. When the research teams are ready to begin, move on to *Slide 24*, which has questions for students to keep in mind as they design their experiment. Give them some time to work with their research teams to come up with an experimental design.

Share

Part 2: Sharing Our Experimental Design (15 minutes)

1. If you have time, gather the whole class together again and advance to *Slide 25* and have students share their experimental designs with each other. Highlight the ways students used replication, randomization, and control in their designs.
2. Once the the groups have shared their designs, play the video on *Slide 26* to hear how the Project Crystal Code team set up the actual experiment at the research site. Was it different or similar to the designs that students came up with?

Reflect

Reflecting on Session 4 (5 minutes)

1. When research teams are done sharing their hypotheses or experimental designs, tell students that they have one last task, as always. In the slideshow, advance to *Slide 27* and play the video, where Georges 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 start working to design a sensor that can be used in the experiment to measure the amount of water in the soil.