Crystal Cove® CONSERVANCY

Session 4: Making a Hypothesis and Designing an Experiment

Focus: Developing a Hypothesis and Designing an Experiment
Grade Level: 3-5
Session Length: 45-75 minutes

Driving Questions

- What is our hypothesis for the Project Crystal research question?
- How can we set up an experiment to test our Project Crystal research question?

NGSS Links

- Engaging in Argument from Evidence
- Planning Investigations

Systems Thinking Characteristics

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

In the fourth session of Project Crystal, students make a hypothesis about which plant type will have the most caterpillars eaten, and then set up an experiment in the garden.

At the start of the session, the group learns how to format their predictions about the ecosystem into a hypothesis, and develop a hypothesis about which plant type will have the most caterpillars eaten. Then, students learn about replication, randomization, and control, and use those ideas to set up an experiment in the garden to answer their research question using clay model caterpillars.

Learning Outcomes & Assessments

By the end of this module, students will be able to...	***You can assess this using...***
1. ***Use*** their understanding of the ecosystem to develop a hypothesis about which type of plants will have more caterpillars eaten from it.	Science journals
2. ***Plan*** and set up an experiment to test their hypothesis in the garden.	Science journals

Session Overview

Section	Description	Length	Format
Launch	Students watch a video of Kaitlin, who introduces the task for Session 4: they will use their models of the ecosystem to develop hypotheses for their research question and set up an experiment in the garden.	5 minutes	Whole group
Explore (Part 1)	Students explore the hypothesis format using an example from a previous experiment, then work in their research teams to develop their own hypothesis.	15 minutes	Research teams
Share (Part 1)	If there is time, student research teams share their hypotheses with the rest of the class.	10 minutes	Whole class
Explore (Part 2)	Students are then introduced to the components of experimental design, and work with their research teammates to set up the experiment in the garden.	30-45 minutes	Research teams
Share (Part 2)	If there is time, student research teams share their experimental design.	10 minutes	Whole class
Reflect	Students reflect on what they've learned from their model.	5 minutes	Individual

Materials

- ***Session 4 Google Slides Presentation***
- Science Journals and pencils (1 per student)
- Student models from Session 3 (1 per research team)
- Clay to make clay caterpillars (20 per research team)

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.)

- Decide how much time you have for the lesson. If you are short on time, you may decide to cut out the *Share* sections of this session.

- Before starting, review the format for the hypothesis. The sentence structure is likely different from what you have used in the past to make a hypothesis, 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 this sentence frame will be too confusing for your class, you are welcome to adjust it, but we encourage you to give it a try!

- Find the models that research teams made in Session 3. Be prepared to share them back with students.

- Visit the site you're going to use to set up student experiments. Scout and identify the plant species that students have decided to use. You'll want a minimum of two plants and ideally five plants of each of the two species. You may want to talk to the garden coordinator to get permission or make signs to let people know about your experiment.

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, Kaitlin will briefly introduce Session 4 and the idea that research teams will work to develop a hypothesis and set up our experiment.

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 (Part 1)

Part 1: Choosing Plants and Developing a Hypothesis (15 minutes)

1. Play the video on ***Slide 4***, where Kaitlin 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.

The example hypothesis is:

If we [do something] plant some seedlings with fences around them and plant some seedlings without fences, and count how many survive

then [what you think will happen] there will be more seedlings that survive in the fenced areas than the unfenced areas

because [why you think it will happen] the rabbits will be able to get to the unfenced seedlings and eat them.

2. Once you've reviewed the example hypothesis, advance to ***Slide 6***, which will give an example of the hypothesis for our experiment:

If we add clay caterpillars to plants with [Adaptation #1] _____ and plants with [Adaptation #2] _____

then more caterpillars will have marks from birds on plants with [the plant adaptation you think this will happen to]

because [why you think it will happen] _____.

3. Break students into their research teams and pass out their models. Give the teams about 5-10 minutes to work on their hypothesis. As they work, move between the teams and offer support as necessary. Encourage them to look at their models and use the ideas there to support their claim as they make their hypothesis.

Share *(Part 1)*

Part 1: Sharing Our Hypotheses (Optional) (5 minutes)

Note: If you expect to be short on time, you can skip slides 7 and 8 and move on to setting up the experiment.

1. If there is time, once students are done making their models, open ***Slide 7*** and play the video. There, Kaitlin will invite them to share their hypotheses with their research team.

2. Advance to ***Slide 8*** 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)*

Part 2: Setting Up the Experiment (30-45 minutes)

1. Move on to ***Slide 9*** to hear Kaitlin share some ideas about how scientists need to keep replication, randomization, and control in mind when they set up experiments. She also describes how she used those ideas to set up her own caterpillar study at Crystal Cove.

2. Split the students back into their research teams and advance to Slide 10. Have each team work together to describe how they would set up their experiment by answering the questions in their science journals.

- ***A.*** What two plant species will you place your caterpillars on?
- ***B.*** How many individual plants will you include in your study? (Make sure to have the same number of each plant species!)
- ***C.*** How many caterpillars will you place on each individual plant?
- ***D.*** What will you keep the same (control) to make sure you don't accidentally affect your results?

3. When research teams are ready, play the video on ***Slide 11***, where Kaitlin will demonstrate how to make a clay caterpillar and attach it to a plant.

4. Give each team enough clay to make 20 caterpillars. Depending on group size, each student will likely make 4-6 caterpillars.

5. Once the groups are ready to set up their experiment, bring the groups out to the garden to attach their caterpillars to the plants. Remind them to follow the plan they made in their notebooks.

Share *(Part 1)*

Part 2: Sharing Our Preliminary Design (Optional) (10 minutes)

1. If you have time between steps 4 and 5 of the previous section (***Explore Part 2: Setting Up the Experiment***), gather the whole class together and have students share their experimental designs with each other. Highlight the ways students used replication, randomization, and control in their designs.

5. Move on to ***Slide 9*** and 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 students to share some of the final components and processes on their list with their research teams.

Reflect

Reflecting on Session 4 (5 minutes)

1. When the research teams are done setting up the experiment, bring them back together and advance to ***Slide 12*** with reflection questions, and give each student a few minutes to answer the questions in their notebooks.

2. Finally, thank the group for their work today! When we come back next week we will be able to put our hypothesis to the test and collect data on our caterpillars to see if they were eaten more on one plant than another.