Crystal Cove® CONSERVANCY

Session 6: Analyzing Data in SageModeler

Focus: Analyzing Data
Grade Level: 6-7
Session Length: 45-75 minutes

Driving Questions

- How can we use mathematical ideas and graphs to represent our data?
- Do the patterns in our data support or not support our hypothesis?

NGSS Links

- Analyzing Data
- 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 sixth session of Project Crystal, student research teams analyze their data to look for patterns, and decide if their original hypotheses were supported or not supported by their data.

Research teams use the data they collected in the garden in the last session of Project Crystal to create a graph in SageModeler that can visually display trends in the data and help us answer our research question. In an optional extension, they can also include data from other research teams and explore using averages to represent groups of data. They then look back on their original hypothesis to see if the trends they observed in the data are consistent with their original hypothesis, or if the data showed an unexpected trend. Finally, they then reflect their original model and decide if they want to make any changes based on their findings.

Learning Outcomes & Assessments

By the end of this module, students will be able to...	***You can assess this using...***
1. ***Create*** a graph in SageModeler that compares experimental treatments, and use it to support inferences.	Research team graphis
2. ***Use*** data as evidence to determine if their original hypothesis is supported or not supported.	Science journals; Group discussions

Session Overview

Section	Description	Length	Format
Launch	Kaitlin introduces students to the task for the day: they will be analyzing their data to see if there is a difference in the amount of caterpillars attacks by birds between the two plants with differing traits	5 minutes	Whole group
Explore	Research teams graph the bird attack mark data from their investigation in SageModeler. In an optional extension, students can share data with other teams who investigated the same adaptations, add more data points to their graphs, and find more means to make their results more accurate. After, the teams look back on their original hypothesis and determine if the trends observed in their data support or do not support their initial ideas.	10-15 minutes 15-20 minutes 10-15 minutes	Research teams
Share	Students share their findings with the whole class.	5-10 minutes	Whole class
Reflect	Students reflect on their experience during Session 6.	5 minutes	Individual

Materials

- ***Session 6 Google Slides Presentation***
- Science Journals and pencils (1 per student)
- Computers (1 per research team)
- ***SageModeler Graphing Template***
- Access to research team models from Session 3

Before You Start Teaching

- Copy over the Session 6 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.)

- Slides 10-15 are an optional extension for more in-depth analysis if there are multiple research teams in your group that investigated the same plant adaptations. You are welcome to skip this section if each team investigated different factors, or if you're shorter on time. If the teams did investigate the same factor, this section provides a chance to think about variation in different team's results, and make their findings more accurate by including multiple samples and calculating averages.

- If you have not recently worked with statistics, it might be helpful to review basic ideas about statistics and terms like mean, median, and mode so that you're familiar with them if students bring them up. In the optional extension for this session, students will specifically need to use SageModeler to add a mean to their graphs to determine where caterpillars were attacked most overall between different teams' experiments.

Learning Sequence

Launch

Preparing to Analyze Data (5 minutes)

1. Open the ***Session 5 Slideshow*** and play the video on ***Slide 2*** for your group.In this video, Kaitlin will introduce the tasks for Session 6: analyzing the data that they collected in the garden in the last session to determine if the plant trait they chose to compare had an impact on the number of caterpillars that were attacked by birds.

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

Part 1: Analyzing Our Team's Data (10-15 minutes)

1. Advance to ***Slide 4*** and play the video. Kaitlin introduces what data we will need in order to answer our research questions: the plant adaptations that we are comparing, and the number of caterpillars attacked on each of those plant types.

2. Move on to ***Slide 5***, which has instructions to set up a simple table in their science journal with the summarized data they will need to graph. Ask the students to look back at their data sheets in their journal from the previous session, and transfer the data into the new table on a blank page in their science journal. An example of this table for data in Moro Canyon is below:

Plant Adaptation	Number of Attacked Caterpillars
Big Leaves	2
Small Leaves	6

3. When students are ready, advance to ***Slide 6***. There, in a video, Kaitlin will talk about why scientists use graphs to display their data, and introduce 3 common graphs that scientists will use, and ask students which they think would be the best choice to graph their caterpillar data.

4. After watching the video, move again to ***Slide 7***, which lists the three common types of graphs, line graphs, bar graphs, and pie charts, and poses the question, "Based on the research question, what do we want the graph to show?"

Ask the students to share their ideas about which graph type is the best option for their data. Do we have trends over time, distinct categories that we're comparing, or are we looking at fractions of a whole?

Because we are comparing two categories -- in this case, two different species of plants with different adaptations -- a bar graph is the best choice here!

5. Once the group has come to a consensus about the best type of graph to use, advance to ***Slide 8*** to watch Kaitlin demonstrate how to enter their data and create a graph in SageModeler. Then advance to ***Slide 9*** with the written directions, split the students into their research teams, and give each team access to a computer and the link to the SageModeler template. Give each team 5-10 minutes to work on creating a graph in SageModeler with the data their team collected.

Part 2: Analyzing Data with Other Team's Results (Optional) (10-15 minutes)

6. If your group investigated the same adaptations across different teams, advance to ***Slide 10*** to hear Kaitlin introduce the idea that each team's data will not look exactly the same, and ask the students to think about what sources of error could influence their data.

7. Advance to ***Slide 11*** and ask the group to discuss the following questions:

- What other factors besides your plant adaptation could influence your results?
  Where the plants were located in the garden, the color of the caterpillars, or even just random chance could all effect our results.

- How could we make our data more accurate, or more likely to represent a real difference between plant adaptations?
  We could collect more data, or combine our results! We could also run the experiment again trying to control for more variables, like making sure each team sets up the experiment the exact same way as the others, but that's outside the scope of what

8. Advance to ***Slide 12***, where Kaitlin will share that we can make our data more representative of the real world by including more data points from other teams. She then demonstrates how to add more data to their graphs in SageModeler, and asks the group to think about how we could come up with one number to represent a group of numbers.

9. Advance to ***Slide 13*** that asks students to discuss with their groups how they could come up with one number to represent a group of numbers. Give them a moment to discuss, then advance to ***Slide 14*** to hear Kaitlin share how we often do this in science, by finding the mean, or average. Afterwards, she demonstrates how to add the mean to a graph in SageModeler.

10. Advance to ***Slide 15***, which gives directions for the next step: students should add the data from the other teams to their data chart, and then display the means to figure out which adaptation had the most caterpillar attack marks overall accounting for multiple teams' data.

11. In order to share data between teams, it's easiest to create a table up on a whiteboard or large piece of paper that students can add they data to that is visible to everyone. You can walk around between groups and write down the data yourself, or have students come up and write their team's data on the whiteboard. An example of how to set this up is below. Each pair of rows (one each adaptation) would contain the data from a different team:

Plant Adaptation	Number of Attacked Caterpillars
Big Leaves	2
Small Leaves	6
Big Leaves	1
Small Leaves	4

Part 3: Interpreting Our Data and Updating Our Models (10-15 minutes)

12. Once the groups have completed their graphs, advance to ***Slide 16*** and play the video where Kaitlin introduces the next step in the scientific process and think about what our findings mean. Students will determine if the data supports their original ideas, or if they need to shift their thinking and model to incorporate new information.

13. Advance to ***Slide 17*** and make sure each team has the hypotheses they made in their science journals in Session 4. Then give them time to discuss the questions on the slide as a team to interpret their data.

Students will need to answer:

- What was your original hypothesis?
  Students can look back at the hypothesis they wrote in Session 4.

- Based on your data, which type of plant had the most caterpillars attacked on it?
  Students can look at their bar graphs and see which bar was higher between the two plant traits they were comparing.

- Was your original hypothesis supported or not supported based on your data? Why or why not?
  If student's predictions in their hypothesis matched what they observed in the data, we say the hypothesis was "supported," or their initial idea was the same as what their data showed. If the data showed the opposite trend than they predicted, we say the hypothesis was "not supported." You can remind the students that we use this language because we are never 100% certain of what is true or not true, but so far, the data we have can tell us what happened this one time.

- Based on your data, is there anything you want to change or update in your model to make it more accurate?
  If data sis not support the original hypothesis, research teams may want to update their model. They can describe any changes here.

14. If there is time, pass out the models that students created in Session 3. Give the research teams time to update or make any changes to their models to make sure they reflect the evidence from their data.

Share

Sharing Our Findings (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 what they found. As different groups share, encourage them to explain their reasoning and ask questions of each other.

If the students didn't combine their data, some students may have different results than others, and this is ok! You can ask the students if they think any other factors could have affected our results. These could be other factors in the environment, like some plants being in different locations than others, or even random chance that birds ate caterpillars more in one side of the garden than another. This is why we never say our results are "right" or "wrong." We can only describe what we saw in our data!

Reflect

Reflecting on Session 6 (5 minutes)

1. At the end of the discussion, advance to ***Slide 19*** in the slideshow and play the video, where Kaitlin will ask students to spend a few minutes reflecting on their experiences today.

2. Advance to **Slide 20**, which will share reflection questions. Ask students to spend five minutes reflecting on their experiences today in their science journals.

3. Finally, thank the class for their time today. Let them know that now that they have interpreted their data, the next step will be to make a recommendation to the State Park Land Managers based on their findings, and create a presentation to share what they learned!