

Focus: Analyzing Data

Grade Level: 7

Session Length: 45-60 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 and Computational Thinking
- Constructing Explanations

Systems Thinking Characteristics

- Identifying Hidden Dimensions of the System
- Proposing Explanations Based on Data
- Thinking Temporally & Making Predictions

In the ninth session of Project Crystal Code, student research teams analyze their data to look for differences between the different leaf litter treatments, and decide if their original hypotheses were supported or not supported by their data.

Research teams use the full dataset from the Project Crystal Code research site to create graphs that can help us think about our research questions about leaf litter decomposition rates and soil moisture. They then look back on their original hypotheses to see if the trends they observed in the data are consistent with their original hypotheses, or if the data showed an unexpected trend. Finally, they look back at their original model and make any changes based on their findings.

Learning Outcomes & Assessments

<i>By the end of this module, students will be able to...</i>	<i>You can assess this using...</i>
1. Describe how scientists use averages and graphs to represent a data set.	Field notebooks; Observation of class discussions
2. Create a graph in SageModeler or Google Sheets that compares experimental treatments, and use it to support inferences.	Student graphs; Field notebooks
3. Use data as evidence to determine if their original hypotheses are supported or not supported, and update their models to reflect new findings.	Field notebooks; Updates to research team models

Session Overview

Section	Description	Length	Format
Launch	Georges introduces students to the task for the day: they will be analyzing their data to see which leaf litter type decomposes the fastest, and how woody mulch and straw-like mulch affect decomposition rates and soil moisture.	5 minutes	Whole class
Explore	Research teams graph the decomposition and leaf litter data in SageModeler or Google Sheets to address our three research questions.	20-25 minutes	Research teams
	After, the teams look back on their original hypotheses and determine if the trends observed in their data support or do not support their initial ideas. If the data did not support their hypotheses, they make any changes to their model to fit their data.	15-20 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 9	5 minutes	Individual

Choosing a Data Analysis Platform

In Session 9, student research teams work together to analyze the data set for leaf litter decomposition rates and soil moisture.

As the lead educator, you can choose which platform you want your class to use while building their model. We recommend choosing between *Google Sheets* or *SageModeler*, but you could also use Microsoft Excel or another platform.

The pros and cons of our two recommended platforms are listed below.

Platform	Pros	Cons
<p><i>Google Sheets</i></p> <p>Cost: Free</p>	<p>Students can work collaboratively in the same document or share links to their graphs directly.</p> <p>Teacher can see thinking in real time.</p> <p>It is similar to platforms like Microsoft Excel, which are used by professionals working in scientific fields.</p>	<p>Creating graphs is not as intuitive as SageModeler, so students will need to focus on the step-by-step process, possibly taking away from their conceptual understanding.</p>
<p><i>SageModeler</i></p> <p>Cost: Free</p>	<p>Specifically designed to support student modeling.</p> <p>Using the platform is very intuitive, making it ideal for younger students.</p> <p>If students created their model using SageModeler in Session 3, it is easy to test the model using new data.</p>	<p>One one person can manipulate the model at a time (meaning one student will need to manipulate the model and share their screen with others).</p> <p>Teacher can only view the contents when the link is shared, so it is hard to see thinking in real time.</p> <p>It is not a platform that would be used by practicing scientists.</p>

Virtual Materials

- Session 9 Google Slides Presentation:
 - *Google Sheets*
 - *SageModeler*
- *Session 9 Field Notebook template (optional)*
- Project Crystal Code Dataset:
 - *Google Sheets*
 - *SageModeler*

Each student will need...

- A device with internet access (a computer, smartphone, or tablet will all work!)
- Field notebook and pencil
- Access to their research team models from Session 3
- Access to their research team hypotheses from Session 4

Before You Start Teaching

- Decide whether you want students to use SageModeler or Google Sheets to analyze their data.
- Copy over the *Session 9 Slideshow* for your chosen platform 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.)
- If you have chosen to use Google Sheets for data analysis, copy over the Google Sheets data file to your own Google Drive account. Decide how you will give students access to the file. You can have them make their own copy as they open it, or create a copy for each student or research team.
- If you have not recently worked with statistics, it might be helpful to review basic ideas about statistics and terms like mean, median, mode, variance, and standard deviation so that you're familiar with them if students bring them up. In this session, students will specifically need to calculate the mean (average) of each data set, and then will use the standard deviation (the amount of variation in a dataset) to determine if the differences between treatments are statistically significant or not.

Learning Sequence

Launch

Preparing to Analyze Data (5 minutes)

1. Open the [Session 9 Slideshow](#) and play the video on [Slide 2](#) for your class. In this video, Georges will introduce the tasks for Session 9: analyzing the decomposition and soil moisture data that they collected last session to determine which mulch type decomposed fastest, and what affect our two plant types have on decomposition and soil moisture.
2. Next, move on to [Slide 3](#), which gives an overview of what students will do and learn during Session 9.

Explore

Part 1: Analyzing Data (20-25 minutes)

1. Advance to [Slide 4](#) and play the video. Georges introduces students to the online platform (SageModeler or Google Sheets) that they'll use to analyze data. During a screencast, she gives an overview of that data we have to work with, and asks students to think about how we can find one number to represent each leaf litter treatment that we are comparing.
2. Move on to [Slide 5](#) which shows an image of the data. Ask students to think about how we could come up with one number to represent a group of numbers. How can we come up with one number that tells us overall which leaf litter type decomposed the fastest?

Prompt students to share any initial ideas they have. If they are familiar with statistics, they may bring up ideas like the median, mean, mode, variance, or standard deviation. Invite them to reflect on which of these concepts will work best to help us compare different leaf litter treatments. (In our case, we want to find the middle or average of each data set, so calculating the mean will be the best approach to start with.)

3. When students are ready, advance to [Slide 6](#). There, in a video, Georges will demonstrate how to calculate a mean, or average for the decomposition rate of each leaf litter type, and graph that number in either Google Sheets or SageModeler.

4. After watching the video, move on again to *Slide 7*, and share the dataset with the students. You can split the students into their teams and have them work on creating all three graphs together, or assign different research questions to graph for each team member.
5. Once the teams have created 3 graphs, one comparing leaf litter decomposition rate, one comparing the effects of restored vs. unrestored plots on decomposition rates, and one comparing plant types' effects on soil moisture, bring the class back together and advance to *Slide 8* to hear Georges introduce the idea of statistical significance. Then move to *Slide 9*, where Georges demonstrates how to test for statistical significance by adding standard deviation error bars onto their graphs.
6. Advance to *Slide 10* and split the students back into their groups and give them a few minutes to add the standard deviation to their graphs.

Explore Part 2: Building a Model (25-30 minutes)

7. Advance to *Slide 11* and play the video where Georges 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.
8. Advance to *Slide 12* and make sure each team has the hypotheses they made in their field notebooks in Session 4, and access to the models they made in Session 3. Then give them time to discuss the questions on *Slides 13-15* as a team to interpret their data.

For each hypothesis, students will need to answer:

- What was your original hypothesis?
- What trends did the data show?
- Were the trends statistically significant?
- Was your original hypothesis supported or not supported?

9. Once the teams have discussed their findings for each of the three research questions, advance to *Slide 16*. Ask students to pull up their original models of the system that they created on either SageModeler or Padlet.

Give students time to discuss the questions about their model on the slide with their research teams and answer the questions in their field notebook.

If the results don't support student hypotheses, you can also invite them to make updates to their original model based on their findings.

Share

Sharing Our Findings (Optional) (5-10 minutes)

1. If there is time, bring the whole class back together. Move on to **Slide 17** and ask students to share what they found and any changes they may have made to their models. As different groups share, encourage them to explain their reasoning and ask questions of each other.

Reflect

Reflecting on Session 9 (5 minutes)

1. At the end of the discussion, advance to **Slide 18** in the slideshow and play the video, where Georges will ask students to spend a few minutes reflecting on their experiences today.

2. Advance to **Slide 19**, which will share reflection questions. Ask students to spend five minutes reflecting on their experiences today in their field notebook.

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.