LE 8 Overview

Overview: Synthesizing and Analyzing Data to Make Decisions Around Our "Should We" Question

This learning engagement seeks to look for patterns in data sets. This includes data collected during student and family field investigations, classroom datasets that have been collected over the year (this may be on a Wondering Wall), and scientific or professional aggregate datasets that span one or more scales (over time, across places or a larger spatial scale). Attending to patterns is one of the crosscutting concepts in the Next Generation Science Standards.

It is important to remember that sometimes, data analysis and finding patterns will lead to new questions, investigations, and rounds of data analysis. Therefore, you and your students may engage in LEs 6 (modeling), 7 (data collection with new tools or approaches) and 8 (analyzing data), and 9 (sharing insights) several times before you are ready to make decisions around your "Should We" question and publicly share your recommendations for action with family and community. That's what scientists do--they conduct multiple rounds of experiments before they share their work with other scientists or in scientific papers!

Big Ideas About Nature-Culture Relations To Have In Mind As You Plan For Learning Engagement

Humans engage in deliberation and decision-making related to nature-culture relations all the time even if they aren't aware of that. Those decisions can be helpful or harmful to nature-culture relations. In this learning engagement, you will support students to become more aware of their decisions and their decision-making processes, and how they can use their wonderings about elements of nature-culture relations to explore decision spaces that are important and consequential to them and their families. From the Nature-Culture Relations framework, we learn that nature-culture relations are especially central to science and the ways in which scientists imagine, conceptualize, and investigate phenomena. Many 21st century challenges to social and ecological systems' health and resilience are caused by unsustainable and imbalanced human-nature relationships and practices. These imbalances are changing ecosystems across the earth to the point that scientists have called these a new era in the earth's history–the anthropocene. A key opportunity and need of the 21st century is for local and global communities' to adapt to changing lands and waters and develop sustainable relations with the natural world. Importantly, issues of power and historicity continue to shape nature-culture relations and our ability to cultivate just, sustainable and culturally thriving societies. It is important for educators to recognize how nature-culture relations and the demands of the 21st century pervade all aspects of learning in formal, informal, and everyday learning environments - particularly in science education. This learning engagement helps to make some of this visible by supporting students to use their and their families' wonderings to ask "Should We" questions related to nature-culture relations that will drive investigations throughout the rest of the storyline, and ultimately lead to them deliberating and making decisions about their "Should We" questions.

GRANT #1720578 LEARNING IN PLACES COLLABORATIVE, BOTHELL, SEATTLE, WA AND EVANSTON, IL

LE 8 LEARNING GOALS

By the end of LE8,

1. students will learn how to find patterns in different kinds of datasets: family data, classroom data, community-based research, and background research, and
2. students will understand how data becomes evidence for decisions around the "should-we" questions.

CONNECTIONS TO NGSS

» **Crosscutting Concepts:**
Patterns; Cause and effect, Scale; proportion, and quantity; Systems and system models

» **Science Practices:**
Asking questions; Analyzing and Interpreting Data; Obtaining, evaluating, and communicating information

» **Disciplinary Core Ideas:**
LS3: Heredity; LS2; Ecosystems; LS4: Biological Evolution ; ESS2: Earth's systems; ESS3: Earth and Human Activity
[NOTE: Applicable standards will depend on the "Should We" question, and related focal phenomena you and students choose.]

Learning Engagement in LE8

Learning Engagement 8 has one lesson:

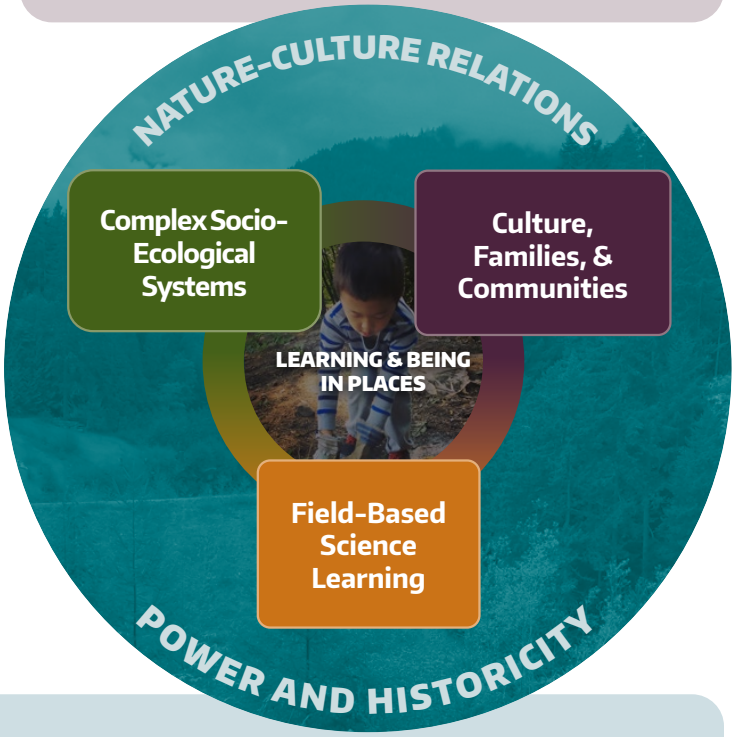
LE 8.1 What "Should We" Do?: Exploring Classroom and Family Decision-Making: In this Learning Engagement students synthesize various data sets, look for patterns in their data, and then make data visualizations that will be used to revise models and create evidence-based claims in LE9.

Engaging the Rhizome

Culture, families, and communities: What people attend to, or what they focus on, varies across cultures. What one learner observes may be important to their family, but may go unnoticed by another learner. Creating opportunities for learners to pursue or share observational phenomena that are interesting can make the activity more personally meaningful and can also create a diverse and collaborative classroom atmosphere. Heterogeneous knowledges and practices - bringing together diverse perspectives as valid forms of sensemaking in the classroom - are at the cornerstone of science as well. For example, recognize and value that learners and their families or communities may have different orientations to the role of humans in nature, and make space for these perspectives in the learning environment.

Complex Socio-Ecological Systems: Socio-ecological systems consist of networks of interacting relations - among humans, more-than-humans, and natural kinds - across multiple spatial and temporal scales. Scaffolding deeper understanding of socio-ecological systems can be supported by scaffolding observations and collecting data across places and over time. In turn, looking for patterns in data that has been collected in the field supports ethical deliberations and decision-making. Conducting observations in the field should become routine practices in your learning environment.

Field-based science Learning: Conducting routinized observations and collecting data outdoors are important scientific practices and contribute to sense making about scientific phenomena. Field scientists, such as some types of biologists and ecologists, use observations and collect data to spark new insights, test hypotheses, and gather data. Making time for learners to observe in the field can lead to diverse questions and hypotheses, and to deeper understandings of scientific phenomena. Additionally, through observations and data collection learners can see measurable change in phenomena over time and across places. These are key in field-based science learning.



Power and Historicity:
Providing learning experiences in which learners can explore, observe, and share their wonderings is critical in order to create equitable learning environments that incorporate multiple perspectives. While learners are always observing, what and how they observe, and what they then choose to share (or feel comfortable sharing) is layered with power and historicity. In schools and other learning environments behavior management and the policing of learners' (particularly Black and Brown learners) observations and connections that they make contributes to cycles of inequities in institutional learning environments. This can happen in subtle or significant ways by ignoring, discrediting, or silencing learner enthusiasm. Instead, create space and encourage learners and their families to share what they observe at home, in their neighborhoods, or in places that are important to them in order to bridge experiences between communities and learning environments.

Learning in Places

Lesson Plan

LE7.1: Designing an Investigation and Collecting Data to Answer "Should We" Questions

Purpose

The goal of LE 8.1 is to **give students the opportunity to synthesize and make sense of the data that they gathered from across settings** (qualitative/ quantitative, home/ community/ school/resource-based) in order to understand the phenomena they are investigating as well as answer the "Should We" question(s). Observations are a primary source of information in scientific inquiries, and through scaffolding and guidance, systematic observations can become a form of data collection. Adding incoming observational data to learners' models, and incorporating this with other forms of data - such as community and background research - are important processes that lead to sensemaking, deliberating, and making decisions about socio-ecological phenomena. Through analysis, data becomes evidence to support patterns that students find in the data.

Why this is important

Observations are a way of perceiving the world around us, and systematic observations can lead to sensemaking about socio-ecological phenomena. Conducting observations is not the same as simply noticing things. Observations are systematic, or methodical, practices of noticing across places and over time. Observations are also a primary source of information in scientific inquiries. Through scaffolding and guidance, systematic observations can become a form of data collection. Data collected in the field can then be used as evidence to explore scientific questions. Adding incoming observational data to learners' scientific models, and incorporating this with other forms of data - such as community interviews and background research from print and digital media - are important processes that lead to sensemaking, deliberating, and making decisions about socio-ecological phenomena. This framework is intended to support educators in facilitating and scaffolding observations and data collection in field-based learning environments.

Engaging family and community knowledge and practices

LE8.1 provides another opportunity for students to engage in science learning with their families and members of their community by analyzing and making sense of the data they collected from family field-based observations and community interviews in LE7.1. Observations are a multi-sensory way of noticing and learning about socio-ecological phenomena in the world. We can observe by seeing, hearing, smelling, feeling, and even tasting things in the world. People the world over have been engaged in observational practices to build their knowledge systems.

LEARNING GOALS

By the end of this lesson, students will be able to:

1. learn how to find patterns in different kinds of datasets: family data, classroom data, community-based research, and background research
2. understand how data becomes evidence for answers to the "should-we" questions
3. learn how to visualize their data to foster sensemaking of phenomena across data sets

CONNECTIONS TO NGSS

» **Crosscutting Concepts:** Patterns; Cause and effect; Scale, proportion, and quantity; Systems and system models

» **Science Practices:** Asking questions; Analyzing and Interpreting Data; Obtaining, evaluating, and communicating information

» **Disciplinary Core Ideas:** LS3: Heredity; LS2; Ecosystems; LS4: Biological Evolution ; ESS2: Earth's systems; ESS3: Earth and Human Activity [NOTE: Applicable standards will depend on the "Should We" question, and related focal phenomena you and students choose.]

ASSESSMENT OPPORTUNITIES

» Small and whole group discussions are formative assessment opportunities to understand students' thinking and to adapt instruction in ways that build on students' interests and prior knowledge.

» LE8.1b: small group and individual data analysis, modeling and sensemaking artifacts

Centering equitable practices:

- **Use family decisions and analyses of those decisions as a rich source of information to support students' sense-making about ethical deliberation and decision-making:** Avoid judging families' decisions and decision-making processes and strategies. Like other activities, deliberation and decision-making are powered and historicized (see the **Power & Historicity Framework**), and your role is not to judge or evaluate families' decisions and decision-making practices. Remember that the goal of this learning engagement is to help students better understand, through their analyses and discussions, complicated decisions (like those that complex socio-ecological "Should We" questions motivate) and how different people engage in deliberation and decision-making about those decisions.
- **Encourage student idea generation, wonderings, questions, comments, and suggestions.** Avoid a rush to judgment that any student's ideas, wonderings, questions, comments, and/or suggestions are silly, misinformed, nonsensical, or off target. Instead, ask clarifying questions. Ask how other students would incorporate whatever was said into ongoing discussions (other students might have perspective on peers' commentary and questions that you don't). Assume a sense-making stance, and a 'desire to participate' stance, and let those guide your actions as a teacher and facilitator.

Teacher background information

Observations as Data

Observations spark wondering, elicit questions, and support data collection in the field. Field researchers use observations throughout their scientific inquiry to make claims and justify them in order to build knowledge. For instance, researchers studying the effects of climate change on endemic butterfly species use systematic observations of spatial and temporal relationships among butterflies, plants, climate patterns, other animal and human communities. Data sets coupled with community-based knowledge and collaboration can lead to deeper understandings of our complex socio-ecological systems. Analysis of data sets and their subsequent findings are then used to support local, regional and global policy (i.e. lighting ordinances near sea turtle habitats) decisions as well as individual behavioral choices (avoiding beaches at night during sea turtle nesting season).

Observations are a way of perceiving the world around us. Conducting observations is not the same as simply noticing things. Observations are systematic, or methodical, practices of noticing across places and over time. During field investigations, educators can scaffold observations with questions and prompts that are relevant to the phenomenon or investigation question of interest. Scaffolding observations will help learners collect data that is relevant to scientific inquiry. Data collection is a record of observations, and allows learners to see measurable change of phenomena over time and across places. Determining what data to collect in an investigation requires careful planning, as it will become evidence for learners to use when making claims about socio-ecological phenomena. After data collection, researchers synthesize their data to look for patterns across time (temporal) and space (spatial). Noticing patterns helps organize phenomena and guide scientific questions. There are three types of data collection that students have collected throughout the learning engagements.

- **Field Investigations:** This includes collecting quantitative (numerical data such as counts) and qualitative (descriptive) data while in the field using observations.
- **Community-Based Research:** This includes reaching out to or interviewing community members about a part of the socio-ecological phenomenon the learners are exploring.
- **Background Research:** This includes finding information that is already out there related to the socio-ecological phenomenon. For example: reference books, internet searches, podcasts, and more.

Creating Data Points and Sets from Observations

A data point is an identifiable element in a dataset. For example, soil temperature collected in 3 locations, 3 times, across 3 students = 27 data points. A data set is a collection of related data points. Data may come from a variety of sources. It will be important to scaffold students to look across datasets to find connections. Datasets from the learning engagements may include:

1. Family and classroom field investigations (LE 7)
2. Community-based data such as interviews (LE7)
3. Classroom datasets (wonderings and noticings that have been shared throughout storyline; this may be located on the Wondering Wall)
4. Reference materials such as books, videos, diagrams, etc.
5. Scientist and Professional Datasets: aggregate data collected over a larger scale, such as a longer period of time or over a greater spatial scale (example datasets include: temperature, sunlight hours, etc. that are included in some of the data collection protocols from LE7)

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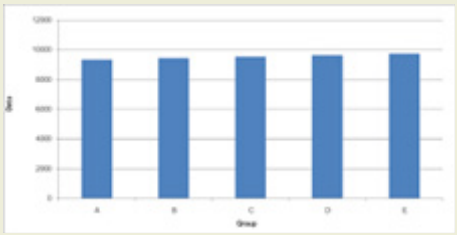
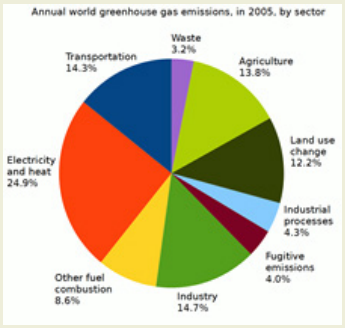
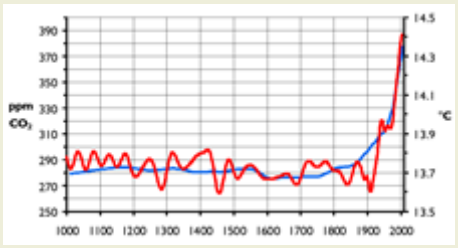
Data need to be organized, or represented, in a way that helps students visualize emergent patterns from data points that span across data sets (time and space). It is by noticing patterns that show up across multiple scales (time, space, etc.) that we can start to make claims about the generalizability of the phenomena that we are observing. This is how scientists engage in the process of developing theories!

Models are one way to represent data that students have been engaging in throughout these learning engagements. Making graphs and charts is another way! Below is an overview of three types of graphs that are commonly used in elementary settings to visualize and communicate data. They can be used to highlight aspects of students' models in order to provide evidence for claims and ethical decisions.

Bar Graphs	Circle Graphs	Line Graphs
Compare data between groups	Shows how the whole is divided into different parts.	Show how data changes over time.
		
Example: Comparing the number of 3 different species (i.e. 5 crows, 2 squirrels, 1 butterfly)	Example: Species abundance in space- out of the 20 species we observed how many were crows, squirrels, butterflies, etc? 25% crows, 10% squirrels, 5% butterflies: shade and label circle to match percentages.	Example: Daylight hours by month, temperatures over time, etc.

To prepare for this lesson

Throughout the storyline, learning activities are sequenced to support deep learning about phenomena in this place and during this season so that we can better understand and make decisions about social and ecological systems that matter to us. Across a seasonal storyline, students will engage in a variety of activities and will need scaffolding to make sense of the phenomena that they are studying. Throughout, we are always connecting back to the key questions: "1) What are we trying to figure out?; 2) How will we figure it out?; 3) How can we keep track of ideas?; and 4) How does it all fit together?" The graphic organizer below is meant to help track, organize, and synthesize learning over time in order to explicitly connect back to these central driving questions.

How to use this tool:

We recommend that you fill out this planning table before introducing it to the class. This can help you connect learning across space and over time, and surface emergent patterns in connection with the investigation question(s) and "Should We" question(s). This is also a time to think about how the broad sets of student-collected and student-generated data can be organized to support the final class project(s). Note: While there may be many activities (including in literacy, mathematics, and social studies!) that contributed to the overarching seasonal storyline, not every activity needs to be incorporated in the summary table. Consider the only the major activities that supported your investigation and "Should We" question(s).

Below are examples of possible ways to use this tool:

- Throughout the seasonal storyline, use this tool as a classroom artifact that frames the activity or learning engagement (what are we trying to figure out; how will we figure it out) and shapes the discussion afterwards (how can we keep track of ideas; how does it all fit together).
- If you are at the end of your data collection and sensemaking cycle, collectively fill out the "Should we" question/s and first two columns. This will help students remember the driving "Should we" question, the investigative questions, and the data that was collected. Then, students can reflect on what they learned (See optional LE8.1c Summary Tool for a Landscape Version for easier planning).

Investigation Summary Table for Your own Planning
Our "Should we" question is:_____

Description of Activity: What were we trying to figure out? [Include any investigation questions]	What data did we gather? What type(s) of graph(s) can represent this data? Investigation Questions	What did we learn from our family tools related to our "Should we" Question?	How does what we learned relate to seasons?	What should we make sure to include in our final explanation and model? include 5 socio-ecological dimensions?	What did I learn from this activity that helps me answer our investigation question?	What did I learn from this activity that helps me answer my "Should we" question?

Example Investigation Summary Table
Our "Should we" question is: Should we add worms to our garden?

Description of Activity: What were we trying to figure out? [Include any investigation questions]	What data did we gather? What type(s) of graph(s) can represent this data? Investigation Questions	What did we learn from our family tools related to our "Should we" Question?	How does what we learned relate to seasons?	What should we make sure to include in our final explanation and model? include 5 socio-ecological dimensions?	What did I learn from this activity that helps me answer our investigation question?	What did I learn from this activity that helps me answer my "Should we" question?
Example: Our investigation question was "Where can we find worms?" We wanted to figure out if there were more worms in the garden bed or in the forest under the log.	Example: We counted the number of worms we found in each place. Note: it was raining and some of us wondered if there were fewer worms in the garden because it was not covered like in the forest.	Example: [From Family "Should we" Model] If we add worms to our garden, in 10 years we may save lots of money on fertilizer. Note: We are imagining the long-term impacts of worms in the soil as a sustainable alternative to buying fertilizer.	Example: In the fall there are lots of leaves falling. Worms help leaves break down and become nutrients for other plants and animals.	Example: Worm habitat; role of worms in ecosystem; web reasoning (worms, millipedes, and fungus all play a role in breaking down dead leaves and logs; birds eat worms, seeds, and other bugs; people use worms in the gardens, to go fishing, and to feed their pets).	Example: We learned that there were more worms under the log than in the garden bed. We think this is because worms like the nutrients from the dead leaves and dead log. We also think worms might be "safer" from predators.	Example: If we are going to put worms in our garden, we should add dead things for them to eat.

MATERIALS

» LE8.1a Summary Table Student Tool
» LE8.1b Finding Patterns in my Data Student Tool (Note: if you do optional Step 3 of this document, make sure that Step 2 and Step 3 are printed as separate pages for a gallery walk)
» LE8.1c (Optional landscape version of Data Summary Table in the To Plan section.

TIME

80 minutes (20 minutes planning with the Summary Table, 15 minutes student planning tool, 45 minutes finding patterns)

Instructional Sequence

Part 1: Noticing Patterns
Whole Group: What data have we collected so far?

1. Before engaging students in the synthesis of their data collection so far, do your own synthesis using the table in the To prepare for this lesson section or using the LE8.1c Data Summary Teacher Tool. Use this tool to focus this and later discussions only around the tools that are related to the investigation and "Should We" questions.

2. Write the Investigation and "Should We" questions on the board or on a piece of easel paper, and tell students: "We have noticed, wondered, and collected data to learn more about our investigation question so far! We have collected data from home with our families, collected data at school, talked to community members and even done background research! Now we are going to learn how to combine our data to see patterns that come up across our data sets and over time."

3. Engage students in a whole group brainstorm about the tools they have used and the data they have collected so far. Write their answers on the board or on a sheet of easel paper to keep track of response. You might say: "Before we look at our data in small groups, let's think back to all of the wondering, noticing, and data collection we have done so far. Can you think of data that we have collected so far that we can use to answer our investigation and "Should We" questions?

4. Write the investigation and "Should We" question on the board.

5. Record students' brainstorming. At this point, write down everything that students share without adding comment about whether or not it is related to the investigation or "Should We" question.

6. Once students have had a chance to share, ask students to turn and talk with a partner to identify which observations and data that you have collected are the best fit for answering their investigation and "Should We" questions.

7. Have students share their ideas and modify the list by crossing off tools or adding more. Use probing questions and invite other students to join in as you finalize the list to reflect the Summary Table you made to prepare for this lesson.

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8. Tell students: "Now we are going to work in small groups to look more closely at these tools and data sets to see what patterns we notice and how these patterns might help us answer our "Should We" question(s)."

Small Summary Table

9. Arrange students in small groups and hand out the LE8.1a Student Summary Table or have students draw the table/ prompts on a sheet of paper.

10. As students complete the table, walk around to the small groups and engage students in thinking about why particular pieces of data answer the investigation and "Should We" question more than others. Engaging students in discourse around data is the most important aspect of this activity, so students can abbreviate, draw, cross-out, and work with this table as a thinking tool rather than a final product. There are no right or wrong answers throughout the data analysis sensemaking tools.

11. As you sit with groups also focus questions on emergent patterns and connections to the "Should We" question to support students before they move on to deeper data analysis activities.

12. Tell students: "I see a lot of great sensemaking happening around our data, the patterns we see, and how they are connected to our "Should We" question. Be prepared to share your patterns and connections with the whole class soon!"

Whole Group Discussion

13. Invite students to share the patterns and connections that emerged while completing the LE8.1a table.

14. Record their patterns and noticing on the board or on a sheet of easel paper. Revisit these sharings as students continue to make sense of their data through analysis and graphing in the next part of this lesson. This will make visible to students how data visualization and analysis can support our sensemaking of phenomena and ethical deliberations over time.

Part 2: Analyzing and Visualizing Data
Looking for Patterns in Our Data

Whole Group and Small Group:

1. As a whole group, tell students, "So far we have talked a lot about data. You may have even heard us use the word evidence through our investigations. Before we analyze our data, let's explore the terms data and evidence a little more. Can someone share what comes to mind when we use the word data?"

2. Invite students to turn-and-talk with a classmate, and then ask students to share their ideas.

    a. Data is the information we collect when we conduct our research, including field-based observations, community interviews, and background research.

3. Now tell students that evidence is different from data. Evidence is the set of data we use to answer our research and "Should We" questions.

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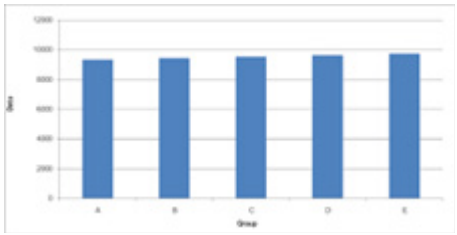
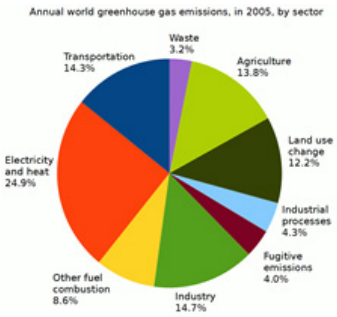
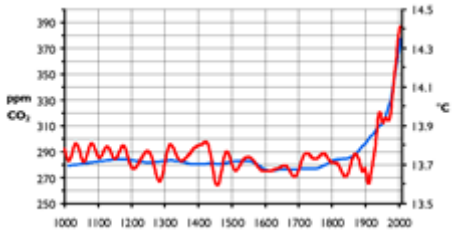
4. Tell students "Now that we have looked for patterns in our data and made connections between those patterns and our "Should We" question(s), we are going to look more closely at those patterns to understand them more.

5. Hand out the LE8.2b student document. This document has students graph their data in Step 1, make claims about the patterns they noticed in their data in Step 2, then share their claims in a classroom Lab meeting in Step 3. Students will use these claims in LE9 to update their models and engage in ethical deliberation.

6. Introduce or remind students to three different ways to graph data that relate to what we want to understand and show about our data. You can project the table below on the screen or use other graphing supports for this lesson.

Bar Graphs	Circle Graphs	Line Graphs
		

a. Tell students that **bar graphs** are used to visualize data between groups. Ask students to share their ideas about what types of data from the noticings, wonderings, and observations might be best represented by a bar graph. Examples include: comparisons between species, comparisons between sites, comparisons between rainfall/ temperature/ sunlight by seasons, etc.

b. Tell students that **circle graphs** are used to show how a whole is divided into parts. Ask students to share their ideas about what parts of their data would be best represented by a circle graph. Examples include species abundance, amount of sunlight hours in a 24-hour day, etc.

c. Finally, tell students that a **line graph** shows how data changes over time, and asks students to share what data they think is best represented by a line graph. Examples include temperature over time, rainfall over time, amount of average daylight hours over time (which could also be a bar graph).

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7. Depending on your students' background and prior knowledge of graphs, this activity can be done individually, in small groups or as a whole class. For less experienced learners, it is best to construct a graph or your data (or graphs of your data) as a whole group activity to model and show what these practices look like.

   a. **Option 1:** Individual/ small groups- have students complete Step 1 of LE8.1b individually, in pairs or a small group around a data set. For this option, students can graph different types of data collected such as their own family data or different class data sets to share with the whole class. When students share their graphs for this option, have students observe the graphs as part of a gallery walk.

   b. **Option 2**: Whole group instruction: For students with less experience graphing, choose a data set to graph as a whole class. Share which data set you will use for the graphing activity, and ask students to think about which type of graph(s) are the best fit for the data. Co-construct the graph with students. Invite students to participate as you draw the graph on the board by questions such as:

      i. "Can someone tell me how many ___ we observed?"
      ii. "Where should I write that number on our graph?"
      iii. "How should I label this?"
      iv. etc.

   c. Have students draw the graph on the LE8.1b document as you draw the graph in front of the class.

Step 2: Making Evidence-Based Decisions

1. Tell students that now that they have created graphs of their data, they are going look for a pattern in their data. For classes that are analyzing multiple data sets, you would look at patterns within and across the data.

2. Tell students: we are doing investigations so that we could make a decision about our "Should We" question. We're also going to try to convince others that this is a good decision, and the way we do that is to back up our decision with **evidence**. Our **evidence** comes from patterns we find in our data. "a claim is a statement that is supported by evidence."

3. We make **evidence-based decisions** all of the time. Brainstorm evidence-based decision with your students using everyday examples by saying: "What are some ways that we use evidence in our everyday lives to make decisions? Turn and talk with a partner and then share some of your ideas with the class."

4. Next, tell students:"When we make a decision about our "Should We" question, we will be making a decision about what we should do. [fill in with your "Should We" questions]. Finding patterns in our data will bring us closer to making a decision about our "Should We" questions.

5. You can structure this practice as either a whole group, small group, pairs or individual activity depending on your students prior experience with and knowledge reading graphs and making claims.

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6. Students will build their models and engage in ethical deliberation in LE9
    a. **Option 1: Individual/ small group:**
        i. Keep students in the same groups from Step 1. Ask students to look at their graphs and to note the patterns they see in the top row of the table in Step 2.
        ii. Next, ask students to explain the pattern using examples from their data points on the graph. Tell students evidence is the actual data in the patterns they see. For example:
            1. Pattern: temperatures are warmest in the afternoon.
            2. Evidence: The graph shows that it was coolest at 6:00am at 65 degrees F and warmest at 3:00pm at 85 degrees F.This is the evidence that students will use to support their claim(s) in the final row.
        iii. Finally, tell students to write a statement that is supported by their evidence.
        iv. This option is best for students who already have experience making evidence-based claims.
    b. **Option 2: Whole group (Turn-and-Talk structure)**
        i. Keep students as a whole group.
        ii. Ask students to look at the graphs that you constructed together as a class. Tell students to turn-and-talk with a partner or partners to look for patterns in the graph. Ask students, "What do you notice about our data? Is there anything that surprised you or that you had predicted before we made our graph?"
        iii. Tell students that these patterns are a type of evidence that can be used to help us understand our investigation and "Should We" questions. And tell students that the evidence is the actual data in the patterns they see. For example:
        iv. Pattern: temperatures are warmest in the afternoon.
        v. Evidence: The graph shows that it was coolest at 6:00am at 65 degrees F and warmest at 3:00pm at 85 degrees F .
        vi. Have students turn-and-talk with their partner(s) come up with 1-2 pieces of evidence they see using data patterns from the graph. Ask students to share their observations of the data in order to co-construct several pieces of evidence for the table. Write down 1-2 pieces of evidence
        vii. Now tell students that they are going to come up with a statement that is supported by their data together as a whole class. Tell students, "Turn and talk with your partner(s) to come up with one statemetn that is supported by their evidence. If students are unsure of how to structure their statement, revisit the everyday examples from earlier in this lesson.
        viii. Have students turn-and-talk with a partner(s) to discuss possible statements, and then have students share with the whole group. After students have shared their statements, invite the class to co-construct a final statement that they feel is supported by the evidence; either write the statement in the class table or have students write it LE8.1b.

Continued next page...

Optional Step 3 (if you used the individual or small group option for this lesson)

1. Use Step 3: The Lab Group Meeting if you followed the individual or small group model for this lesson.
2. Engage students in a Gallery Walk for the Lab Meeting portion of this lesson. You can either have students tape their Step 2 tables to the wall, or they can lay them on their desks.
3. Have students walk around the room to read each other's patterns. As they read their classmate's patterns, have students complete the table in Step 3.
4. Optional: Teach can keep track of patterns across groups by drawing this table on the board or easel paper or projecting it onto the board.

Summary Table

Our "Should we" question is: _____

Our investigation question is: _____

Data we collected:
Patterns we noticed:
Why we think this is happening:
Connections to our "Should we" Question:

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STEP 1: Finding patterns in my data

Name _____ Date _____

We have now collected our data and are ready to analyze! **Data analysis** is the process of finding patterns in your data, **making claims** about those patterns, and backing up your claims with **evidence**. Try to come up with at least **two** patterns from your investigation. The table on this sheet will help you organize your thoughts!

The "Should we" question we are trying to answer is:

_____

The investigation question I am trying to answer is:

_____

In the box below, draw a **graph** or **chart** using data points that you collected:

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Data analysis table

Pattern 1	
One **pattern** I see in my **data** is:	
My **evidence** for this pattern is:	
Claim: (Why I think this pattern is happening)	

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Pattern 2	
One **pattern** I see in my **data** is:	
My **evidence** for this pattern is:	
Claim: (Why I think this pattern is happening)	

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STEP 2: Lab meeting to find patterns in our data

Scientists_____ Date_____

Now that you have come up with a few claims, it's time to talk to each other! Scientists often share their results in **lab meetings** where they give each other feedback on their work. In this activity, you will get together with your fellow scientists and share your results in a lab meeting.

Directions:

1. Decide who is going to share first (you will each have a turn)
2. First person: share at least one claim and your evidence for the claim.
3. Other scientists: ask questions using the table tent question starters!
4. Repeat steps 2-3 until everyone has shared!
5. Fill out the table below and be ready to share with the whole class!

The question we were trying to answer was:

_____

Similarities we noticed across groups:	**Differences we noticed across groups:**	**Relationships we are noticing across groups:**

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STEP 3: Revising our ideas and models

Now that you have shared your thinking with other scientists, the next step is to revise your ideas based on the new information you have learned from your fellow scientists. This is a chance to revise or add to your claims or models as you notice new relationships or variables.

After talking to my fellow scientists, I have new ideas about our investigation question _____

_____

Relationships:
New Ideas:

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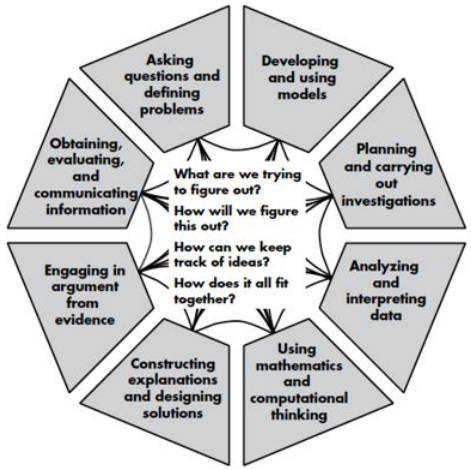
LE 8.1 SUMMARY TABLE

Overview: In our storyline, learning activities are sequenced to support deep learning about phenomena in this place and during this season so that we can better understand and make decisions about social and ecological systems that matter to us. Across a seasonal storyline, students will engage in a variety of activities and will need scaffolding to make sense of the phenomena that they are studying. Throughout, we are always connecting back to the key questions: *"1) What are we trying to figure out?; 2) How will we figure it out?; 3) How can we keep track of ideas?; and 4) How does it all fit together?"*



The graphic organizer below is meant to help track, organize, and synthesize learning over time in order to explicitly connect back to these central driving questions.

How to use this tool: We recommend that teachers fill out this form first before introducing it to the class. This can help teachers demonstrate how to trace the investigation cycle and pop out patterns in connection with the bigger investigation. This is also a time to think about the final activity and record what criteria you want to see reflected in students' final explanations.

Note: While there may be many activities (including in literacy, mathematics, and social studies!) that contributed to the overarching seasonal storyline, not every activity needs to be incorporated in the summary table. Consider the major activities (in the field, garden, and homes) that drove the storyline investigation.

Here are some examples of possible ways to use this tool:

1. **Throughout the seasonal storyline**, use this tool as a classroom artifact that frames the activity or learning engagement (*what are we trying to figure out; how will we figure it out)* and shapes the discussion afterwards (*how can we keep track of ideas; how does it all fit together).*
2. If you are at the **end of your data collection and sensemaking cycle,** collectively fill out the "Should we" question/s and first two columns. This will help students remember the driving "Should we" question, the investigative questions, and the data that was collected. Then, students can reflect on what they learned.

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Investigation Summary Table

Our "Should we" question is: __*Should we add worms to our garden?*_____

Description of Activity: What were we trying to figure out? [Include any investigation questions]	**What data did we gather?**	**What did we learn from our family tools related to our "Should we" Question?**	**How does what we learned relate to seasons?**	**What should we make sure to include in our final explanation and model? [include 5 socio-ecological dimensions]**	**What did I learn from this activity that helps me answer our investigation question?**	**What did I learn from this activity that helps me answer my "Should we" question?**
Example: Our investigation question was "Where can we find worms?" *We wanted to figure out if there were more worms in the garden bed or in the forest under the log.*	*Example: We counted the number of worms we found in each place.* *Note: it was raining and some of us wondered if there were fewer worms in the garden because it was not covered like in the forest.*	*Example: [From Family "Should we" Model] If we add worms to our garden, in 10 years we may save lots of money on fertilizer.* *Note: We are imagining the long-term impacts of worms in the soil as a sustainable alternative to buying fertilizer.*	*Example: In the fall there are lots of leaves falling. Worms help leaves break down and become nutrients for other plants and animals.*	*Example: Worm habitat; role of worms in ecosystem; web reasoning (worms, millipedes, and fungus all play a role in breaking down dead leaves and logs; birds eat worms, seeds, and other bugs; people use worms in the gardens, to go fishing, and to feed their pets).*	*Example: We learned that there were more worms under the log than in the garden bed. We think this is because worms like the nutrients from the dead leaves and dead log. We also think worms might be "safer" from predators.*	*Example: If we are going to put worms in our garden, we should add dead things for them to eat.*

(Modified from AST) ***http://ambitiousscienceteaching.org/tools-face-to-face/#Summtable***

Investigation Summary Table

Our "Should we" question is: _____

Description of Activity: What were we trying to figure out? [Include any investigation questions]	What data did we gather?	What did we learn from our family tools related to our "Should we" Question?	How does what we learned relate to seasons?	What should we make sure to include in our final explanation and model? [include 5 socio-ecological dimensions]	What did I learn from this activity that helps me answer our investigation question?	What did I learn from this activity that helps me answer my "Should we" question?

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