

LE1.1: Socio-Ecological Histories of Places Launch

Purpose

REASONING ACROSS MULTIPLE TIMESCALES

In this opening lesson to the Seasonal Storyline for Field-Based Science, students will be introduced to the Socio-Ecological Histories of Places Framework. It will be an ongoing tool to structure sensemaking about how the socioecological systems we see today have both histories and futures that may not be readily apparent but are nonetheless critically important to consider when learning about and making decisions about places. This launch will give students an opportunity to reflect on what they already know about the various timescales in relation to the places around their school and their neighborhood.

Why this is important

Thinking within and across many time scales is necessary to understand the complexity of socioecological systems more deeply. Research shows that thinking across time scales is an important practice of scientists because they need to understand the geologic and past social contexts of the land they are studying in order to understand the land as it is today, as well as what it might become in the future. Similarly, structural inequalities in our society are historically rooted and continue to accumulate across different scales of time. Grappling with these layered histories and the way they continue to shape the present is critical in order to create ethical, just and sustainable futures.

Engaging family and community knowledge and practices

Students should be encouraged to bring what they know from their own families, experiences, neighborhoods, and communities into the discussion about Histories of Places.

LEARNING GOALS

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

- Describe what they know across each of the relevant timescales
- 2. Connect the timescales to places that they know

CONNECTIONS TO NGSS

- » **Crosscutting Concepts:** Stability and Change
- » Science Practices: Obtaining, Evaluating, and Communicating Information
- » Disciplinary Core Ideas: ESS3.C: Human Impacts on Earth Systems (K-2)

ASSESSMENT OPPORTUNITIES

- » Whole-class discussions
- » Whole-class Histories of Places graphic organizer

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Teacher background information

There are many temporal scales that make a place what it is today, and what it could be in the future. Histories span across lands, waters, plants, animals, and communities over time. A place's histories are impacted by political and other dimensions that have shaped and continue to shape how people interact with, influence, and are otherwise in relationship with lands, waters, and more-thanhumans (like plants and animals, for example), and how all of this takes place in local, regional, national, and global contexts. Thinking across many time scales makes visible the complexity of socio-ecological systems. An important part of sense-making about those systems, and making-decisions related to those systems, is not only exploring places as they are now but also exploring how they could be in the future and what they were like in the past.

To prepare for this lesson

To learn more about each of the timescales, start by exploring the Socio-Ecological Histories of Place Framework, especially the Vignette in Appendix A and the selfassessment in Appendix D. Use these time scales to think about and research the places that are important to you, including the place on which your school is located, as well as the surrounding communities and regions. What are your relationships to those places? What are your students' and their families' relationships to those places? If you don't know the answers to these questions, how could you find out? You should also use this framework throughout the Seasonal Storyline for Field-Based Science to help support your students in thinking about place within and across these time scales. Begin by thinking about places that are important to you, students in your classroom, their families, and surrounding communities. Then think about these places across different time scales, and conduct research using various sources to help vou do that. You can use a chart like the one embedded below to help you document your learnings, wonderings, and thoughts about implications for teaching.



Fill in the graphic organizer with your own ideas, answering these questions:

- What do I know from prior experience and research I have conducted?
- What questions or wonderings do I have?
- How can I support students' sense-making within and across scales of time?



Centering equitable practices:

- All places have historical contexts: Science is often taught from ahistorical perspectives, as if
 scientific studies and theories were done in a social and political vacuum. We know that this isn't true.
 Surfacing histories of places is an important step to help students realize that all places have ongoing
 histories, past, present, and future.
- "Histories" are ongoing: It is very easy for students to assume that, because we talk about timescales as "histories", they are in the past. In this lesson and throughout the storyline, we are trying to understand timescales as ongoing--with histories but also futures. This is why the "living ethical possibilities and responsibilities time" is a timescale that cuts across all timescales, so that we can start to imagine futures for lands, waters, plants, animals, soil, indigenous people, nation-states, and/or the world on a global scale.
 - "De-settle" your own ideas about place and Indigenous peoples: History is often taught in a way that (1) completely invisibilizes Indigenous peoples, (2) romanticizes relationships between Indigenous peoples and settlers, and/or (3) makes it seem as if Indigenous peoples no longer exist. Educate yourself about what Indigenous lands your school sits on, which Indigenous nations are your school's neighbors, and how Indienous practices influence the places, science, and stories of the places where you live and work. Doing this work is an important step in supporting your students to think within and across timescales about complex socio-ecological systems. Vignette A in the Histories of Places framework can give you an example of how to structure this discussion with your students.
 - Continuously support students and families in thinking about the histories of the places they are learning about and studying:

One error educators can make is grounding students and families in the histories of places that are interesting and important to them in LE 1, and then failing to use this framework throughout the rest of the Seasonal Storyline for Field-Based Science. Throughout the storyline, you should continuously be asking important Histories of Places questions and asking learners to keep using these various timescales as part of their sense-making. This will help to ensure that learners are thinking deeply about the complex socioecological systems they are studying, and it will help to ensure that their deliberations and decision-making about aspects of those systems are as complex and informed as possible.



MATERIALS

- » Histories of Places graphic organizer
- » A variety of maps: world maps, maps of the U.S., Indigenous land maps, water maps
- » Materials to make timelines
- » Information (from your own research) about various Histories of Places surrounding the school and student and families' neighborhoods

Instructional Sequence

- 1. Ask students: when I say the word "history", what do you think of? What kinds of places do you think have histories? What kinds of people have histories?
 - » You can keep this as a whole-class discussion or have students talk with a partner, or individually write or draw some ideas first, then share as a whole class.
- 2. Allow students to share the histories that they know about. Write them down on sticky notes or word cards so that you can sort them later into the Histories of Places Framework.
- Ask students: when I say the word "future", what do you think of ? What kinds of places do you think have futures? What kinds of people have futures?
 - » You can keep this as a whole-class discussion or have students talk with a partner, or individually write or draw some ideas first, then share as a whole class.
 - » Students' ideas here will be varied. As you listen to students' ideas about futures, try to take a sensemaking stance--meaning, as students share, ask probing questions like, "can you say more about that?" "Is there anything that you've experienced today that makes you think about that kind of future?" "What timescale do you think that future belongs to?"

Complex Socio-Ecological Systems Culture, Families, 5 Communities LEARNING & BEING IN PLACES Field-Based Science Science Source AND HISTORICHY

Assessment opportunity:

The point of this discussion is to get at students' ideas of histories, that all people and places have histories, and that histories are also what we're living in today.

The point of this discussion is to get students thinking about the idea that all places and people have futures



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- 4. Show students the Histories of Places graphic organizer (you might want to make this poster-sized so that you can hang it on the wall and make it visible throughout the storyline. Here are some ways to explain each timescale to students:
 - » **Geologic time:** this is about the land and water forming, including our mountains, glaciers, rivers, and oceans. While these were formed in the past, they are always still changing.
 - » Plant, animal, and soil time: this is plants, animals, and soil, their histories in places, and also how their relationships between each other and with humans (because we are animals too!) are changing as the climate changes.
 - » Indigenous peoples time: Indigenous peoples have always been on this land and still are.
 - » **Nation-state time:** this is how countries interact with the land, waters, plants, animals, and soil based on the things that are important to those countries.
 - » **Global time:** this is how the places where we live are connected to other places around the world.
 - » Living ethical responsibilities and possibilities: this is how we imagine the future for all of the other timescales!
- 5. Ask students: based on these timescales, which ones were we thinking about as a class as we thought about the word "history"? What about the word "future"?
 - » Sort students' ideas into each of the relevant timescales.
 - » If there are timescales that are blank after step 5A, explain to students: it looks like we know a lot about several of these timescales, but also that we have some things to learn about other timescales! Maybe your families know more about some of these that are blank. We will do some exploration with your families about these, and we will continue to talk about these throughout our investigations in the next couple of months!
- 6. Ask students: what do you know about the history of the place that surrounds our school?
 - » As students share what they know, point out which timescale in the Histories of Places framework they are thinking about.
 - Present to students some of your research about the histories of the place surrounding the school. While you do this, point out the timescales from the Histories of Places framework that you're highlighting. This will help students apply their understandings of the timescales to your description.
- 7. Explain to students that they will get a chance to do this same type of work and have these discussions with their families, and that it will really help our classroom learning to hear from their families.
- 8. Explain to students that we will next explore the place surrounding our school, but as we see what is there **now**, we want to think about what it might have been like in the past and what it could be like in the future, and what questions and wonderings we have about those things

You might have other names for these timescales. What is important is for students to realize that there are multiple timescales along which they are thinking. You might want to show close-ups of each of the images on the Histories of Places graphic and ask students what they see in those pictures, why they think a picture represents a particular timescale.

It is important throughout the storyline that you center students' ideas and questions in your instruction. This means using their ideas as the basis for your instruction by publicly displaying their ideas as legitimate and valid.

Remember to include history of the Indigenous peoples whose land your school sits on. Show students a map of Indigenous land, and make sure to explain that Indigenous people still live on that land, but that it was taken from them without their permission.





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LE1.2 Family Histories of Places Walk

Purpose

OBSERVING HISTORIES OF PLACES IN OUR NEIGHBORHOODS

This family tool is meant to give students and their families an opportunity to observe and wonder about their neighborhoods while using the Histories of Places framework that was introduced in LE1.1.

Why this is important

You have just completed a discussion about histories of places in the classroom. This is an opportunity for families to apply this knowledge to the places where they live. This will also give you an idea of which timescales families are attending to and wondering about. Including these wonderings and observations in with the class wonderings and observations about place is an important power-sharing move to help students see their family knowledges and places as important and valid alongside classroom knowledge.

Engaging family and community knowledge and practices

This is your opportunity to elicit family and community knowledges about Histories of Places where families live. As a teacher, it is impossible to have complete knowledge of all of your students' backgrounds and histories as they pertain to place. This family tool is a chance for you to put students and their families in positions of experts to teach you about what they know. LE1.5 will be an opportunity to merge classroom and family-based wonderings about place into one chart so that you can hold those as you move forward in the storyline.

LEARNING GOALS

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

- 1. Apply the Histories of Places Framework to their observations and wonderings about the places where they live.
- 2. Share and discuss family stories about those places

CONNECTIONS TO NGSS

- » Crosscutting Concepts: Scale; Stability and Change
- » Science Practices:
 Obtaining, Evaluating, and
 Communicating Information
- » Disciplinary Core Ideas: ESS3.C: Human Impacts on Earth Systems (K-2)

ASSESSMENT OPPORTUNITIES

» Family tool LE1.2

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Teacher Background/Preparation Information

As you have familiarized yourself with the Histories of Places Framework and taken the self-assessment, you have done research into the histories of the place occupied by your school and its surrounding land, and you have explored the places around the school with your students. This is an opportunity for you to hear from the families in your classroom what they already know about places and histories. They may be able to fill in some knowledge about the various timescales that were missing after your discussion with your class in LE1.1. They may have firsthand experience with places around the world and understand how your local places are connected globally. They may be Indigenous families and have firsthand knowledge around the ways in which nation-states have forced change with relationships to the land. This family tool is a powerful way to understand the knowledge that is held in the families in your classroom.

Centering equitable practices:

- **Engaging equitable relations with families:** Sometimes schools hold deep deficit views of families, such as assuming that families won't fill this out because they don't care, cannot understand complex timescales or complex systems because either they don't have enough scientific background knowledge or their first languages are not English. Avoid falling into these assumptions. All families engage in sophisticated reasoning about places, have culturally-based practices that they engage in, and have historical knowledge about the world. Allowing opportunities for all families to share these with you is a big step towards building trusting relations with them. It is important to provide translations of all family tools, as well as adequate time for families to return them.
- Broaden at-home work beyond "homework": Homework can be a toxic term to families. In schools, homework
 has been shown to increase inequities and not lead to substantial learning. Try to frame these as "family learning
 activities" with no right/wrong answers to lower the stakes and make these more accessible tools for families to
 fill out. It is helpful to write a target return date on the top of the front sheet.
- All family tools contain valued knowledge!: Families will have different relationships with the school, with "homework", and with sharing personal information with you. This is the **first of many** family tools that will be distributed throughout the storyline. Even if you don't have many that are returned this first time, you can still learn valuable knowledge about families. You can also ask students to share what they discussed with their families even if they didn't return LE1.3 back to you.

MATERIALS

» Family tool LE1.2

TIME

Allow at least 5 days for this to be returned to you. You can hand this out after you've done LE1.1

Introducing the tool to your students

- 1. Explain to students that now that they have explored the Histories of Places, it's time to see if they can find any **evidence** of these timescales as they walk around their neighborhoods with their families.
- 2. Return to the Histories of Places chart that you've started to fill out as a class and remind students that while they already know and wonder about many of the timescales, there are some that we can learn more about. They may be able to fill some of these timescales out as they walk around their neighbourhoods with their families.
- 3. Emphasize to students that there are no right or wrong answers to any of the parts of the chart. It is really just for them to have a family walk so that we can add to our classroom chart what their families notice and wonder about!



Purpose

SUPPORTING SENSEMAKING AROUND PLACE AND NATURE-CULTURE RELATIONS

In this lesson, students will begin to make connections among places, people, and others who share a place. With this lens, we can attune our outdoor learning to attend to species, places, lands, and waters. In this activity, we begin inside the classroom by drawing our schoolyard and who we might find in it (including humans!). After the walk, students draw what they saw on their walk. Students are then asked to think about who they share their neighborhoods with as a way to connect their learning in and across places.

Why this is important

Place-centered learning is foundational to the storyline and is also deeply connected to family and cultural practices and knowledges. It is also critical for field-based science learning. This lesson is an introduction to noticing, wondering, and observing in places--which in turn will lead to "Should-We" questioning and decision-making about socio-ecological phenomena later in the storyline.

Engaging family and community knowledge and practices

In this lesson, it is important to connect to students' prior knowledge, experiences and family practices to places around the school.Your questions should position students' home-based knowledge as strengths for classroom learning. Prompt students to draw on these knowledge bases and experiences as they observe, wonder and draw on the Wondering Walk. Making social and ecological connections between places that are important to students and places around the school will be important as students move towards the LE1.4 family tool.

LEARNING GOALS

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

- 1. Describe what they observe in places around the school
- 2. Start to describe wonderings in terms of various timescales
- 3. Imagine more-than-human uses of places
- 4. Describe human decisions that have occurred in places

CONNECTIONS TO NGSS

- » Crosscutting Concepts: Scale; Systems and System Models
- » Science Practices: Asking questions and defining problems
- » Disciplinary Core Ideas: ESS3.C: Human Impacts on Earth Systems (K-2)

ASSESSMENT OPPORTUNITIES

- » Whole-class discussions
- » Noticing student talk during outdoor walk

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» LE1.2 Student tool

Teacher background information

All students' learning experiences are grounded in place. Whether that place is indoors or outdoors, places help students understand who they are, how they are connected to the land or with each other, and who they share places with. It is important to understand that humans do not all experience the same place in the same way, and this is connected to gender identity, race, class, ability, or other factors. As scientists begin to do place-based investigations, they need to understand the histories of that place, who lives there (humans and more-than-humans), the geological features of the place, and how human decisions have affected that place. This lesson is an introduction into noticing features of places, as well as starting to talk about what places are important to us and why. The Place & Place Designing: Mapping Opportunities to Learn framework will be helpful to you as you think about how to discuss place with your students, and how to plan for instruction by walking in place.

Centering equitable practices:

- Broaden what counts as science and science knowledge, who does science, and where science is done: Science is often taught from very narrow conceptions of what counts as science, who does science, and where science is done. This lesson gives you an opportunity to open up the thinking space in science to include students' prior knowledge, familybased knowledge, and expertise as they begin to engage in place-based investigations.
- Provide equitable access to outdoor learning experiences: It is natural to be nervous about students' behavior while outdoors. This might come from concerns about safety while outside, but it often results in policing of children of color more often and more harshly than white children. Students will be excited to be outside. They will speak in louder voices than they normally would in the classroom. They will spread out but will come back together as they share their ideas. Allow them both emotional and physical space to do this.
- Encourage more-than-human perspective taking: Descriptions of ecosystems are often framed in terms of how ecosystems are useful for humans. In order to engage in ethical deliberation about places, however, we need to support students in taking the perspective of more-thanhumans in natural systems. How is this decision good for the trees? How is this place good for the worms? for the soil? Beginning to ask these questions will encourage students to take on broader perspectives when engaging in ethical deliberation and decision-making around ecosystems.
- Encourage human connections to ecosystems: It is common for science learning to position humans as disconnected or apart-from nature. This activity encourages thinking about connections between humans and the rest of the natural world and starting from assumptions of complex interdependence.



To prepare for this lesson

- Make sure that you have done some place mapping to know where you'll take students on their walk, what you'll draw their attention to, and what questions vou'll ask.
- Make sure that, as you prepare for this lesson, you think carefully about how much time to allocate to the lesson launch, outdoor walk, and the lesson closing. It is important that students have time to reflect on their outdoor observations after you get back inside the classroom.



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MATERIALS

» LE1.3 student tool

TIME 45 min



Instructional Sequence

Lesson Launch: In the classroom (10 minutes):

- 1. Begin the lesson by asking students: when I say the word "place", what do you think of?
- 2. Explain to students that place is the combination of a setting, or a physical location, everything and everyone in that location, our history in that location, and what all of that means to us and our families. It's a big idea that we started talking about when we talked about the histories of places in the last lesson, and that we'll continue to talk about today as we explore the physical location around our school and who else is there!
- 3. Ask students to think about what they would see if we walked around the outside of the school. What plants and animals would we see? What buildings? Would we see rocks? Water? Sand or soil? Other people? How is this similar or different from what you would see around your neighborhood?
- 4. Explain to students that today, we're going to start out by thinking to ourselves about what we think we'll find as we walk around the school outside and drawing those things. Then we'll go for a walk to actually see what's there, and then come back and add to our drawings and talk about what we found.
 - » Ask students to capture their ideas about how they "see" their school yard (e.g., What things have they attended to as they have come to school each day, gone outside for recess, etc.? What things might be important to them?).
 - » For students who may need additional scaffolding, consider asking them to tell a story with a partner before drawing. Use the Socio-Ecological Histories of Place Framework as a guide to consider what students are drawing.
 - For example, are they noticing and representing human-built structures, particular species of plants or animals, other people who are important to them? Do they focus on a particular place around the school (such as the playground, garden, or a pathway to/from school)? Are they representing elements of the school yard as tied to one or more of the time scales? Students' drawings and/or writings suggest how they might be currently thinking about the area around the school as a place for learning, as well as elements of the area that are important to them.



Students and families all experience place in different ways. Sometimes this has to do with what someone looks like, how much money they have, or whether they have trouble walking, seeing, etc. You can point out that we all have different ways of experiencing places, and we notice different things about places based on how we experience them.

This is asking students to make predictions about what they'll see once they're outside. This is a literacy practice as well, and you can also connect this to books about what's in a schoolyard.

Pointing out evidence of human decision-making in places helps orient students to how to notice both human and more-than-human complexity in systems. We want students to understand that humans are deeply connected to, but not necessarily dominant in, socioecological systems.



Instructional Sequence Continued

Outside (25 minutes): supporting place-based observations

- 5. After students document their initial ideas, go outside and walk around the school yard to make observations about who and what is in the place. Students can bring paper and pencil to record their observations, or record them when they come back to class. If you are wondering about where to take students for a walk, think about planning a walking path that provides rich opportunities for students to notice and wonder about who and what shares their school yard.
- 6. Below are some possible prompts, or "backpocket questions", that you might have in mind as you and your students walk outside.

Power and Historicity:

The outside walk is a place where anti-Blackness can arise in how students' behavior is policed outside. Pay attention to encouraging and supporting students' sense making first. The outdoor learning framework is helpful in giving you tips for anti-racist support of students' learning outdoors.

	Species & Behaviors	Relationships	Lands & Waters
Observations	What do you see, hear, smell, or feel outside today? You noticed lots of holes in the ground. Who do you think might have made those? Prompt students to use all their senses and to look up, down, and around.	You found flowers! Who else besides humans do you think would like to find flowers and why? Prompt students to consider web-like rela- tionships about species or kinds they find.	Why do you think you noticed flowers growing in this place? Do you see water or evi- dence of water? Where?
Connections	Do you notice the same animals or plants here as in your neighborhood? Does this remind you of a place that you go to often? What are the similarities and differences?	Why do you think some animals are easy to ob- serve by humans and oth- ers are harder to observe by humans?	Does the land and/or water here look the same or different than the land and/or water in your neighborhood?
Purpose	Why do you think it's important to learn about who we share this place with?	What role do you think XX plays in this place? What are they doing? Why is what they are doing im- portant?	How did this place come to be this way? Why do you think it's important for us to learn about this place and who we might share it with?





Instructional Sequence Continued

Back in the classroom (10 minutes): connecting to outdoor learning

- 7. Once you and students are back in the classroom, have students draw a new picture from their walk or revise their original drawing. As they draw, you can ask them questions like, "did anything surprise you as you walked? did you notice anything outside that is similar to what you find around your house?"
- 8. Have students either share with each other or in a wholeclass format what they noticed as they were walking. Students can then make sense of what they noticed as a whole group and why it might be important to learn more about who they share their schoolyard with. You might consider using the purpose prompts above to scaffold student discussion and thinking during whole group conversation.

Concluding the lesson: preparing for the next lesson

- 9. Ask students: who do we share our schoolyard place with? What is a "place"? Why is it important to notice who is in the places where we spend time?
- 10. Return to the Histories of Places graphic organizer and ask students if they have anything they would like to add to that based on their observations today. What evidence of any of these timescales did they see on their walk today? What are they wondering about now in terms of any of these timescales?
- 11. Explain to students that they'll next be talking with their families about places that are important to them, and what timescales they know or wonder about.

Bringing students back indoors is a transition. Allowing time for this transition and re-engagement with classroom learning should be scaffolded. Use the Outdoor Learning Framework to intentionally plan how you will support students' transition from one place of learning to another.

Assessment Opportunity:

This is an opportunity for you to see students' sensemaking around their outdoor observations.

This discussion question is really important for beginning to get students thinking about ethical decisions around places. Investigating human decisions around places is one step towards this ethical consideration.

Assessment Opportunity:

This is an opportunity to hear how students apply the Histories of Places timescales to their observations today







As students complete their post-walk pictures, some questions you can ask are:

- Did you notice anything that surprised you?
- Did you notice anything that is similar to what you see around your house?
- What changed between your first and second drawing?







LE1.4 Learning Across Places Family Tool

Purpose

REFUSING SCHOOL DOMINANCE IN PLACE-BASED KNOWLEDGE

This family tool is meant to give students and their families an opportunity to share their knowledge about places that are important to them, as well as their wonderings about different timescales from the Histories of Places framework. This is meant to complement the work that you have done with your class in LEs 1.1 through 1.3, as well as to give you and the class an opportunity to include family and community knowledge in your class's wonderings about place.

Engaging family and community knowledge and practices



This is your opportunity to elicit family and community knowledges about place. As a teacher, it is impossible to have complete knowledge of all of your students' backgrounds and histories as they pertain to place. This family tool is a chance for you to put students and their families in positions of experts to teach you about what they know. LE1.4 will be an opportunity to merge classroom and family-based wonderings about place into one chart so that you can hold those as you move forward in the storyline.

LEARNING GOALS

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

- Describe places and practices that are important to them
- 2. Share and discuss family stories about those places
- Discuss and describe their knowledge and wonderings around the seven timescales in the Histories of Places Framework

CONNECTIONS TO NGSS

- » Crosscutting Concepts: Scale; Systems and System Models
- » Science Practices: Asking questions and defining problems
- » **Disciplinary Core Ideas:** ESS3.C: Human Impacts on Earth Systems (K-2)

ASSESSMENT OPPORTUNITIES

» Family tool LE1.4

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Teacher background/preparation information

You have already done so much preparation for this part of the bundle: you have familiarized yourself with the Histories of Places Framework and taken the self-assessment, you have done research into the histories of the place occupied by your school and its surrounding land, and you have explored the places around the school with your students. This is an opportunity for you to hear from the families in your classroom what they already know about places and histories. They may be able to fill in some knowledge about the various timescales that were missing after your discussion with your class in LE1.1. They may have firsthand experience with places around the world and understand how your local places are connected globally. They may be Indigenous families and have firsthand knowledge around the ways in which nation-states have forced change with relationships to the land. This family tool is a powerful way to understand the knowledge that is held in the families in your classroom.

Centering equitable practices:

- Engaging equitable relations with families: Sometimes schools hold deep deficit views of families, such as assuming that families won't fill this out because they don't care, cannot understand complex timescales or complex systems because either they don't have enough scientific background knowledge or their first languages are not English. Avoid falling into these assumptions. All families engage in sophisticated reasoning about places, have culturally-based practices that they engage in, and have historical knowledge about the world. Allowing opportunities for all families to share these with you is a big step towards building trusting relations with them. It is important to provide translations of all family tools, as well as adequate time for families to return them.
- Broaden at-home work beyond "homework": Homework can be a toxic term to families. In schools, homework has been shown to increase inequities and not lead to substantial learning. Try to frame these as "family learning activities" with no right/wrong answers to lower the stakes and make these more accessible tools for families to fill out. It is helpful to write a target return date on the top of the front sheet.
- All family tools contain valued knowledge!: Families will have different relationships with the school, with "homework", and with sharing personal information with you. Even if you don't have many that are returned this time, you can still learn valuable knowledge about families. You can also ask students to share what they discussed with their families even if they didn't return LE1.3 back to you.

MATERIALS

» Family tool LE1.4

TIME

Allow at least 5 days for this to be returned to you. You can hand this out after you've done LE1.1 or after 1.2.

Introducing the tool to your students

- 1. Explain to students that now that they have explored the Histories of Places and who they share the schoolyard with, it's time to do this at home with their families. Explain that they will take LE1.4 home and have a discussion about places that are important to them, and also the timescales that they know and wonder about.
- 2. Return to the Histories of Places chart that you've started to fill out as a class and remind students that while they already know and wonder about many of the timescales, there are some that we can learn more about. Our families may be able to help with that, or add to some of the timescales that we already know something about!
- 3. Emphasize to students that there are no right or wrong answers to any of the questions in here. It is really just for them to have family discussions and so that we can add to our classroom chart what their families already know!



Learning in Places Lesson Plan

LE1.5: Synthesizing Histories of Places and wrapping up the bundle

Purpose

SYNTHESIZING HISTORIES OF PLACES KNOWLEDGE ACROSS HOME AND SCHOOL

This lesson will help you synthesize the noticings and wonderings around place and histories of places from both your classroom lessons and from the family tool LE1.3. This synthesis work is important so that you can see **patterns** in students' thinking, such as:

- What relationships do students and families notice?
- What features of places make them significant to students and families?
- · What do students and families do in these places?

This lesson has 2 parts:

- 1. The first is your own reflection on what you see in the Histories of Places chart from LE1.1, students' drawings and wonderings from LE1.3, and the family tools in LE1.2 and 1.4.
- 2. The second part is to have a discussion with students about the LE1.5 classroom tool from this lesson. Engaging students in the synthesis work from part 1 will help you plan for this discussion.

Engaging family and community knowledge and practices

This lesson is an opportunity to put classroom observations and wonderings alongside family knowledges and practices around place. This sends an important signal to students that their family knowledge is valued and an important part of science learning.

LEARNING GOALS

By the end of this activity, students will:

- Describe places and practices that are important to them in terms of various timescales from the Histories of Places
- 2. Imagine more-than-human uses of places
- 3. Describe human decisions that have occurred in places

CONNECTIONS TO NGSS

- » Crosscutting Concepts: Scale; Systems and System Models
- » **Science Practices:** Asking questions and defining problems
- » Disciplinary Core Ideas: ESS3.C: Human Impacts on Earth Systems (K-2)

ASSESSMENT OPPORTUNITIES

- 1. Filled out Histories of Places chart from LE1.1
- 2. Family tool in LE1.2 Histories of places walk
- 3. Student tool from LE1.3

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4. Family tool LE1.4



Teacher Background/Preparation Information

Throughout this bundle, you have engaged students and families in noticings and wonderings about place and the various timescales within the Histories of Places framework. It is important to take some time now to think about all of the noticings and wonderings that have been shared both in the classroom and from families in order to establish a firm foundation in reasoning across timescales for the rest of the storyline.

To prepare for this lesson

Gather all of the tools from LEs1.1-1.4 and reflect on what has been shared so far using the chart below. This chart does two things. First, it helps you keep track of what students and families share about the places that are important to them and why they are important. Second, you see the diversity of family practices in the places where they learn. For example, after you've synthesized information from students and families, you can share this with students to see if there is anything they would add (e.g., a new place they might add to the list, more information about why a place is important to their family, more information about what they do in a place). This will also give you ideas about **building partnerships with community-based organizations** that families name as important to them. These organizations contribute to students' relationships with places, give you perspective on histories of communities with which your students identify, or even offer learning activities to enhance your investigations. Finally, you can also **map (using Google Maps, for example) the places that are important to families** and communities. Over time, this map could include the places where you are conducting your classroom investigations so that students can see that the places you investigate are also places that are important to them.

Places that are important to students and families	Why the places are important to students and families	Practices that students and families use the places for or do in the places	What time scales are students and families attending to?	What questions are they posing about those time scales?	How do you see power and historicity reflected in the family and student tools?





Now that you have completed this table, reflect on patterns you see in student and family thinking.

- 1. What are the *relationships* students see?
- 2. What features of places make them significant to students and families?
- 3. What do students and families do in these places?
- 4. How are power and historicity showing up in family tools, classroom discussions, and student tools?

Centering equitable practices:

- **Include family wonderings in with students' wonderings from class:** Sometimes when family tools from LE1.3 are slower to come in, it may seem more difficult to include them when you're synthesizing information from class. Avoid this by sending home reminders to fill out the family tools and intentionally asking students to share what they discussed in their families even if they did not return the family tools so that students can see that their families' ideas are truly valued and made a part of the classroom data.
- Broaden what counts as sensemaking: Remember that sometimes families' and students' sensemaking will
 not sound like scientists' sensemaking. This is one way that non-dominant students' and families' experiences
 get discounted in science. Remember that sophisticated reasoning can be found in drawings, descriptions of
 places, and in seemingly simple phrases and words.
- **Encourage more-than-human perspective taking:** Descriptions of ecosystems are often framed in terms of how ecosystems are useful for humans. In order to engage in ethical deliberation about places, however, we need to support students in taking the perspective of more-than-humans in natural systems. How is this decision good for the trees? How is this place good for the worms? for the soil? Beginning to ask these questions will encourage students to take on broader perspectives when engaging in ethical deliberation and decision-making around ecosystems.
- **Encourage human connections to ecosystems:** It is common for science learning to position humans as disconnected or apart-from nature. This activity encourages thinking about connections between humans and the rest of the natural world and starting from assumptions of complex interdependence.





MATERIALS

- » Histories of Places chart from LE1.1
- » Student drawings from LE1.3
- » Family tools from LE 1.2 and LE1.4
- » Synthesis chart for LE1.5

Instructional Sequence

 Remind students that they have now engaged in many explorations of place and histories of places. Point out all of the knowledge they shared in the Histories of Places chart, remind them of the exploration of places around the schoolyard, and the discussions that they had with their families about places that are important to them.

TIME

30 minutes

- 2. Explain to students that they are going to be putting all of that together today before we move on to exploring another aspect of places.
- 3. Show the chart below. Ask students: What places were important to us and our families and why?
 - Ask students to share what they discussed with their families and record their answers. Ask students what they do in those places, what they're wondering about in those places. You can ask students to share one connection they made to the Histories of Places chart and record that on the class charts from LE1.1 and their Histories of Places family walk in LE1.2
 - NOTE: you can ask students to also draw or write their answers to these questions individually and then share with the class or add to the class chart.
- 4. Ask students to specifically think about who they share places with. If they have a hard time coming up with more-than-humans, ask specifically: Do we share these places with the water? soil? other animals besides humans? plants? Do you think those were there before humans got there?
- 5. Ask students: why do you think it's important for us to understand and wonder about places that are important to us? Why is it important to think about and wonder about the different histories in those places? What does that help us do?



Nature-Culture Relations: Avoiding a human-dominant or human-apart-from view of ecological systems

Taking perspectives of morethan-human others is an important step in engaging in ethical deliberation around socioecological systems





Places that are important to students and families	Why the places are important to students and families	Practices that students and families use the places for or do in the places	What time scales are students and families attending to?	What questions are they posing about those time scales?	How do you see power and historicity reflected in the family and student tools?

6. Explain to students that as they continue with their explorations of places, they're going to be constantly going back and forth between explorations they do in school and explorations that they do with their families at home.



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Purpose

CONNECTING TO EVERYDAY AND FAMILY PRACTICES AROUND SEASONS

In this lesson, you will begin exploring what it means to be in a particular season. Seasonal changes are powerful ways to connect to nature-culture relations, since human activity is closely tied to seasonal changes in life cycles of plants and animals and seasonal weather patterns (temperature, daylight hours, rainfall). In this lesson, you and students will begin exploring the idea of seasons, and in LE 1.7, you and students will collect evidence of seasons.

Why this is important

Reasoning about seasons is an important way students can begin to connect their own activities with seasonal cycles. Scientists also study and make sense of ecological places in terms of seasonal patterns, and studying changes in seasonal patterns is one important way that scientists understand the effects of climate change on global systems.

Engaging family and community knowledge and practices

In this lesson, it is important to connect to students' prior knowledge, experiences and family practices around seasons. For families and communities and cultures more broadly, seasonal changes provide touch points. Every family has stories that map onto the change of seasons, and many people's understandings of nature come, in part, from these stories. When these unique perceptions of nature show up in the classroom, students can engage in more culturally relevant science learning. Families may come from places, speak languages, or identify with cultures that have very different ways of describing seasons and seasonal changes. Make sure you invite these ways of knowing and doing, and create an open space to think broadly about how students and families connect with seasons.

LEARNING GOALS

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

- 1. Describe what they do in different seasons
- 2. Have discussions with their families about what they do in different seasons and why those things are important to their family
- 3. Describe decisions they make in different seasons and why

CONNECTIONS TO NGSS

- » Crosscutting Concepts: Cause and Effect; Scale; Systems and System Models, Stability and Change
- » Science Practices: Asking questions, Obtaining, Evaluating, and Communicating Information
- » Disciplinary Core Ideas: ESS3.C: Human Impacts on Earth Systems (K-2)

ASSESSMENT OPPORTUNITIES

- » Whole-class discussions
- » Family LE1.6 Family tool

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Teacher background information

The word "season" can be defined in several ways, from "a time of year marked by changes on earth" (fall, winter, spring, summer) to "a part of the year where we play a certain sport" (soccer season) to "oiling a surface for cooking" (seasoning the cast iron pan). Some of these different meanings may come up in your discussions with your students, and it's important to explore all of these meanings and then explain that this set of lessons will investigate what we do and how we experience the changes on earth across the year.

As you begin this bundle focused on seasons and phenology, you might want to explore the **Phenology Framework** and the National Phenology Network's resources on phenology and its importance in understanding nature-culture relations. As the National Phenology Network (https://www.usanpn.org/) writes: "Phenology is nature's calendar—when cherry trees bloom, when a robin builds its nest and when leaves turn color in the fall. Phenology is a key component of life on earth. Many birds time their nesting so that eggs hatch when insects are available to feed nestlings. Likewise, insect emergence is often synchronized with leaf out in host plants. For people, earlier flowering means earlier allergies. Farmers and gardeners need to know the schedule of plant and insect development to decide when to apply fertilizers and pesticides and when to plant to avoid frosts. Phenology influences the abundance and distribution of organisms, ecosystem services, food webs, and global cycles of water and carbon. In turn, phenology may be altered by changes in temperature and precipitation.

Changes in phenological events like flowering and animal migration are among the most sensitive biological responses to climate change. Across the world, many spring events are occurring earlier—and fall events are happening later—than they did in the past. However, not all species are changing at the same rate or direction, leading to mismatches. How plants and animals respond can help us predict whether their populations will grow or shrink – making phenology a "leading indicator" of climate change impacts.

Centering equitable practices:

- Broaden what counts as science and science knowledge, who
 does science, and where science is done: Do not teach science from narrow conceptions of who does science, what counts as science, or where science is done. This lesson gives you an opportunity to open up the thinking space in science to include students' prior knowledge, family-based knowledge, and expertise as they begin to engage in seasonal investigations.
- Encourage more-than-human perspective taking. Do not frame ecosystems as solely useful for humans: In order to engage in ethical deliberation and decision-making about places students need to be supported in taking the perspective of more-than-humans in natural systems. For example, you can ask questions like, "what do the birds do during this season and why?" "what are the trees in our schoolyard doing during this season and why?" "how are flowers getting ready for this season and why?" Beginning to ask these questions will encourage students to take on broader perspectives when engaging in ethical deliberation and decision-making around ecosystems.
- Encourage human connections to ecosystems: Do not position humans as disconnected or apart from nature. This lesson encourages thinking about connections between humans and the rest of the natural world in terms of the natural rhythms of the seasons.

To prepare for this lesson

Read through the family tool LE1.6 and think about your own family's practices around the season. Why is this season important to you? What types of activities, practices, traditions, etc. do you and your family do during this season? What feelings do you have in this season and why? What words do you associate with this season and why? What do you do to prepare for this season? What decisions do you make in this season? How do you even know what season it is? What evidence do you use to figure that out?

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MATERIALS

» LE1.6 family tool

TIME 45 min



Instructional Sequence

- 1. Begin the lesson by asking students: what did we learn about place in few lessons? You can remind them about Histories of Places, our family connections to places, what we observed as we walked around the schoolyard, etc.
- 2. Explain to students that we are beginning a set of lessons that will explore the seasons--what they mean to us and our families, and how we know what season it is from walking outside. Explain that seasons are important parts of places, and we first want to explore what we think seasons are.
- 3. Ask students: when I say the word "season", what do you think of?
- 4. Ask students: what season are we in right now? How do you know?
- 5. Ask students: what do you do in your families during this season? What choices or decisions do you make during this season?
- 6. Ask students: what do you think the birds are doing during this season? What are the trees doing? What are worms doing?
- 7. Show LE1.6 on the doc cam and explain to students that they will be having these same discussions with their families using this tool.
- 8. Allow a few days for the family tools to return. As they come in, you can motivate more students to bring them in by sharing what was returned and saying, "look at all of the amazing things you do around the seasons in your families! I'm sure each of you has a lot of things that you could share. Who would like to volunteer to turn in their family tool next?"



Accept a broad set of answers here. Remember that families experience seasons differently depending on a variety of factors, including culture, language, and geography.

Decision-making will be a key theme throughout the storyline as we engage with "should-we" questions. Starting the practice of thinking about decisions now will set the class up nicely for talking about "Should-We" questions later.

Family tools are a key tool in sharing power with families and students in your learning space. When school knowledge is shared on the same level as family knowledge, students start to see that their expertise, cultures, and families are important in the school learning space.



Explaining **why** we do the things we do in the seasons will start to get at various aspects of seasonal change (temperature change, change in plants/animal life cycles) that we'll explore in the next lesson

son important to your family?

As you go over the tool,

make decisions based on

emphasize that we all

the season, and these

decisions will become

important later on in our investigations! Why is this season important to your family? What season is it in the place ve live? or 2 things that your family does in this season. In the space below, write down Why do you do these What do you do that is Why are these things What decision do we special in this season? things in this season? important to your family? usually need to make in this season 1. Think about another place that is important to your family. What season is it right now in that place? In what ways is that place different than where you are now? 2. Look at family pictures of places that are important to your family. What season was it in the different pictures you tool? How do you know? Jook for pictures of different places online, in magazines, or in books. What season is it in the different pictures you 3. find? How do you know? Learning in Flaces (NSF) Learning in Places is funded by NSF grant #1720578. Not for distribution.

Remember that your families may come from all over the world, or have family members in places all over the world





Purpose

MAKING OBSERVATIONS ABOUT THE SEASONS

In this lesson, you will begin exploring how we know it is a particular season. Seasonal changes can be subtle, like new leaves being brighter green in color, or very obvious, such as flowers blooming. In this lesson, students will begin to make observations in places around the school in order to eventually make evidence-backed claims about what season we are in. While this might seem like a simple question to explore (what season are we in?), you will find that the types of evidence that your students collect for the season will lead to rich discussions about seasonal changes.

Why this is important

Making observations in outdoor places is a key practice in the Seasonal Storyline for Field-Based Science Education. It is important that students start to understand their observations as important data for making claims. Also, scientists study and make sense of ecological places in terms of seasonal patterns, and studying changes in seasonal patterns is one important way that scientists understand the effects of climate change on global systems.

Engaging family and community knowledge and practices

In this lesson, it is important to connect to students' prior knowledge, experiences and family practices around seasons and the places that are important to them. You can ask questions like "are you noticing anything that reminds you of what you see around your home?" You can also connect observations with what you heard about seasonal family practices in LE1.6. For example, you can ask, "why do you think some families in our class harvest food during this season? What are you observing that helps you answer that question?" Make sure you invite many ways of knowing and doing, and create an open space to make broad connections to student and family knowledge about seasons as you walk outside.

LEARNING GOALS

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

- Make observations outdoors and articulate what they notice.
- 2. Connect their observations and claims about what seasons we're in.

CONNECTIONS TO NGSS

- » Crosscutting Concepts:
 Patterns; Cause and Effect;
 Scale; Systems and System
 Models, Stability and Change
- » Science Practices: Asking questions
- » Disciplinary Core Ideas: ESS3.C: Human Impacts on Earth Systems (K-2)

ASSESSMENT OPPORTUNITIES

- » Whole-class discussions
- » Family LE1.7 student tool
- » Small group discussions

1

Teacher background information

Continue to explore the National Phenology Network's resources on phenology and its importance in understanding nature-culture relations (https://www.usanpn.org/) to understand the types of observations you might expect students to make during the walk.

Centering equitable practices:

- Broaden what counts as science and science knowledge, who does science, and where science is done: Avoid teaching science from very narrow conceptions of what counts as science, who does science, and where science is done. This lesson gives you an opportunity to open up the thinking space in science to include students' prior knowledge, family-based knowledge, and expertise as they begin to engage in seasonal investigations.
- Provide equitable access to outdoor learning experiences. Avoid policing children's minds and bodies while outside. Black and Brown children are often overly disciplined for their behavior, both outside and inside. It is natural to be nervous about students' behavior while outdoors. This might come from concerns about safety while outside, but it often results in policing of children of color more often and more harshly than white children. Students will be excited to be outside. They will speak in louder voices than they normally would in the classroom. They will spread out but will come back together as they share their ideas. Allow them both emotional and physical space to do this.
 - **Encourage more-than-human perspective taking:** Avoid describing ecosystems only in terms of how ecosystems are useful for humans. In order to engage in ethical deliberation about places, we need to support students in taking the perspective of more-than-humans in natural systems. For example, you can ask questions like, "what do you notice the birds doing during this season?" "what do you notice the trees in our schoolyard doing during this season?" "Who is interacting with the flowers during this season?" Beginning to ask these questions will encourage students to take on broader perspectives when engaging in ethical deliberation and decision-making around ecosystems.
 - **Encourage human connections to ecosystems:** Avoid positioning humans as disconnected or apart-from nature. This activity encourages thinking about connections between humans and the rest of the natural world in terms of the natural rhythms of the seasons.

To prepare for this lesson

- Make sure that you have done some place designing to know where you'll take students on their walk, what you'll draw their attention to, and what questions you'll ask. For more information about how to do place designing and why it is important, consult the Place & Place Designing: Mapping Opportunities to Learn Framework.
- Make sure that, as you prepare for this lesson, you think carefully about how much time to allocate to the lesson launch, outdoor walk, and the lesson closing. It is important that students have time to reflect on their outdoor observations after you get back inside the classroom.





MATERIALS

» LE1.7 student tool

TIME 1hour



Instructional Sequence

Lesson Launch

- Remind students: "in our last lesson, we talked about seasons and what we 1. do during the seasons." Invite students to share what they talked about in their families about what their families do in the season and what decisions they make during this season.
- 2. Remind students: last time, we said we were in [fill in the season that was shared in LE1.6]. We said we knew because [fill in what was shared in the discussion in LE1.6].
- 3. Explain to students that today, we are going to be going outside to make some observations about the season. We are going to try to gather some evidence for the current season based on what we see outside.
 - Explain to students: you already have some evidence of the current a. season based one what you're doing in your homes. That's evidence that it's a certain season. We are going to collect a different kind of evidence, based on what's going on outside.
- 4. Show student tool LE1.7 on the doc cam to explain what students will record on their sheets. Explain that they will first predict what season it is, and then go outside and record their observations and wonderings on the sheet.
- Hand out the sheet and allow students some time to write their names and 5. the season on the first page.

Outside (25 minutes): supporting place-based observations

- 6. While you're outside, some questions you can ask to support seasonal sensemaking and nature-culture relations:
 - "what do you notice the birds doing during this season? Why do you a. think they might be doing these things?"
 - b. "what do you notice the trees in our schoolyard doing during this season? Why do you think they might be doing these things?"
 - "how are flowers getting ready for this season?" C.
 - "Who is interacting with the flowers during this season? Why do you d. think that interaction is important?"
 - Do you notice anything here that is also around your house? e. Or something that is really different from what is happening at your house?

Take the opportunity to both ask about different parts of the system as well as encourage students to sense make from morethan-human perspectives.

Continued next page...

coming back to family practices as valid sources of evidence and knowledge.

Make sure that you're always

Even if you don't have all of the family tools back from

LE1.6, you can still ask

these questions.

Back in the classroom: connecting to outdoor learning

- 7. Once you're back in the classroom, have small groups of students share with each other what their observations told them about what season we're in.
- 8. Explain to students: Because we were working by ourselves and/or in pairs, let's take turns sharing with everyone in the class what each of us, or pairs of us, observed outside that helped convince us of what season it is. We are going to track our sharing using this chart. We are also going to track any parts of our observations (called "variables") that come from our observations that we could track over time (throughout this season and maybe throughout different seasons too). These variables could help us ask investigation questions that we can start to explore.

Accept a broad set of answers here. Remember that families experience seasons differently depending on a variety of factors, including culture, language, and geography.

What did we observe? [can be used as evidence] ["Phenomena"]	What does the observation tell us about the season and why? [claim and rea- soning]	Predict: How might our observation be different in an- other season?	Parts of this that we might study ["Variables"]
Maya and Aden observed fuzzy buds on the tree	It might be spring because trees have buds on them in the spring.	There would be no buds on the tree in winter	Changes in buds on trees over time (e.g., numbers of buds on trees, what buds on trees look like)

 Ask students to share either their individual observations or their group thoughts and keep track of ideas on the following chart, using the questions in the columns to guide your discussion.

Decision-making will be a key theme throughout the storyline as we engage with "should-we" questions. Starting the practice of thinking about decisions now will set the class up nicely for talking about "Should We" questions later.

- 10. After the class is done sharing, conclude the lesson by explaining that students will be doing this same walk and reflection activity with their families. Hand out the LE1.7 family tool and explain to students this is the exact same tool that they just finished doing, but it's important to also gather observations from around their homes and neighborhoods with their families so that we can get a complete dataset from our class of both what's around the school and also what's around our neighborhoods.
- 11. Give some time for the family tools to be returned. When you start to get them back, proceed to LE1.8 to synthesize ideas about seasons and wrap up LE 1 Bundle 1.B.



Encourage students to make observations with all of these senses. Your place designing will be important in leading students to places outdoors where there are rich observations to be made. These wonderings are very important to both get students in the habit of asking questions but also for you to notice what students are wondering about. Finding pattterns or themes across wonderings will be important as you proceed in the storyline.

My observations using my senses	This makes me wonder about
In each box, write or draw what you hear , what you touch , what you smell , and what you see .	Now draw or write any questions or wonderings about what you heard, touched, smelled, and saw in this place.
\bigcirc	
hearing	
touch	
A	
smell	
©	
sight	
LOOK Dack at the season you think it is in t it is this season?	his place (page 1). What observations did you make that convince you that
Learning in Places	w NSE grant #1720578. Not for distribution without attribution

LE 1.7 What Season are We In: Observations Student Tool

This lesson gives students opportunities to engage in a few important science and engineering practices: understanding that their observations can be used as evidence for claims, and also looking for seasonal change in many forms.







LE1.8: What does our class mean by season?

Purpose

SYNTHESIZING WHAT WE'VE LEARNED ABOUT SEASONS ACROSS HOME AND SCHOOL

Throughout this bundle, you have been exploring with your students and their families what season means to them, as well as what observations and evidence they can gather about the seasons around the school and neighborhoods. This lesson will give you a chance to synthesize all that you have learned from both family knowledge and from field-based observations into one place.

Why this is important

Seasons are a complex concept that we all experience in different ways, and for which there is diverse evidence when we engage in field-based observations. It is important to take some time to synthesize all of the information gathered across LEs1.6-1.7 to find patterns in the seasonal sensemaking across home and school. This will set you up to go on wondering walks in LE 3.

Engaging family and community knowledge and practices

This lesson gives you an opportunity to put family knowledges alongside classroom knowledge. This allows students to see that their family practices are important and just as valid as classroom-based knowledge.

LEARNING GOALS

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

- 1. Explain that we all experience the seasons in many similar and different ways.
- 2. Explain why seasons are important to us and to our families, as well as to other plants, animals, and other people.
- 3. Explain how we can learn more about seasons by observing changes to our places over time.

CONNECTIONS TO NGSS

- » Crosscutting Concepts:
 Patterns, Cause and Effect;
 Scale; Systems and System
 Models, Stability and Change
- » Science Practices: Asking questions,
 Obtaining, Evaluating, and
 Communicating Information
- » Disciplinary Core Ideas: ESS3.C: Human Impacts on Earth Systems (K-2)

- ASSESSMENT OPPORTUNITIES
- » Whole-class discussions

1

» Filled out Seasonal learning chart

Teacher background information

Throughout this bundle, you have been exploring the concept of "seasons" with your class and their families. You have explored (even if you haven't named) **phenology**, or the cyclical changes of the earth through the seasons. So far, you haven't defined the term "seasons" in any definitive way, because the activities in this bundle were meant to get students and families thinking about their own connections to seasons and finding evidence for the current season.

Centering equitable practices:

- **Broaden what counts as sensemaking:** Do not assume that children and family sense-making will sound like scientist sensemaking. That does not mean that their sense-making is not sophisticated and important to consider. Making this problematic assumption is one way that non-dominant students' and families' experiences get discounted in science. Remember that sophisticated reasoning can be found in drawings, descriptions of places, and in seemingly simple phrases and words
- **Encourage more-than-human perspective taking:** Avoid describing ecosystems are often framed only in terms of how ecosystems are useful for humans. In order to engage in ethical deliberation about places, we need to support students in taking the perspective of more-than-humans in natural systems. For example, you can ask questions like, "what do you notice the birds doing during this season?" "what do you notice the trees in our schoolyard doing during this season?" "how are flowers getting ready for this season?" "Who is interacting with the flowers during this season?" Beginning to ask these questions will encourage students to take on broader perspectives when engaging in ethical deliberation and decision-making around ecosystems.

Encourage human connections to ecosystems: Avoid positioning humans as disconnected or apart-from nature. This activity encourages thinking about connections between humans and the rest of the natural world in terms of the natural rhythms of the seasons.

To prepare for this lesson

- Regardless of how many family tools are returned, you can still have this synthesis discussion. You can ask students to recall the discussions they had in their families even if they didn't return the tools.
- Gather the family tools from LE1.6 and the student and family tools from LE1.7, as well as the charts from classroom discussions in LEs 1.6 and 1.7. Look across the family and student practices, observations, and wonderings and record the patterns or themes that you're noticing across the tools. Try to fill out the chart below as a way to prepare for the classroom discussion. This will allow you to fill in information that is not readily shared by students during the discussion.





MATERIALS

- » Chart paper
- » tools from LE1.6 and LE1.7

TIME 30 min



Instructional Sequence

Lesson Launch

- 1. Remind students:we have been studying the idea of seasons–both what they mean to our families and what observations we can make of the seasons as we walk around the schoolyard and our neighborhoods.
- 2. Explain to students:today we are going to share what you talked about and observed with your families. Emphasize that it's totally ok if they have not returned their family tools-they can still share what they know about what their families do in different seasons!
- 3. Begin by asking students what seasons are important to their families and why, and what they do in different seasons. As students share, emphasize all of the different ways that seasons are important to the families in the class. Ask students: what are some things that you're noticing are the same about how our families experience seasons, and what's different? Why do you think that is?
- 4. Ask students what they observed with their families about the seasons, or if they remember the observations they made around the school? As students share, emphasize that even though they might live close to the school, they may notice things in their neighborhoods that are different than what they notice around the school, since small changes in the land can affect how the plants grow and what the animals do. Ask students: are there observations that were shared here that are similar to what you observed around your neighborhood? Are there observations that are different? Why do you think that might be?
- 5. Finally, ask what questions they have now about the seasons-accept a wide variety of questions and wonderings here. As you move into LE2, you will continue to collect wonderings and questions, and these will help guide your subsequent work in forming "Should We" questions.



Emphasize that there are broad and diverse ways that we experience seasons, and that this can be because of where our families are from, the languages we speak, etc.

Students can start to understand even now that the physical geography of their neighborhoods (hills, sidewalks, etc) and the histories of a place can have an affect on how plants and animals grow and interact.

What seasons are im- portant to us and why?	What do we DO during different seasons? What decisions do we make in this season?	What evidence do we have of the season? (What observations did we make as a class or with our families?)	Questions we have about the seasons and about how the seasons impact the places we care about







LE2.1 Preparing for Outdoor Learning

Purpose

Outdoor learning is experientially and pedagogically different than indoor classroom learning. Especially if you use the same spaces outdoors that students also use for recess, it will be important to allow time to prepare for a different way to interact with those spaces. This lesson will give you and students an opportunity to think about their own and others' needs outdoors, and also to think about how to respectfully interact with outdoor spaces. This begins with the understanding that outdoor spaces are not just for humans' enjoyment and use; they are also homes for more-than-humans such as birds, worms, the soil, and trees. Taking on the perspective of these outdoor neighbors is an important type of complex socio-ecological reasoning, and will be important for students to consider as part of the decisions they make everyday while outdoors.

Why this is important

Many times, students might engage with the outdoors purely from their own points of view--their own needs and wants for play, exercise, space, or even food in gardens. In this lesson, students will be asked to take the perspectives of others who they share outdoors spaces with in order to understand that their own actions outdoors have consequences for these more-than-human others. Because of this, humans are closely connected to, but not dominant over, outdoor spaces.

Engaging family and community knowledge and practices

This lesson asks students to specifically reflect on their own family's needs in terms of food, air, shelter, and water, as a way of connecting to those same needs of their outdoor neighbors. Be broad in the ideas that are included in this discussion: students and their families may have very different needs from each other and from you. This will be a good way of thinking about the diverse needs of outdoor neighbors as well. Just as families all over the world have different needs for survival and thriving, so too do plants, animals, the soil, etc.

LEARNING GOALS

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

- 1. Describe their and their families' own needs in terms of food, air, water and shelter
- 2. Describe, from the perspective of outdoor neighbors (plants, animals, etc.) what their needs are in terms of food, air, water, and shelter
- 3. Imagine more-than-human uses of places

CONNECTIONS TO NGSS

- » Crosscutting Concepts: Cause and Effect
- » Science Practices: Asking questions; Obtaining, evaluating, and communicating information
- » Disciplinary Core Ideas: ESS3A: Natural resources (K-2)
 - ESS3.C: Human Impacts on Earth Systems (K-2)

ASSESSMENT OPPORTUNITIES

» Whole-class discussions

1

» LE2.1 Student tool

Teacher background information

The Ethical Deliberation and Socio-Ecological Decision-Making framework and the Relationships framework will be useful here as a way to get you started in thinking about how perspective-taking and reasoning from more-than-human points of view are important for ethical deliberation and decision-making. When we can imagine the needs of others besides ourselves (especially more-than-human others), we start to understand the connection between our own decisions and consequences for others that we share outdoor places with.

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Centering equitable practices:

- Encourage more-than-human perspective taking:
 Avoid describing ecosystems only in terms of how
 ecosystems are useful for humans. In order to engage
 in ethical deliberation and decision-making about
 places, we need to support students in taking the
 perspective of more-than-humans in natural systems.
 How is this decision good for the trees? How is this
 place good for the worms? for the soil? Beginning to
 ask these questions will encourage students to take
 on broader perspectives when engaging in ethical
 deliberation and decision-making around ecosystems.
- Encourage human connections to ecosystems: Avoid positioning humans as disconnected or apart from nature. This activity encourages thinking about connections between humans and the rest of the natural world and starting from assumptions of complex interdependence instead of human-centric or dominance.

To prepare for this lesson

Fill out the tool yourself in terms of your own family's and outdoor neighbors' needs for food, air, water, and shelter. This will help you both model and anticipate some of the ideas that students will bring to the discussion. You will need to do some **place mapping** to understand some of the outdoor neighbors that you share your schoolyard space with, and do some research on what their needs are. For example, what do cedar trees need to survive in terms of food, air, water, and shelter? How do humans affect the food, air, water, and shelter of the bees that we share our outdoor places with? These kinds of questions will support your students in taking the perspectives of specific morethan-humans outdoors. The Place & Place **Designing: Mapping Opportunities to** Learn framework will be a helpful resource as you plan your outdoor instruction.



MATERIALS

» LE2.1 student tool

TIME





Instructional Sequence

- 1. Ask students: remember when we went on a walk around your schoolyard to see who we shared that place with? What did we find? Who do we share our places with?
- 2. Explain to students that today, they are going to be thinking about what those outdoor neighbors need to survive. Ask: why is it important to consider what they need to survive?
- 3. Ask students to think about one plant or animal that they share the outdoors with. Ask: what does that plant or animal need for food? for water? for air? for shelter? As students share their ideas, fill out a chart that mirrors the LE2.1 tool:

What do animals or plants need to live a healthy life?

What are their needs for food ?	What are their needs for air ?	
What are their needs for water ?	What are their needs for shelter ?	
How do they use soil for a healthy life?		

- 4. Ask students: now think about your families. What do your families need in a terms of food, air, water, or shelter? How is soil important to your life? Give students a chance to individually write or draw some ideas about each of these. Share out as a class: what were your ideas about what your families need in terms of food, air, water, or shelter?
- 5. Compare and contrast your two charts, the one for "plants and animals" and the one for "our families". Ask students: what do you notice is **the same or** similar between the two charts? What do plants and animals need and what do our families need? What is different between the charts? What do you think that means in terms of how we're connected to plants & animals outside?
- 6. Now move on to the final chart: preparing for outside. Explain to students that in the next lesson, they will be taking a walk outside to see what they notice as they walk. Ask students: why do you think we thought about what our families, plants, and animals need to survive as we prepare to go outside? Can you think of ways that we can respect plants and animals' needs while we are outside? What do you think we'll observe about their needs when we go outside? Let's think about that together as we think about how to respect their food, air, water, and shelter. What is an example of respecting plants' and animals' food?

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• Go through the chart, filling in students' ideas.



This kind of perspectivetaking is important for students to consider ethical relationships between humans and more-than-humans in ecological systems.

Putting family knowledge alongside classroom knowledge is a way to share power in the classroom.

Seeing similarities between the needs of their families and the needs of morethan-humans is a way for students to see themselves as a part of socioecological systems.

This discussion is asking students to think about the decisions they can make when they're outside in terms of more-than-human others who live outdoors.



Continued next page...
7. Explain to students: tomorrow we'll be going on a walk outside to see what we notice outside. Ask students: what do you usually do in the schoolyard outside? *Students will probably say "play, run, go to recess."* Ask students: if we're going to go outside to learn, how is that different from going outside to play? You can use a t-chart like the one below to compare and contrast going outside to play vs learn.

What do we do outside when...

We are playing?	We are noticing and wondering?

Students will need practice learning how to learn outdoors, especially in settings where they usually play.

Hopefully students will say "have fun" in both places. You can ask guiding questions like, "what do you think about when you play? What do you think you'll think about when you're going outside to notice and wonder? What do you look at when you play? What do you look at when you're making observations? Is there a difference between how you look at those things?" Why or why not? You can also ask students which of the things they list (in either column) are **also** respecting plants' and animals' food, water, shelter, and air.

8. Tell students that you'll be keeping this list visible in the classroom so that each time they go outside, they are reminded of what they should be thinking about and looking at as they go outside to learn.







Purpose

During this activity students will take a "Wondering Walk" to generate observations about phenomena of interest to them and to generate "I wonder" questions that can fuel their "Should-We" questions and investigations during the seasonal storyline. Students can draw or take pictures of their observed phenomena in the field. Students will also have an opportunity to generate wonderings that they will continue to explore during future learning engagements with increasing specificity and to drive sense-making. As you collect these wonderings in LEs 2 and 3, you will begin to see themes that will lead to "Should We" questions, more focused walks, and modeling in LEs 4 and 5.

Why this is important

When outdoors, students have opportunities to experience and make direct observations of natural phenomena, such as changes in weather over time, life cycles of plants and animals, and shifts in hours of daylight. Deep learning happens when learners' observations, wonderings, and questions are centered. Keeping these wonderings and questions at the forefront of classroom activity creates space for ethical, equitable and effective science learning. Research has shown that when learner questions are central to science activities, those questions can drive sense making and guide the formation of field-based investigations. Additionally, learner questions can offer insight into how they understand scientific concepts, and importantly, how they are making connections to personal experiences and/or family and community knowledges and practices. Making these connections visible is critical in the design of effective and equitable science learning environments. In order to support this, educators can model and scaffold how to ask questions that lead to ethical deliberations and decision-making about socio-ecological systems.

Engaging family and community knowledge and practices

As you launch this lesson, you can discuss that students will take "Wondering Walks" as a way to ask questions about the places that matter to them and their families. You can review the practices and places that are important to the classroom community (including families), and continue to raise questions that students and families have after finishing LE1. A goal of the wondering walks in this learning engagement is to generate a series of student-developed questions directly related to their outdoor observations of phenomena that are intriguing to them. At the end of this lesson, you will send home a family Wondering Walk so that students and families can continue noticings and wonderings in their own neighborhoods.

LEARNING GOALS

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

- 1. Describe what they observe in places around the school
- 2. Describe wonderings in terms of various timescales
- **CONNECTIONS TO NGSS**
- » Crosscutting Concepts: Patterns; Cause and Effect; Scale; Systems and System Models, Stability and Change
- » Science Practices: Asking questions; Obtaining, evaluating, and communicating information
- » **Disciplinary Core Ideas:** ESS3A: Natural Resources (K-2)
- ESS3.C: Human Impacts on Earth
- Systems (K-2)

ASSESSMENT OPPORTUNITIES

- » Whole-class discussions
- » Noticing student talk during wondering walk
- » Student discussions in partners around their wonderings

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- » LE2.2 Student tool
- » LE2.3 Family tool

Teacher background information

Wondering is central to sophisticated scientific field-based observation and questioning. Observations generate curiosity, wonderings, and questions that open up opportunities for learners to engage in speculative thinking about possible relationships, drawing their attention to the unknown. Wondering helps learners consider a broader range of human and more-than-human perspectives when making sense of the values underlying deliberation and decision-making processes. Who gets to wonder, and whether or not these wonderings are taken up in a learning environment, is deeply powered and historicized. Paying attention to wonderings and letting them guide classroom activities makes space for learners to not only be heard and centered in investigations, but also leads to ethical deliberations that are personally meaningful to learners' and their families and communities. A focus on wondering in field-based science contexts opens up space for learners to deliberate and ask questions about the roles and responsibilities of humans within the natural world. Wondering is essential to ethical decision-making and considering what possible futures we imagine, what actions we should take, and what values guide those actions. In this way, and with facilitation, wonderings lead to questions that form the basis for a "Should We" question.

Centering equitable practices:

- Provide equitable access to outdoor learning experiences: It is natural to be nervous about students' behavior while outdoors. This might come from concerns about safety while outside, but it often results in policing of children of color more often and more harshly than white children. Students will be excited to be outside. They will speak in louder voices than they normally would in the classroom. They will spread out but will come back together as they share their ideas. Allow them both emotional and physical space to do this. Consult the Supporting Learning Outdoors Framework for strategies you can use to support students in their learning and sense-making.
- **Encourage more-than-human perspective taking:** Descriptions of ecosystems are often framed in terms of how ecosystems are useful for humans. In order to engage in ethical deliberation and decision-making about places, however, we need to support students in taking the perspective of more-than-humans in natural systems. As you go on your wondering walk, try to model wondering in your questions, such as "I wonder what is beneath this leaf litter?" Pick up some seeds off the ground and ask, "I wonder where these came from? I wonder who eats these?" Look closely at leaves and as, "I wonder why the leaves are curled up like this? I wonder why there are these holes in these leaves? I wonder who or what might be in relation to these leaves?" Beginning to ask these questions will encourage students to take on broader perspectives when engaging in ethical deliberation and decision-making around ecosystems
- **Encourage human connections to ecosystems**: It is common for science learning to position humans as disconnected or apartfrom nature. This activity encourages thinking about connections between humans and the rest of the natural world and starting from assumptions of complex interdependence.

To prepare for this lesson

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- » The Wonderings, "Should We", and Investigation questions framework will be helpful to you as you think about the different kinds of questions at play in the Seasonal Storyline for Field-Based Science Education.
- Make sure you do some place mapping to plan the best place to take your students on the wondering walk. The Place & Place Designing: Mapping Opportunities to Learn framework will be helpful to you as you plan your outdoor instruction.
- Because you want to make the » most of your time, make sure that you identify both a final destination and a good route to take to that destination. Plan what you will point out (make sure you look at different levels--on the ground, even below ground, at eye level, and above), look for signs of seasonal change, or evidence of plant and animal neighbors. Plan out ways that you will ask students to identify and debrief their wonderings with each other as they walk.

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- » LE2.2 student tool (students do in the classroom)
- **TIME** 60 min



» LE2.3 family tool (students and families do at home)

Instructional sequence

Lesson launch: In the classroom

- Remind students: we have done a lot of work to explore who we share our schoolyard and neighborhoods with, and we have asked a lot of questions that we are curious about from that work (point to the questions from LE1 that students and their families raised). We have also learned a lot about histories of places (refer back to the framework and the questions and noticings on it).
- 2. Discuss that today, we will take a "Wondering Walk" to keep thinking about these questions and ask new questions about the places that matter to us. Our goals of the wondering walks are to (1) notice things around the schoolyard that are interesting to us and (2) come up with questions or "wonderings" about things that we notice outside.
- 3. Hand out the Wondering Walk sheet to students.
 - a. On the first page, explain to students that they'll have two ways to record what they're noticing: they can draw and describe in words what they noticed. For every noticing, they should come up with a "wondering", or a question that they have about what they're noticing.
 - b. Students can start by trying to find a plant and an animal outside (they will have opportunities to observe other types of events, processes, humans, and more-than-humans in later wondering walks). Remember that an animal can be a squirrel, bird, insect, worm, another human, or something completely different! A plant can be grass, a flower, a bush, or even a huge tree!

Going outside: Taking a wondering walk:

4. Based on your place mapping, go on your wondering walk. Encourage students to observe at multiple spatial levels: below, at, and above eye level.



Encourage students to draw things in relationship with each other-so, not just a single leaf, but a leaf on a branch. Not just a tree, but what is on the ground next to and around the tree. This will help students start to notice and wonder about relationships in socio-ecological systems.

The outside walk is a place where anti-Blackness can arise in how students' behavior is policed outside. Pay attention to encouraging and supporting students' sense making first. The Supporting Learning Outdoors framework is helpful in giving you tips for anti-racist support of students' learning outdoors.





1. Some questions from LE1.3 that might be helpful to ask while students are walking and observing and generating wonderings:

	Species & Behaviors	Relationships	Lands & Water
Observations	What do you see, hear, smell, or feel outside today? You noticed lots of holes in the ground. Who do you think might have made those? Prompt students to use all their senses and to look up, down, and around.	You found flowers! Who else besides humans do you think would like to find flowers and why? Prompt students to consider web-like relationships about species or kinds they find.	Why do you think you noticed flowers growing in this place? Do you see water or evidence of water? Where?
Connections	Do you notice the same animals or plants here as in your neighborhood? Does this remind you of a place that you go to often? What are the similarities and differences?	Why do you think some animals are easy to observe by humans and others are harder to observe by humans?	Does the land and/or water here look the same or different than the land and/or water in your neighborhood?
Purpose	Why do you think it's important to learn about who we share this place with?	What role do you think plays in this place? What are they doing? Why is what they are doing important?	How did this place come to be this way? Why do you think it's important for us to learn about this place and who we might share it with?

Back in the classroom: sharing observations and wonderings

- 6. As students return to the classroom, have them partner up to share what they observed. Ask students to share their wonderings and observations with each other, circling the wonderings and noticings that were **similar** to what their partners wondered about, and underlining the wonderings and noticings that were **different** from their partner's.
 - a. The partner groups should decide which wonderings they want to share with the rest of the class.
 - b. Partners can either write them on sticky notes or just share in a whole-group discussion.
 - c. However you choose to facilitate this, make sure that you document and/or collect all student wonderings because you and students will use them in LE 3 to create a Wondering Wall.

Bringing students back indoors is a transition. Allowing time for this transition and reengagement with classroom learning should be scaffolded. Use the Supporting Learning Outdoors framework to intentionally plan how you will support students' transition from one place of learning to another.



- 7. As a whole group, record some wonderings on a list in front of the room. You will eventually want to be able to move these around and organize them under themes. It might be helpful to write them on sticky notes and post them on a large sheet of paper at the front of the room. You will add to this from the family walks and as you go on more walks later in LE 2.
 - a. As students share their wonderings, you can ask follow-up questions such as, "what relationships are you wondering about here? where did you notice that? what was around that? How do you think X will change in another season?" These questions will help students connect their wonderings to larger socio-ecological systems.
- 8. Hand out the LE2.2 family tool (Family Wondering Walk) and explain:
 - a. You'll have an opportunity to go on a wondering walk with your family! This is the same sheet we just filled out. Try to walk around your neighborhoods with your families and notice and wonder about places where you live.
 - b. Once you and your family have taken a wondering walk and filled out this sheet, bring them back to class! As we get these back, we will include your family wonderings with our class wonderings and keep building our wonderings list until we come up with some investigations that we want to do based on what we're wondering about.

Students should be encouraged to write down as many wonderings and noticings as they can!

Students should be encouraged to either draw or write their noticings during the walk.

The Season is:	
The weather during our walk: 🗘 🛆	
The temperature during our walk i :	
Find a Plant	
Draw or write what you notice that is interesting to	I noticed:
you.	
Do you notice any relationships that involve this	I wonder:
plant? (For example, relationships with other plants, with an animal with coil with an incost with water?)	
with an animal, with soil, with an insect, with water :)	
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Draw or write what you notice that is interesting to you in the space below.	I noticed:
Do you notice any relationships that involve this animal? (For example, relationships with other animals,	I wonder:
with a plant, with water?)	
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Are there other things you noticed on your walk that you observed and wondered about? Draw or write about those here:

Relationships are very important in these walks, as they form the basis for modeling and investigations. Make sure that students notice what is above, below, and around their plants and animals. Wonderings will be the basis for finding themes that lead to more focused wondering walks later in LE 2 and "Should We" questions in LE 4.

LE2.3: Introduction to five socio-ecological dimensions

Lesson Plan

Purpose

Learning in Places

During this activity, you will teach your students about "socio-ecological systems" and the "five socio-ecological dimensions" that students and families can use to learn more about and deepen their wonderings. Research has shown that the places in which people engage in learning about complex ecological phenomena shape sense-making and can support engagement with complex scientific phenomena in authentic and tangible ways. **Socio-ecological systems** refer to the **interactions between human (social) systems and ecological systems.** The underlying premise is that **humans are part of the natural world**, and all of our systems (e.g. social, political, institutional) are always in relationship with ecological systems. Complex socio-ecological systems are characterized by several spatial, temporal, perspectival, and organizational scales, and students must be supported in sense-making at different levels of scale.

Why this is important

Human communities have always made socioecological decisions, from choices about what to eat, to where to live, how to get around, to what homes to build with what materials, amongst many others. These choices are shaped by our values and cultural practices and fundamentally reflect what we call **construals of nature-culture relations**. That is, how do human communities construct their relations (everyday, institutional, legal, ethical, communal, etc.) with the natural world? Importantly these relational construals have evolved over time in different ways and are often significantly shaped by the technologies and uses of energy we make central to human life. Since the industrial revolution there has been global scale change to these relationships in many places in the world. These changes are also correlated with the development and proliferation of modern nation-states and the histories and dynamics that created them. This lesson will outline 5 ways you can engage your learners in complex socio-ecological systems thinking.

Engaging family and community knowledge and practices

Humans across the globe develop **culturally varied relationships with the natural world** that reflect our 1) values–what we hold to be right and ethical; 2) knowledges–what we hold to be true; and 3) being–how we live our lives. While natureculture divides proliferate in Western industrialized societies, they are not universal. In this lesson, the 5 socio-ecological dimensions provide a framework for studying and seeing our place in the natural world. Families will also take a wondering walk specifically focused the idea of **scale**, and how it relates to the places that are important to them.

LEARNING GOALS

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

- Describe what different "scales" are-of time, space, size, population, and perspective
- 2. Describe wonderings in terms of these various scales
- 3. Describe wonderings and noticings in terms of five socio-ecolgical dimensions

CONNECTIONS TO NGSS

- Crosscutting Concepts:
 Patterns; Cause and Effect; Scale;
 Systems and System Models,
 Stability and Change
- » Science Practices: Asking questions; Obtaining, evaluating, and communicating information
- » Disciplinary Core Ideas: ESS3A: Natural Resources (K-2) ESS3.C: Human Impacts on Earth
- Systems (K-2)

ASSESSMENT OPPORTUNITIES

- » Whole-class discussions
- » Socioecological dimension classroom chart filled out
- » Noticing student talk during focused walks
- » Student discussions in partners around their wonderings

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- » LE2.3 Student tool
- » LE2.3 Family tool



bugs. Kinds are the abiotic beings such as rocks, water, soil, etc. Behaviors are the many different ways species and kinds interact with the environment.

Relationships: Relationships are the ways in which beings interact with each other. For example, how does the behavior of water change with the weather? Which plants do you typically see caterpillar munching on?

> Places, Lands, and Waters: This includes looking at the landscape and noticing where the water is, where the land dips and rises, where the people, animals and plants tend to gather.

Species, Kinds, and Behaviors: This includes different species of plants, animals and

Thinking across scales: This includes thinking through different time and space scales, as well as observing using different perspectives (taking the perspective of a plant, or an animal, or a rock, for example). Thinking across scales is particularly helpful when thinking about life cycles, energy cycles, water cycles, etc.

> Human Decision- Making: Humans have had, and will continue to have, important relationships that shape places. Be sure to think about Indigenous Peoples' Time, Recent History, and the Future when listening to student wonderings. Also, listen to how students position humans in relation to the natural world. Do they position humans as part of the natural world or apart from (i.e., separate from) and/or dominant over the natural world? Help support students' sense-making using position of humans as part of the natural world.

One entry point into a discussion about these dimensions is asking students to **notice** and **wonder** about the various elements in each of the pictures for each dimension. For example, for the "relationships" picture, you can ask, "What relationships do you notice in this picture? Who is the bird in relationship with, why, and how? Who is the tree in relationship with, how, and why? Who is the caterpillar in relationship with, how, and why?" You can also find other pictures and/or use examples from the Wondering Walk you took in LE 2.2.

Teacher background information

Below is a description of the five socio-ecological systems that students and families use in this lesson. The corresponding graphics are ways for you to help your students and families make sense of and explain each dimension.









Centering equitable practices:

- Provide opportunities for students to reason across scales. Avoid keeping sensemaking along just one temporal, spatial, or size scale: Complex socio-ecological systems are made up of multiple sub-systems operating across temporal, spatial/ geographic, size, perspectival, and population scales. It is very important for students to understand how decision-making within socio-ecological systems can have effects on multiple scales at once.
- Encourage more-than-human perspective taking. Avoid describing ecosystems only in terms of how they are useful for humans: In order to engage in ethical deliberation and decision-making about places, support students in taking the perspective of morethan-humans in natural systems.
- Encourage human connections to ecosystems.
 Avoid positioning humans as disconnected or apart-from nature: This activity encourages thinking about human decision-making as integral to systems and as key connections between humans and the rest of the natural world. The challenge is to not position humans as dominant to more-than-humans in systems. This is why more-than-human perspective taking and thinking across scales is so important. As we consider more-than-human needs on the same level as humans needs, we start to see complex interdependence within socio-ecological systems.

To prepare for this lesson

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It will be very important for you to do some background research and place mapping on your own to understand the ways in which each of the five socioecological dimensions shows up around your school. The LE2.3 slides on the 5 socio-ecological dimensions will also be helpful in your planning. On the following page are some examples of questions you can ask and answer as you do this research and place mapping.



Socio-Ecological dimension	Background research questions	Place mapping questions
Species, Kinds, Behaviors (SKB)	 » What species, kinds, and behaviors exist around our school? » Who used to be here? Who is here now? » Make sure to include humans 	 What SKB can I observe around my school? What is a good time of day to explore/observe SKB around the school? What kinds of behaviors can we realistically expect to see? When?
Relationships	 What relationships occur between the species and kinds around the school? Why might those relationships be important? Who benefits from the relationships, how, and why? When in the year do these relationships become visible (if at all)? What are human relationships to these species and kinds? 	 » What relationships can we observe around the school? What relationships exist at different scales(for example, a tiny spider web on a leaf vs. trees in relation with each other in a forest)? » What nature-human relations can we observe around our school?
Places, Lands, Waters (PLW)	 What is the topography of the land around the school? What did it used to look like? How is it different now? What waters does the land around the school interact with? What are significant water-land relationships in the area? How is human activity or human decision-making affected by the lands & waters in the area? 	 Walk around your school and see how the land dips and rises. Notice what happens to the water when it rainswhere it puddles, where it drains. Walk around your school and notice if there are different kinds of soil and plants in different parts of the school and where the land is higher vs. lower.
Human decision-making	 » How is human activity or human decision-making affected by the lands & waters in the area? » What decisions were made about the land to build the school? What did the land around the school look like before the school was built? 	 Walk around the school grounds and notice what evidence of human decision-making you can collect. What kinds of decisions were made? What kinds of decisions are still being made? What decisions do you (and students) make every day around the school? Where and what are they?
Thinking across scales	 Temporal scales: What are Histories of Places around your school (temporal scales)? Also thinking shorter and longer temporal scales: how do places change from morning to night? from hour to hour? from minute to minute? Size scales What are examples of different scales of size that you can think of? How do these show up in your own life? How does your perspective on something change as you look at it under a microscope, then gradually look at the entire object, and then the object in its natural environment? Spatial and perspectives change when you learn about what is above, below, and under focal objects? Population scales What are examples of different population scales that you can think of? What is the difference between studying 1 tree vs. a group of trees, or 1 bird vs. a group of birds vs. a population of birds that inhabit a large region? 	 Temporal scales: Connect to Histories of Places framework and see what evidence you can collect of the different timescales. Think about how the school grounds change over the school year, across one season, across a day/week/month? Size scales What are different scales of size to notice outside, from a grain of sand to the whole beach, from a small tree to a towering cedar? Spatial and perspectival scales Go outside and notice the different spatial scales at which you can observe. How do you understand a place differently when you only look at eye level vs. when you look above your heads, at your feet, and even dig beneath the ground? Population scales How will you support your students in observing and wondering about aggregate groups of kinds (groups of plants vs. just 1)? What species and kinds are in your area where you can ask population-level questions?



MATERIALS

- » LE2.3 family tool (Taking a focused walk together: Thinking across scales)
- » LE2.3 Five socioecological dimensions graphic organizer
- » LE2.3 Socioecological dimensions packet
- » LE2.3 slides (slides 11 & 12) to analyze for scale
- » Laminated pages of the book Zoom, by Istvan Banyai (Picture Puffin Books, paperback published July 1, 1998).

Instructional Sequence

- Ask students to share some of their wonderings or noticings from either their classroom wondering walks (LE2.2 student tool) or their family wondering walks (LE2.2 Family tool). As they share their wonderings, have the blank socio-ecological dimensions chart visible and record students' wonderings and noticings in the appropriate rows.
- 2. Point out to students that you are filling in their ideas into this chart that has different pictures for each row. Show the images, one by one, of the 5 socio-ecological dimensions from the LE2.3 Socioecological dimensions packet. As you go through each one, ask students to notice and wonder about each picture. Ask questions like, "what is going on in this picture? What do you notice? Who is interacting with whom? What is this picture trying to communicate?"
 - a. As they share their ideas, add students' noticing and wonderings to the graphic organizer.
 - b. After you have gone through each of them, ask students to come up with a definition or way to describe each of the dimensions based on their noticings and wonderings. Ask them, "based on all of the things we're noticing and wondering about Species, Kinds, and Behaviors, how would you describe this row? What does this mean to you?
- 3. Explain to students that they have been noticing and wondering about places around the school, and places around their neighborhoods where they live. Explain to them: This chart allows us a way to organize our thinking and try to also expand our thinking in different directions. When scientists study places, they actually study many of these aspects of places all at once. For example, maybe there are a lot of wonderings about "species, kinds, and behaviors", but not a lot about "thinking across scales". This chart allows us to see what areas of thinking we might still need to explore by going on a few more wondering walks.



Analyzing pictures and other sources of information for scientific concepts (such as socioecological dimensions.)

TIME 40 min



- 4. Now focus on the dimension called "thinking across scales". Explain to students that this is often one of the hardest aspects of places for people to think about because it's hard to imagine things that are either too big or too small to see, or things that are too high up or too low to see, or how things that happened in the past are still happening now and will continue happening in the future. These are big ideas!
- 5. Ask students to brainstorm different kinds of "scales"-when we talk about "scales", we're really talking about different ways to describe time, size, groups of species, perspectives of species and kinds, or where we are in space. Make a chart like the one below and allow students to brainstorm each row. The chart below is partially filled out for you to see some possible student examples.
 - a. You can make up actions and movements for these scales too--you don't have to just use words!
 - b. You can also draw pictures to describe the different scales.
 - c. For the "time" row, remind students of the Histories of Places framework as a way to describe different time scales.

different "scales"	our pictures, actions, or words to describe scales	examples from our lives?
time scales	future a long time ago now	Indigenous Peoples Time Plant, Animal, and Soil Time
size scales	teeny tiny huge! gigantic!	dinosaurs ants fleas bacteria
groups of species population scales	single tree forest school of fish	my dog vs. a pack of wolves 1 flower that I picked vs. a bunch in the garden
where we are in space spatial scales scales	low high under over	
perspective/perspectival from whose point of view are we seeing things?		imagining being a worm when it rains

Thinking across scales is an essential part of reasoning and decision-making about socioecological systems.

Assessment Opportunity: Allow multiple ways for students to show their understanding of different scales.

Allow a broad range of answers here to invite students to think about how these ideas are present in their own lives.





6. Zoom book analysis

- a. There are several ways to do this activity: (1) You can keep it as a whole-group activity, but if you do this, it is best to do it under the doc cam to make viewing the details of the pictures easier. (2) You can separate out the pages and laminate them (optional). Then, keeping them in order, divide the pictures into 5 or 6 groups (depending on how many small groups you have). Each group of students should have a group of pictures that are all from the same part of the book. For example, group 1 gets pages 1-8, group 2 gets pages 9-16, etc. Once you have the pages separated, mix up the pages within each group so that the students receive their pages NOT in order (so group 1 gets pages 1-8, but they are mixed up so that they are not order; likewise, group 2 gets pages 9-16, but not in order). Have the small groups order them. Once the groups have their pages in order, discuss what order the groups should be in. (3) If you have a smaller class, give each student a picture and ask them to work together to put them in order.
 - i. As students analyze the pictures, ask, "what scales are going on in these pictures? How do you know when you're going from one scale to the next? What evidence do you have from the pictures?"
- b. Discuss: Why is this book called "Zoom"? What is "zooming"?
 - i. What does this book have to do with the idea of "scale"? Refer back to your chart from step 5 and to remind students of words and pictures that might help them.
 - ii. Show two pictures from the LE2.3 slides (slides 11 & 12): one of the birch tree and one of the ants. Ask: what scales are happening in these pictures?

Thinking across scales family walk

- 7. Explain to students that they are going to get to go on another wondering walk with their families, this time focusing on this idea of **scale**. They're going to walk around a place of their choosing (their yard, their city block, a larger section of their neighborhood, for example) and notice and wonder across scale. For example, imagining what life is like for a teeny tiny bug or a huge, gigantic tree, or noticing and wondering about a single ant and a mound of ants. It's up to them to decide what kind of scale they're going to notice and wonder about, and it will also depend on what is in their neighborhood!
- 8. Hand out the LE2.3 Family tool: Taking a walk together-focused on scales
- 9. Give families time to return the tools (about 5 days).
- 10. Once the tools are returned, these noticings and wonderings will be added to the Wondering Wall in LE3, along with noticings and wonderings from LE2.2 and from LE2.4.

Analyzing pictures for meaning and scientific concepts is integral to the NGSS crosscutting concept of Scale, Proportion, and Quantity.

Use the **Zoom** book and the scale pictures to assess students' understanding of "scale."



LE2.4: Taking a relationships wondering walk

Purpose

During this activity, you build on the last lesson where you learned about the 5 socio-ecological dimensions and focused on **scale** as one of those dimensions. In this lesson, you will go on an outdoor wondering walk to focus on another of the socioecological dimensions, **relationships**. Both **scale** and **relationships** take into account the other **species**, **kinds**, **and behaviors**, **human decision-making**, and **places**, **lands**, **and waters** because they direct students' attention to not only individual objects but how they are interacting with each other. Research has shown that the places in which people engage in learning about complex ecological phenomena shape sense-making and can support engagement with complex scientific phenomena in authentic and tangible ways.

Why this is important

Field-based science practices help to identify and explore socio-ecological relationships. Learners can observe plants, animals, other people, and kinds (such as water for example) in specific places, and focus their observations on understanding what relationships they can observe among who and what are in the environment. For example, perhaps a family might be out for a walk and they notice a sidewalk that is cracked and elevated, and then they notice a tree about six feet from the sidewalk. What relationship might there be between the tree and the sidewalk? Are there other kinds that are involved in that relationship but that can't be observed with one's eyes? How could that relationship be characterized and why? In another example, if a teacher and learners are observing fallen trees in a forest and see bite marks on the trees, and then they notice some water in the same area, what might they predict about the relationships in the area? Who and what is in relationship with who and what? How could they investigate their ideas and make further sense out of their observations?

Engaging family and community knowledge and practices

Relationships are not only between (or among) plants, animals, and other kinds, such as water, the sun, or soil. Humans are in relationships with these other kinds too. For understanding relationships in complex socio-ecological systems, it is important to begin with the premise that humans are part of the natural world (not separate from it). What roles do humans (including human artifacts) play in various socio-ecological relationships? How do human structures change the behavior of species and kinds in a system? How does human decision-making impact these relationships? How does a better understanding of the various relationships in specific places impact human deliberation and decision-making relative to those places? Why is it useful to take the perspectives of other kinds involved in relationships-in-place (as opposed to only exploring these relationships from human-centered lenses)?



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LEARNING GOALS

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

- 1. Describe the "relationships" dimension of the five socioecological dimensions
- 2. Describe wonderings in terms of relationships

CONNECTIONS TO NGSS

- Crosscutting Concepts: Patterns; Cause and Effect; Scale; Systems and System Models, Stability and Change
- » Science Practices: Asking questions; Obtaining, evaluating, and communicating information
- » Disciplinary Core Ideas: ESS3A: Natural Resources (K-2)
- ESS3.C: Human Impacts on
- Earth Systems (K-2)

ASSESSMENT OPPORTUNITIES

- » Whole-class discussions
- » Noticing student talk during focused walks
- » Student discussions in partners around their wonderings
- » LE2.4 Student tool

Centering equitable practices

- Provide opportunities for students to reason with relationships: Avoid noticing single objects or naming objects as you walk outdoors. When students reason with single objects or rush to just name objects, you foreclose opportunities for students to reason about interactions between species and kinds, or interactions between structure and function. When something is simply named, the wondering often stops and students rush to name the next object. Encourage wondering by modeling asking questions and wondering about what relationships might be in play. Guiding questions are in the instructional sequence below.
- **Encourage more-than-human perspective taking:** Avoid describing ecosystems only in terms of how they are useful for humans. In order to engage in ethical deliberation and decision-making about places, we need to support students in taking the perspective of more-than-humans in natural systems.
- Provide equitable access to outdoor learning experiences: It is natural to be nervous about students' behavior while outdoors. This might come from concerns about safety while outside, but it often results in policing of children of color more often and more harshly than white children. Students will be excited to be outside. They will speak in louder voices than they normally would in the classroom. They will spread out but will come back together as they share their ideas. Allow them both emotional and physical space to do this. Consult the Supporting Learning Outdoors Framework for strategies you can use to support students in their learning and sense-making.

To prepare for this lesson

It is very important that you do **place designing and place mapping** before students take their relationships walk. Make sure that you have identified some places around the school that will provide rich opportunities for students to observe different types of relationships. Refer to the **Place & Place Designing: Mapping Opportunities to Learn framework** for guidance on planning your outdoor instruction.

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Teacher background information

This lesson will focus specifically on relationships and ask students to collect evidence of relationships. The Relationships in Socio-Ecological Systems Framework will be very helpful because it provides some background on the different types of relationships in socio-ecological systems. Interdependent relationships undergird all aspects of socio-ecological systems, are dynamic and shift across time, space, and levels of organization. Research shows that sensemaking across these multiple shifting scales requires intentional scaffolding, particularly for young learners. NGSS practices such as observing, modeling, and data collection can support learners' attention to webs of relationships in and across places. This framework features two aspects of interdependent relationships in socio-ecological systems sensemaking: 1) quality of social and ecological relationships that expert scientists, policymakers, and communities think about; and 2) the base relationships of species and kinds that undergird interactions in a system. This framework is intended to develop learners' relational habits of mind - that is the routine sensemaking about interdependent relationships - and support educators, students, and their families to develop a language for attending to powered and historicized relationships at the intersections of social and ecological worlds.

MATERIALS

- » LE2.4 student tool (students do at school),
- » LE2.3 Five socio-ecological dimensions graphic organizer
- » LE2.3 Socioecological dimensions packet

Instructional Sequence

- 1. Have the LE2.3 Five socio-ecological dimensions graphic organizer showing and use it to remind students of the 5 dimensions of socio-ecological reasoning they defined in their last lesson.
- 2. Ask students to share their wonderings from their LE2.3 family tool (Taking a focused walk together: Thinking across scales). Even if not all of the students have returned this, give students a few minutes to share their wonderings and noticings from their family tools with each other and then share as a whole class. Add the noticings and wonderings to the graphic organizer from LE2.3. Many of these will fall under the "reasoning across scales" row, but some may fall under "relationships" or "species, kinds, and behaviors". Be intentional about putting these noticings in other rows and saying something like, "I appreciate how you were reasoning about scale AND relationships, so I'm putting that in the relationships row. Many of your wonderings can fit under more than one of these! They are connected!"
- 3. Explain to students that today, they are going to explore another of these rows, the **relationships** aspect of places as they go on an outdoor walk. Remind students of the definition of **relationships** that they came up with in the last lesson. Ask: what relationships do you think we'll see when we're outside today?
- 4. Show the **LE2.4 student tool** on the doc cam and explain to students that this is going to be like their family walk around **scales**, except this time, they are going to be noticing and wondering about relationships. Explain to students that they may see all kinds of relationships outdoors and that you are really interested in seeing how many different kinds of relationships they can notice and wonder about.



Giving students a chance to share their family knowledges and practices is an important part of signaling to students that the family tools will be an important part of classroom knowledge-building.

Continued next page...

TIME 60 min



Going outside

- 5. As students go outside, give them a question to wonder about as they walk with each other. This is a way to invite sensemaking immediately. For example, you might have them discuss the types of relationships they predict they are going to find and why they think that.
- 6. Even though this walk is focused on relationships, you might want to prompt students to think about some of the other socio-ecological dimensions if you think it will deepen their sense-making and discussions. Below are some examples of prompts you can use to engage and extend your learners' thinking.

Making predictions is an important scientific practice. It attunes students to the observations that they will make, and also helps them connect their prior knowledge to new observations.

Keeping these 5 dimensions visible and present in your teaching through questions will support students in thinking across the dimensions. Notice that the question prompts all have to do with relationships.

Species, Kinds & Behaviors (SKB	Relationships (REL)	Places, Lands, and Waters (PLW)	Thinking across scales (Time Space and Perspective	Human Decision-Making (HDM)
What species are learners noticing? What are they noticing about them? Are there different relationships they're noticing? Where did the bird land? Why? Where is that plant or tree growing? What is below and around it?	What kinds of relationships are students noticing? Who is in relationship with whom? What are the connections to place, time, and humans?	 Who is in relationship with the land and water here? Where are students doing most of their observations? Above, ground level, or below ground? How are humans in relationship with this land? What would this place be like in a different season? 	What are students saying about time - a long time ago, recently, or in the future? Are students thinking about how places, animals, and/or plants have changed over time?	What are students noticing about human impacts and decisions? Are they narrating them as helping, harming, or neutral relations? How do the decisions we make today impact the future of this place?





Back in the classroom: sharing observations and wonderings

- 7. As students return to the classroom, have them partner up to share what they observed, what relationships they noticed, and what they wondered about. Ask students to share their wonderings, observations about relationships with each other, circling the wonderings and noticings that were **similar** to what their partners wondered about, and underlining the wonderings and noticings that were **different** from their partner's.
 - a. The partner groups should decide which wonderings and relationship observations they want to share with the rest of the class.
 - b. Partners can either write them on sticky notes or just share in a whole-group discussion. These wonderings will be added to your wondering wall in LE3.

Relationships family walk

- 8. Explain to students that they are going to get to go on another wondering walk with their families, this time focusing on this idea of **relationships**. They're going to walk around their neighborhoods and notice and wonder about relationships. For example, they might notice that certain birds are in relationship with certain trees or with each other. They might notice that certain kinds of plants attract pollinators and others do not.
- 9. Hand out the LE2.4 Family walk-relationships handout.
- 10. Give families time to return their notes, pictures, wonderings, etc. from their relationships walk (about 5 days).
- 11. Once the tools are returned, these noticings and wonderings about relationships will be added to the Wondering Wall in LE3, along with noticings and wonderings from LE2.2, 2.3, and from LE2.4.



Assessment Opporunity: Listening to students discuss their wonderings is a good opportunity for you to understand what their understanding of "relationships" is.



LE3.1: Organizing wonderings on a Wondering Wall

Purpose

When you launch LE3 in your classroom, your students will have completed wondering walks both at school and at home. You will have LEs 2.2-2.4 as sources of wonderings and questions from both the classroom and families and now have quite a bit of "observation data" across many places. In this learning engagement, you and your students will organize observations into themes on a "**Wondering Wall**."

Why this is important

The Next Generation Science Standards highlight the importance of building classroom knowledge from student ideas and observations. This allows for a collaborative science classroom that both keeps students engaged and is reflective of authentic science practices. In addition to student ideas, you and students have also collected ideas from their families. Ultimately, through these diverse contributions, the Wondering Wall and organization of student and family ideas and wonderings in LE 3 will provide a foundation for further investigations throughout the storyline. Also, when scientists collect observations, they organize them into questions or themes that become the focus of their studies . You and your students and their families have been engaged in investigating the schoolyard and students' neighborhoods and have now collected enough wonderings that you will now use to find themes that will drive the generation of a "Should We" question, more focused Wondering Walks, and investigations.

Engaging family and community knowledge and practices

As you did in LE1.5 and LE1.8, this is an opportunity for you to put family noticings and wonderings alongside classroom noticings and wonderings. When you do this, two important things happen: (1) you have a richer dataset for considering themes for further investigation, and (2) you position students and their family knowledge at the center of classroom science learning, thus helping students see that their families' ways of knowing and doing can make important contributions to science.

LEARNING GOALS

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

- 1. Organize wonderings in terms of five socioecological dimensions
- 2. Notice phenomena in wonderings

CONNECTIONS TO NGSS

- Crosscutting Concepts:
 Patterns; Cause and Effect;
 Scale; Systems and System
 Models, Stability and Change
- » Science Practices:
 Asking questions; Engaging in Argument from Evidence;
 Obtaining, evaluating, and communicating information
- » Disciplinary Core Ideas: ESS3.C: Human Impacts on Earth Systems (K-2)

ASSESSMENT OPPORTUNITIES

- » Whole-class discussions
- » Student discussions in partners around their wonderings

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» Wondering wall

Teacher background information

This lesson is an important step in preparing you for the next phase of the storyline. Because the design of the storyline is dependent on you noticing and organizing student and family ideas in order to decide on the "Should We" questions, the direction of walks, and field-based investigations, there will be some preparation that you should do before this lesson to anticipate the types of themes that might emerge and to see the phenomena in students' and families' wonderings (see below).

Two important ideas to keep in mind for this lesson are **phenology** and **phenomena**. The **phenology framework** will give you guidance on phenology and how it intersects with the storyline (you can use ideas that you, students, and families explored in LE 1.B). **Phenomena** (plural) are observable events, behaviors, relations, or ideas that can be investigated. When we apply that idea to field-based science learning, phenomena are observable events, like trees budding, water flowing and pooling, leaves falling, bees on flowers, human allergies, concrete getting hot to the touch when it's in the sun, etc. Notice that all of these phenomena can be tied to the seasons (phenology) somehow, and we can use field-based investigations to study and explain them. We will be using the word "phenomena" (plural) or "phenomenon" (singular) throughout the rest of the storyline, depending on if we are describing multiple phenomena or one phenomenon.

Centering equitable practices:

Take a sensemaking stance to students' and families' noticings and wonderings: Avoid making the assumption that because student and family wonderings might not sound like wonderings scientists would have, they are automatically less sophisticated, silly, or wrong. Student and family wonderings will likely not look and sound like how a scientist or textbook would phrase a wondering and then state a related phenomena. This can be a reason why some teachers discount students' ideas as not being "scientific" or "sophisticated" enough. It is also one reason why certain students' voices-voices that are more consistent with white, middle class renderings of ideas-get elevated and many students' voices-those of ESOL, special education, or BIPOC (Black, Indigenous, People of Color) students do not. Learning to see the sensemaking in students' and families' ideas means assuming a sensemaking stance-in other words, assuming that students and families are always trying to reason about the world, and are expressing their ideas in ways that make sense to them.



To prepare for this lesson

Because this lesson requires you and your students to organize wonderings and noticings into the 5 socioecological dimensions and then into phenomena, you should do some organizing on your own first in order to plan how to do this with your students.

- 1. Gather the student and family tools from 2.2 wondering walks, 2.3 family walk around scale, and 2.4 student and family walks around relationships. Regardless of how many family tools have been returned to you at this point, include them into your planning.
- 2. Use the chart below to organize the wonderings under each socio-ecological dimension and by emerging phenomena.

Noticing/wondering	Socio-Ecological dimension pres- ent (species, kinds, behaviors; relationships; places, lands, waters; human decision making; scale)	Emerging phenomena
We notice spider eggs in the tree and wonder what kind of spider it is.	Species, Kinds, Behaviors (kind of spider) Relationships (spider in the tree)	Life cycles Role of trees in ecosystems (as shel- ter/habitats, food, etc.)

Organizing student and family wonderings in this way allows you to make some inferences about which dimensions are (or could be) in students' thinking as they share their wonderings and their families' wonderings. Remember that the goal is for you to build toward groupings of phenomena, so you can say things like "These wonderings all seem to be part of X phenomenon."



MATERIALS

- » LE2.2 student wondering walk
- » LE2.2 family wondering walk
- » LE2.3 Family wondering walk on scale
- » LE2.4 student wondering walk on relationships
- » LE2.4 family wondering walk on relationships
- » LE2.3 Five socioecological dimensions graphic organizer
- » LE2.3 Socioecological dimensions packet (1 per group)

Instructional Sequence

- 1. Have the LE2.3 Five socio-ecological dimensions graphic organizer visible and use it to remind students of the 5 dimensions of socio-ecological reasoning and how they defined each one.
- 2. Read some of the wonderings on the graphic organizer out loud. Point out that some of the wonderings could belong in more than one row, and that is ok--we are beginning to see that these are connected in some way.
- 3. Explain to students that today, they are going to take all of our wonderings and noticings and try to organize them somehow. Explain to students that when scientists start to gather a lot of questions and observations, they have to pause and see what they have collected in order to figure out what their next steps should be. This is the purpose of today's lesson!

Small group organizing of wonderings

- 4. Explain to students that this is going to be a 2-step process:
 - a. First, they will look at their tools from LEs2.2-2.4 (both classroom and family) and find the place where they filled out "I wonder". Have them write their wonderings on sticky notes--1 per sticky note. Remind students to put wonderings from **both** family and classroom walks.
 - b. Next, they will take their 5 socio-ecological dimensions packets and separate the pages.
 - c. They will then put their sticky notes on the page of the packet that matches the dimension that they think most fits their wondering. Explain that they'll have some wonderings that could go on more than one page. That's ok--but they should choose one page to put it on.
- 5. Allow students about 20 minutes to do this activity. As you walk around the room, some questions you can ask are:
 - a. did that wondering come from your family walk or from our classroom walk?
 - b. which page of your packet will you put that wondering on? why?
 - c. why do you think that wondering goes on more than one page?
 - d. now that you are revisiting these wonderings, do you have new wonderings?







Finding patterns is an integral way to organize thinking and to describe phenomena.

By giving students ownership over their ideas and their families' ideas, you are sharing power within the instructional space with students and families.

Asking students how they are categorizing their ideas will allow you an opportunity to see their understanding of the 5 socioecological dimensions.

Whole class discussion

- 6. Back as a whole class, have a piece of butcher paper for each of the 5 socioecological dimensions. Ask students, as a group, to place their wonderings on each of the corresponding dimensions.
 - a. You may want to begin to propose, or ask students to propose, more general wonderings under which several wonderings can be grouped. You can label each of those topics with a sticky note. For example, you may have this group of wonderings:
 - i. We wondered what the buds on the trees will turn into
 - ii. We noticed flowers blooming on the sidewalk
 - iii. We noticed buds on the trees and wondered when they would open
 - iv. You might group all of those wonderings under a "trees and flowers budding" phenomenon.
 - Individual students and/or small groups can affix their wonderings to the Wall, and share out what those wonderings are (they can read them aloud to the rest of the class). These wonderings should be from both class and family wondering walks.
 (See "Round 1" below)
- 7. Once students are done placing their wonderings on the appropriate dimensions, choose one socio-ecological dimension that has a larger concentration of wonderings. Say, "We're going to start with this one because it seems like, as a class, we and our families had a lot of wonderings about this." Read the wonderings aloud and ask students if they see any patterns in the wonderings. Ask students, "if you were to group this according to patterns that you see, how would you group them? For example, I see a group of wonderings that all have to do with [fill in a pattern you see]. So I'm going to move all of the stickies that I see in that pattern over to this group here [move the stickies on the page]." Ask students for their input until all of them are sorted. Start to group them by phenomena with students' input.

Asking students to describe patterns in terms of phenomena is an important scientific practice.



GROUP WONDERINGS:





8. As you group the sticky notes with students' input, ask them, "how should we name that group of wonderings? What do these wonderings all seem to be about? Or what do they seem to have in common?" As students name the group, label them with a different colored sticky note with the name that students come up with.

GROUP WONDERINGS BY PHENOMENA

Phenomenor Phenomenor nenomeno 2 Student Student Student Wondering Student Wondering Wondering Student Wondering Student Wondering Wonderina Student Student Wondering Wondering Student Student Wondering Wondering

- 9. Repeat steps 9 and 10 for at least one other socio-ecological dimension (do as many as your class has the stamina or time for). This is important because it will allow you and your students to see phenomena that are common across socio-ecological dimensions.
- 10. As a class, decide on 3-4 of these phenomena to focus on. Students will generate "Should We" questions about these 3-4 phenomena in LE4.

As students group their wonderings into phenomena, this is the beginning of engaging in the NGSS practice of Engaging in Argument from Evidence. They are using the wonderings as evidence to back up claims about how to group the wonderings.



(NSF)



LE4.1: What "Should We" Do?: Exploring Classroom and Family Decision-Making

Purpose

The goal of LE 4.1 is to **give students opportunities to explore and reflect on their family and classroom decisionmaking by analyzing decisions that they and their families make.** Students will document and analyze decisions they make in their classroom. Students and their families will analyze a big decision they have made to reflect on their decision-making processes, as well as to reflect on how their decisions are situated in place, and influenced by things like values and family knowledges and practices. These explorations of decision-making are important preparation for LE 4.2 where students will ask "Should We" questions related to the 3-4 themes and/or phenomena that they highlighted on their Wondering Wall (see LE 3.1).

Why this is important

Asking "what should we do," and deliberating in order to make a decision is something that people do all the time. Deliberations and decisions can be informed by personal experiences, values and beliefs, cultural norms, social networks, and evidence from a myriad of sources. Before students generate "Should We" questions related to the 3-4 themes and phenomena they identified when creating their Wondering Wall, it is important to support them in thinking about decisions and decision-making in their lives, including at home and in their classroom at school. Learning-related research is clear that people sense-make and reason about new concepts, ideas, and practices (like the concept of a "Should We" question), using what they already know, do, and have experienced. This is why you want to begin this learning engagement by asking students to explore, reflect on, and analyze their, and their families', decisions and decision-making processes. Then, students can reference the activities and discussions in this LE when they start to ask "Should We" questions related to complex socio-ecological systems and the nature-culture relations and power and historicity that are part of and shape those systems. Two Learning in Places frameworks will provide important information for you about "Should We" questions, deliberation, and decision-making: (a) the **Wonderings, "Should We," and Investigation Questions framework,** and the (b) **Ethical Deliberation and Socio-Ecological Decision-Making framework.**

Engaging family and community knowledge and practices

LE 4.1 provides another opportunity for you and students to learn from families, this time about a big family decision that they made and who and what were involved in making that decision. Learning from families about their decisions will ensure that you and students are considering different types of decisions, and not only classroom-based decisions and decision-making. Additionally, you will get to learn how families made their decisions. This will help students start to explore what "Should We" questions are in LE 4.2, and how they might deliberate and ultimately make decisions about them. As you have seen in previous learning engagements, incorporating family knowledges, ideas, wonderings, and practices ensures that you and students are able to engage in deeper sense-making because you have a richer dataset to consider. In addition, you position family knowledge as a critical component of classroom science learning, thus helping students see that their families' ways of knowing and doing make important contributions to science.



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LEARNING GOALS

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

 Analyze classroom and family decision-making along several dimensions (for example, purpose of any decision, how decisions are shaped by place, who is involved in any given decision, who benefits and who might not benefit from any given decision, options that are considered during decision-making and why, values that guide decisionmaking and how/why)

CONNECTIONS TO NGSS

- » Crosscutting Concepts: Cause and Effect
- » Science Practices: Asking questions; Analyzing and Interpreting Data; Obtaining, evaluating, and communicating information
- » Disciplinary Core Ideas: ESS3.C: Human Impacts on Earth Systems; ETS1.A: Defining and Delimiting an Engineering Problem

ASSESSMENT OPPORTUNITIES

- » LE4.1b What "Should We" do: Exploring daily decisions in our classroom
- » Student talk (questions they ask, wonderings they voice, ideas and reflections they voice) during small and wholegroup discussions about family and classroom decisions and decision-making

Teacher background information

In LE 4, students are introduced to "Should We" questions. The "Should We" questions that students generate in LE 4.2, and the "Should We" question they ultimately decide they most want to explore and investigate, will drive the rest of the Seasonal Storyline. Because "Should We" questions motivate ethical deliberation and decision-making, support students to start thinking about decisions they make frequently, and how they and their families go about making decisions that are consequential to them. Doing this work will help students better understand what "Should We" questions are. Remember that the goal of LE 4.1 is to support students in analyzing and reflecting on the decisions they make in their classroom, as well as the decisions they make with their families at home. This will help them understand some of the component parts of decisions, and the processes of decision-making.

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 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.



To prepare for this lesson

- 1. Read the **Wonderings**, "**Should We**," and Investigation Questions Framework, and the **Ethical Deliberation and Socio-Ecological Decision-Making Framework**. These will provide you with more background on "Should We" questions, deliberating about them, and ultimately making decisions about them. These frameworks will give you a sense of the types of practices and sense-making in which students will be engaged throughout the rest of the storyline, and why "Should We" questions are so important. Having that bigger picture in mind will help you frame and scaffold discussions, ask probing questions, and facilitate students' sense-making related to the classroom and family decisions and decision-making that they are analyzing during this learning engagement.
- 2. Complete both LE 4.1a and 4.1b (the family tool and student tool) before you ask families and students to use them. This will give you a good sense of student and family activity in this learning engagement. Based on the information asked for in each tool, and knowing the goal of this lesson, as well as the importance of "Should We" questions, ethical deliberation, and decision-making in the Seasonal Storyline, plan questions and discussion prompts and strategies that you want to use to facilitate rich discussions and support student learning related to their analysis of decisions and decision-making. Anticipate student and family questions and concerns and plan how you will address them. Consult the **Discussion, Reflection, and Deliberation Framework** to give you ideas for discussion and reflection strategies to use.
- 3. Send home LE4.1a What "Should We" do: Reflecting on a big family decision at the very beginning of this learning engagement so that families have enough time to decide on a family decision that they want to analyze, and then engage in that work. While families are selecting and responding to questions about their decision, you and students will be documenting some decisions you make in your classroom and analyzing those.



MATERIALS

- » LE4.1a What "Should We" do?: Reflecting on a big family decision
- » LE4.1b What "Should We" do?: Exploring daily decisions in our classroom (student tool)

TIME

1-2 school days to document classroom decisions and answer questions about them; 30 minutes to explore family decisions and decision-making; 20 minutes to synthesize what students learned about decisions and decision-making

Instructional Sequence

Ask families to select and analyze a big decision that they have had to make

 At the beginning of this learning engagement, send home LE 4.1a What "Should We" do?" Reflecting on a big family decision, and invite families to participate. This will give families time to select and analyze a decision, while you and students are documenting classroom decisions and analyzing those.

Documenting and answering questions about classroom decisions

- Use LE 4.1b What "Should We" do?: Exploring daily decisions in our classroom. Decide whether you want each student to document decisions that they notice and/or make during one or two school days, or if you want students to do this work in small groups. Alternatively, you could document these decisions and answer questions about them as a whole class.
- 2. Explain to students: "Before we return to our Wondering Wall and the themes and phenomena we have identified, we are going to talk about decisions and decision-making."
- 3. Ask students the following questions: Who can tell me what a decision is? What does it mean to make a decision? What decisions have you had to make recently? How did you do it? What kinds of decisions have you made in your family? What kinds of decisions do you make when you're outside?"
- 4. Explain to students: "Talking about making decisions may seem unrelated to our Wondering Wall, but it's not! We have some important questions to ask about our themes and phenomena on our Wall and in order to ask really powerful questions, we need to better understand decisions and how to make decisions."
- 5. Explain to students: "In order to do that, we are going to do two things. First, we are going to ask you and your families to choose a big decision that you have had to make as a family and answer questions about that decision. Second, we are going to write down decisions that we make in one or two days here at school, and we are going to answer questions about those decisions."
- 6. Explain to students: "For the rest of the day [or over the next few days], each time we make a decision in this classroom, we are going to stop, write down that decision, and answer questions about it." Go over the elements of the student tool with students so that they know where to write their decisions and so that they know what questions about those decisions they are answering.

Families' decisions and decision-making practices will provide students with important information and questions to ask as they pose "Should We" questions and start to explore those. Remember that the goal is for students to better understand complex decisions and decision-making processes. The goal is not to judge or evaluate family decisions and/or decision-making.

Assessment Opportunity: Use this student tool to get a sense of what decisions students are noticing and how they unpack those decisions. What questions do they have? What support might they need?

Assessment Opportunity: How do students already understand decisions and decision-making?



7. Explain to students: "These can be decisions we make as a class or they can be decisions you make during small group time or they can be decisions you make by yourself. I am sure you have questions so let's talk about them before we start noticing and writing down our decisions."

Discussing classroom decisions

- Now that you and students have recorded some daily classroom decisions, discuss what you recorded and reflected on. Your goal is to surface and highlight important elements of decision-making (using the questions you and students answered about the decisions you documented). You want students to use the following questions to talk about their classroom decisions:
 - a. Who was involved in making the decision? Who was not involved? Why?
 - b. Who or what was impacted by the decision and how?
 - c. Why was the decision necessary and/or important? What was the purpose of making it?
 - d. How did our classroom (or our school) shape the decision we made?

Students will use these same types of questions to discuss their families' analyses of their decisions. Students will continue to use these questions throughout the rest of the Seasonal Storyline so it is important that they discuss and use them in this learning engagement to think deeply about deliberation about decisions as part of decision-making.

2. Explain to students: "Now that we have written down some of our classroom decisions, let's talk about them. Let's try and better understand them." There are different ways you can facilitate this discussion. For example, you can ask several students to share some example decisions and specifically ask them to talk about those decisions by responding to the questions above. In addition to asking students to share, and to bridge this discussion with the next discussion about their families' decisions, you could tell them about a big decision that you have had to make. Then ask students to use the above questions to learn more about your decision. This will give them practice asking these types of questions relative to decisions and decision-making.

Assessment Opportunity: Student questions are a wonderful opportunity to get a better sense of their thinking.

Analyzing decisions from multiple perspectives and the impact of decisions on multiple parts of a system is important to understanding the interconnectedness of socioecological systems.

It is important for students to see their teachers engaging in the work that teachers are asking students and their families to engage in. By you sharing one of your big decisions and by inviting students to unpack that decision and your decisionmaking processes, you signal that everyone has to make decisions and engage in decision-making and that your decisions are also fair game for analysis. A caution here though. You are in a powered position in your classroom as a teacher and as an adult. Be mindful of that so that your decision or decision-making doesn't somehow get positioned as the "right way" to do things.



Discussing family decisions

- 1. At this point, families will have selected big decisions and answered questions about them. Families might have documented decisions and answered questions on the LE 4.1a What "Should We" do?: Reflecting on a big family decision activity sheet and some families might have done this work on blank sheets of paper. The format doesn't matter; their thinking about their decisions and decision-making does! Additionally, some families might not have written anything down, but they might have had discussions so make sure that you ask students to share the discussions they had as a family. You do not have to have all family tools returned for you and students to discuss family decisions and decision-making practices. Use the family tools that you have and again, ask students to share family discussions.
- 2. Explain to students: "Now that we have talked about our classroom decisions, let's talk about your families' decisions and use the same questions to explore them in more detail." Just like with your discussion of classroom decisions, there are many ways you could facilitate this discussion. You could have students present one of their family decisions for analysis (other students could ask the above questions and the student presenting could answer). You could have students get into small groups and they could present their family decisions to each other, and then ask each other the above questions. You could choose to have a few students present family decisions each day over the course of a week (or some other time scale). The point is that students should continue getting practice analyzing decisions using the dimensions present in the above questions. In addition to using those questions, add other questions into this discussion that were part of the family tool (LE 4.1a):
 - a. What data or evidence did you use to help you make your decision?
 - b. What values guided your decision?
 - c. What were the different options you considered when making your decision? How did you know it was the best decision to make?
 - d. How did the decision impact your future?
 - e. How does power and historicity shape this decision?



What "Should We" Do? **Exploring Daily Decisions in Our Classroom**

Name:	Date:				
Daily Decision Log					
What was the decision?	Why was the decision made? What was the goal or purpose?	Who or what was impacted by the decision?	Who was involved in making the decision?	How did our classroom (or our school) shape how we made the decision?	
			•		

Students will use these questions, or versions of them, throughout the rest of the Seasonal Storyline to support their ethical deliberation and decision-making. It is important to consistently ask them to unpack decisions they are making so they get practice using these questions.

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Family Name:

There are additional questions that families respond to that students can also use to support their ethical deliberation and decision-making throughout the storyline.

How did the need to make the decision come to be? What led up to it?	What values guided your decision?	How did the place you were or lived when you made this decision impact it?	How does the natural world impact this decision? How is the natural world impacted by this decision?	What options were considered? Why was this the best decision to make?	Who else was impacted by the decision and how?	How did the decision impact you in the future What did it change in your life?
What data and evidence is the	evidence was info e same. Making sure interviewing a comm	rming your thinkin to engage with multip unity member)	g? There are many d le forms of data and	ifferent ways to enga; evidence is important	ge with data and evid t (for example, collect	ence. Not all ting temperature

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LE4.2: Asking "Should We" Questions from Wonderings and Identifying Focal Phenomena

Purpose

In LE 4.1, students explored their and their families' decisions and decision-making processes. In LE 4.2, you will introduce students to the concept of a "**Should We**" **question**. Using the 3-4 phenomena you and students decided to focus on at the end of LE 3, you and students will now brainstorm "Should We" questions related to those phenomena, and evaluate those "Should We" questions in order to select one of them to use throughout the rest of the Seasonal Storyline. After they make that decision, students will identify at least two focal phenomena that are important for them to learn more about so they can better understand the various elements of their "Should We" question.

Why this is important

Asking "what should we do," and deliberating in order to make a decision is something that all people do all the time. As students learned in LE 4.1, deliberations and decisions can be informed by personal experience, values and beliefs, cultural norms, social networks, and evidence from a myriad of other sources. In field-based science, deliberating and then making decisions involves using knowledge, clarifying values and goals, and exploring potential impacts on humans and more-than-humans, at micro and macro scales, across multiple timescales, and from powered positions. Socio-ecological "Should We" questions (1) explore relationships between humans and the natural world, (2) explore multiple possibilities and how each possibility could impact families, communities, and the natural world, and (3) encourages human decision-making that is ethical and accountable to the natural and social world. "Should We" questions ask us to think about scales of time, including seasons, and processes of change. They ask us to take on others' perspectives and ask, "who would we help with our decision? Who might we harm?" "Should We" questions require deliberation and action even with uncertainty. "Should We" questions require that we think about power and historicity as part of our deliberations and decision making. Having students generate and then decide on a "Should We" question in this learning engagement will ensure that they can use the rest of the Seasonal Storyline to explore and investigate that question in a variety of ways in order to ultimately diblerate and make a decision about their question.

Engaging family and community knowledge and practices

You and students will generate "Should We" questions that relate to the 3-4 phenomena from your Wondering Wall that you identified at the end of LE 3.1. You and students used their and their families' wonderings to construct the Wondering Wall and to generate the 3-4 phenomena that students will use in this learning engagement. In addition, students will be drawing, in part, on their understandings of their and their families' decisions and decision-making when deciding which "Should We" question they want to focus on for the rest of the Seasonal Storyline. Students' learning so far in the Seasonal Storyline would not be possible without their families' knowledges and practices. As you have seen in previous learning engagements, incorporating these knowledges, ideas, wonderings, and practices ensures that you and students are able to engage in deeper sense-making because you have a richer dataset to consider. In addition, you position family knowledge as a critical component of classroom science learning, thus helping students see that their families' ways of knowing and doing make important contributions to science.



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LEARNING GOALS

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

- Explain what a "Should We" question is and generate socio-ecological "Should We" questions
- 2. Use their decision and decision-making analysis questions from LE 4.1 to decide on a class "Should We" question
- Identify at least two focal phenomena that are related to the class "Should We" question

CONNECTIONS TO NGSS

- Crosscutting Concepts: Patterns; Cause and Effect; Scale; Systems and System Models, Energy & Matter Structure and Function; Stability and Change (NOTE: several of these might apply depending on the "Should We" question and related focal phenomena that students select)
- » Science Practices: Asking questions; Analyzing and Interpreting Data; Obtaining, evaluating, and communicating information
- » Disciplinary Core Ideas:
- LS1: From molecules to organisms
- LS3: Heredity
- LS2: Ecosystems
- LS4: Biological Evolution
- ESS2: Earth's systems
- ESS3: Earth and Human Activity
- [NOTE: Applicable DCIs will depend
- on the "Should We" question, and
- related focal phenomena you and
- students choose.]

ASSESSMENT OPPORTUNITIES

- » LE4.2b Asking "Should We"
- questions (student tool)
- » LE4.2c Deciding on a "Should We" question and identifying focal phenomena
- » Student talk (questions they ask, ideas they voice) during classroom discussions and other activities related to LE 4.2a, 4.2b, and LE 4.2c

Centering equitable practices:

- Encourage student idea generation, questions, comments, and suggestions. Avoid a rush to judgment
 that any student's ideas, questions, comments, and/or suggestions about "Should We" questions and related
 phenomena 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 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.
- Give students enough time to think and explore their and their peers' ideas. Selecting a "Should We" question from students' and families' observations and wonderings is a pivotal moment in the storyline. Avoid rushing through these activities. Give students time to explore what a "Should We" question is and then time to generate "Should We" questions from their and their families' observations and wonderings captured on the Wondering Wall.



Teacher background information

In the Seasonal Storyline, a "Should We" question is the type of question that will motivate ethical deliberation, field-based investigations, and decision-making. "Should We" questions are anchored in students' and families' observations and wonderings in place. "Should We" questions are related to: (a) the relationships between humans and the natural world (like other species and kinds, as well as places, lands, and waters), and (b) how human decisions impact the natural world. "Should We" questions ask us to think about different scales (time, space, size, and perspective), and processes of change (and how long it takes to make change). "Should We" questions lend themselves to being explored through a seasonal lens. As mentioned earlier, "Should We" questions motivate some action, or at least deliberation around an action. They rarely, if ever, have a "right" or "wrong" answer, and they can impact families, communities, and the natural world in different ways. Here are some example "Should We" questions that are based on observations:

- 1. We observed a vacant lot in our neighborhood.
 - a. Should we plant more trees [or other types of plants] there?
- 2. We observed that there are a lot of insects in a community garden in our neighborhood.
 - a. Should we use an insecticide in the community garden to kill the insects?
- 3. We observed that water is running off into a certain area of our neighborhood after it rains, and then a lot of birds visit the standing water.
 - a. Should we call the city to ask that they fix the slope of the concrete so water won't pool in that spot after it rains?

As you can see from these examples, "Should We" questions do not lend themselves to easy and clear yes or no answers. "Should We" questions require exploration and investigation using a variety of scientific practices, tools, and sense-making. In addition, students' "Should We" questions should:

- » be able to be explored using the 5 socio-ecological dimensions
- » involve multiple socio-ecological timescales (see LE 1, Bundle A)
- » require students to think about how their decisions would help create different social structures and futures (see Power and Historicity framework)
- » be connected to their neighborhoods and/or school yard (i.e., it should be connected to local place)
- » be interesting and important to students and their families
- » lend itself to field-based data collection
- » have a connection to the seasons



To prepare for this lesson

- 1. If you haven't done so already, make sure you familiarize yourself with the rest of the Seasonal Storyline. Knowing how students and families will explore and investigate, as well deliberate and ultimately make decisions about their "Should We" question will help you guide students in their selection of a complex "Should We" question in this lesson.
 - a. In addition, remember that toward the end of the Seasonal Storyline, students will use versions of the questions from LE 4.1 to help them deliberate and make decisions about their "Should We" questions. It is important that students select a "Should We" question in this learning engagement that is robust enough to deliberate about using these questions. As a reminder, these questions are:
 - i. Who was involved in making the decision? Who was not involved? Why?
 - ii. Who or what was impacted by the decision and how?
 - iii. Why was the decision necessary and/or important? What was the purpose of making it?
 - iv. How did our classroom, our school, and our neighborhoods shape the decision we made?
 - v. What data or evidence did we use to help you make our decision?
 - vi. What values guided our decision?
 - vii. What were the different options we considered when making our decision? How did we know it was the best decision to make?
 - viii. How might the decision impact our futures?
 - b. Plan ahead of time how you will facilitate students' decision-making about which "Should We" question they want to use throughout the rest of the storyline. The decision should be a principled one that takes multiple factors into account (for example, student and family wonderings and interests, phenology, the 5 socio-ecological dimensions, and the above decision-making criteria and questions from LE 4.1).
- 2. Revisit the **Wonderings**, "Should We," and Investigation Questions framework so that you understand how wonderings, "Should We" questions, and investigation questions (which students will generate in LE 6) relate to one another. This framework will help you understand more about the importance of "Should We" questions in reasoning about socio-ecological systems. Additionally, revisit the **Ethical Deliberation and Socio-Ecological Decision-Making framework**. Students' will eventually deliberate and make decisions about their "Should We" question. Understanding those processes as discussed in the framework will provide additional guidance for you about the type of "Should We" question that will lead to field-based investigations and then robust deliberation in preparation for making a decision.
- 3. Use each of the tools before you ask students to use them. This will give you a good sense of student activity in this learning engagement. Based on the information asked for in each tool, plan questions, discussion prompts, and strategies that you want to use to facilitate rich discussions and support students in brainstorming "Should We" questions (related to phenomena they identified in LE 3.1), evaluating them, and ultimately choosing one to use during the rest of the Seasonal Storyline. Through your use of the tools, anticipate student questions and concerns and plan how you will address them.
- 4. Remember that phenology is central to the Storyline for Field-Based Science Learning: Don't forget about the seasons and the impacts that they have on the focal phenomena that students and families are observing and wondering about. Think about how you will support students in thinking about important elements of "Should We" questions, including important connections to seasons that students should consider. For example, asking students questions such as, "How would this be different in another season? Why do you think it matters that both X & Y (2 phenomena) are happening in the same season? Why do you think this is happening in this season?" will get students thinking about the relationship between seasonal changes in life cycle, population growth, migration, intersections with temperature, rainfall, etc. This is the foundation of gaining an understanding of **phenology**. Visit the **Phenology framework** for more background.





MATERIALS

- » LE4.2a "Should We" Questions Slide Deck
- » LE 4.2b Asking "Should We" questions (student tool)
- » LE4.2c Deciding on a "Should We" question and identifying focal phenomena (student tool)
- » The classroom's 5 socio-ecological dimensions graphic organizer you and students constructed in LEs 2 and 3 (this should be visible in the room)
- » The classroom's Wondering Wall you and students constructed in LE 3 (this should be visible in the room)
- Deliberation and decision-making questions from LE 4.1 (consider making a poster of these questions that you hang in your classroom so that you and students can consult them during the rest of the Seasonal Storyline)

TIME

20-30 minutes for students to explore what a "Should We" question is; 30-40 minutes for students to use their Wondering Wall to generate "Should We" questions related to their and their families' observations and wonderings, and then to evaluate the "Should We" questions they generate; 20-30 minutes to decide on their class "Should We" question and then select at least two focal phenomena



Instructional Sequence

Introducing Students to the Concept of a "Should We" Question

- Explain to students: "We just finished studying our classroom decisions and your families' decisions so that we could learn how we make decisions and some important things to keep in mind when we make decisions."
- 2. Explain to students: "Now, I want to introduce you to a special kind of question called a "Should We" question. When you hear "Should We," what does that make you think about? What do you think that type of question would help us do? Does anyone have any thoughts?" Give students time to think about these questions and voice some of their ideas. You don't have to comment on any of these ideas now (whether they are on target or not). This discussion is simply meant to hear students' ideas (not to evaluate those ideas).
- 3. Now show students the "Should We" Questions slides (LE 4.2a) and walk them through the various questions and activities on those slides. Make sure to give them time to ask questions and voice confusions so that you can help support them in understanding what a "Should We" question is.

Using the Wondering Wall to Generate "Should We" Questions

- 1. Call students' attention back to their Wondering Wall that they constructed in LE 3.1.
- 2. Ask students: "Who can remind us of how we made this wall? What processes did we use to make this wall?" Allow students time to remind each other that they used their and their families' observations and wonderings from their Wondering Walks, and then grouped them into themes and phenomena.

"Should We" questions are an important tool that students can use to understand elements of complex socio-ecological systems because they motivate exploration and investigation of those elements and ways of reasoning about them that are important in field-based science. "Should We" questions ultimately lead to ethical deliberation and decision-making.

Assessment Opportunity:

Use students' ideas, questions, confusions, etc. to give you a sense of how they are understanding the concept of a "Should We" question. Provide more examples of "Should We" questions and evaluate them using the checklist (slide 6) if you think students need more practice.

Asking questions that can be explored scientifically is an important part of field-based science and one of the scientific practices used in the Next Generation Science Standards.


- 3. Ask students (if this hasn't come up already): "Who can remind us about the three [or four] phenomena we highlighted on our Wondering Wall? What are they? Why are they interesting and important to us?"
- 4. Explain to students: "Now that we've learned what a "Should We" question is, we are going to use our three [or four] phenomena from our Wondering Wall, and see if we can come up with "Should We" questions related to each one of those."
- 5. Students can use LE 4.2b to help them ask "Should We" questions related to each of the phenomena on their Wondering Wall. There are different ways you can facilitate this activity. For example, you can have a whole class discussion about this and document your discussion on a larger version of the chart in LE 4.2b, or small groups of students could do this work together and then report out to the whole class.

Selecting a "Should We" Question to Use During the Rest of the Seasonal Storyline

- 1. Explain to students: "Now that we have asked all of these "Should We" questions, we have to decide on one we want to learn more about."
- Ask students: "Remember when we learned about "Should We" questions and we used a checklist to explore our example "Should We" question: Should we put a bird feeder outside our window?"
- 3. Explain to students: "We are going to use that same checklist to explore the "Should We" questions we just came up with related to our phenomena on our Wondering Wall."
- 4. Students will use Parts 1 and 2 of LE 4.2c to engage in this work. Part 1 gives them more practice using the checklist that they used in the "Should We" Questions slide deck (LE 4.2a), but this time, using their own "Should We" questions. Part 2 helps students select one "Should We" question they want to use as a class for the rest of the Seasonal Storyline.
- 5. There are various ways you can facilitate this activity. Students could work independently and/or as part of small groups while working on Parts 1 and 2 of LE 4.2c. You could also facilitate this activity as a whole group discussion.
- 6. As noted in the Preparing for This Lesson commentary, depending on how many "Should We" questions students generate, you will want to plan ahead of time about how you will help them make a decision about which "Should We" question they want to focus on for the remainder of the Seasonal Storyline. The decision should be a principled one that takes multiple factors into account (for example, student and family wonderings and interests, the 5 socio-ecological dimensions, the decision-making criteria and questions from LE 4.1). Remember that it is ok to say "look at all of the amazing "Should We" questions we have come up with from your and your families' wonderings! I need to take some time to think about which ones might be the best for us to use throughout the rest of our Seasonal Storyline and why those might be most helpful. I will try to narrow it down and come back tomorrow with some ideas about options we can consider!"

Assessment Opportunity: This is another activity in this lesson that will help you better understand how students are understanding the concept of a "Should We" question.

Remember that all decisions and decision-making processes are powered. Make sure you attend to who in your class is sharing, who isn't and how you could make sure their voices are included, who you tend to invite to talk and who you don't and why and how you could change that, etc. All students in your class should be part of the decision-making process about a "Should We" question.



Selecting at Least Two Focal Phenomena Related to the Class' "Should We" Question

- 1. In this last part of LE 4.2, students will select at least two focal phenomena related to their class "Should We" question.
- 2. Students will use LE 4.2c, Part 3 to select these phenomena. Remember from LE 3.1 that phenomena are observable events, behaviors, relations, or ideas that can be investigated. Phenomena in field-based science learning are observable events, like trees budding, water flowing and pooling, leaves falling, bees on flowers, human allergies, concrete getting hot to the touch when it's in the sun, etc. All of these phenomena can be tied to the seasons (phenology) somehow, and students and families will be able to use field-based investigations to study and explain them. Knowing this about field-based phenomena will help you guide students in selecting at least two that are related to their "Should We" question.
- 3. Depending on the "Should We" question students chose, you and students might decide to use one (or more) of the phenomena already identified on your Wondering Wall. That's fine as long as they relate to the class "Should We" question! You and students can also decide to brainstorm new phenomena that might be important to understand relative to the "Should We" question (or you can use a mix of new phenomena and phenomena from the Wondering Wall).
- 4. Explain to students: "Now that we have selected our class "Should We" question, we are going to also select at least two phenomena that relate to our "Should We" question. We can use phenomena from our Wondering Wall and/or we can come up with new ones. They have to relate to our "Should We" question though. Does anyone have any suggestions?"



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Part 1: Evaluating your "Should We" questions

"Should We" Question:	"Should We" Question:
 "Should We" Criteria (check all that apply): has no obvious right or wrong answer involves the 5 socio-ecological dimensions connected to our school yard and/or neighborhoods We could collect data to investigate this question. is interesting and important to us and our families involves multiple timescales (see LE 1, Bundle A) has a connection to the seasons We could apply our decision-making processes (LE 4.1) 	 "Should We" Criteria (check all that apply): has no obvious right or wrong answer involves the 5 socio-ecological dimensions connected to our school yard and/or neighborhoods We could collect data to investigate this question. is interesting and important to us and our families involves multiple timescales (see LE 1, Bundle A) has a connection to the seasons We could apply our decision-making-processes (LE 4.1)
"Should We" Question:	"Should We" Question:
 "Should We" Criteria (check all that apply): has no obvious right or wrong answer involves the 5 socio-ecological dimensions connected to our school yard and/or neighborhoods We could collect data to investigate this question. is interesting and important to us and our families involves multiple timescales (see LE 1, Bundle A) has a connection to the seasons 	"Should We" Criteria (check all that apply): has no obvious right or wrong answer involves the 5 socio-ecological dimensions connected to our school yard and/or neighborhoods We could collect data to investigate this question. is interesting and important to us and our families involves multiple timescales (see LE 1, Bundle A) has a connection to the seasons We one of archive and important to a schore a schore (LE 4.4)

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If students have generated more than four "Should We" questions, create more of these boxes so they can explore and evaluate all of them.



LE 4.2c Deciding on a "Should We" Question and Identifying Focal Phenomena

Part 3: Identifying at least 2 focal phenomena

Now that your class has decided on a "Should We" question, identify at least two phenomena that are related to that question. These should be phenomena that you need to learn more about so that you can better understand your "Should We" question. Use your Wondering Wall to help you!

Our "Should We" question is:				
One related phenomenon is:	A second related phenomenon is:	A third related phenomena is		



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	ALLIANCE





LE4.3: Modeling the "Should We" Question and Related Focal Phenomena

Purpose

In LE 4.2, students selected a class "Should We" question and related focal phenomena. In LE 4.3, students and their families will start to learn more about the "Should We" question and its component parts, including the focal phenomena they identified. In this learning engagement, students and their families are going to create an initial model that depicts the important elements of the "Should We" question, including the related focal phenomena. This will prepare them to take a series of focused Wondering Walks in LE 5 to collect more observations and generate more wonderings related to their "Should We" question. In LE 6, students will use their additional observations and wonderings from LE 5.1 to revise their initial model.

Why this is important

Creating, critiquing, revising, and otherwise using scientific models is a very important practice in the sciences because it is one way scientists build and test knowledge. There are many types of scientific models; explanatory, computational, scale, and theoretical models, just to name a few. Models help scientists test, predict, explain, and imagine scientific phenomena. Students should have opportunities to generate, revise, and critique models as part of field-based science investigations. This is important work for many reasons. First, generating and revising models of scientific phenomena associated with complex socio-ecological systems is an important part of sense-making, deliberation, and decision-making. Secondly, working with models helps students visualize their thinking so that you, their peers, and their families better understand how they are thinking about the species, kinds, behaviors, relationships among them, and various scales being explored and posited in the model. Third, generating models and using them to explore various scientific phenomena that are part of complex socio-ecological systems help students make decisions about what field-based investigations they should plan and conduct. Scientific modeling is about sense-making and trying to understand why, how, under what conditions, etc. phenomena happen the way they do, and how place, time, and human intervention may impact them.

Engaging family and community knowledge and practices

You and students will invite their families to also create an initial model of their "Should We" question and related focal phenomena. Then, you and students will use families' initial models to revise students' initial models. As you have seen in previous learning engagements, incorporating families' ideas and their thinking ensures that you and students are able to engage in deeper sense-making because you have a richer dataset to consider. In addition, you position family knowledge as a critical component of classroom science learning, thus helping students see that their families' ways of knowing and doing make important contributions to science.



1

LEARNING GOALS

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

- 1. Create an initial model of their "Should We" question and related focal phenomena
- 2. Revise their initial model using their families' initial models (adding important relationships or scales, for example) that students might not have considered in their initial model

CONNECTIONS TO NGSS

- » Crosscutting Concepts: Patterns; Cause and Effect; Scale; Systems and System Models, Energy & Matter Structure and Function; Stability and Change (NOTE: several of these might apply depending on the "Should We" question and related focal phenomena that students are modeling)
- » Science Practices: Developing and Using Models; Obtaining, evaluating, and communicating information
 » Disciplinary Core Ideas:
- LS1: From molecules to
- organisms
- LS3: Heredity
- LS2: Ecosystems
- LS4: Biological Evolution ESS2: Earth's systems
- ESS2: Earth and Human Activity
- [NOTE: Applicable DCIs will
- depend on the "Should We"
- question, and related focal
- phenomena you and students
- choose.]

ASSESSMENT OPPORTUNITIES

- » LE4.3b An Initial Model of Our "Should We" Question and Related Focal Phenomena
- (student tool)

» Student talk (questions they ask, ideas they voice, suggestions they have) during classroom discussions and other activities related to creating their initial model and revising it based on families' initial models

Centering equitable practices:

- Encourage student idea generation, questions, comments, and suggestions. Avoid a rush to judgment that any student's ideas, questions, comments, and/or suggestions related to their initial model are silly, misinformed, nonsensical, or off target. Instead, ask clarifying questions. Assume a sense-making stance, and a 'desire to participate' stance, and let those guide your actions as a teacher and facilitator.
- Support students in modeling their ideas about component parts of their "Should We" question and related focal phenomena. Avoid any commentary that would lead students to believe that scientific modeling is a type of art project. Try and lessen students' concerns about their drawing capabilities. Instead, encourage them to make their thinking visible through their initial models and convey to them that that is what is important (not how well they draw!). Related, when asking students to share their initial models, do not turn that into some type of "show and tell" activity by asking students to simply narrate what they modeled and then have other students comment on what they like or don't like about it. Remember that scientific modeling is about sense-making and trying to understand why, how, under what conditions, etc. phenomena happen the way they do, and how place, time, and human intervention might influence that. When students share their models, therefore, it is important to ask questions such as, "What relationships do you notice in this model? What phenomena are in here? What predictions can we make about how X is related to Y from this model?" You should show students during your instruction how they can use their models to make predictions and hypotheses about the natural world, and consequently how ideas on their models will change as they conduct investigations.

Teacher background information

It is important to remember that scientific models are not static; they are not diagrams that scientists and students draw, and then abandon in favor of the next activity. They are dynamic and ever changing based on new information learned through investigations of phenomena, and discussions with others. Students might also change their models based on information they learn from media of various types, like books and podcasts, and their deliberations about "Should We" questions. Students should be revising their scientific models, and should be supported in discussing how and why they have made revisions. Students will begin to practice revising their initial models by using their families' initial models in order to see if they need to add, rearrange, or rethink any element of their initial models.

To prepare for this lesson

- 1. Read the Modeling and Forming Explanations framework to better understand scientific modeling. This will help you support students' modeling practice as one way they are making their thinking visible about the class "Should We" question and related focal phenomena. Because students will be revising their models throughout the rest of the Seasonal Storyline, you will have the opportunity to see how their thinking changes and deepens as they learn more about their "Should We" question and related focal phenomena by collecting a variety of data and analyzing those data.
- 2. Construct your own initial model before you ask students and families to construct theirs. This will give you a good sense of student and family activity in this learning engagement. You will be able to think through what you would include in an initial model of the class "Should We" question, how the focal phenomena play a role in the model and why, and what you still don't understand about the "Should We" question that you think would be important to understand in order to deliberate about that question and make decisions about it. This will help you better support students. While you are creating your initial model, anticipate student questions and concerns and plan how you will address them.
- 3. Invite families to construct an initial model of the class "Should We" question and focal phenomena at the beginning of this learning engagement. That way, families can construct their initial models at home while students construct their models at school. Families should have ample time to engage in this activity.
- 4. Plan in advance how you are going to facilitate this learning engagement. Will each student create an initial model? Will small groups of students create initial models and then groups share with each other? Will you and students create a whole-class initial model? A combination of these participation structures?
- 5. Once families send back their initial models, make sure you explore them before you and students use them to help students revise their own initial models. Document similarities and differences between family and student initial models. Document families' questions. Doing this work will enable you to ask questions that will help students attend to important features of families' models.



3

MATERIALS

- » LE4.2a Creating an Initial Model of Our "Should We" Question (family tool)
- » LE 4.2b Creating an Initial Model of Our "Should We" Question (student tool)
- » The classroom's 5 socio-ecological dimensions graphic organizer you and students constructed in LEs 2 and 3 (this should be visible in the room)
- » The classroom's Wondering Wall you and students constructed in LE 3 (this should be visible in the room)

TIME

30 minutes for students to create their initial models; 20-30 minutes for students to share their initial models and compare and contrast features of their models; 30 minutes for students to examine their families' initial models and revise their initial models to incorporate families' ideas and thinking

Instructional Sequence

Ask families to create an initial model of the class' "Should We" question

1. Send home **LE 4.3a Creating an Initial Model of Our "Should We" Question**, and invite families to participate. While students are creating their initial models in class, families will have time to create their initial models at home.

Students construct their initial models of the class' "Should We" question

- 1. Explain to students: "Now that we have selected a "Should We" question and related focal phenomena, we want to draw our thinking about this. We are going to make what is called a scientific model. Has anyone heard the word model before? What do you think that means?" Accept all answers and ideas.
- 2. Explain to students: "Scientists' models are more than just drawings. They are tools that scientists use to think with and to test out their ideas. They change as scientists' ideas change through investigations. Those are the kinds of models we are going to create today."
- 3. Explain to students: "We're going to create an initial model, which means that these will be our first thoughts about what we think are the important parts of our "Should We" question and how we think those are related to each other."
- 4. Explain to students: "Your task is to draw everything you think is involved with our "Should We" question and related focal phenomena, and then use arrows and words and other symbols that you choose to show everyone how you think all of those things fit together. Remember that we are using these drawings to see what we understand so far about our "Should We" question and also to identify what more we need to learn about." You can also say, "It's ok if you don't yet know everything that is involved with our "Should We" question. We will add to our models as we learn more!"
- 5. Explain to students: "There are no right or wrong answers with your models. Also, these models are not art projects. They are scientific tools. Do not worry about the quality of your drawing. That is not what is important. Showing your ideas and thinking is what is important."
- 6. Ask students: "What questions do you have?"

Families' ideas and thinking about the "Should We" question that appear in their models will provide students with important information and questions to ask as they revise their initial models. By asking families to create initial models, students understand that their families' ideas and thinking are important to school science.

Models are a very important part of scientific thinking and research. Scientists use them as tools to explain, predict, and test hypotheses. Remember that models are not just drawings and they are definitely not art projects. The quality of the drawings don't matter; the ideas and the thinking are what is important.



Continued next page...



- 7. Answer student questions and then give them time to create their models. Remember that how you facilitate this activity is up to you (individuals creating models, small groups creating models and/or the whole class creating a model).
- 8. After you have given students' time to create their initial models (if you are facilitating this activity individually or in small groups), ask them to share their models with each other. Remember, this is not show-and-tell, with other students commenting about what they like or dislike. The goal is to visualize sense-making and thinking about the class "Should We" question. Ask students to share what they included in their model and why. Ask students to share what more information they think they need to learn. When students share the latter, document their ideas about that because that could help them pose investigation questions later in the Seasonal Storyline.
 - a. If students are having trouble sharing about their models, refer them to the 5 socio-ecological dimensions and ask them questions using elements of the 5 dimensions. Model how to do this and then invite other students to ask those types of questions too when their peers are sharing their models.

Students consider families' ideas and thinking and add to their initial models

- 1. At this point, families will have sent their initial models to school with students. Explain to students: "Let's explore your families' initial models of our "Should We" question."
- 2. Ask: What did they include? What questions did they have? Did they include the same things you included? Did they include anything that was different?"
 - a. Remember that before you have this conversation with students, make sure you have explored families' initial models. Document similarities and differences related to students' initial models. Document families' questions. Doing this work will enable you to ask questions that will help students attend to important features of families' models.
- 3. Explain to students: "If you want to add anything from families models to your models and/or rearrange anything in your model, do it. But don't erase your original thinking. Use another color pencil or pen to add to your model or change them. That way, you will be able to see how your thinking changes as we keep exploring our "Should We" question."
- 4. Give students time to make changes to their models.
- 5. Ask students to share what changes they made and why.
- 6. Ask students: "Based on your initial models and your families' initial models, what do you think we need to learn more about related to our "Should We" question and related focal phenomena?" Document these ideas and suggestions. Students might be able to explore some of them in LE 5 when they take more walks and/or later in the Seasonal Storyline when they begin other types of field-based investigations.

Continuing to use the 5 socio-ecological dimensions provides a framework for students to use to explore their models and think about other elements of the class "Should We" question that they might want to add into their model and/or learn more about.

Assessment Opportunity: Anytime students make changes to their models in this learning engagement and throughout the rest of the Seasonal Storyline, you will be able to see how their thinking and sense-making is changing.

Continued next page...



Creating an Initial Model of Our "Should We" Question

Name:	Date:	
Our class' "Should We" question is:		
Our class' two focal phenomena are:		Students can create their models on the second sheet of this tool, or they can
2		use a blank sheet of paper. Remeber that each time they revise their initial model, they should use a different color pen or pencil so that it is easier to track how their ideas are changing over time.
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LE 4.3a Creating an Initial Model of Our "Should We" Question - Family Tool

Family Name:

The classroom "Should We" question is: _

Our Family's Initial Model of This "Should We" Question (draw and write in the space below; use a separate piece of paper if you want to)

Before you send home this family tool, be sure that students fill in the class' "Should We" question so that their families know what it is.



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LE5.1: Wondering Walks to Observe Focal Phenomena Related to Our "Should We" Question

Purpose

When you launch LE 5 in your classroom, you and students will have identified a "Should We" question and at least two related focal phenomena to learn more about. In order to learn more about them, **you, students, and their families will take focused Wondering Walks** to observe elements of your "Should We" question that you included in your initial models (LE 4.3). Depending on your "Should We" question and related focal phenomena, you, students and families will conduct observations in at least three different places, or over at least three time periods, around the school and in families' neighborhoods. As part of these observations, students and families will identify any **base relationships** that are important to the focal phenomena and the class "Should We" question. This is in preparation for revising initial models in LE 6.

Why this is important

Now that you have chosen a "Should We" question and identified related phenomena, students and families will explore them more deeply by observing them in a variety of places and/or over time (like morning, noon, and early evening, or over the course of a week). As part of these observations, students and families will look for **base relationships** that are important (for example, a plant in relation with another plant, an animal in relation with a plant, an animal in relation with a natural kind, like water). This will help students and families generate new wonderings about their "Should We" question and these phenomena, which will be important precursors to investigating them throughout the rest of the Seasonal Storyline for Field-Based Science Education. The Next Generation Science Standards highlight the importance of engaging in authentic science practices. Scientists who use field-based methods in their research observe phenomena in places (whether that is different places in the same location or across multiple locations), and over time, to better understand those phenomena and to identify elements of them for further investigation.

Engaging family and community knowledge and practices

As you did at various times in LEs 1-3, you and students will incorporate family observations and wonderings into classroom observations and wonderings, as well as into your discussions and reflections about them. As you have seen in previous learning engagements, incorporating family knowledges, ideas, wonderings, and practices ensures that you and students are able to engage in deeper sense-making because you have a richer dataset to consider. In addition, you position family knowledge as a critical component of classroom science learning, thus helping students see that their families' ways of knowing and doing make important contributions to science.





LEARNING GOALS

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

- Make observations of focal phenomena in different places, and/or at different times, around the school
 - a. Use various scales (time, space, size, perspective) to make these observations
 - b. Attend to species, kinds, and behaviors, relationships, places, lands, and waters, and human decision-making
 - c. Document base relationships
- 2. Generate wonderings related to their observations
- 3. Make more observations and generate more wonderings about their focal phenomena with their families in their neighborhoods
- 4. Synthesize observations and wonderings about their focal phenomena and explore similarities and differences across places and times

CONNECTIONS TO NGSS

- » Crosscutting Concepts: Patterns; Cause and Effect; Scale; Systems and System Models, Energy & Matter Structure and Function; Stability and Change [NOTE: several of these might apply depending on the focal phenomena]
- » Science Practices: Asking questions; Planning and carrying out investigations; Analyzing and Interpreting Data; Obtaining, evaluating, and communicating information
- » Disciplinary Core Ideas: LS1: From molecules to organisms
 LS3: Heredity
 LS2: Ecosystems
 LS4: Biological Evolution
 ESS2: Earth's systems
 ESS3: Earth and Human Activity
 [NOTE: Applicable DCIs
 will depend on the focal
 phenomena you and students
 choose.]

ASSESSMENT OPPORTUNITIES

- » LE4.1b Wondering Walks to
- Observe Focal Phenomena
- Related to Our "Should We"
- Question (student tool), and

related student discussions and questions

- » Student talk (observations they make, questions they ask, wonderings they voice) during the Wondering Walks, and other parts of classroom activity
- » LE4.1c Wondering Walk synthesis tool and related student discussions



Teacher background information

As you learned in LE 2, wondering is a practice that is central to sophisticated scientific fieldbased observation and questioning. Remember that who gets to wonder, and whether or not these wonderings are taken up in a learning environment, are deeply powered and historicized. Making space for all student and family wonderings and using them to support student sensemaking positions student and family ideas as important, meaningful, and critical to students' learning. Students and family wonderings are also important precursors to ethical deliberation and decision-making that are personally meaningful and important to students, their families, and their communities. The goal of this learning engagement is to support students and families in focusing their wonderings on elements of the "Should We" guestion and related, focal phenomena that you and students have chosen. One potentially new concept in this learning engagement is base relationships. Base relationships are foundational building blocks of interaction within socioecological systems. For example, base relationships can include a plant related to a plant (moss on a tree), or an animal related to a plant (a caterpillar eating a leaf), or an animal related to an animal (a hawk eating a mouse), or a plant related to a natural kind like soil or water (flowers planted in soil). It is important for students to identify, model, and investigate these base relationships because they are a central component of socio-ecological systems, and understanding those relationships will help students reason not only about the specific relationships but about how they function within the larger system (and to what ends). Additionally, base relationships will undoubtedly be important to students' understandings of their "Should We" questions. For more information about the different types of relationships that are important in complex socio-ecological systems, see the **Relationships in Socio-Ecological** Systems framework. Other frameworks that will be important to consult in this Learning Engagement are: (a) Wonderings, "Should We's," and Investigation Questions Framework and (b) Making Observations and Collecting Data Framework. Additionally, the Discussion, Reflection, and Deliberation Framework will be an important resource for you as you support rich student discussions about students' "Should We" question and related, focal phenomena, their observations of them across place and/or time, including any base relationships they observe, and their synthesis of their and their families' observations and wonderings.



Centering equitable practices:

- Provide equitable access to outdoor learning experiences: Avoid centering student behavior outdoors as your main concern. While it is natural to be nervous about students' behavior outdoors, which might come from concerns about safety while outside, centering their behavior often eclipses their sense-making and robs them of opportunities to learn. Additionally, centering behavior often results in policing children of color more often and more harshly than white children. As you have already seen previous learning engagements, students will be excited to be outside. They will speak in louder voices than they normally would in the classroom. They will spread out but will come back together as they share their ideas, observations, and wonderings. Allow them both emotional and physical space to do this. Consult the Supporting Learning Outdoors Framework for strategies you can use to support students in their learning and sense-making outside.
- Encourage student idea generation, wonderings, guestions, 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 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.
- Use the 5 socio-ecological dimensions to frame observations and wonderings: Avoid too-simplistic framings of the activities in this learning engagement, such as using Wondering Walks to simply classify, point out, or name species related to the class' "Should We" question and related, focal phenomena, and/or framing observations and wonderings solely in terms of how focal phenomena are useful for humans. As you and students take these next Wondering Walks, use your questions to model the use the 5 socio-ecological dimensions as part of observing and wondering about your focal phenomena across places and/or over time. This includes modeling how to take the perspective of more-than-humans, how to focus on relationships among species, kinds, lands, and waters, how to use different scales when observing and wondering (time, space, size), and how to look for evidence of human decision-making (because remember, humans are part of ecosystems, not dominant over them and not absent from them).
 - Create a set of back-pocket questions related to the 5 dimensions and take them with you out on the Wondering Walks to prompt students as they are walking, observing and wondering (they will think about these dimensions too in Part A of the LE 5.1b student tool as they plan for these Wondering Walks, but these back pocket questions will be useful to remind them to use these 5 dimensions as part of their thinking). For example, you could consider the following questions and tailor them to the class' "Should We" Question and related, focal phenomena:
 - Species, Kinds, & Behaviors: What species and kinds are involved in our focal phenomena? What are some behaviors that those species and kinds are engaged in and why? What species and kinds have power over others and why might that be? How does that power play out?
 - Relationships: What relationships between species, kinds, places, lands, and/or waters are involved in your focal phenomena? Who benefits from these relationships? Who might not benefit? Why? How might the relationships we are observing change across different scales of time (geologic time, plant, animal, & soil time, Indigenous peoples' time, nation-state time, global time, the future related to any of these time scales)? [You might choose to make a set of base relationship cards to help focus students' thinking about relationships even more.]
 - Places, Lands, & Waters: What places, lands, and/or waters are involved in your focal phenomena? Who is involved in making decisions about these places, lands, and/or waters? Who is not involved in decision-making, and is that problematic? How so? How have these places, lands, and waters changed over time?
 - Thinking across Scale: What time scales are important to think about related to your focal phenomena? (Look back at the Socio-Ecological Histories of Places work you did in LE 1.A.) What different scales related to space might be important to consider given your focal phenomena (looking at something from above or below, for example)? Try and take the perspective of species and kinds that you listed. Would doing that help you think about your focal phenomena differently?
 - Human-Decision Making: What evidence of human decision making is important to take into account given focal phenomena? Who gets to make the decisions and why? Would different decisions be made if others were making





BOTHELL

To prepare for this lesson

- Make sure you engage in place mapping to plan where you and students could take these wondering walks. This will also help you support students when they do some planning in Part A on the 5.1b student tool. The class "Should We" question and related phenomena will determine whether students should observe them in three different places and/or over time, so as you place map, think about the affordances and constraints of different places (and/or times) with respect to making observations of the focal phenomena. The Place & Place Designing: Mapping Opportunities to Learn Framework will be helpful to you as you plan your outdoor instruction.
- 2. Decide ahead of time how you want students to engage in this lesson so that you can plan how you will orchestrate and facilitate this learning engagement. Students will need to take three different Wondering Walks as part of this learning engagement (to observe in three different places and/or over time). Will each student conduct observations and pose new wonderings? Will students do this in small groups? When making these decisions, center student learning about their "Should We" and related, focal phenomena by conducting observations and posing wonderings.
- 3. Plan discussion prompts and strategies that you will use to ask students to identify and debrief their observations and wonderings with each other as they walk. Remember that students can and should be engaged in sense-making as they are walking (versus waiting to start their sense-making until they are back indoors). Position walking as important work time. For example, you can have a "walking question of the day" that asks students to make a connection between the focal phenomena and their neighborhoods/families/everyday lives.
- 4. Use each of the tools yourself, including the family tool, before you ask families and students to use them. This will give you a good sense of student and family activity in this learning engagement. Based on the information asked for in each tool, plan questions and discussion prompts and strategies that you want to use to facilitate rich discussions and support student learning related to their observations and wonderings, as well as their synthesis of their and families' observations and wonderings. Anticipate student and family questions and concerns and plan how you will address them.
- 5. If you need a refresher on the 5 socio-ecological dimensions, re-read the LE 2.3 lesson plan and revisit the accompanying slide deck.
- 6. Send home LE5.1a Focused Family Wondering Walk before you and students go out on your walks. That way, families will have time to go on their walks and document their observations and wonderings. Make sure to let families know that if they don't have time for three different walks, one and/or two (whatever they have time for) is fine. You and students will incorporate these observations and wonderings into your synthesis work in this lesson (after you and students take your wondering walks at school).
- 7. Remember that phenology is central to the Storyline for Field-Based Science Learning: Don't forget about the seasons and the impacts that they have on the focal phenomena that students and families are observing and wondering about. For example, asking students questions such as, "How would this be different in another season? Why do you think it matters that both X & Y (2 phenomena) are happening in the same season? Why do you think this is happening in this season?" will get students thinking about the relationship between seasonal changes in life cycle, population growth, migration, intersections with temperature, rainfall, etc. This is the foundation of gaining an understanding of **phenology**. Visit the **Phenology framework** for more background.





MATERIALS

- » LE5.1a Family Focused Wondering Walk
- » LE5.1b Wondering Walks to Observe Focal Phenomena Related to Our "Should We" Question (student tool)
- » LE5.1c Wondering Walk synthesis tool (Let's compare our family and classroom observations!); multiple copies of this chart (one for each focal phenomenon students are observing and wondering about)
- The classroom's 5 socio-ecological dimensions graphic organizer you and students constructed in LE 2 (this should be visible in the room)
- » Back pocket questions related to the 5 socioecological dimensions (strongly suggested)
- » The classroom's Wondering Wall you and students constructed in LE 3 (this should be visible in the room)

Instructional Sequence

Preparing for the Wondering Walks

- 1. Ask students: "Who can remind us of our "Should We" question? Who can remind us of our related, focal phenomena?"
- 2. Explain to students: "Now that we have chosen these focal phenomena as important elements of our "Should We" question, we are going to take more Wondering Walks to learn more about them. Our goal is to observe these phenomena in (three different places and/or over time) and ask more wonderings about what we are observing. Before we go outside, we need to do some thinking and planning so that we can make the most of our time outside."
- 3. Make sure students have a copy of LE5.1b Wondering Walks to Observe Focal Phenomena Related to Our "Should We" Question (student tool). Before they go out on their Wondering Walks, they should do some planning using Part A in this tool. (An alternative to providing a copy for every student is asking students to work in groups and providing one copy per group. You might choose to debrief students' responses in Part A after each question or give them time to respond to all of the prompts in Part A and then debrief their responses and questions.)
- 4. Explain to students: "We are going to take about 20 minutes to think and plan before we go outside. You have some questions in front of you we need to think about and answer."
- 5. Explain to students : Thinking about our "Should We" question and our focal phenomena, do you think we should observe those in three different places? In the same place at three different times? Why?"

TIME

30 minutes for students to prepare for their Wondering Walks in the classroom, and 40-45 minutes for each Wondering Walk outdoors; 30-45 minutes to synthesize



Assessment Opportunity: Students' responses should give you information into their understanding of their "Should We" question, and the related, focal phenomena.

Assessment Opportunity: Students' responses and questions should provide you with additional information related to their understanding of the "Should We" question, their focal phenomena, and the 5 socio-ecological dimensions.

- 6. Ask students: "If you think we should observe in three different places, what places do you think we should go? Why? If you think we should observe in the same place but at three different times, what place should we observe and during what times? Why?"
 - » Note: students may suggest places other than the places you have identified in your place mapping. That is ok!
- 7. Ask students: "What dimensions should we use when we observe our phenomena?" (Students should use the 5 socio-ecological dimensions classroom graphic organizer to think about this question. The class' "Should We" question and the specific phenomena you have chosen should guide their thinking about this question in terms of which dimensions are central to your discussions and activity.)
- 8. Explain to students: "Let's think about relationships specifically. As part of our walks to observe our focal phenomena, we will be looking for what we'll call "base relationships" that are part of those phenomena. Base relationships are relationships like a plant related to a plant, or an animal related to a plant, or an animal related to an animal, or a plant related to a natural kind like soil or water. We want to observe these types of specific relationships when we are on our Wondering Walks."
- 9. Ask students: "Who has an example of a plant-plant relationship? Who has an example of an animal-plant relationship? Who has an example of a plant-natural kind relationship? Who has an example of a human-animal relationship?" Ask students for examples of different types of base relationships to gauge their understanding of this concept.
- 10. Ask students: "What questions do you have before we go outside to conduct our observations?" You can choose to respond to these in the moment if they are important to answer before going outside and/or you can choose to table questions that you think might be better to discuss after the Wondering Walks.

Invite families to take a Wondering Walk in their neighborhood to observe focal phenomena related to students' "Should We" question, and to generate additional wonderings

- 1. Send home the family tool (LE5.1a) and invite families to participate before you and students take your walks at school. This will give families time to take this walk and make their observations and generate wonderings while you and students engage in these same activities at school.
- 2. Before sending home this family tool, ask students to fill out the first page of the tool given the planning they just engaged in (Part A of LE 5.1b). Families will need this information for their Wondering Walk.
- 3. Remember to make it clear to families that if they only have time for one Wondering Walk, that's fine!

Remember that base relationships are are foundational building blocks of interaction within socioecological systems. As part of understanding their "Should We" question and ultimately deliberating and making a decision about it, it is important for students to identify the base relationships involved in their "Should We" question, and investigate them through their modeling and their investigations later in the Seasonal Storyline

Assessment Opportunity:

Asking students to provide examples of a concept is a useful way to gauge their understanding and explore any confusions.

Remember that family knowledges and practices are critical to classroom learning, student sense-making, and student identity development. By starting this learning engagement with family activity, you are signaling the importance of families to students' learning and sensemaking at school.

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Going on Wondering Walks to observe focal phenomena

- 1. Based on your place mapping as part of planning for this lesson, and based on students' preparation in Part A of LE 5.1b, go on these Wondering Walks. Students should document their observations and wonderings using Part B in LE5.1b.
- 2. Remember that students' goal is to explore their focal phenomena in three different places and/or at three different times. They should be using the 5 socio-ecological dimensions to guide their observations and wonderings. Notice that as part of each walk, they will be identifying any important base relationships and making sure they add those to their observations.
- 3. Whenever you can, ask questions to deepen students' observations, wonderings, and sense-making about the focal phenomena. Use the back-pocket questions you created when preparing for this lesson.
- 4. Remember to consult the Avoiding Potential Challenges section of this lesson plan for important things for you to keep in mind during this Wondering Walk.

Synthesizing family and classroom observations and wonderings about focal phenomena

- At this point, families will have taken their Wondering Walk to make observations of one (or both) of the focal phenomena in their neighborhood and to pose related wonderings. Remember that some families might have recorded observations and wonderings on the LE5.1a Focused Family Wondering Walk activity sheet and some families might have recorded observations and wonderings on blank sheets of paper. The format doesn't matter; the observations, ideas, and wonderings are what is important! Additionally, some families might not have written anything down, but they might have gone on walks and had discussions so make sure that you ask students to share observations from their walks, and ideas and wonderings from these discussions! You do not have to have all family tools returned to start this synthesizing activity in class. Use the ones you have and ask students to share family discussions.
- 2. Once you and students have completed your Wondering Walks at school, you can synthesize observations and wonderings across locations and/or times at school and in family's neighborhoods.
- 3. You will use LE5.1c Wondering Walk synthesis tool (Let's compare our family and classroom observations and wonderings!) Have students synthesize using this tool for each focal phenomenon they observe. The goal of this synthesis work and related discussions is to collect all observations and wonderings related to your focal phenomena so that students can use them, as well as their analysis of them, to revise their initial model in LE 6. You can ask students to synthesize in several ways. You can ask small groups of students to synthesize their classroom and family observations and wonderings, or you can do this as a whole class.

Wondering Walks provide opportunities for students to observe, as well as wonder and reflect about, nature-culture relations that are important in understanding complex socio-ecological systems. During these walks, students are practicing their observation skills, which are an important part of field-based science.

Complex socio-ecological systems, including the focal phenomena you, families, and students have identified, are powered and have histories that are important to surface, wonder about, and reflect on as part of sense-making. Additionally, you want to make sure that all students have opportunities to participate in these activities in equitable ways.

Organizing, comparing, and contrasting are forms of data analysis that can help surface patterns. Plus, this type of analysis will help generate questions that will be useful in generating "Should We" and Investigation questions later in the storyline.

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- a. It will be useful for you to create cards. You can use index cards or sticky notes, one color for observations, one color for wonderings, and one color for base relationships. Make sure to keep observations (including base relationships) and wonderings attached to the focal phenomenon to which they relate. Write one observation, wondering, or base relationship on each card. Use both student and family tools! This way, students can move cards around as they compare and contrast observations, and then group observations, including base relationships, and wonderings under each focal phenomena.
- 4. Explain to students: "Now that you and your families have gone on a Wondering Walk in their neighborhoods to observe our focal phenomena (in three different places and/or over time) and we have done this at school, it is time to look at all of our new observations, including our thinking about base relationships, and wonderings from our neighborhood and from around our school."
- 5. Explain to students: "Our goal is to capture all new observations and wonderings about our focal phenomena so that we can keep learning more about them and our "Should We" question. Plus, we want to identify which base relationships seem really important to our "Should We" question. We also want to compare and contrast our observations and wonderings because that way, we can see what is similar about what we observed (and where and/ or when we observed it!) and what might be different."
- 6. Using the cards you created, model for students how they can group their observations and wonderings for each focal phenomena.
- 7. Give students some time to look at their groupings. Ask them questions such as, "What do you notice that is the same? What do you notice that is different? For what you notice that is different, how might the place where you made these observations and/or the time when you made these observations impact what is different? Do you think the season has anything to do with what you observed either at home or at school? Why? Which of the 5 dimensions was really helpful to you as you and your families made observations? Why? What base relationships seemed most important to our focal phenomena? Why might that be? What about your wonderings? Are there new wonderings that we don't have on our Wondering Wall yet related to our "Should We" question and our related, focal phenomena? If there are, let's add them to our Wondering Wall."
 - a. To keep track of similarities and differences in observations
 (including base relationships), and wonderings, students can use LE
 5.1c Wondering Walk synthesis tool (Let's compare our family and classroom observations!), or you can make that into a classroom chart and record ideas from this discussion onto this chart.
 - b. If students identify wonderings related to their "Should We" question and/or their focal phenomena, make sure they add those to their Wondering Wall. Adding those will be helpful to them when they revise their initial model in LE 6.
- 8. Ask students: What new questions do you have that we should write down so that we don't forget about them?" Document these questions. You might choose to have a discussion about some of them now, or you might choose to table them and discuss them later in the Seasonal Storyline.

Assessment Opportunity: Student responses to these types of questions can give you a window about how they are thinking about and understanding the 5 socioecological dimensions and their importance in better understanding their "Should We" question and their related, focal phenomena.

> Analyzing observations is an important part of field-based science. Analysis of observations leads to new questions and helps scientists make claims about those questions.

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Learning in Places LE 5.1a Family Focused Wondering Walk

Family Focused Wondering Walk

Please return your observations and wonderings by:

Hello, Classroom Families!

As you know, our class has been observing and wondering about places outside our school. We have been exploring ideas like size, scale, and relationships. You have helped us with this work by taking your own walks in your neighborhood, making observations, and posing wonderings. Thank you!

We grouped all of these observations and wonderings from our neighborhoods and school into phenomena. We have defined "phenomena" as events, behaviors, relations, or ideas that we can observe and investigate, like trees budding or bees landing on flowers. After we did this, we picked a few of these phenomena that are interesting to us and that are related to a type of question we are asking called a "Should We" question. Our class "Should We" question is:

The phenomena we picked that are related to our "Should We" question are:

1. _____ 2. ____

Activity Purpose: We would like your help again! Please pick one of our phenomena to observe in different places or over time. If you picked phenomenon 1, please observe it ______

If you picked phenomenon 2, please observe it _

The places and/or times you choose for observations are up to you. If you only have time for one and/or two walks, that is fine! Please only do what you have time for. Make sure to record any wonderings you have as you observe. Draw or write what you observe using the sheets in this packet or you can do this work on blank sheets of paper if you want. Include what is above, around, and below the phenomenon. Use arrows or words to show relationships. Use a new sheet for each observation.

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After students complete Part A of LE5.1b and you and the students have created a plan for your Wondering Walks, make sure students fill out the first page of the family tool (LE5.1a) so that their families know what to do for the Wondering Walk.



VALUE.	Today's Data	
he case is:	1000 S Date	
he weather during our walk is: 🗘 🖄 🗠		
he temperature during our walk is:		
Our "Should We" Question is:	•	
Part A: Preparing for Our Walk defore we go outside, we need to do some thinkin uestions so that we have a plan when we go outs	g about where we are going to walk, when, and why. Let's answer these ide.	
THE 1 11 11 11 11 11	anomana auterdaz Whara chauld wa laakz it wa naad ta ahaawa thaca	
. Where do you think we will find these pl henomena during three different times, what tir	nes should we go observe? Why? Write down your ideas.	

Make sure students have time to plan their Wondering Walks before they start walking, observing, and wondering. Students' thinking about and responses to these planning questions should be driven by their "Should We" question and their related, focal phenomena.

2. What are some this	ngs we should think a	bout when we are observ	ving these phenomena	? Circle the dimensions
you think will be import	ant for us to use. For eac	h dimension you circle, write	your reason for circling if	underneath the picture
Species, Kinds, and Behaviors	Relationships	Places, Lands, & Water	Thinking across Scales	Human Decision-Makir
What questions do ye	ou have before we go	outdoors?		
What questions do ye	ou have before we go	outdoors?		



Walk #1	
Location 1: Time: Time:	
Weather:	
$-\dot{\alpha} \sim \dot{\Box} = -\dot{*}$	
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Draw what you observe here.	
	Students and families will
	observe focal phenomena
second	using different spatial scales
	(around above below)
	(al ourid, above, below).
↓ below	
We Wonder	
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LE 5.1a Family Focused Wondering Walk

Walk #1 continued...

Now that you have observed this phenomenon from above, below, and around, what relationships are part of this phenomenon that you think are important to highlight? Put a star or a check mark in the box to the left of any relationship you observe that ou think is an important part of this phenomenon. (Don't worry if you do not observe all of these types of relationships. Just check the ones you do observe.)

If you haven't already drawn or written about the relationships you checked, go back to your drawing and add them in. Also, if you have new wonderings after observing any of these relationships, write those down too.

Animal-Animal	Animal-Plant
Animal-Human	Plant-Plant
Plant-Human	Animal-Natural Kind (for example: water, rock, sun, air)
Plant-Natural Kind (for example: water, rock, sun, air)	Human-Natural Kind (for example: water, rock, sun, air)
Human-Human	Other?

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Seasonal Storyline.

For each walk students (and

families) take, they should try and identify any important base relationships that they see. They can also ask wonderings about these. Attending to base relationships will be very helpful later in the

Our "Should We" Que The phenomenon we	estion is observed			
The season is				
	Location:	Location:	Location:	What new wonderings do we have?
	Temperature:	Temperature:	Temperature:	
Differences What is something	Something different we r			
different about your observations across locations?	We think it was different			
Similarities	Something similar we no	ticed was:		What base relationships
similar that you noticed about your				seem important to our "Should We" question?
observations across locations?	We think it was similar because:			

Give students enough time to analyze their observations and wonderings. They should be exploring similarities and differences about their observations across places and/or over time. They should also be thinking about the relationship among place and/or time and the similarities or differences that they notice.

Remeber to make sure students add any new wonderings to their Wondering Wall.

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LE6.1: Revising our Classroom Model(s)

Purpose

In this activity, students will have the opportunity to reason through the different dimensions that are important and relevant to their "Should We" questions through the practice of revising models. Students will become practiced at revising models throughout their investigation as they learn more about their phenomenon; however, in this activity students will use their family knowledge and practices to update their initial models from LE4.3. This is an important equity practice and may offer keen insights into possible avenues for investigating the class's "Should We" question.

Why this is important

Models are important tools for students to use when they are making sense of and explaining their phenomena through field-based investigations and other strategies for learning new information (for example by using books, media, and conversations with experts). Ultimately, students' models will help them explain phenomena, as well as deliberate and make decisions about their "Should We" question. Throughout the rest of the storyline, students will develop, revise, and share their individual, group, and whole classroom models to synthesize new data, make sense of relationships or mechanisms that help explain phenomena, and identify gaps in their understanding that will lead to new questions and additional data to collect.

Engaging family and community knowledge and practices

LE 6.1 provides another opportunity for you and your students to use family observations and knowledges to make sense of the focal phenomena and class "Should We" question as students revise their initial models. Creating and revising models is one way of engaging students in ethical deliberation around the "Should We" question, and including observations and sensemaking from the family tools positions family knowledge as a critical component of sensemaking around complex systems, ecosystem relationships, and ethical deliberation. Read the **Modeling & Forming Explanations framework** and **Relationships in Socio-Ecological Systems framework** to learn more about how to integrate family ways of knowing from the family engagement tools during LE6.1 model revisions.

LEARNING GOALS

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

- learn how to revise a classroom model (or multiple models) about the "Should We" question and related phenomena in order to pose and refine investigation questions (in LE 7).
- 2. synthesize observations from family and school settings to see how surfacing multiple perspectives is important for ethical deliberation.

CONNECTIONS TO NGSS

- » Crosscutting Concepts: Cause and Effect Systems and system models
- » Science Practices: Developing and Using Models; Analyzing and
- Interpreting Data; Engaging in
- Argument from Evidence.» Disciplinary Core Ideas:
- LS1: From molecules to organisms
- 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
- » LE6.1a Student models (individual or group)
- » Student talk (questions they ask,
- wonderings they voice, ideas and
- reflections they voice) during small and whole-group discussions about family and classroom decisions and

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decision-making

Teacher background information

Scientists construct and revise models to understand how the structures, functions, behaviors and relationships of a system change over time and across space. In LE6.1 students engage in these practices by incorporating family observations of the focal phenomena as well as family ethical deliberations around the "Should We" question(s) into their initial models from LE4.3. Modeling is a dynamic and ongoing process that is continuously informed by students' and families' discussions, investigations, and their growing understanding and curiosity about complex socio-ecological phenomena over time.

It may be important to revisit how and why we are revising our classroom initial models of our "Should We" question(s). Students have dedicated time, energy, and emotion to co-creating their models and it can be difficult (even for senior scientists!) to revise or change our models. The emphasis is not on correcting mistakes or misconceptions - rather, we are extending, growing, and stretching our thinking! Below are some frames that might help students understand the practice.

- **Digging Deeper:** Sometimes we revise our models to get more specific about our phenomenon or questions. For example, our initial models may use general terms like "birds," "trees," "forest" or generalities about phenomenon. These are good initial ideas, but getting specific ("birds that eat dead animals," "cone trees," "temperate forests") can help us reason about and make better decisions about our socio-ecological systems. For example, the specific plants that we put in our "pollinator" garden will attract some species of birds more than others. Or deciding to remove snags from a forest will impact birds that make homes in snags, or eat bugs in snags more than other birds.
- **Facing the Sun:** Sometimes, like plants moving to chase the sun, we shift our thinking as we observe and make sense of our observations. We can often shift our thinking when we observe the same phenomenon from a different perspective. For example, we may make a model of a snag as a habitat and food source for many species and a critical part of the ecosystem. From a different perspective, we may consider the snag as fuel for a fire, hazardous if they collapse, or as taking up space that other living plants can use. Revising our models to consider multiple perspectives or viewpoints given the data can be an important practice of scientists.
- New Growth: we want to add new information learned from our various resources; such as what plants attract different species of pollinators, what we learned about snags from an arborist, or from our tally observations, the different kinds of animals that use cone trees.

Students should continue revising their models as they learn new information (in LE 7 and LE 8, for example).

To prepare for this lesson

This lesson requires students to synthesize materials and observations from LE4.3 and 5.1 that include their initial models, family focused wondering walks and classroom focused wondering walks. Make sure that students will have these materials available for their model revisions in this lesson. **LE6.1a** will guide students through the model revision and will help students make sense of their observations with reference to the focal phenomenon and class "Should We" question(s).

There are multiple options for how students can revise their models. You can make copies of students' initial model drawings to have students draw directly onto their models. If you choose this option remember to copy students' models ahead of time. You can also have students use sticky notes and differently colored writing tools to draw directly on their initial models. In either format, model revision can and should be a messy process! Students should feel comfortable crossing things out, adding new details on top of old details, and changing their minds in the process. Engaging students in argumentation practices and ethical deliberation through the revision process is the most important aspect of modeling; initial and revised models are primarily used as artifacts to anchor these discussions.





Species, Kinds, & Behaviors

- important that are missing from our model(s)?
- » Often when students represent animals they use adult or mature forms. How might you include young and old in your web models?
- » Singular representations of species or kinds students often need help thinking about agent (individual) and aggregate (sum of individuals) species and relationships. Depicting multiples of a species or kind may help students.
- » Animals and plants only students often need prompting to include natural elements such as water, wind, sun, moon, rocks, etc.

Relationships

- What relationships did our families prioritize that are missing from our » model(s)?
- Students are capable at very young ages at thinking through effects » within a system at a causal level - that is chain-like reasoning. For example, they might be able to think about pesticide effects to grass - bugs - birds fairly easily. But they need additional support thinking about webs of relationships. What happens to a bird that eats a bug that fed on grass sprayed with pesticides?
- Helping/harming relationships while helping/harming may be a useful and familiar framework for students to think with, there are many types of relationships that help one species while hurting another (e.g., parasitic or predatory). Additionally, these may change as you go up or down in scale. For example, a wolf eating a goat may be considered a harming relationship for the goat. But by predating on weak, sick, or old animals wolves may increase the herds ability to survive thus creating a helping relationship to the herd. Ask students to think about relationships in this manner.

Centering equitable practices:

- Encourage student idea generation, wonderings, guestions, 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.
- Provide ways to engage all students in incorporating family knowledge into their models. If • students are missing family tools, encourage them to remember and write notes about discussions they have had with their families about the focal phenomenon and "Should We" question(s). Remember that returning family tools is only one way for families to support their child's learning and to incorporate family ways of knowing in the classroom, and it is important to provide multiple ways for students to share this knowledge.
- Use the 5 socio-ecological dimensions to support model revisions: •

» What are species, kinds, or behaviors that our families think are







Places, Lands, & Waters

» Many models can be taken "out of context" or applied to places, lands, and waters that do not fit. For example, considering daylight data for an equatorial region would not help students make sense of the changing seasons in the Pacific Northwest. Fluxuations in amount of daylight will not represent the amount of daylight (or changes to amounts) that we experience at this latitude and longitude.



» Ecological models often do not include humans, yet we know this is vital for students to make connections between humans and the natural world. Prompt students to include humans or human presence when possible.



Thinking Across Scales

- » What did families include in their drawings of what their surroundings would look like after 10 years?
- » Defining conventions: have the class create a consensus key or legend that explains what symbols mean that can be used across models to support students' reasoning and explanations. For example, a drawn magnifying glass may represent that a student wants to "zoom in" on a component or mechanism within the big model.
- » While many cultures consider time to be linear and represent time on a continuum from left to right, this is not the only way to conceptualize time. For example, many cultures consider time to be cyclical with the past ahead and the future behind. As you co-create models with your students, consider how your students and families think about time and how you might represent it in ways that honor this thinking.

» Human Decision-Making

- » How were families represented and what stood out in their should we/should we not contributions?
- » "Zoom in" lens makes the invisible visible, consider using a thought bubble to capture thinking about the "Should We" question.
- » Use sticky notes the overlay decision-making examples.







MATERIALS

- » LE4.3 Initial Model or copies of students' initial models
- » LE5.1a Family Focused Wondering Walk
- » LE5.1b Wondering Walks to Observe Focal Phenomena Related to Our "Should We" Question
- » LE6.1a Model Revision Student Document
- » sticky notes (optional)
- » colored pencils or markers (optional)

Instructional Sequence

Revising models from family tools

- 1. Remind students of the model that they drew as a class. Go over the "Should We" question and the important parts of the system that they identified and drew. Tell students: We have gathered a lot of observations about our focal phenomena over our past few lessons. We are going to revisit and revise the models we drew in LE4.3 to see how our focused wondering with our families and classmates changed our thinking about our thinking about our focal phenomena in order to answer our "Should We" question(s).
- 2. Depending on the model revision format you are using, either hand out copies of students' initial models (if you would like students draw directly on their models) or hand out students' initial models and use sticky notes and additional colored writing tools to build on the model.
- 3. Working in small groups, ask students to talk over their family tools and their observations on the Focused Wondering Walks from LE5 and write or draw on sticky notes any new noticings, wonderings, and ideas that emerged from the Wondering Walks and family tools.
 - a. Note: if you do not get many family tools returned, you can run this as a whole-class activity. Before class, make a note of the new aspects of the models that you noticed from the family tools and write them on sticky notes. Then, you can read them out to the class and ask where in the model they should be put.
- 4. Have small groups or individual students use student tool LE6.1a to organize their observations and reflections on the family and classroom focused wondering walks.

TIME



50 minutes (10 minutes to introduce model revision, 25 minutes to revise models, 15 minutes to share revisions with the class)



Scientists need to periodically reflect on what they have done and what they know now in order to decide on next steps. Helping students remember all that they have done is helping to support them in this important practice.

> Assessment Opportunity: Listen to student talk as you sit with small groups to understand student sense making around the models.

Assessment Opportunity:

Students can complete LE6.1a individually or in small groups as an assessment artifact. If students complete the tool individually, they should still discuss ideas as part of a small group.

Continued next page...



Option 1: Whole group model: If you are revising the model as a whole group activity

- 5. Gather the class together and ask students to put their sticky notes on the class's model.
 - a. Have students talk through their thinking as they add and take away components in the model to surface and support sensemaking through class discussions.
 - b. Some questions you can ask here are:
 - i. What new relationships have we added?
 - ii. What did we learn that makes you think we should add that?
 - iii. What are you thinking about differently now? Why?
 - iv. What questions can we ask about this part of the model?
- 6. Invite students to share ideas and reflections about their classmates' model changes. You can say: We removed component A and added component B to our model. How does this change compare to what you saw with your own families? What more would you like to add or change about our model?

Option 2: Small group models: If students will revise their individual or shared models in small groups.

- 7. In small groups, ask students to share their observations from family walks in order to change and add to their initial models. Model how to do this as a whole class before having students work in small groups.
- 8. As students revise their models, walk around from group to group. As you circulate around the room, sit with each group long enough to hear their shared talk and decision-making around model revisions.
- 9. Have students share their small group models in front of the class. You can either have students hold their revised models up as the group shares their changes, or you can post models to the front of the classroom and ask for students to share what the notices about the revisions with the class.

Both Whole and small group reflection:

- 10. Discuss: What new information do we have from your families' models that we just added? How do these new ideas add to or change our understandings of our focal phenomena, and how we answer our "Should We" question?
 Both of these questions are on the LE6.1a student tool so all students should have reflections to share.
- 11. Remind students: We will be returning to this model every time we have some new information that might change our thinking about how to answer our "Should We" question. Plan on returning to the classroom model during LE7 investigations and LE8 data analysis.

Example Model

We decided to use the initial model we created for LE 6.A for this "Should We" question because we think it captures the various parts of the questions and some of the relationships involved. But...we might need to add some critters by the leaves moving forward (depending on our investigations in LE 7).



Becoming practiced at including family knowledges alongside classroom knowledge is an important step in helping students see that their family practices are important to doing science.

Assessment Opportunity: Class discussions enable you to formative assess and adapt lessons based on the range of family knowledges students share with the class.

6

Continued next page...



Let's Revise our Models from our Focused Wondering Walks!

Now that we have conducted more observation or our phenomena across different times and places, we are going to revisit our models from LE4 in order to help us understand how our decisions and how we approach our "Should We" questions can impact the species and kinds around our school and homes.

Our "Should We" Question is _____

The phenomena we observed

Part 1: Revise your Model

Take out your initial model.

Use sticky notes, new drawings, arrows, words and/or other symbols to add more detail to your models. You can also choose to delete details from your old model. It's okay for this revision to look a little messy as you work out your ideas!

- What relationships did you draw in your initial model?What are species, kinds, behaviors and/or relationships that your families think are important that are *missing*
- what are species, kinds, behaviors and/or relationships that your fammes unlik are hiportant that are missing from our model(s)?
- What new relationships did you observe on our classroom focused wondering walks?
 What relationships did your families prioritize that are *missing* from our model(s)?
 - Use thought bubbles or sticky notes to show how parts of your model help us answer our "Should We" questions. Use "Zoom In" lenses to show the invisible features of your model.

As a reminder the types of relationships you might observe on your walks are:

Animal-Animal	Plant-Plant	Plant-Natural Kind (for example: water, rock, sun, air)
Animal-Human	Human-Human	Human-Natural Kind (for example: water, rock, sun, air)
Animal-Plant	Other?	Animal-Natural Kind (for example: water, rock, sun, air)

LE6.1a reminds students of the types of relationships they can build into their models, and has directions to guide model revision.



Part 2: Reflection Questions

LE6.1a pg 2 invites students to think about how their model revisions help them understand the focal phenomenon as well as answer the "Should We" questions(s)

	How do your observations help you understand our focal phenomenon?	How do your observations help answer the "Should We" question?
What new relationships did bu observe on the focused wondering walks with your family ?		
What new relationships did you observe on our classroom focused wondering walks?		







LE6.2: Posing Questions for Field-based Science Investigations

Purpose

In this lesson, students will brainstorm possible investigation questions to answer the class "Should We" question and learn more about the focal phenomena. In the process of posing questions, students will learn about the three primary types of field-based investigations which will support students' investigation design in LE7.1.

Why this is important

Asking questions and defining problems is a core scientific practice that is closely related to the knowledges and values brought to an investigation. Posing and sharing questions, and reframing investigation questions based on different field-based approaches surfaces for students the social and cultural aspects of doing scientific research. Students may come to the classroom believing that scientific research is value neutral or driven only by facts because these are assumptions held within the dominant culture. However, science and scientific investigations are human endeavors that are shaped by the cultural lenses that researchers bring to the investigation.

Engaging family and community knowledge and practices

Asking questions and defining problems are practices that students engage with daily across the settings of their lives in partnership with their families, friends, and on their own. Before students begin brainstorming investigation questions, ask students to surface and share questions that they have asked in order to make informed decisions and/or discover more about their word. In this way, you position family knowledge as a critical component of classroom science learning, thus helping students see that their families' ways of knowing and doing make important contributions to science. Read the Wonderings, "Should We"s & Investigation Questions framework to learn more about centering family knowledge and data from the family tools as students pose investigation questions in this LE6.2.

LEARNING GOALS

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

- 1. describe three different types of field-based science investigations.
- 2. pose research questions and modify questions based on the types of data available or collected.

CONNECTIONS TO NGSS

- » Crosscutting Concepts: Patterns; Cause and Effect; Structure and function; Stability and change
- » Science Practices: Asking Questions and defining problems, Engaging in Argument from Evidence
- » Disciplinary Core Ideas:
- LS1: From molecules to organisms 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

- Whole and small group discussion are formative assessment opportunities
- » LE6.2a Posing investigation
 Questions tool can be used as
 an individual or small group
 assessment artifact

1



Teacher background information

Investigation questions are a unique type of question that can be explored through systematic observation of the social (human) and/or natural (non-human) world. Below is a list of three kinds of investigation questions - these are not the only ones, but will be helpful to you as you construct your investigation. Investigation questions often begin with how, where, when, and under what conditions.

Kind of Investigation Question	Kinds of Considerations to the Question	Example
 Descriptive Questions: Describes the behaviors or characteristics of a species. Describes the relationship between two or more living/ non-living beings. 	Descriptive Questions help us better understand why a particular species acts or relates to others the way it does. A strong answer will include many details about what you have observed over time and in several locations.	How do worms move in the soil? - a close study of worms and their movements/ behaviors in different kinds of soil.
 Comparative Questions: Compare and contrast a phenomenon across places and times 	Comparative questions help us understand why or how a phenomenon occurs, and under what conditions. A strong answer will include details about similarities/ differences across places and across times (day/night, seasons, years, etc).	Where can I find the most worms? - a close study of worms in different locations
 Correlative Questions Explain patterns between different species and/ or species and their environment. 	Correlative questions help to answer relationships and patterns in the world. A strong correlative question will include details about observed patterns	What happens to worms when it rains? - a close study of worms in different weather conditions.

In addition to the three types of questions in the table above (descriptive, correlative and comparative) that guide single investigations, your investigation, or several investigations, might be anchored by an overarching explanatory question (why or how so) or decision question (can we, should we). These kinds of questions give purpose to your investigations, but may not be answered solely by one investigation or even a series of investigations. They may require additional research such as reading what other scientists have learned or discussing your investigations with community members or leaders. Or, they may serve as an umbrella over a series of field-based investigations that complete throughout the year. Below is an example of how explanatory and/or decisions questions can support sensemaking around other types of questions. Notice that decision questions often help answer "Should We" questions while explanatory questions support investigation of focal phenomena. Understanding phenomena can help students answer "Should We" questions so these questions can be asked during the same investigation arc.

- Decision Question: Should we rake dead leaves on our greenspaces?
- **Explanatory Question:** Why might dead leaves in our greenspaces be helpful or harmful to those who live in and visit our neighborhood?
 - » **Descriptive question:** Who/what can we find under dead leaves in our greenspaces? How many critters can we find under dead leaves?
 - » **Comparative question:** What are some similarities and differences between who/what is under dead pine needles and dead leaves? What are some similarities/differences between who/what we find under leaves versus a mowed green space?
 - » **Correlative question:** What happens to the plants in the garden if we find a lot of slugs in the dead leaves? What happens to plants whose roots are covered by dead leaves versus plants whose roots are not?



Centering equitable practices:

- 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 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.
- Use supporting questions to orient students' brainstorming towards the 5 socio-ecological dimensions that thread throughout classroom and family learning engagement, and example questions are highlighted in the tables above.
 - Species, Kinds, & Behaviors

• • • • • •

•

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- Relationships
- Places, Lands, & Waters
- Thinking Across Scales
- Human Decision-Making

To prepare for this lesson

- Decide ahead of time how you want students to engage in this lesson so that you can plan how you will orchestrate and facilitate this learning engagement. Students will be brainstorming potential investigation questions for their field-based investigation design and data collection. These questions will draw on prior family and classroom learning engagements including LE5.1 Asking "Should We" questions and LE 6.1 Revising Models. Decide how students will reference and share these resources as they brainstorm questions for this lesson.
- 2. Decide how you want to introduce the different types of field-based questions and how you will organize student questions around these three topics. This learning engagement is written to foreground student brainstorming in order to anchor later learning of the types of investigation questions.
- 3. Preview LE7.1 to see how investigation questions will lead to field-based investigations in the next Learning Engagement. In particular, look through the 12 research protocols in LE7.1b and the protocol overview table LE7.1f, to see which tools are already available for data collection. You may choose to direct students questions in a way that supports the later use of one or more of these tools during LE7. You can do this by asking whole-group and smallgroup questions to support students' thinking around particular topics. For example, you might ask: "How does the amount of daylight during different times of the year affect our focal phenomena and/or class "Should We" question focus?



MATERIALS

- » LE6.2a Posting Investigation Questions: What more do you want to know?
- » Optional: Sticky Notes

Instructional Sequence

Whole group instruction:

- 1. Remind students of the class phenomena and "Should We" question(s), and tell students: "Now that we have revised our "Should We" question models, we are going to think about how to design investigations and gather data to answer our "Should We" question. Today, we will begin the first step in this process by brainstorming possible research questions to quide our investigations."
- 2. Ask students to share examples of the questions they ask in everyday contexts (with their friends or families for example). You can give an example from your own life as a model. For example, "Today, my toaster stopped working and I wanted to know: did it stop working because the toaster is broken, or because the outlet isn't working?" You may choose to have students take out or reflect on their family "Should We" question activity from LE4.2 to support this reflection.
 - a. Whole Group Discussion- If you conduct this part of the learning engagement as a whole group discussion, have students turn and talk with a partner before sharing their reflections on everyday question asking and asking "Should We" questions with their families.
 - b. Small Group Discussion- You can also enact this part of the lesson as a small group discussion by allowing students to talk with each other and share their "Should We" family tools and everyday questioning reflections with classmates before sharing with the class.
- 3. Tell students "You already have so much practice asking questions to find out more about our world, and to help make decisions in your everyday lives! Today we are going to use those same practices of noticing and asking questions related to our focal phenomena and "Should We" questions.
- 4. Hand out the LE6.2a, Posting Investigation Questions: What more do you want to know? Students can write directly on this tool or can work on a separate sheet of paper as shown in the students worked example below.
 - a. Either share or ask students to share out the class "Should We" question, and have students write it at the top of the page.
 - b. Next, either share or ask students to share the focal phenomena for this investigation, and have students write it at the top of the page.
- 5. Tell students "While we ask many different types of questions in our everyday lives, in order to design our investigation today we are going to focus our questions on further understanding the phenomena we have been Continued next page... observing and our "Should We" question(s).



Assessment **Opportunity**:

Understanding students' everyday practices is a way to adapt instruction to build on these existing ways of knowing. Build on students shared example by showing how they can lead to deeper scientific investigations.



TIME 50 mins



6. Review the tool with students by orienting to the column and rows. Tell students that the column on the left invites them to think about questions related to the 5 socio-ecological dimensions that they have been exploring so far: Species, Kinds, & Behaviors, Relationships, Places, Lands, & Waters, Thinking Across Scales, and Human Decision-Making

Small Group Work

- 7. Arrange (or keep) students in their small groups as you model how to brainstorm investigation questions using LE6.2a. For example, you might say: "Before we come up with questions with our groups, let's think of examples together as a whole class. We can start in the first row by asking, "What more do we want to know about the species, kinds and behaviors that we observed wondering walks?"
 - a. Ask students to share example investigation questions. Record one or two example questions in a visible place in your classroom.
 - b. Next, ask students to think about the types of data they would need to answer this/these question(s). Record answers in a visible place in your classroom.
- 8. Give students time to brainstorm and record investigation questions and related data collection needs in their small groups.
- 9. As students work in small groups, circulate around the room and find time to sit and listen to each group's sensemaking in order to understand the general research interests and ideas among the class.
- 10. Tell each group to pick one guestion from their list that they would like to share with the class. Let students know that the question they pick will be used shape their field-based investigations.
 - a. You may want to let students know that no one question will be picked for the field-based investigation, but that you will consider all of the shared questions to design a field-based investigation that builds on students' prior noticings, wonderings and interests.

Whole Group Instruction

- 11. After students have had time to brainstorm questions and make connections to the types of data they would collect for each question, bring students back together as a whole group.
- 12. Have each group share one question and their data reflections with the class.
 - a. Option 1: You can have students verbally share their question/ data reflections while you write it on a board or sheet of easel paper where it can be saved.
 - b. Option 2: You can have each group write their question/ data reflections on a sticky note to post to a visible place in the classroom. Then, you can read the questions to the class.
 - c. Note: If you have a large class with many groups, pair groups together to pick one question before sharing with the whole group to save time.

Assessment Opportunity: Listening to students ideas and questions can help you plan your investigation and protocols for LE7.1. and LE7.2.

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- 13. When each group has shared a question and data to collect, invite students to look for patterns in their questions. Example questions are below to guide this discussion, and try to tie this reflection back to some of the questions that students shared about their everyday decision making in Step 2.
 - a. What types of questions are we asking as a class?
 - b. What topics are we most interested in exploring?
 - c. How are the types of data we need to collect similar and different across the different types of investigations?
 - d. Tell students: "Besides collecting data outside, we will need to do other types of research too. For example, we will talk to other members in our families and communities that know about these topics, read books listen to podcasts, and watch videos."
 - e. Have students share their own ideas about who they might talk to about the topics on their class list, and other resources they might explore.
- 14. Tell students,"Look at all of the investigation questions you've come up with! We now have to decide on which ones we want to explore, but first I need to do some thinking about the best ones to start with."
 - a. Use students' shared questions to guide the design of your class's fieldbased exploration in the next LE.
 - b. Walk around your school grounds and consider your students family wondering walks data to determine which types of investigations would work well for the class both at home and at school.
 - c. Look through the protocols in LE7.2 to see which ones can support students interests and the affordances of your school and students' neighborhood spaces.

Finding patterns is an NGSS cross-cutting concept and an important field-based science practice

Make sure to emphasize that families and communities are important sources of information.





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

Purpose

In this learning engagement, you and/or your students will design investigations and collect data in the field, classroom, and their neighborhoods. LE 7 begins with planning your class's investigation based on students' questions from LE6.2. You will find planning supports embedded in the first part of the Instructional Sequence to support the planning process. Depending on the age and experience of your students, you may choose to use students' prior noticings, wonderings, models and questions to guide your design of the experiment before bringing students into data collection activities. Note the first part of this Learning Engagement is designed to support your own learning around types of field-based experiments, experimental design, and data collection in order to support your students' early efforts to co-design investigations with you as a guide. For this reason, you will find that the Teacher Planning is longer than prior Learning Engagements and includes multiple planning tools in the text. Take the time to read through the details of this lesson plan, knowing that many of these details are not yet necessary for younger learners to know (such as types experiments).

Why this is important

Throughout human history and across cultures, people have been engaged in observational practices to build their knowledge of systems. Observations are also 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. This process of planning and carrying out investigations enables us to move from opinions, beliefs, or initial ideas about phenomena to making claims from evidence. Students build initial ideas about natural phenomena through everyday observations and explorations within their communities. The prior learning engagements across settings set the foundation for building more complex and disciplined ways of knowing through field-based science investigations that engage students in the practices of developing and using models and planning and carrying out investigations that allow students to gather data across the settings of their lives, including home, their communities and school. As students see phenomena unfold across these settings they will be able to analyse and make sense of data and engage in informed ethical deliberations in order to answer their "Should We" questions in later Learning Engagements.

Engaging family and community knowledge and practices

There are many ways to collect data and gather information to explore a "Should We" question, because "Should We" questions explore the connection between the natural world and human lives, choices, and behaviors. Doing field-based investigations is one way. You can also talk to people in your community, like elders or people who live and work in places that you are investigating. Research tools in this Learning Engagement will help you do this type of community-based research! You can also do background research by finding information in books, podcasts, on the internet, and other forms of media to see what people already know about your "Should We" question. Most of the time, you'll need to do all three kinds of evidence-gathering in order to fully explore your "Should We" question. For example, in LE 1, we ask students to make some initial claims about how they know what season we are experiencing. Students may say they know it is summer because it is hot or it is winter because it is cold. This is not wrong, per se, but it is an incomplete explanation of seasonal changes. Collecting multiple data points enables students to build on their experiences and knowledge about the relationship between temperature and seasonal impacts to refine their ideas.



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LEARNING GOALS

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

 design field science investigations that help answer/refine our investigation question(s) and class "Should We" question

CONNECTIONS TO NGSS

- Crosscutting Concepts:
 Patterns, Cause and effect,
 Scale, proportion, and quantity,
 Structure and function,
 Stability and change
- » Science Practices:
 Planning and carrying out scientific investigations
- » Disciplinary Core Ideas: LS1: From molecules to organisms LS3: Heredity
- LS2: Ecosystems
- LS4: Biological Evolution
- ESS2: Earth's systems ESS3: Earth and Human
- Activity
- NOTE: Applicable ct
- [NOTE: Applicable standards will depend on the "Should
- We" question, and related
- focal phenomena you and
- students chose.]

ASSESSMENT OPPORTUNITIES

- » Class discussions offer formative assessment
- opportunities to guide the
- final design of your field-based investigation.
- » Observing and listening to student talk during data collection.
- Research design planning documents and data collection documents.
- » Community interviews offer writing assessment
- opportunities.

Centering equitable practices:

- **Provide equitable access to outdoor learning experiences:** Avoid centering student behavior outdoors as your main concern. While it is natural to be nervous about students' behavior outdoors, which might come from concerns about safety while outside, centering their behavior often eclipses their sense-making and robs them of opportunities to learn. Additionally, centering behavior often results in policing children of color more often and more harshly than white children. As you have already seen previous learning engagements, students will be excited to be outside. They will speak in louder voices than they normally would in the classroom. They will spread out but will come back together as they share their ideas, observations, and wonderings. Allow them both emotional and physical space to do this. Consult the **Supporting Learning Outdoors Framework** for strategies you can use to support students in their learning and sense-making outside.
- **Use the 5 socio-ecological dimensions to frame observations and wonderings:** Avoid too-simplistic framings of the activities in this learning engagement such as assuming simple cause and effect relationships among observations or observing only one variable at a time. As you and students design and collect data related to your field-based investigation(s), use these times and spaces as opportunities to use the 5 socio-ecological dimensions. This includes modeling how to take the perspective of more-than-humans, how to focus on relationships among species, kinds, lands, and waters, how to use different scales when observing and wondering (time, space, size), and how to look for evidence of human decision-making (because remember, humans are part of ecosystems, not dominant over them and not absent from them). Create a set of back-pocket questions related to the 5 dimensions and take them with you out on your field-based investigation(s) to prompt students as they are collecting data.



Teacher background information

Scientists use investigations to help them answer questions. They carefully plan investigations so that they know what data they want to collect. It is important to know that scientists don't usually do investigations without a purpose—they are always trying to learn more about something and answer some questions. This is why it is important for you to know how an investigation can help you answer your "Should We" question.Working with models helps scientists and science learners visualize their thinking and better understand the kinds, relationships, behaviors, and various scales being explored. Scientific models are dynamic and change based on new information learned through investigations of phenomena, discussions and deliberations with others like family and community, and media of various types. As you co-plan your field-based investigation with students, consider revisiting revised models in order to help students visualize the systems that they will be investigating and consider which types of research questions are the best fit for the phenomena and "Should We" question that your class is investigating.

Investigation questions are a unique type of question that can be explored through systematic observation of the social (human) and/or natural (non-human) world. Below is a list of three kinds of investigation questions - these are not the only ones, but will be helpful to you as you construct your investigation. Investigation questions often begin with how, where, when, and under what conditions.

Kinds of Investigation Questions

- **Descriptive Questions:** Describes the behaviors or characteristics of a species and/ or describes the relationship between two or more living/non-living beings.
 - » Descriptive Questions help us better understand why a particular species acts or relates to others the way it does.
 - » A good answer will include many details about what you have observed over time and in several locations.
 - » Example: How do worms move in the soil? a close study of worms and their movements/ behaviors in different kinds of soil.
- Comparative Questions: Compare and contrast phenomenon across places and times
 - » Comparative questions help us understand why or how a phenomenon occurs, and under what conditions.
 - » A good answer will include details about similarities/differences across places and across times (day/night, seasons, years, etc).
 - » Example: Where can I find the most worms? a close study of worms in different locations
- **Correlative Questions:** Explain patterns between different species and/or species and their environment.
 - » Correlative questions help to answer relationships and patterns in the world.
 - » A good correlative question will include details about observed patterns.
 - » Example: What happens to worms when it rains? a close study of worms in different weather conditions.
- Other Types of Questions: Your investigation, or several investigations, might be guided by an overarching explanatory question (why or how so) or decision question (can we, should we). These kinds of questions give purpose to your investigations, but may not be answered solely by one investigation or even a series of investigations. They may require additional research such as reading what other scientists have learned or discussing your investigations with community members or leaders.







Example of a series of field-based research questions from one "Should We" question:

- Decision Question: Should we rake dead leaves on our greenspaces?
- **Explanatory Question:** Why might dead leaves in our greenspaces be helpful or harmful to those who live in and visit our neighborhood?
 - » **Descriptive question:** Who/what can we find under dead leaves in our greenspaces? How many critters can we find under dead leaves?
 - » **Comparative question:** What are some similarities and differences between who/what is under dead pine needles and dead leaves? What are some similarities/differences between who/what we find under leaves versus a mowed green space? [comparative question]
 - » **Correlative question:** What happens to the plants in the garden if we find a lot of slugs in the dead leaves? What happens to plants whose roots are covered by dead leaves versus plants whose roots are not?

To prepare for this lesson

Before students co-design an investigation in LE7, it is important to talk about what investigations are and how they can help the class answer the "Should We" question. Conducting investigations is a key scientific practice that requires choosing data to collect, and careful examination of these data in the "field". Family investigations will also be critical for gathering evidence to make claims about phenomena of interest. These investigations will eventually help you decide on what action to take around the "Should we" question.

- 1. Designing a Field-Based Investigation at home and school (can be designed for or with students) (LE71.a)
- 2. Doing community based research and/or background research using a variety of sources including family and community members (LE7.1c, LE7.1
- 3. Gathering observation field-based data at home and school (LE7.1b, LE7.1d)

There is no "right" order for students to collect data from home, school, and other resources. For example, you might start with research into what is already known about your "Should We" question to inspire ideas about where to start with your field-based investigations or your community-based research. Or, if you start with your community-based research, that community member can give you clues about resources to read or field-based investigation questions to ask. Or, if you start with field-based investigations, your community-based research can help you explain your findings or it can help you think about the next questions to ask. As mentioned earlier, depending on the age and experience of your students you may choose to do the field-based experimental design before engaging students in the smaller details of planning and data collection practices. There is an appendix at the end of this Learning Engagement (after the instructional sequence) with planning support tools for how to design your field-based science investigation.



MATERIALS

- » LE7.1a Data Collection Planning Tool
- » LE7.1b Data Collection Protocols (choose from a set of 12 protocols which are described in the appendix).
- » LE7.1c Community Knowledge Data Collection
- » LE7.1d Data Protocol Family Tool Cover Page
- » LE7.1e Conducting Background Research
- » LE7.1f Overview of Data Collection Tools (with example questions and data)

Instructional Sequence

Step 1 (Teacher Planning): Design your Field-Based Investigation Note: this part is to be done as preparation before you teach the lesson.

Step 1: Coming up with a research question

- 1. Our "Should We" question is: _____
- 2. Brainstorm phenomena related to the "Should We" question.
- 3. Review student-generated questions from LE6.2. Write, modify, synthesize or copy students' questions that relate to the "Should We" question and related phenomena.
- 4. Review the list of available protocols for field-based research in LE7.1f (also in appendix below). Choose a protocol or set of protocols that can be used to support your students exploration of the "Should We" questions. Review the example research questions and data as models of how you can design your field-based investigation. List protocols that you can use below along with possible research questions and data.

Protocol # and Title (LE7.1b)	Investigation Questions	Qualitative and Quantitative Data

TIME

15-60 Minutes (Time varies by how much students are involved in the experimental design process). See two planning paths below.

HARUPE-CULTURE RELATIONS Understand Complex Socio-Evological Systems LEANNICE BEBING INFLICES Field-Based Science Learning Pomes Automotion Contraction Science Learning Pomes Automotion Contraction Contraction

N **tilth**

5. Design an investigation question or questions based on the work you did above. As you conduct your investigation, we recommend beginning with descriptive questions that might lead to comparative and correlative questions. The more data you collect - the more questions you will have!

Our investigation question: _____

6. Review the other data collection tools to think about how they can be integrated into your field-based investigation. Be sure to include at least one everyday knowledge tool (LE7.1c & LE7.1e) as well as the family data collection tool (LE7.1e) in order to position scientific knowledge in the community, in everyday resources as well as in the land and from school.

LE7.1c Community Knowledge Data Collection LE7.1d Data Protocol Family Tool Cover Page LE7.1e Conducting Background Research

Step 2: Share the Investigation Questions with the Class and Engage in Co-Design of the Investigation

Whole Group

- In LE6.2 students generated possible research questions to answer the "Should We" question. Tell students: "You all came up with excellent questions in the last lesson to help us make decisions around our "Should We" question. I read over all of your questions and compared them to some of the tools we have available for our research, and came up with one investigation question for us to explore together! Our questions is:
- 2. Ask students to brainstorm what this question means to them: can you tell me, in your own words, what you think we'll be investigating? Where do you think we should investigate this question at school/ Where do you think you and your family could investigate this question in your neighborhood?
- 3. Tell students: "Now that we have our investigation question, we are going to think about types of data that we need to collect, and how we will use that data to answer our "Should We" questions. Ask students, "Who can tell me what "data" means?" Ask for their ideas, and confirm that when we say "data", we mean types of information that will help us answer our question. Data can come from studying something outside, talking to people, or reading books/ watching videos, etc.

Give students a brief overview of the investigation structure, and let students know that they will be collecting data at school and at home, and also read books and talk to community members to find more about their research topic.



Small Group Work

- Arrange students in small groups, and give each student a copy of the LE7.1a Data Collection Planning Tool. Have students complete the tool together in order to consider when, where, and how they will collect their data, and to engage in the practice of designing experiments. The purpose of this tool is to get students to think about experimental design, and to share their ideas with the class. You will synthesize and streamline students ideas in the final investigation design.
- 2. Remind students to think about designing an investigation that they can do with their families as well as at school, and to think about family and community experts, books and other resources that they would use to learn more about their research questions.
- 3. ReviewLE7.1a with students before they complete the document in small groups.

Column 1: When will they collect data? Column 2: How many groups of students should collect data (i.e. work in pairs, etc.) Column 3: Where are all of the places you can collect data? Column 4: What data would you collect? Column 5: What tools will you need?

Whole Group

- 1. As part of a whole group discussion, ask students to share a summary of their research design with the class.
 - » Option 1: Students verbally share their research designs with the class. As students share, record the details of their details of their designs in a visible place in the classroom, such as the board or a piece of easel paper.
 - » Option 2: Students draw a model of their research designs to share with the class.
 - » For both options, draw a table similar to the one below on the board or easel paper (or project it onto a screen) to record students' ideas.

Assessment Opportunity: Surface students' understanding of research design, types of data, and data collection.

When will you collect data?	Where will you collect data?	What data would you collect?	What tools will you need?

2. Tell students: "We have done a great job of thinking about all the ways that we can collect data to find out more about our investigation question(s) and answer our class "Should We" questions! I will use your ideas as I look through all of the tools we have for our investigation, and we will begin collecting around our homes and school soon!"



Step 3: Place Map and Pick your Tools for the Investigation

- Before finalizing your investigation plan, engage in place mapping around your school. Look for places where students can collect data using the data collection protocol. Test the protocol by collecting data and using the same tools as the students. Adapt the protocol if you need to meet the affordance of your investigation site.
- 2. Use students research designs to adapt your original research plan, and complete the table below with the final protocols, LE7.1 tools, and other materials that you will need for your investigation. Consider reserving books from the school library to support students LE7.1e work.

Data Collection Tool	How, when, with whom it will be used
The protocol(s) I will use for our school investigation (LE71.b): See the overview in the appendix, and adapt or create your own if you have other data collection needs	
The protocol(s) I will send home to families (LE7.1d cover page + protocol) This should be the same as or support the ones used in class	
Community Knowledge Data Collection (LE7.1c) Have students interview or email others in their community who know about the investigation topic. Make sure that family and community members are positioned as experts and not just professionals in related fields.	
Conducting Background Research (LE7.1e) Engage students in background research using podcasts, books, videos and other resources that students use in their everyday lives.	

3. If your protocol requires student-made tools, plan an activity for students to make these tools as part of an engineering lesson! Make sure that each student has the tools they need or knows how they will be sharing tools as part of data collection.



Step 4: Collecting Data (These steps can occur in any order, but make sure to engage students in family-based learning before collecting data at school)

Invite families to collect data in their own neighborhoods

- a. Send home the family tool (LE7.1d along with the protocol for your investigation from LE7.1b) and invite families to participate before you and your students conduct your investigation at school. This will give families time time to make sense of phenomena and investigation questions before students engage in these practices at school.
- b. Before sending home this family tool, ask students to fill out the first page of the tool with the necessary information for families.
- c. Let families know that it is okay if they can only complete part of the protocol. Engaging their child in data collection around a shared research question is the most important part of family learning.

Collect Investigation Data



- a. Prepare to collect field-based science data from your selected site. You can use the Supporting Outdoor Learning Framework to think about roles for students outdoors, and practices that can support learning outdoors.
- b. Students should have already practiced the LE7.1b protocol with their families, but also review the protocol with students before heading to your research site. Make sure that students have the data collection tools they need, and understand if and how tools will be shared as part of data collection.
- c. As students collect data, they should be using the 5 socio-ecological dimensions to guide their observations and observations.
- d. Whenever you can, ask questions to deepen students' observations, wonderings, and sense-making about the focal phenomena. Use the **back-pocket questions** you created when preparing for this lesson.
- e. Remember to consult the Avoiding Potential Challenges section of this lesson plan for important things for you to keep in mind during this Wondering Walk.

Community-based and Background Research



- a. In addition to using the protocols at home and school, use one or more of the LE7 research tools to collect additional information about your investigation topic.
- **b. LE7.1c** Community Knowledge Data Collection- invites students to interview or email a more knowledgeable community member about the research question and topic.
- c. LE7.1e Conducting Background Research- invites students to collect information about their investigation topic from a variety of resources.
- d. You and your students will synthesize and analyze their data in LE8.



Appendix:

LE7.1f Data Collect Tools Overview

These data collection protocols are designed to support your field-based science investigations. As you plan your field-based science investigation, review these tools to see which one(s) support research your focal phenomena and "Should We" question. Throughout the year, you may choose to do multiple protocols to collect more data to answer the "Should We" question.

Na Col	me of Data lection Tool	Example Investigation Questions (but there are many more!)	Types of Data Collected
1.	Invertebrates (Critters) Biodiversity Tally Sheet	 Where do we find the most bugs/invertebrates (under rocks, in the sun, by water, etc.)? Do bugs like sunny or shady spots, moist or dry soil? 	 » Quantitative: number of invertebrates » Qualitative: species of invertebrates
2.	Biodiversity Species Type and Abundance	» The type and abundance of species in an area	 » Quantitative: number of types of species and how many of each » Qualitative: types of species, maybe also details about them (juvenile, adult, male, female, etc.)
3.	Species Behavior	 » What do species do in our neighborhoods? » How do species interact with each other and kinds? » How does species behavior change with weather, time of day, etc.? 	 » Quantitative: number of different species, number of each species » Qualitative: behavior and relationship observations
4.	Leaf Observations	 » How do leaves change after they have fallen off of a tree? » How does weather affect the look and feel of leaves? » How are leaves similar and different? 	 » Quantitative: Relative number of leaves on the ground. Size of leaves. » Qualitative observations: Changes to leaf structures based on conditions (time, weather, etc.)
5.	Canopy Coverage	 » How does canopy cover affect species on the ground? » How does temperature change under canopy cover? » How does canopy cover change by season? 	 » Quantitative: Densiometer shadings (see tool for details), corresponding species or temperature data » Qualitative: Quality of canopy cover/health in different areas. Behavior of species/ response of plants related to canopy cover. Feeling of air temperature, moisture related to canopy cover.
6.	Soil Observations	 What organisms are found above, below the soil? How are organisms related to each other? Relationships between species and kinds. 	 » Quantitative: relative soil moisture, soil temperature, species counts. » Qualitative: species-kind, species-species relationships, behaviors, etc.
7.	Soil Moisture	 What types of soil are around my school or in my neighborhood? How does soil type relate to moisture, species diversity, abundance, rain runoff, etc.? 	 » Quantitative: Soil moisture levels approximated through paper towel "test"; soil temperature readings (and then identification of soil type) » Qualitative: Soil type, feel, relationship to runoff, etc.



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8. Density of Coverage	 How does the density of species vary in different places? How does the physical environment (soil, leaf coverage, weather) affect the density of species? 	 » Quantitative: grid shavings or density coverage (density observations vary by questions). Count of types of species observed. » Qualitative: species behaviors
9. Observing Relationships at Scales	 How species are related to each other in a place. How organisms interact with their physical environment in a place. How we can notice different types of relationships by observing them at different scales (i.e. zooming and and zooming out) 	 » Quantitative: numbers of species and counts. » Qualitative observations at different scales (zoomed out and zoomed in)
10. Daily/ monthly/ seasonally Time & Temperature Readings	 How does temperature change throughout the day? How do species (plants and animals) and kinds (water and soil) respond to daily changes in temperature? 	 » Quantitative: Time and temperature » Qualitative: (optional) The relative feel of the temperature throughout the day (when sun is high/low)
11. Daily/ monthly/ seasonally Weather Documentation	 What is the weather like where I live? How does the weather change on a weekly and/or monthly basis? 	 » Quantitative: Dates, months, and temperature (optional) » Qualitative: Identification of weather (sunny, cloudy, etc)
12. Daylight by Season	 How does the amount of daylight change throughout the year? How does the amount of daylight relate to other things I observe in my neighborhood, like species abundance and behaviors, bloom times, leaf fall, and temperatures. 	 » Quantitative: Amount of daylight (documenting time of sunrise and sunset) » Qualitative: Seasonal data and optional data







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.



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LEARNING GOALS

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

- 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
- 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 decisions and 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)





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.



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.

Instructional Sequence

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

- 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.

Complex Socio-Ecological Systems Culture, Families, & Communities Markets Field-Based Science Learning

80 minutes (20 minutes planning with the Summary

Table, 15 minutes student planning tool, 45 minutes

Continued next page...



TIME

finding patterns)

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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:

- 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.



- 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.



- 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).



- 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.

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.
 - 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.



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.



LE 8.1 SUMMARY TABLE

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

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

How to use this tool: We recommend that teachers fill out this form first before introducing



explanations investigation. This is also a time to think about the final activity and record what criteria you want to see reflected in students' final it to the class. This can help teachers demonstrate how to trace the investigation cycle and pop out patterns in connection with the bigger

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

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

- Ņ 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

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





LE9.1: Sharing initial decisions and explanations

Purpose

In this lesson, students reflect on the status of their progress towards exploring their "Should We" questions. Students come up with their best decisions for actions they should take around their "Should-We" questions so far, and list the corresponding evidence that they have for those decisions. They explore questions such as "What are the data suggesting we should do and why? Do we have enough information to make a decision? Did we include all of the important perspectives and voices in our research? If not, what should we do next? What questions do we still need to answer in order to make a decision?" Students also reflect on what they should be considering but are not yet—who is left out of our decision? Who should we include?

Why this is important

Human communities have always made socio-ecological decisions. From choices about what to eat, where to live, how to get around, to whether water is safe to drink, amongst many others. These choices are shaped by our values and cultural practices and fundamentally reflect what we call construals of nature-culture relations. Nature-cultural relations are the ways human communities construct their ways of thinking and being (everyday, institutional, legal, etc.) with the natural world. Importantly, these relational construals have changed over time for different communities, and are often shaped by the technologies and uses of energy that have become central to human life in some parts of the world. Since the industrial revolution there has been global scale change to practices of extraction and large scale agriculture, amongst other things. These changes significantly impact nature-culture relations in many places in the world, but are having heightened impacts in what is known as "climate change hotspots". These changes have a pronounced correlation with the development of nation-states, capitalism and the histories and power dynamics that created them, and continue to.

Engaging family and community knowledge and practices

In this lesson, students consider evidence from a variety of sources, including investigations done in students' neighborhoods with their families and in their communities. Students are also asked to deliberate on what actions they might take around their "Should We" questions—and what kinds of values, evidence, and relations drive those actions. These include family and community knowledge and practices, as well as family and community connections to place.



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LEARNING GOALS

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

- Use patterns and explanations from LE8 as evidence for decisions and actions to take around the "Should We" question.
- 2. Deliberate about socioecological decisions and actions even with incomplete information. This includes articulating family, cultural, and community values that drive their decision-making.
- 3. Reflect on the status of their knowledge so far around their "Should We" question.
- 4. Construct new questions to investigate related to any knowledge gaps that they identify.

CONNECTIONS TO NGSS

- Crosscutting Concepts: Patterns; Cause and Effect; Scale; Systems and System Models, Energy & Matter Structure and Function; Stability and Change [NOTE: several of these might apply depending on the focal phenomena]
 Science Practices:
- Obtaining, Evaluating, and Communicating Information, Analyzing and Interpreting Data, Constructing explanations, Engaging in argument from evidence
- » Disciplinary Core Ideas: LS1: From molecules to organisms
- LS3: Heredity
- LS2: Ecosystems
- LS4: Biological Evolution
- ESS2: Earth's systems
- ESS3: Earth and Human
- Activity
- [NOTE: Applicable DCIs
- will depend on the focal
- phenomena you and
- students choose.]

ASSESSMENT OPPORTUNITIES

- » LE9.1b: the ways in which students use patterns from their data across multiple sources to back up their initial decisions
- Student talk (observations they make, questions they ask, wonderings they voice) during the small group discussions
- Whole-group discussions around initial decisions, reflections on their knowledge so far, new questions that are raised

To prepare for this lesson

It will be important for you to review the explanations and evidence generated in LE8 and come up with your own initial decisions around the class's "Should We" questions based on those explanations and the evidence for them. Also, try to fill out the graphic organizers in LE9.1b and 9.1c. That way, you'll be able to anticipate missing pieces that the students might identify, as well as next steps that you might encourage students to take to come to a decision around their "Should We" question.

The Ethical Deliberation and Decision-Making in Socio-ecological Systems Framework and the Wonderings, "Should we", and Investigation Questions in Field-Based Science Framework will both be good references for you as you prepare for this lesson.





Teacher background information

We are living in an unprecedented time in human history–what has been named the Anthropocene. The Anthropocene is a new geological era in which human activity is fundamentally reshaping earth processes– and unfortunately in ways that are having devastating and cascading effects for the social and ecological arrangements of life on earth. However, these impacts are heavily mediated by powered differences across history. For example, many climate change hotspots are not places or communities that are reflective of the technologies or societal structure and uses of energy that created the Anthropocene. While humans have entered this era perhaps unintentionally through development, inventions, and a range of other factors, there are many critically important lessons to be learned. A key skill for coming generations will be to engage in forms of sensemaking, deliberation and decision-making about social-ecological systems that can hold the complexity of the challenges and possibilities in front of us to restore and develop just and sustainable nature-culture relations that support our collective adaptive capacities in the changing earth.

Centering equitable practices

- Make decision-making visible: Avoid making complexity in decision-making invisible. We are always
 making decisions from contexts of power and historicity. For example, we could choose a humandominant perspective when deciding what action to take around the "Should We" question, or we
 could choose to consider more-than-human perspectives as we decide. We could choose to ignore
 historicized racial inequities in places when deciding on our actions, or we could choose to include BIPOC
 (Black, Indigenous, People of Color) people in our community research to understand all of our collective
 perspectives and be better informed as we deliberate. How we conduct our investigations is crucially
 important to the quality of the data that we collect, and consequently the kinds of evidence-based claims
 we can make as we deliberate. When you make underlying assumptions visible to students, they become
 more nuanced and ethical decision-makers. There are several ways that this lesson makes
 decision-making visible:
 - Reflecting on the evidence base for decision-making-and what might still be missing
 - Reflecting on which values are driving decision-making—and what other values might be left out
 - \cdot Taking the perspective of others and considering who the decision benefits and who it does not
- **Encourage more-than-human perspective taking:** Avoid describing ecosystems only in terms of how ecosystems are useful for humans. In order to engage in ethical deliberation and decision-making about places, we need to support students in taking the perspective of more-than-humans in natural systems. How is this decision good for the trees? How is this place good for the worms? for the soil? Beginning to ask these questions will encourage students to take on broader perspectives when engaging in ethical deliberation and decision-making around ecosystems.
- Encourage human connections to ecosystems: Avoid positioning humans as disconnected or apartfrom nature. This learning engagement encourages thinking about connections between humans and the rest of the natural world and starting from assumptions of complex interdependence instead of human-centric or dominance.



MATERIALS

- » Explanations and evidence from LE8.2
- » Student sheet LE9.1a: Initial decisions around our "Should We" question
- » Graphic organizer 9.1b: Our class's initial decisions around our "Should We" question
- » Graphic organizer 9.1C: What should we consider when deciding on our "Should We" question?

Instructional Sequence

- Begin the lesson by reviewing some of the key evidence-based explanations that students formed in LE8.2. Review with students that they just completed investigations in the field (outside) both in their neighborhoods and around the school, with community members, and on the internet/in books. Remind them that they found patterns in those data and formed some explanations based on evidence from those data about their focal phenomena.
- 2. Ask students: What was the "Should We" question that we were exploring through our investigations?
- 3. Explain to students that in this lesson, they will be putting the pieces together to see if they are ready to make a decision about what to do about their "Should We" question. Show LE9.1a: Initial decisions around our "Should We" question on the doc cam. Model for students that, in small groups, they will be making some initial decisions about actions they can take around the "Should We" question. They should come up with at least one action they SHOULD do and one action they SHOULD NOT do. The most important aspect of this should be their "because" statement—and that should be based on what they found in their field-based, community, and other research.
- 4. Hand out **LE9.1a: Initial decisions around our "Should We" question** and allow groups of students to discuss. As you circulate around the room, some questions you can ask are:
 - a. What did we find in our field-based research that makes you think we should/should not do that?
 - b. How did our community-based research help you think about this?
 - c. What did you find in our book/internet research that helps you decide that?
 - d. Is there anything else that we're not considering yet? What else would you want to know?

Class deliberation and decision-making

5. Gather the class back together and show **LE9.1b graphic organizer** as a way to record students' sharing of initial decisions and reasons from the three types of research that they conducted and analyzed in LEs 7 and 8.







Having evidence to support decisions is a form of arguing from evidence.

Assessment Opporunity:

Listening to students' initial decisions will give you an idea of the sense they are making from the data.

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- 6. Ask students: what do you think we should do? Why? Record students' ideas.
- 7. Ask students: what do you think we should NOT do? Why? Record students' ideas.
- 8. As students share, be sure to ask them for their reasons for why they think we should or should not do a certain action, and these reasons should be grounded in the research they conducted. Ask students: why do you think that? What did our evidence from our research tell us?

What is missing in our decision-making?

- 9. Now show students LE9.1C graphic organizer and remind them of the 5 socio-ecological dimensions that we first explored in LE2.3. Explain to students that because our "Should We" question is about a place, and places have lots of different aspects to them, and we need to make sure we're considering how our decision might have an affect on different spects of a place and system, including who else might be affected, how the natural world might be affected, what values drive our decisions, and what evidence is most important to consider. We want to make sure that we haven't missed an important aspect of our question as we try to make a decision.
 - a. You can either keep this as a whole class discussion or ask students to break up into small groups and each take a column of the graphic organizer. The point of this activity is for students to reflect on the evidence that they considered and listed in LE9.1b graphic organizer and see if there are any aspects of socio-ecological systems that they are missing.
 - b. Finally, talk as a class about which **values** are driving their decisionmaking at this time, and who their decision benefits or hurts. It is important for students to see that, along with scientific evidence, our family and community values always affect our decision-making, and that our decisions always have consequences for different human and more-than-human communities.

What questions do we have now?

- 10. Explain to students: it seems like we have some evidence telling us that we should take certain actions, and some evidence telling us that we should NOT take other actions. We have also identified some aspects of our question that we might need to know more about or include in our decision-making. What other questions do we have now that could help us be more sure about which decision to make? What else do we need to know? How should we gather that information? Are we ready to make a final decision?
 - a. If the class feels ready, move on to LE10
 - b. If the class feels like they need more information, go back to LE6.1 to revise their models and ask more questions.

Assessment Opporunity: Asking students for evidence to back up their decisions is a way for you see how they are constructing arguments from evidence.

Considering decisions from multiple viewpoints and reflecting on who is left out of decision-making is a step towards ethical deliberation and justice-oriented methods for research and decision-making.

Making visible the familial, cultural, and communitybased values that drive decision-making is an important step in supporting students' identities as decision-makers in science.

Evaluating the state of one's knowledge and deciding on next steps of an investigation are key scientific practices.



- 11. If the class moves back to LE6.1 to revise their models, you can remind them of the three kinds of revisions outline in LE6.1:
 - **a. Digging Deeper:** Sometimes we revise our models to get more specific about our phenomenon or questions.
 - **b.** Facing the Sun: Sometimes, like plants moving to chase the sun, we shift our thinking as we observe and make sense of our observations. We can often shift our thinking when we observe the same phenomenon from a different perspective.
 - c. New Growth: we want to add new information learned from our various resources; such as what plants attract different species of pollinators, what we learned about snags from an arborist, or from our tally observations, the different kinds of animals that use cone trees.
- 12. Ask students: what kinds of revisions will we be making? Do we have more specific information about something we have on our models? Are we seeing things differently now and do we need to add a new perspective? Do we have new information to add?
 - a. Use the procedures in LE6.1 to revise students' models.
 - b. Using their models, students should identify new questions they have and conduct more investigations.



Make sure to emphasize to students that the "because" is a very important part of their decision! And it should be based in the evidence from their investigations.

LE 9.1a Initial decisions around our "Should We" question - Student Tool

LE9.1a Initial decisions around our "Should we" Question

Overview: At this point you have done investigations and shared patterns with peers. We are going to try to make some decisions around our "Should we" question based on the evidence we have so far.

Decision about our Should we Question so far	Evidence for this decision
We should because 	From our field-based investigations at school and in our neighborhoods:
	From community-based interviews
	From other sources:
Learning in Places Learning in Places is fur	Ided by NSF grant #1720578. Not for distribution without citation
	It is important to emphasize from all three kinds of research is imporant in other words, the field-based investigations are not more imporant than the community-based interviews, for examples.



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LE10.1: Preparing our decisions and recommendations

Purpose

Your students and their families have engaged in multiple investigations around the class's "Should We" question. They have analyzed a variety of data, revised models, and formed explanations. In this lesson, you will first send home LE10.1a Family tool so that students can discuss possible decisions with their families around the class "Should We" question. Working in small groups in the classroom, students will prepare a recommendation for action around the "Should We" question to be shared publicly. The public sharing of your class's seasonal storyline investigation can take many forms: a seasonal summit, a play, written and shared stories, dioramas, etc.

Why this is important

Human communities have always made socio-ecological decisions. From choices about what to eat, where to live, how to get around, to whether water is safe to drink, amongst many others. These choices are shaped by our values and cultural practices and fundamentally reflect what we call construals of nature-culture relations. Nature-cultural relations are the ways human communities construct their ways of thinking and being (everyday, institutional, legal, etc.) with the natural world. Importantly, these relational construals have changed over time for different communities, and are often shaped by the technologies and uses of energy that have become central to human life in some parts of the world. Since the industrial revolution there has been global scale change to practices of extraction and large scale agriculture, amongst other things. These changes significantly impact nature-culture relations in many places in the world, but are having heightened impacts in what is known as "climate change hotspots". These changes have a pronounced correlation with the development of nation-states, capitalism and the histories and power dynamics that created them – and continue to.

Engaging family and community knowledge and practices

In this lesson, students will first discuss possible decisions around the "Should We" question with their families. Then, in class, they will collaboratively consider evidence from a variety of sources, including investigations done in students' neighborhoods with their families and in their communities. Students are also asked to deliberate around what actions they might take around their "Should We" questions--and what kinds of values, evidence, and relations drive those actions. These include family and community knowledge and practices, as well as family and community connections to place.



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LEARNING GOALS

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

- take multiple perspectives when considering decisions around our "Should We" questions,
- 2. deliberate about socioecological decisions and actions even with incomplete information,
- connect evidence from investigations to their deliberations and decisions,
- 4. connect decisions around "Should We" questions to family and community practices and values.

CONNECTIONS TO NGSS

- Crosscutting Concepts: Patterns; Cause and Effect; Scale; Systems and System Models, Energy & Matter Structure and Function; Stability and Change (NOTE: several of these might apply depending on the focal phenomena)
 Science Practices:
- Obtaining, Evaluating, and Communicating Information, Analyzing and Interpreting Data, Constructing explanations, Engaging in argument from evidence
 Disciplinary Core Ideas: LS1: From molecules to organisms; LS3: Heredity;
- LS2: Ecosystems
- LS4: Biological Evolution
- ESS2: Earth's systems
- ESS3: Earth and Human Activity
- [NOTE: Applicable DCIs
- will depend on the focal phenomena you and
- students choose]
- students choose.]

ASSESSMENT OPPORTUNITIES

- » LE10.1a Family tool: What "Should We" do?
 » LE10.1b Student tool: What
- » LE 10.16 Student tool: What decision are we making and why?
- » student talk during small group discussion
- » students' public presentations

To prepare for this lesson

- At this point in the Seasonal Storyline, you and your students should feel confident that you have enough evidence and have gathered enough information to make a final decision around your "Should We" question. You may have done a few rounds of investigations (going from LEs 6.1-9.1 a few times). These will be important as your students start to assemble their recommendations for action around your "Should We" question.
- It will be important for you to review family responses to LE10.1a Family tool-What "Should We" do? so that you can be prepared to incorporate families' decision-making alongside the class's decision-making.
- The Ethical Deliberation and Decision-Making in Socio-ecological Systems Framework and the Wonderings, "Should we", and Investigation Questions in Field-Based Science Framework will both be good references for you as you prepare for this lesson.
- Take some time to carefully consider who you want the audience for the public presentations. You might consider community members who have power to make decisions around the "Should We" questions (city council members, landscapers, city parks, community-based organizations), family, or even other classes in the school. An important part of preparing for these presentations is not only supporting your students in preparing, but also supporting the public audience--with questions to ask students that are both supportive but also authentic to their decision-making processes and acknowledge students' intellectual leadership. For example, the audience members can ask questions such as, "can you describe the evidence you have for your decision?, what other options did you consider and why was this the best choice? If we take the action you suggest, who else could be affected by our actions--other humans, places, more-than-humans? How might this affect all of our futures?"





Teacher background information

We are living in an unprecedented time in human history–what has been named the Anthropocene. The Anthropocene is a new geological era in which human activity is fundamentally reshaping earth processesand unfortunately in ways that are having devastating and cascading effects for the social and ecological arrangements of life on earth. However, these impacts are heavily mediated by powered differences across history. For example, many climate change hotspots are not places or communities that are reflective of the technologies or societal structure and uses of energy that created the Anthropocene--in other words, the communities bearing the brunt of climate change impacts are not the ones using the most energy or producing the most greenhouse gases. While humans have entered this era perhaps unintentionally through development, inventions, and a range of other factors, there are many critically important lessons to be learned. A key skill for coming generations will be to engage in forms of sensemaking, deliberation and decision-making about social-ecological systems that can hold the complexity of the challenges and possibilities in front of us to restore and develop just and sustainable nature-culture relations that support our collective adaptive capacities in the changing earth.

Centering equitable practices

- Make decision-making visible: Avoid making complexity in decision-making invisible. We are always making decisions from contexts of power and historicity. For example, we could choose a human-dominant perspective when deciding what action to take around the "Should We" question, or we could choose to consider more-than-human perspectives as we decide. We could choose to ignore historicized racial inequities in places when deciding on our actions, or we could choose to include BIPOC (Black, Indigenous, People of Color) people in our community research to understand all of our collective perspectives and be better informed as we deliberate. How we conduct our investigations is crucially important to the quality of the data that we collect, and consequently the kinds of evidence-based claims we can make as we deliberate. When you make underlying assumptions visible to students, they become more nuanced and ethical decision-makers.
- Encourage more-than-human perspective taking: Avoid describing ecosystems only in terms of how ecosystems are useful for humans. In order to engage in ethical deliberation and decision-making about places, we need to support students in taking the perspective of more-than-humans in natural systems. How is this decision good for the trees? How is this place good for the worms? for the soil? Beginning to ask these questions will encourage students to take on broader perspectives when engaging in ethical deliberation and decision-making around ecosystems.
- Encourage human connections to ecosystems: Avoid positioning humans as disconnected or apartfrom nature. This activity encourages thinking about connections between humans and the rest of the natural world and starting from assumptions of complex interdependence instead of human-centric or dominance.
- Acknowledge students' intellectual leadership and agency: Avoid speaking for students or their ideas. Students rarely get the opportunity in school settings to hold and show authentic intellectual leadership. They have conducted so much work around wondering and noticing, exploring the multiple dimensions of their "Should We" questions, collecting data from multiple sources, and having discussions and doing investigations with their families.



MATERIALS

- » Revised models from LE6.1
- » LE9.1a student tool (you may have multiple copies of this depending on how many rounds of investigations you went through)
- » LE9.1b-c graphic organizers (you may have multiple copies of this depending on how many rounds of investigations you went through)
- » LE10.1a Family tool--What "Should We" do?
- » LE10.1b Student tool: "What "Should We" do and why?
- » LE10.1c: Student checklist for preparing their recommendations

Instructional Sequence

Before launching this lesson, hand out LE10.1a Family tool and allow some time for the tools to be returned. The chart is the same as it is in LE10.1b Student tool--the point is that students will have discussions with their families about what they "should' do, and then bring back and share their family discussions with each other to come up with small group recommendations.

Instructional Sequence

- 1. Launch the lesson by asking students: What was the "Should We" question that our class has been exploring through our investigations?
- 2. Remind students of the process they've gone through: that they started out doing investigations at home and at school, they analyzed their data and then decided that they didn't have enough information and did more investigations.
- 3. Say to students, "We have done so much scientific work to explore our "Should We" question over the past few weeks. Our next step is to actually make a decision!" Explain to students that in order to do that, we have to make sure that we are considering all sides of the question, based on all of our evidence that we now have.

Preparing decisions and recommendations

4. Show LE10.1b Student tool Making our recommendations on the doc cam. Explain to students that this is the same chart they discussed with their families in 10.1a Family tool that they discussed with their families. Now it's time to talk in small groups about what your recommendations for action will be.

TIME



(depending on how long it takes students to prepare their final recommendations)

Complex Socio-Ecological Systems Culture, Families, 5 Communities LEADNING & BENC INFACES Field-Based Science Learning

Even if only a few family tools are returned, that's ok! Students can still contribute family values and perspectives in their small group discussions.

Keeping track of what steps they have taken is important for understanding what next steps scientists should take in their investigations.



- 5. Hand out LE10.1b Student tool Making our recommendations and allow times for small groups to work together to fill out the chart. Remind students that whatever their recommendation for action is, they need to back it up with at least three pieces of evidence. Also, they need to consider their decision from multiple points of view so that they are considering how their decision affects multiple parts of the system. Remind students that they can look at their models from LE 6.1 if they need help remembering the different more-than-humans that are a part of the system they are considering.
- 6. Tell students that they will be sharing these recommendations with a public audience who will ask them questions about their decisions, so their evidence will be an important part of sharing why they are making their recommendations.
 - a. This chart may take several class sessions to complete. Students might want to draw pictures or maps to add to what they prepare on the student tool.
 - b. Encourage students to discuss their families' recommendations during their small-group work.
- 7. Remember that, as students prepare their decisions around the "Should We" question, their presentations can take different forms--posters, slides, stories, etc. You can choose to have a "whole class" recommendation or have different groups make their recommendations and set up deliberation between groups that have differing recommendations.
- 8. However you configure your class in step 7, make sure that students not only have a decision but a **recommendation for action**. As they gather their recommendations for action, discuss how, in order to convince others to take this action, they need to back up their recommendations for action with arguments that include evidence, others' (including more-than-human) perspectives, and values.

Public Presentations

9. Based on how you set up the class configurations in step 7 above, make sure to bring your class through a rehearsal of their public presentation, including rehearsing some questions that they'll likely be asked (see the "To prepare for this lesson" section of this lesson plan).

Ethical deliberation around evidence, multiple perspectives, and multiple dimensions of socioecological systems is a important part of ethical decision-making.

One of the important parts of making decisions around the "Should We" question is to recommend communitybased action.





Why was this "Should We" question important to our family and our community?		Mak fam	ke sure that students ar ilies consider at least tw
What options are we considering?	Option 1:	opti	ons for their decisions.
	Option 2:		
What is our decision?	We should		
	Inis is supported by these 3 pieces or evidence: Evidence from my outdoor investigations at home and schools		Students and familie
	2. Evidence from my outdoor investigations at nome and school:		should use at least
	3. Evidence from other research:		from across their
	Values that are guiding our desisions		investigations.

A decision should imply some collective action that we should take and that students recommend.	What action should we take now? We should	
	How are we thinking about the places we live The places we live are important in this decision because when we make our decision?	
	How does our decision change our livesnow or This decision changes our lives now because in the future?	
	This decision changes our lives in the future because	
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This part of the tool asks learners to take perspectives of others to think about the ethical consequences of their actions and decisions.

Who does this decision affect?	This decision affects the more-than-humans in this place because:
	This decision does NOT benefit:
	This decision affects our family because:
What questions do we want to investigate next?	
Learning .	

At the end of the storyline, you and your students should have more questions to start a new seasonal storyline.

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