LE 6 Overview

Overview: Revising "Should We" Models and Posing Investigation Questions

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 make students' thinking visible, help them explain phenomena, as well as deliberate and make decisions about their "Should-We" question. Modeling is a dynamic and ongoing process that is continuously informed by students' discussions, investigations, and their growing understanding and curiosity about complex socio-ecological phenomena over time. Students are adept at drawing and storytelling, and educators should support students in using those skills to create models that explain ideas and observable and unobservable processes associated with phenomena. Furthermore, drawing and storytelling enables students to identify and reason about key Socio-Ecological Dimensions that may be challenging to articulate in conversation or writing alone.

In this Learning Engagement, students will revise their initial models of the class "Should We" question to layer in home based knowledge and additional ways of thinking about the "Should We" questions from the family and classroom engagement in LE4 and LE5. In addition, students will brainstorm and pose different types of field-based science investigations to prepare for designing a field-based investigation in LE7.

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

This learning engagement continues the work of focusing students' and families' observations and wonderings along five socio-ecological dimensions, now through the practices of modeling system components and connections to revise students' understanding of the "Should We" questions and related phenomena. By using the five socio-ecological dimensions to revise their models students can see the complex relationships between, for example, plants and other plants, and/or plants and animals, and/or animals and kinds (soil and water, for example) and the ways that relationships look similar and different at scale, from school to family investigations. The process of constructing and revising models is itself an argumentation practice that engages students in ethical deliberations and human decision-making and the role that humans play as part of (rather than separate from or dominant over) the natural world. Students' model revisions in LE6.1 prepare students to brainstorm and pose potential investigation questions in LE6.2 to see the breadth of data they would need to collect as they design investigations to answer their "Should We" questions in LE7.

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LE 6 LEARNING GOALS

This learning engagement incorporates both school and family learning activities to support students in revising models and designing investigations. By the end of LE6,

1. students will 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. students will synthesize observations from family and school settings to see how surfacing multiple perspectives is important for ethical deliberation,
3. students will describe three different types of field-based science investigations,
4. students will 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, Systems and system models
[NOTE: several of these might apply depending on the focal phenomena]

» **Science Practices:**
Asking Questions and defining problems, 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 DCIs will depend on the focal phenomena you and students have chosen.]

Learning Engagement in LE6

In this launch of LE6 it is important to surface for students the work that they have already done around noticing, wondering and modeling relationships with their families and classmates in prior learning engagements, as students will use these resources when revising their models in LE6.1

LE 6.1 Revising the Classroom Model of the "Should We" Question: In this activity, students will add to or revise the classroom model to incorporate family sensemaking about the "Should We" question, as well as incorporate new information and understandings from other sources (e.g., books, conversations with experts, media)

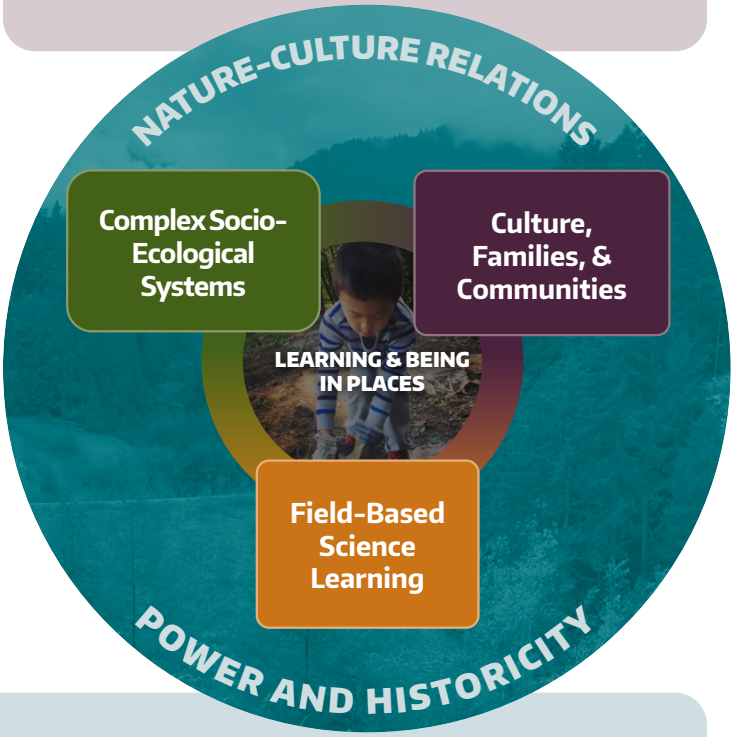
LE6.2 Brainstorming investigation questions: In this learning engagement, students will brainstorm possible investigation questions to answer the class "Should We" question and learn more about the focal phenomena. In the process of posing questions, students will learn about the three primary types of field-based investigations which will support students' investigation design inLE7.1.

Engaging the Rhizome

Complex Socio-Ecological Systems: There are many types of relationships within and across systems. These relationships include predator-prey, helping or hurting, causal relationships (X causes Y to happen), among others. Research demonstrates that even young learners begin to understand causal relationships among organisms and natural components within a system. Revisiting models allows students to create increasingly complex models as they synthesize observations across space and over time as they move through the storyline.

Field-based science Learning: This learning engagement incorporates scientific practices that are critical to field-based science learning: (a) modeling of socio-ecological phenomena which also engage students in (b) argumentation from evidence as they decide on how to represent relationships in their models, which sets students to (c) ask questions to frame their field-based investigations.

Culture, families, and communities: Families play a central role in this learning engagement. Students use families' tools to revise their initial models to include details about socio-ecological relationships that are important to their own families. This ensures that students understand that their families are valuable sources of information, and that everyone can learn something from them.



Power and Historicity:
When students see their families as valuable sources of information and as educators, it is empowering. It signals to students that families' perspectives, knowledge, and lenses on the natural world are important because they are helpful in better understanding socio-ecological phenomena. The activities in this learning engagement are designed, in part, to make visible to students that scientists are not the only people who engage in modeling as a practice to better understand the world. Students, families, and teachers can expertly engage in this sensemaking practice too!

Power and Historicity while learning outdoors:
As you have learned in LEs 1-5, classroom and outdoor teaching and learning are always done from powered positions. When student and family ways of knowing, doing, wondering, etc. are included in classroom learning, and positioned as equal to the knowledge, ideas, and wonderings generated in school, it signals to students and families that family knowledge is important and valued in the classroom. As a reminder, when students see themselves, their families, and the places that are important to them play a central role in what they learn in school, they understand that school science is related to their lives and their communities. This also signals to students that science does not stop when they leave school, and that their "Should We" models and investigation questions are relevant in their own neighborhoods as well as at school.

Learning in Places

Lesson Plan

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:

1. 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 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.

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 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:**

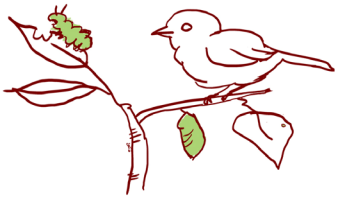
Species, Kinds, & Behaviors

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

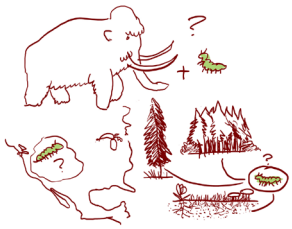
» What relationships did our families prioritize that are missing from our model(s)?

» 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.

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.

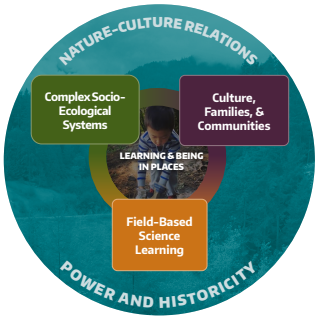
MATERIALS

- 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)

TIME

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

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.

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.

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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?

Helping students see their models as important sources of information, hypotheses, and predictions is an important part of the scientific practice of modeling.

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.

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.

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.

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

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).

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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* 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.

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)

Part 2: Reflection Questions

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

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- What are species, kinds, behaviors and/or relationships that your families think are important that are *missing* from our model(s)?
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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)
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Part 2: Reflection Questions

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

Lesson Plan

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

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

To prepare for this lesson

1. 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 small-group 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

TIME
50 mins

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 guide 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 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.

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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 question 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.

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

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.

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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 field-based 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.

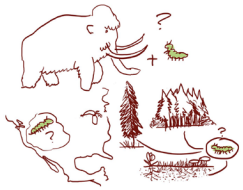
Asking Investigation Questions: What more do you want to know?

Now that we have observed and modeled the phenomena in our "Should We" question, we are going to brainstorm investigation questions that we can ask!

Our "Should We" question is _____

The phenomena we observed _____

5 Socio-ecological Dimensions	Investigation Questions	Data we could collect
What more do we want to know about the **species, kinds and behaviors** that we observed wondering walks? 		
What more do we want to learn about the **relationships** that we observed? 		

How can we learn more about the **places, lands, & waters** where we live? 		
How can we consider time and space (**scale**) as we conduct our investigations? 		
How does **human decision-making** affect where we live?