beetles

Science and Teaching for Field Instructors

Student Activity Guide

Interview an Organism

Interview an Organism gives students the opportunity to enter the world of an organism. Students slow down and have a "conversation" with an organism of their choosing, asking questions that can be answered through more observation while paying attention to its surroundings and the scale of its world. It helps take students to a "next level" of observing and questioning as they learn to ask themselves questions that lead them to make deeper observations. In the process, they get to know their chosen organism.

In this Exploration Routine, students search for interesting organisms and observe them. Each pair of students chooses an organism to study, comes up with questions about the organism's appearance and structures, while attempting to answer each one through observations. Then they move on to more probing questions about the organism's behavior, ecosystem, and relationships to other organisms. Afterwards, students share with other pairs and then with the whole group.

Students will...

- Ask questions that can be answered through observation.
- Answer their questions through observations.

Grade Level:
Grades 5–8. Adaptable for younger or older students.

Timing:
40+ minutes

Related Activities:
I Notice, I Wonder, It Reminds Me Of; Discovery Swap; and *Structures & Behaviors*

Materials:
For students: Journals or index cards and pencils
Optional: Hand lenses, nets, small collection cups, rulers, stopwatches

Tips:
To ensure a successful experience, review the teaching tips found on page 2 and throughout this guide.

Setting:
Choose an area where students can find intriguing organisms, like tidepools; underneath logs; in chaparral, ponds, or streams; in a forest, etc.

NEXT GENERATION SCIENCE STANDARDS

FEATURED PRACTICE
Asking Questions

FEATURED CROSSCUTTING CONCEPT
Structure and Function

DISCIPLINARY CORE IDEAS
Structure and Function or Interdependent Relationships in Ecosystems

For additional information about NGSS, go to page 12 of this guide.

THE LAWRENCE HALL OF SCIENCE
UNIVERSITY OF CALIFORNIA, BERKELEY

Interview an Organism

ACTIVITY OVERVIEW

Interview an Organism	Learning Cycle Stages	Estimated Time
Preparing to be Interviewers	Invitation	5 minutes
Preparing to Explore	Invitation, Concept Invention	5–10 minutes
Exploring and Interviewing Organisms	Exploration, Concept Invention	20 minutes
Discussing Interviews	Application	5 minutes
Wrapping Up	Reflection	5 minutes
TOTAL		**40+ minutes**

TEACHING TIPS

Field Card. On page 16 of this guide is a pocket-sized version of this lesson that you can use in the field.

Read the Instructor Support Section. Beginning on page 9, you'll find more information about pedagogy, student misconceptions, science background, and standards.

Scaffolding for students. It's best to lead *I Notice, I Wonder, It Reminds Me Of* first, which will help students develop skills in making observations and asking questions. *Interview an Organism* takes these skills to a level deeper by focusing specifically on how to ask questions that can be answered through observations.

Ecosystem Literacy. Read the BEETLES resource *Ecosystem Literacies* and *Exploration Guides* for ideas on how to help students explore and think about organisms from specific ecosystems.

Scout ahead of time. It's critical that students have organisms to check out during this activity. Scout the area ahead of time to make sure there are enough critters for students to find and observe.

All materials created by BEETLES™ at The Lawrence Hall of Science.
Find the latest activities and information at http://beetlesproject.org.

Preparing to Be Interviewers

1. **Explain that students are surrounded by interesting organisms, and that they will get to find organisms, then choose one to interview and get to know.** Tell students that they're surrounded by interesting organisms that they walk past every day, without getting to know them. Today they're going to explore and check out a bunch of organisms, then they will pick one organism to "interview" to learn more about it.

2. **Explain that since the organisms won't be able to talk, students will ask questions that can be answered through observations.** Explain that it will be important to ask interview questions that the organism can "answer back." Since it can't really talk, students will find answers by looking more closely at the organism; making careful observations is a way to get answers from nature.

3. **Model interviewing with a silent person, asking types of questions that can be answered through observation, while writing types of questions on a whiteboard.** Choose a student volunteer and explain that you're going to "interview" this person to show some types of questions that can and can't be answered through observation. The person won't answer verbally. Instead, you'll observe the volunteer closely to answer your questions. As you go, write the title for each type of question on a whiteboard.
   - **Descriptive questions** describe the features of the organism's body or surroundings. For example: *What color eyes do you have? I see you have greenish-brownish eyes. What are the main structures of your body? I see that you have a head held up by a neck, and 4 limbs. At the end of each limb, I see you have smaller bendable parts. How do you use your structures? It looks like the bottom 2 hold up your body and help you move around, and the top 2 are for grasping things. What type of place are you in?*
   - **Counting and measurement** questions are great to use to look closely for details you might otherwise miss. For example: *How tall are you? Let's see, you're about 1 foot shorter than me. How many digits are at the ends of your limbs? 5. Are all your limbs the same length? Hmm, the bottom 2 are longer. How many other organisms of the same species are nearby? Let's see, I count 16. Let me count again to verify that. Are you all the same size? No, different sizes. How far apart are you from each other? Are you all the same distance apart?*
   - **Behavior questions** are questions about the organism's behavior, like its movements, and its relationship to its habitat and to other organisms. For example: *What are you doing? Hmm, at first you seem to be standing still, but your feet move every few seconds and you put your right hand in your pocket and took it out. You keep looking over at that tree, and now you're smiling. Interesting... What other behaviors of yours can I observe? Do you stay mostly in shade or in direct sunlight? Are there others like you here? Do you interact with each other? How? What will happen if I step closer to you? What will happen if I put a rock near you? How long will you stay still before moving again?*
   - **Time questions** are often about behaviors. For example: *When you dive underwater, how long till you come back to the surface? Is it always the same amount of time? How long will it take you to climb up this branch to the top?*

TEACHING NOTES

Interviewing plants. This activity write-up is written with a "critter" focus, but it can also be used with plants, fungi, lichen, and other non-animal organisms.

Choosing your volunteer. You will be using the student to model observations, so try to choose a student who you think is not very insecure about their appearance.

TEACHING NOTES

4. **Model asking a "thinking or feeling" question that can't be answered through observations.**
   - **Thinking or feeling questions** are ones about what the organism is feeling or thinking. While these are interesting to wonder about, we can't answer them through direct observation. *What are you thinking? Oops! That's not a question that can be answered through observation! When you smile, you might be thinking of something funny, but that's an inference I'm making, not an observation.*

5. **Model asking a "why" question that can't be answered through observations, then modify it into "How..." "What..." or "What happens if..." questions that can be answered through observations.**
   - **Why questions** are often fascinating but are usually not answerable through direct observation in the time we have for our interview. *For example, Why do you have short hair? or Why aren't you moving?* You can rephrase a why question, though, to begin with "How..." "What..." or "What happens if...?" Then you can make observations that are relevant but usually don't completely answer the Why question. For example, *How long do you stay in one place?* and *What happens if I nudge you with a leaf?*

6. **Encourage students to try questions from several categories except the last 2.**

"Every observation is the answer to a question. Our job is to find the right questions." –Todd Newberry

Using hand lenses. Hand lenses are a great tool students can use to deepen their observations of their organisms and open up different types of interview questions they can ask. See the BEETLES activity *Hand Lens Introduction* for information on how to teach students to use hand lenses effectively.

Preparing to Explore

1. **Explain that thinking about an organism's surroundings can lead to questions and help students understand the organism.** Explain to students that it's easier to come up with interview questions, and to understand organisms, when you know a bit about where an organism lives and what it's like there. Explain that an organism is just one part of an ecosystem, and all organisms interact with other things in its ecosystem.

More on Ecosystem Literacy. Read the BEETLES resource *Ecosystem Literacies and Exploration Guides* for ideas on how to help students explore and think about organisms from specific ecosystems.

2. **Build students' Ecosystem Literacy by discussing a few environmental conditions that influence organisms in the area.** Ask students to think about how the living and nonliving factors of the ecosystem affect the organisms they will interview. The more they consider the whole ecosystem, the better interview questions they will ask. Use a few parts of the ecosystem that particularly define the life of organisms that live here. Avoid telling how organisms survive in the area and facts that aren't relevant to how organisms interact with their environment. Examples of things to say:
   - **Stream:** *The organisms we find in this stream live underwater. How is living underwater different from living out of water?* [Hear student responses.] *When you find organisms, think about how they breathe, how they deal with currents, and how they might protect themselves from predators.*

- **Intertidal:** *Think about what it means to be an intertidal organism. What are the environmental conditions that affect organisms here?* [Hear student responses.] *Imagine what it must be like to survive under icy-cold water for many hours at a time and then to survive totally exposed to air and hot sun for many hours at a time. How do you think they do that? These creatures are also pounded for hours each day by waves. When you interview organisms, think about how they might survive here.*

3. **Give examples of how to use this information to come up with interview questions about how the organism interacts with its ecosystem.** Tell students to use what they just learned about the environmental conditions in the ecosystem to help them come up with deeper questions about the organism's behaviors and about how it interacts with its ecosystem to survive. Give some examples:
   - *For an organism in the intertidal: "Q: What do you do when a wave comes in? A: Oh, you go underneath a rock. Q: Do waves ever hit you? How close do they come before you go under a rock? A: Waves come close (about 2 body lengths) but I haven't seen them hit you."*
   - *For an organism in the forest: "Q: How does your camouflage coloration help you to blend with this environment? A: Wow, you look a lot like those sticks."*
4. **Explain to students that they need to move at the same pace as the organism they are interviewing: SLOW DOWN.** Most things in nature move and unfold more slowly than people are used to. If you are impatient or move too quickly, you'll miss the most interesting observations. Remember, nature won't speed up just because you have arrived! When you are making observations in nature, there is almost never a reason NOT to be slow.
5. **Explain to students that body position matters: GET DOWN.** Tell students they need to put their bodies in the best position to conduct their interview and to make observations. They may need to sit down or lie down or put their face uncomfortably close to grass or rocks to be able to see the organism at eye level. In some ecosystems, they may need to look into small crevices or look up under overhanging rocks. In almost all cases, students will observe more and have better interviews if they get down low!
6. **Explain to students they need to LOOK CLOSELY: Many fascinating observations are small!** Tell students to use their hand lens whenever possible to make observations. It will cause them to get down, slow down, look closely, and notice details.
7. **Explain to students that if they slow down and are patient and quiet, organisms may come out of hiding.** Tell students they need to be aware of how the organism they are observing is observing them. They have to give them time to get over the shock of their arrival.

TEACHING NOTES

Anthropomorphism and empathy. Anthropomorphism is when people project human attributes onto non-humans, such as other organisms. Anthropomorphism can help people develop empathy and concern for other organisms, particularly with young students and when dealing with organisms that are very different from humans. It's very useful (and scientific) to try to understand the needs and perspectives of other organisms. But in making an anthropomorphic statement, students are thinking about what a human might experience, not what the organism actually experiences. This can lead to misunderstanding other organisms, or missing the opportunity to observe what the organism is actually doing. For a scientific perspective, and a perspective of accurately understanding the organism, students should strive for **"accurate empathy"**—trying to imagine what it would be like for the organism to just be the organism, not what it would be like for them to be in the organism's position. See the background section for more on anthropomorphism and empathy.

"Empathy is a stimulated emotional state that relies on the ability to perceive, understand and care about the experiences or perspectives of another person or animal."
—Ashley Young, Kathayoon A. Khalil, and Jim Wharton.

Interviewing Organisms helps us slow down, get down, and look closely. "They drove 150 miles to the intertidal, but wouldn't go the last 4 feet—get down low!" —Todd Newberry

"It helps to alternate between postcard vistas and close-up details. It gives balance. Our life is mostly postcard vistas. On a field trip you are inside the postcard—look for details."
—Todd Newberry

TEACHING NOTES

8. **(Optional) Explain that students will use their journals to record information about the organism.** Tell students they'll be using their journals to sketch their organisms and record information they find out during the interview, much like a field scientist would. Some groups might not be able to sit through this many instructions at a time. If that is the case, consider gathering students to give directions for journaling after they choose their organism.

9. **(Optional) Use a portable whiteboard to introduce tips for journaling:**
   - Write your interview questions and record answers in writing and drawings.
   - Make an accurate sketch of the organism, but don't worry about making a pretty picture.
   - Make the drawing large enough to show the organism's structures.
   - Use arrows or labels for specific features of the organism.
   - Include date, location, and weather conditions on the page.
   - Include notes about the ecosystem in which the organism lives.

Exploring and Interviewing Organisms

See the BEETLES resource *Ecosystem Literacies and Exploration Guides* for information about techniques for safely finding and catching organisms in different types of ecosystems.

1. **Explain that they'll look for lots of organisms, then will choose one.** Explain that students will explore and try to find lots of organisms at first. Then, at your signal, pairs of students will choose one organism to focus on for their interview.

2. **Set boundaries and share materials and techniques for catching organisms (if necessary).** Let students know they don't have to catch the organism they interview; in fact it's better if they don't, so they can observe them interacting with the ecosystem. Some organisms, though, like freshwater macroinvertebrates, are much easier to observe in a cup.

3. **Split students into pairs, and send them to explore.**

Students may get (positively) distracted. While interviewing their organism, students may become distracted by another critter in the area or may become fixated on answering one question—for example, counting how many other organisms are in the area. That's great! Allowing them to follow their interests gives them practice engaging with nature in a way that is authentic for them, and often leads to more detailed and elaborate observations.

4. **As students search for organisms, be a co-explorer and help any who are struggling.** Focus students by modeling useful searching techniques, using a hand lens, and engaging them in dialogue about the organisms they find and the surrounding environment.

5. **After about 5 to 10 minutes, signal that it's time to choose an organism, ask questions, and observe for answers.** Let the group know that it's time to choose one organism and begin interviews. If you're using journals, tell students to brainstorm and write down some descriptive, counting, measurement, behavior, and time questions. Have them think about the environmental conditions as they are coming up with questions. Once they have their questions, they should start their interviews, and write words and drawings to answer their questions based on their detailed observations. If they're not using journals, they can do this orally.

6. **Circulate, listen to interviews, and support pairs who are having trouble coming up with questions.** Make sure students are asking different types of questions, and that they are using words and drawings. If students are struggling, remind them to think about their organism's ecosystem and surroundings, or to just say, "I wonder..." until a good interview question (answerable through more observations) pops out. Remind students to use their hand lenses.

7. **Ask pairs to wrap up their interviews, then carefully release any captive organisms as close as possible to where they found them.**

Discussing Interviews

1. **Pairs share questions and observations, describe structures, and discuss how organisms used their structures to survive in the ecosystem.** Bring the group back together and pair students to share with each other questions they came up with that led to interesting observations. Ask them to also share structures they observed (body parts), and what behaviors the organisms seemed to use those structures for (function) to help them survive in their ecosystem.

2. **Ask a few students to share their questions, observations and structures with the whole group.** Ask a few students to share an interesting question or observation. If many students are excited to share their ideas, encourage them to pat their heads (or use some other visual signal) if another student shares an observation or idea they also had. Also include structures they observed, and behaviors they think they might be used for.

3. **Highlight that different kinds of questions are valuable, and questions that can be answered with evidence, like you just did, are "scientific."** Explain to students that scientific questions are questions we can answer with evidence. Sometimes we can investigate and make immediate observations to find evidence. Sometimes we can do experiments or long-term observations (which we didn't have time for in this activity), and other times we can just look them up. Nonscientific questions that can't be answered with evidence are interesting and valuable too!

4. **Explain how looking at structures and thinking about how they function is a thinking tool scientists use to understand how the world works.** When scientists study an organism (or anything else in the natural world), sometimes they focus on its structures, and how those structures might function.

TEACHING NOTES

Structure and Function Crosscutting Concept. Thinking about the structures in the natural world and how they might function is something many different kinds of scientists do. For students to appreciate this big idea of science, they'll need to have multiple experiences using this lens to explore nature. See the Instructor Support section for more information about making connections between this activity and the Next Generation Science Standards.

TEACHING NOTES

Wrapping Up

1. **Ask students to *Turn & Talk* or *Walk & Talk* about the following questions:**
   a. What helped you to learn about the organisms you interviewed?
   b. What are some organisms you could interview in the future, here or when you return home? What questions could you ask of them?
   c. Are there questions you had that would take longer than you had to answer? What kinds of investigation would it take to answer them?
2. **Point out that interviewing organisms is a skill that students can use anytime and almost anywhere.** Emphasize to students that they can use these skills to find out more about any organism, anytime, even when they go back home after this field experience.
3. **Encourage the group to interview organisms they find later in the field experience.** Explain to students that if your group has a brief encounter with an organism, like a snake that slides past or a bird that flies by, they can do a brief interview together to learn more about the organism. In the case of a longer encounter with an organism, they can do a full interview to try to learn more.

Instructor Support

Content in the session. There is a lot of content in this session. Much of the content is integrated into the steps of the activity, and relates to observation skills: how to ask questions that lead to deeper observations, how to make observations, types of questions that can and can't be answered through observations, and how to best position yourself to observe. There's also content in the form of what students learn about whatever specific organisms they choose to observe, much of which you can't predict, because they choose their own organisms. For the most part, students will get this information through their own observations, and through those of their fellow students. It's best if the instructor doesn't tell students what they know about the organisms before students study them, so students can learn from their own questions and observations. But it *is* helpful to introduce some content to students about the ecosystem and the environmental conditions that are typical there. This helps students understand some of the context in which the organisms live, and will help them conduct more fun and successful interviews.

A short "ecosystem literacy" introduction, which is integrated into the activity steps, helps students better understand the organisms they find. "Ecosystem literacy" means understanding the conditions, including the main living and nonliving factors, that influence life in that ecosystem. Organisms are a reflection of their environment. Their structures only make sense in relation to the environment where they live. Knowing the environmental conditions in which organisms live enriches students' observations by helping them to think about how an organism meets its needs. Find more about this in the BEETLES resource *Ecosystem Literacies and Exploration Guides*.

Delving deeper with organisms. It's easy for students to declare they are finished with this activity after just a few minutes, or to say, "we didn't find anything," or "our organism didn't do anything." It's human nature for our brains to go into "neutral" sometimes. Tell students this is going to happen to them at some point, and challenge them to notice when it happens, and then to notice the next interesting observation they make as they re-engage. Push them to go deeper, to be more probing question-askers. Offer some questions yourself. Demonstrate observing and interviewing the organism to get an answer. Remind students of question-starters like What, What if, Where, How, and How Many? Encourage them to riff with "I wonder..." until they hit on a question they can answer through observation.

Being patient. While students are observing an organism, that organism and all the others in the area are probably observing the student! Many animals use their senses to avoid predators, so their life depends on knowing when you arrive and on avoiding you. Some organisms sense sound, and if you make noise, they disappear. Some organisms sense light, and if you make a shadow over them, they run away. Some organisms sense vibrations and can feel your steps as you approach long before you see them. Some organisms that live in water can taste your arrival if you put your finger in the water. So, when you arrive at a spot, many organisms have already sensed you coming, and might be hiding. If you slow down and are quiet, they may come out of hiding. You have to give organisms time to recover from the shock of your arrival.

TEACHING NOTES

Why Interview Organisms?
"People know they have to work out and practice to become a good tennis player, yet they don't think they have to work out and practice to get good at asking questions. If you pose questions regularly, you learn the right ones to ask, and you develop stamina in finding answers to them. You can keep on rephrasing and reposing questions to an animal until it just gives up and answers. It's a great game!" –Todd Newberry

"A useful definition of love is sustained, compassionate attention."
–John Muir Laws

Providing students with opportunities to spend time and focus in on one thing in nature helps them to forge emotional connections with nature, which are an important aspect of environmental literacy.

TEACHING NOTES

Anthropomorphism and empathy. Anthropomorphism is when people project human characteristics and values onto non-human creatures and things. It's useful and scientific to attempt to understand the needs and perspectives of other organisms. Anthropomorphism can lead to understanding, empathy, and environmental concern, especially for younger students, or with organisms that are very different from humans, like barnacles or earwigs. It's valuable to attempt to understand the perspectives of other organisms, but it is also important to remember that we can't ever fully understand the perspective and life experience of another being, and the more different from us it is, the less we can understand. Anthropomorphism can be fun and playful, but must be used with awareness. In making an anthropomorphic statement, students are empathizing with what a human might experience, not what the organism actually experiences. Without awareness, anthropomorphism may lead to misunderstanding other organisms.

For a scientific approach and a goal of accurately understanding the organism, instructors can help students strive for "accurate empathy"—trying to imagine what it would be like for the organism to be itself, not how it would be for them to be in the organism's position. Students will often say things such as "The lizard likes that rock," or "It's scared." Some of this language is inevitable, partly because it's sometimes hard to find language to describe observations without drifting into anthropomorphism. Encourage students to remain aware of what it is actually possible to observe, as opposed to immediately making an inference based on their observations. You might say, "It can be useful to try to imagine what it's thinking or feeling, but we can't know these for certain. What we can be much more certain of are our observations, such as that the lizard is on the rock more than it is off the rock." You might offer possible rephrasings: "It keeps returning to that rock," or, "It's backing up and holding up its claws when I get close." Imagining the perspectives of other organisms is almost second nature within some cultures that place high value on empathizing with non-human living and nonliving

"Anthropomorphism can both help and hinder one's ability to accurately empathize with others. When true similarities are found with animals, anthropomorphism can help people better understand or empathize with the animal (Chawla 2009; J. Warmouth, personal communication, June 6, 2015). Anthropomorphism has also been linked with feelings of compassion or empathic concern (Sevillano et al. 2007; Tam et al. 2013). Whether our projections are correct or not, when we see animals as human-like, we have a greater likelihood of considering them worthy of moral consideration and in turn, worthy of protection. Assuming we know what the appropriate actions are, anthropomorphism has potential to motivate conservation action (Tam et al. 2013). Young children, especially, benefit from anthropomorphism and its ability to make animals relatable (Gebhard et al. 2003; Myers 2007; C. Saunders, personal communication, June 3, 2015). However, as people mature, if they continue to project their personal experiences without trying to cognitively understand the animal's, it can lead to incorrect empathy that can negatively impact animals and people (Arluke 2003;

Root-Bernstein et al. 2013; J. Fraser, personal communication, August 4, 2015). This can be seen when humans project our understanding of our infants' needs on young animals. People will come across baby deer curled up and alone, assume that it is abandoned and bring it to an animal rescue not understanding that the mother has left the baby there purposefully and will be back to collect it. Also, there are the accounts of people believing they can communicate with wolves or bears and end up dying or becoming seriously injured due to their incorrect empathy.... Our sensory experiences of the world are dramatically different than animals so even if we try we will never know what it is like to be another species. Therefore, anthropomorphism might help activate compassionate emotions for these animals but our sensory perception of that experience is not an accurate representation of the animal's experience. It could very easily be dramatically better or worse than what we feel. For instance, we might be able to imagine but will never truly understand the world from the perspective of an animal that relies on echolocation instead of sight." (*Empathy for Animals: A Review of the Existing Literature* Young, Khalil, and Wharton 2018)

things, and this may take the form of anthropomorphism. It can come across as offensive if an instructor cuts off anthropomorphism abruptly, especially if it's integral to a student's culture. In this situation, a "yes, and..." approach can be effective. For example, if a student says that the sea otters holding hands shows that they love each other, an instructor might say, "that may be true, and we've also found that it helps keep them from drifting apart as they sleep."

Conceptual Knowledge

There are different types of scientific questions. Some questions can be answered in a short time, like during this activity, while to answer others you need long-term observations, research, or mostly reasoning. In this activity, students develop the ability to ask better questions and to recognize the types of questions that can be answered in the short term through focused observations. This helps students tell the difference between the sorts of questions that can be answered through immediate observations and those that they need research or other types of investigation to answer. The purpose of the interview device is to give students experience with in-depth observation. Each question is an invitation to look closely at an organism, or to change the observer's point of view. This also helps students learn content through their observations of organisms, though what they learn will depend on what they find and focus on.

Social emotional learning connection

Students can also use the organism interview tool on themselves, with each student asking questions about their surroundings and about themselves that they can answer through paying attention to what's around them, their

"Humans aren't as good as we should be in our capacity to empathize with feelings and thoughts of others, be they humans or other animals on Earth. So maybe part of our formal education should be training in empathy. Imagine how different the world would be if, in fact, that were 'reading, writing, arithmetic, empathy."

–Neil deGrasse Tyson

TEACHING NOTES

About the Next Generation Science Standards (NGSS). The development of the Next Generation Science Standards followed closely on the movement to adopt nationwide English language arts and mathematics Common Core standards. In the case of the science standards, the National Research Council (NRC) first wrote a Framework for K-12 Science Education that beautifully describes an updated and comprehensive vision for proficiency in science across our nation. The Framework–validated by science researchers, educators and cognitive scientists–was then the basis for the development of the NGSS. As our understanding of how children learn has grown dramatically since the last science standards were published, the NGSS has pushed the science education community further towards engaging students in the practices used by scientists and engineers, and using the "big ideas" of science to actively learn about the natural world. Research shows that teaching science as a process of inquiry and explanation helps students to form a deeper understanding of science concepts and better recognize how science applies to everyday life. In order to emphasize these important aspects of science, the NGSS are organized into three dimensions of learning: Science and Engineering Practices, Crosscutting Concepts and Disciplinary Core Ideas (DCI's). The DCI's are divided into four disciplines: Life Science (LS), Physical Science (PS), Earth and Space Science (ESS) and Engineering, Technology and Applied Science (ETS).

Read more About the Next Generation Science Standards at:

- www.nextgenscience.org/
- ngss.nsta.org/

feelings, and their behaviors. An internal or journaling dialogue about these might look like, "What am I feeling in my body right now? I'm noticing that my stomach feels clenched. What am I feeling? I seem to be feeling stressed about something. What am I stressed about? I think I might be feeling stressed because I think X is mad at me. What's going on around me? I'm in a really beautiful spot in the forest, and everyone else seems to be doing interesting things. It seems like Y is looking at something interesting. Maybe I'll go over and join in. Etc." Research in neuroscience tells us that by simply paying attention to and labeling our emotions, rather than stuffing them, it helps us reduce the emotion. This is also a practice of mindfulness that helps students be more self-reflective and self-aware.

Misconception: Other organisms are like humans, and we can know what they are feeling and thinking by observing them.

More accurate information: When students assume that organisms perceive the world the way they do and make their observations through that lens, it limits the accuracy of their understanding and even biases their observations. It also limits the extent to which students can truly empathize with the organism. In making an anthropomorphic statement, students are empathizing with what a human might experience, not what the organism itself experiences. Students should strive for "accurate empathy"—trying to imagine what it would be like to be the organism, not how it would be like for them to be in the organism's position. Todd Newberry says, "Our job as scientists is to insinuate ourselves into the world of the organism, not to drag it into ours." Scientific observations should reflect a more humble approach to investigating the world. Science acknowledges that we must attempt to understand other organisms based on careful observations (along with other verifiable evidence), rather than by making broad inferences about their similarities to us humans.

Connections to the Next Generation Science Standards (NGSS)

BEETLES student activities are designed to incorporate the "three-dimensional" learning that is called for in the NGSS. Three-dimensional learning weaves together Science Practices (what scientists do), Crosscutting Concepts (thinking tools that scientists use), and Disciplinary Core Ideas (what scientists know). Students should be exploring and investigating rich phenomena, and figuring out how the natural world works. The abilities involved in using Science Practices and Crosscutting Concepts—looking at nature and figuring things out, using certain lenses to guide thinking, and understanding ecosystems more deeply—are mindsets and tools students can take with them and apply anywhere to deepen their understanding of nature. Plus, they're interesting and fun to do!

Interview an Organism features the science practice of Asking Questions and the crosscutting concept of Structure and Function. Students have the opportunity to build understanding of various relevant Disciplinary Core Ideas in the Life Sciences, depending on the natural phenomena they explore, the observations they focus on, their prior knowledge, and the guidance of the instructor. Students may develop understanding of DCI's in Structure and

Featured Science and Engineering Practices

Engaging Students in Asking Questions. According to the Framework for K-12 Science Education, students not only need to ask questions about the phenomena they see in the natural world, they also need to categorize questions as "scientific" (testable or answerable through observations and experience) or "non-scientific" (questions that aren't answerable through direct observation). To fully engage with this practice, students also need to think about how they might get answers to their own questions.

- In *Interview an Organism*, they do just that—they intentionally come up with questions they can answer through observation, then make observations to answer those questions.
- Be sure to help students reflect on how they could "interview" other organisms in the future in a similar way, or how they could think about ways to answer their questions in the future, so that they begin to internalize the practice of asking questions, and recognize it as a transferable skill.

Featured Crosscutting Concepts

Applying the Lens of Structure and Function.

- Asking students to focus on identifying and observing structures will help them apply the lens of structure and function, because students will begin to make sense of what structures are.
- Later, asking students to make explanations for how those structures could help their organism survive in its environment leads them to make sense of how understanding structure and function are connected to understanding the organism's environment.
- To further engage students in making use of this crosscutting concept in a later activity, ask students to compare the structures of organisms in different environments and make possible explanations for how the different structures may help organisms survive in the unique environmental conditions of their ecosystems.

Applying the Lens of Systems and System Models. Although Structure and Function is the featured crosscutting concept in this activity, you could feature Systems and System Models to meet different learning goals.

- Isolating systems of study and investigating the parts of a system and the flows into, out of, and within a system is a useful tool in science and engineering.
- A further step could be to have students begin to notice smaller systems within the ecosystem, for example to recognize a tree as a system with its own internal parts, or an organism as a system of interacting body parts. The more systems that students identify, the more they will come to recognize the usefulness of a systems lens to understand the natural world.
- Throughout your students' field experience, keep asking them to point out interactions between the parts of the different ecosystems they see.

TEACHING NOTES

Importance of teaching science practices. "Engaging in the practices of science helps students understand how scientific knowledge develops...It can also pique students' curiosity, capture their interest, and motivate their continued study." -National Research Council, A Framework for K-12 Science Education. Focus on these science practices will help to ensure a more scientifically literate public who will be better able to make thoughtful decisions.

About Crosscutting Concepts in the NGSS. Crosscutting concepts are considered powerful thinking tools for how scientists make sense of the natural world. The seven "big ideas" listed as crosscutting concepts are: Patterns; Cause & Effect; Scale, Proportion & Quantity; Systems and System Models; Energy & Matter: Flows, Cycles and Conservation; Structure & Function; and Stability & Change. These concepts may sound familiar, as they are quite similar to the themes referred to in science literacy documents as being important ideas that unify all disciplines of science and engineering.

TEACHING NOTES

- The systems lens is a way for humans to understand things. To use it, we make up artificial boundaries, like when we are focusing on one organism and its interactions with its ecosystem.
- Students need to be able to identify the artificial boundaries of a system, and to recognize that each organism and object does not exist by itself, but interacts with the other parts of the system it's in. In Interview an Organism, students think about how their organism interacts with other parts of its ecosystem.

Featured Disciplinary Core Ideas

Building a foundation for understanding Disciplinary Core Ideas. Students need multiple learning experiences to build their understanding of NGSS disciplinary core ideas. *Interview an Organism* gives students an opportunity to develop understanding of some disciplinary core ideas related to Structure and Function and to Interdependent Relationships in Ecosystems.

- As students observe their organisms' structures and think about how they make sense in the context of the organisms' environment, they will build some understanding of the idea that organisms have characteristic structures that aid in survival (LS1.A). To take students deeper with their understanding of this idea, give them more learning experiences in which they observe organisms' structures and make explanations for how they might function to aid in survival.
- As students observe their organisms interacting with the environment, they will build some understanding of the ways in which organisms get what they need from their ecosystem to survive (LS2.A). Students can go deeper with other BEETLES activities that explore specific organisms' ways of interacting with the environment. The specific ideas you focus on will vary, depending on the age and level of your students.

Performance Expectations to Work Toward

No single activity can adequately prepare students for an NGSS performance expectation. Performance expectations are designed as examples of things students should be able to do to demonstrate their understanding of content and big ideas in science after they engage in multiple learning experiences and instruction over a long period. They are not the "curriculum" to be taught to students. Below is one performance expectation that this activity can help students work towards.

4-LS1-1.Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

Translating the codes used in the NGSS. Each standard in the NGSS is organized as a collection of performance expectations (PE) for a particular science topic. Each PE has a specific code, provided here so that they can be easily referenced in the NGSS documents. The first number or initial refers to the grade level: K - kindergarten, 1 - first, 2 - second, etc.; MS - middle school, and HS - high school. The next letters in the code refer to the science discipline for the standard: LS, PS, ESS, ETS. The number following the discipline denotes the specific core idea within the discipline that is addressed by the PE, and the last digit identifies the number of the PE itself.

So... 3-LS4-4 means it's part of a third grade standard (3) for life science (LS), addressing the fourth core idea (4), Biological Evolution: Unity and Diversity, within the life science standards, that deals with Biodiversity and Humans. It's also the fourth performance expectation (4) that makes up the complete LS4 standard at this grade level.

Activity Connections

This should not be the only activity students do to develop their understanding of these concepts and expand their skill with this practice. Do multiple activities over the course of a day or program to give students more opportunities to deepen their understanding.

I Notice, I Wonder, It Reminds Me Of and *NSI: Nature Scene Investigations* are other great exploration/inquiry routines that complement *Interview an Organism*. If you have multiple days with students, you might first want to introduce *I Notice, I Wonder, It Reminds Me Of*, followed by either *NSI* or *Interview an Organism*, or both, later on. *Discovery Swap* is another Exploration Routine that gives students the chance to explore and focus on an organism, but with additional resources like keys or field guides and more opportunities for peer-to-peer discussion.

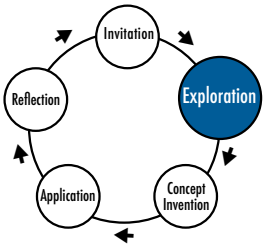
For more activities to develop students' engagement in the practice of asking questions, use the optional sections in *I Notice, I Wonder, It Reminds Me Of*, or engage students in *Exploratory Investigation* to give them the experience of answering scientific questions through designing and doing scientific investigations.

To continue with activities to develop students' understanding of concepts related to Structure and Function and to Interdependent Relationships in Ecosystems, see BEETLES adaptations activities as well as focused explorations.

Consider using *Interview an Organism* after students have spent some time exploring an area, to get them to focus in on an interesting creature, such as during a tidepooling experience.

This activity is based on a routine developed by Todd Newberry, Emeritus Professor of Biology, University of California, Santa Cruz. See the chapter "A Philosophical Interlude" of his book *The Ardent Birder* for more on "interviewing organisms."

TEACHING NOTES



Interview an Organism and the Learning Cycle. This activity brings students through a full learning cycle. Within a sequence of many activities focused on developing an understanding of questioning, structure and function, or interactions between organisms, this activity is an Invitation or an Exploration.

FIELD CARD

Cut out along outer lines and fold along the centerline. This makes a handy reference card that will fit in your pocket.

Interview an Organism

Preparing to Be Interviewers

1. Explain: we're surrounded by interesting organisms, you will find organisms, then choose one to interview & know.
2. Explain: since the organisms can't talk, you'll ask questions that can be answered through observations.
3. Model interviewing with a silent person, asking types of questions that can be answered through observation, while writing types of questions on a whiteboard:
   a. *Descriptive*: Body structures, surroundings
   b. *Counting & measurement*: Height? Limbs? Digits? Length? How many individuals? Sizes? Far apart?
   c. *Behavior*: Movements, relationship to habitat & other organisms, in shade or sun? Interact with others? What happens if I...
   d. *Time*: Often about behaviors, e.g: *Time underwater? How long to climb?*
4. Model asking "thinking or feeling" question that can't be answered through observations.
5. Model asking a "why" question that can't be answered through observations, then modify it into How..." "What..." or "What happens if... " questions that can be.
6. Encourage students to try questions from several categories except the last 2.

Preparing to Explore

1. Explain: thinking about an organism's surroundings can lead to questions, & help understand the organism.
2. Build students' Ecosystem Literacy by discussing a few environmental conditions that influence organisms in the area. Give examples of how to use this information to come up with interview questions about how the organism interacts with its ecosystem .
3. Explain: SLOW DOWN, GET DOWN, LOOK CLOSELY.
4. Explain: with quiet patience, organisms may come out of hiding.
5. (Optional) Explain journaling: write/draw questions & answers; make accurate sketches; draw large; use arrows or labels; include date, location & weather; take notes about ecosystem.

Exploring and Interviewing Organisms

1. Explain: you'll look for lots of organisms, then will choose one.
2. Set boundaries & share materials & techniques for catching organisms (if necessary).
3. Students explore in pairs.
4. As students search for organisms, be a co-explorer & help any struggling.
5. After ~5-10 minutes, signal time to choose an organism, ask questions, & observe for answers.
6. Circulate, listen to interviews, & support struggling pairs.
7. Pairs end interviews, release any captive organisms as close as possible to where found.

Discussing Interviews

1. Pairs share questions & observations, describe structures, & discuss how organisms used their structures to survive in the ecosystem.
2. Ask a few students to share their questions, observations, & structures with the whole group.
3. Explain: different kinds of questions are valuable; questions that can be answered with evidence, like you just did, are "scientific."
4. Explain: looking at structures & thinking about how they function is a thinking tool scientists use to understand how the world works.

Wrapping Up

1. Turn & Talk or Walk & Talk:
   a. What helped you to learn about the organisms you interviewed?
   b. What are some organisms you could interview in the future, here or when you return home? What questions could you ask of them?
2. Explain: interviewing organisms is a skill you can use anytime & almost anywhere.
3. Encourage the group to interview organisms they find later in the field experience.

ABOUT BEETLES™

BEETLES™ (Better Environmental Education Teaching, Learning, and Expertise Sharing) is a program of The Lawrence Hall of Science at the University of California, Berkeley, that provides professional learning sessions, student activities, and supporting resources for outdoor science program leaders and their staff. The goal is to infuse outdoor science programs everywhere with research-based approaches and tools to science teaching and learning that help them continually improve their programs.

www.beetlesproject.org

THE LAWRENCE HALL OF SCIENCE
UNIVERSITY OF CALIFORNIA, BERKELEY

The Lawrence Hall of Science is the public science center of the University of California, Berkeley. *www.lawrencehallofscience.org*

Principal Investigator and Articulate Beetle: Craig Strang
Project Director, Lead Curriculum & Professional Learning Developer, and Idea Beetle: Kevin Beals
Project Manager, Professional Learning & Curriculum Developer, and Beetle Herder: Jedda Foreman
Curriculum & Professional Learning Developer and Head Fireball: Lynn Barakos
Curriculum & Professional Learning Developer and Champion-Of-All-The-Things: Emilie Lygren
Research and Evaluation Team: Bernadette Chi, Juna Snow, and Valeria Romero
Collaborator, Super Naturalist, Chief Scalawag and Brother-from-Another-Mother: John (Jack) Muir Laws
Project Consultants: Catherine Halversen, Mark Thomas, and Penny Sirota
Advisory Board: Nicole Ardoin, Kathy DiRanna, Bora Simmons, Kathryn Hayes, April Landale, John Muir Laws, Celeste Royer, Jack Shea (emeritus), Drew Talley, & Art Sussman.
Editor: Mark Woodsworth
Designer: Barbara Clinton

The following programs have contributed to the development of these materials by field testing and providing invaluable feedback to the development team. For a complete list of contributors and additional partners, please see our website at beetlesproject.org/about/partners/

California: YMCA Camp Campbell, Rancho El Chorro Outdoor School, Blue Sky Meadow of Los Angeles County Outdoor Science School, YMCA Point Bonita, Walker Creek Ranch, Santa Cruz County Outdoor Science School, Foothill Horizons Outdoor School, Exploring New Horizons Outdoor Schools, Sierra Nevada Journey's School, San Joaquin Outdoor Education, YMCA Camp Arroyo, Shady Creek Outdoor School, San Mateo Outdoor Education, Walden West Outdoor School, Westminster Woods.
Other locations: Balarat Outdoor Education, CO; Barrier Island Environmental Education Center, SC; Chincoteague Bay Field Station, VA; Eagle Bluff Environmental Learning Center, MN; Great Smokey Mountain Institute at Tremont, TN; Wellfleet Bay Wildlife Sanctuary-Mass Audubon, MA; Mountain Trail Outdoor School, NC; NatureBridge, multiple locations; Nature's Classroom, multiple locations; North Cascade Institute Mountain School, WA; Northbay, MD; Outdoor Education Center at Camp Olympia, TX; The Ecology School, ME; UWSP Treehaven, WI; Wolf Ridge Environmental Learning Center, MN; YMCA Camp Mason Outdoor Center, NJ; and YMCA Erdman, HI.

Photos: Pages 1 and 2 by Kevin Beals. *Icons*: Backpack by Rémy Médard; Growth by Arthur Shlain; Cut by Nathan Thomson; Outside by Petr Holusa; Park by Antar Walker; &Time by Wayne Middleton all from The Noun Project.

Funding from 2012-2015 for BEETLES publications such as this one has been generously provided by the S.D. Bechtel, Jr. Foundation, The Dean Witter Foundation, and the Mary A. Crocker Trust.

To contact BEETLES™, email beetles@berkeley.edu