beetles
Science and Teaching for Field Instructors

Student Activity Guide

Structures & Behaviors

Observing an organism for an extended period of time can be a rewarding learning experience that helps students develop a meaningful relationship with the natural world. Students often engage more deeply in observing an organism if they're given some sort of task to focus their observations. In this activity, pairs of students find an organism, then observe and record its structures and behaviors. Students apply the lens of adaptations as they come up with explanations for how their organisms' structures and behaviors might help it survive in its habitat. In a group discussion, students consider the relationship between organisms' structures and possible functions, which is a useful science thinking tool that can help them to better understand the natural world. This activity helps students develop a definition of adaptation that includes both behavioral and structural adaptations (Adaptations are inheritable structures or behaviors that help a population of organisms survive in their habitat), and gives students the experience applying that definition to an organism in the local ecosystem.

Students will:

- **Identify structures and behaviors of an organism.**
- **Create explanations of possible benefits of structures and behaviors of organisms.**
- **Understand that adaptations are inheritable structures or behaviors that help a population of organisms survive in their habitat.**
- **Make connections between the structure and function of different features of an organism.**

Grade Level:
Grades 3-8. Adaptable for younger or older students.

Timing:
about 45 minutes

Related Activities:
Adaptations Intro-Live!
Whacky Adapty
Related & Different.

Materials:
For instructor: Portable whiteboard; Marker. *For students:* Pencil; Journal/Paper; Small container for organisms
Optional, but recommended: 1 hand lens per student

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

Setting:
Choose an area with critters to catch & observe, e.g., under logs, in a compost pile, near a pond or stream

NEXT GENERATION SCIENCE STANDARDS
For additional information about *NGSS*, go to page 6 of this guide.

FEATURED SCIENCE PRACTICE
Constructing Explanations

FEATURED CROSSCUTTING CONCEPT
Structure & Function

DISCIPLINARY CORE IDEAS
Interdependent Relationships in Ecosystems
Structure & Function
Natural Selection
Adaptation

THE LAWRENCE HALL OF SCIENCE
UNIVERSITY OF CALIFORNIA, BERKELEY

Adaptations-Focused Activity

Structures & Behaviors

ACTIVITY OVERVIEW

Structures and Behaviors	Learning Cycle Stages	Estimated Time
Introducing the Activity	Invitation	**5 minutes**
Identifying Possible Adaptations	Exploration	**20 minutes**
Discussing Adaptations and Connections to Science	Concept Invention, Application	**15 minutes**
Wrapping Up - Reflection	Reflection	**5 minutes**
TOTAL		**45 minutes**

TEACHING TIPS

Field Card. On page 11 of this guide, you'll find a condensed, pocket-sized version of the lesson that you can carry with you in the field.

Read the Instructor Support Section. Beginning on page 6 you'll find more information about pedagogy, science background, potential misconceptions, and standards connections.

Repeated exposure to the adaptation definition. It's helpful for students to discuss and apply the definition for an adaptation many times in order to fully understand the concept. It works well to introduce the definition through activities like *Whacky Adapty* and *Adaptations Intro: Live!*, then apply the concept during *Structures & Behaviors*, and continue to discuss the idea throughout field experiences.

The *Adaptations Intro Live* student activity is designed as an introduction to adaptations, and works well just before this activity. If you do choose to do this, you can skip over the deer example at the beginning of the activity, and just review the adaptation definition before digging into the chart and organism. You might still choose to use the deer example to fill out the chart, or you might use the organism you focused on in the other activity.

Introducing the Activity

1. **Ask students to *Think-Pair-Share*: What structures do all deer have, & how might those structures help them survive in their habitat?** Ask them to identify some of the structures (body parts) of deer, think of a few possible benefits of each of those structures, and share with a partner, (e.g., brown fur to help them blend into their habitat). Ask a few students to share what the pair discussed with the whole group.

2. **Explain that inheritable helpful body structures are *adaptations*.** Many of the structures just named are examples of adaptations. Share this *partial* definition of adaptations with students:
   - ▶ *Adaptations are inheritable structures that help a* **population** *of organisms survive in their habitat.*
   - Explain "inheritable" if necessary–a characteristic that is passed on through the genes of parents to their offspring.

3. **Lead students in a *Think-Pair-Share* about behaviors that help deer to survive in their habitats.** Ask them to think of behaviors of deer that might help them survive in their habitat (e.g., deer move their ears in the direction of sounds they hear to listen for predators). Ask them to share with a partner, then ask a few to share with the whole group.

4. **Explain that helpful behaviors, like breathing or flinching, can be adaptations too, but only if they are inheritable.** Behaviors can be adaptations too, but only the behaviors that organisms are born with are considered adaptations. This includes instinctual behaviors like breathing or flinching, not the behaviors an organism learns or chooses to do. Add "behaviors" to the definition of adaptation:
   - ▶ *Adaptations are inheritable structures* ***or behaviors*** *that help a population of organisms survive in their habitat.*

Identifying Possible Adaptations Using Chart

1. **Draw chart on whiteboard as students prepare chart in journals.** At the top, they write "Possible Adaptations of _______." In the left column, they write, "Structure/Behavior," and in the right column, they write, "How it might help this population of organisms survive in its habitat."

Possible adaptations of _______	
Structure/Behavior	How it might help this population of organisms survive in its habitat

2. **Model filling out the chart, using deer as an example.** Using their ideas from the brainstorm you just did, write a few examples of deer body structures and behaviors in the left column, and possible benefits of those characteristics in the right column on your whiteboard.

3. **Explain that students will search for organisms within boundaries, then pick one organism to observe in pairs, thinking about the organism's possible adaptations & filling out the chart.** Explain that they will first find an organism with a partner. Then they will try to identify possible

TEACHING NOTES

See BEETLES *Discussion Routines* for logistics of *Think-Pair-Share*.

Model organism choice. If deer are not common at your site, you might want to choose another organism that students are familiar with as an example.

Why include "population" in the definition of adaptations. Individual organisms do not adapt, but populations do. In evolutionary biology, a population is a group of interbreeding organisms of the same species that can produce viable offspring. If students talk about *individual* organisms adapting, gently correct their language to reflect that the term actually applies to changes in *populations* of organisms, not to individuals. For more information about common misconceptions related to adaptations, see the Instructor Support Section.

Try to limit the use of complex vocabulary. If too many hard words are introduced at once, students can become confused. If they've already had exposure to some of the words on the chart, such as "organism," or "population," they'll have an easier time. It's best to choose a few important conceptual words, and give students multiple exposures to them, in both written and oral form. With very young students, you can simplify language on the chart. For example, substitute "living thing" for "organism," or eliminate "adaptations," and just focus on structures and behaviors and the possible benefits.

Observing plants. You could try this activity with plants, but students need additional background knowledge about plant structures and functions to be able to think about their possible benefits; it's also much more challenging to consider plant "behaviors."

TEACHING NOTES

Refer to the *Ecosystem Literacy and Exploration Guide*. Additional information about preparing students to explore and find organisms in specific ecosystems can be found in the BEETLES Resource *Ecosystem Literacy and Exploration Guide.*

Students focused on the same species or on different species? If you have access to lots of the same kind of organism, such as isopods in compost, you might choose to have all pairs study and discuss the same type of organism. This adds coherence to the discussion. Otherwise they can study any organisms they find, which has the benefit of students being exposed to a diversity of organisms through the activity.

Observing large animals. Let students know that if they happen to see animals too large or too difficult to capture (like a bird or a rabbit), they can think a bit about its behaviors and structures, but that it would be best to focus on an animal they can catch and observe for a chunk of time.

Opportunities for embedded assessment. When students are sharing their ideas in the large group, pay attention to their statements and the extent to which they are able to use tentative language and cite evidence for their explanations. Take note, too, of the level at which they show understanding of the Disciplinary Core Ideas listed for this activity. For more information, see the Instructor Support Section.

adaptations of that type of organism. They should consider what structures and behaviors they think it was born with, that might help the organism survive in its habitat. Give boundaries appropriate to the area large enough for students to find a variety of organisms.

4. **Explain that when identifying adaptations–inheritable structures & behaviors–it's essential to think about an organism's habitat.** Explain that adaptations are very particular to the environmental conditions in the organism's habitat. For example, something that lives in water has very different adaptations from a land creature.
5. **Briefly mention (or ask them to share) a few environmental factors that may affect the organisms in the specific ecosystem they're exploring.** [weather, access to water, food sources, etc.]
6. **Share any tips or techniques that may help students find organisms.** [lifting logs, using nets, plastic cups, etc.]
7. **Pass out materials.** Pass out small containers for catching critters. If you are using hand lenses, hand one to each student or pair.
8. **In pairs, students find an organism to observe and complete the chart while instructor circulates.** Students should choose a small animal they'll be able to observe for at least a few minutes. Each pair will choose one organism to observe together, but each student will fill out their own chart in their journal. Circulate, ask questions, and troubleshoot any problems.

Discussing Adaptations & Connections to Science

1. **Ask pairs to share & discuss observations with another pair; remind them to share the evidence behind their thinking.** For a few minutes, ask pairs of students to find another pair to share their ideas and point out the various structures, behaviors, and possible benefits they wrote down. Ask them to share what made them think a structure could be beneficial, including their evidence. Provide an example of sharing evidence, such as, "If you think the antennae on your organism's head could benefit the organism with finding its way, because you saw it tapping the ground with them and then moving forward, share that observation as your evidence."
2. **Lead whole group discussion of their explanations of possible benefits of different structures & behaviors.** This is a good opportunity for students to hear each others' ideas, and also for you to do some coaching on using making scientific explanations, as needed. Follow up on interesting threads, and see if you can get the whole group engaged with debating an explanation. If they have something to add or want to respectfully disagree, encourage them to do so. Encourage them to allow others to look at their organism in a cup, if they need to clarify any confusion about a point being made.
3. **Describe how all types of scientists use making connections between structures and their function, as a powerful tool for understanding.** Explain that they were figuring things out and coming up with ideas, just as scientists do. Making connections between a structure and its function is a powerful tool for understanding that's used in all types of science.

4. **Explain that scientists who study things other than organisms think about structures & function, too.** Tell students that they can think about this when they look at buildings, cars, or other human-designed things. They can ask themselves how the material something is made of, or its shape, might help it to work.

5. **Give example of a connection between structure & function, and ask students to give other examples. Listen to their ideas.** For example, you might say that the toughness of the structure of an exoskeleton may serve the function of protecting an insect from getting crushed or scratched as it crawls under wood.

6. **Remind students to include evidence when they make explanations.** Encourage discussion by asking what they observed about a particular structure or habitat that led them to think about its function or how it's used by the organism. For example, you might as them why they think an insect's body would need protection from living beneath a log. [it has a soft body, the log has sharp things that could hurt it]

7. **Explain that thinking this way will help them better understand the connection between structures of living things and how they function.**

8. **Ask: What other interesting things did you observe?** Encourage discussion & elicit different perspectives. Follow the natural thread of interest among your students. You might consider a particular organism's adaptation, or a structure or behavior, that someone could not explain. Ask: "Does anyone have a different explanation for that?"

9. **Students carefully release organisms.** Tell them to carefully return their organisms to their habitat, as close as possible to where they were found..

Wrapping Up & Reflection

1. **Lead *Thought Swap*** (formerly known as *Walk & Talk*). Ask students to talk to a partner about the benefits of the following structures and behaviors of other organisms that they probably didn't observe today:
   - *Many bats only come out at night. How could this behavior be beneficial?*
   - *Whales have a thick layer of blubber. How could this extra layer help them survive in the ocean?*
   - *What helped you to learn about adaptations today?*
   - *(Optional) Based on what you thought about today, what behavioral and structural adaptations do you think humans have and why? Remember behavioral adaptations don't include behaviors we learn or choose to do.*
   - Pose any other questions that might be interesting to your group.

2. **As you encounter other interesting organisms during your hike, ask, "What do you think some adaptations of this kind of organism might be?"** If they mostly bring up structural adaptations, ask them about behaviors, and vice versa. Keep asking, "does anyone have a different explanation?" to encourage alternative viewpoints.

TEACHING NOTES

Connections between structures & behaviors. It may come up in conversation (or you might choose to bring it up) that structures and behaviors are also very connected, like a frog using its tongue (structure) for catching flies (behavior). The way it flicks its tongue, how far it can flick it, how it uses it to capture the fly etc., are all based on the characteristics of that structure (what it's made of, what shape it is, etc.).

Celebrate ambiguity! The topics that tend to be most interesting to discuss are those without a clear answer, but with a bit of grey area in them. Discussions about whether or not a particular behavior is an adaptation may not lead to an answer, but can be very interesting and informative for students. Through this kind of open-ended discussion, students are actively applying and refining their understandings about adaptations. See the Instructor Support Section for more on facilitating talk around these kinds of grey area topics.

See the BEETLES Student Activity *Thought Swap* (formerly known as *Walk & Talk*) for more information about how to lead this routine.

Discussing human behavioral adaptations can be confusing. Much of human behavior is learned or, more accurately speaking, the result of complex interactions between inherited structural features and experiences of the individual. For example, human brains are genetically engineered to process and produce language, but one must be taught the specific words and symbols used in one's cultural group to be able to speak a language and be understood. This can make it very challenging to identify human behaviors that are adaptations. It's much easier to discuss the adaptations of simpler organisms, whose behaviors are mostly instinct-driven.

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Instructor Support

Teaching Knowledge

Building understanding of a definition through real world experience. Many students have memorized the standard definition of *adaptation*, but have not applied the concept to any organisms they have observed directly. *Structures & Behaviors* can spur students into making creative explanations, as they try to discover and describe the adaptations of the organisms they find. While it's important to promote accurate thinking about adaptations, it's also essential that students are given ample time to observe and freely explore organisms using the lens of figuring out their adaptations.

When students find an organism, they often get caught up in identification, and once it's identified, they may lose interest in exploring it further. There are so many fascinating aspects of organisms beyond identification, if you just know what questions to ask. This activity provides students with a useful and intriguing question to ask of any organism they might encounter anywhere: How might its structures and behaviors help it survive in its habitat? The main goal behind this activity is for students to develop an accurate definition of adaptation, and to realize that thinking about adaptations is a lens to apply to any type of organism they find. This lens can help students go beyond just naming, and develop a deeper curiosity about organisms, their structures, functions, and behaviors, and their relationship to the ecosystems they live in.

Science Language. Using precise scientific language is important when teaching about adaptations. Your students may arrive thinking that they already know what it means to "adapt," because the word is often used in common language to refer to adjusting to a new situation. Understanding the difference between the common and biological uses of the term is essential if students are to understand the scientific ideas behind **evolution.** It can sometimes be helpful to be explicit in contrasting the science meaning with the everyday meaning of "adapt," so that students can better clarify the differences. (i.e., pointing out that it doesn't mean the same thing when we talk about *adapting* to cold weather by wearing warm clothing). Make sure to read over the common misconceptions listed below in order to help reinforce a more accurate view of how populations of organisms change over time.

Conceptual Knowledge

Adaptations are inheritable traits that improve the fitness of a population of organisms. Fitness refers to an organism's reproductive success. Evolution happens because some individuals in a population are more reproductively successful than others. Evolution is the process of change that occurs in populations **over generations**. Traits that improve fitness will be passed on to more offspring than traits that do not improve an organism's fitness, and these traits become more prevalent in a population. This is how a population of organisms changes over time. If a population becomes so different from other members of the same species that it can no longer reproduce with them, then this population is considered a new species. This process is called ***speciation***.

While we often think of evolution and adaptations in terms of observable external changes in a population (such as beak size), it's important to remember that inheritable traits are the result of genetics. It's through DNA that these traits are passed on from one generation to the next.

Many adaptations do not fit neatly into the categories of "behavioral" and "structural." Often an adaptation is a combination of both a structure and a behavior. For example, the behavior of a bird making a call can't exist without the structure that allows it to make that sound. However, discussing behavioral adaptations helps students think more broadly about observable traits that can be considered adaptations.

It's often difficult to identify which behaviors qualify as adaptations. To be considered an adaptation, a trait must be inherited from one generation to the next. It can be tricky, but interesting, to try to figure out if a behavior is inherited or learned. For example, a student may say that the schooling behavior of a fish may be learned, and another student may argue that it's instinctual. What a wonderful scientific argument for students to engage in! If something like this comes up, encourage your students to discuss the question using evidence and reasoning. You might have them do a thought experiment, and imagine designing a scientific investigation that could answer the question. For example, one might put some newly-born fish in a tank without any adults around. If they swim in a school, that would be evidence that it's an instinctual behavior, (i.e., there aren't any older fish to "teach" the behavior).

It can also be complicated to decide whether certain structures qualify as adaptations. As well as being inheritable, a trait must provide a survival benefit to a population of organisms *in their current environment* in order to be considered an adaptation–that is in the most strict sense of the term. Examples of some things not considered adaptations are what are called *vestigial* structures—structures that no longer have a function for the organism, such as the hind legs found in whale species or the eyes of the blind mole rat. This also provides some intriguing questions to ponder with students.

Common Misconceptions

Misconception: An individual organism can adapt.
More accurate information. This is the most prevalent misconception about adaptations. In common English usage, the word "adapt" can refer to something an individual does, e.g., "I moved to a new school and I adapted by making new friends." However, in scientific usage, *populations of organisms adapt over generations*, but individuals don't. Adaptations are *inherited* structures or behaviors—they aren't acquired during an organism's lifetime. If a person works out a lot and develops big muscles, that person's children will not inherit big muscles, so it's not an adaptation. An adaptation must be something an organism is born with, like long legs. If longer legs help organisms run faster, survive and have more offspring than those with shorter legs, then longer legs may eventually become an adaptation and spread throughout the population.

NOTES

For more information about miconceptions related to evolution and adaptation. The Museum of Paleontology at UC Berkeley has a very extensive website designed specifically to provide resources for educators teaching about evolution. They have a more thorough discussion about misconceptions on which the information in this instructor support section is partly based. Please see the *Understanding Evolution* page at: http://evolution.berkeley.edu/

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 http://www.nextgenscience.org/ and http://ngss.nsta.org

Misconception. If a population or organism tries hard enough, it will adapt to its environment.
More accurate information. Adaptations originate in random genetic mutations. While most genetic mutations are harmful to organisms, every once in a while, a mutation will help an organism have a survival advantage and thus produce more offspring. The offspring who inherit the beneficial trait will also have more offspring. Evolution does not occur because an organism "wants" an adaptation. It works through random trial and error. Genetic mutations randomly occur, and beneficial ones are passed on to the next generation.

Misconception. "Survival of the fittest" means only the strongest organisms will survive.
More accurate information. The term *fitness* has nothing to do with physical strength in the context of evolution. In biology, fitness refers to how successful an organism is at reproducing, thus passing on its genes. Fitness is more important than survival when we think about evolutionary success. Bacteria, mayflies, and mice are all examples of organisms with short life spans, but high reproductive fitness. One way to think about "survival of the fittest" is that traits which improve an organism's fitness will "survive" in future generations of a species.

Connections to Next Generation Science Standards (NGSS)

BEETLES student activities are designed to provide opportunities for the "three-dimensional" learning required in the NGSS. To experience three-dimensional learning, students need to engage in Science Practices to learn important science ideas (Disciplinary Core Ideas) and deepen their understanding by relating that content to overarching Crosscutting Concepts. Students should be exploring and investigating rich phenomena, and figuring out how the natural world works.

Structure & Behaviors engages students in the science practice of *Constructing Explanations* to build a foundation for understanding disciplinary core ideas related to *Structure and Function*, *Interdependent Relationships in Ecosystems*, *Natural Selection*, and *Adaptation*, and connect those ideas to the crosscutting concept *Structure and Function*. (Note: "Structure and Function" is a crosscutting concept; it is also the title of a category of Disciplinary Core Ideas within the Life Sciences).

Featured Science and Engineering Practices

Engaging students in Constructing Explanations. According to *NRC's A Framework for K–12 Science Education*, a major goal of science is to deepen human understanding of the world through making explanations about it—students should develop their understanding of science concepts through making their own explanations about natural phenomena. In *Structures and Behaviors,* when students observe an organism, then describe how its structures and behaviors might help the organism survive in its habitat, they're constructing their own explanations. For example, a student who writes, "I think it probably uses its antennae to feel where it's going," has constructed a possible explanation for how structures sticking out of an isopod's head help the organism survive.

In order for students to be fully engaged in this practice, they need to go beyond just making explanations as described above. They also need to consciously use tentative language ("I think that..."), base their explanations on evidence, and consider alternate explanations based on that evidence. The large group discussion in which students share their ideas about possible adaptations is a critical step in this activity because it's an opportunity to encourage students to include their evidence and reasoning when they give an explanation, and to entertain alternate explanations.

Featured Crosscutting Concepts

Learning science through the lens of Structure and Function. The idea that structure and function complement each other is a useful tool for explaining things in science. In the designed world and in any natural system, the shape and material of a structure is related to what it does, and vice versa. In *Structures & Behaviors,* students observe an organism's structures, and make possible explanations for how each one helps the organism survive in a specific environment. In other words, students look at structures and think about how they might function. Yet, students aren't introduced to the specific language and scientific application of "structure and function" until they are asked to reflect on their own thinking processes toward the end of the activity.

If students don't get the chance to consider how the idea of structure and function connects to the explanations they're making, they miss the opportunity to recognize the idea of structure and function as an important way of looking at the natural world. They also might not realize that the idea of structure and function also applies in other scenarios, such as looking at a certain model of car and thinking about what it was designed to do. Make sure to emphasize this with students, and to provide additional opportunities in their field experiences to apply the idea of structure and function in different contexts.

Featured Disciplinary Core Ideas

Building a foundation for understanding Disciplinary Core Ideas. The *NGSS* make it clear that students need multiple learning experiences to build their understanding of disciplinary core ideas. *Structures & Behaviors* provides students with an opportunity to develop understanding of the life science core ideas related to LS1.A *Structure and Function*, LS2.A *Interdependent Relationships in Ecosystems,* and LS4.B-C *Natural Selection, Adaptation.*

Specifically, when students are making explanations of how particular structures of organisms might help that organism to survive, they develop some understanding of the core idea that organisms have characteristic structures that serve functions in growth, survival, behavior, and reproduction (LS1.A). When they focus on how an organisms' structures and behaviors help it survive within the context of its habitat, they are building some foundational knowledge of how organisms are dependent on, and interact with, the living and non-living parts of the environment (LS2.A). By using a working definition of the term "adaptation" as they consider which inherited characteristics

NOTES

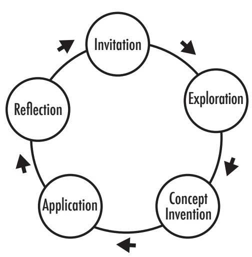
Importance of teaching science practices. "Engaging in the practices of science helps students understand how scientific knowledge develops...It can also pique students' curiosity, capture their interest, and motivate their continued study..." -National Research Council, *A Framework for K-12 Science 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.

NOTES

Translating the codes for the NGSS performance expectitons. Each standard in the NGSS is organized as a collection of performance expectations (PE's) for a particular science topic. Each PE has a specific code, provided here so 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-LS4-3 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 Adaptation. It's also the third performance expectation (3) that makes up the complete LS4 standard at this grade level.



As a discrete activity, Structures and Behaviors completes a full learning cycle. Within a sequence of other activities focused on developing student understanding of adaptations, this activity could serve as an Exploration or a Concept Invention.

could be critical to an organism's survival in an environment, students develop foundational understanding of adaptation as a process that results in the combination of traits that appear in populations of organisms (LS4.B-C).

You can informally assess student understanding of these concepts during different stages of the activity through individual interactions with students, and by listening carefully during the group discussions. This information can help determine which ideas to focus on in future lessons, so follow-up activities or discussions can be used to further student understanding.

Performance Expectations to Work Toward

When examined closely, it's clear that the *NGSS* represent complex knowledge and multifaceted thinking abilities for students. No single activity can adequately prepare someone for an NGSS performance expectation. Performance expectations are examples of things students should be able to do, after engaging in multiple learning experiences or long-term instructional units, to demonstrate their understanding of important core ideas and science practices, as well as their ability to apply the crosscutting concepts. As such, they do not represent a "curriculum" to be taught to students. Below are some of the performance expectations that this activity can help students work towards.

3-LS4-3. Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

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-LS1-4.Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.

Activity Connections

You can lead students into the theme of adaptations using the *Whacky Adapty* and/or *Adaptations Intro-Live!* activities. Both of these activities introduce a brief definition for adaptations. In *Adaptations Intro-Live!* the instructor models this with a live organism that the whole group can see. These activities also serve to help the instructor find out whether or not students have a solid grasp on the concept of adaptations. If they do, it can be a nice follow-up to use the *Related & Different* activity to extend student understanding of species and diversity.

You can also prepare students for close observation of organisms using the BEETLES activities *Discovery Swap* and *I Notice, I Wonder, It Reminds Me Of.*

FIELD CARD

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

Structures & Behaviors

Introducing the Activity

1. Ask students to *Think-Pair-Share*: What structures do all deer have & how might they help them survive in their habitat?
2. Explain: inheritable helpful body structures are adaptations.
   - ▶ *Adaptations are inheritable structures that help a population of organisms survive in their habitat.*
3. Students *Think-Pair-Share* behaviors of deer that help them survive in their habitat.
4. Explain that *inheritable* helpful behaviors, like breathing & flinching, are adaptations too!
   - ▶ *Adaptations are inheritable structures* ***or behaviors*** *that help a population of organisms survive in their habitat.*

Identifying Possible Adaptations

1. Draw chart on whiteboard as students prepare chart in journals.
2. Model filling out the chart, using deer as an example.

Possible Adaptations of a ______	
Structure/Behavior	How it might help this population of organisms survive in its habitat

3. Explain that students will search for organisms within boundaries, then pick one organism to observe in pairs, thinking about its possible adaptations and filling out the chart.
4. Explain that when identifying adaptations–inheritable, helpful structures & behaviors–it's essential to think about the organism's habitat.
5. Briefly mention (or have them share) environmental factors that may affect organisms in the ecosystem.
6. Share any tips for finding organisms.
7. Pass out materials.
8. In pairs, students find an organism to observe & complete chart while instructor circulates.

Discussing Adaptations & Connections to Science

1. Students share & discuss observations with another pair; remind them to share evidence behind thinking & respectful disagreement.
2. Whole group discussion of their explanations of possible benefits of different structures & behaviors.
3. Describe how scientists make connections between structures and their function, as a powerful tool for understanding.
4. Explain that scientists who study things other than organisms think about structure & function, too.
5. Give example of a connection between a structure & a function, (e.g., insects exoskeleton protect them from living under logs) & ask students to give other examples. Listen to their ideas.
6. Remind students to include evidence when making explanations. (e.g., why might an insect need protection from living under logs?)
7. Explain that thinking this way will help them better understand the connections between structures of living things and how they function.
8. Ask students: What interesting things did you observe? Encourage discussion and different perspectives.
9. Students carefully release organisms.

Wrapping Up & Reflection

1. Lead *Thought Swap* (formerly known as *Walk & Talk*) using the following questions.
   - ▶ *Many bats only come out at night. How could this behavior be beneficial?*
   - ▶ *Whales have a thick layer of blubber. How could this extra layer help them survive in the ocean?*
   - ▶ *What helped you to learn about adaptations today?*
   - ▶ *(Optional) Based on what you thought about today, what behavioral and structural adaptations do you think humans have and why? Remember behavioral adaptations don't include behaviors we choose to do.*
   - (Add any other questions that might be interesting to your group).
2. As you encounter other interesting organisms, ask, "What do you think some adaptations of this organism might be?

beetles

Science and Teaching for Field Instructors

THE LAWRENCE HALL OF SCIENCE
UNIVERSITY OF CALIFORNIA, BERKELEY

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