beetles

Science and Teaching for Field Instructors

Student Activity Guide

Most Successful Organism Discussion

This is a fun, casual "mini discussion" that can be used to get students generating and sharing ideas in a low-stakes setting, and to help build a culture of discourse and develop discussion skills within a group. It's an interesting and fairly easy topic for students to think about and participate in. Students tend to love talking about the "most," "least," and "how many" facts about nature. The very broad category of "organism" means all students will probably have something to contribute to the discussion. Engaging in this kind of talk can help prepare a group to participate in similar or more involved discussions later, and it can "run in the background" while the group is eating lunch or a snack, or whenever they seem ready to sit and chat.

Students will...

- **Participate in a casual discussion in which they share ideas, make tentative claims, and use evidence and reasoning to evaluate each other's claims.**
- **Consider other ways of evaluating "success" beyond the anthropocentric view.**
- **Become aware of bacteria, an organism that is vital to ecosystems, but hard to observe in the outdoors.**
- **Share prior knowledge about organisms with each other.**

Grade Level:
Grades 3–8

Timing:
7–20 minutes

Related Activities:
Walk & Talk; Turn & Talk; Argumentation Routine, What Lives Here?; Structures and Behaviors; Interview an Organism, Discussion: Wildfire Management; Ecosystem Theme Hike

Materials:
Chart of some candidates for most successful organism.
Optional: Images of organisms from the chart.

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

Setting:
Anywhere students can sit comfortably for about 20 minutes.
Works well to do while students are eating a picnic lunch.

NEXT GENERATION SCIENCE STANDARDS

FEATURED PRACTICE	FEATURED CROSSCUTTING CONCEPT	DISCIPLINARY CORE IDEAS
Argue from Evidence.	Structure and Function.	Structure and Function Growth and Development of Organisms Interdependent Relationships in Ecosystems Adaptation

For additional information about NGSS, go to pages 9–11 of this guide.

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Most Successful Organism Discussion

ACTIVITY OVERVIEW

Most Successful Organism Discussion	Learning Cycle Stages	Estimated Time
Leading the Discussion	Invitation, Exploration, Concept Invention, Application	5–15 minutes
Wrapping Up the Discussion	Reflection	2–5 minutes
TOTAL		**7–20 minutes**

TEACHING TIPS

Field Card. On page 12 of this guide, you'll find a condensed, pocket-sized version of the lesson that you can carry in the field.

Read the Instructor Support Section. Beginning on page 7, you'll find more information about pedagogy, student misconceptions, science background, and standards.

Working up to discussion. Before launching into this discussion, give your students some practice discussing science ideas. Try some pair talk first, with activities like *Walk & Talk* and *Turn & Talk*. Establish a culture of discussion and consider introducing discussion norms. This is a great activity to do once students have had some experience with pair talk, to help a group build up to a deeper or more challenging discussion later on.

Connect to your surroundings. When students bring up organisms that are in the area, make connections to what you can see right there, and what your group has already seen. Continue to make connections after the discussion is over. For example, if the group talks about bacteria during the discussion, point out evidence of bacteria when you encounter it (i.e., irregular spots on leaves or decaying scat), or mention when they eat, bacteria living in their guts help break down food so their bodies can use it.

Choose the right moment for the discussion. It's important to lead this discussion at a time when students will be able to engage. Don't start it right when students begin a field experience for the day, or when they clearly have physical energy and are excited to explore. Try leading the discussion after students have hiked up a large hill, after they've just spent time running around, or at an idle moment when the group seems ready to chat, like over lunch.

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Leading the Discussion

1. **Introduce the opening question to students.**
   - *Here's a question for you all. What is the most successful organism ever? Who's got a nomination?*

2. **Listen to a student response, and ask them to share the evidence and reasoning behind their nomination.**

3. **Facilitate the discussion by giving other students the chance to share their ideas about the first nomination, asking for other nominations, and asking follow-up questions.** Ask other students to share their ideas, agreement, or disagreement about the first nomination. Use the follow-up questions below to deepen their thinking. Then, continue leading the discussion by giving other students the chance to share different nominations, using follow-up questions, *Turn & Talks*, and opportunities to show agreement or disagreement to keep the group engaged. Allow conversation to flow, and to follow students' interests. Don't ask every follow-up question with each organism, don't be formulaic with the order of questions you ask, and only use Structure and Function for specific follow-up questions when you think students will have some knowledge of an organism's basic structures.

   General follow-up questions:
   - *What's your evidence and reasoning for X being the most successful organism? What makes you think X is so successful?*
   - *What do you all think of that nomination? Agree? Disagree? Why or why not?*
   - *Who's got a different nomination?*

   Structure and Function specific follow-up questions:
   - *How might the structures of this organism help it be successful?*
   - *How have its structures helped it survive in its habitat(s)?*

4. **Continue the discussion, keeping it as student-centered as possible.** It's fun for the discussion to be as student-driven as possible, with students coming up with the nominations, sharing reasons for and against each organism, and defining criteria for success.

5. **Occasionally add information from the chart (page 13) and photos (pages 14-15) as needed.** If the discussion is sluggish or uninspired, make a nomination yourself, or share information about an organism from the chart (or from your own background knowledge) then, ask students to discuss how that affects their thinking. If you bring organisms like brine shrimp or bristlecone pines from the chart on page 13 into the conversation as candidates, there's a good chance at least some students in your group won't be familiar with them. These students may feel confused or left out of the conversation. It can help to show a photo of the organism (cut cards from pages 14-15) being discussed to help keep everyone involved.

TEACHING NOTES

Discussion Norms. Norms can greatly improve emotional safety in a discussion See page 7 for more information.

Exposure to the word, "organism." Before launching into this discussion, ask students if they know the word "organism" (any living thing), or define the term earlier in the field experience and use it at least a couple times before doing this activity.

Organism-specific follow-up questions: What is it about a blue whale's habitat that has allowed it to be so huge? Why aren't there organisms that big in the forest? On land? Beetles are found in every ecosystem except polar regions and the ocean. Why can't they survive in those ecosystems? Bacteria and fungi are successful largely because of the relationships they have with other organisms. What other organisms survive through different relationships? Feel free to add some info from the chart now and then, but don't get carried away with introducing information. It's more engaging as a forum mostly for students to share what they know with each other.

More on Structure and Function. The NGSS Crosscutting Concept of Structure and Function states that an object or living thing's shape and substructure determine many of its properties and functions. Introducing this "big idea" into the discussion can lead to thinking about organisms in different and often interesting ways. For example, what is it about a cockroach's structure that allows it to live without its head? Survive so long without air and food? Survive extreme heat? What about brine shrimp's structure could help them to survive being dried out? Students might not have the background knowledge to discuss the structures of every organism that is nominated, so use these questions strategically.

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TEACHING NOTES

Defining "successful organism." There might be different ideas on how to define/measure a successful organism: Is it the organism that can reproduce fastest? Has impacted the Earth most? Can survive in the most places? Has lived on Earth longest? Deciding as a group what success means in this context is an interesting discussion in and of itself.

There is no right answer. The answer to the question is subjective, which is part of what makes it interesting to discuss. There's no right answer, but it brings up interesting ideas about different organisms, and the interesting metric of what makes an organism successful. Many people automatically think of humans as the most successful organism, separate from and superior to nature. It's useful for students to realize there are different ways of being successful, and that there are ways in which other organisms are far more successful than humans.

6. **At an opportune moment, ask students to discuss what it means for an organism to be successful.** It's likely that students will bring up different definitions of success embedded within their statements. For example, the statement, "I think ants are most successful, cause they're everywhere," implies "being everywhere" as a criteria for success. At a point when it seems interesting and worthwhile (for example, if students nominate two very different organisms and disagree about which one is most successful, or if a student raises the question about what constitutes "success"), take some time to discuss and define "success" for organisms.

   ▶ *What are some different ways of defining "success" for a type of organism?*

7. **If students don't bring up bacteria, nominate them yourself and point out some reasons they are successful.** Bacteria may be considered successful because of their importance to ecosystems and how ubiquitous they are. Make sure bacteria are part of the discussion, and ask students to describe and discuss their own thoughts about its nomination. Some facts about bacteria to share to help justify its nomination include (see chart on the field card on page 13) for more information on bacteria and other organisms):
   - There are about 10 times as many bacterial cells in a human as there are human cells. Bacteria are everywhere, all around us and inside of us!
   - Bacteria are important decomposers, they live in guts of animals, breaking down food.
   - They are so successful primarily because they have different kinds of relationships with so many other living things.

8. **During the discussion, when a particularly interesting point is brought up, or if some students are becoming disengaged, do a *Turn & Talk* to promote participation and engagement.** Mixing up whole group discussion with *Turn & Talks* helps keep students engaged, and provides opportunities for everyone to participate comfortably in one-on-one discussion.

Wrapping Up the Discussion

1. **While the group is still jazzed about the topic (before they lose interest), briefly summarize the nominations and the overall discussion.** It's unlikely the group will all come to a consensus during the discussion, but that's not really the point anyway. Yet finishing a discussion without any type of conclusion can feel unsatisfying for a group. A short summary of the discussion often leads to a feeling of accomplishment, and is a good way to help bring discussion to a close if a consensus hasn't been reached.

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For example:

- We're going to wrap up in a couple minutes, and I want to take a moment to trace how our thinking changed during this discussion. First we said "humans" are the most successful, and came up with some reasons supporting that, then someone brought up bacteria, and some argued that they were most successful because they've been around so long and there are so many of them. But then there were more arguments supporting humans, such as that they have altered the Earth environment so much. Then someone brought up cockroaches, and how tough they are, and people brought up some interesting facts about cockroaches. But then we discussed how brine shrimp are even tougher. Then we discussed different ways of how organisms might be considered successful, and we brought up quantity, toughness, how long they've been around, and in the end we decided that we really couldn't decide, cause there are so many different ways of deciding what success is.

2. **Briefly mention how the group used the Crosscutting Concept of Structure and Function to guide some of their thinking about organisms' successes, and how it could be useful in other settings.** Point out how thinking about structures of an organism helped the group understand why certain organisms have been so successful. For example, they might have said that plants are the most successful organism, because they can make food from air and water through photosynthesis, which is directly related to the photosynthetic structures they have.
   - ▶ *We used the scientific thinking tool of Structure and Function to think about how structures have helped some organisms be successful.*
   - ▶ *Scientists use the idea of Structure and Function to help them deepen their understanding in many fields of study, like engineering or physics.*

3. **Point out that the goal of the discussion wasn't to decide on an answer, but to bring up and discuss interesting ideas.** Explain to the group that the question is a hard, if not impossible, one to answer definitively because there are so many different ways to define "success." Point out that the goal was more for everyone to share their ideas, and for the group to get practice with discussion.

4. **Explain that it's helpful to learn to be comfortable not knowing an answer, rather than deciding on an answer for simplicity and closure.** Point out that it's valuable to discuss interesting questions in life without necessarily arriving at an answer. Explain that it's a human tendency to choose a simple answer to a complex question just to have closure, but that many interesting questions or problems don't have simple answers. Encourage students to try to get comfortable with not knowing the answers to complex questions, and to try to avoid settling on a simple answer just for the sake of feeling like they have an answer.
   - ▶ *If you can see reasons why different organisms could be considered most successful, or if you can see different ways of being successful, those are signs of flexible, broad-minded thinking. That's an important life skill.*

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TEACHING NOTES

5. **Ask the group to discuss some of the following questions in a *Walk & Talk* or *Turn & Talk* to reflect on how they did with the discussion.** Invite students to point out how the group did in the discussion. Were they inclusive, and did they make space for everyone to contribute if they wanted to? Did people listen to each other? Did they build on each other's ideas, or mostly just take turns making statements?
   - *How did you think the group did as a whole in this discussion? Did we listen well? Did we build on other's ideas and disagree respectfully, or mostly just take turns making statements without building on what was said before? What could we do better next time?*
   - *What skills did you feel like you got better at during this discussion?*
   - *What did you learn, and what helped you to learn?*
   - *What are you still wondering about? Are there any organisms you want to learn more about after having this discussion?*

6. **Point out the importance of discussion skills in science, life, and citizenship.** Explain that discussion skills are important for the exchange of ideas and increased understanding in science. They're also important for the exchange of ideas anywhere, and in other settings like building relationships, making decisions, and general success in life and as citizens of the world.

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Instructor Support

TEACHING NOTES

Teaching Knowledge

Discussion Norms. Norms can help set students up for success in discussion. If you have gone over discussion norms already with your group, remind students of those norms at the beginning of the activity. If you haven't yet introduced them, do so before engaging in discussion An example of some discussion norms: Listen actively and share ideas; Share and ask for evidence; Build on ideas of others; Keep an open, curious mind; Disagree respectfully to increase understanding; Pay attention to participation.

Engaging students in discussion. Many learners are used to education being a one-way delivery of information and need some modeling and coaxing to share the sorts of tentative questions and ideas that are involved in intellectual inquiry and discussion. They may also be afraid of admitting what they don't know in front of peers and especially leaders. In order for students to be able to engage in discussion, it's important to set up a culture of discourse in your group, and to give students opportunities to discuss in pairs and small groups before participating in a whole group discussion, like this mini-discussion. To build a culture of discourse, create and nurture an atmosphere of respect and intellectual curiosity by responding equitably to students' ideas as a facilitator, and by facilitating—not dominating—the discussion.

When you respond to students, do it in a neutral, accepting manner, then ask follow-up questions to find out more about their thinking. To help student learners improve their discussion participation skills, it's also useful to point out examples when you or others model good discussion practices, such as asking for evidence, or building on someone else's idea. Encourage learners to politely monitor each other's discussion practices as well. Encourage respectful agreement and disagreement, and establish that, when there is disagreement about ideas, students will not be ridiculed for having the "wrong" answer. Emphasize that sharing ideas as a group is an important part of the learning process.

For more on building a culture of discussion and building discussion-leading skills, see BEETLES *Encouraging Student Discussion and Productive Talk* resources and *Discussion Strategy Videos*.

Supporting English Language Learners. Engaging in argument about interesting questions, such as "What is the most successful organism?" can be very productive for language development. Sentence starters can help support students in their primary language and in English. Consider creating a board with sentence starters, such as:

- I agree because...
- I wonder if...
- I disagree because...
- I'm not sure, but I think...
- The evidence seems to show...
- Maybe...

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TEACHING NOTES

- The evidence makes me think...

Seeking out the edges of your own understanding. Don't be afraid if the discussion steers towards topics and questions that you don't fully understand, such as if a student brings up an organism you're not that familiar with. Let learners see you brainstorming and grappling with ideas too. Engaging in authentic inquiry together makes you a "guide on the side" and provides students with a model of someone who's not the expert on everything (and nobody is!). Some educators may avoid discussing unfamiliar topics because they're afraid they'll lose respect from their learners. When you take time to figure things out alongside your students, you actually gain their respect for being a curious and scientific thinker.

Follow-up questions. You can also use follow-up questions to probe students' claims and engage other learners, such as: What is your evidence for that? What makes you think that X is an important part of being a "successful" organism? Why do you think Y is a more successful organism than Z?

Embracing an unanswerable question. The point of this mini-discussion is not to decide on an answer but rather to bring up and discuss interesting ideas. Students are often eager to know the "right" answer but the question "What is the most successful organism?" is compelling because there are a variety of interesting and "right" ways to answer it. Important learning happens as students engage in argument about different claims. A compelling question like this provides opportunities for students to practice supporting their ideas with evidence, analyzing and evaluating evidence, distinguishing between facts and opinions, and respectfully critiquing their peers' ideas. All of these are critical aspects of how scientists learn about and make sense of the natural world.

Conceptual Knowledge

Defining success. There are different ways to think about what defines a "successful" organism: Is it the organism that can reproduce fastest? Has impacted the Earth most? Can survive in the most places? Has lived on Earth the longest? If the group chooses to define success, how they do so will determine which organisms get the spotlight. Below are possible arguments according to various definitions of success. We didn't put them here as "right" answers to share, but as examples of the kinds of reasoning that may probe students in their discussion.

- Most influential organism: If one thinks of success in terms of power or influence, it could be argued that the most successful organism is the one that has had the greatest impact on the Earth system. By this definition, some might argue that algae have had the biggest impact on Earth because they're the ancestors of all land plants. Others might point to cyanobacteria, a bacterium that photosynthesizes, and is responsible for first transforming Earth's atmosphere, making it oxygen rich, which so many organisms now depend on. With the rapid changes that humans have caused and the profound impact they've had on the Earth system, another strong argument could be made for humans being "most successful."

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- Most reproductive success: Another interpretation could be that the most successful organism is the one that has the most reproductive success. But when you think about comparing reproductive success, what should you measure? The species that reproduces fastest? In that case, bacteria may win the race, because they can double their population in minutes! If you measure quantity to represent reproductive success, again, bacteria may come out on top. In particular Pelagibacterales—free-living bacteria that live in the ocean, and in some instances, in freshwater lakes—are among the most abundant, making up between a quarter and a half of all single-celled organisms in the ocean, or in other words, up to half a million microbial cells in each teaspoon of seawater!
- Longest-living: If you think of success as the ability to survive and outlast other organisms, you might argue the organism that has lived longest is most successful. Trees top the list for longest-living individuals. The oldest-known individual plant is a Great Basin bristlecone pine, measured to be more than 5,000 years old. Many clonal colonies have lived much longer. For example, a colony of quaking aspen, connected by a massive underground root system, is estimated to have lived for 80,000 years!

Connections to Next Generation Science Standards (NGSS)

BEETLES student activities are designed to provide opportunities for the "three-dimensional" learning that is called for 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. The *Most Successful Organism Discussion* engages students in the practice of *Engaging in Argument from Evidence* to build understanding of Disciplinary Core Ideas related to *Structure and Function, Growth and Development of Organisms, Interdependent Relationships in Ecosystems*, and *Adaptation*, and relate those ideas to the Crosscutting Concept of *Structure and Function.*

Featured Science and Engineering Practices

Engaging students in Engaging in Argument from Evidence. The *Framework for K-12 Science Education* highlights the importance of reasoning and argument in determining the best explanation for a natural phenomenon. The *Framework* states that engaging in argument is critical to students' understanding of the culture of science. In *Most Successful Organism Discussion*, students support their ideas (claims) about which organism is most successful with evidence, critique each other's ideas, and reevaluate their own ideas based on new evidence. As they do this, they gain practice with scientific argumentation. Be sure to keep probing students' claims about phenomena, asking them to critique each other's arguments based on the available evidence, and share why they agree or disagree, so that they begin to internalize the practice of engaging in argument from evidence, and recognize it as a transferable skill.

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

See sidebars on Practices and Crosscutting Concepts on the following page.

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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 *Most Successful Organism Discussion*, students discuss how the structures of different organisms function to help them be successful. If students don't get the chance to consider how the idea of structure and function connects to the arguments 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. Emphasize this with students, and 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. *Most Successful Organism Discussion*, provides students with an opportunity to develop understanding of some Disciplinary Core Ideas relating to LS1.A: Structure and Function, LS1.B: Growth and Development of Organisms, LS2.A: Interdependent Relationships in Ecosystems, and LS4.C: Adaptation.

When students consider how organisms' structures help them succeed, they develop an understanding about how organisms' internal and external structures help them survive and reproduce (LS1.A). As they discuss reproduction as a key aspect of survival and success, they bring up ideas about how organisms' unique behaviors can increase their odds of reproduction (LS1.B). Students may also discuss how different organisms are more or less successful in different environments, and in doing so, bring up ideas about how organisms only survive when their particular needs are met (LS2.A), and different organisms survive better or worse in different environments and adapt to changes in an environment through the process of natural selection (LS4.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 you determine which ideas to focus on in future lessons, so follow-up activities or discussions can be used to further improve student understanding.

Performance Expectations to Work Toward

When examined closely, it's clear that the NGSS represent complex knowledge and 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

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.

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.
(continued on next page)

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 toward:

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 and Additional Ideas

To continue to develop the practice of engaging in argument, use *Walk & Talk, Turn & Talk, Argumentation Routine, What Lives Here?,* or *Tracking*.

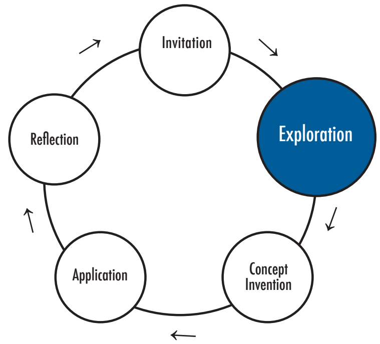
For more activities that integrate the Crosscutting Concept of Structure and Function, use *Structures & Behaviors* or *Interview an Organism*.

This "Mini-Discussion" could be a great lunchtime topic during either the Ecosystem or Adaptation Theme Hike.

TEACHING NOTES

(Continued from previous page)

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.



As part of an extended field experience, this discussion would primarily serve as an Exploration.

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FIELD CARD

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

Most Successful Organism Discussion

Leading the Discussion

1. Introduce the opening question.

   ▶ *What is the most successful organism ever? Who's got a nomination?*

2. Listen to a student response, & ask them to share the evidence & reasoning behind their nomination.
3. Give a few other students the chance to share their ideas about that nomination, while asking follow-up questions to keep the discussion going. Follow-up questions:
   - What's your evidence and reasoning for X being the most successful organism? What makes you think X is so successful?
   - What do you all think of that nomination? Agree? Disagree? Why or why not?
   - Who's got a different nomination?

   Follow-up questions to use when appropriate & interesting:
   - How have the structures of this organism help it be successful?
   - How have its structures helped it survive in its habitat(s)?
4. Continue discussion, keeping it as student-centered as possible, & occasionally interject information from the chart (see below), as needed.
5. When it feels appropriate during the discussion, ask students what it means for an organism to be successful.

   ▶ *What are some different ways of defining "success" for a type of organism?*

6. If students don't bring up bacteria, nominate them yourself & help students realize bacteria are all around & in them, & are successful largely because of their relationships with other organisms.
   - There are about 10 times as many bacterial cells in a human as there are human cells.
   - Bacteria are important decomposers, they live in guts of animals, breaking down food.
   - They are so successful primarily because they have different kinds of relationships with so many other living things.
7. During the discussion, when a particularly interesting point is brought up, or if some students are becoming disengaged, do a *Turn & Talk.*

Wrapping Up the Discussion

1. Before the students lose interest, briefly summarize the nominations & overall discussion.
2. Briefly mention how the group used the Crosscutting Concept of Structure & Function to guide some of their thinking about organisms' successes.
3. Point out that the goal of the discussion wasn't to decide on an answer, but to bring up & discuss interesting ideas.
4. Explain that it's helpful to learn to be comfortable not knowing an answer, rather than deciding on an answer for simplicity & closure.

   ▶ *If you can see reasons why different organisms could be considered most successful, or if you can see different ways of being successful, those are signs of flexible, broad-minded thinking.*

5. Ask the group to discuss some of the following questions in a Walk & Talk or Turn & Talk to reflect on how they did with the discussion.

   ▶ *How did you think the group did as a whole in this discussion? Did we listen well? Did we build on other's ideas and disagree respectfully, or mostly just take turns making statements without building on what was said before? What could we do better next time?*

   ▶ *What skills did you feel like you got better at during this discussion?*

   ▶ *What did you learn, and what helped you to learn?*

   ▶ *What are you still wondering about? Are there any organisms you want to learn more about after having this discussion?*

6. Point out the importance of discussion skills in science, life, & world citizenship.

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FIELD CARD

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

Bacteria:

- There are about 10 times as many bacterial cells in a human as human cells.
- Important decomposers, they live in the guts of animals, breaking down food.
- They are very successful primarily because they have established different kinds of relationships with so many other living things.
- There's more bacteria biomass than all plants & animals on Earth.
- They're among the first life forms on Earth.
- They can survive in acidic hot springs, radioactive waste, deep in Earth's crust.

Brine shrimp have survived:

- Completely dried, set on fire, or boiled at 221 degrees F.
- Chilled to almost absolute zero (-459 degrees: the temperature when atoms stop moving).
- Set out on the Moon (then returned).
- In 20,000 feet ocean depth.
- When eggs buried for 10,000 years (some hatched and survived when water was added).

Bristlecone pine:

- One of the longest-living life forms on Earth.
- Oldest more than 5,000 years old, which makes it the oldest known individual of any species.

Blue whale:

- The largest organism that has ever lived on Earth.

Sharks:

- They've been around more than 420 million years, and they're found in all seas.
- The whale shark is the largest fish in the world.

Beetles:

- More different kinds of beetles than of any other type of organism: about 25% of known life forms are beetles.
- Very diverse and found in almost all ecosystems (not seas or in polar regions).

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Cockroaches have survived:

- Active for a month without food.
- No air for 45 minutes.
- 12 hours at 17.6-23 degrees F.
- With heads cut off, can still be active & live for weeks. The severed head can also survive for hours. How can they survive headless? They breathe through holes in the body, have nerve tissue clumps throughout their body, and have less blood pressure so they don't bleed to death.

Fungi:

- The main decomposers in terrestrial ecological systems, and abundant worldwide.
- In bread, antibiotics, and other helpful products.
- Cause many diseases.
- Can digest wood, which most other organisms can't.
- An estimated 90% of plants have relationships with fungi that help the plants survive.

Plantlike organisms (photosynthesizers):

- Changed Earth's environment by making oxygen-rich atmosphere.
- Can make food from carbon dioxide, water, and sunlight.
- Most life depends on food made by plants.

Possible discussion questions: **How have the structures of this organism helped it be successful?** How have its structures helped it survive in its habitat? **What is it about a cockroach's structures that allows it to live without its head?** Survive so long without air and food? Survive heat? **What is it about a blue whale's habitat that allows it to be so huge?** Why aren't there organisms that big on land? **Why can't beetles survive in arctic regions and the ocean? What other organisms survive through relationships (like bacteria and fungi)?**

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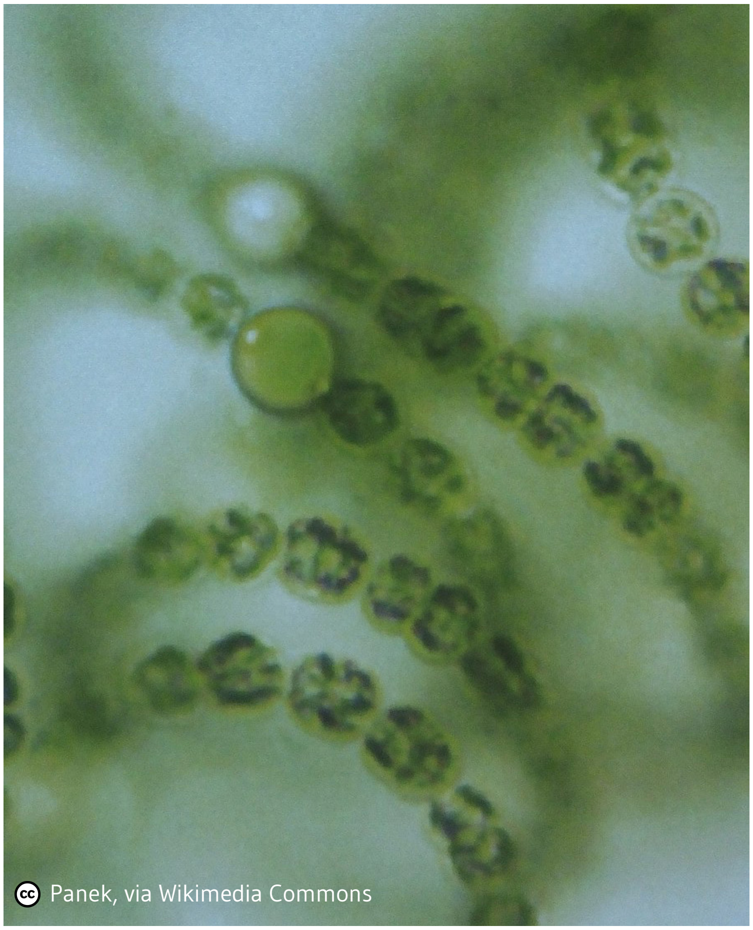
Organism Pictures



Panek, via Wikimedia Commons

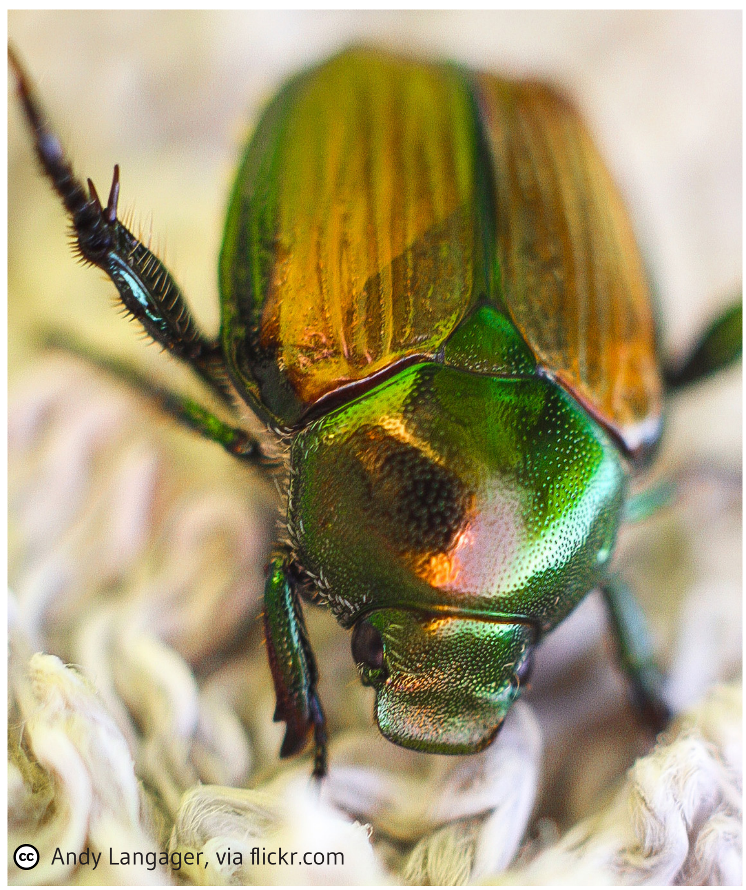
PLANTS

artemia salina, via flickr.com

BRINE SHRIMP

Nigel Jones, via flickr.com

FUNGI



Andy Langager, via flickr.com

BEETLES

BRISTLECONE PINE

BLUE WHALE

BACTERIA

COCKROACH

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.

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

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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.

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