beetles
Science and Teaching for Field Instructors

Student Activity Guide

Blending In & Standing Out

Students tend to be fascinated by colors and patterns of organisms, and by thinking and learning about these and other adaptive strategies. Colors and patterns in nature are a great entry point to understand adaptations. This activity focuses on how organisms' patterns and colors help them stand out or blend in with their environment, and how this helps them survive. Students observe the main colors in the landscape, then search for plastic animals hidden there, noticing which blend in with their surroundings and which stand out. Then, students discuss what made the animals blend in or stand out, construct explanations for how this could help the animals survive, and learn four categories for color and pattern adaptations: camouflage, mimicry, warning, and attraction. Students apply these concepts as they search for real organisms in the area, then discuss how patterns and coloration might help the organisms survive in their habitat.

Ideally, this activity should be part of a series of learning experiences on adaptations, after an activity that introduces the concept of adaptation, such as *Adaptations Intro-Live*, and/or *Whacky Adapty,* and followed by activities like *Structures & Behaviors, Related & Different, Discovery Swap,* and *Interview an Organism*.

Students will...

- Take part in a "Colors Hunt," recording the main colors in the environment.
- Sort organisms into the categories "Blends in" or "Stands out," then discuss how blending in or standing out from the environment might help them survive.
- Learn the terms "camouflage, mimicry, warning, and attraction," then apply them while observing real organisms.

Grade Level:
Grades 2–8. Adaptable for younger or older students.

Timing:
45–60 minutes.

Related Activities:
Whacky Adapty, Adaptations Intro-Live!; Structures & Behaviors; Related & Different; Discovery Swap; I Notice, I Wonder, It Reminds Me Of; Interview an Organism; What Lives Here?

Materials:
- Plastic animals or "Hiding Cards"
- Whiteboard and marker
- 7 signs
- Journals and pencils
- Blending In/Standing Out Discussion Cards

See Gathering Student Materials page 3 for more information.

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

Setting:
An area along a fairly wide trail, or an open, flat space with plants around it.

NEXT GENERATION SCIENCE STANDARDS

FEATURED PRACTICE	FEATURED CROSSCUTTING CONCEPT	DISCIPLINARY CORE IDEAS
Constructing Explanations	Structure and Function	Structure and Function (and others)

For additional information about NGSS, go to page 16 of this guide.

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Blending In & Standing Out

ACTIVITY OVERVIEW

Blending In & Standing Out	Learning Cycle Stages	Estimated Time
Colors Hunt	Invitation	5 minutes
Searching for Plastic Animals	Exploration	10 minutes
Discussing Colors in Nature	Exploration, Concept Invention	10 minutes
Thinking about Organisms	Concept Invention, Application	10–15 minutes
Searching for Real Organisms	Concept Invention, Application	10–15 minutes
Wrapping Up	Reflection	5 minutes
TOTAL		50–60 minutes

TEACHING TIPS

Field Card. On pages 21–22 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 11, you'll find more information about pedagogy, student misconceptions, science background, and standards.

When & where. This activity is most successful if done when and where there are organisms around, and ideally, organisms with a wide variety of colors and patterns (e.g., in Spring in an area rich with flowers, insects, birds, salamanders, etc.). Read the "Preparation" section for more tips on hiding animals.

Push students to go deeper. Your students will most likely already be familiar with the concept of camouflage, but probably haven't thought about the specific types of patterns, coloration, and strategies that help organisms blend in and stand out, and how those play a part in different survival strategies. This is a chance to take students deeper in their understanding of colors and patterns in nature, and to build the foundation for later understanding of larger and more complex concepts like natural selection and evolution.

PREPARATION

1. **Setting up plastic animals.** The "animals" you hide should have realistic coloration. Plastic ants, snakes, flies, beetles, or worms work well. If you can't find realistically colored plastic animals, you can cut out and use the "Hiding Cards" instead (see pages 30–31) . If you use plastic animals, you should have some that are camouflaged (including animals with body stripes and eye stripes), some that are easy to see because of warning coloration (ladybug, coral snake, poison dart frog, etc.), some with attraction coloration (birds), and some with mimicry coloration (walking stick, praying mantis, moth with false eye spots, etc.). If you can go to the site of your exploration ahead of time to set out animals, and know others won't disturb them, great! You won't have to worry about it in the moment. If you can't do it beforehand, you can sneakily hide animals during the first step of the activity, while students are looking for different shades of colors. As a last resort, you could ask a chaperone to hide the animals for you, but this might make it more difficult to make sure all of them are picked up afterwards, and won't ensure that they're placed well. The animals should be hidden "in plain sight," not underneath something or anywhere students would have to move things in order to see them. Make it fun! Put the camouflaged animals on something they blend in with well. Put the ones that stand out on backgrounds they'll be easy to see against. It works best to hide the plastic animals in an area next to a trail or road, or where students won't walk, so they won't accidentally be stepped on. A spot with a wide trail or fire road and mixed vegetation along the side of the trail works great. Keep your area for hiding them small (no more than 30' x 9'), otherwise it will take longer for students to find the animals, and it increases the chances of losing some plastic animals. Since this activity involves some sitting and focusing, be sure to do a more active activity before it, especially if you have a very energetic group.
2. **Prepare group signs.** Print and cut out group signs. Laminate for continued use (or, for the text-only signs, re-write on a manila folder or other stiff sign. See materials list at right for full list of group signs.
3. **Prepare student Discussion Cards.** Print and cut out student cards. Laminate for continued use. You'll need to print enough Discussion Cards in order for each pair of students to have 1 card.

MATERIALS

For instructor:

- ❏ Plastic animals or Hiding Cards
- ❏ Whiteboard and marker.
- ❏ Group signs: "Blend In," "Stand Out," "Camouflage," "Mimicry," "Warning," "Attraction" and "Adaptation Definition" (pages 23-27, 32).
- ❏ Student Cards: Discussion Cards (pages 28–29).

For each pair of students:

- ❏ Journals and pencils to record observations during the Colors Hunt.

TEACHING NOTES

Defining "organisms." If your students don't know this word yet, let them know that it's any kind of living thing, including animals, plants, fungi, etc.

What's the difference between "habitat" and "ecosystem?" Ecosystem is all the living and nonliving things that interact with each other in a particular environment. Examples: "desert ecosystem," "tropical rainforest ecosystem," or "coral reef ecosystem". Habitat is the *home of a particular type of organism*. It's an ecosystem, or part of an ecosystem including all the living and nonliving things that provide all the needs a type of organism needs to survive. Examples: "the chickadee's habitat," or "the rock crab's habitat." "Habitat" is often misused when it's used to describe what should really be called an ecosystem. It's accurate to say, "the poison dart frog's habitat," but it's inaccurate to say, "the rainforest habitat" ("the rainforest ecosystem" would be accurate).

Paint chips for young students. Many instructors carry paint chip samples and offer them to students, challenging them to find something in nature that matches the paint chip. For younger students (or if you really like using paint chips), you might offer paint chips during the Colors Hunt and challenge students to find all the things that match a certain color.

Avoiding losing plastic animals. Worried you won't remember where you put all the animals? It's easy to forget. You might want to jot down notes about where you've hidden them.

Colors Hunt

1. **As you're walking to the site you've chosen, ask students to *Walk & Talk* about the following questions:**
   - *What kinds of colors or patterns (stripes, spots, etc.) have you noticed on organisms here, or in other places, in photos, videos, etc.?*
   - *What kinds of things make something blend in with nature? What kinds of things make something stand out in nature?*
   - *How might an organism's color help it survive in its habitat?*

   If you happen to see an organism (don't forget nonanimals) with interesting coloration/patterns, ask:
   - *What do you notice about the ____________'s coloration and patterns? How might those colors or patterns help it survive in its habitat?*

2. **Explain the Colors Hunt: Students will look around the area, write names at the top of a page of the main colors they see, then make dots underneath for each shade of that color they see.** When you've arrived at your chosen site, tell students their challenge is to notice and record colors in the area. They'll write the name of each main color they see (like "green") along the top of a page, then put a dot underneath it for every shade of that color they see. Demonstrate on a whiteboard, for example:
   - *"I see green, brown, red, and blue around me, so I'm going to write those at the top of my page. On this leaf, I see three shades of green, so I'm going to put three dots under 'green.'" There might be tons of different shades for some colors. See how many you can find!*

3. **If you didn't set up your plastic animal hunt in advance, do it stealthily right now, someplace nearby.** Try to place the animals without students noticing what you're doing. If possible, ask a chaperone to supervise students while you're doing this, so you can get a little out of view of students.

4. **If students say they're "done" finding colors, point out that there are many more shades/variations to find, and challenge them to find as many different variations of each color as they can.**

5. **After students have had time to explore, but before they lose interest, call them back and ask:**
   - *Which colors did you find the most of?* [Students will probably find many in the green and brown earth tones range, depending on your site and season. Some may say, "blue" because of the sky.]
   - *Which colors stood out from the surroundings the most?* [This will vary, depending on site and season, but colors like red, blue, yellow, and purple often stand out the most.]

Searching for Plastic Animals

1. **Tell students they'll look for plastic animals on the side of the trail/road/area hidden in plain sight, while thinking about which ones blend in and which stand out from their surroundings.** Explain to students that they get to explore colors more. They'll walk around the area you've chosen (or down the trail along which the animals are placed), looking for plastic animals you've put there. Explain that none of the animals are hidden behind or under anything; they're all out in the open. Some will be easy to see, but some will be harder to see. Students should pay attention to which animals are harder or easier to see against their surroundings.

2. **Explain the boundaries of where students will be looking.**

3. **Explain that students should be quiet while looking, and not react when they see something, so they don't give away the locations of any of the animals or distract others.** Explain that when students see an animal, they should not touch it or point to it, because that will give away its location to others. They'll have a chance to share what they saw later, and for now they should just notice each one silently, think about whether it blends in or stands out from its surroundings, and count in their heads how many they find.

4. **Tell students to go sloooowly, and to look at different levels.** Explain that in nature the slower you go, the more you'll tend to see. Encourage students to go slowly as they search. Depending on where you hid the animals, explain the different height levels they should be looking and not looking, such as on the ground, on branches above the ground, etc.

5. **Model searching slowly and silently, without pointing or reacting.** Model what it might look like to search slowly without pointing to animals, saying out loud what a student might be silently thinking as they search:
   - ▶ *OK, I'm gonna walk super slow and look until I see an animal, looking at the ground and in the branches above the ground too. Oh! I see one! But right, I shouldn't point to it, get excited, or react. I'm just going to be chill, casually look at it, think about whether it was hard or easy to see, and keep walking along, looking for others.*

Discussing Colors in Nature

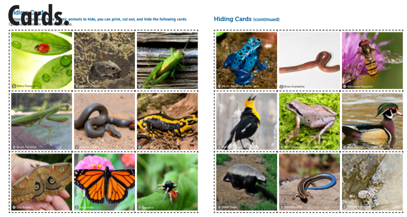
1. **Put the "Blend In" and "Stand Out" signs in the center of the seated circle, and tell students to put their animal in one of the two categories (or in the center if they think it's between the two categories).** Help students categorize the animals, and ask questions about their reasoning behind their choices. If your group needs more structure for this to go smoothly, make it so.

2. **Ask students to *Turn & Talk* about what made a plastic animal blend in, and what made one stand out against their surroundings.**

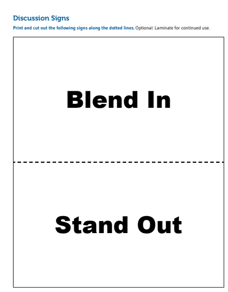
TEACHING NOTES

Using cut out photos instead. If you've chosen to use cut out pictures of animals, substitute those for the plastic animals described here.

See pages 30–31 for the Hiding Cards.

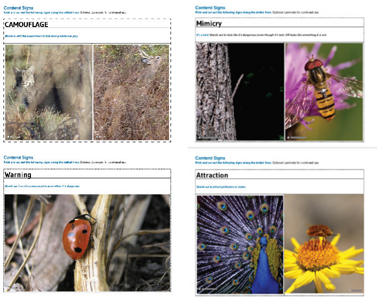


See page 23 for the Blend In & Stand Out Cards.



TEACHING NOTES

See pages 24-27 for the Content Signs.



Ladybugs taste nasty and/or are poisonous to small animals (but it would take eating a lot of ladybugs to harm a human). Students might wonder why ladybugs are brightly colored, since they seem so cute and innocent. Explain that they are poisonous to smaller animals, like birds. They taste bad to humans, but a human would have to eat many of them to feel any ill effects, so they aren't considered poisonous to humans.

3. **Lead a discussion about common characteristics of the "Blend In" group.** Ask students to take a moment to look at the animals in the "Blend In" group, and to share characteristics shared among those animals. They might say "same color as the background, small size, splotchy patterns, shaped like something in nature, etc." Ask questions like:
   - *What do animals in this group have in common? Patterns? Colors? Size?*
   - *How does each [pattern, color, etc.] help the organism blend in with its surroundings?*
   - *How might these kinds of coloration and patterns help an animal survive in its habitat?*
4. **Explain that this kind of coloration/pattern is called "camouflage" and it helps an animal blend in with its surroundings without needing to hide all the time.** Another way to avoid being seen is to hide under or behind things. Having colors that blend in with surroundings allows an organism to move around to feed and do its business while still being hard for predators or prey to see.
5. **Set out the CAMOUFLAGE sign near the "Blend In" group and point out that both predators and prey use camouflage, which may include patterns like stripes or spots.** Explain that animals are camouflaged either to avoid being eaten (prey), or so they can sneak up on another animal to eat it (predators), or both of those. Explain that sometimes stripes or spots help camouflage an animal.
6. **Ask students to brainstorm other creatures in nature that are camouflaged.** Listen to student ideas.
7. **Tell students to look at the animals in the "Stand Out" pile and discuss common characteristics among them.**
8. **Ask for different explanations for how standing out might help an organism survive in its habitat.** Ask:
   - *How might coloration that makes organisms stand out help them survive?* Listen to student ideas and ask follow-up questions to draw out their reasoning.
9. **Set the WARNING sign near the "Stand Out" group and explain that warning color and/or behavior can help an organism survive.** Explain that if an animal is poisonous, and another animal discovers that by eating it, it doesn't help the now-eaten poisonous animal. It's better if the poisonous animal can warn predators away using warning colors or behaviors before they try to take a bite.
10. **Ask students to brainstorm other creatures in nature that use warning coloration and/or behavior.** If students only mention organisms that have warning coloration, remind them about warning behaviors, and visa versa.
11. **Set out the ATTRACTION sign near the "Stand Out" group, and explain that colors that stand out can also help some kinds of organisms survive by helping them find mates.**

12. **Ask students to brainstorm other organisms in nature that use coloration and/or behavior that stands out to attract mates.** If they're only mentioning examples of coloration for attraction, remind them about *behaviors* for attraction, and visa versa.

13. **Explain that both warning and attraction colors and patterns communicate, "Here I am!" but for different reasons.**

14. **Set out the MIMICRY sign and say, "It's a trick!,"** then explain that some organisms imitate other organisms' either to mimic (imitate) warning coloration, or to blend in and camouflage. Explain that some organisms have warning coloration, but are not actually harmful, so it's a trick! Point out how other organisms look like something else to scare others away, such as spots that look like a bigger animals' eyes. Others look like a leaf or something else as a form of camouflage.

15. **Explain that these four categories, camouflage, warning, mimicry and attraction, can help the group understand some ways organisms are adapted to survive in their habitats.**

Thinking about Organisms

1. **Hand out one Discussion Card to each pair of students, then tell the group to look at their card, make observations, and decide which category they think it belongs in.** When every pair has one, tell them to discuss which category of coloration (camouflage, warning, mimicry, or attraction) it belongs in. They might decide that it belongs in more than one category.

2. **After pairs have had the chance to talk about their card, but before they lose interest, tell students to pass cards to the left.** When you think it's appropriate, tell them to all pass their card to the left and discuss their new card in the same way.

3. **Repeat this with the other cards.**

4. **When all students have their original card, (or earlier if they are losing interest), ask one pair at a time to put their card in the category where they think it belongs, explaining their reasoning.** If attention spans are short, they can all do this at once, and then you can discuss any particular cards of interest with the whole group.

5. **As students place their cards, encourage discussion and disagreement among the group, and add relevant content (but don't drag the process out too long).** When a pair of students places their card and explains their reasoning, encourage other students to ask them questions about their reasoning, or to disagree with their placement (using evidence). For instance:
   - *Do you agree or disagree with that placement of XX? What makes you think it belongs in a different category?*
   - *Would you have placed the card in the same place? Why or why not?*

TEACHING NOTES

Choosing images for the Discussion Cards. The species on the Discussion Cards were carefully chosen to show a range of different strategies, to include animals most students might have heard of before (like sharks), and to help them think about those organisms in a different way. Some were also chosen to be challenging or complicated for students to think through (the stripes on raccoons aren't intuitive, and are fun/puzzling for students to think about). If you want to use photos of animals that are more common in your area, use similar considerations to help you decide which ones to use.

See pages 28–29 for the Discussion Cards.

TEACHING NOTES

6. **Optional: Guide further discussion of organism coloration and patterns.** If your group is "into it" and seems excited to keep talking about organism patterns and coloration, consider using one or more of the following questions to stimulate discussion. You might also choose to use some of these questions later on after the activity, like while they're walking. If your students don't seem into a discussion right now, skip this and move on to the next step of the activity. Most of these discussion questions relate to one of the Organism Cards students looked at in the previous section. Hold up the appropriate card if you ask students a question that relates to it.

   Possible discussion questions:

   - How do you think camouflaged animals find each other, such as when it's mating season?

   Male & female cardinal picture:

   - Often, a male bird is bright colored, but the female bird is camouflaged. How might that help them survive in their habitat?

   Flower picture:

   - What about flowers? How do their bright colors help these plants survive?
   - What are other ways, besides color, that plants might attract insects and pollinators?

   Raccoon picture:

   - Eye stripes are pretty common among mammals, birds, and fish. How do you think eye stripes help them survive in their habitat? What about tail stripes?

   Shark picture:

   - There are many ocean mammals and fish that are lighter colored on the underside, and darker above. How do you think that helps them survive in their habitat?
   - Can you think of land animals that are lighter on the underside, and darker above? How do you think that helps them survive in their habitat?

See "Adaptation Definition Sign" on page 32.

7. **If you haven't used the term "adaptation," introduce it using the sign.** Adaptations are inherited structures or behaviors that help a population of organisms survive in its habitat.

   ▶ *"Adaptation" is a word scientists use for things like colors or patterns on an animal's body that help it to survive in its habitat.* [Share definition.] *"Inherited" means the organism got it from their parents, not during its life (like a scar or other injury).*

Assessment opportunity. This is an informal assessment to see where your students are at with this concept, and if they need more support with it or not.

8. **Ask students: Aside from coloration, what are other adaptations of organisms you've seen or heard of?** Hear students' thoughts and ask their understanding of the term and concept. Are they bringing up things that are actually adaptations, or do they seem confused? If students share ideas that aren't adaptations, gently correct them before moving on.

Searching for Real Organisms

1. **Explain that structure and function is a thinking tool scientists use to try to understand better how things work.** Explain that focusing in on the shapes, colors, and materials that make up anything, not just organisms, is a way to learn about it and to start to think about how it functions.

2. **Explain that students have already been using that "big idea" to help them understand better how organisms survive in their habitats.** Point out how students have used this tool in thinking about organisms' patterns, and how they function to help organisms survive.

3. **Explain that students will now search for, observe, and discuss real organisms in the area, focusing on their colors and patterns, as well as their structures and behaviors.** They will discuss how coloring, patterns, structures, and behaviors might help each organism survive in its habitat.
   - ▶ *When you find an organism, notice its surroundings. Do you think its coloring, patterns, and behaviors work for camouflage, warning, mimicry, or attraction? How would that help it survive in its habitat? Are there other structures (body parts, like eyes, scales, antennae, legs, wings, etc.) that might help it survive?*

4. **Walk students to an organism-rich area, give guidance, and do an organism hunt (including plants and fungi).** Give students any guidance, strategies, safety warnings, and boundaries they need to hunt for organisms in the area you've chosen. Send students off to search for organisms. This might be catching grassland organisms with nets, looking under logs, looking for organisms in a creek, etc. Remind students to look at plants and fungi too!

5. **Before they lose steam, call the group together.**

6. **Pick one or more interesting found organisms, and ask students to discuss how the organisms' coloration, patterning, structures, or behavior might help it survive in its habitat.** Listen to student explanations, ask for agreement or disagreement, and evidence.

7. **Students *Turn & Talk* about other possible adaptations of the organism(s), then share out with whole group.**

8. **Repeat with a few more organisms, if students have the attention for it.**

TEACHING NOTES

Take a walk. Walk students to a new area before starting this discussion. Encourage them to look around and notice colors in nature, and talk about how they help the organism survive in its environment. Or leave it unstructured, if they need time to chill.

How to guide students to find organisms. See BEETLES Ecosystem Literacies and Exploration Guides for more instructions on how to help students explore and find things in nature.

Emphasize the "in its habitat" part of the discussion. Adaptations only make sense in the context of the organisms' habitat. If students share ideas about how a color helps the organism survive without referring to the organisms' habitat, remind them to include that in their thinking. For example: "If the brown color helps it camouflage, what is it about this particular color of brown or pattern on its body that helps it survive in its particular habitat?"

TEACHING NOTES

Other questions. This topic can be super interesting for students to discuss, but there's only so long a group can talk about a topic at a time. If they're into it, keep the discussion going. Consider also using any of the Discussion Questions that you didn't use earlier in the activity, later during your field experience. If they lose interest, shift gears.

Wrapping Up

1. **When it's time to move on, *Walk & Talk* with a few of the following application questions, then one or two of the reflection questions.**

   Application questions:

   - *How might the adaptations and coloration of organisms be different in order to survive in an environment like* ____________ [name a very different environment, like desert, beach, wintery mountain, etc.]*?*
   - *What questions do you have about the organisms you saw?*
   - *What were the colors of most of the organisms we found in this area? What might be an explanation for that?*
   - *Think back to your journal page showing the colors here. What colors do you think we'd mostly see in X place? Do you think the colors of the organisms there might be different?*
   - *Can you think of any animals that are camouflaged in color, but have warning behaviors?*
   - *Why do you think so many plants are green?*

   Reflection questions:

   - *What surprised you during that activity?*
   - *If you went hiking or visited a park with a family member, how might you share some of what you learned about colors and patterns in nature?*
   - *What helped you learn during that activity?*

2. **As you continue with your field experience, encourage students to think about colors and adaptations when they find other organisms.** If you happen to see an organism with interesting coloration/patterns during your field experience, ask:
   - *What do you notice about the* ____________*'s coloration and patterns? How might those colors or patterns help it survive? What other adaptations does it have*

Instructor Support

Teaching Knowledge

TEACHING NOTES

Taking discussions deeper. Your students will probably be familiar with the basics of camouflage, but the many ways organisms use color and patterns to blend in or stand out will probably be less familiar, especially for younger students. The activity is designed to help students closely observe and discuss different color-related adaptations, and to deepen their understanding of colors in nature. If you have older students who seem engaged and who you think are up for the challenge, you might want to take the discussion further, and help them think about how color-based adaptations have evolved. You could get a discussion going about how environmental changes affect organisms with color-based adaptations. You might:

- Choose an organism students observed in their surroundings or one from an Organism Card and describe a possible environmental shift that might affect the organism's survival, such as the introduction of a predator that is immune to the poison of an organism with warning coloration, a shift in the plant community where a camouflaged organism lives, or a decrease in the population of a poisonous organism that the chosen organism mimics. Ask students how the population of chosen organisms might be affected: Would the organism's coloration/pattern still be useful? Why or why not? What might happen to the population of organisms over time?
- Ask questions that are thought experiments about adaptations:
    - What are some interesting adaptations you can think of? Choose one of the interesting adaptations offered by the group, and challenge them to try to explain a nonfiction storyline for how that adaptation might have evolved. What could have been going on for that particular adaptation to be developed? What might have been happening in the environment, or with other organisms around it?
    - The rough-skinned newt is slow and easy to catch, but they are so poisonous to eat that one could kill 20 people. But common garter snakes can eat these newts and survive. Why and how might newts have become so poisonous?
    - Modern snakes have no legs, but there is evidence that ancestors of snakes did have legs. What could be a possible explanation for snakes developing the adaptation of having no limbs?
    - Blackberries have seeds in sweet fruit. How might that have evolved?
    - The snapping shrimp has one huge claw that it can use to make a sound so loud that it can kill or stun small fish. How might this adaptation have evolved over time?
    - Many dung beetles roll a ball of dung away from where it was found, and lay their eggs inside. This ball provides food for their hatching young. How might this behavioral adaptation have evolved?

TEACHING NOTES

» Elephant seals can hold their breath for more than 100 minutes. What might be a series of evolutionary changes over deep time that resulted in elephant seals' ability to do this?
» North American monarch butterflies fly hundreds to thousands of miles south from late summer through autumn and return north during the spring months. How might this behavioral adaptation have evolved?
» Female bees are the only ones in a colony that can sting. Male drones don't have stingers. Queen bees also have stingers, but they use them only to kill potential rival queens as they emerge from their cells. What's a possible explanation for the evolution of the adaptation of bees having stingers?
» When predators first developed the ability to see the different colors of prey species, which individuals would be more likely to survive and which would be more likely to be eaten? Over time, what would happen to the populations of prey species?
» Some banana slugs are bright yellow. Some are greenish-yellow with black spots. Some are black. Do you think banana slug coloration is for camouflage or for warning?

The purpose of these discussions would not be for students to come away with specific facts, but to push them to think about how evolution works, how populations and species evolve over time, and how the adaptations they observe in this activity developed through species interactions that made certain features more beneficial to survival and reproduction than others.

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 used a lot in common language to refer to adjusting to a new situation. Students need to understand the difference between the common and biological uses of the term if they're going to understand the scientific ideas behind evolution. Sometimes it's helpful to be explicit in contrasting the science meaning with the everyday meaning of "adapt," to help students see the difference (i.e., pointing out that it doesn't mean the same thing when we talk about adapting to cold weather by wearing warm clothing). Read the common misconceptions listed below to help you understand student confusions about the topic and how to deal with them.

Content Knowledge

Adaptations are inheritable traits that improve the fitness of a population of organisms. In this case fitness doesn't refer to how strong an organism is—it refers to how successful it is at reproducing. Evolution happens because some individuals in a population are more successful reproductively than others. The ability to run faster, to be better at finding food, or to avoid being eaten all increase an organism's reproductive success. That's because individuals that are better at surviving have better chances of reproducing than those that aren't. It's kinda hard to reproduce when you're no longer alive. Evolution is the process of change that takes place 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 common 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 changes we can see in a population (like beak size), it's important to remember that heritable traits are the result of genetics. It's through DNA that these traits are passed on from one generation to the next.

Coloration as an Adaptive Trait

Coloration is an adaptive trait because certain kinds of coloration help some organisms survive and reproduce more successfully. Of course, color adaptations are only helpful when other organisms have eyes to see them. Color became important in adaptations as organisms evolved eyes, about 550 million years ago. When organisms began to see color, new predator-prey dynamics arose. For example, predators could spot yellow prey against the blue background of the ocean a lot more easily. And then a whole bunch of color-based adaptations arose—adaptations that made it so prey could hide from predators or predators to sneak up on prey, unseen; as well as adaptations that allowed organisms to use color to signal things like, "Hey, I'm dangerous, don't try to eat me!" or, "Hey, look how pretty I am, I'd make a great mate!"

The Basis for Colors in Nature

Two different mechanisms are responsible for the wide range of colors we see in nature—pigments and structural color. **Pigments** are colored chemicals that absorb certain wavelengths of light and reflect others. It's the reflected wavelengths that we see, and we don't see the absorbed wavelengths. Pigments cause the orange color of carrots, the green color of leaves, and the red color of crabs. Pigments do not just give color to an organism, they serve other purposes too. For example, the chlorophyll that makes plants green is also used by plants to get energy from the Sun through photosynthesis. Chlorophyll absorbs red and blue wavelengths and reflects green wavelengths, which is why plants look green. The melanin that determines human skin color also protects us from ultraviolet radiation. Pigments can also be passed from one organism to another via diet. Pink flamingoes are only pink because they eat pink crabs, shrimp, and algae.

Structural color is color that comes from how something is shaped. If you find a bright blue feather from a jay, hold it up so it's backlit, and the bright blue color will disappear. The feathers have microscopic structures that interact with light to reflect certain wavelengths—blue, in this case. Most blues in nature, like the vibrant, iridescent blues of beetles and butterflies, are structural colors, not pigments. Structural colors can be mixed with pigments to blend colors. For example, several snakes and frogs evolved to blend in with their leafy green surroundings by mixing yellow pigments with blue structural color. Structural colors can last a really long time. In fact they can last so long that multithousand and even multimillion-year-old beetles have been found with their striking blue-green iridescence intact.

TEACHING NOTES

Categories of Adaptive Coloration

Camouflage. Camouflage includes a wide range of mechanisms that help organisms disguise themselves. Camouflage can help prey avoid being found by predators, or on the flip side, can help predators avoid being seen by prey so they can sneak attack. Some organisms have fur, feathers, or scales that match the color of their background. For example, arctic foxes grow a white coat that matches the snow in the winter and a brown coat that matches the dirt in the summer. Other organisms have both colors and patterns that help them blend in, such as moths that look like the color and texture of tree bark. In some cases, organisms have "disruptive patterns"— stripes or spots that make it harder to see their outline. Leopard spots are an example of a disruptive pattern. Some organisms build their own camouflage, like decorator crabs, which take materials like seaweed, algae, sponges, shells, and gravel from their environment and stick them onto themselves.

Warning colors. Some organisms use bright colors and patterns to warn predators that they are poisonous (harmful if eaten or touched) or venomous (inject venom into other organisms) and not worth the risk of eating. There are lots of examples, like brightly colored poison frogs, venomous coral snakes, and many kinds of insects, like monarch butterflies and ladybird beetles (ladybugs). Warning coloration helps both prey, which can avoid being eaten, and predators, which avoid eating something that will harm them.

Mimicry. Some organisms have evolved to mimic (imitate) other organisms. In some cases, predators have evolved to mimic harmless organisms. One example of this is flower mantises, which mimic flowers and can go unnoticed by prey and catch them more easily. In many cases of mimicry, harmless organisms have evolved to mimic harmful organisms, which can help them avoid being eaten. There are a lot of insects that use this type of mimicry, but other animals, like some birds, snakes, and octopi, use it too. There's also mimicry in some plant species, and it can help with pollination. The plant's flowers look like a female of a certain insect species and can trick males into trying to mate with it.

Colors that attract. Sometimes organisms' colors and patterns are not useful for hunting or defense, but help attract mates. Often one sex of a species is brightly colored while the other is more dull and camouflaged. Peacocks are one well-known example of this—male peacocks have the showy long green feathers, which they fan out to attract females. The females are much less flamboyantly colored. The more camouflaged look of many female birds makes it easier for them to hide while sitting on eggs. Sexual dimorphism (when one sex of a species looks or behaves different from the other) happens in many other species of birds, as well as many species of frogs and fish.

Many flowers also use color to help in reproduction too—in their case, to attract pollinators. Different pollinators are attracted to different colors. For example, hummingbirds are attracted to red and orange flowers, bees are attracted to bright white and yellow flowers, and butterflies are attracted to red and purple flowers. These specific plant-pollinator relationships make it more likely that a pollinator that gets pollen from one plant will then take that pollen to another individual of the same species, instead of wasting the

TEACHING NOTES

pollen on another species of plant.

VISTA = Variation, Inheritance, Selection, Time, Adaptation

VISTA is a helpful device for remembering important building blocks for understanding evolution, and can guide how we teach students about the topic. But it's only appropriate if you're teaching a whole sequence of activities meant to guide students to understandings about evolution, including natural selection.

Variation: Genetic variation is the raw material for evolution. The processes that drive evolution are based on genetic variation among organisms of the same species. Individual organisms can vary in size, coloration, ability to fight off diseases, and in countless other traits.

Inheritance: Knowing that characteristics are passed from parents to their young through genes will help students understand how adaptive traits are passed on to surviving generations. Understanding that new variations of organisms often form during reproduction helps lay a foundation for understanding that natural selection can only happen when there are new characteristics introduced into populations. This idea also helps combat the common misconception that variations happen as a response to changes in the environment. The variation is always there, but selective pressures, like changes in the environment, select for certain traits to be more successfully passed on.

Selection: For any new genes or traits to end up in a population of organisms, you need selection. Selection is not random in either artificial (guided by humans) or natural selection: You may hear people say that the complex features of living organisms could not have been produced by random events. They're right, because these events are not totally random. The mutation that produces these traits may be random, but the selection process is not. In natural selection, the traits that persist in a population of organisms are those that give an advantage in the organism's habitat. Selection is a pressure that selects for certain traits in a population by giving a survival advantage to organisms with that trait.

Time: Scientists don't actually know a typical rate for evolution, because fossil evidence shows that changes in life forms have happened at different rates. Sometimes these changes happen over very long periods of time (gradualism) but they also happen in shorter bursts after long periods with little change (punctuated equilibrium). Some big changes have been found in fossils dated less than 100,000 years apart. But the most significant changes in organisms have happened over a very long time. Changes in populations of organisms usually happen over millions of years.

Adaptations: Adaptations are the result of evolution in a species, not in a single individual. An organism does not decide to produce adaptations. Species do not develop adaptations because they want or need them. Certain genetic changes help organisms survive and reproduce, and to pass on these changes to future generations. These characteristics then become new adaptations of the species. Populations as a whole adapt as a result of changes in habitat, or changes in the adaptations of other species in their habitat.

Common Relevant Misconceptions

Misconception. An individual organism can adapt.

More accurate information. This is the most common misconception about adaptations. In common English, the word "adapt" means something an individual does, like "I moved to a new school and I adapted by making new friends." But in scientific usage, *populations of organisms* adapt over generations, but individuals don't. Adaptations are *inherited* structures or behaviors—they're not things an organism gets during its 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 through the population.

Misconception. If a population or organism tries hard enough, it will adapt to its environment.

More accurate information. Adaptations come from 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 produce more offspring. The offspring who inherit the beneficial trait will also have more offspring. Evolution does not happen because an organism "wants" an adaptation. It works through random trial and error. Genetic mutations randomly happen, 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 and 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 the traits that improve an organism's fitness will "survive" in future generations of a species. Coloration is a good example of an adaptive trait that can increase fitness, but has nothing to do with physical strength.

Connections to Next Generation Science Standards (NGSS)

BEETLES student activities are designed to incorporate the "three-dimensional" learning that is called for in the Next Generation Science Standards (NGSS). Three dimensional learning weaves together Science Practices (what scientists do), Crosscutting Concepts (thinking tools 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

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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/

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. And, they're interesting and fun to do!

In *Blending In & Standing Out*, students:

- Engage in the practice of *Constructing Explanations*
- Relate what they learn to the Crosscutting Concept of *Structure and Function*.
- Build understanding of Disciplinary Core Ideas related to *Structure and Function*, *Growth and Development of Organisms*, *Interdependent Relationships in Ecosystems*, *Biological Evolution: Unity and Diversity*, and *Adaptation*.

(Note: "Structure and Function" is a Crosscutting Concept and 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 *Blending In & Standing Out*, students make explanations when they categorize plastic animals as "Blends In" or "Stands Out," and share their reasoning behind their choices.
- They discuss/explain how coloration and patterns, which make different organisms "blend in" or "stand out," might help them survive.
- Finally, once they've been introduced to camouflage, warning coloration, coloration for attraction, and mimicry, students apply their understanding of coloration and adaptations to explain how the structures of organisms help them survive in their habitats. For example, if a student says, "I think that the brown spots help the snake camouflage in its habitat so it can sneak up on prey," that student has constructed a possible explanation for how the snake's coloration helps it survive.

In order for students to be fully engaged in the practice of constructing explanations, they need to go beyond just saying an explanation. 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 of organisms in their surroundings 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, to use the language of uncertainty, and to consider alternate explanations.

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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.

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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.

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 *Blending In & Standing Out,* students observe an organism's coloration, patterns, and structures, and make possible explanations for how these help the organism survive in a specific environment. In other words, students look at structures and think about how they might function.
- But students aren't introduced to the specific language and scientific application of Structure and Function until they are asked to apply what they've learned about coloration and adaptations to explore organisms in the surrounding area toward the end of the activity.

If students don't get the chance to think about 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 situations, like looking at a type of car and thinking about what it was designed to do. Emphasize this with students, and give them more 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. Students need multiple learning experiences to build their understanding of Disciplinary Core Ideas. *Blending In & Standing Out* provides students with an opportunity to develop understanding of some Disciplinary Core Ideas related to *Structure and Function* (LS1.A), *Growth and Development of Organisms* (LS1.B), *Interdependent Relationships in Ecosystems* (LS2.A), *Biological Evolution: Unity and Diversity* (3-LS4-2), and *Adaptation* (LS4.C).

- As students discuss how the unique coloration, patterns, and structures of organisms help them avoid predators, catch prey, or attract mates or pollinators, they build some understanding of how organisms have structures that aid in survival (LS1.A) and/or increase their chances of reproduction ((LS1.A and LS1.B).
- As they discuss how organisms use camouflage, warning coloration, and mimicry to their advantage in predator-prey relationships, they also develop an understanding of interdependent relationships in ecosystems (LS2.A).
- As students try to explain how different colorations have evolved over time, they discuss why the coloration of different individuals animals makes them more likely to survive and therefore more likely to leave offspring (3-LS4-2).

- Finally, throughout the activity, as students think about how the coloration, patterns, and structures of organisms help them survive *in their particular environments*, they build some foundation for understanding how the environment influences populations of organisms over generations (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 decide 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

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 Disciplinary Core Ideas and Science Practices, as well as their ability to apply the Crosscutting Concepts. 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:

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

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 help the instructor find out whether or not students have a solid grasp on the concept of adaptations. You could also use *Structures & Behaviors*, either before or after, to deepen students understanding of how structures and behaviors, beyond those related to color, help organisms survive. *Discovery Swap* is a great application of these concepts to other organisms. Finally, *Related & Different* could work as a nice follow-up to extend student understanding of species and diversity.

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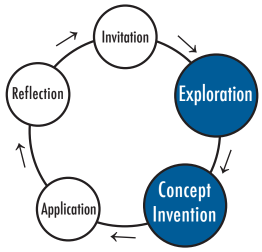
Translating the codes used in the NGSS. Each standard in the NGSS is organized as a collection of performance expectations (PE) for a particular science topic. Each PE has a specific code, provided here so that they can be easily referenced in the NGSS documents. The first number or initial refers to 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.

TEACHING NOTES



Learning Cycle Stage. As a separate activity, Blending In & Standing Out completes a full learning cycle. Within a sequence of other activities focused on developing student understanding of adaptations, this activity could serve as Exploration or Concept Invention.

To prepare students for close observation of organisms, use the BEETLES activities I *Notice, I Wonder, It Reminds Me Of*, or, *Interview an Organism*. And to take students further in thinking about how organisms interact in their surroundings, consider using *What Lives Here?*

FIELD CARD

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

Blending In & Standing Out

Colors Hunt

1. While walking to the site, *Walk & Talk*:
   ▶ *What kinds of colors or patterns (stripes, spots, etc.) have you noticed on organisms here, or in other places, in photos, videos, etc.?*
   ▶ *What makes something blend in in nature? Stand out?*
   ▶ *How might an organism's color help it survive in its habitat?*
   ▶ *If you see an organism with interesting color/pattern, ask:*
   ▶ *What do you notice about ___________'s color and pattern? How might those help it survive in its habitat?*
2. Explain Colors Hunt and place plastic animals if you haven't already.
3. After students have had time to explore, gather & ask:
   ▶ *Which colors did you find the most of?*
   ▶ *Which colors stood out from the surroundings the most?*

Searching for Plastic Animals

1. Explain: Look for plastic animals hidden in plain sight, while thinking about which blend in & which stand out.
2. Explain: Boundaries, be quiet while looking, don't react when you see something, & go slowly & look at different levels.
3. Model searching slowly & silently, without pointing or reacting.
4. Students begin searching. Support those who are struggling.
5. After a few minutes, tell students to find a partner.
6. Explain: Each person shows partner where 1 plastic animal is, picks it up, & discusses if it blends in or stands out.
7. Circle and ask how many animals they found during the initial hunt.
8. Tell group how many you hid.

Discussing Colors in Nature

1. Put blend in/stand out signs in the center of the circle. Students put their animal in one of the 2 categories, or in the center.
2. Use *Turn & Talk* about what made a plastic animal blend in, & what made one stand out against surroundings.
3. Lead discussion asking questions like:
   ▶ *What do animals in this group have in common? Patterns? Colors? Size?*
   ▶ *How does each [pattern, color, etc.] help the organism blend in with its surroundings?*
   ▶ *How might these kinds of coloration & patterns help an animal survive in its habitat?*
4. Explain: These coloration/patterns are Camouflage, & help an animal blend in with its surroundings without hiding.
5. Set CAMOUFLAGE sign near "Blends In" group & explain that predators & prey use camouflage.
6. Students brainstorm other camouflaged creatures in nature.
7. Students discuss common characteristics of "Stands Out" pile.
8. Ask for explanations for how standing out might help an organism survive in its habitat.
9. Set WARNING sign near "Stands Out" group & explain warning color/behavior can help an organism survive.
10. Students brainstorm other creatures that use warning coloration/behavior (e.g., ladybugs).
    ▶ *Set ATTRACTION sign near "Stands Out" group, & explain that colors that stand out can help organisms survive by helping them find mates.*
    ▶ *Brainstorm other organisms in nature that use coloration/behavior that stands out to attract mates.*
    ▶ *Explain that both warning & attraction colors & patterns communicate, "here I am!"*
    ▶ *Set MIMICRY sign & say, "It's a trick!" Explain some organisms mimic warning coloration to blend in & camouflage.*
    ▶ *Explain: These 4 categories help us understand how organisms are adapted to survive in their habitats.*

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FIELD CARD (Continued)

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

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Thinking about Organisms

1. Each pair gets 1 Organism Card, makes observations, & decides which category they think it belongs in.
2. Students pass cards to left &repeat with the other cards.
3. When all students have their original card, (or earlier), 1 pair at a time put their card in the category where they think it belongs, explaining reasoning.
4. As students place cards, encourage discussion & disagreement, & add relevant content.
5. Optional questions:

   ▶ *How do you think camouflaged animals find each other, such as when it's mating season?*

Male & female cardinal picture:

▶ *How might a bright colored male bird & camouflaged female help them survive in their habitat?*

Flower picture:

▶ *How do flowers' bright colors help some plants survive?*

▶ *What are other ways, besides color, plants might attract insects and pollinators?*

Raccoon picture:

▶ *How do eye stripes help mammals, birds, and fish survive in their habitat? What about tail stripes?*

Shark picture:

▶ *There are many ocean mammals and fish that are lighter on the underside, and darker above. How do you think that helps them survive in their habitat?*

▶ *Can you think of land animals that are lighter on the underside, and darker above? How do you think that helps them survive in their habitat?*

6. If you haven't used "adaptation," introduce it using the sign.
7. Ask: Aside from color, what are other adaptations of organisms you've seen or heard of?

Searching for Real Organisms

1. Explain: Structure & function is a thinking tool scientists use to understand things like how organisms survive in their habitats.
2. Explain: Students will search for, observe, & discuss real organisms in the area, focusing on colors, patterns, structures, & behaviors.
3. Walk to organism-rich area, give guidance, & do organism hunt.
4. Before they lose steam, call the group together.
5. Students discuss how 1+ found organisms' color, pattern, structure, or behavior might help it survive in its habitat.
6. Use *Turn & Talk* about other possible adaptations of the organism(s), then share out with whole group.
7. Repeat with a few more organisms, if students are into it.

Wrapping Up

1. Use *Walk & Talk* with some questions, then reflection questions:

Application questions:

▶ *How might adaptations & coloration of organisms be different to survive in* [name a very different environment]*?*

▶ *What were the colors of most of the organisms we found in this area? Can you explain that?*

▶ *What colors do you think we'd mostly see in X place? How might colors of organisms there be different?*

▶ *Can you think of camouflaged animals with warning behaviors?*

Reflection questions:

▶ *What surprised you during that activity?*

▶ *If you went hiking or visited a park with a friend, how might you share what you learned about colors & patterns in nature?*

▶ *What helped you learn during that activity?*

2. Encourage students to think about colors/adaptations when they find other organisms.

www.beetlesproject.org

Discussion Signs

Print and cut out the following signs along the dotted lines. Optional: Laminate for continued use.

Blend In

Stand Out

Content Signs

Print and cut out the following signs along the dotted lines. Optional: Laminate for continued use.

CAMOUFLAGE

Blends in with the environment to hide from predators or prey.

Content Signs

Print and cut out the following signs along the dotted lines. Optional: Laminate for continued use.

Warning

Stands out from the environment to warn others it is dangerous.

Content Signs

Print and cut out the following signs along the dotted lines. Optional: Laminate for continued use.

Mimicry

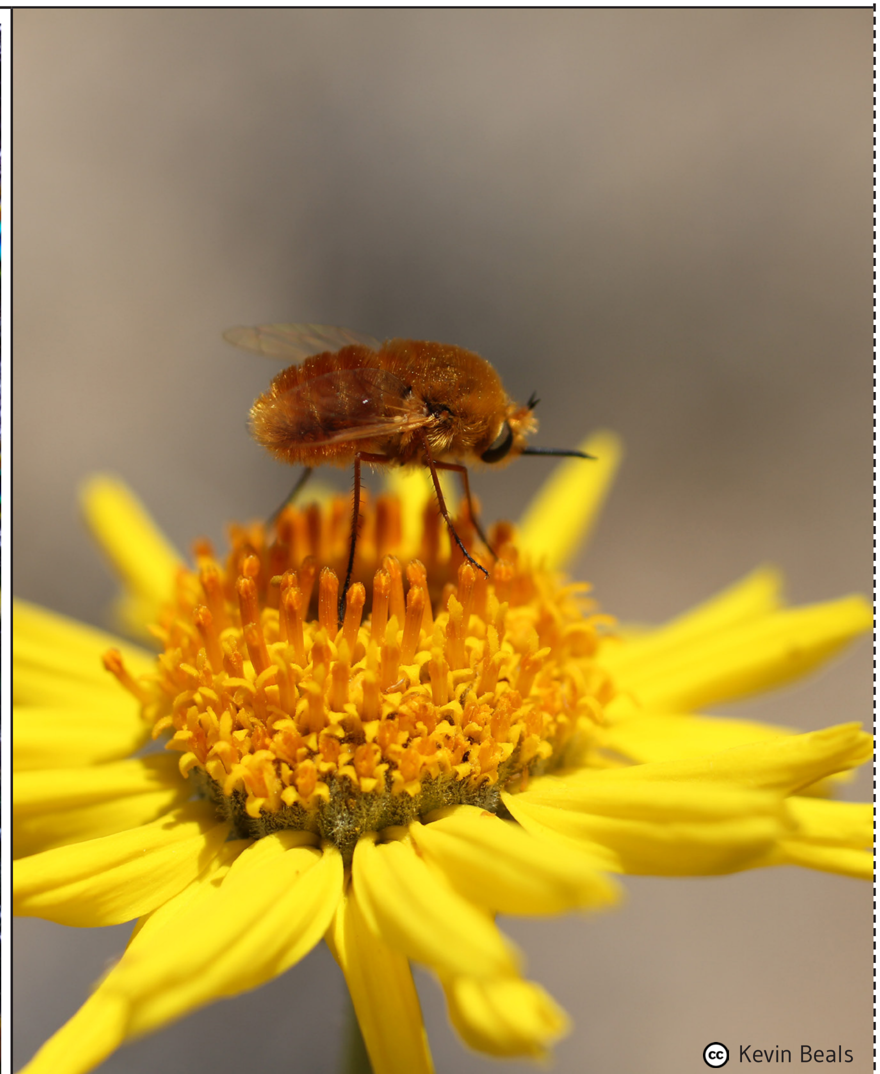
It's a trick! *Stands out to look like it's dangerous (even though it's not), OR looks like something it is not.*

Content Signs

Print and cut out the following signs along the dotted lines. Optional: Laminate for continued use.

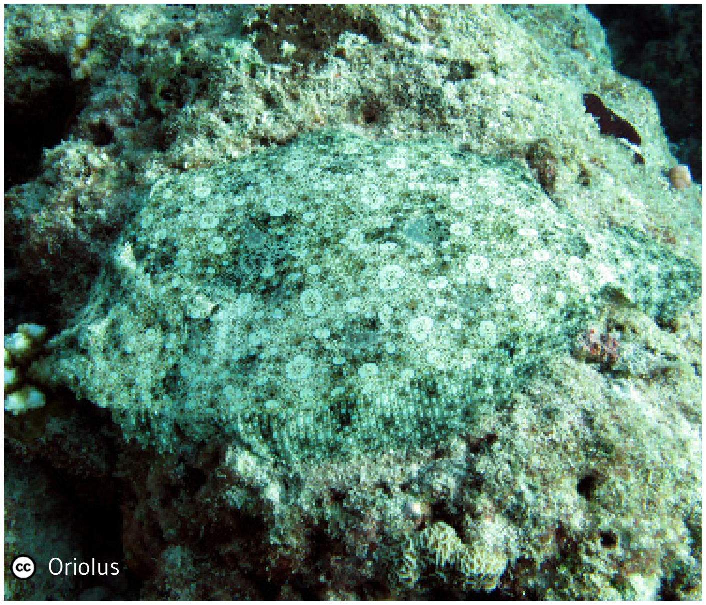
Attraction

Stands out to attract pollinators or mates.



Discussion Cards

Print enough cards to have 1 card per pair of students and cut out the following cards along the dotted lines. Optional: Laminate for continued use.



Discussion Cards (continued)

Hiding Cards

Optional: If you don't have plastic animals to hide, you can print, cut out, and hide the following cards. Optional: Laminate for continued use.

Hiding Cards (continued)


(cc) Mystic Aquarium, Selbe Lynn


(cc) Brian Gratwicke


(cc) Konstanin Papushin


(cc) Matt Stratmoen


(cc) The Wandering Herpetologist


(cc) Mick Thompson


(cc) Steve Slater


(cc) Michelle Minor


(cc) Tambako the jaguar

Adaptation Definition Sign

Print and cut out the following sign along the dotted line. Optional: Laminate for continued use or write out on a manila envelope.

Adaptations are inherited structures or behaviors that help a population of organisms survive in its habitat.

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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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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