Think Like A Scientist

Are They The Same?

NSTA eBooks+ Kids

TEACHER'S GUIDE

Topic 1

Do All Animals or Plants Within a Group Show the Same Patterns?

One of the most overlooked ways in which animals and plants may show variation is by the numbers of spots, stripes, petals, or other differences in general pattern. This topic will encourage students to evaluate how plants and animals may vary in ways that may not be immediately clear, and therefore probe more deeply into the investigation.

By the end of the topic, students will be able to:

- conduct investigations about the variations that may be found between patterns in different groups of plants and animals;
- use quantitative data to measure, describe, and compare the variation in patterns between organisms within a group; and
- develop a model of how individual plants or animals might show variation in pattern so that they might be distinguished from other members of a group.

whole class and engage in a larger discussion.

Teacher's Note

This book focuses on amphibians because of their widespread distribution and because many species of frogs and salamanders are currently in decline. This is primarily due to habitat loss and a fungal disease known as chytrid. The presence or absence of frogs and salamanders in an area can give vital information on the health of local ecosystems, as most natural places in North America are suitable habitats for these creatures. Even deserts can be home to amphibians, such as the Sonoran Desert toad and the desert slender salamander. For additional information on using local amphibians as a theme for lessons, you may read more at http://www.nsta.org/store/product_detail.aspx?id=10.2505/4/sc17_055_02_48.

Students may not immediately have all of the answers to the above questions, but prompts to look at certain structures such as feet (neither frogs nor salamanders have claws), skin, and images of both frog and salamander tadpoles can help them establish the commonalities shared by these groups, as well as the differences between them. Though they generally have dry, warty skin, toads are classified with frogs, and newts with salamanders.

English Language Arts Connection

An informational table that records student observations from images might help students evaluate the similarities and differences between salamanders and frogs. Images of each species can be downloaded and printed from a variety of websites, including http://www.sciencefromallangles.com/activities.

Example table:

Species	Does it have claws?	Are the back legs longer than the front legs?	Does it have a tail?
Bullfrog	No	Yes	No
Spotted salamander	No	No	Yes
American toad	No	Yes	No
California newt	No	No	Yes
Spring peeper	No	Yes	No
Gray tree frog	No	Yes	No
Red-spotted newt	No	No	Yes
Leopard frog	No	Yes	No

different numbers of spots. To help bring this to their awareness, the interactive will prompt students to gather and report data about the number of spots on each salamander after individuals have been sorted into groups.

The "Check Your Thinking" button on this page allows students to review characteristics that distinguish both groups of salamanders, as well as identify features shared by both types.

Differentiated Instruction

Students who can trace their heritage to other parts of the globe might be motivated to learn more about amphibians from places where their families are from. Among the fascinating amphibians in other parts of the world are the Chinese giant salamander (an endangered species), the goliath frog of West Africa (another endangered species), the dart frogs of Central and South America, the Indian bullfrog of South and Southeast Asia, the marsupial frogs of Australia, and the Lake Titicaca frog of Bolivia and Peru. Fire-bellied newts are well-known inhabitants of China, Korea, and Japan, and a variety of newts and salamanders live in Europe, including the marbled newt and the fire salamander.

English Language Arts: Writing

Building upon the theme of amphibians around the world, students might be asked to research a particular amphibian species (CCSS.ELA-LITERACY.W.1.7) and then write a short report about this amphibian (CCSS.ELA-LITERACY.W.1.2). How are they similar or different from the amphibians that we see in this story? How is their habitat different from habitats near your school?

Students have different writing and drawing abilities. Because of this, you may want to encourage some students to use more writing instead of drawing or vice versa. The key is to get students to communicate their ideas in the most effective way for them.

Mathematics Connection

In order to build students' spatial skills, you may challenge them to fit the maximum number of spots onto the blank outline of a salamander while still maintaining a distinction between each spot. Can they fit more spots if each spot is smaller? How about different shapes—would more square spots fit in a space than round ones? What about triangular markings? This activity will give students many opportunities to count a variety of different shapes, draw them, and explore their definitions (CCSS.MATH.CONTENT.1.G.A.1).

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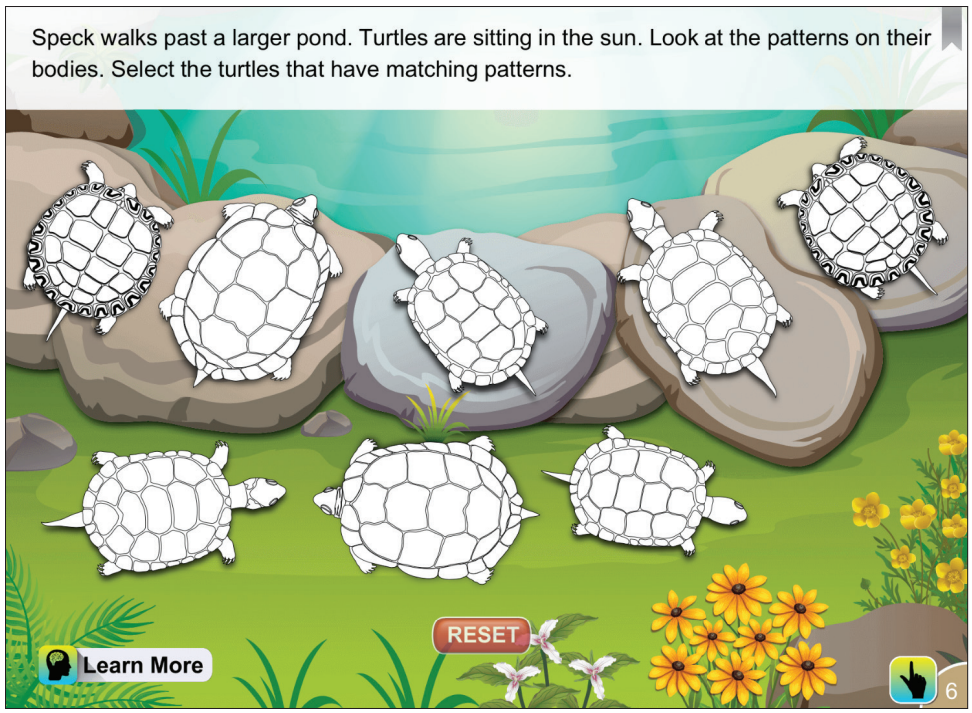

In this interactive, readers see a black and white version of eight different turtles. Students investigate the shell and skin patterns on four different species of turtles. Each of these overall patterns distinguishes members of a group from the others, but none of these patterns is exactly the same among all individuals. For this reason, the interactive provides an opportunity for students to investigate how patterns might be similar within a group of animals but are not exactly the same.

The "Learn More" button further reinforces the differences between turtles, frogs, and salamanders by looking more closely at their life cycle. Both frogs and salamanders lay eggs in wet places, where they will eventually hatch into tadpoles that must undergo metamorphosis to reach their adult form. In contrast, turtles lay eggs with a shell and the hatchling babies look much like miniature versions of their parents. There is no need for metamorphosis in turtles; they will grow into their adult form without any major shift in body plan.

Discourse

As with previous questions, these might be posed to the whole class, to pairs, or to small groups. Alternatively, students could be asked to draw a turtle and then compare their turtles with others in the class. What features do they share?

- What animals are these?
- Has anyone ever seen a turtle in the wild or in your neighborhood? Where?
- What are some differences between frogs, salamanders, and turtles?
- Does anyone know the kinds of turtles that live near us?

Teacher's Note

Plants are a group of organisms with much to offer budding scientists, particularly because working with them rarely poses the same ethical issues as working with live animals. While many teachers, students, and parents might surely object to animal dissection, few would mind students dissecting fruits, as entailed in the end-of-topic investigation.

In addition, despite lacking any sort of a brain, plants have surprising abilities to get animals to do their bidding. Flowers attract insects, hummingbirds, and even bats to carry pollen from one location to another, while fruits develop so that animals may eat them and distribute their seeds. There is even one group of plants in Central America that "enslaves" the ants that live on them. A chemical that is secreted from the plant's nectar prevents the ants from digesting food from other sources, and therefore the ants can only feed from their host plant, defending it vigorously from invaders (Heil 2013). More information on this ant-plant system is provided in the e-book Home Is Where My Habitat Is, also available through www.nsta.org/ebooks/kids.

Hands-On Activity

Do your students have access to flowers with varying numbers of petals? If so, why not have them gather data? Perennial plants like black-eyed Susans and purple coneflowers are easily found at many garden centers and can be planted for student investigations from year to year. If you do not currently have a flower garden on school grounds, students may design one that considers plant needs like water and sunlight.

Have students count the petals on different flowers and record this data for analysis. Then have students analyze these data to determine the most common numbers (mode), as well as the median number of petals.

English Language Arts: Writing

If your school has a flower garden or decides to establish one, students can write short narratives from the perspective of a particular plant at different times of year and describe what they see around them (CCSS.ELA-LITERACY.W.1.3). At the end of the year, students can combine these writings into a journal or book titled, *A Year in the Life of a Plant*.

Teacher's Note: Get more plants into your curriculum!

The American Society of Plant Biologists (ASPB) is an organization of researchers who seek to emphasize the importance of plant science in our modern world. The basis of our food production, whether it is grains, fruits, vegetables, or animal feed, is all derived from plants. To learn more about the ASPB and their Twelve Principles of Plant Biology, please consult the following link:

https://aspb.org/education-outreach/k12-roots-and-shoots/the-12-principles-of-plant-biology-2/.

From genetic engineering to soil conservation, there are many opportunities for students to learn more about plant science!

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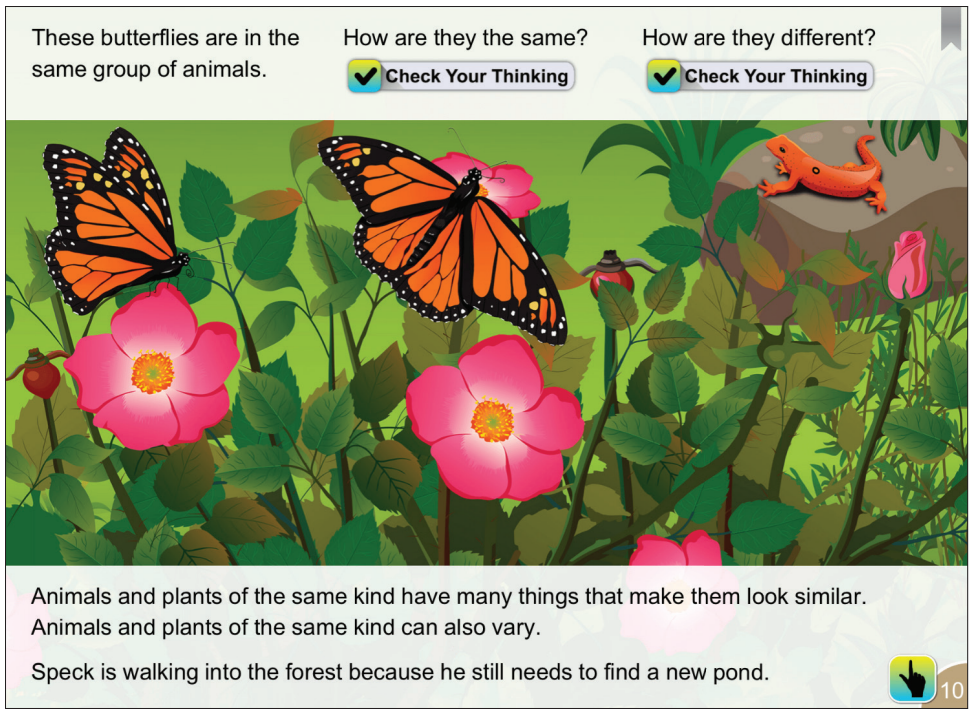

This page provides another opportunity for students to explore variations in patterns among a group of living things that are too often ignored: insects. Insects comprise more than three-quarters of all known animal species, making them among the most diverse of all organisms. In contrast, vertebrates only make up about 1% of known animal species, and few new species are likely to be discovered.

Thinking Beyond

While many people might initially rejoice at the thought of a world with fewer insects, the current decline of many species is cause for alarm (Vogel 2017). As the biologist E. O. Wilson has said, "If all mankind were to disappear, the world would regenerate back to the rich state of equilibrium that existed ten thousand years ago. If insects were to vanish, the environment would collapse into chaos." Not a comforting thought!

If your school has a garden that attracts pollinators, consider having students conduct an investigation into the species that visit at different times of year. If your school does not have a pollinator garden, students might be able to gather data about their school grounds to determine a proper location and create a design that will serve to attract pollinating species. Are there patterns that students might notice during different times of day? Might they see seasonal patterns if data is compiled and analyzed over several years? While students can't be expected to distinguish between the 4,000 bee species that are native to North America or the

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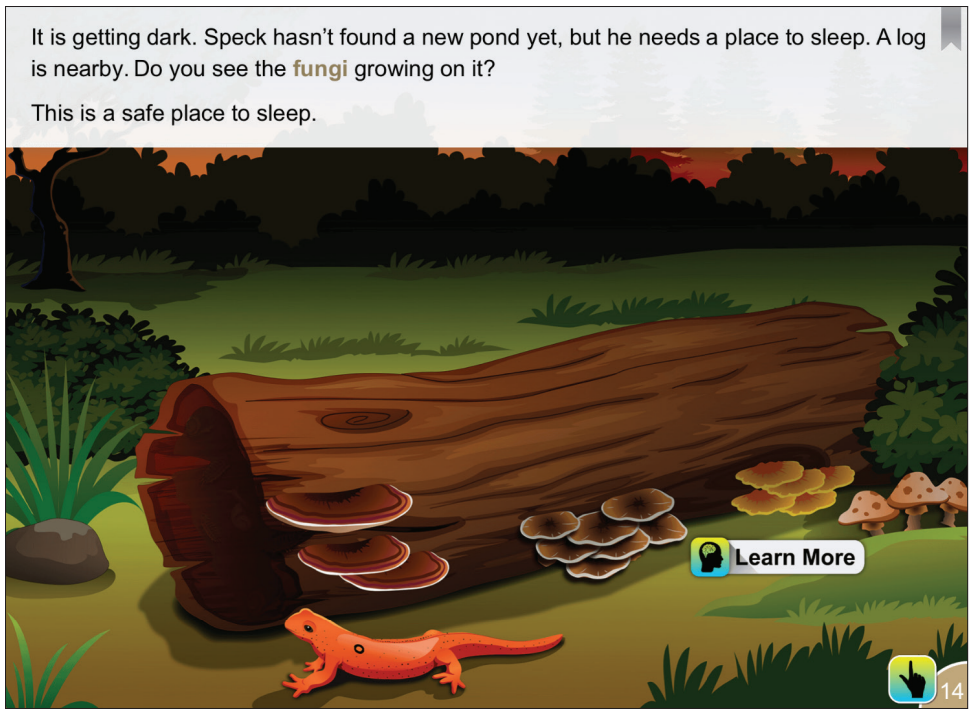

This page encourages students to observe different types of fungi and decide which individuals belong in the same group. Point out that we see certain patterns in the structures of fungi but that these structures do not all necessarily grow in the same proportions.

Teacher's Note

On this page, students are introduced to a variety of fungi that might be found on the forest floor. While many new science standards (including NGSS LS3.B: Variation of Traits, the DCI addressed for this e-book) emphasize the need to study both animals and plants, a whole other kingdom of organisms (the fungi) also should not be ignored. Though they generally do not move, and therefore might be considered plant-like, fungi are actually more closely related to animals. They are also essential decomposers in many ecosystems, responsible for returning the nutrients found in animal and plant waste back to the soil. In fact, many scientists consider fungi to be an essential part of the "brown food web," which runs parallel to the "green food web" that begins with plants (Zou et al. 2015).

Thinking Beyond

Along with the shelf fungi and mushrooms that we see on this page, there are many other types of fungi, including a variety of species that are important to humans. People eat the molds that grow in blue cheese and the yeasts that make bread rise. There are even fungi that can

End-of-Topic Investigation: Where can we find differences in size?

Safety Notes

1. *Follow safety guidelines as set out in the beginning of the teacher's guide.*
2. *Freshly-fallen leaves are generally safe to handle, but care should be taken to ensure that they are not recovered near patches of poison ivy or other irritating plants and that these leaves do not have mold on their surface. To avoid contact with potential allergens, non-latex gloves should be used.*
3. *While collecting leaves, teachers must ensure that potentially harmful animals (e.g., snakes, scorpions) are not in the area. It may be best to collect leaves on a playing field or other site of frequent human activity because the chances of encountering biting or stinging animals are far less.*
4. *Care must be taken to ensure that students are not eating any of the study subjects; teacher supervision is essential.*
5. *Be aware of allergies! Although this activity involves the use of leaves, fruit, and tubers, rather than highly-allergenic foods, certain students may have particular sensitivities.*

Materials

- Scale (analog or digital—preferably one that weighs to the nearest ounce or gram)
- Rulers (at a minimum, measuring to the nearest centimeter or quarter inch)
- Paper towels
- Safety goggles
- Non-latex gloves

Activity

For this activity, students will be investigating leaves, fruits, and tubers. Quantitative data on leaves might be collected in the fall or by using salad leaves (such as baby kale or spinach) that might be available in a grocery store. Fruits and tubers (e.g., potatoes, cassava) might also be seasonally available, and larger specimens are recommended. Like the animals in this topic of the book, these fruits and tubers will be weighed, and larger specimens are more likely to have a wider variation when placed on a scale.

If children are going to be collecting fallen leaves outdoors, direct them to classify these leaves based on their appearance. What sorts of patterns do certain types of leaves exhibit? Why should we put them into the same group? To begin, show students various types of leaves and ask if they know what kind they are, based on overall structure. If a student guesses correctly, how do they know? What were the clues? This will help to familiarize all students with different ways to