

BIODIVERSITY BASICS PREVISIT MATERIAL

This program is designed to educate students about biodiversity and how it affects them in their everyday lives. They will learn that biodiversity encompasses three interrelated levels of life:

- 1) The number and variety of species on Earth
- 2) The genetic diversity within a species
- 3) The Earth's ecosystems

They will also discover why biodiversity is important, what the status of biodiversity is around the world and how they can help to protect biodiversity.

Pre-visit Activities

The following activities will allow the students to become familiar with concepts taught in this program. These activities are to be completed prior to your visit to the nature center. All activities are adapted from *Biodiversity Basics An Educators Guide to Exploring the Web of Life* published by the World Wildlife Fund.

1. **Something for Everyone:** using a mystery story that introduces biodiversity, students will match mysterious notes from the story with facts about biodiversity, and list ways biodiversity affects people.
2. **Ten-Minute Mysteries:** students will solve "mysteries" to discover some amazing and little known connections among people, species, and ecosystems.
3. **Sizing Up Species:** by playing a team game students will find out how many species may exist within different groups of organisms.

Vocabulary:

Biodiversity: the variety of life on Earth, reflected in the variety of ecosystems and species, their processes and interactions, and the genetic variation within and among species.

Ecosystem: a community of plants, animals, and microorganisms that are linked by energy and nutrient flows and that interact with each other and with the physical environment. Rain forests, deserts, coral reefs, grasslands, and rotting log are all examples of ecosystems.

Fauna: the animals that live in a particular area.

Flora: the plants that live in a particular area.

Fungi: organisms that use living or dead organisms as food by breaking them down and then absorbing the substances into their cells. Fungi make up one of the five kingdoms of living things on Earth. Mushrooms, yeast and molds are types of fungi.

Gene: a segment of DNA that includes the coded information in an organisms cells that makes each species and individual unique. Genes contain the hereditary characteristics that are transmitted from one generation to the next and determine how organisms look and behave. Genes are responsible for features such as hair color and texture, and resistance to disease.

Habitat: the area where an animal, plant or microorganism lives and finds the nutrients, water, sunlight, shelter, living space, and other essentials it needs to survive. Habitat loss, which includes the destruction, degradation, and fragmentation of habitats, is the primary cause of biodiversity loss.

Microorganism: a living organism too small to be seen with the naked eye. Bacteria, protozoans, viruses, microscopic algae, and some types of fungi are all microorganisms.

Organic: (1) describes matter that is living or was once living; (2) describes agricultural products grown or raised without pesticides or other synthetic chemicals.

Species: (1) a group of organisms that have a unique set of characteristics (like body shape and behavior) that distinguishes them from other organisms. If they reproduce, individuals within the same species can produce fertile offspring; (2) the basic unit of biological classification. Scientists refer to species using both their genus and species name. The house cat, for example, is called *Felix cactus*.

Something for Everyone

Biodiversity is a big subject—so big that it can be hard to know how to approach it with students. On the other hand, the fact that it is so all-encompassing means biodiversity can appeal to all students, no matter what their interests. In this activity, your students will read a mystery story that will introduce them to some of the ways that biodiversity affects our everyday lives. They'll try to piece together mysterious messages that will lead them to the amazing truth: Biodiversity impacts what we eat and wear, the medicines we take, the music we listen to, the furniture we sit on, the books we read, the sports teams we root for, and virtually every other part of our lives.

Before you begin:

Make one copy of the story "Mystery at Leetown High" for each student and each group of students a copy of the "BioForce Fact Book."

What to do:

1. Read the "Mystery at Leetown High."

Hand out a copy of the first part of the story to each student and give the kids plenty of time to read it. (You might want to make it a homework assignment.)

2. Discuss the story.

Discuss "Mystery at Leetown High" with the students. Using the clues provided, discuss possible solutions to the mystery.

3. Finish reading "Mystery at Leetown High."

4. Define and discuss the term biodiversity.

Ask the students what they think the word means. Then explain that, as the story points out, biodiversity describes the variety of life on Earth and all its interactions. Point out that biodiversity includes not only the number of different species in the world but also the different kinds of habitats the species live in and the variety of genes that each organism is made up of.

5. Match notes with appropriate biodiversity blurbs.

Provide each group with a copy of the "BioForce Fact Book." Have the students work in small groups to match each note from the story with the biodiversity blurb in the fact book that pertains to it. (Tell the students that some blurbs refer to two or more notes. They can write the number of the appropriate blurb next to each clue on the story sheet.) Possible answers are listed below.

Mystery Notes (Answers)

Remember: Students may have more answers than the ones listed below. Ask them why they chose their various answers. (The numbers in parentheses represent the number of each fact presented in the "BioForce Fact Book.")

Jehan's Notes

You can't get away from it! (1,2)

Ignoring it could be a fatal mistake! (11, 14)

Your very life depends on it! (4, 5, 11, 14)

Megan's Notes

Your pizza depends on it! (7)

Without it, nine-nut crackling crunch bars wouldn't even exist! (10)

Leetown High cafeteria food would be even worse without it! (13)

Noah's Notes

Without it, there would be no Detroit Tigers. (3)

The future of the Baltimore Orioles could depend on it! (12)

If it didn't exist, you wouldn't be a member of the Leetown Leopards junior varsity basketball team. (3, 4)

Jamal's Notes

It could provide a cure for cancer! (5, 11)

It's the source of many important prescription drugs. (5)

It's the world's largest pharmacy! (11)

Miscellaneous Notes

Not hundreds. Not even thousands. We're talking millions! (1, 2)

A vampire could save your life! (5, 8)

Aliens are among us! (6)

Don't look now, but there may be something fishy about your nail polish. (15)

Bugs rule! (8, 9)

Mystery at Leetown High

"Man, this is getting weird," said Jehan under her breath. She stared at the small piece of paper that had fluttered onto the floor when she opened her locker. Six mysterious words, scrawled in bright green ink, stared back at her.

You can't get away from it! blasted the green letters. Jehan felt her skin crawl. It was the third note of it's kind she'd gotten in two days, and they were starting to creep her out.

She'd found the first one in her geometry book yesterday after lunch. Your very life depends on it! the note had announced. At the time, Jehan hadn't paid much attention to it. *Whoever owned this book last year didn't get all their papers out*, she thought, pulling out the note to add it to the recycling box. But for some reason—she wasn't sure why,—she crammed it into the back of her notebook instead.

Later that day Jehan had found another message, this time in her jacket pocket. She frowned slightly as she read its menacing words: Ignoring it could be a fatal mistake! Just what was *that* supposed to mean? Was it some kind of threat? Jehan impatiently stuffed the second note into the back of her notebook next to the first one.

Now, looking over her shoulder, Jehan bent down to pick up the third note. *OK, who's trying to freak ne out?* she wondered. Just then she saw her friend Megan coming toward her. "Aha," muttered Jehan, folding her arms against her chest. Weird notes were just the kind of thing Megan's warped sense of humor would dream up.

"Hey, J, check this out," said Megan, thrusting a piece of paper at Jehan. "I just found it in my locker. It's the third note I've gotten since yesterday."

Your pizza depends on it! said the note cryptically.

Jehan's eyes narrowed. "Oh, right," she said. "I'm supposed to think you have nothing to do with these notes just because you're pretending to get them, too."

"Too?" said Megan, looking surprised. "You mean I'm not the only one? Well, that's a relief?"

Jehan glanced suspiciously at her friend, but Megan didn't have that I'm so-innocent look she always wore when she was playing one of her dumb jokes. In fact, she really *did* look innocent.

Jehan sighed and showed Megan the three notes she'd gotten. Megan whistled under her breath. "Fatal mistake! Can't get away from it! Your life depends on it!" she read dramatically. "At least only my *pizza* depends on it, whatever 'it' is. So who's got it in for you, J?"

Good question, thought Jehan. *For that matter, why did Megan get a note about pizza, of all things? What did that have to do with anything?* She shook her head. Nothing was making sense.

"You should've seen the one I got yesterday," Megan said as they headed toward English class. "It said something like, 'Without it, nine-nut crackling crunch bars wouldn't even exist!' Apparently my incredible crunch bars are so famous they're even mentioned in anonymous notes," she said sighing. Megan was a great cook and she knew it.

"Wait a minute," said Jehan, stopping in her tracks. "Pizza and crunch bars... what did your third note say?" She had a feeling she was on to something.

"It was totally bizarre, something like 'Leetown High cafeteria food would be even worse without it!'" Megan made a face. "Hard to imagine," she said.

"I knew it. All of your notes have something to do with food. And all of mine sound like something out of a *Dr. Detecto* story," said Jehan. She loved mysteries and suspense thrillers, especially the comic book series called *Dr. Detecto, Private Eye*. She couldn't get enough of *Dr. Detecto's* dumb adventures. The investigator bumbled his way through all kinds of mysteries, but he always managed to solve them.

Megan wasn't following Jehan's train of thought. "So what? What's a pizza got to do with *Dr. Detecto*?" she asked.

"It's not what pizza has to do with *Dr. Detecto*. It's the fact that whoever wrote the notes knows

something about us."

Jehan smiled. She was beginning to feel a little like a detective herself. *OK, how would Dr. Detecto solve this mystery?* she wondered secretly. First, she figured, he'd collect more clues.

At lunch, Jehan got a chance to do just that. As she and Megan picked at something that was supposed to be lasagna, their friends Noah and Jamal joined them. A small piece of paper fluttered out of Noah's jacket pocket as he draped the jacket over a chair. "Hey, what's this?" he said, picking the paper up. It was another note. Noah said it was the third one he'd gotten since yesterday. Jamal said he'd also gotten three notes.

Excellent, thought Jehan, pulling a pencil and small notebook out of her backpack. "So what did your notes say?" she asked the guys.

Just as Jehan had suspected, each of their notes focused on a topic that they were especially interested in. Noah's all had something to do with sports. The one he had just found said, Without it, there would be no Detroit Tigers. Another claimed, The future of the Baltimore Orioles could depend on it! And the third note said, If it didn't exist, you wouldn't be a member of the Leetown Leopards junior varsity basketball team.

Jamal, who had decided when he was seven years old that he was going to be a doctor, got notes having to do with medicine. It could provide a cure for cancer! announced one. It's the source of many important prescription drugs, read another. It's the world's largest pharmacy! stated the third.

Jehan copied down each note. "Hmmm. If the four of us are getting notes, I bet the other kids are, too," she said. "The next step is to find out who."

"How are you going to do that, Dr. Detecto?" asked Jamal, tapping his pen on the table. He had a funny look on his face, as if he was extremely amused by the whole thing.

"I'll think of something," answered Jehan. In fact, she was already thinking of her friend Nikki, who was in charge of making the daily announcement over the intercom.

That afternoon, all of Leetown High heard the following announcement: Have you been getting strange, anonymous notes over the past few days? If so, come help solve the mystery by meeting in the study area tomorrow, right after seventh period.

When Jehan got to the study area the next day, Jamal was already there. Soon Noah and Megan showed up. And over the next few minutes, at least ten other kids came in. Jehan called the meeting to order and asked the kids to read their notes. There were some strange ones, all right:

- *Not hundreds. Not even thousands. We're talking millions!
- *A vampire could save your life!
- *Aliens are among us!
- *Don't look now, but there may be something fishy about your nail polish.
- *Bugs rule!

"OK," said Jehan. "looks like we've got everything from bugs to pizza to nail polish here. That covers a lot of territory. I have no idea what it all means, but I have a feeling there's someone here who does. Jamal, how about giving us a clue?"

Mystery at Leetown High (conclusion)

Jamal looked pleasantly surprised. He smiled at Jehan, stood up, and said, "Welcome to the third meeting of the BioForce—the Leetown Biodiversity Club. Thanks for getting everyone together, Jehan. You saved me the trouble!"

One purpose of the club, explained Jamal, was to explore the incredible variety of life on Earth—called biodiversity—and the different ways it affects people's lives. Another was to take action to help protect biodiversity, both locally and around the world.

"Biodiversity has something for everyone," said Jamal. "whether you're interested in sports or art or animals or food or social issues or—" he grinned at Jehan, "—whether you just like a good mystery."

"There's plenty of *that* in these notes," said Megan. "I mean, what could pizza possibly have to do with biodiversity?"

"It's all right here," said Jamal, passing out copies of a booklet called *The BioForce Fact Book*. "If you read through this you'll find out what all your notes mean."

Jamal explained that the booklet was the first project of the founding members of the club. They had designed it on the computer and planned to sell copies to raise money for a local charity. Other projects in the works included a food festival, featuring ingredients from biodiversity "hot spots" around the world ("Count me in," said Megan); a display for the local community library on the link between toxins and health issues (Jamal was in charge of that project); and an undercover investigation of local pet stores to see whether tropical parrots and aquarium fish had been illegally taken from the wild. (Jehan volunteered to lead the investigation.)

Later, after the next BioForce meeting had been set and the current meeting adjourned, Jamal and Jehan walked out to catch the late bus together.

"So, how did you know I was the one behind all those notes?" asked Jamal.

"Oh, please. It was a no-brainer," laughed Jehan.

Jamal raised his eyebrows. "No way," he said. "Not a single person saw me planting those notes! I was amazingly sneaky!"

"Sneaky, yes, but you're no match for a natural detective like me," smirked Jehan. "First, you practically waved your green pen under my nose at lunch yesterday. I figured it was the same one the notes were written with, since they were in bright green ink. Second, who else would have known enough about all that medical stuff to come up with the three notes you pretended to get? And third, you were the first one at the meeting today. That was the real clincher. You're never on time for anything!"

"OK, so maybe it was an open-and-shut case," grinned Jamal. "But you're definitely tough to fool. Nice work, Dr. Detecto."

The BioForce Fact Book

1. When it comes to knowing what kinds of life forms are out there, scientists may have only scratched the surface. So far they've identified about 1.7 million species—but there may be as many as 100 million! All those species, along with the different ecosystems they live in and the billions of genes they contain, make up the variety of life called biodiversity.
2. Biodiversity is everywhere! Planet Earth is literally crawling with life, from tiny bacteria in the soil under your feet to gigantic whales as long as a city block.
3. Lions and tigers and bears—and blue jays and cardinals and eagles! These animals are just a few of the ones that sports teams are named after. There are dozens of others. Animals inspire us not only in sports but also in many other areas of our lives.
4. Biodiversity is much more than a source of names for sports teams. For example, scientists are learning that the millions of species on Earth, along with the ecosystems they live in, have a role to play in supporting one another. Because of this, many scientists and others feel that human well-being depends on keeping Earth's biodiversity healthy.
5. The natural world is one big medicine chest. One-fourth of all prescription drugs used today were originally derived from plants. And scientists think that many more are waiting to be discovered among the rich diversity of life on Earth.
6. One of the biggest threats to the biodiversity of many areas is "alien" species—species that humans, either accidentally or purposefully have introduced into places where they didn't occur before. (Norway rats, the kudzu vine, and starlings [a type of bird] are a few of the thousands of examples.) These species often thrive in their new homes because they may not have many predators in the areas they're introduced into. As a result, alien species can "take over" their new habitats and push out species that were already there. (Scientists also call alien species introduced or exotic species.)
7. You can thank biodiversity for your favorite edible fungus, whether it's the "blue" in your blue cheese salad dressing or the mushrooms that mingle with the olives and pepperoni on top of that popular Italian-American cheese and tomato-sauce pie.
8. There's a lot of beauty out there in biodiversity land—colorful coral reef fish, majestic eagles, cuddly looking pandas... So why, you might ask, did nature have to ruin things by coming up with bugs, slugs, and other less-than-beautiful creatures? Well, you should be glad it did. Even the ugliest, weirdest, and scariest species have a role to play in nature. And many are proving valuable to people in ways no one could have guessed. Take vampire bats. Scientists have found a way to use their saliva to dissolve dangerous blood clots in humans. Not even the cuddliest, cutest panda can do that!
9. We humans are totally outnumbered. So are the rest of our fellow mammals. For that matter, so are reptiles, amphibians, and fish. That's because the total number of vertebrate species (those with backbones) doesn't even come close to the number of insect species. There are more than 950,000 known species of insects, and scientists think the total number may be tens of millions. Aren't you glad insects are smaller than we are?
10. People are helping to preserve areas rich in biodiversity by growing and harvesting crops in ways that don't harm the habitats they're grown in. For example, in some tropical areas, farmers grow Brazil nuts, cashews, and other crops for export to North America, Europe, and elsewhere. By providing a product that people want and by using careful growing and harvesting methods, they ensure the protection of the areas' biodiversity.

11. Rain forests and other natural areas could have medical marvels within their midst—in the form of a cure for cancer, AIDS, or other life-threatening diseases. Scientists have stepped up their efforts to learn about the medicinal plants in these areas. In some places, they're learning a lot from shamans and other native healers.

12. The loss of tropical rain forests and other natural areas results in a loss in biodiversity—and not necessarily just in those areas. For example, recent studies suggest that populations of certain birds that migrate back and forth from North America to the tropics are decreasing because of the loss of rain forests and other tropical habitats. Some of our most colorful songbirds, including Baltimore orioles, are among the casualties. Habitat loss is the main reason we're losing biodiversity.

13. OK, so cafeteria food isn't exactly a gourmet treat. But at least you can choose what you're going to eat from a variety of different foods. If the thought of forcing down those soggy-looking Brussels sprouts makes you gag, you can choose the macaroni and cheese. Now consider for a moment what your school lunch might be like if the Earth didn't have much biodiversity. Yikes! Those overcooked Brussels sprouts might be the only thing on the school lunch menu! Oh, wait—there's always the salad bar. Of course, all it has on it is iceberg lettuce. Oh, well—bon appetit!

14. People list many reasons for wanting to protect biodiversity. Some feel that the quality of human life is richer simply because we're surrounded by so many other life forms. They say that this is reason enough to protect biodiversity. Others believe that we depend on biodiversity for our very survival. They feel that, without the complex interactions of all those species and the ecosystems they're a part of, everything from our atmosphere to the planet's oceans—not to mention humanity itself—could suffer the consequences.

15. Did you know that the red color in some face powders, lipsticks, blushes, and eye makeup comes from the bodies of crushed insects? And the luminous, translucent look of some nail polish comes from ground-up fish scales? Biodiversity works in mysterious ways.

Future Worlds

Some people look into our future and see a gloomy, inhospitable picture: a world that is less than healthy, less safe, less diverse, more crowded, and more polluted. While such portraits of doom may scare some people into action, they often have the opposite effect. Negative forecasts can become self-fulfilling prophecies, making people—especially young people—resigned and hopeless. This activity doesn't take a doom and gloom approach. Instead, it is designed to get your students to begin envisioning the future they want to inhabit.

Before You Begin

Make a copy of "Future Blocks" and "Priority Pyramid" for each student and each group. Also provide scissors and glue or tape.

What to Do

1. Make personal pyramids.

Give each student a pair of scissors and a copy of the "Future Blocks." Explain to the students that the blocks list 15 different possible conditions or components of their future world. Have the students read through all the conditions. Make sure they understand all the words in the blocks. Then ask them to think about which of these conditions they most want to have as a part of their world when they're, say, 50 years old. Clean air? Tigers? Less crime?

Have students rank all the components from the most important to the least important. Tell them to cut out the squares and arrange them in the pyramid. The most important component should be placed in the top box of the pyramid, the next two components on the next tier, and so on. Once the students have arranged all the blocks, have them mark each block with the number that reflects the priority rating they gave it. (The priority rating numbers are one through five and correspond to the levels of the pyramid.)

2. Create group pyramids.

Arrange the group into teams of four or five students. Have the students work together to come up with a single pyramid that represents the team's priorities for the future. Everyone on the team should record the priority ratings each member of the team gave each block and compare them with his or her own personal pyramid.

3. Suggest methods of reaching consensus.

It might not be easy for teams to reach consensus regarding the group pyramid. The students may discuss their reasons for various choices, prioritize options, or try other methods of reaching a group decision. But if they get stuck or seem to be struggling to achieve a fair process, you may want to interrupt and share the following negotiation suggestions:

a. make a list of all the possibilities for the top spot. Are there more than three? If not, would everyone accept having his or her first choice listed among the top three? If that's the case, students may have an easier time resolving the question of order.

b. Give everyone a chance to present his or her choice for the top square of the pyramid and explain why it was chosen. The other students should listen closely to these explanations. A student who lists bees as a top priority, for example, may explain that she's concerned with how bee pollination is critical for food production. Then other students who have pushed to place "enough food for all people" in the top spot may realize that they share the same concern as the "bees" proponent. This strategy may help narrow choices or change the nature of the discussion.

c. If the students are still struggling to reach a resolution, have them take time-out to reflect on the process. Are certain views being overlooked because some students are quieter or less stubborn than others? Is the group uncomfortable with anyone's way of working out the problem? By reflecting on the dynamics of their discussion, the students may be able to isolate the obstacles to group consensus.

3. Continue giving new mysteries.

Once your students have solved the practice mystery, challenge them to solve some of the other mysteries provided, either as an entire class or in teams. If you have the students work in teams, pair teams of two to three students so that each team can take turns posing mysteries to the other. Divide the six mysteries so that each team has half of the mysteries and answers that they'll then read to the team they're paired with. Give each team copies of only the mysteries they'll read to the other team.

4. Discuss some of the connections as a group.

Discuss which connections the students found most amazing or surprising and why. Did any of the mysteries change the way the students feel about living things? Ask your students what important point is made by all of these mysteries. (Answers will vary, but students should observe that humans depend on plants, animals, and microorganisms in many important ways.) Discuss the term biodiversity with the students. (Biodiversity is the diversity of life on Earth, including the wealth of different genes, species, and ecosystems.) Be sure the students understand that our dependence on other living things is a dependence on biodiversity.

5. Write statements about the connections between people and biodiversity.

Divide your group into small teams. For each mystery it solved, ask each team to write a sentence or brief statement that describes the important connection to biodiversity the mystery revealed. For example, a statement related to the moldy bread mystery could be: "Biodiversity is a source of important medicines, such as penicillin." Or, "Some small organisms that we might not think are important can be very useful—and even lifesaving."

Ten-Minute Mysteries

Mystery 1

A 55-year-old woman is rushed into the emergency room. Two days later, she checks out of the hospital wearing an "I LOVE VAMPIRE BATS" button on her sweater. WHY?

Answer: The woman went to the hospital with chest pains that were caused when blood clots clogged the arteries around her heart. Doctors used a medicine derived from vampire bat saliva to unclog her arteries, making her well enough to leave the hospital. Research has shown that vampire bat saliva works twice as fast in opening clogged arteries as more common medicines.

Clue #1 The woman went into the hospital with chest pains.

Clue #2 The woman's chest pains were caused by clogged arteries.

Clue #3 Vampire bats have a chemical in their saliva that keeps the blood of the animals they feed on from clotting.

Mystery 2

Roberto Fernandez goes with his sister Isabel to their local farmer's market to buy organic vegetables. Arriving at the market, they realize they don't yet know which farmers are the organic ones. As they look around at the different stands, Roberto sees a sign for a farm called "Mantis Meadows." "Oh, there!" he exclaims. "I bet that farmer is organic." WHY?

Answer: The praying mantis is an insect that eats other insects, including farm pests. For that reason, praying mantids are often encouraged by organic farmers, who do not use chemical pesticides. When Roberto saw a farm called "Mantis Meadows," he figured that was the place using nonchemical means to help control pests.

Clue #1 Insects that feed on crops are one of the biggest problems for farmers.

Clue #2 Organic farmers do not use chemical pesticides to kill insects.

Clue #3 Praying mantids eat lots of insects.

Mystery 3

Theresa Lee is watching TV with her sister Alice when a commercial for cold medicine comes on. In the commercial, four koalas sneeze and cough before taking the advertised remedy. "That's appropriate!" Theresa says. WHY?

Answer: The commercial is advertising a cough medicine made from eucalyptus leaves. Eucalyptus is also a favorite food of koalas.

Clue #1 The advertised medicine is especially designed to soothe coughs.

Clue #2 Many ingredients in cough medicine are extracted from plants.

Clue #3 This cough medicine contains eucalyptus leaves.

Mystery 6

A little girl goes to the zoo with her parents. "I wannna see the pink flamingoes!" she says, pulling her mother's arm toward the flamingo exhibit. But when they get to the exhibit, the little girl starts to cry. "What's wrong, sweetie?" asks her father. "you said you wanted to see the flamingoes—well, here they are!" The little girl stamps her foot. "But they aren't pink enough!" she says, pouting. The girl's parents look at each other and sigh. "She's got a point," says the mother. "These birds aren't very pink at all. And look those two over there—they're practically white." Why aren't the flamingoes pink enough?

Answer: Whether or not a flamingo is "in the pink" depends on its diet. In populations, of wild flamingoes, eating large quantities of a tiny crustacean causes the birds' feathers to become pink. But in captivity, that same type of crustacean isn't necessarily readily available. Because of this, zoo flamingoes sometimes look like much paler versions of their wild counterparts. But zoo keepers can remedy the situation by supplementing the birds' diet. Sometimes they use the real thing—crustaceans. But other color "enhancers"—including carrot juice—will work in a pinch!

Clue #1 Flamingoes feed on tiny water animals.

Clue #2 In the wild, flamingoes are almost always pink.

Clue #3 Flamingoes living in a zoo often have a different diet from flamingoes living in the wild.

Sizing Up Species

Did you know that a single tree in a rain forest can be home to more than 1,000 different kinds of insects? Or that a coral reef can support as many as 3,000 varieties of fish and other organisms? Or that the deep ocean floor may be home to more than 10,000 species of living things? The sheer number of organisms living on Earth is extraordinary. So far, scientists have identified about 1.7 million species, but there are actually many more. Estimates range from 3 million to more than 100 million.

Before you begin:

You'll need to make a set of number cards for each group using a thick marker. To make each set of cards, you'll need six small pieces of paper (post-its work well). Write the following numbers on separate cards: 4,000; 9,000; 19,000; 72,000; 270,000; 950,000. (Make the numbers large enough to be seen from a distance.) If you like, you can color-code each card set by using different colors of paper or markers.

Make six signs writing one of the following words or phrases on each sheet: insects; trees, shrubs, and herbs; mammals; birds; fungi; and fish. Then hang the signs on the walls in your classroom.

What to Do:

1. Discuss how many organisms there are on Earth.

Ask your students to estimate how many different kinds of organisms (species) they think are in the biosphere. You may first need to explain that a species is an interbreeding population of organisms that can produce fertile, healthy offspring.

Discourage students from simply guessing a total number of species. Instead encourage them to reflect on prior knowledge and observations. Allow students to discuss their reasoning. Have each student make an estimate and explain how he or she arrived at that number. If estimates are low, ask students if they considered organisms of all sizes, including microscopic organisms. Finally reveal to the students that so far scientists have identified approximately 1.7 million different organisms in the biosphere. But they predict that there may be an additional 2 to 100 million species that haven't been identified yet.

2. Decide how many species are in each group of organisms.

Hand out a set of number cards to each team, and explain that each card represents the number of species scientists have identified in a particular group of organisms. Hold up a number card (for example, 19,000) and explain that 19,000 refers to the number of bird, plant, mammal, insect, fish or fungi species that scientists have identified. (Remind your students that this is not the number of individuals but the number of species— there may be millions or billions of individuals.) Now explain that each team has to work together to decide which group of organisms listed on the signs posted around the room this number refers to. Once their decisions have been made, the teams should tape their number cards on or below the appropriate signs on the wall. (Teams should write down their choices so they remember them.)

3. Discuss the students' decision-making process.

Ask your students to share the methods they used for making decisions. Did they guess or reason? Many teams may start with the highest and lowest number they are most certain about and they use a process of elimination. Other teams may base their guesses on experience and observation.

4. Reveal the actual numbers.

Go to each sign and tell your students the correct answers. Then have your students discuss their reactions. Did any of the answers surprise them?

Insects	950,000	Birds	9,000
Plants	270,000	Mammals	4,000
Fungi	72,000		
Fish	19,000		