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THE LOUISVILLE ZOO
BACKYARD
ACTION HERO
2014
GUIDEBOOK
2015
Tropical Rainforests
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Welcome Future Heroes!

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At Toyota Motor Manufacturing, Kentucky, Inc. (TMMK), we believe that protecting the environment is part of our mission to be a good neighbor across Kentucky. As we build cars in our plant in Georgetown, we are committed to protecting the environment, obeying the environmental laws, preventing pollution and continuously improving our processes. But the commitment doesn't stop there. It is everyone's responsibility to protect the environment.

Becoming a Backyard Action Hero is the first step in learning about how we coexist with the plants and animals that make up our environment. Once you have learned about some of the things in this book, you will be ready to take conservation action in your own backyard and beyond. Good luck!

Sincerely,

Your Friends at

Toyota Motor Manufacturing, Kentucky, Inc.

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The Louisville Zoological Gardens, a non-profit organization and state zoo of Kentucky, is dedicated to its mission to "Better the Bond Between People and Our Planet" by providing excellent care for animals, a great experience for visitors, and leadership in conservation education. The Zoo's collections which include botanical gardens are accredited by the Association of Zoos and Aquariums (AZA) and the American Alliance of Museums (AAM). The Louisville Zoo is also an agency of Louisville Metro Government.

2014-15 Backyard Action Hero Guidebook

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An Introduction to Rainforests

Hello Backyard Action Heroes. Young people have a lot of energy and creativity. Can you channel yours to influence the survival of precious life forms on our planet. The more knowledge you gain, the more likely you will be prepared to help protect and save this wonderful planet of ours. Together, we can instill a sense of responsibility in our friends, family members and beyond and show them how our daily actions can make a difference for all living creatures!

Travel is a wonderful way to learn about our planet. While we all can't pack our bags and spend time in the rainforest, we can help you learn about this amazing part of the world in this Guidebook. Use our Backyard Action Hero (BAH) Guidebook and the Louisville Zoo as your conservation resources to start your virtual journey to far away places. You will learn what is so unique about the tropical rainforest – the most biodiverse ecosystem (a community of living and non-living things working together) on this planet.

When looking at a particular ecosystem, it is important to first look at those non-living or abiotic factors that influence what can live in an ecosystem. The tropical rainforests of the world tend to exist in and around the equator. Due to the directness of the sunlight throughout the year, and because most of the equator is over the ocean, there is a lot of warm moist air in this region. That warm moist air rises, cools and condenses and falls back to the ground as rainfall. Tropical rainforests in and around the equator get their name from this great amount of precipitation. These rainforests average between 100 to 180 inches of precipitation in a year. In comparison, here in Kentucky, we average about 45 inches.

Temperatures in and around the equator in the tropical rainforest areas tend to stay pretty warm and relatively constant. The direct sunlight and the moisture in the air, which helps hold on to heat, means that the temperature in the rainforest averages about 85 degrees both day and night. Moisture in the air is referred to as humidity. The higher the humidity, the more heat the air will hold on to, so even though the sun goes down

at night, the humid air holds on to the heat it gained during the day. You might already know that deserts are very different in that they heat up during the day and cool off a lot at night due to lack of moisture in the air.

As we talk about some of the creatures living in the rainforest, be aware that they have adaptations to deal with the abundance of rain and cannot tolerate big swings in temperature. They definitely do not like the cold. This is why when you come to the Zoo during some of the chillier times of the year, certain animals are not found outside but inside one of their exhibits where it is nice and warm! Tropical rainforest animals are generally provided both indoor and outdoor access so they can choose where they want to go depending on the temperature.

A few more interesting points about the tropical rainforest include the fact that more species can be found in these rainforests than in any other ecosystem on the planet. Roughly half of all the species on the planet live in the tropical rainforests. If you trace your finger along the equator on a map or globe you will find that the major areas of rainforest on the planet are the Amazon region of South America, the Congo region of Africa and in areas among the many islands of the Indonesian Archipelago. An archipelago is just a fancy word for a large group or chain of islands. You might look specifically for the islands of Borneo and Papua New Guinea as segments of that chain.

The tropical rainforests of the world used to cover about 15% of the earth's surface, going back about 200 years ago. Today they only cover about 6% due to deforestation. People have deforested these areas for a number of reasons including to make way for agriculture, to harvest exotic woods and for mining purposes. It is estimated that only about 2% of rainforests is still untouched and as it would have existed before human disturbance.

When looking at a tropical rainforest, it is important to understand that the structure of the forest plays a big role in where that great variety of species can be found. Typically, scientists divide the forest vertically into four layers: 1) the forest floor, 2) the understory, 3) the canopy and 4) the emergent layer. Some species are unique to a specific layer, while some move freely between layers. There are various reasons why certain creatures live where they do, some of which involve abiotic factors such as the amount of available sunlight, water, or soil conditions. And some involve biotic factors such as what their predators are or what they prey upon.

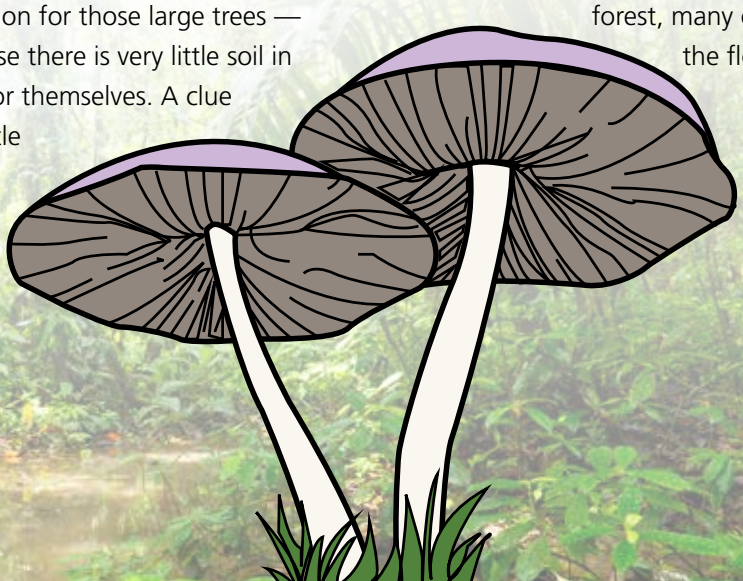
The Forest Floor

Let's start with a look at the forest floor. One of the major misconceptions about the tropical rainforest is that the entire area is like a jungle from a Tarzan movie. Many people believe that in order to make your way through the forest, you need a machete to chop away the dense vegetation. The reality is that if you were dropped in the middle of the rainforest blindfolded, and then removed your blindfold, it might take a while for your eyes to adjust due to the lack of light. This is because only about 2% of the light that shines down in these areas actually makes it to the forest floor. Most of the light is stopped by the vast canopy of leaves that are far overhead. This lack of light means that when you do start to look around, there is really not much low lying vegetation at all. The only places that thick vegetation will be found on the floor would be near the edges of the rainforest, say along a river, or where a tree has fallen and light can penetrate to the ground.

Another thing you would notice as your eyes adjust to your surroundings is the large trees — trees reaching, in some cases, over 200 feet high and whose canopy of leaves blocks out most of the sunlight. You will also notice something different about the bottoms of those trees. You will find yourself standing next to large structures which seem like extensions of the roots up into the sides of the tree. These large buttressing structures provide an extra sturdy foundation for those large trees — needed because there is very little soil in which to anchor themselves. A clue that there is little soil underfoot is that the ground you would be walking on would be covered with mosses and fungi growing all over the abundant intertwined roots from the large trees.

The forest floor is teeming with detritivores, organisms that feed on dead decaying matter. The lack of soil is associated with the action of these detritivores that immediately go to work on anything that makes it to the forest floor. Materials that reach the floor almost immediately start breaking down, or decomposing. Nutrients, such as dead leaves, animals or their waste products, are consumed by fungi and insects which act as nature's recyclers. The trees and detritivores depend on each other so closely that we often refer to them as having a symbiotic relationship. The great biodiversity of the tropical rainforest comes from the rapid reuse or recycling of materials that have little chance of becoming soil.

Animal life on the rainforest floor isn't as obvious as you might think. The floor lacks an abundance of large animals due to the lack of low-lying vegetation. Large animals such as wild pigs, tapir or jaguars would mainly be found near the rivers and forest edges. Only in these areas can vegetation be found for the plant eaters on which the carnivores feed. Insects, such as leaf cutter ants and beetles, make up most of the species found throughout the forest, many of which are on the floor.



To see an animal that calls the leafy rainforest floor its home, you don't have to leave Louisville to spot...

The Gaboon Viper

The Louisville Zoo's HerpAquarium is home to this really big terrestrial (living on the ground) reptile.

The gaboon viper has several adaptations that have enabled it to survive in different habitats including tropical rainforests. Size is an adaptation that these snakes utilize. When you think of gaboon vipers, you need to think BIG! Nearly everything about them is big, and their size plays a key role in their ability to survive in this environment. One of the first things you will notice about these vipers is their large bodies, both the length and girth. A more substantial body enables them to consume prey that many other snakes can't manage; their hefty size also provides space for a large respiratory system which the gaboon uses to deter potential predators. When confronted by a predator, gaboons will inflate their lungs full of air enabling them to emit a very loud, long and frightening hiss that causes most animals to flee, including humans!

In addition to being very thick-bodied and able to grow over six feet in length, gaboon vipers also have very big heads, an adaptation that serves multiple purposes. First of all, there are many plants with large leaves in tropical rainforests that end up falling to the forest floor; the size and shape of the gaboon viper's head makes it blend in with the leafy forest floor providing very effective camouflage. Secondly, a big head allows the gaboon viper to accommodate the longest fangs of any snake in the entire world plus enormous venom glands. There are other snakes that have venom that is more potent than the gaboon vipers, but the large glands enable this snake to inject prey with the highest venom yields of any species of snake on the planet. Having such long fangs also enables them to inject their venom very deep into a prey animal which makes it faster-acting and more effective. Many venomous snakes strike a prey animal and then release it, but not the gaboon viper. Instead, they often bite and hold their prey, allowing them to pump their prey full of venom for a quicker kill.

Long-term survival and vigorousness of the species depends on superior size — reproduction would be compromised without it. Before gaboon vipers reproduce, the males engage in combat with each other, and only those that survive go on to produce offspring. During combat, males begin by rubbing their chins along the back of their opponents raising their heads up as high as they can while becoming intertwined in an effort to physically topple each other over. Large size provides a distinct advantage in this competition. In order to achieve a size advantage, males must succeed in finding food over a long period of time — the reward being a larger size enabling them to pass on their successful genes to the next generation. The rigors of this process demonstrate how adaptations are rewarded through evolution in the natural world.

The Canopy

When most people think of the rainforest, the types of animals that come to mind are things like monkeys and orangutans, sloths, tree frogs and colorful birds. Many of these species are canopy dwellers. If you are in the rainforest and look up to see where all the tree leaves come together near their tops (blocking out most of the sun), you are looking at the canopy. This is where a lot of the larger species tend to spend a majority of their time. Some of these species never leave the canopy. Sloths, for instance, only go down to the ground for a specific purpose — to urinate or defecate. If they do this where they live in the canopy, the smell might attract a predator.

The canopy offers everything that is needed for a wide variety of animals to survive: fruit, leaves, nectar, nuts and insects. The creatures that feed on these items are in return eaten by predatory animals. As an example, small monkeys may eat fruit and/or insects and boa constrictors may feed on the monkeys.

Local Hero Day Gardner

An animal that can be found living in the rainforests of southeast Asia and here at the Louisville Zoo is the orangutan. Day Gardner is a keeper at the Louisville Zoo who works closely with the orangutans that reside in the Zoo's Islands exhibit. She is here to tell us a bit about these fascinating animals.

"Orangutans are primates and one of the members of the Great Ape family. There are two different species of orangutans which are named according to their native habitats: Bornean and Sumatran. Sumatran orangutans are lighter in color, taller, and slightly thinner than their Bornean counterparts. Bornean orangutans have darker hair, have a rounder body shape, and weigh a bit more than Sumatran orangutans. Males of both species have distinctive facial features called "cheek pads" — fatty flaps of tissue that make their faces look plate-like.

"Orangutans live in the rainforests of southeast Asia and are strictly vegetarian. Their hair is coarse and their skin is oily to allow them to survive in their humid environment. They are solitary and so do not live in family groups like gorillas or chimpanzees. Females and males come together only for a short time to breed, then separate, allowing the mother to raise her young alone for about nine to eleven years.

"Due to commercial logging, palm oil plantations, and the limited amount of space and resources on their island habitats, the orangutan population is rapidly dwindling. Some experts estimate the species have less than 25 years left in the wild before extinction."

Be sure to visit our orangutan ambassadors, Segundo, Amber, Teak and Bella and learn more about these intelligent and curious apes.

Day Gardner and Segundo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The Understory

Between the forest floor and the canopy is what might be considered a transitional area usually referred to as the understory or sub-canopy layer. In this area, there are some shorter trees that are just getting their start. Some of the new trees get started from seeds spread throughout the forest by some of those animals living up in the canopy. If a seed happens to fall in the right area with enough soil and water and sunlight peeking through, it may have a chance to grow. Other trees may actually start their life springing from the roots of a larger tree or as an epiphyte. Epiphytes are plants that start life by growing on other plants, with their roots hanging in the air collecting moisture and nutrients that come from above. Orchids and plants known as bromeliads, which some people like to grow as houseplants, are good examples of epiphytes. Many small animal species use these plants as places to hide or live. Some of these plants hold water in which animals like tree frogs lay their eggs. When a larger tree dies or falls in the forest, the smaller trees of the understory may get a chance to take off and join their taller cousins in its place. The diversity of trees in the tropical rainforest is much greater than in the forests of Kentucky. A hectare of rainforest (about 2.471 acres) can contain more species of trees than the entire state of Kentucky.

International Hero
Dr. Sara Bennett

The Jane Goodall of the Amazon

"Hi from the lower reaches of the Matamatá, a creek that drains into the Amazon River. I'm a conservation biologist and work with a Colombian national park (Amacayacu) with the Ticuna indigenous community on the challenge to understand how this forest works — and how to take care of it now for future generations. What does this mean? We're still working on it ourselves.

What we know is that Amacayacu is one of the most diverse (species-rich) forests in the world. It's also a forest that's useful and used by the people who live here. Populations have grown over the years which means that some parts of the forest have disappeared. The large vertebrates are hunted for food and are particularly vulnerable to these changes, especially the largest primate in this region, the Woolly monkey. Woollies reproduce v-e-r-y slowly and need a huge area of virgin untouched forest in order to find food all year long.

That's why Woolly monkeys have been selected as a conservation priority. Their regional population is in trouble because they are good to eat and the babies are sold as (illegal) pets; even in the national park you have to walk for at least a

The Louisville Zoo is home to the only two Woolly monkeys in North America.

The Emergent Layer

The final layer of the tropical rainforest is represented by the tallest trees found in the area. Some trees are so tall, they emerge above the canopy layer and create a separate area of habitat known as the emergent layer.

The emergent layer tends to be inhabited by colorful birds such as parrots that will sun themselves next to the colorful flowers in these high-rising trees. The parrots' coloration imitates some of these flowers so that the birds are somewhat camouflaged. Large birds of prey, such as the Harpy Eagle in the Amazon, utilize this high vantage point to search for prey in the expansive canopy below. Fruit bats may also be found in the emergent trees.

Louisville Zoo Fruit Bat

day to get even close to finding them. And they are important — because of what they eat and what/how/where they poop. Woollies eat an incredible number (more than 200 different species) of different types of ripe fleshy fruit which big seeds they swallow and then later defecate far from the mother tree. This kind of seed dispersal is important because the seeds that end up close by mostly get eaten by seed predators so are not distributed throughout the forest. Biologists have compared the number of species of plants in the forest understories of South American and African forests with normal densities of large primates and where they have been over hunted to predict the future composition of the forest. Where the primates have disappeared or been overexploited, the next generation of these forests will be much poorer in plant species.

The Ticuna people are hunters. What's special about them is that since 2004 they have not hunted the Woollies in their territory. We started a program with them last year to monitor the Woolly monkey population in order to know whether it is recovering, still declining, or stable. It is not easy to find them and even harder to count them! We're experimenting with an approach in which for five days, a large group of us spreads out through the forest looking for Woollies and counting any we find — like playing Where's Waldo. We think there are three to four troops with a total population of 100-110 individuals. And counting!"

CHALLENGE

Dr. Bennett would like to know what you see in your own backyard. Draw a picture or write a description of your own backyard and mail to:

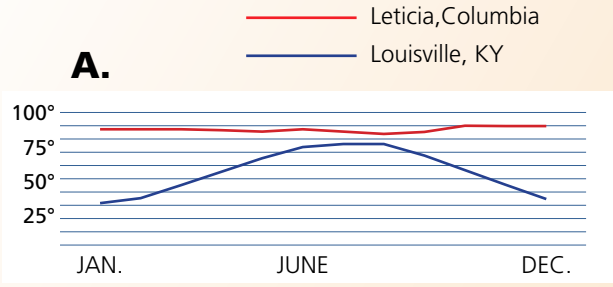
BAH: Dr. Sara Bennett Challenge
Louisville Zoo
1100 Trevilian Way
Louisville, KY 40299

FIND THE PATTERN CHALLENGE

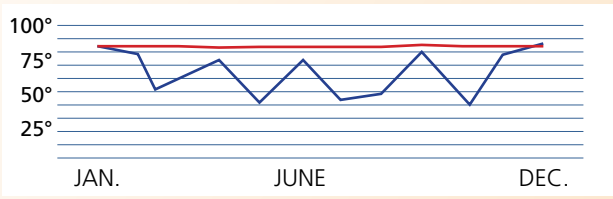
Living in the rainforest like Dr. Sara Bennett has for many years means getting used to living in a hot and wet environment. No winter coats for her! Here is a good activity for you so that you can better understand the differences between Leticia, Colombia (which is not far from where Dr. Sara Bennett lives) and Louisville, Kentucky.

Study the Climate Charts to the right. Compare the average temperatures between Leticia and Louisville. Which of these two graphs below best displays the pattern between the two cities?

A.



B.



Now look at the Average Precipitation Chart. Take a pencil and write down your prediction for the average precipitatio in Louisville. Next, visit world-climates.com and see how close you are. Finally, compare Louisville's precipitation to Letica, Columbia. Which city gets the most rainfall?

Crossword Puzzle Answers

[Across] 3: Canopy 5: Abiotic 7: Bromeliads 9: Emergent 10: Symbiotic 12: Terrestrial 13: Precipitation 14: Understory [Down] 1: Equator 2: Ecosystem 4: Epiphyte 6: Biodiversity 8: Humidity 11: Floor

Climate Chart Answers

[Average Temperature] Chart A.

Climate Charts

Average Temperature (Degrees Fahrenheit)

Month	Leticia, Columbia	Louisville, KY
January	79.9°	31.7°
February	79.9°	35.6°
March	79.9°	46.2°
April	79.7°	56.3°
May	79.3°	65.3°
June	77.9°	73.2°
July	77.5°	77.2°
August	78.8°	75.7°
September	79.6°	69.4°
October	80.4°	57.6°
November	80.2°	47°
December	80°	36.9°

Average Precipitation (inches)

Month	Leticia, Columbia	Louisville, KY	
		predict.	Actual
January	14		
February	13.2		
March	13.9		
April	13.9		
May	11.5		
June	8		
July	6.2		
August	6.7		
September	9.3		
October	10.4		
November	11.9		
December	11.5		

Source: world-climates.com

RAINFOREST VOCABULARY CROSSWORD PUZZLE

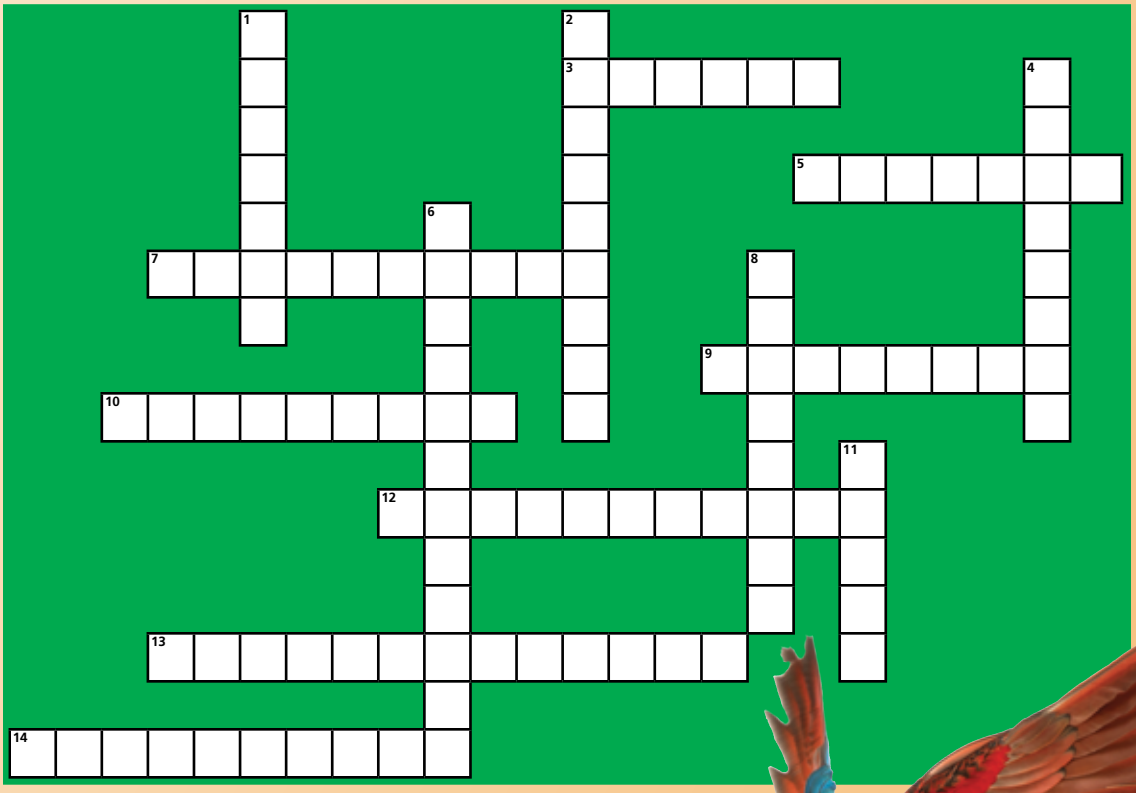
All of these terms and descriptions can be found in this Guidebook. *(Answers on previous page)*

ACROSS

3. Where all the tree leaves come together near their tops and block out most of the sun
5. Non-living factors that influence what can live in an ecosystem
7. Related to the pineapple family, these plants have thick waxy leaves that form a bowl shape for catching rainwater
9. Layer that tends to be inhabited by color birds
10. When two or more organisms depend on each other to live, they have a _____ relationship
12. An animal that lives on or near the ground, as opposed to in water or in trees, is said to be this
13. Water released from clouds in the form of rain, freezing rain, sleet, snow, or hail
14. Layer between the forest floor and the canopy

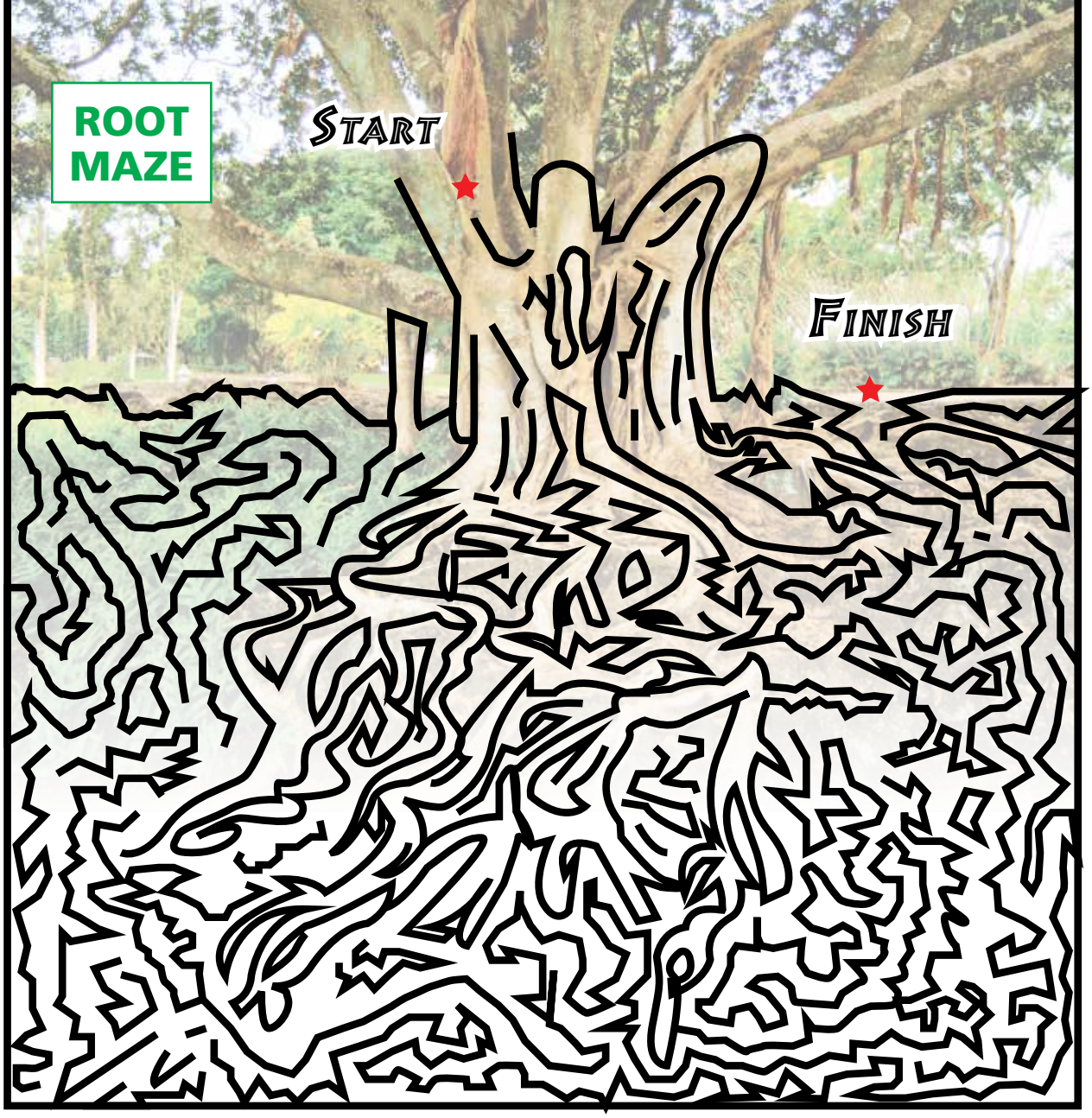
DOWN

1. The imaginary line around the middle of Earth where tropical rainforests tend to exist
2. A community of living and non-living things that work together
4. Plants that start life by growing on other plants
6. The variety of life in an ecosystem
8. Moisture in the air
11. Lowest layer of the rainforest is The Forest _____



HOW MANY ANSWERS DID YOU GET CORRECT?

ALL 14 ANSWERS	Wow! Congratulations. You're a Backyard Action Hero NINJA
More than ten answers	Orangutan Commando (Well done)
More than five answers	Gaboon Viper Warrior (Nice effort)
More than one answer	Mushroom Cadet (Try looking through the book again)



Sustaining the Rainforest

It is estimated that over half of all the species on the planet can be found in tropical rainforests. Scientific studies in the rainforest provide evidence that about 80% of the species found there have yet to be identified. The diversity of the rainforest is very important to the creatures that live there as well as to humans. As an example, the U.S. National Cancer Institute has identified approximately 3,000 species of plants that could be useful in fighting cancer. Seventy percent of those are rainforest plants. One fourth of all medicines in the western world have rainforest plant ingredients. Indigenous people in the rainforest, those who are native to that area, utilize even more plants for food and medicines than we do. The knowledge these people have of the rainforest is just becoming known to those of us who do not live there.

When it comes to food, about 80% of the food we eat comes from rainforest-derived plants and animals. Examples are citrus fruits like oranges, lemons, limes and grapefruit. Other fruits such as avocados, bananas, pineapples and tomatoes originally came from the rainforest. Vegetables and grain such as corn, potatoes, yams and rice originated from rainforest plants — not to mention chocolate,

Your Mission: Get Involved!

Kentucky may seem a long way from the tropical rainforest, but it takes everyone working together to protect and save the delicate ecosystems of our planet. Here are some things that you, your family, your teachers and classmates can do:

- Reduce your carbon footprint. Unplug computers and other electronic devices when you're not using them. TVs, DVD players, and cell phone chargers use a lot of electricity — even when they're turned off. You can save 400 pounds of carbon emissions a year by doing this!
- Use energy-efficient lightbulbs and turn off lights when you leave a room.
- Avoid buying products that contain palm oil. Palm oil plantations, especially those found in Sumatra and Borneo, are some of the primary contributors of forest destruction where animals like orangutans live. When the forests are burned to make way for palm oil plantations, carbon dioxide is released into the atmosphere contributing to global warming.
- Walk or ride your bike whenever you can. You'll save on gas and it's good for you!
- Use your own cloth shopping bags to avoid using plastic or paper bags. Look for products made of recycled materials or that come from sustainable sources. Visit your local farmers' market and support local farmers.
- Check out green living tips on Louisville Metro's Office of Sustainability website (louisvilleky.gov/sustainability). Set up rain barrels in your garden, learn to compost or get involved in an innovative "Citizen Science" program headed by the new Institute for Healthy Air, Water and Soil in Louisville. You can even help monitor air quality using the "Egg" (instituteforhealthyairwaterandsoil.org).

The Louisville Zoo is your partner in conservation. Together, "we can better the bond between people and the planet." Visit louisvillezoo.org/education for information about zoo field trips, classes, camps, overnight programs, resources for parents and teachers, and more. You can find previous Guidebooks at louisvillezoo.org/BAH.

vanilla, black pepper, cinnamon, a wide variety of nuts, ginger and sugar cane.

The rainforests of the world also provide us with a wide variety of ecological benefits. They help produce a large part of the oxygen we breathe, as well as remove excess greenhouse gasses we generate, such as carbon dioxide (CO_2). Rainforests help prevent soil erosion and cool the areas where they grow. Forested areas help purify water and prevent flooding. As we've explained, the tropical rainforests of the world are extremely important to our planet. Conservation of these vital areas needs to be a goal for all of us, especially for potential Backyard Action Heroes like yourself.

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What is a Backyard Action Hero?

A Backyard Action Hero – or BAH as they are called – is a kid or adult who is really into wildlife and habitats and is ready to take action to protect them. They think being "green" is cool, and they know that to really make a difference they not only need to learn, but they also need to act! BAHs care about animals and habitats in their own backyards as well as all around the world.

The Louisville Zoo is a great place to learn about all kinds of plants and animals. Be sure to visit us and meet our animals and their keepers, our very own conservation heroes living right here in Kentucky.

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Present this coupon and receive

ONE FREE CHILD'S ADMISSION

With the purchase of one regular adult general admission to the Louisville Zoo.

Valid during regular Zoo hours. Not valid with other offers, for ticket packages, "The World's Largest Halloween Party!" or other after-hours events. One ticket per transaction. Expires 6/30/2015

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