

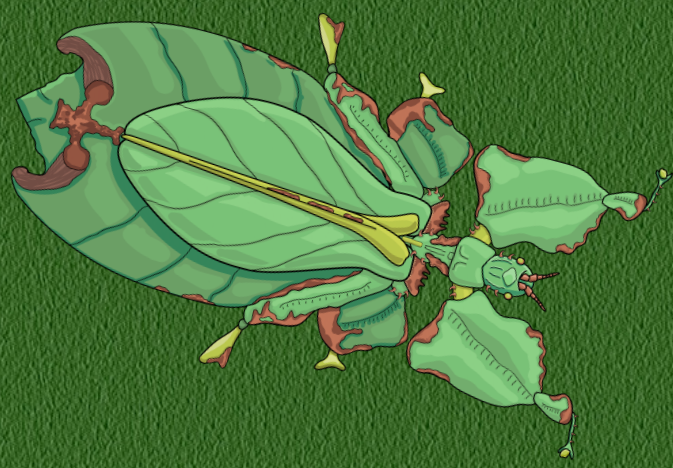


Expedition: INSECTS

Smithsonian 15,000 km



Smithsonian
Science Education Center



EXPEDITION: INSECTS



There are insects in every place on Earth. Some of them like the warmth of the Sun, and others live in the bitter cold. Some are very colorful, and some are not. Some make loud noises, and some are silent. Some eat other animals, and some eat only plants. There are so many kinds of insects that the scientists who study them, called entomologists, have not yet discovered all the types that exist in the world.

Even though there are millions of insects, all of them are the same in a few ways. Every insect's body is divided into three parts that are called segments. Every insect has three sets of legs and one pair of antennae. The most important thing that every insect has in common is a family history full of changes. Each insect species on Earth has changed slowly over time and continues to do so today. Many small changes in how insects look and behave have built up over millions of years. This means that compared to the generations that lived before them, some insects today are much bigger. Some are much smaller. Some have new body parts and some eat different foods. All these changes happened in a natural process we call evolution. Evolution makes future generations of insects better at surviving in the wild.

To get a sense of how insects live in nature, we are going on an expedition around the world with Smithsonian entomologists. We will travel to faraway places on several continents to find these creatures in their natural habitats. At the end of our travels, we'll have a field book full of our observations.

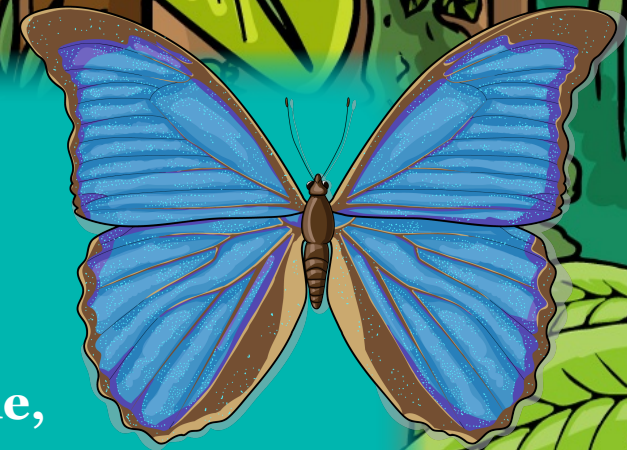
Here's where we'll go






BLUE MORPHO BUTTERFLY

We are in the rainforest in Costa Rica. Above us, a large butterfly flaps its wings and shimmers in the air. We watch as it flies toward us. On one side, the wings are bright, sparkling blue. On the other side, they are dark brown and have spots that look like eyes. When the butterfly lands, it brings its wings together above its body so that we only see the brown sides. When resting in this position, the butterfly's dark colors camouflage well among the dark plants of the forest. When it takes off, it suddenly looks intensely blue again, and as it flies, it can be seen from miles away. To us, it looks like the butterfly disappears as it lands and then reappears when it takes off a moment later.





The butterfly, called a Blue Morpho, has two colors on its wings for a reason. This insect—just like every other insect and animal in the world—tries to survive. If it lives long enough to mate and have offspring, many of its characteristics will be passed on to the next generation. One way to live longer is to avoid the predators that want to eat them. Because the butterflies seem to disappear when they land in the rainforest, predators have trouble tracking them and catching them.



We watch as the Blue Morpho rests on an old banana. It extends a long proboscis to drink the juice. It dips its legs in the juice, which have sensors on them that allow it to taste.



We take an even closer look at the upper side of the Blue Morpho butterfly's wings. The blue color is so intense that the wings look like they could be pieces of the sky. They also look very shiny. This powerful blue is different from colors we see in most other places in the world. Usually colorful objects have something inside them that produces the color. But in butterflies the color is not caused by anything that is inside the wings. It comes from the texture of the surface of the wings. Although they look smooth, they are

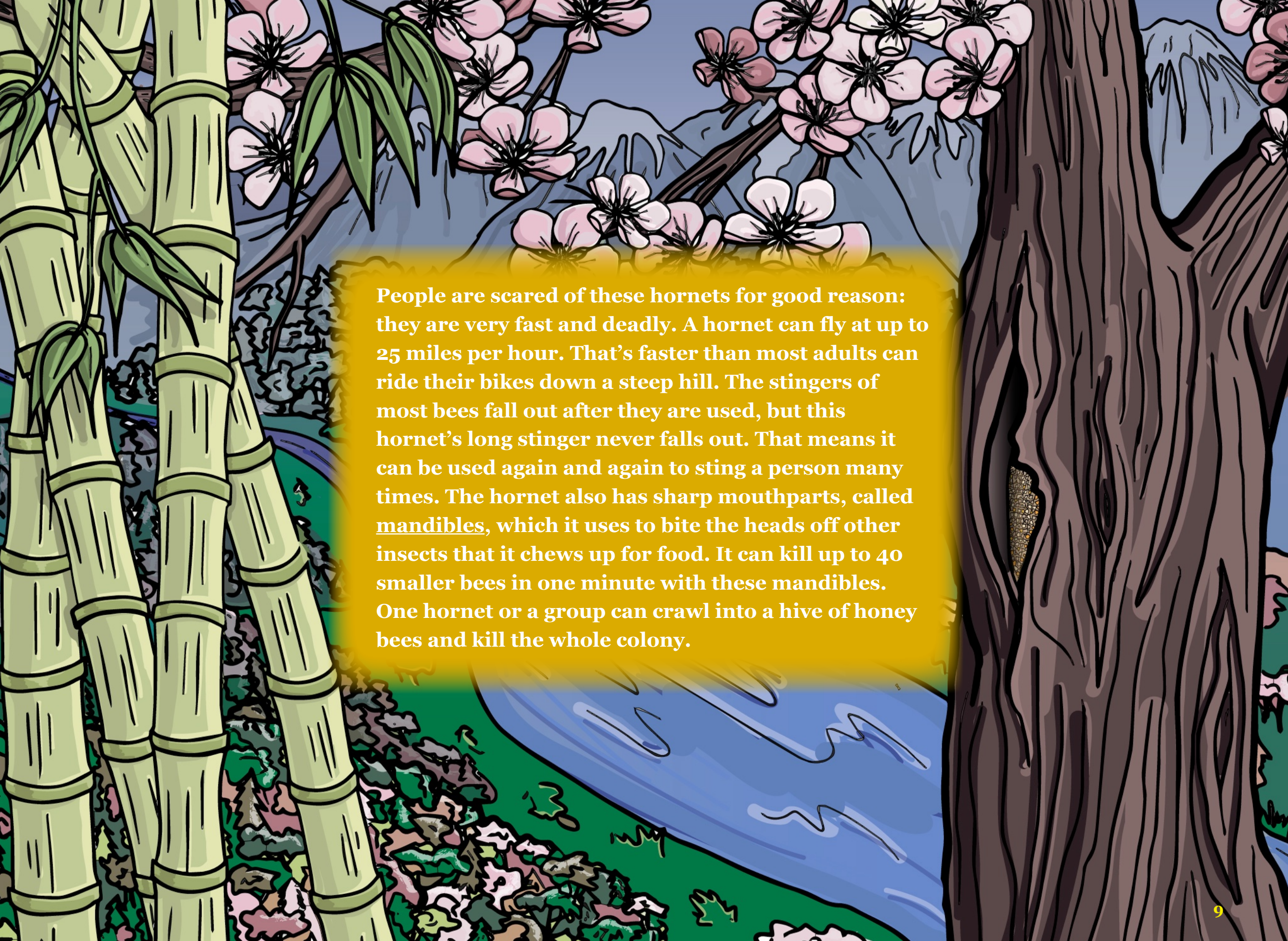
actually covered by millions of tiny scales. These overlap like rectangular tiles on a roof. The scales are set apart in such a precise way that they can bend and control light rays that come from the Sun. By controlling rays, the scales allow only pure blue light to shine from the wings. Color that is created by intricate texture is called structural color. Only a few other types of living things on Earth are able to make colors in this way.




ASIAN GIANT HORNET

Our expedition travels to Japan, where we are searching for the Asian giant hornet. We can't get too close because this hornet is huge and dangerous. Its body is almost as long as your pointer finger, and it has thick orange and black bands. Compared to many honey bees, it is more than twice as big. Many hornets live together in enormous nests of honeycomb. People who live alongside these insects in Asia are very afraid of them.






People are scared of these hornets for good reason: they are very fast and deadly. A hornet can fly at up to 25 miles per hour. That's faster than most adults can ride their bikes down a steep hill. The stingers of most bees fall out after they are used, but this hornet's long stinger never falls out. That means it can be used again and again to sting a person many times. The hornet also has sharp mouthparts, called mandibles, which it uses to bite the heads off other insects that it chews up for food. It can kill up to 40 smaller bees in one minute with these mandibles. One hornet or a group can crawl into a hive of honey bees and kill the whole colony.



Sometimes hornets succeed in killing honey bees. But some smaller bees are able to fight back. The Japanese honey bees have been dealing with the hornet predators for a long time, so they have evolved a defense. When a hornet crawls into their hive, about 500 little honey bees surround it. They form a buzzing ball around the hornet. Then they vibrate their wings, creating energy. With all that

activity, the hive starts getting hotter, and hotter, and hotter. When the hive is about 116°F (46.7°C), the trapped hornet can no longer survive. Although some of the small honey bees may have died from the heat as well, their colony as a whole can continue. This is how honey bees work together to defend their community.



Although the hornets are very aggressive, every year there are fewer and fewer of them flying around Asia. It seems strange that such powerful insects could be having trouble surviving in the wild. But human changes to their habitat have made it more difficult for hornets to find places to create their nests and live. The case of the hornets shows that human activity can impact even the strongest, mightiest of insects.

MALAYSIAN WALKING LEAF

Malaysia is a country just above the equator in Asia. The land is full of moist, green forests. As we stand in an opening between the trees, leaves rustle and sway in the wind. All of a sudden, a leaf on a blackberry bush appears to jump to life. It begins crawling along a branch! Confused, we look closer. We see that what we thought was a leaf is actually a large, green insect.

This insect is called the Malaysian walking leaf. It is wide, flat, and green, and its edges are brown and crumpled, just like a leaf. Because they camouflage themselves perfectly in the trees, it is almost impossible to spot these insects in the wild.

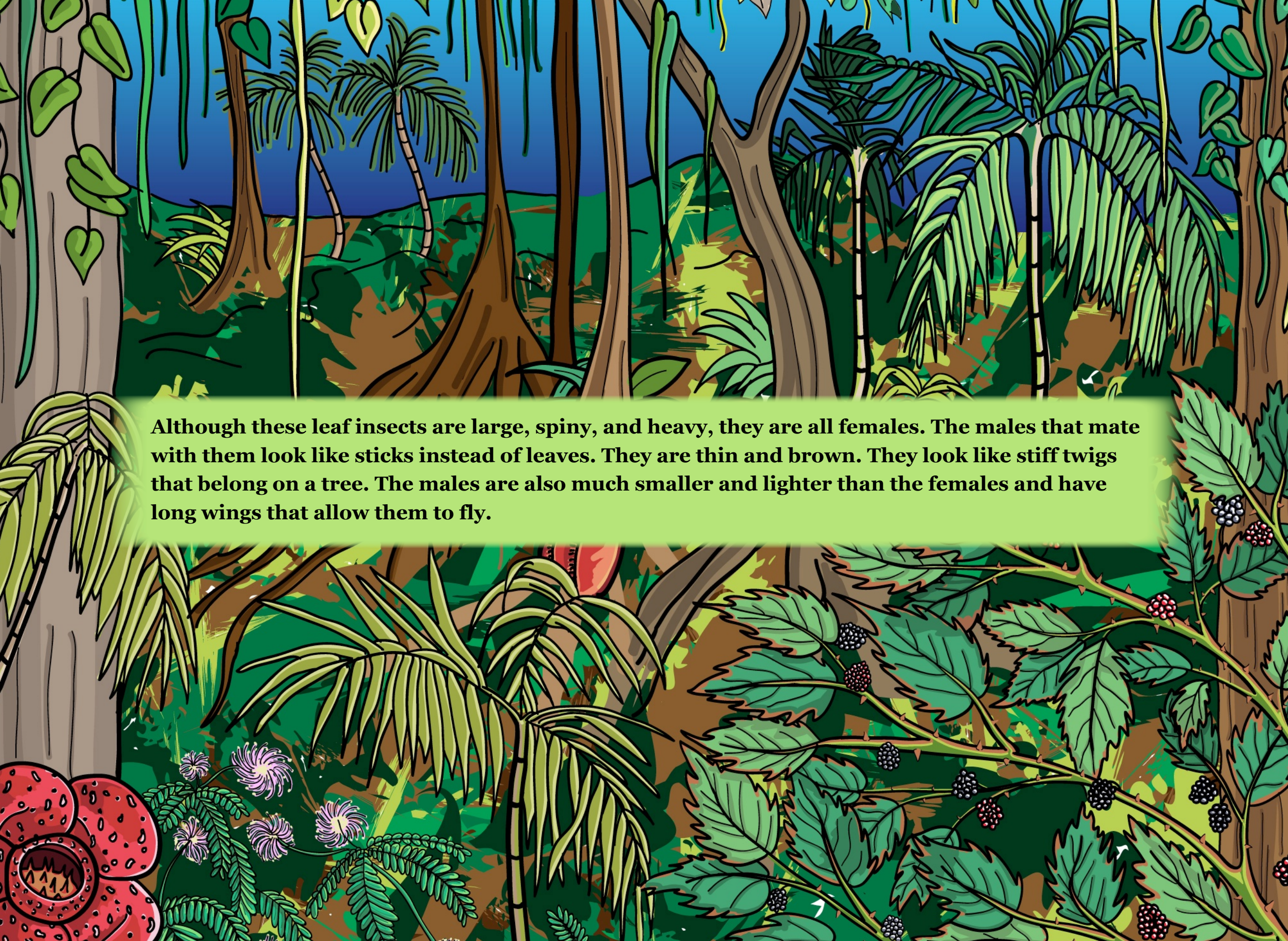




Although the insects look like leaves, they are not thin or flimsy. In fact, they are some of the heaviest insects in the world. Their thick, long bodies can weigh more than two ounces. That's about as much as five house keys. They have very short wings that are not powerful enough to lift their heavy bodies, so they can't fly. Unlike real leaves, the walking

leaves are good fighters. When a predator tries to sneak up behind it, the insect does a handstand, lifting its back end into the air. Then it brings its back two legs together with a loud *snap*. The legs have small spines on them that are sharp like thorns. By snapping together its back legs, the insect hurts other animals that try to catch it.





Although these leaf insects are large, spiny, and heavy, they are all females. The males that mate with them look like sticks instead of leaves. They are thin and brown. They look like stiff twigs that belong on a tree. The males are also much smaller and lighter than the females and have long wings that allow them to fly.

The Malaysian walking leaf insects look like the leaves and sticks in the forest where they live. But they don't have costumes or make-up to make them look this way. Instead, their bodies just grow like this. That's because the species has evolved over time to blend in better and better with the environment. Long ago, the individual insects that were a little greener and a little more leafy survived longer than others because it was

harder for predators to find them. Because they survived longer, they had more time to create more offspring. In every generation for thousands of years, the insects that could camouflage the best lived longest. Eventually, after many years, the Malaysian walking leaves evolved to camouflage themselves almost perfectly in the plants where they live. And that is how they survive.

Can you find the Malaysian Walking Leaf?



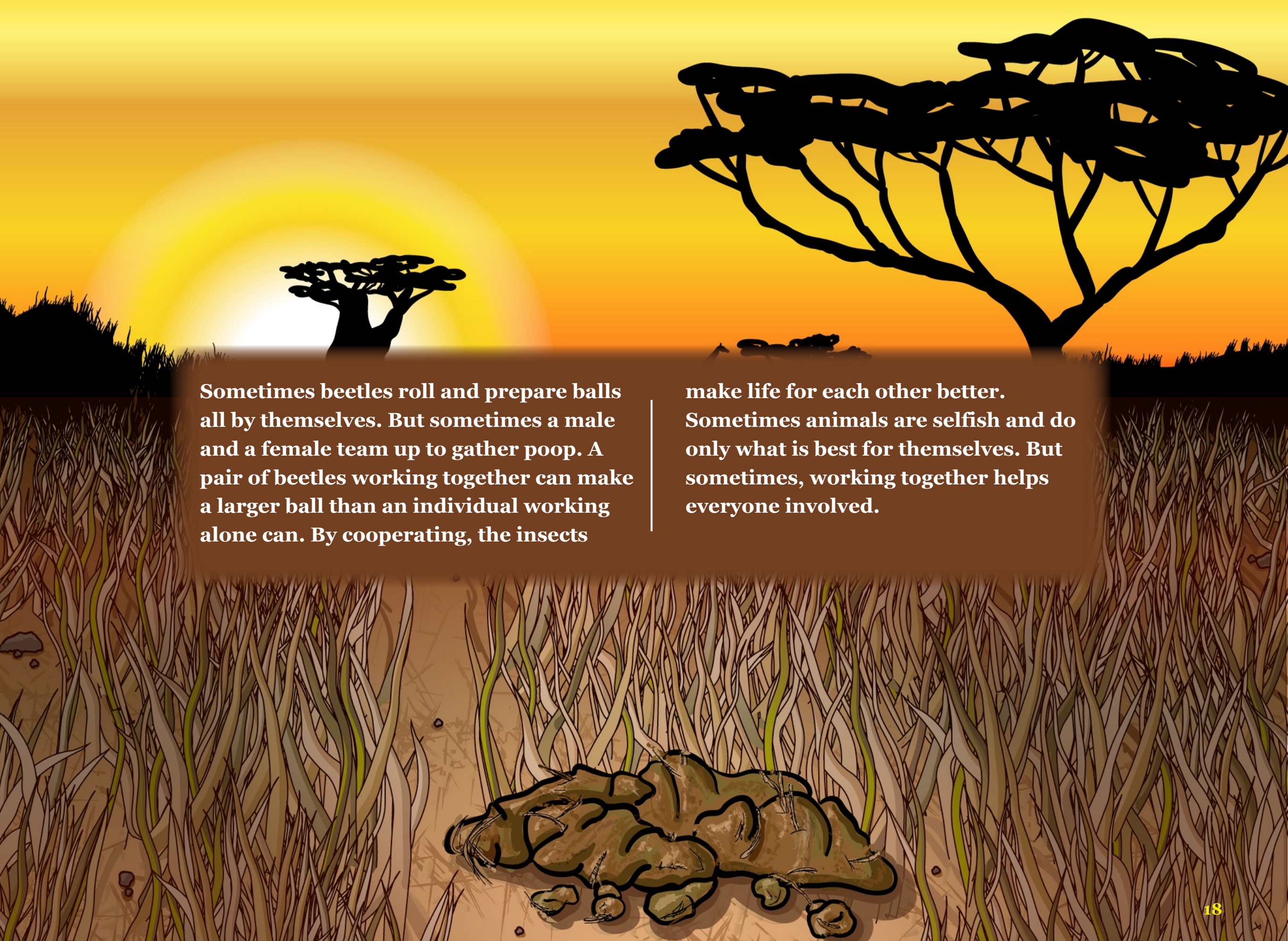
AFRICAN DUNG BEETLE

Now we are on an open plain in South Africa where many huge animals roam free. There are giraffes, zebras, rhinos, and wildebeest. All of these animals have something in common: they poop. From the perspective of a small black insect called the African dung beetle, this is a very good thing. That's because this dung beetle depends on the poop of larger animals in order to live. It eats poop, lays its eggs in poop, and spends a lot of time gathering poop into balls. To the big animals that discard it, the poop is just waste. But it is everything to the little black beetles.



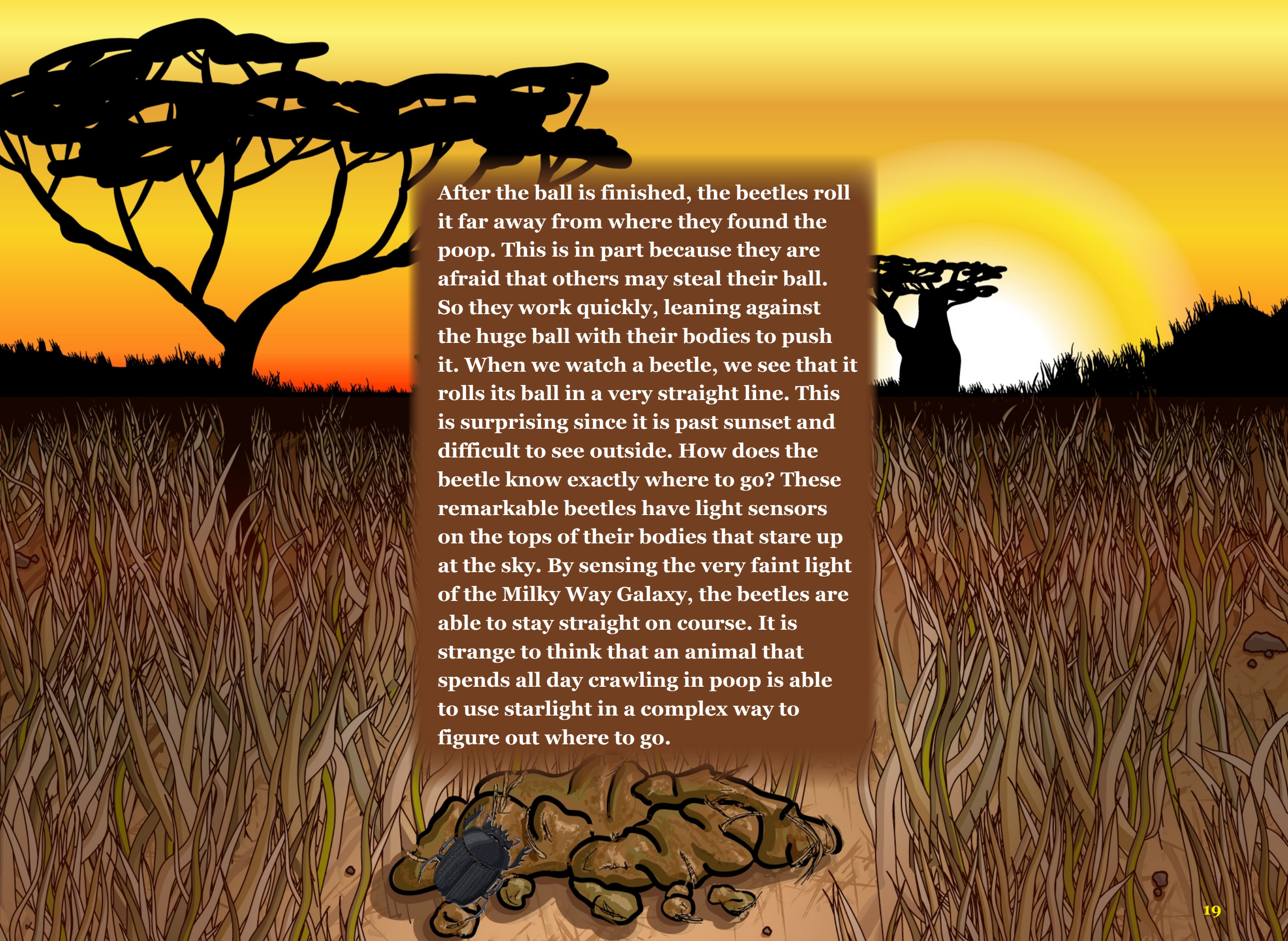
The African dung beetle works hard to roll poop into balls. It finds the poop on the ground where it was left by a larger animal like a giraffe. The beetle uses its arms and legs to gather the sticky stuff into a ball. When it is finished, the ball is bigger than the insect. The dung beetles use balls of poop for two main purposes. They use some balls as food. Other balls are for reproduction. The dung beetle lays an egg inside the poop and then buries the ball. The egg develops underground, and the young beetle grub eats the dung before crawling up to the surface.





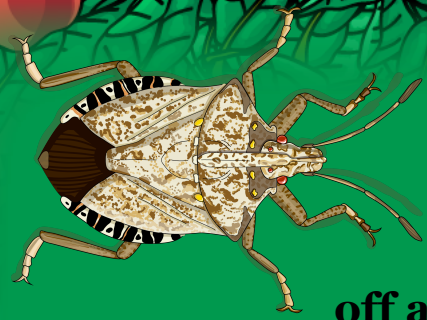
Sometimes beetles roll and prepare balls all by themselves. But sometimes a male and a female team up to gather poop. A pair of beetles working together can make a larger ball than an individual working alone can. By cooperating, the insects

make life for each other better. Sometimes animals are selfish and do only what is best for themselves. But sometimes, working together helps everyone involved.



After the ball is finished, the beetles roll it far away from where they found the poop. This is in part because they are afraid that others may steal their ball. So they work quickly, leaning against the huge ball with their bodies to push it. When we watch a beetle, we see that it rolls its ball in a very straight line. This is surprising since it is past sunset and difficult to see outside. How does the beetle know exactly where to go? These remarkable beetles have light sensors on the tops of their bodies that stare up at the sky. By sensing the very faint light of the Milky Way Galaxy, the beetles are able to stay straight on course. It is strange to think that an animal that spends all day crawling in poop is able to use starlight in a complex way to figure out where to go.

BROWN MARMORATED STINK BUG



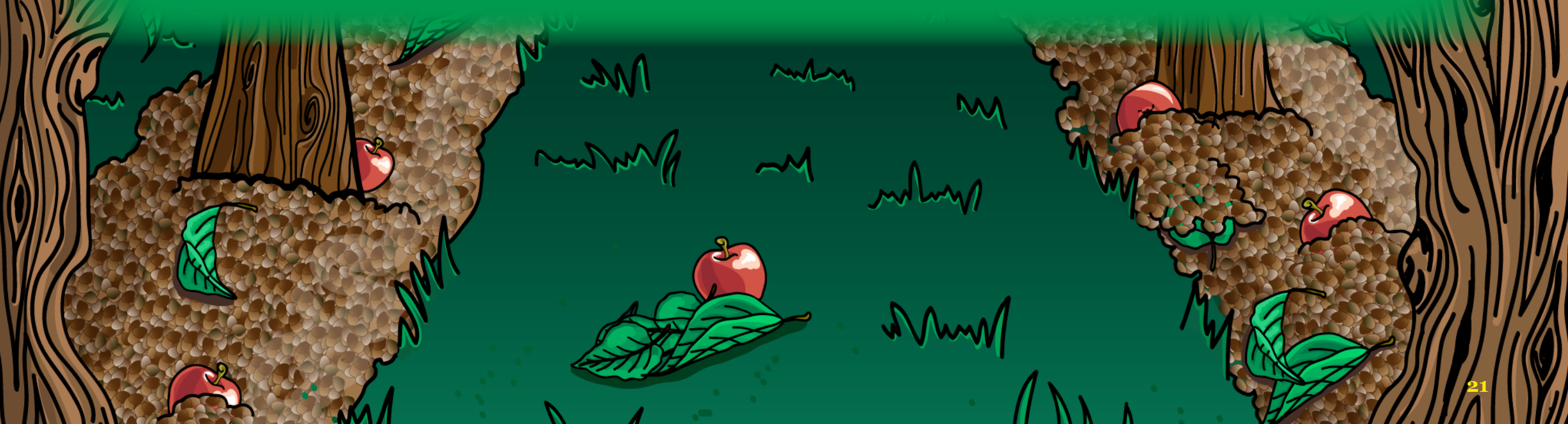
To find our next insect, we walk between rows of trees in an apple orchard in the United States. Small brown bugs crawl and fly everywhere. We pluck one off an apple hanging in a tree. The insect is less than an inch long. Its body is covered by a pattern of light lines, and it is shaped like a shield. These bugs, called brown marmorated stink bugs, live in orchards and fields during the spring and summer. When winter comes, they crawl by the thousands into buildings to avoid the cold. They creep in through spaces in door frames and chimneys. In most of the 50 states, people find stink bugs in their houses and on their properties all the time.

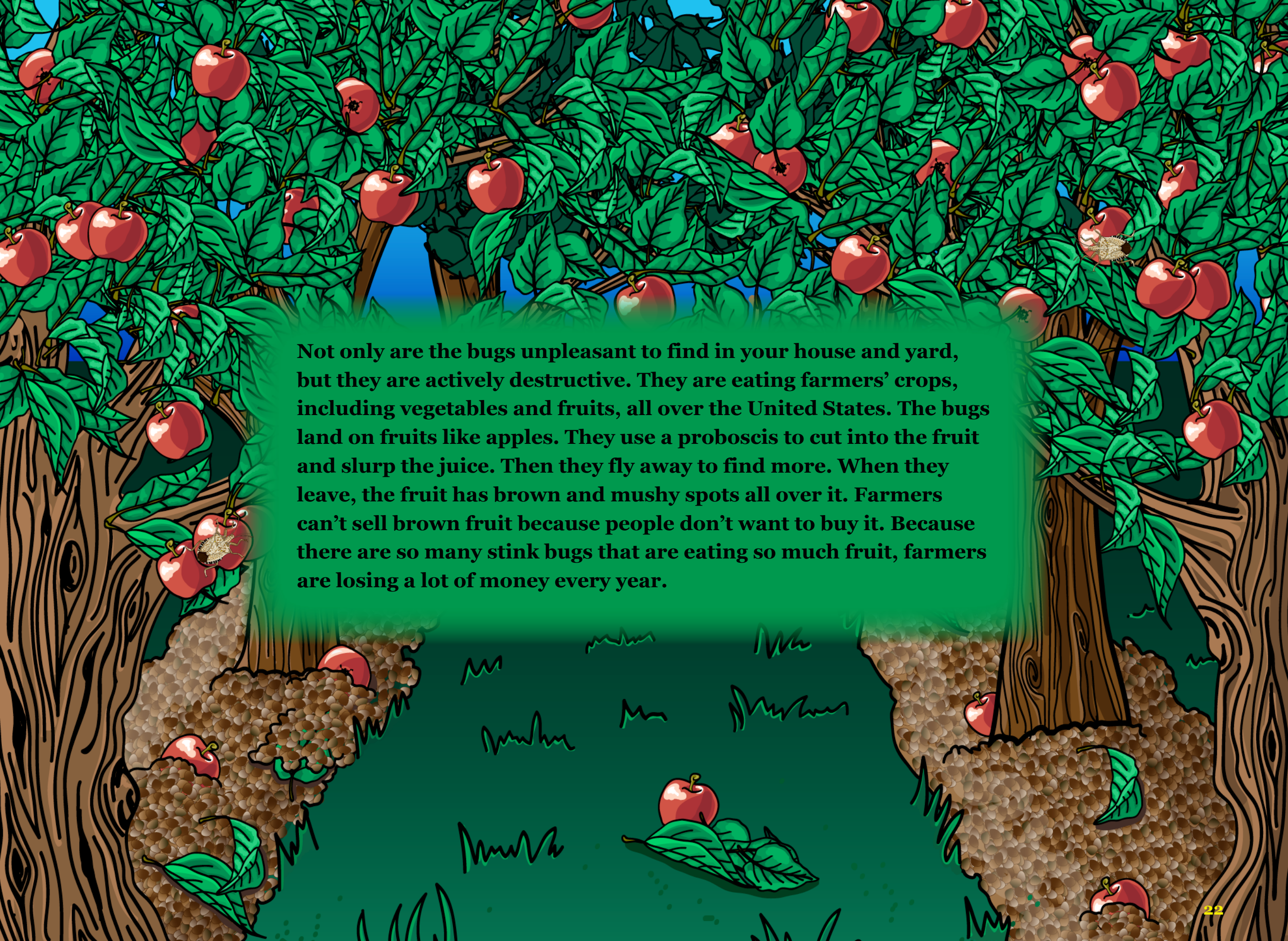




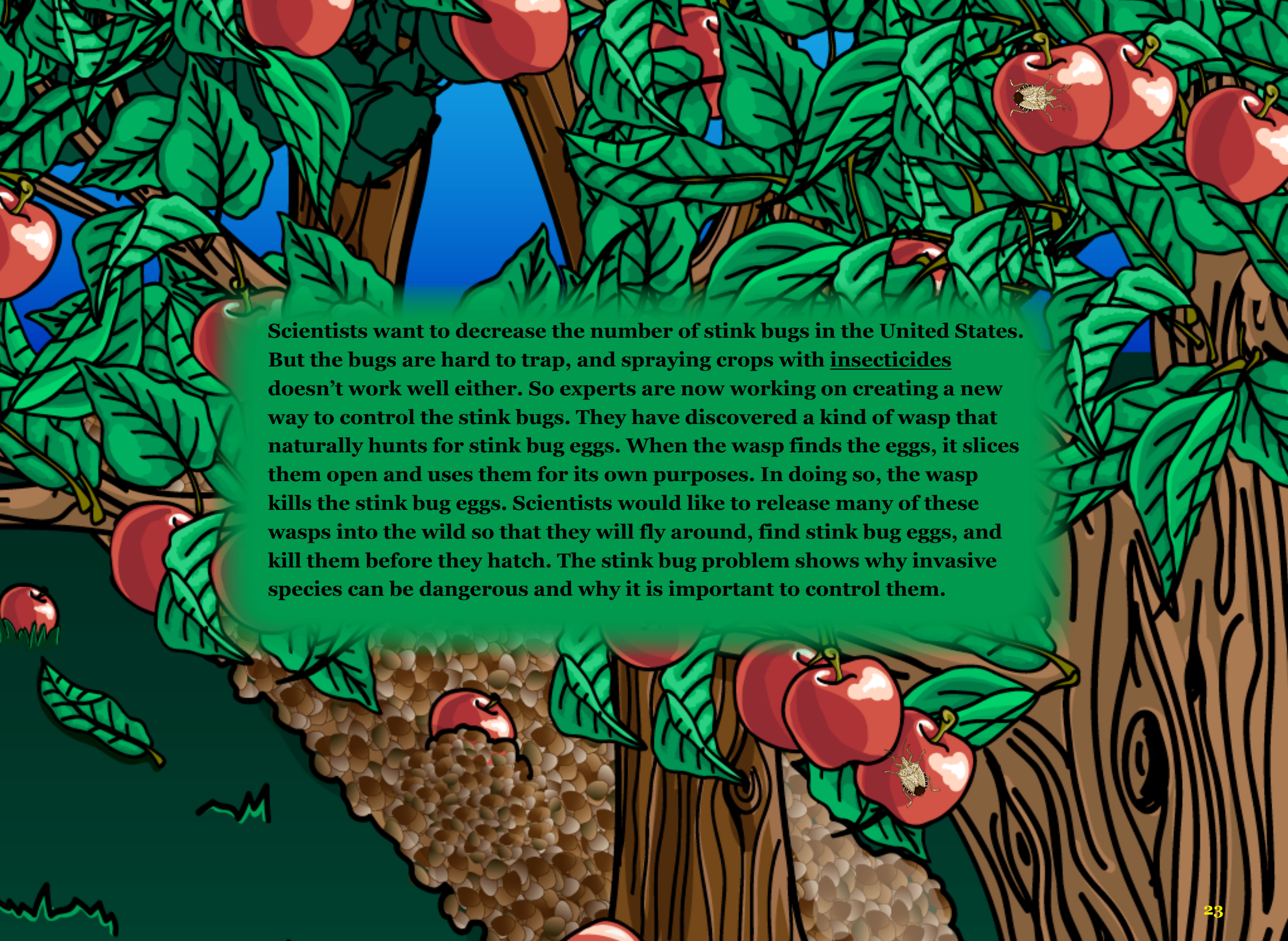
Although stink bugs don't sting or bite, they are a big problem for the United States. The problem starts with the fact that brown marmorated stink bugs are not native to America. Thirty years ago, they did not live anywhere on the continent. They lived only in Asia. But then a few stink bugs flew onto a boat that was setting sail for the United States. They survived the long ride and when

they reached America, the stink bugs made themselves at home. They mated quickly and had many, many offspring. They found a lot to eat in America and did not have to worry about many predators, so their population expanded. It is still growing and growing. Because the bug is not originally from North America and does not belong there, it is called an invasive species.





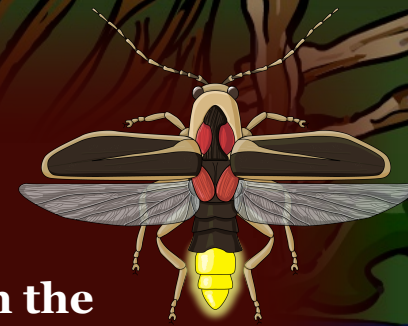
Not only are the bugs unpleasant to find in your house and yard, but they are actively destructive. They are eating farmers' crops, including vegetables and fruits, all over the United States. The bugs land on fruits like apples. They use a proboscis to cut into the fruit and slurp the juice. Then they fly away to find more. When they leave, the fruit has brown and mushy spots all over it. Farmers can't sell brown fruit because people don't want to buy it. Because there are so many stink bugs that are eating so much fruit, farmers are losing a lot of money every year.




Scientists want to decrease the number of stink bugs in the United States. But the bugs are hard to trap, and spraying crops with insecticides doesn't work well either. So experts are now working on creating a new way to control the stink bugs. They have discovered a kind of wasp that naturally hunts for stink bug eggs. When the wasp finds the eggs, it slices them open and uses them for its own purposes. In doing so, the wasp kills the stink bug eggs. Scientists would like to release many of these wasps into the wild so that they will fly around, find stink bug eggs, and kill them before they hatch. The stink bug problem shows why invasive species can be dangerous and why it is important to control them.


FIREFLY

We reach a house in eastern Canada that has a big backyard and a porch. It's a warm summer evening and the Sun is setting. We sit on the porch and gaze at the bushes, the plants, and the pond. As we watch, small yellow dots of light blink on and off in the air and on the leaves. They look like little holiday lights floating in the backyard, but they are actually living things that we call lightning bugs, or fireflies. Despite the name, they are not actually flies—they are beetles. We cup our hands gently around one and catch it. Its body is long and slender, and its back is mostly black. It has a red head with big black eyes at one end. The yellow light shines out of its other end. After inspecting the bug up close, we let it fly away from our palm so that it can get back to its business.

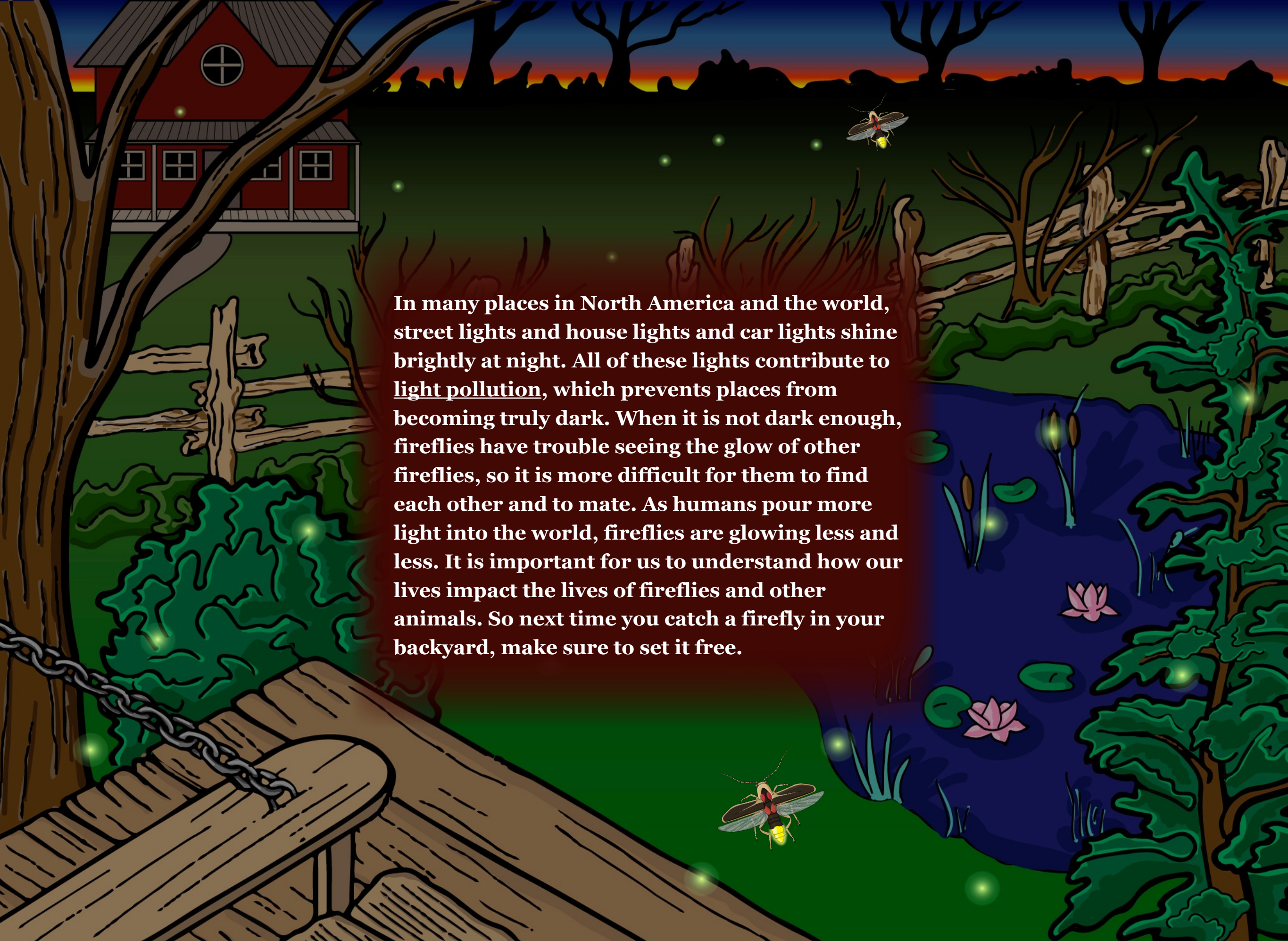




People can't make light without a lightbulb and electricity. But fireflies can make light using only what is hidden inside their tails. Inside each one there are a few specific ingredients. Each ingredient is a chemical, like oxygen or luciferin. To make the light, the firefly mixes these chemicals together so that they react. The beetle controls when the ingredients do and don't mix, so it can turn its light on and off like a light switch. Using chemicals to make light is called bioluminescence. Many fish in the oceans and mold in caves can also make light in this way. The beginning of that long word, "bio," is a root that means "living," and the middle of it, "lumin," means "light." Together, the word means "living light." And that's what fireflies are: living lights.

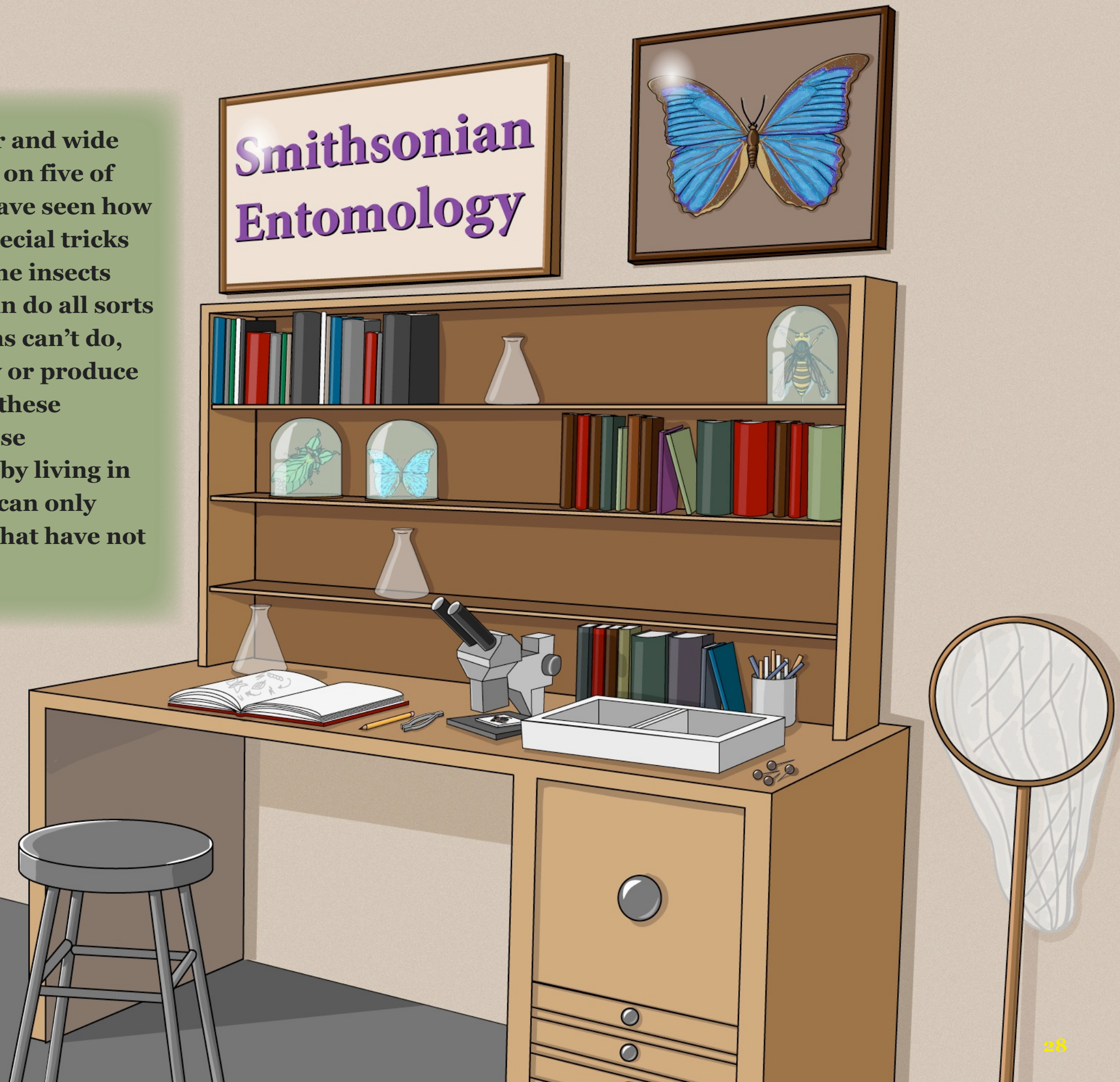


Although it is beautiful, the light that fireflies emit is not just for show. It is for communication, like an e-mail or a phone call from one beetle to another. A female firefly resting on the ground turns her light on and off to make a certain pattern of flashes. Male fireflies that belong to the same species as she does read the blinking pattern as a message, which says, “Come here! Come here!” By blinking their lights on and off, the females let males know where to find them. This allows them to mate and make another generation of fireflies.

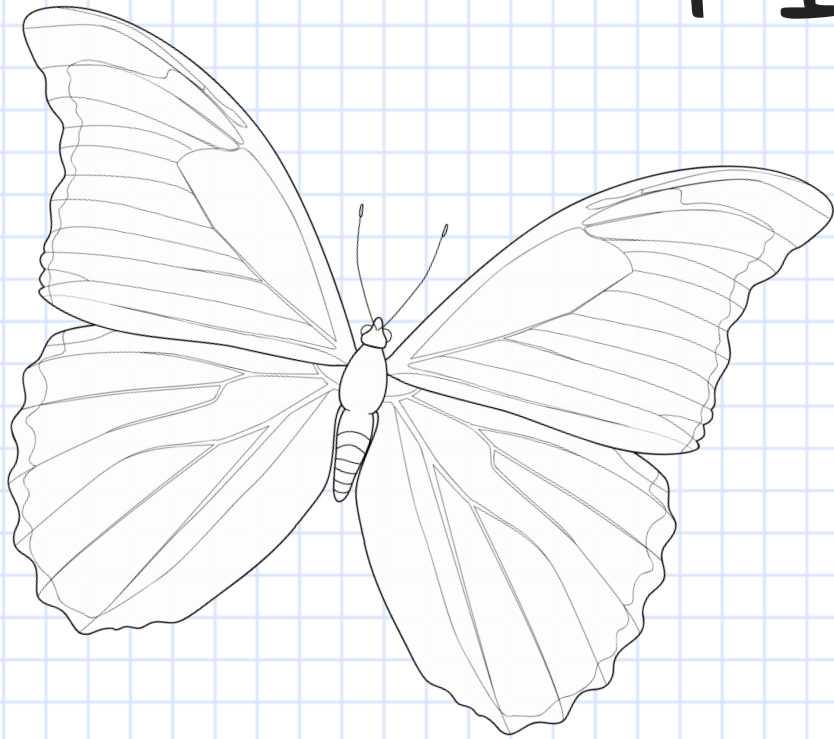


In many places in North America and the world, street lights and house lights and car lights shine brightly at night. All of these lights contribute to light pollution, which prevents places from becoming truly dark. When it is not dark enough, fireflies have trouble seeing the glow of other fireflies, so it is more difficult for them to find each other and to mate. As humans pour more light into the world, fireflies are glowing less and less. It is important for us to understand how our lives impact the lives of fireflies and other animals. So next time you catch a firefly in your backyard, make sure to set it free.

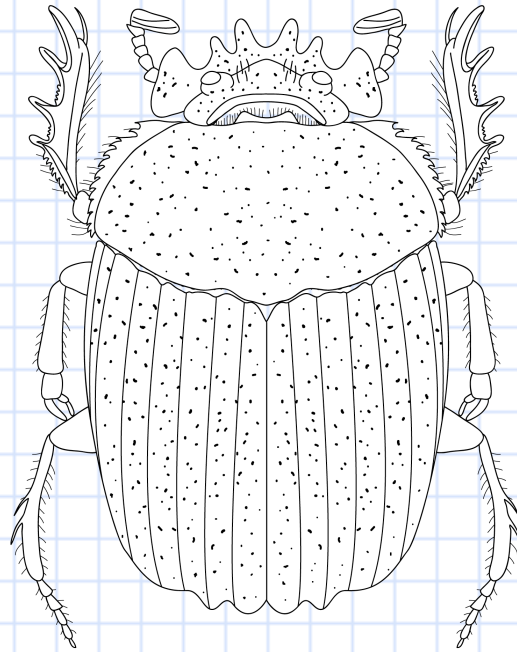
We have now traveled far and wide and we have seen insects on five of Earth's continents. We have seen how every kind has its own special tricks for living and thriving. The insects may be small, but they can do all sorts of amazing things humans can't do, like camouflage perfectly or produce light. We now know that these animals have evolved these remarkable abilities just by living in nature. Studying insects can only yield amazing new facts that have not yet been discovered.



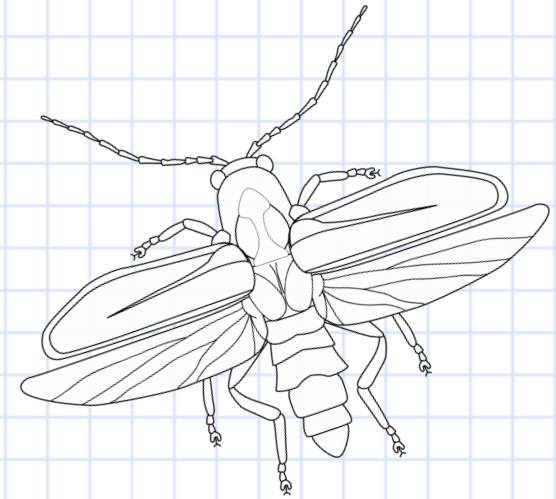
FIELD BOOK



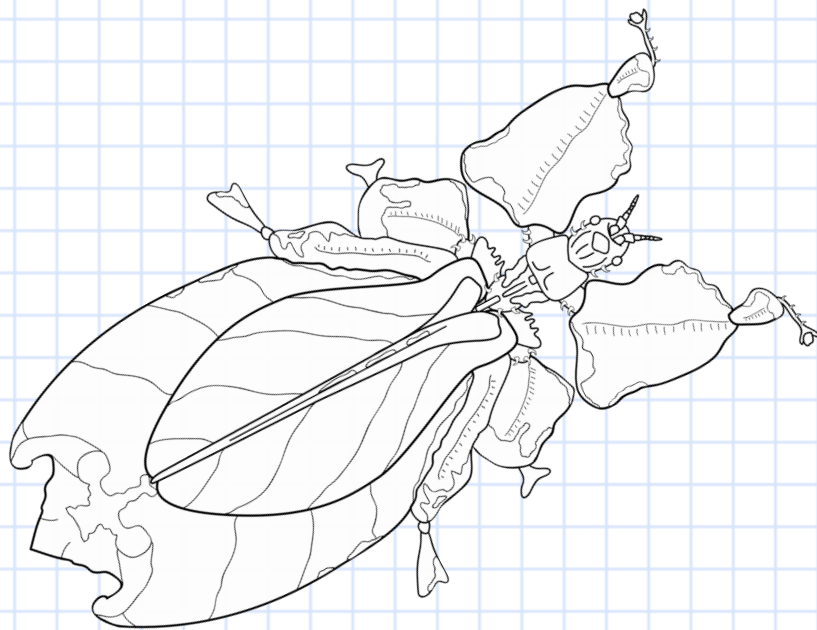
Blue Morpho Butterfly



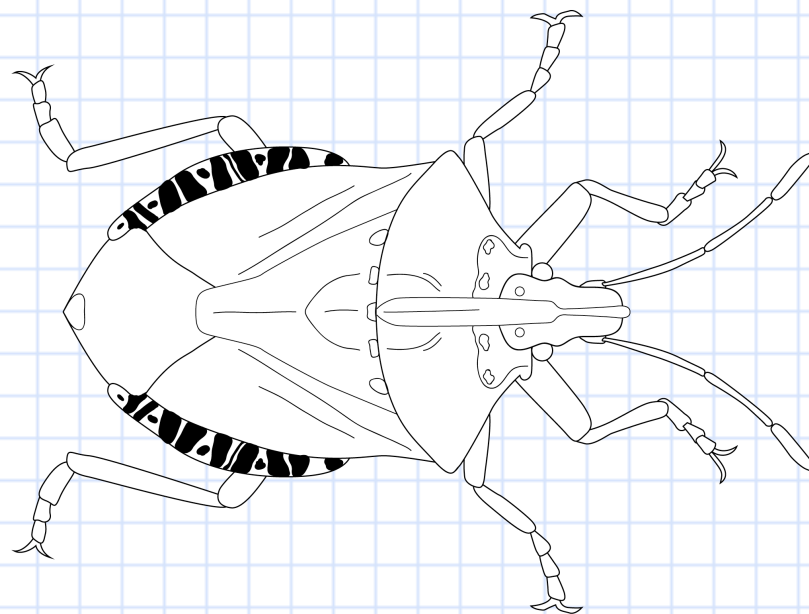
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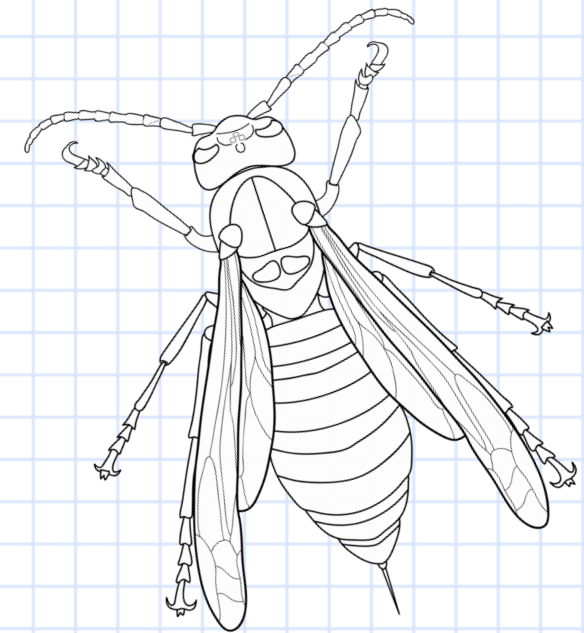
Firefly



Malaysian Walking Leaf

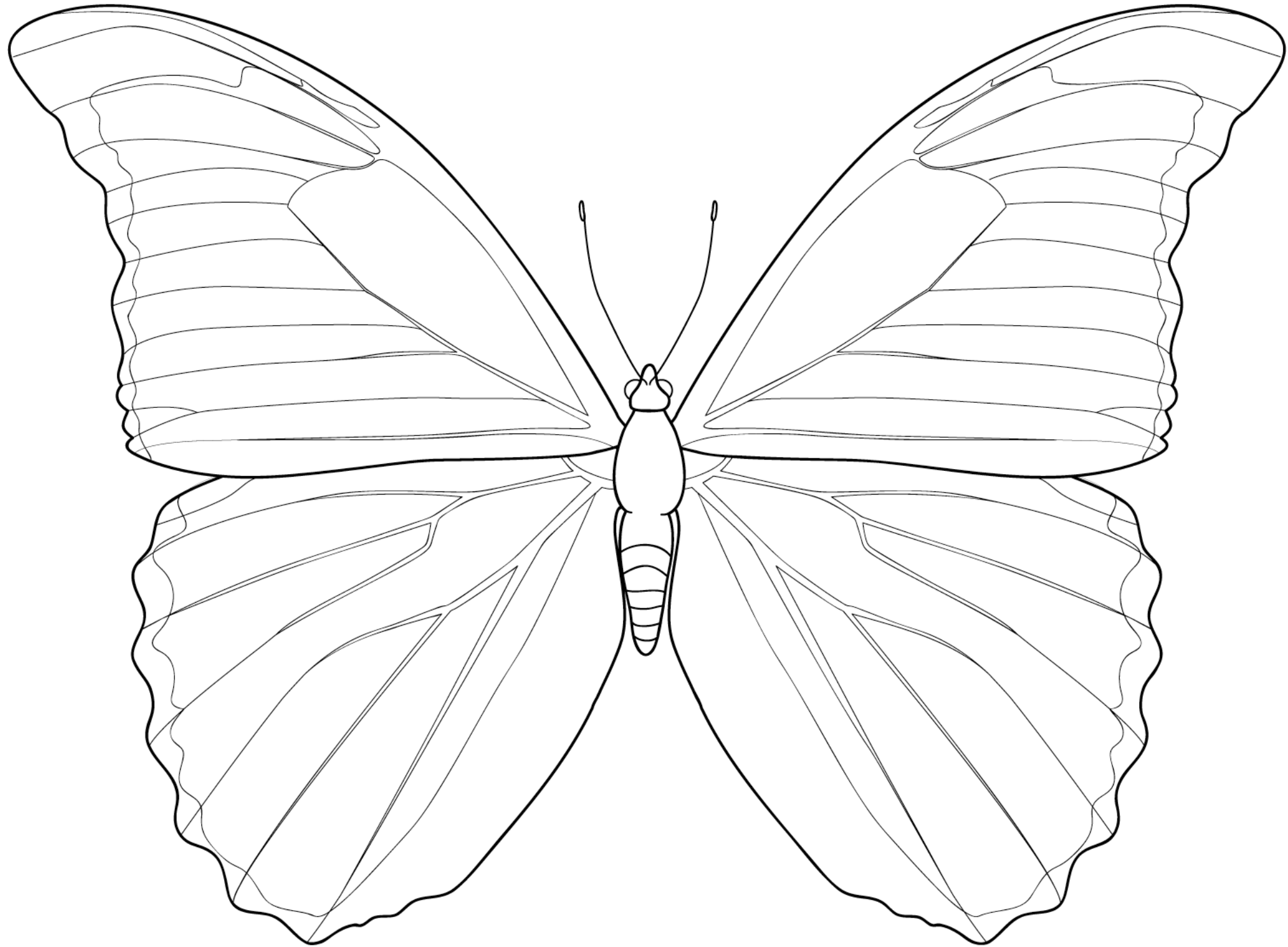


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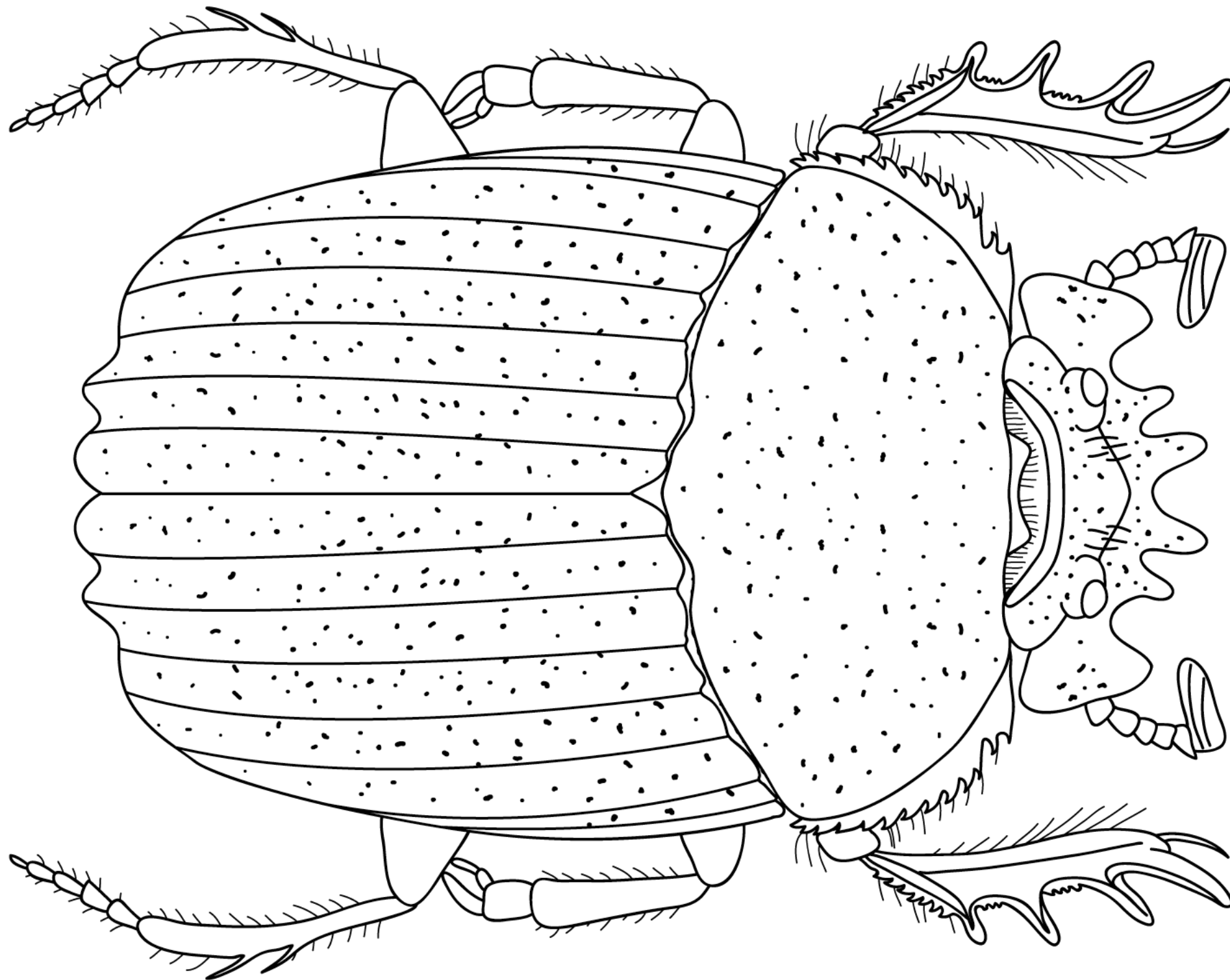


Asian Giant Hornet

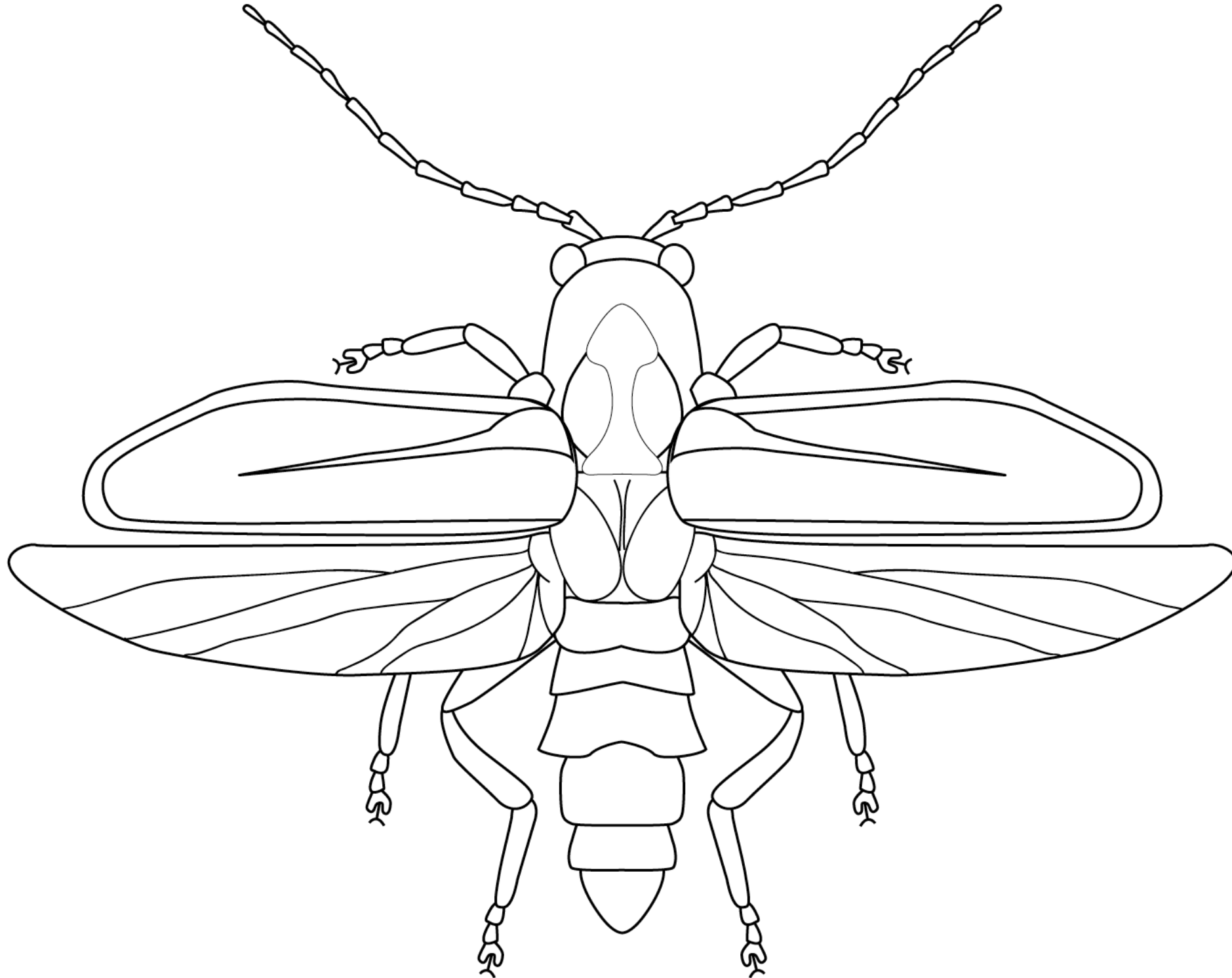
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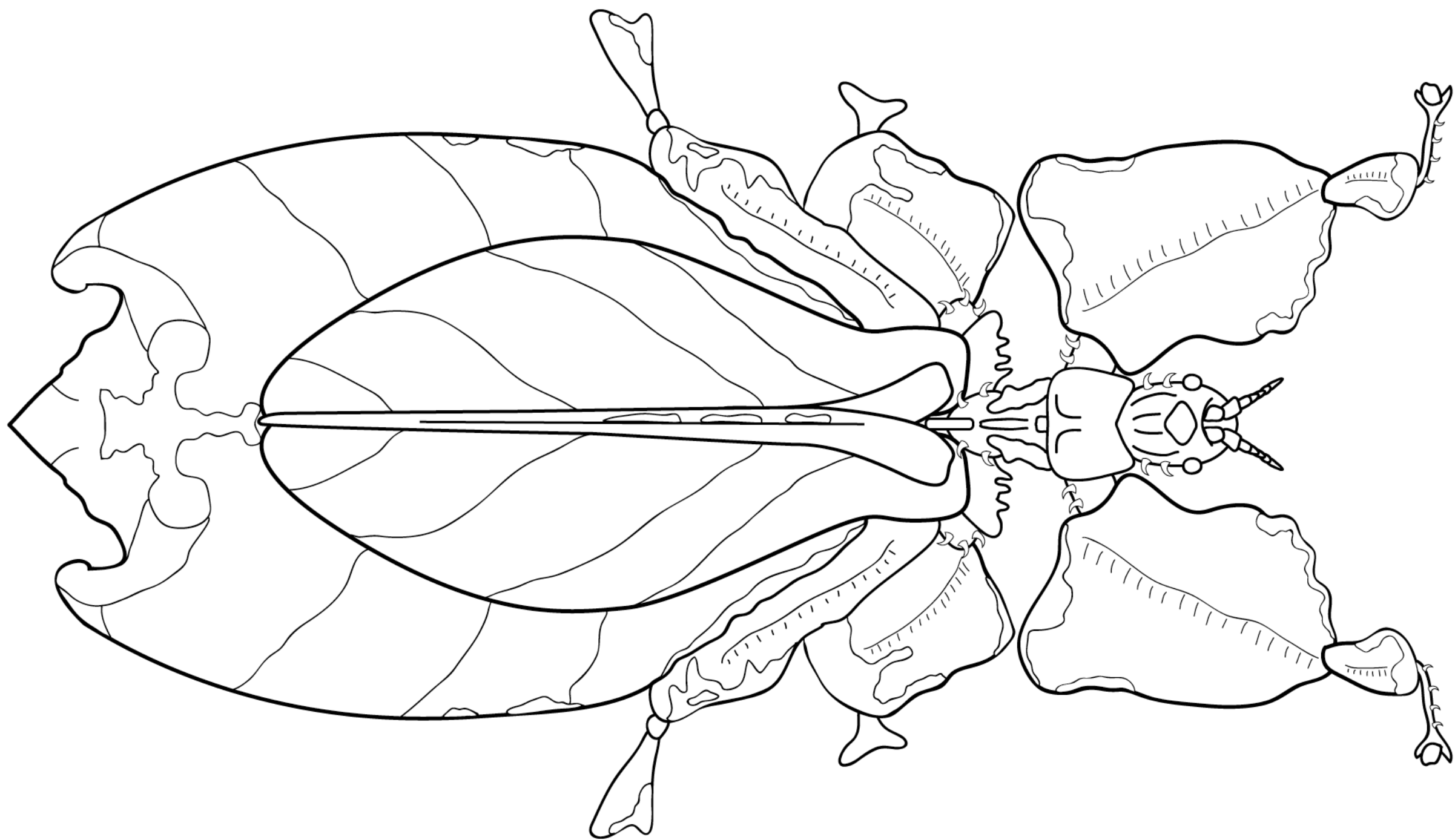
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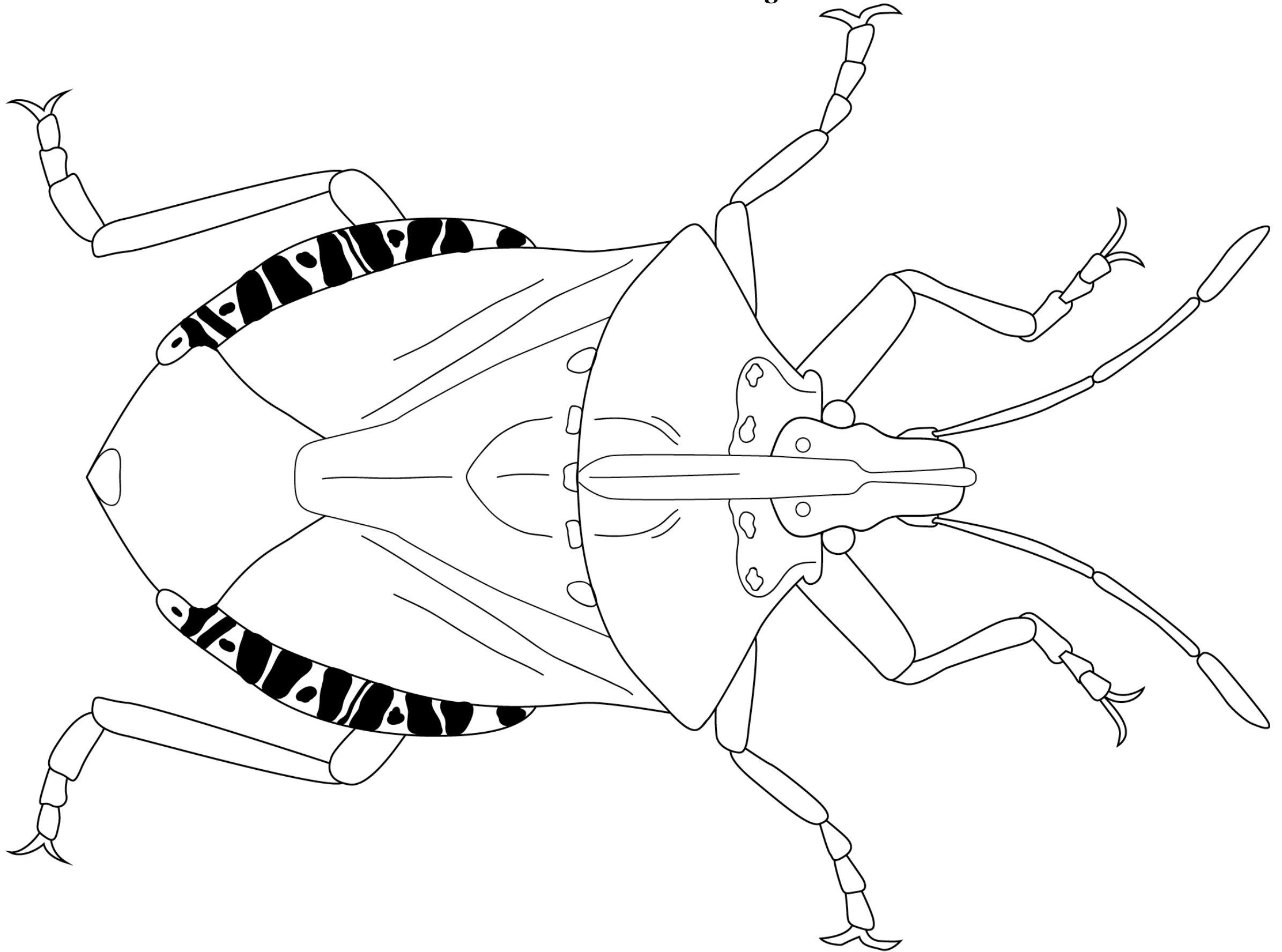
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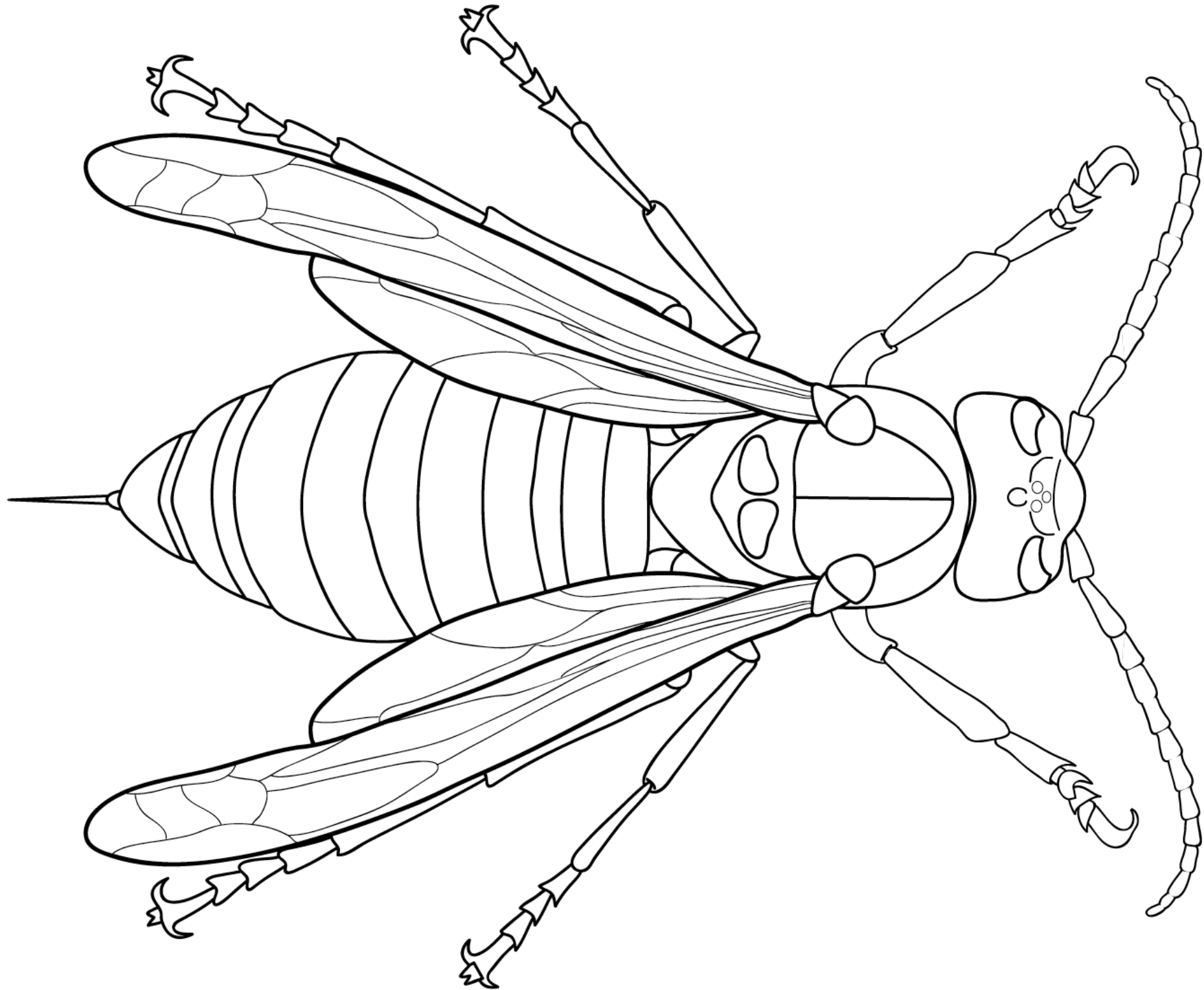
Malaysian Walking Leaf



Brown Marmorated Stink Bug



Asian Giant Hornet





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