

# GILA MONSTER

A SCIENCE · 3D ADVENTURE

MIDDLE SCHOOL



By MIKE HEITHAUS Ph.D

symbioeducation™

# KEY WORDS

ABIOTIC

ADAPTATION

BIOME

BIOTIC

CLIMATE

CONDUCTOR

ECTOTHERM

HABITAT

INSULATOR

MONSOON

PREDATOR

PREY

SOLITARY

SUCCESSION

WEATHER

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# AMAZING REPTILES

Lizards are an incredible group of reptiles. There are more than 5,000 species of lizards, and they can be found on every continent except for Antarctica. Lizards are found in diverse **biomes** and **habitats**, including forests, oceans, and deserts. Some lizards eat small **prey**, like ants and insects while others, like Komodo dragons, can eat huge prey. Many lizards are also prey for larger **predators**.



Common flying dragon



Fan-throated lizard



Thorny devil



Monitor lizard



Marine iguana

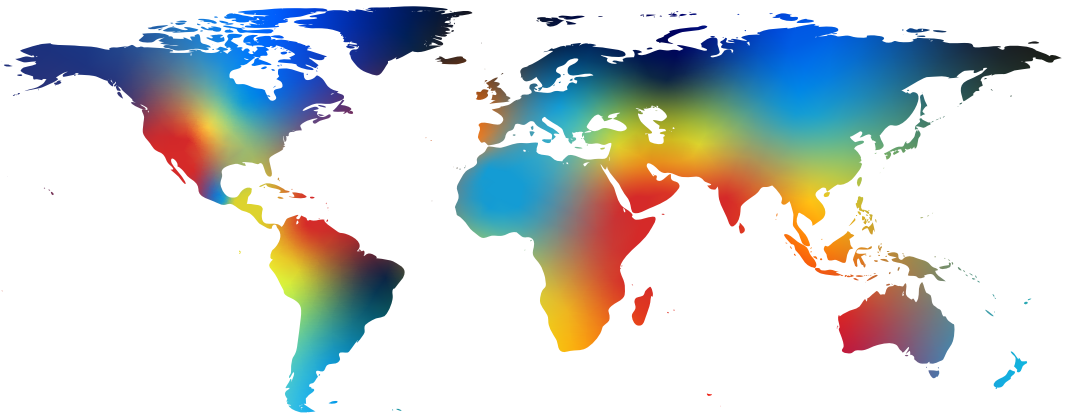


Emerald basilisk



Even though lizards are found on many continents, the number of species, the types of species, the size of populations and the growth of individuals isn't the same everywhere. The number of types of lizards and the size of their populations depend on many factors. Some contributing factors are biotic, such as the amount of available prey and different food sources. Other factors are abiotic, like the temperature, amount of rainfall, or number of places to find refuge.

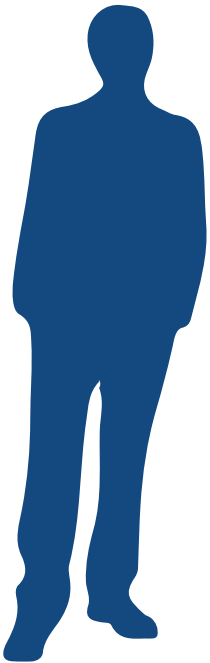
### LIZARD SPECIES RICHNESS



The number of lizard species is greater in warmer areas than cold ones. In the map above, the regions in red contain more lizard species than the regions in blue. Other factors, both biotic and abiotic, also influence the number of lizards in an area and the size of their populations.

# LIZARDS GREAT AND SMALL

Lizards range in size from very small – just a few centimeters long – to the truly monstrous Komodo dragon (*Varanus komodoensis*). Komodo dragons can weigh up to 70 kg (150 lbs) and grow to lengths of 3 m (10 ft). They can take down prey as large as deer and water buffalo. But Komodo dragons are tiny compared to the largest lizards that ever lived. No, not dinosaurs; they are not lizards! Mosasaurs were ocean-dwelling lizards during the Mesozoic era. The largest species found to date grew longer than 17 m (almost 60 ft). That's longer than a humpback whale!



PYGMY CHAMELEON



CAROLINA ANOLE



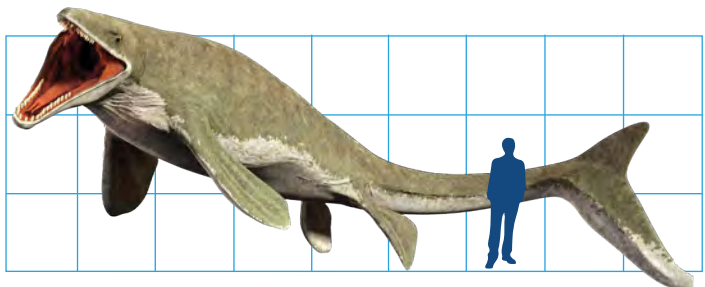
GREEN IGUANA



KOMODO DRAGON



MOSASAUR



# NOT A MONSTER

Today, the largest lizard living in the United States is the Gila monster (*Heloderma suspectum*). They grow to around 60 cm (about 2 ft) long and weigh less than 2 kg (around 4 lbs). They are the only venomous lizard native to the United States, which, along with their bizarre appearance, probably earned them the name “monster.” There are certainly plenty of myths about Gila monsters that fit their name. People have claimed that their breath is so bad that it could kill its prey or overcome a person. Others have said they have impenetrable armor and can spit venom. Some say that their bite is always fatal. It turns out that none of these are true, but Gila monsters are nonetheless incredible lizards.

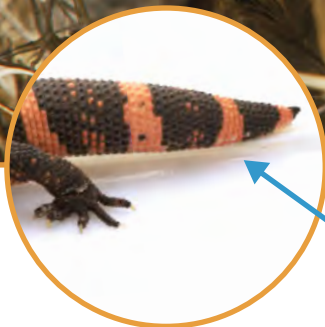


Gila monsters live in deserts of the southwestern United States and northwestern Mexico, including the Sonoran Desert. Many think that having venom makes it easy to survive, but Gila monsters live in very harsh environments. Finding enough food, water, and shelter can be a challenge. And to make matters worse, their home is changing. We’re going to study how Gila monsters survive in this extreme environment, but first, we need to know about these fantastic lizards and their desert home. Let’s start with the monsters.

# A GILA MONSTER MENU

Gila monsters are predators. They eat other animals including small mammals, birds, frogs, small lizards, and insects. Gila monsters are also scavengers, and they will happily eat dead animals.

Gila monsters' favorite foods are bird and reptile eggs. Sometimes these eggs are easy to find, but usually they are hidden. Gila monsters have a very good sense of smell that helps them find eggs. They use their long, sharp claws to dig into nests. Food can be scarce in the desert, but Gila monsters are adapted to survive for a long time without eating. In fact, they may only have to eat five to ten times each year. This is because when they do eat, they consume huge meals, providing enough energy to fuel their bodies for weeks.



Fat deposits in the tail can store enough energy to last months.





VENOM!

Gila monsters have very strong jaws and an impressive bite. When they bite their prey, they won't let go. This may help their venom flow into their prey through grooves in their teeth. But, Gila monsters mainly eat eggs and prey that are not very dangerous. Why would they produce venom if they don't need it to catch prey? Scientists think that Gila monsters use their venom to stay safe from predators. If Gila monsters aren't careful, they could become prey for coyotes or hawks. However, having venom makes Gila monsters a dangerous meal, and their colors help to advertise it.

Many animals that are poisonous or venomous have bright colors. These colors warn predators that they might get sick or get a nasty bite if they attack. Scientists think the bold colors of Gila monsters warn their predators that they are dangerous. When predators get close, it's hard to miss their bold orange and black color pattern.

Color isn't the Gila monsters' only warning signal. When they are threatened, they sometimes open their mouths and hiss. If a predator does grab them, Gila monsters are tough. The beadlike scales that cover their skin, called osteoderms, are actually tiny pieces of bone. Osteoderms help protect the lizard when a predator attacks and prevent them from getting scraped up when they squeeze under rocks or into burrows.

Gila monster venom is very potent. Their bites can be painful, but the venom could only kill an adult human in extremely rare circumstances. It may seem strange, but scientists are using Gila monster venom to *help* people! Many chemicals in nature can be used to make medicines. Scientists are studying the chemicals in Gila monster venom. One chemical found in Gila monster venom helped scientists create a treatment for diabetes. Other chemicals are being tested to see if they can help scientists create drugs to cure several different diseases.



## WHERE TO LIVE?

Gila monsters like to live in places where there is plenty of shelter. In fact, they spend most of their time in burrows or under rocks. They like these shelters because they are moist and prevent them from getting too hot. Gila monsters also lay their eggs underground, where hatchlings are most likely to survive.

Female Gila monsters usually lay between four and six eggs in the summer. They bury their eggs in the sand deep in a burrow and then walk away. The eggs hatch about four months later, but the young lizards stay underground for several months before they emerge. This keeps them safe from predators and other challenges they will face on the surface.

As soon as they hatch, baby Gila monsters can fend for themselves. They even have venom at this young age. It takes Gila monsters between three and five years to reach maturity. They can live for 20 years or more.

Gila monsters are usually **solitary**. That means that they live alone most of the time. Sometimes though, they will share burrows. Males fight each other during the mating season. These fights are usually wrestling matches instead of major battles. That way, neither male is likely to get hurt.





# SURVIVING THE DESERT

Life in the desert isn't easy. Gila monsters need to find enough food and water. During most of the year they have to worry about not getting too hot. But during the winter, they may need to keep from getting too cold. One way to survive is to find the right place to live. Gila monsters are only found in areas where there is enough water. If there isn't enough water for shrubs to grow, then there won't be enough water for Gila monsters to survive. Finding enough water in the desert may not be easy. There is no permanent source of water and there can be months between rainfalls. When it does rain, it is critical for Gila monsters to find puddles or small creeks for water.

Finding water is one reason that Gila monsters usually stay in the same place for many years. That way, they learn the locations of water sources. If the locations of good watering holes change, the Gila monster might have to move in order to survive. However, when they find water, they make the most of it. They can drink up to 25% of their body weight in water at one time. This would be like a person drinking around 19 L (5 gal) of water in one sitting. Gila monsters store the water in a special internal sac called a urinary bladder. It is like having a built-in canteen.





Even with a built-in canteen, Gila monsters can't lose too much water. Like other reptiles, they are **ectotherms** (cold-blooded). This means that their body temperature depends on the environment around them. They can only survive if their body temperature is within a certain range. How do they keep their bodies from getting too hot or too cold? The best way is to choose the right place to spend time. And the right place to be depends on how energy, in this case heat, moves through matter.

Most of the year, it is too hot for Gila monsters to be out in the sun during the day. It is cooler in the shade where the sun doesn't directly heat them, so the lizards stay under cover. They can also head underground. Dirt is a good **insulator**. That means that heat doesn't travel through it very well. The shade and the ground around the burrow keep the air in it cooler than it is above ground. Gila monsters take advantage of this, since surface temperatures soar above 30°C (100°F).

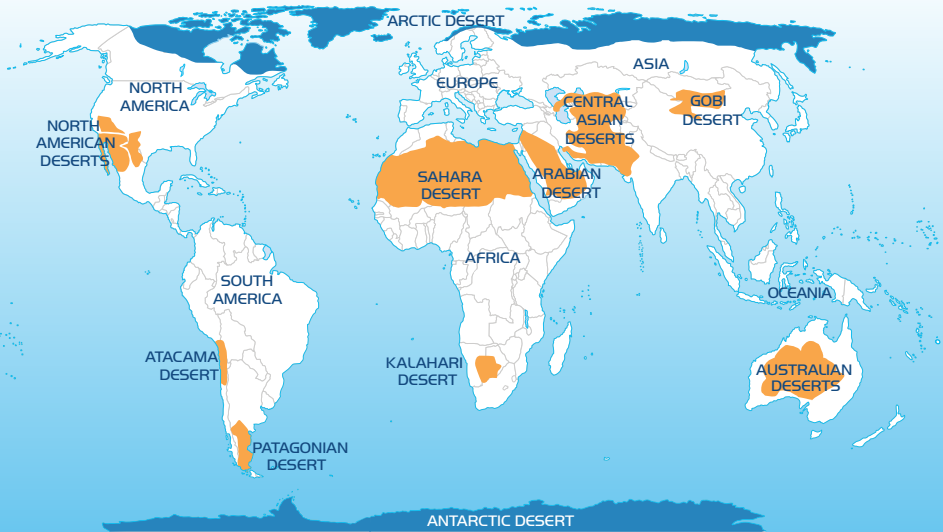
Gila monsters also change when they are active based on the temperature. When it is too hot during the day, they stay in their burrows and come out at dawn, dusk, or during the night. When it is cooler, Gila monsters need to warm their bodies up to be able to move around. To do this, they can bask in the sun. They can also sit on warm rocks. The rocks are **conductors** of heat. That means heat travels into objects, or organisms, so a Gila monster sitting on a rock during the day, gets heated from the sun on its back and the rock on its belly.



# DESERT CLIMATE

What kind of place do you imagine when you think of a desert? Is it somewhere very hot and very dry? This type of desert is a subtropical, or hot and dry desert. But, subtropical deserts are not the only type of desert. Deserts occur in other **climates** as well. All deserts have little precipitation. Some have almost no rain. But not all deserts are hot. Semiarid deserts have long, dry, summers. In the winter, there can be some rainfall, and it is cool. Coastal deserts have cool winters and warm summers. Cold deserts, like Antarctica, are cold all year long.

What determines the climate in a particular area? Why are deserts found where they are? Many factors determine climate. They include the amount of energy from the sun, gases in the atmosphere, how energy moves around the earth, the position relative to oceans, how oceans circulate, and the presence of mountains.



The colored portions of the map are deserts around the world.  
Cold deserts are shown in blue.

# IS IT WEATHER OR CLIMATE?

Many people confuse weather and climate. Weather is the short-term conditions in the atmosphere that normally last for hours or days. When people talk about today's temperature, humidity, clouds, fog, or precipitation, they're referring to the weather.

## WEATHER



8 AM  
15°C/59°F



2 PM  
22°C/72°F



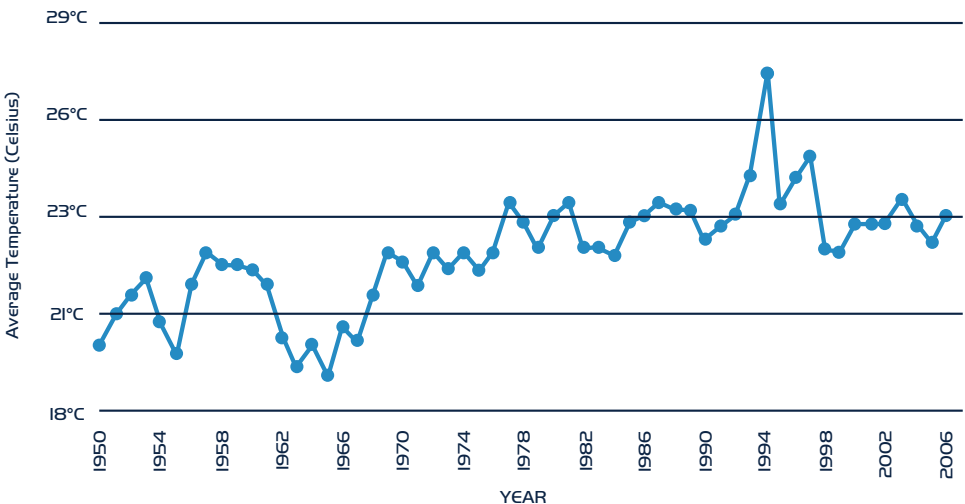
6 PM  
20°C/68°F



11 PM  
12°C/54°F

Climate is the average weather conditions over a long time period, like decades. Two important parts of climate are seasonal patterns of average rainfall and average temperature.

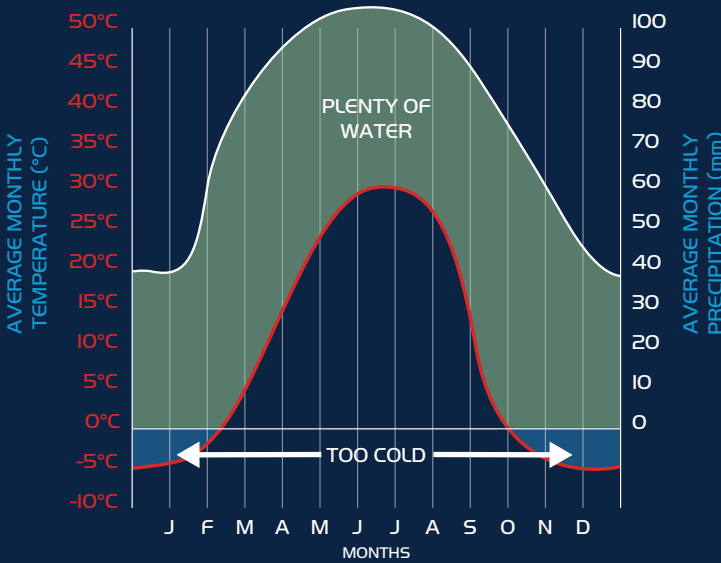
## AVERAGE TEMPERATURE IN TUCSON, ARIZONA FROM 1950 - 2006



# WHAT IS YOUR CLIMATE?

Climate diagrams show monthly average precipitation and temperature which can help identify biomes. The diagrams here are from a deciduous forest in the northeast United States and in Tucson, Arizona.

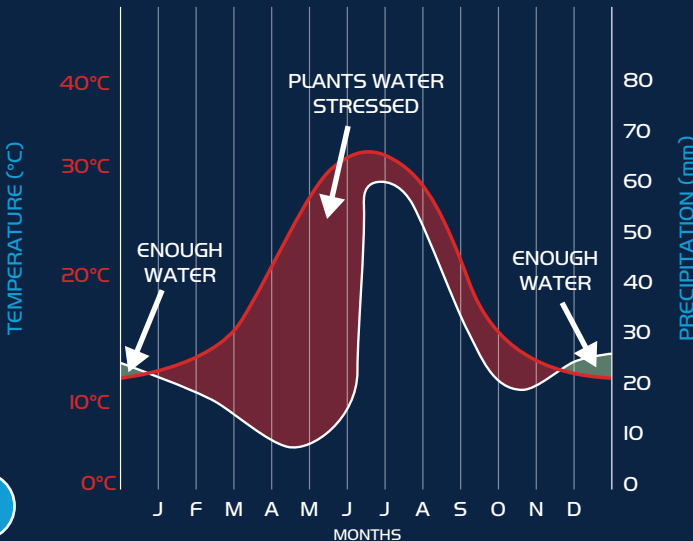
What do you notice about the temperature? What about the rainfall? Can you predict what the graphs might look like in a tropical rainforest?



Climate graph for a deciduous forest.

The times of year when plants have enough water are shaded in green (when the curve for rainfall is above the curve for temperature).

The times shaded in blue indicate it is too cold for plants (Below 0°C).



Climate graph for the desert in Tucson, Arizona.

Times of year when plants have enough water are shaded in green and times when there is water stress are shaded in red (when curve for rainfall is below curve for temperature).



# WORLD OF CHANGE

When people see a desert or another natural ecosystem, they sometimes assume they are ancient and unchanging. But, ecosystems change and so does the climate. In fact, ecosystems can change quickly. After a fire or an agricultural field is abandoned, new plants begin to grow. And slowly, animals return to the area. Over a few hundred years, a forest may be in an area that was once just soil. This process of change is called **succession**. Even the newest land on earth, lava flows, are eventually colonized by small plants. The roots of the plants break down the rock, which creates soil. It may take thousands of years, but eventually an entire ecosystem can develop.



When an old field is abandoned, it slowly changes as new species appear and some disappear.

Other changes in ecosystems can take hundreds of thousands or even millions of years. Some of these very slow changes are the result of climate changes. When temperatures and the amount of rain or snow changes, some plants may flourish, and others may go extinct. Some populations adapt to the new conditions while others do not. Organisms preserved in fossil records can give scientists clues about how climates have changed. What was once a tropical swamp millions of years ago may now be a desert. The Sonoran Desert was once home to huge dinosaurs. The fact that huge dinosaurs could have never survived in a desert environment is a clue that the Sonoran Desert used to have a very different ecosystem.

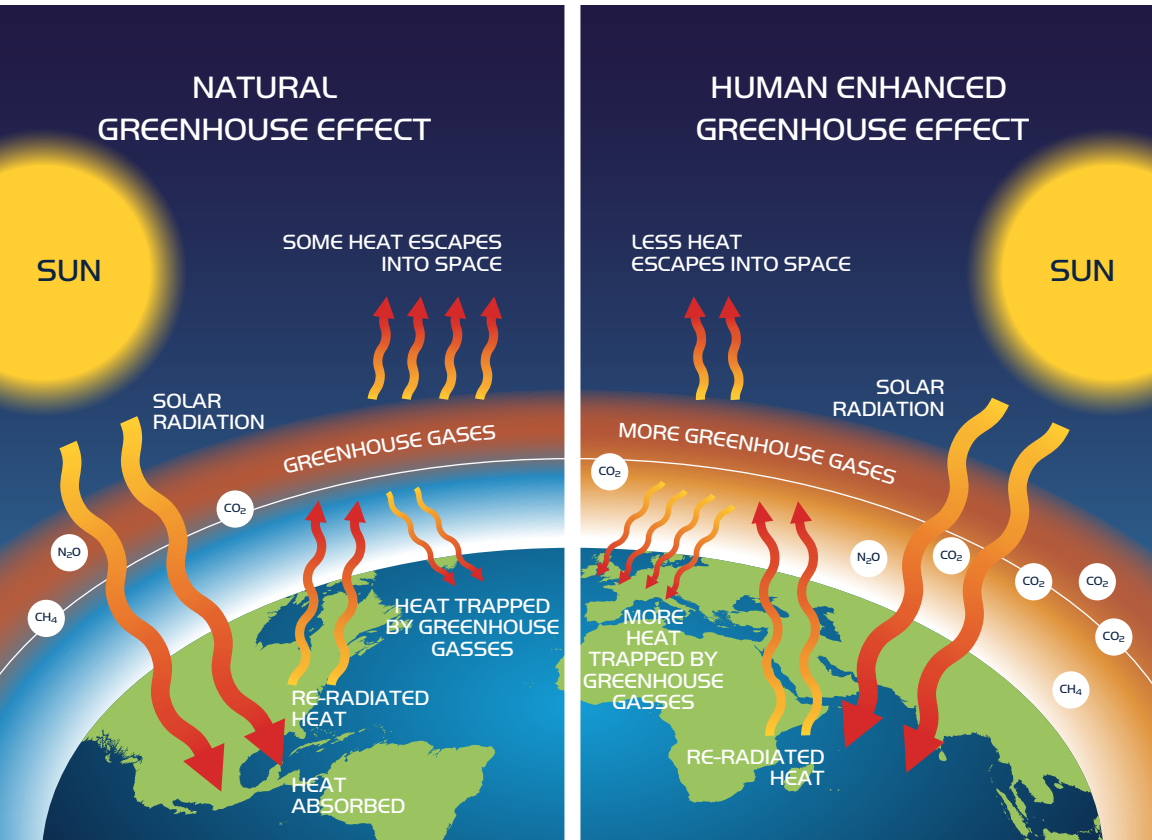


**Dr. Debbie Colodner is a geologist at the Arizona-Sonora Desert Museum. She is holding a vertebrae from a dinosaur found in a rock layer in the Sonoran Desert!**

# CLIMATE CHANGE

Why does the climate change? Over the history of the earth, movement of continents and major volcanic eruptions have caused large changes in climate. These changes have both wide-scale consequences for the planet and more local effects.

Today, the speed of climate change is very fast compared to the past. This is because humans are contributing to increases in the amount of carbon dioxide in the atmosphere. Having some carbon dioxide in the atmosphere is normal. In fact, without it, Earth would be too cold for life. Here's how it works:



**Too much carbon dioxide has negative impacts. Excess amounts of carbon dioxide in the atmosphere leads to the greenhouse effect and more trapped heat.**



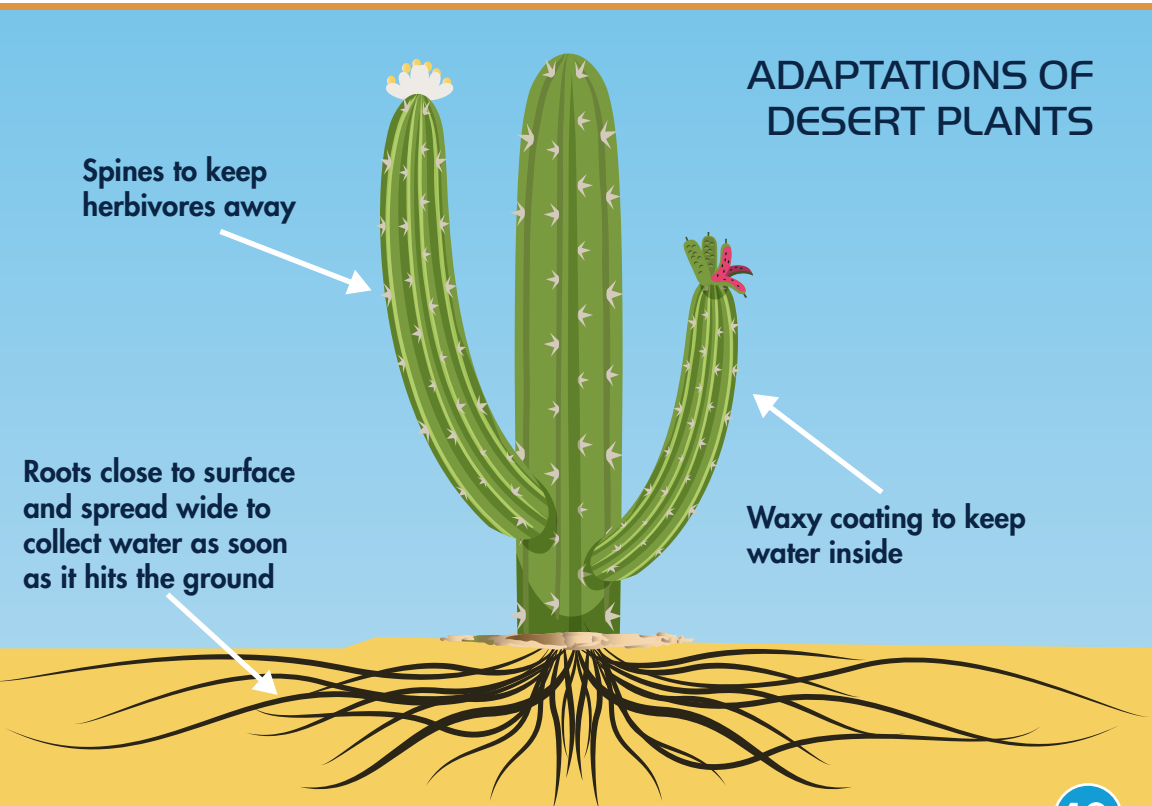
The changing climate is a challenge to organisms all over the planet, including Gila monsters. Gila monsters may face direct threats from a changing climate, like increased temperatures and lack of water. Other effects might be indirect, such as changes in the rest of the food web, including plants or organisms that eat them.





# PROVIDING A BASE

They may not look like much at times, but the plants of the desert are critical. They harness energy from the sun and take matter from their environment (carbon dioxide from the air, and water and nutrients from the soil) to create energy and build their bodies. Without the plants, there would be no usable matter for animals to survive. Some of the plants of the Sonoran Desert, like the saguaro cactus, are truly impressive. All plants have body systems that have to work together to produce energy, grow, survive, and reproduce. Most plants couldn't survive in the desert. The plants in the Sonoran Desert may have the same basic systems as other plants, but they have special **adaptations** that help them survive and reproduce in desert environments. In hot and dry deserts, saving water is especially critical.



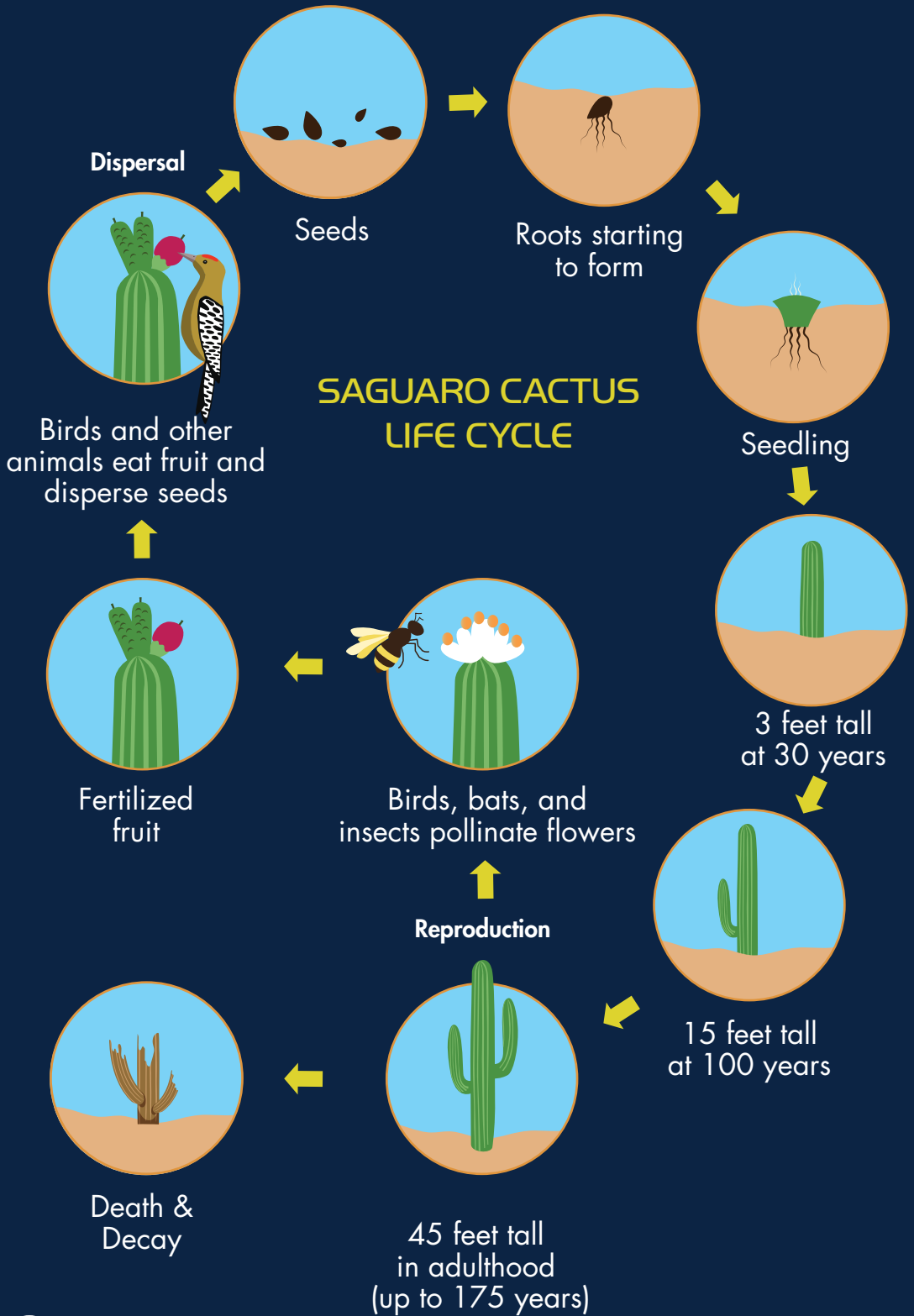
## ADAPTATIONS OF DESERT PLANTS

Spines to keep herbivores away

Roots close to surface and spread wide to collect water as soon as it hits the ground

Waxy coating to keep water inside

# SAGUARO CACTUS LIFE CYCLE



# WHAT'S IN A BIOME?

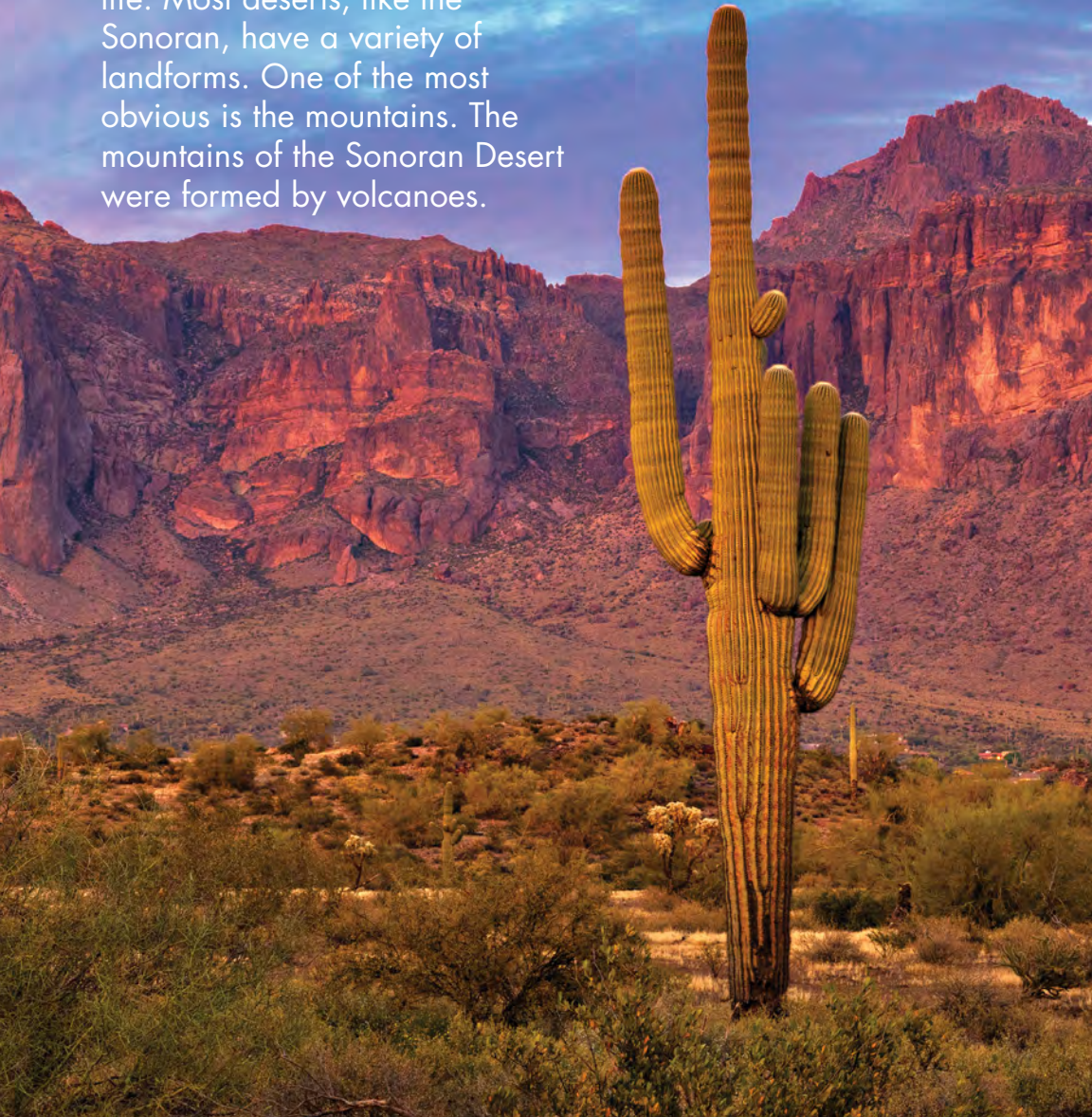
Certain plants are adapted to certain environmental conditions including temperature, the amount of precipitation, and even the nutrient levels in the soil. Because plants respond to differences in monthly average temperatures and precipitation, scientists can classify places by the dominant plant forms found there. These broad types of habitats are called biomes. For example, deciduous forests are a biome that has forests dominated by trees that drop their leaves in the winter.





# GILA HOME

When most people think of deserts, they think of a place with large sand dunes and almost no life. Most deserts, like the Sonoran, have a variety of landforms. One of the most obvious is the mountains. The mountains of the Sonoran Desert were formed by volcanoes.



To learn more about how the Sonoran Desert mountains were formed visit this site:

[https://www.desertmuseum.org/books/nhsd\\_geologic\\_origin.php](https://www.desertmuseum.org/books/nhsd_geologic_origin.php)



Even though there isn't much rain in the desert, water plays a role in the shape of the land. When it does rain, streams form and cut through the landscape which is usually dry. But during **monsoons**, or brief heavy rains, the streams can transform into raging rivers that can even sweep away cars!

The Sonoran Desert has different landforms. Gila monsters like to live on the slopes of the mountains and hills (below left).

Even in the desert, water transforms the land. When monsoon rains come, the water cuts through the land, eroding rock and depositing finer materials in washes (below right). These washes can be a natural hazard. They can transform from dry creek beds to raging rapids in minutes.





The Sonoran Desert is far from a lifeless place. Its variety of landforms also feature multiple types of biomes. Hot deserts exist in low elevations. The temperature becomes cooler in the elevated mountains. At middle elevations, woodland biomes are found. At high elevations, where it can be very cold during parts of the year, pine forests are found. This change in biomes at higher elevations in the mountains is similar to the change in biomes at farther distances from the equator. Because of its many biomes, the Sonoran region has many different species. The types and population sizes of species in each biome is influenced by many factors. Some are biotic, like the presence of food and predators. Other factors are abiotic, like the amount of water, air temperature, and nutrients in the soil.

The Saguaro cactus is an iconic species of the Sonoran Desert. Gila monsters are found alongside these huge cacti.





# STRESS IN THE SONORAN?

Gila monsters face some serious threats. Their biggest current threat is habitat loss. People are turning the lizards' desert homes into places for agriculture or cities. It is important to protect enough habitat for Gila monsters and other desert animals and plants to survive. Luckily, national and state parks provide areas where Gila monsters are safe from direct threats. But some threats occur even inside protected areas.

Like the climate around the world, the climate of the Sonoran Desert is changing and is predicted to continue to change. Scientists have used climate models to predict that the Sonoran Desert is likely to have higher temperatures, less predictable precipitation, and more extreme weather in the future. What does this mean for Gila monsters? If it gets too hot or they have to go too long without water, then even changing where they live and when they are active might not be enough to save them. Gila monsters may have to migrate to new areas, or they might become extinct. Scientists need additional research on Gila monsters' current survival tactics, resiliency in the face of change, and potential future habitats.



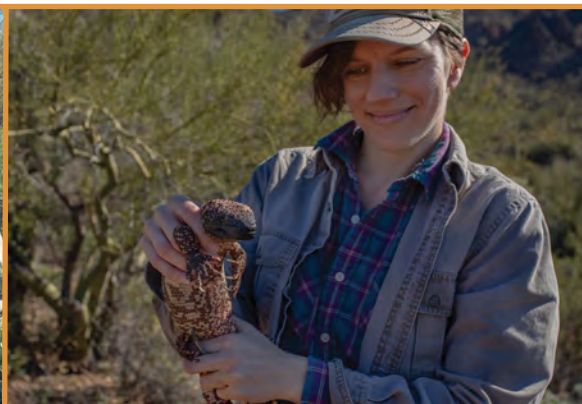
# STUDYING GILA MONSTERS

Biologists have been studying Gila monsters for many years. Some are interested in the chemistry of their venom. They want to know how it works and how it might be used to help develop new medicines. Others want to know more about the lizards themselves and how they manage to survive in harsh environments. Let's join one of these scientists to help with her investigation.

Dr. Karla Moeller has been studying how Gila monsters survive, how they use their habitats, and how their health might be affected by stress and a changing climate. Eventually, she wants to be able to predict how climate change might affect the health of Gila monsters if there are longer, hotter and drier periods in the desert.

To study Gila monsters, she puts special tracking devices in them. She plots where they go and what landforms and habitats they frequent. She uses technology and special instruments to see inside their bodies to measure how much water they are carrying. And, she measures the chemistry of their blood to learn about their hydration and health. She and other biologists even trained some lizards to walk on a treadmill to measure their energy use.

Now you are ready to join the team to study Gila monsters!



# GLOSSARY

**ABIOTIC FACTOR**

related to or resulting from non-living things

**ADAPTATION**

a trait of an organism that helps it survive in its environment

**BIOME**

a large area, defined by its climate and the type of organisms that live in it

**BIOTIC FACTOR**

related to or resulting from living things

**CLIMATE**

weather conditions in an area over a long period of time

**CONDUCTOR**

a substance that transmits heat, electricity, or sound

**ECTOTHERM**

an animal that gets its heat from the environment; cold-blooded

**HABITAT**

the natural home or environment of an animal, plant, or other organism

**INSULATOR**

a substance that does not easily allow the passage of heat, electricity, or sound

**PREDATOR**

an animal that catches and eats other animals

**PREY**

an animal that is eaten by another animal

**SOLITARY**

living alone

**SUCCESSION**

change in species present in an environment over time

**WEATHER**

the conditions in the atmosphere at a particular time



# PHOTO CREDITS

Abbreviation Key: SS = Shutterstock.com

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# SCIENCE 3D

Thanks for exploring with us! Our science adventures take us around the world to uncover secrets of the most amazing animals and places. Our mission and passion is to share these scientific discoveries with you. There are so many cool things to see out there, even in your own backyard, so get outside and explore!

## MIKE HEITHAUS PH.D.

Dr. Mike Heithaus is a scientist, explorer, author, educator, and television host. He is a professor of biology and Dean of the College of Arts, Sciences & Education at Florida International University. Mike and his students study sharks, whales, sea turtles, and other large marine animals around the world. They also work with people to help protect these species. Mike loves sharing his work with others. He has written text books and helped create programs for students in elementary, middle, and high school. He has been on television programs including on PBS, National Geographic, and Discovery Channel's Shark Week.

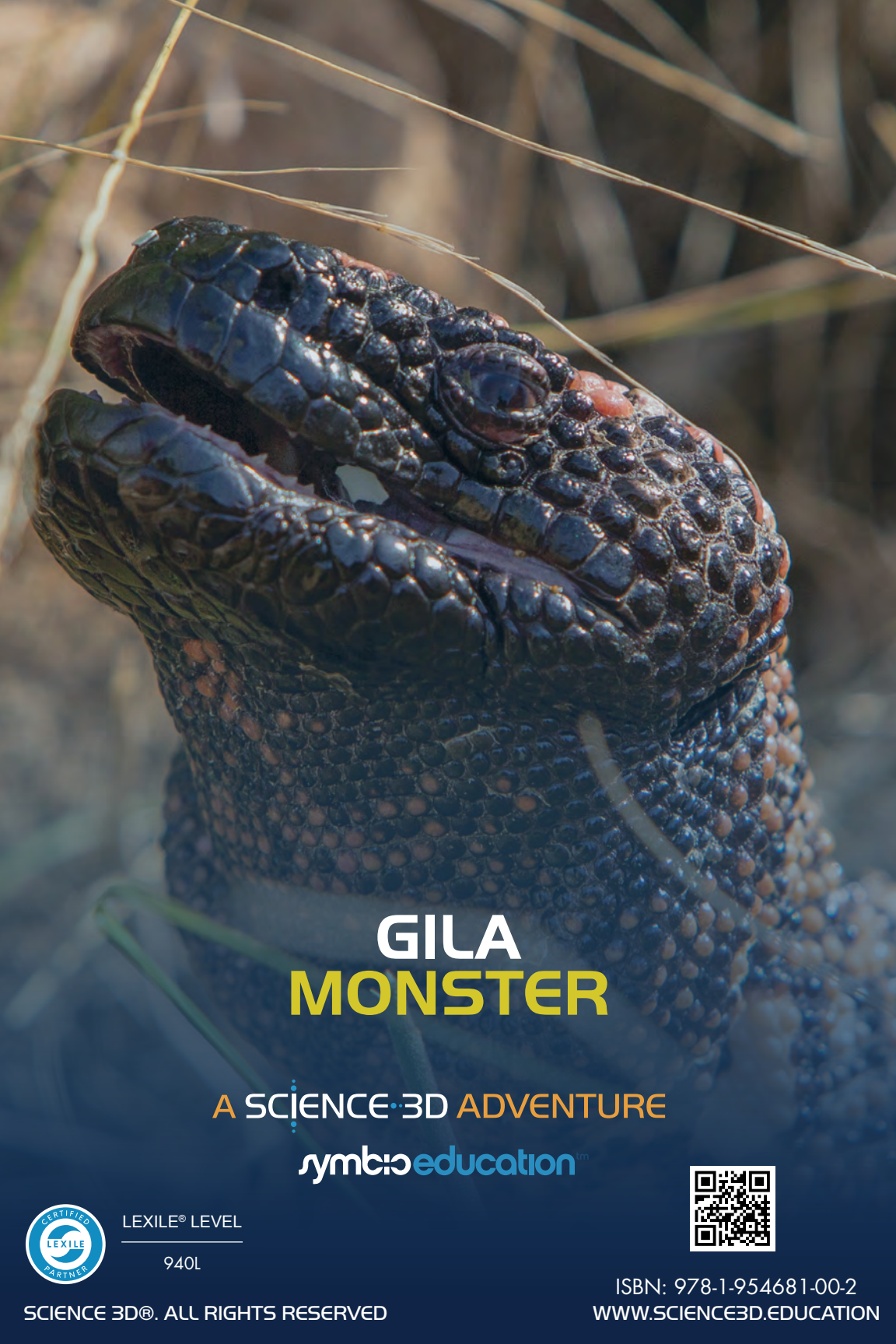


## PATRICK GREENE

As a wildlife filmmaker, Patrick has always had a passion for animals. He started to draw pictures of sharks and whales when he was just five years old. Later, he went to college to become a marine biologist and learned a lot about science. Then he got a job in television and learned how to make videos, too. Since then, he's gone all over the world studying and filming wild animals. He's made shows for National Geographic, PBS and ABC, and even won an Emmy Award. He loves making videos to teach students about science and about the many creatures that share our world.







# GILA MONSTER

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