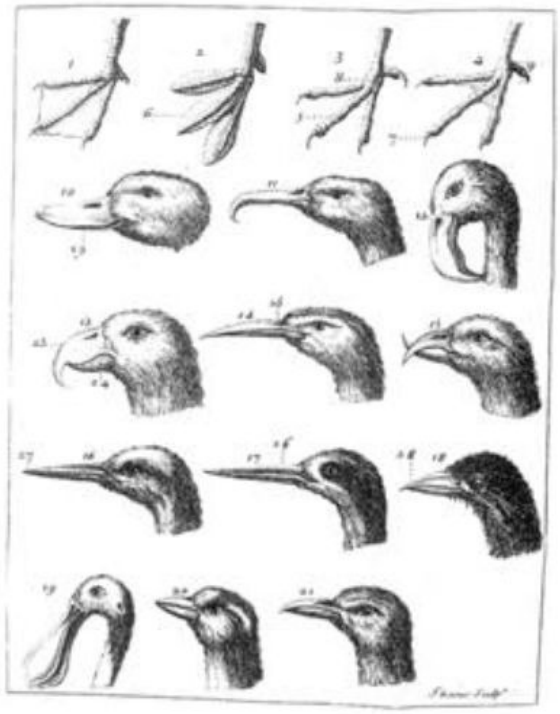
When Fish First Walked

by ReadWorks



A few hundred million years ago, the competition for food between fishes was fierce. So much so that gradually, some fish developed the ability to get out of the water and reach food sources that none of the other fish could get to. They survived long enough to successfully reproduce, and passed this characteristic on to future generations. In fact, from these fish eventually originated the animals with two pairs of limbs, including human beings.

This is an example of natural selection. An organism that develops a trait that helps it survive in its environment will have a better chance of reproducing and passing that trait on to the next generation. As a consequence, organisms with this helpful trait will become more prominent while other organisms of the same species die out. Why do giraffes have long necks? Why do rabbits produce so many offspring? Natural selection can help us understand why some species are the way they are.

The term "natural selection" was coined by Charles Darwin, who developed the scientific theory of evolution. Darwin was born in England in 1809 and spent his life observing animals and plants from around the world. He explained the theory in his landmark book *On the Origin of Species*.

Sometimes, the changes that occur among a group of organisms will seem very small but still play an important role in their survival. Take, for example, the peppered moth. The peppered moth was light in color and had speckled wings. It was hard to pick out against many of the trees and buildings in England and could camouflage itself easily. But during the Industrial Revolution, London became polluted, and the smog turned everything black. Now the moths could be seen more easily by predators; they had nowhere to hide. Around this time, dark-colored peppered moths, which are almost invisible against a dark background, began to appear and soon became widespread. The lighter moths, on the other hand, became scarce in these sooty industrial areas.

Another case that has to do with survival through camouflage involves the little deer mouse. Typically, deer mice are dark brown, which makes it easier for them to hide from owls and other predators in the dark soil of the woods. The deer mouse that lives in Nebraska's light-colored Sand Hills, however, has gone from brunette to blonde so it can blend in and have a better chance at survival. It took thousands of years for these mice to change the color of their coats, which may sound like a long time, but when it comes to evolution, that's pretty quick!

One interesting case study is that of the Galápagos finches, about 14 species of bird that were studied by Darwin on the Galápagos Islands. Often referred to as "Darwin's finches," these birds look

very much alike. The most significant difference among them is the size and shape of their beaks. Every different beak evolved the way it did so as to be suited to a particular feeding task. When, in 1977, a drought hit the island, vegetation withered and the only seeds left were large and tough. The finches with deeper, stronger beaks were able to crack through these seeds, and many more of them survived than their smaller-beaked brothers. However, in the mid-1980s, during an especially rainy time, smaller, softer seeds flourished. The birds best adapted to eat them had smaller beaks and they fared much better.

Where have all the dull male peafowl (peacocks) gone? Well, female peafowl (peahens) choose their mates based on the color and brightness of their plumage. This means that peacocks with impressive tail feathers are able to find mates more easily. A few thousand years ago, there were many more males with dull feathers, but they kept getting passed over by the females and did not reproduce. Their numbers therefore began to dwindle. These days, they're quite rare.

Darwin's theory teaches us that an animal or plant that adapts to its environment and remains alive long enough to procreate will thrive. The dodo bird, which has gone extinct, was not lucky in this respect. A lack of predators for thousands, and maybe even millions, of years meant that the dodos never learned to fly. When humans finally arrived to their home on the island of Mauritius, the dodos had no way of protecting themselves and, in the 17th century, were wiped out. It isn't easy being on the wrong side of natural selection. Fortunately for us humans, the fish with the fleshy, leg-like fins came out on top.

Selective Breeding

by ReadWorks

Charles Darwin, a British naturalist who lived in the 19th century, is best known for his book *On the Origin of Species*. In it, Darwin established the idea of evolution that is widely accepted today. He proposed that all species alive have evolved through adaptation to their surroundings. Natural selection, the process by which varied traits that increase survival and enable reproduction are passed down from generation to generation, is probably the most famous principle from the book. Darwin's book also addresses the perhaps less well-known concept of artificial selection. Today artificial selection is more often called "selective breeding." Selective breeding involves breeding animals or plants for a specific, typically desirable trait. By doing so, the desired genes from the plant or animal will be passed on to its offspring.

Dog breeding is one of the most common examples of artificial selection. You need only to tune into a dog show on TV to see the power of selective breeding at work. Crossbreeds, for example, are dogs born from parents of two different breeds. Mixed breeds are born from parents of more than two breeds, and pure breeds are born from a single breed. All three varieties are featured in most dog shows. Many of these dogs were bred to achieve certain desirable physical or behavioral traits.

Beyond the context of dog shows, dogs are a particularly interesting example of selective breeding. After all, we call dogs "man's best friend" for a reason. Dogs originally evolved from wolves. Eventually, humans were breeding different types of dogs to accomplish certain jobs. For example, some dogs were bred to hunt well. Others were bred with desired traits to herd cattle. But it was a trait known as "tamability," or a dog's ability to be tamed and live among people, that resulted in humans keeping dogs as pets. Now that many people live relatively quiet, domestic lives, how well a

dog can herd sheep is not of huge importance. What matters most is whether a dog makes a good companion.

Charles Darwin may have been the first to describe the process of selective breeding, but the practice may be more than 2,000 years old. The Romans are said to have practiced selective breeding among their livestock, favoring cows that produced a lot of milk. But it wasn't until the 18th century that farmers began practicing it on a large, industrial scale.

Today, farmers breed chickens to have extra-large breasts and to lay a lot of eggs. A wild fowl-a chicken that lives in the woods-lays between 20 and 30 eggs per year. In contrast, a chicken born out of selective breeding can lay as many as 300 eggs per year.

In the same way that chickens are selectively bred for having more meat and laying a greater amount of eggs compared to wild chickens, cattle are often selectively bred either for more meat or for more abundant milk production compared to cattle in the wild. Over the course of the 1700s, the size of bulls sold for slaughter increased dramatically-from around 300 pounds (about 140 kilograms) to nearly 800 pounds (about 360 kilograms)-as a result of selective breeding. Also as a result of selective breeding, the dairy cow, which does not display a lot of girth or muscle, can produce enough milk for 10 calves. One can identify a dairy cow by its udders, which can hold over 5 gallons (over 19 liters) of milk.

Even though people selectively breed to yield animals with desired traits, there are dangers to selective breeding. Temple Grandin, an animal welfare advocate, notes that breeding animals for size and strength interferes with natural animal processes. Breeding roosters for muscle, for example, can make them top-heavy and unsteady on their feet, interfering with their courtship dances. This, in turn, can alienate them from hens.

Speaking of hens, what about those that were bred to lay 300 eggs per year? Laying one egg a day makes a hen's bones brittle, since the eggs soak up the bird's calcium supply. And what about so-called broiler chickens-the ones that are bred for their large breasts? Often, their bodies grow so fast that their skinny legs can't support them.

Cows required to produce enough milk for 10 calves tend to burn out quickly. Cows not subject to selective breeding can live up to 30 years without burning out. But prolific dairy cows tend to make it just four or five years before they are considered worthless, and then they are sent to be slaughtered.

Selective breeding comes with both benefits and drawbacks. Think of all the joy that dogs have offered humans in the form of companionship over the last 100 years. Selective breeding is to thank for man's best friends. And yet, the pain and suffering that livestock endure makes us think twice. It is important to keep in mind that, in some cases, the negative consequences of selective breeding may outweigh the positive.

Why Do Cave Fish Lose Their Eyes?

by American Museum of Natural History

This article is provided courtesy of the American Museum of Natural History.

Wikimedia Commons/Daniel Mayer

Carlsbad Caverns National Park

Deep underground there are caves where the sun never shines. If you found yourself in one of these caverns without a flashlight, you would see nothing at all; just total blackness.

In some of these underground caves, there are fishes, crustaceans, salamanders and other animals that have evolved to live without light. For example, more than one hundred species of cave fishes live their lives in constant darkness. They depend on senses other than sight to hunt, eat and reproduce.

Many of these species of fishes are blind or nearly blind-some don't even have eyes. Yet they all evolved from fishes that could see. Somehow, over millions of years, these fishes not only developed the ability to live without sight-they lost the ability to see altogether.

How did that happen? How can evolution cause a species to lose a trait? It's a mystery that evolutionary scientists have been struggling to unravel. The search for an answer gives us a fascinating look at how evolution works.

Regressive Evolution

We usually think of evolution as a process in which species acquire new traits. But in cave fishes we have an example of regressive evolution, a process in which species lose a trait-in this case, the ability to see.

NPS

Blind cave fish, Mammoth Cave National Park, Kentucky

How does this happen? Do cave fishes go blind because they don't use their eyes? Though at first this idea might seem to make sense, it actually has no basis in science. It is your genes that determine which traits you inherit. For example, you have five fingers on each hand because of the genes you got from your parents. However, if you have an accident and lose a finger, your children will still be born with five fingers on each hand. If you lift weights and become a body builder, it doesn't mean your children will be born with bulging biceps. In each case, your genes haven't changed-even though your body has.

The fact that cave fishes don't use their eyes has absolutely no effect on the DNA in their chromosomes. They are blind because something happened to the genes that control the

development of their eyes. This change is passed on from parent to offspring. That explains why a blind fish would have blind offspring. But it doesn't explain how a whole species of blind fish came to exist.

Evolution works by a process called natural selection. If an animal is born with a trait that gives it an advantage over other individuals, it will be more successful at having offspring. When this happens, evolutionary scientists say that that animal is "selected" for having that trait. Its offspring and succeeding generations will inherit that trait, spreading it throughout the population. But in the case of cave fishes, how does being blind give a fish an advantage in the dark? And if being blind is not an advantage, then how did natural selection lead to a species of blind cave fish?

Two Answers

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Mexican tetra (Astyanax mexicanus)

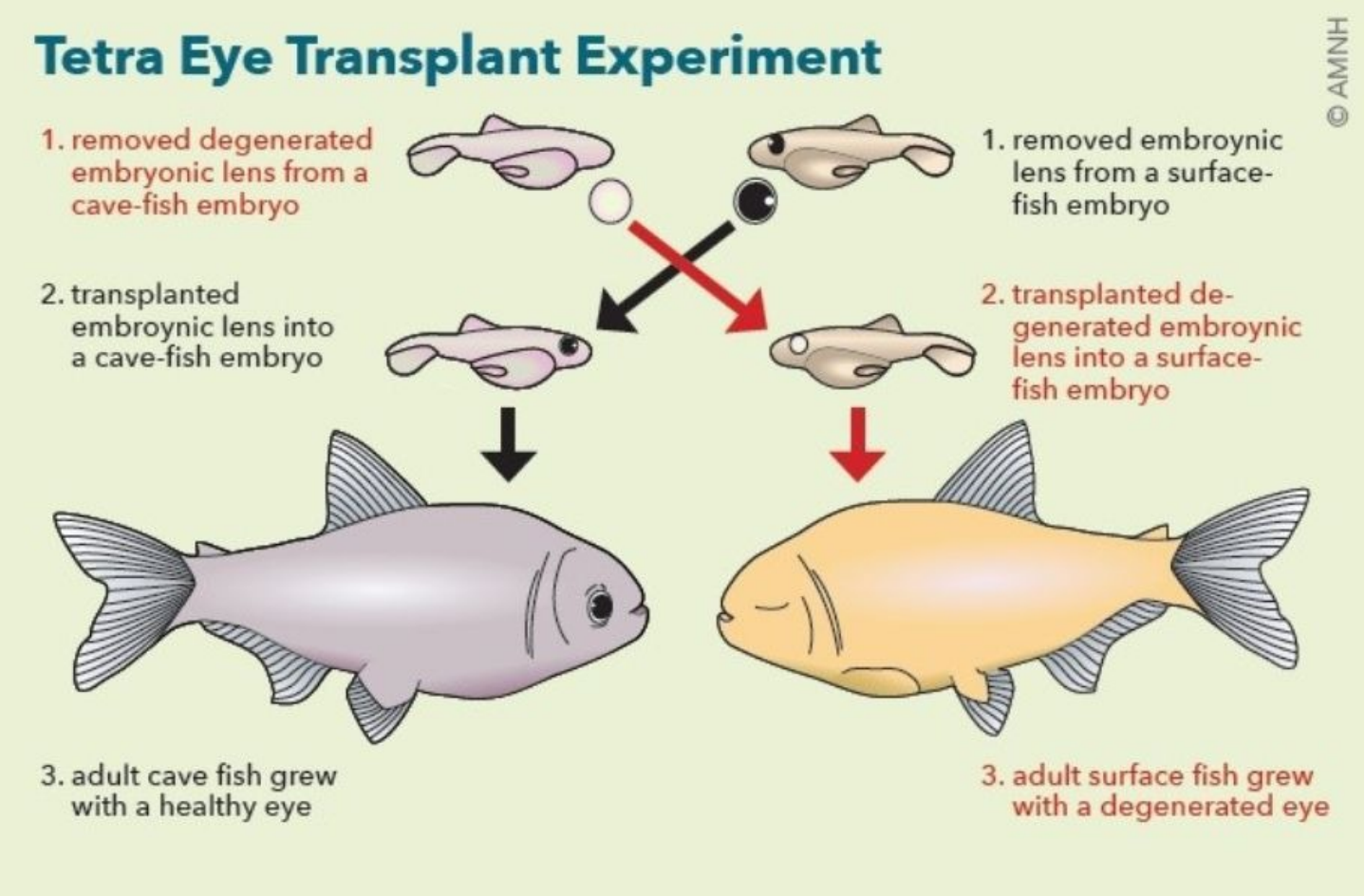
Scientists have studied one species of blind cave fish, the blind Mexican tetra (*Astyanax mexicanus*). They have come up with competing explanations for blindness in that fish, which likely will help them to understand other cave fishes as well.

The first hypothesis assumes that blindness does give the fish some sort of evolutionary advantage, though not directly. What if the gene or genes that cause blindness also are responsible for some other change in the fish? And what if it was that change, not blindness, that gave the fish an advantage to reproduce? Scientists call this pleiotropy-when multiple effects are caused by the same mutation in one gene.

The second hypothesis is based on the fact that natural selection does not just reward success, it also weeds out failures. In a lake, where there is sunlight, a fish born blind would have trouble competing with other fish that can see. It probably would not survive to have offspring. But a fish born blind in a dark cave would not be at a disadvantage, since in the darkness no fish can use their eyes. In those conditions, natural selection will not work to weed out the mutation for blindness. Over millions of years, many more mutations will accumulate and eventually the entire population of fish will be blind. This is called the neutral mutation hypothesis.

An Eye-Opening Experiment

A group of scientists at the University of Maryland carried out an experiment with two varieties of the same species of Mexican tetras. One variety lives in bodies of water near the surface where there is sunlight and can see. The other variety of tetras lives in dark caves and is blind.



American Museum of Natural History

In their experiment, the scientists transplanted a lens from the eye of a surface tetra embryo into the eye of a cave tetra embryo. The cave-fish embryo would normally develop into a blind fish. But the lens from the surface tetra transplanted into the cave tetra caused all of the surrounding tissues to develop into a healthy eye. This experiment demonstrated that the genes involved in the development of the eyes of the cave tetra were still totally functional.

The scientists knew that there are many genes responsible for the development of each part of an eye (for example, the retina, iris, cornea and lens). Each part develops independently. The results of the experiment showed that the genes for eye development in the Mexican tetra were all ready to work properly, given the correct signal. The experiment seemed to suggest that blindness in the Mexican tetra was not caused by many mutations, but instead by a small number of mutations in genetic "master switches."

These master switches are genes that control the function of many other genes. In this case, the switches control genes responsible for eye development. These master switches have the ability to disable the eye genes. These remain intact, but inactive. Putting a healthy lens into the cave tetra

embryo seems to trigger master switches to send a signal to the inactive eye genes, allowing cave tetras to develop eyes.

If scientists could find the genetic "master switches" that made cave tetras blind, they could discover if the same switches had effects on other traits of the fish that do give it an evolutionary advantage for surviving in caves.

The researchers did indeed find one of those genes. It is nicknamed Hedgehog or the Hh gene. They discovered that the Hedgehog gene does more than cause blindness in cave tetras-when the fish develops without eyes, the skull bones move into the empty eye socket, which at the same time enlarges its nose. Unlike other vertebrates, fishes use their nose only for smelling. It could be that the same control gene (Hh) that stops eye development in the fish also enhances its sense of smell. An enhanced sense of smell would be a definite advantage for a fish that lives in darkness.

As a result of these and other experiments, it now seems highly likely that blindness in cave tetras is in part the result of pleiotropy-one mutation that causes blindness in the fish and at the same time, gives them an enhanced sense of smell.

Evolution Works

Scientists are still studying cave fishes, and new discoveries are sure to be found. But one thing is already clear-the answer lies in the basic processes of evolution that are already well understood. With new tools that give scientists the ability to map genes, find specific mutations, and understand the development of embryos, we are increasing our understanding of how evolution works.

Naturally Selected to Survive

by Michael Stahl

The earth has changed, over and over again, throughout the course of its history. Some of these changes have happened quickly. Others have occurred over long stretches of time. For example, the planet has experienced ice ages that took place over *thousands* of years. During those eras, huge sheets of ice covered much of the surface of the globe. Then for a few thousand years between the ice ages, the earth warmed up. Scientists believe that this cycle has actually occurred a few times.

As the planet goes through this cycle, environments may go through changes. In order to survive in changing environments, species oftentimes must undergo a process of adaptation. Adaptation refers to a mutation or genetic change that enables an organism such as an animal or plant to survive in its environment. This trait is passed down from one generation to the next, becoming an inherited trait of the species. A species may have to adapt to warmer temperatures, increased precipitation, or even developing air pollution. If the organisms of a species cannot change along with the area in which they live, they risk dying out. Though an uncountable number of species that have roamed the earth have become extinct, the planet has seen many others adapt as well. These select organisms have been able to go on living in their environment.

A species adapts to a changing environment as organisms with favorable traits reproduce and survive. These favorable traits, which help the species survive, are passed down through different generations of the species. This process is called "natural selection." Recent history has given us an important example of how organisms are able to survive once their environments change.

Light gray peppered moths and dark-colored peppered moths lived in the countryside between the cities of Manchester and London in England. Many years before the 19th century, more of the light gray peppered moths had been able to survive in their environment mostly because of their color. Their thin layer of skin, as well as their large wings, was mostly gray with a little bit of black "peppered" all around. This color was advantageous because the light gray peppered moths were camouflaged when they stayed on gray-colored areas on the sides of trees in their habitat. Predators, which were mostly birds, could not see the light-colored moths on the trees because the color of the moths blended in with the color of the trees. Instead, the predators were able to see the dark-colored peppered moths more easily.

In the early 19th century, though, England began the first years of its Industrial Revolution. Many areas, especially in and between the cities of Manchester and London, became populated by a growing number of factories. This was because companies began to use a lot of new machinery that

had been invented in the decades before. These machines made work a lot easier in many ways. The companies could build more products faster than ever before. However, many of these factories needed coal to provide energy for the machines. When coal burns, it gives off a lot of dark-colored smoke. Soot is a black substance that collects on a surface that comes into contact with smoke. Smoke's dark particles stick onto surfaces like paint. In the English countryside near industrialized areas, the trees began to blacken with soot because of all of the smoke in the air from the factories. This made the light gray peppered moths much more vulnerable. Predators could see them on the trees more clearly and easily hunt them down.

Sometime in the next hundred years, scientists began to notice a huge change in the moth population living in and between the cities of Manchester and London near where many of those factories had been constructed. Most of the peppered moths were the dark-colored kind! What caused this change was the fact that predators had eaten a lot of the light gray peppered moths because the moths were clearly visible on the black-colored trees. The dark-colored peppered moths in the area survived much more easily and mated with other dark-colored peppered moths until most of the population of peppered moths became dark-colored.

Many scientists feel that this example of evolution in a species supports Charles Darwin's theory of natural selection. An author named J.W. Tutt published a report about the moths a few years after Darwin's death, writing that the change in the peppered moth population seemed to support Darwin's ideas. Though Darwin was not alive to read the Tutt report, his teachings about nature live on.

The Descendants

by Bobby Oerzen

Is a newfound prehistoric species our direct ancestor?

Matthew Berger wasn't looking to revise the story of human origins. He was just chasing his dog Tau. But one day in August 2008, the 9-year-old boy stumbled upon a 1.9 million-year-old collarbone at a South African dig site. His discovery has sparked a new debate into the ancestry of human beings.

Matthew Berger

Matthew's father is Lee Berger, a *paleoanthropologist*-someone who studies the origins and the predecessors of the human species. Since 2008, Berger and his colleagues have been excavating the site where Matthew made his discovery. They've dug up a big collection of well-preserved bones, including a skull, a pelvis, a hand, and an ankle, that came from two individuals. One was an adult female, the other a juvenile male (around 10 to 13 years old). Likely those of a mother and her son, the fossil remains are of *hominids*. Hominids are humans and the extinct humanlike creatures from which we developed.

Gallo Images/Getty Images

Photographers surround Lee Berger, his son Matthew, and the bones of A. sediba that father and son found.

Berger believes the hominid fossils his team found are those of a newfound species, one he calls *Australopithecus sediba*. The word *sediba* means "wellspring" in Sotho, an African language. *A.sediba*, says Berger, could be a direct ancestor of humans-the wellspring of our lineage.

All In The Family

The term *Australopithecus* refers to a *genus* (group of related species) that appeared in Africa between 4 million and 5 million years ago. Also called *australopithecines*, they had large apelike faces with big teeth. Their bodies were light, roughly 32 kilograms (70 pounds), and relatively short, about 1.2 meters (4 feet) tall.

Current evidence indicates as many as six known species of australopithecine lived before-and during-the time of *A.sediba*. Like most primates, australopithecines were well adapted to climbing trees. Unlike most primates, however, they were also *bipedal,* able to walk upright on two feet.

Bipedal locomotion became more efficient later as the australopithecines evolved into a new genus whose species had smaller faces and larger brains-the genus *Homo*. The first known *Homo* species-*H. habilis*-was named for the stone tools it apparently made. *H. habilis* had a very precise handgrip and short finger length- features that support the idea of toolmaking among the species.

As other species of the *Homo* genus evolved, their brains became larger and more complex. Modern humans (*H. sapiens*) have the most advanced and complex brains of all.

To Berger, *A. sediba* represents the species that connects the two groups *Australopithecus* and *Homo*. The *A. sediba* fossils contain "mosaic" features, he says, combining traits from both groups. *A. sediba* was adapted in its upper body to climbing trees, but its hands were hauntingly modern-those of a toolmaker. And its brain, though small, was strikingly human in structure.

AP Images; Jon Hrusa/EPA/Newscom

A skull (top) and other bones (below) from two partial skeletons of the newfound species, A. sediba, discovered in South Africa

"The many advanced features found in the brain and body make it possibly the best candidate ancestor for our genus *Homo*," he says.

The main problem with Berger's theory is timing. *H. habilis* appeared 2.5 million years ago. How could it have descended from an *A. sediba*, which lived half a million years in the future? That would be like a daughter giving birth to her mother.

Berger isn't dissuaded by that criticism. He believes that the fragmentary fossils that belong to the early members of the *Homo* genus might have been dated incorrectly. They might have come from individuals that lived after *A. sediba* and were actually its descendants.

Dead End?

Critics do agree that *A. sediba* is a new species but believe it became extinct without evolving into another species. That type of extinction is common in evolution, says Ian Tattersall, a paleoanthropologist at the American Museum of Natural History in New York City. "Nature's way of experimenting is by throwing different species into the ecological arena," he explains. "The better-adapted species survive, while the others go extinct."

Indeed, two or three early *Homo* species might have lived side by side 1.9 million years ago in Africa. It's possible that *A. sediba* lived among those species.

"[Evolution is] not a linear process," says Tattersall, explaining that one species doesn't necessarily give way to another and another. There are many "evolutionary dead ends"-species that simply die out.

Even if *A. sediba* is one of those dead ends, Tattersall maintains, "it gives us a better picture of what hominids looked like at the time."

Articulate Bones

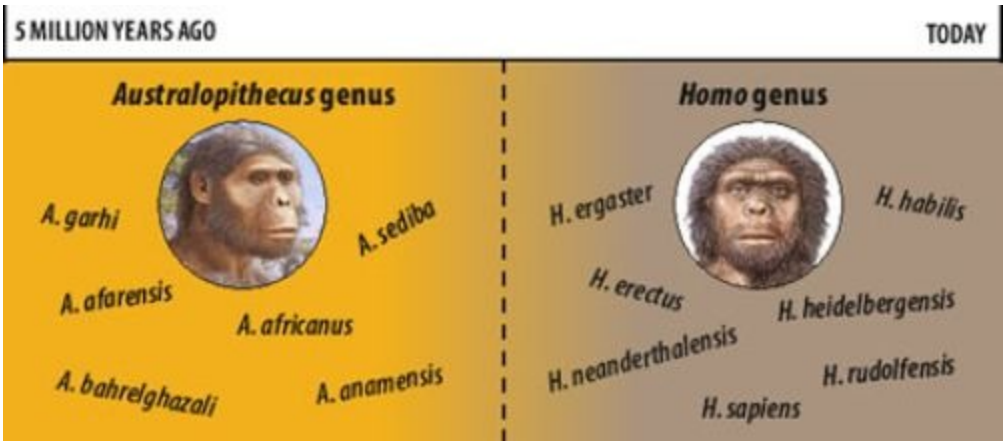
The *A. sediba* fossils that Berger's team found are amazingly well preserved and *articulated*-some of the bones were found still fused together. Typically, with fossils that old, only bone fragments remain. With the *A. sediba* fossils, however, "the most astonishing thing is the completeness," says Tattersall about the articulated remains.

Although Tattersall calls the mosaic features of *A. sediba* "incredible," he is less sure than Berger that *A. sediba* is a linear ancestor of *H. sapiens*. Nevertheless, the fossils tell us a lot about our evolutionary past, he says. The "mix-and-match" mosaic features show how nature experiments.

Whether or not humans are descended from *A. sediba*, our ancestors underwent the same *selection pressures*-the conditions that force a species to continue adapting to survive. "And out of this evolutionary ferment," Tattersall says, a tinge of excitement in his voice, "our genus *Homo* arose."

Family Tree

Prehuman evolution has wound its way through two *genera* (groups of related species) during the past 5 million years. The first genus, *Australopithecus*, existed roughly 5 million to 2 million years ago. The second genus, *Homo*, arose 2.5 million to 2 million years ago. Species in the second group had bigger brains and longer legs and used tools. Humans (*Homo sapiens*) are the only surviving species in that group. Scientists are trying to determine the exact connections between all the species in each genus to find out which ones became extinct and which ones evolved into later ones that finally became humans. Listed at right are many of the known species in each genus.



Mauricio Anton/Photo Researchers, Inc.

Shedding Light on the Dinosaur-Bird Connection

by American Museum of Natural History
This text is provided courtesy of the American Museum of Natural History.

When people think of dinosaurs, two types generally come to mind. There were the huge herbivores, like *Apatosaurus*, with their small heads and long tails. There were also those fearsome carnivores, like *Tyrannosaurus rex*, that walked on two legs and had a mouthful of teeth like kitchen knives.

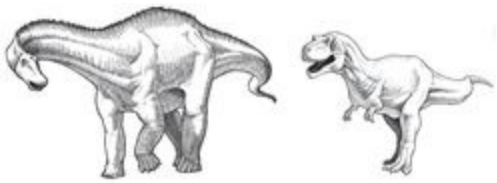


Image Credit: © AMNH

Living Dinosaurs

These large dinosaurs are no longer around, but dinosaurs still live among us today. They are the birds. It's difficult to imagine that a bird on your window sill and a *T. rex* have anything in common. One weighs less than a pound. The other was the size of a school bus, tipping the scales at eight tons. But for all their differences, the two are more similar than you might think. In fact, birds and *T. rex* are close relatives. They all belong to a group of dinosaurs called theropods.

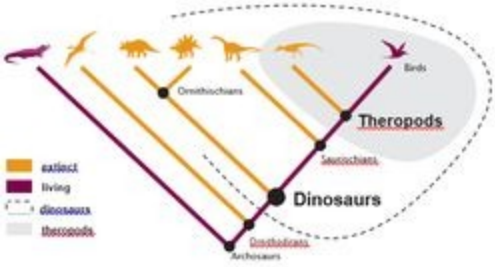


Image Credit: © AMNH

This is a cladogram, a "tree" showing the relationships among organisms. The group called dinosaurs includes the extinct dinosaurs and all their living descendants. All its members, including living birds, descended from the very first dinosaur-their common ancestor. That's why birds are a kind of dinosaur (just as humans are a kind of primate).

Finding the Evidence

To better understand the link between non-bird dinosaurs and birds, scientists look for features they share. When studying

Photo Credit: © Pamala Wilson

living birds, they can observe their behavior and study their anatomy. It's a different story altogether when it comes to long-extinct dinosaurs. Behavior cannot be observed, and all that's left of these animals are the clues found in ancient rocks. This evidence includes fossilized bones, teeth, eggs, footprints, teeth marks, and even dung.

Skeletal Evidence

When paleontologists compare a skeleton of a living bird to the fossilized skeleton of a non-bird theropod, like *Sinornithosaurus*, they see many similarities. They both have a hole in the hipbone, a feature that distinguishes most dinosaurs from all other animals. This feature allows an animal to stand erect, with its legs directly beneath its body. All theropod dinosaurs, including birds, have a furcula, also known as a wishbone. Another shared characteristic is the presence of hollow bones. Hollow bones reduce the weight carried by an animal. This feature enables the animal to run faster. It probably also played a role in the evolution of flight.

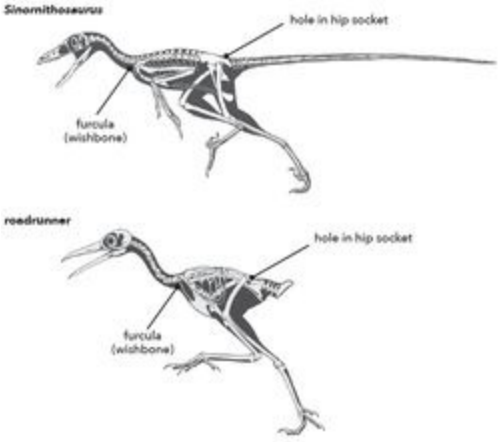


Image Credit: © AMNH / Sean Murtha

Sinornithosaurus and the roadrunner are both theropod dinosaurs.

Behavioral Evidence

Birds build nests, lay eggs, and brood their nests. When scientists look at some non-bird theropod fossils, they see evidence of these same behaviors. The first discovery of this evidence was in 1993 in the Gobi Desert in Mongolia. Scientists unearthed a *Citipati* fossil brooding a cluster of eggs. Its limbs were folded back against its body. It is one of the few fossils ever found that demonstrates behavior. In this case, parental care. It shows that the behavior of brooding the nests that we see in living birds was already present in the non-bird ancestors of birds.

Photo Credit: © AMNH / Mick Ellison

Citipati, like many other non-bird dinosaurs, had feathers. Yet it could not fly. Feathers were once thought to have evolved for flight. The discovery of more and more non-flying dinosaurs with feathers disproved that explanation. For these dinosaurs, feathers may have served other functions, like gliding, insulation, protection, and display. Feathers play that same role in many bird species today.

Based on the evidence of shared characteristics, scientists have concluded that birds are a type of theropod dinosaur.

Brain Evidence

Birds are the only dinosaurs with the ability to fly. This is very interesting to scientists who want to know when the capability of flight emerged. To find out, some scientists study the brains of bird and non-bird dinosaurs. Soft tissue, such as brains, is almost never preserved in the fossil record. What is preserved is the imprint the brain left on the inside of the skull. Now scientists are using computed tomography (CT) scanners to create endocasts. These are detailed, three-dimensional reconstructions of the interiors of fossilized skulls.

Photo Credit: © AMNH / Mick Ellison

Sinornithosaurus had feathers similar to those of modern birds-even though it could not fly.

In a recent study, researchers were able to peer inside the braincases of more than two dozen specimens. "Technology allows us to look inside these specimens without destroying them," says Dr. Amy Balanoff, a Museum research associate. "It's a non-destructive way to basically slice up a dinosaur brain. We look inside and see what it can tell us about the evolution of the brain within dinosaurs. Most of us grew up thinking that dinosaurs had tiny brains, but actually some had really big brains."

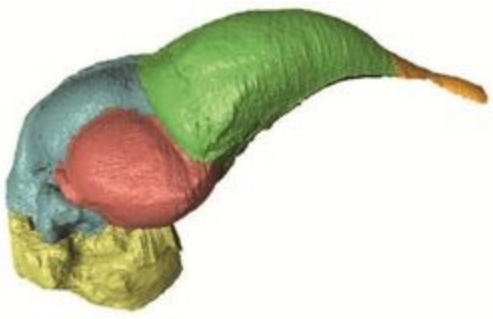


Image Credit: © AMNH / Amy Balanoff

Scientists use computed tomography (CT) scans of dinosaur skulls to create detailed, 3-D reconstructions of their interiors. This one shows the space inside the skull of Archaeopteryx.

The endocasts allow Balanoff and other researchers to explore the outer shape of the brain in more detail. In addition, the casts also provide new information about the volume and shape of different regions of the brain. For example, scientists looked at a detailed view of the dinosaur cerebrum, a region of the brain related to cognition and coordination. They found that this region was very large in non-bird dinosaurs closely related to birds. Dr. Balanoff's research suggests that these dinosaurs developed big brains long before flight and that these bigger brains prepared the way for them to fly.

When examining skeletal, behavioral, and brain evidence, scientists see that birds and non-bird dinosaurs share many features. This helped them conclude that dinosaurs aren't extinct after all. They're living among us today.

An Unexpected Trip

by ReadWorks

Sarah wasn't quite sure what was going on. She had been sitting in the back of the car for hours as it rumbled up the highway's six spotless lanes. There were not many other cars. When they turned off the main highway, Sarah wasn't very worried. This was the way to the house her parents had far, far out in the country. She'd been before, for summers. Sometimes she got to bring her friend, Sam. Going to the house by itself did not worry Sarah. The chains rattling around the back seat next to her, though, were a different story.

Sarah's mom and dad had said not to worry and that everything was fine. If everything was fine, though, why had they gotten so upset when the phone had rung last night? This time of month, Sarah usually spent the night with her grandmother, watching old movies and eating popcorn that Grandma made on the stove in a pot (not in the microwave). It was delicious. She couldn't quite make out what her mom had been saying into the phone. Something like, "What do you mean, you can't come, Mom? I need you. No, you don't understand; it has to be tomorrow night!" Later, her mom and dad told her that Grandma wasn't coming, and that she'd have to come on a little car ride with them.

"Can I still have popcorn the way Grandma makes it?" Sarah had asked. Her parents had seemed nervous before, but when she asked this, they'd looked at each other and had a nice, loud laugh, collapsing into a hug.

"We'll see what we can do, ladyface," her dad said, giving her a kiss on the cheek.

Today her parents had woken her up very early in the morning. They'd told her they'd only be gone for a night but let her pack as many toys and movies as she wanted. Sarah was a little confused- normally one night meant two toys and two movies. Her mother was very strict about this, and Sarah had often gotten a stern talking-to when her mother found an extra game or stuffed animal packed in-between her sweaters.

Today, however, there weren't any toy restrictions. There were no restrictions on soda, junk food or TV watching. Her parents didn't seem to be paying much attention to her. They weren't doing much of

anything, actually, except staring out the windows as the flat countryside rolled past.

When they made it to the cottage, it seemed strange. It was fall, and what looked beautiful in the summertime seemed odd and spooky now. The friendly green trees had lost their leaves, and now had sharp-looking branches pointing in every direction. In summer, Sarah loved playing in the little barn-shaped garage. Today Sarah couldn't tell what was hiding in its shadows. She hurried out as soon as the car engine shut off.

True to their word, Sarah's parents made her popcorn as soon as they got to the house in the late afternoon. Her mom put one of her favorite movies on the TV, covered her in a blanket and sat in the kitchen. Her father brought things into the house, and then disappeared into the garage for a long time. She heard banging. She could not imagine what was going on. Eventually, she fell asleep.

When she woke up, the sun was setting. Her mom sat in a chair across the room, looking her in the face. It was not usual for Sarah's mom to be there when she woke up, lovingly looking into her eyes. Tonight she seemed nervous.

"Where's Dad?" Sarah asked, rubbing her eyes.

Her mom looked down, and twisted her fingers together. "Your dad . . . he has some things he has to do. Alone. We'll see him in the morning." Suddenly, she stood up. "Sarah, it's time for bed."

"Mom! It's not even dark out!"

"Sarah."

"And I'm not tired! I just woke up!"

"Don't argue with me!" Sarah's mom yelled. She hardly ever yelled. Sarah was a little scared. Mom let out a deep sigh. "Sarah, honey, we should go to bed. It's been a long day. I'll lie down with you."

They went to her room, and read books together. Sarah was not tired. They talked and read for a long time. Eventually, Sarah's mom fell asleep. Sarah tossed and turned, burrowing her head into her mom or rolling far across the bed. She decided she needed to walk around a bit. Her legs were crampy. Plus, she *had* had an awful lot of soda to drink. She got up to walk to the bathroom.

The bedroom door opened with a long, low creaking sound. All the lights in the house were off. Sarah could only see because of the big full moon shining through the windows. She put her hands on the wall, feeling her way forward, bumping into tables and tripping on shoes. Just as she got near the bathroom, she realized she could hear a sound. It was like a wailing, crying sound. It was like a dog that was hurt, but also somehow . . . different. Mixed in with the howls and yelps were the sounds of the chains rattling. Sarah remembered that sound-the one the chains next to her in the car made every time it hit a bump in the road. What was going on?

She realized the sound was coming from the garage, which connected to the house via a small door. As Sarah crept towards the door, the howling stopped. What was in there? It sounded hurt and afraid. Maybe Sarah could help it?

She eased open the door, which made its own low creak, like a very old ghost waking up in the morning. At first, Sarah saw nothing. Then out of the darkness, a huge shape lunged at her. It was

covered in wild, dark fur. It had a huge snout full of long, sharp teeth that snapped and trailed froth. It made the loudest sound Sarah had ever heard as it came at her. Then at the last minute, she heard the sound of chains, and the animal seemed to snap backwards. Sarah screamed as loud as she could. The thing came at her again and snapped back towards the wall a second time. Then a lot of things happened at once: Sarah heard her mom yell her name. She fell to the floor. Things started to go dark. Just before they did, Sarah noticed something very odd. The thing was wearing a torn up pair of red pants. "Just like my dad's," she thought as she drifted off.

The next morning, Sarah was in bed. Birds chirped. Sun streamed in the window. Had it all been a dream? Sarah stood up and went into the house. Everything looked normal. She smelled bacon and heard it sizzle and pop in the pan. She made her way to the kitchen where her mom was happily frying up eggs and bacon. The waffle maker was out too, sending steam up towards the ceiling. Her dad sat at the table sipping coffee. When he saw her come into the room, he put down the paper he was reading. He motioned for her to come over.

Sarah hesitated a little, and went over and sat. Her dad looked at her kindly. "Hey, ladyface," he said. "Do you know what a werewolf is?"

Save the Monarch Butterfly

This text is from the U.S. Fish & Wildlife Service.

Jim Hudgins/USFWS

a monarch butterfly on swamp milkweed in Michigan

The monarch butterfly is one of the most recognizable species in North America, and it's in trouble. Habitat loss and fragmentation has occurred throughout the monarch's range. Pesticide use can destroy the milkweed monarchs need to survive. A changing climate has intensified weather events, which may impact monarch populations.

Numbers of monarchs have decreased significantly over the last 20 years, but together we can save the monarch. In the United States, there is a massive effort to provide habitat for monarch butterflies, imperiled bumble bees, and other pollinators. There is no one group or agency responsible for providing habitat needed for monarch conservation. All organizations, agencies, and individuals must work together to improve, restore, and create grassland habitats to save monarchs.

No matter who you are or where you live, you can get involved today. Start by planting milkweed and nectar plants that are native to your area. Garden organically to minimize your impacts on monarchs, their food plants, and other pollinators. Become a citizen scientist and monitor monarchs in your area. Educate others about pollinators, conservation, and how they can help.

Pollinators

This text is from the U.S. Fish & Wildlife Service.

These hard-working animals help pollinate over 75% of our flowering plants, and nearly 75% of our crops. Often we may not notice the hummingbirds, bats, bees, beetles, butterflies, and flies that carry pollen from one plant to another as they collect nectar. Yet without them, wildlife would have fewer nutritious berries and seeds, and we would miss many fruits, vegetables, and nuts, like blueberries, squash, and almonds . . . not to mention chocolate and coffee . . . all of which depend on pollinators.

[. . .]

HOW YOU CAN HELP

Pollinators need your help! There is increasing evidence that many pollinators are in decline. However, there are some simple things you can do at home to encourage pollinator diversity and abundance.

1. Plant a Pollinator Garden
2. Provide Nesting Sites
3. Avoid or Limit Pesticide Use

WHY POLLINATORS ARE IMPORTANT

Pollinators, such as most bees and some birds, bats, and other insects, play a crucial role in flowering plant reproduction and in the production of most fruits and vegetables.

Examples of crops that are pollinated include apples, squash, and almonds. Without the assistance of pollinators, most plants cannot produce fruits and seeds. The fruits and seeds of flowering plants are an important food source for people and wildlife. Some of the seeds that are not eaten will eventually produce new plants, helping to maintain the plant population.

In the United States pollination by honey bees directly or indirectly (e.g., pollination required to produce seeds for the crop) contributed to over $19 billion of crops in 2010. Pollination by other insect pollinators contributed to nearly $10 billion of crops in 2010.

A recent study of the status of pollinators in North America by the National Academy of Sciences found that populations of honey bees (which are not native to North America) and some wild pollinators are declining. Declines in wild pollinators may be a result of habitat loss and degradation, while declines in managed bees is linked to disease (introduced parasites and pathogens).

WHAT IS POLLINATION?

Pollination results when the pollen from the male part of the flower (stamen) is moved to the female part of the same or another flower (stigma) and fertilizes it, resulting in the production of fruits and seeds. Some flowers rely on the wind to move pollen, while [other flowers] rely on animals to move pollen.

Animals visit flowers in search of food and sometimes even mates, shelter, and nest-building materials. Some animals, such as many bees, intentionally collect pollen, while others, such as many butterflies and birds, move pollen incidentally because the pollen sticks on their body while they are collecting nectar from the flowers. All of these animals are considered pollinators.

How to Build a Pollinator Garden

This text is from the U.S. Fish & Wildlife Service.

Monarch butterflies and pollinators are in trouble. You can help by planting a pollinator garden! You can plant a garden anywhere - your yard, school, church, business, or even in a pot for your front steps.

A simple, native flower garden will attract beautiful butterflies to your yard and help pollinators stay healthy. In addition to nectar from flowers, monarch butterflies need milkweed to survive, so if you notice the leaves on your milkweed have been chomped, don't worry, it's a great sign!

Courtney Celley/USFWS

Pollinator garden in Minneapolis, Minnesota. Creating habitat, no matter the size, is helpful for monarchs and pollinators.

Before gardening

Gather your supplies, and research what varieties of milkweed and wildflowers are native to your area. You can also look up pollinator-friendly plant lists for your region. If you're starting from seeds, find a local seed supplier.

Joanna Gilkeson/USFWS

Despite its namesake, milkweed is not a weed. These beautiful wildflowers are the only source of food for monarch caterpillars and essential for their survival. Plant milkweed that is native to your area, and attract all kinds of pollinators.

What you'll need

- A yard, raised bed, or some flower pots
- Garden tools to break the soil or build a raised bed
- Extra dirt and mulch
- Native milkweed and nectar plants

Seven easy steps

1. **Choose your location:** Butterflies enjoy basking in the sun. Gardens should be planted in sunny spots, with some protection from the wind.
2. **Take a look at your soil:** Break ground to see the consistency of the soil in your yard. Soil may influence the kinds of plants you can grow, or may require special considerations. If you find that your soil type doesn't match the plants you'd like to plant, you might consider building a raised bed or using flower pots.
3. **Prep your soil:** If you're planting in your yard, remove the lawn and current plant cover and rake the soil. Additional dirt can be helpful no matter the location and is necessary for raised beds and flower pots - add your soil to the bed or pot.

Choose your plants: Find a nursery near you that sells native and local plants and milkweed for your area. Native plants are the ideal choice because they require less maintenance and tend to be heartier.

1. Choose plants that have not been treated with pesticides, insecticides, or neonicotinoids.
2. Plant perennials to ensure your plants come back each year and don't require a lot of maintenance.
3. Choose a diversity of plants that bloom throughout the seasons to ensure pollinators benefit in the spring, summer, and fall. This will also ensure that your garden is bright and colorful for months!

4. Jim Hudgins/USFWS

Native wildflower gardens add a pop of color to your garden, help bumblebees and butterflies, and need less maintenance. This purple coneflower attracted both bumblebees and a crab spider! What's not to love?

5. **[Choose] seeds or small plants:** Small plants that have already started growing in a nursery are simple and show instant return on pollinator visits, especially if you are planting in a small space. Seeds are best if you have more time. If you'd like to use seeds, plan ahead to plant in spring or fall, giving the seeds time to germinate. Seeds can also be best if you are doing a very large garden as they tend to cost less. Remember to water your seeds even before you see plants.
6. **Plant your flowers and milkweed:** For small plants, dig holes just big enough for the root system. Cover the roots with dirt, and reinforce with dirt or straw mulch to reduce weed growth. For seeding, spread seeds across your freshly prepared garden, and cover them with dirt. Consider adding some flat rocks so butterflies can bask in the sun!
7. **Wait, watch, water, and weed your garden:** It may take some time, but you will eventually see butterflies and other pollinators enjoying your garden. Make sure to weed and water your garden to keep it healthy.

Best of luck, and thank you for helping monarchs, bumble bees, and other pollinators!

The Mexican Long-Nosed Bat

This text is from the U.S. Fish & Wildlife Service.

the Mexican long-nosed bat

The Mexican long-nosed bat, first discovered in 1937, is primarily found in Mexico, but also lives in the southern part of the United States (Texas and New Mexico), and is relatively larger in comparison to other bat species. If you happen to be in an area where they live, the Mexican [l]ong-nosed bat can be identified by its dark gray to dusky brown color. Additional features include a long muzzle with a prominent nose leaf (small fold of skin) at the tip, a long three-inch tongue, and a small tail that may appear to be missing.

These bats are found in desert scrub vegetation covered with century plants (agaves), mesquite, creosote bush, and a variety of cacti, which serves as their primary food source. While the population status of the Mexican long-nosed bat is uncertain, there are strong indications that they are declining. The largest reported population of Mexican long-nosed bats in the United States is in Texas in and around Big Bend National Park.

The feeding ecology of the Mexican long-nosed bat is of great importance in understanding its life history and recent decline. The bats are considered an important pollinator for century plants, because they have developed a mutualistic relationship with one another. The bats' migration from northern Mexico to Texas coincides with the blooming of the plants from June through August.

As the Mexican long-nosed bats move along their migratory path, they are attracted to large quantities of nectar that are present in century plants. In flight, the bats hover over the plants, while using their long tongues to drink the nectar. Their tongues become coated with pollen grains that stick to their fur, thus transferring the pollen as they move from one plant to another to feed. The century plant needs this cross-fertilization to produce fruit and viable seeds for more century plants.

In 1988, the Mexican long-nosed bat was listed as endangered by the U.S. Fish and Wildlife Service. Some of the factors that contributed to the listing include harvesting of agaves for the production of liquor, limited growth and lifespan of the agave plants, frequent wildfires, and the clearing of rangeland areas in northern Mexico. The clearing of rangeland reduces the food supply, which affects the bat population.

The Lesser Long-Nosed Bat

This text is from the U.S. Fish & Wildlife Service.

[The lesser long-nosed bat] (*Leptonycteris curasoae yerbabuenae*) is a medium-sized, migratory nectar bat native to the [southwestern] United States and northern Mexico. It has an extensive range, spanning southeastern Arizona through southwestern New Mexico in the United States, and moving south into Mexico for the winter months. The lesser long-nosed bat is yellow-brown or cinnamon gray and is about three inches (8 cm) long. The tongue measures approximately the same length as the body and provides access to the nectar of deep desert flowers. This species also has a small noseleaf on the tip of its nose. A "noseleaf" is a small flap of tissue shaped like a leaf growing out of the top of the nose. The wingspan of the lesser long-nosed bat is approximately 10 inches long. These bats can live for about 12 years.

Bill Radke/USFWS

the lesser long-nosed bat (Leptonycteris curasoae yerbabuenae)

George Gentry/USFWS

habitat of the lesser long-nosed bat, showing Saguaro cacti

Lesser long-nosed bats are nectar feeders and important pollinators for their nectar plants. In the United States, this includes agaves, saguaro, and organ pipe cacti. As the bats approach the host plant flowers, they use their long, extendable tongue to gather nectar, [which is] stored at the bottom of the flower. In the process, the bat's face and neck fur become covered with pollen that it unwittingly transports to other flowers it visits, resulting in cross-pollination. Like other nectar feeders, lesser long-nosed bats may either hover at, or land on, flowering stalks to feed. Although nectar, pollen, and insects are consumed, fruits, especially fruits of the columnar cacti, are also eaten after the flowering season, and these bats are also important seed dispersers for these cacti species. Lesser long-nosed bats are also opportunistic feeders at hummingbird feeders because of the loss of habitat and other food sources. The loss of habitat and other food sources is mainly due to human development and increased fire due to invasive non-native species and changes in the amount and timing of precipitation.

The lesser long-nosed bat is found in a variety of vegetation communities including desert scrub, desert grasslands, Madrean oak woodlands, thorn scrub, and tropical deciduous forests supporting agaves, saguaro and organ pipe cacti, and flowering trees; their primary food source. Female lesser long-nosed bats migrate north, following the blooming desert flowers in the spring, into southwestern Arizona to give birth. Roosts are typically within caves and mines, offering darkness and protection. The adult males tend to roost in different locations than the adult females and babies, often remaining in Mexico. Day roost sites include caves and abandoned mines, and night roosts range from these same caves and mines to buildings, bridges, and trees.

Overwintering Monarchs

This text is from the U.S. Fish & Wildlife Service.

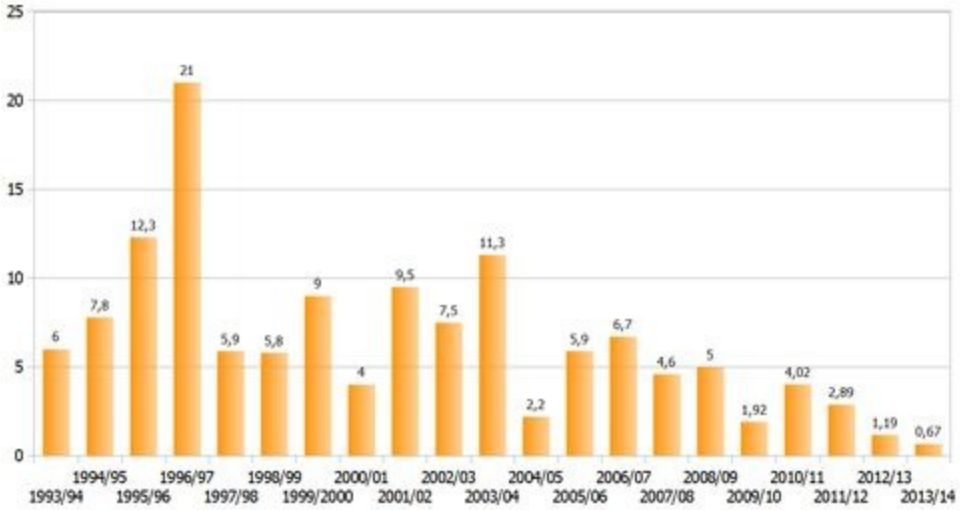
After a phenomenal two-month-long migration from the United States and southern Canada, beginning in August, the North American monarch butterfly reaches Mexico, where it spends the winter months.

The monarchs cluster in Mexico's rare oyamel fir forests, occasionally taking shelter in pines and other trees. The oyamel trees provide much needed refuge and protect the butterflies from extreme temperatures, rain, snow, and predators. As temperatures drop over the winter, monarch movement decreases, and the butterflies form large, dense clusters on oyamel branches, coloring the forest orange.

By mid-December, monarchs have settled into their overwintering homes. With colder temperatures, monarchs gather in several predictable areas, with little movement[.] This is when the overwintering count takes place. The monarch population is estimated by the total area they occupy in the overwintering grounds, and has been conducted by the World Wildlife Fund and the Mexican National Commission of Protected Natural Areas since the winter of 2004-05.

Mexico established the Monarch Butterfly Biosphere Reserve in 1980 to protect the monarch's mountainous home. Just over 60 miles from Mexico City, the 138,000-acre reserve is sectioned off into several sanctuaries that provide winter refuge to the millions of monarchs who migrate to Mexico each fall. From roughly late October through February, monarchs live in the forested mountains of Mexico, where temperatures are mild enough for survival. This habitat is only found on 12 mountaintops on the planet, and is essential to the persistence of the monarch and its migration.

[S]tatus of the monarch population [in 2016]



overwintering area of the monarch butterfly (y-axis=total area of forest that monarchs occupy (hectares); x-axis=winter season)

The 2015-16 monarch butterfly population estimates reflect a 255% increase in the area occupied by monarchs in the overwintering habitat since [the previous] year. Overwintering monarch butterflies occupied approximately 10 acres of habitat in Mexico [the winter of 2015-16] compared to [the previous] year's estimate of 2.8 acres. This is great news, but more work is needed to restore the eastern population of monarchs.

To provide some context, in the winter of 2013-14, experts reported the lowest monarch population on record with an occupied 1.66 acres of overwintering habitat. In 1996-97, monarch populations peaked with estimates reporting more than one billion monarchs occupying 44.5 acres of habitat.

You can help!

You can help monarchs as they prepare to migrate between Mexico, the U.S., [and] Canada each year by planting native milkweed and wildflowers. Avoid tropical milkweed, and delay mowing during times of peak monarch activity in your area. Everyone and every little bit of habitat can help. The more monarchs we have, the better they can withstand extreme weather and climate events.

Letters from the Past

by ReadWorks

In the muggy heat of late July in Washington, D.C., it is easy to remember that our nation's capital is built on top of a swamp. The temperature and the humidity battle each other to see which can reach 100 first. Business people suffer through their commutes, red-faced and moist from the heat, dripping with sweat that stubbornly refuses to evaporate. Jamal and Lisa were familiar with the D.C. heat waves. Every summer they came to stay with their grandmother for the month of July. Every summer the heat was miserable. This summer was no exception.

Jamal lay on the screened-in porch, his body draped over a chair. He held a glass of sweet tea to his forehead, trying to absorb some of the cool. It was early afternoon, and his grandmother had lain down for her daily nap. The heat in the middle of the day gave her migraines, and she had learned that sleep was the best escape.

"Jamal! Jamal!" said Lisa, trying to get his attention.

"What?" he asked, irritated at the interruption.

"I'm going to sort out the attic. Want to come?" she asked, unperturbed. Lisa was two years younger than Jamal and was used to being blown off.

"You're crazy," Jamal said. "It's got to be 100 degrees up there, not to mention that it's dusty and full of spiders and who knows what else."

"Grandma said that if we see anything we want up there, we can keep it," said Lisa.

"What makes you think I want any of that old junk?" asked Jamal.

"Suit yourself," said Lisa. She went to the bedroom to change into old clothes that could get covered in sweat, dust, and possibly dead spiders.

Up in the attic, Lisa began to see Jamal's point. The heat in the house rose upwards, only to be trapped in the small attic. Everything was covered in a fine layer of dust, mummified by the passing of time and inattention.

Lisa thought briefly about turning around and heading downstairs, spending the rest of the day lounging on the porch with Jamal. Maybe they would play a game or find a movie on the television. But something pushed her to investigate the attic further. A tingling in her body suggested that in these dusty boxes stacked against the walls something important was waiting for her.

As Lisa began going through the boxes, she realized that no one had touched them for years. The first boxes held memorabilia from her grandparents' youth: old family photographs that had turned yellow around the edges, diplomas from high school and college, even pictures of a pet pig that one of her grandmother's sisters had kept for several years. Lisa came across a picture of a pretty girl with "Maud" written across the bottom. She stared at the photograph. Maud was her grandmother, and it was hard to believe that the wrinkled woman downstairs had been this laughing, vivacious girl.

She sorted through the boxes, labeling them more clearly and throwing out anything that seemed useless. After a couple of hours, Lisa's back ached, and her shirt was drenched.

"Lisa, honey!" she heard her grandmother call. "Come take a break and have some tea."

Lisa went downstairs and took the picture with her. "Grandma, is this really you?"

Her grandmother laughed. "What, you can't believe it? Yes, that's me; that was taken at my homecoming almost sixty years ago."

"You were beautiful, Grandma," said Lisa admiringly.

"You'd be surprised, Lisa," her grandmother responded. "Adults, all of us, were once young and irresponsible like you."

"I don't think Mom was ever like that..." said Lisa. She couldn't imagine her stern, hardworking mother doing anything remotely irresponsible. Her mother held the family together and took care of Lisa and Jamal. But no one would ever call her the life of a party.

"Your mother..." her grandmother's voice trailed off as she carefully chose her words. "When your father died in the service, your mother was still just a girl herself. You were a baby, and Jamal was only two. She had to grow up real fast. She loves you two so much, and that's why she's so strict."

Lisa nodded. She knew her grandmother was right. She just wished that she could see a glimpse of the fun-loving, carefree woman her mother had once been. Lisa finished her tea, thanked her grandmother, and turned to go back upstairs.

"Lisa," her grandmother called, as Lisa climbed the stairs. "There's a box of your parents' things in the corner up there. Maybe it will help you understand better."

Lisa looked through several of the boxes before she found the one her grandmother had mentioned. It was smaller than the others, with "Laura," her mother's name, written on it in cursive. When she opened the box, she found a pack of old letters, tied together with a faded blue ribbon.

Opening the first letter, she skimmed through until she saw the signature: Daryl. These were love letters between her father and her mother. Lisa's father had been in the army when he'd first met her mother, and had written her from every duty station. Lisa read through the letters voraciously. Her mother was witty and charming in the letters, teasing Daryl and citing inside jokes they had. It was a side of her mother that Lisa had never before seen. She was so full of hope, so optimistic about the life that they would have together when he returned.

Lisa took the packet of letters downstairs to the den, where her grandmother was watching TV. She curled up almost in her grandmother's lap, even though she was too old to be doing that anymore. Her grandmother put her arm around Lisa and began to stroke her hair.

"Grandma?" Lisa asked. "Will it be okay with Mom that I read the letters?"

"Oh, honey," said her grandmother. "She was the one who asked me to show them to you."

Jackie Robinson Throws the Opening Pitch

The text and images are from "America's Story from America's Library" by the Library of Congress.

Library of Congress

Jackie Robinson

The crowd roared with applause as one of baseball's greatest heroes, Jackie Robinson, stepped out onto the field. On October 15, 1972, Robinson, then 53, threw out the ceremonial first pitch at the second game of the World Series--25 years after he became the first African American to play in Major League baseball.

Robinson became a legend in 1947 when he debuted with the Brooklyn Dodgers, breaking the Major League baseball color line. He finished that first season as baseball's Rookie of the Year, batting .297 and leading the National League in stolen bases with 29.

In Robinson's phenomenal baseball career, he was voted Most Valuable Player, won a World Series with the Dodgers against their New York rivals, the Yankees, and was elected to the Baseball Hall of Fame. For many of his retired years, Robinson refused to set foot into a stadium in a personal boycott, demanding the hiring of more minorities in baseball's managerial and front-office positions.

Robinson left behind an amazing record of baseball accomplishments and a heroic beginning for others, perhaps some of your favorite players.

College Football Coach Amos Alonzo Stagg

The text and images are from "America's Story from America's Library" by the Library of Congress.

Credit: "Western Championship, Chicago-Michigan at Marshall Field, Chicago," 1905. Prints and Photographs Division, Library of Congress. Reproduction Number LC-USZ62-128940.

Turn-of-the-19th century football players

September 16, 1960

Have you ever wished you could change the rules of a game you like to play? Maybe if you play a game long enough, you'll be able to make those changes. Amos Alonzo Stagg played and coached football for 71 years. He was 98 years old when he retired as a football coach from Stockton Junior College on September 16, 1960. When he played at Yale and made the original All-America football team in 1888, the game was still a fairly new sport. What innovations did Stagg bring to football?

Credit: "Football team," 1895-1910. Prints and Photographs Division, Library of Congress. Reproduction Number LC-D4-32468.

Western Football Championship of 1905

Stagg is credited with the use of dummies for tackling practice and introducing several plays that have become basic to football. If you are a football fan, you may be familiar with the "end-around play," the "shift," and the "man in motion." These are all plays that Stagg developed during the 41 years he coached at the University of Chicago. Innovations like these helped

Stagg lead his team to victory at six Western Conference (later called the Big Ten) championship games, including the one in the photograph. Stagg is so closely associated with football that many forget he was one of the first to play the new game of basketball. He even participated in the first intercollegiate basketball game in 1896. What new sport could you be among the first to play?

Don Carter and Bowling

The text and images are from "America's Story from America's Library" by the Library of Congress.

Credit: Rothstein, Arthur, photographer. "Pin boy in bowling alley. Clinton, Indiana," 1940. Prints and Photographs Division, Library of Congress. Reproduction Number LC-USF34-029484-D DLC.

Like this young man, Don Carter worked in a bowling alley as a pin boy, before there were pin-setting machines

Bowling Great Don Carter Was Born July 29, 1926

Do you like to bowl? Don Carter, born in St. Louis, Missouri, on July 29, 1926, loved the sport. He became one of the greatest bowlers of all time. Carter's fascination with bowling started when he was a child. He had a job as a pin-setter, resetting the 10 pins by hand before there were machines to do so. He went on to dominate the professional sport in its heyday. In 1961, Carter became the first bowler to win the All-Star, World's Invitational, Professional Bowlers Association of America (PBA) national championship and American Bowling Congress Masters tournaments in the same year. Where did Carter's favorite sport come from?

Credit: "American Bowling Congress, Bowling Tournament, Milwaukee, Wis..," ca. 1905. Prints and Photographs Division, Library of Congress. Reproduction Number LC-USZ62-52739 DLC.

An American Bowling Congress tournament in 1905, when modern rules for bowling were created

Articles found in the tomb of an Egyptian child buried about 3200 B.C. included nine pieces of stone, to be set up as pins, toward which a stone "ball" was rolled. Bowling has gone through many

transformations, but the sport has been around a long time. In Britain, lawn bowling is a popular sport. Dutch explorers under Henry Hudson may have brought pin bowling to America.

Bowling became a popular sport during colonial times. In early games, the ball was often rolled down a wooden plank. Author Washington Irving, in his short story "Rip Van Winkle," referred to bowling in the U.S. as early as 1819-1820. However, the sport lacked rules and equipment standards. At the end of the 19th century, things quickly changed.

Credit: "Two Hundred," 1902. Prints and Photographs Division, Library of Congress. Reproduction Number LC-USZ62-97137.

Women bowlers in 1902 tally up their scores on a blackboard [300 points is a perfect game]

In 1895, bowlers in New York City organized the American Bowling Congress (ABC) and set down rules. In 1901 they started national tournaments. The Women's International Bowling Congress (WIBC) formed in 1916. Technological advances such as the introduction of the hard rubber ball in 1905 and the development of the automatic pin-setting machine in the early 1950s made bowling more popular than ever. League bowling peaked in the mid-1960s, when Don Carter was at the peak of his game. Then, many people were on bowling teams and professional tournaments were broadcast on TV. Today, an estimated 70 million people bowl several times a year in the U.S., but the sport is not as popular as it once was. Some say professional bowling will make a comeback as a broadcast and spectator sport. What do you think?

Althea Gibson's Firsts

The text is from the "America's Story from America's Library" by the Library of Congress.

Althea Gibson playing tennis at Forest Hills, N.Y., 1957. Prints and Photographs Division, Library of Congress. Reproduction Number LC-USZ62-115789.

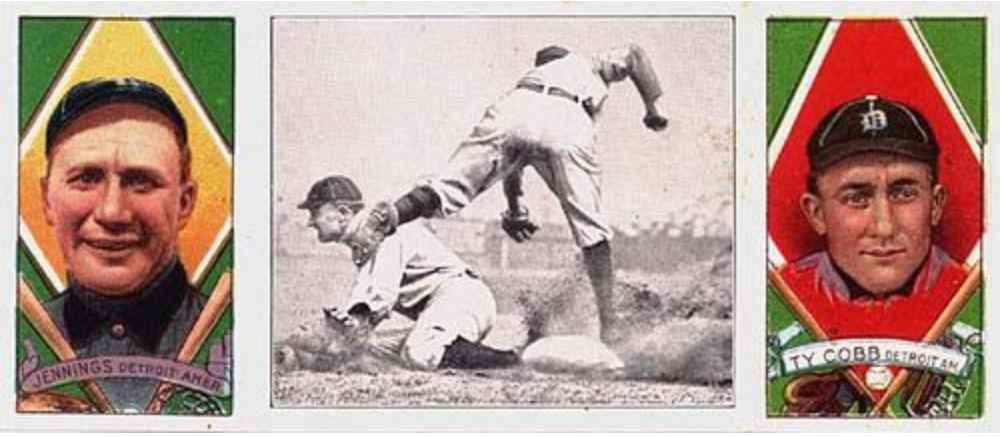
Have you ever been the first person to do something? Maybe in a sport or at school? Long before Monica Seles, Steffi Graf, or Chris Evert won the women's singles title at the Wimbledon tennis tournament in England, there was Althea Gibson. Gibson not only won the title on July 6, 1957; she was the first African American (male or female) to win a tennis championship at Wimbledon. The Wimbledon title was just the beginning of a long line of Gibson "firsts."

Althea Gibson was thirteen years old when she took her first tennis lesson, and [two years] later, she won her first tournament. Gibson was a great athlete. She was the first African American to compete for the U.S. Nationals. She won many U.S. and international titles, but Althea Gibson had something much tougher than tennis tournaments to face.

Throughout her career, Althea Gibson struggled against segregation, the practice of separating blacks from whites. Imagine winning a tournament and then not being allowed into the same hotel or restaurant as the other players. It might make you want to quit playing tennis, but Althea Gibson never gave up. She became the first black woman to be named Athlete of the Year by the Associated Press-twice. All those Gibson "firsts" helped pave the way for future champions like Venus and Serena Williams. . . .

Ty Cobb's 4000th Hit

The text and images are from "America's Story from America's Library" by the Library of Congress.



Credit: "Hugh Jennings/Tyrus Cobb," 1912. Prints and Photographs Division, Library of Congress. Reproduction Number LOT 13163-31, no. 120.

Ty Cobb in action, baseball card from 1912

Ty Cobb Made His 4,000th Hit July 18, 1927

Who do you think are the greatest baseball players of all time? If it were 1927, you might have named Babe Ruth or Ty Cobb. On July 18, 1927, Cobb recorded his 4,000th career hit. Can you imagine getting 4,000 hits? Cobb is considered by many to be the greatest offensive player in baseball history. He started his professional baseball career when he was 18 years old. For 22 out of 24 seasons, he played with the Detroit Tigers. In this baseball card from 1912, Cobb is stealing third base.

Credit: Ty Cobb, Detroit, and Joe Jackson, Cleveland, standing alongside each other, each holding bats, ca. 1913. Prints and Photographs Division, Library of Congress. Reproduction Number LC-USZ62-97880 DLC.

Ty Cobb and Joe Jackson check out each other's bats

Ty Cobb's nickname was the "Georgia Peach" because he was born in Narrows, Georgia. Besides

being a great player, Cobb was a fierce competitor. He stole home 50 times, won 12 batting average titles, and managed the Detroit Tigers for six seasons while also playing centerfield. There's some debate about the exact figure for his lifetime batting average, but for 23 years he batted at least .300. In this photo, there are two of the greatest hitters in baseball--Ty Cobb and Joe Jackson. Traded to the White Sox in 1915, Jackson averaged .356. Both players were involved in scandal. Do you know what they did?

Ty Cobb, 1909-1911. Prints and Photographs Division, Library of Congress. Reproduction Number LC-USZC4-8980.

Ty Cobb, one of the greatest players in baseball history

Joe Jackson was banned from baseball after being involved in a conspiracy to "throw" (fix the outcome of) the World Series in 1919, known as the Black Sox Scandal. Cobb was allowed to resign from professional baseball in 1926 after supposedly being involved in gambling violations. Later, baseball's first commissioner, Judge Kenesaw Mountain Landis, cleared Cobb of charges and allowed him to play again. Cobb, a left-handed batter who threw with his right hand, was elected to the Baseball Hall of Fame in 1936. Cobb's autobiography, titled My Life in Baseball, was published in 1961.

Baseball Great, Walter Johnson

The text and images are from "America's Story from America's Library" by the Library of Congress.

Walter Johnson, Washington Nationals, baseball card portrait, 1909-1911. Prints and Photographs Division, Library of Congress. Reproduction Number LC-DIG-bbc-1046f.

Walter Johnson, "The Big Train" on a 1913 baseball card

Baseball Great Walter Johnson Died December 10, 1946

Who's the best pitcher you've ever seen play baseball? Between 1907 and 1929, many fans would have answered "The Big Train," Walter Johnson. Baseball great Walter Johnson died on December 10, 1946, at the age of 59, but he left behind an amazing legacy of records to beat. He scored more shutout victories (110) than any other major league pitcher. In 1913, he set a record for most consecutive scoreless innings, pitching 56 of them. His record stood for more than 50 years, until Don Drysdale beat it in 1968. Johnson's strikeout record (3,508) held until 1983. In all-time wins, Johnson is second only to Cy Young. What was this productive pitcher's secret weapon?

Credit: Washington baseball team, season 1913, 1913. Prints and Photographs Division, Library of Congress. Reproduction Number LC-USZ62-119122.

Senators in uniform: the Washington Baseball Team in 1913

Johnson's best pitch was hardly a secret. His fastball is considered to be among the best in baseball history. One sports reporter in Johnson's day remarked, "He's got a gun concealed about his person. You can't tell me he throws them balls with his arm." He started developing his famous pitch on the mound of in his Kansas high school. When the Washington Senators recruited him in 1907, he said he would come to try out only on the condition that the team would pay his way home if he failed in the big leagues. Johnson needn't have worried!

Credit: Walter Johnson, Washington Nationals, baseball card portrait, 1909-1911. Prints and Photographs Division, Library of Congress. Reproduction Number LC-DIG-bbc-1047f .

Most Valuable Player, Walter Johnson on a baseball card from 1909-11

Honored in 1913 and in 1924 as the American League's Most Valuable Player, Johnson retired from playing baseball in 1927. Two years later, he took over as manager of the Senators until 1932. He was among the first players to be elected to the National Baseball Hall of Fame. The "Five Immortals" first chosen for the honor were Ty Cobb, Christy Mathewson, Babe Ruth, Honus Wagner, and "The Big Train" Walter Johnson. So, how's your fastball?

The Father of Figure Skating

The text and images are from "America's Story from America's Library" by the Library of Congress.

Credit: J.H. Bufford's Lith. "Jamaica Pond, West Roxbury, Mass. / lithog. & published by J.H. Bufford, Boston.," ca. 1859. Prints and Photographs Division, Library of Congress. Reproduction Number LC-USZC4-2024.

Ice skating in pre-Civil War America

Humans may have skated across the ice on a pair of rib bones from a local reindeer as early as 1000 B.C. Some 2,800 years later, just before the start of the Civil War, an ice skating craze swept across the U.S. In big cities and small towns, people strapped skates over their shoes and took to the ice.

Unlike today's competitors, skaters who participated in ice skating championships in the mid-1800s had a limited number of moves, made in a stiff and rigid style. It took the father of figure skating, and a new century, to add grace and flair to the sport.

Credit: "Jackson Haines," 1912. Prints and Photographs Division, Library of Congress. Reproduction Number LC-USZ62-106732.

Jackson Haines, the father of figure skating

Jackson Haines, the father of figure skating, originated the type of figure skating you see on TV today. In the 1860s he brought ballet style and techniques to the sport. Although he won the U.S. men's championship, his expressive style did not yet catch on in the U.S.

Haines went to Europe in 1865 and became a popular success but died before his style of skating caught on. Called the "International Style," Haines's form of skating eventually overcame resistance in the U.S., and on March 20, 1914, the first national figure skating championships in the "International Style" were held at New Haven, Connecticut. Have you developed your own personal style of skating? Would a pair of reindeer rib bones help?

Professional Golfer, Kathy Whitworth

The text and images are from "America's Story from America's Library" by the Library of Congress.

Have you been following the spectacular golfing career of Tiger Woods? Well, he's got a big task ahead of him to match the achievement of Kathy Whitworth, professional golf's all-time leading tournament winner. Born September 27, 1939, in Monahans, Texas, Kathy Whitworth won her first tournament [the Kelly Girl Open] in 1962. In 1985, she won her 88th, setting the tournament victory record for a professional golfer-man or woman. She sure stayed out of sand traps! And her honors go well beyond that.

Whitworth started playing golf at the age of 15. At 19, she joined the Ladies Professional Golf Association (LPGA) Tour. Over the next 15 years, she received the LPGA Player of the Year Award seven times. In 1965, and again in 1967, the Associated Press named her Athlete of the Year. [GOLF] Magazine called her "Golfer of the Decade" for her outstanding performance between 1968 and 1977. And in 1975, Whitworth was inducted into the LPGA [Tour] Hall of Fame. During that time, she also worked with her peers to help women golfers gain greater recognition and financial rewards.

Credit: "Womens Metropolitan Golf Championship, Nassau Country Club.," 1913. Prints and Photographs Division, Library of Congress. Reproduction Number LC-USZ62-121145 DLC.

By the 1920s, women's amateur golf tournaments like this one at the Nassau Country Club were attracting a range of players and large crowds.

[Today, Whitworth's] focus is on helping other women master the game that privileged American women first tried in the mid-1890s. At the time, women of social status found the adventure and challenge of golf as an opportunity to engage in sport. In the 1920s [in the United States], after women championed the suffrage movement and gained the right to vote, [more] women began playing in amateur tournaments. In the 1940s and 1950s, golfing greats such as Babe Didrikson Zaharias started the LPGA . . . and tried to make the sport more accessible to women of all races and social classes. With new super champions today such as Karrie Webb and Tiger Woods, golf is more popular than ever. Why not pick up a club and try a swing? Fore!

Across the Lake

by W.M. Akers

"What do you think's over there?" asked Bart.

"What do you mean?" said Patsy.

"On the other side of the lake. What do you think is over there?"

Patsy and Bart were sister and brother-twelve and eight years old. They were on vacation, but Patsy was bored out of her mind. Ever since Bart was born, their family had been coming to Lake Wenatchee, a crystal blue sheet which stretched as far as the eye could see. Ever since Bart was born, they had stayed in the same cabin, a musty old wreck just steps from where the water met the gritty beach. And ever since Patsy was 10, she had hated coming here.

The mosquitoes got bigger every year. By now they were larger, it seemed, than her fist. The humidity got worse, and the rain became more constant. If this is what people meant by climate change, she thought, she was opposed to it. She spent most of the day reading in bed, stretched out on the scratchy blanket on the rock-hard mattress, wishing she was at home with her friends doing normal summer stuff: going to the mall, watching movies, eating popsicles in the park. She wished she was anywhere but Lake Wenatchee.

But there was nowhere else Bart wanted to be. He didn't mind the humidity, he found the constant rain soothing, and thought the giant mosquitoes were the most amazing animals he had ever seen. He didn't have time for reading on a scratchy blanket because he was in love with the lake. As soon

as dawn broke, he was on its shore-building gritty sand castles from the gritty sand. He imitated the birds, trying to get their attention. He crept up on geckos, hoping they would want to play. He threw rocks in the water doing everything he could to entertain the fish. Bart loved nature-even if the towering mosquito bites that dotted his arms and legs were proof that nature didn't love him back.

"I bet the other side of the lake is even better than this side," he said.

Trying to act interested, Patsy said, "What makes you say that?"

"It's tough to believe, I know, because this side is so unbelievably super perfect. There are birds and lizards and mosquitoes and fish. But something in my gut tells me that it's even better over there."

The summer before, Patsy and her mother had driven to the other side of the lake to buy shampoo at the drugstore. The other side of the lake was nothing too exciting: strip malls and gas stations, with a shopping mall in the middle. But before she told Bart the truth, she wanted to know what he was imagining. It would be more fun to burst his bubble that way.

"Describe it to me," she said. "Tell me everything that's on the other side of the lake."

"Fish, obviously. But much bigger ones, I bet. The kind we saw at the natural history museum last year-like the super-underwater kind that have the little lamp hanging in front of their eyes. I bet there's a whole bunch of those. And birds, too-obviously-but great big huge ones. Not just seagulls and stuff-falcons, hawks, and snowy owls."

"And bald eagles, too, I bet."

"Tons of them."

"Do you know what they call a group of eagles?"

"I don't know...a flock?"

"A convocation."

"No way."

"It's true! I learned it in science class last year."

"So if I went to the other side of the lake, I'd see a convocation of eagles?"

"And I bet that's not all you'd see. What else?"

"Uh...I don't know." Bart tossed a rock into the lake and watched the ripples drift slowly to the dock. He was appearing to lose interest.

"Come on, Bart! Let your imagination run wild. Anything in the world could be over there. So what do you want to see?"

"Well, uh...an ice cream store."

"What *kind* of ice cream store? The best one in the world?"

"Definitely."

"What makes it the best one in the world?"

"Well, uh-all the ice cream costs 25 cents. And if you ask for a free sample, they give you a whole scoop. And they have all kinds of crazy flavors, like butternut peanut butter walnut, and triple chocolate marshmallow fluff surprise."

"Triple chocolate marshmallow fluff surprise? What's the surprise?"

"More marshmallow."

Patsy felt her stomach give a rumble. "Huh. That actually sounds really good."

"Of course. And next to the ice cream store is a roller coaster park."

"And all the roller coasters are free?"

"Yep. And each one has a double loop-the-loop."

"You'd better ride that before you go to the ice cream store, not after."

"Good point." Bart trailed off again, distracted by a snail. Patsy found herself strangely impatient. She wanted to know what else was on the other side of the lake.

"Is there anything that I will like?"

"You like ice cream."

"Yeah, but what else?"

"Uh, I don't know. I guess there's probably a movie theater and stuff."

"But I can see movies at home. What's over there that's special?"

"There's a clothing store where they give you five free outfits, just for coming in the door. And all the clothes fit you perfectly, and the sales ladies are never mean to us, just because we're kids."

"Oh man, that sounds great."

"Yeah! And..." Bart tried to remember what else his sister liked. "There's a place where you can get free notebooks for school!"

"Really?"

"The really expensive kind, with the heavy paper and colorful covers and stuff. And you can have all the fancy pens you want!"

"That does sound nice..."

"Wait a minute! Didn't you and Mom go over there last year? To buy shampoo or something?"

"Yeah."

"Well, what was it like?"

Patsy remembered the strip malls and gas stations-a lake of concrete, where the humidity was unbearable and the mosquitoes, somehow, even bigger-and she looked at her brother's hopeful, dreaming face.

"It was exactly like what you said," she said. "Free ice cream and roller coasters and everything. Exactly like that."