BURPEE

MEMBER MAGAZINE
SEPTEMBER 2024

Out of the Rock

WHALES WHAT EXACTLY ARE THEY?

HELL CREEK AMBER + PRESERVATION

Delve into the exceptional preservation qualities of Hell Creek amber...

UNEARTHING HISTORY WITH MRBEAST

Burpee Museum's Collaboration

Cover Art by: Claire Jorgensen

BURPEE

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DINOSAURS + FOSSILS + FUN

A SCIENTIFIC FOOTPRINT

Strategic Planning and Growth

At Burpee Museum, we witness the wonder and joy of discovery every day—a young student holding a real fossil, a child petting a live lizard, a grandmother sharing stories of local wildlife. These moments light up eyes and hearts, fostering a deep connection to our natural world. Museum experiences spark a fire of inquiry. This is the essence of science and learning: digging into our questions!

Josh Mathews, in the Broast Paleontology Lab on Burpee's campus, maps out the bone "jumble" to a young visitor. The fossils are currently undergoing preparation after excavation from the Hanksville-Burpee Dinosaur Quarry in Utah.

Burpee Staff continues our mission both inside the museum and outside. Here two staff members collect invertebrates for student biology classes at Burpee's AquaAerobics Water Lab on the shores of the Rock River.

Expanding our Reach

I am happy to announce a new chapter for Burpee Museum: the 'Expand the Scientific Footprint' initiative. This strategic plan goal propels us towards fresh horizons and greater scientific influence. In 2023, Burpee Paleontologist Josh Mathews and the Hanksville Burpee Dinosaur Quarry were featured by world-famous YouTuber MrBeast! While paleontology remains integral, we're enthusiastic about diversifying our scientific pursuits and widening our impact. The completion of the Biology Wet Lab in 2023, coupled with my ongoing biology education and research, expands our scientific domains. The support of our Board of Trustees, our hardworking staff, volunteers, and you make these initiatives possible!

The STEM Gap

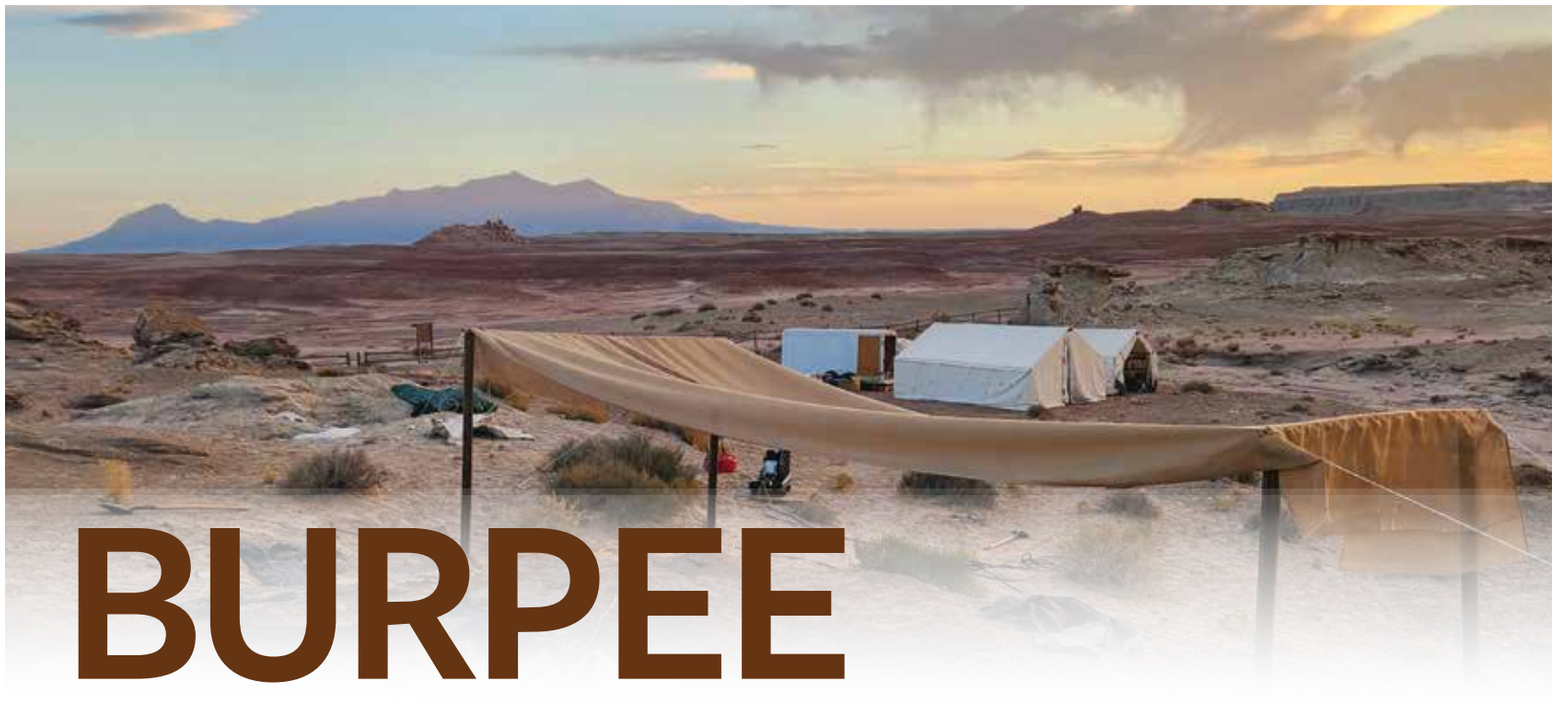
Access to resources in Science, Technology, Engineering, and Mathematics (STEM) is not equitable. There are individuals with geographic, financial, and other barriers that prevent opportunity. This is one of the reasons Burpee is committed to reaching across that STEM gap and providing inclusive education through scholarships, outreach programming, and more. It is thanks to the volunteers and donors that we are able to do this.

Anne using a dip net to collect nymphs at the Madison Arboretum

Successes

As usual, my heart swells with pride. The Burpee Staff, Board of Trustees, Volunteers, Community Supporters, and Donors continue to carry us to new and exciting futures. It is my honor to work with the community to ensure Burpee's mission of scientific learning, research, and conservation will outlive us all.

Respectfully and Enthusiastically Yours,
Anne Weerda
Executive Director



BURPEE IN THE **SPOTLIGHT!**

Author: Josh Mathews

Paleontology, especially dinosaurs, captivates people of all ages and backgrounds. The mere mention of "dinosaur" conjures images of a fantastical world with massive, lumbering creatures and fierce carnivores, much like Hollywood's portrayal in films like Jurassic Park. But is this cinematic depiction accurate, or does it more closely resemble modern ecosystems, such as Africa's Serengeti, where predators and prey coexist in a dynamic balance?

Media—through television, movies, and documentaries—greatly influences our perception of prehistoric life. Each new program incorporates the latest scientific discoveries, reflecting the ever-evolving nature of paleontology. As new evidence emerges, older theories are refined or replaced, leading to more nuanced understandings of prehistoric ecosystems.

While major universities and renowned museums like the Smithsonian and the American Museum of Natural History often dominate the media spotlight, smaller museums also play crucial roles in paleontology. They may not have the same level of visibility, but they can make significant contributions to the field.

A prime example is the Burpee Museum, which gained international recognition with the discovery of Jane, a remarkable dinosaur fossil. This find propelled Burpee onto the global stage and helped its paleontology program grow into a respected and influential institution.

Josh Mathews and Jimmy Donaldson
a.k.a MrBeast

IMAX DINOSAUR DISCOVERIES

In the spring and summer of 2022, I was invited to consult on an IMAX project about dinosaurs, set to debut in a major museum and travel to others. "Dinosaur Discoveries: A Holographic Adventure" follows an early-career paleontologist and her team as they use holographic projections to explore Earth's history from dinosaurs to the present. My role involved providing insights on fieldwork and the setup of remote dig sites.

Although much of the film was shot in a studio, I traveled to Los Angeles to help build a simulated desert dig site. This included setting up large tents and creating replica field jackets with fossil casts as props. Many items in the movie, such as site-label boxes, feature actual Burpee sites from Utah, Montana, and my dissertation research. While Burpee wasn't mentioned by name, this allowed me to subtly highlight our fieldwork. This project, while a fun adventure, also showcased Burpee's growing prominence. Burpee was coined the "little museum that could" during the early years of the Jane project, and we have continued chugging along.

Josh Mathews with the Youtube Team.

YOUTUBE: MRBEAST

In August 2023, I was contacted by a producer from MrBeast's YouTube channel. For those unfamiliar, MrBeast, a.k.a. Jimmy Donaldson, is the world's largest YouTube influencer, known for videos that often surpass Super Bowl viewership. His content usually contrasts items of different values, like $100 vs. $10,000 hotel stays.

The producer's email proposed featuring "cool jobs," with dinosaur excavation being one of them. Initially skeptical, I confirmed its authenticity with Dr. Steve Brusatte, who recommended proceeding. We arranged to film at the Hanksville-Burpee Dinosaur Quarry in October, where I, alongside MrBeast's crew, excavated bones.

Planning the shoot was intense, involving weeks of preparation and several iterations, all kept secret for safety reasons. On site, we unearthed the quarry's largest bone to date—a 5-foot Diplodocus femur. The video, released in late November, quickly went viral, amassing over 130 million views. Although the Burpee Museum wasn't mentioned, there are shots inside our museum, and I made sure to wear our branded clothing during the shoot for the world to see!

Although Burpee Museum might be considered "small" compared to major city institutions, I'm incredibly proud of our progress over the past 20+ years. Dinosaurs attract visitors and are a driver to foot traffic at Burpee, our educational programs are exceptional and Burpee is gaining national and global recognition. We aim to continue growing and expanding our scientific impact beyond dinosaurs, and raising awareness is a great start!

WHAI

What exactly are they?

Author: Carl Deaton

Whales are fascinating because their evolutionary story is unique: a story of aquatic organisms moving to the land, and then back to the water once again. The initial move from water to land during the Devonian (360-420 mya), organisms like Tiktaalik found selective advantages in moving to a terrestrial environment that subsequently caused an explosion of animals living out of the water.

Millions of years later, some of the artiodactyls, a hoved mammalian group, began a journey back to the water. From the outside they don't look much like whales of today at all, but skull analysis reveals amazing similarities to modern whales!

Artiodactyls

A TRANSITION STATE

One of these lineages of artiodactyls began a transition back to water: Pakicetidae. Looking at their ankle bones, their terrestrial nature is revealed with bones very similar to a modern artiodactyl, the hippopotamus. This is the most basal group of modern whales, which lived around 50 to 49 million years ago. Pakicetus and relatives were 3 to 6 feet long with long legs for running on land. They spent much time on dry land, contrasting sharply with modern whales.

Pakicetus

BACK TO THE WATER

Moving the evolutionary clock forward the group takes to the water with long heads, bodies, and powerful hind limbs. Ambulocetids might have walked on land briefly and lacked a modern whale's fluked tail, but may have had webbed feet. They were about 10 feet long and illustrate the transition from land to aquatic life leading to modern whales.

Ambulocetids

LES

Protocetid

Protocetids still had strong forelimbs that could support the weight of their body on land, however were likely amphibious much like the Ambulocetidae. While it is unclear if they had flukes, they were more adapted for life in the water than their ancestors, including loose vertebrae, and nostrils further up the skull leading to the iconic blow hole of modern whales. A fossilized fetus found in a Maiacetus was positioned head first, suggesting they still gave birth on land, and not in the water as the tail first delivery of dolphins and whales.

Unearthed by paleontologists in the deserts of Northern Africa, Basilosaurids were long-bodied, toothed whales with rear flippers that had well defined limbs, unlike modern whales. They were unable to support their weight on land with these limbs, but it is unknown how they were used in movement. They had relatively small skulls compared to their large bodies and strong bites, and varied from 8 to 65 feet in length.

Modern whales, or cetaceans, include both toothed whales like sperm whales and dolphins (odontoceti) and baleen whales like blue and humpback whales (mysticeti). These fully aquatic carnivores range from the small vaquita porpoise at about five feet to the enormous blue whale, which can reach 90 feet. And thus, through this lens of whale evolution, we see nature's remarkable ability to adapt, shifting from water to land and back to water.

EVOLUTION CONTINUES TODAY

Author: Anne Weerda

"Mere chance ... alone would never account for so habitual and large an amount of difference as that between varieties of the same species."

Charles Darwin, On the Origin of Species (1859)

Charles Darwin discussed the immense selective pressures exerted on organisms throughout time and across different environments on Earth.

Although it is essential to categorize diverse organisms into distinct groups and create a phylogenetic map of Earth's biodiversity, the classification often halts at the species level. Within a single species, there is substantial natural variation. This variation is crucial, as it drives the success or failure of survival and reproduction, and ultimately contributes to future speciation.

A Snapshot of the Evolutionary Process?

If we pause the evolutionary clock and examine a single extant, living species of fish, we can observe remarkable diversity in the form of distinct ecotypes with varied behaviors and phenotypes. It's as though evolution momentarily stands still before our eyes. A striking example of this is the Three-Spined Stickleback (Gasterosteus aculeatus).

At the end of the Pleistocene, the rapid melting of the last large ice sheets caused sea levels to rise, creating new inland freshwater lakes and streams. Originally a marine species with anadromous populations, the oceanic Gasterosteus aculeatus (Three-Spined Stickleback) began to invade these newly formed freshwater habitats. This invasion led to diversification within the species, resulting in distinct limnetic, benthic, and marine ecotypes that occupy different regions of freshwater bodies and the ocean. Oceanic G. aculeatus closely resembles these newly evolved freshwater populations, providing insights into ancestral traits.

The Three-Spined Stickleback is an exemplary model for studying adaptation and evolutionary processes. It illustrates how oceanic populations independently evolved into multiple freshwater populations, each adapting to local conditions. This process resulted in allopatric morphotypes—distinct morphological features due to geographical or ecological separation.
Today, the limnetic ecotype inhabits the limnetic zone, characterized by deeper waters with high light conditions. Its prey consists primarily of zooplankton, which can be patchily abundant. In contrast, the benthic freshwater ecotype resides in the benthic zone at the substrate level, whether shallow or deep, and preys on macroinvertebrates associated with or attached to the substrate.

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Cryptic Speciation...should be removed

A Look Alike

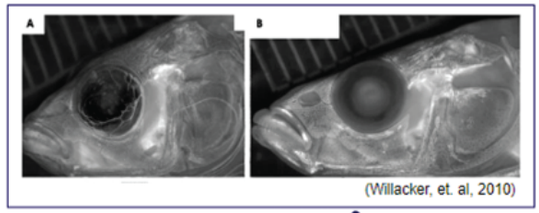
Sometimes two distinct species of different genetic makeup are hard to differentiate based on their physical appearance. A prime example is the Nile crocodile. At first glance, Crocodylus niloticus and Crocodylus suchus might seem identical, but genetically, they are quite distant and represent two separate species.

Interestingly, ancient Egyptians, however, were able to distinguish between them. They selectively used the smaller, tamer Crocodylus suchus in ceremonies and held it in sacred regard.

Diversity can be striking even within a single species. Take the Mexican tetra fish (Astyanax mexicanus) as an example. Surface-dwelling tetras live in well-lit streams and have functional eyes, which are essential for navigation. In contrast, the cave-dwelling ecotype of the same species inhabits pitch-dark caves and lacks functional eyes. Although cave-dwelling fish start with eye-forming cells, these cells are redirected during development, leading to the complete absence of eyes in the cave form. This blind cave tetra also lacks pigment, giving it a pinkish-white appearance. It swims in midwater above rocky and sandy bottoms, feeding on crustaceans, insects, and annelids but is omnivorous in captivity. It relies on its nasal cavity and lateral line system to detect food and vibrations, rather than sight.

In an interesting study, surface-dwelling tetras raised in darkness developed traits similar to cave-dwelling tetras. These offspring showed changes in gene activity related to starvation resistance, metabolism, and neural signaling, which could affect behavior. However, they also developed pigmentation cells that are useless in the dark.

Phenotypic plasticity describes how a single set of genes can produce different traits based on environmental conditions. These changes, occurring during development rather than through genetic mutations, can influence survival and evolution. Traits beneficial in dark environments might become genetically fixed over time if advantageous. This mechanism allows species to rapidly adapt to new environments, as seen with stickleback ecotypes and other colonizing species. Understanding phenotypic plasticity offers insights into how organisms adapt and evolve in response to changing conditions.



Benthic

Shorter, deeper skulls, and shorter snouts.
Significantly larger orbit diameter.

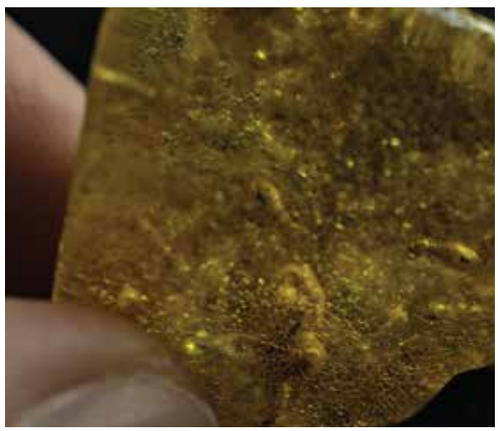
Limnetic

Longer skulls and longer snouts.
Smaller eye orbit diameter.

WINDOWS

Hell Creek Amber & Preservation

Author: Stew Cook



Amber jewelry from collections and Baltic Amber from EDU Collections

Paleontology is nothing short of necromancy, but it, of course, has its limits when it comes to what the fossil record provides us. We can learn all we can from the bones and traces of extinct animals, like dinosaurs, but our pictures of them will never be one hundred percent. The fossil record is wrought with incompleteness and poor preservation, with few exceptions. However, one medium of preservation breaks this principle and commonly preserves such exquisite detail as well as provides an abundance of information not normally preserved in rock. For unparalleled preservation, we can look to a mythical substance: amber.

ENAMORED WITH AMBER

Long before we used amber as a source of scientific information, we revered it for its beauty as an artistic medium. Humans have been collecting amber since the Neolithic era, using it to make jewelry, sculptures, and many other art forms. Many cultures also used it for perfume, incense, and medicine. We have always been enamored with amber, but it was not until much later that we realized the greatest treasure amber provided was its potential for glimpsing millions of years into the past.

Contrary to “Jurassic Park” movies, amber is not fossilized tree sap but polymerized plant resin. Plants produce resin to combat various environmental threats, mainly pathogens and herbivorous insects. Made of organic molecules such as phenolic compounds and terpenoids, which give resins their signature smells, resins are commonly exuded from trees as a defense. However, we still know very little about the roles of these substances.

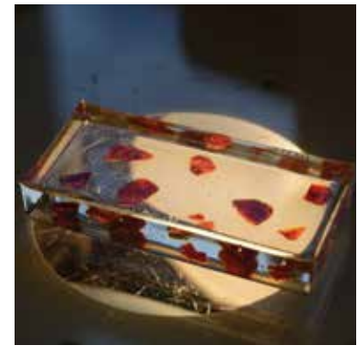
Created by polymerization—the linking of small molecules into larger ones—the resin becomes sticky and viscous. Over time, it continues to polymerize, turning into the glassy substance we know as amber. Scientists are still studying this long-term polymerization process, but we know it can take millions of years to create “mature” ambers. Unlike the fossil remains of dinosaurs, which are completely replaced with rock, amber is the very same substance it was millions of years ago when it was exuded from a tree—it has only transformed!

PRESERVING THE SMALLEST

Amber has been incredibly important to paleontology because of the preservation bias towards large-bodied organisms. Fossil deposits like the Late Jurassic Morrison Formation are a great example of how larger organisms, like dinosaurs, are well-preserved, while small organisms, like arthropods, are incredibly rare to find in rocks. Only in rare lagerstätten, such as the Mazon Creek Fossil Deposits in Illinois or the Green River Formation in the Western United States, are small organisms preserved. However, these specimens are flattened two-dimensionally and offer limited information.

Amber, on the other hand, offers three-dimensional specimens with incredible preservation of small structures, like hairs or even soft tissues. Yet, like all paleontological records, the amber record suffers from incompleteness. There are immense periods with no amber deposits or lagerstätten that preserve small-bodied organisms. Discovering and studying amber deposits that fill in these gaps is vital for piecing together the history of the smaller players in Earth’s history.

IN TIME



HELL CREEK AMBER

One of these deposits is surprisingly found in the heart of one of the most well-known fossil deposits in the world: the Late Cretaceous Hell Creek Formation. Famous for its superb preservation of dinosaur and vertebrate fossils, amber from these rocks has long been overlooked. Commonly small and friable, it has not been an attractive source of research. However, work done by myself and the Carter County Museum, a long-time friend of Burpee, in Carter County, Montana, has been delving into how to study this amber and what it can tell us. Found in the same rocks as Jane, Homer, and Pearl, Hell Creek amber is becoming much more promising than it was decades ago. Various insect taxa and possibly even vertebrate integument, like hair and feathers, are being discovered.

Hell Creek amber is in a unique position, preserving micro-ecosystems of the Latest Cretaceous—a distinction held by few other fossil deposits worldwide. With enough work, we hope Hell Creek amber can inform us about the insects and other

micro-communities of this time and possibly give us a glimpse into the effects of the Cretaceous-Paleogene mass extinction on these communities.

sSo far, the CCM team has established a methodology to successfully conserve this amber after collection and has discovered three orders of insects within it. Although amber deposits can preserve incredible detail of organisms, amber from the Hell Creek Formation often shows poor preservation, frequently only preserving the cuticle of insects or just a hollow mold where the specimen once was.

Work by many researchers, including Paleofest 2024 speaker Victoria E. McCoy, has shown that insect preservation in amber is often restricted to the outer cuticle or hollow voids left behind by inclusions—similar to amber from the Hell Creek Formation. McCoy's research indicates that resin composition and other factors can significantly affect the level of preservation seen in amber.

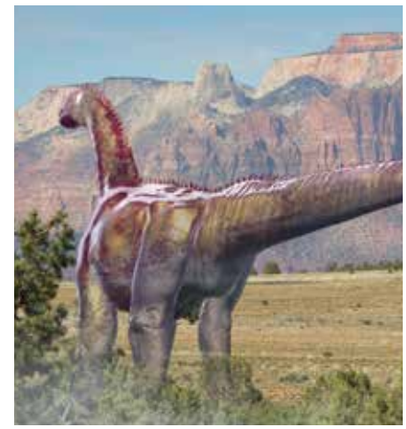
Understanding amber preservation in arthropods is still an emerging field, and the preservation of vertebrate specimens in amber is even less understood. Advancements in this area will open new doors to the information we can glean from these remarkable specimens.

In the meantime, Hell Creek amber remains an emerging field. The Carter County Museum team and I hope to publish our findings soon and introduce the world to what this long-studied formation still has to offer.

DIGGING FOR DINOS

A Journey to Change your life

Author: Claire Jorgensen



A Jurassic giants stares at modern day exposures. Artist: Stephen Scommers

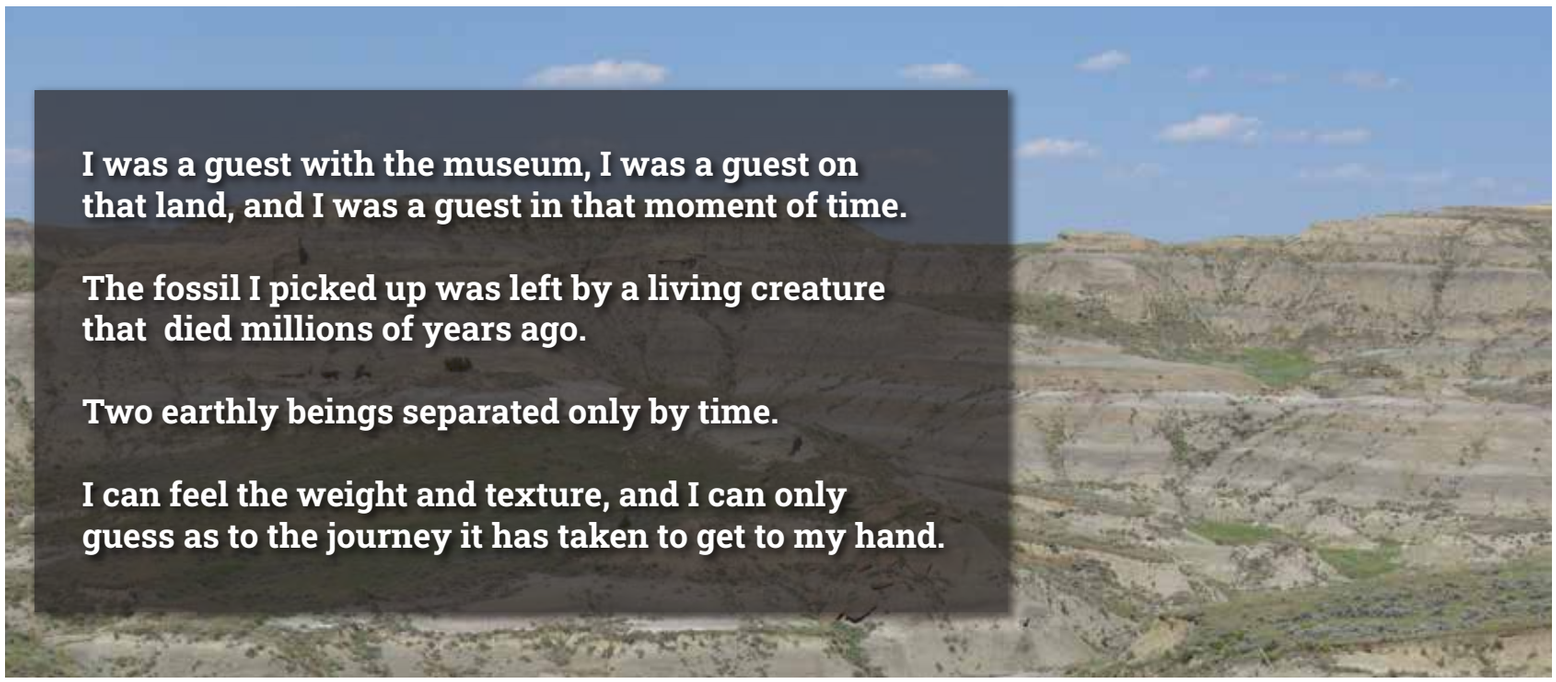
At 14, I had no clear idea of what I wanted to do with my life. We were expected to choose a career path and commit to it. It seemed like everyone around me had already made up their minds. Although I was drawn to various fields and had many interests, including biology, paleontology, museums, zoos, art, and anthropology, I struggled to narrow it down. Faced with my chronic indecision, I was determined to explore as many of these fields as possible.

A museum near my hometown offered the chance to join a paleontological dig, and I eagerly signed up. Even if it wasn't a career path, I was thrilled at the prospect of digging up dinosaurs.

The site was remote, hot, and dusty, but surrounded by fossils, I couldn't have been happier. Despite my youth and inexperience, I was welcomed by passionate paleontologists and fellow enthusiasts. There were bones everywhere, and the excitement to share their love of science and prehistoric life was palpable.

I worried that all the fossils might have been found already. As soon as I stepped into the field, a paleontologist casually told me I had stepped on a fossil, and panic set in. Had I ruined a piece of scientific history? Noticing my concern, the paleontologist reassured me that everyone breaks fossils at some point. Relieved, I inspected my first find and learned how to use paleo glue to piece fragments together. The idea that this small fossil could one day be displayed in a museum and contribute to paleontological knowledge was inspiring.

It struck me that the small fossil I had helped find could one day be displayed in a museum. My discovery might contribute to paleontological knowledge, and I was deeply moved by the thought.



Leaving the dig, I was excited for the future. Although I didn't pursue paleontology, I realized I didn't need to choose just one path. I had fallen in love with the entire artistic and scientific process—from the paleontologist who unearths fossils to the preparator who cleans them, the museum that displays them, the artist who designs exhibits, and the educator who shares this knowledge with visitors. I now work as an educator with the Burpee museum and I get to be a part of it all. It all started with that very first dig.

Participants create a field jacket out of plaster to protect dinosaur bones when they are removed and transported safely back to the museum

Hanksville, Utah

Each year, Burpee's Director of Paleontology, Joshua Mathews, leads teams in Utah and Montana to dig up dinosaur bones and fossils, adding exciting finds to our collection.

Join us on a

DINOSAUR HUNT!

Have you ever wanted to dig up real dinosaur bones?

Every summer, crews from Burpee Museum lead expeditions to the Badlands of Utah and Montana to participate in fossil excavations. Team members prospect for new bones eroding out of the hills and learn how to excavate fossils properly and how to protect them for their journey back to the Burpee paleontology lab, where they will be cleaned by skilled fossil preparators for research and exhibit.

No Experience Needed!

No experience is needed to join the team. Our paleontologists will provide hands-on training in the field on how to recognize dinosaur bones and proper excavation techniques to remove them from the rock safely.

2024 Season:

UTAH | May 2024
MONTANA | Aug 2024

For more information go to:
burpee.org/expeditions

GRAVITY DEFYING GECKOS

A symphony of force in a single toe

Author: Anne Weerda

WHAT'S THAT RUNNING ON THE CEILING!?

You probably spotted a gecko! If you've visited the SPROUTS learning lab at Burpee, you may have noticed the geckos. With over 950 species in 64 genera, Burpee's selection of 7 species offers a glimpse of this group's diversity.

GRAVITY DEFYING?

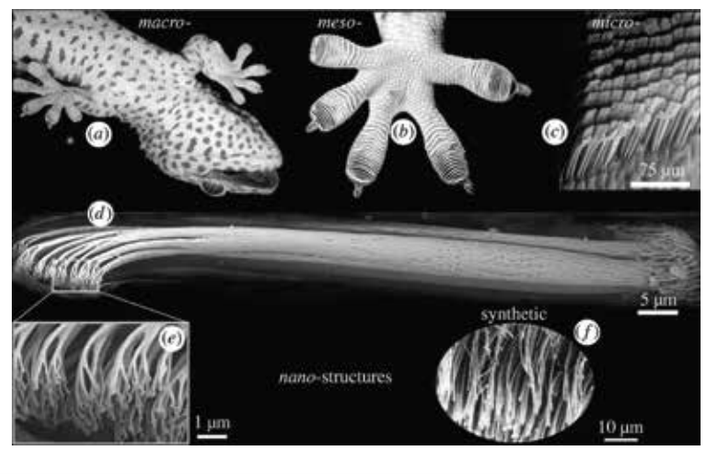
A common misconception is that geckos have "sticky" toes. If you touch a gecko's toe, it feels soft and smooth, not sticky. There are no suction cups, and if you place their feet on a hard vertical surface, the gecko will fall. So what's the secret?The gecko's toes need to be "engaged" to cling to a surface. It's not magic; it's van der Waals forces! These forces allow geckos to attach and detach their toes within milliseconds while running on vertical surfaces.Examining a gecko's foot, you'll find thousands of tiny keratinous hairs, called setae. Each hair is only 1/10 the diameter of a human hair and has hundreds of projections ending in a "spatula" shape, key to their adhesion.

HAIRS OF POWER!

In the unattached state, the setae are curved toward the gecko's body, with the spatula tips pointing away from the surface. When the toes touch a surface, the setae bend out of the resting state, flattening against the surface. The gecko detaches by increasing the angle to the substrate above 30 degrees, allowing quick attach and reattach motions as it runs.

THE FORCE IS STRONG!

Van der Waals forces are part of our every day, but often unnoticed. They are induced by molecular polarizations, weak compared to other forces, but substantial on the micro and nanoscale. In a gecko's foot, the spatula projections on a single hair get super close to the walking surface. When this happens, about 0.4 µN of force develops between a single spatula and the surface. While tiny individually, combined across millions of projections, they generate an adhesion force of about 10N, or 2.25 pounds. Quite a strong force for a tiny gecko!



a Ventral view of a tokay gecko (Gekko gecko) climbing a vertical glass surface.

b Ventral view of the foot of a tokay gecko, showing seta-bearing scansors (adhesive lamellae).

c Microscale array of setae are arranged in a nearly grid-like pattern (scanning electron micrograph)

d Single gecko seta (image by S. Gorb and K. Autumn)

e Nanoscale array of hundreds of spatular tips of a single gecko seta.

f Synthetic spatulae fabricated from polyimide at UC Berkeley in the laboratory of Ronald Fearing using nanomoulding (Reproduced from Campolo et al. 2003).

STAFF SPOTLIGHT: KADE

Visitor to Vital Team Member!

Author: April Bieschke

The Burpee Museum of Natural History is a place of discovery and learning, sparking passions that lead from volunteering to becoming an integral part of the museum's mission.

Kade's journey with Burpee began early. "I have memories of field trips to Burpee as early as three or four. I even met Mr. T when I was around four and started volunteering with him 10 years later," Kade recalls. These early visits laid the foundation for his lifelong connection with the museum.

As Kade grew, his involvement deepened, turning a childhood fascination into a meaningful role. His experiences and memories from those early visits shaped his passion for paleontology and his commitment to the museum's mission. Today, Kade helps bridge past and present, sharing the wonder that first inspired him with new generations.

Kade's love for Burpee's animals blossomed during the pandemic. "I started volunteering in mid-2021 to learn more about paleontology," he shares. "I ended up falling in love with handling and teaching about the animals, leading to my employment a year later." This twist led Kade down a fulfilling path where passion and profession merged.

When asked about his favorite animal, Kade hesitated. "I don't pick favorites, but Vinnie, our Veiled Chameleon, is often overlooked." Vinnie stands out for his unique traits and the trust built between him and Kade. "Initially, I only knew how to care for chameleons, so I'm a bit partial. Vinnie still doesn't like many people, but he's come a long way since early 2022 and seems to tolerate me," Kade notes with a smile.

Kade dedicates much time to researching animal behavior and is active in reptile-keeping groups, drawing on collective wisdom. "There are so many things we can teach and learn from animals, but what's important is seeing kids become more engaged when they see them," Kade says.

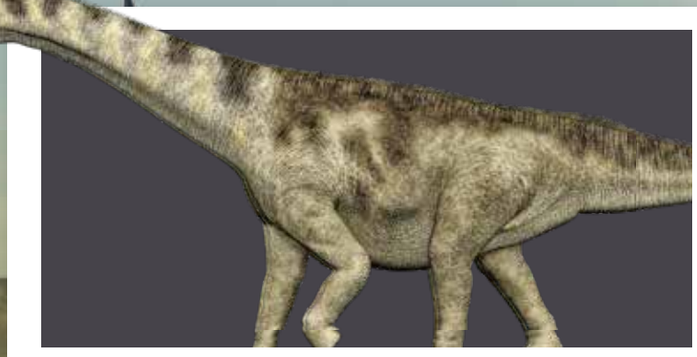
He's seen how children go from disinterest in taxidermy or rocks to fascination with live animals. "It allows kids who may not be science-obsessed to share my love for the natural world. I love seeing their eyes light up and their excitement to learn. I also learn so much from the kids, each with their own passions to share."

As Kade graduates high school and looks toward college, his experiences at Burpee have crystallized into newfound passions. "Burpee gave me a place to have fun and 'nerd out.' I hope it does that for our current and incoming volunteers and guests too. Being involved at Burpee has shown me how much I enjoy educating and engaging with people, especially kids."

What began as childhood curiosity in paleontology has evolved into a potential career in teaching. The Burpee Museum isn't just a collection of bones and rocks; it's a vibrant community where passion and learning converge. Through Kade's experiences, we see the magic that happens when a love for the natural world meets the eager curiosity of visitors, young and old alike.

Giants of the Jurassic

Author: Julie Junod



One of the most iconic scenes in cinema comes from Jurassic Park, directed by Steven Spielberg and released on June 11, 1993. The music swells, the jeep stops, and paleontologists stare at living sauropods. Based on Michael Crichton's novel, the scene features Alan, Ellie, and Malcolm (played by Sam Neill, Laura Dern, and Jeff Goldblum) encountering dinosaurs for the first time.

They are speechless at the sight of a Brachiosaurus—one of the largest terrestrial dinosaurs ever. With a majestic reach for a branch and an earth-shaking stomp, the Brachiosaurus captures paleontologist Alan Grant's awe, marking a profound shift in his world and sparking dinosaur mania worldwide.

Why choose the Brachiosaurus for this groundbreaking encounter? Its sheer size and non-threatening nature made it ideal. As a sauropod, the Brachiosaurus was a herbivore known for its gentle demeanor. Who can resist the charm of a giant with a 30-foot-long neck and legs as thick as tree trunks?

THE SAUROPOD CLADE

The Brachiosaurus is one of about 250 sauropod species that lived across nearly all continents during the Mesozoic Era. Sauropods first appeared around 201 million years ago during the Early Jurassic Period. Early sauropods were about the size of a modern rhinoceros, and three-quarters of all sauropod species weighed less than today's largest land mammals. However, between 164 and 145 million years ago, sauropods grew to become enormous and highly diverse. By 90 to 75 million years ago, sauropods disappeared from North America.

Among the 250 sauropod species that roamed Earth over 126 million years, body proportions varied greatly. While their features remained recognizable, each species had unique characteristics. Some were slender, others stocky; some had necks matching their tail length, while others had mismatched necks and tails.

Certain sauropods exhibited brachiation, with front legs longer than back legs, like the Brachiosaurus. Additionally, the placement of their legs varied, allowing different species to coexist and thrive. The largest sauropods had unique teeth, head shapes, and body proportions, enabling them to occupy different ecological niches.

SIZING UP THE GIANTS

During the Late Jurassic, sauropods reached colossal sizes. In North America, sauropods like Apatosaurus could grow up to 75 feet long and weigh 50 tons. Achieving such massive sizes is a puzzle for paleontologists due to the scarcity of complete skeletal fossils. Fossilization needs rapid sediment coverage, often from catastrophic events like landslides or floods, which are rare. These events can also damage and scatter bones, making complete finds even rarer. Moreover, sauropod heads were loosely attached, so many fossilized sauropods lack their heads. Most identified fossils are from juveniles, as smaller bodies were more easily buried by sediments.

PODS!

HOW DID THEY GROW?

Histological analysis of bone structures reveals how sauropods grew so large. Today's reptiles grow slowly compared to mammals, which can reach adult sizes in a few years. Sauropods, hatching from basketball-sized eggs, must have grown much faster than modern reptiles, as confirmed by their bones. Sauropod nesting grounds suggest they didn't care for their young, laying large clutches of eggs and leaving hatchlings to fend for themselves. Faster growth rates would have helped them avoid predators. Histological evidence shows sauropods grew faster than today's reptiles, reaching full size in 20-50 years—impressive given their massive sizes!

A DAY IN THE LIFE

Sauropods spent most of their days eating, consuming hundreds of pounds of plants daily to sustain their massive size. This immense consumption removed significant energy from the ecosystem. How did these ecosystems maintain balance with so many species eating plants?

Diversity in traits, especially in tooth and neck design, played a key role. Sauropods had two main types of teeth: flat and spoon-shaped, and thin and peg-like. Brachiosaurus and Camarasaurus had flat, spoon-shaped teeth for tougher vegetation, while Diplodocus had thin, peg-like teeth for softer vegetation and stems. This dietary variation reduced competition for food, helping prevent resource depletion and allowing multiple sauropod species to coexist.

MY, WHAT A LONG NECK YOU HAVE

A debate about sauropods, especially larger species, concerns how they held their necks. Anatomical evidence suggests some held their necks parallel to the ground. For example, Diplodocus likely held its neck out front to browse low-lying shrubs. This posture has been identified by studying vertebrae and muscle attachments in certain species.

For other large sauropods with limited fossil evidence, neck posture and mobility remain debated. Advances like virtual fossils provide new ways to study sauropod necks. Daniel Vidal, a vertebrate paleontologist, uses 3D scans of modern animals like giraffes and sauropod skeletons to explore if they held their necks more upright. Vidal was a guest speaker at Paleofest 2024.

BURPEE'S SAUROPODS

Most sauropod fossils in the U.S. have been found in the Morrison Formation, with 24 recognized species, mostly juveniles. From the Hanksville dig site in Utah, the Burpee Museum of Natural History has unearthed fossils of three confirmed sauropods: Diplodocus, Apatosaurus, and Camarasaurus. The largest find, a 60-inch femur from a Diplodocus named Mr. Beast, is on display in our Jurassic Exhibit, "River of Bones." There are also unidentified sauropod fossils that might belong to Brachiosaurus or Barosaurus.

As more fossils are unearthed and technology enhances our understanding, museums offer the public a chance to experience these wonders up close. Whether your favorite dinosaur is a sauropod or another species, their massive size continues to inspire awe.

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