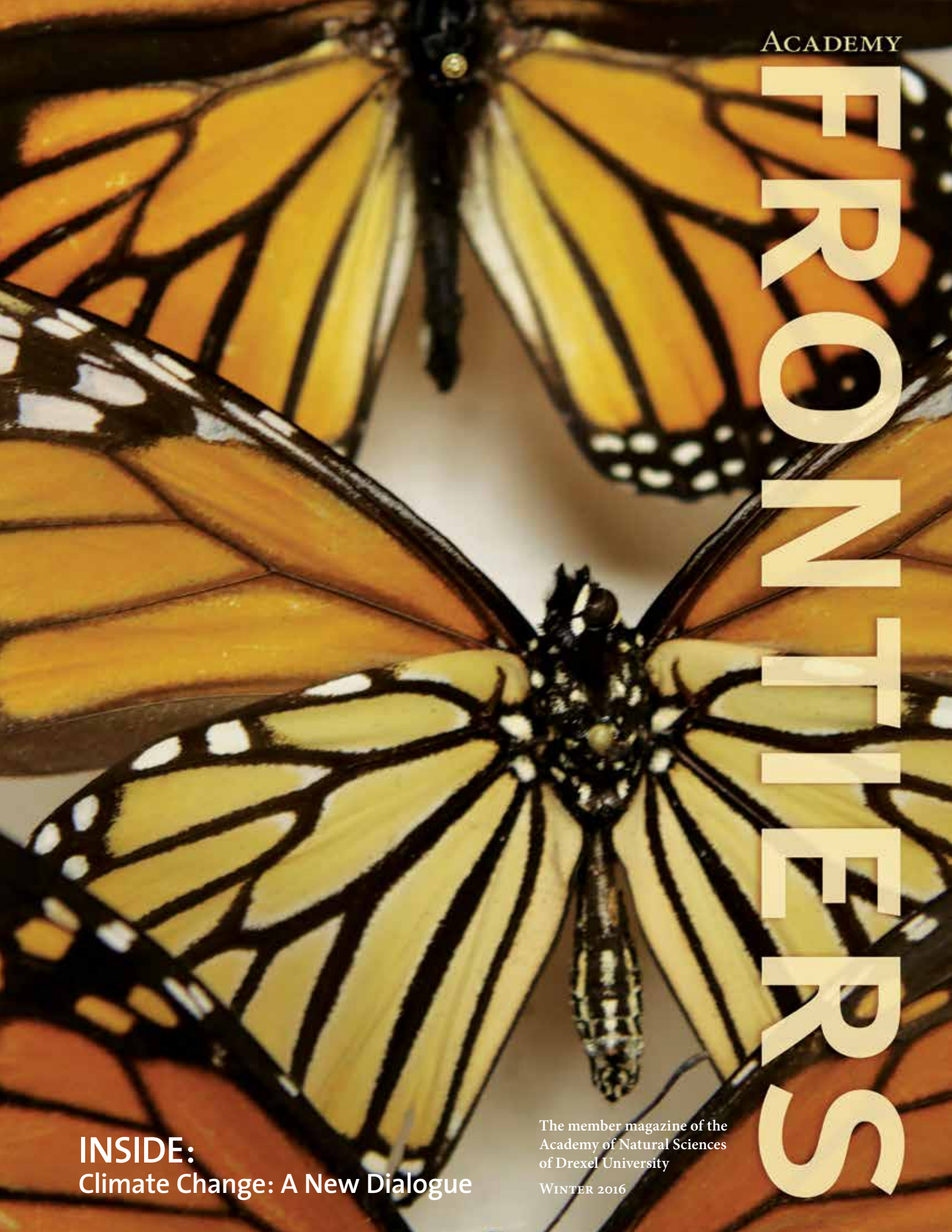

ACADEMY

FRONTIERS

INSIDE:
Climate Change: A New Dialogue

The member magazine of the Academy of Natural Sciences of Drexel University

WINTER 2016

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Academy Frontiers is a publication of the Academy of Natural Sciences of Drexel University, 1900 Benjamin Franklin Parkway, Philadelphia, PA 19103.

Please send questions or comments about *Academy Frontiers* to ans_editor@drexel.edu.

Academy membership includes a subscription to *Academy Frontiers*, free general admission to the museum, discounts in the Academy Shop and Academy Café, invitations to special events and exhibit openings, and much more.

For information about Academy membership, call 215-299-1022 or visit ansp.org/membership.

On the cover: *The number of monarch butterflies migrating to their overwintering grounds in Mexico each year is declining, and scientists are investigating links to climate change. Along with deforestation in Mexico and agricultural disruption of the milkweed flora in the U.S. where the butterflies lay their eggs, extreme weather and dramatic temperature changes may be affecting the timing of monarchs' annual migration. Photo by Mike Servedio/ANS*

Academy Greetings

Katie Clark/ANS

Dear Friends,

Scientists have been sharing compelling evidence of the existence of climate disruption for more than 20 years, and their point is finally hitting home. Throughout the world there is increasing recognition of humans' complex role in both triggering and mitigating the effects of climate disruption. Last summer, Pope Francis' encyclical prompted us to think further about how climate disruption affects our communities and resources. We explored this dimension of the conversation on September 21 at an Academy-hosted forum entitled "Climate Change: A New Dialogue" (more on page 12).

Through environmental programs such as the climate forum, scientific research, and publications, the Academy is contributing a unique and crucial voice to the climate conversation. On September 23, *The Philadelphia Inquirer* published an op-ed by several scientists and members of the Academy's leadership team, Roland Wall, David Velinsky, and Ted Daeschler. Roland, David, and Ted explored how climate disruption is affecting the natural systems that we study, as well as the wider impacts of ecosystem changes:

> *While we waste time arguing settled science—that climate change is occurring—we lose sight of the myriad human costs this change is initiating. Sea-level rise, superstorms, temperature extremes, and catastrophic flooding are all just words until they happen. When they happen, lives and livelihoods are destroyed, often irrevocably.*

A version of the piece is printed on pages 8 to 11, along with photographs that illustrate some of climate disruption's devastating impacts through the lens of Academy research. I hope you will take time to read (or re-read) this important piece and to attend an upcoming Town Square program on our changing world.

Support from you, our Academy members, enables Academy scientists and educators to study the plants, animals, and natural systems affected by climate disruption and share our discoveries with the public. If you have already contributed to the Academy's Annual Fund, I want to thank you for making a difference. If you haven't had the chance, it is not too late to donate. Your gift could make a profound impact on our work and the world in which we live.

All the best,

George W. Gephart, Jr.
President and CEO

FOUNDED IN 1812, the Academy of Natural Sciences of Drexel University is a leading natural history museum dedicated to advancing research, education, and public engagement in biodiversity and environmental science.

Contents

Mike Servedio/ANS

Tarantulas: Alive and Up Close

Special Exhibits Gallery
January 30–May 30, 2016

Tarantulas have a reputation that precedes them—terrifying, fast, hairy, scary—the biggest, baddest, and most fearsome of all spiders. In the Academy's newest hands-on exhibit, *Tarantulas: Alive and Up Close*, you will come face-to-face with a stunning array of live tarantulas—fangs and all. Play a guessing game to learn about speedy tarantulas that dwell in the highest treetops and others that live underground, only emerging under cover of darkness to ambush their prey. Find out why certain species prefer the desert and the rainforest, and learn how tarantulas may play an important role in human medicine. Get the facts on why tarantulas are so hairy as you venture through an air current that simulates the sensitivities of a hairy spider. Explore a tarantula burrow, see live feedings, check out arthropods under a microscope, and dress up like an eight-legged beast to get your photo taken!

Drawn to Dinosaurs Returns

Art of Science Gallery
Open Now

Drawn to Dinosaurs delves into the science and art of visualizing a living animal based on fragmentary fossils. This intimate exhibit illustrates what scientists can deduce from the fossil record when creating a reconstruction of a skeleton or model and what they must look to artists to interpret. The centerpiece is a full cast of the plant-eating dinosaur *Hadrosaurus foulkii,* discovered in 1858 in Haddonfield, NJ. The Academy created a full cast of this duck-billed dinosaur and put it on display in 1868, becoming the first place in the world where the public could go to see a dinosaur. Now it's back.

Bruce Tepper/ANS

Dinosaurs Unearthed

Special Exhibits Gallery
June 25, 2016–January 16, 2017

Back by popular demand—roaring, moving, life-size animatronic dinosaurs invade the Academy of Natural Sciences of Drexel University for a multi-sensory experience for the whole family. State-of-the-art and scientifically accurate—down to the feathers on *T. rex*—*Dinosaurs Unearthed* features more than a dozen realistic, full-bodied dinosaurs, as well as skeletons, fossil casts of skulls, claws, and horns, real specimens of mosasaur and spinosaurus teeth, an *Oviraptor* egg, and the ever-popular coprolite (dino poop). Visitors will experience brand-new interactives, such as a multi-touch table and a scale that tells you how you measure up to different dinosaurs. A dig site for young paleontologists, a Dino Detective touch-screen quiz, chances to control dinosaur movements, and other activities encourage exciting hands-on exploration.

BETH WATSON: WETLAND ECOLOGY THEN AND NOW

Kirk Raper/ANS

Elizabeth Watson remembers the exact moment she decided where she wanted to spend the rest of her life. As an 8-year-old, she took a tour of the Don Edwards National Wildlife Refuge, a haven at the southern tip of the San Francisco Bay. She doesn't know whether it was the moist, salty air brushing her face, the waterfowl foraging through the vegetation, or the hazy stillness of the marsh, but she felt an immediate and deep connection to the wetlands.

Today Watson keeps a picture from that day in her Academy office as a reminder of the place her career got its start. A pushpin hole and gray adhesive marks are evidence of the photo's importance, carried with her from workplace to field station. In the photograph, Watson is standing on a bridge in front of a solitary stand of California bulrush, an inundation-tolerant marsh plant that is a legacy of the wetland loss of the 1940s and 50s. The photo was taken in the exact spot where she would later conduct graduate-level research on the historical formation and expansion of the wetlands.

Watson appreciates wetlands for their aesthetic value; she is captivated by their resplendence and the patterns of the tidal channels. But on a practical level, wetlands have real value to the environment, and she is just as passionate about wetland ecology and conservation.

Wetlands are biologically diverse areas teeming with waterfowl, mammals, reptiles, amphibians, and invertebrates. They provide food and shelter for a variety of wildlife, as well as resources for commercial and recreational fishing and other activities.

"Fringing coastal wetlands can help protect us from storms by absorbing high wind and wave energy and soaking up floodwaters," she says. "Wetlands store a lot of carbon, which if oxidized, would be a huge amount of emissions. They truly help mitigate the effects of climate change."

Yet wetlands are disappearing and drowning at an alarming rate. Wetland loss is a crucial issue, one that has only been on researchers' radars for a few decades, if that, Watson says. Rising sea level as well as changes in water quality, ecosystem structure, hydrology, sediment transport, and the introduction of non-native species by humans have altered the landscape. Wetlands are often targeted for drainage and conversion in both developed and developing countries where land for new construction is in short supply.

Watson can literally feel the changes as she wades through the marsh. As section leader in the Academy's Patrick Center for Environmental Research since December 2014, she travels to Barnegat Bay, New Jersey, Delaware, and Pennsylvania several times a year to monitor soil, marsh elevation, plant biomass, and species composition. The most difficult part of her job is carrying her gear through the region's marshes. Marsh soils that used to be firm and easy to navigate are becoming soupy and hard to traverse because of waterlogging and decomposition. Unable to resist erosion, this mushy composition threatens the future of the marsh.

Home to food sources such as blue crabs and waterfowl and serving as passageways for treated sewage, wetlands display a clear imprint of human activity. As an assistant professor in Drexel University's Department of Biodiversity, Earth & Environmental Science, Watson wants her students to gain a deep understanding of our place in the environment and the natural processes that sustain us. She recently took students on a field trip to the John Heinz National Wildlife Refuge at Tinicum, the largest remaining freshwater tidal marsh in Pennsylvania. Some of the students were amazed by the diversity and beauty of the marsh and clearly connected with the place, writing about the marsh in their research papers and proposing potential research projects.

Watson and her team have no trouble recruiting students and Academy scientists to accompany them on field research days. "The Academy has been involved with wetland monitoring for several years, and even people who are casually involved have seen the changes that are occurring—increased ponding, plant die-backs, and major erosion," Watson says. "While the days are long and the work is muddy, people really get how vulnerable these places are, and how important the data collection efforts are."

Yet there is hope for the future, Watson says, and scientists and governments are studying these changes and putting coastal management and protection programs in place to guard coastal ecosystems and communities against sea-level rise and storms.

"The potential for transformation is exciting," Watson says, "and as a wetland scientist I have an important role to play in envisioning the future of our coasts." *~Mary Alice Hartsock*

drawn to dinosaurs

By Mike Servedio

Mike Servedio/ANS

In 1868, the Academy displayed the first fully mounted dinosaur skeleton, Benjamin Waterhouse Hawkins' *Hadrosaurus foulkii*. On November 1, the Academy welcomed back "Haddy" and our popular dinosaur exhibit, *Drawn to Dinosaurs*, to the Art of Science Gallery. The exhibit contains a full-size cast of the famous dinosaur, accompanied by a life-size chalk drawing of *Hadrosaurus* by Academy Dinosaur Hall Manager and paleo-illustrator Jason Poole.

On the opening day of the exhibit, I got to spend five hours watching Poole create the chalk drawing. Starting with just an outline, and with the full-size cast of *Hadrosaurus* looking on, Poole went to work quickly. In just over an hour, the outline became a full-fledged dinosaur, shaded completely in green and with the beginnings of a facial structure. Within another 20 minutes, the drawing contained orange highlights on Haddy's face and underbelly.

Throughout the day, Poole took questions from curious onlookers of all ages. Students from nearby Moore College asked Poole about his background and how he got into paleo-illustration. A 6-year-old boy wanted to talk all about his own dinosaur drawings. Poole recounted the history of *Hadrosaurus* and its origins as the first-ever fully mounted dinosaur to those who wanted to know why the Academy had chosen it for the exhibit.

As he went to work on the eyeball, I asked if drawing the facial features has gotten easier with practice. Poole recently published his second book, a coloring book called "A Dynasty of Dinosaurs." He quickly said, "Nope. It's ALWAYS one of the hardest parts to get right." He spent the next 45 minutes going up and down a small ladder, walking around the room looking at the drawing from different perspectives and checking the size and shape of the eyes and mouth.

Finally content with the face, Poole moved on to the details of the body. "Maybe I shouldn't have done scales on this one," he laughed as he drew what seemed like his 500th circle in three hours, wiping sweat from his forehead and stretching his wrist, moving it up and down. As he reached the tail of the dinosaur, the scales became more rectangular. He explained to me that different body parts required differently shaped scales, depending on their movement.

Poole finished his work by shading in black and white along some of the scales. He descended off his ladder one last time to take in the drawing from across the room. I asked him if he was satisfied with the end product and he said he was, though he admitted that he'd probably see something he wanted to change every time he walked by. Haddy isn't a big talker, but I think he would be happy with the portrait. Don't you agree?

POLAR ICE CAPS: AN EXPERIMENT

By Allison Krisch

When we talk about climate change, we often talk about the polar ice caps. Polar ice caps are large dome-shaped sheets of ice that are found on the North Pole and the South Pole of our planet. It is estimated that approximately 70 percent of Earth's freshwater supply can be found in our polar ice caps. Scientists worry that climate change—particularly an increase in warmer weather at the poles—could cause large portions of our polar ice caps to melt.

Remember, water has three different states: solid, liquid, and gas. For water to become a solid, it must freeze. Water normally freezes around 32 degrees Fahrenheit or 0 degrees Celsius. If the temperature is above freezing, ice can begin to melt. The higher the temperature, the more likely ice will melt!

ICE EXPERIMENT

SUPPLIES
- Three cups of similar size
- Ice cubes
- Timer or clock
- A piece of paper and a pencil

For this experiment, think of your house as the earth. Each room in your house contains its own climate. For example, your kitchen might feel warmer than your bathroom, so the kitchen would have a warmer climate than the bathroom. Choose three different "climates" (or rooms) for the experiment.

If you know that one part of your house is much warmer or much colder than another room, choose that one!

Take the ice out of your freezer. What does the ice first look like? What does the ice feel like?

For this experiment, the ice will represent the polar ice caps and each room will represent different climates on Earth. We will be testing to see which of our climates allows the ice to melt the fastest and which of our climates allows ice to melt the slowest.

Fill each cup with ice. Observe how much of the cup is filled with ice and how much space is left. Try to fill each cup with the same amount of ice. Once the cups are filled, place each cup in one of your selected climates (rooms). Make some predictions. How long do you think it will take for each cup of ice to melt? Which climate will the ice melt in first? Using your piece of paper, write down your predictions so that you can check on them later.

Set the timer for 10 minutes. Once the timer buzzes, check on each of your cups of ice. How much of the ice has melted? How much more time do you think it will take for the ice in each cup to melt? Record your predictions and reset the timer. After another 10 minutes, check on the ice again. Repeat until all of the ice is melted.

Which cup of ice melted the fastest? Which cup of ice melted the slowest? Do you think that the climates of each room influenced how fast the ice melted?

Repeat the experiment using different rooms if possible! You could also try this experiment by placing one cup outside and one cup inside. Check the weather before you head outside. What is the temperature today? Is it above freezing or below freezing? Make a prediction about how you think this might affect how quickly the ice melts.

CLIMATE VERSUS WEATHER

If you want to understand climate, you can start by learning about the weather that occurs where you live. Weather refers to a specific event that happens outside each day or over a period of several days. What does the weather look like today? Is it hot or is it cold? Is it sunny or is it cloudy? Is it raining or is it snowing? All of these events are weather.

Climate refers to the average weather conditions that occur in a specific place over many years. Here are a few characteristics of climate:

- Climate describes the range of what you might expect in a given location—the limits of what the weather might be. In Philadelphia, it may be cold in March or it may be warm. It may be 25 degrees Fahrenheit or it may be 75 degrees Fahrenheit. But it will almost never be 0 degrees Fahrenheit or 100 degrees Fahrenheit in March.
- Climate describes average weather. On any given day, it might be hot in Philadelphia and cool in Miami, but on most days, it's hotter in Miami than it is in Philadelphia.
- Climate describes long-term trends. If it's cold for a few days, that's weather. If it's an ice age, that's climate.
- Climate change refers to changes in the average climate of an area over an extended period of time. The changes could include an increase in rain or snow, hotter days in the summer, or colder days in the winter.

Mike Servedio/ANS

Papal Visit Helps Bring Climate Message Home

By Ted Daeschler, David Velinsky, and Roland Wall

Last summer, Pope Francis riveted the world with the release of "Laudato Si," the papal encyclical on the environment. Outlining our unique place in history, this simple, powerful, and very human message called on people of all faiths and nations to recognize changes that need to be made to ensure a future for both nature and human society.

At once a studied argument and a call to action, the encyclical in spirit can be summarized in one sentence: "Never have we so hurt and mistreated our common home as we have in the last 200 years."

As Philadelphians, we anticipated the pope's visit as a chance for the people of our region to bring that message home—to understand accepted climate science and to take action.

Our own work at the Academy of Natural Sciences of Drexel University builds on more than 70 years of efforts to understand and manage the ways people affect our planet's life-support system. We're especially interested in streams and rivers (supplying 60 percent of the nation's drinking water), in the variety of living things (which in turn supply, well, almost everything), and the threats to their survival. But, as the encyclical made clear, global climate change has the potential to overshadow all our interactions with the environment. As long ago as the mid-19th century, scientists understood that emissions of greenhouse gases could drastically alter the state of the Earth.

Now these early predictions have been borne out, and we are moving toward conditions not seen in recorded history. To say that climate change poses a threat to the ecosystem is like saying a burning building poses a threat to the furniture. Scientists of earlier eras could treat the greenhouse effect as a hypothetical curiosity; we don't have that luxury.

The leading economist Jeffrey Sachs, a key Vatican adviser who helped organize the encyclical, echoes this in a recent article: "The pseudo-debate about climate science has always been about politics, not science." To mark the pope's visit to Philadelphia, Sachs expanded on these thoughts as the first of several distinguished panelists at a free public forum, "Climate Change: A New Dialogue," held September 21, 2015 at the Academy.

The 2014 National Climate Assessment did not equivocate: "Climate change, once considered an issue for a distant future, has moved firmly into the present. [...] We know with increasing certainty that climate change is happening now." In scientific

LEFT: The Academy's Ornithology Collection is helping scientists demonstrate the effects of climate change on black-capped and Carolina chickadees, two similar yet genetically distinct species with respective ranges in the northern and southern United States. The species merge within a central hybrid zone where they produce genetically mixed offspring. Using geographic data and chickadee tissue samples preserved by former Academy Curator Frank Gill in the 70s and 80s, Cornell ornithologists confirmed that the hybrid zone moved seven miles north between 2002 and 2012. This northward shift has occurred as the minimum average winter temperature has increased, suggesting that the hybrids require a certain average low temperature for survival and are moving north to stay within that temperature range as the climate warms. Robert Driver, former Academy ornithology curatorial assistant who is studying these populations as a graduate student at Villanova University, says that hybridized chickadees are less likely to hatch successfully compared with genetically homogeneous populations.

RIGHT: When global temperatures increase, oceans warm and ice melts, causing seawater to expand and flood into coastal areas. Here, Academy wetland ecologist Elizabeth Watson stands in front of the remains of Atlantic white cedar trees in Dividing Creek, New Jersey. Like many other trees in coastal forests, these trees are not salt tolerant. They died as a result of sea-level rise, leaving space for salt marshes to creep inland.

Kirk Raper/ANS

circles, the reality of this hasn't been a subject of serious debate for years. By several estimates, 97 percent of climate scientists agree that the world is warming due to human actions.

We're not climate scientists. We study Earth's living systems. As such, we wouldn't presume to make expert statements on highly specialized fields like atmospheric chemistry and climatology. But we are part of the world's scientific enterprise, and we understand the level of scrutiny and testing faced by any scientific conclusion. We know well the gauntlet of data collection, peer review, experimental replication, conference debates, and ongoing reevaluation that any new idea must go through to become part of the scientific consensus. To have 97 percent of scientists in any field agree on the broad outlines of a principle is about as close to certainty as science ever gets.

Again, we're not climate scientists, but we are the ones who try to figure out what climate change will do to the natural systems on which we all rely. And we already see hints of what is happening.

Academy scientists are watching sea-level rise unfold in the coastal wetlands of our region. Migration patterns, from birds to bugs, are shifting, and patterns of plant growth are moving steadily north.

In the rawer conditions of Mongolia, where Academy researchers have worked for decades, we are indeed watching definitive changes in climate, measured by science and confirmed by the deep local knowledge of the nomadic herders who aid our work.

While we waste time arguing settled science—that climate change is occurring—we lose sight of the myriad human costs this change is initiating. Sea-level rise, superstorms, temperature extremes, and catastrophic flooding are all just words until they happen. When they happen, lives and livelihoods are destroyed, often irrevocably.

The papal encyclical went to the heart of the matter, highlighting the human costs and the moral imperative of recognizing and addressing the problem. President Obama echoed this in announcing new regulations to limit greenhouse gases: "We're the first generation to feel the impact of climate change and the last generation that can do something about it."

BELOW: In the past 70 years, Mongolia's average annual temperature has risen almost 4 degrees Fahrenheit. Weather patterns have changed drastically as a result of Arctic amplification, a phenomenon in which global warming spurs temperatures in and around the Arctic to rise at a faster rate than they do in the rest of the world. Formerly silky, calm rains have become short yet intense downpours that quickly run off, fail to moisten the ground, and upset the migrations of the herders who depend upon the land for survival. The short grass and bare earth in this photograph reveal the effects of overgrazing and climate change, both of which are becoming widespread in Mongolia.

Mike Servedio/ANS

We commend the president for stating the issue so plainly, and we especially commend Pope Francis and the Pontifical Academy of Sciences for making such a compelling case for action. Speaking as both scientists and citizens, we say the debate is over. It's time to get to work.

Roland Wall is senior director of environmental initiatives at the Academy of Natural Sciences of Drexel University.

David Velinsky is vice president for environmental research at the Academy of Natural Sciences of Drexel University and head of the Department of Biodiversity, Earth & Environmental Science at Drexel University.

Ted Daeschler is vice president for collections and associate curator of vertebrate biology at the Academy of Natural Sciences of Drexel University and an associate professor in the Drexel University Department of Biodiversity, Earth & Environmental Science.

A version of this opinion piece appeared in The Philadelphia Inquirer *on September 23, 2015. See it online at philly.com.*

ABOVE: Academy Entomology Curator and crane fly expert Jon Gelhaus has been identifying crane flies on his property in Camden County, New Jersey, for more than 20 years. Only in the past few years has he recorded the crane fly species *Tipula mariannae*, known previously only from Florida and therefore a surprising new record for New Jersey. Gelhaus says this could be evidence of the species expanding its range north along the Coastal Plain. "Is it due to climate warming? I don't know, but it is intriguing," says Gelhaus. Only a handful of scientists specialize in crane flies, so he may be among the first to ask these important questions.

Stephen Mason/ANS

ACADEMY FORUM ON CLIMATE DISRUPTION: A LOOK BACK

By Roland Wall, Senior Director, Environmental Initiatives

For over 200 years, the Academy of Natural Sciences has been a hub for the study, discussion, and enjoyment of science. Since the work of Ruth Patrick in the mid-20th century—and continuing today—the Academy has translated science to the public to help explore crucial questions affecting humanity. With the emergence of issues such as climate change, the Academy is committed to building public awareness and communicating the clear scientific realities of an increasingly complex world.

On September 21, the Academy of Natural Sciences held an evening forum featuring several renowned experts on climate change and its implications. Entitled "Climate Change: A New Dialogue," the forum was designed to complement the papal encyclical on the environment by recognizing the human as well as scientific implications of climate change. Setting the tone for the evening, Academy President and CEO George Gephart said of the pope's message: "This document, which by now is well known to much of the world, summarized in plain, clear language the same warning that scientists have been cautiously making for the last 20 years—that our planet is facing tremendous challenges."

Keynote speaker Jeffrey Sachs, a leading adviser to the Vatican on climate change and sustainable development and director of the Earth Institute at Columbia University, framed his comments by linking the upcoming vote on the United Nations Sustainable Development Goals and recent scientific thinking on limited planetary resources. With 2015 poised to be the hottest year on record (surpassing the hottest-year record of 2014), Sachs indicated that cultures all over the world are facing the impacts of climate change. From droughts in California to an emerging hunger crisis in Southern Africa, "every place I go has massive climate derangement. […] Wherever you go, you talk about the weather," he said.

Joining Sachs was Michael Oppenheimer, a highly respected climate change researcher at Princeton University and science adviser to the Environmental Defense Fund; Jacqui Patterson, director of the NAACP Environmental and Climate Justice Program and coordinator and co-founder of Women of Color United; and Katherine Gajewski, who heads the City of Philadelphia's Office of Sustainability and is responsible for implementing the City's pioneering Greenworks plan. Each echoed the call for clear science, realistic planning, and a fundamental change in how humans relate to our planet. The panelists discussed what makes cities and people vulnerable in an era of high energy production and consumption. With cautious optimism, they detailed the potential for scientists, government officials, and citizens to create solutions to our sustainability crisis.

Keynote speaker Sachs' comments aligned very much with the panelists' in expressing the urgency for humans to use our knowledge about climate change to positively shape our communities. We have the technologies, wealth, and knowledge to build a more sustainable world. "The core crisis," he said, "is a moral one." To address it, we will need "the moral sense" to use climate change "for the common good."

"Climate Change: A New Dialogue" was the first in a new series of evening programs to address critical public issues that involve science and the environment. Please check ansp.org for additional information on upcoming programs throughout the year.

> The scale and the pace of change that's required with all of the science [...] demands very, very fast-paced action at a very, very large scale. [...] We're going to have to be fundamentally recreating our society, and with that comes the opportunity to rebuild and reshape our cities and the communities that we live in.
>
> — Katherine Gajewski

> The marrying of the social framework that the pope presented with the scientific challenge of climate change reminds us that science has the capability of improving the human situation.
>
> — Michael Oppenheimer

> Coal combustion as an energy production process is a dangerous practice both in terms of the communities that house those facilities, the workers that are engaged in those activities, and of course the harm to the planet with coal-fired power plants being the number one contributor to carbon dioxide emissions, which is the number one driver of climate change.
>
> — Jacqui Patterson

Q: WHAT CAN ARCHIVES TELL US ABOUT CLIMATE CHANGE?

ANS Archives Coll. 407

A. Many people view archives solely as sources for history books, but the archives of science institutions are increasingly being recognized as gold mines of information for the study of climate change. The field journals of scientists from the 19th and early 20th centuries are particularly useful for this kind of investigation. Not all field journals are the same, and they offer scientists a wide range of data.

Many journals in the Academy collections cover a few days or a few weeks of an expedition—a short-term view of a location. The species that a scientist saw at a given time in a given place (sometimes including many plants and animals, sometimes focusing on just one type) can be compared with those species scientists see today in that same place. What species are still present? What species have disappeared? What species do they find now that their predecessors did not?

Other field journals have nothing to do with exotic expeditions. Some scientists kept journals that focused on a single place—often very close to where they lived and worked—over a longer stretch of time. The earliest example of this in the Academy's Archives can be found in the William Bartram Papers (Coll. 407). William Bartram (1739–1823) was an early American naturalist and artist born in Philadelphia. As a child he traveled into the field with his father, merchant and scientist John Bartram (1699–1777), to collect plants and animals. William Bartram is known for his book *Travels through North and South Carolina, Georgia, East and West Florida*, a significant classification of the flora and fauna of the American South. His work was widely read in Europe at the time and inspired British poets such as William Wordsworth and Samuel Taylor Coleridge.

For 20 years (1802–1822), Bartram kept a diary of the happenings around his garden (the Bartram's Garden of today). His entries can run as short as the one from January 7, 1818, which reads: "Morning cloudy. Mild. Ther. [thermometer] 40." Or slightly longer, as on January 3, 1802: "Cloudy no frost light showers… frogs are heard whistling wind."

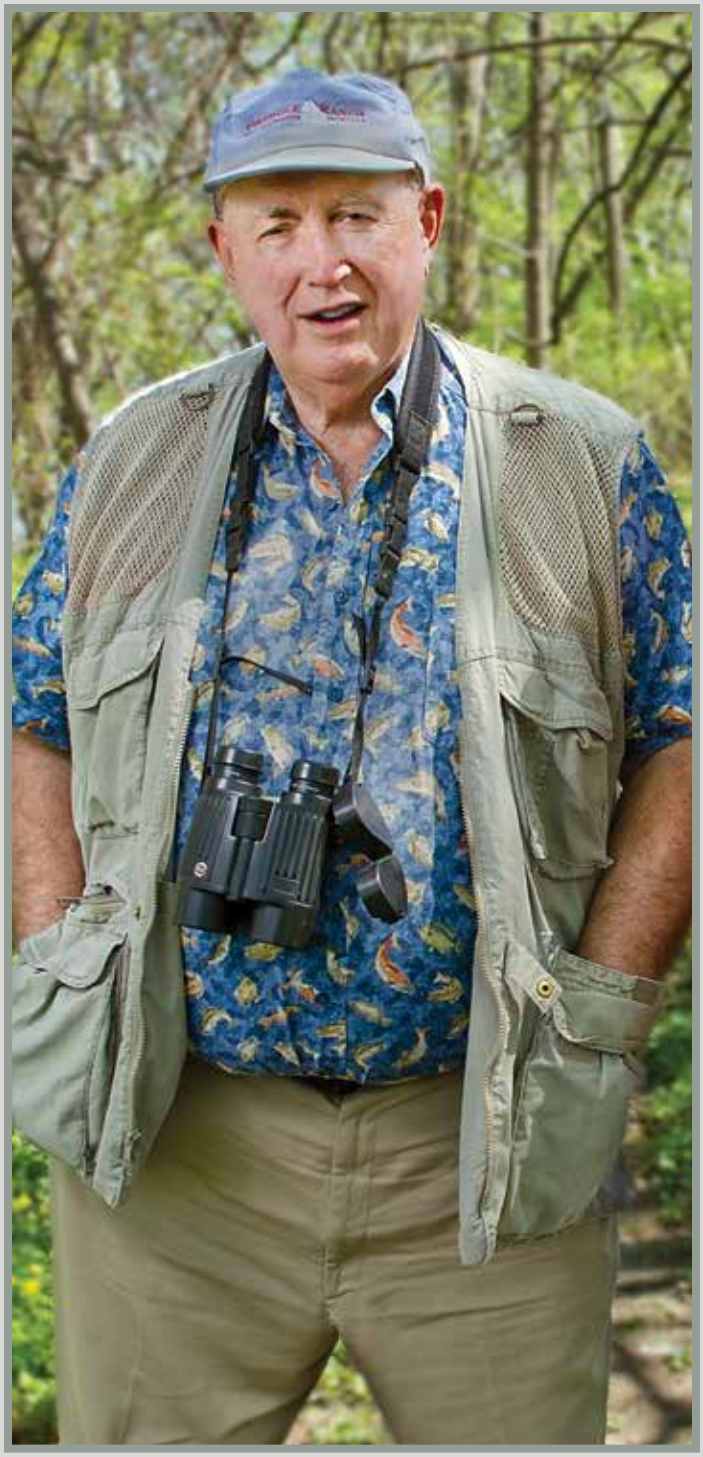
He frequently offered even more detail. On April 15, 1803, he wrote: "Cherrys Plums + Pears in Flower. Morning misty. Wind N.E. began to rain about noon when a density of the atmosphere was so great that it became almost necessary to Light Candles to dine by + shortly afterwards, the Wind + rain increasing became a tempestous [sic] evening."

Bartram recorded temperatures, the appearance of frosts, the days when plants first sprouted, and the movements of animals. He included common names for animals as well as their scientific names when he knew them. With his records, and the records of other scientists, we can begin to see how our environment has changed.

The William Bartram Papers serve as only one example of how archives remain relevant and can inform current scholarship or sciences. While archives continue to be used, and will always be used, for the writing of history books, researchers continue to find new applications for the information they provide. *~Jennifer Vess, Brooke Dolan Archivist*

IN MEMORIAM: R. JAMES MACALEER

> "I personally considered it a great honor and privilege to serve with Jim. I consider him to be a great friend and mentor."
>
> — Mike Reed, Academy Trustee



© Alex Rudinski for ANS

In October 2015, the Academy lost a great leader, champion, benefactor, and friend, R. James Macaleer. As a devoted supporter, avid birder, and former board chair, he was instrumental to the Academy's success in the early 21st century. He navigated the Academy through difficult financial times, helping to maintain the institution's vibrancy and strength through his extraordinary leadership. He was a key advocate for the Academy's affiliation with Drexel University, a milestone that paved the way for a sustainable future for the institution.

> "If it weren't for Jim, we wouldn't be here today. Jim had this unstoppable force, refused to take no for an answer, wouldn't accept anything but the best here, and he really turned the place around."
>
> — Nate Rice, Ornithology Collection Manager

Macaleer became interested in birding as a 15-year-old boy scout, and his interests grew throughout his life. During a 1998 trip to New Zealand and Australia, he and his wife, Jean, found themselves sneaking away from their tour group to go bird-watching. Around the same time, Macaleer was invited to join the Academy's Board of Trustees. He was fascinated by the various scientific disciplines and especially the Ornithology Collection.

In addition to Macaleer's inspired work as the Academy's Chairman, the Macaleers have been extremely generous to the Academy over the years. This fall, the Academy was pleased to honor the Macaleers' exceptional contributions through the Maclure Award.

"Jim and Jean Macaleer's tremendous leadership, philanthropy, and support of the Academy, especially through some difficult times, make them a perfect fit for the Maclure award," said Academy President and CEO George Gephart.

The Academy is immensely grateful for Jim's unparalleled support, energy, and generosity. He will be greatly missed by all of us.

LESSENING TAXES IN RETIREMENT

Once you retire, certain expenses will diminish or disappear. One expense that won't go away, however, is taxes.

No matter how much you have in retirement savings, a portion of the money will go to pay federal and state taxes. Having different types of retirement accounts—taxable, tax-deferred, and tax-free—is a smart move. Managing your retirement savings carefully may enable you to support an organization you care about, such as the Academy of Natural Sciences.

Tap your taxable accounts first. Conventional wisdom has long held that retirees should take withdrawals from their taxable accounts first. That way, you can benefit from low capital gains rates while investments in your tax-deferred and tax-free retirement accounts continue to grow.

Next in line are your tax-deferred accounts. These include traditional IRAs, 401(k)s, and other retirement-savings plans. Withdrawals from these accounts will be taxed at your ordinary income tax rate (except for any after-tax contributions you made, which will be tax-free). Remember, in most cases, you'll pay a 10 percent penalty if you take withdrawals before you're age 59½.

Last up—your Roth IRA. You may withdraw your Roth contributions at any time, tax- and penalty-free. As long as you're 59½ and have owned a Roth for at least five years, earnings are tax-free, too. Unlike traditional IRAs, you're not required to take minimum withdrawals when you turn 70½.

Exceptions. There are a few good reasons to depart from the conventional withdrawal hierarchy. For example, once you turn 70½, you'll need to take annual required minimum distributions from your traditional IRAs and other tax-deferred retirement accounts. If these accounts grow too large, the mandatory withdrawals could push you into a higher tax bracket. To avoid this problem, start taking withdrawals from your IRAs before you turn 70½.

Beneficiary Designation. If the largest asset in your estate is your retirement plan, you may be surprised to learn that the IRS may impose income tax on the remaining balance in the account if you designate it to a beneficiary.

This tax is in addition to the estate tax that may be imposed on the account. For estates fully subject to the estate tax, the result can be that up to 60 percent of the value of your retirement plan will be consumed in taxes before your child, relative, or friend receives it.

Consider naming the Academy as beneficiary of your retirement plan, then use other assets not subject to income tax to make gifts to your heirs. As a qualified non-profit, the Academy won't pay income tax on its distribution, and your heirs will receive their share of your estate without the burden of extra taxes.

Do you have questions about these and other methods of making charitable donations? Contact Amy Marvin, vice president of institutional advancement, at 215-299-1013 or marvin@ansp.org. She would be delighted to assist you. Thank you for your generosity!

This publication is prepared exclusively for the Academy of Natural Sciences of Drexel University's Institutional Advancement Department. Its purpose is to inform you of some of the opportunities available through tax and financial planning. The items contained herein are believed to be accurate with the federal tax law and regulations at the time of publication. You should be sure to consult with your own legal advisers about the applicability to your situation.

On behalf of the Academy's Board of Trustees, we wish to recognize and thank those who have contributed to the Academy between **September 1 and November 30, 2015**. Your generosity helps to fund our many programs of research and education, and we are tremendously grateful for your support.

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NEW TRUSTEE WELCOMED LAST FALL

On September 1, 2015, Jeffrey Eberly was promoted to chief financial officer of Drexel University, adding to his existing role of vice president for finance & associate treasurer that he has held since February 2014. Prior to Drexel University, he worked at Drexel University College of Medicine in various capacities, with his last position being the associate dean for operations, chief financial officer, and treasurer. Eberly also serves as the treasurer of the Dragon Risk Limited Co., a for-profit captive insurance company for the University.

Will Klein

CARNIVORE CAPADES

Join us **Presidents Day Weekend, February 13–15,** to meet the meat-eaters of the Academy! Learn about lions, study sharks, and talk about *T. rex*! Meet our live animals, discover our dioramas, and round out your visit with a trip to *Tarantulas: Alive and Up Close* to discover the world of these special predators.

Jeff Fusco for ANS

FOUNDERS' DAY

On **Monday, March 21,** the community is invited to pay what you wish to celebrate the anniversary of the Academy's founding. Bring your friends and family to enjoy dinosaurs, butterflies, dioramas, and our renovated children's discovery center, *Outside In*. Stop into the Café for lunch or a snack, and find some awesome dino and tarantula swag in the Academy Shop. The special exhibit fee to see *Tarantulas: Alive and Up Close* will still apply on this day.

Mike Servedio/ANS

ADULT OVERNIGHT

On **April 9,** pack a sleeping bag, put on your pj's, and leave the kids at home—the Academy is hosting an overnight for adults only! Start your evening with a beer or glass of wine, listen to true stories about our creepy collections, navigate the underbelly of the Academy, and see some of the real skeletons in our closet. This experience will include dinner, drinks, and breakfast. You must be 21+ to attend this event. Visit ansp.org to purchase tickets.

Mike Servedio/ANS

PALEOPALOOZA

Join us on **Saturday and Sunday, March 5 and 6,** for Paleopalooza, a two-day fossil festival of gigantic proportions. See real fossils from the world-famous collection of the Academy of Natural Sciences, meet expert paleontologists, and take guided tours of Dinosaur Hall. Plus enjoy hands-on activities, crafts, and dinosaur-themed fun for the whole family.

CUISINE FROM THE COLLECTIONS

Megan Kelly for ANS

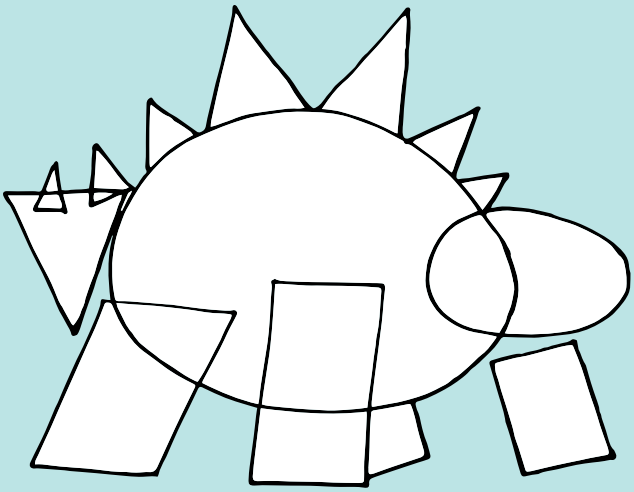
On **Saturday, November 7,** the Academy hosted *Cuisine from the Collections: Cocktail Edition*, our annual fundraiser that benefits the Academy's mission to advance research, education, and public engagement in biodiversity and environmental science. More than 250 guests joined co-chairs Elizabeth Bales and Michael Dell'Angelo, Anna and Todd Cassidy, Beth Overley Adamson and Terry Adamson, and host committee members to celebrate the evening. All enjoyed imaginative pairings of gourmet foods with creative cocktails, inspired by the Academy's collection of more than 18 million plant and animal specimens. Academy scientists showed off scientific specimens such as coconut crabs to help guests learn a little bit of the natural history behind the delicious food featured that evening. Live animals, including alligators and crocs, even made an appearance!

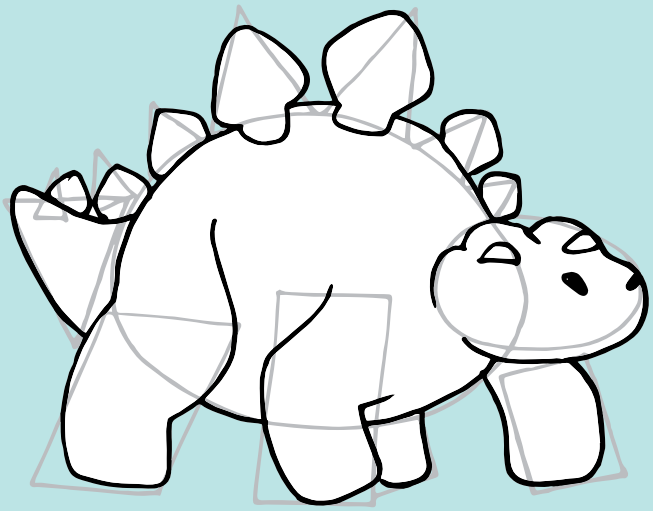
JUST FOR KIDS

Welcome to the *Academy Frontiers* page for kids, one of the many great ways you can participate in the Academy's Kids Club!

DRAW A DINOSAUR

Are you drawn to dinosaurs? You've probably seen *Hadrosaurus foulkii* in our Art of Science Gallery, against the backdrop of a beautiful illustration of the living dinosaur by Academy paleo-illustrator Jason Poole. Now it's your turn to try drawing a dinosaur, and it's actually easier than you might imagine. Read the instructions below, and see what you can create!



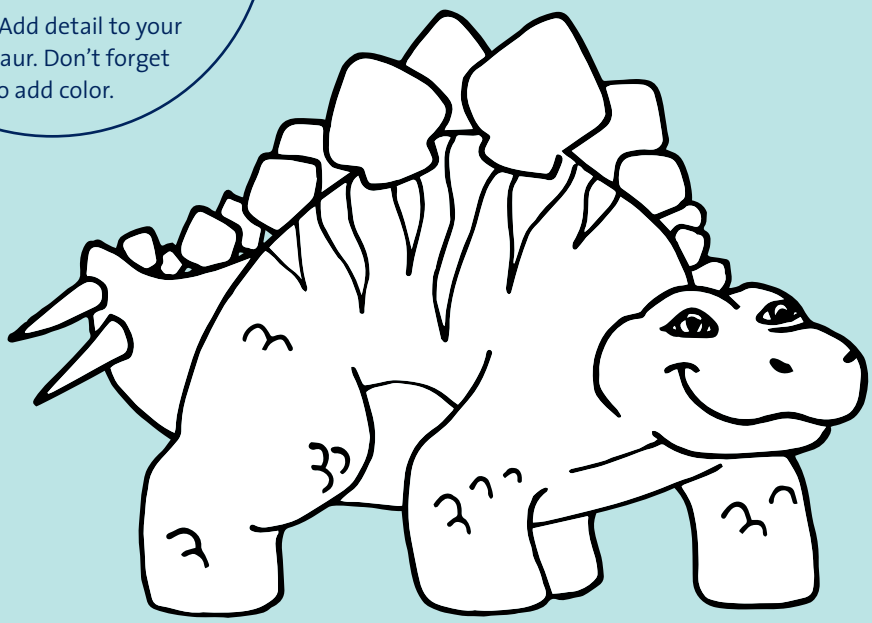


SKETCH A STEGOSAUR

STEP 1: Draw two ovals, add rectangles for legs, and triangles for plates.

STEP 2: Begin to add curvy lines inside or around the shapes.

STEP 3: Add detail to your stegosaur. Don't forget to add color.



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CALENDAR OF EVENTS

JANUARY

Animal Mythology Weekend
Saturday through Monday, January 16–18, 10 a.m.–5 p.m. M

Tarantulas Member Opening
Friday, January 29, 5:30–9 p.m. M

Tarantulas Opening Weekend
Saturday and Sunday, January 30–31, 10 a.m.–5 p.m. $*

FEBRUARY

Carnivore Capades
Saturday through Monday, February 13–15, 10 a.m.–5 p.m. M

Scouting for Science: Insects and Spiders
Saturday, February 27 $

MARCH

Paleopalooza
Saturday and Sunday, March 5–6, 10 a.m.–5 p.m. M

Friends and Family Safari Overnight
Saturday and Sunday, March 12–13, 6:30 p.m.–9 a.m. $

Founders' Day
Monday, March 21, 10 a.m.–4:30 p.m. M

Spring Break Camp
Tuesday through Friday, March 22–25 $

Tiny Tot Explorers
Wednesdays, March 30–May 18, 11 a.m. $

APRIL

Scouting for Science: Watery Worlds
Saturday, April 9 $

Adult Overnight
Saturday and Sunday, April 9–10, 6:30 p.m.–9 a.m. $

Friends and Family Safari Overnight
Saturday and Sunday, April 16–17, 6:30 p.m.–9 a.m. $

All photos © Outhouse Exhibit Services

M Free for members $ Fee Registration required

Unless otherwise noted, all events held at the Academy are free with museum admission. *$3 Individual and Family level member fee for *Tarantulas*. Family Plus level members and above receive free admission.
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