UNIVERSITY of WASHINGTON | DEPARTMENT OF BIOLOGY

BIOLOGY STUDENT NEWSLETTER

WINTER 2022 ISSUE 40

IMPORTANT DATES FOR WINTER QUARTER

Jan 3	First Day of Instruction
Jan 9	Last day to drop a class without a fee thru MyUW
Jan 10	All Courses Require Entry Codes to Add
Jan 14	Last Day to Apply to Biology major in Winter
Jan 16	Last Day to drop a class without the use of the ANNUAL DROP
Jan 17	Martin L King Jr Holiday
Jan 21	Spr Time Schedule online
Jan 23	Last Day to Add a Class through MyUW
Feb 9	Last Day to Apply for Grad Reg Priority (GSP) for Spring
Feb 11	Undergrad Research Symposium App deadline
Feb 11-27	Spring Reg Priority 1
Feb 21	Presidents' Day Holiday
Feb28-Mar27	Spring Reg Period 2
Mar 11	Last Day to Withdraw (from all Win Qtr classes)
Mar 11	Last Day to use ANNUAL DROP or convert to S/NS
Mar 12-18	Final Examination Week
Mar 21-25	Spring Break
Mar 28	Grades posted on transcript
Mar 28	Spring Quarter Starts

FROM THE CHAIR OF THE UNDERGRADUATE PROGRAM

Jennifer Ruesink, Chair of UPC

What is Wonderful about Biology?

We're in this department because we each have our own answer to that question – whether it's the discovery or the explanation or the solutions that biology can provide.

Here are some advances in the Biology department in 2021 that seem pretty wonderful to me:

- *Using basic biological research on circadian rhythms to predict the consequences of daylight savings time for people.*
- *Interrupting illegal wildlife trade by genetic techniques that link shipments to their ecological point of origin.*
- *Learning about flowering genes in an ocean plant by expressing those genes in the model plant Arabidopsis.*
- *Calling out practices in science that are exclusionary – some specific examples this year addressed gender data collected in a way that excluded non-binary scientists, and provided a forum for decolonizing science.*
- *And in a year of catastrophic climate events – heat dome, floods, fires, wind – exploring the direct effects on wildlife, as well as how these events can increase human-wildlife conflict.*
- *See inside this newsletter for how scientists in our department are revealing fossils that transform scientific understanding of deep-time evolutionary change.*

Arabidopsis

These examples show the creativity and inspiration of UW Biology. They also reflect a commitment to integrative approaches in the study of complex living systems: Can you see how so many of those examples require information collected at multiple scales, or show how larger- and smaller-scale phenomena reciprocally interact? As undergraduates, you are enmeshed in this integrative culture and encouraged to draw connections across your broad set of requirements, as well as beyond biology to how you navigate your life.

Many of your fellow students are deeply engaged outside of classes in research, service, or training that furthers their biology interests. Be sure you are aware of opportunities for financial support (https://www.biology.washington.edu/programs/undergraduate/awards) and for networking with like-minded peers in biology and medical clubs (https://hub.washington.edu/get-involved/sao/rso-directory/). UW also provides a variety of health services, which may be part of what you need to keep going in college, or you may be able to recommend to others (https://wellbeing.uw.edu/).

I'm so happy to be back to in-person learning, and just as happy that UW is using best available science to make decisions about safe classroom practices during the on-going pandemic. Welcome to a new year – it may be hard to predict exactly how it will unfold, but we are bound to learn some more wonderful biology! *Jennifer Ruesink*

HOW DO I TALK TO AN UNDERGRADUATE ACADEMIC ADVISOR? Use Email or Zoom!

Biology Academic Services in-office advising & services are closed and will be remote-only until further notice.

We welcome UW and prospective students to contact us with any questions regarding a Biology option.
Here are the advisors, their emails and their favorite dinosaur.

Janet Germeraad
Academic Services Director
Janetjg@uw.edu

Stegosaurus! *Because they have really cool armor of plates and a spiked tail.*

Jason Patterson
Academic Counselor, Senior
patterj@uw.edu

Triceratops! *Big and imposing yet passive and defensive.*
I had one of the original dinobot transformers.

Sheryl Medrano
Academic Counselor, Sr
smedrano@uw.edu

Brachiosaurus!
My favorite dinosaur is really any herbivorous one, but The Land Before Time movie from my childhood helped me love the Brachiosaurus.

Julie Martinez
Program Coordinator
juliebio@uw.edu

Brontosaurus! *What sport is the Brontosaurus good at? Squash!*

WINTER QUARTER 2022 ACADEMIC ADVISING (REMOTE-ONLY)

ZOOM DROP-IN ADVISING HOURS (10-15 min meetings):
Monday - Thursday 9 a.m. - 12:00 p.m. and 1:00 p.m. - 4:00 p.m.

Join Zoom Meeting: https://washington.zoom.us/j/92869479267 (link is external)

Meeting I.D.: 92869479267

ZOOM ADVISING APPOINTMENTS*:
Please email an adviser to make an advising appointment for long term planning.
***Please note that we are available for drop-in advising only during the first week of registration.**

For general questions, you may reach us at: bioladv@uw.edu or at 206-543-9120

Current / prospective students, parent, and community questions not addressed by our webpage will all receive an answer. Academic Services Staff will closely monitor this email account to ensure a timely response and make phone or other Zoom appointments to address concerns.

Please consult the website first for general answers on: advising, admission, degree plans, matrix of courses, and forms

OUR PALEOBIOLOGY FACULTY Paleobiology minor offered by the department

SIDOR LAB

CHRISTIAN SIDOR

What is your research or interest in?
I study vertebrate evolution during the Permian and Triassic (300–200 MA), specifically focusing on the origin of mammals and their nearest relatives.

What is your favorite part of your research?
I have the most fun doing fieldwork, where you never know what kind of surprising fossil you might find.

Who or what inspired you to do the research you do today?
My Ph.D. supervisor at the University of Chicago, Dr. Jim Hopson was a huge influence.

Do you have an advice to give a student wanting to do research?
Paleo research can have a steep learning curve, since it's rarely something undergraduates have much exposure to. However, the paleo labs at UW can put together bite-sized projects that can be a useful starting point. Plus, there's a lot that we do in paleo that crosses over to other research topics, like analyzing CT data or histology.

Undergrad classes taught: *Biol 451/ Biol 453*

WARD LAB

PETER WARD

What is your research or interest in?
I have three fields of interest:
1) How organisms deal with major environmental change
2) Researching speciation patterns and ecology of the living cephalopods Nautilus and Sepia.
3) A final field of research is examining the stratigraphic history of West Coast Cretaceous basins through detailed biostratigraphy and basin analysis.

What is your favorite part of your research? *Getting out in the field.*

Who or what inspired you to do the research you do today?
The great early books on dinosaurs and paleontology.

Do you have an advice to give a student wanting to do research?
Make the search for answers a primary drive in your life.

Undergrad classes taught: *Biol 280/ Biol 451*

STRÖMBERG LAB

CAROLINE STRÖMBERG

What is your research or interest in?
In a nutshell, I am interested in the key role that plants played in creating our modern ecosystem. I am curious about how environmental changes drove plant evolution and vegetation changes, which, in turn, drove animal evolution. I am particularly curious about the evolution of grasses and grassland ecosystems over the last 100 million years.

What is your favorite part of your research?
I love it all, but fieldwork holds a special place in my heart. Standing atop miles and miles of beautiful sedimentary rocks and meditating for a moment about how they contain the evidence of the life that once covered or roamed the landscape is awe inspiring! I also love the discovery of seeing the fossils and learning something new about Earth's past life. For me, this typically happens when I look through the microscope, because the fossils I most often study are tiny so-called plant stones (phytoliths) that we extract from sediment samples. And I love working with students and colleagues, bouncing ideas and learning from each other!

Who or what inspired you to do the research you do today?
Oh, so many people! A famous invertebrate paleontologist, Steve Stanley once came to my department (when I was a starting graduate student) and gave a talk which inspired me to look into grassland evolution. Christine Janis, a vertebrate paleontologist, and Scott Wing, a paleobotanist (and my postdoc mentor) and others wrote papers that inspired me to take an ecological perspective to paleontology. To name a few!

Do you have an advice to give a student wanting to do research?
Well, perhaps that hard work, resilience and perseverance is >50% of what makes a good scientist. There will be many dull, repetitive moments, many failures along the way, and half the battle is just staying in, working through the problems. Also, read broadly and collaborate! The best ideas come when diverse groups of people come together and share ideas.

Dr Strömberg's Webpage: *http://www.stromberglab.org*

Undergrad classes taught: *Biol 438/ Biol 447*

WILSON LAB

What is your research or interest in?
I am interested in the early evolution of mammals in the context of major episodes of earth history, like the K-Pg mass extinction event.

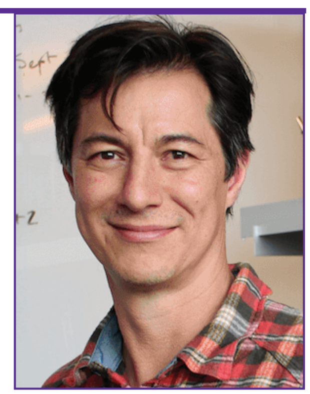
What is your favorite part of your research?
It's a tie between doing field work and studying specimens in collections.

Who or what inspired you to do the research you do today?
A lot of people did, but probably most centrally my PhD advisor at UC Berkeley Prof. Bill Clemens.

Do you have an advice to give a student wanting to do research?
Take the initiative, find a lab that does work that excites you, and be curious and persistent.

Dr Wilson Mantilla's Webpage: *https://faculty.washington.edu/gpwilson/wordpress/*

Undergrad classes taught: *Biol 354/ Biol 438/ Biol443*



GREG WILSON MANTILLA

SHE IS GIVING THE BURKE'S DINO DAY LECTURE THIS SPRING Lindsay Zanno

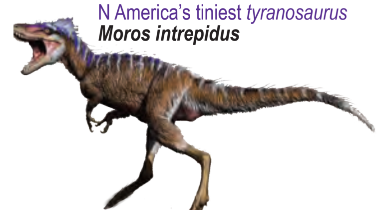
LINDSEY ZANNO
Born 1976 USA

Lindsay E. Zanno is an American vertebrate paleontologist and who is an expert in the taxonomy of therizinosaurs and is known for her innovative use of X-ray computed tomography in reconstructing dinosaurs. She is the director of the Paleontology & Geology Research Laboratory at the North Carolina Museum of Natural Science and Associate Research professor, Dept of Biological Sciences, NC State University. Her education includes a BS in Biological Anthropology, University of New Mexico in 1999, summa cum laude, MS in Geology, University of Utah, 2004 and PhD in Geology, University of Utah 2008.

With Peter J. Makovicky of the Field Museum of Natural History, Zanno excavated a large carnivorous allosauroid dinosaur in Utah, *Siats meekerorum*, that was unusual because the Neovenatoridae, carnivorous allosauroids, had been unknown in North America. Making Siats, one of the largest meat-eating dinosaurs on the continent She was also the lead author of the paper describing the small-bodied basal tyrannosauroid *Moros intrepidus*, North America's tiniest tyranosaurus. Named it the 'Harbinger of Doom' because the tiny tyrannosaur helps bridge the fossil gap between the smaller dinosaurs of the the Jurassic period and super-predators of the Cretaceous period. Tyrannosaurs sort of appear out of nowhere during the last 15 million years of the Cretaceous period leading up to that great mass extinction event that happened at about 66 million years ago. And by the time they show up in the fossil record, they're already these large-bodied predators that are dominating the ecosystems of the day. But that's kind of the final chapter of their story. What we've been missing are the first chapters of how they got to be that way in the first place. We need to fill in that gap. We have a five foot tall Tyrannosaur about 95 million years. And we know we have a 2,000 pound animal just 15 million years later. So how quickly tyrannosaurs went from these tiny animals to taking over that giant predator niche is a gap we still need to fill in.

Zanno's research interests and methods are broad. Her lab uses morphological data from extinct and living vertebrates to address evolutionary patterns on geologic timescales, with a focus on Mesozoic dinosaurs. Specifically, she is one of the world's leading experts on evolution of theropod dinosaurs—a group that includes the iconic predator T. rex and Velociraptor, as well as living birds. An important component of Zanno's research program is exploratory in nature. Her teams typically spend several months a year on expedition collecting fossils of dinosaurs and other Mesozoic vertebrates for scientific research. Goals of the field program are aimed at understanding how changing climate and environmental conditions affected life on land during the Cretaceous.

N America's tiniest *tyranosaurus*
Moros intrepidus



PIONEER IN THE WHOLE FIELD OF TAPHONOMY Anna Kay Behrensmeyer

ANNA KAY BEHRENSMEYER
Quincy, Illinois

Dr. Behrensmeyer is a senior research geologist and curator of vertebrate paleontology at the Smithsonian's National Museum of Natural History. At the museum, she is co-director of the Evolution of Terrestrial Ecosystems program and an associate of the Human Origins Program. Behrensmeyer's research uses geological, paleontological, and ecological approaches to interpret information about evolution and ecology that is preserved in the geological and fossil record. She is known for her pioneering research in taphonomy, the study of how organic remains become fossilized and biases that result from this process. Taphonomy is essential for understanding information contained in the fossil record, providing guidelines for ecological inferences about ancient animals and environments including early humans.

In her own words: *I study how dead remains became fossils by looking at what happens in modern environments. I take what I learn from watching carcasses decay and bones get scattered, trampled and buried to interpret the history of fossil deposits of the past. That's kind of the nucleus of my research – understanding what happens today so I can "time travel" and reconstruct the past.*

One of my major projects is in East Africa. I'm looking at what happens to modern bones in Amboseli National Park, Kenya, to find out how the dead represent the living. For example, I count what bones are preserved and what these bones tell us about the living animal populations in the Park. Are bones from large animals like elephants easier to preserve because they are big and strong, or are bones of small animals such as gazelles easier to preserve because they can be quickly buried? I've found that the answers depend on the burial environment. This helps me interpret fossil deposits with both elephant and gazelle-sized animals, because I know that the numbers of fossils of different sized animals may not be an accurate record of their numbers when they were alive in the original ecosystem. From there, I can figure out how to correctly interpret numbers of large versus small animals preserved in fossils from the same place and time.

The Evolution of Terrestrial Ecosystems Program has biannual meetings where young scientists (of all gender identities) can collaborate. She recalls one of her graduate students finding a stronger voice in this supportive meeting environment. After three days of intense discussion, these aspiring researchers would go home "and have more confidence that what they wanted to do was valid and good science," Behrensmeyer explains. The program lasted over six years for some of the people in this cohort. "You can't just meet someone once and have an effective impact. It has to be sustained." Now, young scientists from those initial groups are mentoring their own early career researchers.

FOUND A COMPLETE ICHTHYOSAUR SKELETON AT AGE 12 Mary Anning

MARY ANNING
Born 1799 Lyme Regis, Britain

Mary Anning was an impoverished, self-taught fossil hunter whose remarkable discoveries paved the way for modern paleontology. Through her carefully documented finds, she expanded human knowledge of ancient life, although until recently her work was overlooked or dismissed due to her gender & social status.

Around 200 million years ago, during the Jurassic period, that coastline was covered in a warm sea teeming with prehistoric life. That sea eventually receded, but the soft sedimentary rocks that formed the seabed remained, and the remains of animals that had been buried in the seabed slowly became stone themselves. Part of the seabed eroded away, forming cliffs; every wave or ferocious storm eroded those cliffs, exposing a cornucopia of fossils. Her father, Richard Anning, became a beachcomber, selling small fossils to those tourists who wanted a souvenir of their vacations. By the time Anning was 6, she was a regular presence by her father's side, helping him find, excavate and clean fossils.

Ichthyosaur Skeleton

Tragically, Richard died on Nov. 5, 1810. His death left Molly, a widowed mother of two, pregnant with a third child and destitute. A few months after Richard's death, Mary Anning uncovered a large ammonite. A woman bought it from her for half a crown, more than anyone had ever paid Richard for a fossil. Once Anning realized she could earn money for her family through fossil hunting, she went to the beach regularly. Less than a year later, Anning, with the help of her brother, uncovered a fossil that baffled scientists. It was 17 feet (5.2 meters) long, had 60 vertebrae, and took months to excavate, and by the time the Annings were done, word had spread in town that she had discovered a monster. Part of it looked like a fish, but part looked like a crocodile — something like this had never been seen before, or at least not by the London scientific establishment. It would ultimately be named ichthyosaur, meaning fish-lizard. Ichthyosaur fossils had been found before, but Anning's specimen was the first complete skeleton, and it threw the scientific world into turmoil. Until Mary's incredible discovery, it was widely believed that animals did not become extinct. Anning continued fossil hunting throughout her teenage years between 1815 and 1819 finding "several" more complete ichthyosaur skeletons. Anning's next major find was even more controversial than her first ichthyosaur: In 1823 she discovered the complete skeleton of a plesiosaurus, a four-limbed extinct marine reptile. In 1828, she discovered the first pterosaur, a winged reptile that lived during the dinosaur age, to be found outside Germany. In her lifetime, she would go on to discover multiple species of extinct fish as well as a number of other sea creatures.

UW EMERITIS & DEFENDER OF FLORISSANT FOSSIL BEDS Estella Bergere Leopold

ESTELLA BERGERE LEOPOLD
Born April 1927 Madison, Wisconsin

Estella Leopold is a paleobotanist and a conservationist who conducted groundbreaking research on fossilized pollen.

From 1955-1976, Estella worked for the US Geological Survey collecting and comparing fossils from the Rocky Mts and other places in the US and the world. Her work on the Tertiary flora of Colorado led her to a spectacular fossil deposit near the town of Florissant where paleontologists have found > 1,700 species from > 50,000 specimens. She teamed up with others as the Defenders of Florissant to block planned real estate construction until Congress established the 6,000 acre Florissant Fossil Beds National Monument with a bill signed by President Nixon in 1969.

As the co-recipient of the 1969 Conservationist of the Year Award from the Colorado Wildlife Federation and an elected member of the National Academy of Sciences in 1974, Estella is widely recognized for her pioneering research on pollen from the Rockies to Alaska. She was awarded the 2010 International Cosmos Prize for her lifelong work that illuminates the harmonious co-existence of nature and mankind.

In 1976, Estella joined the UW. As a Professor of Botany and Forest Sciences and Director of the Quaternary Research Center (QRC), she researched the forest history of the Pacific Northwest and did collaborative research in China. Estella pioneered the use of fossilized pollen and spores to understand how plants & ecosystems respond over eons to climate change and other factors.

As a conservationist, she helped stop two dams which would have flooded parts of the Grand Canyon and helped block the burial of high level nuclear waste under Hanford, Washington. Along with her QRC colleagues and citizen environmental organizations, she made a case for a national monument at Mt St Helens, where scientists could study and the public could learn about how an ecosystem responds to traumatic disturbance. "Love is very important in conservation work," she said "If you don't love it, how are you going to work to protect it? And to love it, you have to know it." As the author of 100+ scientific publications, Estella has had profound impact in the fields of paleobotany, forest history, restoration ecology, & environmental quality.

Today, she serves on the board of the Aldo Leopold Foundation (www://Aldoleopold.org) which is located in Baraboo, Wisconsin on the 80 acres with the Shack, made famous by her father, Aldo Leopold in A Sand County Almanac. In 2012 she published Saved in Time with H. Meyer to tell the story of the Floirssant Fossil Beds Monument. In 2016, she published stories of her childhood experiences with family and ecological restoration in Stories of the Leopold Shack, Sand County Revisited.

FOUR DINOSAURS EXCAVATED: An Ostrich-sized Theropod, A Duck-Billed Dinosaur


A team of students, volunteers, and UW/Burke staff excavate the Flyby Trike in northeastern Montana. Photo by Rachel Ormiston/Burke Museum.

A team of Burke Museum and University of WA paleontologists excavated four dinosaurs in northeastern Montana summer 2021. All fossils will be brought back to the Burke Museum where the public can watch paleontologists remove the surrounding rock in the visible fossil prep lab.

The four dinosaur fossils include: the ilium (hip) bones of an ostrich-sized theropod (meat-eating, two-legged dinosaurs that includes T. rex and raptors); the hips and legs of a duck-billed dinosaur; pelvis, toe claw, and limbs from another theropod that could be a rare ostrich-mimic Anzu or possibly a new species; and the remarkable discovery of a Triceratops skull and other fossilized bones. Three of the four dinosaurs were all found in close proximity on Bureau of Land Management land that is currently leased to a rancher.

In July 2021, a team of volunteers, paleontology staff, K-12 educators as part of the DIG Field School program, and students from both UW and other universities worked together to excavate these dinosaurs. The fossils were found in the Hell Creek Formation, a geologic formation that dates from the latest Cretaceous (68 to 66 million years ago). Typical paleontological digs involve excavating one known fossil. However, the Hell Creek Project is an ongoing research collaboration of paleontologists from around the world studying life right before, during, and after the K-Pg mass extinction event that killed off all dinosaurs except birds. The Hell Creek Project is unique in that it is unbiased sampling of all plant and animal life found throughout the rock formation.

“Each fossil that we collect helps us sharpen our views of the last dinosaur-dominated ecosystems and the first mammal-dominated ecosystems,” Burke Museum Curator of Vertebrate Paleontology and UW Biology professor Dr. Gregory Wilson Mantilla said. “With these, we can better understand the processes involved in the loss and origination of biodiversity and the fragility, collapse, and assembly of ecosystems.”

All of the dinosaurs except the Triceratops will be prepared in the fossil prep lab this fall and winter. The Triceratops fossil remains on the site because the dig team continued to find more and more bones while excavating and needs an additional field season to excavate any further bones that may be connected to the surrounding rock. The team plans to finish excavation in the summer of 2022.

Called the “Flyby Trike” in honor of the rancher who first identified the dinosaur while he was flying his airplane over his ranch, the team has uncovered the frill, horn bones, individual rib bones, lower jaw, teeth, and the occipital condyle bone nicknamed the “trailer hitch”—the ball on the back of the skull that connects to the neck vertebrae. The team estimates approximately 30% of the skull bones have been found to-date, with more potential bones to be excavated next year.

The Flyby Trike was found in hardened mud, with the bones scattered on top of each other in ways that are different from the way the bones would be laid out in a living animal. These clues indicate the dinosaur likely died on a flood plain and then got mixed together after its death by being moved around by a flood or river system, or possibly moved around by a scavenger like a T. rex, before fossilizing. In addition, the Flyby Trike is one of the last Triceratops living before the K-Pg mass extinction event. Burke paleontologists estimate it lived less than 300,000 years before the mass extinction event.

Another Theropod (possible Ostrich-mimic Anzu) and A Triceratops

Burke Museum Fossil Prep Lab Manager Kelsie Abrams examines fossils from the Flyby Trike while excavating in northeastern Montana. Photo by Rachel Ormiston/Burke Museum.

A closeup of the Flyby Trike's occipital condyle bone nicknamed the "trailer hitch"—the ball on the back of the skull that connects to the neck vertebrae. Photo by Rachel Ormiston/Burke Museum.

"Previous to this year's excavations, a portion of the Flyby Trike frill and a brow horn were collected and subsequently prepared by volunteer preparators in the fossil preparation lab. The frill was collected in many pieces and puzzled together fantastically by volunteers. Upon puzzling the frill portion together, it was discovered that the specimen is likely an older 'grandparent' Triceratops," Burke Museum Paleontology Prep Lab Manager Kelsie Abrams—who also participated in this summer's fieldwork—said. "The triangular bones along the frill, called 'epi occipitals,' are completely fused and almost unrecognizable on the specimen, as compared to the sharp, noticeable triangular shape seen in younger individuals. In addition, the brow horn curves downwards as opposed to upwards, and this feature has been reported to be seen in older animals as well."

Amber and seed pods were also found with the Flyby Trike. These finds allow paleobotanists to determine what plants were living alongside Triceratops, what they may have been eating, and what the overall ecosystem was like in Hell Creek leading up to the mass extinction event.

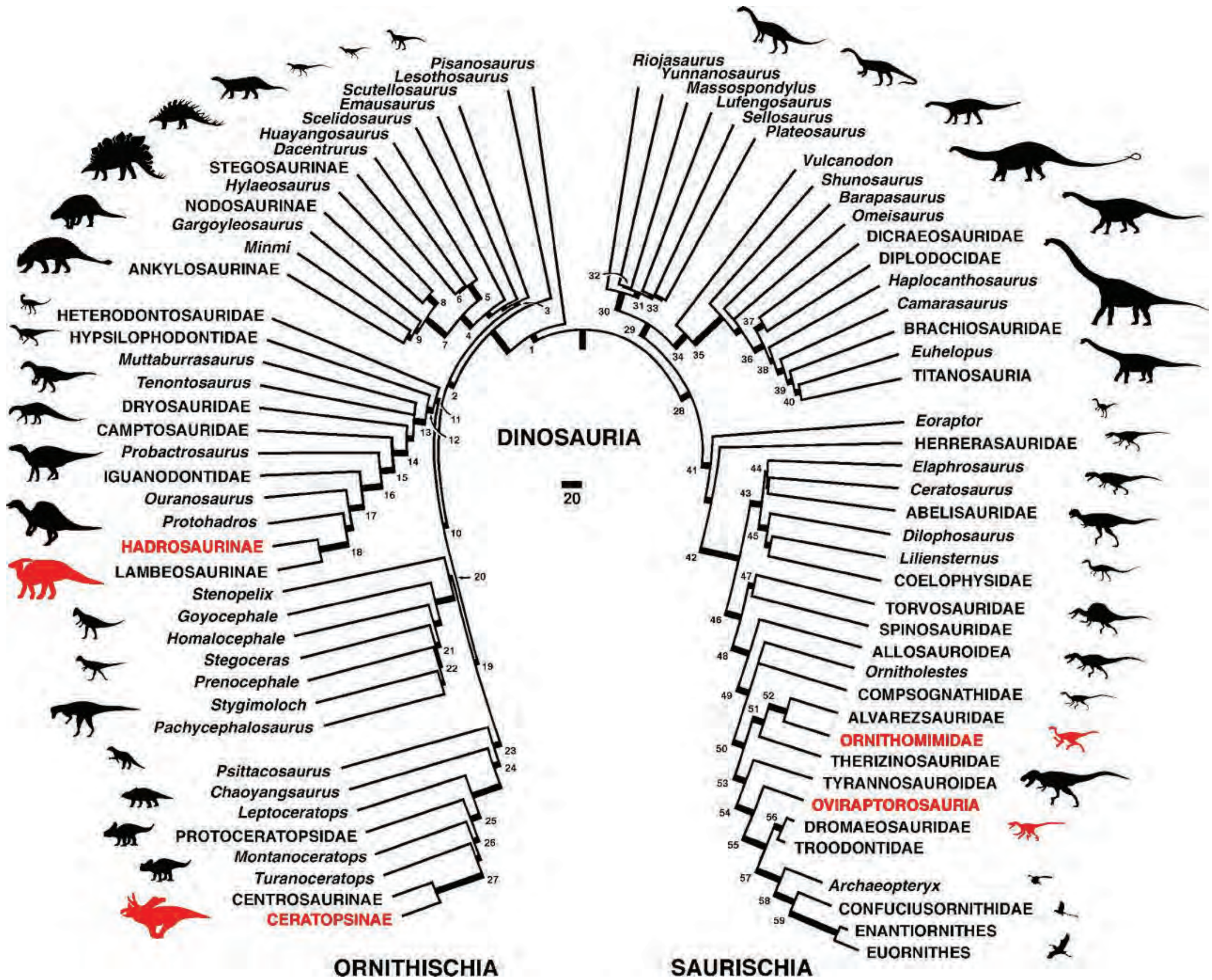
"Plant fossil remains from this time period are crucial for our understanding of the wider ecosystem. Not only can plant material tell us what these dinosaurs were perhaps eating, but plants can more broadly tell us what their environment looked like," UW Earth and Space Sciences and Burke Museum graduate student Paige Wilson said. "Plants are the base of the food chain and a crucial part of the fossil record. It's exciting to see this new material found so close to vertebrate fossils!"

Visitors can now see paleontologists remove rock from the first of the four dinosaurs—the theropod hips—in the Burke's paleontology prep lab. Additional fossils will be prepared in the upcoming weeks. All four dinosaurs will be held in trust for the public on behalf of the Bureau of Land Management and become a part of the Burke Museum's collections.

With working labs you can see into, one-of-a-kind objects all around you, and galleries filled with curiosity and conversation, at the Burke, you see—and feel—a world alive. The Burke Museum is located on the University of Washington campus in Seattle with a focus on dinosaurs, fossils, Northwest Native art, plant and animal collections, and cultural pieces from across the globe.
The Burke is the Washington State Museum of Natural History and Culture. The Burke is an active research museum that cares for 18 million geology, biology and cultural objects from Washington state and around the world, preserving natural and cultural history and generating new discoveries.

Located on the UW campus at 4300 15th AVE NE, Seattle, WA 98105. Operating hours are 10 am - 5 pm, Tuesday-Sunday (closed Mondays), and 10 am - 8 pm on the first Thursday of each month. Admission: $22 general, $20 senior, $14 student/ youth. **Admission is free to children three and under, Burke members, UW students, faculty, and staff. Admission is free to the public on the first Thursday of each month.**

WHERE DO THOSE DINOSAURS BEING EXCAVATED FIT IN? Check the tree below



Ornithischia is an extinct order of mainly herbivorous dinosaurs characterized by a pelvic structure superficially similar to that of birds.

Saurischia the orders of herbivorous or carnivorous dinosaurs that have the pubis of the pelvis typically pointed downward and forward and that include the sauropods and theropods.

Hadrosaurids are known as the duck-billed dinosaurs for the flat duck-bill appearance of the bones in their snouts.

Ceratopsidae is a family of ceratopsian dinosaurs including Triceratops, Centrosaurus, and Styracosaurus. All known species were quadrupedal herbivores from the Upper Cretaceous.

Ornithomimosauria, ornithomimosaurs ("bird-mimic lizards") or ostrich dinosaurs are theropod dinosaurs which bore a superficial resemblance to the modern-day ostrich.

Oviraptorsauria: The *Anzu wyliei,* a cross between an emu and a lizard described by te Smithsonian Institution and Carnegie Museum scientists who found it as the "chicken from hell".

Phylogeny of Dinosauria, showing the relationships among ornithischians (left) and saurischians (right).. The evolution of hadrosaurids within Ornithopoda (nodes 11 through 18) and birds within Tetanurae (nodes 46 through 57) provide the best examples of sustained skeletal transformation. Numbered nodes are listed here, with normal and bold text indicating stem- and node-based taxa, respectively (88): 1, Ornithischia; 2, Genasauria; 3, Thyreophora; 4, Eurypoda; 5, Stegosauria; 6, Stegosauridae; 7, Ankylosauria; 8, Nodosauridae; 9, Ankylosauridae; 10, Neornithischia; 11, Ornithopoda; 12, Euornithopoda; 13, Iguan- odontia; 14,Ankylopollexia; 15, Styracosterna; 16,Hadrosauriformes; 17, Hadrosauroidea; 18,Hadrosauridae; 19, Marginocephalia; 20, Pachycephalosauria; 21, Pachycephalosauridae; 22, Pachycephalosaurinae; 23, Ceratopsia; 24, Neoceratopsia; 25,Coronosauria; 26, Ceratopsoidea; 27,Ceratopsidae; 28, Saurischia; 29, Sauropodmorpha; 30, Prosauropoda; 31, Plateosauria; 32, Massospondylidae; 33, Plateosauridae; 34, Sauropoda; 35, Eusauropoda; 36,Neosauropoda; 37, Diplodocoidea; 38, Macronaria; 39,Titanosauriformes; 40, Somphospondyli; 41, Theropoda; 42,Neotheropoda; 43, Ceratosauria; 44, Ceratosauroidea; 45, Coelophysoidea; 46, Tetanurae; 47, Spinosauroidea; 48,Neotetanurae; 49, Coelurosauria; 50,Maniraptoriformes, 51, Ornithomimosauria; 52, Ornithomimoidea; 53, Tyrannoraptora; 54, Maniraptora; 55, Paraves; 56, Deinonychosauria; 57, Aves; 58, Ornithurae; 59, Ornithothoraces.

Figure from *The Evolution of Dinosaurs* published in SCIENCE by PAUL C. SERENO

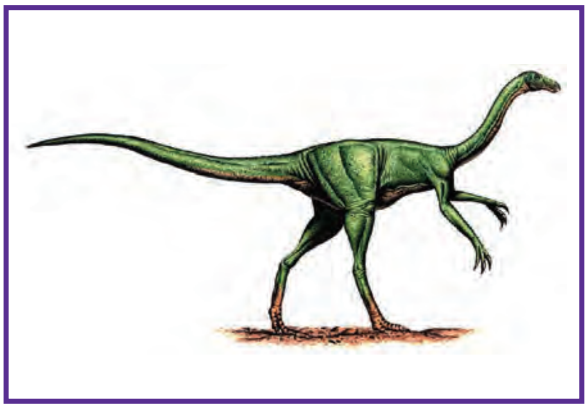
AND THIS IS WHAT THE FOUR MIGHT LOOK LIKE Did they taste like chicken?

TRICERATOPS, The name literally means ‘three-horned face’. Is an extinct genus of herbivorous chasmosaurine ceratopsid dinosaur that first appeared during the late Maastrichtian stage of the Late Cretaceous period, about 68 million years ago in what is now North America. It is one of the last-known non-avian dinosaur genera, and became extinct in the Cretaceous–Paleogene extinction event 66 million years ago.

Bearing a large bony frill, three horns on the skull, and a large four-legged body, exhibiting convergent evolution with rhinoceroses and bovines, Triceratops is one of the most recognizable of all dinosaurs and the most well-known ceratopsid. It was also one of the largest, up to 9 meters (29.5 ft) long and 12 metric tons (13 short tons) in weight.

HADROSAURIDS They are known as the duck-billed dinosaurs for the flat duck-bill appearance of the bones in their snouts. Hadrosaurs were among the most dominant herbivores during the Late Cretaceous in Asia and North America, and during the close of the Cretaceous several lineages dispersed into Europe, Africa, South America and Antarctica.

Like other ornithischians, hadrosaurids had a predentary bone and a pubic bone which was positioned backwards in the pelvis. Unlike more primitive iguanodonts, the teeth of hadrosaurids are stacked into complex structures known as dental batteries, which acted as effective grinding surfaces.



OSTRICH-SIZED THEROPODA (Ornithomimidae) From Greek “Ornith” (bird), “mimos” (mimic) and “-idae” (family), named for a group of dinosaurs closely related to Ornithomimus with features seen in modern, land-dwelling birds like emu and ostrich. Ornithomimidae—literally “bird mimics”—are the advanced ornithomimosaurs. They are affectionately known as “ostrich dinosaurs” because of their medium build, long-necks, small-heads, large-eyes, toothless beaks, and long powerful hindlimbs with “pinched” metatarsals that may have made them the fastest land-dwelling dinosaurs of all.

Though they sported long sloth-like forelimbs with huge curved claws, they were probably used for snagging branches on which to feed, and the sheer abundance of their remains in North America is consistant with the idea that they were plant eaters, as herbivores usually outnumber carnivores in an ecosystem.

The first ornithomimid appeared at the turn of the Early Cretaceous (99 mya ish) and the last of their kind were still tearing around North America and Asia right up to the very end of the age of dinosaurs.

THEROPODA (Oviraptorosauria, Caenagnathiadae, Caenagnathinae, *Anzu*) It is possibly the rare ostrich-mimic *Anzu*.
Anzu wyliei – United States, Late Cretaceous (66 million years ago), from the Hell Creek formation of the Dakotas, *Anzu* has been described by the Smithsonian Institution and Carnegie Museum scientists who found it as the ‘chicken from hell’ and a cross between an emu and a lizard. Anzu (AHN-zoo) is the name of a bird-like deity from Sumerian mythology, while wyliei honours Wylie J Tuttle, the son of a museum donor.

Anzu wyliei is characterized by a toothless beak, a prominent crest, long arms ending in slender, relatively straight claws, long powerful legs with slender toes, and a relatively short tail. *Anzu* measured about 3 metres (9.8 ft) to 3.5 metres (11 ft) long, up to 1.5 metres (4.9 ft) tall at the hips and 200 kilograms (440 lb) to 300 kilograms (660 lb) in weight.

250 MILLION YEARS AGO, THEY HIBERNATED IN ANTARCTICA *Lystrosaurus*

In the tusks of creatures that lived before dinosaurs, paleontologists found signs of hibernation-like metabolism.

How to tell if something that died 250 million years ago hibernated when it was alive? After all, hibernation — a state of reduced metabolism — is a good strategy for making it through long, harsh winters when food can be scarce. Biologists would not be surprised that evolution figured this out early in the history of life. But uncovering convincing evidence of that is hard.

"As a paleontologist, what you're presented with is a pile of bones," said Christian A. Sidor, a professor of biology at the University of Washington and curator of vertebrate paleontology at the Burke Museum in Seattle. "And that just tells you where the animal died. It doesn't even tell you where the animal lived."

But Dr. Sidor and Megan R. Whitney, a former graduate student who is now a postdoctoral researcher at Harvard, believe they have good evidence of hibernation behavior in an animal that lived in Antarctica a quarter of a billion years ago — before the age of dinosaurs.

This was a tumultuous time for life all around the planet, which was recovering from the largest mass extinction ever on Earth, marking the end of the Permian geologic period and the beginning of the Triassic. Antarctica then as now, was near the South Pole, and might have provided something of a haven from the cataclysm, often called the Great Dying.

Dr. Whitney said this animal, Lystrosaurus, was about the size of a medium dog with a beak like a turtle and two small tusks, and it was one of the species to make it through the mass extinction. "It's an odd animal," she said. "It's kind of a sausage shape. And it had no teeth except for the two tusks that came out from the face."

Despite its dinosaur-sounding name — it means "shovel lizard" in Greek — this creature was more closely related to mammals. The tusks — just a few inches long, probably used to dig up roots and tubers to eat — provided the telltale signs that the metabolism of Lystrosaurus periodically slowed down.

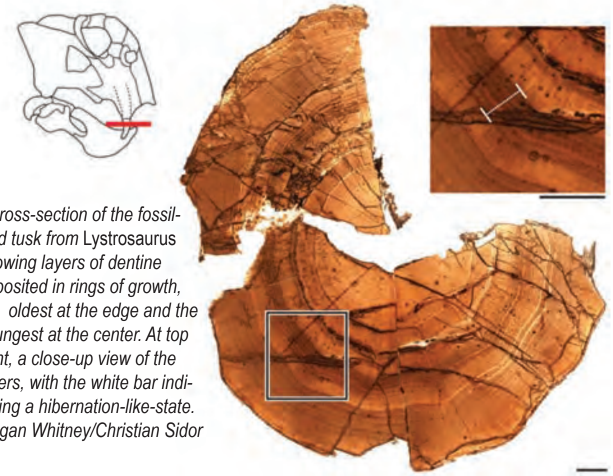
As with modern-day elephants, the Lystrosaurus tusks grew continuously. Thus, cutting a thin cross-section of a tusk provided a record of the animal's life, much like tree rings, with alternating dark and light circles. Dr. Whitney and Dr. Sidor compared the patterns in the tusks of six Lystrosaurus that lived in Antarctica with four from South Africa.

The Antarctic tusks included closely spaced, thick rings — likely periods where growth of the tusks slowed, maybe stopped, because of stress — while the South African ones did not.

Although all of Earth's land at the time was combined into the supercontinent Pangea, the part that is now Antarctica was still near the South Pole and the part that is now South Africa was still hundreds of miles to the north. Temperatures were warmer then, so Antarctica was not draped with ice sheets. But Earth was tilted about the same as it is now, which would have led to short days during winter. The dark days would have slowed the growth of plants, leaving little in the way of food for herbivores such as Lystrosaurus to eat.

Thus the researchers interpreted the thick, dark rings as a result of hibernation-like metabolism. The patterns are similar to what is seen in the teeth of modern-day mammals that hibernate in winter. The findings also suggest that Lystrosaurus was warm blooded. While the metabolism of cold-blooded reptiles can often shut down entirely, hibernating mammals periodically rouse themselves. The findings were published in the journal Communications Biology.

Whether Lystrosaurus actually hibernated or otherwise slowed its metabolism — biologists refer to the strategies as torpor — may never be known. "This is a first study of its kind," Dr. Whitney said, "so it's going to be preliminary."



A cross-section of the fossilized tusk from Lystrosaurus *showing layers of dentine deposited in rings of growth, the oldest at the edge and the youngest at the center. At top right, a close-up view of the layers, with the white bar indicating a hibernation-like-state. Megan Whitney/Christian Sidor*

Christian A. Sidor, a paleontologist at the University of Washington, excavating fossils in Antarctica in 2017. Megan Whitney

FREQUENTLY ASKED QUESTIONS Torpor in Antarctic *Lystrosaurus*

MAJOR FINDINGS
We provide evidence for a hibernation-like condition in a mammal relative (*Lystrosaurus*) that lived in the Antarctic portion of Pangea about 250-million years ago. This discovery was enabled by high-resolution incremental growth marks preserved in the tusks of *Lystrosaurus.*

WHAT IS LYSTROSAURUS?
- Lystrosaurus is a type of dicynodont, a major group of primarily herbivorous vertebrates that were common during the Permian and Triassic periods. Dicynodonts are characterized by their turtle-like beaks and ever-growing tusks (present in most species) and are distantly related to modern mammals.
- Lystrosaurus is known from rocks about 253-248 MA and ranged in size from about the size of a corgi to slightly smaller than a cow.
- Fossils of Lystrosaurus are known from China, Russia, India, South Africa, and Antarctica and this geographic distribution was one of the early pieces of evidence used in support of a large supercontinent called Pangea.
- Fossils of Lystrosaurus have been found in burrow structures in South Africa and similar burrow trace fossils have been recovered from Antarctica (but not with Lystrosaurus inside them)

WHAT IS TORPOR?
- Torpor is a term that refers to the general pattern of vertebrate physiology where there are periodic reductions in metabolic activity. These periods of slower metabolism are often related to seasonal changes in the environment that create unfavorable conditions.
- Hibernation is one form of torpor and is found in warm-blooded animals today. Hibernation is marked by reduction of metabolic activity with periodic small reactivations of activity throughout the hibernation period. This is in contrast to a different kind of torpor called brumation which is common in cold-blooded animals. In brumation metabolic activity is completely inactive for the entirety of the torpor period.
- Modern examples of hibernators include many North American bear species, echidnas, many rodent species, some lemurs during dry seasons, hedgehogs, badgers. Modern examples of daily torpor include many birds, bushbabies, and many bat species. Modern examples of brumation are found in many reptiles including lizards, turtles, and snakes.

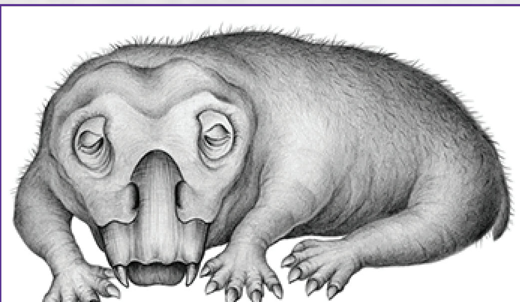
WHAT WAS ANTARCTICA LIKE IN THE EARLY TRIASSIC?
- In general, the Early Triassic (252-247 MA) was a warm period in Earth history.
- The climate of Antarctica during the Early Triassic is still a subject of active research, but it is clear that the continent was NOT under a thick ice sheet like today. Fossil plants, including fossil forests, as well as a wide variety of land-living vertebrates demonstrate that the continent was habitable for at least part of the year.

WHAT IS THIN-SECTIONING?
- We make thin-sections of fossil bones and teeth so that we can study the fine, inner details that are preserved in these hard tissues. These small, microscopic details act as storybooks, preserving a lot of information about the biology of these animals while they were alive. As is easy to imagine, studying the biology of animals that lived millions of years ago can be challenging. These details, in this case the tree-ring-like growth marks, preserve critical clues into the biology of fossil animals.

HOW DID YOU ANALYZE THE TUSKS?
- The way that these tusks grow is layer by layer, growing inward towards the pulp cavity.
- Growth of the tusk happens periodically during both normal and stressful times for the animal. Each increment of growth will leave behind a ring. We looked at both normal growth mark rings and growth marks that were especially thick, that represent a stressful time for the animal.
- We counted how much growth was happening between these rings as well as how thick the stressful rings were.
- We compared periods of regular growth and stress in polar Antarctic tusks to those from non-polar South African localities from the same time period.

HAS TORPOR BEEN FOUND IN THE FOSSIL RECORD BEFORE?
- It's been reported in some fossil rodents, where hibernation marks were found in the ever-growing incisors. But these are relatively recent fossils (Pleistocene) on the order of hundreds of thousands of years old.
- Our study is by far the oldest evidence of torpor.
- Given how widespread torpor is in modern vertebrates, it is expected that this is not a new trait and has likely been widespread throughout the vertebrate evolutionary history. However, it is a difficult feature to study in the fossil record.
- This study provided a unique opportunity to study torpor in the fossil record. First, Lystrosaurus had ever-growing tusks which provides a lengthy record of regular and stress growth rings. Second, we have two populations to compare, a polar population from Antarctica and a non-polar population from South Africa.
- This study suggests torpor was present even 250 million years ago and lends support for the idea that being able to have a flexible physiology may serve as a key feature in surviving mass extinctions.

WHAT THIS PAPER DOES NOT SAY:
- Lystrosaurus was a reptile (or a dinosaur!). Although distantly related, Lystrosaurus is more closely related to mammals, including humans, than to any reptile. Lystrosaurus is a member of a very early branch on the lineage that eventually gave rise to mammals.
- Lystrosaurus was the only animal experiencing torpor in the Early Triassic. This is the first study of its kind. There is a rich assemblage of vertebrates from the Early Triassic of Antarctica and similar studies on their seasonal physiologies have not yet been examined.
- This proves Lystrosaurus was hibernating. This is a preliminary study that puts forward a hypothesis. Our hope is that there is continued testing of this hypothesis and continued sampling of Lystrosaurus and other polar vertebrates to look for signals of hibernation or other forms of torpor.



Life restoration of Lystrosaurus in a state of torpor.

READING THE (FOSSIL) LEAVES Strömberg Lab's Paleobotany PhD Candidates

Paleobotanists in the Strömberg Lab are interested in what the ancient Earth looked like. What plants covered the landscape? What did the structure of this vegetation look like? What was the paleoclimate during these times? How did all of this change through time, and how did those changes in plant communities relate to how animal sevolved? The study of ancient ecosystems responding to environmental changes in the past can help us better understand how our world may respond to the current climate-induced crisis and make predictions for our future.

PhD candidate Paige Wilson (second from left) discussing leaf fossils with participants in the Burke Museum DIG Field School in northeastern Montana.

One of the most pivotal events in "recent" Earth history is the Cretaceous-Paleogene (K-Pg) mass extinction, ca. 66 million years ago. This is the latest of the major mass extinctions that have rocked the planet in it's 4.5 billion year history. The K-Pg mass extinction marks the demise of non-avian dinosaurs and the point at which more modern ecosystems began to establish themselves. Paleobotany PhD candidate, Paige Wilson is investigating this window of time using fossil leaves as an archive of past forests. Her study involves the careful collection and analysis of over 5,000 fossil leaves documenting a ca. 2 million year window around the mass extinction event. Fossil leaves inform us about fundamental changes in plant communities through time, the magnitude of plant turnover during the mass extinction event, and selective pressures placed on plants during this chaotic time period. Further, fossil leaves help to track shifting paleo-temperatures which may have also influenced vegetation changes around this time. Over 60% of plant taxa in northeastern Montana disappeared during the K-Pg mass extinction, and were replaced by new species that included more fast-growing plants which could re-colonize the devastated landscape. It took hundreds of thousands of years for the vegetation to regain the level of diversity present before the mass extinction, and even then plant communities were permanently altered by the mass extinction event.

Fossil of the extinct species Leepeirceia preartocarpoides *preserved in the Late Cretaceous Hell Creek Formation of northeastern Montana.*

Our planet has experienced many other events in it's "recent' history that have been less catastrophic than mass extinctions, though significant enough to reshape Earth's ecosystems. These include several large-scale climate change events, the most recent of which occurred 17-14 million years ago, called the mid-Miocene Climatic Optimum. At the height of this warming event, global temperatures were ~8 °C warmer than modern and atmospheric pCO^2 was elevated to ~400-700 ppm or more. PhD candidate Alex Lowe, along with colleagues at the Burke Museum, is studying the details of how this climatic event reshaped the plant communities growing in the Pacific Northwest. To do so he is studying 18 fossil plant sites in Washington, Oregon, and Idaho that span the global warming event in time. He spends part of his summers visiting them to collect fossil plants, including leaves, cones, fruits, and flowers, as well as sampling sediment containing microscopic plant fossils like pollen, spores, and phytoliths (silica bodies), all of which can tell you about the ancient plant communities that lived there. He also collects volcanic ash to radiometrically date the sites and determine their ages.

Back at the Burke Museum, Alex and a team of undergraduate research assistants catalog, photograph, and identify the fossil plants so that the ancient plant community can be described in terms of species composition, diversity, and ecology. Work comparing these sites to each other through time is on-going, so stay tuned to learn more about how this story unfolds!

*Fossil swamp cypress (*Taxodium dubium*) from the ~16 million year old Clarkia fossil site in northern Idaho.*

PhD candidates Alex Lowe and Will Brightly of the Strömberg lab, along with undergraduate field assistant Derek den Ouden, carting fossil plants collected from the river bank at the ~15 million year old Succor Creek fossil site on the Idaho-Oregon border.

TWILIGHT FOR THE NAUTILUS Ward has Studied the Iconic Sea Creature for 45 Years

Peter Ward is a Paleontolgy professor for the Dept of Biology. He studies speciation patterns and ecology of the living cephalopods. The following is an exerpt from the magazine, *Nautilus*.

We wanted to know how they were managing to survive. Could they cross large bodies of water to find sufficient food? Our transmitters picked up the nautiluses as they swam above the bottom of the ocean. Each second, they sent us their position, their depth, and the temperature of the water they were in. They didn't descend below 800 meters because at that depth the ocean pressure would cause their shells to implode. Our tracking showed they followed the ocean bottom contour toward shallower water, where there was more food, but also more danger. Their predators, sharks and large fish, are visual hunters, so the nautiluses were safer in the darker, deeper depths.

The water temperature in the ocean layer, defined as the Mesophotic Zone, through which the nautilus travels, is growing so warm that it's destroying the life of all the organisms that thrive there. The Mesophotic Zone ranges from 100 meters to 500 meters deep, where light, when it penetrates to the bottom, is a dim twilight, even at noon. The animals in this twilight zone share many characteristics, but among the most important is slow growth, leading to extended adolescence, low fecundity once maturity is attained, and long lifespans.

The very first nautiloids appeared 500 million years ago on well dated fossils. Recent studies using oxygen isotopes of their skeletons, and technique that yields temperature of skeletal growth, reveal the nautilus first evolved when they were shallow-water species. But sometime around 60 million years ago, their species migrated down into the Mesophotic Zone, while all those that stayed in the more flourishing shallows went extinct.

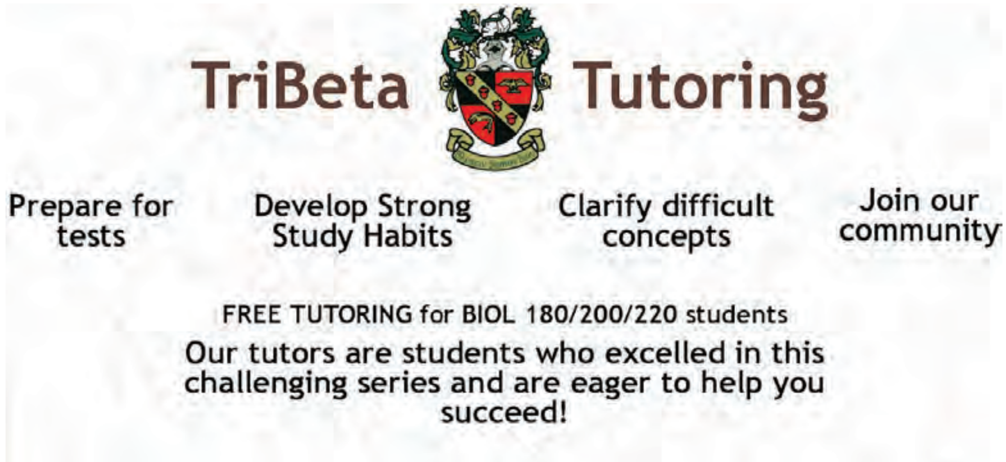
In deep water, both species can live for a very long time, at least a century. A key to their longevity is they evolved to live at extremely low metabolic rates. Nautiluses can bump across the ocean bottoms with almost no energetic effort, using their 90 tentacles to chemically search for that perhaps once-a-month windfall of a dead fish falling down the reef cliff onto their muddy habitat. But their genius is their buoyant shell. They expend virtually no energy in searching for food. Their body plan involves one of the greatest evolutionary trade-offs of all time. Swimming takes energy. Breathing takes energy. For the nautilus, the energy expended for swimming also allows for respiration.

Perhaps if Nautiluses and Allonautiluses only had to survive the warming depths, they would do as they have always done—eke by. If they were only fished by those who can sell a single, freshly killed Allonautilus for $1,000—a sum more than the annual income in the area where they are found—perhaps there would be a world in a thousand years with this iconic animal. But the nautilus are being rapidly killed simply for food by fishing communities in the tropics, the nautilus livelihoods are slowly being destroyed by climate change and overfishing.

Nautilus *with tracker attached..*

TRIBETA TUTORING ONLINE & IN PERSON: Monday - Thursday: starts Mon January 10th

TriBeta Tutoring will be offered Winter Quarter in-person at the Hitchcock 4th floor study lounge and online over Zoom.



Tutoring starts during the second week of the quarter on January 10th and ends the week before final exams.

Tutors will be present in person (at HCK 4th floor lounge) and over Zoom, Mon-Thurs to answer your questions about BIOL 180/200/220. Zoom link and finalized schedule are on our website: https://sites.google.com/view/uwtribeta/tutoring?authuser=0

IN-PERSON INSTRUCTIONS: Come to HCK 4th floor study lounge, scan the QR code posted on the wall to log-in. A tutor should be present to assist you!

ONLINE INSTRUCTIONS: Click on the Zoom link on our website to join. When you join, a tutor should be present to assist you. Tutors will have a tutor designation in their Zoom name. If multiple students are present in the meeting, then the tutor might move you into a "breakout" room so that they can assist you more individually or encourage you to work with other students in your class. If no tutors are present in the meeting, then it is likely all tutors have moved into breakout rooms to assist other students. Please wait a few minutes for a tutor to become available.

WE PROVIDE FREE TUTORING FOR INTRODUCTORY BIOLOGY (BIOL 180/200/220) students at the University of Washington. Our tutors are undergraduate students at the UW who have excelled in the introductory biology classes and are eager to help other students succeed too. Website of our tutoring page: ***https://sites.google.com/view/uwtribeta/tutoring?authuser=0***

2021-2022 Executive Board

TriBeta Biological Honor Society

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Our website: ***https://sites.google.com/view/uwtribeta/home***

Full Membership is eligible to **any** student who has completed two Intro Biology courses (180/200) and one additional biology course with a GPA of 3.0 or higher.

WHAT IS TRIBETA?

Beta Beta Beta is a national honor society dedicated to improving the understanding and appreciation of biologial studies. It is a platform for students to earn recognition for their efforts and accomplishments while networking with other students and UW Biology staff with the same interests.
In short: a really great organization.

Be on the lookout for TriBeta events for this coming quarter.

BIOLOGY STUDENTS FOR EQUITY: Look for Events

Greetings from
Biology Students For Equity

We are an RSO started about 5 years ago, but never more relevant. “Unprecedented” is overused, but you know now, more than ever, we need community, safe spaces for difficult conversations, and action to help makethe department climate kinder and more productive for our BIPOC (black, indigenous, people of color) community members.

We seek to give undergraduates a voice through our collaboration with the Biology department’s Diversity and Equity Committee as well as foster community through our undergraduate mentorship program. Our main goals are to discuss, call out, and address inequities in STEM. Follow us on our **Instagram or Facebook Page (@biologystudentsforequity)** to keep up to date with future events.

If you are interested in joining our email list, becoming a member, or want to learn about how to plug in to our community, please email us at

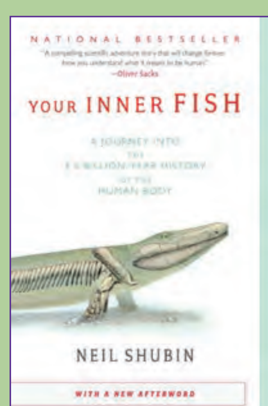
BSE

biologystudentsforequity@gmail.com.
We hope to work with you and for you.

All Humans Are Welcome.

BIO BOOK CLUB: *Your Inner Fish by Neil Shubin*

Get Ready for Bio Book Club! We will choose a fiction or non-fiction book each quarter with a scientific thread, but that also examines social, cultural, and environmental topics. Please feel free to send book recommendations to **Sheryl Medrano** at *smedrano@uw.edu*.



Neil Shubin, the paleontologist and professor of anatomy who co-discovered Tiktaalik, the “fish with hands,” tells the story of our bodies as you’ve never heard it before. The basis for the PBS series.

By examining fossils and DNA, he shows us that our hands actually resemble fish fins, our heads are organized like long-extinct jawless fish, and major parts of our genomes look and function like those of worms and bacteria. Your Inner Fish makes us look at ourselves and our world in an illuminating new light. This is science writing at its finest—enlightening, accessible and told with irresistible enthusiasm.

DEPT OF BIOLOGY AWARDS

UNDERGRADUATE SCHOLARSHIP & AWARD WINNERS

DONALD S. FARNER SCHOLARSHIP
Caroline Rawls (Promislow Lab)

EXCELLENCE IN BIOLOGY SCHOLARSHIP
Marcus Chu
Amanda Chen
Mary Smith
Linda Tran (Yang Lab, School of Medicine)
Bill Young (Promislow Lab)

PORATH-JOHNSON SCHOLARSHIP
Yuliana Romo-Perez
Jeesoo Yoon

EDITH LUCENA RIEHL SCHOLARSHIP
Batool Mutawe

FRYE-HOTSON-RIGG AWARD
Ava Kloss-Schmidt (Steinbrenner Lab)

KATHARINA CASEY LEADERSHIP AWARD
Rohita Rangu
(Zraika Lab, School of Medicine)

JOHN & DOROTHY FRANCO AWARD
Ava Kloss-Schmidt (Steinbrenner Lab)

WALTER & MARGARET SARGENT AWARD
Hunter Furutani
(Brown Lab, School of Medicine)
Linda Tran (Yang Lab, School of Medicine)

GRADUATE WRITING FELLOWSHIP WINNERS

TUNNICLIFFE WRITING FELLOWSHIP
Mo Turner (Ruesink Lab)

MELINDA DENTON WRITING FELLOWSHIP
Will Brightly (Strömberg Lab)

FRYE-HOTSON-RIGG WRITING FELLOWSHIP
Aji John (Hille Ris Lambers Lab)

KATHRYN HAHN WRITING FELLOWSHIP
Zoe Kulik (Sidor Lab)

PALEO PLANTS IN THE COLLECTION Greenhouse crew plant picks

Paleobotany is a section of botany that focuses on plant fossils. By studying these geologic remains, paleobotanists can better understand the evolutionary history of plants and reconstruct what climates and ecosystems were like long ago. Many ancient lineages of plants still exist today and they include: spore-bearing plants like mosses, ferns, and horsetails; gymnosperms which are seed-bearing plants that don't flower; basal angiosperms which are the earliest flowering plants like water lilies and star anise; and magnoliids which are the next oldest group of flowering plants like magnolias and bay laurels. The hardworking staff of the Biology Greenhouse cultivates many examples of our green, ancient friends, so please stop by when the greenhouse is open again to visitors.

Nile Kurashige's pick: Wollemi Pine, *Wollemia nobilis*

The Wollemi Pine has many aspects that make it an extraordinary plant. The oldest fossil record dates back to 90 million years ago. It was thought to only exist as fossils until it was miraculously found in New South Wales, Australia in 1994. There are very few plants left in habitat and the exact location is not published to protect them. The 2020 fires threatened to clear the area but firefighters fought extra hard to protect the plants. The plant can also produce multiple shoots from one tree, a process called self-coppicing. Our staff, Dr. Paul Beeman, has been successful in triggering self-coppicing by washing off the resin that protects the apical tip. We are lucky to live in a mild enough climate that we have a happy specimen growing along the Burke-Guilman trail that has produced both male and female cones. If we're lucky, we'll get to see it reach a height of 40m!

Melissa Lacey's pick: Tree fern, *Dicksonia antarctica*

Tree ferns are primitive plants, dating back to the Carboniferous period (350 mya). They are true ferns and so they reproduce by spores which require proper moisture to germinate and are often found in damp tropical forests. Not technically trees, they get their name from their stature as some grow to be over 5 meters tall stretching their fronds into the forest canopy.

What I particularly like about them is how their trunk can become an entire ecosystem due to its fibrous nature holding plenty of water and therefore supporting the growth of epiphytes. Due to their moisture retention, in rainforests of Australia these species hardly burn and recover quickly after fires.

Paul Beeman's pick: *Welwitschia mirabilis*

Welwitschia mirabilis is one of the oddest looking plants in the department of Biology's plant collection. It is thought to be a relic of the Jurassic period when gymnosperms dominated the flora of the world. They represent the only member of its family and genus still alive. They are dioecious and have separate male and female plants.

They consist of a short stem, two leathery leaves and a tap root. The cones arise between the leaves. Its two permanent leaves are unique in the plant kingdom. They are the original two leaves the plant develops. They continue to grow throughout the plant's life and are never shed. In habitat the thick leathery leaves are tattered in the wind. Some plants are estimated to be over 2000 years old.

They are endemic to the Namib desert in parts of Namibia and Angola. They live in the fog belt, which is thought to be critical to seedling survival, as rainfall averages 3.9 inches per year. They have unique structures on their leaves that allow them to harvest moisture from the dew that forms at night. They are also the only gymnosperms that have been shown to perform CAM photosynthesis.

PALEO PLANTS IN THE COLLECTION Why our Paleo plants are so special

Olivia Kaplan's pick: Gemma Fir Mosses, *Huperzia squarrosa*

Huperzia is a genus of Lycophyte which are also known as Gemma Fir Mosses. This basal vascular genus is distributed in temperate, arctic and alpine habitats, including mountains in tropical Asia.

I find this paleo genus so interesting because these plants are known to form associations with endophytic fungi (fungi that live inside plant cells)!

In one particularly exciting example, Shiraia sp Slf14 is an endophytic fungus present in Huperzia serrata that produces Huperzine A, a biomedical compound which is being used as a drug to treat Alzheimer's disease in China.

Katie Sadler's pick: Deobao fern, *Cycas debaoensis*

The "Debao fern" cycad, is endemic to small areas in Debao County, in the Guangxi region of Southern China. Discovered in the late nineties, this cycad grows in mixed evergreen and deciduous forests on steep limestone slopes. It has become endangered due to habitat loss.

It is the only tri-pinnate leaved cycad known, a trait which gives the leaves a 3-dimensional quality. All cycads are dioecious-individual plants of a species are either male or female. It is a Gymnosperm, which are evolutionarily important because they are the earliest "seed" producing plants in the evolution of the plant kingdom. Like all gymnosperms, they produce "naked" seeds, which are exposed–allowing direct pollination. Cycads, are pollinated by specific species of beetles. You can find this beautiful specimen on display near the LSB 2nd floor staircase.

Kaileah Burn's pick: King Fern, *Angiopteris evecta*

One of the largest ferns in our collection is the Angiopteris evecta, also referred to as the King Fern. Our fern is from New Caledonia, but they are also found in Southeast Asia. The Angiopteris evecta we currently have is our bonsai sized fern compared to the wild growing species. The Angiopteris evecta has a massive rhizome that can measure up to 3ft in diameter and 4ft tall. The fronds that emerge from this rhizome can reach up to 30 ft in length and 8ft wide!

There are fossil records of similar looking fronds found in Paleozoic rocks dating back to 300 million years ago, when they most likely were the dominating species of the plant world.

Terry Huang's pick: *Austrobaileya scandens*

Austrobaileya is a member of the famous basal angiosperms and it is the only member of its genus and family. This special vine grows in the humid, wet understory of the Daintree Rainforest of northeastern Queensland, Australia, where it has survived through many extinctions and ice ages. I particularly love its water lily-like flowers of jade-green and cream flecked with fetching black dots. It's fabulous fragrance–week-old, dead fish – is really attractive to flies, who are fooled into pollinating its flowers. Why such a rich stench? This plant was around when *T. Rex* roamed the earth, so bees and butterflies were still an evolutionary dream. *Austrobaileya* had to make do and lure who was always readily available - flies. Some things do stand the test of time.

THE TEACHING COLLECTION The 8,000 plants are still being sorted in the rooms.

Katie Sadler is our new Greenhouse Manager. Our main greenhouse crew is Paul Beeman, Nile Kurashige, Melissa Lacey, Olivia Kaplan and Kaileah Burns who water and care for the plants seven days a week.

When the Biology Greenhouse opens, visitors will only be able to visit the four rooms that contain the Teaching Collection. GH1 **Desert**, GH6 **Cool Tropics**, GH8 **Warm Tropics** and GH9 **Tree of Life**. The other rooms will be marked for research and entrance is not allowed.

Greenhouse Room 1 Desert Room

Greenhouse Room 8 Warm Tropics Room

Greenhouse Room 6 Cool Tropics Room

Greenhouse Room 9 Tree of Life