ON DISPLAY SEPTEMBER 15, 2022 - APRIL 30, 2023

Dinosaur Explorer Field Trip Guide

Fellow Educators,

Thank you for your interest in the Cox Science Center and Aquarium (CSCA). We look forward to meeting with you and your classes while you explore our exciting new exhibition, Dinosaur Explorer!

This Field Trip Guide is designed to enhance your Science Center experience by helping you and your students prepare for your visit. This guide will answer questions such as: how long you can expect to spend at the science center and where you can eat your lunch. As you know, by preparing students in advance for their trip, they will better focus on the science content. Additionally, this guide includes some quick and fun activities to further enhance the educational experiences offered by the exhibit.

Have additional questions? Please call our Group Sales Coordinator at (561) 832-2026. It is our sincere hope that your experience embodies our mission to “Open Every Mind to Science.” We’ll see you at the Science Center!

Sincerely,

The Education Team

Cox Science Center and Aquarium

COX SCIENCE CENTER AND AQUARIUM

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Pricing and Policies

Pricing

Pricing for groups scheduled in advance

Self-guided visit admission per student……$10
Visit plus an additional demo/planetarium show per student……$14
Visit plus a laboratory program per student……$16-$20
Mini Golf on the Conservation Course add-on ticket……$1
*One chaperone is required per 10 students at $8 per chaperone.

Policies

• Final payment must be made by the day of your scheduled visit.
• If final payment has not been received by the day of your visit, reservations are subject to cancellation. NO REFUNDS WILL BE GRANTED.
• On the day of your scheduled visit, check in your group at the Front Desk under your group/contact name. Additional tickets may be purchased at the group rate on the day of your scheduled visit, if space is available.
• Increase in headcount should be called in as soon as possible to ensure availability.
• Acceptable forms of payment are check, money order, or credit card (Visa and Master Card).
• Please make checks payable to the *Cox Science Center and Aquarium* and mail to:

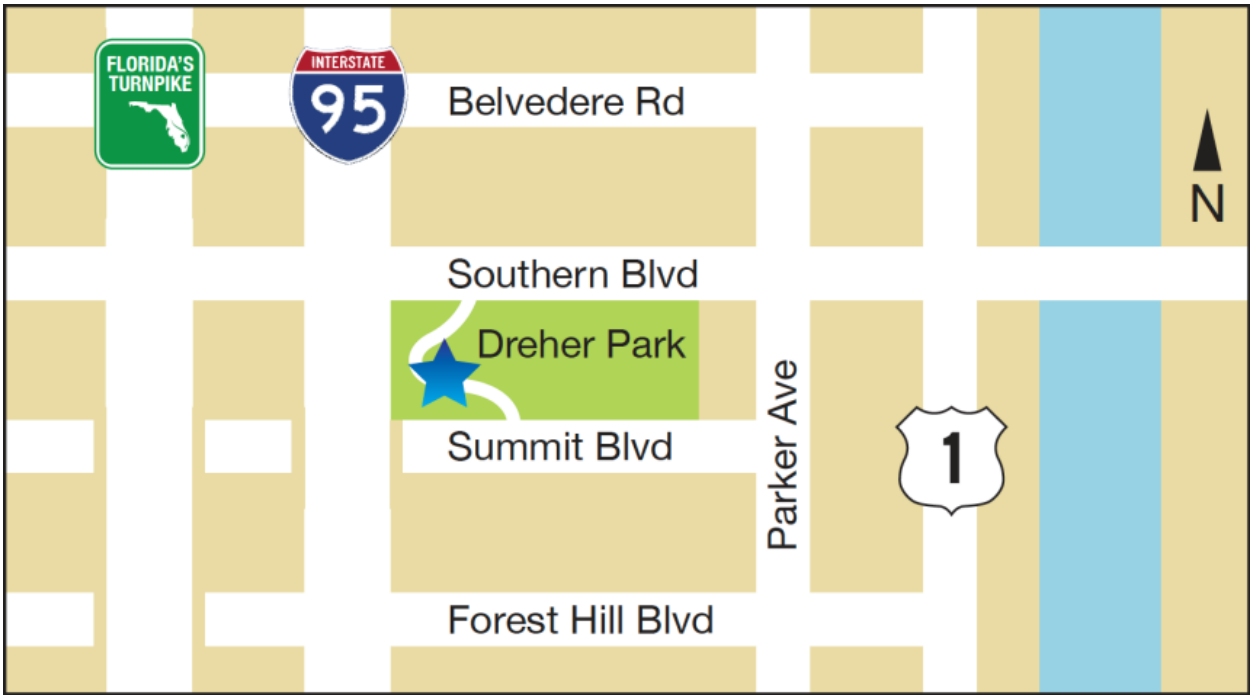
Cox Science Center and Aquarium, Attention: Group Sales
4801 Dreher Trail North
West Palm Beach, FL 33405

• Surcharges may apply for special event days and holidays.
• Science center memberships, coupons and other discounts are not applicable with school group rates.
• Teacher Members receive $25.00 off first program booked

Directions and Map

The Cox Science Center and Aquarium is located at:

4801 Dreher Trail North,
West Palm Beach, FL 33405.
Phone: (561) 832-1988



From the Florida Turnpike:

Take the Southern Boulevard exit 97 east, and continue just past I-95. Make a right into Dreher Park. Follow Dreher Trail to the Cox Science Center.

From I-95, heading south:

Take exit 68, Southern Boulevard and head east. Immediately over the I-95 bridge, make a right into Dreher Park. Follow Dreher Trail to the Cox Science Center.

From I-95, heading north:

Take exit 68, Forest Hill Boulevard east to Parker Avenue. Turn left on Parker Avenue (north) to Summit Boulevard. Turn right on Summit (west). At the first light (Dreher Trail North), turn right and continue around to the Cox Science Center.

Science Center Manners

PLEASE REVIEW THESE GUIDELINES WITH YOUR STUDENTS BEFORE YOU ARRIVE AT THE SCIENCE CENTER.

- Please walk, do not run, while in the science center. This is for your safety, as well as the safety of others.
- Please do not touch the glass on any exhibits, including the aquarium.
- Please enjoy yourselves and the hands-on exhibits, but leave them the way you found them.
- Please keep eating and drinking to the patio and picnic areas outdoors.
- Please have students remain with their chaperone at all times.
- Chaperones, please refrain from using your phones while supervising students at the Science Center.
- Violation of the rules could result in your group being asked to leave the Science Center.
- No refunds will be given.

Science Center Store Rules

- Students must be accompanied by a chaperone while in the gift shop. Please do not allow more than 5 children per chaperone in the store at one time.
- All sales are final, so please choose carefully.

What to Do at the Science Center

Arrival

Welcome! Once you arrive at the science center, have students either remain on the bus or line up on the patio space leading up to the front doors. Have your group leader check in at the front desk and get directions on where to go first. One of our CSCA staff members will welcome and orient your group as a whole.

Programs

Favorite programs such as planetarium shows, Nitromania, or Touch Tanks can be scheduled for a small fee to be added in with your field trip. **Call (561) 832-2026 in advance to schedule.**

Lunch

Picnic tables are available on the Science Trail or you can eat within Dreher Park, surrounding the Science Center. Snacks and individual lunches are available for purchase at the Nuts About Sugar Cafe located in the main exhibit hall.

Exhibits

There are many exciting exhibits to explore at the CSCA:

Aquariums of the Atlantic

See marine life from around the world in over 10,000 gallons of salt and fresh water aquariums. A living coral reef, sharks, eels, the invasive lion fish and a "touch tank" create this wonderful undersea exhibit hall.

Travel through Florida's diverse ecosystems of Everglades, Coral Reefs, Gulf Stream, and Open Ocean, home to the most beautiful native fish such as queen angels, lookdowns, moray eels, stingrays, seahorses and many more.

The Hidden World of the Everglades

Experience the Florida Everglades ecosystem and listen to sounds of Florida's wildlife in their natural habitat in this interactive exhibit about America's only sub-tropical wilderness.

River of Grass

Find out where our water comes from as you follow a drop of water from the Everglades to your faucet in this interactive display.

Florida Conservation Station

This learning station brings to life the immense variety of life in Florida and the complex relationships among living things. Visitors become real world biologists at these learning stations that include hands-on experiments and research activities.

Frozen Shadows

Lights, Action! 'Freeze' your shadow on the wall while you experience the effects of phosphorescence.

Marvin Dekelboum Planetarium

Palm Beach County's only public planetarium features a full-dome, newly renovated digital projection system. Sit back and be transported through the Universe with daily star shows, interactive astronomy presentations and other immersive science adventures. It's only $4 more per adult/child visitor to book as a group.

Discovery Center Powered by PNC Grow Up Great

Children 6 years and younger can play and discover in their very own space! The Center's features include a giant 16 x 5-foot water table, a wall-sized Lite Brite play area, lounge area for parents, story time area with bookshelves, a dress-up area and more.

Nano Exhibit

Nano is an interactive exhibition that engages family audiences in nanoscale science, engineering, and technology. Visitors will be able to build a giant model of a carbon nanotube, explore progressively smaller magnetic materials, and explore the relative effects of static electricity and gravity using the Static vs. Gravity discs.

Hands and Minds on Science

Explore the basic principles of science with hands-on displays representing the states of matter, including solid, liquid, gas, and plasma displays. Continue through the gallery for more basic principles of electricity revealed through conversion machines and Jacob's Ladder.

Out of This World

Part of the Ambassadors of Space Exploration, the Science Center was honored by Apollo 14 Astronaut Dr. Edgar Mitchell with a long-term loan of an authentic Moon rock collected during the Fra Mauro expedition. This exhibit also features a Mars rock found in Nigeria in 1962, a 232 pound meteorite.

Mitchell was the Lunar Module Pilot on NASA's 3rd Moon expedition where Mitchell became the 6th man to walk on the Moon. Authentic mission footage accompanies this rare display.

Brain Teasers

Exercise your mind with puzzling challenges for all ages!

Conservation Golf Course

Enjoy our 18-hole miniature golf course focused on Florida native plant and animal conservation and designed by Jim Fazio and Gary Nicklaus. Set within a giant butterfly garden and a series of babbling brooks, this educational mini golf experience is sure to be unlike any other. **Price is $1 per students for groups only.**

Hurricane Simulator

Have you ever experienced hurricane force winds? In our Discovery Hall, dial up the winds of a Category 1 Hurricane and see the 78 mph wind make your skin crawl! Visitors can also learn how to better protect their lives and property, and what to do once the storm has passed. The booth uses video, audio and high wind speed to make you feel like you are right in the storm!

Science On A Sphere

Science on a Sphere (SOS) is a room sized, global display system that uses computers and video projectors to display planetary data onto a six foot diameter sphere, analogous to a giant animated globe. Researchers at NOAA developed Science on a Sphere as an educational tool to help illustrate Earth system science to people of all ages.

Journey Through the Human Brain

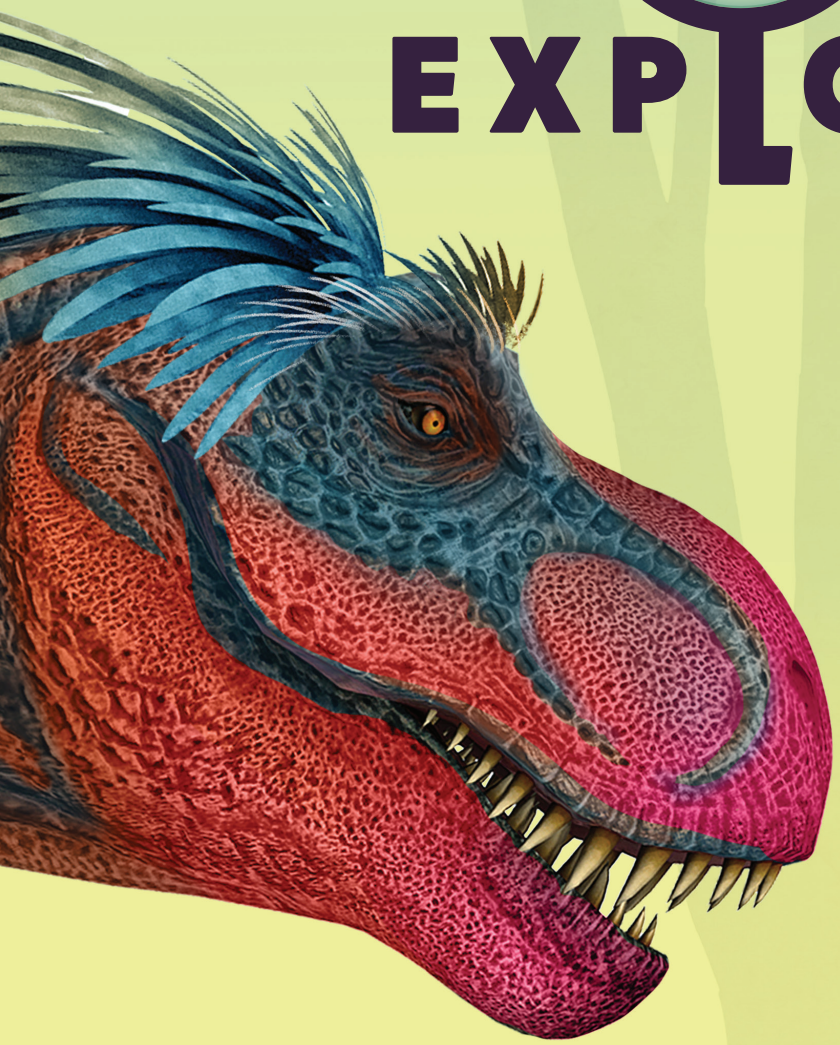
The Cox Science Center in collaboration with the FAU Brain Institute presents the world's most advanced neuroscience exhibit which will inspire a new generation of scientists, technologists, and medical professionals. Journey Through the Human Brain features the latest research and innovations, with high-tech displays, immersive experiences, and state-of-the-art equipment. It takes a bottom-up approach to telling the story of the human brain, from the molecular level to the integrated circuitry that reveals how the brain informs our senses, creates our thoughts and emotions, and how it has evolved into the most complex structure in the universe. There is something for all ages in this permanent exhibit.

Fisher Family Science Trail

Enjoy the outdoors while continuing your science exploration! The upgraded quarter-mile trail connects 15 new exhibits, including a Physics Forest, FPL *SolarScape*, splash pad, gem panning station, shark tooth dig pit, a dinosaur walk, picnic areas and much more!

DINOSAUR EXPLORER

Education Guide



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*Exhibition is in development and subject to change.

EDUCATION GUIDE

INTRODUCTION

Dinosaur Explorer **is an immersive exhibition showcasing various dinosaurs who once lived across the globe. The exhibition highlights many of the new findings made by paleontologists by showing how the combination of spectacular new fossil discoveries, comparisons made to living creatures, and groundbreaking high-tech approaches have allowed them to breathe life into these long-extinct creatures of the past. The exhibition is composed of 6 galleries and as students move through each they will compare body temperatures, analyze brain sizes, evaluate feeding habits, and observe other dinosaur behaviors to see how your own unique biology stacks up to that of the dinosaurs!**

This exhibition will thrill students and spark their interest to learn more about how dinosaurs lived, evolved, and died. *Dinosaur Explorer* **is not only a snapshot into the past but a look into the tools and techniques scientists are currently using to learn more about the evolution of life on earth.**

Visit *Dinosaur Explorer* **for more information.**

*Exhibition is in development and subject to change.

ABOUT THIS GUIDE

The guide is composed of twelve activities that embody the ideals of STEM and are aligned with the Next Generation Science Standards. These lessons and activities bridge the learning from the exhibition to the classroom.

Six of the activities cover a variety of 3rd–5th grade performance expectations and six of the activities cover a variety of 6th–8th grade performance expectations so teachers can choose which activites are best aligned with their curriculum and which best fit their student's needs and interests.

ACTIVITIES

There is a 3rd–5th grade and a middle school activity that corresponds to each of the main Galleries in the exhibition. Some of the activities should be done at the exhibition but most are either an introductory or follow-up activity designed to enhance and expand student's experience with the Dinosaur Explorer exhibition.

*Exhibition is in development and subject to change.

INTRODUCTORY ACTIVITY 1

ACTIVITY: Why aren't there Fossils Everywhere?

In the Introduction Gallery students will learn about a variety of dinosaurs that lived all over the earth and how they evolved differently to survive. Students will learn how Paleontologists use fossils to piece together how animals lived millions of years ago. In this activity students will learn how things decompose and why some conditions are better for preserving fossils than others.

GALLERY:

Introductory

GRADE LEVEL:

3rd–5th

NGSS STANDARD:

5-LS2-1

Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

MATERIALS:

- Apple, chicken bones, or any kind of other food scraps the students want to test
- Plastic Containers
- Dirt from outside to ensure it has the right bacteria
- Vegetable Oil
- Vinegar
- Water

*Exhibition is in development and subject to change.

PROCEDURE:

- Ask students why some fossils are preserved and others are not. Ask students if they know anything about or have heard the term "decomposition."
- Talk to students about how everything breaks down over time but depending on the environmental conditions–they break down slower or faster.
- Show students images of the fossils from excavation sites around the globe and ask if they see any similarities in the environmental conditions. Ask students to predict under what conditions would fossils break down most quickly.
- Tell students that the same general principles that cause bones to decay also cause fruits and vegetables to decay. Today they are going to design an experiment to determine how environmental conditions affect the rate of decay of organic materials.
- Put students into groups of 3-4. Each group needs to identify the food they are going to decompose (for example–an apple core, chicken bones or an orange) and three conditions they are going to place their food in (in water, dry dirt, wet dirt, just the air, oil, etc.)
- Have groups make a sketch of their food scraps before placing them in their conditions. Have students use the plastic containers to create their three environments and then immerse their scraps in the jar.

  If you have a camera, take pictures of the food scraps before students bury them. You can use these pictures as a comparison when the experiement is done.
- Wait 4-8 weeks. The longer you wait the better the results. Have students dig their environments and recover any remaining food scraps.
- Students should draw what is remaining of their scraps and compare these drawings with their originals.
- Ask students to share their results and ask under which conditions did the food break down the most and break down the least.
- Ask students what real world environments most closely resemble the environments they made in their jars and what this means in terms of finding fossils. Where do students think is the best place to find fossils and why?

INTRODUCTORY ACTIVITY 2

ACTIVITY: How do Paleontologists know what they know?

In this activity students play the role of a Paleontologist by trying to put "fossils" together to learn more about dinosaurs.

GALLERY:

Introductory

GRADE LEVEL:

Middle School

NGSS STANDARD:

MS-LS4-2

Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern fossil organisms to infer evolutionary relationships.

MATERIALS:

- Iguanodontid handout
- Scissors

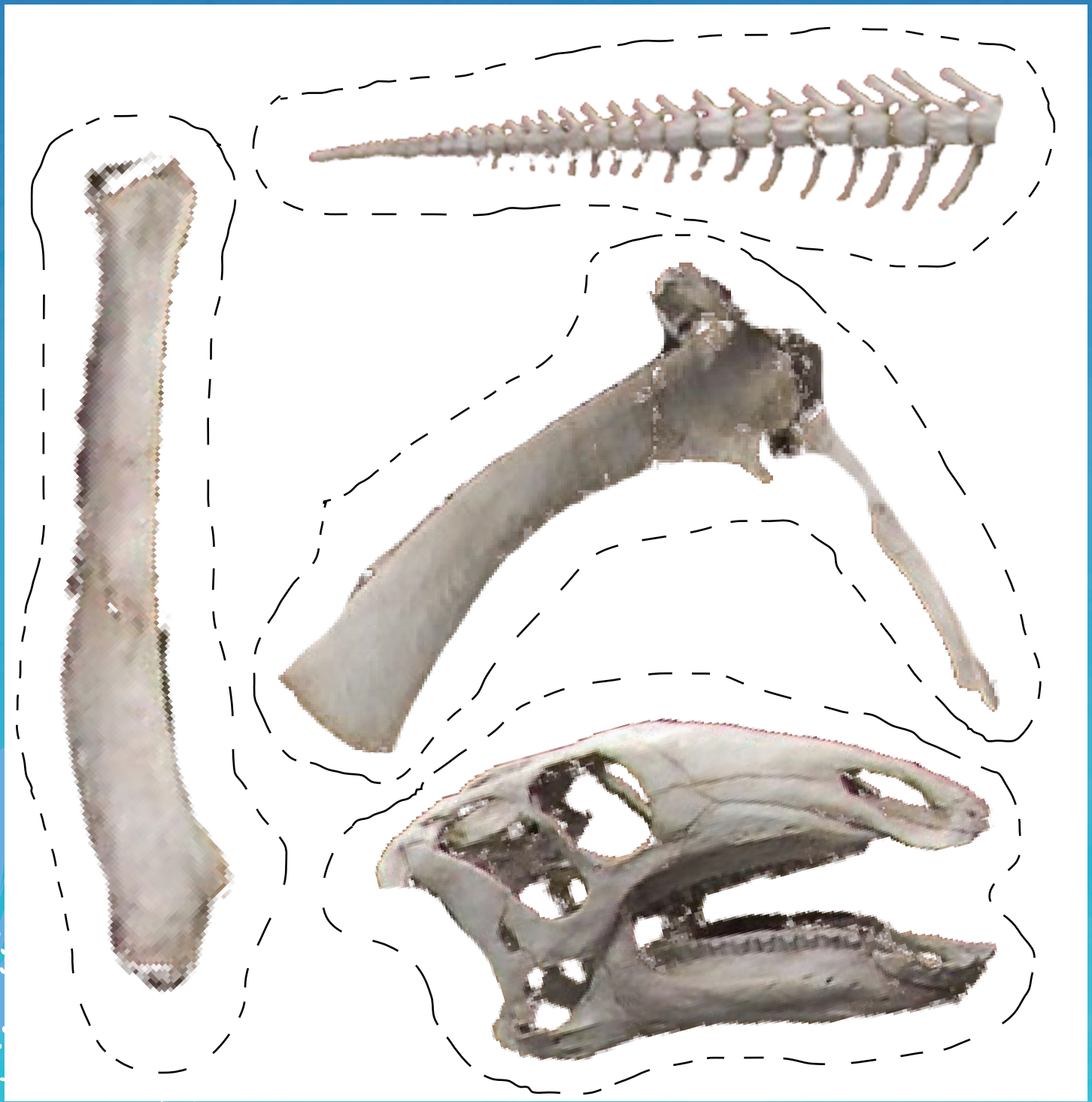
PROCEDURE:

- When students enter the *Introductory Gallery* of the *Dinosaur Explorer* exhibition they will learn about a type of scientist called Paleontologists and how they piece together clues to learn more about ancient life. These scientists have learned much of what they know from fossil evidence. However, rarely do scientists find complete sets of fossils. Instead they find a bone or bone-fragment and have to figure out what animal the bone is from. In this activity students will find "fossils" and have to use their deductive skills to figure out what type of animal the bones belong to.
- Cut out the sections of the Iguanodontid Handout. There needs to be one for each student. Make piles of all the bones in each set.
- Ask students how we know about life that existed on earth before humans. Ask students what a fossil is.
- Talk to students about how the job of a Paleontologist is to look for, dig up, and identify fossils. Tell them today they are going to be Paleontologists!
- Put students into groups of 3 or 4 and tell them that they are going to go on a fossil hunt. Give the group of students the first set of fossils from the Iguanodontid handout.
- Have each group discuss what they notice and make predictions about what the animal looked like. Ask probing questions like "is that an arm bone, leg bone, ribs?", "Does it look like it belongs to an animal that is long and skinny or short and wide?", "How do you know?". Have students sketch what they think the animal looks like.
- Tell students that on their fossil hunt they found a second set of fossils from the same animal. Give students the second set of fossils from the handout. Have them add them to the other fossils and sketch their new ideas for what the animal looked like.
- Tell students that they just found the last set of fossils and give them the last set. Have them put the entire puzzle together and draw the animal. Show students the image of the Iguanodontid and have them compare if with their own drawings.
- Ask students to talk about how their drawings changed as they got new evidence.
- Talk to students about what they could do if they were not able to collect all the fossils. How would they know they identified the animal correctly?
- Have students discuss the complete fossil skeleton and ask them to identify what anatomical structures are similar and different to animals today.

IGUANODONTID FOSSILS SET 1

IGUANODONTID FOSSILS SET 2

IGUANODONTID FOSSILS SET 3



BODY TEMP ACTIVITY 1

ACTIVITY: Keeping Cold-Blooded Dinosaurs Warm

In the Body Temperature Gallery students learn that dinosaurs were ectotherms and are dependent on environmental conditions and their physical features to keep their bodies warm. In this activity students design and test a device that keeps water protected from both the heat and the cold to model how dinosaurs regulated their body temperature.

GALLERY:

Body Temperature

GRADE LEVEL:

3rd–5th Grade

NGSS STANDARD:

3-5-ETS1-3

Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

MATERIALS:

- 16-ounce clear water bottle with label removed
- Various art supplies (Styrofoam, colored paper, rubber bands, food coloring, cardboard boxes, etc.)
- Thermometer

*Exhibition is in development and subject to change.

PROCEDURE:

- After visiting the Body Temperature Gallery in the *Dinosaur Explorer* exhibition, discuss with students the various adaptations that dinosaurs have that help them survive.
- Discuss why maintaining body temperature is so important to the survival of all animals. Review with students the various strategies cold-blooded animals use to keep their internal temperature steady and survive even when faced with extremely hot or extremely cold environments.
- Ask students to discuss ways that animals have adapted to stay warm in cold climates and cool in hot climates. Some of the main adaptations are fur, fat, and color.
- Tell students that they are going to be challenged with designing and constructing a dinosaur's outer shell or coat that prevents changes in the "animals" temperature. Their design needs to be able to hold a bottle of water which will represent the animal's body temperature. Each group will recieve a bottle full of water and will test how their design helps the water resist temperature changes.
- Talk to students about coolers, thermal mugs, and other things that are commonly used to keep beverages warm or cold. Brainstorm ways students can construct their design to contain some of these features.
- Have groups discuss and sketch their design. Once you have seen their ideas give groups their water bottle and other materials. Give students time to construct their design.
- After groups are done constructing, have them record the initial temperature of the water and place it in their design. Place each group's design with the water bottle inside in a freezer and wait for an hour. Remove the water bottle, take and record the temperature, and have each group calculate the change to its initial temperature.
- Have students share their results and discuss why some models worked better than others. What were some of the common design features?
- Assuming it is hot enough outside, have students fill the water bottle up with room temperature water and record it's temperature. Groups then place their bottles in the sun for an hour and record the change in temperature to the water.
- Students should discuss how and why the models did better or worse in the cold in comparison to the heat.
- Come back together as a class and discuss the results. Have groups talk about why they think some designs resisted cold better and why some resisted heat better. Ask students if they were to make another model what improvements they would make. To conclude, ask students how their results are seen in nature. Are there any dinosaurs that have physical features that are reflected in their models?

BODY TEMP ACTIVITY 2

ACTIVITY: What is a Dinosaur?

Are dinosaurs extinct? It all depends on what a dinosaur really is. Is it a reptile? Is it a bird or a mammal or something different? For this activity students will use their prior knowledge to answer questions about some key characteristics of animals they already know. Then, while exploring the *Dinosaur Explorer* exhibition, they will try to answer the same questions about dinosaurs to help them better understand what dinosaurs were (or are!?!).

GALLERY:

Body Temperature

MATERIALS:

- None

GRADE LEVEL:

Middle School

NGSS STANDARD:

MS-LS4-2

Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern fossil organisms to infer evolutionary relationships.

*Exhibition is in development and subject to change.

PROCEDURE:

- Throughout the *Dinosaur Explorer* exhibition, and particularly in the Body Temperature Gallery, the concept of what is a dinosaur is explained. There is a special focus on how dinosaurs evolved, how they cross-populated, and the similarities and differences they have with the animals of today.
- Tell students that they will soon visit the *Dinosaur Explorer* exhibition but before going we need to first answer the question, "What is a Dinosaur?"
- As an entire class, have students explain what they think a dinosair is. During this discussion be sure to ask if dinosaurs are reptiles, or birds, or neither. Are they warm-blooded? Do they lay eggs?
- As a class, create a table with a list of 10 questions that students need to ask about an animal to know if it's a bird, reptile, or mammal. These questions can involve things like the following or any appropriate questions students generate on their own.

  Does this animal have scales?
  Does this animal have feathers?
  Does this animal lay eggs?
  Is this animal cold-blooded?
  Does this animal have a live birth?

- As a group, answer these questions about reptiles, birds, and mammals. Be sure students record the correct answer on their table.
- Either individually, or in groups, have students make predictions on their table.
- While in the museum, students search for the actual answers to their questions about dinosaurs and record them on their table.
- After returning to school ask students to share their findings and ask them what–if anything–was a surprise.

  Discuss what they learned and wrap up by asking students the question again, "After all this research, what is a dinosaur?" The answer is complex and not universally agreed upon.

  However, the point of this activity is not to find *the* answer but for students to start asking questions and trying to make sense of what they learned.

INTELLIGENCE ACTIVITY 1

ACTIVITY: Escape Artists

Students research a variety of escape strategies that dinosaurs and other animals use in the wild and then challenge each other to design a new way for dinosaurs to escape from predators.

GALLERY:

Intelligence

GRADE LEVEL:

4th Grade

NGSS STANDARD:

4-LS1-1

Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

MATERIALS:

- Internet access
- Art supplies such as construction paper. tape, glue, scissors, pipe cleaners, and paper clips.

*Exhibition is in development and subject to change.

PROCEDURE:

- Have students reflect on the Intelligence Gallery in the *Dinosaur Explorer* exhibition. Have students talk about what are the advantages of having a larger brain and being smarter. Ask student how dinosaurs used their brains to both catch and escape from predators.
- Ask students what other escape strategies they know about that other animals use to avoid predators. Write responses on the board.
- Put students into groups and have them conduct research online about various strategies dinosaurs and other animals use to stay safe. Write new finding onboard.
- Assign each group a biome (tropical rainforest, temperate forest, desert, etc.). Tell students that each group needs to go online and write a description of their biome. They need describe the types of flora, fauna, and the climate.
- Have students choose which type of dinosaur would be the main predators in their biome. It doesn't have to be a dinosaur that actually lived in that type of climate. Students need to identify how this dinosaur catches its prey. For example, do they attack as a pack or do they hide and wait for the prey to come to them?
- Have students brainstorm and design a made-up dinosaur (prey) that would be best adapted to survive in their biome. They need to be sure to include the following characteristics:

  Size
  Color
  If it's a herd or pack animal, or not
  What it eats
  Strategies used to avoid predators

- Have each group construct their dinosaur using that art supplies and then present it to the class. During their presentation, students need to be sure to explain how their dinosaur is designed specifically to survive in their Biome and against the dinosaur predator.
- After each group's presentation, ask the other groups to explain why this dinosaur would or would not survive in their biome. For example, would the same dinosaur be adapted to survive in the rainforest and in the Tundra? Why or why not?
- After all groups have presented, ask the class to identify which escape strategies were and were not successful in multiple Biomes.
- Discuss the result of the activity. Have students think about what dinosaurs would be able to live in multiple biomes and why. As a class or in groups, have students design a dinosaur that is best able to escape predators in any habitat.

INTELLIGENCE ACTIVITY 2

ACTIVITY: Dinosaur forms and functions.

In the Intelligence Gallery students learn how scientists can predict the intelligence of the animal by calculating the ratio of its brain volume to its body size. In this activity students identify other features of animals that also help us understand how they behave.

EXHIBIT:

Intelligence Gallery

MATERIALS:

- Internet Access

GRADE LEVEL:

Middle School

NGSS STANDARD:

MS-LS4-1

Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth under the assumption that natural laws operate today as in the past.

*Exhibition is in development and subject to change.

PROCEDURE:

- In the *Intelligence Gallery* students learn how scientists can infer how smart an animal is by looking at the ratio of an animal's brain volume to its size. Ask students if how an animal moves or is shaped tells us anything about their behavior. Ask what is the reason we walk on two legs while cats and dogs walk on four. Ask why some animals have eyes in the front of their face while others have eyes on the side of their face.

- Tell students that for this activity they are going to research a dinosaur to learn about some of its behavior and then they will act out how they think that dinosaur would behave while the rest of the class tries to guess what kind of dinosaur they are.

- Tell students that just by the way dinosaurs and other animals move and are shaped we know a lot about how they behave.

- Put students into 6 groups and tell them that they are going to research the following 6 types of dinosaurs. These are all dinosaurs they will learn about in the *Dinosaur Explorer* exhibition:

  Velociraptor
  Tenontosaurus
  Pachyrhinosaurus
  Nanuqsaurus
  Orinthomimus
  Stegosaurus

- Tell students that the 3 features they need to research and identify for their dinosaur is feet type, eye placement, and teeth shape.

Please note that the dinosaur information provided below is not always true in ALL dinosaurs and other animals but is a general rule of thumb for most animals whether they live now or millions of years ago.

Feature 1: Eye Placement
Side of Head = Prey
Front of Head = Predator
Having Eyes on the side of your head allows prey to see wide view to help spot predators. Having eyes in the front of the head allows predators to focus on and attack a prey.

Feature 2: Foot Shape
Hoof = Pack Animals
Claws = Predator or Burrower

Feature 3: Teeth
Sharpe = Carnivore or Omnivore
Flat = Herbivore or Omnivore
Sharp teeth are used to tear apart meant while flat teeth are used to grind fruits, vegetables, and grasses.

- Have each group find and record the information above for each dinosaur.

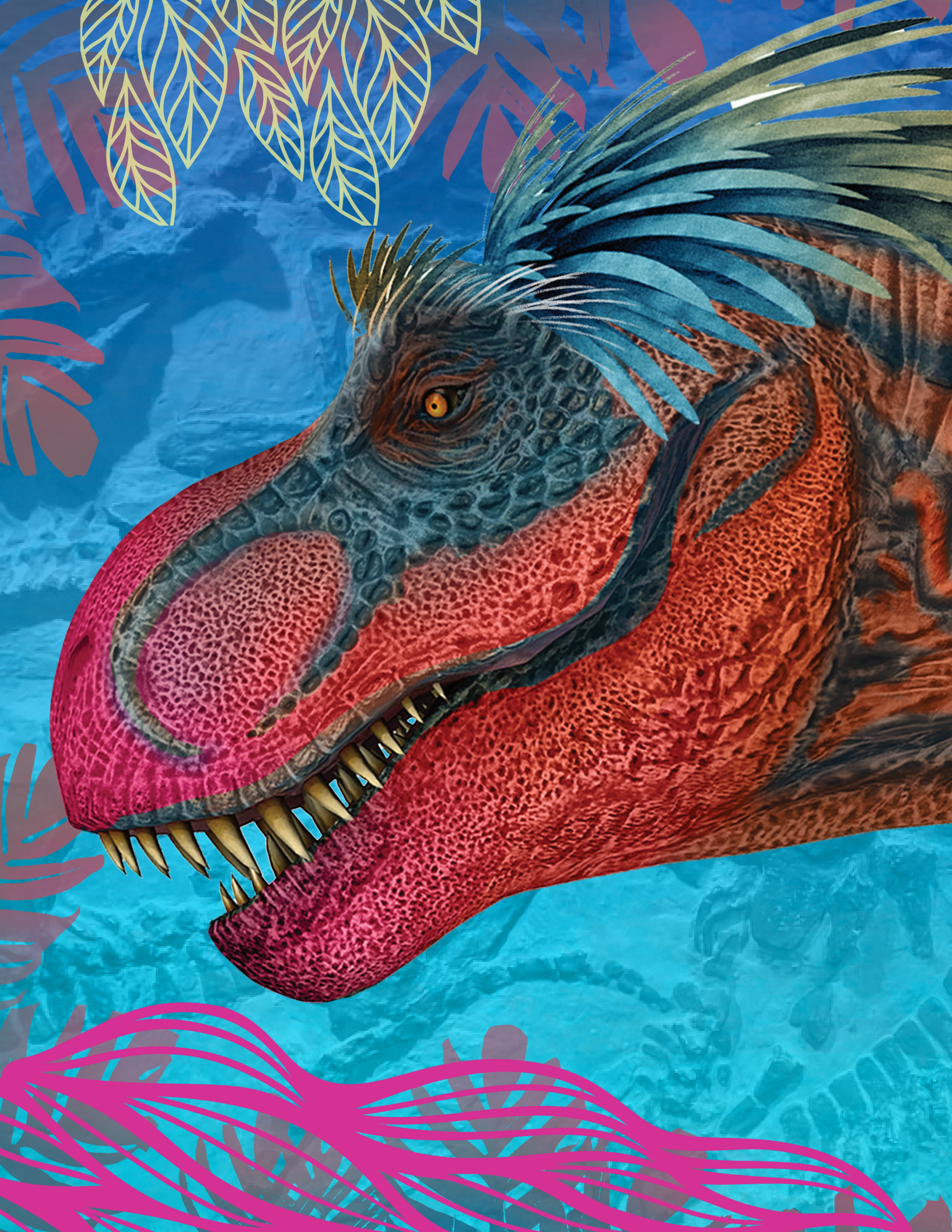
- Tell students that each group is going to be secretly assigned one of the dinosaurs and will have to come up with a way to act out how the dinosaur's behavior so that the rest of the class can figure out which dinosaur they are.

- Assign each group a dinosaur. Give groups 10 minutes to create a skit where they silently act out how their dinosaur behaves.

PROCEDURE (Cont'd):

- Have each group act out their animal in front of the class. After each group presents, the other groups should review the research they conducted on all the dinosaurs and write down which dinosaur they think the group was acting out.
- After all the presentations have groups read out what animals they thought the groups were acting out and then have groups share the dinosaur they were actually trying to act out.
- Ask students to explain how animals shape helps us understand their behavior.
- Ask for other examples of other animal characteristics–beyond teeth, feet, and eye placement–that tell us about how an animal behaves.
- Discuss why groups that had the similar dinosaurs did or did not have similar behaviors.

*Exhibition is in development and subject to change.



FEEDING & HUNTING ACTIVITY 1

ACTIVITY: Eating to maintain balance

Students play a game to observe how the population of predator and prey dinosaurs interacted to stay in balance.

GALLERY:

Feeding and Hunting

MATERIALS:

- Graph paper

GRADE LEVEL:

3rd Grade

NGSS STANDARD:

3-LS4-3

Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

PROCEDURE:

- When visiting the *Feeding and Hunting Gallery* in the *Dinosaur Explorer* exhibition ask students to pay special attention to the various ecosystems that are on display. Tell students to not just focus on one dinosaur but on everything in the exhibit and to think about how they are all interconnected.
- Discuss with students what an ecosystem is and what it means to have a balanced ecosystem.
- Have students pay special attention in the *Feeding and Hunting Gallery* to how different dinosaurs evolved to eat different things. Discuss the interdependence of predators and prey.
- After returning to school, ask students to share what they know about ecosystems and balanced ecosystems. Write responses on the board.
- Ask students what the terms predator and prey mean and ask for some examples. Ask students how or if the population of these animals are connected.
- Tell students they are going outside to simulate what it's like for different dinosaurs to survive in the wild!
- Count students off from 1 to 4. Separate the ones from the twos, threes, and fours. Have students line up so the ones are facing the twos, threes, and fours about 20 yards apart. Tell the ones that they are the *Tyrannasaurus Rex (TR)*, or the predator. Tell the twos, threes, and fours they are the *Edmontosaurus (EM)*, or the prey.
- On a large poster record the number of prey and predators.
- Tell students that the goal of the game is for the *EM* to run from one side of the field to the other without getting tagged by the *TR*. The goal for the *TR* is to tag as many *EM* as they can.
- Tell students to be careful as they run then tell the *EM* to try and run to the other side of the field while the *TR* try to tag them.
- If an *EM* is tagged it means it has been eaten. The student who was tagged becomes a *TR* for the next round. If a *TR* does not tag an *EM* it dies and becomes an *EM* in the next round.
- Repeat this process 5 or 6 rounds being sure to record the population of *EM* and *TR* on the poster each round.
- Go back to the classroom and have the students graph the data.
- Discuss the trends and ask students why the populations of both *EM* and *TR* were always going up and down. Note that if the *EM* population got too high then more *TR* would survive and bring the *EM* population back down. Talk to students about how this is an example of a balanced ecosystem where one species needs to stay in balance with another for its own survival.
- Discuss with students how this balance of predators and prey was important to both the survival of dinosaur ecosystems and to the survival of animals today.

FEEDING & HUNTING ACTIVITY 2

ACTIVITY: The Perfect Tooth

Students investigate how and why various dinosaurs have different shaped teeth and then design a tooth that is multifunctional.

GALLERY:

Feeding and Hunting

GRADE LEVEL:

Middle School

NGSS STANDARD:

MS-ETS1-2

Engineering Design. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MATERIALS:

- Fruit or Vegetables such as carrots, apples, or celery.
- Popcorn or pretzels
- Dried fruit, jerky, or bread

*Exhibition is in development and subject to change.

PROCEDURE:

- Talk to students about what they noticed in the *Feeding and Hunting Gallery* of the *Dinosaur Explorer* exhibition. What did they notice about the various dinosaurs? What was similar and what was different?
- Talk to students about how they eat. Ask them if they eat different foods in different ways and if so, how and why?
- Put students in pairs and have them look at each other's teeth. Ask students to describe how some teeth are different from others. Have students describe the different shape and location of the different types of teeth.
- Students should notice three distinct types of teeth. The front teeth are called incisors. Next to them are pointy canines and the back are molars.
- Pass out the three types of food to the students and have them predict which teeth they will use to eat each item. Have students eat each type of food one at a time paying attention to which teeth they use to chew it. Have groups share their results.
- Ask students to describe the different functions for the different types of teeth. The incisors are used to bite into and pierce fruits and vegetables. The canines are used to tear and rip into meat or other tough foods and the molars are used to grind food.
- Ask students to predict which kinds of teeth various animals have. Ask them what kinds of teeth dinosaurs, cows, tigers, rabbits, or whatever other animals they are curious of have. Have students look up those animal's teeth.
- Ask students to draw conclusions about the relationship between an animal's diet and their teeth shape. In general, carnivores have more and larger canines, herbivores have incisors and large molars, and omnivores have all three.
- Put students into groups and have each group record their favorite 5 foods. Tell each group that they need to design just one type of tooth that will allow them to be able to eat all of their favorite foods.
- Give students 20 minutes to brainstorm and design their teeth. Groups should draw their teeth and label how they will work. Have each group present their design to the class.
- Wrap up the activity by discussing how dinosaurs and other animals have evolved teeth to be best shaped for their diet and talk about how this is an excellent example of how in nature form follows function.

BEHAVIOR & DISPLAY ACTIVITY 1

ACTIVITY: How does a dinosaur hide?

In the *Behavior and Display Gallery* students learn about various adaptations on dinosaurs that were used to attract mates, protect themselves and stay warm. Camouflage is one of the most common adaptations seen in dinosaurs and other animals. In this activity students conduct an experiment to test how effective camouflage is in helping prey stay away from predators.

GALLERY:

Behavior and Display

GRADE LEVEL:

3rd Grade

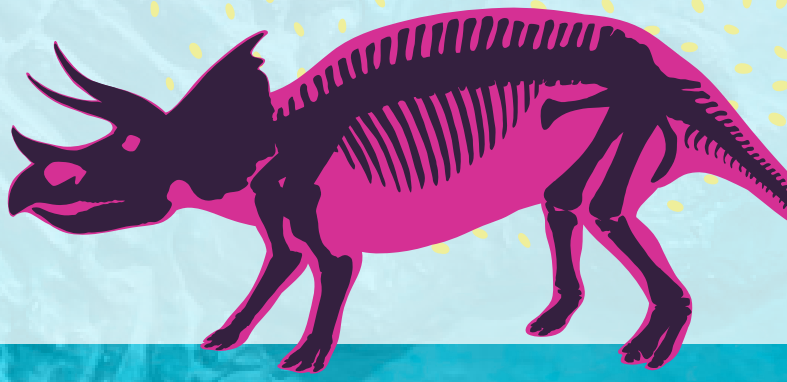
NGSS STANDARD:

3-LS4-2

Biological evolution: Unity and Diversity: Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.

MATERIALS:

- Construction paper of various colors
- Hole punch outs of various colors (the tiny circles made when using a hole punch)
- Color pencils or crayons
- Scissors
- Graph paper
- Printout of various environments such as the rainforest savannah, or alpines.



*Exhibition is in development and subject to change.

PROCEDURE:

- Ask students to define camouflage and ask them to name any animals that were camouflaged in the *Dinosaur Explorer* exhibition. Ask students WHY these dinosaurs are camouflaged.
- Put students in groups and tell them that they are going to conduct a test to see how effective camouflage is in hiding from predators. Pass out a different colored sheet of construction paper to each group and then spread out an assortment of various colored hole punch outs on their paper. The color of the construction paper should match one of the colors of the hole punch outs.
- Tell students that they are going to pretend to be predators–like a *Tyrannasaurus Rex*–and their prey are the hole punch outs. Give them 15 seconds to capture as many prey as they can. Tell them the only rule is that they can only capture one prey at a time. (No sweeping up prey).
- When time is up have groups tally their results and randomly spread all the hole punch outs back on the construction paper. Repeat this process 4 times.
- Have groups graph and share their results. As a class, discuss why they got the results they did and talk about why it was harder to find the hole punch outs that blended into the construction paper. Ask students how this does model real life and how it is also an oversimplification.
- Tell students that they are now going to be challenged with designing their own camouflage that is best designed for specific environments.
- Pass out one of the environment printouts to each group and a dozen blank hole punch outs to each student. Challenge students to camouflage their punch outs to best blend into their environment. Give students 15 minutes to design and color their hole punch outs. Tell students the punch outs don't have to be one color. They can be multiple but each student's punch outs should all be the same.
- After students have finished making their punch outs, have everyone in the group randomly place them on their environment printout and pass it to another group.
- Have students go through the same process as they did in steps 3 and 4. Groups need to record and graph their data and share it with the class.
- Discuss what kind of camouflage did the best in this experiment and why. Ask students to discuss what changes they would make to improve how camouflaged their hole punch outs were and how to improve the experiment to get more accurate results.
- Talk to students about the importance of color in dinosaurs–not just for camouflage–but for other purposes as well (temperature regulation, attracting mates, etc.) and ask if dinosaurs are too big to be able to be camouflaged.
- Discuss with students what camouflage was most successful in multiple environments.

BEHAVIOR & DISPLAY ACTIVITY 2

ACTIVITY: How could dinosaurs survive?

Dinosaurs once ruled the earth but are now extinct. Why? What adaptations did they need for them to survive extinction? In this activity, students create a modern dinosaur that has all the evolutionary features they think a dinosaur would have needed to survive the last great extinction. When students finish this activity tell them that all dinosaurs did not go extinct–in fact–many survived and are now modern day birds.

GALLERY:

Behavior and Display

MATERIALS:

- Paper

GRADE LEVEL:

Middle School

NGSS STANDARD:

MS-LS4-2

Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organism to infer evolutionary relationships.

*Exhibition is in development and subject to change.

PROCEDURE:

- Ask students how can fossils be used to help scientists learn about the behaviors of extinct animals?
- Ask students why there are no longer dinosaurs on earth. Ask students to discuss how they think they went extinct.
- Most likely students will have heard that dinosaurs went extinct because of the impact of a meteor. Discuss why a meteor hitting the earth would cause 60-70% of all life on earth to go extinct. There are several theories but generally most scientists believe that the dust thrown up by the impact of the meteor blocked out the sun–causing plants to die–and changing the global temperature for months or possibly years.
- Ask students if all life died after the meteor hit (no) and have them explain why or why not. Ask students what types of animals survived the extinction.
- Ask students to discuss what type of animals survived. Write the animals listed below on the board and have students add comments, questions, and new ideas.

  Crocodiles–lived in water so they are able to avoid extreme heat and cold caused by impact.

  Horseshow Crabs–able to eat basically ANYTHING so even when the plants died they could find food.

  Cockroaches–they also can eat just about anything and reproduce quickly.

  Small Mammals (like mice and rats)–able to burrow to get out of extreme weather and can hunt for insects and other bugs to get food.
- Tell students they are now going to reengineer dinosaurs so that they could survive the meteor impact. Tell students that on a blank sheet of paper they are going to draw a new kind of dinosaur, a kind of dinosaur that would be able to survive the impact.
- Give students time to draw a dinosaur and make sure they label the adaptations using at least 2 from the list you created on the board.
- Have students present and explain their drawing with the class.
- Ask students what were some of the similarities and differences of their drawings. As a class, discuss some of the features that are most common and discuss any unique ideas.
- Tell students that not all dinosaurs went extinct! In fact many of today's birds are direct descendents (mostly predatory birds) of dinosaurs. Ask students if any of their drawings looks like a bird and discuss why or why not.

FAMILIES & NESTING ACTIVITY 1

ACTIVITY: Dinosaur Genes?

In the *Families and Nesting Gallery*, students learn about how parent dinosaurs care for their young. In this activity, groups of students will look at how these parent dinosaurs pass on certain characteristics to their young.

GALLERY:

Family and Nesting

MATERIALS:

- A coin for each pair of students

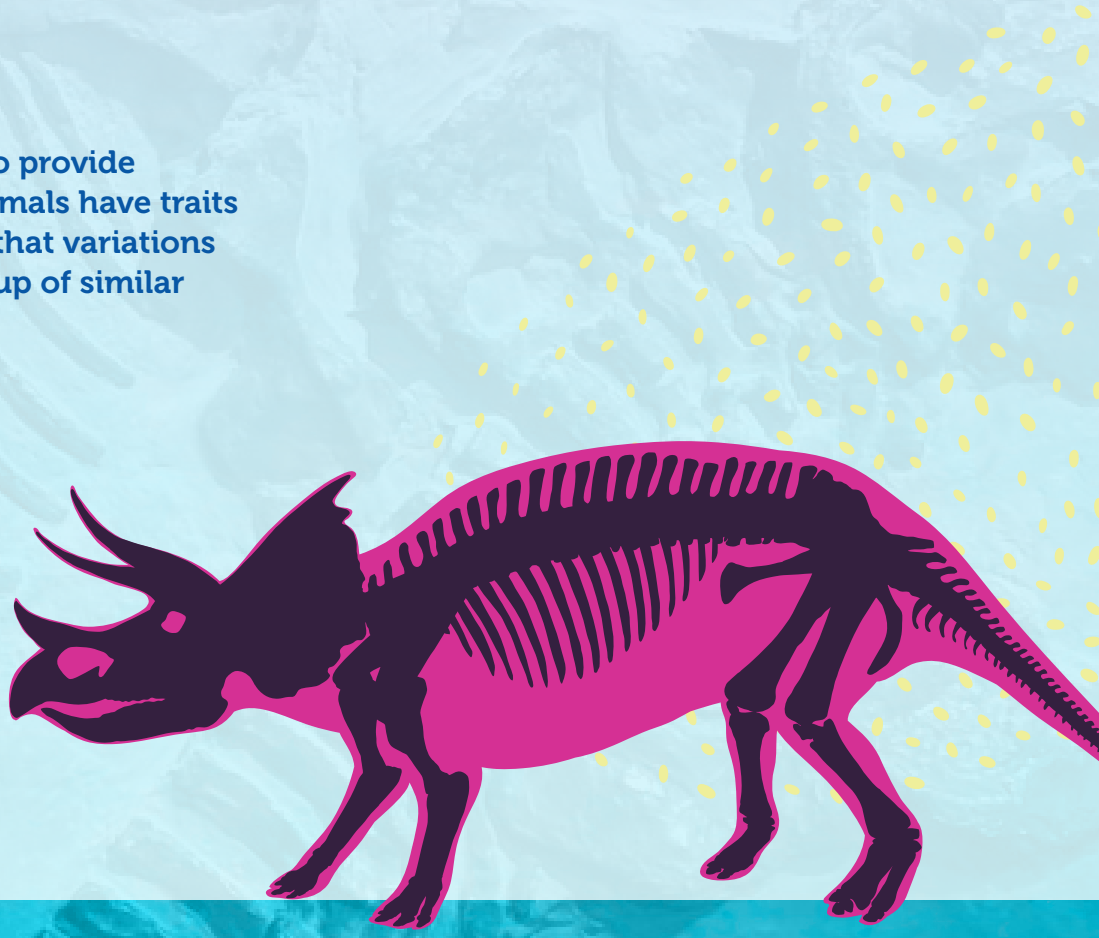
GRADE LEVEL:

3rd-5th Grade

NGSS STANDARD:

3-LS3-1

Analyze and interpret data to provide evidence that plants and animals have traits inhereted from parents and that variations of these traits exists in a group of similar organisms.



*Exhibition is in development and subject to change.

PROCEDURE:

- Before visiting the *Dinosaur Explorer* exhibition ask students why dopeople look different and why do siblings often look similar? Ask students why you get some characteristics from your Mother and some from your Father?
- While in the *Dinosaur Explorer* exhibition, have students pay close attention to all the dinosaurs. Have them all make a list of 5 things that are different about them. For example, their color, the shape of their head, and the size of their feet.
- When you return to the classroom ask students to share their lists and write the responses on the board.
- Have the class choose 5 of these characteristics to focus and identify the phenotypes for these traits. For example, large feet vs small feet and claws vs. hooves.
- Tell students that they are going to make a dinosaur by randomly choosing which of the 5 traits they want their dinosaur to have. Once everyone is done, partner students up and tell them their dinosaurs are going to mate.
- Have each group make a chart like the one below and give them a coin. Have them fill in the chart with the characteristics of each of their dinosaurs.

Trait	Male	Female	Heads/Tails	Sketch of Trait
Sketch of Offspring				

- Explain to students that when parents make a baby they both pass their genes onto the child BUT only one of the genes becomes dominate (or visible).
- Ask each pair to look at the first gene listed on their worksheet and read the description of the male and of the female.
- Have each pair flip a coin and if it comes up heads the offspring have the male gene and if it's tails it has the female gene.
- After assigning the gene, have students sketch and construct their new creature.
- If time allows–repeat this process several times with the offspring to demonstrate why offspring from the same parents can look so different.
- Have teams present their offspring bring sure to indicate how the offspring are similar and different from their parents.
- Ask students to describe how this activity models real life genetics and how it is now completely accurate.
- Have students compare how the parent's generation and the offspring's generation look similar and different. Why is this?

FAMILIES & NESTING ACTIVITY 2

ACTIVITY: How do dinosaurs care for their young?

In the *Families and Nesting Gallery*, students learn that various dinosaurs cared differently for their young. In this activity students will research a dinosaur to determine how it cared for it's young and how similar or different that is to animals today.

GALLERY:

Families and Nesting

MATERIALS:

- Internet access

GRADE LEVEL:

Middle School

NGSS STANDARD:

MS-LS1-4

Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specified plant structures affect the probability of successful reproduction of animals and plants respectively.

PROCEDURE:

- Discuss with students what they learned about how dinosaurs cared for their young in the *Families and Nesting Gallery* of the *Dinosaur Explorer* exhibition.
- Discuss what they know about how other animals care for their young. Tell students that animals care for their young in four special ways:

  Shelter
  Feeding
  Teaching
  Protecting

- Ask students to share how animals they already know about care for their young in special ways.
- Ask students what kind of animals dinosaurs were. Were they reptiles, birds, mammals, or something else?
- Put students into groups and have them choose an animal from each of the following groups then have them go onto the internet to determine how each care for their young in the four special ways described above:

  Reptiles
  Birds
  Mammals
  Dinosaurs

- Have groups present their findings about how all 4 of the animals they choose care for their young. At the end of each presentation ask the group which animal cared for their young in a way most similar to their dinosaur.
- After all the groups have presented, have a class discussion about how dinosaurs cared for their young. Did all dinosaurs have the same behaviors or did some care for their young differently than others? Were dinosaurs mostly like one of the other groups or a mix of two or more? What do these findings tell us about the evolution of dinosaurs?

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