Dinosaur Journey Exhibits Guide

A teacher-friendly map and explanation to the exhibits at Dinosaur Journey

1. The Hall of Tracks

As you come into Dinosaur Journey and walk under the archway, you will be in the exhibit hall! Directly in front of you is a life-size head and leg reconstruction of *Tyrannosaurus rex*. Fun fact: *T. rex* fossils have never been found in the Grand Valley. The rocks from 65 million years ago have been eroded away between then and about 50 million years ago, when the next layer of rocks were deposited. We know that *T. rex* lived just over the border in Utah at this time, however, since we have found its fossils in rocks there that were not eroded away.

Turning left will take you to the Hall of Tracks. On the left side of the hall of tracks we have several different prehistoric animal tracks, ranging from heron tracks from Nevada to 220 million-year-old dinosaur tracks from right here in Colorado. These tracks are touchable – students can carefully run their fingers over where dinosaurs stepped millions of years ago.

Students can also look at the wall displays; the one on the left showcases a large dinosaur trackway, coupled with small lizard-like reptile tracks. On the right there are pterosaur (flying reptile) tracks, as well as tracks from herbivorous and carnivorous dinosaur tracks. Just before the short wall on the right are some mammal tracks in a case. These are some of the oldest mammal tracks in the Grand Valley area!

2. *Camptosaurus* and *Ceratosaurus*

At the end of the Hall of Tracks there is a mounted skeleton of the plant-eating dinosaur *Camptosaurus*. C*amptosaurus* is one of the most common herbivores from the Morrison Formation, a group of rocks laid down across the American West about 152 million years ago by rivers, lakes, and floodplains. The skeleton in front of you is actually a cast of the original bones (some of which are on display elsewhere in the museum). Original fossil specimens are heavy, fragile, and irreplaceable, so mounting them is difficult, dangerous, and expensive. To make sure that our visitors can see what these animals looked like, we focus on having casts for our skeletal mounts. We do have plenty of original fossils on display too, however! The fossils that are in cases and at the base of the exhibits (like the *Apatosaurus* pelvis to the left of the *Camptosaurus*) are all original fossils, 95% of which were found right here in Mesa County.

In the last display case on the right there are original fossil bones of a dinosaur called *Ceratosaurus magnicornis*. These bones, and others in our collection area, represent what is called the holotype of this species. A holotype is a specimen that is either the first of its kind ever found, or the best example of a new species. In the case of this animal, it is the first and only

Ceratosaurus magnicornis ever found. It was discovered just across the Colorado River at the Fruita Paleo Area and is also the official dinosaur of the town of Fruita.

3. Wall of Trivia

This is a great location to review a couple of the things that that students have seen in the first two stops, as well as setting up learning expectations for the next portion of the gallery tour. If the students are not lifting up the panels before moving on, it will allow them to understand what they should be getting from each exhibit and to perform a quiz on the way back out of the exhibit hall. Directly behind the Wall of Trivia, above the cave entrance, is a mounted skeletal cast of *Camarasaurus*. This dinosaur is one of the most common dinosaurs we find in the Late Jurassic Morrison Formation.

4. *Utahraptor* and the Cedar Mountain Formation

This is the first animatronic dinosaur exhibit that the students will see during the gallery tour and it is usually the most frightening. Here a *Utahraptor* has decapitated a sauropod dinosaur, likely "*Moabosaurus,*" and is in the process of raising eating it. *Utahraptor* has never been found in Colorado (hence the name), but it is known from the Cedar Mountain Formation just over the border, between here and Moab. We have the same rock layers here in the Grand Valley so it is not unreasonable to think that *Utahraptor* fossils might be found in our area in the future.

This robot was built in the mid-1990s and represents our understanding of these large carnivorous "raptors" as it existed at that time. This view is best exemplified by the "*Velociraptor*" dinosaurs from *Jurassic Park*. The real *Velociraptor* was small and feathered and probably was the Cretaceous equivalent of a coyote (see our mounted skeletal cast of *Velociraptor* near Station 12). Like *Velociraptor*, *Utahraptor* would have been feathered. It would not have been able to open doors, however, since its wrists could not bend like that. Instead they were locked in place with the palms of the hands facing inward.

To the left and the right of the *Utahraptor* display are casts of the bones of other animals found in the Cedar Mountain Formation. These include the feathered plant-eating dinosaur *Falcarius*, a sauropod leg bone, the skull of the armored dinosaur *Gastonia*, and several other *Utahraptor* bones.

5. *Brachiosaurus* and Grand Valley Paleontology

Brachiosaurus is a long-necked, long-tailed plant eating dinosaur belonging to the larger group of dinosaurs we call sauropods, like the *Camarasaurus* you saw earlier. *Brachiosaurus* was also seen in *Jurassic Park*; in fact it is the first dinosaur you get a good look at as the jeeps are rolling across the field. It is the large dinosaur the group pulls up next to that is eating the top of a tree. At this location you can see that the movie was only exaggerating the size of *Brachiosaurus* a small bit. The mounted arm cast in front of you is obviously only one part of this animal. With the arm attached to the body, then adding the neck, you can image how *Brachiosaurus* would have

towered over the surrounding countryside. With its head 41 feet off the ground, *Brachiosaurus* certainly would have had its pick of the finest treetop morsels.

The story of *Brachiosaurus* starts here, in Colorado's Grand Valley. *Brachiosaurus* lived across the western United States, browsing the broad floodplains that would one day become the Morrison Formation. 152 million years after the last *Brachiosaurus* perished, paleontologists visited the area to comb the rich rock layers for fossils. Elmer Riggs, from the Field Columbian Museum in Chicago, found the bones of a gigantic animal eroding out of what is now called Riggs Hill in the Redlands area of Grand Junction (see our website or handout for directions on how to visit this site). Once Riggs and his crew had excavated the fossils they were shipped back to Chicago where they were studied and put on display. Riggs described the bones and gave it its name in 1903; *Brachiosaurus altithorax*. A cast of the skeleton is on display outside the Field Museum in Chicago still, while another mounted cast stands at O'Hare International Airport. Several original bones are also on display in cases at the Field Museum. The arm you see here is a cast of the original arm found by Riggs and seen in the quarry photos on the wall. In the case you can also see tools and plaster left behind by Riggs. Museum personnel also recovered several large bone fragments that you can see here; although they do not have any identifying marks, they came from Riggs' quarry and are likely part of the holotype of *Brachiosaurus*!

6. The Triassic Period

The Triassic Period marks the start of the Mesozoic Era and the rise of the Age of Dinosaurs. During the Triassic Period, life on Earth was recovering from the greatest mass extinction ever seen. At the end of the Permian Period, virtually all life in the seas and almost all life on land perished. The Triassic was a time of rebuilding, and strange new types of animals evolved to fill empty roles in this new and changed ecosystem. In western Colorado we have rocks that record the very end of the tumultuous time. The Chinle Formation, represented by the red rocks at the base of the cliffs in Colorado National Monument, was laid down by streams and lakes on a vast floodplain that extended from what is now Texas, New Mexico, and Arizona, up into northern Utah and even Idaho. 203 million years ago, when these rocks were being deposited, this area would have looked very different and would have been populated with creatures you might not recognize today.

While the Triassic Period is traditionally seen as the rise of the Age of Dinosaurs, no Triassic dinosaur bones have yet been found in Colorado (and they are very rare in neighboring Utah). The pelvis you see on display, from a small carnivorous dinosaur called *Coelophysis*, is one of the few remains of dinosaurs known from this time in our area. It was found near Moab in 2005 by museum scientists and volunteers. Other creatures, less familiar to us today, are the metoposaurs like *Koskinonodon*. These giant amphibians had heads shaped like toilet seat lids and would have looked like giant salamanders if we were to see them alive. Like modern amphibians, they had to lay eggs in the water and go through a tadpole stage before becoming massive fish eaters in adulthood. Also prowling the waters were giant crocodile-mimics called

phytosaurs. The remains of one was found near Bedrock; you can see the tooth sockets from this portion of its upper jaw.

The Triassic rocks of Colorado have not been well explored compared to those in adjoining states. Who knows what sort of discoveries await paleontologists in the future!

7. The Animals of the Morrison Formation

The majority of the fossils that are found in the Grand Valley are found in what is called the Morrison Formation. This section of the exhibit hall highlights many of them that have been found here or close to our area.

As you walk into this gallery there is a free-standing display with bones in a case. These bones are the holotype of *Mymoorapelta*. *Mymoorapelta* was first found at the Mygatt-Moore Quarry, located just 15 minutes west of the museum in Rabbit Valley (see our website or handout for directions on how to visit this site). Like *Ceratosaurus magnicornis*, this (and its other bones in our collections) represents the first and/or best example of this animal yet found! A mounted skeletal cast is on the far right of the gallery as you walk in.

Moving further in there is a small model of a dinosaur. This is *Fruitadens*, a dinosaur found only in Fruita! It also happens to be the smallest plant-eating dinosaur yet discovered. Fruita has other fossil animals from the Morrison Formation named after it as well, including *Fruitachampsa* (a fossil crocodile) and *Fruitafossor* (a fossil mammal). In addition, legged snakes have been found in the Morrison Formation at Fruita, though they are not named for the town.

Behind *Fruitadens* is a mounted skeletal cast of another iconic dinosaur, *Stegosaurus*. *Stegosaurus* is Colorado's state fossil (declared in 1982 by the governor). *Stegosaurus* fossils have been found across western Colorado, including just west of Grand Junction. *Stegosaurus* was equipped with fearsome spikes on its tail, which could be used to drive off predators. Some of the tail spikes from a *Stegosaurus* found in Rabbit Valley are on display in the small case near the tail. Although *Stegosaurus* is best known and recognized for its large plates that run down its spine (the name *Stegosaurus* means "roofed lizard" after all), we still aren't really sure what their purpose was. Defense? Display? Something else? We hope that future specimens can help illuminate this mystery.

On the left-hand side of this gallery is a cast of a juvenile *Camarasaurus*. While the adult-sized *Camarasaurus* towering over the entrance to the exhibit hall is huge, it is important to remember that all dinosaurs hatched out of eggs and grew to their full adult size over the course of several years or decades. This particular *Camarasaurus* was probably around 10 years old when it died and was buried on a river bank in what is now northeastern Utah. Uncovered by scientists from the Carnegie Museum of Natural History in what is now Dinosaur National Monument, this specimen gives us one of the best looks we have at what young sauropod dinosaurs looked like. Compare its head to the skull cast of an adult *Camarasaurus* and notice how much growing this animal had yet to do!

8. Growing Pains

Along the wall to your right you can see a growth series of thigh bones (the femur) from a theropod dinosaur called *Allosaurus*. *Allosaurus* is the most commonly discovered theropod from the Morrison Formation; its remains have been found across western Colorado, as well as in adjoining states. In Utah there is a site called the Cleveland-Lloyd Quarry where dozens of *Allosaurus* remains have been unearthed. It is not clear why there are so many *Allosaurus* all in one location but it does allow scientists to study how these predators grew. You can see that over the life of an *Allosaurus*, its femur became enormous but started out small. *Allosaurus* would have hatched out of an egg roughly the size of a football, so the first femur on the left-hand side of the display is about the size of a chicken's. You can see a similar size progression with the claws, arranged in a circle on the left-hand side of the wall. Adult *Allosaurus* had massive meat-hook claws that it could use to grab onto struggling prey. More on that at station 13.

Right at the corner of the wall, near the smallest *Allosaurus* femur, is a glass case containing two vertebrae from *Apatosaurus*, the most commonly-found herbivore at our Mygatt-Moore Quarry. This animal must have received some sort of trauma because these two bones from its spine (vertebrae) fused together while the animal was alive. Bones, like all parts of our bodies, are alive and constantly changing. In response to some outside event, the bones of this animal grew together in a way that they normally would not. This would have slightly limited how the *Apatosaurus* could have moved its spine and may have been painful. This might be a good time to ask students what they think could have caused this injury. You will probably have to point out that the ribs would have been coming out to the sides of the vertebrae, making it very unlikely that this was a bite or claw wound.

9. Temporary Exhibit Hall

This area is where our temporary exhibits are housed. For 8-9 months out of the year we have our exhibit, Dinosaur Graveyard, here. This showcases the animals and plants we have found in the three decades since we began work at the Mygatt-Moore Quarry, arranged in a way that they might have been laid down during the Jurassic Period.

During the summer we bring in traveling exhibits from all over the country. Check at the front desk or our website for exhibit-specific teacher guides.

10. The Cretaceous Period

Although the vast majority of the fossils from the Grand Valley come from the Late Jurassic Morrison Formation, there are younger time periods represented in the area as well. The Cretaceous Period marks the end of the Mesozoic Era. This is a time when the continents began to more closely resemble their current layouts. A massive inland seaway connected the Gulf of Mexico with the Arctic Ocean. And at the end of it all, a huge asteroid slammed into the planet in what is now the Yucatan Peninsula, causing the extinction of not only the non-avian dinosaurs

but vast groups across all branches of the tree of life. This extinction paved the way for the rise of large mammals including, eventually, ourselves.

The *Triceratops* skull that dominates the Cretaceous Period display is one of the largest ever found, although its horns were eroded away before it was found. Rocks dating from the very end of the Mesozoic Era are absent here in the Grand Valley, having been washed away about 55 million years ago. In order to find this skull and other latest Cretaceous fossils, museum scientists ventured to Montana in the 1970s. They came back with a snapshot of what life was like at the end of the Mesozoic Era.

Next to the *Triceratops* skull is part of the pelvis, the pubis, of a *Tyrannosaurus*. Museum scientists uncovered part of the hips of a *Tyrannosaurus* on this expedition; a cast of the pubis and the original fossil ilium (upper hip bone) in a case are mounted next to our robotic baby *T. rex*. Only about two dozen partial and complete *Tyrannosaurus* skeletons are known, so we are very fortunate to have these are part of our collections here!

Next to the case holding the *Tyrannosaurus* ilium is a selection of hadrosaur (duck-billed dinosaur) bones. Hadrosaurs like this *Edmontosaurus* were the most common dinosaurs during the Late Cretaceous in western North America. They had broad bills for nipping plants from the ground and a battery of constantly growing/replacing teeth to grind down vegetation they had plucked from the ground.

11. *Dilophosaurus*

One of our most popular robotic attractions has to be our animatronic *Dilophosaurus* model. Built in the 1990s by Dinamation (a robotic dinosaur exhibits company), it was constructed to take advantage of the popularity of the spitting *Dilophosaurus* in the movie *Jurassic Park*. Unfortunately the movie got a lot of things wrong about *Dilophosaurus* and some of these myths continue today. Sadly, one of those misconceptions is the spitting; there is no evidence that *Dilophosaurus* spat.

Dilophosaurus is not found in western Colorado but is known from adjoining Arizona, and it has been found in rocks that are exposed at Colorado National Monument (the Kayenta Formation). *Dilophosaurus* is the first large carnivorous dinosaur that we know of, and its size and power can teach us about how dinosaurs came to become the dominant form of life on land. In the Kayenta Formation we find dinosaurs (like *Dilophosaurus*), as well as early mammals and some creatures that resemble forms from the Late Triassic. By the middle of the Jurassic Period, however, dinosaurs had filled virtually every major role in the terrestrial ecosystems of Earth. The Early Jurassic Kayenta Formation gives us a snapshot of this change.

Dilophosaurus itself was a powerful animal. It had long, sharp teeth and large, clawed hands. Some fossils of *Dilophosaurus* show evidence of trauma, possibly caused by subduing large prey with its arms. We know, however, that *Dilophosaurus* did not have a scary, pop-up frill like in *Jurassic Park.* The muscles required to raise such a frill would have left marks on the neck bones

of *Dilophosaurus.* We don't see any evidence of these muscle scars, even though we have several complete *Dilophosaurus* necks. *Dilophosaurus* also didn't spit; it lived in a desert, making the loss of water an unnecessary waste. We also find no evidence of venom grooves or glands in the teeth or jaws of *Dilophosaurus*. We can chalk that one up to science fiction.

12. Lair of the Skulls

Dinosaur skulls came in all shapes and sizes! Here in the Hall of Skulls students can see many different varieties, showcasing how diverse dinosaur were! On the left is the skull of *Allosaurus*. This skull was found in Dinosaur National Monument in far northeastern Utah and it shows typical theropod dinosaur features. The upper and lower jaws have blade-like serrated teeth. There is a large sinus (not an eye hole!) in the middle of the skull that would have reduced weight and increased strength in the head. It was likely also connected to the respiratory system in a fashion similar to that of today's birds and crocodiles. You may notice that the eye sockets, behind this large sinus, face sideways. This means that in order to see in 3D, like humans, dogs, cats, eagles, and many other predators do, *Allosaurus* would have had to turn its head rapidly from one side to the other, much like some birds today.

The next skull, moving clockwise around the hall, is on the wall. It is the skull of *Edmontosaurus*. *Edmontosaurus* was discussed a bit at the last station, but here you can really see the duck-like beak and the rows of grinding teeth. Although it doesn't show up in the skeleton, fossilized skin has been found around the skull of *Edmontosaurus* showing it had a small fleshy crest on the very back of its head, similar to a rooster's cockscomb.

In the corner is a cast of the skull of *Camarasaurus*. As we saw back at stop seven, *Camarasaurus* has a skull adapted to eating plants. The broad, spoon-shaped teeth would not have been good at slicing up meat. Indeed they would not have worked well for processing small plants either. With its long neck and big, blunt teeth, *Camarasaurus* was probably best suited for pulling off larger parts of trees. Although sauropods couldn't chew (something that *Jurassic Park* got wrong), they may have had "stomach stones" similar to some birds today that would help them mash up and digest plant matter.

The next skull cast is from a horned dinosaur (ceratopsian) that was actually found in Canada. *Pachyrhinosaurus* is related to animals like *Triceratops*, but lived earlier in the Cretaceous Period. Unlike many other horned dinosaurs, *Pachyrhinosaurus* did not have a nose horn. Instead it had a flat, bony boss that may have supported a blunt keratinous pad. The single spiked horn between the eyes on the forehead was probably not much use as a weapon. Students again can think of reasons why this horn might have existed. Make sure that when they are coming up with ideas they are thinking of ways they could test these ideas as well.

The last skull in the Lair of Skulls is a cast of our *Triceratops* skull, which is up on the wall. This was covered at stop 10.

13. Alice the *Allosaurus*

Without a doubt the single most terrifying predator to roam the Late Jurassic floodplains. Growing in excess of 30 feet in length, *Allosaurus* was not the largest meat-eating dinosaur from the Morrison Formation, but it was the most common. Its head, over two feet long, contained dozens of sharp, serrated teeth. Its arms were muscular and ended in three huge, sharp, powerful talons. *Allosaurus* preyed upon all sorts of animals, from small two-legged plant eaters to armored *Stegosaurus* and the massive sauropods like *Apatosaurus*.

The head of *Allosaurus* gives us clues as to how this animal behaved and hunted. Its eyes did not face forward, as in *T. rex*, but instead were located on the sides of the head. In order to get a clear sense of depth, it would have had to flick its head back and forth rapidly, much like some birds today do. The skull of *Allosaurus* was strong and well-built, despite seeming so hollow to look at. This is at odds with the fact that its bite force was relatively weak for an animal its size; roughly on par with a modern American Alligator. The answer to this enigma may come from the muscle attachments on the back of the skull that lead to the neck. These muscles would have allowed *Allosaurus* to move its head in a way different from other predatory dinosaurs that we have studied. Namely, it could use its jaws like a hatchet, slamming down into its prey or food with tremendous force. Think of a hawk ripping apart a mouse, except much larger. *Allosaurus* also couldn't hear us talking or screaming; its ears were adapted to pick up deep sounds like modern crocodilians do. That also means that *Allosaurus* was likely also making sounds deeper than we could hear. When it roared, instead of hearing it you might have felt it as an uncomfortable rumbling in your guts.

This *Allosaurus* mount is a combination of various skeletons found at the famous Cleveland-Lloyd Quarry in central Utah. Here in western Colorado we have lots of specimens of *Allosaurus* as well. *Allosaurus* is in fact the most common dinosaur we find at our Mygatt-Moore Quarry in Rabbit Valley. We also find evidence of *Allosaurus* among the non-*Allosaurus* remains; claw and tooth marks on sauropod bones from the area show how *Allosaurus* was feeding on the sauropod dinosaurs that roamed the Jurassic West.

14. The Cenozoic

At the end of the Cretaceous Period, 65 million years ago, all non-avian dinosaurs became extinct. In addition, huge groups of other animals died off on both land and in the sea: pterosaurs, ammonites, mosasaurs, and many others. This extinction opened the next geological age, the Cenozoic Era. This is sometimes called the Age of Mammals. Here in western Colorado we have a great rock record that showcases how Earth's like recovered in the wake of this devastating extinction. Although we do not have rocks that directly preserve the transition, rocks from just after the extinction shed light on life's rebound.

The gars in the fish tank are modern species that have ancient roots. Along the wall to the right of the tanks are fossil fish, including gars just like our living specimens. These fossils

come from deposits of three fossil lakes that stretched across Wyoming, Utah, and Colorado, called the Green River Formation. The Green River Formation preserves a slice of time from the Eocene Epoch. Many animals, like these gars, would be familiar to people today. Other animals, like the long-tailed turtles and freshwater stingrays, would seem odd. Three-toed horses the size of dogs roaming the shores of the lakes would also give a modern visitor pause.

Ice age (Pleistocene) fossils are also found in the Grand Valley, mainly around river gravel deposits or dry caves. Although they are not common compared to dinosaur fossils from older rocks, we still find evidence of what life was like in our area only a few thousand years ago. The *Smilodon* (saber-toothed cat) skull cast is from one such animal that prowled the area, while in the slant-topped case students can look at fossils from ancient horses and mammoths. That's right: we know that mammoths used to inhabit the Grand Valley about 12,000 years ago! This is the last stop on our self-guided exhibit guide. Feel free to go back over the exhibits to take a closer look at anything that might have caught your eye. Alternately, proceed back towards the *Camarasaurus* and take the hall to the left of the cave to visit the gift shop on your way out.