Lesson: “Why did the dinosaurs go extinct?”

VIDEO TRANSCRIPT

EXPLORATION VIDEO 1

Hi, it's Doug! This building was a very special place to me when I was a kid. It's the Field Museum in Chicago, Illinois. It was special to me because of what was inside. This is where I got to see my first dinosaur. It was one of the most famous dinosaur fossils ever: it's a Tyrannosaurus rex that goes by the name of Sue. Now, Sue may have a cute nickname, but Sue was a massive creature with powerful jaws and razor sharp teeth. And she wasn't the only interesting dinosaur at the Field Museum. There were all kinds of amazing dinosaurs there. Things like Triceratops with three horns on its skull, and Stegosaurus with bony plates down its back and spines on its tail. Dinosaurs are so different from any living things today that it's amazing to think about them being really alive, roaming the earth before human beings ever lived. The last dinosaurs lived millions of years go. No one has ever seen a living dinosaur. All we have are their fossils, which are like puzzle pieces that scientists can put together to try to create a picture of what dinosaurs looked like. From all the different kinds of fossils that scientists have found, we've learned that there were many different kinds of dinosaurs. Now, most of the time, we think of the really big dinosaurs, like Tyrannosaurs rex or Triceratops, which was the type of dinosaur called a ceratopsian. The largest dinosaurs were like Titanosaur or Brontosaurus, with long necks and long tails. Those are types of sauropods. But not all dinosaurs were big. There were small dinosaurs, too, like Velociraptor, which were only about

half as tall as an adult human. Scientists try to figure out how each kind of dinosaur would have survived. They ask questions like, "What did it eat?" and "How did it get its energy?" Unlike animals living today, scientists can't just watch dinosaurs in the wild to see how they get their food. Instead, they have to study fossils to get clues. How do you think scientists could figure out what dinosaurs ate, just by looking at their fossils?

EXPLORATION VIDEO 2

Scientists have studied dinosaur fossils, especially fossils of dinosaur teeth and jaws, and they compare them to animals living today in order to figure out what they might have eaten. For dinosaurs with sharp teeth, it's safe to assume that they must have been carnivores that ate meat. By comparison, dinosaurs with broad, flat teeth would have been able to grind up plants. They were probably herbivores. There were also dinosaurs that ate both plants and animals — for example, dinosaurs that had beaks, like this one. These were the omnivores that ate both plants and meat. To figure out what dinosaurs ate, scientists have also studied coprolites — fossilized poop. By looking at coprolites, scientists can find evidence of what kind of food dinosaurs were digesting. Using all of this evidence, we can get a pretty good idea of what different dinosaurs ate. We can even start to piece together food chains for dinosaurs. For example, Tyrannosaurus rex was a carnivore with sharp teeth for eating other dinosaurs, like Triceratops. Triceratops was an herbivore, with broad, flat teeth for grinding up plants. So we can make a food chain connecting T. rex to Triceratops to plants. And just like food chains of animals living today, notice that dinosaur food chains always come back to plants. Plants are the producers in the food chain. Plants make their own food from carbon dioxide and water and get their energy from sunlight, instead of getting energy by eating other living things. During what was kind of like the Golden Age of the dinosaurs, a period of time called the Cretaceous, there

were plants like palm trees, pine tress, magnolia trees, and ferns, and lots of animals were eating those plants, not just dinosaurs. Dinosaurs weren't the only animals alive at that time. There were lots of other kinds of reptiles, like prehistoric crocodiles, lizards, and turtles. There were also lots of insects, like dragonflies, beetles, crickets, and more. There were even mammals like these living with the dinosaurs. All of these animals were interacting together, and it wasn't as simple as a food chain. You've made food chains before, but now you're ready for something more challenging. Now you're going to connect many food chains together to build a food web.

ACTIVITY INTRODUCTION VIDEO 1

In the first part of today's activity, you're going to make a food web from the time of the dinosaurs. You'll get a set of cards containing various animals from the Cretaceous Period. Now remember, this isn't a food chain you're going to make. You're making a food *web*, connecting animals to everything they eat, not just to one thing. Like, if you read the T. rex card, you'll see that it eats Triceratops and it eats duckbill dinosaurs, so you'll connect both cards to the T. rex. It's not always easy, though. You'll have to think like a scientist to make decisions about how to connect these animals. What eats what? The T. rex card also says it eats smaller animals, but which? It wouldn't just eat every animal it finds. T. rex would never bother trying to catch something as small as mice. It would take the T. rex so much energy to catch all of them he'd need to get full that it wouldn't be worth the trouble. So, one thing to think about is an animal's size. You can find that information written on each card, along with other helpful clues. I'll show you how to get started, step by step.

ACTIVITY PART 1 STEP 1

Find a partner to work with. If you're working alone, that's okay too. When you're done with this step, click the arrow on the right.

ACTIVITY PART 1 STEP 2

Get your supplies. You'll get more later.

ACTIVITY PART 1 STEP 3

Cut along the dotted lines to make a set of cards. When you're done, there should be 13 total.

ACTIVITY PART 1 STEP 4

Read each animal card and mark them as carnivore, herbivore, or omnivore. Then, sort them into groups and set aside any remaining cards.

ACTIVITY PART 1 STEP 5

Before you start your food web, here's a tip to help keep things organized. Take your carnivores and line them up in order of size from largest to smallest. Under that, line up your herbivores from largest to smallest. And then next to them, your omnivores. Finally, put your plants down at the bottom. Go ahead and do this now.

ACTIVITY PART 1 STEP 6

Here's what we've got so far, if you want to compare with how yours looks.

ACTIVITY PART 1 STEP 7

Discuss. Then fill in question number one on your worksheet.

ACTIVITY PART 1 STEP 8

Here's what we decided to do. It's okay if you decided something else. We decided that T. rex probably wouldn't eat these creatures. We think these animals are too small for T. rex to bother with. Now, the card said it ate these two large herbivores, so we thought it would probably eat this large herbivore too. We also decided that T. rex would have no trouble gobbling up other carnivores. Use your colored strips to connect the T. rex to everything that you decided it would eat.

ACTIVITY PART 1 STEP 9

Now that T. rex is connected to its food, it's time to connect the rest of the animals. Decide what each animal eats. Then use strips of colored paper to connect the animals with everything they eat. Connect them to all their sources of energy. Now, it's okay to modify the strips to make them as long or as short as you need. When you're done building your food web, be sure to watch the next video.

EXPLORATION VIDEO 3

Scientists have worked out a lot of clues about dinosaurs by studying their fossils. They figured out things like what they might have looked like and what they ate. But there's still one huge question left. The biggest mystery of all about dinosaurs: why aren't there any dinosaurs living today? Why did they go extinct? Scientists find fossils by digging down into the layers of rock

beneath our feet. The farther down you dig, the farther back in time you go. That's because the youngest layers of rock are on the top. These layers built up more recently. The older layers of rock are at the bottom. These are the layers that were laid down a longer time ago. So the fossils you find in the older layers of rock are from animals and plants that lived a longer time ago. Scientists only find dinosaur fossils in the older layers, right up until about this point. But in the layers of rock above that point, any fossils they find are not those of dinosaurs. They belong to more recent animals and plants. Using a special technique called radiometric dating, which is something you'll study in older grades, scientists were able to figure out that this dividing line between where there are dinosaur fossils and where there aren't, seems to be a point in time that was about 65 million years ago. That's why we think some huge, horrible event or events must have happened 65 million years ago that killed off the dinosaurs. But what was it? Scientists have come up with lots of hypotheses, or different ideas, to explain what might have happened. In the 1980s, two scientists — actually, a father and a son named Luis and Walter Alvarez — had evidence to support a hypothesis that many people know today. You might have heard of it. The Alvarezes thought that maybe an asteroid, a giant rock from space, hit the Earth 65 million years ago and that killed the dinosaurs off. At the time, when this idea was first proposed, many other scientists weren't convinced because the Alvarezes didn't have evidence of exactly where an asteroid had hit the Earth. They needed to find a crater of where an asteroid hit. Now, craters aren't common on the Earth. They usually get eroded by wind and water over time. But we do find some craters on Earth such as these that filled up with water and became lakes. But these craters either weren't big enough or weren't from the right time period to have caused the dinosaur extinction. It took the Alvarez team 10 years of searching before another group of scientists found a crater that was big enough and old enough to be the one that could have led to the dinosaurs going extinct. It's called the Chicxulub crater. This is an artist

illustration of what it might have looked like. It's located here, in the Yucatan Peninsula of Mexico. And today, it's mostly under water, which explains why it was so hard to find. It's in the shape of a giant bowl, about 100 miles across, which scientists think means it probably came from an asteroid about seven miles across. That's the size of a city. This was a huge piece of evidence in support of the Alvarezs' hypothesis: that an asteroid hitting the Earth could have been responsible for killing the dinosaurs. But it's not like the asteroid hit the entire planet. It just hit one spot in Mexico. Even though the crater was huge, it's not for sure that the impact would have even been felt on the other side of the world. So how exactly could a rock from space cause dinosaurs all over the world to go extinct? What do you think? Do you have any ideas?

ACTIVITY PART 2 STEP 1

Here's an interesting clue. You know that when an animal eats another animal or plant, it's getting energy. Let's show how energy flows on our food web and see what happens. Draw arrows on all the connector strips to show how each animal gets its energy. For example, I drew an arrow from the Triceratops to the T.rex, since eating the Triceratops gives the T. rex energy. In other words, the arrow points from food to animal.

ACTIVITY PART 2 STEP 2

It's easy to accidentally draw the arrows in the wrong direction, so double-check your arrows. If you drew any in the wrong direction, just rotate them, like this.

ACTIVITY PART 2 STEP 3

Your food web shows where all the animals get their energy, but what about plants? Discuss.

ACTIVITY PART 2 STEP 4

The living plants get their energy from sunlight, so connect the sunlight card to the living plants with a colored paper strip. Draw an arrow to show the flow of energy.

ACTIVITY PART 2 STEP 5

Now that you've seen the energy flow in your food web, discuss, then watch the next video.

EXPLORATION VIDEO 4

Scientists have used evidence from the Chicxulub crater to try to explain how an asteroid could've caused dinosaurs all over the world to die. They can estimate how big the asteroid was, how fast it was moving, and how big the explosion was when it hit the Earth. Scientists think that the explosion was millions of times more powerful than the biggest explosion ever created by human beings. It was so big that the impact melted the rock underneath, turning it to lava, and created cliffs that formed the ridges of a crater. Any dinosaurs living in the Yucatan Peninsula would've died instantly when the asteroid hit. But, what about dinosaurs in other places on the Earth? Well, we know that, as the asteroid was falling towards the Earth, it would've started burning on its way through the atmosphere, igniting into a giant fireball, starting fires on Earth that would've burned up living things for many miles. Also, because the asteroid hit partly in the ocean, scientists think it would've created a giant tsunami, or ocean wave, that went far onto the land, killing dinosaurs even hundreds of miles away. In the impact, the entire asteroid was turned to dust and vapor. In fact, we can still see the dust from the asteroid today. After the dust settled, it formed a layer in rocks all over the world. This layer of asteroid dust was the evidence that gave Luis and Walter Alvarez the original idea that, maybe, an asteroid was

what had caused the dinosaurs to go extinct. At first, dinosaurs living in faraway parts of the world would've been safe, they wouldn't have felt or seen the initial impact. But, very quickly, the sky would've been filled with burning ash and debris. As this asteroid dust moved through the atmosphere, it would've blocked out a lot of sunlight, leaving the ground beneath cold and dark. It would've stayed that way for a long time, because dust all over the world couldn't just blow away. It was hanging in the sky for many years. Now, it might surprise you that an asteroid hitting part of Mexico could block sunlight all around the world, but, even in recent times, similar things have happened with dust in the sky. For example, there have been volcanoes that, even though they didn't lead to lots of things going extinct, they did lead to dust getting spread all around the world. In the year 1815, an enormous volcano in Indonesia exploded and sent so much dust and ash into the air that it was colder and darker for an entire year afterwards. Crops all over the world didn't get enough sunlight to grow, and there were terrible famines. People living as far away as Europe, practically on the other side of the globe, called it the “year without a summer.” With so little sunlight, plants can't get as much energy from the sun, and many of them will wilt and die. With all that in mind, turn your attention back to the activity, and think about what happens to the food web.

ACTIVITY PART 3 STEP 1

Put one of your black markers on the Sunlight card. That represents the dust that blocked out the sunlight plants need to grow.

ACTIVITY PART 3 STEP 2

Discuss.

ACTIVITY PART 3 STEP 3

Here's what we did. We used our black strips of paper to show which organisms lost a source of energy. You can try it and see what you think. Since sunlight is the energy source of living green plants, we used a black strip of paper to block the arrow from the sun to the living green plants. Then we put a black strip on each of the arrows that leads from the green plants, since now they can't give away any energy. Try this out, then go to the next step and we'll think about what to do next.

ACTIVITY PART 3 STEP 4

Discuss.

ACTIVITY PART 3 STEP 5

Discuss.

ACTIVITY PART 3 STEP 6

Answer question number two on your worksheet.

ACTIVITY PART 3 STEP 7

Discuss.

ACTIVITY PART 3 STEP 8

Answer question number three on your worksheet, then watch the final video.

WRAP-UP VIDEO

In the food web activity, you figured out how an asteroid impact could've caused the dinosaurs to go extinct. With the knowledge that dust from an asteroid impact blocked sunlight, you used the food web as a model to figure out what happens to an ecosystem when you block sunlight. You probably reasoned that lots of plants would die because they don't have enough sunlight energy to make their food. And, after the plants die, that in turn would kill off a lot of herbivores who depend on the plants for food. Then, most of the carnivores would die too, because there would be fewer herbivores to eat. So, scientists think that an asteroid impact in one part of the Earth could've caused dinosaurs all over the Earth to go extinct because its dust blocked out sunlight and caused a collapse in the dinosaurs' food web. But an asteroid isn't the only hypothesis you might hear to explain the dinosaur extinction. For example, some scientists think dinosaurs might've started dying off even before the asteroid hit, because their food webs might've been disrupted by volcanic eruptions that were changing the Earth's climate at that time. Since the extinction happened so long ago, scientists will need even more evidence before we can say we know for sure what caused the extinction. What we do know is that most of the animals and plants on Earth, about 75% of them, went extinct at the end of the Cretaceous Period, 65 million years ago. But, that means that not all living things died — 25% of living things survived. Looking at the survivors, we can see some of the things they had in common that might've helped them survive. One thing you might've noticed is that most of the survivors were small, which meant they didn't need very much food to survive. They could live off of much less energy than, say, a T. rex or a Triceratops. When food became scarce, it was good to be a small animal. We can also see that many of the survivors were omnivores, meaning they weren't picky eaters. These were animals that could get energy from eating a variety of plants

and animals, including dead plants and animals, which would've been easy to find after the extinction event. Scavenger animals would've had plenty of food. Scientists who have studied the fossils of animals before and after the extinction think that very few pure carnivores and very few pure herbivores survived. Scientists have also hypothesized that animals that could hibernate, or live underground for long periods of time, would've been more likely to survive. By going underground, they would've been able to escape the fires and intense heat after the asteroid impact. And, by hibernating, they also would've reduced the amount of energy that they needed to survive. Eventually, life did flourish again after the Cretaceous extinction event. When the asteroid dust settled, the sun shone again. Most of the living green plants had already died, but some plants had dropped seeds that survived, or had roots that survived. When the sun shone again, it gave energy to those seeds and roots, and living plants, once again, flourished. Over a long time, new food chains developed, and food webs formed that no longer included the dinosaurs. However, at this point, I have to let you in on a secret. It's actually not the case that all of the dinosaurs went extinct. Scientists have figured out that there was one group of dinosaurs that did survive the extinction. It was a group of small dinosaurs which had beaks and lots of feathers. This group of dinosaurs today, of course, just goes by the name of *birds*. But, birds are so closely related to dinosaurs that scientists consider them a type of dinosaur. And when you look closely at a bird, it's really not all that surprising. Have fun and stay curious!