The Story of the Earth

A cosmology and geology event for eight-year-olds

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I invented this session for students of Jasper Elementary School, grade 3, and tried it for the first time in June of 1990 as part of the school's one-day outdoor-ed experience. It proved to be popular, so until my wife and I moved to Canmore in 2009 I was asked to repeat it every year. I have also presented it at other schools. Here are the notes I use to remember how the session goes. It takes about an hour. Feel free to present "The Story of the Earth" to your own students.

Preparation

Before the event I set up my big **dome tent** (designed for six adults; seats about 20 kids) at a suitable location: a flat place within a short walk of the car, preferably beside a stream with lots of stones. But the tent can also be set up indoors, in a classroom or the school library. I bring **chair pads** for the kids to sit on inside the tent, and a **floor mat** at the entrance where the kids can stand while removing their shoes. By the tent entrance, I set up a sign with the words **"Story of the Earth: Enter Here."**

I bring a **small treasure-chest type box** big enough to hold the following items: **a marble** (regular size), **a piece of rock** (I use a chunk of gold ore from British Columbia,) **a plastic container with sparkles in it** ("stardust," make sure the container closes tightly or you will have sparkles all over everything), **a fossil** (I use an ammonite), **a feather** (represents birds), a silly little **furry toy that squeaks** (represents mammals) and a cut piece of **picture-sandstone or Biggs Canyon jasper,** available in most rock shops (represents science of geology). I cover the objects inside with a **bandanna** and remove them from under it as I talk.

For doing the second half of the session, which I call "Rocks by the River," I bring a **punch-type can opener** and a small bottle of very mild **rock-testing acid.** To mix the acid, I use paint-store muriatic acid, which is fairly strong hydrochloric (20° Beaumé, industrial strength), and I dilute it until it is just a little bit stronger than vinegar (one drop of muriatic to eight or ten drops of tap water). The bottle should have a squirter on it or an eyedropper in it.

In the "Story of the Earth" tent (takes about twenty minutes)

The kids line up at the entrance. I go in first. Sometimes some of the adults come in, too. Everyone takes off their shoes, enters and sits down on the pads.

I begin by asking, "What's the biggest thing you can think of?" Kids say things such as "an elephant," "a mountain," "the Earth" and so on, until they reach the ultimate: the whole **universe.**

I ask them to imagine the whole universe squeezed down smaller than a marble (withdraw marble from under the bandanna), which is the way scientists think it was in the beginning.

I tell them that this incredibly squinched universe exploded in the **Big Bang.** I ask the kids to make the noise of the Big Bang—the loudest noise they can (plug your ears!)—when I count to three.

One, to three, ***BANG!*** And all the energy went flying out in every direction, making the universe as big as the Earth in only an instant (snap fingers). The energy began to turn into matter—a gas called **hydrogen,** which you can't see or smell—which began making lumps. (I hold a pretend lump in my hands and toss it to a kid. I toss other lumps to other kids. They play along.) The lumps became bigger and bigger. (Lumps in kids' hands grow. They become too heavy to hold, so we dump them into the middle of the circle, where they all become one lump, which keeps growing. Soon it's as big as the school, as big as the Earth …) The lumps began to heat up and glow, then to shine brightly in the cold and the darkness of space. They were now the (kids can answer this one) **stars.**

The stars made **stardust** (pick up pinches of sparkles and dribble into cup). Stardust is all the **atoms.** "Everything," I say, "is made of stardust." (I point to a kid.) "Your nose is made of stardust." (To another.) "Your hair is made of stardust." (Another.) "People are made of stardust! You, and you and you—you're all made of stardust!" This delights the kids. I pick up another pinch of sparkles and dribble it into the cup.) "Even this fake stardust is made of real stardust!" They get it.

I pull out the rock specimen. "This rock is made of stardust. It's real gold ore from a mine in British Columbia."

Some of the stardust formed **planets** such as ours. There was no life on Earth at first, because it was red-hot molten rock. But then it cooled down and water came out—some water also came from **comets,** which are like big dirty snowballs—and that gave us the oceans, where life began as single **cells**. Ask kids to make the sound of a life beginning: the *smallest* sound they can make. (Their expressions while doing this are wonderful.)

The cells divided to make lots more cells (make popping noises of cells dividing; kids do it, too, bouncing up and down as they sit), millions and millions of cells. They had little wiggly cell fingers (hold my hands by my shoulders and wiggle fingers; kids do the same). Then two cells joined up (I take the hands of the kids sitting on each side of me; kids do the same) to make a small **sea animal.** The sea animal breathed in the seawater (lean toward the centre of the circle, going "shlurp!") and breathed out the seawater (raise hands; lean back; go "whoosh!"). The kids join in right away. Repeat this a few times (shlurp! whoosh! shlurp! whoosh). The kids are giggling and laughing.

The small sea animals became bigger and bigger. Soon the sea was full of life, like this ancient **fossil** (pass around the fossil and talk about it).

"What came next?" I ask. **"Dinosaurs!"** they say. Kids of that age love dinosaurs; I ask them to name some, which they do. We talk about dinosaurs for a few minutes.

"But then," I say, "the dinosaurs died when an **asteroid** hit the Earth." I hold the rock specimen up high—the asteroid—and bring it down slowly, telling the kids that they can be the dinosaurs dying. They're supposed to make the sound of the asteroid crashing, too. We count to three again. The kids make explosive sounds as the rock touches down, then they fall over and writhe around.

"How come the dinosaurs got killed?" I ask. "The asteroid could not have hit them all on the head." Some kids know: the dust thrown up by the impact made the Earth cold and dark for enough years to kill the plants that most dinosaurs ate, and then the meat-eating dinosaurs that ate the plant-eating dinosaurs died, and so on. And not only the dinosaurs died. About two-thirds of all life-forms died.

"But actually, not all the dinosaurs died," I say offhandedly. Most of the kids are mystified. They have been told that all the dinosaurs died. But as the years go by more and more of them know what I am about to say. "Some dinosaurs survived. And they are all around us right now." Some kids are perplexed. Others are getting a little frightened. "Listen for them," I say. The kids listen. We hear a **bird** (pull out the **feather**).

"Birds are dinosaurs," I say. "Not so many years ago, scientists realized that birds are actually dinosaurs." I ask the kids, "How come the birds survived, but the other dinosaurs didn't?" The kids may

have ideas. If they don't, I tell them, "Nobody knows for sure, but what is it that birds do so well?" The kids say, "Fly around!"

"So," I say, "maybe some birds could fly long distances to find food, while the other dinosaurs couldn't, especially the big ones, so they starved. And birds have feathers, too. Do you think that those feathers could have helped to keep the birds warm?" (The kids think so.) "And birds are warm-blooded, too, while many of the dinosaurs that didn't survive might have been the cold-blooded ones."

I ask the kids, "Has anybody here ever had dinosaur for dinner?" Some of the kids realize that I'm speaking of chicken and turkey. "If you like to eat chicken or turkey," I suggest, "you can tell your mum or your dad that you'd like to have dinosaur for dinner. See what they say. Maybe you could go out to Kentucky Fried Dinosaur." The kids think this is very funny.

Something else survived the asteroid impact: **mammals** (pull out the furry toy and pass it around). Ask the kids how come mammals survived. Some may have ideas, such as mammals having fur to keep them warm, or mammals putting away food for later, or mammals hibernating during cold periods, or mammals bearing their young directly, instead of in shells, and so on.

Ask them whether people are mammals. Most kids know this. "So when people came along, we humans took over the whole Earth. And some of us are **geologists,** who study this kind of thing. (My degree is in geology.) Geologists have learned all this from studying rocks"—pull out the picture-sandstone and show it, no need to pass it around—"and this rock, with its pictures, looks almost as if it has stories in it. Maybe one of you will grow up to be a geologist and discover something really neat about the Story of the Earth."

I tell them that the Story of the Earth is over. As they get ready to leave the tent, I ask them again: "What are people made of?" "Stardust!" they shout. End of first half-hour. The kids head over to the cooking shelter for a ten-minute break and a treat.

Note: some kids may insist that God made the universe, the stars, and human beings. Cosmology and geology can be upsetting for such students. I reassure them that what I'm telling them is science, and science is different from religion. They can learn about the scientific story of the Earth I'm telling them here in public school, where we don't teach religion. That's because different kids have different religions, and in public school it wouldn't be fair to teach just one or two. After school, kids can go home and enjoy the religious story of the Earth if they like. In Canada we are free to have both science and religion, which isn't the case in some countries. We are lucky. (If I ever give this session at a separate or religious school, I will explain that I'm giving just the scientific story.)

Rocks by the river, if the site allows (takes about half an hour)

For this part of the session, we need a place with lots of stones lying around. A gravelly streamcourse in the front ranges of the Canadian Rockies is perfect. These notes are for such a location, but if you are elsewhere and familiar with the geology there, you might be able to modify the method for use there.

I ask each kid to find an attractive stone and bring it back to where we're forming a circle.

"We are going to do some real geology," I say, when everyone is sitting down, "just like I do when I'm studying rocks in the mountains." The kids are impressed.

"There are three kinds of rock that are common around here: **quartzite, limestone and dolostone.** By using this (show the beer-can opener) and this (show the bottle of rock-testing acid), you can tell which is which."

Work on each kid's stone in sequence. First, have the kid scratch at the stone with the can opener. If the rock is harder than steel (can-opener doesn't scratch it), then it's quartzite. If it's softer than steel (can-opener scratches it easily), then it might be limestone or dolostone. To find out which it is, we test

the rock with acid. Have the kid put a small drop on a clean part of the stone and watch carefully. Ask them to be careful not to get any acid on their hands or their clothes. Dilute geology acid won't hurt them, but it can weaken cotton fabric.

If the drop of acid fizzes a lot, it's limestone. If it fizzes only a little, it's dolostone.

Some kids might find **shale:** a soft, splitty, dark-colored rock that typically doesn't fizz. "Good for you," I say, "you found **shale.** And shale is not as common to find along the river as limestone or dolostone or quartzite. That's because shale breaks up into tiny pieces when it gets moved along by the water."

Some kids might find a piece of smooth, black rock that is harder than steel. It's **chert.** "Chert is special rock. It's really hard, but it splits in a way that lets you make it into arrowheads and stone tools."

Other kinds of fairly soft, scratchable rock present in many Rockies streams are **sandstone** and **siltstone.** "If it's rough, and you can see the grains of sand, then it's sandstone. Pretty simple! If you can't see the grains of sand, but it still feels a bit rough, then it might be siltstone. Here's a way to tell. Tilt it back and forth in the sun. Does it sparkle? Then it's probably siltstone. Siltstone is made of tiny bits of quartz. They're a little too small to see easily just with your eyes—you really need a magnifying glass—but the sparkle gives it away." (I also bring a few magnifiers for use on days that aren't sunny.)

Then, after identifying all the rocks, I ask, "Where did these stones come from?"

"From the mountains," the kids reply.

"Where are they going?"

"Down the river to the sea."

"Let's help the stones along," I suggest. Everybody gets to throw their rocks into the stream. (In Jasper, which is located in a national park, collecting rocks is not allowed, so the kids have to get rid of them, and they love to do so by chucking them into the water). Make sure they throw from the edge of the water, not from farther back. Kids standing close to the edge can be hit by rocks thrown by kids standing farther back. Adult supervision required here!

We finish the hour by gathering for a photograph. I ask them, just as the picture is taken, "What is everything and everybody made of?"

"Stardust!" they shout. That's the main thing the kids will remember from the session, and it's a fine thing, indeed.

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