Tale of Stardust

DLN: Hi everybody! We've got a really special edition of Way Cool Science. My name, once again, is Scott Sala, science educator for Denver Public Schools and with us in the studio is Kevin Gilliland, spacecraft engineer from Lockheed Martin. It's just a thrill to have you on the program- a great resource, Lockheed Martin and Denver- and we today are going to be focusing on comets and past missions and future missions and all of the really cool science that's involved in the exploration of a comet. Thanks for coming in, and let's jump right in. Tell us about what the Stardust mission is.

KG: *Stardust is a spacecraft that was designed- and it's the only spacecraft that was designed- to go visit a comet and bring pieces back to Earth. It's the first time we've ever done that. It was built here in Denver by Lockheed Martin. This is where our mission control center is, in Denver. It's a small spacecraft. When we think of spacecraft, maybe we think of astronauts. This is a robotic spacecraft, so we don't have any astronauts on board. It's a class of mission called a discovery class, which is low budget, very inexpensive- just a fraction of a cost of what a manned mission would cost.*

DLN: So when you say "relatively small," most people, I think, have a pretty good conception of how huge the space shuttle is.

KG: *This whole thing, the main part here, the whole thing is like a big desk or maybe about the size of a grand piano.*

DLN: Oh, wow- so it is small.

KG: *It is. When I say we visited a comet, we flew past the comet so fast particles were coming at us faster than the speed of a bullet. We got so close we were actually right inside the coma.*

DLN: Let's talk a little bit about that, because that is something people won't know about, the structure of the comet.

KG: *The center of the comet is a solid piece and it's usually pretty small- maybe 5, 10, 20 miles. The center of the comet, or the nucleus, is solid and it's bits of rock and ice. When the sun heats the nucleus, those bits vaporize and create a cloud of dust and particles. That cloud, which we call the coma, can be hundreds of miles wide. Then sunlight pushes those particles out behind the comet and create that beautiful tail. That tail can be millions of miles long.*

DLN: One of my first experiences with comets, I was actually out camping in the Utah desert when Hyakutake made its orbit. You look out at night, and the tail takes up about a third of the sky, so it's really moving.

KG: *Yes, they're huge. We get so used to seeing stars and planets. When you see a comet in the sky, it's rare, beautiful, and really unforgettable.*

DLN: Let's go back to the "speeding bullet" concept because I would think that normally you don't want to meet a speeding bullet head on because the spacecraft's moving at a very high rate and you'd just think that these particles would shatter. So my initial instinct was they're kind of sneaking up at the same speed, kind of like the space shuttle docking with the International Space Station, kind catching up to it.

KG: *We hit him head on. We are collecting the particles, and we want to capture the particles, but of course we can't smash it. We have a collector, and a substance in the collector that's called aerogel, and* *that's able to capture the particle. Did you ever play egg toss, and you have to catch an egg that's kind of fragile? You have to catch it, slow it down. Or if I asked you to study insects and you had to go out and look at what was smashed on your windshield- that wouldn't work very well. So inside this collector grid, there are blocks of what we call aerogel. Even at a particle going 10,000 MPH, the small particle can be caught by the aerogel and slowed down and preserved so it's good enough to study. Now the rest of the spacecraft, that's another story. The rest of the spacecraft has shields on the front of it, so if we get a particle hitting that fast here, even a small one, we need to protect the rest of the spacecraft so we collect dust here but we have these shields to protect the rest of the spacecraft.*

DLN: Tell us more about the mission and how it got to Wild 2.

KG: *We have some animation that shows our orbits. First of all, everything in space orbits, so our mission is a very slow orbiting spacecraft going around the sun. You can see the blue circle is Earth. Stardust left Earth and went a little bit farther out into space, and it goes quite a bit more slowly. Then two years after our first orbit we came back by Earth and flying by Earth nudged our orbit a little bit. We flew out even farther into space and did two orbits there before we flew by the comet. Now this sounds like a lot of flying around, but it took those three orbits to ensure that we got to the comet at just the right place, and at just the right speed. Then we had to come back to Earth, bring the capsule back to Earth, and again we had to come to Earth just at the right time, and enter the atmosphere at just the right angle.*

DLN: This brings up a lot of questions about how much mathematical scientific precision has to be. Because you're not even aiming at something right now, when it launched, you're aiming at something that's not there yet.

KG: *Well, its orbit- the orbit of the comet- is very well-known and with a great amount of certainty, astronomers know where the comets are going to be. We know how orbits behave, and as I said, everything in space is orbiting something and we're orbiting the sun. Even though we say, "flying around," we're fixed in space in that orbit, just like this table is on the Earth. It takes energy to move it. It would take energy to change the orbit. After studying the physics of orbits, we can predict very well where we'll be and when.*