

Astronomy Cast 278 for Monday, October 29, 2012:
Animals in Space

Fraser: Welcome to Astronomy Cast, our weekly facts-based journey through the Cosmos, where we help you understand not only what we know, but how we know what we know. My name is Fraser Cain; I'm the publisher of Universe Today, and with me is Dr. Pamela Gay, a professor at Southern Illinois University – Edwardsville. Hi Pamela, how are you doing?

Pamela: I'm doing well. How are you doing, Fraser?

Fraser: Good. So as we are recording this right now, Hurricane Sandy is chewing up the Eastern seaboard of the United States, so we want to send our warm wishes and hopes for safety for everyone involved there. Please keep your head down! And we were just noting this before the show: if it doesn't out cut your power, enjoy this opportunity to see the Milky Way for the first time.

Pamela: Except how are they going to hear us if they cut their power? Never mind.

Fraser: Never mind.

Pamela: Yeah, metaphysics...

Fraser: They're going to watch it on YouTube through their cell phones and then look up and notice that there's a cloud of stars in the sky.

Pamela: It's a great use of battery life during emergency circumstances.

Fraser: Yeah, exactly. I also wanted to...I put a quick post into Astronomy Cast a couple of days ago sort of mentioning our super awesome "phases of the moon" app, which we've just updated, and now it works on Android, it works on IOS, and I'm holding it up to the screen, but the people, I guess, watching the podcast won't

be able to see it, but it's really cool. You can just kind of drag the Moon, drag the terminator back and forth, and see the phases change and lots of cool stuff. We actually just submitted the iPad app, so you can find that on either iTunes (just search for "phases of the Moon"), Universe Today, or search for it on the Google play store ("phases of the Moon-Universe Today"), and you'll be able to find it. It's only .99 cents and it helps us feed out children, so...

Pamela: And what I love about it is you actually got the librations correct, so...

Fraser: Yeah, well, we actually based it on NASA imagery, so NASA released a whole pile of really highly detailed animations of the Moon, and we incorporated it into this app, so you can actually see the shadows changing over the Moon, you can see how the Moon wobbles back and forth... It's very cool and I hope you people find it very helpful for seeing when the next moon phases are, and also just hand it off to a kid and let them drag the Moon back and forth to see how it works.

Pamela: On more thing: during our last hour of recording, which was last week, for those of you listening to this on the podcast, we put out a plea for people to donate for Astrosphere.org to help pay for our server costs, and I love our listeners, Domfromderby– I may not be able to pronounce our listeners – Domfromderby tweeted, "I'm 31 tomorrow in case anyone wants to get me anything just click on the donate button to help make more shows – ta." And I love the idea that someone's asking to have his birthday gifts help get more science out, help us keep our servers turned on, and communicate out to the world, so I just wanted to share that piece of awesome human goodness, and during the last hour while we were recording we actually got two donations, so if any more of you want to help, it's "astrosphere.org." If you go to astronomycast.org, that goes to pay for our audio editing, if you go to Astrosphere.org that helps pay for the servers for the forums, and for a lot of other things.

Fraser: All of the other science outreach that we're doing. Cool!

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Fraser: So we always think about humans in space, but the cold hard reality is that animals have always been first in space: first to fly, first to orbit, and sadly first to die. Let's learn about how our animal companions have been our trusty partners in space exploration, and let's recognize their noble sacrifices over decades of experiments. Yeah, we were...we've not been very nice to our animal companions as it relates to their sacrifice in space exploration, so I think this is kind of a morbid episode, but I think it's important to recognize just how important animals have been in helping out with space exploration.

Pamela: But it is a good episode as we head into Halloween because it is an episode filled with the creepy-crawlies.

Fraser: That's true -- scary episode! Now you actually dug up a really great piece of history for the sort of first animal explorers who have been pushing the boundaries of not really space exploration, but perhaps air exploration? So tell us the story.

Pamela: One of the places that when I'm researching for the show I go as a starting point is Wikipedia because it links to everything off of that and it usually is full of random, esoteric information that I wouldn't know to Google, and I came across this sentence that is awesome. It simply reads, "Animals had been used in aeronautic exploration since 1783 when the Montgolfier brothers sent a sheep, a duck, and a rooster aloft in a hot air balloon, the duck serving as the experimental control." There's some joke waiting to be told. I don't know what it is, but a sheep, a duck, and a rooster...

Fraser: Yeah, but the duck was the control.

Pamela: And the rooster wasn't. I'm not sure what that says about rooster.

Fraser: Well, the duck flies, right?

Pamela: Roosters pretend to fly. They don't do it so well.

Fraser: Yeah, but a duck can actually fly and go to high altitude, while a rooster was never meant to, or has long evolved out of the ability to fly, so I think that was the point was, if the duck is normally able to fly, what would happen to a rooster that doesn't fly. So what was the outcome?

Pamela: It doesn't say. I'm assuming they came back fine. It's not like hot air balloons go very high.

Fraser: With the tenor of this episode, I'm going to assume they crashed somewhere and were forgotten.

Pamela: I think it would have been listed though. That would have been listed, so I'm thinking it was all good for those three critters.

Fraser: Alright, so that's...but then that was the beginning of I guess airline, air travel exploration, but let's talk about actual space exploration. So when did animals first join the quest to explore the final frontier?

Pamela: The 1940s. Once we had recovered, conquered, stolen – I'm not sure what word we want to go for here...

Fraser: Liberated?

Pamela: ...V2 rockets from Germany during World War II, both America, both the United States, and the Soviet Union had their retinue of stolen German rocket scientists, and began to fling things into space, and what's interesting is the differences in what got flung by the two nations. Here in the United States we started simple with fruit flies, went on to rodents, went on to monkeys, the Soviets went to dogs instead. I'm not sure why; I'm not sure what that says, but the Soviets had a long history of sending well, "muttniks" was the derogatory term used here in the United States.

Fraser: Muttniks?! I've never heard that before!

Pamela: Yeah, Muttnik to go with Sputnik.

Fraser: I've never heard that. That's awesome!

Pamela: And we sent up monkeys and mice and fruit flies.

Fraser: So what was the first...what were they doing here? They were testing these out on V2 rockets?

Pamela: Right, so it started out with fruit flies just trying to figure out how bad is the radiation because we had no information as to what happens when you go up, so start with fruit flies, start with something that...well, they're going to die if you radiate them.

Fraser: Yeah, they're fragile.

Pamela: Yeah.

Fraser: Although you would think how hard it is to get rid of fruit flies from your house, but they are actually kind of fragile.

Pamela: Yeah, radiating them will kill them -- unlike cockroaches, but that...we're going to get there. So it started with fruit flies, mice, went on to Rhesus monkeys... yeah. One of the interesting things with the fruit flies is they also were launching moss, and I'm not quite sure what was being looked at. We look back on these experiments and it's just sort of like, "What were they thinking?" But at the same time, they had no information.

Fraser: Well, they didn't even know if you could eat in space. They weren't sure if that you could swallow, that somehow gravity was required to get food from your mouth down to your stomach.

Pamela: Well, what gets me is why didn't they ask a fourth-grade girl hanging upside down eating her snack at recess because, really, we all did it because we were told not to? So yeah, the 1940s were the years of the fruit flies and the monkeys, and one of the disturbing things was these poor critters, they...medical

technology wasn't that advanced either, so it wasn't like today where you go in and they tape electrodes all over you and they just have to shave your head if they want to do fancy brainwave analysis, and even then they don't have to do much shaving nowadays, but back then, not quite there yet so there was a lot of embedding electrodes, there was no taping monitors to the body and to the back, it was into the body, so that was a little bit disturbing.

Fraser: Yeah, but then these animals weren't expected to survive for very long anyway.

Pamela: No. No.

Fraser: It's a sad episode if you like animals. Right. OK.

Pamela: Yeah, but they did put them under anesthesia for launch because they didn't want to scare the bejesus out of them, although I don't know why they thought launch was scarier than zero gravity.

Fraser: Or having electrodes implanted in your head.

Pamela: Well, yeah.

Fraser: Well, yeah OK, so then what is sort of like the first real important animal experiment that was done?

Pamela: I think the first big one that people pay attention to might be Laika? It was the Soviet dog that orbited all the way around the planet. A lot of people also look back and remember the monkeys, Able and Baker. Miss Baker, she actually lived at the Huntsville Space and Rocket Center until 1984, and lots of people got to see her in the public while she was on display there.

Fraser: Right. So that's a successful return to Earth. That's a monkey that was treated with...

Pamela: And Laika was not a successful return. Laika orbited...

Fraser: OK, so let's start with Laika, then. Can you talk about the Laika mission and sort of what happened?

Pamela: So Laika was the second-ever orbiting spacecraft, and they carried the first animal into orbit, and this was a Soviet spacecraft, November 3, 1957. Laika was just a happy pooch with pointy ears, easy to draw cartoon characters of, stamps made after Laika, and Laika died during flight because they didn't know how to bring Laika back, so this was one of those points in history where we had the technology to launch things, had the technology to orbit things, did not have the technology to bring things back. So Laika went up, Laika orbited, Laika proved that it's safe to orbit, Laika was put to sleep.

Fraser: Right. And so Laika sort of crashed...or I mean, could Laika actually survive in orbit?

Pamela: Laika survived in orbit, yeah. How long are you going to keep a dog alive in space? Well, they figured that one out later, but...yeah.

Fraser: And so this was like the first mission right after Sputnik, right?

Pamela: Not right after, but yeah.

Fraser: But you said the next orbit, right? So Sputnik was the first orbit.

Pamela: So this was Sputnik II.

Fraser: Right, and so it carried a little dog inside, and Laika was a little...almost like a Jack Russell terrier, like a little dog, right?

Pamela: Right, a little pointy-eared cute dog, lots of cartoons, so this was followed in 1958 by a squirrel monkey (Gordo) getting launched from here in the United States, and then we had Miss Baker and Able that went up in 1959, so the 1950s were the years of the dogs and monkeys. Also, of note were several frogs, lots of mice, small critters. Along the way the basic idea was to try and get a sense of:

how does weightlessness affect biological processes? They launched eggs. Can the eggs be hatched once you bring them back down to Earth? All sorts of different things, but mostly they were worried about will things survive. Now, the first critters to be brought back from orbit were -- cause Able and Baker didn't orbit, they just went up -- in the 1960s sputnik V went up with Belka and Strelka, so this was the first one to orbit animals, bring the animals back, and what's kind of neat is one of the puppies of Strelka was given to Caroline Kennedy by Nikita Khrushchev, and one of the side effects of this is there's now long lines of space puppies.

Fraser: I want a space dog!

Pamela: Isn't that kind of awesome?

Fraser: Yes! I didn't know! Now I totally want a space dog!

Pamela: So yeah, these are the things that we have done. We have sent dogs to space, we have returned dogs from space, we have bred the dogs that went into space, we have turned them into political pets from space.

Fraser: Right. Well, I really want one. That's awesome! Right, OK, but the point here is these dogs were returned safely to Earth and able to breed afterward, and I mean, this is part of the experiment, right? This is like: we send a dog to orbit, bring it back, can it breed? And because they didn't know, right? They didn't know any of this stuff.

Pamela: And so then the next big breakthrough was figuring out if you send something into space, can it think? Can it maintain the ability to do activities?

Fraser: Right, so like is your brain going to work? Will the glucose move around properly?

Pamela: Do you become dumb like you do at altitude because there is all sorts of stories from people who build telescopes at the tops of mountains, climbing high peaks where they simply lose reality. It's the "no matter how long I keep cutting it

it's still too short" – it's problems like that, and this is where Han the Chimp came in. This is the first chimp sent into space, he was a friendly little soul, and he actually went into space and he pulled levers, and the good and the bad of this is he was trained to pull the levers in order to get banana treats, but if he didn't, he'd get shocked. It was one of these where they did both the shocking and the treating and...yeah. It was the 1960s, so yeah.

Fraser: I believe that would be an animal rights violation right there.

Pamela: I'm not sure – that's the part that bothers me. I'm pretty sure that's legal.

Fraser: Right, so I guess the point here is they knew if you were at high altitude your brain didn't work right, and I'm sure to a certain extent they knew this was caused by the low air pressure and the lack of oxygen getting to your brain, but could there be something else just about being far away from mother earth that would affect you in orbit. They didn't know, so they taught this chimp a whole pile of cool tricks and sent him to space and see if he could perform these tricks in the same way.

Pamela: And this was kind of the last test before they let human chimps go into space because one of the complaints of the early astronauts was they were being treated like trained monkeys -- they weren't given their own buttons to escape out, they weren't given very many controls. It was they wanted to fully automate the rockets, and so Ham was the trained monkey -- that precluded the astronauts who felt they were trained monkeys, and Ham successfully proved that you could do it. He came back happily able to interact with his trainers. Yeah. It was all good.

Fraser: I would think he wouldn't have liked those trainers after they shocked him, but...anyway, continue.

Pamela: [laughing] So, as time progressed and more and more nations began to get into the launching mammals into space act, with France flying rats in the 1960s. France did have a space program at one point. We had China in the 1960s launching rodents. The Russians continued to launch their dogs, and this was one that when I tried to research it I wish I could have found more information because

in the 1960s at the beginning of Voskhod program, they launched two dogs for over twenty days. I'm trying to figure out...I can figure out how they fed them, I can figure out how they watered them, but were they like floating in a capsule filled with, well, processed food and water? It's not like you can catheter a dog that...did they catheter the dog?

Fraser: Probably had some kind of fancy diaper on him. And then they had some kind of feeding tube...

Pamela: For 22 days?

Fraser: Whatever. They're dogs. They're cruel to animals. Send them into space, let them poop in their diapers and eat from tubes, you know, they probably kept them constrained in some kind of harness...

Pamela: Used airflow? I'm hoping they used airflow because...

Fraser: I don't think they cared.

Pamela: Yeah, that's what bugs me, and the other part that bugs me is here I am 38 years old and what's the first question I have? What happened to the canine poo and pee? But yeah, that's exactly where my brain went.

Fraser: Yeah, they just didn't care. But they sent...it was later on the Gemini mission, they had a couple of astronauts up there for the better part of two weeks. It was pretty complicated. They had a lot of that kind of thing going on. Read some of the...

Pamela: You have to have no privacy concerns if you're an astronaut. Everything's hanging out.

Fraser: If you watch like from the Earth to the Moon and you see what they were in, how small that capsule was... It's just astounding how they lived through it. I mean, Apollo was like a luxury hotel compared to the Gemini missions. OK, so

we've got some dogs up there for twenty days, which is a fantastic feat, and it shows that a living creature can survive in space for twenty days.

Pamela: So we're now entering the period of time where the Americans and the Soviets were successfully launching humans. We're seeing other nations work to launch rodents, and looking through this history, you find all these nations that I wasn't aware had their own space programs. Argentina launched a rat, and so there's just all these people thinking, "We're going to be next," and no, it was America and the Soviet Union that kept going, but over time, we began launching more and more different critters, trying to understand the effects of 0-G. One of my favorite stories is during Skylab in 1973, they started doing student programs, where they allowed students to suggest various projects that can be done in space and one of the suggested projects was to launch spiders and see what would happen. And the reality is spiders do not like 0-G; they will not leave their little test tubes unless forced. They will cling to their test tubes. When you force them out of their test tubes, they attempt to swim through 0-G, but once you get them going, they will build webs that aren't quite up to snuff compared to what you see on the planet Earth, but over time they increased their ability. What was kind of awesome with this particular experiment is the first web that got built was a somewhat drunken looking web, but it was recognizable that this is a spider web with a spider sitting in the spider web, and because the spiders can go a long time without eating, they fed the spiders prior to launch and figured they'd kill the spiders before they needed to eat again, but the astronauts were so thrilled with the results of the initial experiment that they were like feeding the spiders pieces of rare meat to keep them going.

Fraser: Wow! That's amazing.

Pamela: Unfortunately, the spiders eventually died of dehydration. They were provided water, but apparently, 0-G, water, sponge...spiders just didn't get the whole notion real well.

Fraser: Right, but they didn't plan for the possibility that the astronauts would want to take care of the spiders and continue watching them and seeing how they learned over time, but I mean, other experiments later on came along, I know, and

started to take multiple generations into account. A lot of these long duration space flights went into that.

Pamela: And right now on the International Space Station – just to jump forward, we have with the International Space Station, they just finished installing on the Japanese Experiment Module a really neat fish tank, and I'm a big fan of fish tanks. And this is like the best fish tank ever. No cleaning of the fish tank is required, and their goal is to figure out what happens to multiple generations of fish born in space, and it never really occurred to me that fish suffer the same bone degeneration that astronauts suffer because, but you're weightless in water, but you're not actually weightless in water; you're suspended in the water, but there's still all the gravitational effects on your biology, and in space you don't have that, so they have this really neat fish tank with neat little fish in it and they're planning to go through multiple generations of the fish to see what ends up happening. Is there a higher mutation rate? There's so many different questions to be asked, and we have found examples of space change in biology – salmonella becomes much, much more virulent in space, and I can imagine food poisoning actually turns you into a rocket in space, so really those two shouldn't be mixed.

Fraser: Waterbears become more adorable.

Pamela: They're just adorable anyway.

Fraser: Yeah. Right, and the Soyuz just docked like a week ago with these fish, which is great. OK, so when last we saw our heroes we were looking at the spiders on the Soyuz capsule – oh sorry, on the Spacelab.

Pamela: Spacelab, yeah.

Fraser: I mean, then there was years and years of the space shuttle missions, and you need an actual space station. I mean, there was a ton more experiments done with plants, with animals...it went on and on.

Pamela: It wasn't just with those. There were also the tomato seeds in space in the early 80s, which then got brought back and given to schools all across America to

grow to see if the tomato seeds would continue to grow. There have been a ton of spiders sent into space, a ton of mice sent into space, mice born in space, and what's interesting is it's actually challenging to find results from these stories because results, other than the salmonella becoming much more virulent, there hasn't been anything so Earth-shattering that it's made the cover of "Science" or "Nature," so biology seems to be pretty happy to go in space, and there's just a lot of brain...uh, bone degeneration (not brain degeneration) bone degeneration going on.

Fraser: Now there's one tragic story about an animal in space. I don't know if you know about this one. There were some nematode worms on...

Pamela: Oh yeah, this one actually isn't a tragedy I don't think.

Fraser: On Columbia, right?

Pamela: The Columbia was a tragedy, so the last mission of the Columbia, the first space flying space shuttle, and it unfortunately blew up in 2003. It was doing an experiment with worms called nematodes, and they were in a special container that somehow they managed to survive the explosion of the Columbia during re-entry, survive the high heat, survive impact and this was one of those moments of...well, we know that when big enough asteroids hit the Earth, it sent debris and dinosaurs into space, and we now know that the nematodes could survive re-entry, so ideas behind Panspermia become much more realistic, and it's also a little bit terrifying how hard it is to kill a nematode.

Fraser: Yeah. So there were generations and generations of these nematodes that have been, I know, passed around. Researchers were able to get their hands on them and do experiments on them and continue on the lines of them, and yeah they kind of survived, which is back to that concept of...

Pamela: Not kind of – they did survive.

Fraser: They did survive! And it's like the waterbears. The waterbears can withstand almost anything and go to space. They really truly will be our future space travelers. So where do we stand now? Fish? We just sent some fish to the space station. Do you think we'll ever see more permanent – like pets in space? Things like a dog in space, or a monkey in space?

Pamela: One of the things Bigelow's doing, and I'm not sure if they're intending this to be pets or not (I don't think they're intending it for it to be pet), but I know folks that own Madagascar hissing cockroaches as pets because they're giant cockroaches seven inches long sometimes, and they like to hiss, and for a variety of different reasons, including the fact that these suckers can survive in near-vacuum, Bigelow has launched them, and scorpions, and other creepy-crawlies into space in their Genesis I and Genesis II inflatable modules, and they're basically looking at what are the effects on 0-G on these biologicals, and it's kind of extraordinarily gross, but this is what Bigelow is doing. They haven't launched any bedbugs yet, so I think their hotel business is still in line, be doing just fine.

Fraser: Wouldn't it be a nightmare if the Bigelow hotel gets infested with bedbugs? How would you get rid of them?

Pamela: You don't. You just give up.

Fraser: What a disaster! You give up. De-orbit. De-orbit. That's it. Cool. Alright, well I think we're good for animals in space, so thank you once again. And again, I hope everyone on the East coast stays safe with Hurricane Sandy, and we will see everybody next week.

Pamela: Sounds great, Fraser. I'll talk to you later.