***Citizen Science: Stories of Science We Can Do Together***

**Season 2, Episode 4: CitSciCon with NASA Projects**

*[Theme music]*

**Bob Hirshon**

Welcome to Citizen Science: Stories of Science We Can Do Together! In this episode, fasten your seatbelt and put on your virtual space suit – wait, that doesn't work; *first*, put on your virtual space suit, *THEN* fasten your seatbelt! All set? Great, because you are about blast off into the realm of NASA exploration!

*[Theme music fades out]*

If you, like me, and heck, almost everyone, wanted to be an astronaut when you were growing up, you probably learned quickly that it's extremely difficult, and gave up. Or not, and you are an astronaut right now, in which case: congratulations!

But even if you're *not* an astronaut, you can still be an important part of NASA's mission of exploration as a NASA Citizen Scientist—anyone, from anywhere in the world, of any age, is invited to participate! The SciStarter Team recently partnered with the Citizen Science Association on the first annual CitSciCon with NASA projects. There were two action-packed days of online, livestreamed events featuring over two dozen NASA citizen science projects looking for people with the Right Stuff! People just like you. And the best part? You can still watch the recordings and get started with all the projects on SciStarter.org/NASA.

For example, *Backyard Worlds: Planet 9* needs sharp-eyed volunteers to try to answer two questions: the first is–

**Adam Snyder**

Is there a large planet at the fringes of our solar system awaiting discovery?

**Bob**

That's Backyard Worlds: Planet 9 Project Manager Adam Snyder.

**Adam**

So a few years ago, in case you didn't know, a few astronomers predicted that there might be a large planet at the outskirts of our solar system that's affecting how other things out there in the solar system are moving around, called it Planet Nine, it hasn't quite been discovered yet, but the really interesting thing is, and the reason that we're doing this project, is it we may have taken its picture already. Which is fascinating. The problem is, the sky is really really big. And so we need a lot of eyes to look at a lot of images at the right time to see if we can find it.

**Bob**

They're also looking to see what *else* might be just *outside* our solar system.

**Adam**

So the "else" in this question are objects we lovingly refer to as brown dwarfs. / So brown dwarfs, you can think of them a little like Jupiter. But a bit more massive, a bit warmer. And they're floating on their own, so they're not orbiting a star in most cases.

**Bob**

The project uses images taken by a telescope called the Widefield Infrared Survey Explorer, or WISE.

**Adam**

And what WISE does is it surveys the entire sky in infrared wavelengths and it's been doing this for several years. So Planet Nine, if it exists, is in our solar system, so it should move with some orbital motion. And nearby objects just outside of our solar system should move relatively quickly compared to everything else that's much much further away, just because they are so close. And so what we do is we look for that movement.

**Bob**

Now, working with NASA scientists to find planets and dark stars may sound like it's just for science whizzes, but Rosa Castro, a Backyard Planet volunteer from New York, now living in Sweden, says you shouldn't be intimidated.

**Rosa Castro**

And I really encourage people out there to give it a go; it's not something that is as difficult– cause when we hear scientific stuff, a lot of us assume that you need to know a lot of math, you need to know the jargon, you need to be trained by NASA, but the fact is that it's really something that is really user friendly. It's truly extremely user friendly. /You, too, can do it!

**Bob**

She says that after just a short tutorial, you'll be ready to use their marking tool to show any moving objects. Snyder says just doing that would be a big help to the project. But if you want to go further, you can take additional tutorials and learn how to dig deeper, provide more information, and alert the science team if you've found something especially promising.

So what have they found so far?

**Adam**

When it comes to results, you could look at it as good news and bad news: We haven't found Planet 9 yet. If we found it, we'd be very excited and we would tell you. We haven't found it yet, so that could mean that it's not there, maybe it's beyond our reach of our images, or maybe it's, as I said, we haven't had the right person have the right image at the right time to find that object. So if it's out there it could still potentially be in our images and we'd love for you to come and help us find it.

**Bob**

With regard to brown dwarfs, the project has been incredibly successful.

**Adam**

We have found so many brown dwarfs that we have had trouble keeping up. We are doing so well in this area, it's amazing. We can't publish fast enough. /In 20 parsecs, which is something like 65 light years, so this is a fairly local region of our galaxy, of the 500 or so brown dwarfs that have been found, 20% came from our project. So we're making a really significant impact on the map of our solar neighborhood. And our impact goes well beyond that; just mapping the galaxy, we have so many high impact discoveries, from extreme sub-dwarfs, to co-moving companions, planetary mass companions, free floating planetary mass objects, they're popping up in our searches and we have so much coming and so much we've already done that we're super excited about.

**Bob**

If that sounds exciting to you, why not join them? Just go to scistarter.org/NASA and find Backyard Worlds: Planet Nine. The next Backyard World discovery could be yours.

But if finding a new world in or near our own solar system is just too local for you, how about searching for exoplanets: planets or the precursors of planets orbiting other stars? NASA needs help with that, too, which is why they created Disk Detectives.

**Steven Silverberg**

So when we're looking for planets around other stars, it's interesting to consider, apart from planets, what things about our solar system can be signposts of there being a planetary system around another star?

**Bob**

That's Steven Silverberg, from the Disk Detectives project. Like Backyard Worlds, they also use data from the WISE telescope.

**Steven** And if we try to take an alien's point of view of our solar system, and we look into the infrared, we see that the most notable thing is dust. We actually have lots of leftover dust, from planet formation, collisions of planetesimals–

**Bob**

WISE can spot stars with potential disks of dust around them by looking for excessive infrared light near the stars. But that light could be produced by other light sources in the field of view, like stars just behind the target star.

**Steven**

Basically, you look for stars that have more infrared light around them than they should; WISE found a few billion sources. It's then a matter of finding the 20-30,000 debris disks, and protoplanetary disks– the disks that will eventually form planets– hiding in that very, very large haystack. (32:35)

**Bob**

And that's where citizen scientist volunteers come in. Like Josh Hamilton, from Lansing, Michigan.

**Josh Hamilton**

(33:30) We basically take images / and you tell the program, you notice one of the six things we're trained to notice. And after doing about 300 of those classifications, you get an email/ and it invited me to be part of the advanced team / joined in the weekly Zoom calls, eventually was trained to be on the citizen science team. In that process, was able to be a co-author on a couple of papers. And even took some of the knowledge that I got from studying with the team at Disk Detective, was able to discover and name a couple of new variable stars, and have a paper right now that I'm writing that's in peer review. /So that's kind of my involvement with NASA citizen science and Disk Detective."

**Bob**

So was Hamilton an astronomer or other scientist before getting involved?

**Josh**

I actually work in Michigan at a Catholic church, as the adult information director, so kind of an interesting combination: I do not have a science background, but I've always loved science, so this kind of gives me the best of both worlds, being a part of this project.

**Bob**

Silverberg says that if you'd like to join Josh and thousands of other Disk Detective volunteers, there's plenty of work to be done.

**Steven**

So if you'd like to take part, we're definitely open for business: I uploaded about 2500 new things to look at earlier this week. So you can go to scistarter.org/NASA, we're a partner with SciStarter, you can start classifying. And if you've made 300 or more classifications, we invite you to consider joining our advanced user team, because we want the contributions of dedicated citizen scientists like y'all.

**Bob**

NASA Citizen Science officer Mark Kuchner points out that as exceptional as Josh is in the NASA Citizen Science community, he's far from alone: many citizen scientists have made important discoveries, and have been included as co-authors of science research papers. And overall, Kuchner says that in recent years, citizen science has become a major force at NASA.

**Marc Kuchner**

This is something that completely amazes me: just in the last few years, I've gone from bragging about how hey, we are accomplishing some amazing stuff to we now dominate multiple scientific fields. So NASA Citizen Science projects have discovered most of the known comets,/ all of the known samples of interstellar material, half of the ultra-cool brown dwarfs,/ most of the long period extrasolar planets. Through this work, 191, that's now up to 194 as of last week, NASA citizen scientists have become named co-authors on scientific papers.

**Bob**

And he explains that you don't have to be a US citizen to be a NASA "citizen scientist."

**Marc**

The word 'citizen' in Citizen Science, that's, um– pay no attention to that. We don't mind if you're a citizen or not a citizen; it really doesn't matter. We welcome volunteers from any country, all around the world, and it's... that was just a word that was trying to capture the idea that we're opening up science to– as broadly as possible. To anyone who wants to be in it, whether you have an advanced degree in science, any degree in science, whether you remember any science from school or not. It doesn't matter; all of our NASA Citizen Science projects all try to teach you what you need to know as you go. And they all intend to welcome new folks in.

**Bob**

And whether you become a published research contributor, or just post occasional observations, you get the satisfaction and pride that comes from being a part of important scientific exploration.

**MacDonald Chirara**

One of my friends they told me they were doing this cool NASA thing without them being a scientist–

**Bob**

That's university student McDonald Chir ara, from Zimbabwe.

**MacDonald**

– so I was like Ah, what is it? And they told me about it and it was just a simple application, and I found this interesting and fascinating.

**Bob**

McDonald participates in GLOBE Observer: Trees, a project that maps tree distribution.

**MacDonald**

Something really cool to know that the data which I am recording is being compared to the data which NASA satellites are out there recording, so it's something that makes me feel proud of myself.

**Bob**

Not only does this highlight NASA Citizen Science's embrace of the international community, but also reminds us that NASA's mission is not only to explore outer space, but also Earth itself.

For example, FjordPhyto looks at phytoplankton living in the frigid waters surrounding Antarctica. These tiny marine organisms are at the base of polar food chains that support everything from shrimp and other invertebrates, to fish, penguins and whales.

The project was created by marine scientist Allison Cusick, who started her college career with the goal of becoming, yes, an astronaut, but later fell in love with the forbidding yet alluring Antarctic environment– particularly the phytoplankton that support the rich marine ecosystem that thrives just off-shore. She says freshwater from melting glaciers are having a big effect on these tiny but important organisms.

**Allison Cusick**

Over the past couple of decades, scientists have found that 87% of the glaciers are retreating, so that is putting a lot of freshwater or meltwater into the marine environment.

**Bob**

NASA satellites can observe changes to phytoplankton density from space, since the algae are green against the blue water. But they need people on the ground to really understand what's happening. The answer? Adventure-loving tourists.

**Allison**

We have partnered with the tour operators that work down in Antarctica for 5 months every season, and that's kind of like way more than any scientist is able to be down there unless they're living in a station on land. And there are many ships that are traveling up and down, north and south of this coastline. So what we have done is partnered with certain tour operators from the International Association of Antarctic Tour Operators and the Polar Citizen Science Collective to train guides that work aboard these ships on how to take samples. And then the travelers come down every day of those five months, they're able to engage them in collecting samples.

**Bob**

They measure temperature and salinity, use fine nets to collect phytoplankton and identify them, and even conduct sophisticated analysis of water samples to determine the water's origin. Cusick says the sorts of tourists who visit Antarctica are often also eager to help explore.

**Allison**

They're curious, they've come down to this amazing place to see it firsthand and get to help contribute to polar research, which is a very data limited region of the world, because it's some of the harshest environments that Earth experiences. And it's been amazing to watch their faces light up; and they also have said that it enriches their travel experience; some have told me they have felt that childlike spark of curiosity; it's just amazing to know that they have contributed something incredibly important while they were on their vacation down here. And they go home and tell their friends and family about it. And over the past couple of seasons– so the season is actually the opposite of the Northern Hemisphere, their summer is November through March– we've had over 3000 participants actually hands on collect samples from the water. And that's amazing.

**Bob**

She says the best way to get involved is to join them: just book a tour to Antarctica and get your feet wet (maybe not literally). But she says you can also participate without leaving home.

**Allison**

Since we understand that not everybody can go to Antarctica, there are ways you can still get involved with phytoplankton and appreciating the microscopic life that exists in your own backyard, even if it's a puddle or a pond or a river or you have access to the ocean. We have an iNaturalist project, so you can take photographs from your iPhone if you're able to use a microscope to look at the invisible world, and post those photos to iNaturalist, which is an observation tool that records what you're seeing. Of course you can visit our website, FjordPhyto.org, learn even mor, and we would love if you would engage with us on social media, @fjordphyto, we're on Twitter, Instagram, Facebook and YouTube. And we also would love to know if you have plans to book a trip Antarctica, then we'd love to talk about how to get involved in that way.

**Bob**

And of course you can check them out at Scistarter.org/nasa. Now, if you're looking for a project that's tropical rather than polar, you could consider NASA NEMO-Net, where you identify different types of coral, based on images collected with unmanned aerial vehicles, or UAVs.

**Alan Li**

We fly UAVs (unmanned aerial vehicles) over these coral sites to basically come up with 3D models of the coral using a new technology that we call Fluid Lensing that actually can see through the water surface.

**Bob**

That's NASA NEMO-Net Project Manager Alan Li.

**Alan**

You know that the water's surface is wavy, there's a lot of distortion, there's refraction, you can't really see what's underneath it. And this technology really brings whatever is underneath those shallow systems, really brings it to bear.

**Bob**

Li explains that corals are dying all over the world due to a phenomenon known as bleaching.

**Alan**

So what happens is, during these warming temperatures, the corals, you can think of it like they're undergoing their own sort of a fever. Because they think something is wrong because all of sudden, the water is getting too warm. So as a result, they expel the algae, within their systems that help them make their own food. So in essence, they're trying to burn out whatever they think is wrong with themselves when the ocean temperatures are getting too hot. And they can do this for a little while. But over time, you can imagine, you can't really survive a fever for more than two weeks, that's pretty extreme already, and this is happening at a much longer scale. And a lot of these places, like the Great Barrier Reef in Australia, and all these tropical regions, they are seeing mortalities in these coral reefs by up to 50%, or even more, and that is what we are really trying to mitigate here.

**Bob**

NASA-NEMO Net is a game-like app in which volunteers examine 3D and 2D images of the sea floor and identify corals. That data helps the project's artificial intelligence algorithms learn to spot coral and assess reef health. And it also raises awareness of the problem.

**Alan**

A lot of this is out of sight out of mind, unfortunately, for a lot of people. Because if you see a forest burning down, everyone would be in a panic. But these ecosystems, which are prolific in life and they have so much biodiversity, are actually collapsing. And nobody really can see them, and so it's very hard to do anything about it.

**Bob**

The app helps alert players to the threat of coral bleaching, and gives them the opportunity to help by playing.

**Kellen Homan**

It's kinda like a game cause it's not schoolwork–

**Bob**

That's 10-year old NEMO-Net citizen scientist Kellen Homan.

**Kellen**

You can choose where you want to be and what you want to do. There's 2D and 3D and stuff like that./ And there are some key regions that have coral. They are, you can classify Guam, the Great Barrier Reef, American Samoa, Hawaii, or Puerto Rico coral. So that's where most of the coral is, probably.

**Bob**

Li says NASA NEMO-Net is fun for all ages, kid through grownup, and you can learn more by clicking on the info link for the project at scistarter.org/nasa.

Now in addition to oceans, NASA is also interested in terrestrial and aerial science, and have a series of projects called NASA GLOBE Observer, done in conjunction with the international GLOBE Program. In these projects, citizen scientists make ground-based observations that are tied to NASA earth-observing satellites. They include GLOBE Observer: Trees, Clouds, Mosquito Habitat Mapper and Landcover. Holli Kohl is project coordinator for all of GLOBE Observer, and the lead on GLOBE Observer- Landcover. She defines landcover as simply what's on the land around you: grass, trees, pavement, farmland, desert, etc.

**Holli Kohl**

So landcover matters because it is shelter. It's a shelter for wildlife, it's shelter for us. It is food. It contributes to a community's vulnerability, like floods or wildfires. It can influence pollution, like water pollution. If there's not open soil to absorb water, pollutants that get on the land can runoff into the water. So, it's part of the carbon cycle which is how carbon circulates through our planet, which is key component of climate change. It is part of the water cycle. So it is intimately tied to life and every aspect of how our planet function./ And that's why landcover is important: it's one of those really basic, fundamental measurements that we don't even really think about because we see it and we're surrounded by it all the time, but it's a pretty important one, and that's why we want help observing it.

**Bob**

Volunteers take photos of the land around them, and answer questions about local conditions, and this information is coupled with satellite observations.

**Holli**

So when you open the app, it will ask you about surface conditions/ things that change, that might influence how a satellite will view the ground. So that's "is it raining right now? Is the ground wet? Are there leaves on the trees? The things that change from day to day.

Then you'll take photos in four directions, the app will show you where to go, one facing north, one south, one east, one west, and there's a little compass thing that you line up, and as soon as you're facing north, it'll turn green and you tap the screen and you take a picture/ And then you'll take a picture facing up and facing down, and you can be done at that point. Or you can help us tag the photos with the landcover that you see.

**Bob**

Now, for NASA GLOBE Observer: Landcover you share data on what is immediately near you, and the project collects those observations from points all over the world. Snapshot Wisconsin is kind of the opposite of that: the project collects trail camera images only in Wisconsin, but citizen scientists all over the world can view them and help identify the wildlife in the photos.

**Emily Donovan**

We have two major goals: the first is to engage the public in hands on learning experiences through natural resources. And the second is to collect data needed for wildlife management decision-making.

**Bob**

That's Emily Donovan, research scientist with the Wisconsin Department of Natural Resources and member of the Snapshot Wisconsin team. The project employs over 2000 cameras on trails throughout the state, and when they detect motion, they snap three pictures. The images help scientists track animals of interest, like elk.

**Emily**

Elk were removed from the state some time ago, and over the past few decades have been reintroduced to the state, so the higher camera density in those areas is to keep extra close attention to what's going on with those elk throughout the state. We've invested lots of resources, we want to know where they are spending their time and how the population is doing.

**Bob**

She says in some cases, the images augment efforts conducted by trackers on the ground.

**Emily**

We do have on the ground wolf surveys, where people go and look for tracks on the ground. But some areas of Wisconsin are very remote, and difficult to survey. So we use the trail camera data to supplement those surveys, and then we can create the most complete picture possible.

**Bob**

And while you might expect that most of the project volunteers are local, it seems that people all over the globe enjoy viewing and identifying Wisconsin wildlife.

**Emily**

So of course we have lots of people in the state of Wisconsin who are managing the cameras for us, and uploading the photos, but a huge effort comes from our global audience. / We've had folks log on to classify photos from across the whole world. And so this is something that you can do from wherever you are.

**Bob**

And they'll need that large national and international cohort of volunteers to keep up with their image capture efforts: the project has now collected over 50 million photos.

So, by now, it should be obvious that no matter who you are, what age you are, where you live, or how much or how little you know about science, there are NASA Citizen Science projects just for you. And this podcast has only touched on a few of them! To learn more, go to scistarter.org/NASA where you can learn about all of the NASA projects available, and even check out some of the webinars that were conducted as part of CitSciCon. You, too, can join NASA and boldly go where no one has gone before. I'm Bob Hirshon. Thanks for listening.

*[Theme music]*

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 *[Theme music fades out]*