Video Transcript - Living Together – Parasites and Hosts

Maggy Benson: [00:00:30] Welcome everyone. Thanks for joining us for another episode of, live from Q?rius, Smithsonian Science How? I'm Maggy Benson

Maggy Benson: We have a really awesome show for you today. With us is Dr. Anna Phillips, an invertebrate zoologist here at the Smithsonian's National Museum of National History.

Maggy Benson: Anna, thank you so much for being here.

Anna Phillips: Thank you for having me.

Maggy Benson: So, Anna, you're an invertebrate zoologist, but you are studying parasites. What do you do as a parasitologist, [00:01:00] here at the Smithsonian?

Anna Phillips: A parasitologist is a scientist who studies parasites. So, in my research I look at parasite diversity. So, the different kinds of species of parasites. I look at how different parasite species are related to each other.

Anna Phillips: And then, what host organisms parasites are associated with.

Maggy Benson: So, lets take a step back and actually can you tell us what a parasite is?

Anna Phillips: Parasites are organisms that live on or inside a host organism. Parasitism is a type of symbiosis, and that's a relationship between two organisms. [00:01:30] When the parasite gains a benefit from being in the host, and the host has a negative effect from that relationship.

Anna Phillips: So, the parasite, in this case, is getting a home, it's getting nutrients from the host. Whereas the host is losing some of its nutrients.

Maggy Benson: That doesn't sound like a great relationship for that host.

Maggy Benson: I'm wondering why we should study parasites in the first place. I'm sure you have that answer, but don't tell us. Let's [00:02:00] actually ask our viewers.

Maggy Benson: Viewers, tell us why we should study parasites in the first place? Participate in a live poll with us now. You can respond using the window that appears to the right of your video screen.

Maggy Benson: Should be study parasites because parasites are valuable as medicine? Dangerous to humans? Members of food chains? or Members of ecosystems? Take a moment to think about it and put your answer in the window to the right.

Maggy Benson: And remember this is the same place where you can post questions for Dr. Anna Phillips to answer, live, on our show today. [00:02:30] And for parasitologist Whitney and Jimmy, special guests in our chat, to respond to you.

Maggy Benson: Anna, we can see the results coming in, and people have selected [00:03:00] all of the possible answers. But, 55 percent as of right now think that the answer is dangerous to humans. What do you say?

Anna Phillips: Some parasites are dangerous to humans, but actually all of these answers are correct.

Maggy Benson: Trick question, huh?

Maggy Benson: So, you're studying parasites to learn about all of these things.

Maggy Benson: But, I mean. The one that strikes me as a little bit surprising is valuable is medicine. You just told me that parasites take nutrients from the host. So, how are parasites valuable to medicine?

Anna Phillips: [00:03:30] There's lot of things we can learn from parasites. For instance, parasites are an exciting area of research where we can learn about how they interact with their hosts' immune systems.

Anna Phillips: So, some parasites may cause a little bit of an immune response. An example of a parasite that has been used in medicine are leeches, for instance. So, in the 17 and 1800's, leeches were used as a cure [00:04:00] all.

Anna Phillips: So, everything from headaches to the common cold, and this is because people thought that things that made them sick were in their blood, bad blood.

Anna Phillips: They want to get rid of that blood.

Maggy Benson: Did leeches get rid of that blood for them?

Anna Phillips: Right. So, many species of leeches feed on blood, and they were using those leeches. They would put them on and have them suck the blood off. And then once the leech is removed, that wound would continue to bleed.

Anna Phillips: And, today we use leeches in medicine. We know now that leeches have anticoagulants in their saliva, and that's what causes that wound to continue bleeding.

Anna Phillips: And they [00:04:30] are used in medicine today, but for a much refined purpose. Not as a cure all. So, they're used especially after surgery when we have things like skin grafts. Or, if you have a digit that's been cut off, like your finger, and they reattach it. They can attach a lot of those vessels that take blood into the finger, but it's more difficult to attach vessels that take the blood out.

Anna Phillips: So, what will happen after surgery, is that the blood will rush into the finger and then it will start to swell. Leeches have tiny mouths, so they [00:05:00] fit very well on the tips of fingers, and noses, and ears. So, when you put the leech on, it begins to suck the extra blood out of the finger. And then those anticoagulants go into the finger and help the blood continue flowing.

Maggy Benson: And that continuation of the blood flow, I'm sure, actually promotes healing then.

Anna Phillips: Right.

Maggy Benson: Wow, that's incredible. I never knew of such an application. Now, I'm looking over your shoulder and I do know what a leech looks like, and it looks like we have a live one here today. Can you show us?

Anna Phillips: We do. So, this leech is from North America. And [00:05:30] you see the ...

Maggy Benson: It's pretty big.

Anna Phillips: Yeah, this is one of our larger leeches.

Maggy Benson: So, is this one of the leeches used in medicine.

Anna Phillips: This one actually isn't. So, there's some leeches that don't feed on blood. And it feeds mainly on earthworms.

Maggy Benson: Oh, wow. So, that's pretty interesting.

Maggy Benson: So, that big end I see, is that the part where it feeds onto the earthworms or it may suck your blood if it's that type of leech?

Anna Phillips: Well, a lot of people think that this big end is the mouth part, but this is actually its tail. [00:06:00] Leeches have a circular sucker on their tail that's only muscles. So they're not feeding from that end. This tiny end at the other end, that's where the mouth is.

Maggy Benson: Oh, so this right here that we're seeing on this screen, that's actually the sucker that allows it to adhere?

Anna Phillips: Right. That's the tail sucker. So that's kind of like a suction cup that presses against glass.

Maggy Benson: Wow. So, leeches are a little less scary to me now.

Anna Phillips: Good.

Maggy Benson: So are there any other modern applications of parasites in the medical field?

Anna Phillips: Right. Parasites, this is a really exciting part of research, in the sense [00:06:30] that, parasites, when they are in our bodies, a lot of time they are sort of flying under the radar with our immune systems.

Anna Phillips: And understanding the mechanisms, how parasites can be inside of us and our immune system doesn't fully react to it, it's really interesting. So, there's some cases, like on the screen, there's whipworm. Where people are using worms as drug therapy. Or as worm therapy, really. For people with autoimmune diseases, where their bodies are reacting against their own tissue.

Anna Phillips: So things like ulcerative colitis [00:07:00] and Crohn's Disease. If we give them things like whipworms and hookworms, it gives the body something to attack. And so, the body will attack the worms, rather than the persons own tissues.

Maggy Benson: Wow, that's so fascinating. You know, it actually gives me a deeper appreciation of parasites. I can't say that I came into this really loving the idea of parasites. I've always come to this thinking about parasites being really dangerous and really deadly. Is that true? Is that a natural aversion?

Anna Phillips: They can be harmful to [00:07:30] humans. Most parasites though, aren't going to be deadly. They may cause a little bit of a reaction or none at all. This is because the parasite wants to have a long term association with its host. And that helps provide it homes, so it can become an adult and reproduce more.

Maggy Benson: So it's actually beneficial for that parasite not to kill the host?

Anna Phillips: Right.

Maggy Benson: But can it kill you?

Anna Phillips: It can. There are some. Some of the smallest parasites of humans can be some of the deadliest.

Anna Phillips: So, like on the screen, on [00:08:00] the small circular light pink, those are red blood cells, and the dark pink are worms. These are plasmodium species, this is the parasite that causes malaria. They're very tiny, they live in our blood.

Maggy Benson: So they can be deadly, but not always, and they actually have some beneficial uses.

Anna Phillips: In certain cases.

Maggy Benson: So I saw a fish there. I'm familiar with parasites parasitizing other animals. Can parasites live in or on anything that's living?

Anna Phillips: For the most part, all free living [00:08:30] organisms have some sort of parasite.

Anna Phillips: So when we look outside, we think about - there's things like crabs, and squirrels, and birds, and fish - all of these free living animals probably have some sort of parasite. Parasites are really diverse, parasitism is a lifestyle, so it's not necessarily a way to group organisms, that they're parasites. It's more that there's many kinds of parasites that are parasitic.

Maggy Benson: Interesting.

Anna Phillips: So parasites include things like intestinal worms, fleas, ticks, lice, [00:09:00] blood parasites, single celled organism called protozoans.

Maggy Benson: Interesting. So you're mentioning a lot of different hosts, things that have parasites themselves. What is the diversity of hosts? What does that look like if they're impacting all different animals, across all different genera? I know, specifically, the tapeworm, bird tapeworms have multiple hosts. Can you explain what that cycle looks like?

Anna Phillips: [00:09:30] There are many species of tapeworms that will parasitize all vertebrates. Many parasites have what is called a complex life cycle. And so what this means is that through the parasite's lifecycle, that it metamorphoses between different shapes and different forms.

Anna Phillips: So in this case on the screen you see the bird, which has a tapeworm. It's shedding eggs into its feces. So as the feces pass out, the eggs go into the environment. The eggs then [00:10:00] get eaten by what's called an intermediate host. This is a host that the parasite is just developing and growing. And in this case, it's a copepod. Then, that intermediate host gets eaten, possibly, by another intermediate host. And therefore, the tapeworm passes into the next one. It metamorphoses again, and then eventually ends up in the bird, as an adult, where it reproduces to start its cycle over again.

Maggy Benson: So that's just one example of one type of tapeworm. [00:10:30] And it depends on all of those different species to be able to reproduce and be successful. Does that mean if that an ecosystem changes, if there was a drought or if something major happened in that climate or ecosystem, that the parasites life would be impacted?

Anna Phillips: Definitely. These life cycles, because they are complex, and have so many different players in them, it means that they can be a bit fragile. So all these connections have to be made at the right times. The [00:11:00] parasite getting into the different host species in the correct order. So if something changes, then the parasite might not make it to the next stage.

Anna Phillips: For instance, when birds migrate, they're moving to a different location where those intermediate hosts may not be. So, if something disrupts that, like climate change for instance, which may make birds migrate at a different time, or they

may go to a different area, that can disrupt that parasite's life cycle and it might not make it into the next stage.

Maggy Benson: Interesting.

Maggy Benson: So, we have a lot of student questions coming in. Thank [00:11:30] you all for sending them, keep them coming. We're gonna get to some of them now.

Anna Phillips: Okay.

Maggy Benson: This one comes from Roberto from the Ocean Academy. What fruit can you find most parasites in?

Maggy Benson: Which actually, is an interesting question, can you find parasites in plants?

Anna Phillips: Roberto, you're thinking outside the box a little bit from what I'm talking about. Because I'm talking a little bit about animal parasites. So, we get these from eating other animals. But, there's a whole field about plant parasites. And so, parasites can live on things like fruit. So, this is one of the reasons you want [00:12:00] to wash your fruit before you eat it, or peel it.

Maggy Benson: Smart.

Maggy Benson: So, we have another question, but it comes in by video. So, let's have a look.

Olu: Hello, my name is Olu, and I would like how many known species of parasites are there.

Maggy Benson: Great question. How many known species of parasites? I wonder if scientists even know that answer.

Anna Phillips: Olu has a very common question that we all want to know the answer to. It's hard to say, and it's hard to put a definitive number, because there's so many parasites we haven't discovered yet.

Anna Phillips: But, the best estimates [00:12:30] we can get is that, of all the species on Earth, over 50 percent, over half of them, are parasitic.

Maggy Benson: We have another question, this one comes from Karen from Bethesda. What's the largest parasite in the Smithsonian's collection?

Anna Phillips: Wow. Karen, you're thinking big. So we have some very long tapeworms. And some of the tapeworms can be 30, 40 feet in length.

Maggy Benson: Oh, my goodness.

Anna Phillips: Yeah.

Maggy Benson: That's a big worm.

Anna Phillips: But, there sort of coiled [00:13:00] up.

Maggy Benson: That's terrifying.

Anna Phillips: Yeah. But, they're sort of coiled up in jars. They end up being very big jars.

Maggy Benson: What kind of animal does 30 foot tapeworm live in?

Anna Phillips: Mammals.

Maggy Benson: Oh, wow. That's actually a great segue, we're gonna talk a little bit more about The National Parasite Collection that is here at the Smithsonian. Newly acquired. And a little bit about your research.

Maggy Benson: But, first, I think we should ask our viewers a question about why we would ever keep a collection of parasites to begin with.

Maggy Benson: [00:13:30] Viewers, here's an opportunity to participate in a live poll, tell us, parasite collections are for: Keeping parasites safe? Learning more about parasites? Reproducing parasites? or Killing harmful parasites?

Maggy Benson: Put your answer in the window that appears to the right of your video screen.

Maggy Benson: [00:14:00] Anna, we can see the results. 78 percent, 86 percent, the bar is still moving, think that learning more about parasites would be a valuable reason to keep a collection. What do you think?

Anna Phillips: Definitely. We learn more about parasites from this collection every day. But, actually, keeping parasites safe is another thing we do with this collection.

Maggy Benson: You must have to keep them safe to be able to study them in the future, right?

Anna Phillips: Right.

Maggy Benson: What do you have here from the parasite collection? [00:14:30] I see a wonderful array in front of us now, to share with us.

Anna Phillips: Well, speaking of really big specimens, we had this jar here of tapeworms from a dolphin. The dolphin stranded in Maryland a few years ago, and we were able to recover these tapeworms. There's probably about three to five in this jar.

Maggy Benson: That's it? Only three to five worms.

Anna Phillips: Yeah.

Maggy Benson: Wow.

Anna Phillips: This is *Diphyllobothrium latum*, it's a fish tape worm. So the dolphins got it from eating fish. And it's one of the longest tapeworms that we know. [00:15:00] These can easy get to be 35 feet in length.

Maggy Benson: Wow, that's incredible. So what's the value of having this dolphin tape worm from just a few years ago and comparing it with the collections over time?

Anna Phillips: Well, we had specimens from dolphins, of parasites of dolphins in our collection. But what the value of this is that you can look back and see which species of parasites have been found in dolphins in the past. And then you can also look at which dolphins have hosted which parasite species. So you can look back at specimens [00:15:30] from 100 years ago, you can look at them from 50 years ago, and then you can look at what we're finding today and compare that across time.

Maggy Benson: So you mentioned that you can look back at specimens from 100 years ago. Our National Parasite Collection dates back to over 100 years old. How did that start?

Anna Phillips: It started in 1892, and it originally was housed at the USDA because parasites were considered pests in agriculture, of our livestock. And there was a lot of research going on at USDA [00:16:00] about how to prevent our livestock from being infected. But today, the parasite collection includes parasites of all kinds of things, including our livestock as well as people and our wildlife.

Maggy Benson: It's grown quite a bit since 1892.

Anna Phillips: Yes.

Maggy Benson: You showed me that last week, let's show our viewers.

Maggy Benson: Anna, thank you so much for having us here.

Anna Phillips: Sure.

Maggy Benson: There are jars everywhere. Where are we?

Anna Phillips: We are in the US National Parasite Collection.

Maggy Benson: What can you show us today?

Anna Phillips: Let's go see.

Anna Phillips: [00:16:30] These worms are from a pig.

Maggy Benson: Oh, my goodness. There are so many. And even the label on the jar looks so old. How old are these worms?

Anna Phillips: Well this collection was founded in 1892, and it started because parasites are considered pests in agriculture. So parasites can infect animals that we eat, like pigs. We need to know [00:17:00] how they can get these worms, and how to prevent them from getting these worms.

Maggy Benson: So this is really important for keeping our animals, our livestock, healthy?

Anna Phillips: Right.

Anna Phillips: These are tapeworms from a fox, and these are roundworms from a skunk. And this is the main value of this collection because it's important to know what parasites are in wildlife, because those can be transmitted to our livestock and then also to humans.

Maggy Benson: We're looking at so many jars here. How many parasites are in this collection?

Anna Phillips: There's several worms in [00:17:30] this jar, but these are just some of the over 30 million specimens in this collection. And it keeps growing.

Maggy Benson: You told me there, it's still growing. And you are one of the people who are adding to that collection, as a scientist here at the Smithsonian. Do you go out and do field work to be able to collect more specimens to add to this collection?

Anna Phillips: We do. We're always ... Scientific collections are dynamic, and we are always assessing new specimens. And we're always getting more specimens for the collection.

Anna Phillips: Sometimes we do this by going [00:18:00] into the field and collecting ourselves. So, a few years ago we went to Brazil and collected bird parasites. So, we wanted to look at ... We were around Sao Paulo, Brazil, sort of in the southern part of the country. And we were looking at all the different birds there, to see what kinds of parasites were associated with these species.

Maggy Benson: That's interesting.

Maggy Benson: So how do you actually get the parasites out of the birds? How are you extracting those?

Anna Phillips: We were working closely with ornithologists in the field. And we were looking at all aspects [00:18:30] of the birds including their blood, and looking at blood parasites. But once we got the parasites, we took them back to the lab and we prepared them in a print wave for permanent mounts.

Anna Phillips: So putting them on glass slides we can look at them with a microscope. And then also taking DNA vouchers.

Maggy Benson: So how are you identifying those parasites? I can't imagine that a parasite this size is inside of a bird.

Anna Phillips: Right, well, you'd be surprised at the size of some parasites in birds. We were looking [00:19:00] at the structures of the tapeworms, and also the other parasites, to identify the species. And then, we also would sequence the DNA, using those DNA vouchers.

Anna Phillips: And, by sequencing the DNA, we can compare that between the different specimens we collected, to learn more about how they're related to each other.

Maggy Benson: Interesting. And do you also use microscope to look at those features of those animals?

Anna Phillips: Yes. There's several kinds of microscope we use. The scanning electron microscope is what we used to create these images.

Maggy Benson: [00:19:30] They're beautiful. It looks like art.

Anna Phillips: Yeah. They're pretty striking.

Anna Phillips: So, the scanning electron microscope looks at the exterior of the specimens. And we can see really tiny parasites really clearly.

Maggy Benson: So, using SEM technology, scanning electron microscope technology, and DNA, and looking at the features of all of these parasites, what did you find in your Brazil work?

Anna Phillips: Some of the specimens that we collected in Brazil, we were able to, for instance, this tapeworm [00:20:00] was a species that we re-described. It was the first time that it has been found since 1908.

Maggy Benson: Oh, wow.

Anna Phillips: So from this trip, we were able to re-describe these two species. And we were also able to describe two new species that hadn't been known to science before.

Maggy Benson: So, that's a brand new discovery of two new animal species.

Anna Phillips: Right.

Maggy Benson: Very cool. Or parasite species, rather.

Maggy Benson: Very cool. So are there other scientists around the world who are working on these kinds of projects? To better understand parasites in different ecosystems and animals.

Anna Phillips: [00:20:30] There are. This was part of a larger project that was funded by The National Science Foundation. It took about six years. There were over 65 participants in 21 countries that came together. And we were looking at the diversity of parasites across vertebrate classes.

Anna Phillips: So we had a team that were working on the tapeworms of mammals. We had a team that was working on the tapeworms of fish, and I was on team bird.

Maggy Benson: Oh, and this is what we see here.

Maggy Benson: So it looks like birds and mammals have the market on [00:21:00] tapeworm diversity, the most different kinds of tapeworms. Is that true?

Anna Phillips: Yeah, of tapeworm species, they do.

Anna Phillips: But also there's a large part of the diversity in the sense that some of the oldest tapeworm lineages are found in sharks, and rays, and skates.

Maggy Benson: Oh, interesting. Why would that be?

Maggy Benson: Is it because they've been on Earth longer than some of those bird species?

Anna Phillips: Well, the lineage of sharks, skates, and rays is a very old lineage in the tree of life. And [00:21:30] so in geologic time, these animals came about much earlier than many others. And this makes sense that we have very old lineages of tapeworms in a very old lineage of vertebrates. Especially when you think about the oceans being some of the oldest habitats we have on Earth.

Maggy Benson: This research that you're sharing with us here today, Anna, is really interesting work, and it's great to know that you and other scientists around the world are collaborating to learn more about parasites and the ecosystems they're living in.

Maggy Benson: We have a lot of student questions and let's get to as many as we can.

Anna Phillips: Okay.

Maggy Benson: [00:22:00] This one is from Ryan and Aiden. Can leeches be used to suck venom from a snakebite?

Maggy Benson: Oh, that's a great thought.

Anna Phillips: Yeah, I hadn't heard that one before. So, thank you Ryan and Aiden. I have not heard about using leeches for that. They probably wouldn't do very well with it,

because they don't feed for very long. And they're trying to feed on the blood, and so I'm not that they would be very efficient at pulling just the venom out.

Anna Phillips: Yeah.

Maggy Benson: And they might get sick too.

Anna Phillips: Yeah, you probably need to see [00:22:30] a doctor. Tell someone you've been bitten by a snake if that happens.

Maggy Benson: Vicky from Chicago. Do you have to take care of your parasite collection in any special way?

Anna Phillips: Okay, so this is a great question about jobs Vicky. Because, we have an entire team here in the department of invertebrate zoology, that specializes in collections management. So we have people who have special training to work with glass slides, specimens on slides, and specimens in jars and in fluids. To make sure that the specimens [00:23:00] don't dry out, to make sure they're in the proper fluid.

Maggy Benson: How do you collect these parasites? It's a question, we don't have a name for it, but one of our students wants to know. How they've been collected over time.

Anna Phillips: So, there's a few different ways you can get specimens of parasites. So one is to look at the blood. So you can take a little bit of blood and you can find parasites that way. Another is, kind of like in our bird life cycle, where the eggs are coming out in feces, so you can actually [00:23:30] collect feces and find parasites.

Maggy Benson: Poop.

Anna Phillips: Poop.

Anna Phillips: So, you can find eggs in poop. And then, in other ways. How we got the dolphin tapeworms is when there's animal, we do a necropsy. And so then we can actually get the adult parasites out, when they're doing a necropsy. To find out why the animal died.

Maggy Benson: That dolphin had died on shore.

Anna Phillips: Right.

Maggy Benson: And you were essentially able to do an autopsy on it.

Anna Phillips: Right. We wanted to know what had happened.

Maggy Benson: So, we have another question from Audia. Let's have a look.

Ami: Hi, I'm Ami, and I was wondering if you could tell me which types of parasites are more effective. [00:24:00] Parasites that live symbolically with their host, or parasites that kill off their host.

Maggy Benson: That was Owen with that question. A great question.

Anna Phillips: Owen? Okay. Owen.

Anna Phillips: So we were just talking about how, if a parasite gets into its host and it kills it too quickly, it decreases the amount of time it has to reproduce and create more parasites.

Anna Phillips: So a lot of parasites will cause a small amount of immune response. [00:24:30] So that they can sort of fly under the radar, and not cause the host to be too sick or to die. So most of the parasites don't want their host to die, because it takes away their home.

Maggy Benson: Great. And Ami, I'm sorry I mispronounced your name. It was Ami, I fed you the wrong name.

Anna Phillips: Okay.

Maggy Benson: So, this one is from Dominic. Do parasites live in bats?

Anna Phillips: Yes. There's lots of parasites in bats.

Maggy Benson: So, this one's coming from the Q?rius [00:25:00] Lab Group, the folks that we have watching here from the Smithsonian with us. Is it common for humans to get tapeworms?

Anna Phillips: Hi Q?rius Lab. Yes, it can be, but it depends on what you eat. So one of the ways we get parasites is if you don't cook your meat properly. And so we can get tapeworms from fish, we can get tapeworms from pigs, and from cows, and a few other things, but it usually comes when we eat undercooked meat. So as long as you cook your meat well, [00:25:30] you'll probably not get tapeworms.

Maggy Benson: Emily and Sophia ask, what is the most interesting parasite you have ever studied.

Anna Phillips: Oh, I have to think about this one. Thanks Emily and Sophia.

Maggy Benson: Is it like picking your favorite child or your favorite pet?

Anna Phillips: There's so many. Yeah, it's difficult because leeches have a special place in my heart, but then also I really like bird tapeworms. But I think [00:26:00] there's different parts of each of those that I like. So I really like the part about blood feeding with leeches. But then bird tapeworms ... I really like birds too. So

learning about the different parts of those biology, and then you're comparing them, is part of the most interesting part of my job.

Maggy Benson: Well, it sounds like there's a lot to learn about parasites. So, you have plenty to choose from.

Maggy Benson: So the Q?rius Lab Group would like to know. What made you want to study parasites in the first place? Was this always a lifelong goal of yours?

Anna Phillips: Not exactly. [00:26:30] I was not one of those five year olds saying, I want to study parasites someday. But, I did know, when I was young, that I liked nature and I liked learning about different animals. I like being outside.

Anna Phillips: And as I progressed through school, and I learned more about different kinds of animals, I learned about parasites. And I became interested in that. And so there's a whole field of parasitology out there that can be applied in different ways. And even if you like ... A lot of parasitologists also know a lot about host groups. So [00:27:00] if you like a certain kind of animal, like birds for instance, you can study the parasites of birds.

Maggy Benson: So, this is from Watkins fourth grade class. Thank you so much for joining us. What's the most harmful parasite for humans?

Anna Phillips: Very serious. So Watkins fourth grade. Today there're many parasites that can make people very sick, but not necessarily kill them. So, these are things that cause diseases like onchocerciasis. Filarial worms. Schistosomiasis.

Anna Phillips: These [00:27:30] are some of the most broadly, most infective things for humans, that can make them very sick. The most deadly parasite for humans today is malaria. Or is plasmodium that causes malaria. It kills over, I think, 400 million people a year.

Maggy Benson: Wow. So we have one last question before we wrap up. And this one is from Glenwood Academy, asking what the oldest specimen is in our collection?

Anna Phillips: Hi Glenwood Academy. [00:28:00] So the oldest specimen in our collection. It's a specimen from 1809, and it's from a sea turtle.

Maggy Benson: Wow, and that actually predates when the entire collection started.

Anna Phillips: It did. It did.

Maggy Benson: Very interesting. Anna, thank you so much for being here today.

Maggy Benson: And taking all of our questions about parasites, and teaching us a little bit about The National Parasite Collection. What you do here at The Smithsonian.

Anna Phillips: Thanks for having me.

Maggy Benson: Thank you all so much for sending in all of your wonderful questions. Check out [00:28:30] The Q?rius Website, www.qrius.si.edu to get teaching resources about this topic, to learn more about parasites, and to see the archive of this program which will be available later this evening.

Maggy Benson: Thank you so much for joining Science How? and we'll see you next time.