

Ask A Biologist Vol 101 (Guest: Bruce Strickrott)

Exploring the Dark Side of the Earth

Dr. Biology is out of the studio again and this time with his shoes off and inside the tiny, but powerful submarine named Alvin. He's there to talk with the chief pilot of Alvin, Bruce Strickrott, about what it is like to explore the deep ocean. Listen in as we explore the living world, including the one that remains mostly unknown and ready for the next generation of scientists to take their shoes off and dive into dark side of the earth.

Transcript

Dr. Biology: This is Ask A Biologist, a program about the living world and I'm Dr. Biology. Okay, I've got to tell you I'm excited about this show. Because today we get to go into a space that is used to travel to what my guest calls the dark side of the earth. Now while we hear about the dark side of the moon, what would be the dark side of the earth? Want a hint? Okay. Even though we've explored about every piece of land on the planet, the oceans that cover about two thirds of all the earth's surface are mostly unknown and you guessed it, mostly dark. Why are most of the oceans left unexplored? Well, while humans can you scuba gear to go under water. We cannot go much further than a hundred feet, or around 30 meters. To do that requires special equipment. We need what might be called a real-world transformer that allows humans to climb into it and travel to the bottom of the sea.

Dr. Biology: My guest today is one of the few people who explores the ocean floor on a regular basis. Bruce Strickrott is the chief pilot and group manager of the Woods Hole Oceanographic Institution Deep Submergence Vehicle. [deep breath] And that is a mouthful, but you might know this vehicle by its name, it's called Alvin. This tiny but powerful submarine has been on trips to exotic, nearly impossible places to go, and where unusual and amazing animals live. And for this show we're actually going to be going inside Alvin to do the podcast, which I think might be a first. I guess you could say we're interviewing both Bruce and Alvin. Are you ready? Let's go.

[Background instrument sounds]

Dr. Biology: Bruce, I appreciate the amazing studio. More lights than any studio I have been in. And I am going to fully open and transparent. We are not diving now. That's why we can have this equipment in here. If we were diving it would be a different story.

Bruce: Alvin's my happy place. I've spent a lot of time planning and thinking about diving and we do a lot of work to get it ready to go on the water, but when you get in and you get to take people down, that's when everybody's happy.

- Dr. Biology:** I will tell you this is a place that a lot of people would love because there are no shoes allowed.
- Bruce:** No shoes. And the story behind that, by the way, it comes from a guy by the name of George Meyer who was one of the techs back in the sixties and seventies and he said they used to always wear shoes in the hull. And the hull was steel and painted white. And George had the unlucky duties of cleaning up after them and he finally put his foot down literally and said, “No more shoes”. So we do not bring shoes in to the sub. We all wear socks and some people wear these cute Alvin socks. They have little Alvins all over them.
- Dr. Biology:** I think a lot of people want to know some of the real basic things, like how many dives have you piloted and how many dives have you been on?
- Bruce:** Wow, okay. Good question. So I count dives that had been on. I've been on about 390. I think I'm getting up to 390 which means I'm just about ready to pull in a third place behind Pat Hickey and Dudley Foster. The submarine has had 5,038 dives. We completed the 5,038th dive just a few days ago with our new pilot to be, Drew Bewley. It was his solo. So I sat there and took pictures and looked out the window and pretended I knew a thing or two about the corals that we were looking for.
- Dr. Biology:** A lot of people think about science and they think they have to be the scientists to be part of science, but this is a really good example that you've been doing this for how long and quite frankly you're as much a part of science as the scientists.
- Bruce:** This is my 24th year and when I got started I was fresh out of college with a degree in ocean engineering, which was a really good decision. Thanks to a man by the name of Ray McAllister who encouraged me to change majors. It's basically mechanical engineering with oceanography, glued on top of it. So you learn about waves and you learn about waves in the ocean and learn about structures and structures in the ocean corrosion and you learn about vehicles and systems like Alvin. Alvin is based on fundamental principles of physics is how we get underwater. And I ended up getting hired by the Alvin group and I never looked back.
- Dr. Biology:** What's even more impressive with Alvin - Alvin now over 50 years old,
- Bruce:** Fifty-five years this year and there is a fabled ship of Theseus. They would take a piece off and they'd put a new piece on and eventually they rebuilt the whole ship and Alvin is effectively just like that. I believe the oldest systems on the sub are from the 1970s and they go away in about six months. And when we come out in the end of 2020 early 2021 we'll effectively have the newest vehicle that we've had in the program. And we have this constant question, what's the oldest piece on the sub? And I'm sitting here puzzling it because we're going to be moving things off. And I believe that the oldest piece on the sub will be that ladder.
- Dr. Biology:** It'll be ready for the Smithsonian, right?

Bruce: Sure, yeah, definitely. Oh, interesting enough. We have the original arm from the 1960s it's sitting in the warehouse. It was a colossus and it's an amazing thing. And when you walk by it, you sort of don't recognize what it is and what it represents. It was run with chain drives, little motors.

Bruce: And we want to get a team of young people to come in and volunteer to rebuild the thing and run it with a raspberry pie and set it up so people can actually give it a world, right. But when you look at it, you got to realize this is a mechanical device. It was the first device to ever sample hydrothermal vents directly by people. It was the first device to sample a tube worm and it just sits there kind of waiting for someone to give it some care. But I want to get a team of people to come in and make it work again.

Dr. Biology: It'd be a great exhibit. I could just see something where the public could come in and it doesn't even have to be physically where they'd come in. It could be actually virtual.

Bruce: Virtual. Yeah but it's big. That's the problem is that it's large. There's a great image of it laying on the sea floor. Because at one point in time it basically fell off and it's this sort of great image because you know the person who took the image was thinking, now what do I do? And the irony is there's one of the two arms that we have that are now the port arm on the sub. We have that same image with that arm. It fell off the sub, the release bolt that kept it on broke. And one of our pilots called me up. I was running the offset they and he called me up and I heard him say over the underwater telephone, the arm fell off the sub. And I then knew why I was being called up to where we track the sub. And inevitably when we listen to the video, it's a funny story because he was sitting with a really good friend and scientist, named Dr. Brian Glazer, saw this happen in the video. He was in the sub watching and he said, what just happened? And the pilot, Sean Kelly, said the arm just fell off the sub. And Brian's response was, that can't be good. And Sean quickly said, the following, it's not my fault. And that discussion will be perpetual in the historic archives of the stories that we tell

Dr. Biology: The thing about it is because Alvin can dive so deep. Uh, when I was doing my research is 4,500 meters.

Bruce: Yeah, we can go to 4,500 meters. 4,500 meters is 14,450 feet and in a year we're going to go to 6,500 meters, which is just shy of 22,000 feet. And to put this in an image that people can handle, Mount Rainier, which is one of the tallest volcanoes in the continental U S is 14,410 feet. So if you ever look at Mount Rainier, that's how deep we go now. And if you ever get up to Alaska and go see Denali Denali's 22,000 feet tall. So we're up in our game from Mount Rainier to Denali, the tallest mountain in North America.

Dr. Biology: But when we talk about going up into these mountains, hundreds, if not thousands of people could climb up into those mountains. Not very many people get to go down that deep in the ocean.

Bruce: Well, we've done the numbers. We think we've taken over 5,000 people down to

the bottom of the ocean in various depths. And we keep adding to that list. So anybody listening to this, I want to remind them that if they're a young person at school that 10 years can go by in a blink of an eye and we hire people in their early twenties and they can come out and work with us and get a chance to ride. Or they can be a scientist. So you could be 10 years old right now and be thinking to yourself, if I get to the right place or study the right things or I meet the right people, I could be in that submarine one day on the bottom of the ocean looking out the window.

Dr. Biology: And you don't even have to be 10 years old. Maybe you're doing a job that seems rather boring. Certainly most things seem boring than diving into the depths of the ocean.

Bruce: We have a great job, those of us that do this love what we do and people give us a lot of credit, but we're very lucky. And we're normal people just like anybody else who went the right way and met the right people and we're encouraged to do the right things. And now we get a chance to have someone like you come and ask us what we do.

New Speaker: And when I got to get into Alvin, actually it had been in Alvin twice now, and I guess that's, that's something to be said. You talk about the sphere and when you look at Alvin pictures there, inevitably the outside of Alvin and Alvin doesn't look like a sphere. So let's talk a little bit about why it's a sphere inside here and what does it do for you when you're going so deep in the ocean?

Bruce: Okay, so, one of my good friends who was the chief pilot, Bobby Lee Williams, would say that the sphere, the personnel sphere, which is what we sit in a sphere, was to keep the big O out of the people's space. So we're in the people space. We're in a titanium sphere with acrylic windows that are really thick and they're all to keep the pressure inside at surface equivalent one atmosphere and the outside the high pressure out.

Bruce: I want people to think about a titanium sphere and everybody thinks, oh cool metal. Metal comes from the earth. So we dug a hole in the ground. Somebody did, grabbed a bunch of rock, did some magic to the rock and turned it into the sphere that we used to go to the bottom, the ocean. So we manipulate the planet to go to places with people. I like to ask people the following question. What's the most extreme animal on the bottom of the ocean? People will say crabs or tube worms, and what they forget is that the people inside the submarine of the most extreme animal on the bottom of the ocean, because without the sphere, we wouldn't go there.

Bruce: The sphere was made in Wisconsin. It's an amazing video to watch. Molten slabs of titanium being pressed into these hemispheres and machined and welded with a ray gun. Basically shot electrons through the crack between the two perfectly machined surfaces of two hemispheres and fuse the metal together. Same thing with the windows, they are welded inserts. If you shot a laser through the center of every window, they would intersect in the center of the sphere. It's that perfect. It will take us to 6,500 meters. It's been tested to 8,400 meters and it can

go to 6,500 regularly. So we're happy about the safety of the sphere. And here's something else to think about. When we take it to 4,500 meters, we lose eight gallons of volume on the inside. So next time you go to the store and you're buying some milk count up eight gallons of milk and look at it. And think that goes away. When we we're at 4,500 meter. We lose 11 gallons at 6,500 meters and at 8,400 meters we lost 14 gallons of milk, basically. The good news is that when we go back up the surface, all that comes back again and we measured all that and we saw, Hey look, it didn't bend. It just shrunk.

Background : Alarm, alarm, alarm

Female voice: Attention aboard the Atlantis, This is a drill, this is a drill. Man overboard starboard side.

Bruce: Man overboard.

Dr. Biology: Okay. And luckily it's just a drill. Back to Alvin, I'm looking inside here and so we're talking 50 years and there are an amazing amount of lights and toggles, things that I could imagine would be around 50 years ago. But I also see some really high tech flat panel screens here. So what have we been changing lately that's been making Alvin that much better and able to do its job?

Bruce: Well? All right, so when I started we had a different sphere. So this is actually the third sphere. And it was smaller and we didn't have many computers in the sub. At the time we had a 486 computer and we ran Unix operating system. Now we have a combination of Linux and Windows. We had a special device called the collector, which counted frequencies. So if you wanted to send data into the hull like temperature, you would convert the temperature into a frequency and count the frequency and that would tell you what the temperature was. Now we do serial data just like the USB drive that you plug into your computer. We use the exact same thing and we pipe data in and out of the hole at a crazy rate. In fact, we used to do it over copper and now we do it with light.

Bruce: To put this in perspective, we have fiber optic penetrations that go through the hull. We are bringing the ROV, Jason, the remotely operated vehicle, Jason is aboard right now. It's going to be operating for the next month. Jason uses three glass fibers to send all the data, all the telemetry to control the vehicle and all the video. We have 20 that go through the hull of Alvin. So we can pump all this great video and we've pumped controls. And basically here's what we do. If I want to turn a light on I touch screen, it says turn this light on. Basically this little switch there, little virtual switch that sends a digital command over light out to a computer that's outside the sub, a dedicated tiny little microprocessor, it turns the light on and then it sends all the data back on. How is it like working?

Bruce: Uh, does it have a problem? And all that information is fed back into the computers inside the hull. We have a network inside the hull just like you would have at home, a whole virtual little network. So Alvin is a very, very bright robot that we get to climb in. I like to tell people that we have one of the few mechatronic transformers that anybody can actually use. We climb into a robot

and we strap it on, we become part of it. And the way that you know that is when we're in the sub on a dive, we call ourselves Alvin. The three of us in here, we don't say, Hey, it's Bruce. What's up? We call up and say Atlantis, the support ship, Alvin. We call Atlantis and say Alvin. We become this cohesive, three brain, six eyed robot.

Dr. Biology: I actually was going to say four brains because you have the computer systems on here.

Bruce: Brain of Alvin, right, which has its own personality, mind you.

Dr. Biology: Oh really, in what way?

Bruce: You know, I like to think of people and when they think that they're putting energy out into the universe so to speak, right? We were having this conversation. And Alvin has had so many really talented and bright people project their thought energies at it, so I'm convinced it's become alive. It's like Pygmalion. We've loved it so much that it's become alive and the sub does not like to sit and not work. Typically when we come back after like a month off, it lets us know it'll have a minor issue here then and then we have to, we have to touch it and fix it like a thoroughbred and then it acquiesces and then it performs astoundingly.

Dr. Biology: So it feels like it's been neglected. Now with all the dives you've been on, I have to ask, is there one that stands out over any other?

Bruce: Uh, there are some that stand out. I would say some of the places that I've visited have been remarkable. There's a place in the Southern Pacific called Pito, P I T O, deep and it's where the earth is torn itself open and it exposes this wall that makes half dome at Yosemite look like nothing. If this area was on land, it would be a Mecca for climbers. It's kilometers high and kilometers wide and it's just astounding vertical wall that we dive on. And to be there, you're just dwarfed by the size of this thing. As you come up the wall, you'll pass overhangs with rocks as big as small houses parked on there and you realize it's, it's a pretty interesting but scary place. And you just pass by, and say hi rock nice of you to stay there. We dive on hydrothermal vents that are as big as buildings, so when people look at these underwater geysers, they think, you know, here's a Geyser. It's there, it's small.

New Speaker: You have to imagine a warehouse that's as tall as eight stories. The whole thing is hot and it has all these spouts of super, super heated water, 380 degrees centigrade, which is about 700 Fahrenheit. And then just the whole rest of this warehouse is emanating warm water and it's this community. It's crazy. It looks like a castle and you're dwarfed by this thing. There's so much warm water pumping out of this structure that it creates upwelling. And as you approach it, the sub starts to float upwards and all the little tube worms are in the breeze. And they sitting there and you can see it and you just stare at this thing and realize how colossal it is. And it's just an energy dump into the environment and all the animals live off of. It's amazing. So one of the things I like to do and I go talk to people is let them connect.

- Bruce:** They know about the dark side of the moon and then they have an image of what it means, right? Well we go to the dark side of the earth. We go to a place where there is no light and it's a huge part of the planet that lives and breathes without any light at all. And it literally is the dark side of the earth. And the animals that live there have evolved without light. And it's a phenomenal place and most people are vaguely aware of it, but not aware of the scale and the amazing beauty and the importance of it all.
- Dr. Biology:** You made me think about wondering what it's like to go on a dive with Alvin. And why I'm saying this is you mentioned there is no light and we typically as humans don't go deep enough that we don't think of the ocean without light, but that is exactly what happens after a certain depth.
- Bruce:** So it's hard for humans to experience no light. You have to go into a cave and turn out the light and your brain actually makes false images because there's no light at all. We lose light when we go into water within the first 10 minutes or less. Often five minutes and you can see the light diminished and the colors will change. They go from blue to green to gray to none, and the only light that's around is the light that we supply. And if you look out in there, you can see a lot of animals will make light of course bioluminescent. But as you get down to about 200 meters deeper all those animals have evolved to live in no light and they use the light to attract friends. They use the light to attract food. They may even use the light to scare off the enemy.
- Bruce:** And then we come blasting through and they light up and we will flash our lights at them because they think, Oh my God, this is a friend. And it's fun to get new observers and have all the animals turn it into a starry night on the way down. But, on the bottom, interesting enough, [there are] no light in the frequency that we see. We've actually taken cameras down that were meant to look deep into space, park them in front of hydrothermal vents, turned off every light that Alvin produces covered up the windows. So we don't provide any light at all taking the long exposures of hydrothermal vents because they emanate infrared. And we're convinced that there are animals in the Atlantic in particular, shrimp that have receptors on their backs that see in the infrared. And that might be how they navigate to the places that they live, which is right smack next to the hot water. So we told a bit of a fib there. There is light in the deep ocean, but it's unique light and it's in a spectrum that we can't see.
- Dr. Biology:** And we see that with quite a few animals. Insects, certain reptiles, are really good at seeing beyond what we typically see as humans. So this is such a cool job. How did you end up in this space, literally in this space? It just seems like a career that you don't just fall into, but maybe you did.
- Bruce:** Well, when I was young, the Apollo program happened and I was four and a half years old. I watched Neil Armstrong walk on the moon and I'm very connected with the space program. I think it's very important and I love it. And my brother and I were really big fans of the Apollo missions and we had a giant map of the moon and we had all the locations where they landed, right? And I never really pursued the astronaut as an adult, uh, but I'd always wanted to do something in

that kind of realm. Something different that wasn't a normal job. And I was Navy for six years and got my degree in ocean engineering. And uh, right before I graduated from college, I saw the posting for the job with the Alvin group and I thought, wow, that would be just such a great thing.

Bruce: Wrote them next day, overnighted my resume and my application and then called them incessantly until I got an interview. And then I got an interview and I studied constantly for a week. Every single thing I could get about Alvin I read. Went to the interview and did reasonably well I suspect and just hoped. And about three weeks went by and I got the phone call from Dudley Foster and he offered me the job and I was in the hallway at the school jumping up and down. And my buddy Pierre, he sees me. He goes, you got it, didn't you? I was like, yes. Figured I'd be here three and a half to four years. Then I made pilot and I've been doing it ever since and it's a blast.

Dr. Biology: So for my guests. And um, most of them are scientists in the sense that they call themselves scientists. They have some kind of title that's a scientist. In reality, just about everybody's a scientist, whether they know it or not. You're certainly a scientist. What was it that, if you look back, was there ever a time in your life that you thought that you wanted to be an explorer? Was there an aha moment of that or is this something that you got later in life?

Bruce: I don't know if I ever had to make the decision. I think I've always been that way always since I was a kid. And your statement that everyone is a scientist is a fact and I proved that. I have two young daughters and I remember as a kid I would walk out into the yard. My kids, I take them out and do this all the time and I would find a rock or a piece of wood or something and I would turn it over because nine times out of 10 there'd be a whole bunch of interesting things happening underneath that just plain old little log. Or I would walk down the street with my brother and we would go to where the ponds and creeks, this is in upstate New York and there would be fish and tadpoles and frogs and we would spend hours just immersed in this environment, learning about what was going on around us, finding newts and anything that was interesting or new.

Bruce: We didn't write data down and we didn't catalog, but we had books on butterflies and would spend hours trying to figure out which ones we saw. We'd go to thousand islands at one of the campgrounds there was an insect display that was mind boggling and for the next months that's all my brother and I did was catch bugs and look at them. And I think if you stop exploring, you're really missing out, and I've said this, you can never be so old that you can't have an aha moment. Everybody should pursue as much as they can, a life that surprises them. It's an absolutely fabulous thing. We have this brain, we have this opportunity to go out in the world and learn about things and maybe turn off the television every once in a while and step outside and enjoy the fact that we're living on this little rock in the middle of a great universe and we know it. That is a gift.

Dr. Biology: And now I'm going to do something cruel to you because you have one of the coolest jobs. I'm going to take it away. I'm curious, what would you be or what would you do if you weren't doing this kind of a job?

Bruce: Well, let's say if I wasn't doing this, but I knew that I did this, I would be out with young people encouraging them to pursue their dreams because you only get so many laps around the star. That's what I like to call birthdays, lap day. You only get so many of those and you have a great opportunity during those labs to do what it is that makes you happy. And I would encourage people to not be persuaded to do something that is guaranteed. I would be out there convincing people to pursue their dreams.

Dr. Biology: How about hobbies?

Bruce: Do I have hobbies? Um, I love machines. So I love cars and I have a couple of Jeeps, which I really like. I'm a big skier, I love technology. So I've got, uh, a bunch of different projects. I've got flying robots with cameras on them and I've got little robots that run around. I'm a big fan of the R2D2, so I've got a whole stack of different sizes of R2D2s running around. I'm a big fan of that robot. Mostly, that kind of thing, right. I like to cook, which is good if you're good at it. I like to just learn new things. I mean, I've read a lot when I get a chance.

Dr. Biology: And the last question I ask is, what advice would you have for someone who wants to become you?

Bruce: Well, first of all, it can be anyone, girl, boy, it doesn't matter, right. And I would look at the avenue to getting to where I am as either one that pursues technology or one that pursues scientific knowledge. So you can come out and be a scientist that uses a submarine regularly. And that could be biology or chemistry or physics, oceanography. Folks that come in here are very educated. Most of them, they have PhDs, they're very dedicated and they're passionate about learning. That's important to be a good scientist. You need to be passionate about the desire to learn new things. On the technology side, I ended up studying ocean engineering and I was fascinated by underwater. I'm a scuba diver and as soon as I got into water, I noticed this world that was dramatic and amazing. And I just wanted to be there. And, most of the people that we have in our program have both a technical background in engineering and they have the ability to do things with that.

Bruce: So fix electronics or fix mechanical systems. And each of the people in our group, if you talk to them about what their hobbies are, their hobbies speak directly to why they're good at what they do. Some people build cars, some people fly planes, some people do all that. Some people will do electronics. And most of the people in this group I suspect would say, I get to do my hobby and they pay me to do it. And that goes back to what I said. If you're passionate about something, do it because then you'll never hate going to work.

Dr. Biology: Before we go. I do, I have one question. I've been sitting next to a mask here and I know why it's probably here. The big question is, has it ever been used?

Bruce: So the mask looks like an overgrown scuba dive mask? It's part of a system that's called the emergency breathing apparatus and we are in the sphere and when we're underwater, I did a numbers once and I think there's something like the equivalent of 10, 747s holding the hatch shut. So needless to say, we're not

getting out. And if we had a fire in here or if the CO2 scrubber, which takes carbon dioxide out of the atmosphere, were to fail, we have to go on the EBAs the emergency breathing apparatus. And I was on a dive when we had a single scrubber and it decided to stop working. It got real quiet in here. I was with a pilot and training and I was with Cindy van Dover who used to be a pilot and all three of us had had experience training on the masks and here we are together and we had to put them on and we aborted the dive. We came up quick. We wore the masks. We got a picture of us all smiling and laughing cause we look like goofballs wearing the masks. We recovered on the surface and took them off when we open up the hatch, fixed the scrubber and that was it. So they've been used twice

Bruce: I think for that reason. Luckily we've never had a fire in this sphere and we work real hard to prevent that. But yeah, I've had to wear them.

Dr. Biology: Well on that note, Bruce, I want to thank you for letting me come in and visit you in Alvin and to be on Ask A Biologist.

Bruce: This is great and uh, I appreciate your time and I'm glad that we're going to be able to reach out to people and don't be afraid to contact us and ask questions and join in some of our cruises when we're online. And in short order, we hope within a year or two we'll be sending images back to shore live from the submarine.

[Background instrument sounds fade out.]

Dr. Biology: And with that, we're back outside of Alvin. You've been listening to Ask A Biologist. My guest has been Bruce Strickrott Chief Pilot and Group Manager for the Woods Hole Oceanographic Institution, Deep Submergence vehicle called Alvin. If you enjoyed today's show, here's a heads up, we are also going to have a VR 360 tour of Alvin. And this is going to be part of our marine biome section coming up in a few months.

Dr. Biology: The Ask A Biologist podcast is produced on the campus of Arizona State University and is usually recorded in the Grassroots Studio housed in the School of Life Sciences, which is an academic unit of The College of Liberal Arts and Sciences. Today, we were in Alvin, the amazing submarine that takes scientists to explore some of the most extreme places on our planet. And remember, even though our program is not broadcast live, you can still send us your questions about biology using our companion website. The address is askabiologist.asu.edu or you can just Google the words, ask - a - biologist. I'm Dr. Biology.