LEVERAGING WPI PROJECT CENTERS FOR COLLABORATIVE MICROPLASTICS RESEARCH

SUPPLEMENTAL MATERIAL

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INFORMED CONSENT PROCESS

Hello, we are a group of WPI IQP students working with Professor Laura Roberts and Professor Tanja Dominko regarding the collection of microplastic data from oceans. We are conducting this interview to understand how project centers can help us fulfill our goal in monitoring microplastics, as well as how project centers can work together on global research projects.

This interview will last approximately 30 minutes. Your participation is entirely voluntary, and you may skip questions or withdraw at any time. Upon request, we will keep your answers anonymous, with no names or identifying information appearing in any reports or publications.

- Would you like your answers to be kept anonymous?
- Do we have your permission to take notes on what is said?
- Do we have your permission to record audio of this conversation?
- Can we use your responses in our final report? If so, would you like to be referred to by your name or by your organization?

Your participation is greatly appreciated. If interested, we can share a copy of our results with you at the end of the project.

PROFESSOR JOHN-MICHAEL DAVIS INTERVIEW TRANSCRIPT

Jared: So as far as some background on our project, we were focused on starting a citizen science program in Ice;land to monitor microplastics. However because of the lack of Sponsor and uncertainty of travel we decided to change the scope of our project to include WPi's global project centers. And we hope to connect global project centers using a kit to monitor microplastics at each specific site.

Patrick: So I guess our first question would be, how reasonable would it be to ask one of your students or faculty to take this kit that's basically a 4in mesh with a pvc pipe.

Professor Davis: That seems feasible to me, to carry in luggage yea.

Billy: As far as time goes, the process itself would take about 20 minutes. However it would also require students or faculty to take a trip to a river, beach or some body of water. Is that something that typically happens at some point during the trips where students would be available to do that?

Professor Davis: Sure. So our project center is PUerto Rico. Students are a short walk from the beach and there's estuaries everywhere. When you're testing for microplastics are there certain bodies of water that you are more interested in? Is it the kind of thing where you want to go off the coast a little bit?

Billy: Yea at this point we are more focused on the protocol so just getting any sort of data. WE are more focused on the convenience on the sites and the students taking the samples just so we can get something going. I don't think anything in our research has indicated that it would be really important that we go offshore or downstream or wherever it may be. Just on the beach or close to the beach should be found for our samples.

Jared: That is something we will be trialling in Iceland and work through some of those problems, as far as how far out you should be sampling as well as what depth you should be doing as well.

Professor Davis: I'm curious if your team has heard of Max Laborians work. She's at a University in Newfoundland. And she's done a lot of citizen science microplastic testing in her lab. And a lot of it is kind of low cost alternatives. Some of her students used panty hose through one of their systems and trawled in a boat and collected. She's worked with local fishermen, dissecting fish and inspecting microplastics in the fish. So there might be some interesting resources though it seems like you already have some sort of kit already established. I can share the link with you here.

Billy: Yeah, thank you. I don't think we came across that in our research.

Professor Davis: I did my PHD in the same department as her. That is why I am familiar.

Jared: Okay so the second part of our project is the whole connecting project centers. Right now, we are kind of using microplastics as an example or one way as project centers can collaborate on a greater project. Do you have any other ideas or types of projects that would benefit from collaboration between multiple project centers?

Professor Davis: The purpose of comparing multiple sites as a case study is that it helps inform different phenomena and different circumstances. In your example of microplastics you can get a sense of different rates of microplastics in different places and then what does that tell you, perhaps different sources, different areas that are more highly contaminated than others, etc. But you can kind of think more broadly. You know anything happening in one place is happening somewhere else and can be informed by that. A lot of the work that we are doing now in Puerto Rico now is based on community based resilience. You know how communities can be more resilient to climate change. And climate change disasters. So I'm not sure, I'm sure there are other places especially places that are vulnerable such as islands or places in low flood plain areas that are wrestling with similar issues. There might be comparisons on how they go through that thought process. You know you have to think about potential issues and how you're supposed to respond to them. So I don't know, the impetus for that kind of thing would likely be research driven, so if your interested in one phenomenon like microplastics, or whatever you're interested in and the benefit of all these project centers is you have somewhat easy conduits to test different things you want to at different places. And as long as you have project center directors that have the time and the interest that could help facilitate understanding different concepts and different places then it could be quite helpful. But I don't know if I have any topics that are jumping out to me right now that I'm working on in PUerto Rico that I'd be interested in exploring in different places. I should also preface this by saying I've only been directing the Puerto Rico project center for about a month. So I haven't been on the ground for an extended period of time.

Billy: Well thank you, that is good information. Do you see any potential barriers to collaboration between projects? I think you might have touched on that in your response just now. Like specific things that would get in the way.

Professor Davis: I guess one is the human element of just time. You know, if you just ask different project center directors, they just might not have the time. They might have the interest to do microplastics testing and stuff like that or whatever the linked project is. And so that can be tricky and so you might want to think of ways for the project center director to do that. So you kind of mention you know for the microplastics example we have this kit we can send with you. But my initial thought was having a similar IQP project setup that would look at microplastics in the same way you look at them in Iceland but looking at them in Ghana, Australia, New Zealand, India, Puerto Rico. That way you can have some real robust data you can use across sites. So that would be a different level of effort because then you're asking project centers directors to find local sponsor organizations that are interested in microplastics testing. Which to me wouldn't

be a stretch because I think a lot of project centers have an environmental bent to them so I'm sure there would be interest in that. And microplastics are certainly a pressing issue worldwide. But if it's something else you're talking about like well take our kit down and spend a day at the beach and spend a day at the beach and see what you find. You know you could probably convince students to do that then you might not need the time or the energy of the project center directors to do much. It could just be like stopping in during the ID 2050 class and doing a 15 minute talk. And then see if anybody is interested just as a hobby. Something to do on the weekend. So I guess there's different levels and if you go for the quick and dirty kind of hobby spare time thing you aren't going to get any of that sophistication or you know data points. You are going to get a very quick one point sampling. Which for microplastic testing wouldn't be particularly helpful.

Aaron: Yea what we are kind of hoping is that you know the more project centers that get on board with this kind of quick testing method. The longer the we are able to keep people interested and keep it in the minds of project centers that it is a topic that they are participating on and they are helping out with but later down the line, they will be interested in dedicating one of their project slots to implement a further citizen science approach and actually make a more in depth project on it.

Professor Davis: Yea it's interesting because WPI has done some stuff in that vein where IQP teams are rallying around a specific theme. Two things kind of stand out to me. One is when Covid 19 started, a lot of IQP's couldn't work with their sponsor for various reasons. So they just had to find projects on the fly and a lot of them were based on Covid, looking at different aspects of it such as education, healthcare etc. There was also this whole webpage on the global lab, dedicated to covid based projects. So this could be a similar thing you do with microplastics where you have the framework for what you're doing with citizen science and microplastics. Your developing tools approaches and data that can be shared and this could be a springboard that teams could contribute to. But the trick might be… You know for IQP's we like our students to do something more than just follow procedures and replicate what's been done. Typically that's not exciting research. Just like your project is an open ended project. Just thinking of future research questions that are unresolved that you could inspire other center directors or IQP teams to take on. So you can do some things and then you can leave the door open for other things that are comparative. They can also figure out a new protocol or I don't know another way to analyze data for example. A good juicy research question

Billy: Thanks. A little bit in that same vein, is there anything like what you just mentioned that makes project prompts particularly interesting to project center directors?

Professor Davis: That's a good question. And different project center directors come from different backgrounds and find different things interesting. So I can give my own perspectives but I don't know if that resonates with other center directors but I imagine it works for some. For me I find IQP projects to be particularly interesting and valuable if they can travel beyond a site. You want to address a local pressing need and it should be tangible. Why are you testing for microplastics? That's why I like what one of my colleagues did. She's not just testing for

microplastics, she also testing for it in the fish. Because that's like direct local consumption. If the microplastics are in the water it's a bit abstract and you're like it's there but does it really bother me? You know? Maybe I swim in it, you don't drink the water certainly. That's why she tests fish, because that's like one point of contamination that the body can accumulate as fish are one of the bigger animals we eat in the water. That's like a very poignant thing, locals are catching and eating fish going into the local population. The pressing need there is really visible, instead of saying there's a bunch of plastic in the ocean. And then you could do interesting things like how much fish is in people's diets in different places and like what the contaminant loads are and it gets really complicated. And you can see how that can travel to different places and you can learn from different microplastics studies and contamination studies and relate that to the local people. It's that connection between global and local with one issue and so that's one way a project can travel and not only be interesting to the one area you do it but you're also generating results to people in the East coast and people in iceland. And that's kind of the same for any research, if you find something interesting and local and that's the end of it then its really only interesting to the small group of people but if you can find ways for it to expand and travel then your research becomes more interesting to a wider audience.

Billy: I think that's all the questions we had for you. Do you have any for us?

Professor Davis: I'm curious about the kit you have? Is it something you designed and built already?

Billy: We decided to focus more on setting up the infrastructure of the method itself than really optimizing the kit and getting the optimal way to sample. We mainly focused on prior research and saw what they did. Our kit consists of four inch 100 micrometer mesh. So just like a filter. The primary way we found in prior research was passing 50 to 100 liters of water through that mesh and then the mesh can just be detached and sent in for analysis.

Professor Davis: And so is that you are trawling that in a boat?

Billy: you would take a bucket and fill it with water and pour it through a funnel through the mesh

Jared: So when looking at different methodologies we were really focused on making and finding a method that could be made quickly, cheaply and used easily. Through our research we landed on that method.

Professor Davis: Interesting. And you will be doing that testing while in Iceland?

Jared: yes we will be testing and refining kind of working though the problems while we are there.

PROFESSOR DANIEL DIMASSA INTERVIEW TRANSCRIPT

Billy: Let's start with how our project came to be. Our assigned project was to set up a citizen science program in Iceland which is our project site. But as the term progressed we thought about the possibility of not traveling as well as not having a sponsor. We thought it would be better to shift our project to utilizing WPI's project centers to create a global network of microplastic samples. To do that we were planning on creating a sampling kit that all of the project centers could take with them to their location, take the sample and then take that sample back to WPI for analysis so that WPI can have a bank of data from all over the world. So your site is Berlin, correct? So I think you responded that you would not have access to ocean water in our survey?

Professor DiMassa: Right right. Our students are not really traveling much for field work. They're just working around the city primarily. And they work with some rivers there. And I should say this past year, we've been remote because of Covid and so we haven't worked directly with waterways in Berlin. And in theory it's possible we will have projects along those lines in the future. It sorta depends on our sponsors.

Billy: So the survey wasn't super accurate. We are also interested in taking samples in rivers and other waterways.

Jared: I know we talked about having a test kit being sent with students. It consists of a 4 in round piece of pipe about 12 inches long, do you think that's something if students are willing, to run water through the tube with a mesh screen and take a sample of microplastics

Professor DiMassa: Yeah yeah, that would be fine. I'm curious on how your collection kit works, just because we had a project where students were trying to develop a similar type of kit. And what they decided on was a 5 gallon bucket with a mesh screen on it. They would then have water be dumped into this bucket. This idea being they would then filter out these microplastics. But ultimately what they found was it was really difficult to identify the microplastics. Because they didn't know what they were looking at. Especially without the use of a particular type of microscope. And so they felt that their results were inconclusive so I'm wondering what you're interested in them bringing back to you.

Jared: Yeah, so our current plan is to have students take a sample in the field and then that sample will be sent back to WPI for further analysis. Because of two things, like you mentioned, it's very hard to identify microplastics in the field accurately. And secondly if everything comes back to a centralized place of analysis, I think we will have much cleaner data that is much more easily comparable.

Professor DiMassa: Yeah, I suppose the other thing is the other thing we've learned from the project we did this past year is that microplastic pollution might not be as dramatically visible in freshwater as in saltwater. You might not find a whole lot. Berlin has a pretty extensive network of freshwater lakes and we had a sponsor that is interested in testing for microplastics but there might just not be a dramatic amount of microplastics in those waters. I'd certainly be interested in taking a sample and bringing it back to campus for you guys.

Billy: Yea so we had a similar idea for that kit where it is a smaller mesh filter and you just pass 100 liters of water and they were able to do that in 20-30 minutes. We are also looking into the possibility of using labs at WPI to have access to chemicals to dissolve off organic matter and drying ovens to dry the sample and microscopes to inspect the sample. As to whether or not we will be able to accomplish that in this term we don't really know yet. But we are looking into that and that track being able to be accomplished in other terms.

Jared: So microplastics is one part of our project and the other project is trying to initialize some connected research between project centers. I know for our project we're using microplastics as one way to connect project centers.

Professor DiMassa: That's a big question. And I don't have the kind of familiarity with all of the project centers or with enough project centers to really give you great ideas. I can just say with the project center that I'm at right now we're doing projects on the topic of citizen science. And so certain projects within that area could connect to projects elsewhere. We have had some projects on light pollution for example. As part of that work we've asked some of our student teams to look at work done in maybe Acadia National Park. Because I believe there's been work done there and presumably that's a topic that might come up elsewhere. I think professor Fred Bianchi has done some work on that. He's in music but has done work at Acadia National Park. Microplastics, yeah I think that's a great idea because I know several project centers touch ion issues with microplastics. We work with some researchers in Berlin that are at an institute of freshwater ecology. So issues with respect to water pollution and plastics could pop up on our radar in the future. One of the things we are doing in Berlin in a sort of different vein is doing project work in refugee communities. Personally, that's something I'd love to see more of at WPI in that area. Berlin, Germany is not the only place that has worked hard to figure out how to support communities of refugees. And presumably projects across our global projects program could work in that area but I dont know of any that are doing that right now. But that would be of interest to me personally.

Patrick: I know you just listed off a bunch of topics that we can use for different collaboration ideas. What would you see as some barriers to collaborating with other IQP groups and such.

Professor DiMassa: There are different communication barriers. They are determined by different factors. A couple years ago I advised projects in Switzerland and we had a sponsor who was developing a heat pump dryer that would dry fruit. The idea was that the dryer could help certain places in the world dry their fruit for reasonable prices and for them to sell the fruit for a profit. This was a researcher in Switzerland who was interested largely in developing this dryer for

communities in Latin America. And we had project work in areas where he is interested in connecting up this project he was developing. I think we ended up connecting with students in Ecuador. But the challenge there was the project center in Ecuador was running in a different term. So our project was in A term and Ecuador was maybe running in C term. So it became more complicated. The term system is a little difficult. Communication in general. Language issues. You want your sponsors to be able to communicate with each other perhaps. A lot of the burden for communication falls on the students and advisors. And so sometimes there's a time issue. Students and advisors are so focused on their own work that they're too busy to focus on work at another site. It's difficult to get folks…. IQP is already a difficult experience to explain to people outside of WPI. To try and then link it up to build the experience into wider networks becomes all the more complicated. So I think it's a real time commitment and communication becomes a challenge, language becomes a challenge.

PROFESSOR COURTNEY KURLANSKA INTERVIEW TRANSCRIPT

Aaron: Would you like us to tell you more about the project?

Billy: Sure, so our project we started does not have a sponsor.

Professor Kurlanska: OK

Billy: Yes, we started already being unsure of whether or not we're going to be able to travel. Our original prompt was to set up a citizen science microplastic collection program presumably in Iceland.

Professor Kurlanska: OK

Billy: But as our project developed, guided by our professors, we shifted the goal of our project to a global microplastics collection program through WPI's projects centers.

Professor Kurlanska: OK

Billy: Because we thought it would be difficult to set up connections in Iceland only being there for a few weeks and not having a sponsor to get us communicating with anyone. We didn't want to gamble our project on luck, so we set out to make this global program, basically our small term plan would be to have a kit that we can send with all of the groups or as many groups that wanted to participate and they would take a sample of the water wherever they are and send that back to WPI where it can be analyzed and then uploaded to some global database where WPI would have a database of all this information on microplastics all around the world.

Professor Kurlanska: OK

Aaron: Yeah, so would you have any questions on what we are doing?

Professor Kurlanska: No, I mean there are so many logistics questions.

Everyone: Yeah.

Professor Kurlanska: That come to my brain, and I guess you guys are going to Iceland right

Billy: Yes.

Professor Kurlanska: Are you gonna collect or you get…

Patrick: Yeah, that's the plan.

Aaron: We came to the point during D term in our ID 2050 class where we made the decision to not have our project really have anything to do with Iceland in case we didn't get to go.

Professor Kurlanska: Right

Aaron: Where we could kind of wash our hands and say okay you know none of this has anything to do with Iceland anymore, we'll still be fine. Since we are going we're gonna have the opportunity to test the kit that we develop and test the collection process using our fellow students, if that goes well, we'll make sure that our process and instructions are viable and easy to understand so that if we send a kit with other IQPs or with other students then we're not sending something that's really obscure or hard to follow.

Professor Kurlanska: Can I ask a couple questions? I guess methodological questions in relation to that, in Iceland if you guys go, how are you determining locations around the island? I mean I understand ocean plastics, the ocean is a big place but like I mean is there some systematic way that you're looking to collect samples at the different locations.

Billy: Right, I mean as far as determining which locations are best, is that what you're asking?

Professor Kurlanska: Well but not like I know you're thinking of project centers with oceans like South Australia, New Zealand, Iceland. But I mean in Iceland is there an expectation that you would get multiple samples either from different locations or different times? Time is kind of limited to the 7 week term.

Billy: Right

Professor Kurlanska: But I'm wondering if given ocean currents and what not, would different locations have different importance.

Jared: That's something we're still working through. When we go to Iceland we'll actually test our kit out, we'll have a better understanding of how long it takes to collect a sample.

Professor Kurlanska: OK

Jared: And then based on that we can make decisions about whether or not having students collect multiple samples is something that's realistic or not.

Professor Kurlanska: OK

Jared: So I think it's still a work in progress

Professor Kurlanska: OK, I was just kind of curious

Aaron: Yeah, we're also trying to cater greatly to the convenience of students because if this is an inconvenient process then no matter what encouragement you give your students they will still be unhappy probably to get out and do it.

Professor Kurlanska: Ok, and what's the size of the water sample that you guys collect given your test kit.

Aaron: So that's also something that we are going to be testing, it depends on a few things, like the materials we are able to send with the students. Which is one of the questions that we were actually hoping to ask you about.

Professor Kurlanska: Sorry I didn't mean to dominate the conversation.

Aaron: No, no, actually in our interview earlier today was mostly just questioning us which is wonderful because it gets us critically thinking about our project. That's one of the things where it depends on size constraints of, … Would it be possible to send a kit of some size with you? With students? To a project center?

Professor Kurlanska: Well if that's a question well they always make us bring them, well I have no idea what size you guys are talking about for test kits, I dunno, I usually have one of those first aid packs that they…

Billy: It probably wouldn't be that much wider than that.

Professor Kurlanska: They're about this big and about that fat.

Billy: Oh they'd probably be wider than that. Our current working methodologie, the amount of water sampled could really vary because the way we are planning on doing it, you just pass water through a mesh, like a mesh sieve, so the amount you sample is really just up to the amount of time you spend pouring samples through the sieve. And then you could take the sieve and then just that needs to be analyzed. So it's a small thing to be sent back.

Professor Kurlanska: Ok, gotcha so it's not actually sending water back?

Billy: Correct

Professor Kurlanska: That would be problematic

Everyone: Yeah, the TSA would not like that.

Professor Kurlanska: Yeah, no but with microplastics, I'm thinking like microscopic, and I'm thinking about the scientific breakdown of how small is the sieve that catches.

Billy: I think 100 micrometers.

Professor Kurlanska: Yeah, I'm not a science person.

Aaron: 0.1 millimeters, so a hundredth of a centimeter.

Professor Kurlanska: Alright so… so no water is being transported just the sieve with whatever contents are on it.

Aaron: Which I think we determined to be the most ease of use for students and also allows for easy transportation back to WPI for analyses.

Professor Kurlanska: Yeah, ok.

Aaron: Also, to go with the student time frame, I know some project centers allow students to have more free time then other centers. Do you know that students get to go to the beach and do they get to have that free time to do that.

Professor Kurlanska: So at our project center it's not an option, right? Unless they vacation before or after and fly into Guayaquil or go to the Galapagos, which some students do but Cuenca is isolated. No, there is no ocean nearby.

Patrick: Are there any bodies of water nearby?

Professor Kurlanska: Well yeah, I mean there are four rivers that run through Cuenca so yes, and there is also El Cajas national park, which supplies water for the region so there is definitely water resources, just not oceans, I don't know how many lakes there are, per say. But there are rivers and we have done or are working with one organization down river that is really interested in looking at the sources of pollution in the river. It's actually a former WPI student who runs an adventure tourism or outdoor thing so we had a team working with him virtually last year trying to understand the sources of pollution and he really actually liked to get up in there with the water samples and testing them and that kind of stuff so there's definitely water.

Billy: And we are interested in taking samples not only in oceans but also in rivers and lakes where it's an option.

Professor Kurlanska: Yeah so that would definitely be an easy thing to do. It's literally four that run through the city.

Jared: That's good to know.

Billy: So that kind of brings us to the other part in our project which is not only project centers working together to measure microplastics, but also an incentive to get project centers working together on all types of projects.

Professor Kurlanska: OK

Aaron: I think we are really hoping to get different answers to this question, because everyone kind of addresses it from their own background.

Professor Kurlanska: Right

Aaron: So that is very helpful.

Professor Kurlanska: I had a question kind of going back a step when you were talking about deploying this to different project centers, and you were talking about the students taking the samples, how many actual samples would you expect from each location?

Billy: I don't think we really need a whole lot

Aaron: No I don't think we do

Billy: Really even one would be enough, but three to five I guess would be ideal to get scientifically sound data.

Professor Kurlanska: Yeah I guess getting students is certainly one way because you guys seem a little concerned about student buy-in and the willingness to do it. If students don't want to do it I can't imagine advisors wouldn't want to. Like most centers, they have two advisors. I mean I guess it doesn't seem like that much of a burden to me but of course yes students are a great option but sometimes, you are right, they don't want to do things so I think potentially framing this around the centers and that a member of that team. Because centers also have local coordinators, well most centers do at least, who are there on the ground and could potentially if you left them four different kits could check it at four different points in the year. But I don't know if that's important. I don't know if that's a variable that matters, plastic pollution at each time of year. I honestly just don't know enough about it. Or the other thing I guess I would think about is over time are we looking for change, change over time. So like how frequently do you want this to be done, so if it's over multiple years or if it's once a month is there someone on the ground that can do it, things like that, so I think yes students are the obvious option but there are also other options given the infrastructure and support systems that we have on the ground thanks to WPI.

Aaron: I think that's kind of the beauty of being able to reach out to so many different centers is the fact that if we are able to scale up to a large amount of locations then we only need a relatively small amount of samples from each location, and it doesn't give you the same clarity of data at the local scale as getting, 50 samples on one coastline would, but it gives us a broader sense of scale of what the problem on a global stage is. So it would require less time commitment from each center individually.

Professor Kurlanska: So I think that's a question you guys probably need to figure out, what sample size do you need for it to actually be accurate. Or to be a decent representation of the ocean.

Billy: So with a few exceptions there are not many IQPs that do this, that connect project centers to work on a global objective. So I guess we want to get your thoughts on that, would that be a good thing or is it contradictory to the local aspect of IQP's.

Professor Kurlanska: I think that there is lots of opportunity for it, but I do think that you'll have to meet the needs of local sponsors. So I think that one of my concerns or hesitations towards going all in on something like that is who is the sponsor in this case. Is it some sponsor at WPI as we certainly do that when we don't have local sponsors. But I work in a place where we have more than enough local sponsors so that the project can meet those sponsors' needs, is It something a sponsor is interested in or is it something that's independent. So if we say that we have twelve projects a year because we have two terms, so if we say we are going to dedicate one of those twelve projects to this collaborative thing like yeah we would do that. I don't think there's any question about that. But if somebody's like "I want six of your projects to go for this" then yeah I think that takes away from the local nature of IQP. But I think it's a scale issue and I think some places that only have four or five projects a year they may not want to dedicate a team to that kind of initiative. Especially if they aren't tight on sponsors I mean Covid has made a lot of this a lot harder as you are all well aware. Because you don't have a sponsor.

Aaron: Yep

Professor Kurlanska: But our sponsors have continued to work with us remotely and I think a part of it is just an issue of need, so have you thought of other themes that people have discussed water in general across different things, What kinds of collaborative projects were you thinking of.

Billy: Well that's one of the questions that we wanted to ask you actually. But the main one that we have seen at WPI is Ingrid Shockey's "Climate Stories". And we interviewed her the other day and got some good answers about her thoughts. But do you have any, I know you just asked us this question but any thoughts you had.

Professor Kurlanska: Oh well I'd have to think about that. I do think professor Shockey's is a really good one and it does combine that science and humanistic component very effectively. I do know that Joe, he was doing a water one, because he was centered in the middle east he was collaborating these water ones between places. I think that there is definitely potential for collaboration on potentially appropriate technology and exploring its place in. And the types of appropriate technologies. Especially as a tech school we tend to think of high end technology as the solution or the answer but that's not necessarily the way to go in a lot of places where they don't have access to the same resources. I'm also biased because I'm an anthropologist so I tend to think about those kinds of things and I also tend to think about maybe a project that highlighted local or innovative solutions. As opposed to us coming in and solving it, how are local communities solving it and these problems and what are they bringing to the table. If we look around the world and find you know what's the biggest challenge in this location, ok how are they addressing it. That might be an interesting thing but again it's the humanistic side and not the technical side.

Aaron: From what our research has been currently, and similar groups and studies that have used similar methodologies, they used a sample size of 100L of water passed through the sieve, and they used a 4L jug of water, and so through their use of their jug size and sieve, they were able to pass 100L of water through their sieve in 20 minutes of work. So it would be pretty much a 20 - 30 minute time commitment at the most.

Professor Kurlanska: So yeah it's not a whole lot to ask, I don't think, but I think it sounds like a great idea and trying to leverage our network of project centers to do these kinds of larger multi-sited research projects is awesome. I guess the other question becomes, you guys set this up and then next year you graduate, what happens? What happens with that?

Billy: We are working on that from a number of fronts, none of them particularly fruitful but that is something we are thinking about.

Aaron: We are trying to address this issue

Billy: We are working with professor Dodson and the global lab to see if that's something they want to take up.

Professor Kurlanska: Oh and It's Joe from the global lab that is interested in water issues, Joe Doiron. He just joined the global lab recently.

Aaron: Wonderful, the other thing we are hoping the global lab can help us with is storing data from these datasets. We are really hoping that they can help back this project on that front as well.

Professor Kurlanska: Ok, Another question becomes, what's the point? Well I don't want to say that because that sounds callous but what does measuring the level of microplastics in the water in different locations tell you. What are you going to do with that information?

Billy: This is a conversation we have in our PQP meetings a lot. I think what we've determined so far is that right now the data just doesn't exist, so there's no analyses to move forward with, so I mean data doesn't solve a problem obviously. So what we were hoping is that having data like this can contribute to informed policy decisions and coming up with a plan for how to solve the problem as if nobody knows if the problem exists or can't quantify the problem then you can't really move forward with it.

Jared: And to add onto that another thing to keep in mind is that microplastics is just like one example of this kind of project that could utilize WPI's global project centers so I think right now microplastics right now is just one way of trialing a larger more connected network of project centers if that makes sense.

Professor Kurlanska: Yeah no that makes sense, I do think Australia was working with microplastics as well. But were they doing the kind on the beach?

Jared: They did sand sampling, and I think they also did towing a net behind a boat sampling. Which is one of the problems that we've encountered is that you have all of these different methods for collecting data and as a result it's really hard to compare data points with each other. I think by creating one centralized method, the data itself would become more useful and valuable.

Billy: And they are doing long term microplastics monitoring but in one location over time, and we are meeting with Professor McCauley's project, and we are meeting with him and we are going to talk with him about how IQP's stay in use in the future. One question I had for you, you mentioned the advisors taking up the project potentially, how could we make the project more attractive for advisors and make them more likely to get on board.

Professor Kurlanska: Well I think the approach would honestly be with the Center director, and so if they say "Hey we are supporting this and we are not going to set up a project center about this but we want these samples taken", then they can basically say the things that need to get done, and get the sample taken whether it's by you guys or by students and the advisors might just be like it will be easier if I just do it. Right, like I mean that might be what it boils down to, or they might be like hey guys we are going to go do this as part of a field trip, let's go. Because we also do that kind of stuff right? So I think your answer for that is really, from the top down, which is not always the best way to do things but when you are trying to coordinate , you know we have all of these like 50 project centers, not that you're going to get all 50 involved, but if the center directors on board then they can in some ways mandate that this occurs, and then it's the advisors responsibility to get it done. When I was advised in Monte Verde I had to take students on a field trip, like it's something that I just had to do, so I think that's your answer to that, that it's going to have to come from the center directors. To get that drive. And it might not happen, but I advised in Acadia this past summer and I had to drive down all the stuff for all the Covid testing because I was told I had to do it, my trunk was full of Covid testing equipment, and cleaning supplies. Because that was the covid summer, and then I had to drive them all back when we stopped testing. So I think yeah the center directors will be your target in that one to get them on board with it. But it doesn't sound like you necessarily want dedicated teams, you really just want a sample.

Aaron: Yeah I think that's one of the things that we hope to put in our future considerations, that might be a little bit out of our scope for our project to try to encourage project center directors to set up full IQP's but it is something that other project center directors have done in their locations like Steven McCauley, we met with professor Sturm today who directs the Hong Kong center and they did a project with a local university to do microplastic collection around the Hong Kong coast. So I think that's something that is definitely a future consideration, and is maybe not exactly what we are hoping to do right now.

Professor Kurlanska: Very cool, do you have any other questions for me guys?

Aaron: I don't think so. Do you have any other questions for us?

Professor Kurlanska: No, I think you guys did a really good job of addressing what I was curious about and if I have any thoughts on the sample size and that kind of stuff I'll let you know. It sounds like a great kind of project so if you want to move onto rivers I'd say Ecuador is on board at least for one of the co directors. And we have a man on the ground, who lives there and I'm sure she would do it as well.

PROFESSOR STEPHEN MCCAULEY INTERVIEW TRANSCRIPT

Billy: As you know, we started off with our project intending to create a citizen science program in Iceland to collect microplastics, but as we considered the possibility of not travelling and not having connections in Iceland, we moved more towards globalized collection through WPI's project centers. To do that, we determined we would develop a tracking kit that could be brought with students and faculty to all the locations to take a sample of water at whatever location they're at which could then be sent back to WPI for possession. From that, we could have a congregation of data from around the world that could be used for future analysis or policy making.

Also, we wanted our project to serve as an example for future connected research at WPI and lay the groundwork for how other projects can take advantage of this network as some projects have done, but we wanted to expand upon that.

Aaron: The first thing that we're interested in is the feasibility of travel kits to project center locations. The methodology that we are currently looking to use for the sampling would require a four inch diameter sieve attached to a funnel with which you use some sort of container like a bucket. From the research we've done so far, if you pass 50-100 liters of water through the sieve it gives you a reasonable enough amount of water to collect enough microplastics to obtain a reliable sample size.

Professor McCauley: How did you establish that?

Aaron: So we've been doing a lot of reading of previous research done on the topic. We originally narrowed it down to four methods of collecting microplastics samples, the two main ones being collecting microplastics from sand or from water. We decided that the water method is easier as you end up with less rocks and debris from your samples, so that's how we got to that point. Do you think it would be feasible for students to travel with a kit that would consist of a 10 inch diameter mesh and take a sample at Port Philips Bay, for example

Billy: And since our project is more focused on globalization and setting up the infrastructure, we decided to just go with existing research instead of conducting our own research and development of the process since we're more focused on putting the process up around all these locations instead of developing the process itself.

Professor McCauley: I hear what you're saying, I actually think that you're making a greater contribution to that effort of demonstrating how WPI's global network can support research, and I think you're making that contribution simply by doing your project actually, by doing the microplastics work and by sort of catalyzing this sort of network around microplastics research

and monitoring. So I'd actually suggest you don't need to say much more about your efforts to kind of foster the global network until you get to the very end of this thing and say, so what are the impacts of what we're doing here and it demonstrates the power for lack of a better word of that network, or demonstrates the potential of that network, but I don't think you need to spend a lot of time sort of ruminating on that too much. Personally, if you see what I'm saying, I think you'll make a stronger contribution by just doing a kick-ass project about the microplastics network and really catalyzing that action. It's a huge impact to actually catalyze that network and I actually think that something could be happening here. We've been knocking on the door of this microplastics opportunity for about four or five years now, the first project was in 2017 in Melbourne and I'm sure you've read that IQP, that was the first one where they demonstrated the beach sampling methodology. Then we did another project in Iceland and that got a little bit of tracking, but not very much. Have you looked at that project? They ended up looking at Blue Plastics, some other NGO in Iceland if you remember that? [Aaron: Yes]. So anyway, all of that's just to say that I'm now getting more interest from the folks back in Melbourne because they have heard what you all are doing and they are like woah we didn't know that the methodology and research they had helped to kick off in 2017 had lead to some work in Iceland and some interest in the Greece project center and the interest in the Hong Kong [project center], so they're really excited and so we're planning a workshop, I guess you could call it, or a seminar or a round table, about this microplastics opportunity for the global network as part of the Oceania Project Hub's event that we're doing as part of a Global School series, so this is going to be in mid to late October, and I think you might know about that and I think you have been invited to participate right?

Aaron: So we talked with Professor Ingrid Shockey earlier this week, and she mentioned that as well, that we would be allowed to join that.

Professor McCauley: Yeah, we'd love to have you join it and share what you're doing and what you're thinking, it makes a really cool contribution to this really growing network which you're already a part of and which your project is really helping to turn the corner on because I really like what you've come up with which is a simple methodology which is really transferrable and demonstrates the vitality and potential of the network in a way that's hard to come up with the right kind of transferrable methodology because of all of the restraints that you know about like the 7 week terms, the undergraduate student researchers, what can you generate that's scientifically valid and allows us to keep building towards a real enterprise of environmental monitoring, and you've kind of got all the right notes, you're really hitting it really well in terms of that framing and putting something into action that's very actionable, and that's what's gonna have the biggest impact is to actually let us see this network in action, let us see what it's really looks like, and I think the best way you're gonna do that is to really drill into the real details of what this methodology and transferrable technique is going to require, it's going to require being really fine tuned about what the sampling technique is gonna be in different places because it's quite complicated, like you've figured out that water is better than sand, which I think is a good idea. But even around water, there's lots of questions around the sampling protocol and how tightly constrained you need to be with giving those instructions to IQP teams that are gonna go

around, because if you're getting water from the river for example, it matters what part of the water column you're in, the middle or the top, because of the turbulence. And that was one of the other projects that the team in Melbourne worked on with the, I think it was called the MOWAG?

Aaron: McWAP

Professor McCauley: Yeah. So that's what they were dealing with is this challenge of sampling from water in the river. And then there's other sampling techniques in, you know, other places, so how rigid does the sampling have to be for different IQP teams who are going to do it for example that would be one kind of question. And if you can lay out all these parameters and details through whatever research you're pulling together on this and just inform folks, and where there are still questions or uncertainties, that's great to point those out too, that will still have to be developed beyond your project in terms of as this project goes in motion. But I think what you're doing is really setting the stage for some IQP teams to really pick this up and run with it, and the great thing is that Project Center Directors are very often interested in a project that they can put into action in their place because we have to come up with 6 every term and sometimes we're like okay we have 5 or 4, we need a couple more. But then there's a human side of that too, which is what responsibilities fall on the project center director to manage this project, because unless it connects with a local sponsor who really wants to do this methodology, but that's why it's a little interesting because most traditional sponsors, they want to do their own things, that's why they're sponsoring projects. So if we're asking them to participate in this particular methodology, there's questions around that. Either they have to think it's a cool idea and want to join onto it, but how do we introduce it to them, how do we invite them onto it, or do the center directors just run this project without the connections of a local sponsor? Those are all possibilities, but those are also some dynamics that might be valuable to think through as you set up this infrastructure for global science and environmental monitoring. I think it's so cool, and I think you're going to be able to pitch your project as making this really cool contribution at that level, but you're going to make it just by going through and really working out the details of this method.

Aaron: I think that's something that a couple of project center directors have brought up to us is the fact that projects through IQP's have traditionally been through sponsors.

Billy: So we wanted to ask you… you mentioned earlier the microplastics project in Melbourne, that's still going and actively being used, the process that was developed?

Professor McCauley: Yeah, we've done about probably 4 or 5 projects on the microplastics issue in Melbourne, and a few of them have explored different methodologies for sampling. One was on the beach, that was in 2017. Another was in the water columns, that was the one with the acronym there [McWAP], and then another one was a little broader, it was about a citizen science protocol for sampling microplastics. And I actually haven't looked closely at that one, I didn't advise that one, but it would seem to me that would be a really important one to look at because they were doing some of this same kind of thinking which is, if we're going to be having different people, different groups with different levels of training, you know citizen scientists, all using this

same methodology, what kinds of details do we need to think through and communicate to them so that it's a really robust and easily repeatable methodology. So I think they did some of that thinking in that project that might be nice to look closely into if you haven't seen that one. Like I said I think it was something about citizen science protocol for microplastics monitoring.

Aaron: I believe we've done some research into that one.

Professor McCauley: So we've done a number of IQP over those 5 years and the organization themselves, Port Philips Ecocenter, that's sort of a major issue that they've been pursuing for a while, so they continue to be leaders in that area, really. They are also connected with some international networks around the Waterkeepers' Alliance and some other international alliances around clean water, and they participate in some of these, and it's kind of a different subset of global networks than where we are. But April, who is the director of the [Port Philips Bay] Ecocenter, we've invited her to that panel on microplastics as well, so it will be really cool to hear about what they're doing in that space.

Billy: So we were interested in, is there anything specific that those projects did to be long lasting so that they are able to be transferred overtime without the students being there? Because that is something we are concerned about is the longevity of our project when we're not the ones running it.

Professor McCauley: Well they would be the right people to ask, I wonder if we could even set up an interview with April or Pham(?), she's the environmental science director at the ecocenter. Between the two of them, I know they're quite busy and they're working on their annual report right now, but I can ask her about it because I think she might see the opportunity and even deepen the conversation a little more with exactly what you guys are thinking, I think that would be helpful actually so maybe I can let her know that request might be coming and if you guys think you can, if you'll have time, maybe explore an interview with her.

Billy: Sure, yeah. Thank you.

Professor McCauley: Okay, let me jot that down and I will ask her first if she has time for it and if you haven't heard from me in 4 or 5 days, maybe just ping me and remind me.

Billy: Okay, will do.

Aaron: So I know that a lot of what we've been talking about so far is specifically for microplastics, but one of the other things we've been trying to do is to also have interviews with project center directors that might not have any interest in microplastics in general. The reason behind that is because we really hope to make this statement with our project on microplastics that this idea of projects that are connected over multiple project centers could actually be a really good thing. So we're trying to get ideas on what are other types of projects that could benefit from this kind of collaboration.

Professor McCauley: Yeah, well I'm sure you're familiar with the Climate Stories project Ingrid Shockey has done. That was a cool one because similar to what you're thinking of, it required a skillset that a team of undergraduate STEM students can realistically take on in a 7 week training period then execute in a 7 week project term, so it had that going for it. And it also addressed the core IQP goal of having the team engage and interact with stakeholders and really listen to stories. So in a way that was really an excellent example of really getting good IQP learning outcomes and doing something that contributed to a growing set of resources around climate change. And what I also like about it is that it really accomplishes the goal of showing a global environmental challenge, a global sustainability challenge, climate change, the biggest issue, and the way it manifests in local, specific areas. And that's where I think the power of WPI's global network of project centers can really be realized as this kind of light footprint kind of a network, because we don't really own buildings all of over the world we just drop in but in that way, the teams kind of drop in and provide that local view of a global challenge. And if we have them done in enough places it starts to show you that kaleidoscopic perspective on local manifestations of the global challenge. So I like that about it, it has that real nice local global kind of sensibility. So all those things are great about the climate stories project. One challenge I think we had with it is that it does require the technical expertise of videography, and that's something that students can learn in a project term, but I think it's pretty reliant on someone already having some skills that they bring into it, and we had some teams where at least one person brought a lot of skills in that area, and we had a team in Australia where most of the team had brought some videography background to it, so they did a really nice job. We have done other video projects, it wasn't a part of the climate stories program, it was on a different topic, and it kind of bombed, and that was our first time working with that sponsor. And so the relationship with that sponsor has never really gotten off the ground after that again because it just didn't go well because the team didn't have the skills and we all underestimated what it would take. So that just highlights the importance of a methodology that's, and I think yours it wouldn't be overly technical in any particular way, so that's great, it has that going for it too.

Aaron: Are there any other social issues you see that are being applied to?

Professor McCauley: It could be any number of issues, it could be anything, any environmental monitoring, any human perspectives on things. Probably the things that are most readily available are environmental science, environmental monitoring type things that require only a low tech monitoring device, and social issues that don't involve really engaging closely with city leaders or planners or policy makers or politicians, because those things take a certain access to, but if it's kind of research questions that are relevant to people on the ground, then it could be great. And it doesn't have to be with video either, it can just be with a photograph, a portrait of people and their story, or their perspective on something. Whatever the topic is, but that kind of an approach, that approach is people on the ground. And we've had plenty of IQP's where people stand outside of a supermarket and ask people their question on earthquake preparedness or perspectives, whatever it is. So that's eminently doable. So I would say any kind of problems that avail themselves to those accessible approaches

Aaron: Thank you.

Professor McCauley: By the way have you looked at any of the stuff that they've done at the Venice project center?

Aaron: Not particularly, is there anything specific you're thinking of?

Professor McCauley: Just in the sense that they've done a lot of environmental modelling and monitoring of sea level rise and I think they've done a number of projects that involve low tech sampling devices, that might be helpful. But of course you need to focus on microplastics. But I think that's one area of your research you want to really drill into is getting real specific on the sampling device and sampling technique and protocols, and I don't know if you can develop one and test it out, I don't know if you have time for that, I know you're travelling and it will be cool to see when you're in Iceland what you can explore, even absent of any connections with a local sponsor, it would be cool if you can meet some people, maybe from this blue planet organization or anyone to just let them know what you're doing just to see if it clicks. And beyond that, what you can do is test out the sampling protocol in a number of different kinds of environments and really explore what are the complications and complexities of using this device in lots of different environments. Whether it's really still almost a hot springs kind of thing, or a river, and what level in the river, so really look closely at all the different research you've seen on very specifics about sampling protocols because I really think that's going to be a huge part of it.

Aaron: Alright, we definitely will. We also hope to have our fellow classmates test our protocol to get another perspective

Professor McCauley: Yeah, right on. I like it.

Jared: Alright so moving forward I know collaborating with the project center directors will be important to get our project implemented, are there any best practices you think we should follow to increase our chance of buy-in from project center directors?

Professor McCauley: Yeah, that's a good question. The appeals of the project for a project center director would be that it doesn't require having a local sponsor. Maybe it's better if it does, and they can explore interest among organizations in their site, but if for whatever reason they just don't have anyone who's interested in that and they need a project, it's kind of a good, not emergency project, but an option that's there in case someone needs a project and doesn't have a sponsor, so that's a selling point of it I would say. Another selling point is that the project can contribute to what's becoming a bit of a network and contribute to science. And as center directors, we're always interested in our projects contributing to interesting things and being a part of interesting networks and opportunities, so that's a selling point also. And then I guess I would say, what would be really helpful for center directors is if you, maybe you all can do this, really develop thoroughly what the project description would entail. And when whoever it is has this opportunity where a project center director is looking for a project and someone says oh hey, we have this microplastics opportunity that other folks have been doing, it's contributing to something, here you go. And send them the project brief and they don't have to do a lot of

inventing and figuring it out on their own because the resources are already there. And I think the key resource would be one or two things. One would be the project brief, we call it the project brief or project description, it's really just a one to two page description of the project and the methodology and the opportunity. There's a lot of still openness and the teams will have to figure out a lot. But if you could develop that as part of this project, what would the project brief look like so that if a project center director in ecuador or in cape town was interested in contributing to this project, could we just send them a brief and they could kind of get rolling with it. And then the other thing would be, I don't know what you all were thinking about this, but will it require a low tech sampling device that teams take with them and travel with them. And if so, do you have four versions of it so that everyone on the team brings one, what is the device, are you all going to make it and have it as a kit so it would be this kit you would give to a center director, and then they're off and running with it. That would be a cool way to go, but if you don't even need a device, maybe you're just using a plastic bag, or whatever, then you don't even need a device but then you still need really clear directions about the sampling protocol, and really spell that out and in fact all the details like do they need to be 5 meters from the edge, how deep, and where. Or maybe you could give them some variability and open enededness about the sampling, but then you need to give them some way to document it, to say if you document it in some other place, something like that, and maybe you have to give them room for more research questions too, because we don't necessarily need every team to keep doing the same thing, although that's cool too because then we get the sampling from around the world, but maybe you can build into the project brief just a lot of openness too to add a lot of dimensions to the research network, so to speak. So if you all can prepare those resources, I would think that would be the fundamental deliverable of your project, would be to have those resources ready for any center director to pick it up, then it would be sort of a canned thing that's really operationalizable.

Billy: Do you have any questions for us about our project?

Professor McCauley: Maybe this is still an open question, but when you were describing the method itself, some questions I had were how would the team, if its the team that's going to be doing the sampling, or if the team is going to be coordinating citizen scientists for them to do the sampling, whichever way, do they send the samples back to WPI, and if so to who, and then how is the sample then tested, what's that side of the whole program?

Billy: So once they pass the water through the mesh filter, they would be able to take the mesh itself and store that with their luggage when they travel back. Then we are still working on seeing what can be done as far as the analysis goes. We looked into using the Goddard labs, but we've hit a dead end on that, so that might be something we need to open up to future projects.

PROFESSOR AARON SAKULICH INTERVIEW TRANSCRIPT

Aaron: Then I should tell you that we're recording. Wonderful, so I don't remember exactly where we left off in determining where our project was during our last conversation with you.

Professor Sakulich : Well, if you don't remember, I certainly don't remember. I've spent less time on it than you have.

Aaron: That is fair.

Billy: Yeah, so as you know we started with the approach of making a citizen science program in Iceland.

Professor Sakulich : Oh, that's right. Yeah, it's all coming back to me, OK?

Billy: Then as we considered the possibility of not traveling and traveling for a shorter period of time and not having connections to sponsor, we decided to shift the project more towards using WPI's Global project centers to collect microplastics from around the world and then have a global repository of data at WPI. So to do that, we set out to make a sampling kit that advisors or students could take with them to the sites to take a sample and then bring back to WPI for analysis.

Professor Sakulich : Oh, OK.

Aaron: And then the second part of that is reaching out to Project center directors who may not have you know.... Project centers where there is freshwater or ocean water where they can take microplastic samples, reaching out to them and asking you know what other kinds of projects that you would like to see. This approach being taken for?

Professor Sakulich : Oh, OK.

Aaron: And you know trying to get an idea of you know what does the future of this kind of project hold for, for WPI project centers.

Professor Sakulich : Right? Well was that a question? No, that wasn't it. Oh OK, that's the question you're trying to answer.

Aaron: Yeah, so that's that's what we're trying to do and so far we've had some productive talks with Project Center directors on, you know, the availability of, you know, traveling with a kit to project locations and also you know time constraints for students, uhm? Being like you know, will

students have time at the project centers you know to go visit a river or an ocean? Uhm, will they have the ability to take 20 or 30 minutes of their time to take a microplastic sample? All that kind of stuff so nothing. And productive conversations on that front.

Professor Sakulich : OK. Well, one thing that I might mention is you might want to consider. I guess I would say the political situation in each country. So like at the London Project Center, to go down to the river and get a little vial of water and mail it home. It's probably fine at the Morocco project center. If I was to grab some like local water and mail it home I think the police would have a lot of questions. For me it's slightly different. I don't know what term I should be using, but it is a slightly different climate over there.

Aaron: Yeah, so we hope to sidestep that somewhat by, you know, the process that we've come to for the microplastic sampling basically involves. By a four inch diameter mesh attached to kind of a funnel in which you pour water through and then at the end of the sampling you know the like after. I think we've decided on 50 liters of water being poured through this mesh. You can detach the mesh alone. And the mesh can be transported back to WPI for analysis.

Professor Sakulich : That's still going to look real shady. No no. That is fine, that is fair.I, I mean we have we have. We have project centers in some countries that are technically police states, right? And you don't want to do anything to stand out in those countries, Morocco. Uh, Thailand.

Billy: I don't know about.

Professor Sakulich : South Africa and maybe I think they would. Just want to bribe rather than. Arresting you, but you know what I mean, yeah, yeah.

Aaron: That's probably true. That's probably true. Yeah, so then the other other part that we've been working on recently for our project. There's one trying to set up an analysis of after we've taken the microplastic samples. Yeah, we've been trying to find someone at WPI. You know, either in the Goddard Laboratories. Uhm, or you know students run clubs to try to figure out if someone has the time or the interest to do analysis on these microplastic samples in the future. Uhm, we haven't had a huge amount of success on that front, but the other front that we have had success on is trying to come up with a repository or like a database for our data set and we've had some productive talks with Leslie Dodson. Regarding the Global Labs involvement in that and the possibility of an addition to the Global Labs website where you know students could store datasets from IQPs or from projects. Because you know currently all of the IQPs are submitted to digital WPI. And then you have all the PDFs there, but you don't have any of the data from those projects there. All of the data is in a link somewhere in the IQP project paper, and if you're searching for it, then there's an external link. And so we're trying to come up with a way to. To have a WPI hosted database that students don't have permissions to, it's, you know, professors that actually will be. Around for a while and students just submit their data to us.

Professor Sakulich : Right? So it would seem to me. Obviously, you're the experts in this topic, but to me you know. My first thought is that what might be best would be to provide a template for every IQP. Like here is the form you should fill out with your data. You've got this column and these rows or whatever it might be, right? But if everybody is using an identical temp. Then it doesn't really matter if the data is recorded in a template in an appendix to the paper, because somebody can go and just go to the appendix. And oh OK, here's what I want, and they might have to do that for 5, 10 or 20 different papers. But it would be, you know, an afternoon's worth of work. Or you can ask the students to submit the template too. You can also ask the students and the teams to submit their template of data to this repository. This archive that you're talking about, the one thing you definitely want to avoid is a faculty member having to[add to the database]. And any significant amount of data, right? If it's, you know, review the template and press accept. Right? That's perfectly fine. If it is, take the template and type in all the numbers. There's not a single person on this campus that's going to do that. Not because we're against, you know, data. It's just every year we have to do more work with less resources. So within two years, we're not going to have time for any edits.

Aaron: That is fair, that is fair. Yes, that's kind of where we are with our project right now. I think that you know one of the things that we would like to talk to some more about is, you know, other types of projects that could use this approach. This kind of dispersed data collection approach. Considering you are a project center director who might times two who might have some insight into this.

Professor Sakulich : Times 2. So my immediate thought is that this sort of approach might be more valuable, for the reason that the MQP is meant to reflect the kind of work that you will do when you graduate. So if you're a civil engineering student. For your MQP, you design a bridge or a wastewater system or whatever. Or if you're a chemical engineer for your MQP you design or refine a refinery or a new type of air freshener or whatever, it is what chemical engineers do. I don't actually know what IQP is supposed to be and so there's a lot of quantitative data that comes out of a MQP. Right? No, for an IQP the purpose of the IQP is to show the limitations of quantitative data and how if you want to come up with a lasting solution to a problem, you've got to engage with the people that are affected by that problem, right? Uhm, so the data that comes out of an IQP. It's really more of a social science project with a lot more qualitative data. This person said this. This person said that. And sometimes you can make that quantitative like we sent out a survey, and 80% of people said yes. Or 30% of people said banana or whatever it may be. But generally speaking, a project. Focusing on microplastics, the project is going to be about developing a process that works for the local community. It's not necessarily going to be, and it would be very unusual for it to be about collecting just tons of raw data to determine what kind of plastic. Is it? How much is there so on and so forth. So like the one that we previously did in Iceland about microplastics was comparing different methods of identifying microplastics to determine which method would be the one that's most likely to be used by the local people. It wasn't, you know, we did a statistical analysis of every shoreline and found that polyethylene is the primary problem. Does that make sense? I mean, the Sky's the limit. You know what I mean? Like it could be anything. The difference that makes it a little bit more difficult is that not many

MQPs are done off campus. So the real value of the structure that you're designing with this archive where people can share data is that it would be at different parts of the world collecting data, but for the most part those data are going to be more qualitative. So when you put together your template, there's going to have to be. Some if you choose to go that route, there would have to be some degree of flexibility and accommodation for non numerical data you know what I mean.

Aaron: Oh, that's a really good point.

Professor Sakulich : That might have been too rambly, but I think you get the gist of what I'm trying to get at.

Aaron: Yeah, that's a really good point. We should make sure to do that. Yeah, I mean those. That was the one really big question for us that we had to ask.

[Inaudible]

Professor Sakulich : What's all this then?

Aaron: One of the other things that you know we are open to understand better if you know getting project center directors you know involved in this collaborative research. Yeah, as you're saying the IQP's are more focused on local sponsorship driven projects.So like, do you think that there's a way that we can convey this project to project center directors that would, you know, make them more willing to participate in this kind of project.

Professor Sakulich : The answer is yes. I do think there's a way to make that happen, but the question you're asking is very, very broad, right? So every project center director is a different person with a different philosophy with a different background. Even with different goals, right? So there was one project center where the project actually won the Presidential IQP award and the project was the students building a latrine in a settlement so that people would poop in a specific area rather than just in the middle of the road. Or whatever. Everybody else loved this project because of the impact, right? Like, oh, they've changed the lives of those, those, those poor peasants somewhere else and we've gone and saved them. When I asked the students in that project what they learned from the project, the only thing they could tell me was which end of a shovel had the handle on it. I don't think you need to pay a full term tuition at college to learn, right?

Aaron: Yeah no.

Professor Sakulich: So I think that that was actually an awful project. And I would never have anything to do with that kind of project. So among Project Center Directors, there's this. There's different disagreements, right? Is it a project, an educational thing? Or is a project something like you're contracted to do some work? I am very firmly in the first camp that it's an educational

thing. So when you're trying to sell this idea for lack of a better word to project center directors, you're going to have to realize that it's not one big monolithic group with all the same opinions, you're going to have to take a different approach. Approach each project center director and that's another thing. That's like the point of the IQP right when you're trying to solve a problem, you can't treat people as interchangeable units and just take one approach to them. Everybody will have a different stake in the process. So what I can say in the most general terms is that if a project center director sees the value of the project, or they see that students are excited in the project, they will be more likely. To adapt it like in Iceland because of the pandemic, we started experimenting with these sponsorless projects and I'm actually really excited about them because it gives students so much more freedom than just like. Being pimped out to a company and they tell you what work to do and then you do it. You know what I mean? Uhm, there are definitely center directors that have been here for a long time. They will not even consider doing a project that doesn't have a sponsor. So the only way for you to convince them would be to get a sponsor in their country to say I'm interested in microplastics and then maybe. The project center director would say oh, have you considered this? You know, collection database or whatever? Those center directors, those advisors, rather well know those center directors are usually people that have been with a dog for a long time. If you do something one way for 10 or 15 years. You will do it that way until you die. Like there will be. Be no change in what you do, right? Some of the younger project center directors might be a little bit more flexible and you can give them the sales pitch and they might say oh, wow, that actually sounds like really an exciting initiative. I want to get involved in it.Some project center directors have had trouble maintaining sponsors during the pandemic. It's not just Iceland like a couple of centers have been just flat out cancelled. I know of a couple of project centers where the sponsors have said. You come back two years from now. We're not interested in working with you right now, so they're going to need this kind of project. So so. I feel as though these kinds of open-ended questions. There's like a whole rainbow smorgasbord of stuff I want to express to you, but.

Aaron: What we're looking for. Uh, yeah, I mean, that's that's, that's exactly what we're looking for. Yeah, like those are little big questions.

Professor Sakulich : OK.

Aaron: We were mostly just hoping to check in with you and give you an update on our progress and let you know that we're trying, that's for sure.

Professor Sakulich : Well, that counts for a lot in my well, so that's another thing when I was talking about the differences in faculty opinions. I'm of the opinion that the IQP should be a learning experience, right? So if somebody does not. Build the structure that the sponsor wants, but they learn a lot about how to work on a project. They get a good grade from me. There are other project center directors that are like you were told to build an outhouse and you didn't build it. Therefore you get an NR and it doesn't matter how much you learned and, and I think that's a bad attitude. And I am the enemy of such people. There can be no peace between us, uh.Yeah

so. I really do think the IQPs get familiar with how to approach stakeholders to a problem and the project centers or stakeholders and they all have a different stake in what's going on. So to speak.

Aaron: Yeah, we've had a few project centers express this opinion to us of the necessity of having a sponsor at a.

Professor Sakulich : So the thing is there's a charitable way to interpret that, and there's an uncharitable way. The charitable way is that they are the people that really strongly believe in having a sponsor for every project they're trying to show the students what it is like to work on a project. In the real world where somebody is kind of like hiring you to do something. And they also want to provide the maximum amount of resources to the students, right? Because if you have a sponsor, there is a person that can say you know you go to the sponsor and you say we have a question about XYZ and the sponsor says oh talk to Dave or here's a book or look at this website or whatever. So the charitable interpretation is that those people want to provide the most resources to the students. The uncharitable interpretation is that those people are lazy. There will definitely be positions when you graduate and you go out and you're working in the world. There will definitely be occasions where you have a boss or a sponsor or whoever that says I want this thing done. Here are the resources I can give you. There will also be occasions where your boss will say I want you to answer this question. I don't know anything about it. Good luck. And learning the process of how you would go about answering a question where you don't have a person that's sitting there directing your every move to me is very, very valuable. However, it takes a lot more effort and a lot more. Time and a lot more patience. And it's also a very non WPI student way of doing things right I feel. A lot of WPI students, even in the classes I teach much less the project. Uhm, like I'm teaching a lab class this term on land surveying, right? 'cause it's civil engineering so you get your Toyota light, you set it up on the tripod. You start measuring angles and distances and one of the labs. The last lab of the term is to get the equipment. Go do a survey someplace. And then tell me about it and people are crapping in their pants. They can't understand how this is a lab, right? Like it literally says pick some place of interest to you and survey it. And I have people coming up to me and be like what? What places of interest to me, I don't know what is of interest to me unless you tell me. Uhm, and I'm being a little unkind, like obviously, but uhm. Yeah, I think there's a lot of advisors and a lot of center directors. Look at the IQP as the students have to complete a project. They need a sponsor to tell them how to complete a project. My opinion is students need to learn how to complete a project and so in a lot of ways, having an unsponsored program project is much stronger for that specific learning objective. I don't know. I've been weirdly amped about this because, uhm, like obviously the tradition is you have sponsored projects and then the pandemic came along and all the sponsors were like we're not going to do a project. Most of the sponsors were like we're not going to do it. By my reckoning, 1000 hours on zoom with different people like each of us drinking a beer at 8:00 o'clock at night. Being like, well, I think sponsors are blah blah blah and like these are the conclusions.

Aaron: Well, I can tell you for sure that we are learning how to put the other projects through a lot of reaching out to people and a lot of interviews and talks and reading papers. And contemplation and us sitting around on a table and looking at each other with blank stares. We're figuring it out.

Professor Sakulich : You have two professional pathways in life, right? Presuming you stick in engineering and you don't win the lottery, or like to travel the country in a converted school bus surfing every day. Not that that's my dream, but. You can either learn how to answer very open-ended, vague research questions like this under your own initiative by finding your own resources and identifying your own resources. Or you can do whatever the mathematical equivalent of flipping hamburgers is, where your boss is going to show up at your cubicle every morning and be like I want these calculations done using this method and you'll sit there. And do it, yeah again, I'm exaggerating a little bit for comedic effect. Like obviously it's not that clear cut, but I do think that a lot of people were; are not. A lot of people have always done projects with sponsors and so something like you're talking about like microplastics at multiple project centers. They would be unwilling to even consider the idea of having a project like this tied to something larger unless one of their sponsors comes to them and says I want a micro-project. This is how it's going to be done. These are the resources I have. No no. There's one guy in particular I like a lot and I was like I'm doing sponsorless projects. And it was like I'd vomited a dead cat onto the table. In front of them, you know. You're doing what?

Aaron: Well, fair enough. It does. It does align with what we've seen in our interviews so far.

Professor Sakulich : OK, has anybody been in favor of considering the idea of sponsorless projects?

Aaron: Yeah, yeah, there's been a couple that have been. Really open to the idea.

Professor Sakulich : Oh good.

Billy: They sort of acknowledged that it would be easier to get going if a sponsor was present, but it's definitely still possible without a sponsor.

Professor Sakulich : Yes, if there was a person there to tell you how to do everything.

Billy: Yeah, that was kind of.

Professor Sakulich : It would obviously be easier.

Aaron: Yep. Oh yeah, good.

Professor Sakulich : I'm glad I'm very much looking forward to hearing your report, seeing your presentation, and I look forward to hearing back about your trip. I understand you got to get tested today, right?

Aaron: Have you tested? You're tested everybody. Yeah, there we go. Yes, actually speaking of our final presentation, we have been invited by. Uh, two or three different, a couple of different projects under directors too. One person. Uhm, sometime in October. Yeah, late October they said there's going to be a kind of a roundtable kind of conference on Oceania. Water microplastics? Uhm, kind of projects and project centers, and they've invited us to go talk at that and kind of give our final presentation at that as well.

Professor Sakulich : OK, let me be real frank with you. On the one hand, once you get your grade, you don't have to do anything about this ever again. On the other hand, this would be a good opportunity, right? Some things like this, even if nothing comes of it and you don't convince any project center directors. To adopt your system, you get the experience of presenting at a conference which is going to make you better at presenting at conferences as it's good training for your professional career, so I strongly recommend that you take advantage of this opportunity. I don't know if it's a thing at WPI or somewhere else or whatever. If it's somewhere else and there's like a registration fee, let me know and we'll squeeze from this. We'll scrape from that. We'll figure it out. We will cover whatever costs would be involved.

Aaron: Yeah, from the sound of it, I think it's going to be a WPI.

Professor Sakulich : Simulate this. OK.

Aaron: But I will let you know, and they've said that you know any. Anyone that we find you know to be pertinent to showing up and hearing it. They're welcome to come, so I would assume that you're welcome to come and sit in here if you find that interesting.

Professor Sakulich : OK, it will be easier if you can forward me maybe like the time and date and location. And all of that.

Aaron: Yes no no. Definitely when we have some more information, well, I just thought I'd put it on your radar.

Professor Sakulich : OK great yeah. Yeah, keep me in mind. With it

Aaron: But that's one.

Billy: Do you have any last questions for us?

Professor Sakulich : Hey, do you have any questions? About Iceland for me.

PROFESSOR INGRID SHOCKEY INTERVIEW TRANSCRIPT

Billy: So we started, not really sure what direction we were taking the project because it was kind of described vaguely as "use citizen science to collect microplastics samples".
And as we... because we don't have a project sponsor

Professor Shockey: okay

Billy: so as we developed our project we kind of figured out that we weren't gonna be able to make a whole lot of connections getting something, long lasting done in Iceland without sponsors and only being there for a few weeks so we thought it would be a better use of our time to work with WPI and WPI's project centers to coordinate and create this program to get samples like microplastic samples from everywhere that WPI goes on their projects.

Aaron: And that was kind of strengthened by the fact that we didn't actually know we were gonna travel.

Professor shockey: Right, right.

Jared: And for a while it was going to be really hard to organize something on the ground in Iceland while we don't think we're traveling.

Professor Shockey: I know, I know

Aaron: yeah so we kind of built our project around the fact that we would hope to still be able to do it, even if we weren't able to go.So now we're left with a project that doesn't actually require us to be in Iceland.

Aaron: So we're planning a lot of interviews done before we go to yeah yeah all of the or as many of the projects center directors on it because if we can get some more information yeah

Professor Shockey: Right.

Aaron: And then as we were thinking about this idea of utilizing the project centers there's no one name that everyone kept coming back to, which was yours. About the fact the only project that has happened that has collected data from multiple different project sites in one single project has really been your Storing Climate Change Project. And the first thing to start we're really hoping to hear a little bit about how you can start the project and what that process is like?

Professor Shockey: Yeah so it's like two questions in one question

Aaron: Yeah sorry.

Professor Shockey: When I was like …. So how it started it just seems to me that because we all here and in the project center building all the faculty here, we travel to so many different sites I mean I run India site and I co direct the Wellington site but you know I've also gone to Iceland and Puerto Rico land so I've been all over the place. And it just seemed to … and I'm an environmental sociologist. So it seemed like a great opportunity for faculty and like together with students to do this collaborative kind of research that took advantage of the fact that we essentially have researchers on the ground in like 50 different locations all over the world I mean that is just an unbelievable opportunity because if I was just doing my own research you know what I have to get a grant and I have to travel to a place or hire some graduate students or something but just having you know every 7 weeks a team going and working on something to bring it back here and to like become a hub for this kind of knowledge and information sharing just seems like a really great opportunity but I also like about it is what you said earlier which is kind of connecting. For me like what was interesting was connecting it to citizen science so like projects involved in you know, really connecting with local people on the ground not just you know my interests but like something that's common to a lot of these different sites that interest the people that are living in these communities so that was interesting to me. How's it going... that's.

Everyone: *laughing *

Professor Shockey: That's right this is like it's like a Tik Tok prompt and like how it started versus … how you thought because it's different. It's going okay are you. What happened was it was really successful so there's a lot of data and then I'm just one person trying to. Trying to like collect the data and put it somewhere in my spare time so that is actually the weak link and thinking about how the process could be so much fun and interesting, it may not really anticipating what would you like to just get data you know term after term after term in and just be like oh my god like what am I going to do with it at all. So it makes me realize that there should be some planning and in my case I probably should take additional research time to just sit down with all the data and then move it to the next level or just have the group of students; You know start to think about how do you use data to the next level like is it going to be an on-going website is it going to be a research center where other people can come in and access these data like how is it going to get amplified out to the rest of the community of. So I did have a little bit of research time to think about that when I was working in the global lab, and the global lab seems like the ideal place to help with that kind of situation and I think. You know I just think that everything is there to help me to make that work and to make it happen it's just like you need time and space to do it so for me that's the question.

Aaron: Yeah that's actually one thing that we're trying to do as well. We realize that we might come across this problem and the one thing that we actually are just sort of thinking of the other day is there's the digital WPI website which posts like all the PDF's of the IQP's and MQP's. We work... like we're going to try to reach out to them and see what it be possible to try to host like

databases on there as well that are relevant to the IQPs or MQPs and not just you know the research papers themselves because that way it would be a kind of a standardized place where WPI datasets could be but where students or faculty could access them easily.

Professor Shockey: Exactly right because now we have things like we have the new program on climate change community climate adaptations we have a new graduate program on that part about it. So for people who want to go into the field of climate adaptation I mean just to be able to access the work that's been done by everybody working on climate change or if those you know those individuals want to specialize that microplastics as you know some sort of related issues last time and climate change but an environmental issue background what level that they you know they would have the ability to jump into that yeah I agree. Yeah. So you know there are potential structures in the global school that could, Could make having something like an internal database or having something that's part of a collaboration between researchers a little bit more funded or like you have like a physical space where things you know could land.

Aaron: Okay cool. It's nice to know there are other people also looking into that issue.

Since, we have such a few emails and it just kind of bounced between professors; you might try to refer you to this person.

Professor Shockey: Yeah right this was always.

Billy: So going back to the project when you're trying to get the project off the ground and get other people involved, were there any barriers you encountered like with getting other people to pick up the project to contribute in a way that made it like conherant.

Professor Shockey: I don't know if I would call them barriers. I think they were unexpected elements that made it interesting. When I started distributing the problems for other people to pick up the kind of stories of other sites I would just give it to a site director and I would say here is the general prompt for the student team yeah and it basically says "find local residents of different ages of different kinds of people and just collect their stories. And then just what was funny to me was how many different ways that could be interpreted. It was really wide open and so people just kind of went with the fact that it was like wide open. Okay, so I've heard of people who would take it literally and they just collected interviews, I got transcripts, I got a few recordings. And I got a report. And then I go to other versions that were just very different things, different kinds of media and you know you probably know there's one that was done 2 years ago that does in fact have a bunch of Tik Tok and other media that they uploaded like YouTube videos and things like that so that the primary focus of the report was this kind of social media with a very you know a smaller right up but the gist of the output with social media which is super interesting. But for me as the recipient, okay now I'm dealing with multimedia and I'm trying to figure out how all the right kinds of people come together. What do we know, how do we combine data from a long interview with a science climatologist from New Zealand and then to a Tik Tok. It's a very different kind of data. So I don't think it was a barrier but it did offer a challenge to me. I wish I had thought of that as an expanding situation.

Barriers? Are there any barriers? I think some of the barriers were more technical, like some of the… The way I envisioned it in the beginning was that it would be a lot of recording and filming and we had a lot of technical challenges. You know, an individual team could have an excellent videographer and excellent audio person… or you can have nobody. Or you could have an equipment break, you know people could say they had this incredible interview with this person and none of it was recorded. So there are just the ordinary consequences of training and equipment, it's hard to make that fail proof. If you're going to collect on your topic and you want to collect it all the same way with the same level of skill and the output, how can you make every team leave WPI with the exact same tools and ability to capture data? And that was really challenging, some teams were really prepared, some were less prepared

Aaron: And did most of the teams use equipment that was provided by the Global Lab?

Professor Shockey: Yeah, most of the more recent teams used that equipment and also took advantage of the training in the global lab. So that was super helpful, but I actually had started this project, you know the first one was back in 2014, and it was much more informal, people were just using their phones to take pictures, record things, get informal conversation, and then transcribe it into text. So the types of equipment we used has varied quite a bit.

Aaron: So it's been at 4 different project centers

Prof. Shockey: At least!

Aaron: Right, at least. But you weren't the center director involved in each of those locations. So how did you get the center directors that were in charge of those locations, was that just through friendships you have or?

Professor Shockey: Yeah, in every case it was somebody, well first of all, a lot of the site directors are housed in this building [the project center], so we all know each other, and we often face the same situation where a group of students are supposed to head out in a few weeks and a sponsor goes haywire and suddenly we don't have a project. So there's a culture already between us of having emergency backup projects for each other if something happens like that. So for a little while my climate change project was kind of a go to if something went wrong, you can always do my project, so that was helpful. A couple people reached out to me, maybe the China one. Just, the word spread, and the way it worked was I was the sponsor for that team, so even if they were in London I was essentially the sponsor for the teams working with the community.

Billy: So in addition to the microplastics part of our project, we're hoping that our project can help serve as an example for future projects to get collaborative research going on. So are there any projects that you see have good potential for collaborative research in the future between WPI's project centers?

Professor Shockey: Yeah, there's so much. I think because of the nature of my work, it's easy for me to think of things like air quality, water quality, and those are pretty broad topics. I think a huge one right now that could really take advantage of the fact that we have this new graduate program is climate change adaptations. So that would be projects that were collecting data on communities around the world, how they themselves are locally solving climate change crises in their communities using their own technology and local knowledge because that is a wealth of information. And a lot of it is technological, a lot of it is specific to a particular site, so there's so much to learn from a small community in New Zealand to a community in Alaska to someone in New Mexico whatever the case may be. So that's a really good one. If you asked another one of us, because we all have different backgrounds like anthropologists and geographers and other things like that I'm sure people would have other [ideas] you know like smart city work, would be another good one. Yeah, there are a million.

Aaron: That's actually very interesting, because I just saw a news article that in Iceland, the first CO_2 air capture commercial unit just opened up this weekend. So that would be an interesting application of the local climate solutions.

Professor Shockey: I saw that! They're sucking it right out of the air and embedding it into the ground there, that's incredible. Yeah the microplastics, I think they found them on all 7 continents, right?

Aaron: I think like, our research we've obviously done a lot into how it affects aquatic life and like the prevalence of microplastics in fish meat and all that kind of stuff. So it's everywhere, there just isn't a huge amount of data on how much in each place.

Professor Shockey: mhm, and what they're doing, if anything

Aaron: That'd be a good follow up to our project.

Jared: I know one other thing we were thinking about, I think we've touched on a little bit, was just how our project and your project and how we can build other projects based on the data collected. And so I just wondered, you said you have all this data and you're kinda having trouble knowing what to do with it or making it useful. Do you think a project would be useful, to sort through the data and figure out what to do with it?

Professor Shockey: Yea because just my project on climate change stories, if you start to dissect all the data we got, you know a big chunk of it talks about climate change adaptations. So when talking to people in India, they're saying we never had problems with this kind of animal, but now their habitat is changing and we have to put up these really complicated fences to keep them out of our area. And so there's technical fixes that are being mentioned in different kinds of conversations. And then there are policy things that are problematic that are being mentioned in these different things and idk I think there's these indicators in those data about what a next step would be that some of the sites would have in common. It could be the basis of a funding opportunity for graduate students or researchers, where you would say…. If I were to look at just

my India one and combine it with Albania but you could just do a high altitude version of the project, looking at fragile mountain ecosystems. So there are so many ways to slice up that data and then to specialize and sort through it and say what would be good here at WPI and really leverage the expertise we have here as a University and then specialize in that sort of thing.

But I really feel like when collecting data like for your project, that is either ½ or ⅓ of the way and you should really remember that. It's easy to get the data but then someone has to analyze it and someone has to make it into something. And for you all to make something that makes data would probably be pretty simple and within the course of your IQP would be really simple. But a real contribution would be then what?

Aaron: Yea, I know a few professors told us we should try and look into an MQP group to try and put together and analyze the data. Our data is a lot more quantitative and some of your interviews are qualitative.

Professor Shockey: Yea some of it could be MQP work and things like that. I mean we could have yearly conferences, where we bring in experts and we look at all the data. It's something we don't really do a lot of in the global projects. We could start a journal? I don't know what youve found in your research thus far and what they did with the data they've collected?

Billy: Yeah, the big issue is that everyone that is wrong is doing it in a different way and no matter how you do it, you're missing a lot of them. And if you use different methods then the data isn't comparable. So it's really hard to get anything large scale.

Professor Shockey: I mean that's the same problem I faced, with the technology for the recordings to be the same. You have to organize your citizens and your participants, this is the structure we're going to use.

Billy: So obviously, we'd love to have different projects spurred from our work. So are there any aspects of projects or anything we can do to make our project good to start other projects.

Professor Shockey: I think you have an opportunity at the end of your term to suggest what the next step would be and I think some of these unanswered questions that you are all raising here I mean those are questions you probably won't be able to answer. You know these may be somewhere where we need to spend some time. And so the question is, are these questions that students can take on? Or is that a project maybe the faculty have to ponder like all of us that want to be involved in that work have to get together and make some decisions about the kind of work we want to do collaboratively to narrow the field and for them to manage projects to happen next. That helps us carve out a couple hours to just talk about it.

PROFESSOR DOMINIC GOLDING INTERVIEW NOTES

- Integrity of sample through transport
    - Sample changing through time/specific location
        - Where is the best way to take samples to get consistent   data?
    - Concerns of how to keep samples organized
        - Minimize space taken by meshes
- Concerns over water quality and safety (River Thames)
- Concerns that collaboration moves away from local contributions
    - Would be helpful to be able to work with local sponsors

PROFESSOR STEPHAN STURM INTERVIEW NOTES

- Why take samples for WPI when Hong Kong Universities are taking samples around Hong Kong?
    - Lasting impact
    - Universalized Sampling methods
        - Institutional framework
- Not entirely up to project directors
    - There to make connections
- No continued work
    - Need to find an individual or group who is interested in continuing project
- Collaborative research is good, but needs interest in all levels
    - Sponsor support
        - Certain sponsors could have interest
            - WWF, Friends of Surf
- Project to build up design projects through project centers

VALTÝR SIGURÐSSON

Billy: So, I think this is our first question. We wanted to know a little bit more about your background. So how did you get started in this field?

Valtýr Sigurðsson: And somebody at our company was sampling for microplastics. So the ministry, the Environmental Ministry asked us to gather data about the sources and pathways of microplastics to the ocean. And I, within the company, was the only one willing to do that. So I just dove into that and I made a report. And sadly, it's Icelandic so [inaudible] But similar reports were made. But then the other marine companies, our results were very similar. So that's how [inaudible].

Billy: And how long have you worked for biopol?

Valtýr Sigurðsson: Since summer of 2015.

Jared: OK, so based on your research into microplastics, how would you say they affect Iceland specifically?

Valtýr Sigurðsson: The fact of microplastics is very well known. It's kind of hard to say specifically how it is here in Iceland. There may be some special conditions here. We have a fairly rudimentary sewage system, so fibers from laundry, they go straight out into the ocean. And also all the microplastics that can [inaudible].

Aaron: And when we were doing some research, we came across one of your reports like the marine microplastic sampling protocol from. I think it was like May of 2020. And we were wondering how it was decided where the samples should be taken. So it was the method of the net and bringing it up from the bottom from the depth of 20 meters to the surface. But we were wondering how it is determined what region to take samples from?

Valtýr Sigurðsson: That was not very thought out.[inaudible]. It was just to see if we could find it[microplastics]. And we were just trying to develop our methods. And we use the sampling tricks that we regularly prove for other purposes. This place is something [inaudible]. Yeah, so I [inaudible] That's just to further some volume of work. We already bought some new equipment, it's called [inaudible]. That's a net to drag along the service. We can cover more surface, more volume and also add to our sampling of the surface. Our methods of sampling like I said just [inaudible]. And we get very few [microplastics]. So we increase our [inaudible].

Aaron: So then you also mentioned that. During the sampling, there weren't very many microplastics found in the samples, and you think that that's because of how the currents around

Iceland work and that most of the microplastics are taken away from the mainland.

Valtýr Sigurðsson: Generally very simple steps. Let's face it. [inaudible].So when you send them through a water column or open water somewhere we just don't get high concentrations. Higher concentrations are not everywhere. [inaudible] The sediments are long. So I don't know what we really want to get an answer to this question. So how is microplastic concentration related to this? [inaudible]

Aaron: OK interesting, very interesting.

Billy: You said that's the reason.. That is, not that many microplastics are found because there aren't as many in the water as compared to the sediments or other areas. You think? If more like technology develops, if more accurate sampling is able to be used, that more would be found there or is, do you think it's just not many microplastics in the water compared to those areas?

Valtýr Sigurðsson: The technology is very good technology. We would find more. Uh, we will find smaller. So we cannot do it easily. We cannot find them at the low limits because you have some limits. Of course, between macro [inaudible] You would decrease. [inaudible] more particles out of every measure. See more operating sediments and also, I guess it has to do with concentrations in the samples. Especially the water test. There are places where the concentration is higher. [inaudible]. We have very high concentrations in parts in other parts of the world. [inaudible]

Billy: Sorry, say again.

Valtýr Sigurðsson: There were high concentrations in the sediment. [inaudible location]

Billy: No, I don't know where that is.

Aaron: It's Swahlberg, yeah, north of the [inaudible].

Valtýr Sigurðsson:Yeah, it's uh. It's just out in [inaudible] It's north of Iceland. There's a [inaudible] Different polymer types, ocean currents. [inaudible]

Aaron: Cool cool thank you.

Billy: Do you have any questions for us?

PROJECT CENTER DIRECTOR SURVEY RESULTS

The full results to the Project Center Director survey can be found at the following QR code and link.

[Survey Results](#)

Connecting WPI's Global Project Centers to Monitor Microplastics

An Interactive Qualifying Project
submitted to the faculty of
WORCESTER POLYTECHNIC INSTITUTE
in partial fulfilment of the requirements for the
degree of Bachelor of Science

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May 12, 2021

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2.2.1: Sources of Microplastics	Jared Leonard	All
2.2.2: Impacts	Patrick Hyland	All
2.3: Methodologies for Tracking Microplastics	Billy Garvey	All
2.4: Citizen Science	Aaron Boyer	All
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3.1: OBJECTIVE 1	Billy Garvey	All
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3.3: OBJECTIVE 3	Jared Leonard	All
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3.5: OBJECTIVE 5	Patrick Hyland	All
3.6 Potential Obstacles	All	All
3.7 Ethical Considerations	All	All

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CHAPTER 1: INTRODUCTION

A report from the Ellen MacArthur Foundation predicts that by the year 2050, our oceans will contain more plastic than fish (MacArthur et al., 2016). While large pieces of plastic are easily detected, microplastics are much harder to detect due to their small size. The EPA defines microplastics as pieces of plastic less than 5mm in length (California State Water Resources Control Board, 2020). Most of these plastic pieces come from the discharge of wastewater and the degradation of large pieces of plastic over time.

Several reports have shown that these microplastics can have adverse effects on all trophic levels of aquatic life. Filter feeders consume microplastics which subsequently travel up the trophic levels, eventually contaminating the fish humans consume. A 2020 study examined 270 fish and found that seven percent of the fish had microplastics in their edible tissue (Daniel et al., 2020). This finding is especially concerning because the consumption of microplastics by humans can impede the development of the endocrine system and cause neurotoxicity (Campanale et al., 2020 & Prüst et al., 2020). Organizations such as The Big Microplastic Survey are attempting to track these microplastics by mobilizing citizens to quantify the problem. This organization is an effective congregation of collected data, but it is missing critical data in many countries around the globe, including Iceland (Microplastics Survey, 2018).

Worcester Polytechnic Institute (WPI) has a network of over 50 global project centers used for student research in the form of Interactive Qualifying Projects (IQP's), which are social science and technology projects performed by WPI students. While students conduct projects specific to locations they travel to, there is a lack of collaboration among project centers. Multiple project centers around the world have carried out similar projects involving microplastics. Students in Iceland, Hong Kong, and Australia have all attempted to use citizen science to track microplastic. Due to the nature of IQP's, these projects were limited to a local impact and did not make connections with the other sites. With global connectivity, these projects could have a more significant impact.

Our project aims to utilize citizen science methods to leverage WPI's global project centers to collect microplastic data. We hope that our project will serve as an example of how future projects can connect project center sites on global issues. To maximize the impact of our

project, we will create a microplastics collection process and a centralized data repository to bring data together from WPI's worldwide network of project centers.

The following chapter will discuss microplastics and their impacts in addition to existing microplastic tracking methodologies. It will also discuss the benefits of a citizen science approach along with WPI's Global Project Program (GPP). The third chapter will discuss our plans to implement a citizen science-based microplastic tracking system through the GPP.

CHAPTER 2: BACKGROUND

Microplastics in the ocean have been increasing rapidly, causing damage to aquatic and human life through the food chain. This chapter will introduce types of plastic, where microplastics in the ocean come from, and investigate the effects of microplastic on humans and the aquatic ecosystems. It then lays out existing methods of collecting microplastic data along with the benefits of citizen science. Lastly, it describes WPI's Global Projects Program (GPP), explaining we could use it to collect data worldwide.

2.1. Plastics

Ever since Leo Baekeland produced the first Bakelite plastic in 1907, humanity has become increasingly reliant on plastics in our day-to-day lives (Mercelis, 2020). Today, the six most used types of plastic are Polyethylene Terephthalate (PET), High-Density Polyethylene (HDPE), Polyvinyl Chloride (PVC), Low-Density Polyethylene (LDPE), Polypropylene (PP), and Polystyrene (PS) (EPE, 2019). While each type of plastic may have various use cases, they are all synthetic substances made by processing petroleum. As a result of their chemical composition, most bacteria cannot break them down, meaning it could potentially take hundreds of years for them to decompose (Urbanek, 2018). When its resistance to degradation is combined with the fact that it is light, durable, and cheap to produce, it is easy to see why it was called a wonder material (Haque, 1999). The unique qualities of plastic have made it the go-to material in many applications from single-use cups to pipes that last decades. Due to its wide range of uses, almost every industry has adopted plastic, resulting 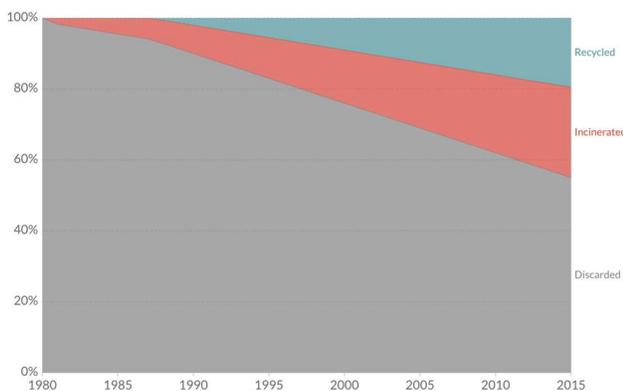in more than 381 million metric tons of plastic produced annually. Unfortunately, most of this plastic is in products with a short life span, causing more than 275 million metric tons of plastic to be thrown away each year (Ritchie & Roser, 2018). Out of the nearly 275 million metric tons discarded, less than 20% is recycled worldwide as seen in Figure 1. Some companies are trying to solve this problem by using biodegradable plastics in their products.

Figure 1. Chart of plastic disposal methods (Geyer et al., 2017)

However, due to the conditions necessary for biodegradation, plastics marketed as biodegradable rarely decompose in the ocean (Hahladakis, J. 2020). This issue has added to the amount of plastic improperly disposed of that ends up in our oceans.

2.2. Microplastics

While large pieces of plastic in our natural environment are easy to identify, microplastics are much harder to detect because of their small size. The National Oceanic and Atmospheric Administration (NOAA) defines microplastics, shown below in Figure 2, as pieces of plastic less than 5 millimeters (mm) in length (NOAA, 2021). While microplastics may be tiny and in some cases invisible to the human eye, they make up a significant amount of plastic in our oceans. A report from the Pew Charitable Trust found that

Figure 2. Microplastic sample (Bollendorff, n.d.)

microplastics made up 92% of plastic in the ocean (Conkle et al., 2018). Another study estimated that more than 14.4 million metric tons of microplastic have sunk and are now resting on the ocean floor (Barrett et al., 2020). On average, there are approximately ten pieces of microplastic per cubic meter of seawater (Wood, 2019). Due to ocean currents, this plastic is not distributed equally throughout the world's oceans. Instead, ocean currents collect microplastics and act as conveyor belts, moving them around the world. This process can result in beaches on uninhabited islands becoming littered with plastic (Movement of Aquatic Trash, 2020). Due to the global nature of microplastic pollution, the world must collaborate to identify and combat sources of microplastic pollution.

2.2.1 Sources of Microplastics

More than one-third of microplastics in the ocean come from the wastewater discharge of washing machines. As synthetic textiles like polyester and nylon have become more popular, synthetic fibers have become more prevalent in our oceans. When clothes made using synthetic fabrics are washed, they break down, releasing microfibers (Wood, 2019). Microbeads are another type of microplastic that are often found in wastewater. Microbeads are small pieces of plastic added to washable cosmetic products such as soap, shampoo, and toothpaste. The microbeads these products contain are washed down the drain when used (Hersher, 2020). Most wastewater treatment plants are not equipped to remove microfibers and microbeads, so they are discharged with the treated wastewater.

Car tires are the second leading source of microplastic pollution, accounting for 28% of the microplastic in our oceans (Wood, 2019). As a car drives, friction with the road surface wears down tires, releasing tiny pieces of plastic. When it rains, these pieces are washed off the road into rivers that empty into the ocean. In addition to car tires, microplastics come from city dust, road markings, and marine coatings, among many other sources (Wood, 2019).

Not all microplastics enter the ocean as microplastics; some enter as large pieces of plastic that with time, degrade into microplastics. When large pieces of plastic are not disposed of properly, they will eventually make their way into waterways that ultimately terminate in the ocean. Upon entering the ocean, solar UV radiation and waves begin the long process of breaking down plastics into smaller pieces until they become microplastics (Hersher, 2020). With microplastics constantly entering the ocean, understanding their impact on humans and marine life is essential.

2.2.2 Impacts

Ocean plastics are a global problem for both humans and marine life. Scientists estimate that there are more than 5.25 trillion pieces of plastic in our oceans. Unfortunately, fish often mistake these pieces of plastic for food. This causes the fish's stomach to fill with plastic, as shown in Figure 3 below, making them feel full when they are not getting the nutrients they need

to survive. With time, the fish will begin losing weight and potentially starve to death (Hahladakis, J. 2020). Additionally, research suggests that the toxic compounds absorbed by microplastics can be transferred to the organism after ingestion (Wayman, C., & Niemann, H. 2021). When released, these chemicals can interfere with natural feeding habits, resulting in abnormal growth and reproductive

Figure 3. A Rainbow Runner that ingested 18 pieces of plastic (Eriksen, 2008)

problems (Jefferson, M. 2019). Even though microplastics are present at every level of the food chain, we still lack an understanding of specific details of transmission between trophic levels (Jefferson, M. 2019).

The risks microplastics pose to human health is a developing area of research. According to *The Lancet*, a UK medical publication, 84% of drinking water samples globally had particles of plastics in them, with up to 94% of samples in the United States containing plastic. In 2018 at the United European Gastroenterology Week in Vienna, researchers found that all eight people tested had microplastics in their stool samples (Jefferson, M. 2019). This study is one of the first to examine the presence of microplastics in humans. This result is concerning because when consumed by humans, microplastics which have absorbed toxic compounds have been shown to cause organ damage, inflammatory responses, and increased oxidative stress. (Wayman, C., & Niemann, H. 2021). Due to the risks microplastics pose to the environment and humans, tracking them is critical to understanding the problem's scale.

2.3 Methodologies for tracking microplastics

Researchers have already established several methodologies for tracking microplastics that vary in complexity, cost, effectiveness, and type of microplastic detected. The methods of sampling that researchers use fall into two main categories: water sampling and sand sampling. Water sampling involves the use of filtration to separate ocean water from the microplastic it contains. Sand sampling involves taking samples from a beach and separating the microplastics

from the sand. Both methods have their benefits and drawbacks, so it is essential to evaluate the problem and select the most appropriate sampling method.

Water sampling is the most common method as it includes grab sampling, tow net sampling, and pump sampling (Covernton et al., 2019; Zheng et al., 2021). The grab sampling method is by far the simplest, requiring only a vessel to contain water, typically a glass jar or metal bucket to minimize contamination from a plastic vessel, and a sieve to filter microplastics. A mesh of approximately 50 micrometers (μm) is standard when collecting the majority of microplastics. However, one study suggests using a 63μm mesh, followed by an eight-micrometer mesh with a pressurized pump to effectively separate all microplastics from the water, including very fine microfibers (Covernton et al., 2019; Green et al., 2018).

Another common method of collecting microplastic samples is the tow net method. This method involves dragging a net with a fine mesh from a boat to collect microplastic samples. The nets used vary from a net designed to catch zooplankton to a net specifically designed to collect plastic samples called a manta trawl. In either case, these nets typically have a mesh of 300 to 350μm, significantly larger than those used in the grab method (Green et al., 2018; Zheng et al., 2021). As such, studies that use the tow net method acknowledge that they vastly underestimate the actual number of microplastics in their samples. Several studies directly compared these two methods. The studies consistently found that the grab method of sampling detects three to four orders of magnitude more microplastics per unit area than the tow net method (Green et al., 2018; Zheng et al., 2021). However, the tow net method has the benefit of sampling a much larger area.

The final water sampling method used is the pump sampling method. This method involves a pump submerged just below the water's surface, which collects water and pumps it through a sieve. This method has the benefit of pressurized water, so a mesh of 20μm can be used, which is smaller than both the grab and tow net methods (Zheng et al., 2021). This method also benefits from its ability to sample a larger volume of water more easily than the grab method with similar accuracy. However, it samples significantly less volume than the tow net method. In all cases, A very fine 0.45μm glass-fiber filter is used to separate the very fine particles from the water samples. Some studies suggest using a concentrated hydrogen peroxide solution to dissolve organic matter and isolate the microplastics (Zheng et al., 2021). All

methods likely require laboratory processing to complete these final steps and additional visual inspection of the remaining plastic samples by microscope.

Researchers have also established a process for extracting microplastics from beach sand. A 2017 study lays out a proposed standardized method of collecting these samples so that it may be replicated by other researchers. This is because the sand sampling method is used less often than the water sampling methods and so it lacks a standardized methodology (Besley et al., 2017). This proposed sand sampling process has many steps and requires a large amount of equipment compared to the water sampling methods, but it may be necessary depending on the type of data a researcher intends to collect.

First, a small volume of sand is collected and passed through a 5mm sieve. The sample is then dried at 60°C for 6 hours. The sample is transferred to a salt solution, where density separation causes the microplastics to separate from the sand. The floating microplastics are decanted and passed through a 47μm filter to remove any remaining sand particles. Optionally, the resulting sample is observed through a microscope to quantify the types of microplastics present. Despite the multitude of tools and methodologies available to collect usable data on the tracking of microplastics, they are essentially unimportant if they go unused.

2.4 Citizen Science

Implementing and sustaining data collection using scientific methodologies on a large scale is the final step in being able to track microplastics. Large-scale microplastic tracking will not exist until organizations or civilians take the time to implement these methodologies on their own. The amount of labor required to go to and collect data from every beach is too high for any organization to achieve, so we must utilize the public for this issue (Microplastic Survey, 2018). Cultivating civilian participation to use as a tool in the scientific process is the idea behind citizen science (US General Services Administration, n.d). When a problem in the scientific community requires large amounts of data to be collected, categorized, transcribed, or analyzed, citizen science can help to ease the burden on researchers (Bonney et al., 2014). By utilizing individuals who are already at or willing to go to specific locations to collect data, tracking microplastics can happen around the world simultaneously by the public.

While citizen science can help research specific problems, it can simultaneously raise awareness of global issues we need to face together. This awareness among citizen science

participants leads to individuals changing everyday behaviors to positively influence the environment (Jones, 2013). Jones argues that three factors affect whether individuals are motivated to protect and enhance the environment: knowledge of problems, attitude towards change, and connection to nature. Participation in citizen science positively impacts each of these factors by providing an outlet to increase knowledge of problems. Among surveys of first-time citizen science participants, over 60% responded that they felt more motivated to protect the environment (Jones, 2013). With project centers worldwide, WPI has a unique opportunity to implement a wide range of citizen science projects.

2.5 WPI Global Projects Program

WPI boasts an extensive Global Projects Program that sends students worldwide to conduct projects alongside local populations. Every student must complete an IQP, which most students elect to conduct at one of WPI's global project sites. WPI sends students to over 50 international project sites, shown below in Figure 4, in 37 countries (Worcester Polytechnic Institute, n.d). WPI considers the IQP a valuable experience because it "requires students to address a problem that lies at the intersection of science or technology with social issues and human needs" (Cape Town Project Center, n.d, para 1). This unique perspective allows WPI students to apply their skills in science and technology to effect social change that has a meaningful difference.

Figure 4. Map of WPI project centers (Worcester Polytechnic Institute, n.d)

Although WPI has an impressive network of sites in many countries, WPI is not currently leveraging these sites to collect data globally. Students often conduct projects that are similar to each other at different locations. However, the various project centers do not typically cooperate to build on previously completed projects across multiple sites. For example, there have been IQP's conducted on the topic of microplastics in Iceland, Australia, and Hong Kong. The Iceland and Hong Kong projects focused on developing methodologies for

collecting and analyzing microplastic samples, while the Melbourne project was focused on developing a citizen science collection approach (Akyildiz et al., 2015; Bayas et al., 2017; Alexander et al., 2018a). These projects conducted similar research and expectedly reached similar conclusions. However, these methodologies and programs fell off in use quickly after the team completed the projects. The Iceland microplastics project team developed a website and database to store the data that citizen scientists collected through this program. As of May 12, 2021, that database contains no data points (Alexander et al., 2018b). A few IQP's have managed to achieve global collaboration, such as the Storying Climate Change series of projects sponsored by Professor Ingrid Shockey (WPI Global Lab, 2019). Through connecting multiple project sites, this project has continued to further our understanding of climate change over the years. However, this is an exception, and most IQP's do not achieve this level of global interconnectivity.

      The following chapter will discuss the goal of this project and the objectives we will use to accomplish that goal. It will also lay out the methodologies that we will use to complete these objectives. Next, it will discuss the potential obstacles we could face in executing our project and how would overcome them. Lastly, it will discuss the ethical considerations of our project and how we will ensure our project is compliant with the Institutional Review Board's (IRB) requirements for human subjects.

CHAPTER 3: METHODOLOGY

The goal of this project is to utilize citizen science methods to leverage WPI's global project centers in the collection of microplastic data. We will work with project center directors to understand their needs when designing our program so that it has sustained use. In addition, we will test our process in Iceland to view it from a student's perspective. Based on these needs, we developed the following objectives to achieve our goal:

Objective 1: Establish a microplastic data collection process

Objective 2: Understand the needs and interests of project center directors

Objective 3: Determine a sustainable way to implement a database

Objective 4: Revise the collection process

Objective 5: Develop a sustainable implementation plan

To meet these objectives, we will collect data using content analysis, semi-structured expert interviews, surveys, and field data collection. We chose these methods to collect qualitative data from the project center directors who will be involved in our project. In addition, these methods will help us collect qualitative data about the ease of use of the microplastics sampling methodology and quantitative data about its effectiveness.

The following chapter details how the team will meet these objectives, the methods used to meet them, and why these methods were chosen. In addition, sample questions for our surveys and expert interviews are included in appendices A through E.

3.1 OBJECTIVE 1: Establish a microplastic data collection process

Our background research showed that a standardized methodology is essential for collecting data points that are comparable to each other when developing a global microplastics program. In addition, a low barrier to entry is necessary to create an effective citizen science program (Shirk & Bonney, 2015). This means that we will need to find a collection method that is easy to execute, yet still effective in collecting consistent data.

While examining collection methods, we hope to understand the benefits and drawbacks of various microplastics tracking methodologies currently in use. To do this, we will conduct interviews (Appendix A) with experts studying microplastics. According to an article published by Rowley, interviews are especially effective in gathering the opinions and experience of

interviewees (2012). In this case, we are interested in learning about the experts' experiences studying microplastics and how we can make that easier by collecting useful data for them. We will ask questions that will allow us to grasp what data types are most helpful to analysts who may use this data to conduct further research.

Once we understand the needs of experts, we will choose a collection method that satisfies their needs. To do this, we will begin by conducting content analysis on existing methods. The data gathered in these studies is often quantitative and focused on the effectiveness of the method and type of data collected. However, we will analyze the methods for effectiveness in addition to their ease of use and cost. We will combine the information collected through interviews and content analysis in a decision matrix to determine what tracking methodology is most compatible with our project.

3.2 OBJECTIVE 2: Understand the needs and interests of project center directors

To ensure the support of project center directors, we need to understand their motivation for participating and what our project can contribute to them. With our project relying on their support, failing to understand their interest could jeopardize the project's long-term success.

To begin gauging the interest of project center directors, we will conduct an email survey (Appendix B). An email survey will allow us to efficiently reach the directors of all 50 plus project centers while allowing respondents to respond on their own time. We anticipate center directors whose sites are near oceans are most likely to be interested in a project tracking ocean microplastics. However, we hope that project center directors without a vested interest in microplastic will still be interested in the outcome of our project because we are one of the first IQP's attempting to coordinate collaboration between multiple project centers. To incentivize director participation in the survey, we will ask what other types of projects they would like to see globally adapted and offer to share the results after the survey is complete. The communication and sharing of ideas should help to promote possibilities for future projects that the directors can carry forth.

Once we have established center directors' interests in our project, we will interview directors (Appendix C) who have expressed interest. From these interviews, we hope to understand how we can work with them on a case-by-case basis. While interviewing directors who manage project centers near the ocean, we must understand the constraints of each location

while we establish standardized testing methodologies. Interviewing project site directors is critical for this as they can provide us with information on site-specific obstacles that we may need to work around. These interviews will also help us plan how the data collection will proceed in specific countries. Some project center directors may prefer to create IQP's to establish citizen science programs, while others may prefer to ask students to collect data on their own time. Interviews with directors without vested interests in microplastics are still important. These interviews will allow us to gather data on what types of future projects other center directors would like to see. With this data, we can help establish connections between directors with similar interests and promote connectivity between project sites.

3.3 OBJECTIVE 3: Determine a sustainable way to implement a database

We will need to determine the best way for students at project centers worldwide to upload data to a centralized location. Additionally, it will be essential to identify a solution that makes this data easily accessible for future analysis. To ensure the long-term success of our project, we must find and implement a data aggregation solution that maximizes the value of the data collected.

To understand what makes a good database, we will perform semi-structured interviews (Appendix D) with WPI's Data Science faculty. From these interviews, we hope to gain an understanding of what we should look for when choosing a database with a focus on what has worked in the past. We will also ask questions about the best practices to follow when setting up a new database. Taking this approach should allow us to understand the ways WPI or the WPI Global Lab could support this project in the future via database hosting and maintenance.

Once we understand the characteristics of a good database, we will assess existing solutions and choose one. To make this choice, we will utilize a decision matrix that compares potential database solutions, as this allows us to compare multiple factors with ease. We will fill out the matrix by researching each database. When we analyze the matrix, we hope to understand the benefits and drawbacks of each solution. We will examine various factors such as cost and ease of use depending on the interview results with members of the Data Science faculty. Ultimately, we will use the decision matrix to pick a database that fulfills the project's needs in the best way possible.

3.4 OBJECTIVE 4: Revise the collection process

Once we have a prototype of our data collection process, we will have student volunteers in our Iceland cohort trial it. This method also allows us to get quantitative data from our collection process, which we can compare to established research to measure the validity of our approach. This will allow us to understand if the process needs revision for accuracy or ease of use. In addition, this will populate our database with data points that can serve as examples for future groups.

As we work on revising our process, we will need to understand if our approach is feasible for student volunteers across the globe. To ensure this, we will conduct interviews (Appendix E) with student volunteers who trial our process. We will ask all students in the cohort to volunteer, and interview as many as we have time for. If there is not enough time to interview all participants, we will select participants through random sampling. We will use the results of the interviews to revise the process so that center directors can more easily implement it globally.

3.5 OBJECTIVE 5: Develop a sustainable implementation plan

Once we have developed and revised our microplastic collection method, we will propose our process to the GPP center directors and assist them in implementing our process at their sites. If possible, we will present our methods to the center directors during a sandbox meeting. Here, we will provide them with ways to communicate with us personally to devise a plan to implement our project at their specific site. This presentation will include decision matrices justifying our choice of database and microplastics collection method. It will also provide the center directors with the benefits of collaborative research as a whole and how if successful, our project can serve as an example for future projects in collaborative research between project centers.

3.6 Potential Obstacles

To ensure that our project sees sustained use, we need the commitment of project center directors to implement our project. After the survey and interviews, we may determine that the directors are not interested in participating in our project. In that case, we will need to adapt the

outcome and deliverables of our project. Instead, we will look for alternative groups of people to implement our process, such as WPI alumni located worldwide.

In addition, we currently do not know our travel timeline for the project because of Covid-19 travel restrictions. This may affect our ability to test and revise our process on site in Iceland. If we cannot travel to Iceland, we will test our data collection process locally. Additionally, we are planning on starting the project at WPI. If that changes, we would need to adapt some of the methods we are planning on using.

This project will rely on creating a database. To do this, we are planning on reaching out to WPI faculty in the Data Science department for guidance. If we cannot make connections with faculty, our project's success may suffer. If we are unable to find a faculty member willing to help us host and manage our database, we will need to find an alternative solution. Additionally, we will need to ensure that any database we create is accessible to future students and is not linked to us.

Finally, we will need to manage our time effectively to ensure that we complete our project on time. To do this, we will follow the schedule outlined in Appendix F.

3.7 Ethical Considerations

We will interview microplastic experts and WPI faculty. Our final report will include identifying information about these individuals if they permit us to do so. We plan to include identifying information of microplastics experts as validation of the data they provide. We will also include the identifying information of project center directors because we need to reference the project centers at which we will implement our project. The student volunteers who trial our process will remain anonymous in our report. We will be adhering to all IRB protocols and use a verbal consent process in all interviews, as seen in Appendix G.

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APPENDIX A: INTERVIEW WITH MICROPLASTIC EXPERT

The following interview questions will be asked during an interview with an expert on microplastics. The interview will be semi-structured, so the questions will not be asked in a predetermined order instead they will be asked in an order that flows with the conversation.

- How did you first become interested in microplastics?
- Are there any gaps in existing microplastics research if so, what are they?
- In what ways can future research aid our understanding of microplastics?
- What are the best practices to follow when collecting microplastics data?
- Which type of data microplastic data is most valuable to researchers?
- How do we ensure the data collected is seen as scientifically sound?
- Is there anything we should keep in mind while we set up our data collection methods?

APPENDIX B: SURVEY FOR PROJECT DIRECTORS

This survey will be in Qualtrics. It will be emailed to all project center directors so they can take the survey on their own time. The contents of the survey is the following:

Hello, we are a group of WPI students working on an IQP regarding the collection of microplastic data from oceans. We are specifically targeting collaborative research and how it can be used to address global issues such as microplastics. This survey is to understand the interest of WPI global project site directors in collaborative research regarding our project.

Your participation is entirely voluntary, and you may withdraw at any time. If requested, we will keep your answers anonymous, with no name or identifying information appearing in any reports or publications. Otherwise, we may use your name and answers in our final report. This survey should take less than 10 minutes to complete.

Your participation is greatly appreciated. If interested, we can share a copy of our results with you at the end of the project. If you have any questions, please contact us at gr-plasticocean@wpi.edu.

Survey Questions

Would you like your name and answers to be kept anonymous?
- Yes
- No

Which project center(s) do you direct?
_____

How often does your project center collaborate with other centers?
- Never
- Seldom
- Sometimes
- Frequently
- Always

Would you like to participate in more collaborative research with other project centers?
- Yes

- No

What do you think is holding back collaboration between project centers? (Select all that apply)
- Lack of communication
- Lack of interest
- Lack of organization
- Not encouraged by WPI
- Other _____

Do students at your project center(s) have access to the ocean?
- Yes
- No
- Other _____

Has your project center worked with microplastics in the past?
- Yes
- No
- I don't know

Would your project center be interested in participating in collaborative microplastics data collection? (This is not a commitment)
- Yes
- No
- Not applicable

What other types of projects do you think could benefit from collaborative research? (Ex. Climate Change, Social issues)
- Not applicable
- _____

Would you like to receive a copy of the results of this survey?
- Yes. Email: _____
- No

Can we contact you about an individual interview to discuss this project in more detail? If so, please leave your email:
- Yes. Email: _____
- No

APPENDIX C: INTERVIEW WITH PROJECT SITE DIRECTORS

The following interview questions will be asked during semi-structured interviews with the global project center directors. Due to the nature of the semi-structured interview the order of questions may be changed during the conversation. If certain directors are able to offer useful advice in specific categories, the interview may deviate from the list of questions.

- What are the most common subjects of projects you host at your project center?
- Do you believe project centers should be more interconnected in terms of projects?
- How could our project work to increase connectivity for you?
- Have you had past experience with projects you believe would have benefitted from multinational data?
- Are there projects you hope to pursue in the future that could benefit from global project center connectivity?
- Do you know of any other current project centers that may have similar interests as yours? Especially in terms of climate, culture, geography.
- In what manner would you like to see this heightened connectivity, possible methods could include website connection, group meetings?

APPENDIX D: INTERVIEW WITH DATA SCIENCE FACULTY

The following interview questions will be asked during an interview with a member of WPI's Data Science faculty. The interview will be semi-structured, so the questions will not be asked in a predetermined order instead they will be asked in an order that flows with the conversation.

- What constitutes a successful database?
- How can we encourage use of the database?
- Are there any best practices to keep in mind when we set up our database?
- How can we maximize the value of the data stored in the database?
- Is there anyone at WPI who could host and maintain the database we create?
- What kind of databases have worked in the past?
- What should be our top priority when selecting a database?
- Is there anything we should keep in mind when we choose a database?

APPENDIX E: INTERVIEW WITH STUDENT VOLUNTEERS

The following interview questions will be asked during an interview with student volunteers who trial our data collection process. The interview will be semi-structured, so the questions will not be asked in a predetermined order instead they will be asked in an order that flows with the conversation.

- What did you already know about microplastics prior to participating in this project?
- Approximately how long did the process take you to complete?
- Were the directions to complete the collection process clear?
- What was easy about the microplastics data collection process?
- What was difficult about the process?
- What do you think could be done to make the process easier to use?

APPENDIX F: TIMELINE

Task	Week						
	1	2	3	4	5	6	7
Gauge Center Directors Interest	■	■					
Understand the needs of the center directors		■	■				
Choose a sampling technique		■	■				
Develop a database for data collected			■	■			
Test and refine our data collection process				■	■	■	
Implement the plan we develop					■	■	
Write final report				■	■	■	■

APPENDIX G: ORAL CONSENT OF INTERVIEWS

Hello, we are a group of students from Worcester Polytechnic Institute in Massachusetts. We are conducting a survey/interview/focus groups to understand how project centers can collaborate to collect microplastics data. Scientists around the world will use this research to study microplastics on a global scale.

This survey/interview/focus will last approximately 30 minutes. Your participation is entirely voluntary, and you may skip questions or withdraw at any time. We will keep your answers anonymous, with no names or identifying information appearing in any reports or publications upon request.

Do we have your permission to take notes?
Would you like your answers to be kept anonymous?
Can we quote you in our final paper? If so, would you like to be referred to by your name or by your organization?

Your participation is greatly appreciated. If interested, we can share a copy of our results with you at the end of the project.