

EPISODE 44
THE SCIENCE FILES

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MICROFIBRE AND ACCESSIBILITY

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DR. ROB THACKER: Welcome everyone to what I think is Episode 44 of the Science Files with Dr. Rob in the hot seat; I'm the cat with the buttons, and if you don't get that check my Twitter feed.

It's a chilly morning and the winter solstice is a mere 18 days away, so if you haven't bagged your leaves you'd better get cracking. Rich is away in Calgary this week, but by the wonders of the telephone will join us anyway. Behind the glass is our fantastic producer, Katie Hartide.

But before I chat with Richard, I'd like to outline today's show. We've got two really important things to dive into and one is a real yarn, and don't worry folks you'll get the pun in a second.

Firstly, did you ever wonder what you're flushing down the drain each time you wash your clothes? Sure there's detergent and the dirt you're cleaning off, but did you stop and think about the fact that every time you wash your clothes you lose just a little bit of the fibres on your clothes? Now if those fibres are cotton and wool no problem, they'll break down fairly quickly, but what if they're microfibres?

If you don't know, microfibres are manufactured fibres that can be turned into a vast variety of different fabrics, you probably have some at home. You may even have seen some

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of their amazing properties like, in particular, water repellency. In fact, they sound like wonder materials and yet there's a problem.

Recent research has shown that small amounts of microfibres washed away as we clean our clothes are making their way into our rivers, lakes and oceans, just like the microbeads that have recently tabled to be banned in 2018. Microfibres are so small they pass through the sewage filtering system, although some are captured. But with millions of people washing clothes each week, those small amounts soon add up to tons of pollution. But why are microfibres so bad for the environment?

Our guest today, and we're delighted to welcome back Dr. Linda Campbell, and many of you may know she is definitely my better half, was the Canada Research Chair at Queen's and is now a senior research fellow at Saint Mary's. She is an expert in environmental science and, in particular, the impact of metals and certain types of molecules in aquatic ecosystems.

In her view, microfibre pollution is a serious issue we need to address and she'll outline some of the problems it presents to both us and aquatic ecosystems in the second quarter of the show. But, as some of you already know from her last appearance on the show, Linda is deaf. And while last time we didn't spend much time talking about issues of accessibility, the recent and very public halting of the release of the Nova Scotia **Accessibility Act** shows there is

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real concern about providing accessibility in the workplace.

Linda has agreed to talk to us about her concerns and her experiences related to accessibility in science. And if I can give just a teaser of her views, it's often not about what she can do but rather what people think she can do.

But before we get to Linda, I'm going to talk to my good friend, Richard, and I'm going to press the button and see if he's there. How you doing, Richard? Are you on the line?

RICHARD ZURAWSKI: Hi, Rob. It's only 8 o'clock in the morning here in Calgary.

DR. ROB THACKER: You'd normally be up for about three hours then.

RICHARD ZURAWSKI: Yes, well, I have been up for three hours. I got in late last night. I'm still on Atlantic Time. I was pooped but I woke up at 4 o'clock in the morning ready and raring to go.

DR. ROB THACKER: Oh, I bet, I bet. So do you want to just tell us a little bit about what you're doing out there while you aren't in the studio keeping us jovial and happy with your tones?

RICHARD ZURAWSKI: Well, I got tired of pushing buttons so I'm taking a bit of a sojourn. I'm the Green Party of Canada climate change critic in the shadow cabinet and the Green Party is having a special general meeting in Calgary at the Southern Alberta Institute of Technology ...

DR. ROB THACKER: Uh-huh.

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RICHARD ZURAWSKI: ... and about 350 Greens are descending on Calgary and the campus. It's a beautiful campus. It's still dark outside, just lightening up right now. And of course we're above the 49th parallel so the amount of daylight, as you just mentioned, is precipitously low. It hasn't reached the bottom just yet but there's a little more than ...

DR. ROB THACKER: You've still got 18 more days.

RICHARD ZURAWSKI: ... six and a half months we're on to summer ...

DR. ROB THACKER: Yeah.

RICHARD ZURAWSKI: ... that's all I can say. And it's not too bad; it's only about minus four or five out here. Tomorrow it's going to be minus 15 so I'm going to have to bundle up but that's what I'm doing here.

DR. ROB THACKER: So I've got to jump in and tease you a bit. I mean, it's the Green Party, it's environmental science; don't you all agree on everything?

RICHARD ZURAWSKI: You're giving me chest pains, Rob.

DR. ROB THACKER: So you probably saw that report this week about this issue that a lot of people who sort of deny climate change like to say, well, if you look at the rate it's slowed down. But there was a paper in **Nature** just this week showing that the probability of that continuing is really low.

RICHARD ZURAWSKI: Yeah. Well, what we have is a lot of the temperature uptake happened in the oceans and now we're

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starting to see ... we had an incredibly warm couple of weeks in the North Pole where temperatures again got above the freezing mark. Do you remember last year this happened. So the ocean uptake has been a really big problem in terms of the atmospheric temperatures.

DR. ROB THACKER: Well, it's one of the hardest parts we have in all of the models, and I know about this a little bit. So the interface between the oceans and our atmosphere really is the biggest difficulty in all of the modelling and as we learn more about that we'll actually make the models considerably better.

RICHARD ZURAWSKI: Well, what's really the big problem is nobody lives out on the ocean with the exception of Maritimers and Atlantic Canadians who do a lot of their livelihood on the ocean.

DR. ROB THACKER: That's where some people want you to live.

RICHARD ZURAWSKI: Around the coastal regions. But nobody lives out in the middle of the ocean so we don't sample things.

DR. ROB THACKER: Sure.

RICHARD ZURAWSKI: And so we ... and even if you have a million ships in the ocean, which we do, that's just a fraction of the information that we get from land surface. And really, land surface is only about 30 percent of the total surface area of the earth, so you're right, we don't know

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anything about the interface, comparatively, between the ocean and the atmosphere and so this has always been a bit of a bugaboo especially when it comes to the climate deniers.

DR. ROB THACKER: So I want to jump in on a little sort of slight tangent. So one of the things that came up on the Monday edition of the **Science Files** was someone complaining about me talking about space so I want to take issue with this and saying well, he never does anything; the most important thing that's ever come out of it is velcro. So I know that's not true and that velcro is pretty important.

RICHARD ZURAWSKI: Well, you see this is this idea that you have to have an immediate direct technological response to any investment (and trying is just stupid?). So many of our advances in science take time. And it doesn't matter if it's semi-conductors or different types of material science or engineering applications or even the application of mathematical theorems into science, it takes time and we don't know where the advances will come and to say that we do is the height of foolishness. And that's a neo-liberal inverted totalitarianism approach ...

DR. ROB THACKER: Well, and it's wrong as well so I want to jump in. Like, you just ...

RICHARD ZURAWSKI: Yeah.

DR. ROB THACKER: ... you mentioned it. You mentioned semi-conductors, and the amazing thing is like we all have cell phones with cameras now. Pretty much everyone

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who has a cell phone has a camera on it. And the sensor in that is no longer the charge-coupled device, the CCD, it's something called CMOS. And so CMOS ...

RICHARD ZURAWSKI: Yes.

DR. ROB THACKER: ... imaging sensors were actually spun off out of NASA. So now you're looking at billions and billions of dollars in revenues and so on that have come out of something that was essentially developed because NASA needed a more efficient imagining system. I mean it's kind of incredible.

RICHARD ZURAWSKI: No, but, Rob, let me jump in.

All you have to do is take a look at GPS. Without the theory of relatively, special relatively, we wouldn't have any idea of how to make it work, and that was invented/discovered in 1905 by a young fellow by the name of Albert Einstein. And so you say what good is it? Well, it's really good when it comes to GPS ...

DR. ROB THACKER: Yeah, when we look at ...

RICHARD ZURAWSKI: ... your global positioning ...

DR. ROB THACKER: ... how much money GPS is worth.

RICHARD ZURAWSKI: ... cannot function without special relatively.

DR. ROB THACKER: I know. And there's ... like, even enriched baby formula, memory foam, there's a whole bunch of things. In fact, if you're really interested just Google "NASA spin-off." There's over 40 separate things that are

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worth billions and billions of dollars of revenue now that NASA has contributed to.

So even though I don't think that's why we should do space exploration because the knowledge is about as an important a cultural thing as we do, nonetheless, there's a lot of economics that comes out of it.

RICHARD ZURAWSKI: Yes. And for me, I don't really care if economics comes out of it. When Fourier was doing his wave analysis ... trying to do Fourier Analysis, he wasn't thinking of weather models, but weather models couldn't exist ... weather forecasting couldn't exist without the boundary conditions that are imposed by Fourier Analysis so that we can come up with a grid network that actually does the forecasting for us. So I get tired of it, I get cranky about it, and it's just stupid.

DR. ROB THACKER: You get cranky.

RICHARD ZURAWSKI: Yes, so you noticed.

DR. ROB THACKER: Okay. So the last thing I'd like to sort of talk about in this opening quarter is I was wondering if you got to see ... and I think this is really interesting. I have a close friend who's suffering from Parkinson's disease, so this is something that I'm very concerned about, and I was wondering if you saw the release this week that they now believe there may be a link, and they've not 100 percent confirmed this, but there seems to be a link between bacteria in the gut and Parkinson's disease.

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RICHARD ZURAWSKI: Well, isn't that amazing. The gut bacteria becoming more and more and more important. We didn't even know that gut bacteria was an important part of ulcers. 40 years ago people used to have their stomachs half removed because of ulcers because nobody believed that it had anything to do with gut bacteria and now we know that gut bacteria actually cause you to do all sorts of decisions ...

DR. ROB THACKER: It's actually ...

RICHARD ZURAWSKI: ... in your brain.

DR. ROB THACKER: ... pretty amazing.

RICHARD ZURAWSKI: They influence it. Yeah, it's amazing. That's why we talk about probiotics; we talk about things like yogurt actually re-setting. When you take antibiotics to kill off the biota you have to re-introduce it again so that you have a healthy body.

DR. ROB THACKER: So I just want to talk about this study a little bit. So what's fascinating about this study is that they took, basically, feces from people who suffered from Parkinson's disease and gave this to mice who had been grown up in what they call a germ-free environment; they still have some bacteria in them but they've been grown up in ...

RICHARD ZURAWSKI: Did you say "feces"?

DR. ROB THACKER: I did indeed say "feces."

RICHARD ZURAWSKI: Oh poop!

DR. ROB THACKER: Oh, here we go. I'm not even going to come back with what I was going to come back with; not on

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air anyway. So anyway, they gave this to the mice and it turned out incredibly that the mice who were exposed to these bacteria from the people who suffered from Parkinson's disease actually developed motor problems of their own, which is really just mind-blowing. Because we've been so focussed ...

RICHARD ZURAWSKI: Yeah.

DR. ROB THACKER: ... on what's going on in the brain with Parkinson's, that to see this come out in a link to a bacteria is incredible.

Now I should say that they don't fully know what the exact link is, that's really hard to figure out, but nonetheless this may be the beginning of some new studies in figuring out the real complexities behind Parkinson's.

RICHARD ZURAWSKI: Well, you see, Rob, what this opens up is the question of co-relation and causation.

DR. ROB THACKER: Absolutely.

RICHARD ZURAWSKI: And when we start dealing with biological systems, sometimes it's really difficult to determine whether it's just co-relational, like chocolate and Nobel Prize winners in Switzerland ...

DR. ROB THACKER: Damn! I was just ...

RICHARD ZURAWSKI: ... or ...

DR. ROB THACKER: ... eating chocolate last night.

RICHARD ZURAWSKI: There is hope for you yet. I expect to see you in Oslo very shortly ...

DR. ROB THACKER: Okay. Thanks very much.

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RICHARD ZURAWSKI: Or is it (inaudible/voices overlap)

...

DR. ROB THACKER: All right, Richard, we're going to

...

RICHARD ZURAWSKI: ... Stockholm.

DR. ROB THACKER: ... have to head out for a short break but we'll be right back after these messages. Hold on the line, my friend.

RICHARD ZURAWSKI: All right, Rob.

DR. ROB THACKER: Welcome back to the **Science Files**. It's an interesting episode today because we've got Richard in Calgary. You still there, Richard?

RICHARD ZURAWSKI: I'm just actually talking to some colleagues here at the Green Party. They're really fascinated by the fact that we're using ... and it was pointed out to me that not only is special relatively coming into ...

DR. ROB THACKER: It's general relatively.

RICHARD ZURAWSKI: ... with respect to GPS but general

...

DR. ROB THACKER: Yeah.

RICHARD ZURAWSKI: ... relatively as well. So we can even look at 1916 as being a threshold. But enough of that.

I'm really excited about Linda being back on the show again.

DR. ROB THACKER: And so let me introduce Linda.

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Okay, so, listeners, Linda Campbell, Senior Research Fellow at Saint Mary's, welcome to the show.

DR. LINDA CAMPBELL: Very nice to be here. It's nice to see you again. I miss Richard, though.

DR. ROB THACKER: Richard, you should be here to talk with Linda.

RICHARD ZURAWSKI: I wish I could be. I wish I could be. It's such an amazing thing that Linda does.

First of all, dealing with toxicity is incredibly important; and secondly, pointing out that we get so much better when we become inclusive. And it doesn't matter whether it's women in science, which Linda is, or whether it's people that actually need different ways of looking at the world to help us out in science and further everyone else in science. And that's what Linda does so well.

DR. ROB THACKER: Absolutely. So I think the way we're going to do things is, first of all, we'll go with the microfibres today and then we'll focus on accessibility later in the show.

I do want to just mention that Linda is being interpreted today, so the interpreter is there for all of us so we can have this conversation as well. So if you see there's sort of like translation issues and so on, that's typical when we're dealing with different languages and that's fine. So let's lead with microfibres.

RICHARD ZURAWSKI: Ah, yes.

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DR. ROB THACKER: So first of all, we hear a lot about plastics and so on in the environment, particularly the Pacific Ocean; that area the size of Texas that's covered with or people say there's a lot of plastic in it. Can you give us an idea of how significant this problem is, Linda?

DR. LINDA CAMPBELL: Yes. Plastic is such an amazing material. You know, where we are now we wouldn't be here without plastic, so plastic can be a good thing; there can be many positives; however, the problem is what we do with it after we're done using it and we don't think about that. We just use it and then forget about it, so there's a lot of issues that come up because of that but we still have time to approach those issues. You know, ban everything, ban all the plastic forever, probably not, but still we have some considerations that we can do. For example, Canada has been very successful in banning microbeads in cosmetic products and that's a really great step forward.

DR. ROB THACKER: Okay. Can you explain what microbeads are? Because people hear a lot about this and it sounds like a fancy name but it's not always clear what they actually are.

DR. LINDA CAMPBELL: Microbeads, they're tiny partlets of plastic and they're designed to remove dirt from your face or your hands or whatever that's in the cosmetic product. That's really what it is. They're just very tiny, tiny materials and they go through filter systems in the waste water

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treatment plants. So in the morning you're scrubbing your face ready to go, it goes down the drain, but then what happens to it then? And that's the issue. So it gets into the environment through that way. It absorbs contaminants, fish will then eat those, it will be transferred up the food chain and then we're eating fish. So birds will eat fish, we will eat fish, mammals, really a whole lot.

DR. ROB THACKER: So how do we know that the fish are actually eating these things?

DR. LINDA CAMPBELL: Yes, there's been a lot of science that have done some investigation on this. So you'll open up a fish and you'll actually see them in the stomach and it's a massive amount. So depending on where they are from, but sometimes the plastics are incorporated into the tissues.

DR. ROB THACKER: So it's actually gathering in the stomach and intestines of the fish?

DR. LINDA CAMPBELL: Yes.

DR. ROB THACKER: And does that cause digestion problems for the fish, problems in the intestines and so on?

DR. LINDA CAMPBELL: Mm-hmm. And plastics also absorb the chemicals and then that will get into the intestine system and it's more acidic. And when that has been broken down with that digestive tract, the chemicals inside those plastics will be released and that will then be absorbed into the tissue of the animal.

DR. ROB THACKER: So is that a problem for what's

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happening in the whole food web, though? I mean, surely the fish that just eat them, I don't know, maybe they just go away or whatever or is it a bigger problem? Is there some kind of concentration of these effects in any way?

DR. LINDA CAMPBELL: The first part really looking at the entire ecosystem: things that eat the fish. And so what is inside of that is then transferred up the food chain, and it's whatever is eating the smaller fish and going up the food chain, and at the top there would be birds that eat fish. And it has been found inside of birds. We found microbeads. And so ...

DR. ROB THACKER: Wow.

DR. LINDA CAMPBELL: ... where are they getting ...

DR. ROB THACKER: Wow.

DR. LINDA CAMPBELL: ... birds don't eat microbeads. And they're so small. But really it's coming from the fish that they're ingesting.

DR. ROB THACKER: So we're already seeing things that go from rivers, lakes and so on, out of those into birds and then presumably other things eat the birds as well.

DR. LINDA CAMPBELL: Yes, exactly.

DR. ROB THACKER: Okay. So we've actually ironically talked about microbeads, but microfibres, these are somewhat different. Can you tell us exactly what microfibres are and more their properties and so on?

DR. LINDA CAMPBELL: Yes. The nice thing about

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microfibres is we have more control over that; we have personal control. For example, these microfibres are coming from clothing. Right now we're getting colder outside, winter is coming, and we see more and more people bundled with fleeces. We need fleece; we have to keep warm in the winter. But one thing when we think about that is when we're doing our wash of the fleece material what happens in that wash process. So we have pilling on our shirts, you know, how it pills up on fleece, and then that will come off in the wash process and then that gets broken down into very, very small parts and it goes through ...

RICHARD ZURAWSKI: Could I jump in here?

DR. ROB THACKER: Absolutely. Go ahead, Richard.

RICHARD ZURAWSKI: Okay. So what I wanted to ask was ... my understanding is that a lot of the plastics start to mimic some of the biological functions that we have. For instance, they start taking the place of some of the enzymes that we have in our bodies and the chlorine atoms and the fluorine atoms actually sort of insinuate themselves into our bodies and they can lead to all sorts of immune diseases and even cancers. Am I correct in assuming that?

DR. LINDA CAMPBELL: Yes, the chemicals within the plastic that will absorb onto the plastic as well and that goes through the environment and the chemicals can mimic a lot of biological factors, especially for organic contaminants. And, as well, the surface of your fleece, so like the

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waterproofing aspects and so forth, the nanoparticles that are sometimes embedded into the plastic, that can also be released in the wash process.

DR. ROB THACKER: I'm going to jump in with a question. Wasn't there an issue with something that ... some kind of chemical that was mimicking estrogen in fish or something?

DR. LINDA CAMPBELL: There's a lot of chemicals that will mimic estrogen. The structure is pretty common actually. So the organic carbon, six carbon, so those link together and it looks like a ring, and a lot of hormones have the same structure and a lot of hormones function on a lock and key. So that means that that is then fixed into that structure and it triggers the cascade effect of that process. So a lot of the chemicals that then mimic that structure can trigger that process, that cascading process, and leads to cancer and so forth, but that process doesn't follow exactly what the hormones' triggers do. But there are a lot of links to health issues.

DR. ROB THACKER: Okay. I mean, sorry, the human impacts of this are really quite incredible but we're going to come back. We're going to talk about this in more detail with Richard in Calgary, Dr. Linda Campbell here in the studio right after these messages.

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DR. ROB THACKER: And welcome back to the **Science Files**. We're talking microfibre pollution today and accessibility in science. In the studio is Dr. Linda Campbell and we have the heart and soul of the **Science File**, he's going to have a go at me for teasing him about that, Richard on the line from Calgary.

So I'm going to jump in. Richard, I hope you're still there as well. I want to ask Linda a quick question. And so the engineers would always probably come out and say, Well, you know, we could find some way of catching those microfibres or microbeads, so why don't we actually go and just do that?

DR. LINDA CAMPBELL: And to set up a filter with that fine enough filter material to catch the microfibres in laundry, wow, that would just require so much energy, a considerable amount of force to push that water through that filters; it would be very expensive for that solution.

DR. ROB THACKER: Okay. So we've got to have ...

DR. LINDA CAMPBELL: And really ... go ahead.

DR. ROB THACKER: Go ahead.

DR. LINDA CAMPBELL: And really, the waste water treatment plants, for example, Halifax Water here, and how they process the waste is really quite interesting. What they do with the water is they filter it through different filters, gravel, charcoal, sand, and very effectively, for their waste water treatment; 99 percent of waste within our water that is

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filtered out.

But again, with something that fine with microfibres it would still go through that processing and would require a lot of energy. The better solutions would become prior to actually entering the waste water treatment.

DR. ROB THACKER: Okay. So the other thing that I'm really curious about is, I mean, it feels like this is a really new topic and I'm just sort of curious to know how much research is being done about microfibres and microfibre pollution. Because I understand there was ... actually Patagonia who amazingly make all of these microfibre products were actually paying for research themselves which is kind of really socially responsible.

DR. LINDA CAMPBELL: Yes, they did a fantastic job. I read the report from Patagonia and it was very well done, and they analyzed each part of the chain for processing. So where the materials are from and all the way through to what happens with material afterwards. And it's quite ironic because they make their products from plastic bottles and ironic that they're trying to save plastic by recycling these bottles and then it becomes an issue at the end.

But really, again, going back to the beginning and how to work through that, they did fantastic work in their research and they found high quality materials doesn't break down as easily as others. So there's less of an issue with high quality materials.

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They also found that the front load washing machines are better compared to top load because it's more gentle cycle on your fabric and then there's less of those microfibrils that break off from your material that go through the waste water treatment. And they also looked at the type of detergent; which one would be better to use for washing your clothing and so forth. Very important solutions and what we can do now.

DR. ROB THACKER: So that's really surprising that different detergents could have an impact.

DR. LINDA CAMPBELL: Yes, some of the detergents they have what's like a stain-remover property to it, bleach, really anything that will then impact the structure of the fibre itself and it's more harsh with that stain removers and that will break down the fibres more quickly.

DR. ROB THACKER: So, I mean, part of ... again, the engineer comes through here, I mean, is ... you have to move fibres and fabrics around in the washing machine. I mean is there any hope of us being able to have a really smooth cycle? I would think that wouldn't clean very well.

DR. LINDA CAMPBELL: Exactly, yes. And it's quite a challenge. Washing machine manufacturers are aware of the issue. But, wow, it's those technical challenges that will come into play are really interesting. Whoever finds the solution will certainly make a lot of money.

DR. ROB THACKER: Talking microfibrils with Dr. Linda Campbell. So, I mean, the question obviously is right there:

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Is what are we going to do? I mean, amazingly we've taken all of these plastic bottles that we were worried about, converted them into something else and now we have another problem with those. What are we going to do?

DR. LINDA CAMPBELL: Keep going with the recycling of the bottles. You know, we have so many of those, we don't want to just throw those out and end up in the ocean at that great Pacific garbage patch swirling around in the ocean. So best to use those, but what we can do is think more in-depth about that process from start right until the end. And it does take that time. And it's worth the time to think about that whole chain and that will be less of a problem than at the end.

DR. ROB THACKER: I mean, are we envisaging banning microfibre clothing at some point? I mean, there are millions of pieces of clothing out there right now, I mean, that would be really difficult to do.

DR. LINDA CAMPBELL: I don't think that you could ban microfibres; that would not be effective.

DR. ROB THACKER: Okay.

DR. LINDA CAMPBELL: Because how many articles of clothing ... I think right now the sweater I'm wearing, it's a very nice sweater ...

DR. ROB THACKER: Yeah.

DR. LINDA CAMPBELL: ... but I'm sure it's a mix of nylon with synthetic fabric ... cotton, and synthetic fabric so, you know, I'm not going to throw this out just because of that.

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But we have to think again more carefully about our washing process and what we're doing with materials.

DR. ROB THACKER: Okay. Okay. Well, there we go.

So now I want to just switch directions just a little bit. So, I mean, it's clear there's going to be a lot more debate about what happens to research in microfibres and how we deal with their disposal, but I'd like to focus on accessibility. And you're a highly successful academic, former Canada Research Chair at Queen's, now a Senior Research Fellow at SMU, can you tell us a bit about how you got to where you are and any some of the issues that you feel comfortable about talking to within accessibility in your career and some of the barriers perhaps you faced?

DR. LINDA CAMPBELL: Certainly, okay. I'm trying to think how to make this message interesting talking about my journey, but I'll do my best.

DR. ROB THACKER: Okay, I'll make it easier. Do you want to start perhaps even with school, high school and so on, what it was like for you learning science in high school and what kind of accessibility issues you had there?

DR. LINDA CAMPBELL: Okay. I did not work with interpreters in high school or in university because I felt the best access to information was directly from the teacher. So not all people would use that same option that I certainly took advantage, but lip-reading or reading the book in advance, reading note-takers' notes. Luckily, I had

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wonderful science teachers in high school, and really very engaging; a lot of hands-on work. So it just really more motivation through that process because of those instructors. And it was not a (foreign?) topic at school; I was lucky in that way.

With university when I was doing my undergraduate degree, again, I did not use interpreters, I preferred using note-taking services, and that was a challenge but I found a really good note-takers and persuading them to work in my team. And I was very lucky again. And because those students were fantastic note-takers, the best, so that did work out in my undergrad. And when I went in to do my PhD ...

DR. ROB THACKER: I've got to jump in quickly on that. I mean, part of me thinks that in working with you like that you probably ended up helping them to work and do studying better themselves ironically.

DR. LINDA CAMPBELL: Mm-hmm, that's right. So what I did, part of my persuasion process in getting them involved was to sit down with them ...

DR. ROB THACKER: Okay.

DR. LINDA CAMPBELL: ... and I would bring my book, heavy books, and it became very fit, using my backpack, with walking everywhere with my books. So I brought those in and I had supplementary notes while they were taking notes, so it helped with spelling, drawing pictures, and so forth, and saved them time. And then we would combine both notes together and I

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think they really liked that.

DR. ROB THACKER: So we're talking accessibility right now with Dr. Linda Campbell and Richard is on the line from Calgary. Are you still there, Richard?

RICHARD ZURAWSKI: Yes, I am. I did want to jump in.

DR. ROB THACKER: Go ahead.

RICHARD ZURAWSKI: I do have a question about the link. And it appears to ... you know as I was listening to Linda talk, we have all these innovations that business starts to take and there's a big difference ... we're talking about washing clothes and microfibres and we're talking about the mitigation of the introduction of something that we really ... the sciences have been telling us for many years we have to be really careful with plastics because they're going to wind up in the ecosphere; they're going to wind up in mimicking hormones; they're going to wind up in the ocean but we just introduced them. And we look at that and call it the fault of science when, in fact, what it is is the fault of business because business trolls science and looks for these applications and we start producing clothes out of plastics in spite of the fact that we do know scientifically there are problems with that.

So right now we have a plastic problem precisely because of business but not because of the science. I just wanted to make that clear.

DR. ROB THACKER: And that's a very good point. I

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mean, and to a certain extent a number of the problems that come up we don't actually predict forehand as well, although we know obviously that disposing of plastics is an issue. And so one of the things that we actually can control if we're very careful about this is packaging, because packaging of plastics is one of the biggest issues.

RICHARD ZURAWSKI: And businesses, of course, will go to the cheapest common denominator. And so then that actually creates more work for Linda which in terms of scientific research because now we have ...

DR. LINDA CAMPBELL: Mm-hmm. And that does mean that we need to be ... apply very good solutions to the problems and that requires a lot of innovation for those solutions. So ...

RICHARD ZURAWSKI: Yes.

DR. LINDA CAMPBELL: ... different approaches to solving the problem and, therefore, science is required; it must require diversity in science. Different people go through different ...

RICHARD ZURAWSKI: We have to figure out how make business responsible for science.

DR. LINDA CAMPBELL: Yes, and we have to be more innovative.

RICHARD ZURAWSKI: Yeah.

DR. ROB THACKER: Well, Linda has just touched on something really important there, I think, and that's the impact of diversity and science, and I was wondering if you

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wanted to give us more examples of that. Because we tend to think of science as just being this thing you do, it has a very well, sort of, like, prescribed system for how you do scientific discovery and so on, but there seems to be a lot of evidence now that actually having different people can actually change how science gets done.

DR. LINDA CAMPBELL: And a lot of people do think that science well, it's an old man's club that do the work. They're in the white lab coats, they have their glasses on, and they come up with very clever solutions to problems, but science is very collaborative in the work. A lot of the ...

RICHARD ZURAWSKI: Oh, that's a wonderful comment.

DR. LINDA CAMPBELL: ... problems that we face right now ...

RICHARD ZURAWSKI: That's wonderful.

DR. LINDA CAMPBELL: ... are very complex. So that then does mean that we can't just have one approach to fix the problem; it doesn't work anymore. And so then how do we approach that? We really do need to support and welcome diversity into science. We have to be more diverse and have clever people working together and that's really wonderful because everyone will then bring their own perspectives and different ways of solving problems. And then when we bring these people together that then will really improve how we manage things within the world.

DR. ROB THACKER: So I think that's a fantastic

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comment because it's bringing out into the open the fact that science is based up on new and better and good ideas and different ways of looking at things and different solutions to things as well and the more different perspectives you have the better it can be. Okay ...

RICHARD ZURAWSKI: I think, Rob, you've hit on a point because I think back in the late 1800s/early 1990s Linda is absolutely correct, it was an old man's, white man's, purview to do science, and there was this thing called eugenics, which basically said ...

DR. ROB THACKER: Oh, good heavens.

RICHARD ZURAWSKI: ... men are better at science, certain races or certain skin colours are better at this and that and it became very exclusionary and hierarchical. And I think that, Linda, it's just absolutely evident on so many levels that contributions in science are collaborative and they can come from anywhere.

DR. ROB THACKER: Absolutely. You're listening to the **Science Files**. We'll be right back after some messages.

DR. ROB THACKER: Welcome back to the **Science Files**. We've been talking microfibres and accessibility in science today with Dr. Linda Campbell, and Richard is on the line with us in Calgary as he does a little bit of discussing with his

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Green Party friends.

So I'd like to talk and throw out a question to Linda. So we're not focussing today so much on physical disabilities, we're speaking largely about deafness, but one of the things that often people are interested in is sign language and so on. So I'd like to ask you how you handle sign language for complex technical terms and so on. A lot of people are very curious about that.

DR. LINDA CAMPBELL: Thank you, Rob. And it's quite amazing the way to explain science concepts in sign language. It's actually easier because sign language is a visual, it's a 3-D language, so that means that you set things up in space and all those concepts then are out in space, 3-D, and it's a very simple and quick to describe something. Within English it might take an entire paragraph or two or three sentences to explain something, but in sign language it could take two seconds to explain so it's really nice in that regard, and there's a lot of benefits with that.

And, as well, looking at science, it moves so quickly. Really, all languages within the world struggle keeping up with the science innovations that are happening. So, for example, in China they've developed new words for different technological items. Phones are being, you know, translated. How do we work with these kind of new terms? So it's not just sign language that is trying to keep up with science innovation; really it's an international problem how we keep

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up with the pace of science.

And what we're looking at for sign language is analyzing the concept "what's that word" and then how we can translate that and express it in sign language. Sometimes it's a transliteration; sometimes it's spelled, finger spelling; sometimes it's just expressed conceptually in sign language. And it's very important to have community involvement. They can't just have one person making up a sign, it really takes the community; has to agree on what this will then look like. So people will come up with different terminologies and we all then agree on which one is the preference or perhaps two signs that are preferable and it's a really dynamic process.

RICHARD ZURAWSKI: You know, as you talk, Linda, this is (something?) to me, because I've often heard that understanding multiple languages makes your brain work in different ways. And I'm thinking that learning sign language would actually be good to be taught in the early years in preschool and in school systems. Is this something that you think we should be doing and is feasible?

DR. LINDA CAMPBELL: I think everybody should learn it, yes, deaf and non-deaf.

RICHARD ZURAWSKI: Yes, I think it would be fab- ... I see ...

DR. LINDA CAMPBELL: You're going a little back off topic, but coming back, because I don't want to spend too much time on this, but it's quite ironic that we have all of these

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programs that are teaching babies sign language. So these babies are not deaf, they're hearing, but they're not then at the same time allowing deaf babies to learn sign language and it's a double-whammy. It's very ironic because deaf babies, they're not learning in their natural language. They can't hear. It's a visual language is what they require. But looking at non-deaf babies, they're learning two languages at the same time, so something I think that all children, yes, should certainly learn sign language from a very young age. You can ...

RICHARD ZURAWSKI: I agree with you totally.

DR. LINDA CAMPBELL: ... teach sign language to really someone before they speak.

RICHARD ZURAWSKI: As a politician, I would like to be able to institute something like that and I'd like to speak further with you on it once we get off the air.

DR. ROB THACKER: We can let you do that.

So I've got a ... now you've opened the politics can of worms, Richard, so now it's open, here we go.

RICHARD ZURAWSKI: I did. Yeah.

DR. ROB THACKER: So many people who are listening may well be aware that we have the **Accessibility Act** of Nova Scotia that's being developed right now, and I was wondering if Linda has any comments on that and to what extent she's been watching what's been going on and so on. Because I think it's fairly common knowledge that the initial release of the **Act** was

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actually held back and now it's under review under a real fine-tooth comb.

DR. LINDA CAMPBELL: Yes, Nova Scotia **Accessibility Act** is very exciting for all of us. And, yeah, people are looking at it economically and looking at the expense, but we also have to look at the economical benefits of including more diverse people into the workforce. So again, all of these abilities to solve different problems, different skills, wow, like that would be so fantastic for Nova Scotia. And it's really important to think that far ahead.

When we're talking about microfibres, again, we're looking back at that chain from beginning to end, so we have to apply that as well, and looking at microfibres' cost reductions from starting at the beginning to end. And that's the same with accessibility, we have to look at every part of the chain and the costs of inclusiveness and the benefits of inclusiveness. So the Nova Scotia **Act** is ...

RICHARD ZURAWSKI: If I could jump in, Rob.

DR. LINDA CAMPBELL: ... they're trying ...

RICHARD ZURAWSKI: One of the most important things about this is that it's an investment in the future and investments take time, they take money initially, but they have enormous dividends after a while. It's infrastructure in our society that's just as important as building a new building or transportation networks. Communication is crucial and I think this has so much potential. You know, I

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hadn't realized that, that's the other side of it, as to how much potential this has. So I'm really appreciative to hear this.

DR. ROB THACKER: Well, I think Linda has made the really key point here, that it's very easy to look at the situation where you have one particular business owner who's trying to deal with some kind of accessibility issue and talks about the costs there but, in fact, there can be significant other costs that are built up and improvements in terms of revenues at the end of the day that everything balances out and makes our society stronger.

But I just want to jump into Linda and talk about worldwide accessibility legislation. I mean, presumably Nova Scotia isn't the first to look at developing an Act; there must be other countries that have these, other provinces and so on. And I was wondering if you could give people examples of where they could go to look at what's been done elsewhere.

DR. LINDA CAMPBELL: Yes. In the States they are the leaders in this type of accessibility Act. And you and I were just watching the movie, the Bluenose Film Festival, and it's talking about the woman who helps lead Accessibility Acts in the United States and all of the disability people lying on the street protesting for accessibility. And that led to the **Americans with Disabilities Act**, the **ADA**, and that's such a powerful Act in the States, and that has improved the social complex in the States, and that's a model for the entire world.

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And there's a lot of other countries as well, are developing Acts.

Here in Canada there are two provinces that have already enacted Acts; one is Ontario and one is Manitoba. And Nova Scotia could be one of the leaders in terms of provinces developing Acts. And I think we can improve on the Ontario and Manitoba Acts here in Nova Scotia. The opportunity happens next week. There will be open consultation periods, and that's December 7th and 8th, and so I encourage everybody to think about following the news for those consultations.

DR. ROB THACKER: So are we working on anything federally? Like, I mean, I have to say that Trudeau seems to be very interested in making sure that we do address a lot of these issues. In particular, everyone knows that his Cabinet he had representation of women and is very concerned about these issues. What's happening on the federal level?

DR. LINDA CAMPBELL: And it's very interesting; at the federal level as well things are happening. So, for example, Justin Trudeau, our Prime Minister, has gone ahead and developed a **Federal Accessibility Act** for across Canada. So that's in the consultation period and so that will be for all Canadians, so that consultation period is happening right across Canada in different provinces. And for Nova Scotia, that will be on next week as well, it's going to be a busy week, and that's December 9th, and that will be here in Halifax. And that will be consulting with all Canadians and how we then can

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become better accessible society for everybody.

DR. ROB THACKER: So we're beginning to run out of time but I just want to ask: Where should people go to get information about this if they're curious about accessibility legislation and what it means for Nova Scotia?

DR. LINDA CAMPBELL: For the federal level there is ... I think if ... there's a website that's very complex, but if you just Google "Federal Accessibility Act consultation" that will take you to the right link. Probably the first link on the list. For Nova Scotia, it's more of a challenge to find that information. If you go to the Disabled Persons' Commission, their website, they have information there.

DR. ROB THACKER: Thank you. And we have run out of time. Thank you so much, Linda, for coming on the show, always appreciate your points of view and learning about what's happening in the environment and also accessibility.

I'd like to thank Richard, my good friend. How are you doing?

RICHARD ZURAWSKI: Well, we're all milling around just getting ready for the 9 o'clock launch here. And this has been an amazing show.

Rob, I'd like to thank you for facilitating this. Linda, amazing. I would like to ... I think we need a **Science Files** based just on this kind of stuff, this is just fabulous.

DR. ROB THACKER: We'll have to work on it. I've got to cut you off my good friend, I'm afraid. And we've got to

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thank you Katie behind the glass. Thank you so much Katie.
Thank you everyone for listening. Join us again next week for
a fantastic show on science.

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