

Jasmin Habib: The title for the next group's presentation is, 'The Rise and Response to Anti-Science Movements.' You will have seen their exhibits if you were here earlier. We have Ben Maclellan, James Mallari, and Erin Tonita.

Erin: Hello, today, we're going to be talking about the research that we did these past couple of months, tackling the topic of science and democracy with the threat of populism.

To start, science is absolutely integral to democratic society. Democracy relies on having a public that is educated and able to advocate for policies and decisions that are in their best interests.

However, the recent rise in populism has challenged this. So, science is viewed as an establishment, and sometimes populist ideals view this as elitist and something that's not to be trusted.

At the same time, there's also been a rise in scientific illiteracy, as well as misinformation through the form of anti-science movements. This has just led to a population that is more vulnerable to misinformation and not being able to advocate for policies that are in their best interests.

Today, we're going to walk you through our research findings as well as our exhibit that we just hosted recently, exploring the relationship between science and democracy.

You can probably tell who we all are because we're dressed the exact same as in these photos. So, as future scientists we're interested in how science plays into democracy, because we want to be able to further democratic pursuits through our lives as future scientists.

So, I'm Erin, I study Physics at the University of Waterloo.

This here is Ben, he also studies Physics, and James who is studying Psychology and also has a background in Biology.

James: The main goal for our project, the overarching one, was to address science in the context of scientific illiteracy, mistrust, and misinformation.

This is just an overall view of our exhibit as a whole. We had a main poster exhibit, which addressed the main concepts, as well as individual separate exhibits, which zeroed in on the specific topics of interest, and provided some suggestions and recommendations for each of those topics.

Ben, took a look at open science, Erin explored art in relation to science, and I, myself, took a look at citizen engagement and public participation in science.

The main poster presentation looked at science, the scientific community and establishment, the institution that produces knowledge, looked at opinions, the public opinion, the perceptions, the preferences, policy as well. Policy as in, user allocation and restrictions and how all of these three things interplay with each other in a bi-

directional manner, and how populism can emerge from these ... From the quagmire of today's political environment, and the implications of this to the future of democracy.

Ben:

Great, so this took the form of three academic style posters. There are a lot of different ideas that we've had in there, so I'm just going to summarize a couple ones that we thought were important just to give you an overview of some of our findings.

So, looking at maybe the first, call it a branch, the first concept of science. Really, really important in discussing the interplay between science, opinion and policy, is science communication. So, it's absolutely crucial how knowledge and research findings are disseminated to the public.

And, this doesn't always work, sometimes scientists don't know how to communicate properly, or the channels are biased. However, that information which gets from point A to point B influences the perspectives that the public has of science, both as the findings and as an institution, as well as influencing the policy side.

So, creating legislation that is evidenced-based, that's how policy should be made, in our opinion, it will give the best results for the majority of the public.

Now, looking at the second branch, so, opinion. Democracy is very much built on the politicians, the representatives who listen to their constituents. It doesn't always happen, but it's an important part. So, public opinion on any matter should again, it doesn't always, if you heard the quote from Henry earlier today, a little scary, that a large portion of legislation was pushed through by lobbyists, but the politicians should listen to their constituents.

And this gets interesting when the information that the public has may be misguided through biases or misinformation. Looking at how science and opinion interact, there's a lot of barriers to the public engaging with science. This is a huge issue, it's both a result of, and contributing to the distrust that some people have in the scientific establishment.

Now, moving over to our last column, or last concept is policy. Policies can often define or help define our societal norms. So, the way that we framed legislation in the past affects how people think of it in the future or currently.

An example of this would be, the current opioid crisis, in that our past legislation on illegal drugs is framing the stigma that people have around addictions, and making it hard to implement the fast acting, effective policies for this issue.

As well as policy interacting and influencing science, the biggest way that this happens is through funding, and the regulations that are around what you can research, etc. So, the funding that's given to researchers defines what we would research and where we go as a scientific avenue, especially when political parties are changing often,

long-term research can often be hard to sustain, and this makes it difficult to make some evidence-based policies because there's not been resources there to fully understand the problems that we're dealing with.

That's an overview of what we called our main posters, or main exhibit, of the issue that we looked at. Now we're going to go through individual recommendations based on some of our interests.

I looked at open science. So, science is a public good, it's paid for by taxpayer money, right? The money you pay with your taxes goes to researchers, some amount of it, to perform basic science research and to improve our society.

Yet, most people cannot access any of that research, it's hidden behind a very large paywall often. You need to be a part of a large institution with lots of funding to access it. So, I'm arguing that this can foster distrust in the scientific establishment, and weaken the dissemination of knowledge. People don't have access to the most up to date findings and understandings of the world.

Now, one avenue that I think is important to consider and move toward is open science. Open science is the belief that anybody, anywhere, anytime, has access to any science, any research findings. And, this will hopefully, improve transparency, reputability, and education.

Now, this has been a growing trend in recent years, it is on the rise, and a lot of publishers are moving to this model. Away from the paywall model, there are lots of complications but I think it's a good pursuit to have. I just wanted to say, on the education that having both the science, the methods, the data open source, available to anybody, can improve the education that we're able to have. Because, both teachers and students have access to the most up to date, most important and relevant resources possible.

Now, to display this information, our findings, I'm a science student, I'm a Physics student, I really like numbers and data. We all took different approaches in how to display this, so I took, buzzword here, but I took a data-driven story, as I called it. A little flashy interactions with the data. But the story of you as a public citizen, your taxpayer money, where's it going to, and how is this interacting with science? And then, how is the current model of publishing, the paywall system, how does it work? How does open access work? And then a little bit of analysis on what some of these outcomes, positive and negative, with open access could be?

To sum up, I firmly believe that open access is a great way to move forward in terms of improving scientific literacy and trust in the scientific establishment.

Erin:

My mini exhibit that I focused on was the combination of art and science. The hope was that by combining art and science, we can reach a wider audience in a more accessible manner.

One of the main findings of our research, that we conducted was that, the most effective way to actually communicate science is through an interdisciplinary approach between science and art.

Another benefit of this is that fostering a mutual appreciation between scientists and non-scientists alike, was also found to improve the effectiveness of communicating science.

When that appreciation was also fostered, we were able to dismantle this elitist label which is another benefit. My personal opinion, it is also a really fun and engaging way to learn. So, I took the approach of actually creating some paintings and poems that combine science and art.

I took the lenses of telescopes and microscopes alike to look at some unfamiliar yet familiar, close and far. I created a series of four paintings displayed here, and I used digital painting as a technique to further deconstruct the binary between science and art. And then, each painting was displayed in the exhibit with a little blurb describing what is actually depicted, and describing some of the actual science behind what you see.

The hope was to engage the public, all of you hopefully, in some science, and learning science through, maybe a more interesting way than you typically come across.

In the top left corner of the slide, is probably what everyone can most easily recognize, snowflakes. In Canada, we are pretty familiar with these structures. They come down every year, quite a lot. And so typically we see them as white, colorless. But, when they're viewed through polarizing lenses, we can see this rainbow effect that reveals some details in their structures.

So, that's represented by the middle flake. And then, the painting next to this is actually some neural stem cells. Stem cells are a very active area of research right now. They're very interesting because they have the ability to differentiate into a number of different specialized cells such as brain cells as well as tissues'. This can be very interesting for treating different medical diseases, and is being researched quite heavily right now.

And, in the bottom left of the slide, we have the cosmic microwave background radiation. So, this is radiation that's permeating all around the universe, pretty much uniformly. And it's all around us right now.

Since it's microwave we can't actually see it or observe it, but when we have microwave sensitive instruments we are able to see this. And it's also quite interesting because it's believed to have originated from the very early stages of the universe. And, that's why we give it the label of the cosmic microwave background.

And, the last painting I have up there, is of a semi-conducting crystal. This is a material that is commonly used in thin film solar panels. It's

usually chosen because it has a really good ability to convert sunlight into electricity.

And then as another component of my project, I also converted some scientific paper abstracts into poetry. Which is fun and had some silly results.

James:

I took a look at the divide between the scientific community and the public, and how public participation could actually address this.

It's a multi-faceted issue, but I have chosen to highlight a few main things that I could possibly address. So, is viewed the public as an outsider, from the perspective of scientists. A serious scientist found that about 50% of respondents saw the public as non-scientific. And, 25% as outsiders, already then creates the divisive kind of relationship.

Ineffective science communication is contributing to lower scientific literacy rates. Ineffective science communication fails to reach the public, but it also allows for alternative communicators to drown out the voices of scientists and accurate representation and having competing agendas fill that void.

The idea of alienation can also occur, because knowledge is power, right? For those who do not have the access, ability or the resources to produce their own knowledge, they can feel disenfranchised. So, Karen Cooper calls these intellectual have-nots.

So, how can public participation address this? Citizen science which is involving the public in the actual research, used in partnership with professional science, not only brings in the public to this scope of research, it also helps in increasing the scientific literacy rates by direct public engagement.

What does this look like? It could be one person, it could be a million people, with varying degrees of participation, from just data collection, and contribution, to collaboration and cool creation of science. Anyone can be a scientist, it's pretty nuts.

At the same time, it can empower communities, like I mentioned, knowledge is power. Science addresses the community's questions, the kinds of things that are important to them. It allows the community to produce their own new and reliable knowledge. This also helps develop social capital.

So, communities can gather around common goals and this helps to shift the power dynamics. Because power is central to the idea of politics.

By doing that, it helps promote this idea of democracy. My exhibit was artsy. I created a participatory display where visitors were asked some questions and invited to answer them and post them. The display is kind of a play on the "Beyond Ideas" branding, which I have some issues with.

Well, anyway, beside the point. The display is meant to engage the public with big questions of science, much in the way that citizen science does.

Erin:

To sum up our presentation, we explored how science and democracy interplay, and we also looked at how populism comes into this. We focused mainly on the flow of scientific information, looking at how science informs public opinion and policy.

We also looked at some avenues for potentially tackling the threats of anti-science movements, and some populist ideologies that are a threat to science, including open science, interdisciplinary communications, as well as citizen science.

Ben:

We just want to leave you with a cliché picture of Calvin and Hobbes, and a quote by Isaac Asimov. That nations may be divided in everything else, but they share a single body of science.

Thank you so much for your attention.