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SCIENCE AND WELL-BEING: FROM AMAZEMENT TO CITIZENSHIP CONFERENCE
Session: Humankind on Earth: Wisdom and Responsibility to Co-Exist

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Via Videoconference to Monterrey, Mexico

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Before I begin, let me say how honoured I was to be invited to this conference at the University of Monterrey and I regret very much that I am not able to be with you in person today.

I wish to thank Dr Fernandez for suggesting that I participate via videoconference link. I appreciate this opportunity very much and look forward to a stimulating dialogue today.

Introduction: Global warming—how did we end up in such a crisis?

There is perhaps no issue facing the world today that is more contentious than global warming.

For more than two decades, scientists have been trying to convince the public that global warming due to the accumulation of greenhouse gases is a reality, and that humanity needs to respond quickly to slow the warming or face significant, possibly unmanageable, environmental changes.

It hasn't been an easy story to tell. Global warming is a complex phenomenon with multiple causes and effects, requiring careful and sophisticated scientific investigation and analysis in a variety of academic disciplines.

Yet, in spite of this complexity, consensus within the scientific community about global warming has existed for years.

In contrast, the community at large has been mired in emotional controversy and debate about the problem—unable to come to consensus. And as result, many people have been unable to respond to the problem with little more than a rising sense of panic and hysteria.

Take Canadians as an example.

As a northern nation, Canada is in a better position than most countries to see first-hand the causes and effects of global warming.

It is in the Arctic, as we know, where the effects of global warming are most easily seen.

Although largely uninhabited and located far from southern industrialized cities, the Arctic has become a sort of "dumping ground" of industrial waste, toxic air pollutants, and chemical contaminants transported to the Arctic from the south by air flows; oceanic currents; animal, bird, and fish bodies; and, of course, by humans.

Yet, in spite of our relative proximity to this crisis, Canadians have been just as emotional and confused as others in our response to the problem.

Scientific literacy versus passion and emotion

How did we end up in such a crisis?

Part of the answer lies, I would argue, in the fact that many people lack the scientific literacy needed to understand the science of global warming.

What do I mean by scientific literacy?

Scientific literacy is not only a set of skills or the accumulation of scientific knowledge, but it is also—even primarily—an attitude towards learning and the world.

An attitude that is rooted in wonder and curiosity about the natural world. One that leads to a constant process of questioning and analysis in a constant pursuit of knowledge and wisdom.

Scientific literacy is, in some ways, the refinement of a child's spontaneous response to nature.

Think of a tiny girl out in the garden. She sees a bee fly into a flower.

"What is it?" she asks……"A bee," you answer.

"Why is the bee in the flower?" she continues.

"To drink the flower's nectar." you respond.

And so the conversation will continue to move forward as she observes with curiosity, questions, and asks another question building from the one before it.

As adults, we encounter much more complex phenomena than bees in flowers, but the depth—or absence—of our scientific literacy is revealed in our willingness to move through the same kind of questioning process.

Are we willing and able to look at the phenomena before us, ask questions, listen to the answers, and move forward in the conversation?

We might characterize this conversation as a Socratic dialogue guided by reason.

Indeed, reason is a crucial element of scientific literacy.

History reveals that when people lack the scientific literacy to assess an issue, they tend to respond to scientific problems with emotion and passion rather than reason—passion that is coloured by all sorts of social, economic, and personal fears and concerns.

A variety of examples come to mind: the very slow acceptance of the value of hygiene in preventing the spread of infection and disease in the 19th century; the dangers of smoking; or the destructive effect of human-generated CFCs on the ozone in the 20th century.

In the current case of global warming, the public's emotional and passionate response has been fed by a host of interpretations of the future promoted in the media by special interest groups, popular culture, and religion—rather than science.

For instance, people's worries for their economic welfare have been inflamed by special interest groups—largely from business, government and industry—who forecast that combating global warming will lead to economic catastrophe both on the global and personal level.

Hollywood and other forms of popular culture have fed people's panic by depicting unrealistic catastrophic climate changes in movies such as "The Day After Tomorrow."

Even religious leaders have fuelled believers' apocalyptic dreams of the second coming—reading in the increase of unusual climatic events that this signals the end of the world.

These responses may be unreasoned, but they are powerful because they arise from strong passionate emotions that *over-ride* reasoned assessments of the scientific evidence.

From my perspective, these emotional and passionate responses to global warming reveal a general lack of scientific literacy in the world's citizenry today.

How to build scientific literacy?

It has become a truism that literacy is critical to democracy, but clearly "scientific literacy" is as critical a part of engaged citizenship as reading and writing.

Every engaged citizen, scientist or not, needs to be scientifically literate—to have the capacity to understand and reasonably evaluate scientific issues in order to have the determination to take action to effect change.

How do we, as science educators, build this scientific literacy in our citizens?

We must start at the beginning, by fostering a child's curiosity and wonder in the natural world.

As the title of this conference suggests, amazement is the root of responsible citizenship because, as I mentioned earlier, it stimulates that attitude of inquiry and analysis so crucial to a citizen's ability to assess evidence with reason.

We must also give citizens the knowledge they need. We must persist in communicating to the public the science of global warming.

Because Canada, as an Arctic nation, is a better position than many other countries to observe and assess the effects of global warming, the University of Alberta is taking a leadership role in developing a greater understanding of these effects.

Our campus is home to the Canadian Circumpolar Institute—a network of more than 200 researchers involved in research relating to Arctic regions around the globe.

Some of the world's most prominent northern researchers are now based at the University of Alberta. Let me tell you a little about the research activities of the Canadian Circumpolar Institute.

Social Anthropologist, Mark Nuttal, is the lead author of the International Arctic Council's ground-breaking *Arctic Climate Impact Assessment*.

Professor of Earth and Atmospheric Sciences, John England, along with his team, are making important discoveries about the chronology and dynamics of Arctic ice sheets and their impact upon sea level changes.

Biologist David Hik is studying changes in animal populations, the structure of tundra, and the composition of alpine meadows in order to assess their relation to climate change.

As you can see, research at the Circumpolar Institutes is highly interdisciplinary. Together the members of the Institute are attempting to draw as full a picture of circumpolar activities and the effects of global warming as possible.

This research has the potential to radically change our view of the Arctic.

But we face an important challenge.

Challenge before scientists

How do we, as scientists and science educators, translate academic discoveries into public knowledge—how do we move new knowledge out of the university and into the public imagination?

How do we give them the knowledge that can create scientific literacy around the issue of global warming?

How do we give them the tools they need to redirect their emotional and passionate responses to global warming from a place of fear and panic to a place of determined collective action?

It is not easy and I do not have the answers.

But, history can be instructive—and it can give us hope.

I find enormous hope, for instance, in the example of Mario Molina and Sherry Rowland, Nobel laureates in Chemistry.

As you well know, after Molina and Rowland published their first paper in 1974 outlining how human-generated CFCs were causing serious harm to the earth's ozone layer, it didn't take long for the majority of the scientific community to accept their findings.

The public response, however, was much different.

Emotions and passions were inflamed by special interests groups—mainly from industry—who called Molina and Rowland's science into question while raising public fears about the devastating economic impact of reducing CFCs.

With the public's attention pulled away from the science into an emotional realm, the average citizen failed to get behind actions to reduce CFCs.

Everything changed when a hole in the ozone appeared over Antarctica in 1985. Within two years, an international agreement to phase out CFCs was signed.

That agreement, known as the Montreal Protocol, has been called by former UN Secretary General Kofi Anan the most successful international treaty in history.

What caused the transformation in the public response to the CFC issue?

Emotion and passion changed to determined action.

When?

The change occurred when the scientific evidence *overtook* attempts to turn the issue into an emotional debate based upon half-understood facts and fears.

It happened when the public gained enough scientific literacy on the issue to redirect their energy from defending their personal interests to fighting for the good of the entire globe.

Signs of hope

There are hopeful signs that we are on the precipice of a similar transformation in public opinion around global warming.

The fact that Al Gore was awarded the Nobel Peace Prize is one such sign.

As he has indicated through the title of his movie, "An Inconvenient Truth" and his book "The Assault on Reason," the transformation of citizens from panicked inaction to determined action depends on their rejection of the irrational and their acceptance of scientific evidence about global warming.

It is critical that scientists take advantage of this moment to increase the scientific literacy of the global populace—to advance the world's knowledge and understanding of the problem of global warming and also work towards the development of effective solutions.

Again, Canada's unique geography and history means that the University of Alberta has a critical role to play.
Due to our proximity to huge reserves of natural gas and oil in northern Alberta, the University of Alberta has been a leader in the development of technologies which have improved oil and gas exploration and production for decades.

We are now poised to move forward in response to global warming to become leaders in the development of sustainable and alternative energy sources.

In partnership with other Albertan and Canadian institutions, we have recently created the Canada School of Energy and Environment.

Our collective aim is to stimulate the development of new technologies to mitigate the environmental impact of current energy sources while acting as a catalyst for the development of sustainable alternate energy sources.

In order for the public to choose these alternatives—to take determined action—in response to global warming, they need to be scientifically literate about both the problem of global warming and potential solutions.

Let us look to the example of Mario Molina and Sherry Rowland—or that of many other scientists in history who have stood up against prevailing opinion and political might—and persist in educating our students and the public.

If we do, then perhaps change will begin. Perhaps then the world's citizens will come together—as they did in eradicating the production and use of CFCs—to take determined action against global warming.

Thank you.