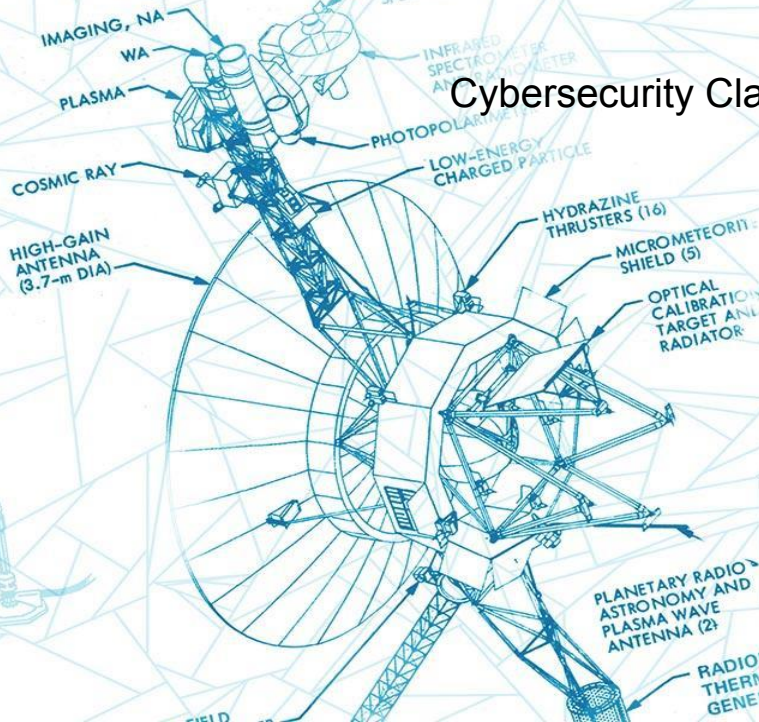
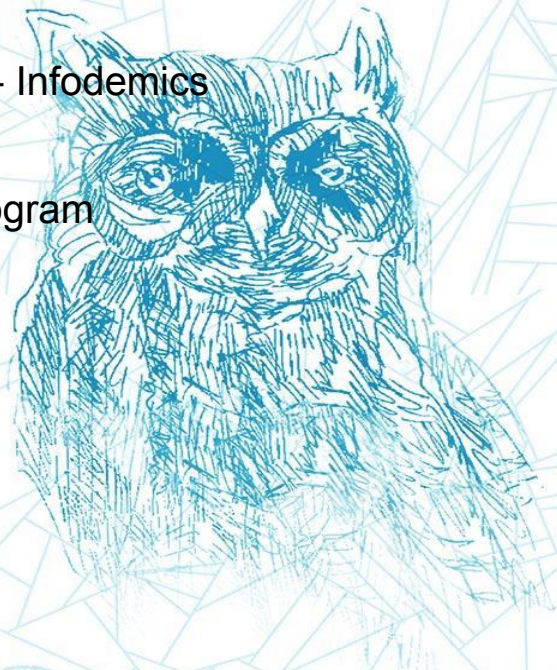


# Science

Digital Science - Scientific Facts and Fakes - Infodemics

Cybersecurity Classroom Training Program





# Module purpose

This module has been created to help students and teachers explore science through the lense of technology. The sections and activities of this module are appropriate for grades 9 through 12 and are compatible with all science courses (from general sciences to physics, chemistry, biology, environmental studies, and Earth and space science).

A goal of the module is to explore the benefits and the dangers of technology on science and scientific research.

**“A scientifically and technologically literate person is one who can read and understand common media reports about science and technology, critically evaluate the information presented, and confidently engage in discussions and decision-making activities regarding issues that involve science and technology.**

Science Co-ordinators' and Consultants' Association of Ontario (SCCAO) and Science Teachers' Association of Ontario (STAO/APS0), 'Position Paper: The Nature of Science' (2006), p. 1” Ontario Curriculum

# Module sections

- **Section 1 - [Real world science](#)**
  - ◆ Activity - Evaluate scientific adaptability
- **Section 2 - [Scientific abilities](#)**
  - ◆ Activity - Science communication project
- **Section 3 - [Concepts of science](#)**
  - ◆ Activity - The journey of a scientist

# Section 1 - Real world science

**Section Summary:** This section will relate science to technology, society, and the environment through linked topics.

**Section Steps:**

<u>Explore</u>	<u>Discovery</u>	<u>Evidence</u>	<u>Current Events</u>
#Technology #Physics #Space	#Data #Crowdsource #Research #Algorithm #AI	#Statistics #Data #Government #Research #Metrics	#Discrimination #Documentary

**Section Activity:** Evaluate scientific adaptability



# Section 1 - Explore

We never had pictures of black holes, but that changed in 2019. Before this moment, it was impossible. It took years of work for hundreds of people to achieve this accomplishment. This picture was taken at the very limit of our scientific capabilities (theoretical, experimental, and technical).

This process was documented with a film. Black Holes: The Edge of All We Know is “[A documentary film following the quest to understand the most mysterious objects in the universe, black holes.](#)”

[The Edge of All We Know](#)

by Peter Galison



# Section 1 - Discovery

Thanks to technology you can also participate in discoveries even if scientific research is not your job. This type of voluntary participation is “[citizen science](#)”. Participants of amateur scientists usually have desire for discovery and exploration. Their participation is also useful to the scientific process. For example, having a lot of people is an effective way of going through tons of visual data. Even with modern AI, sometimes humans are needed to look through images to find patterns for scientists. The following article discusses the resurgence in citizen science during the COVID-19 pandemic.

READ: [Citizen science is booming during the pandemic](#) by Sigal Samuel

An interesting idea of citizen science is to have more people participate in the scientific process. There is obvious value in having the public involved in this process, “At a time when public trust in experts has declined precipitously, some scientists are arguing that a more collaborative research model can help counter science skepticism.” Citizen science may be a solution to remedy public trust of science by using technology for the good. Having a collaborative process could also help to counter some of the amplified anti-science voices on the internet.



## Section 1 - Discovery (Cont.)

It is possible to be passively involved in citizen science all the while still having an important impact. It is even possible to start at home right now. One way of doing this would be through the Folding@home project. This distributed computing program folds proteins to develop open source therapeutics.

DISCOVER: [Folding@home: Together We Are Powerful](#)

Folding@home competes with the best supercomputers. Their interconnected network of GPUs and CPUs from around the world is very powerful. This solution is cost-effective and efficient.

WATCH: [FIGHT Coronavirus From Home! - Folding@Home](#) by Techquickie

To participate, you can simply use the computer you have now or build something new. There are guides that can help you start, such as this one "[Building an Efficient Desktop Machine for Folding@Home](#)".





## Section 1 - Discovery (Cont.)

FACT: “Despite these glitches, F@H zoomed to a peak performance of 1.5 exaFLOPs, making it more than seven times faster than the world's fastest supercomputer, Summit, at the Oak Ridge National Laboratory.” ([The coronavirus pandemic turned Folding@Home into an exaFLOP supercomputer](#) by Andy Patrizio)

It also reached a peak performance of “[reached 2.43 exaflops by April 12, 2020](#)”.

SCALE: “[An exaFLOP is one quintillion \(10<sup>18</sup>\) floating-point operations per second, or 1,000 petaFLOPS. To match what a one exaFLOP computer system can do in just one second, you'd have to perform one calculation every second for 31,688,765,000 years.](#)”

Researchers can save a lot of money by using this type of peer-to-peer network. Although, it is true that some of the cost (like electricity) are covered by the users of the network.

“Summit, funded by the U.S. government, cost about \$200 million and is capable of making 200 quadrillion (that’s 200,000,000,000,000,000) calculations per second.” ([Meet Summit, the world’s most powerful computer](#) by Boris Ladwig)



# Section 1 - Evidence

Gathering data is key to using technology to support scientific research.

It is important to ensure a high quality of information. Although, it can cause serious problems when shared information is unreliable.

DISCOVER: [How to use Dimensions data in scientometrics research?](#)

Our current scientific research efforts require collaboration from many people from around the world. So this type of global research requires data management solutions. Having a simple yet efficient data collection systems will be the key to achieving successful collaboration.

[Dimensions.ai](#) is “a more open and comprehensive data infrastructure that empowered users to explore connections between a wide range of research data.” The technology and tools that we have should empower researchers with easy access to the information they need.



# Section 1 - Evidence (Cont.)



Government  
of Canada

Gouvernement  
du Canada

## Science and innovation

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Scientific research, funding, datasets, innovation support, facilities and educational resources.

EXPLORE: Navigate this site to find a reference page related to your science class and something you studied. This can give you an example of real-life application and a Canadian example.

The Canadian government supports many scientific endeavors. They might provide financing for research or for services. The links below show the different aspects of science the government is involvement with.

### Services and information

[Biomanufacturing](#)

[Research funding and awards](#)

[Science subjects](#)

[Open data, statistics and archives](#)

[Research institutes and facilities](#)

[R&D and innovation](#)

[Intellectual property and copyright](#)

[Directory of scientists and research professionals](#)

[Science education resources](#)

[Our environment](#)



# Section 1 - Evidence (Cont.)

Another example of data management in the modern world of networking and web searching is a service like Altmetric.

They, Altmetric, “Provide detailed attention insights for faculty, staff and students and help them see a richer picture of the reach and influence of research.”

EXPLORE: [Altmetric Top 100 in 2020](#)

“87.7 million mentions”

“3.4 million works”

**THE 2020  
ALTMETRIC  
TOP 100**

Altmetric tracked **87.7 million** mentions of **3.4 million** works in 2020. Here are the 100 most discussed articles across 20 disciplines.

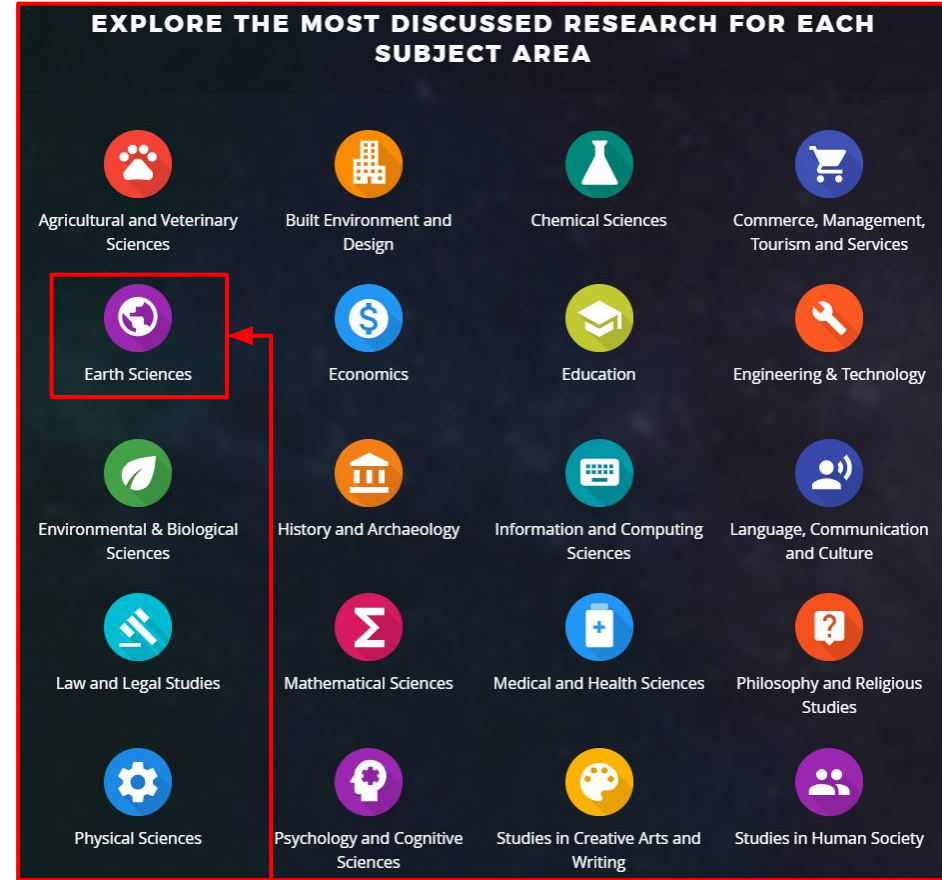
[About the Top 100](#) [Explore the full list](#)



# Section 1 - Evidence (Cont.)

On this web site it is possible to navigate the “most discussed research” based on a lot of different topics. Going from agriculture to human society studies.

EXPLORE: Let’s find the first article as a demonstration. If we click on “Earth Sciences” we’ll see the list of research articles for this subject area.



# Section 1 - Evidence (Cont.)

Below is the first article in the “Earth Sciences” category. You can also see the corresponding Altmetric score for this article, “4863”. The second picture on the side is the communication and sharing breakdown for the article. Click on the picture below for “More info”.

Showing 5 articles in subject area **Earth Sciences**



#19 of 100  
Global human-made mass exceeds all living biomass

In 2020, human-made material, or ‘anthropogenic mass’, outweighed natural biomass on Earth. For every person on Earth, anthropogenic mass equal to their bodyweight is produced every week.

Published in *Nature*  
Date December 2020  
Subject area **Earth Sciences**

[More info](#) [Open Altmetric Details Page](#)



# Section 1 - Evidence (Cont.)

What is genomics?

DEFINITION: “[Genomics also involves the sequencing and analysis of genomes through uses of high throughput DNA sequencing and bioinformatics to assemble and analyze the function and structure of entire genomes.](#)”

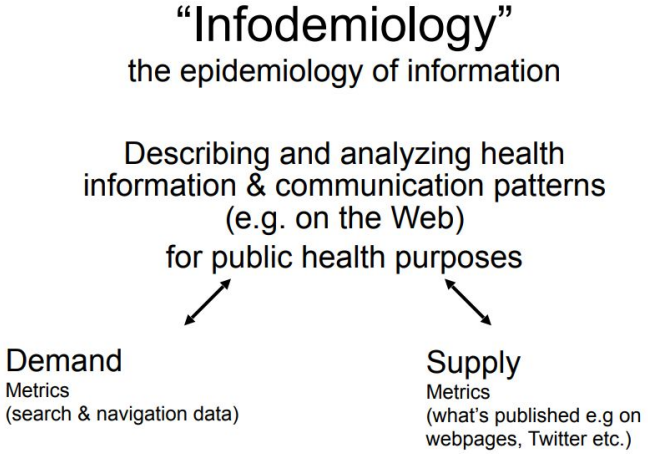
By using modern technology we can push forward our understanding of biology. In this module we've mentioned many ways that technology can be part of bioinformatics, genomics, and sciences in general (e.g., Folding@Home, Dimensions, Altmetric, The Rabbit Hole of Knowledge, Google Trends, etc.). Advancements in computing technology is permitting scientists to progress with genome research. Developments in artificial intelligence will also help accelerate this process.

READ: [Artificial intelligence could be new blueprint for precision drug discovery](#)

# Section 1 - Evidence (Cont.)

READ: [AI breakthrough could spark medical revolution](#) by Paul Rincon

Another area of science and health research requiring modern technology is [infodemiology](#).



EXPLORE: In 2020, public health has taken much more space in our thoughts as a society, probably beyond anything before. Infodemiology tries to use metrics and data from the internet to guide public health measures. Especially during the COVID-19 pandemic, there has been many issues of misinformation relating to masks and vaccines. Through infodemiology it is possible to gage the effect of this misinformation on public health.

Eysenbach G  
Infodemiology and Infoveillance: Framework for an Emerging Set of Public Health Informatics  
Methods to Analyze Search, Communication and Publication Behavior on the Internet  
J Med Internet Res 2009;11(1):e11 <https://doi.org/10.2196/jmir.1157>





# Dark Side - Combating misinformation: Science up first

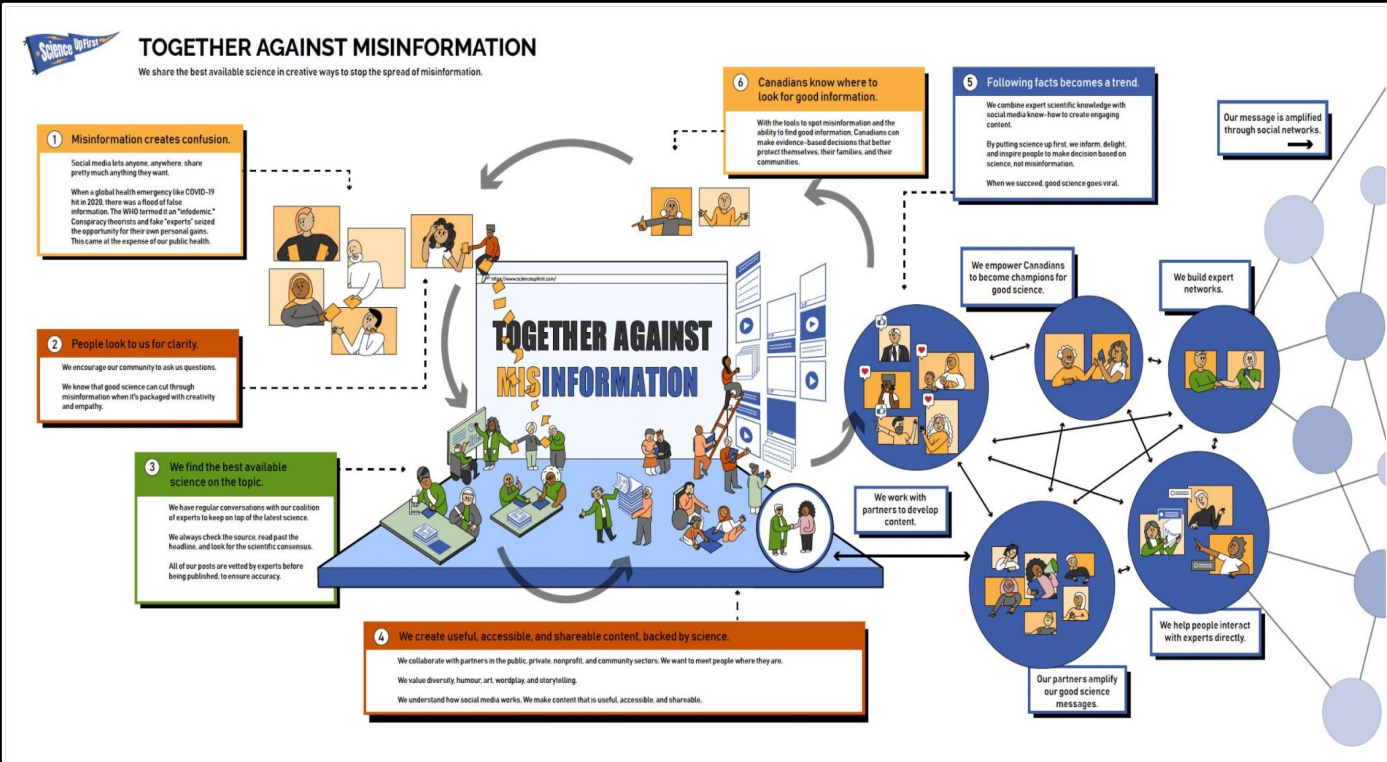


Science Up First is a Canada-wide initiative launched by scientists, researchers, and other experts to help combat misinformation. Currently, they're focusing on the COVID-19 pandemic and information about vaccines. They aim to spread vetted information through various social media platforms (since that is how a lot of the misleading information about the pandemic has been spread) in creative ways to attract a larger audience.

[RETURN TO MODULE](#)



# Dark Side - Together against misinformation



# Section 1 - Current Events

Discussions on discrimination and equity in STEM are important. STEM reflects society and discrimination is still today a problem that impacts many people. Falsely, some believe that being in a higher education environment makes people “immune” to prejudice and racism. Even though many in the STEM fields would say they are unbiased, it remains a fact that many institutions still support discriminatory rules and practices that promote inequities.

DOCUMENTARY: [Picture a scientist \(Trailer\)](#)

A big challenge in STEM for minorities is often representation. This lack of representation is so many times brushed off as simple lack of interest by those minorities when in reality it is a result of systemic discrimination.

Often times research requires funding and funding is available through governments. So researchers need to be involved politically to lobby for grants. This is one obvious way where social issues can impact sciences.



# Section 1 - Activity

**SUBJECT:** Evaluate scientific adaptability

**CONTEXT:** Evaluate your community, a local organization, or a group in your everyday life. Demonstrate their scientific adaptability through a report. Remember to apply concepts of your science class to your evaluation. Are they adapting to a world that is rapidly evolving in terms of technology (e.g., ransomware, online profiles)? Are they adapting and preparing for the impact of climate change (e.g., adapting farming, construction technology)?

**TASK:**

1. Select subject for study.
2. Identify criteria for evaluation of the subject matter based on chosen scientific topic.
3. Complete research on the subject.
4. Write report including science based recommendations.

EXAMPLE: “It’s about learning how to become resilient and adaptive to that particular situation [communities] are dealing with.” ([No, we can't fireproof towns and cities — but here's how we can make them more resilient](#) by Jade Prévost-Manuel)

# Section 2 - Scientific abilities

**Section Summary:** This section will develop the skills, strategies, and habits of mind required for scientific inquiry.

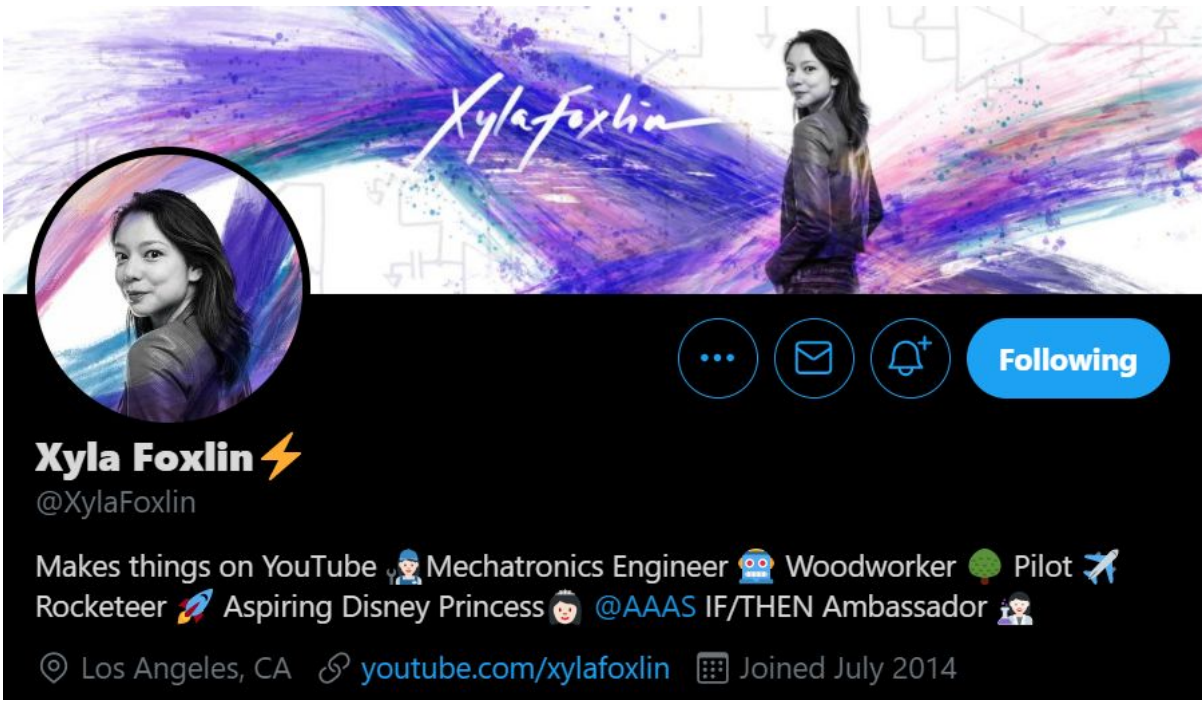
## Section Steps:

<u>Explore</u>	<u>Analyze</u>	<u>Evidence</u>	<u>Current Events</u>
#Engineering #Woodworking #Creativity #Diversity #Inclusivity	#Communication #Bias #Curiosity	#Studies #Music #Causation #Subjective	#Social media #Facts #Sources #News

**Section Activity:** Science communication project



# Section 2 - Explore



SUMMARY: Xyla Foxlin is a YouTube creator and entrepreneur. The content of her channel is based on her engineering and construction skills. Through her abilities and leadership, she is making an impact by being a positive role model for aspiring STEM students.

EXPLORE: Xyla Foxlin on [Twitter](#) or on [YouTube](#)



## Section 2 - Explore (Cont.)

Xyla Foxlin is the executive director of Beauty and the Bold a non-profit organization. Their mission is “Making STEM accessible and engaging for everyone.”

They are especially looking to encourage women and BIPOC by “[m]aking STEM accessible and engaging for everyone.”

EXPLORE: Beauty and the Bolt [Website](#) and [YouTube Channel](#)

When less than 28% of the STEM workforce are women or minorities, we know something needs to change. Help us support young makers, engineers, and scientists reach their full potential.

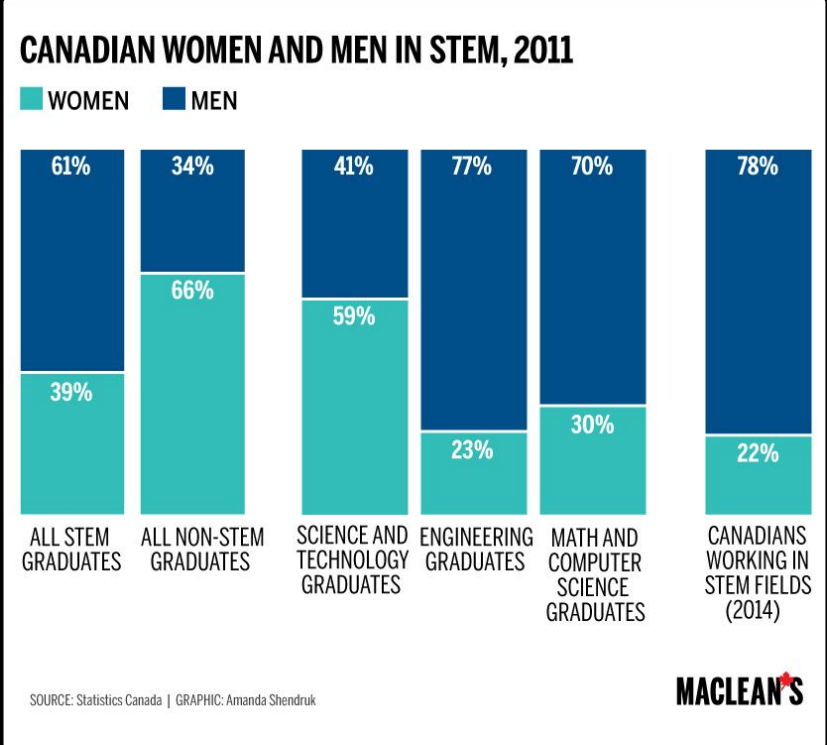
**“Women remain underrepresented in the science and engineering workforce...(they) make up half of the total U.S. college-educated workforce, but only 28% of the science and engineering workforce.”**

— National Girls Collaborative Project. Source: <https://ngcproject.org/statistics>



# Dark Side - Disparities in STEM

Female contributions in STEM have often been overlooked and currently disparities still exist in STEM fields. For example, fewer women are completing their STEM-related degree than men. In terms of computer science and math, as the chart indicates only 30% of Canadian graduates are women. There is work to be done, but much progress has been made in part due to social media and information being available to almost anyone.

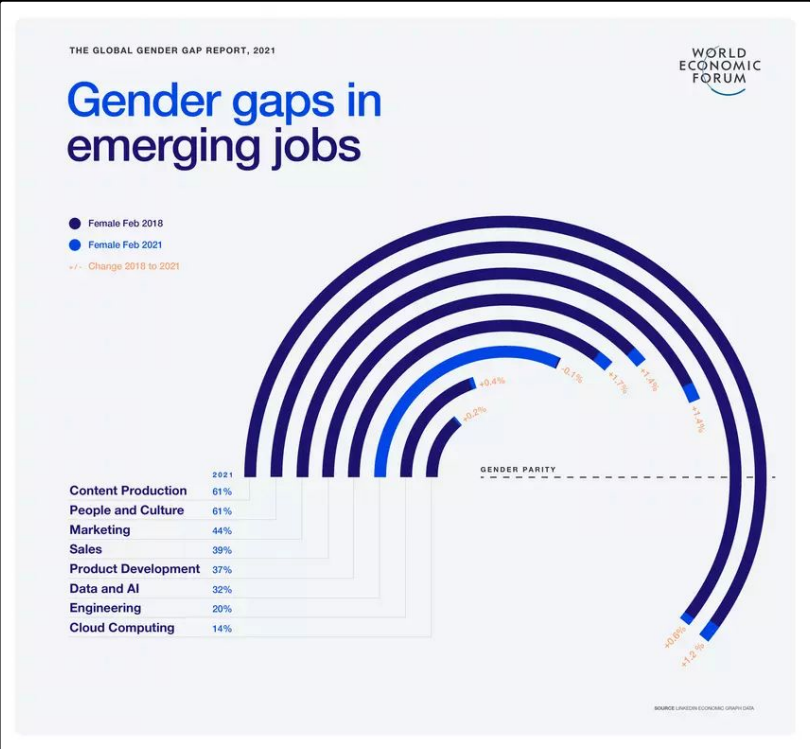


[RETURN TO MODULE](#)





# Dark Side - Disparities in STEM (Cont.)



Even in 2021, the [World Economic Forum reports](#) that women only make up 14% of professionals in cloud computing, 20% in engineering, and 32% in Data and AI.

According to [another study](#), only 24% of the cybersecurity workforce is made up of women.

[Women in Cybersecurity](#) by (ICS)<sup>2</sup>  
Cybersecurity Workforce Report

# Dark Side - Disparities in STEM (Cont.)

However, there are some initiatives designed to tackle these numbers:

[Girls Go CyberStart](#) - “In just 3 years, 30,000 high school girls have discovered the exciting world of cybersecurity”

[Women In Cybersecurity](#) - “WiCyS is where the recruitment, retention and advancement of women in cybersecurity happens.”

[And here's a list of 50 more associations and groups](#) - “Cybercrime Magazine is committed to presenting the true face of women in cybersecurity.”

## Section 2 - Analyze

There are two science communicators which are famous in America's collective experience of science. Those scientists are Neil deGrasse Tyson and [his mentor](#) Carl Sagan.

In the video below Neil deGrasse Tyson discusses many subjects related to science and education in the 21st century. He is inspirational and looks to encourage people to strive for continued curiosity.

[MasterClass Live with Neil deGrasse Tyson](#) by MasterClass



### IDEAS:

- ▶ Risk of bias in scientific research
- ▶ Objective truth
- ▶ Effective communication of science
- ▶ Importance of being scientifically literate and to have the ability to ask questions (not what you know, it is what you think)
- ▶ Curiosity of the unknown leads to discovery



## Section 2 - Evidence

QUESTION: Should you study with music?

As a student you often have to study. Getting to and through high school, you've probably developed many studying strategies. Listening to music might part of those strategies in your tool kit.

QUESTION: Is listening to music an effective strategy or is it a distraction?

Aside from your initial perception on this issue, try to identify positive and negative ideas for each side.

## Section 2 - Evidence (Cont.)

Music for studying is popular on YouTube and Spotify.

1. Lofi Girl is a YouTube channel with over 8.75 million subscribers.
2. This “[study beats](#)” song has over 5 million views.
3. This “[study to](#)” song is a livestream with over 23 thousand people listening at any moment since February 22, 2020.



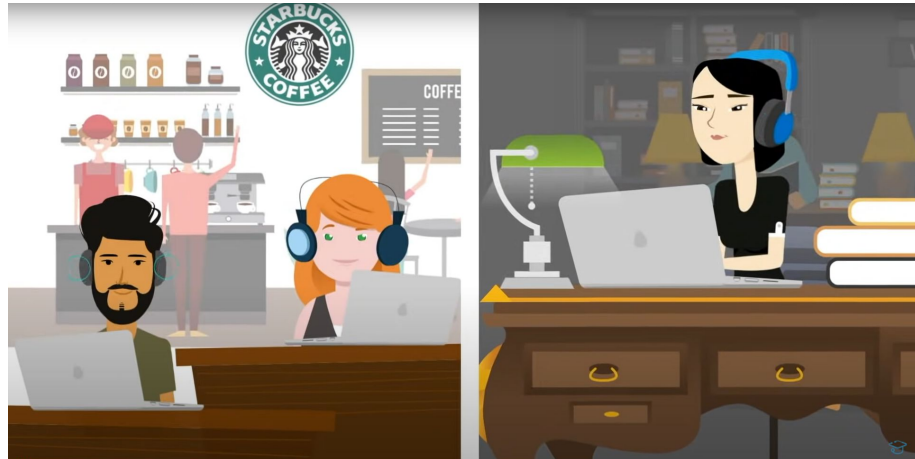
Listening to music appears to be popular.

Now, let's see what the research and the data shows.

## Section 2 - Evidence (Cont.)

Over time popular beliefs like the [Mozart Effect](#) have taken over pop culture and media narratives of the influence of music on studying and intelligence. Although this may be an interesting or fun idea, the Mozart Effect would in the end only count as pseudoscience because causation cannot be established. The video below will review studies on the subject and relevant hypothesis. *\*Changing state hypothesis*

[Should You Study with Music? | The Science-Backed Verdict](#)  
by Med School Insiders



## Section 2 - Evidence (Cont.)

What are other study experts saying?

It seems that studying with music successfully will depend a lot on your own preferences or what works for you (subjective). For example, music with lyrics may be a distraction for tasks based on writing or reading. Although, we will need more research to develop clear objective guidelines for everyone.

[Can Music Help You Study More Effectively?](#)

by College Info Geek

QUESTION: Now that we have reviewed the details of this topic, what will you do?



## Section 2 - Current Events

You will need to scrutinize sources you find online. This can apply to everything in your life. It is even more important with so-called “scientific” information (whether in the form of an article, any secondary sources and even some primary sources).

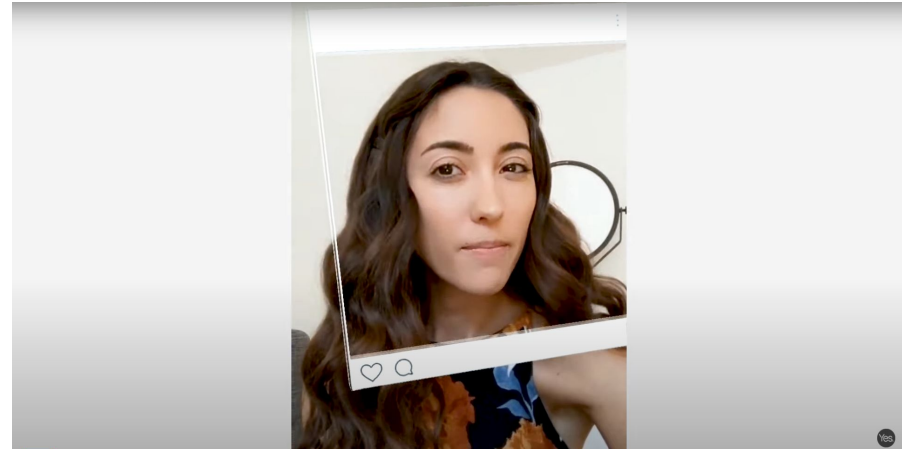
You will notice that in the news, scientific papers are summarized, boiled down, simplified, interpreted for wide audiences. In doing this, among many possible issues, the writers and editors may actually lose the real results of the paper.

Some sources are actually try to publish dishonest misrepresentation of science for their own purpose.

One solution is fact checking, but this requires going to the primary source yourself.

[Don't believe everything you see online...](#)

by YesReneau





## Section 2 - Current Events (Cont.)

How does the mainstream news treat scientific research?

One way media often misleads their readers when writing about healthcare is by using relative risks instead of absolute risk. This will make statistics sound more impressive.

Here's is a technical analysis of relative and absolute risk in healthcare. This video demonstrate how these concepts can have an effect on our perspectives as an audience (or on patients in this case).

[Number Needed to Treat: Treatments Don't Work Like You Think They Work](#)  
by Healthcare Triage



# Section 2 - Current Events (Cont.)

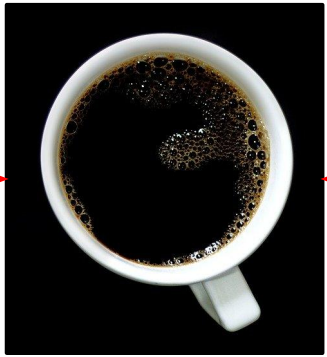
Here are two common debates you may see online or in media. Chocolate and coffee are superfoods and healthy, [5 seconds later], oh no wait, they are actually terrible for you, never eat or drink them again. Let's see what we can find on Google News. Did you find reliable sources of scientific information?

HEALTHY: [See news articles](#)



NOT HEALTHY: [See news articles](#)

HEALTHY: [See news articles](#)



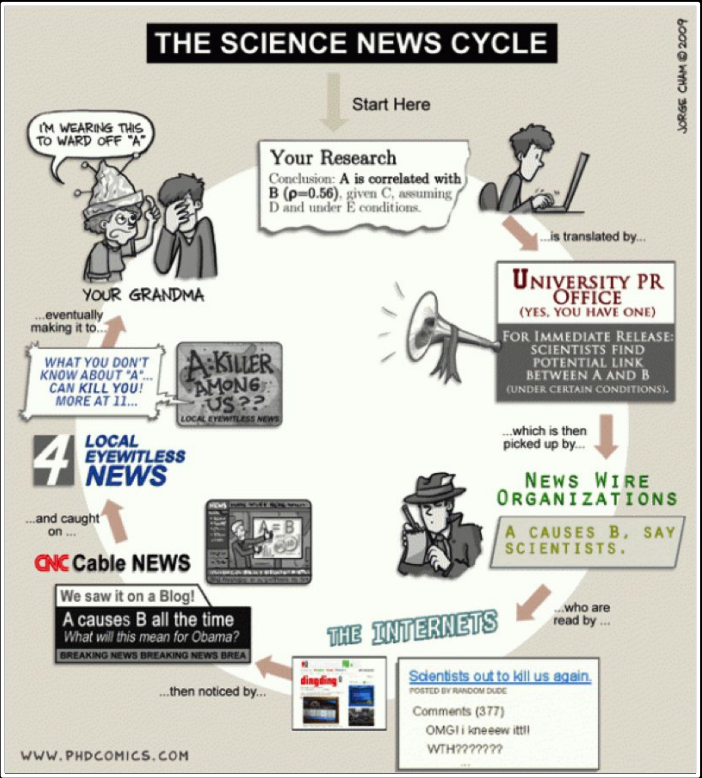
NOT HEALTHY: [See news articles](#)



# Dark Side - Miscommunication in science

Science involves being objective while sharing knowledge and evidence with the public. When communicating the impact or relevance of certain information, it's important that the true significance and meaning of the information isn't lost when translating scientific jargon into public information.

Social media, news outlets, and the internet can contribute to the spread of fake or misleading scientific information which further leads to infodemics and decreasing trust in science. This pipeline in science communication can distort information and lead to unprecedented outcomes.



# Dark Side - Dangers of Pseudoscience

There are many claims of pseudoscience: the Earth is flat, extraterrestrials in the Bermuda Triangle, astrology, magnetic field therapy, etc... Why do these claims earn so much attention when they seem to be silly, unsupported and relatively harmless?

Oftentimes, pseudoscientific claims/recommendations may seem innocuous; however, there are deadly consequences that can arise within the population that does believe in them - whether intentionally or not. The noticeable and more severe dangers lie within healthcare and government policies regarding the environment.



## Section 2 - Activity

**SUBJECT:** Science communication project

**CONTEXT:** Prepare a video to communicate a concept to an audience with no science background. To have a more engaging video employ a demonstration, visual examples, or other entertaining and interactive strategies. *\*Use an online animation tool to make your activity visually engaging. Try to use props from your house, so that your audience could also try the experiment at home.*

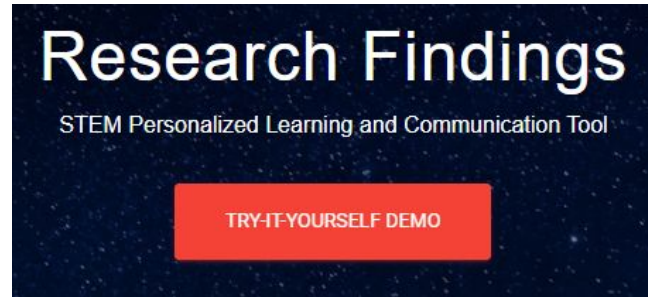
**TASK:**

1. Select a topic (confirm your choice with your teacher).
2. Research your topic using [The Rabbit Hole of Knowledge](#) (see next slides for instructions).
3. Plan an outline or write a script for your video presentation.
4. Produce your video.
5. Share your video.

INSPIRATION: @HankGreen1 - [How can I erase permanent marker?](#)

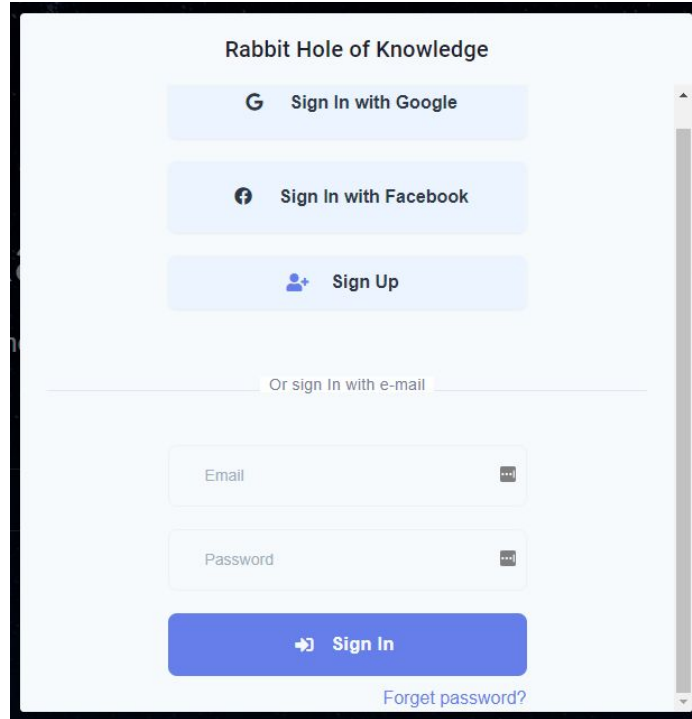
# Activity - Topic Research

Use [The Rabbit Hole of Knowledge](#) to find “the current scientific conversation surrounding a research field. [RHK] present[s] scientists' differing perspectives in plain language through a variety of media forms”.



# Activity - Topic Research (Cont.)

Login with one of your accounts or create one.



The screenshot shows a login interface for 'Rabbit Hole of Knowledge'. At the top, the title 'Rabbit Hole of Knowledge' is centered. Below it are three light blue buttons: 'Sign In with Google' (with a Google 'G' icon), 'Sign In with Facebook' (with a Facebook 'f' icon), and 'Sign Up' (with a person icon). A horizontal line separates these from the text 'Or sign in with e-mail'. Below this are two input fields: 'Email' and 'Password', each with a small eye icon for toggling visibility. At the bottom is a large blue 'Sign In' button with a right-pointing arrow icon. A link for 'Forgot password?' is located at the bottom right of the form area.

# Activity - Topic Research (Cont.)

Start your research. The example below is a search for the word “solvent”.

## Rabbit Hole of Knowledge

Grasp the essence of complex scientific findings and generate research ideas through the synthesis of public references and social network mentions of leading scholarly publications

Search

solvent





# Activity - Topic Research (Cont.)

RABBIT HOLE OF  
KNOWLEDGE

Search  
solvent



- Videos
- News
- Blogs

- [La sigaretta elettronica FA MALE. Ecco le prove! \(o forse no?\)](#)
- [Organic Solvents and Genes Compound MS Risk](#)
  - [Gebonden oersoep vult zich met sliertjes](#)
- [Superbug killer: New nanotech destroys bacteria and fungal cells](#)
  - [Black phosphorus coating kills superbugs then self-destructs](#)
    - [A lack of regulation is killing e-cig users](#)
- [Irritating Compounds Discovered In 'Vape Juice'](#)
  - [Juul users inhaling chemicals not listed](#)
    - [Health risks of e-cigarettes emerge](#)
- [Recent Discoveries and the Latest Trends in Cancer Research](#)
- [Pesticides and solvents exposure linked to Parkinson's \(Photos\)](#)

# Section 3 - Concepts of science

**Section Summary:** This section will guide the students to understand the basic concepts of science.

**Section Steps:**

<u>Explore</u>	<u>Analyze</u>	<u>Evidence</u>	<u>Current Events</u>
#Results #Theory	#Bias #Discrimination #AI #Algorithms	#Pseudoscience #Space #Internet	#Debates #Collaboration #Truth #Gaming #Fraud

**Section Activity:** The journey of a scientist, history of field of study, evolution of the field, values, beliefs, tools, challenges (apply to your science class)



## Section 3 - Explore

Scientists may have theories and ideas to explain strange phenomena. Sometimes these phenomena might be themselves theoretical. That is when researchers and scientists will elaborate experiments to test and verify these theories. The scientists' goal is to confirm theory through experimentation, but the results may not correspond to the theory.

In the video by Physics Girl she explains the details of one such moment. Where theories did not exactly correspond to the results of the experiment.

When this happens, what will the scientists do next?

[This result could change physics forever](#)  
by Physics Girl



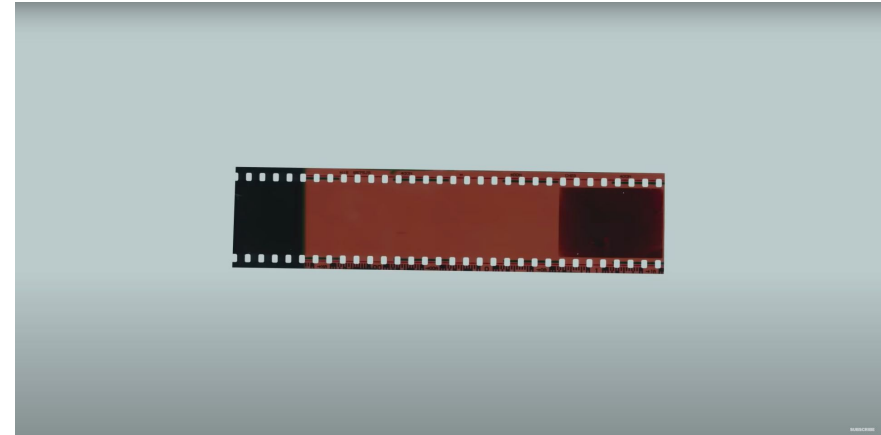
## Section 3 - Analyze

There are examples where technology we often use was created with issues. One such technology was colour film for photography. A more modern issue is colour balance for photography and videography. By using specific chemicals they would have different colours appear on the photos.

### OTHER REFERENCES:

- 1 - [The Racial Bias Built Into Photography](#)
- 2 - [How Kodak's Shirley Cards Set Photography's Skin-Tone Standard](#)

[Color film was built for white people. Here's what it did to dark skin.](#) by Vox



Like it is noted in the references above, photography companies did not have a product for their consumers with darker skin tones. This was both a business choice and a reflection of society.

**TASK:** Can you find examples of video or photo technologies that still demonstrate discrimination based on skin colour today?

## Section 3 - Analyze (Cont.)

One of the issues Kodak had with the technology for their films with dynamic range. With digital photography this has been less of an issue as users can often manually adjust many of the settings of their camera.

Recently, with these digital cameras everywhere, companies have started creating programs to gather data from them to be used and sold. These databases are typically organized by AI and algorithms. The data can then be used for example by researchers or law enforcement. Unfortunately, it may not be as comprehensive or reliable as we first thought because they may be flawed like the humans that have designed them.

[How To Photograph Dark Skin Tones | Aundre Larrow](#) by Moment

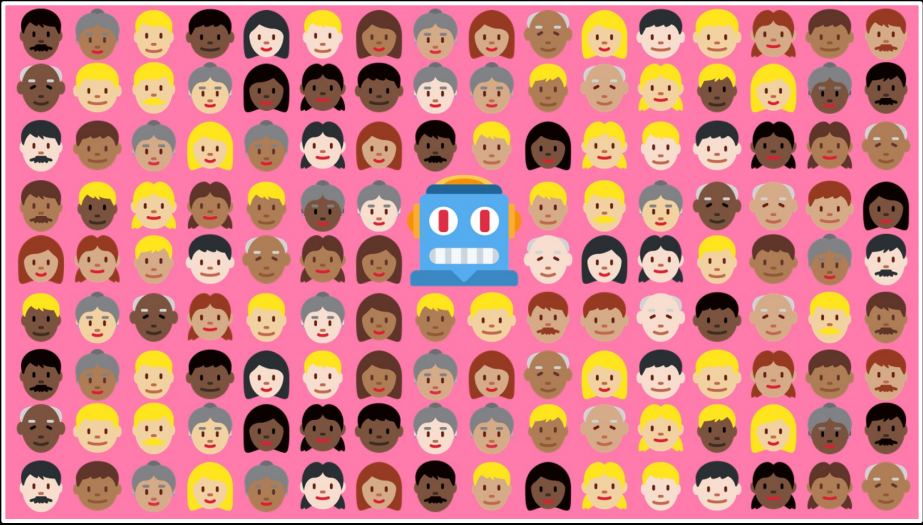


“However, it’s humans who design the data and systems that exist within an AI system, and that’s where researchers say the biases can be created.”

([U of T team working to address biases in artificial intelligence systems](#) by Faiza Amin)

# Dark Side - Racism in AI

Systemic racism is prevalent in AI due to bias and unfair data being used to train algorithms. Even subtle differences can be powerful, as we influence algorithms and computers based on our own beliefs, either consciously or subconsciously.



# Dark Side - Google's Vision AI

Google's AI software was shown to be racist after the object in the dark-skinned individual's hand was labelled a gun, whereas in the light-skinned individual's hand, it was labelled a monocular. These results are often a result of mislabeled training data, inherent biases from the engineering team, and a lack of accountability.

The image displays two side-by-side screenshots of Google Vision AI search results. Both screenshots show a hand holding a green object. The left screenshot, dated 2020-04-03, shows a dark-skinned hand holding a green object, with labels 'Hand' (77%) and 'Gun' (61%). The right screenshot, dated 2020-04-02, shows a light-skinned hand holding the same green object, with labels 'Hand' (72%) and 'Monocular' (60%).

Label	Percentage
Hand	77%
Gun	61%

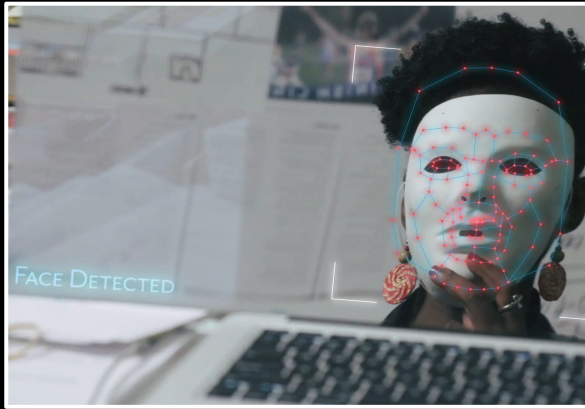
Label	Percentage
Hand	72%
Monocular	60%

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# Dark Side - Joy Buolamwini

[Joy Buolamwini](#) is a computer scientist at MIT as well as an activist for algorithmic justice.



[Coded Bias](#) is a documentary detailing how Buolamwini discovers that facial recognition is racially biased and does not recognize dark-skinned faces accurately.



[The Algorithmic Justice League](#), created by Joy, is dedicated to uncovering bias in algorithms and fighting racial inequalities in AI.

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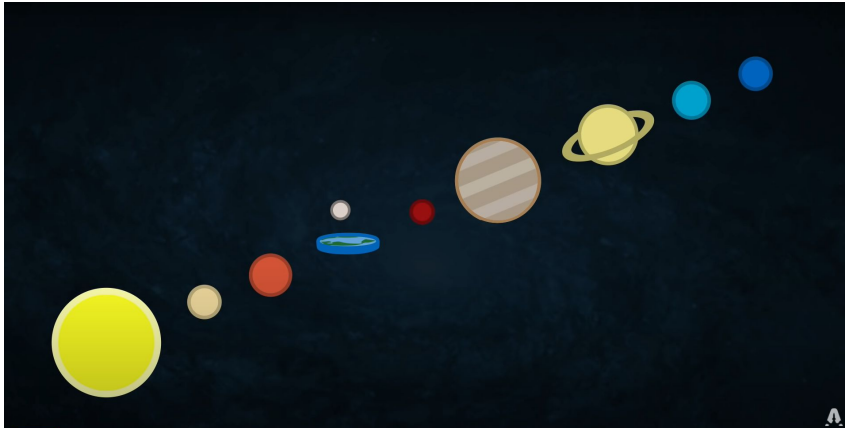




## Section 3 - Evidence

Depending on your perspective, the internet might have a utopian or dystopian feel. Demonstrating a dystopian result of the internet is strangely the resurgence of believers in the [“flat Earth”](#).

This pseudoscientific belief is gaining somewhat in popularity as these believers can more easily connect with each other. Some people just like to contradict others, while some believe blindly, etc. By contrast, thanks to modern technology we’ve never had as many ways to confirm that the Earth is a sphere. Like many other deniers of a well established theory, these people usually try to confirm their beliefs instead of looking for evidence against their ideas.



[Neil Tyson Demonstrates Absurdity of "Flat Earth"](#)  
by StarTalk

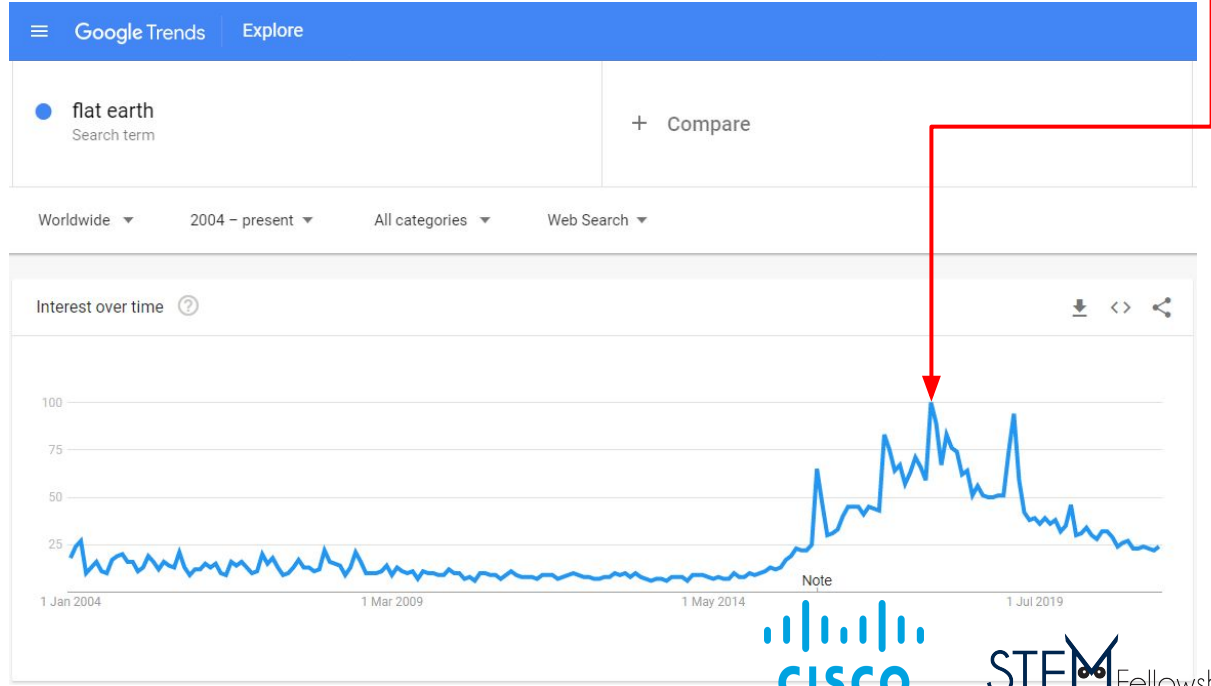
# Section 3 - Evidence (Cont.)

Let's find out what was happening at this peak (November 2017)?

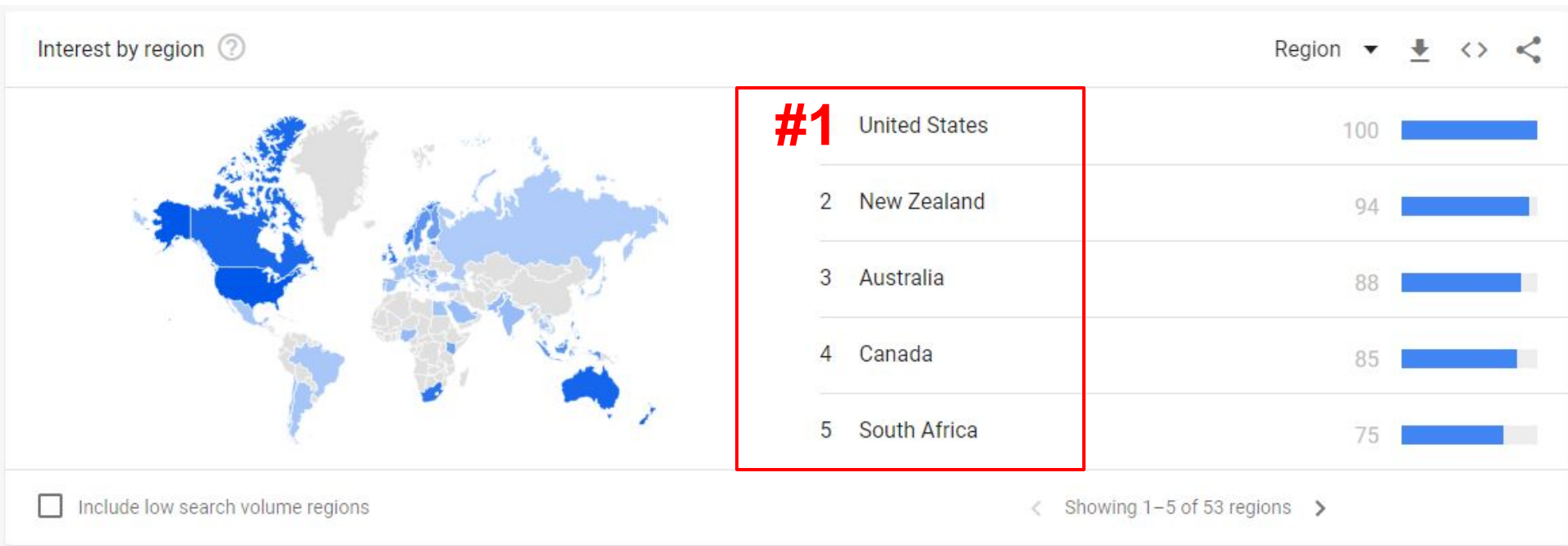
['I Don't Believe In Science,' Says Flat-Earther Set To Launch Himself In Own Rocket](#) by Colin Dwyer (NPR)

Since the news media discussed this story, they also inadvertently amplified the subject and the flat earth movement.

We can see this happening through the data [Google Trends](#) has collected.



# Section 3 - Evidence (Cont.)



In this picture, we can see which countries have been using Google to find information about “flat earth”.



# Section 3 - Evidence (Cont.)

Related topics ? Top ▼ ↓ <> ↔

1	Earth - Planet	100	<div style="width: 100%;"><div style="width: 100%;"></div></div>
2	Flat Earth - Topic	80	<div style="width: 80%;"><div style="width: 80%;"></div></div>
3	The Flat Earth Society - Topic	11	<div style="width: 11%;"><div style="width: 11%;"></div></div>
4	The Bible - Religious text	4	<div style="width: 4%;"><div style="width: 4%;"></div></div>
5	Moon - Natural satellite	2	<div style="width: 2%;"><div style="width: 2%;"></div></div>

< Showing 1-5 of 25 topics >

Related queries ? Top ▼ ↓ <> ↔

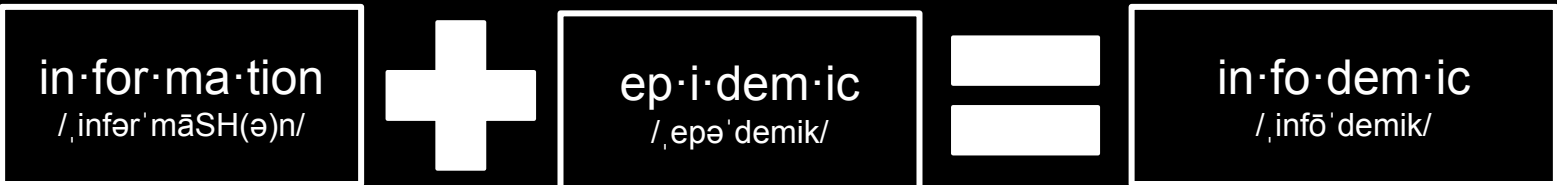
1	the flat earth	100	<div style="width: 100%;"><div style="width: 100%;"></div></div>
2	the earth	97	<div style="width: 97%;"><div style="width: 97%;"></div></div>
3	is earth flat	90	<div style="width: 90%;"><div style="width: 90%;"></div></div>
4	the earth is flat	65	<div style="width: 65%;"><div style="width: 65%;"></div></div>
5	flat earth society	32	<div style="width: 32%;"><div style="width: 32%;"></div></div>

< Showing 1-5 of 25 queries >

In this picture, we can see the related topics and queries to “flat earth”. Some of the questions and statements are interesting. Some are even a little surprising, such as the “bible - religious text” search topic.



# Dark Side - Infodemics



Infodemics occur when there is too much information circulating around a topic, much of it being misinformation or disinformation. This mix of facts, fiction, opinions, propaganda, rumours, and fears has several negative consequences, such as affecting people's physical and mental health and undermining efforts to get the situation under control. A prime example of an infodemic (a term coined by the WHO) is the COVID-19 pandemic.

## Dark Side - Infodemics (Cont.)

- The rapid spread of information, particularly due to social media, has led to an infodemic during the pandemic because it became difficult to find trustworthy sources. The risks include reducing the effectiveness of the public health response because without trust in accurate, scientific information, immunization targets won't be met and tests used to diagnose the virus won't be used.

READING: [COVID-19 Information Pandemic: Developing an evidence-based approach among youth](#)

by Dr. Sacha Noukhovitch, Founder and President of STEM Fellowship

EXPLORE: [Understanding the infodemic and misinformation in the fight against COVID-19](#) by Department of evidence and intelligence for action in health, PAHO

# Dark Side - Flattening the infodemic curve

## Top tips for navigating the infodemic



**1. Assess the source:**  
Who shared the information with you and where did they get it from? Even if it is friends or family, you still need to vet their source.



**2. Go beyond headlines:**  
Headlines may be intentionally sensational or provocative.



**3. Identify the author:**  
Search the author's name online to see if they are real or credible.



**4. Check the date:**  
Is it up to date and relevant to current events? Has a headline, image or statistic been used out of context?



**5. Examine the supporting evidence:**  
Credible stories back up their claims with facts.



**6. Check your biases:**  
Think about whether your own biases could affect your judgment on what is or is not trustworthy.



**7. Turn to fact-checkers:**  
Consult trusted fact-checking organizations, such as the International Fact-Checking Network and global news outlets focused on debunking misinformation.

## Section 3 - Current events

Scientific concepts are sometimes, even for experts, difficult to understand. Problems and solutions may be beyond most people's knowledge. Scientists are so focused on their research so it may become difficult for them to contradict their field of expertise. In the end, the scientific process shouldn't be corrupted by pride, it is about the search for the truth. In search of this truth, collaboration and varying perspectives become powerful tools.

PART 1: [Risking My Life To Settle A Physics Debate](#)  
by Veritasium



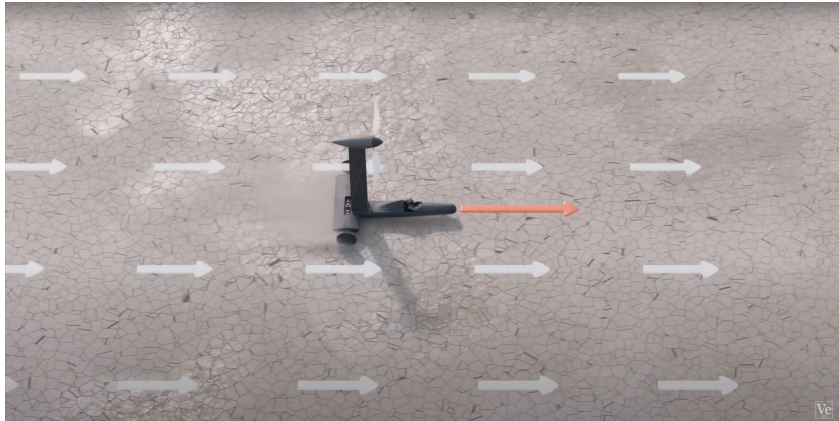
In this video scientists are debating if a type of vehicle that is designed to travel faster than the wind (without additional propulsion than the wind) is possible. Most people do not think that it is possible. YouTuber, Derek Muller, set out to show everyone that it is real. He will try to do what Rick Cavallaro, one of the creators of the [Blackbird vehicle](#), has been trying to do for almost 20 years.



## Section 3 - Current events (Cont.)

Like people online debating so many things (smh), even scientists, YouTubers, and other experts can find themselves taking sides. Before taking a side on a debatable topic, it might be important to learn more about it, to understand it. Also, a good starting point would be to question your own intuition.

PART 2: [A Physics Prof Bet Me \\$10,000 I'm Wrong](#)  
by Veritasium



In this second part, there are many more twists and turns. The lessons the audience can learn from this video are noteworthy. It is pertinent to see how to have a debate without personal attacks. To achieve a final consensus accepted by parties involved.

## Section 3 - Current events (Cont.)

The DDWFTTW (dead downwind faster than the wind) vehicle has been argued about online for a long time. Here are a few examples that may be interesting to explore.

2008: [Wind-Powered Perpetual Motion](#) (*math blog post with 399 replies*)

2008: [DDW Faster than the wind and the MythBusters](#) (*sailing discussion forum 3.8k replies*)

2009: [DDWFTTW - Directly Downwind Faster Than The Wind](#) (*boating forum with 30 pages*)

2010: [A Long, Strange Trip Downwind Faster Than the Wind](#) (*tech article*)

2010: [Wind-powered car goes down wind faster than the wind](#) (*science article*)

2012: [Wind-Powered Vehicle Can Also Travel Upwind Faster Than the Wind](#) (*tech article*)

2013: [DDWFTTW Vehicle Analysis](#). (*blog article*)

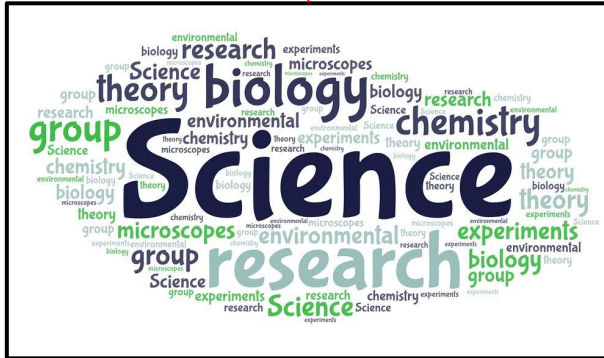
2017: [Running Faster than the Wind](#) (*sailing article*)

It finally took until 2021 to resolve the science behind this problem. This theory may remain contentious even after demonstrating the science. As many still associate it with some sort of perpetual machine or as simple pseudoscience.



## Section 3 - Current events (Cont.)

What does science and Minecraft have in common?



## Section 3 - Current events (Cont.)

It seems that competitive Minecraft and scientific research have a few things in common. Like a rigorous process, repetition, and well, unfortunately, corruption.

Reading: [Why Are Gamers So Much Better Than Scientists at Catching Fraud?](#) by Stuart Ritchie

“Dream’s ill-begotten time, which was rightly struck from the books, became the latest in a long line of scam achievements exposed by moderators using sophisticated tools to uphold the field’s standards.”

Scam achievements are not a new phenomenon. The more important question is, are we creating a system that encourages fraudulent behaviour rather than striving for the truth?

At least, if we want to find this corruption in research or gaming, we can rely on probability which makes some achievements “mathematically impossible.” This is one way to expose cheaters.

# Dark Side - Negativity towards negative results

We frequently see groundbreaking discoveries and breakthroughs published in scientific journals. But what happens when scientists come across non-positive results in their research?

Getting such results after spending valuable money and hard work can be disappointing, and may even impact young researchers' careers. Researchers may not publish negative results due to reasons such as:

- Waste of resources - Why spend money publishing a negative result?
- Low impact - Most journals want exciting positive results for a larger audience
- "Ruin your career" - May not get future funding due to negative results

All of these factors contribute to publication bias. Unfortunately, despite the tens of thousands of available journals, places to send negative results are exceedingly scarce.

# Dark Side - Why it is important to publish them

- Preventing duplicate experiments and waste of resources
- May lead to false conclusions - If 19/20 lab experiments were negative but not published, and 1/20 was positive and published, the findings may in fact be spurious.
- Lives may be on the line - clinical trials need to be registered publicly regardless of positive or negative results



## Section 3 - Activity

**SUBJECT:** The journey of a scientist

**CONTEXT:** Discover the journey of a scientist. Study their education path, their professional experiences, the history of field of study, the evolution of the field, their values, beliefs, tools, and challenges. Make sure to apply concepts or ideas related to your class. For example, describe the history of a theory and how it relates to your scientist's journey.

**TASK:**

1. Select a scientist. Identify reasons for your selection.
2. Research your scientist and their first of study.
3. Discuss the influence and impact of technology in their journey.
4. Identify why this person's journey might be impactful to others, to society, to yourself, etc.
5. Suggest ways to follow in your scientist's footsteps to promote curiosity and discovery.

STORIES: [I wasn't always a scientist](#) by the Royal Society

# Module Conclusion

As you can see, scientific pursuits will push technology further and encourage innovations. Unfortunately, with these new technologies we may face social and ethical challenges as a society. Hopefully, this module will encourage you to continue exploring science and technology. We also hope that you have seen that everyone and anyone should participate in the world of science.

