Assignment:: Become an expert on a single climate change concept. Adopt a 'learn first' approach to your knowledge-building.

Sample topic: **Prove that single use plastics do leach greenhouse gases into the atmosphere!**

Research Criteria:

- Demonstrate use of the guideline: Navigating the Library Online
- Show your 'growing thinking' by using a self-determined pattern of note making

Sample Note Making:
You don't need to *start* working in columns.
You can copy and paste your accumulated notes into a left-hand column, to help you to *see* your presentation thinking. Scrolling is easier than moving between slides to refine your thinking.

Research Running Record - My knowledge growing with my questions and answers from sources I progressively find and use	**Evolving Presentation Planning (selected info that might make it into my slide show)**
?How does the single use plastics industry contribute to climate change? My 'good article to start': "Why quitting plastic will help stop climate change" https://www.1millionwomen.com.au/blog/why-quitting-plastic-will-help-stop-climate-change/ (7 Aug 2017) Notes: … plastics started to be manufactured in the 1940s; given longevity of the product "every single piece of plastic ever made still exists today" **!?How long does it take for plastics to decompose?** - Plastic industry creates … guess … "billions of tonnes of carbon pollution each year"	Start with a powerful image on screen  (Photo by: Shaafina Ali, The Surf Channel, Oct. 10, 2014) "billions of tonnes of carbon pollution come from the plastics industry each year" (1 Million Women, 2017)

- ***Pollution* from the plastics *industry* derives from**:
    - oil and gas manufactured into plastic,
    - oil and gas consumed in the manufacturing processs,
    - transportation to manufacturer and of manufactured goods,
    - disposal systems and processes

- !What values are reflected in plastics consumption?
    - !self-centeredness
    - convenience
    - consumption culture
    - disposable income

- Examples of single use plastics?
    - water
    - pop
    - plastic bags
    - plastic packaging

"What Is the Carbon Footprint of a Plastic Bottle?"
https://sciencing.com/carbon-footprint-plastic-bottle-12307187.html
Notes:

> Pacific Institute, a nonprofit research organization, estimates that the energy used in the production and use of plastic bottles is equivalent to filling the bottles one-quarter full with oil.

- Manufacture of 1 pound of plastic produces 3 pounds of carbon dioxide

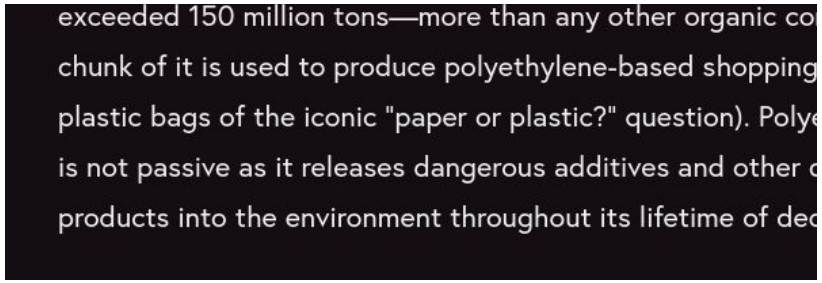
www.outrider.org
- Plastic releases toxic chemicals as it decomposes
- Ethane (turned into ethylene) is a byproduct of fracking for fossil fuels
- As plastics decay the emit methane and ethylene; both are greenhouse gases
- Sunlight triggers decay

Plastics started to be manufactured in the 1940s ("Why quitting plastic helps")

Given longevity of the product,
"every single piece of plastic ever made still exists today" (1 Million Women, 2017)

My question:
Does the degradation of single use plastics actually impact climate change, i.e. add greenhouse gases to the atmosphere?

- ?Will production of single use plastics decrease? No, production rate is anticipated to triple by 2050
- 40% of plastic waste goes to landfill



?What are the greenhouse gases?

https://climatekids.nasa.gov/greenhouse-cards/
(well it's NASA - their reputation depends on correct info)

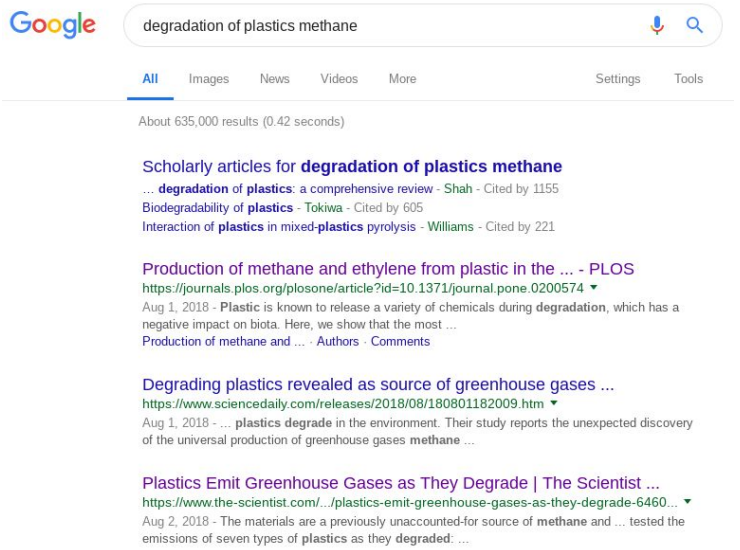
Production of methane and ethylene from plastic in the environment
https://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0200574&type=printable

- Chemicals released during degradation negatively impact the biota
- Polyethylene is the most produced and discarded synthetic polymer globally
- "Production of trace gases" from polyethylene increases over time - from ambient solar radiant
- These gases include methane and ethylene

Sarah Royer, lead researcher on this topic at University of Hawaii:

2018 video sets the topic of plastic degradation
https://www.hawaii.edu/news/2018/08/01/greenhouse-gases-linked-to-degrading-plastic/ (<2 min.)

What do you understand/question from this information? (pair-share)



From Sarah Royer et. al. (2018) University of Hawaii

- Chemicals released during degradation negatively impact the biota
- "Production of trace gases" from polyethylene increases over time - from ambient solar radiant
- These gases include methane and ethylene

- 212 day incubation of produces: 5.8 ?units methane, 14.5 ?units of ethylene, 3.9 of ethane, 9.7 propylene
- In air, degradation effects are worse than in water - 76 times worse for ethylene
- "Our results show that plastics represent a heretofore unrecognized source of climate-relevant trace gases that are expected to increase as more plastic is produced and accumulated in the environment."
- "Polyethylene is not inert and is known to release additives"

" Scientists are worried that human activities are adding too much of these gases to the atmosphere."

Bioethylene production from Ethanol: A Review and Techno-economical Evaluation (31 March 2017)
https://onlinelibrary.wiley.com/doi/full/10.1002/cben.201600025

- Manufacturing of bioethylene from 1st generation bioethanol is new technology alternative to polyethylene, a fossil fuel derivative; the same from 2nd generation bioethanol does not yet have a process

?Is ethylene a greenhouse gas?

Emissions of Greenhouse Gases in the U.S. (2011)
https://www.eia.gov/environment/emissions/ghg_report/glossary.php
(.gov,

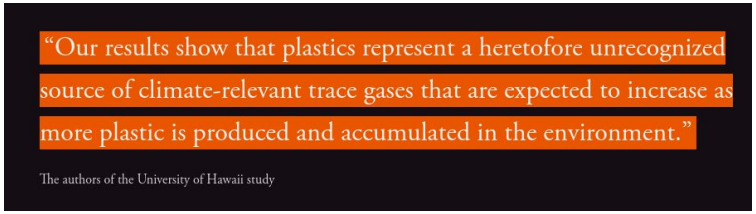
- In air, degradation effects are worse than in water - 76 times worse for ethylene
- "Polyethylene is not inert and is known to release additives" ("Production of methane and ethylene")

Simply put:

- ethene and methane are both hydrocarbons
- hydrocarbons are released into the atmosphere when products containing them, degrade in both air and water, with exposure to sun
- release of gases is augmented by the fact that surface area increases as product continues to break down into pieces (Royer, 2018)

My question:

Does the degradation of plastic actually impact *climate change*, i.e. add greenhouse gases to the atmosphere?



(University of Hawaii, 2018)

Ethylene: An olefinic hydrocarbon recovered from refinery processes or petrochemical processes. Ethylene is used as a petrochemical feedstock for numerous chemical applications and the production of consumer goods.

Methane: A colorless, flammable, odorless hydrocarbon gas (CH_4) which is the major component of natural gas. It is also an important source of hydrogen in various industrial processes. Methane is a greenhouse gas. See also *Greenhouse gases*.

https://www.quora.com/Where-is-Ethane-on-the-periodic-table

- Ethane - C2H6 (2 carbon 6 hydrogen)

https://www.livescience.com/63274-plastics-release-greenhouse-gases.html

To learn what gases plastics were releasing, the research team collected samples of the seven most common types of consumer plastic — both newly produced pieces and fragments fished from the ocean — and monitored the objects' gas production while floating in seawater or exposed to air. All of the samples emitted methane and ethylene, but low density polyethylene (LDPE) exposed to air produced more gases than all other material-environment combinations. A thin material found in plastic wrap and grocery bags, LDPE is one of the main plastics in production and one of the most frequently discarded, said Sarah-Jeanne Royer, a marine biologist at the University of Hawaii at Manoa and the lead researcher on the paper.

Image annotation: methane, ethylene, and particularly low density polyethylene (LDPE) emit gases that become trapped in the upper atmosphere; therefore, they are greenhouse gases

https://www.nationalgeographic.com/environment/plasticpledge/

Canada is the 6th largest producer of ethylene used in plastics (ECCC)

Polyethylene is the most produced and discarded synthetic polymer globally (?)

Production rate of single use plastis is anticipated to triple by 2050 (name best of several)

End of presentation.

Lifecycle of a plastic water bottle (Avery, 2018)
https://youtu.be/J6dV7DYX4qk

Different plastics compounds present different recycling challenges. Image

courtesy of the Ellen MacArthur Foundation in The Washington Post

Take the plastic pledge! (do this in advance and provide an annotation)

https://www.nationalgeographic.com/magazine/2018/06/the-journey-of-plastic-around-the-globe/

https://www.nationalgeographic.com/science/2018/09/news-BPA-free-plastic-safety-chemicals-health/
(national geographics - duh, again reputation to uphold)

?What kinds of plastic waste cannot be recycled in Peel?

http://peelregion.ca/scripts/waste/how-to-sort-your-waste.pl?action=search&query=grocery+bag
How to sort your waste in Peel Region

The Lifecycle of a PET bottle
https://www.youtube.com/watch?v=J6dV7DYX4qk&feature=youtu.be

- Found in search for bottle *cap* recycling

Global News. Everyday plastics quietly pollute the air as they degrade"

> Every type of plastic in the test was found to release the invisible pollutants. However, the highest polluter was low-density polyethylene, one of the most widely-used plastics on the planet. The material is used to make plastic bags, shampoo bottles, food storage containers and a wide range of textiles and construction components.

> To learn what gases plastics were releasing, the research team collected samples of the seven most common types of consumer plastic — both newly produced pieces and fragments fished from the ocean — and monitored the objects' gas production while floating in seawater or exposed to air. All of the samples emitted methane and ethylene, but low density polyethylene (LDPE) exposed to air produced more gases than all other material-environment combinations. A thin material found in plastic wrap and grocery bags, LDPE is one of the main plastics in production and one of the most frequently discarded, said Sarah-Jeanne Royer, a marine biologist at the University of Hawaii at Manoa and the lead researcher on the paper.

(Live Science, 2018)

By **Sarah Kaplan**
January 20, 2016

A September 2008 photo released by the Ocean Conservancy on March 10, 2009, shows a trash-covered beach in Manilla, Philippines. (Tamara Thoreson Pierce/Ocean Conservancy/AP)

Researchers at the University of Hawaii at Manoa have identified a wide range of plastics that silently leach methane and ethylene gases as they degrade through exposure to the sun. Both gases have previously been identified as contributors to climate change. Global News. Month of Giving Back https://globalnews.ca/video/rd/1393855555725/ Keywords: plastic bottle decomposition, recycle plastic bottle caps for charity,	Rubbish island in the Maldives https://weather.com/travel/news/thilafushi-trash-island-maldives-20140930 The Lifecycle of a PET bottle https://www.youtube.com/watch?v=J6dV7DYX4qk&feature=youtu.be Topic-extending questions: 1. What is the environmental impact of higher grade (denser?) plastics? 2. What happens to plastic residue from the recycling process? 3. Is ethene being looked at as a GWP (Global Warming Potential) factor?

Presentation Outline

Need a powerful image

2018 video sets the topic of plastic degradation
https://www.hawaii.edu/news/2018/08/01/greenhouse-gases-linked-to-degrading-plastic/

According to activists 1millionwomen.com.au and outrider.org, each year the plastic industry creates

> billions of tonnes of carbon pollution

and

> “Every piece of plastic ever made still exists today.”

What products do you think of when I talk about plastic?

Definitions:

Hydrocarbon: An organic chemical compound of hydrogen and carbon in either gaseous, liquid, or solid phase. The molecular structure of hydrocarbon compounds varies from the simple (e.g., methane, a constituent of natural gas) to the very heavy and very complex.

Methane: A colorless, flammable, odorless hydrocarbon gas (CH_4) which is the major component of natural gas. It is also an important source of hydrogen in various industrial processes. Methane is a greenhouse gas. See also *Greenhouse gases*.

Ethylene: An olefinic hydrocarbon recovered from refinery processes or petrochemical processes. Ethylene is used as a petrochemical feedstock for numerous chemical applications and the production of consumer goods.

Most kinds of fuel have hydrocarbons in them. Hydrocarbons store energy. Coal, oil, and natural gas all have hydrocarbons in them.

When we burn fuels with hydrocarbons, we make carbon dioxide (CO_2) gas. The carbon dioxide goes into the air.

https://www.windows2universe.org/comments/comments.html
National Earth Science Teachers Association (2010)

According to a frequently reference journal out of the University of Hawaii at Manoa, polyethylene is the most produced and discarded synthetic polymer globally

and

“Production of trace gases” from polyethylene increases over time - from ambient solar radiant”

Highest polluter is low-density polyethylene, “one of the most widely-used plastics on the planet (University of Hawaii)

LDPE exposed to air produced more gases than all other material-environment combinations. It’s the material found in grocery bags and cling wrap. One of the main plastics in production. One of the most discarded plastics (LiveScience.com)

Different plastics compounds present different recycling challenges. Image courtesy of the Ellen MacArthur Foundation

After 212 days in the ocean 5.8 units of methane were produced from plastic samples and 14.5 units of ethylene ar produced.
It gets worse.
Plastic on the ground for the same amount of time degrades with 76 times more ethylene produced and 2 times as much methane.

The Lifecycle of a PET bottle
https://www.youtube.com/watch?v=J6dV7DYX4qk&feature=youtu.be

- Found in search for bottle *cap* recycling

Global News. Month of Giving Back
https://globalnews.ca/video/rd/1393855555725/

****

Any topic must connect to both climate change AND science concepts

My meandering through topics ...

?The problem with coal?

?Why a ‘carbon challenge’?

?What is your ‘carbon footprint’?

?What would a community need to do to claim ‘zero-emissions’ status?

?Why ban single use plastics?

?How does the plastics industry contribute to climate change?

?What does it mean that US is most responsible for climate change?

?How does fracking contribute to climate change?

?How does the single use plastics industry contribute to climate change?

“One really good article to start”

https://www.1millionwomen.com.au/blog/why-quitting-plastic-will-help-stop-climate-change/
(women who started an climate activist movement (2009); not scientists)
Why quitting plastic will help stop climate change. (7 Aug 2017)
Notes:

- Plastics clog landfill, pollute ecosystems, choke the ocean and enter the food chain
- **Pollution from the plastics industry comes from**:
    - oil and gas manufactured into plastic,
    - oil and gas consumed in the manufacturing processs,
    - transportation to manufacturer and of manufactured goods,

        - disposal systems and processes

- Additional info … plastics started to be manufactured in the 1940s; given longevity of the product “every single piece of plastic ever made still exists today”

!?How long does it take for plastics to decompose?
?Find a video on single use plastics manufacturing

- Plastic industry creates … guess … “billions of tonnes of carbon pollution each year”

- !What values are reflected in plastics consumption?
    - !self-centeredness
    - convenience
    - consumption culture
    - disposable income

- Examples of single use plastics?
    - water
    - pop
    - plastic bags
    - plastic packaging

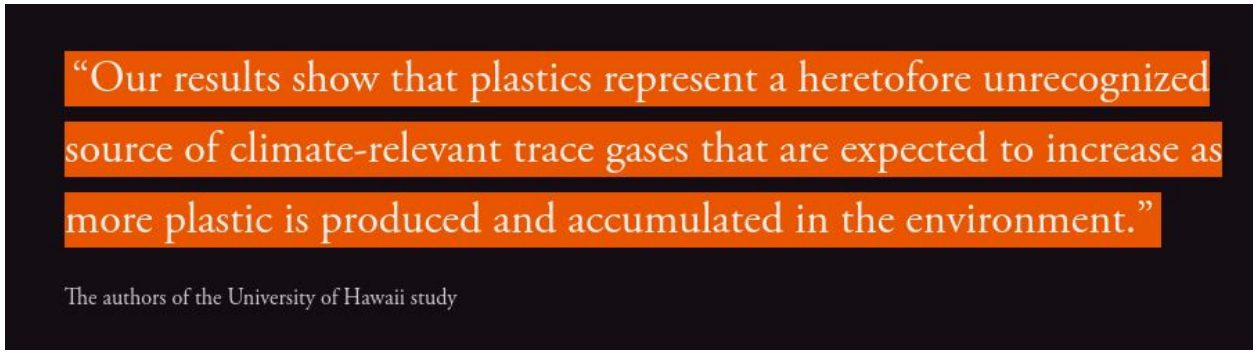
“What Is the Carbon Footprint of a Plastic Bottle?”
https://sciencing.com/carbon-footprint-plastic-bottle-12307187.html
Notes:

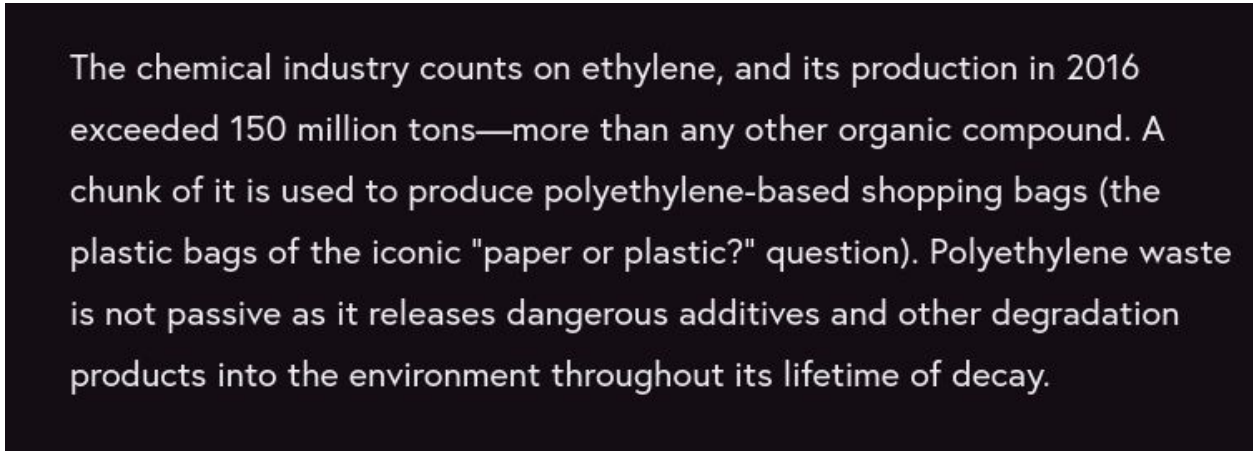
> Pacific Institute, a nonprofit research organization, estimates that the energy used in the production and use of plastic bottles is equivalent to filling the bottles one-quarter full with oil.

- Manufacture of 1 pound of plastic produces 3 pounds of carbon dioxide

www.outrider.org
(?

- Plastic releases toxic chemicals as it decomposes
- Ethane (turned into ethylene) is a byproduct of fracking for fossil fuels
- As plastics decay the emit methane and ethylene; both are greenhouse gases
- Sunlight triggers decay
- ?Will production of single use plastics decrease? No, production rate is anticipated to triple by 2050
- 40% of plastic waste goes to landfill





?What are the greenhouse gases?

https://climatekids.nasa.gov/greenhouse-cards/
(well it's NASA - their reputation depends on correct info)

Production of methane and ethylene from plastic in the environment
https://journals.plos.org/plosone/article/file?id=10.1371/journal.pone.0200574&type=printable
(.org, journal, 2018, University of Hawaii at Manoa - I see this institution a lot!, three funders are named and a doi # is provided)

- Chemicals released during degradation negatively impact the biota
- Polyethylene is the most produced and discarded synthetic polymer globally
- Methane and ethylene
- "Production of trace gases" from polyethylene increases over time - from ambient solar radiant
- 212 day incubation of produces: 5.8 ?units methane, 14.5 ?units of ethylene, 3.9 of ethane, 9.7 propylene
- In air, degradation effects are worse than in water - 76 times worse for ethylene
- "Our results show that plastics represent a heretofore unrecognized source of climate-relevant trace gases that are expected to increase as more plastic is produced and accumulated in the environment."
- "Polyethylene is not inert and is known to release additives"

Greenhouse gases are gases that can trap heat. They get their name from greenhouses. A greenhouse is full of windows that let in sunlight. That sunlight creates warmth. The big trick of a greenhouse is that it doesn't let that warmth escape.

" Scientists are worried that human activities are adding too much of these gases to the atmosphere."

Bioethylene production from Ethanol: A Review and Techno-economical Evaluation (31 March 2017)
https://onlinelibrary.wiley.com/doi/full/10.1002/cben.201600025
(Wiley is a respected educational publisher with longevity and reputation at stake, has a doi and cited by 13)

- Manufacturing of bioethylene from 1st generation bioethanol is new technology alternative to polyethylene, a fossil fuel derivative; the same from 2nd generation bioethanol does not yet have a process

?Is ethylene a greenhouse gas?

Emissions of Greenhouse Gases in the U.S. (2011)
https://www.eia.gov/environment/emissions/ghg_report/glossary.php
(.gov,

> **Ethylene:** An olefinic hydrocarbon recovered from refinery processes or petrochemical processes. Ethylene is used as a petrochemical feedstock for numerous chemical applications and the production of consumer goods.
>
> **Methane:** A colorless, flammable, odorless hydrocarbon gas (CH_4) which is the major component of natural gas. It is also an important source of hydrogen in various industrial processes. Methane is a greenhouse gas. See also *Greenhouse gases*.

https://www.quora.com/Where-is-Ethane-on-the-periodic-table

- Ethane - C2H6 (2 carbon 6 hydrogen)

https://www.livescience.com/63274-plastics-release-greenhouse-gases.html
(since 2004, created as a complement to space.com; Webby awards in 2008 and 2010; large staff all have linked profiles)

To learn what gases plastics were releasing, the research team collected samples of the seven most common types of consumer plastic — both newly produced pieces and fragments fished from the ocean — and monitored the objects' gas production while floating in seawater or exposed to air. All of the samples emitted methane and ethylene, but low density polyethylene (LDPE) exposed to air produced more gases than all other material-environment combinations. A thin material found in plastic wrap and grocery bags, LDPE is one of the main plastics in production and one of the most frequently discarded, said Sarah-Jeanne Royer, a marine biologist at the University of Hawaii at Manoa and the lead researcher on the paper.

Image annotation: methane, ethylene, and particularly low density polyethylene (LDPE) emit gases that become trapped in the upper atmosphere

https://www.nationalgeographic.com/environment/plasticpledge/
Take the plastic pledge! (do this in advance and provide an annotation)

https://www.nationalgeographic.com/magazine/2018/06/the-journey-of-plastic-around-the-globe/

https://www.nationalgeographic.com/science/2018/09/news-BPA-free-plastic-safety-chemicals-health/
(national geographics - duh, again reputation to uphold)
Images of plastic waste in the animal world

-

?What kinds of plastic waste cannot be recycled in Peel?

http://peelregion.ca/scripts/waste/how-to-sort-your-waste.pl?action=search&query=grocery+bag
How to sort your waste in Peel Region

The Lifecycle of a PET bottle
https://www.youtube.com/watch?v=J6dV7DYX4qk&feature=youtu.be

- Found in search for bottle *cap* recycling

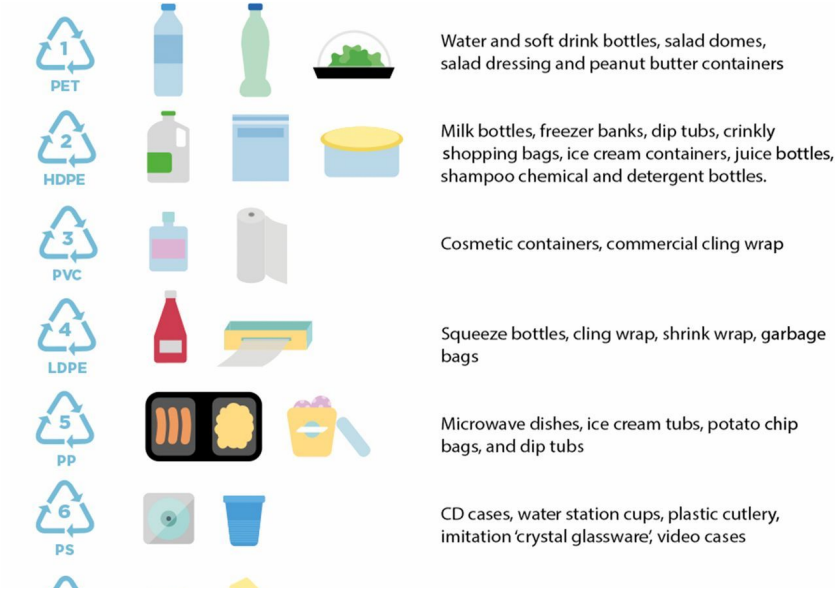
Global News. Everyday plastics quietly pollute the air as they degrade"

> Every type of plastic in the test was found to release the invisible pollutants. However, the highest polluter was low-density polyethylene, one of the most widely-used plastics on the planet. The material is used to make plastic bags, shampoo bottles, food storage containers and a wide range of textiles and construction components.

Researchers at the University of Hawaii at Manoa have identified a wide range of plastics that silently leach methane and ethylene gases as they degrade through exposure to the sun. Both gases have previously been identified as contributors to climate change.

Global News. Month of Giving Back
https://globalnews.ca/video/rd/1393855555725/

Keywords: plastic bottle decomposition, recycle plastic bottle caps for charity,



Presentation and rubric

- Set the thinking/topic and the terminology - early in your slides
- Questionning throughout the research process
- Need other sources
- Use of paper and pen, online, or both? (your memory alone?!)
- Highlight stuff that needs follow-up
- Stay course-related/keep focus
- Show a habit of critically assess sources
- Use second source verification
- Raise a q that you hope someone will explain!
- An interactive element

Things I did in my notemaking …

- Progressed in my questions - the more I learned, the more ‘pointed’ my questions
- Right-justified my questions
- Bolded selected questions
- Point form and indented notes
- Indicated questions with a ? and my ideas with !
- Sometimes screenshot specific sections
- Placed quotation marks around quoted material
- Critically assessed my websites (in parentheses below each)
- Colour coded ‘like’ elements, ex. website critical assessment in purple
- Focused on my own learning first, assignment criteria second
- Bolded and coloured key terms
- Sought out answers and sought to build authority in my sources
- Endeavoured to grow my understanding, ex. ‘Size’ comparisons
- Refined my search terms to match my improving questions
- was selective about sources
- Sought out secondary sources for key facts