Lesson # 5: Setting the Stage

Topic:	**Pros and Cons to Technology and Innovation**
Science 14 Program of Studies outcome(s): Science, Technology and Society (STS) and Knowledge	Students will: **1.** Describe how the flow of matter in the biosphere is cyclical along characteristic pathways and can be disrupted by human activity • identify and assess the needs and interests of society that have led to technologies with unforeseen environmental consequences *(e.g., fishing technologies that result in harvesting more than the rate of reproduction, use of pesticides such as DDT, impact of driving a car on atmospheric compositions)* • https://education.alberta.ca/media/3069383/pos_science_14_24.pdf
Skills	Initiating and Planning: Ask questions about relationships between and among observable variables and plan investigations to address those questions • Identify questions to investigate arising from practical problems and issues • Define questions and problems to facilitate investigation Analyzing and Interpreting Analyze qualitative and quantitative data, and develop and assess possible explanations • Identify new questions and problems that arise from what was learned Communication and Teamwork Work collaboratively on problems; and use appropriate language and formats to communicate ideas, procedures and results • Receive, understand and act on the ideas of others • Communicate questions, ideas, intentions, plans and results, using lists, notes in point form, sentences, data tables, graphs, drawings, oral language and other means • Work cooperatively with team members to develop and carry out a plan, and troubleshoot problems as they arise • Evaluate individual and group processes used in planning, problem solving, decision making and completing a task
Attitudes	Most of the Attitude Outcomes stated in the Program of Studies are included into each of the *Wading in for Water* lessons. This includes; Interest in Science, Mutual Respect, Scientific Inquiry, Collaboration, Stewardship, and Safety. Please refer to the specific outcomes · https://education.alberta.ca/media/3069383/pos_science_14_24.pdf

Planning ahead	-Set up Bioaccumulation Activity game: page 11 of http://aep.alberta.ca/about-us/documents/TeachersGuide-PeregrineFalcon-2000.pdf -Have the Groundwater Activity drawings from Lesson #1 available to view - Assessment for Outcome #1 would be ideal to during the next lesson.
Type of lesson	Small and large group discussion Bioaccumulation Activity Brainstorm
Word Wall	Listed in Appendix A

Getting Started

Topic opener "hooks"	Intro/ Hook ideas: • What is DDT? What was it originally developed to do? Was it created to help or hurt people? What does it do in the long term? Is it still being used? What is the alternative? • Resource: https://www.epa.gov/ingredients-used-pesticide-products/ddt-brief-history-and-status and http://npic.orst.edu/factsheets/ddtgen.pdf o Connection to mosquitos and more recently to Zika Virus, or any other concerns or disease that is spread by insects (dengue, chikungunya, malaria, bed bugs, ticks and Lyme Disease, etc.) Human health and safety vs. ecosystem biomagnification and consequences. • In Alberta, a direct effect of DDT is how it moved up the food chain and has harmed the shell thickness of the Peregrine Falcon eggs. • Predict what happens when the shell is thin. It is easily crushed! This directly impacts that survival of individuals and the species. This top predator was almost extinct (at risk) for many years, until a Recovery Plan was put into place by the Alberta Government to help protect them, and to help breed them and release them back into the wild. • DDT was banned in 1972, and now much safer pesticides are used where needed to prevent this situation from happening again. It has been banned for almost 40 years, and the Peregrine Falcons in Alberta are still "At Risk" of extinction. • Short student video (time: 2:55): https://www.youtube.com/watch?v=Y_dKOTgdS4c • Fact sheet: http://aep.alberta.ca/fish-wildlife/wild-species/birds/falcons-woodland-hawks/peregrine-falcon.aspx • Teacher Resource: http://aep.alberta.ca/fish-wildlife/species-at-risk/species-at-risk-publications-web-resources/birds/documents/SAR-AlbertaPeregrineFalconRecoveryPlan-Mar2005.pdf Bioaccumulation Activity: • Refer to the Teacher Resource developed by Alberta Environment found here: http://aep.alberta.ca/about-us/documents/TeachersGuide-PeregrineFalcon-2000.pdf • Using Activity 2 (p. 11) of the document, students learn about peregrine falcons and the use of DDT in the 1950's and 1960's. • Play the game to illustrate how a toxin such as DDT may enter the food chain and become magnified as it moves up the consumer levels to the peregrine falcon eventually impacting survival of the species. • Compare humans and peregrine falcons in their respective food chains. How could

	bioaccumulation and **biomagnification** serve as a threat to humans? Discuss the difference between "**bioaccumulation**" (i.e. an organism ingesting more and more toxins) and "**biomagnification**" (toxins being passed along through the food chain/web) • Bioaccumulation, does it go away? Which organisms will be most at risk? Belugas in the Arctic ocean link: https://www.whalefish.org/single-post/2014/04/29/Bioaccumulation-and-Biomagnification-in-the-marine-environment And Depending on time of year, check out a web cam, there are many to choose from in the prairies, here is one link: http://www.ab-conservation.com/wildlife-cameras/peregrine/ • If we know that some materials cannot be recycled, how does this fit into the statement "matter cycles", whether we are talking about water, carbon, nitrogen, or oxygen? What happens? Brainstorm some examples.
Lesson Sketch	1. Groundwater Activity: Review from Lesson #1 the students' groundwater diagrams. Let's find out more about the water that we can't see: http://aep.alberta.ca/about-us/documents/FocusOn-GroundwaterBasics-2014.pdf 2. What is a watershed? Discuss the main watersheds in Alberta and where they drain on the continent. Resource: 3. List of watersheds: https://albertawilderness.ca/issues/wildwater/headwaters/ and http://albertawater.com/learn/where-does-alberta-s-water-come-from/what-s-a-watershed Image of watersheds: https://rivers.alberta.ca/ 4. Reference: maps of Canada with full watersheds: http://www.nrcan.gc.ca/earth-sciences/geography/atlas-canada/selected-thematic-maps/16888 • List where the Alberta watersheds drain: Arctic Ocean, Hudson's Bay, and Pacific Ocean (the tiny segment of the Milk River Basin drains into the Gulf of Mexico) 5. Where are farms generally located? This is a topic to carefully approach. Nutrients are gathered (crops) every year and shipped away. The nutrients (such as nitrogen, phosphorus, potassium, sulfur, copper, and many others) need to be replaced to maintain the correct balance, usually by using fertilizer. Eutrophication occurs when nutrients run off the land and accumulate in places not accustomed to them. This is a wonderful segue to discuss the importance of wetlands (http://www.mbgnet.net/fresh/wetlands/what.htm) • prairie potholes • bogs • fens • rivers • lakes, and streams ** **Remember:** Matter cycles, but what if more ends up in one spot in a short period of time? 6. We have learned about the water cycle, the carbon cycle, the oxygen cycle and the nitrogen cycle. If matter cycles, why would we care if it is cycled from one form to another? What we have will always be there, just the form changes. Right? So why might people want to protect groundwater? Or worry that nutrients are taken from the soil when you grow crops? 7. Nature of Things Episode: Save our Lake (~45 minutes) Depending on the group of students, you may want to pause in different spots to discuss what the video highlights http://www.cbc.ca/natureofthings/episodes/save-my-lake Sample script for introducing the field study: *Our class will be monitoring water in Alberta, and*

	*contributing to a database of information around the province. We will be collecting data from (list selected location here). Over time, we will be able to monitor the data to see if things are changing in the different water bodies. We will be entering the data online on the SEEDS website during lesson #11(*https://seedsconnections.org/share-about-water*). 'Monitoring' is about collecting data, not making decisions. We will be able to analyze our data over time and from that possibly develop a management plan or suggestions to present to local officials.* 8. What are the impacts on water if humans change the landscape? Divide the class into groups of 2-3 students and ask them to brainstorm how their assigned industry may impact water. The industry may include; grain farming, cattle ranching, mining, forestry, fracking, fishing, tourism, etc. **NOTE:** Consider the role that industry, community partners, environmental organizations, local and provincial governments, and others may play when engaging students in a balanced discussion about water in your community. There are both challenges and good news stories to share regarding each stakeholder's social responsibility and the ways in which emerging technologies and innovative thinking may contribute to managing and caring for our water and other natural resources. 9. Now let's identify and assess the needs and interests of society that have led to technologies with unforeseen environmental consequences a. What is a fishery? http://www.dfo-mpo.gc.ca/fm-gp/sustainable-durable/fisheries-peches/species-especes-eng.htm • It is the Department of Fisheries and Oceans to ensure that a fishery is sustainable. What does that mean? • How does a fishery collapse? fishing technologies that result in harvesting more than the rate of reproduction, Resource: *http://www.rcinet.ca/en/2016/10/06/canada-could-suffer-another-fishery-collapse-warns-official-gelfand-oceana/* b. Are pesticides bad? Discuss why humans rely on pesticides, pros/cons to modern agriculture. What are the alternatives? http://www.hc-sc.gc.ca/cps-spc/pubs/pest/_fact-fiche/pesticide-food-alim/index-eng.php and http://helpingcanadagrow.ca/
Closing ideas	Ask: What is potable water? Water that is safe for humans to drink. • Who has a right to potable water? http://www.un.org/waterforlifedecade/human_right_to_water.shtml and http://en.unesco.org/themes/water-security (UNESCO Sustainable Development Goals) • Should we trust our water supply in Alberta? Explain. • Water crisis in Walkerton, Ontario: http://www.cbc.ca/news/canada/inside-walkerton-canada-s-worst-ever-e-coli-contamination-1.887200 • Where does your water comes from? What if you drink from a well? Is it safe? How do you know? According to Alberta Health Services Environmental Public Health department, a private residence with a well can be tested for bacteria twice a year and once every three years for chemistry, free of charge. If the results come back with an issue, the water must not be consumed and steps such as "shock chlorination" must be taken then tested again to make the water safe to drink again. http://www.albertahealthservices.ca/info/service.aspx?id=1052212 • What about First Nations water supplies? http://edmontonjournal.com/news/local-news/alberta-first-nations-still-lack-consistent-access-to-clean-water • Is bottled water safer than tap water? http://news.nationalgeographic.com/news/2010/03/100310/why-tap-water-is-better/ • What happens if you run out of water during an outdoor trip (hunting, fishing, hiking, etc.)? There are different emergency supplies you can pack for such circumstances to prevent serious illness such as *E.coli* or *Giardia* (beaver fever) contamination. There are drops/tablets

	that can be dropped into the water (less expensive), and there are also small hand pumps that filter the water (more expensive): https://www.mec.ca/en/products/gear/camping-and-hiking-gear/water-bottles-and-filters/water-treatment/c/1236

Notes:

Reminder: Next class is an ideal time to assess Outcome #1.