Lesson #2: Setting the Stage

Topic	**Matter Cycles**
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 • Describe, in general terms, how water, carbon, oxygen and nitrogen are **cycled** through the biosphere • 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 Performing and Recording: Conduct investigations into the relationships between and among observations, and gather and record qualitative and quantitative data • Carry out procedures, controlling the major variables • Estimate measurements • Organize data, using a format that is appropriate to the task or experiment • Use tools, technology and apparatus safely Analyzing and Interpreting Analyze qualitative and quantitative data, and develop and assess possible explanations • State a conclusion, based on experimental data; and explain how evidence gathered supports or refutes an initial idea • Identify and evaluate potential applications of findings • 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
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	*Safety First: Refer to your school/department/district regulations* Book a science lab with the following equipment for each lab group: • Hotplate • Flask • Stopper • Sugar • Salt • Water • Thermometer • 500 mL beaker x 3 • Various sizes of graduated cylinders • Ring clamp • Timer (stopwatch or cell phone timer) Note: Add in 2 eggs (or more) to be placed in vinegar the day before to remove the calcium carbonate shell. Once it is removed, the mass should be recorded and then placed in the different substances for at least a few hours.
Type of lesson	*Lab safety review* Lab Discussion **NOTE:** Lab Station Activities – Student Sheets found here
Word Wall	Listed in Appendix A

Setting up Lab Stations:

Lesson #2 makes use of lab stations. The National Science Teachers' Association (NSTA) has an excellent article on how to set up lab stations including all of the things you need to consider. It also provides a template for assigning student roles within each group to increase learner engagement. Access the article here:

http://www.nsta.org/publications/news/story.aspx?id=53323

Information on assigning student roles can also be found in Appendix B

Getting Started

Topic opener "hooks"	**Intro/ Hook ideas:** Give the following scenario: You are stranded without a cell phone, have run out of drinking water and other supplies and are: • on a desert island OR • lost in the forest OR • your car runs out of gas while driving in the Badlands OR • lost at sea Challenge: You need water to survive, so how do you get safe drinking water that doesn't make you sick? • Discussion about evaporation and condensation; what supplies would you need to make this happen? Or, if you have a match and could boil the water, how long until it is safe? Discuss why tea is a safe option for hydration historically and in developing countries. Refer to the UNESCO Sustainable Development Goals http://en.unesco.org/themes/education-sustainable-development
Lesson Sketch	1. Review lab safety rules and expectations: *Refer to your school/department/district regulations* Teacher resource: http://www.uft.org/chapters/lab-specialists/lab-safety-rules-for-students 2. Students will be placed in groups to visit 5 water lab stations, allowing them to practice simple laboratory skills and the Scientific Method. Some of these skills will prepare for the Water Quality Action Project. Each group member should be assigned a role (See Appendix B) Teacher Resource: http://www.nsta.org/publications/news/story.aspx?id=53323 **NOTE:** The stations should take students an equal amount of time to work through. Suggestion: Only allow a station change when all groups have completed the station. Station 2 has three parts and students can move freely between them. See the attached student sheets, lab set up images, and station set up sheet. (Student Lab Stations Activity Sheet). Ask students to clean up the lab station as they found it before moving to the next station. • Station 1: Build a model of the hydrologic cycle. Collect condensation from saltwater using a hot plate, beaker, tinfoil, and ice cubes. Teacher reference:

(https://thewaterproject.org/resources/lesson-plans/rainmaker-experiment)

- Station 2a: Measure volumes of water using several graduated cylinders - show how to measure and explain *meniscus*. Measure quantity of water correctly (use various sizes of graduated cylinders and beakers). Have a few capillary tubes of varying sizes set up to further emphasize correct and accurate measurement. Teacher reference: https://water.usgs.gov/edu/meniscus.html

- Station 2b: measure the mass of an egg in distilled water, and then in salt water (prepared the day before & remove the shell with vinegar).

- Station 2c: Is salt water more or less dense than freshwater? Place an egg in each to compare. Challenge: How could you float the egg in the middle of the beaker (not floating at the top or resting on the bottom).

- Station 3: Determine how much sugar can be dissolved in cold vs warm vs room temperature water using a ring clamp, hot plate and thermometer. Be sure to accurately measure the temperature of each container of water? What other variables need to be controlled (i.e. volume of water). Using a timer, determine how long it takes to dissolve the sugar. Is there a maximum amount of sugar that will dissolve? Teacher resource: http://www.sciencekids.co.nz/experiments/dissolvingsugar.html

- Station 4: How long does it take to boil tap water? Salt water? "Contaminated" water (i.e. soft drink or Gatorade)? Implications on a large scale. Predict what may happen when these substances freeze.
    - Measure the temperature of tap water, add some ice cubes and measure the temperature again.
    - Sprinkle a tablespoon of salt and measure the temperature again.

- Station 5: Water movement with temperature changes. How does water react to different temperatures? Adding heat into the system makes molecules move more quickly. Set up a large glass pan of tap water over a candle on one side and to a bowl of ice cubes on the other side. Add drops of food colouring to the water, one drop where the candle is under the pan, and one drop where the ice cubes are under the pan. Draw a model to illustrate that water molecules move more quickly when heat is added and more slowly when heat is removed.

3. Return to the classroom after the groups have visited all 5 stations.

- Matter cycles: Using the stations, discuss where the water goes to and comes from. Does it ever leave the system? No! Water changes form – solid, liquid, vapour. Now we can say that matter doesn't leave the system, it moves, transforms, but doesn't leave.

    - Carbon Cycle: What are fossil fuels? Where do they come from? How are they extracted? How did they get there? Based on what we discussed about matter cycling and not leaving the system, where does carbon go

	once it is extracted? Is it considered renewable? What about carbon cycling from sources that are not mined by humans? Carbon is a building block of life making up important components such as DNA, carbohydrates (breads and sugars), lipids (fats) and proteins (meat, tofu, beans, etc.). Emphasize the link between the carbon cycle and the oxygen cycle. Image: http://www.sciencekids.co.nz/images/pictures/earth/carboncyclediagram.jpeg Teacher resource: https://www.youtube.com/watch?v=2D7hZpIYlCA o Oxygen Cycle: photosynthesis, respiration, combustion (related to carbon). Image: https://www.exploringnature.org/graphics/ecology/oxygen_cycle_color72.jpg o Nitrogen Cycle: Nitrogen is the largest percentage of gas in our atmosphere. How do we get it into a usable source? Bacteria rules! Discuss nitrogen fixing bacteria & relation to legumes, decomposers, other bacteria that convert back to atmospheric nitrogen. What about fertilizer? Fertilizer = animal waste and compost, or sprinkled from an energy intensive process. What about lightening? A chemical reaction occurs! Image: https://www.pmfias.com/wp-content/uploads/2016/05/Nitrogen-Cycle-wiki.jpg Teacher resource: https://www.youtube.com/watch?v=leHy-Y_8nRs
Closing ideas	Discussion: What is a Carbon Tax? Why did Alberta implement one in January, 2017? Based on what we have learned, we know that matter cycles, so why have a carbon tax when the amount of carbon is always the same? Rationale: https://www.alberta.ca/climate-carbon-pricing.aspx Calculate how much a household will be pay each month: http://www.cbc.ca/news/canada/calgary/multimedia/alberta-carbon-tax-calculator-1.3900339

Notes: