URANIUM AND OIL SPILLS: IT'S GARBAGE DAY, HUMANS (GRADE 7)

SARAH SOLTER (/USERS/SARAH-SOLTER)

During this inquiry-based unit, students will learn that the pure substances and mixtures that we use, both as individuals and as industries, have discoverable properties that are explained using the Particle Theory. There are methods we use to mix and separate them. Most importantly, there are social, medical, economic and environmental effects when we eventually dispose of these chemicals. Together we will explore these properties and methods using media, classroom demonstrations, and student run experiments. Citing the model of uranium, we will investigate this pure substance's properties, history of use, environmental and medical effects, and methods we currently dispose of it. Based on this knowledge, we will propose, defend, and explain alternative methods of disposal that may improve our world. Students will also explore the effects of crude oil spills in our oceans as an example of the release of an industrial mixture into our environment. Using these foundational skills, students will then focus on a pure substance or mixture that is meaningful to them as a group. Following the model process, they will inform their peers of their personal investigation, solutions, and conclusion.

Grade Level/Course Code: Grade 7

Strand(s) and Unit(s): Pure Substances and Mixtures

Inquiry Focus:

Particle Theory, Elements, Molecules, Periodic Table, Chemical Properties, Physical Properties, Mechanical Mixture (Heterogeneous mixture), Homogeneous Mixture (Homogeneous mixture), Dissolve, Alloys, Solute, Solvent, Saturated, Unsaturated, Super Saturation, Dilute, Concentrated, Sieving, Filtering, Magnetism, Sorting, Floating, Settling, Evaporation, Distillation

Timeline:

The timeline for this inquiry is dependent upon the organization of your timetable. When I assembled this unit of study, I was teaching both Language and Science to a grade 7 class and so had access to multiple periods per day over the course of 8 weeks. It also gave me the opportunity to assess both subjects at the same time.

Since these two subjects were integrated, I took the time to teach the students note taking skills for both videos and articles, step-by-step research techniques, and provide group time for consultation. During additional language periods I also spent time consolidating proper paragraph writing using the Point, Proof, Explanation (PPE) format, and using in-text citations and referencing. The time input was much greater than what I have listed for a teacher assessing only science related curriculum, but the overall payoff was much greater as well.

The time allocated for the subject of science differs by the mandate of each school board in Ontario. I have assigned my lesson blocks in units of one hour for the sake of simplicity and that is the maximum length of a classroom period at my school. You can shorten some of the lessons by assigning some of the videos to be watched during personal time or as optional. If you have 3 science periods a week, this unit can realistically be completed in 10 weeks with 2 weeks to complete the final skills and research tasks.

Big Ideas:

- Matter can be classified according to its physical characteristics. (Overall expectations 2 and 3)
- The particle theory of matter helps to explain the physical characteristics of matter. (Overall expectations 2 and 3)

- Pure substances and mixtures have an impact on society and the environment. (Overall expectation 1)
- Understanding the characteristics of matter allows us to make informed choices about how we use it. (Overall expectations 1 and 3)

Overall Expectations:

Science and Technology: Grade 7

Understanding Matter and Energy: Pure Substances and Mixtures

1. Evaluate the social and environmental impacts of the use and disposal of pure substances and mixtures.
2. Investigate the properties and applications of pure substances and mixtures.
3. Demonstrate an understanding of the properties of pure substances and mixtures, and describe these characteristics using the particle theory.

Language: Grade 7

Oral Communication:

1. listen in order to understand and respond appropriately in a variety of situations for a variety of purposes

Reading:

1. read and demonstrate an understanding of a variety of literary, graphic, and informational texts, using a range of strategies to construct meaning

Writing:

1. generate, gather, and organize ideas and information to write for an intended purpose and audience

Specific Expectations:

Science and Technology: Grade 7

Understanding Matter and Energy: Pure Substances and Mixtures

1. assess positive and negative environmental impacts related to the disposal of pure substances and mixtures
1. assess the impact on society and the environment of different industrial methods of separating mixtures and solutions

2.1 follow established safety procedures for handling chemicals and apparatus

2.2 use scientific inquiry/experimentation skills to investigate factors that affect the solubility of a substance and the rate at which substances dissolve

2.3 investigate processes used for separating different mixtures

2.4 use scientific inquiry/experimentation skills to investigate the properties of mixtures and solutions

2.5 use appropriate science and technology vocabulary, including mechanical mixture, solution, solute, insoluble, saturated, unsaturated, and dilute, in oral and written communication

2.6 use a variety of forms to communicate with different audiences and for a variety of purposes

3.1 distinguish between pure substances

3.2 state the postulates of the particle theory of matter

3.3 use the particle theory to describe the difference between pure substances and mixtures

3.4 distinguish between solutions and mechanical mixtures

3.5 describe the processes used to separate mixtures or solutions into their components, and identify some industrial applications of these processes

3.6 identify the components of a solution

3.7 identify solutes and solvents in various kinds of solutions

3.8 describe the concentration of a solution in qualitative and in quantitative terms

3.9 describe the difference between saturated and unsaturated solutions

3.10 explain why water is referred to as the universal solvent

Language: Grade 7

Reading:

Demonstrating Understanding

1. demonstrate understanding of increasingly complex texts by summarizing important ideas and citing a variety of details that support the main idea

Making Inferences/Interpreting Texts

1. develop and explain interpretations of increasingly complex or difficult texts using stated and implied ideas from the texts to support their interpretations

Evaluating Texts

1. evaluate the effectiveness of both simple and complex texts based on evidence from the texts Teacher prompt:

Writing:

Developing Ideas

1. generate ideas about more challenging topics and identify those most appropriate for the purpose

Research

1. gather information to support ideas for writing, using a variety of strategies and a wide range of print and electronic resources

Classifying Ideas

1. sort and classify ideas and information for their writing in a variety of ways that allow them to manipulate information and see different combinations and relationships in their data

Organizing Ideas

1.5 identify and order main ideas and supporting details and group them into units that could be used to develop a multi-paragraph piece of writing, using a variety of strategies and organizational patterns

Key Concepts:

Particle Theory, disposal of waste, solutions, mechanical mixtures, pure substances, separation techniques; human impact on environment, society, economy and other humans

Prior Skill Sets

Literacy

- Note taking from factual videos (like scikids), inspirational videos (like TEDTalks), and text resources
- Providing references and in-text citations (we used MLA in our class)
- Writing paragraphs using Point Proof Explanation (PPE) format.

Science

- Determining independent and variables when performing experiments.
- Experience with Scientific Method, performing laboratory experiments, and writing rudimentary lab reports
- Understanding the difference between quantitative and qualitative data

Prior Knowledge:

- The postulates of Particle Theory (If you have already taught the Heat unit for Grade 7. If not, I have integrated practice with the postulates into some of the lessons and created a **Topic 0: Particle Theory** that you can use as a refresher, if needed. Having an anchor chart posted will help when you make references to them.)
- The three basic states of Matter and their properties
- Humans impact our environment in positive and negative ways

Materials and Equipment:

- Pencil and paper
- Markers and chart paper (for anchor charts and planning)
- iPads or lap tops with internet access (YouTube for the videos and article research. We used Google Classroom to share ideas and references electronically. Students also submitted paragraphs to me through Google Classroom)
- Projector (to share work and watch some of the videos as a class)
- Materials for the experiments and demonstrations are listed in each topic covered

Safety:

- Ensure that students follow the board policy for internet safety
- Ensure that students follow lab safety procedure, including wearing protective equipment such as goggles and gloves when working with chemicals that are unknown to them
- STAO provides a safety resource for Science and Technology in the Elementary Classroom http://stao.ca/res2/unifElemSafety/ (http://stao.ca/res2/unifElemSafety/)

Instructional Planning and Delivery:

- Topic 0: Particle Theory
- Topic 1: Pure Substances
- Topic 2: Pure Substances vs. Mixtures (mechanical mixtures and solutions)
- Topic 3: Creating Mechanical Mixtures and Solutions
- Topic 4: Separating Mechanical Mixtures
- Topic 5: Separating Solutions
- Final Task (Skills): Create and implement a process to separate a complex mixture into its components
- Research and Solve a disposal problem as a class (Case Study: Uranium)
- Final Task (Inquiry): Choose a Pure Substance or Mixture that humans use and determine, through research and your own ideas, the most effective way to dispose of it when we have finished using it.

*Outlines and lesson plans for each topic are included in the **Lesson Content** file*

Lesson Sequencing and Content for Project Unit

A note before beginning the lessons. I use a lot of short youTube videos in my lessons and for my own background knowledge. There is quite a variety out there. I recommend you look them over before presenting them to your class. Some of them are designed for kids in mind (Crash Course Kids, SciKids, Bill Nye), some are just a random teacher talking and drawing on a white board (sometimes they just need to hear the same stuff from someone else to make you seem more credible), and some have more shocking and controversial content (e.g. news stories of birds being coated in crude oil, talk of radiation exposure from Uranium use). You are left to be the judge of what your students are mature enough to handle.

Secondarily, one of the main resources I use in my classroom is Nelson: Science and Technology Perspectives 7 (2009). Some of the class and student demonstrations I use are taken from this text, as are modified versions of some of the experiments. This text also provides a variety of examples that support the concepts that we teach to our students. I include page references for the sections that I use in my own classroom for that purpose.

Additionally, many of the demonstrations that I do in the front of the class (with as many student volunteers involved as feasible) are able to be done in groups with the full participation of the class. The ones that I do as demos, I do in the interest of saving time. There are a lot of concepts in this unit that need to be introduced and reinforced in the span of 10-12 weeks, based on the 150 minutes a week that is allocated for science in my school board. The more hands-on-materials time the better, but this is the balance that I find has worked in my classes.

A note to teachers new to teaching Science

Timelines and Group Dynamics

When new to teaching science, our instinct is often to extend lab time so that students can complete experiments or demonstration models. Often, as with other subjects, more time does not equal a better product. Deadlines are important to keep you and the class on schedule; there is a lot to get done. One way to help students achieve these deadlines includes assigning students certain roles within the group for certain experiments (see Lab Work in Groups below).

Another method I use in conjunction with the above is to combine the data of groups when there is a common procedure, by having the students post data on a shared electronic table or on chart paper. Later in this unit, students will test how much oil different materials will remove from a mixture of oil and water. In a given amount of time, one group may test 4 materials and another group only one. When all groups have the combined data they will be able to complete a write up even though, in this instance, they did not collect sufficient data as a single group.

Lab work in Groups

One of the most challenging, and rewarding, tasks of teaching science is the laboratory component of the curriculum. Students often work in pairs or groups of four depending on the nature of the experiment, the timeline, and the amount of equipment that you have. Providing students with a standard set of roles during an experiment leads to greater engagement and accountability. This helps to avoid the situation where one student will consistently take the lead (or do all the “fun stuff”) and some others are left with, or choose to contribute, nothing.

These roles may vary in specificity from lab to lab, but some tend to be useful in almost all cases.

- Materials Manager: This student retrieves and returns all equipment and materials at the beginning of and during the lab. They clean all glassware and set it to dry (this alleviates a mob at the single sink we have in our classroom).
- Data Recorder: This is the only person in the group to record data (I give them a clipboard to distinguish the role) although all members of the group contribute to the observations and relaying data to the recorder.
- Lead Experimenter: This is the person to perform the experiment. This role may be subdivided for any given lab as applicable. This person is also responsible for the final wipe down of the lab bench and surrounding area.
- Lab Coordinator: This person keeps the group on task. They read out the procedure and remind others of the purpose and timeline.

These are roles that need to be introduced and practiced, but the time investment is very valuable in the long run. This is especially true if you are on a rotary schedule where you will be teaching the same students year over year.

Science Vocabulary

There is a lot of it. Some words are used interchangeably with others, depending on the video, the text, the website, and even the curriculum. For example, in this unit, the Ontario Curriculum documents refer to “mechanical mixtures” whereas the text I use states “heterogeneous mixtures”.

Some of the vocabulary that I list in my lessons I use to facilitate learning and is not found in the curriculum at this grade level. For example, I use the periodic table of elements in the first lesson to provide context for students. Where can they go to find a list of pure substances? I also use the word **compound**, to help students understand that pure substances can also be combinations of elements that are bonded together. A concept that many of them have found confusing. Although students are not to be assessed on this word in grade 7, I use it to clarify the understanding of “pure substance”, words that students are assessed for at this grade level.

Find the level of detail with which you and your students are comfortable and stick to that. You can use the anchor charts suggested in the lessons to include synonyms if it will help. Following the specific vocabulary listed for the strand in the curriculum documents will provide for the simplest assessment of student understanding.

Assessment

Throughout this unit there are a variety of opportunities for assessment **as learning** (diagnostic), **for learning** (formative), and **of learning** (summative).

Assessment **as learning** opportunities take place most often at the beginning of class time when you introduce a topic. This is a time to ask questions of students that allow you to assess how familiar they are with a given topic. This will allow you to determine how deeply you need to go into detail in your lesson. Will you need a wide variety of examples, or just a few?

The most common technique I use to assess **for learning** in this unit is the Exit Card. An exit card is a question that requires only a short answer (usually written), but demonstrates whether or not a student understands the concept that you have presented in class. Usually given in the last 5 minutes or so of class and handed to the teacher upon leaving the room. This is a quick and effective way of tracking misconceptions and misunderstandings. These can be addressed in the quick review at the beginning of the next class.

Another technique to collect data **for learning** is by using performance checklists during lab time. I have provided a sample that can be altered as needed for specific labs. This way you can give specific feedback to students about how they are fulfilling their specific role during lab work. Once you have provided descriptive feedback and next steps over the course of a couple of labs, you are able to use the checklist for assessment **of learning** as well.

Exit cards can also be used for assessment **of learning** provided that students have already received some form of feedback on the concept and have been given the opportunity to correct their misconceptions.

Further assessment **of learning** opportunities are provided both in the final research and skills tasks.

Accommodations for ELL and IEP students

You understand the capabilities and needs of your students. Ministry documents and your Learning Resource staff will help you to select the expectations of focus for each of these students.

I provide some specific suggestions for accommodations in the body of this unit. Generally, though, providing a printed (or electronic) simplified outline of the media (video or podcast) to these students will help them to focus their attention on the important concept and a representative example of that idea. Adding pictures or drawings that are meaningful to the student will help them to access the knowledge as well. Simplified text notes from you, providing the student with the targeted concept and allowing the student to provide the examples, will further support learning.

Topic 0: Matter and Particle Theory

(This is listed as Topic 0 because you may have already taught the basics of Particle Theory and its application to heat as part of the Heat Unit for grade 7. If you have, skip to Topic 1. Particle Theory will be applied to a number of the lessons throughout this unit.)

Timeline for topic

- 30-45 minutes

Learning goals

- Review and clarify understanding of Grade 5 expectations for Properties of and Changes in Matter (Grade 5 expectations 3.1-3.8) including the three basic states of matter and their properties, that matter changes among all three states as a result of absorption or release of heat
- State the postulates of Particle Theory
- Describe how Particle Theory applies to our world, through examples.

Expectations covered (Science and Technology)

- 3.2

Vocabulary

- Solid, Liquid, Gas, Particle Theory, Matter, Particles

Materials

- Anchor chart that lists the postulates of Particle Theory (Different texts list a variety of phrasings and even the number of postulates. The curriculum lists them as follows:)
    - all matter is made up of particles;
    - all particles are in constant motion;
    - all particles of one substance are identical;
    - temperature affects the speed at which particles move;
    - in a gas, there are spaces between the particles;
    - in liquids and solids, the particles are close together and have strong forces of attraction between them
- A three column/seven row blank table entitled: Postulates of Particle Theory. Have them title the three columns Postulate/Picture/Examples (or have them pre-labelled)
- Three beakers: one with ice cube, one with liquid water, one sealed and labelled “Vapor”

Lesson Plan

- Show students the three beakers. Each of these beakers contains the same substance, but it is in a different state. Turn to the person next to you and talk about what the substance might be and the name of each state in each beaker (Water – H20: Solid, liquid, gas).
- Back in grade 5 you learned the three common states of matter. You also learned that a substance, such as water, can change between states. What causes a solid to become a liquid or a liquid to become a gas? (Heat).
- Draw the three beakers on chart paper and label them “solid” “liquid” and “gas”. All of these samples are made up of exactly the same particles. Particles are so small that they are invisible to the eye. Everything is made up of particles. Every single particle of pure water is made of the same thing: 2 atoms of Hydrogen and one of Oxygen. However, these particles have different properties when they are in different states.
    - *Show the ice* When a substance is a solid, the particles are packed very closely together. When I push on a piece of ice, the particles of my finger can’t pass through the particles of ice because the particles of ice are so close together. Those particles are also strongly attracted to one another. It’s going to take a lot of external force to break them apart. The last thing you need to know about these particles is that they are always moving. Because they are so attracted to one another, they aren’t moving far, but they are still vibrating in place.
    - *Show the water* When I heat a solid substance, it changes to a liquid state. Heat causes particles to move faster and farther apart. It also reduces the attraction that they have to one another. If I push my finger into the water, the particles move around my finger. They are also constantly moving around each other. This allows liquids to flow in a way that solids can’t.

- *show the beaker that represents water vapor*. When we add heat to liquid water it becomes water vapor, a gas. We can't see water vapor, but that doesn't mean that it isn't there. We can't see particles of oxygen either, but we know that they are in the air because we are breathing them in to keep us alive. Heated particles move even faster and farther apart than those of a liquid. There are huge spaces, now, between the particles, and their attraction to one another is even weaker. If I open up this container the particles will escape, moving further and further from one another.

- *Draw a representation of the particles of the different states of water on the chart paper to give students a visual. Be sure to draw the particles themselves as the same size, but further apart as they shift between states*.
- Now, let's look at the Postulates of Particle theory on the anchor chart and tell me about how each one can be applied to the substance of water that we've just discussed.
- *Watch the video listed below. It will provide students with a number of examples that they can add to their table. Guide them to draw a visual representation of particles for each of the postulates. For example draw a number of equal sizes squares for "all matter is made of particles". Have students refer to this table as the unit progresses. They can add examples where appropriate*

Background and Resources

https://www.youtube.com/watch?v=npv74D2MO6Q&index=2&list=PLTDPcHzTdAQnFN42BXhS7gGzihuwCap3Y (https://www.youtube.com/watch?v=npv74D2MO6Q&index=2&list=PLTDPcHzTdAQnFN42BXhS7gGzihuwCap3Y)

- Part(icles) of Your World (2015). (3:30). Crash Course Kids.

Review of states of matter with lots of examples. Discusses how everything is made up of matter and extends to particles – explaining properties of matter as well. Also reviews changes of state with additional examples.

Assessment

- Exit Card: Explain what is happening to the particles of ice-cream as it sits in a cone on a very hot day. Use as much scientific vocabulary as you can in your explanation *sample vocabulary: solid, liquid, particles, state, heat*
- (Sample answer: The ice cream is changing from a solid to a liquid when it absorbs heat. The particles are moving faster and farther apart as the ice-cream melts. As it becomes a liquid, the particles are less attracted to one another and are able to flow over one another.)

Topic 1: Pure Substances

Timeline for topic

- 1 hour to teach (or review) and consolidate the postulates of Particle Theory
- 1 hour to identify pure substances and apply particle theory to them

Learning Goals

- Define and apply the postulates of Particle Theory
- Define and Identify examples of pure substances
- Describe the difference between Elements (Aluminum) and Compounds (Sodium Chloride) that make up pure substances
- Understand that we use pure substances every day and everything we use is eventually disposed of

Expectations covered (Science and Technology)

- 1.1, 2.5, 3.1, 3.2

Vocabulary

- Elements (Atoms), Compounds (Molecules), Periodic Table, Pure Substance, Particle Theory, Chemical Properties, Physical Properties

Materials

- Demonstration materials
  - Aluminum foil
  - A diamond (from a piece of jewelry, or a photo)
  - A piece of wood where the grain is clearly showing
  - 250ml beakers of the following:
    - Marbles mixed with sand
    - Salt mixed with pepper
    - Salt
  - Show the class beakers containing the following samples (Label them clearly - maybe have them watch as you pour them):
    - Distilled water
    - Tap Water
    - Salt water

- Class set of the Periodic Table of Elements
- Chart Paper
  - List of Pure Substances T-Chart [Elements (atoms)/Compounds (molecules)]
  - List of Mixtures T-Chart (Solution/Mechanical Mixture)
  - Unit Vocabulary List (add words and definitions as you go)

Lesson Plan

- Show the class photos or actual samples of the following.
  - Aluminum foil
  - A diamond
  - A piece of wood where the grain is clearly showing
- What substances do you think are in the beakers? Describe them? How could you test to see if you are right? (Talk about chemical and physical properties if need be.) Which ones might be pure substances? (The aluminum or the diamond, because each piece looks exactly the same.) This is a property of pure substances. No matter how many pieces you break off, it is still made of the same molecules.
- I have handed out a copy of the Periodic Table of Elements. Essentially, this is a complete list of all the atoms in the universe known to humans. (Take them though the sample element to give them an idea of how to read the table. Just point out the basics (name, symbol). Let students look to see some of the elements that they recognise and have them share them aloud). Check your periodic table. Find Aluminum. Aluminum foil is pure aluminum. All of the atoms in this sample are Aluminum. There are no other types of particle; no other types of atom. This is a pure substance. Find Carbon on the Periodic table. This is what diamonds are made of. All the atoms in a diamond are Carbon atoms. It is a pure substance. Add these two examples to the Elements side of the pure substances T-Chart. Add “wood” on a post-it note to the mixtures T-chart (we’ll pick which side it goes on later).
- Show the class beakers containing the following samples:
  - Marbles mixed with sand
  - Salt mixed with pepper
  - Salt
- What substances do you think are in the beakers? Describe them? How could you test to see if you are right? (Talk about chemical and physical properties if need be). Which ones might be pure substances? (The salt, because each piece looks

exactly the same.) This is a property of pure substances. No matter how many pieces you break off, it is still made of the same molecules.

- Check your periodic table. Find Sodium and Chlorine. In this container is Sodium Chloride, a **compound** of these two elements. They are combined in a way that no matter how small you crush the salt each piece will always be made up the same ratio of Sodium to Chlorine bound together. You can't break these bonds physically. When you buy a box of salt, the only **particles** or **molecules** (these can be used interchangeably) are Sodium Chloride. We will add this to the compound side of our pure substances T-chart. Add "marbles and sand" and "salt and pepper" on a post-it note to the mixtures T-chart (we'll pick which side it goes on later).

- Show the class beakers containing the following samples (Label them clearly - maybe have them watch as you pour them):
  - Distilled water
  - Tap Water
  - Salt water
- Let's move on to examples that are liquids. Look at the three samples. Which one is the Pure Substance, and why? (Think/Pair/Share). The distilled water. It is treated so that all impurities are removed: it is pure water. Distilled water only has molecules of oxygen and hydrogen in it, bound together in a ratio of 2 hydrogens to 1 oxygen (H2O). You can look these up on the Periodic table too. No matter how little you pour, you will only have these molecules in your cup.
- The other two samples look the same, but are mixtures of different particles. What is the combination of particles that is in the salt water? Add "saltwater" on a post-it note to the mixtures T-chart (we'll pick which side it goes on later).
- What is the combination of particles in the tap water? (Most cities add fluoride – find that on the periodic table too- to help prevent cavities in the teeth of their citizens. Other impurities such as sulphur-periodic table- and calcium carbonate are in water as well. Add "tap water" on a post-it note to the mixtures T-chart (we'll pick which side it goes on later).

- The take home message is that pure substances look the same throughout the sample and contain only one type of atom (element) or molecule (compound). Some mixtures look like Pure Substances (like Saltwater does) but is made of different molecules. We will find ways to tell pure substances from those kinds of mixtures in a later class.
- This also brings us back to Particle Theory. One of the postulates is that all matter is made up of particles. All the particles of a pure substance are composed of one type of particle. If we could zoom in on a single grain of salt, we would see millions upon millions of Sodium and Chlorine atoms bonded together. We wouldn't see any other particles there. If we zoomed in on a piece of aluminum foil? What particles might we see there? (only Aluminum atoms).

- Now, when I'm done with my distilled water. How do I dispose of it? What about my salt? If I pour it in my garden, it'll kill my plants. Salt has an effect on my immediate environment in a way that distilled water does not. What about my used aluminum foil? How do I dispose of that?
- Find Atomic Number 80 in the periodic table. What element is that? (Mercury). For years, mercury was used in household thermometers. It is very toxic. If you eat it, your body doesn't know how to get rid of it. If it vaporizes and you breathe it, it enters your lungs. The effects of mercury on our bodies are very negative. We can't just put it out with the trash on garbage day. It has very negative effects on the environment. We have to learn how to dispose of elements like this very carefully. They are very useful, but also very dangerous if not disposed of correctly.
- Find Atomic Number 94 on the periodic table. Case and point.
- Use a text (I use Nelson: Science and Technology: Perspectives 7 pg. 20, 21) to provide your students with further examples of pure substances and their uses. Add them to the anchor chart. Perhaps have your students create on-going personal charts as well.

Background and Resources

https://www.youtube.com/watch?v=OpWFUqPPtWE (https://www.youtube.com/watch?v=OpWFUqPPtWE)

- The Classification of Matter (2013). (4:22). The Science Classroom.

Calm guy talking as he draws on the screen. He does a good job of separating Pure Substances into Elements and Compounds, and mixtures into Heterogeneous and Homogeneous.

https://www.youtube.com/watch?v=ANOtoVBAzDU (https://www.youtube.com/watch?v=ANOtoVBAzDU)

- Physical and Chemical Change Examples (2017). (2:42). Moo moo Math and Science.

Definitions of physical and chemical changes followed by a variety of video examples the narrator explains as he goes.

https://www.youtube.com/watch?v=nlSemv2fLN8 (https://www.youtube.com/watch?v=nlSemv2fLN8)

- What's My Property: Crash Couse Kids #35.2 (2015). (4:26). Crash Course Kids.

Fast talking commentary paired with animation series for kids that give great examples of properties attributed to metals and gummy frogs. Engaging for kids.

Assessment tools

- Exit card: Magnesium, an orange, table sugar. Which of these are Pure Substances? How do you know? (Magnesium is on the Periodic Table of Elements so it has to be a pure substance. An orange has a peel and pulp – different parts- so it cannot be a pure substance. Table sugar is up to your interpretation. It looks uniform and may be all one form of sugar. Some table sugar is made of multiple forms of sugar. Look at student reasoning to guide you, rather than an absolute.)

Post this question in the last few minutes of class and distribute small slips of paper (or, if students have available devices, post it on Google classroom and have them submit their answers electronically). For ELL or IEP students have physical samples or photos on hand and conduct the Exit Card orally.

Students will submit their responses and you will have a good snapshot of their initial understanding of this concept as they leave the classroom. You will be able to provide full class, small group, or individual redirection as needed in the following class.

ELL and IEP accommodations

- Reduction in the number of vocabulary words may be an accommodation for students on an IEP. If you want them to have access to the same number of words, perhaps provide them with some of the words and their definitions, having them only to add the examples
- ELL students could use an electronic version of the table that would have two additional columns. One for a translation of their language of choice and another for a pictorial representation that they could cut and paste from the internet

Topic 2: Pure Substances vs. Mixtures (mechanical mixtures and solutions)

Timeline for topic

- 1 hour teach and demos (exit card)

- 1 hour review concept text reading and research into more examples including alloys (exit card)

Learning Goals

- Define and Identify examples of pure substances
- Understand that we use pure substances every day and everything we use is eventually disposed of
- Describe the difference between mechanical mixtures and solutions (providing examples of each)
- Use Particle Theory to distinguish between the above and Pure Substances

Vocabulary

- Heterogeneous, Homogeneous, Mechanical Mixture, Solution, Dissolve, Opaque, Translucent, Transparent, Alloys, Particle Theory

Materials

- All the samples from last day (day 1)
- An empty beaker of the same size as the others (day 1)
- 2 same sized beakers, 400 ml water and 400ml saturated salt solution (day1)
- Heat lamp or window space for 2 beakers (day 1)
- Samples of different alloys (a gold ring, a brass musical instrument, a bronze medal, a stainless steel fork)(day 2)
- Bottle of vinegar with a label (day2)
- Chart paper: Components of Solutions (solute/solvent/solution)(day 2)

Expectations covered

- 1.1,2.5,3.1, 3.2,3.3,3.4 3.6,3.7

Lesson Plan

Day 1

- Review of last day's concepts. What are the two kinds of pure substances? How do we identify them? What are some examples from class? Review and return the exit cards from last class – add the three examples to the T-charts. Do any of you have pure substances that you can add to our T-chart?
- Let's look again at our samples from last day. Starting with the first set of three solids. We determined two of these to be Pure Substances. Why? How is the third one different from the other two? (You can see different colours and textures in the grain). This is one of the properties of a mechanical mixture – that you can see differences where there are different types of particles. Wood has different types of cells, for different purposes, that are made up of different particles. Mechanical mixtures are also known as heterogeneous mixtures (hetero =different). Let's move "wood" from the centre of our mixtures chart into the correct category
- Looking at the next set of samples, which one was the pure substance, and why? Now that we have a definition for mechanical mixtures, how can we apply it to these other two samples? Let's move the post notes to the right side of the T-chart.
- Looking at the liquid set of samples, which one was the pure sample and why? We discussed that all the samples look the same but that the tap water and the salt water had a combination of particles. What were the particles in the salt water? Possibly in the tap water? Since these samples look the same all the way through, we refer to these as homogeneous mixtures or solutions (homo=same). In the case of the salt water, the particles of salt **dissolve** into the water. What is happening on the molecular level is that we have a container of water particles. When we mix the salt in, the grains dissolve or come apart in the water. The individual particles of Sodium Chloride are more attracted to the water particles than they are to each other and so they come apart and mix with the water particles. Essentially, the salt particles fit between the microscopic spaces between the water particles. *There is a really good visual in the video "Concentration vs. Solubility Help"*.

- Remember, that in the liquid state, water particles flow over one another and are constantly moving, leaving spaces between them. Let's move salt water post it to the proper side of the T-chart. Tap water? Same thing. What other examples can you think of where you mix a solid and a liquid and the solid dissolves into the liquid? (You'll get a lot of examples involving sugar, coffee, tea.)
- We've looked at solids and liquids; now look at a gas example. (Show the empty beaker). What is in the beaker? (air) What does air look like? (transparent, colourless) Is air a pure substance or a solution? Why? (Think/Pair/Share)
- Some students will need some support with this. Prompt them with what gas to we inhale and what do we exhale? If these are both in the air, then what is the classification for air? What other particles might be in the air?
- Wikipedia states "By volume, dry air contains 78.09% **nitrogen**, 20.95% oxygen, 0.93% **argon**, 0.04% **carbon dioxide**, and small amounts of other gases. Air also contains a variable amount of water vapor, on average around 1% at sea level, and 0.4% over the entire atmosphere."
- This makes air a solution.
- Students watch and take notes on "The classification of Matter" (4:22) to consolidate their learning.
- My students also read the Nelson text sections 1.4 and 1.6 to add to the list of examples that we can put on the T-charts.

Assessment

- Exit Card: Draw and label an example of a pure substance, a mechanical mixture and a solution at the molecular level (think particles).

Post this instruction and collect responses at the end of class to provide you with the level of understanding the students have with the content that was introduced today.

Day 2

- Review concepts and the exit card, correcting any misconceptions that students might have. Add any new examples of PS or mixtures, that students might have come up with, to the charts for future reference.
- Last day, we talked about liquids and gasses that are solutions, but we didn't talk about solid solutions. The most common ones are combinations of 2 or more metals that are heated to become liquids, mixed together, then cooled. These are called **alloys.** Each metal has properties that are considered positives or negatives based on the purpose for its use.
- (Show the gold ring).For example, gold makes pretty jewelry, but is very malleable (or soft) for a metal, so other metals like silver, copper, nickel or palladium is often mixed with it to give it strength or alter its colour. Since gold is the biggest component of a yellow gold alloy, it is called the **solvent.** The smaller components, silver and copper, are called the **solutes.** The particles of solute mix in with the particles of the solvent to create the solution. (Put yellow gold on to the new T-chart.)
- As a class, look at the other metal samples and add them to the T-chart as well.
- Let's go back to the Salt water from last class. It's a solution too. Based on what you know about our sample of salt water, which component is the solute and which is the solvent? Why?
- (Show the bottle of vinegar) the label says 5% acetic acid. It's dissolved in water. Which is the solute and which is the solvent?
- What other substances dissolve really well in water?
- Since so many substances in our world dissolve well in water, we refer to water as **the universal solvent.**
- This is a really good thing. This is also a really bad thing. Because water is such a good solvent, it is very easy for us to pollute water and not be able to detect the levels of pollution just by looking at the water. For example, pesticides and herbicides from farmers' fields can be washed into rivers and travel to lakes during a heavy rain.

Background and Resources

https://www.youtube.com/watch?v=OpWFUqPPtWE (https://www.youtube.com/watch?v=OpWFUqPPtWE)

The Classification of Matter (2013). (4:22). The Science Classroom.

- Calm guy talking as he draws on the screen. He does a good job of separating Pure Substances into Elements and Compounds, and Mixtures into Heterogeneous and Homogeneous

Assessment tools

- Exit card option 1: Can you tell the difference between a pure substance and a mixture just by looking at it? Explain using particle theory (Mechanical mixture (mm)= Yes, because the particles of a mechanical mixture are more attracted to their own particles than to others in the mixture. The appearance of as mm is not uniform. Example: chocolate chip cookie. Solution (s) = No. Both pure substances and solutions are uniform in appearance. The particles of the solute and solvent in a solution are interspersed at a particle level and we cannot see the different particles visually).
- Exit card option 2: Which of these three examples of matter are PS/MM/S and how do you know? (Provide one or 2 novel examples.)

Extensions

- There are a number of solutions that we have in our own homes. Find five. What is the name of the solution? What is the solvent, and what are the solutes? How do you know?

Topic 3: Creating Mechanical Mixtures and Solutions

Timeline for topic

- 4 hours

Learning Goals

- Not all potential solutes are able to dissolve in all potential solvents (Demonstration: modified Nelson pg 41). When a potential **solute** does not dissolve in a **solvent**, the result is a **mechanical mixture** and the solute is considered **insoluble**
- Particles of a **solvent** have spaces between them that allow the particles of a **solute** to slip between them (modified Nelson pg 40) - Volume X +Volume Y >combined volume of X and Y
- When the spaces between the particles are full and no more solute can fit, the solution is **saturated.** (modified Nelson pg 44)
- A variety of factors affect how quickly a solute will dissolve in a solvent (class lab: When mixing sugar and water, which independent variable results in the fastest dissolving of a given mass of sugar in a given volume of water?)

Vocabulary

- Solvent, Saturated, unsaturated, supersaturated, diluted, concentrated, insoluble, soluble

Materials

- Demonstration materials (Demo 1) (or do it in student groups, if you wish, but expands the time and materials needed to get the same point across)
    - 3 test tubes each one filled 2/3 with a different liquid with the test tubes labelled clearly (ethanol, vegetable oil, and water)
    - A scoopula
    - Table sugar
- Demonstration materials (Demo 2)
    - 250ml empty graduated cylinder
    - 100ml of room temperature water
    - 50ml of table sugar

  - Stirring rod (to help dissolve the sugar more quickly)
- Demonstration materials (Demo 3) (and Day 3 lab/group – substituting sugar for the salt during the lab)
  - 250 ml beaker
  - 100ml graduated cylinder
  - 100ml of water
  - Stirring rod
  - Electronic balance
  - Weighing paper
  - Table salt
  - Scoopula
  - Thermometer (to measure the temperature of the solvent)

Expectations covered

- 2.1, 2.2, 2.4, 2.5, 2.6, 3.3, 3.6, 3.9

Lesson Plans

Day 1

- Review of last day's concepts and add examples of alloys and solutions seen at home to the T-charts. If you have any industrial examples to add, to expand their scope and give them some ideas for what PS or M they will focus on for the final task.
- Introduce the "Informal Lab BLM Template" *I use these because many students often have little focus when I try to demonstrate a concept. They are waiting for the big payoff. I make it clear to my students that they need to have some investment in what they think the result will be. It is, in fact, predictable. That they need to predict what might happen based on the concepts they already know or information they already have. This is an important concept for all scientists. They may not get the results they predicted (e.g. misunderstanding a concept, lab errors, a factor that they did not anticipate), but they face this head on and acknowledge it in their writing. The focus is on the fact that they are answering the question that they set out to answer, and now they better understand the concepts applied to this.*
- Talk the students through possible testable questions for Demonstration #1. What are we trying to achieve? (Sample question: Does sugar dissolve in all liquids?) Next, the Prediction. They need to make a prediction about sugar in each of the different potential solvents. What do they know about each of the solvents? Have they had prior experience? Have they seen videos? Give specifics for their predictions. (Guiding sentence: I predict the sugar will dissolve in water. When my dad stirs sugar into his tea, it always dissolves, and tea is mostly water. This happens because the particles of sugar mix completely with the particles of water. Alternatively, an "if. . .then. . .because…" statement works really well.)
- How should a data table be structured for this demonstration? What information are we trying to discover? How could this be recorded in a table so it can be best understood? *This is often a difficult task for students if they haven't done this before. It is also an excellent skill for them to develop. This practice forces them to recognise what type of data they are collecting, therefore reinforcing the purpose of the demonstration. In this case the table will be simple; a column each for Liquid, Sugar dissolved y/n, and, optionally, Observations.*
- Performing the demonstration: add a scoopula of sugar, cap it, and shake it for 15 seconds (Questions: why do we shake it? – shaking helps speed dissolving if dissolving is going to occur. Why are we going to shake each one for 15 seconds? – we must treat each sample the same way to get comparable results. This is a **controlled variable.**)
- Pass around the first capped sample for students to record observations on their table. What do you notice? How could you clearly describe that?
- Do the same for all three samples.
- Share results if you'd like (depending on the experience level of the students with demonstrations and experiments).
- Prompt them with the following questions for the discussion:
  - How do your results compare to your predictions?
  - Which solute and solvent particles are strongly attracted to one another and which ones are not? How do you know?
  - How does the answer to the previous two questions relate to particle theory?
- Prompt them for the conclusion. Using your results and your connections to particle theory, answer the testable question

Assessment

- You can use this lab for assessment or take it up as a class.

Background and Resources

https://www.youtube.com/watch?v=UntEw3Bvjxw (https://www.youtube.com/watch?v=UntEw3Bvjxw)

- Solvents, Solutes and Solutions (2016). (3:36). Shannon McElwee.

A good breakdown of the definitions with concrete examples. Animated.

https://www.youtube.com/watch?v=1y3bKIOkcmk (https://www.youtube.com/watch?v=1y3bKIOkcmk)

- Super Saturated Solutions: O (2011). (2:52). M3lls34.

Someone's classroom demonstration of salts coming out of a supersaturated solution when a seed crystal is added. Lots of "oohs" and "ahhs". My students thought it was hilarious.

Extension

- Follow up with other fluids. Have students suggest some fluids and what the results of these experiments might be. Run this as a lab.

Day 2

- Review the discoveries from the past day: not all solutes dissolve in all solvents. Many solutes dissolve in water – which is why it is referred to as the universal solvent.
- Yesterday, when we tested sugar in the three potential solvents, we found that it dissolved completely in the water. Our results revealed a solution: the test tube was filled with a transparent, colourless liquid. Where did the sugar go? (write down the suggestions on chart paper) How might we measure to see if this is true?
- Hand out the "Informal Lab Template" (the following is an activity adapted from Nelson (2009) pg. 40).
- What I am going to do is mix 100ml of water with 50ml of sugar. I am going to mix the mixture with the stirring rod until all the sugar is dissolved. Why am I stirring it? (This will make the sugar dissolve more quickly). **The testable question is: What will be the final volume of the mixture of 100ml of water with 50ml of sugar?** (Record this on the template.)
- You are going to make a prediction as to what the final volume of the mixture is going to be. Without giving exact measurements, we can only make 3 general predictions:
  - Option 1: the final volume will be **less than 150ml**
  - Option 2: the final volume will be **equal to 150ml**
  - Option 3: the final volume with be **greater than 150ml**
- Sometimes it is easier to make and explain a prediction when all possible predictions are laid out in front of you. Even if some of those options seem silly or counter intuitive, it is important to at least look at them as they are possible.
- Choose one of the predictions above and try to explain (using words and/or pictures) why the one that you chose is a realistic option).
- What is a good way to record the data for this demonstration? Do we have possible qualitative observations? (e.g., looking for no sediment on the bottom) Do we have qualitative observations? (final volume)
- Create a simple table as a class.
- Combine the sugar and water and stir until dissolved in the graduated cylinder. The volume should be less than 150ml. As the sugar dissolves, it is breaking up into the individual molecules of sugar and those molecules (particles) are slipping in between the particles of water. The total volume of the solution is therefore less than the volume of each individual component.
- Have students write a discussion section, comparing their results to the prediction and trying to explain, using particle theory, why this happened.
- Have them conclude by answering the testable question.

Assessment

- If using the lab performance assessment as students complete the lab, you can provide assessment **for learning** for previously taught, but unassessed skills, or **of learning** for practiced skills.
- Exit card: If the water were heated further, would the final volume of the solution be greater or less than the results that we found in class? Use particle theory to support your ideas. (Sample answer: If the water were heated further, according to particle theory, its particles would be moving more quickly and would be further apart. This would increase the volume of the final solution.)

Day 3

- Review concepts from last day. Why did the 50ml of solute, mixed with 100ml of solvent result in a total volume of less than 150ml of solution? (Particle theory: particles have spaces between them. Particles of solute have a greater attraction to particles of the solvent than to that of one another. They separate and fill the spaces between the water particles. We can no longer see them, but they are there. How might someone test this mixture at home to be sure that the sugar has not simply vanished? Measurement. The total volume is much greater than that of the solvent alone, so the solute must be there. At home we could taste the mixture and it would be sweet (don't ever do this in the lab). If we raised the temperature of the solvent, how do you think that this would affect the volume? (If the temperature is raised high enough, the volume would be greater than at the lower temperature because Particle Theory states that particles will move faster and **farther apart** when heated).
- Today, we are going to demonstrate that there is a maximum amount of given solute that will dissolve in a given volume of solvent. When this threshold is reached, we call the solution **saturated.** The other vocabulary that we need to know in this topic is **solubility.** This is the maximum amount of solute that will dissolve in solvent **that is at a given temperature.** Why do you think that temperature plays such a big role in solubility? Think about what we just discussed about the effects on a solvent's particles when the temperature is raised.
- The other thing that you need to know about solubility is that its units are **g of solute/ml of solvent.** This is considered a rate because the first unit, grams, measures the mass of the solute, divided by the millilitres, the volume, of the solvent.
- Add all of the vocabulary to the chart paper at this time and review the following (dilute, concentrated, saturation, solubility, unsaturated).
- For example, the Solubility of table salt (NaCl) in water at 20 degrees C is 36g/100ml. If I have 100ml of 20 degree Celsius water in this beaker here (measure with 100ml graduated cylinder). And I add 5g of salt (measure on the electronic balance on top of the weighing paper and add it to the beaker) and stir it until it dissolves. I have created an **unsaturated solution**. Why is it unsaturated? Because, I can fit even more solute into this solution and have it dissolve. How many more grams can I add until this solution is saturated? (31 more grams). What do you think I will see if I add 32 more grams instead? (Most of the salt will dissolve, but some will fall to the bottom and remain, regardless of the amount of stirring that you do.)
- In your lab groups today, you will be answering the testable question: What is the Solubility of sugar in water at today's room temperature? (Have them determine, or give them the temperature of the solvent).
- The standard Solubility of sugar in 100 ml water at 20 degrees Celsius is 204 g/100ml. You will predict what the Solubility might be in class today and explain your prediction referring to Particle Theory and what you already know about solutions
- You will follow the provided procedure and add 10 grams of sugar, stirring to dissolving then add the next 10 grams until the last addition doesn't dissolve. From there you can estimate your solubility.
- Discuss your results with regard to your hypothesis.
- Conclude the lab by answering the testable question with regards to your results.

Assessment

- Have the students submit the lab, ask questions of different group members as the lab is being performed (focus on the vocabulary that is important to the lab)and spot check each group to see how well each group member is performing their assigned task.

Background and Resources

https://www.youtube.com/watch?v=HB8w6uqbGv8 (https://www.youtube.com/watch?v=HB8w6uqbGv8)

- Solubility and concentration tutorial (2014). (8:84). Amy Cater.

A PowerPoint lecture by a Grade 8 teacher with a Southern Accent. Great refresher for teachers; may be too advanced for students.

https://www.youtube.com/watch?v=xCXkDN7Phcc (https://www.youtube.com/watch?v=xCXkDN7Phcc)

- Solubility vs. Concentration: Chemistry Help (2014). (3:27). eHowEducation.

Explains how salt dissolves into water and gives examples of units for solubility and concentration.

Extension

- Watch a video about supersaturation to add another level to their understanding
- Have students research other solubility values for solutes in different solvents. Post them on chart paper, compare and discuss.

Day 4

- Review concepts from last day's lab.
- If I have a sugar cube and I place it in water, it will eventually dissolve. My testable question is as follows: what is a factor that I could change that would allow my sugar cube to dissolve more quickly?
- Brainstorm ideas with the class and put them all on chart paper.
- You should get suggestions like: heat the water, crush the cube, and/or stir the water. I've also gotten: increase the volume of water, shake the container, and change the solvent. Be prepared for anything and decide for yourself what will be acceptable factors.
- Have lab groups design their own procedure, adding to the list of materials that they need as they go. I refer them to procedures that we have used from texts in the past. Give reminders that each step is numbered and constitutes a single action. They must also assign roles to each member of the group as we have done in the past. Each person within the group may have their own prediction for the lab, but must coincide with the factor that they have chosen, as a group, to demonstrate the quickest dissolving of the sugar. We review that tests must also be repeated to ensure accuracy of the results. (At least 3 trials for both the control and the test.) Before they are allowed to retrieve their supplies, they must have a group data table created that includes spaces for how long the dissolving takes (in seconds) and qualitative observations. (By circulating, you can assess whether they know how to ensure a fair test, step by step procedure that will produce an answer to the question.)
- *For timing I make it clear that I will make the materials available at the beginning of the next lab day, pending they show me all the initial paperwork. The lab must be completed next day – so if they need to do work in the interim, this is their responsibility. The write-up for the lab is due the day after the lab.*
- As groups complete the lab, I have them enter their data (usually the mean) for both the control and the test. The next day, we have a discussion about the data. If all the control (full cube in water) samples are very close in time, what does this tell us about our data? If there is a number that is very different than the other posted numbers, what does that tell us? (outlier – their other data may be suspect, their procedure may be flawed). If our control numbers are close, can we compare our other results even if different people did them? Can the information give us an idea of what might be the strongest factor in the speed of dissolving of sugar in water? *Many students enjoy this comparison because it brings up further questions about the same topic. They also get a bigger picture of what they are working on*.

Topic 4: Separating Mechanical Mixtures

Timeline for topic

- 5 hours

Learning Goals

- determine which methods of mechanical separation would be best used with provided situations (demo activity 1)

- practice techniques separating oil from water and applying it to cleaning up real world oil spills from the ocean (lab 1)
- understanding the impacts of oil disposal by humans (accidental or intentional) into our water systems. (knowledge building through examples)

Vocabulary

- Sieving (sifting), filtering, magnetism, sorting, floating and settling, scooping

Materials

- Student Activity(Day 1) (Adapted from Nelson (2009) pg 56 – 57)
  - Separation tools for each group: filter paper, funnel, sieve, spoon, pipette, bar magnet (in a sealed snack sized ziploc bag), wash bottle, extra containers for putting components that are separated (I use single serve apple sauce containers),
  - “unknown mixtures – premixed by you” in 250 ml beakers for each group
    - # 1: sand and iron filings
    - #2: water, floating beads, and sand
    - #3: sand, gravel and water
- Student Experiment (Day 3)
  - Per student group:
    - Shallow bowl (students will fill with 50ml of water and a 50ml of vegetable oil)
    - A variety of tools to remove the oil (without the ability to lift or pour the bowl). Cotton balls, pipettes, paper towels, J-cloths, spoons, and any other suggestions students might have
    - A beaker to put the extracted oil
    - A series of graduated cylinders to later measure the volume of oil (and often water) extracted

Expectations covered

- 1.1, 1.2, 2.1 2.3, 2.5, 3.5

Lesson Plan

Day 1

- Review concepts of last day.
- **Prepare the following for 2 classes from now**
  - Have volunteers pour the water and salt solutions using graduated cylinders (to practice lab technique). Talk about meniscus, why we use graduated cylinders and not beakers to measure liquids. Why are we using an equal volume of each liquid?
  - Place the beakers by the window or heat lamp. Explain that we will look again at the beakers over the next couple of days.
  - As a class (or individually), have students predict what they might see, with regard to the beakers over the next few days. Why might this be happening? (Have them predict for both the beakers as separated entities) What is different between the two initially? What might account for the difference in the results (salt vs. no salt)?
- Today our focus is on the different techniques that we use to separate mechanical mixtures. The techniques that we use will differ based on the components that are in each of the unknown mixtures.
- *Do a show and tell with the class on the different separation items that are available to them. Give them tips on how to use them most effectively, and ask students what types of mixtures might each technique be best at separating. Tips like “pre-folding the filter paper as you insert it into the funnel” are helpful as well.
- List all the techniques on an anchor chart.
- Have students create a data table with four columns: Technique/tool used, component separated, remaining components in mixture, and observations.
- You can assign a role for each student or have them rotate for each mixture for greater involvement (based on a lab group of 4 students).

   - Job 1: Collect and return equipment for the given mixture
   - Job 2: Facilitate the separation
   - Job 3: Record observations and complete the data table
   - Job 4: Oversight (task focus and reminders of job requirements)
- All three unknown mixtures should be completed this day.

Day 2

- Review all of the separation techniques and tools that were used in the previous activity. Ask if students could recommend any other tools or techniques that would have been useful in the separation of any of the components of last day's lab.
- Have students "Jig Saw", each with a copy of last day's results (either in paper form or on a shared document). Create 4 groups, each with a member from each of the original groups. Have them discuss which techniques and tools they used for each of the unknown mixture and have them come to an agreement on which ones they feel, as a group would be the most effective if they could repeat the activity.
- Have them return to original lab groups and compare notes.
- Give students time to read follow-up material (I use Nelson (2009) pg. 58-61) to find other situations where these techniques could be used both in the lab and in the wider world.

Assessment

- Exit card: Which technique and tools would best work to separate a mixture of Iron filings and Water? Explain why.

Day 3

- Review separation techniques. Prompt for some examples that they learned from the follow-up reading or watching, from last day.
- What are the types of mechanical mixtures that we might need to separate in the real world?
- *See my list of videos of news footage of the Exxon Valdez or BP Deepwater Horizon oil spills – show one to the class. Give some detail. Show another of either the 5 year or 10 year retrospectives of the impact of a spill later. What effects are still felt?*
- We are going to explore some different methods for separating oil from water. We are going to combine all our data and see what might be the most effective techniques for doing so.
- Our testable question is as follows: which method will remove the most oil from 50 ml of vegetable oil/50 ml of water mixture in 1 minute? (Provide all methods that you are willing to let them explore on chart paper so they have a frame of reference. Show and tell each one. I allowed my students to perform a trial for as many methods as they could in the timeframe I provided. After groups completed a trial, they would discard any absorptive material, pour the oil water mixture into a waste oil container (not down the sink) and set up the bowl with new oil and water for the next trial.
- All the data was pooled and put on a class chart. Not all the techniques had the same number of data points and we discussed how that would have an impact on our understanding of the data, and why we used the mean volume as the deciding factor of efficacy).
- Have students create a data table with 5 columns: Technique/Tool Used, Total volume of extracted liquid/Volume of Oil/Volume of Water/Anecdotal Observations/Possible improvements.
- Each group should discuss and record a prediction of which available technique (or they can come up with their own) should extract the most oil in the time limit of 1 minute. They must provide a reason for choosing that one.
- At the end of the lab have all students add their data to the chart paper (or enter into a shared doc).
- Each group calculates the mean volume of oil extracted for each technique and completes a discussion of which one they believe is the most effective – providing data and presenting a conclusion.
- Follow up with a class discussion of the results and conclusions for each group.

Background and Resources

https://www.youtube.com/watch?v=VaRdUHrUnBs (https://www.youtube.com/watch?v=VaRdUHrUnBs)

- Exxon Valdez Oil Spill: in the Wake of Disaster Retro Report(2013). (12:09). The New York Times.

Excellent overview and statistics of the impact of the spill. Footage of the time and afterwards. Failure of clean up, but talks about a variety of techniques including booms and surfactants. Good pace. Devastating.

https://www.youtube.com/watch?v=NLdH33JmscM (https://www.youtube.com/watch?v=NLdH33JmscM)

- There's still oil on this beach 26 years after the Exxon Valdez Spill (2016). (&:01). National Geographic.

Researchers find evidence of oil on the beaches where salmon are spawning.

https://www.youtube.com/watch?v=pZKBDVurCdk&t=138s (https://www.youtube.com/watch?v=pZKBDVurCdk&t=138s)

- Deepwater Horizon disaster, five years later (2015). (10:24). CBC News: The National.

Focuses on the medical impacts on clean-up crews, divers and fishermen who are in the water after the disaster.

https://www.youtube.com/watch?v=-OVNd6Fa9fg (https://www.youtube.com/watch?v=-OVNd6Fa9fg)

BP Oil Spill Effect on Wildlife (2010). (9:10). AttackOfTheShow.

- Reporting on the BP oil spill as it is happening. Description of the effects of oil on site. Interviews with BP workers. Criticism of the clean up (oil separation efforts).

There are a number of “5 years later” type videos worth exploring to show students that the effects of human disposal of oil are wide reaching and persistent. Oil spills are accidental disposal of oil into the environment, but disposal nonetheless.

Day 4

- Review concepts.
- *Show as a class or have groups watch videos about how oil spills are cleaned up in the ocean. There are also videos listed about experimental and innovative techniques for oil extraction* Watch follow-up videos of what techniques are actually used to clean up oils spills in the ocean. Show demo of adsorptive polymer as well as discuss the chemical that does the same thing *name* to connect what we do in the lab, to the real world. Have students take notes and record what they've learned.
- Have a class discussion. How do the methods that we used to clean up a spill of vegetable oil in water compare to how oil spills are cleaned in ocean? What are the alternatives?
- What are the overall impacts of oil spills in oceans?
- Have each lab group of students complete the same table organizer template that is used in the **Case Study: Uranium** file. Here they will record the impacts that oil spills have had on all 4 of the realms that affect our world. (e.g., Economic – tourism on impacted beaches. Fisheries hurt by poisoned fish)
- Get together at the end of class and combine the knowledge. Explain that we will be looking at the impacts of other pure substances and mixtures that we dispose of in the environment in the same way (using the same template).

Background and Resources

https://www.youtube.com/watch?v=YuT4pfgVc4c (https://www.youtube.com/watch?v=YuT4pfgVc4c)

- Does Oil Spill Damage Last Forever? (2015). (5:00). Seeker.

Fast talking, but excellent overview of frequency of recent oil spills, the big ones of the past, and pictures of the damage over time to animals and physical beach and ocean environments. Great graphic of how seabirds have transported the oil over distances.

https://www.youtube.com/watch?v=3DbSlAg3F3A (https://www.youtube.com/watch?v=3DbSlAg3F3A)

- How Do We Clean Up Oil Spills? (2015). (3:41). Seeker.

Great list, with photos and commentary of techniques and tools that are used by companies to clean up ocean oil spills.

Assessment

- A possible assessment (that I would use when I teach these students Language as well), is a paragraph that answers the question "What is the best way to clean up and oil spill in the ocean?". Using the Point Proof Explanation method, students can use evidence from their own experiments, videos and articles that they have viewed and read in class. In-class support for this would take 2-3 days for writing and conferencing with students. This is an assessment **of learning**.

Topic 5: Separating Solutions

Timeline for topic

- 2 hours

Learning Goals

- Describe the process of evaporation with reference to the classroom demonstration (demo 1)
- Explain further examples of how solutions are separated into their components using evaporation
- Describe the process of distillation using provided and novel examples provided by videos and text

Vocabulary

- Distillation, evaporation, solute, solvent, process

Materials

- Beakers of water and salt water that have been sitting by the window
- Videos and text for consolidation of process

Expectations covered

- 1.2, 2.1, 2.3, 2.5, 3.5, 3.6, 3.7, 3.8 (quantitative only)

Lesson Plan

Day 1

- Review of last day's concepts and add examples.
- This is the time to look at the 2 beakers that have been sitting by the window for the past number of days. What has happened? Record observations on chart paper. Prompt students to use the word **evaporation** to the process for the missing water in both of the beakers. Where has the water gone? Why? Have them use **particle theory** to help explain it. Focus on the white rings that have formed on the glass of the saltwater example? What is the white stuff? Why is it not on the other beaker? Explain that the water evaporates, but the salt does not. It comes **out of solution** and some of it

deposits on the glass. The rest of it is in the salt water solution. Is the remaining saltwater solution **more concentrated** or **more dilute** than the original solution? Why? Prompt them to use the vocabulary of **solute, solvent, evaporation, volume.**
- Have each student compare the results to their original prediction (to draw a conclusion that answers the testable question asked on the first day. This can be collected to serve as evidence of understanding of scientific process, use of vocabulary, and understanding of concepts).
- Exit card: What separation process was the demonstration at the window? How do you know?

Day 2

- Review the discussion about evaporation from last day.

- We've talked about oil spills over the past few days. In an endeavour not to have oil in our environment, how do we dispose of waste oil? *Watch provided videos about the physical separation techniques (for the mechanical mixtures portion) that lead into distillation (to separate the oil solution into different grades of oil)*.
- While reviewing the process with your class, focus on the process of distillation.
- Discuss the differences between the processes of evaporation and distillation.
- Use text examples (or have students follow –up research) of mixtures that are separated using each method. (Nelson text 67-69, 72-76). Have students add these mixtures to the class generated charts that are up in the room.

Background and Resources

YouTube Videos (Oil)

Title	Channel	Time	Notes
Don't throw away that used oil	NAPA Autoparts	2:00	https://www.youtube.com/watch?v=oMHJHKFnVz8 (https://www.youtube.com/watch?v=oMHJHKFnVz8) PSA and commercial but gives a good overview of what happens to oil when it is removed from your car. (You could also reference that new electric cars require no oil changes so that will reduce the need for fossil fuels both as a fuel for the car and a lubricant for the engine)

Used Oil Recycling – Vancouver BC	Metro Vancouer (2008)		https://www.youtube.com/watch?v=ue15NmMsYbQ (https://www.youtube.com/watch?v=ue15NmMsYbQ) Point of View of an oil recycling company. Explains how the oil is separated and the components that are recycled. Includes how they separate "drips" of oil from used containers "sometimes 20% of the container, by weight, oil"!! They also recycle Ethylene Glycol (antifreeze) – mentions distillation. Explain environmental effects of oil dumping, government incentives to recycle and pressures to dump oil in the environment.
How used motor oil is recycled	Arthur Bleiou (2015)	7:26	https://www.youtube.com/watch?v=XhreBkmfosg (https://www.youtube.com/watch?v=XhreBkmfosg) 4:16 to 6:20 gives a great overview, using computer animation of the complex separation process the rest is a sale pitch for the company. There are some interesting shots of the machinery, though.

Conclusion of Lessons Section

This is the end of the section on knowledge and skill building for the unit. Next, there is a Skills Final task – that incorporates the knowledge and lab skills developed over the course of this unit. Additionally, there is a Research and Solve Final task that, through a teacher assisted case study (Uranium), students research the impacts of disposal of pure substances and mixtures by humans on the environment and themselves.

See attached files.

(mailto
subject
out
this

(https://www.facebook... https://connex... catalyst/uranium-and-oil-spills-its-garbage-day-humans-grade-7)

WATCH THE VIDEO

04:20 min

(//www.youtube.com/embed/GKSDxNYOv_w?width=800&height=450&iframe=true)

RESOURCES

- Unit Outline (https://connex.stao.ca/sites/default/files/unit_outline_0.docx)
- All Lessons (https://connex.stao.ca/sites/default/files/lesson_content_0.docx)
- Case Study: Uranium (https://connex.stao.ca/sites/default/files/case_study_uranium_0.docx)
- Research Sample: Uranium (https://connex.stao.ca/sites/default/files/research_sample_uranium_0.docx)
- Skills Final Task (https://connex.stao.ca/sites/default/files/skills_final_task_0.docx)
- Lab Template (https://connex.stao.ca/sites/default/files/lab_template_0.docx)
- Final Task Rubric (https://connex.stao.ca/sites/default/files/final_task_rubric_0.docx)
- Lab Skills Assessment (https://connex.stao.ca/sites/default/files/sample_lab_skills_assessment_0.docx)

ELEMENT

- Inquiry (/expert-elements/inquiry)

(/classroom-catalysts) **RETURN TO CATALYSTS (/classroom-catalysts)**