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[**WABS ACCESS STEM PBL Unit/Lesson Plan Template**](https://docs.google.com/document/u/1/d/1lzkUygoxlsEvaoczfdcXTIwzbba2y2ON/edit)

**U**NIT OVERVIEW

| **Title of PBL Unit: Duwamish River Project/Stormwater Treatment at KCIA**  **Target Grade Level(s): 10**  **Subject(s): Chemistry**  **Author(s): Ji Hea Shin** |
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| **Problem Statement: How can King County International Airport effectively steward stormwater runoff?** |
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| **Unit Overview and Table of Contents:**  **This unit is part of a multidisciplinary project working with KCIA (King County International Airport) in adapting their stormwater management system for severe rain events. Pre-teaching will begin with students researching local bodies of water near their homes to figure out what contaminants are in the water, how they affect their communities, and ways that their community is addressing the stormwater issues around them. Students will look at different types of filtration systems to see how gravity filtration works versus chemical filtrations as part of their solution. In chemistry, they will design lab procedures to test which filtration system works best and use their collected data as evidence to support their solution for KCIA.**  **Table of Contents:**   1. **Super funds and Chemical Structures** 2. **Filtration systems: physical or chemical**    1. **Designing and testing different types of filtration systems**    2. **Collecting data and using data to support proposals** |
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| **Standards:**  **Lesson standards (NGSS, CCSS, CTE):**  NGSS: HS-PS1-3 Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles (ions, atoms, molecules, and networked materials).  NGSS HS-PS1-3: Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.  Develop a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-PS1-4),(HS-PS1-8) |
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| **21st-Century Skills:**  Habits of mind and ways of working together help students build their capacity for workplace expectations. What 21st century skills will students be developing in this lesson (e.g. Communication, Collaboration, Critical Thinking, Creativity)?  1.A.1 Use a wide range of idea creation techniques (such as brainstorming)  1.A.2 Create new and worthwhile ideas (both incremental and radical concepts)  1.A.3 Elaborate, refine, analyze and evaluate their own ideas in order to improve and maximize creative efforts  1.B.2 Be open and responsive to new and diverse perspectives; incorporate group input and feedback into the work  1.B.3 Demonstrate originality and inventiveness in work and understand the real world limits to adopting new ideas  2.D.1 Solve different kinds of non-familiar problems in both conventional and innovative ways  2.D.2 Identify and ask significant questions that clarify various points of view and lead to better solutions  3.A.1 Articulate thoughts and ideas effectively using oral, written and nonverbal communication skills in a variety of forms and contexts  3.B.1 Demonstrate ability to work effectively and respectfully with diverse teams  3.B.2 Exercise flexibility and willingness to be helpful in making necessary compromises to accomplish a common goal  3.B.3 Assume shared responsibility for collaborative work, and value the individual contributions made by each team member  4.B.2 Manage the flow of information from a wide variety of sources  6.A.1 Use technology as a tool to research, organize, evaluate and communicate information  8.C.1 Go beyond basic mastery of skills and/or curriculum to explore and expand one’s own learning and opportunities to gain expertise  8.C.2 Demonstrate initiative to advance skill levels towards a professional level  9.B.1 Respect cultural differences and work effectively with people from a range of social and cultural backgrounds  9.B.2 Respond open-mindedly to different ideas and values  9.B.3 Leverage social and cultural differences to create new ideas and increase both innovation and quality of work  12.A.2 Learning from and working collaboratively with individuals representing diverse cultures, religions and lifestyles in a spirit of mutual respect and open dialogue in personal, work and community contexts  12.E.2 Demonstrate knowledge and understanding of society’s impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.)  12.E.4 Investigate and analyze environmental issues, and make accurate conclusions about effective solutions |
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| **Locally and/or personally relevant for students:**  How do students build on their understanding of their school community or on what matters to students? Are there ways to make a strong connection to women or underrepresented minorities in STEM fields – to increase proportionate representation of those groups in STEM?  Duwamish people and effects on populations that depend on the riverway for recreational use. Connections to the effects on groups that belong to lower socioeconomic status will be made like those who make a living fishing from the Duwamish river or live near the polluted riverways. The school is also located near the Duwamish river and many students live near the Duwamish river. |
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| **Connections to career and educational pathways:**  How will students learn about connections to career and educational pathways into the unit/lessons?  They will get to learn about the different occupations related to regulating stormwater in the project and how professionals create solutions to solve engineering problems. They will also get the chance to communicate and share ideas/solutions to professionals in the industry and receive feedback on their ideas. |
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**LESSON OVERVIEW**

This section should be repeated for each individual lesson that makes up the unit.

| **Lesson Number and Title: #1 Super funds and Chemical Structures** |
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| **Problem Statement: How does a superfund form and how can we clean it up/prevent them?** |
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| **Lesson Objectives: Students will be able to describe a super fund and research the toxicity levels of different chemicals and propose a solution to clean up or prevent them.** |
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| **Lesson Standards:** NGSS: HS-PS1-3 |
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| **Materials: Google slides (linked below in lesson), King County website (linked below), Google doc with key terms (linked below)** |
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**If relevant to a single lesson, please include:**

| **Lesson 21st-Century Skills:** |
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| **Lesson-Locally and/or Personally Relevant for Students:** |
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| **Lesson-Connections to Career and Educational Pathways:** |
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**LESSON PREPARATION**

| **Time Required: 2- 50 minute periods** |
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| **Grouping of Students for Instruction: recommend mixed ability grouping, may pair students with a device if needed.** |
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| **What is the instruction? (Consider the PBL procedure that is being addressed here):**  **Students identify key chemical terms and chemicals that contaminate superfunds to understand the effects of stormwater runoff contamination and propose possible solutions to prevent/clean up contamination.** |
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| **Possible Accommodations: Students with vision impairment should be partnered with someone that can describe an image for them.** |
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| **Possible Extensions: Students may design labs that could test out their solutions (try out filtration systems, test water samples of the Duwamish for pH level, or design a chemical filtration)** |
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| **Possible Assessment: Students will be able to identify the different chemical structures and describe and design different types of filtrations (physical v chemical).** |
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| **References and Resources:**  **Google slides:** [**https://docs.google.com/presentation/d/1NFdQdw5xBg-XN\_b-Xg-WoADKYr3XHGAmzYMtpK5RF4k/edit?usp=sharing**](https://docs.google.com/presentation/d/1NFdQdw5xBg-XN_b-Xg-WoADKYr3XHGAmzYMtpK5RF4k/edit?usp=sharing)  **King Country Website:** [*https://kingcounty.gov/depts/health/environmental-health/healthy-communities/duwamish-fishing/superfund.aspx#:~:text=The%20toxic%20chemicals%20in%20the,cPAHs*](https://kingcounty.gov/depts/health/environmental-health/healthy-communities/duwamish-fishing/superfund.aspx#:~:text=The%20toxic%20chemicals%20in%20the,cPAHs)*)%2C%20dioxins%20and%20furans.*  **Google doc:** [**https://docs.google.com/document/d/1yL02NaYQXIM3PsHXSKUr\_6cCiqpJlTGlMaq2oHECQb4/edit?usp=sharing**](https://docs.google.com/document/d/1yL02NaYQXIM3PsHXSKUr_6cCiqpJlTGlMaq2oHECQb4/edit?usp=sharing) |
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| *Teacher* | *Students* |
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| *(20 minutes) Show Google slides (about 15-20 seconds/image) then discuss the questions on the student side:* | *Discuss the following questions:*  **What do you notice about the images?**  **How do you think this is happening?** |
| *(1-2 minutes)Tell the students about the upcoming project:*  We are launching a project in which we will partner with King County International Airport (KCIA) to improve the existing stormwater system, particularly for major rain events, predicted to increase due to climate change. To understand the impact of stormwater runoff, today we will be talking about the chemical effects and why it is important to solve the issue and come up with potential solutions. |  |
| (20 minutes) First we need to identify some key terms used within the scientific community: | Give each group a list of terms to research and describe definitions in their own words on [google doc.](https://docs.google.com/document/d/1yL02NaYQXIM3PsHXSKUr_6cCiqpJlTGlMaq2oHECQb4/edit?usp=sharing) |
| (10 minutes) Discuss with students, what is next and record a list of questions that students come up with to drive their research. | After looking at the key terms list, what are some questions/concerns you have about the superfund?  *Possible responses:*  *How did the superfund in the Duwamish come to be?*  *Who might be affected by the pollution in the superfund sites?*  *How do these chemicals affect humans?*  *Where is the pollution coming from?*  *How can we prevent more toxic chemical build up?* |
| (15 minutes) Share King County website that discuss the effects of superfunds in the community:  Resource 1) How contaminants pollute the community and environment | Students will look over the King County website and answer the following questions in their groups to start a brainstorm:   1. How do the contaminants affect the community? Which people groups are most affected? 2. What are some ways to clean up the contaminants? 3. **What are some ways to prevent the build up of contaminants?** |
| (20 minutes) Have students look at the KCIA stormwater runoff issue:  **What are some ways that the KCIA could prevent stormwater runoff?** | Students will brainstorm different ways to prevent stormwater runoff and make a list of questions they would like to ask a professional and research to form a data-driven decision in choosing their solution.  Possible solutions:   * + Stormtech septer system   + Stormtech changer system   + Oil/water separators (Gravity settling type of filtration)   + Infiltration system   + Vortex system/ centripetal force to pull out other sediments   + Oil water separators (underground detention facilities), the oils are kept in a first container/vault (tend to float -density); water goes underneath and deposits sediments - to clean: truck comes to suck up all the sediments   + Perlite/carbon/charcoal (media filters)   + Grass (natural filtration)   + Edge Drains 3-4 ft below ground collects water and conveys into the storm filter system)   + Large water quality vault |