**Lesson Number 2: Smell Your Way Home**

**Problem statement:** How do contaminants in water runoff affect the marine life of our local waterways?

**Learning objectives:** Inquiry-based: Students will understand that fish “smell” their way around their water sources and that contaminants make it harder for them to “smell” their surroundings (affecting their ability to get food, find their ‘home’, and avoid predators).

**Lesson standards (**Source: [Next Generation Science Standards](https://www.nextgenscience.org/search-standards)**)**

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| **Standard** | **How the Standard Will Be Assessed** |
| **Lesson standards NGSS** Practice 1 Asking Questions and Defining Problems (Grades 3-5):  Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships. | No summative assessment for this lesson. Only formative check-ins based on students’ questions and interactions**.** |

**Soft skills: (**[Source: Social Emotional Learning Standards, Benchmarks, and Indicators](https://www.k12.wa.us/sites/default/files/public/studentsupport/sel/pubdocs/Appendix%20D%20Standards%2C%20Benchmarks%20Indicators.pdf)**)**

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| **Soft Skill** | **Standard** |
| Collaboration | STANDARD 3 SELF-EFFICACY  Individuals have the ability to motivate themselves, persevere, and see themselves as capable. BENCHMARK 3A  Demonstrates the skills to set, monitor, adapt, persevere, achieve, and evaluate goals. |

**Success Criteria:**

· Ask questions about what would happen if a variable is changed.

· Identify scientific (testable) and non-scientific (non-testable) questions.

· Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.

· Use prior knowledge to describe problems that can be solved.

· Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constrain

**Locally and/or personally relevant for students (whole unit):**

Our community (Washington State) has many waterways that have the potential to be contaminated, or are already contaminated. As a region, we have many industries (and people) that rely on seafood. Keeping the water clean, and reducing pollution, will help ensure future generations have access to the seafood and marine animals that are so important to our community (industries-food, tourism, seafood, local Tribes).

**Connections to career and educational pathways (whole unit):**

They will learn about maritime careers (Port of Seattle/NOAA) and scientific careers that relate to the maritime industry.

**Materials:**

* 8 paper cups
* 8 cotton balls (if you are using ‘oil’ scents)
* 4 scents (cinnamon, lavender, peppermint, garlic, etc.) You can use essential oils, gum, candy, etc. The goal is 4 scents that smell strong enough that the students can recognize them, but not too strong to where the scent can’t be covered by the “chocolate contaminant”).
* Smell your way home watershed poster with 4 rivers labeled
* Chocolate syrup
* Cup cheat sheet
* Salmon predator and lead videos
* 4 cup labels (labeled A-D) and 4 cup labels (4 river names)
* Blindfolds/sleep masks (one per team or 1 per each set of ‘buddies’)
* Chart paper and chart markers

**Lesson preparation:**

* Use 1 cotton ball each for the 4 scents. Make 2 sets of the scents (1 set for ‘imprint’ cups & 1 set for river cups). Label the cups A-D (imprint cups) and label with 4 rivers (river cups). Remember which letters go with which rivers (ie lavender cup is #A AND the Columbia River-Use the Cup Cheat Sheet).
* Set up Watershed poster /rivers poster.
* Have ‘salmon smells facts’ ready to read to the students.
* Have chocolate syrup ready for phase 2 of the lesson.
* Have both videos ready.

**Time required:**

1 hour

**Grouping of students for instruction:**

Students should be in groups of 6 for the majority of this unit (working group). However, students will be split into 4 groups for this activity. Keep students from working groups together in their groups for this activity.

**What is the instruction? Consider the PBL Procedure that is being addressed here:**

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| **Understanding the Problem/ Lesson Steps** | |
| **Teacher** | **Student** |
| 1. Introduce the “Smell Your Way Home” activity (4 groups-or duplicates if you have a large group). 4 cups with smells on one side of the room with labels (A, B, C, D) and 4 cups will matching smells on the other side of the room (Puyallup River, Skykomish River, Skagit River, & Nisqually River). Make sure to have a cheat sheet so you know which river matches which letter. Each group will stand behind their letter cup.  Show the students the rivers poster, with the 4 rivers’ paths outlined to the ocean. Tell the students they will work with a buddy, pretending to be salmon, to ‘smell their way’ from the starting line (their letter cup-the ocean), to their home river (river named cup). | 1. Students will get into their groups (specifically with a buddy), and listen to directions about the activity. They will question any unclear directions. They will observe the river map and understand that they are trying to go from the ocean to their ‘home river’, using their sense of smell. |
| 2. Blindfold one person in each set of buddies for each of the 4 group. Have them smell their letter cup and identify the scent. Only the students who are actively engaged in the activity should have on blindfolds. This should be a direction given before the activity starts, to reduce off-task behavior. | 2. Buddy pairs will work to help the blindfolded buddy smell their letter cups (A, B, C, D). Students will whisper with their partner. They should first make sure they know what their smell is (lavender, cinnamon, etc). If they need help, they can ask the non-blindfolded buddy to also smell the cup to help determine the smell. |
| 3. Students will move to the other side of the room with their buddy to try and find the cup with the smell that matches their cup from the first set. \*\*This can be made more fun by adding obstacles (salmon ladders, dams, etc.) along the way. Make sure to give specific instructions on how students are expected to move across the room, to reduce off-task behavior. | 3. The non-blindfolded buddy will then walk their buddy across the room to the 4 cups with river labels. Expectations of how and where to walk will be laid by out the teacher, to reduce off-task behavior during this movement piece. |
| 4. Once the students feel that they have found their matching cup, they need to whisper the name of the river to the teacher, so the teacher can affirm their answer of which imprint ocean cup letter goes with which river name. If they are not correct, they can retry the first cup and set of second cups. If you choose to only have 1 set of buddies go at a time (for A, B, C, D), remind them not to tell the other students in their group which cup they believe is their home river on the other side of the room. If you choose to have all buddy sets smell the cups around the same time, and move across the room at relatively the same time, this will reduce a buddy group revealing the answer too early. After each pair has move across the room and found their ‘home river’ scent, have them go back to their lettered cup starting point. | 4. The blindfolded student needs to tell their buddy which cup matches the smell from the first set. This will be their ‘home river’. They need to confirm their guess with the teacher. They will then go back to their original letter cup and wait for the other sets of buddies to finish. Voices are off at this point in the activity. |
| 5. Give students a question to ponder, so they are not focusing on you, the teacher, during this next step. Pour a small amount of chocolate syrup in each of the ‘river’ cup, not enough to cover up the original smell, but enough to make it harder to smell the original smell. Turn the river labels away from the students’ view and mix them up (so they are not in the same place as before). They should remember the name of their river, which is what you want them to whisper to you. | 5. Students wait at original cup (A, B, C, D), but are not “watching” the teacher. They may have a question to ponder (What was your smell? What do you know about the river you selected? How did you and your buddy work together? What could be improved for round 2?). |
| 6. Repeat the ‘smell your way home’ activity, having students first smell their uncontaminated imprint cup and then work to find their home river again, now that the smell has been ‘contaminated’. Help any students who are feeling discouraged by encouraging them to go back to their letter cup if they are confused. | 6. Students repeat the ‘smell your way home’ activity. The “river” smell should be harder to detect, now that it has been ‘contaminated’. Buddies work together to smell the scents. You might considering switching which buddy is blindfolded, so they both get a chance to be the salmon. They may also take a different ‘path’ to their river this time, to make the activity more engaging. |
| 7. Once students have corrected identified their home river cup, have students turn in blindfolds and go to a general meeting area. | 7. Students turn in materials and go to a general meeting area for a discussion. |
| 8. Have questions posted for students to work on while you wait for the rest of the buddy groups to finish identifying their rivers. Discuss “What did you learn/notice from this activity about the importance of smell?” Teachers may want to chart students’ ideas on a chart paper, once everyone is at the meeting space. Teacher should take this time to do a formative check-in to see how students are understanding the concepts from this lesson. | 8. Students engage in a discussion about what they learned/noticed from the activity about the importance of smell and what happens when a smell is changed/river is contaminated. Students will share out ideas and/or questions to teacher and/or classmates in order to solidify new information. |
| 9. Show the 2 videos (information & links below). **Watch the predator video first.** (Explanation below). The less information you give, the more the students are able to question and wonder about the causes for the behavior of the fish. However, based on your grade-level, you may want to give more information (definitions) of contamination, olfactory, predator/prey behavior, etc. Watch the video once with no discussion. Then watch it a 2nd time and discuss why the salmon stayed still and then what happened when it moved.  **Then watch the lead video**. Give students information before watching (regarding the set-up of the video-explanation below). After watching the video, discuss WHY the salmon in Tank A and Tank B acted differently. Discuss how the lead added to tank B made it difficult for that salmon to smell the ground up fish in the water, which should have alerted it to danger. | 9. Students will watch the first video twice (once with little discussion or pre-teaching of information, and then a second time to add context and details about the setup). Students will question their groups/teacher about what they’re noticing and wondering. Students will re-engage their focus and repeat the steps for video number two. |
| 10. Inform students that the person who made these videos is a fisheries biologist. Discuss careers that might help the salmon population. | 10. Students discuss and chart types of careers that might help the salmon population. |
| 11. Read the “Salmon Smell Facts” to the students. You may want to make these into colorful posters or simply read the facts aloud. | 11. Students will listen to facts about salmon and add the new facts to their understanding of the relationship between salmon survival and smell. |
| 12. Put up the watershed pictures next to the river picture from the ‘smell your way home’ activity. Discuss how the rivers are part of the water shed. Discuss how the things along the watershed (neighborhoods, factories, roads, etc.) could contaminate the water that the salmon are living in, along the watershed? (You may choose to chart their answers). | 12. Students will build an understanding of a watershed and how human interaction with this environment hurts salmons’ ability to ‘find their way home’. Students will turn and talk with their groups and share out information with the class. |
| 13. Engage students in a wrap up conversation about what they learned and what the PROBLEM is that they think they’ll be working on in this unit (How contaminants in the water affect marine life). | 13. Students will form the ‘problem’ for this unit, and possibly come up with some potential solutions. |
| \*\*TIP: The layout of this lesson can easily be flipped where the videos, facts, and watershed discussion come first and the ‘Smell Your Way Home’ activity comes at the end. You may choose to flip this lesson if you, as a teacher, feel more comfortable pre-teaching concepts before the activities. |  |

**Accommodations:**

* Visual posters for EL and visually impaired students, group work to help with students who aren’t able to smell the smells, and group work to help clarify information for students who struggle to connect the activities with the new knowledge.

**Extensions:**

* Give more information about how salmon smell their rivers, changing the smells in the canisters, learning about the 5 types of salmon, salmon or river research, etc.

**Assessment:**

* No assessment for lesson #1, other than walking around and listening to students’ conversations, whole class discussion, and checking in about the ‘new ideas’. Lesson standards and soft skills observed only through formative check-in with students.

**References:**

* Instructional Plan Created during the 2019-2020 school year by Verónica West, Jenn McNease, Erin Wells, and Tim Rhoades of the Northshore School District in Washington State as part of their work with the Washington Alliance for Better Schools (WABS) ACCESS STEM program.
* Instructional Plan Consultants (not responsible for the content of this instructional plan):
  + Steve Harvey, teacher, Everett School District in Washington State
  + Linda Richard, Associate Director of Instructional Leadership, Washington Alliance for Better Schools (WABS)
  + Mick Shultz (Port of Seattle), Lisa Hiruki-Raring (NOAA-Alaska Fisheries Science Center)

**Resources:**

* Watershed Images-<http://www.lakecountyil.gov/2375/Watersheds>
* Salmon Smell Facts-<https://medium.com/@GrrlScientist/salmon-scent-and-going-home-again-grrlscientist-57cffde055ae#.bogezym5o>
* River Image- geology.com
* **Salmon Videos courtesy of David Baldwin, the NOAA Fisheries biologist:**

1. Predator- In this video, 2 adult cutthroat trout (predators-red) are in a tank with a juvenile Coho salmon (prey-yellow). Have the students notice that the salmon tries to be still/invisible when the trout swim by. The salmon then begins to swim again, but does not realize the trout are close by and is then eaten.

2. Lead Salmon- **Before watching, tell the students that the top images are the same tank, the bottom images are the same tank, and the video is sped up.** The images on the top are of the same tank-Tank A (side and front view). The images on the bottom are of a different tank- Tank B (side and front view). The fish in the top tank has **not** been exposed to any toxins. The salmon in the bottom tank has been exposed to lead. The scientist puts ground up salmon into both tanks (mid-way through the video). The smell of ground up fish is supposed to alert the fish to danger, and their correct response is to get low to the ground and slow their swimming down, in order to not be seen. The fish in Tank A slows down and moves to the bottom corner of the tank. The fish in Tank B, **that has been exposed to lead**, continues to swim around as if nothing has happened. The fish’s sense of smell has been dulled by the “contaminant”.