Life Science: Ecosystems

Grade 6

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Anchoring phenomenon

Southern Resident orca populations have been declining rapidly over the last decade.
https://www.youtube.com/watch?v=iZ2Gl3OR7jk

Essential question about phenomenon/unit:

What is causing the Southern Resident Orcas to die?

Gapless explanation:

There are two different types of orcas in the Pacific Northwest. There is a large group of transient orcas that travels long distances to forage for food. There is a smaller population called the Southern Resident orcas that eat exclusively salmon and live exclusively off the Northwest coast of North America. J-32 was part of the Southern Resident populations, specifically the J-Pod. Humans contribute to pollution that is often accumulated on hard, impermeable (liquids can't go through) surfaces. These impermeable, or impervious surfaces, get rained on and the pollutants get washed down storm drains. Unlike sewer, the contents of the storm drains are neither filtered nor treated. This means that the pollutants in stormwater are emptied directly into Puget Sound or the Pacific Ocean. Toxins from the pollution get into sediment and into producers, the organisms at the bottom of the food chain. Going up the food chain, toxins build up more and more with each level. Secondary consumers have more toxins than primary, and tertiary have more toxins than secondary, etc. This phenomenon is called bioaccumulation. Chinook salmon, which are Southern Resident orcas' primary food source become contaminated with these toxins due to bioaccumulation, causing the salmon populations to decline greatly. When an animal is starving, its body first burns muscle, but after prolonged starvation it begins to burn fat stores. Toxins in orcas are primarily stored in blubber so as the blubber burns off, toxins begin to release into the rest of the body, resulting in poisoning of vital organs, and ultimately, death. Necropsy results reveal that at time of death, the orcas' bodies are highly toxic due to bioaccumulation and their blubber is very thinned due to starvation. Since the orca whales are secondary consumers and eat the salmon, which are primary consumers they are ingesting the toxins in large amounts. The result is that the whales are dying due to toxicity, but they are also dying due to starvation since their food source is also decreasing. With the death of the individual orcas, the overall population of the Southern Resident whales is decreasing.

NGSS *Performance Expectations* addressed in this unit:

Standard	PE	DCI	CCC
MS LS2-1	**Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. (Activities 5 & 7)**	**LS2.A: Interdependent Relationships in Ecosystems**	**Cause and Effect**
MS LS2-2	**Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems. (Activity 4)**		**Patterns**
MS LS2-3	**Develop a model to describe the cycling of matter and the flow of energy among living and non-living parts of an ecosystem. (Activities 2, 4, & 6)**	**LS2.B Cycle of Matter and Energy Transfer in Ecosystems**	**Energy and Matter**
MS LS2-4	**Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.**	**LS2.C Ecosystem Dynamics, Functioning and Resilience**	**Stability and Change**
MS LS2-5	**Evaluate competing design solutions for maintaining biodiversity and ecosystem services. (Activity 3)**	**LS2.C** **LS4.D: Biodiversity and Humans** **ETS1.B Developing Possible Solutions**	

Summary Table of ALL Activities in Unit

Activity	*Learning Target*	*Evidence Students Could Gain*	*Connection to Phenomena*	*Materials Used*
Activity 1: All About Southern Resident orcas (Used this for Common Core Writing Standard)	Students learn more about Southern Resident Orcas, and contextualize the phenomenon more by doing a small project on individual whales in J-Pod	Southern Resident Orcas feed primarily on Salmon. Students read that the salmon population has decreased.	J-32 was part of J-Pod, which is part of the Southern Resident Orcas. Dependence on salmon leads to starvation when salmon are gone.	Article on orca decline problem and the differences between southern resident and transient orcas: students do individual projects on individual whales: Meet the Whales
Activity 2: Stormwater Runoff: Drained Video and Parking Lot Demo (SEP:Cause and Effect) LS2-3 & LS2-4	Students learn about the different types of pollution that makes its way into the Puget Sound via storm drains.	Students observe "pollution" (food coloring) getting into the "storm drain" (holes in parking lot) and going out into the "Puget Sound" (bottom pan) when it "rains" (water from spray bottle) Observe in video the toxicity of the pollutants on salmon young in the video.	The toxins from the pollution get into the sediment and is ingested through the food web, eventually making its way up via bioaccumulation to the Orcas. Pollution gets into storm drains and the water flows from those storm drains into rivers, lakes, and eventually the Puget Sound. Effects of toxins on Orcas food source.	Parking Lot Demo: Created a demonstration using 2-liter bottles, aluminum foil, cardboard, tubing, and aluminum pans, to represent the direct route from parking lot to storm drain to outfall at Puget Sound. Food coloring represents the Pollution and a spray bottle represents rain.. Drained Video: and video guide Possible resource:
Activity 3: Permeable Concrete Demo and Article (MSLS2-5) (SEP: Structure and	Students learn that the ground naturally filters water and that there are alternative ways	Students realize human actions are what is causing this high accumulation of toxins in the Puget Sound.	Due to human choices of how to pave our roads, the pollution is making its way into storm drains and out to the Puget Sound.	(We adapted this article for 6th grade curriculum by making it shorter) Pavement samples borrowed from WSU

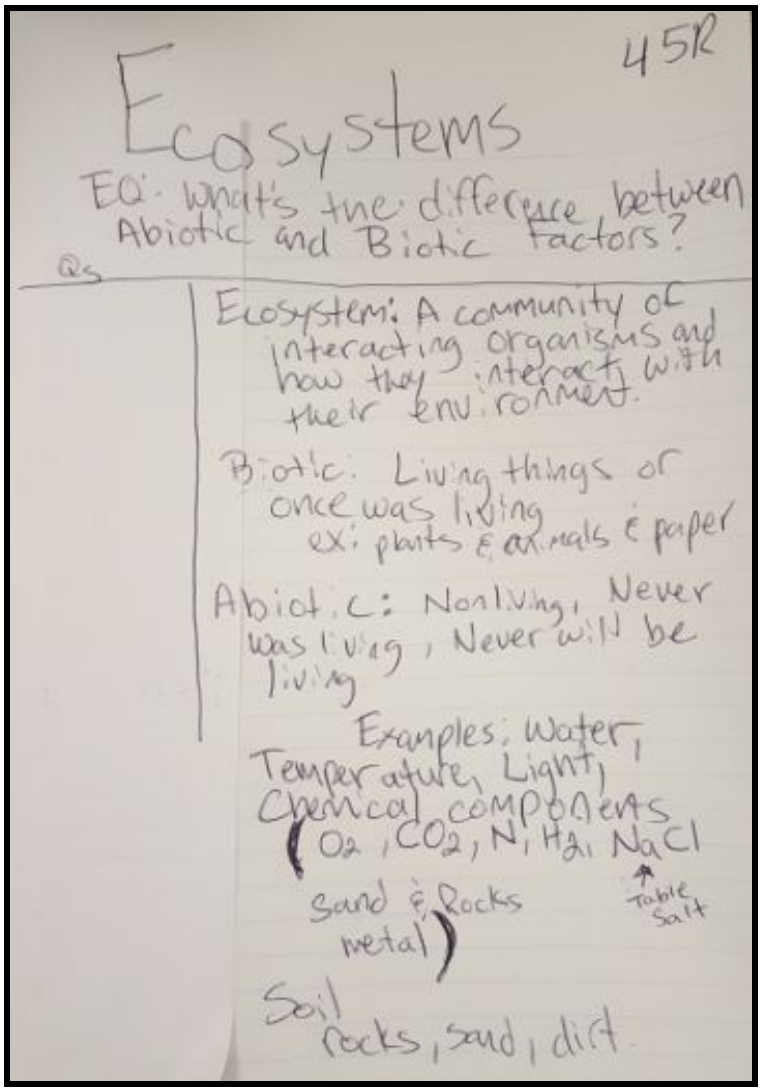
Function) LS2-5	to pave the road that is more environmentally friendly.	Students observe water filtration through different types of concrete.		Puyallup extension.
Activity 4: Food Chain Foldable, Owl Food Web and Pellet Dissection (SEP: Flow of Energy) LS2-2, LS2-3	Students learn about Producers, Consumers, Decomposers, and the flow of energy through an ecosystem.	Students observe how owls depend on their prey for sustenance to survive. Students observe the flow of energy through an ecosystem using their foldable. Students also observe how species are interconnected, because of the food web.	The Predator Prey relationship between orcas and salmon is not a closed system. Populations in an ecosystem affect many other populations and each organism plays a critical role in the ecosystem's function.	Food Chain Foldable (Energy from Sun, Producers, Decomposers, Primary Consumers, Secondary Consumers, Tertiary Consumers.) Owl Food Chain with Owl Pellet Dissection Procedure: (Owl pellet dissection kits can be purchased from various online stores)
Activity 5: Limiting Factors Video and Carrying Capacity Article (SEP: Systems and System Models / Patterns)a LS2-1	Students learn about how limiting factors, such as food, can cause decreases in population due to starvation.	Students interpret data of lichen and reindeer population over time which shows that lack of food causes starvation and population decline.	As salmon population declines, there is less food to sustain the orca population, thus causing starvation.	Limiting Factors YouTube Video: Overshooting Carrying Capacity Activity:
Activity 6: Bioaccumulation simulation, worksheet, and video (Stability and Change) LS2-3	Students learn how toxins move through a food web. Students also learn that bioaccumulation increases with increasing trophic levels.	Students simulate bioaccumulation and see that tertiary consumers have more toxins than primary consumers.	Toxins from the pollution get into sediment and into producers, the organisms at the bottom of the food chain. Going up the food chain, toxins build up more and more with each level. Secondary consumers have more toxins than primary, and tertiary have more	Bioaccumulation Simulation Cards Bioaccumulation Video We use Bioaccumulation Worksheet and class activity from Hazards on the Homefront

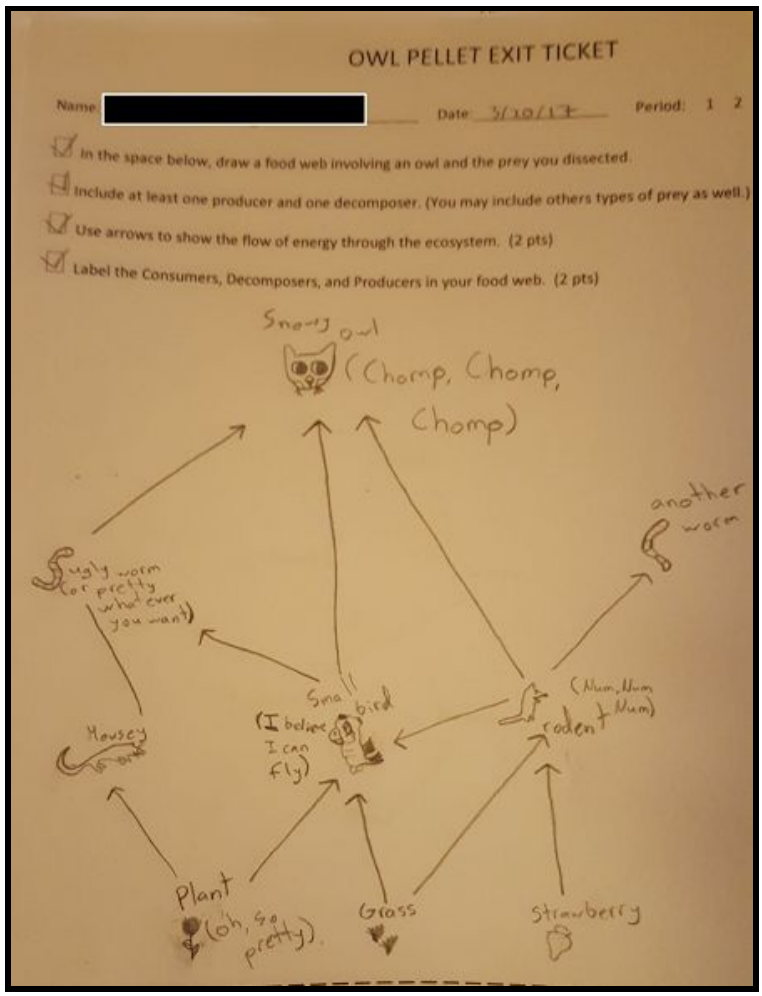
			toxins than secondary, etc. This phenomenon is called bioaccumulation.	Curriculum (King County Hazardous Waste). Similar activities in this free resource:
Activity 7: Starvation Article, Salmon Decline Article, and "House" clip (Cause and Effect) **LS2-1**	Students learn that after the body no longer has food to burn for energy it starts to burn muscle mass then starts to burn fat. Students also learn that toxins are stored in fat cells and that once the fat cells are burned, toxins are released into the system	Students see in video due to lack of food the body goes into starvation mode and fat is burned. Fat soluble toxins are released into the body of the young man which is making him sick. (This is a great visual for how toxins are released)	Due to lack of food, orcas are starving. First, their bodies use muscle mass, then start to burn fat. The toxins from bioaccumulation that are stored in fat are released throughout their bodies.	House Clip (from Season 1, Ep. 11 of TV Show House M.D., available at NBC.com/house): Begin clip at 36:16, end at 37:12 (WARNING: entire episode is not suitable for school viewing) What Happens to Your Body When You are Starving: Salmon Decline and Orca Starvation Article:
After The Unit Assessment Necropsy Report	Here are a few links to the necropsy reports to give to students after the unit if you want. We adapted the articles below into one for 6th grade. Link #1 Link #2 Link #3			

Additional Documents

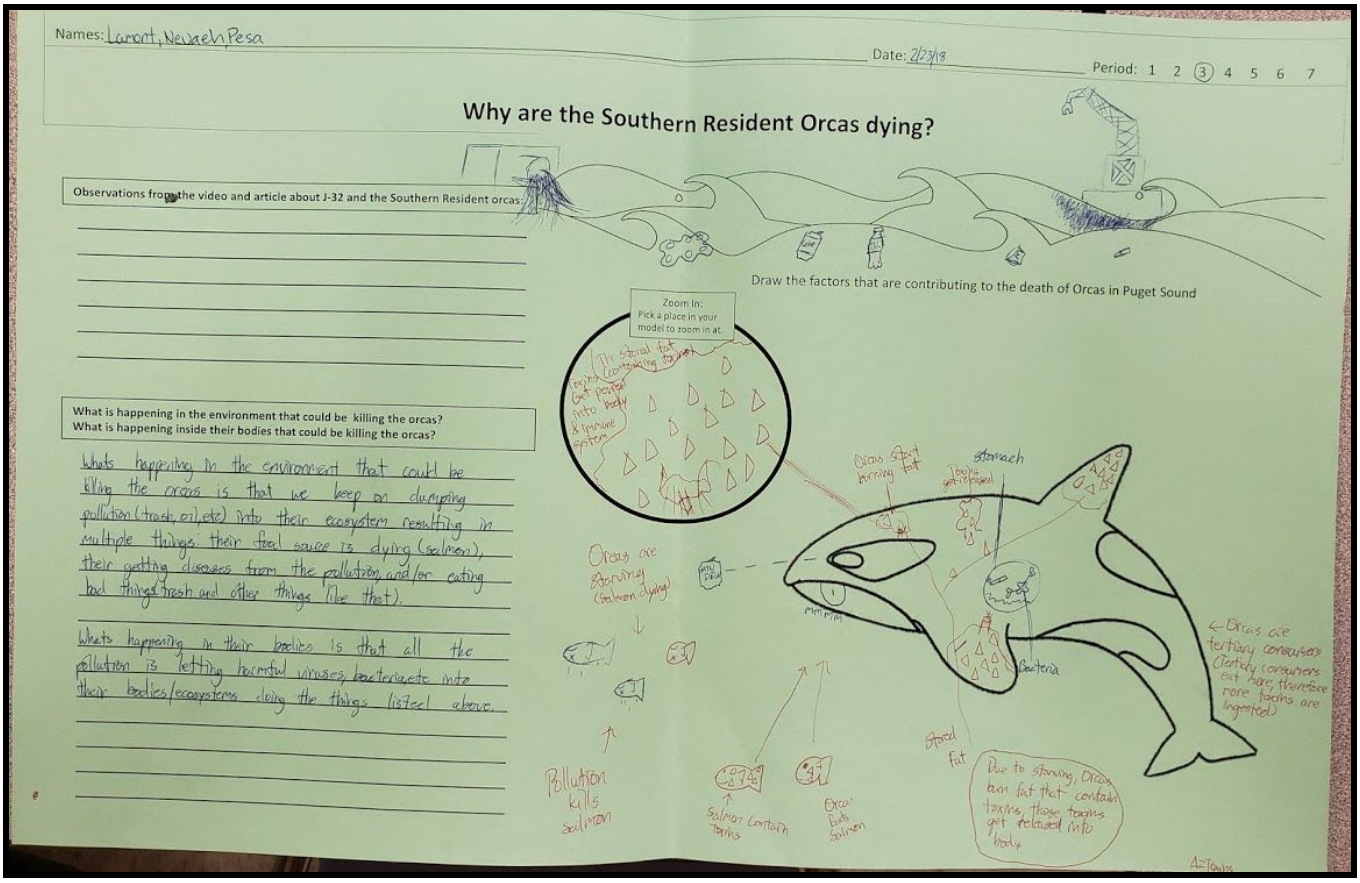
- [Model Template Scaffold]
- [Additional final template]
- [3-column unit assessment]
- [Explanation checklist for model and assessment]
- [3-column assessment rubric and student self reflection]

Picture Collage/Links to student work examples (click on picture to see a larger version).

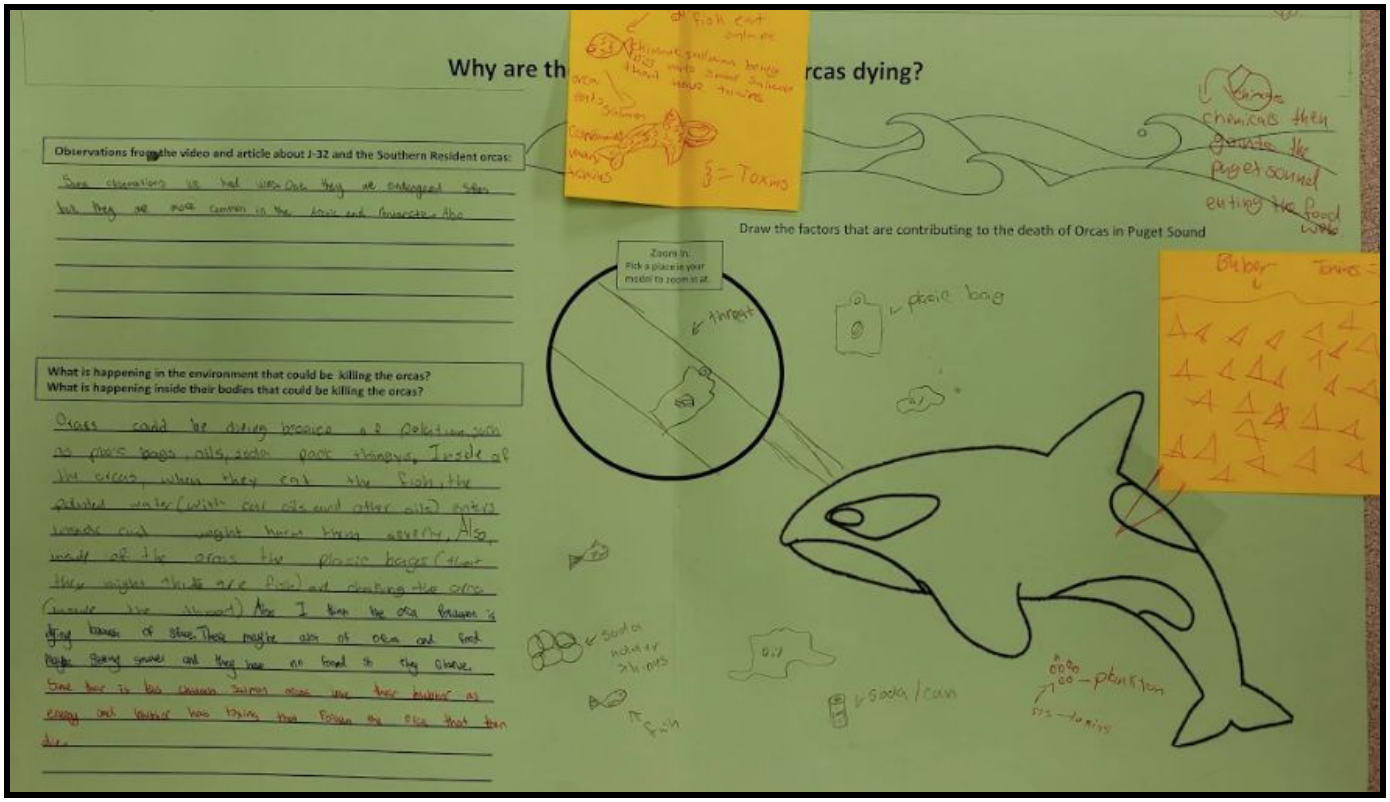




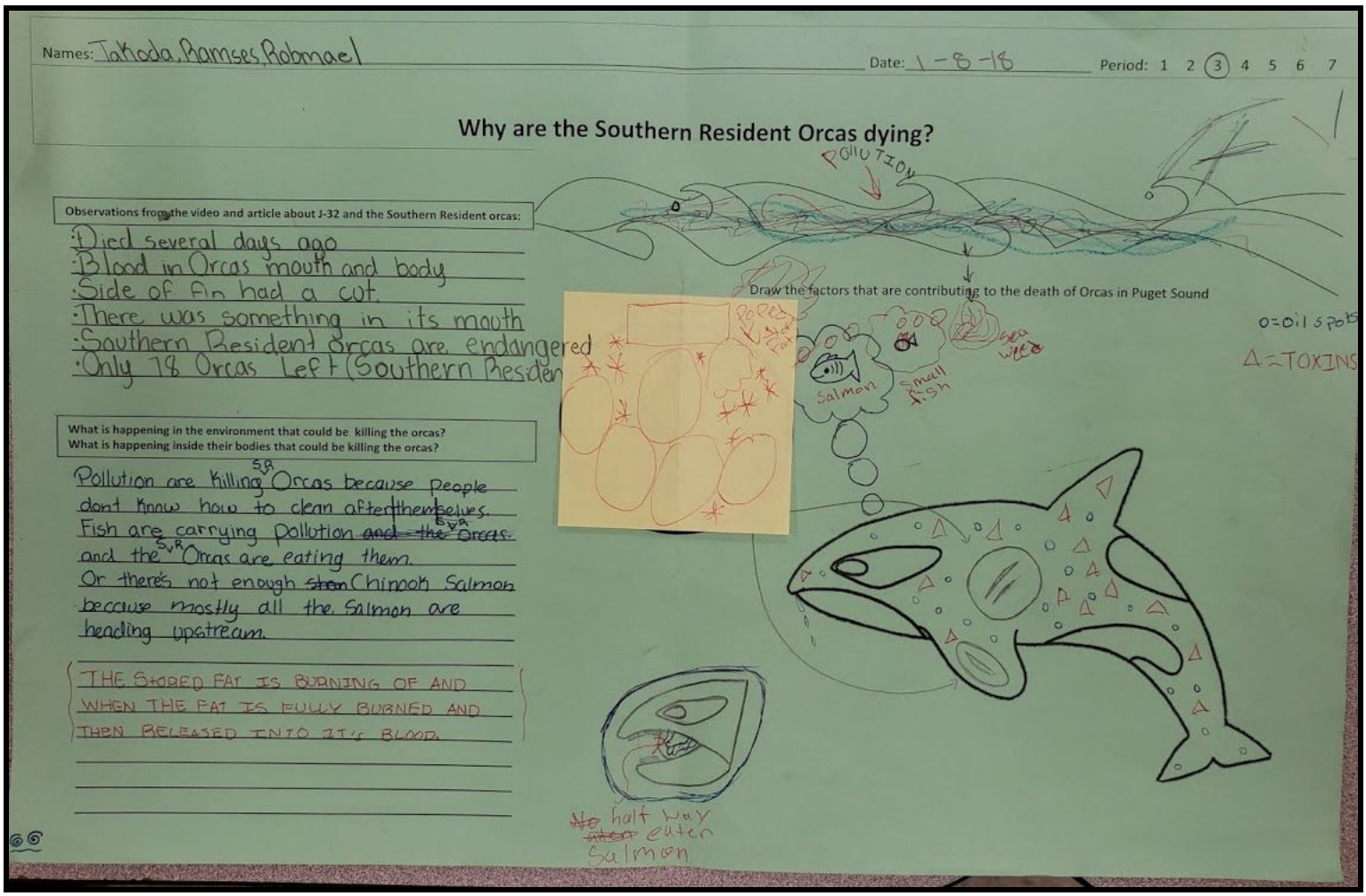
Student Final Model #1



Student Final Model #2



Student Final Model #3



Names: Tahoda, Ramses, Robmael

Date: 1-8-18

Period: 1 2 (3) 4 5 6 7

Why are the Southern Resident Orcas dying?

Observations from the video and article about J-32 and the Southern Resident orcas:

- Died several days ago
- Blood in Orcas mouth and body
- Side of fin had a cut.
- There was something in its mouth
- Southern Resident Orcas are endangered
- Only 78 Orcas Left (Southern Residen

What is happening in the environment that could be killing the orcas?
What is happening inside their bodies that could be killing the orcas?

Pollution are killing S.R. Orcas because people dont know how to clean after themselves. Fish are carrying pollution ~~and the Orcas~~ and the S.R. Orcas are eating them. Or there's not enough ~~stron~~ Chinook Salmon because mostly all the Salmon are heading upstream.

THE STORED FAT IS BURNING OF AND WHEN THE FAT IS FULLY BURNED AND THEN RELEASED INTO IT'S BLOOD.

Draw the factors that are contributing to the death of Orcas in Puget Sound

POLLUTION

Salmon

Small fish

O=Oil spots

Δ=TOXINS

~~No~~ half way ~~eaten~~ eaten Salmon