SALMON SUMMIT 2022

Pacific Northwest
NATIONAL LABORATORY

STEM AT PNNL

Thank you for bringing your students to the Salmon Summit! We enjoyed sharing what we do and loved all the smiling faces and engaging chat during the live streaming event!

Below you will find three separate classroom activities that you can use to support the tagging station you observed.

1) Salmon Migration Pathways – Measurement and Decimals Task
2) Salmon Measurement and Data Analysis
3) Decimals and Fractions Task

We hope you find these useful to continue the excitement of Salmon Summit!

If you have any questions, don't hesitate to contact us:
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Teacher's Guide

Instructions

Below are three mathematical tasks that follow the instructional methods of a 3-Part Lesson.[1]

1. Before the students begin the mathematical task, as a whole class, review the context of the problem and ensure students understand what is expected.
    a. Helpful hints (identified with asterisks) are provided to the teacher to assist students in their thinking throughout the reading of the mathematical task.
2. Once students are comfortable with the context of the problem, allow the students to work in their groups with group roles to solve the problem.
    a. Teachers may choose to assign the group roles or allow students to pick roles.
    b. Teachers should try to allow the students to work through the problem as much as possible on their own.
    c. If students finish early, there is an extension problem that can be offered to the group.
    d. Encourage all members to be prepared to explain how the group got to the answer.
3. After students complete the problem, bring the class back together to share their work and come to a consensus.
    a. Teachers should be strategic and pick groups that had different methods or strategies of finding the answer.
    b. Teachers should encourage consensus building (just as scientists and researchers do) of a solution rather than determining who is correct or incorrect.
    c. Teachers should encourage students to explain their reasoning and thinking.
    d. Teachers should make connections between strategies to help students build a community of learners and see how their methods make sense to one another.

In the last section, there is a worksheet option that can be used in place of any of the three mathematical tasks.

[1] Van de Walle, J.A., K.S. Karp, and J.M. Bay-Williams. 2016. *Elementary and middle school mathematics*. London: Pearson Education UK.

Activity #1: Measurement and Decimals Task

Teacher's Guide

*While releasing salmon at the park, we got an update on a new tag used on a salmon that was released 2 years ago and has now returned to its birthplace to spawn. **We must use our tools around us to answer a question your supervisor asked your team (the experts). ***From the data, we know the salmon has moved 0.57 meters (m), as shown on the map, since its release (indicated on the map).****Describe a potential migration pattern of this salmon using a sketch and written explanation. *Extension:* How many river kilometers (RKm) did the salmon swim?

*You can mention that the park does not have internet, so we cannot just look up the answer or use technological tools to answer the question. Reiterate that salmon are born in freshwater, move to the ocean, and then return to their birthplace to spawn and die. **Sometimes questions like these come up, and we must estimate or try to determine an answer on the spot. Using the tools around us is normal for scientists and researchers. ***Students may need help understanding what the pins on the map are. They are the dams where a fish can be detected. The idea is for students to convert the measurement in m to centimeters (cm). ****Students can then decide to use a measured-out piece of string to map out the route or use a ruler to draw lines for the migration pattern. Reminder: Fish do not follow a straight path.

Options for Differentiation:

- Replace the 0.57 m with 57 cm for students who need support with decimals.
- Have students use the following table to determine a migration pattern instead of measuring for students who aren't ready to use a ruler or string to measure. Students will need to know that that 1 cm on the map is about 30 RKm.

Location to Location	Distance (RKm)
From Pacific Ocean to Bonneville	234 RKm
From Pacific Ocean to The Dalles	308 RKm
From Pacific Ocean to John Day	347 RKm
From Pacific Ocean to McNary	470 RKm
From Pacific Ocean to Ice Harbor	538 RKm
From Pacific Ocean to Lower Monumental Dam	589 RKm
From Pacific Ocean to Little Goose	635 RKm
From Pacific Ocean to Lower Granite	695 RKm

Standard:

CCSS.MATH.CONTENT.4.MD.A.2: Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams, such as number line diagrams, that feature a measurement scale.

Learning Targets:

1. Students will work as a team to solve a word problem using their knowledge about decimals, measurement, salmon, and their team roles.
2. Students will work as a team to solve a word problem using at least two of the following: drawings, manipulatives, written explanation, and/or number sentences.

Materials:

- Fish Migration Map
- String, Ruler, Tape (may be helpful in keeping string on the paper)

Fish Migration Map

Research Team Name_____ Your Role_____

Name_____ Date_____

Standard: CCSS.MATH.CONTENT.4.MD.A.2: Use the four operations to solve word problems involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams, such as number line diagrams, that feature a measurement scale.

Instructions: Researchers at Pacific Northwest National Laboratory are requesting your assistance with understanding how salmon move throughout the Columbia River Basin. Follow the below steps to successfully complete your task as a research team. Check the boxes as you complete each step.

BEFORE your group starts working on the problem

- ☐ Pick a research team name with your group
- ☐ Review your team role
- ☐ Go around to each team member and have everyone share a summary of their role
- ☐ Be prepared to be called on about any part of the task when we come back together as a class

Team Roles:

Facilitator (1)	Recorder (2)
• Reads the task as many times as needed aloud • Makes sure everyone understands each step and expectations BEFORE the team writes down the final answer • Keeps track of time and the team's noise level	• Makes sure everyone on the team agrees and gets the same answers • Listens to what every member says and writes down what is discussed to share with the class • Takes clear notes for everyone to be able to follow if they are asked to share
Quality Control (3)	**Manager (4)**
• Summarizes the team's steps to solve the problem so everyone understands • Makes sure the answer is clearly indicated and includes units • Checks that the team's answer addresses the question	• Is the only one allowed to ask questions • Is responsible for gathering and cleaning up materials • Identifies the math vocabulary and concepts needed to solve the task • Makes sure ALL parts of the problem are answered

START YOUR TASK (next page)

- ☐ Review the below learning targets to make sure your team knows the goals of this task

Learning Targets:

1. We will work as a team to solve a mathematical task using our knowledge about decimals, measurement, salmon, and our team roles.
2. We will work as a team to solve a mathematical task using a picture and written explanation.

Your team's task: While releasing salmon at the park, we got an update on a new tag used on a salmon that was released 2 years ago and has now returned to its birthplace to spawn. We must use our tools around us to answer a question your supervisor asked your team (the experts). From the data, we know the salmon has moved 0.57 m, as shown on the map, since its release (indicated on the map). Describe a potential migration pattern of this salmon using a sketch and written explanation.

Extension: How many RKm did the salmon swim?

Written Explanation:

Answer Key

Measurement and Decimals Task

Drawings or Manipulatives: Students will have a variety of solutions. Students' images should include the potential paths the salmon could take. The strings should start at the release site and trace the Columbia River to the Pacific Ocean and back to the release site. There may be places of multiple overlap, depending on the students' story. *Written Explanation:*
Question: Describe a potential migration pattern of this salmon using a sketch and written explanation.
Sample Answer: Based on my above picture, my 57 cm of string spans from the release site to the Pacific Ocean, where the salmon swims back and forth between _____ and _____.
Extension Question: How many RKm did the salmon swim?
Sample answer: Students should know from previous conversations how to find the amount of RKm. Given the hints above (1cm = 30 RKm), the salmon should have swum about 1,710 RKm.

Activity #2: Measurement and Data Analysis Task

Teacher's Guide

Your research team asked the question of "How long are the salmon when we release them at the park?" Your team cannot agree on which unit of measure to round to. Half of your team wants to round to the nearest ½ cm, and the other half of your team wants to round to the nearest ¼ cm. Based on your fish tank, which method of measurement should your team use to answer the question and why? Your team must provide a line plot for each method of measurement and an explanation as to which method should be used.

Extension: Describe how you would answer the question, "How long are the salmon when we release them at the park?"[2]

Options for Differentiation:

- If line plots are a topic not yet covered, consider having students use a bar graph instead of a line plot to compare the data.
- For students in higher grades, encourage students to use mean, median, mode, and range to describe the data in their explanations. (CCSS.MATH.CONTENT.6.SP.B.5.C).

Standards:

CCSS.MATH.CONTENT.4.MD.B.4: Make a line plot to display a dataset of measurements in fractions of a unit (½, ¼, ⅛). Solve problems involving addition and subtraction of fractions by using information presented in line plots.

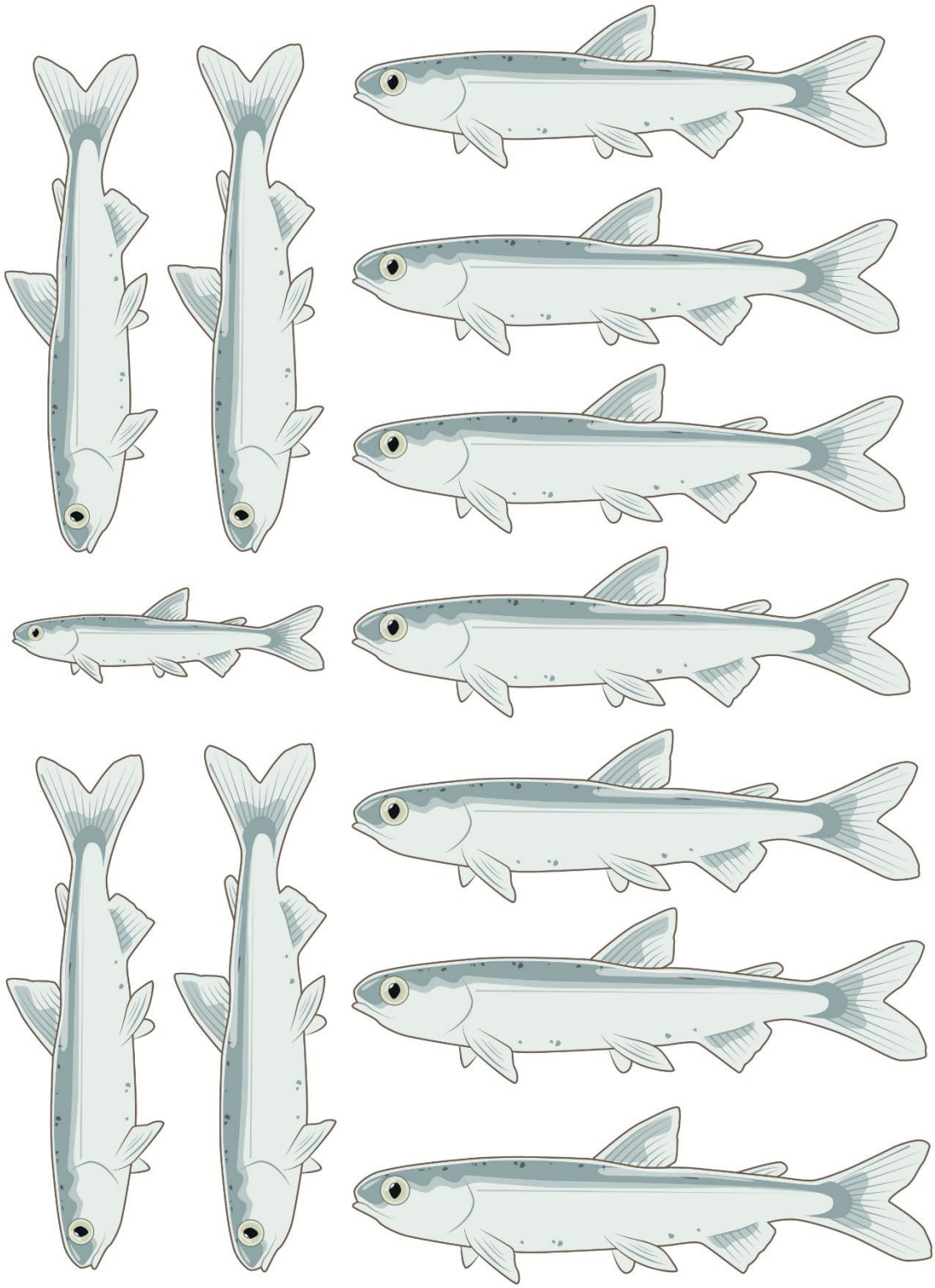
Learning Targets:

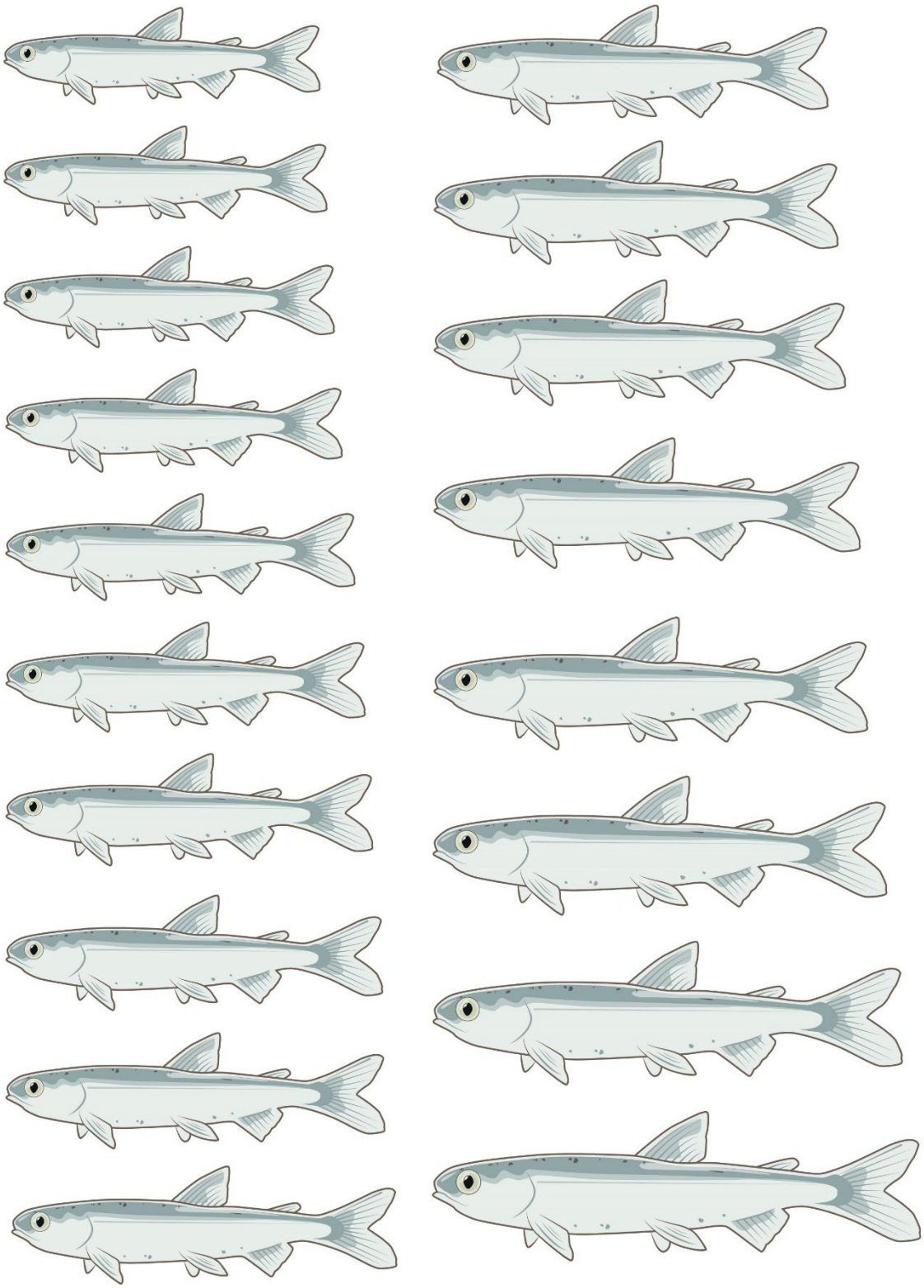
1. Students will work as a team to solve a word problem using their knowledge about fractions, measurement, line plots, salmon, and their team roles.
2. Students will work as a team to create two line plots and explain their reasoning through a written explanation.

Materials:

- Fish Tank (bowl of cut out printed fish)
- Ruler

[2] Adapted from: Button Diameters. Illustrative Mathematics. http://tasks.illustrativemathematics.org/content-standards/4/MD/B/4/tasks/1039. Accessed: 3 May 2022.





Research Team Name_____ Your Role_____

Name_____ Date_____

Standard: CCSS.MATH.CONTENT.4.MD.B.4: Make a line plot to display a dataset of measurements in fractions of a unit (½, ¼, ⅛). Solve problems involving addition and subtraction of fractions by using information presented in line plots.

Instructions: Researchers at Pacific Northwest National Laboratory are requesting your assistance with understanding how salmon move throughout the Columbia River Basin. Follow the below steps to successfully complete your task as a research team. Check the boxes as you complete each step.

BEFORE your group starts working on the problem

- ☐ Pick a research team name with your group
- ☐ Review your team role
- ☐ Go around to each team member and have everyone share a summary of their role
- ☐ Be prepared to be called on about any part of the task when we come back together as a class

Team Roles:

Facilitator (1)	Recorder (2)
• Reads the task as many times as needed aloud • Makes sure everyone understands each step and expectations BEFORE the team writes down the final answer • Keeps track of time and the team's noise level	• Makes sure everyone on the team agrees and gets the same answers • Listens to what every member says and writes down what is discussed to share with the class • Takes clear notes for everyone to be able to follow if they are asked to share
Quality Control (3)	**Manager (4)**
• Summarizes the team's steps to solve the problem so everyone understands • Makes sure the answer is clearly indicated and includes units • Checks that the team's answer addresses the question	• Is the only one allowed to ask questions • Is responsible for the gathering and cleaning up of materials • Identifies the math vocabulary and concepts needed to solve the task • Makes sure ALL parts of the problem are answered

START YOUR TASK (next page)

- ☐ Review the below learning targets to make sure your team knows the goals of this task

Learning Targets:

1. We will work as a team to solve a word problem using our knowledge about fractions, measurement, line plots, salmon, and our team roles.

2. We will work as a team to create two line plots and explain our reasoning through a written explanation.

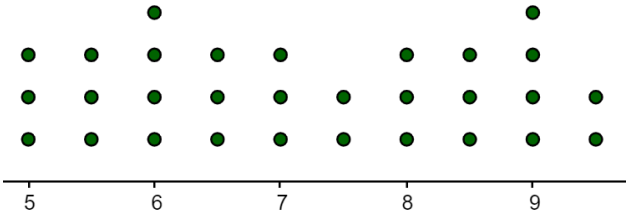
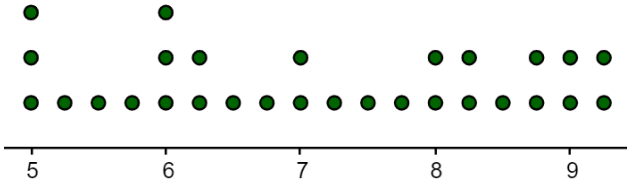
Your team's task: Your research team asked the question of "How long are the salmon when we release them at the park?" Your team cannot agree on which unit of measure to round to. Half of your team wants to round to the nearest ½ cm, and the other half of your team wants to round to the nearest ¼ cm. Based on your fish in your tank, which method of measurement should your team use to answer the question and why? Your team must provide a line plot for each method of measurement and an explanation as to which method should be used.

Extension: Describe how you would answer the question, "How long are the salmon when we release them at the park?"

Line Plot for ½ cm Measurements *Written Explanation:*	*Line Plot for ¼ cm Measurements*

Answer Key

Measurement and Data Analysis Task

Line Plot for ½ cm Measurements	Line Plot for ¼ cm Measurements
 *Written explanation:*	
Question: Which method of measurement should your team use to answer the question and why?	
Sample answer: Our team should use ¼ cm measurements to be more accurate in representing our data. When using the ½ cm measurements, the fish is evenly spread between 5 cm and 9 ½ cm. When using the ¼ cm measurements, we could see that there are two peaks at 5 cm and 6 cm and a large group of fish between 8 cm and 9 ¼ cm. By using smaller measurements, we can see more differences in the lengths of the fish.	
Extension question: Describe how you would answer the question "How long are the salmon when we release them at the park?"	
Sample answer: The fish are between 5 cm and 9 ¼ cm. There are three fish at the peak of 5 cm and three fish at the peak of 6 cm.	

Activity #3: Decimals and Fractions Task

Teacher's Guide

You have now released your fish at the park. The researchers are observing the behavior of the 500 released fish as they approach a dam. *Based on the dam, you know that ¼ of the fish use the conventional spillway route, 0.05 of the fish use the turbine route, one out of ten of the fish use the juvenile bypass system, and ⅗ of the fish use the spill with raised weir system.**Using words and number sentences, describe how many fish would use each system of the dam. *Extension:* You received an update from the researchers. One school did not release fish, so there were only 460 fish released. How many fish would use each system of the dam?

*Use the attached picture as a reference so students understand what each system looks like. **The teacher may need to remind students that survival rate means the number of fish survived divided by the total number of fish released.

Options for Differentiation:

- For students who need friendlier fractions, consider using $^{25}/_{100}$, $^{5}/_{100}$, $^{10}/_{100}$, and $^{60}/_{100}$.
- For students who are not comfortable with fractions, replace the fractions with decimals (0.25, 0.05, 0.1, and 0.6).
- For students who are not comfortable with decimals, replace the decimals with fractions (¼, $^{1}/_{20}$, $^{1}/_{10}$, and $^{2}/_{5}$).
- For classes who need more of a challenge, exchange the 500 fish in the initial problem with the 460 fish in the extension problem.
- For students who may need more guidance, the teacher can consider introducing a table to help organize the students thinking. Example provided below.

System	Problem	Fraction	Decimal	Amount out of 500 fish
Conventional Spillway	¼			
Turbines	**0.05**			
Juvenile Bypass	**One out of ten**			
Spill with Raised Weir	⅗			

Standard:

CCSS.MATH.CONTENT.4.NF.B.4.C :Solve word problems involving multiplication of a fraction by a whole number, e.g., by using visual fraction models and equations to represent the problem.
CCSS.MATH.CONTENT.4.NF.C.6: Use decimal notation for fractions with denominators 10 or 100.

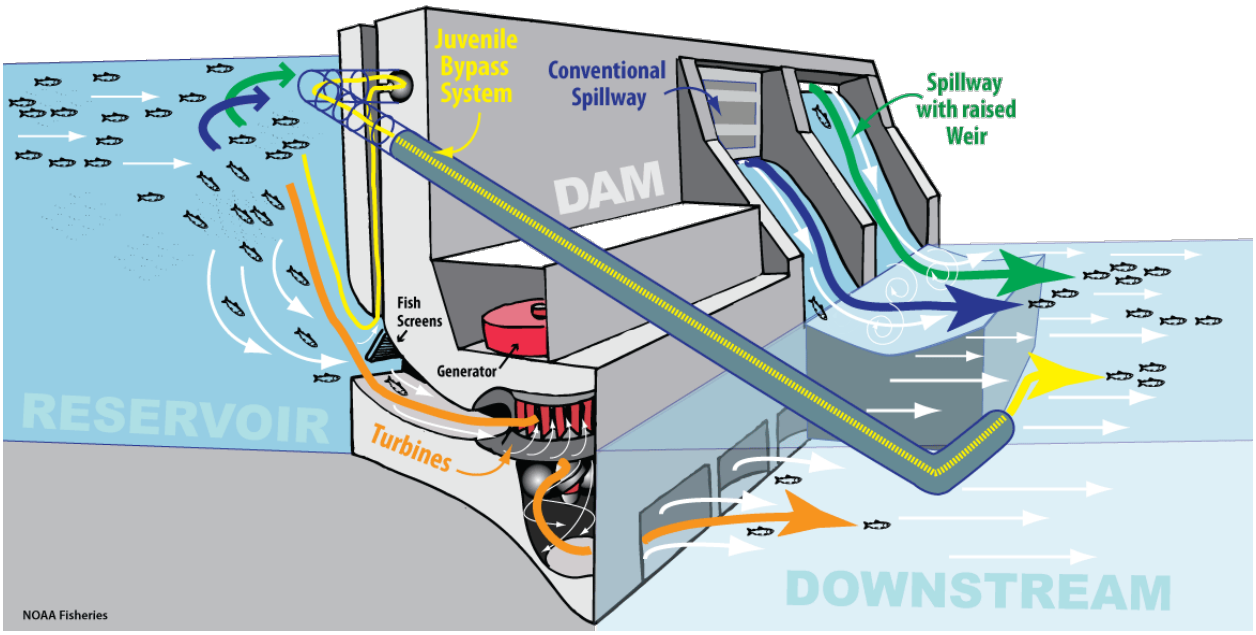
Learning Targets:

1. Students will work as a team to solve a word problem using their knowledge about decimals, fractions, hydropower, and their team roles.
2. Students will work as a team to solve a word problem using at least two of the following: drawings, manipulatives, written explanation, and/or number sentences.

Materials:

- NOAA Hydropower Fish Passage Systems Image
- Fish Passage Map Print-Out

NOAA Hydropower Fish Passage Systems[3]



Fish Passage Map Print-Out

[3] Image from https://www.fisheries.noaa.gov/west-coast/endangered-species-conservation/juvenile-downstream-passage-west-coast.

Research Team Name_____ Your Role_____

Name_____ Date_____

Standard:

CCSS.MATH.CONTENT.4.NF.B.4.C : Solve word problems involving multiplication of a fraction by a whole number, e.g., by using visual fraction models and equations to represent the problem.

CCSS.MATH.CONTENT.4.NF.C.6: Use decimal notation for fractions with denominators 10 or 100.

Instructions: Researchers at Pacific Northwest National Laboratory are requesting your assistance with understanding how salmon move throughout the Columbia River Basin. Follow the below steps to successfully complete your task as a research team. Check the boxes as you complete each step.

BEFORE your group starts working on the problem

- ☐ Pick a research team name with your group
- ☐ Review your team role
- ☐ Go around to each team member and have everyone share a summary of their role
- ☐ Be prepared to be called on about any part of the task when we come back together as a class

Team Roles:

Facilitator (1)	Recorder (2)
• Reads the task as many times as needed aloud • Makes sure everyone understands each step and expectations BEFORE the team writes down the final answer • Keeps track of time and the team's noise level	• Makes sure everyone on the team agrees and gets the same answers • Listens to what every member says and writes down what is discussed to share with the class • Takes clear notes for everyone to be able to follow if they are asked to share
Quality Control (3)	**Manager (4)**
• Summarizes the team's steps to solve the problem so everyone understands • Makes sure the answer is clearly indicated and includes units • Checks that the team's answer addresses the question	• Is the only one allowed to ask questions • Is responsible for the gathering and cleaning up of materials • Identifies the math vocabulary and concepts needed to solve the task • Makes sure ALL parts of the problem are answered

START YOUR TASK (next page)

- ☐ Review the learning targets to make sure your team knows the goals of this task

Learning Targets:

1. Students will work as a team to solve a word problem using their knowledge about decimals, fractions, hydropower, and their team roles.
2. Students will work as a team to solve a word problem using at least two of the following: drawings, manipulatives, written explanation, and/or number sentences.

Your team's task: You have now released your fish at the park. The researchers are observing the behavior of the 500 released fish as they approach a dam. Based on the dam, you know that ¼ of the fish use the conventional spillway system, 0.05 of the fish use the turbines system, one out of ten of the fish use the juvenile bypass system, and ⅗ of the fish use the spill with raised weir system. Using words and number sentences, describe how many fish would use each system of the dam.

Extension: You received an update from the researchers. One school did not release fish, so there were only 460 fish released. How many fish would use each system of the dam?

Work and number sentences: *Written Explanation:*

Answer Key

Measurement and Decimals Task

Work and number sentences:

System	Problem	Fraction	Decimal	Amount out of 500 fish
Conventional Spillway	**¼**	*¼ or 25/100*	*0.25*	*125 fish*
Turbines	**0.05**	*1/20 or 5/100*	*0.05*	*25 fish*
Juvenile Bypass	**One out of ten**	*1/10 or 10/100*	*0.1 or 0.10*	*50 fish*
Spill with Raised Weir	**3/5**	*3/5 or 6/10 or 60/100*	*0.6 or 0.60*	*300 fish*

Extension:
500 − 460 = 40

¼ of 40 = 10
1/20 of 40 = 2
1/10 of 40 = 4
6/10 of 40 = 24

125 − 10 = 115 fish use the conventional spillway
25 − 2 = 23 fish use the turbines
50 − 4 = 46 fish use the juvenile bypass
300 − 24 = 276 fish use the spill with raised weir

Written Explanation:

125 fish out of 500 would use the conventional spillway because 500 × (25/100) = 125.

25 fish out of 500 would use the turbines because 500 × (5/100) = 25.

50 fish out of 500 would use the juvenile bypass because 500 × (10/100) = 50.

300 fish out of 500 would use the spill with raised weir because 500 × (60/100) = 300.

125 + 25 + 50 + 300 = 500 fish that were released.

Decimals and Fractions Task Worksheet

Name_____ Date_____

Standard: CCSS.MATH.CONTENT.4.NF.B.4.C :Solve word problems involving multiplication of a fraction by a whole number, e.g., by using visual fraction models and equations to represent the problem.

Learning Target: I will solve a word problem using multiplication of fractions by a whole number.

Instructions: Read the scenario and answer the questions using words and pictures. Use the table to help guide your thinking and reasoning.

Problem: 500 fish were released at the confluence of the Snake and Clearwater rivers seen on the below map (where the red and blue rivers meet). There are eight dams between the release location and the ocean. Determine how many fish would successfully cross each dam and make it to the ocean.

Dam	**Survival Rate**	**Fish Successfully Crossed (Round Appropriately)**
Lower Snake River Dams		
Lower Granite Dam (1)	$^{95}/_{100}$	
Little Goose Dam (2)	$^{93}/_{100}$	
Lower Monumental Dam (3)	$^{97}/_{100}$	
Ice Harbor Dam (4)	$^{98}/_{100}$	
Lower Columbia River Dams		
McNary Dam (5)	$^{94}/_{100}$	
John Day Dam (6)	$^{96}/_{100}$	
The Dalles Dam (7)	$^{93}/_{100}$	
Bonneville Dam (8)	$^{96}/_{100}$	
Show all your work:		

1. How did you decide to round your answers? Why did you choose to round that way?_____

   _____

   _____

   _____

2. What is the overall survival rate for the Lower Snake River Dams? _____
3. What is the overall survival rate for the Lower Columbia River Dams? _____
4. Divide your answers in #2 and #3. Which series of dams has a higher survival rate? Explain.

   _____

   _____

   _____

5. What is the overall survival rate for the eight dams total? _____

Answer Key

Problem: 500 fish were released at the confluence of the Snake and Clearwater rivers seen on the below map (where the red and blue rivers meet). There are eight dams between the release location and the ocean. Determine how many fish would successfully cross each dam and make it to the ocean.

Dam	**Survival Rate**	**Fish Successfully Crossed (Round Appropriately)**
Lower Snake River Dams		
Lower Granite Dam (1)	$^{95}/_{100}$	**475**
Little Goose Dam (2)	$^{93}/_{100}$	**442**
Lower Monumental Dam (3)	$^{97}/_{100}$	**429**
Ice Harbor Dam (4)	$^{98}/_{100}$	**421**
Lower Columbia River Dams		
McNary Dam (5)	$^{94}/_{100}$	**396**
John Day Dam (6)	$^{96}/_{100}$	**381**
The Dalles Dam (7)	$^{93}/_{100}$	**355**
Bonneville Dam (8)	$^{96}/_{100}$	**341**
Show all your work:		

1. How did you decide to round your answers? Why did you choose to round that way? I rounded up to the nearest whole number regardless of the decimal because it would not make sense to have part of a fish successfully cross the dam. (Other answers may include rounding to the nearest whole using decimal place value to inform rounding up or rounding down.)

2. What is the overall survival rate for the Lower Snake River Dams? $^{421}/_{500}$

3. What is the overall survival rate for the Lower Columbia River Dams? $^{341}/_{396}$

4. Divide your answers in #2 and #3. Which series of dams has a higher survival rate? Explain. The Lower Columbia River Dam series has a higher survival rate because 0.86 is more than 0.84.

5. What is the overall survival rate for the eight dams total? $^{341}/_{500}$