Name _____ Teacher _____ Date _____

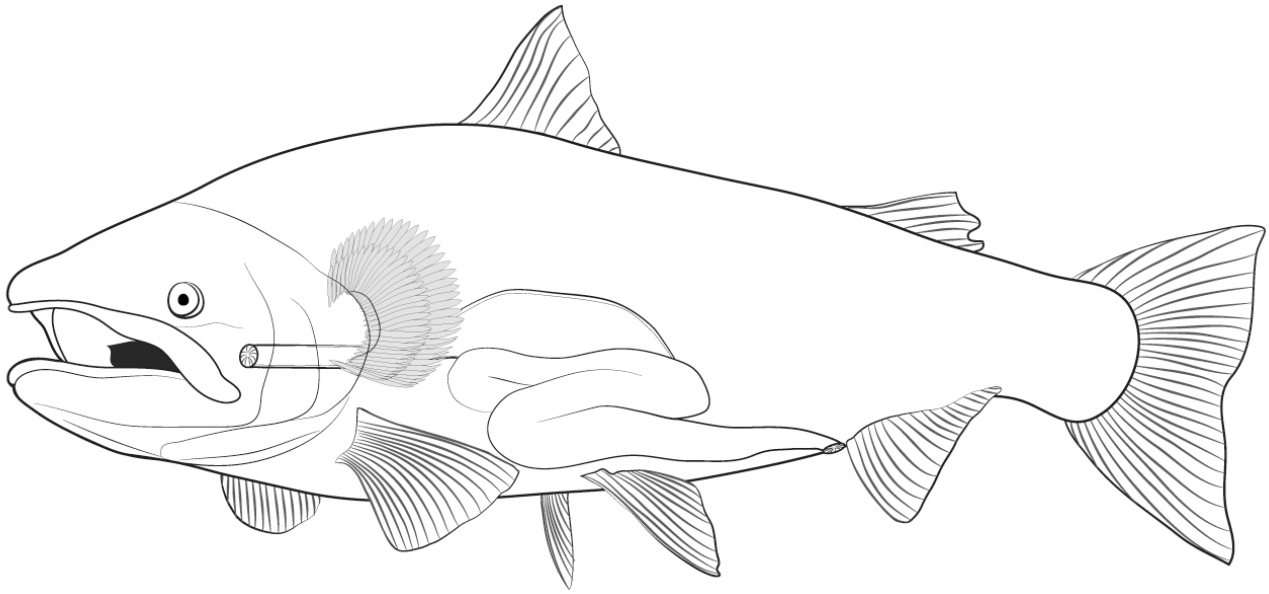
6.1: Grading Salmon Worksheet

*This worksheet has "grading" in the title because at this point, students can be held accountable for correct answers. Level 4 (correct) responses to the questions are in **blue bold italics** below.*

Red italics suggest ways to grade student responses by giving them points for correct or partially correct answers. There are 24 points total on this worksheet.

Draw and label arrows that represent the molecules that carbon atoms are in as they move into, through and out of the salmon as it moves and grows.

Label each arrow to show the kind of molecules that the carbon atoms are in: large organic molecules (LOM), small organic molecules (SOM), or carbon dioxide (CO_2).



What happens to the food the salmon eats as it moves and grows?

Salmon digest the food they eat, turning large organic molecules into small organic molecules. They use the digested food they eat in two ways: for biosynthesis (for growth) and for cellular respiration (for energy).

1 point each for digestion, cellular respiration, and biosynthesis (3 points total)

How does the salmon get oxygen and use oxygen as it moves and grows?

Dissolved oxygen moves from the water into the salmon's blood in its gills. Salmon cells use the oxygen as one of the reactants needed for cellular respiration.

1 point each for getting dissolved oxygen from water and using oxygen for cellular respiration (2 points total)

A. Investigating how Salmon grow and function

A class was interested in how salmon grow. The teacher started the lesson by telling his students that a salmon eats a lot of food each week but only gains a little bit of weight. The teacher asked, "What happened to the mass of the rest of the food?"

a. Three students shared their ideas about what happened. Do you agree or disagree with what each student claims?

Agree	***Disagree***	Marshall: “The salmon’s body turned most of the mass of the food into energy in order to move and grow.”
Agree	***Disagree***	Eva: "The salmon breathed out most of the extra mass of the food as gases dissolved in water, like CO_2.”
Agree	***Disagree***	Boe: "The salmon’s body got rid of most of the extra mass of the food as solid waste (feces)."

1 point for correctly answering each line. 3 points total. Note that based on the information given, either agreeing or disagreeing with Eva and Boe is reasonable (see explanation below).

b. Provide an explanation. Why do you agree or disagree with each student’s claim?

The best explanations will consider answers to the Matter Movement and Matter Change Questions: Three things can happen to food that animals eat: (a) undigested large organic molecules eliminated as feces, digested food used either for (b) cellular respiration and energy or (c) biosynthesis and growth. Students can use this knowledge to evaluate the three claims:

- ***Marshall’s claim is incorrect because it violates the principle of conservation of matter: Matter cannot be converted to energy in chemical or physical changes.***
- ***Eva’s claim correctly recognizes CO_2 as a product of cellular respiration. A Level 4 response could reasonably be “not sure” if there is an explanation that we can’t be sure how much of the food is used for cellular respiration.***
- ***Boe’s claim correctly recognizes that undigested food leaves the salmon’s body as feces. Again, a Level 4 response could recognize that there is no information about how much of the food is digested by the salmon.***

1 point for rejecting Marshall’s claim as impossible

1 point for recognizing Eva’s claim as possible due to cellular respiration (but possibly disagreeing with the claim that cellular respiration accounts for MOST of the mass)

1 point for recognizing Boe’s claim as possible due to undigested food (but possibly disagreeing with the claim that undigested food accounts for MOST of the mass)

3 points total

c. The class generated some data. They measured the starting mass of 5 salmon and put each salmon in its own aquarium. Then they gave each salmon 300 grams of food and made sure the salmon always had the same amount of water in their aquariums. After one week, the students measured the masses of the salmon, leftover food and salmon feces. Below are the data they generated.

Sample	Change in salmon mass (g)	Change in food mass (g)	Mass of solid waste (g)
1	+20	-200	+40
2	+20	-201	+50
3	+30	-203	+50
4	+10	-109	+4.0
5	+40	-203	+70
Average	**+24**	**-183**	**+50**

Which claim do you think is best supported by the data?

a. Marshall’s claim

b. Eva's claim

c. Boe's claim

Explain how the patterns in the data support the claim that you chose.

The best responses recognize that undigested food (solid waste) and growth (change in salmon mass) together account for only an average of 80 out of 200 grams that the average salmon ate. So the data support Eva's claim better than the other two.

1 point for choosing Eva's claim

1 point for pointing to mass differences as evidence

2 points total

d. What additional evidence would you collect to help show that the claim you chose is the best claim?

The best responses propose questions that target limitations in the data (recognize there is an unaccounted for matter pool, i.e., water); they focus on matter tracing and are constrained by principles such as matter to energy conversion.

1 point for identifying additional evidence that could be collected (could be water, oxygen, CO_2, or other conditions)

B. A question about how salmon grow and function

When a salmon was one month old, it weighed 0.2 kg. After 1 year, the salmon has grown into an adult salmon, weighing 5 kg. Where did its increase in mass come from?

Select True or False for the following statements.

Some of the salmon's mass:

True ***False*** *is created by the salmon.*

True ***False*** *comes from the air.*

True ***False*** *comes from sunlight.*

True False *comes from water.*

True False *comes from food.*

1 point for correctly answering each line. 5 points total.

Which ONE of the following do you think provides the MOST mass to the salmon?

a. Mass the salmon's body created

b. Air

c. Sunlight

d. Water

e. ***Food***

1 point for correct answer.

Explain your choices. Where do you think the increase in the mass of the salmon comes from?

Level 4 responses explain that organic molecules in the salmon's body come from organic molecules in food.

1 point for correct answer.

How does the salmon's digestive system (stomach and intestines) help it gain mass as it grows?

Level 4 responses recognize that the digestive system makes large organic molecules in food into small organic molecules that enter the salmon's blood. Level 4 responses do not equate digestion to cellular respiration or use vague terms such as "breaking down"

food.

1 point for correct answer.

How does the salmon's blood help it gain mass as it grows?

Level 4 responses recognize that blood carries small organic molecules to all the cells the body.

1 point for correct answer.

C. Something interesting about salmon

What is something interesting that you learned about the salmon that makes this animal different from other animals?

1 point for correct fact from readings or discussion.