

3-D Performance Assessment

Performance Expectation: **HS-LS2-4**

Grade Level: **High School**

Status: **Mid-Revision**

Title	The Effect of Mercury on Biomagnification		
Designed by	Ashley Leung, Yong-Ju Reichenberger, and Jessica Ross	Course(s)	Living Environment/Biology

Performance Expectation	HS-LS2-4: Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. Clarification Statement: Emphasis is on using a mathematical model of stored energy in biomass to describe the transfer of energy from one trophic level to another and that matter and energy are conserved as matter cycles and energy flows through ecosystems. Emphasis is on atoms and molecules such as carbon, oxygen, hydrogen and nitrogen being conserved as they move through an ecosystem. Assessment Boundary: Assessment is limited to proportional reasoning to describe the cycling of matter and flow of energy.
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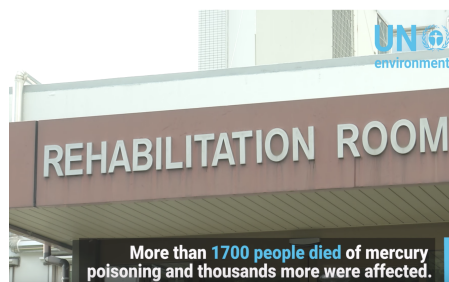
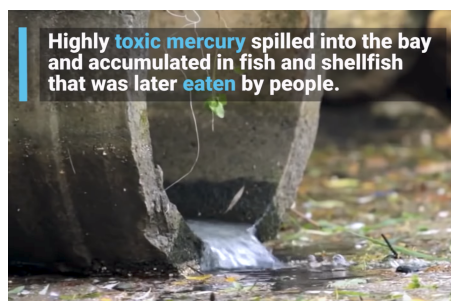
Science and Engineering Practice	Using Mathematical and Computational Thinking • Use mathematical representations of phenomena or design solutions to support claims.
Disciplinary Core Ideas	LS2.B: Cycles of Matter and Energy Transfer in Ecosystems • Plants or algae form the lowest level of the food web. At each link upward in a food web, only a small fraction of the matter consumed at the lower level is transferred upward, to produce growth and release energy in cellular respiration at the higher level. Given this inefficiency, there are generally fewer organisms at higher levels of a food web. Some matter reacts to release energy for life functions, some matter is stored in newly made structures, and much is discarded. The chemical elements that make up the molecules of organisms pass through food webs and into and out of the atmosphere and soil, and they are combined and recombined in different ways. At each link in an ecosystem, matter and energy are conserved.
Crosscutting Concept	Energy and Matter • Energy cannot be created or destroyed; it only moves between one place and another place, between objects and/or fields, or between systems.

Student Performance	1. Representation 2. Mathematical modeling 3. Analysis
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Name: _____ Period: _____

The Effect of Mercury on Biomagnification

Due to Syracuse, NY industrial past, Onondaga Lake has high levels of mercury contamination. Mercury is a neurotoxin that negatively impacts the brain and nervous system. As recreational boating and fishing on Onondaga Lake have increased in recent years, the NYS Department of Health is concerned about fish consumption. You will be shown a [video](https://bit.ly/2K0CwZI) [Link: bit.ly/2K0CwZI] of a highly toxic mercury spill in Japan in 1956. People in that area were affected by Minamata disease.



You are a researcher at the NYS Department of Health and you have been asked to make recommendations regarding the safety of eating fish caught in Onondaga Lake. The mathematical representation below shows how mercury accumulates in aquatic ecosystems. Remember: A mathematical representation may not include numbers directly, but can represent quantities through diagrams.

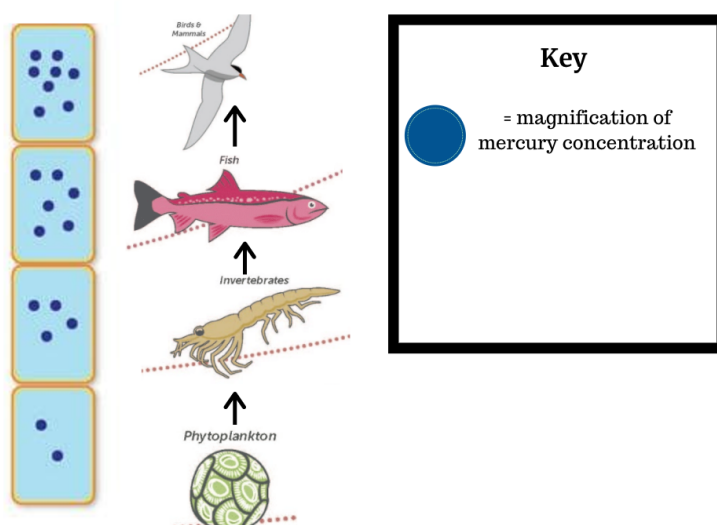
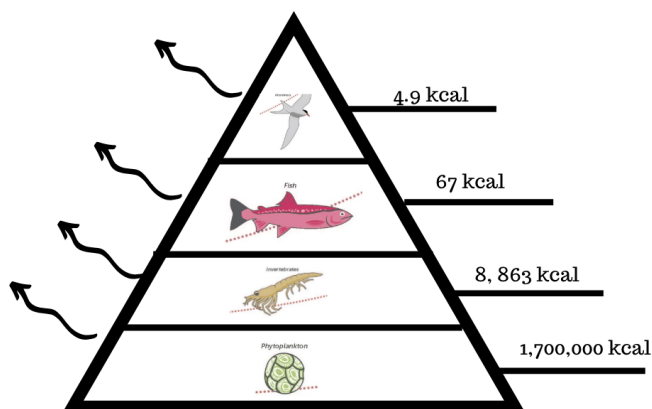
Image modified from design by David Orr:
davidorogenic.com

Biomagnification of mercury in aquatic food webs: a worldwide meta-analysis

RA Lavoie, TD Jardine, MM Chumchal, KA Karen & LM Campbell | *Environmental Science & Technology* | <http://dx.doi.org/10.1021/es403103t>

Figure 1:

Figure 2:



1. Explain the **mathematical relationship** between each organism as energy is transferred between trophic levels based on the energy pyramid figure 1.

2. Using the mathematical representation of “Biomagnification of mercury in aquatic food webs”, complete the graphic organizer below to **explain biomagnification in terms of matter flow in an aquatic ecosystem**.

① Describe the Phenomenon	
② System List components	③ Which components will you model?
	④ How will you model these components?
	⑤ Identify the Model
⑥ Analyze results	

3. **Make a claim** using evidence from the data chart regarding the safety of consuming large fish from this lake using the chart below.

Claim:	Evidence: (Data from mathematical representations)
Reasoning: (Justify your answer in terms of matter flow between organisms and their environment)	

4. According to the mathematical representation in Figures 1 & 2, there is an observable change in the magnification of mercury concentration of each organism in the trophic level.

Describe the relationship between trophic levels and the mathematical representation of mercury concentration.

5. Provide evidence to support the claim that: “Energy cannot be created or destroyed; it only moves between one place and another place, between objects and/or fields, or between systems” using information from the mathematical representations above.
