BREATHING WITHOUT AIR

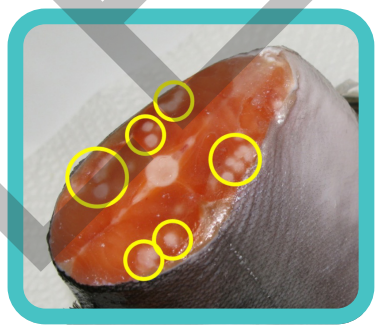
STUDENT WORKBOOK

LAUNCH

THINK ABOUT IT!

1. What are the differences between the salmon flesh in the two photos?

2. Which of these two photos has salmon that you would rather eat (assuming you would eat salmon)?

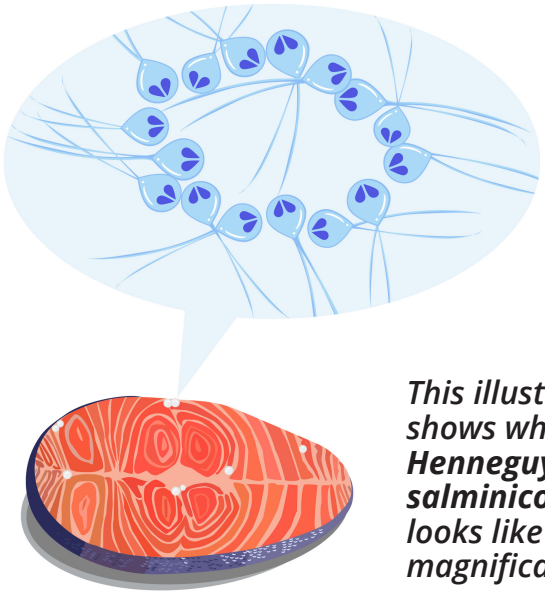


The salmon on the right is infected with a parasite named *Henneguya salminicola*. It is a microscopic, multicellular animal (related to sea jellies) that burrows into the flesh of salmon. It causes milky flesh, also known as tapioca disease, because it produces white, gooey cysts inside the salmon.

While the parasite is not harmful to humans if eaten, it makes the salmon flesh less appetizing and prevents people from wanting to purchase and consume it. Even if the fish tastes the same, its texture and appearance are affected.

One thing most animals, including the ones that are parasites, have in common is that they need oxygen to survive. They may get oxygen in different ways: mammals and birds have lungs that help them breathe, fish have gills, and some frogs breathe through their skin.

Until 2017, there were no known animals that could live without oxygen. Then, the study of *Henneguya salminicola*, which was originally discovered in 1919, changed that idea. According to an analysis of the parasite's genetic code and what its cells look like under a microscope, the parasite does not have the cellular structures that would make it capable of taking in oxygen. So far, it is the only organism that has multiple cells but does not need oxygen.



This illustration shows what Henneguya salminicola looks like at 400X magnification.

ACTIVITY 3

THE CARBON CYCLE

Cellular respiration is one of many processes in which carbon is involved. Let's examine the other ways in which carbon moves or cycles through organisms and the environment.

LEARNING GOALS:

I can model how photosynthesis and respiration cycle carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

8 CYCLES AND SPHERES

Earth's Spheres

In respiration, oxygen from the air and chemical energy from glucose move into the body of the organism, and carbon dioxide moves from the organism back into the air. In other words, matter and energy move between different parts of Earth. These areas where matter and energy are stored are often known as the spheres of Earth.

MATTER AND ENERGY REVIEW:

Matter is anything that has mass and volume.

Matter is made of atoms, the smallest units of chemical elements. An ***element*** is a type of matter with only one kind of atom.

A ***compound*** is a type of matter with two or more elements chemically bonded.

Elements and compounds are ***pure substances***, meaning they each have only one type of particle, or smallest unit observed on a sub-microscopic level.

A ***mixture*** is a type of matter with two or more compounds or elements physically combined.

Matter cannot be created or destroyed, only moved.
The total mass of the reactants of a chemical reaction is equal to the total mass of the products, and the atoms of the reactants are rearranged to form the products.

Energy is not matter; it does not have mass or volume and is not made of atoms.

Energy cannot be created or destroyed, only converted to other forms.

ACTIVITY 4

ENERGY FLOW

In the last activity, you explored how carbon, a type of matter, moves through the environment. Many of these changes involve a flow of energy, such as cellular respiration. How does energy move through the environment?

LEARNING GOALS:

I can use mathematics to show how matter cycles and energy flows among organisms in an ecosystem.

ENERGY EFFICIENCY

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Trophic Levels

Energy moves through trophic levels in the environment. A **trophic level** is one of several hierarchical levels in an ecosystem, containing organisms that share a nutritional relationship to the initial source of energy. An **ecosystem** is a community of biotic and abiotic things and the interactions between them.

Different types of organisms make up the trophic levels. In the first trophic level, **autotrophs** get energy from the Sun to make glucose using photosynthesis. Autotrophs are sometimes called producers because they produce chemical energy from light energy.

In the next trophic level, and the levels above that, are **heterotrophs**, which cannot convert the Sun's energy to glucose. Heterotrophs are sometimes called consumers because they must consume other organisms to survive. Some heterotrophs eat producers, and these are called **primary consumers**. Some heterotrophs eat primary consumers and are called **secondary consumers. Tertiary consumers** eat secondary consumers.

LATIN ROOTS

In Latin, the root troph- means "nourishment."
Auto- means "self," so "autotroph" means "nourishment from self."
Hetero- means "other," so "heterotroph" means "nourishment from others."

Models of trophic levels typically show the flow of energy rather than the direction of consumption. The two types of models used to show this flow are food chains, which show a single path of energy, and food webs, which show all the interactions in an ecosystem. In this food chain model, notice how the arrows show the flow of energy from the Sun to producers and then to each level of consumer.

LAUNCH

SCIENCE UNLOCKED

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Kit	SU-BREATH
Instructions	IN-BREATHS
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