Subject code:	Bio1	Fundamentals of Biology
Learning Guide Code:	3.0	Transport and Circulation of Materials
Lesson Code:	3.1	Trends and Strategies Used by Organisms to Transport Materials
Time Limit:		30 minutes (1 session)

MATERIALS

To complete this module, you need the following:

1. pen and paper
2. phone/tablet/laptop
3. stable internet connection

TARGET (1 min)

At the end of this module, you should be able to describe the trends and compare various strategies used by organisms to transport materials for energy utilization and maintenance.

HOOK (3 mins)

Public transportation is one of the most important aspects that determines a country's progress and growth. And when we talk about public transportation, railway systems are viewed positively by most citizens because of its potential efficiency not only when it comes to mobility but also its effect on land use and development in urban centers. One great example is that of Japan.

Japan is an archipelago which is comprised of four major islands, Honshu, Kyushu, Hokkaido and Shikoku. These four major islands are connected by an extensive network of railways making it convenient for both locals and tourists to travel around the country. In addition to this, Japan's railway system is known to be one of the most efficient and organized in the World.

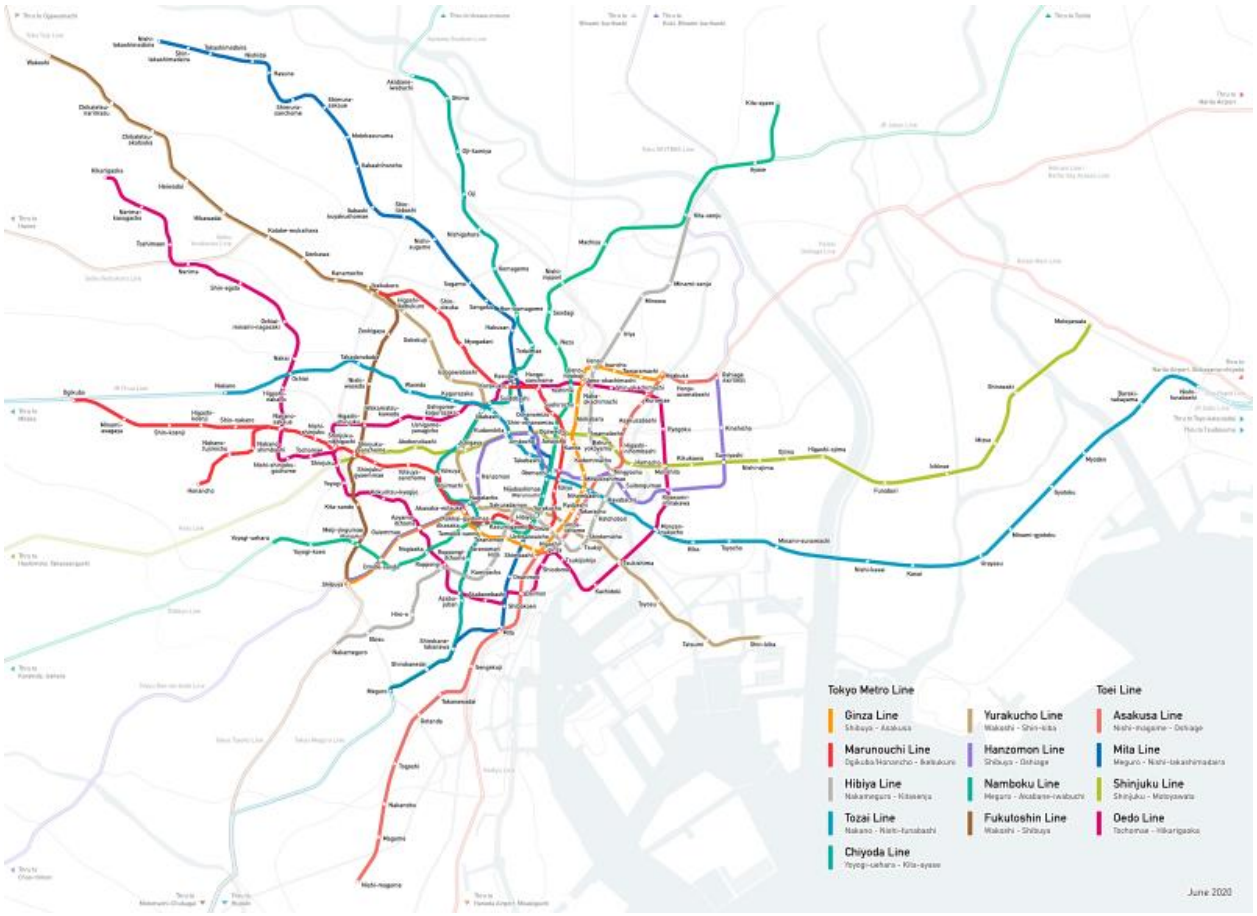

Figure 1. Map of Tokyo Subway By Yveltal - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=91619243

__ THINK!

What do you think are some similarities that we can see in our public railway system and the

This is non-graded.

In this chapter, we'll be learning more about the importance of transport in living systems and we'll dig deep into the details of probably one of the more complex systems, the circulatory system!

IGNITE (15 mins)

Living organisms are capable of transporting important nutrients along with waste products to and from cells. A molecular exchange involving every cell in the body and its environment is essential in maintaining life.

Recall that the process of diffusion is the net movement of molecules brought about by concentration gradient. This process moves oxygen gas and carbon dioxide between neighboring cells as well as their surroundings. This process however, is too slow and inefficient when distances exceed a few millimeters.

This chapter will discuss the different adaptations by various organisms to transport materials throughout their bodies.

Unicellular organisms utilize their cell surfaces as a place of exchange with the outside environment. Most multicellular organisms however, have developed circulatory systems to deliver important nutrients and along with oxygen to support their larger sizes.

Non-vascular plants are generally shorter than their vascular counterparts. Because of this, they lack a transport system for essential minerals, water and food. Instead of roots, non-vascular plants have rhizoids, which are slender, hair-like structures that serve for anchorage like roots. **Vascular plants** on the other hand have specialized conducting tissues responsible for conducting water, food and other essentials throughout the plant body.

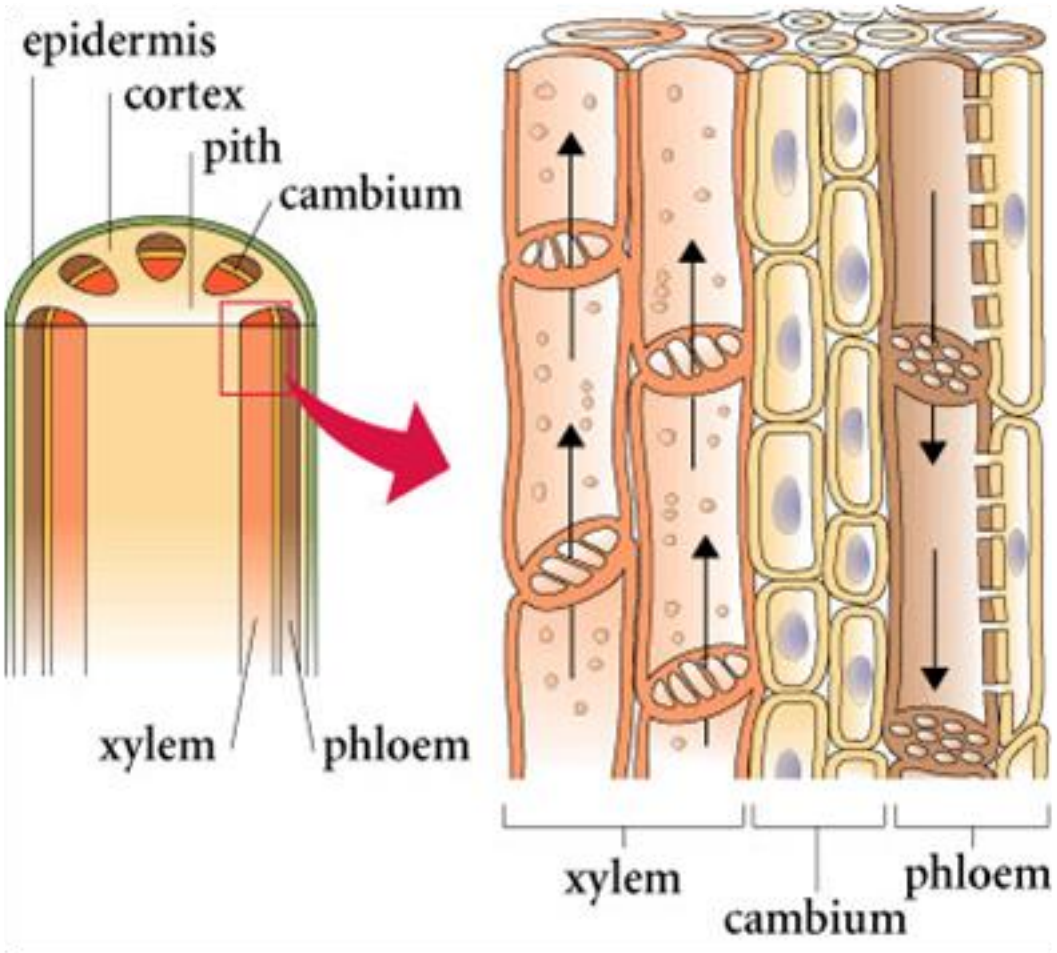

Figure 2. The Vascular Tissues in Plants Xylem and Phloem from https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(Boundless)/25%3A_Seedless_Plants/25.4%3A_Seedless_Vascular_Plants/25.4B%3A_Vascular_Tissue%3A_Xylem_and_Phloem licensed by CC-BY-NC-SA 3.0

The same pattern is found in animals. One of the adaptations employed by some animals is having a body plan that allows cells to have a direct contact with the environment. Sponges are one of the simpler members of the animal kingdom. They do not need a circulatory system since diffusion would allow them to have an exchange with their environment.

In animals like sea jellies and other cnidarians, a central **gastrovascular cavity** is present to distribute substances throughout the animal body. This cavity also aids in digestion too. In such animals, fluid would bathe both the inner and outer tissues, this allowing the exchange of important gases and wastes. Apart from sea jellies, flatworms also have a gastrovascular cavity. This cavity combined with their flat bodies make them suitable

for exchange with the environment. This is because the flat body optimizes the exposed area while minimizing diffusion distances.

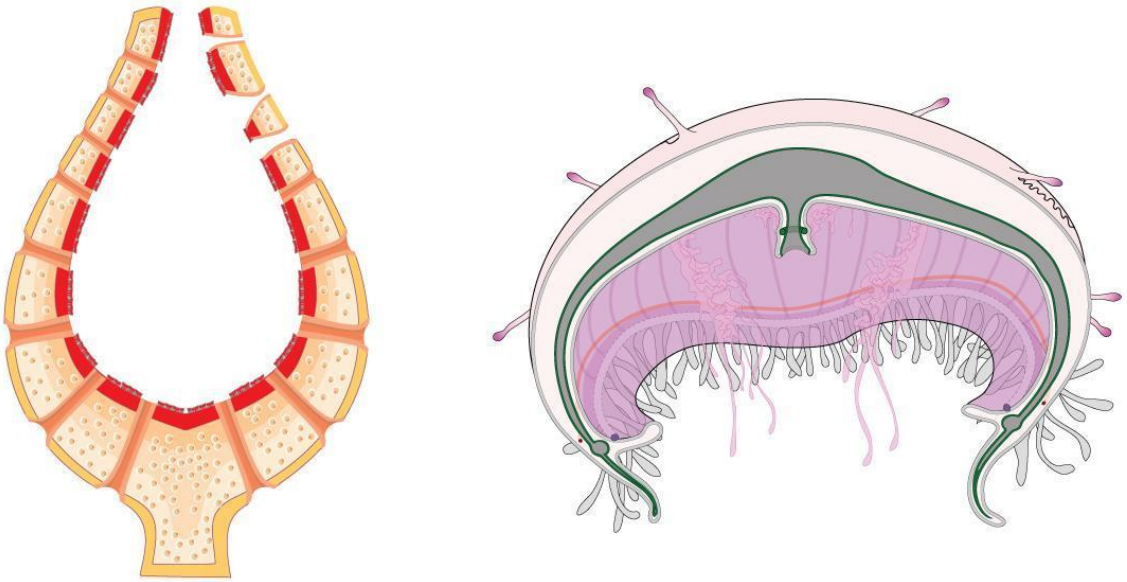

Figure 3. The gastrovascular cavities in simple animals like (a) sea sponges (b) jellyfishes. https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(OpenStax)/7%3A_Animal_Structure_and_Function/40%3A_The_Circulatory_System/40.1%3A_Overview_of_the_Circulatory_System licensed by CC-BY-NC-SA 3.0)

Higher forms of animals have adapted to have a circulatory system that moves fluid around the cells' surroundings and the tissues where the exchange of materials would occur. A circulatory system has three basic parts: the fluid circulating around the body, a set of vessels and the heart, which pumps the fluid. In this module, we will expound more on the types of circulatory systems particularly that of the open and the closed circulatory systems.

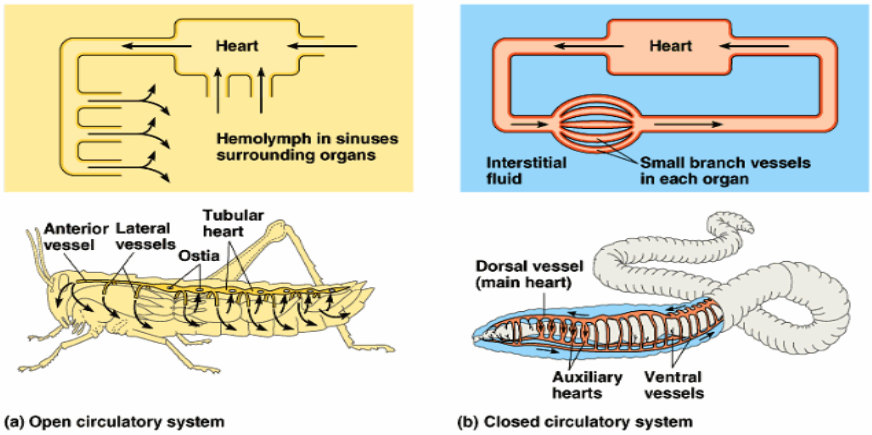

Figure 4. Open and Closed Circulatory Systems from https://www.tes.com/lessons/mXjVH9Wpc49srQ/circulatory)

An **open circulatory** system has a circulatory fluid called the hemolymph. This circulatory fluid is also the interstitial fluid that surrounds the cells. Some species of mollusks and members of Arthropoda have open circulatory systems. The contraction of the heart allows the hemolymph to traverse the interconnected sinuses that surround the organs. In these sinuses, exchange of materials happens between the hemolymph and the body cells. The relaxation of the heart allows the hemolymph to be drawn back in via pores equipped with valves that close whenever the heart contracts.

In **closed circulatory** systems, the fluid called blood is distinct from the interstitial fluid. The heart or hearts in some organisms pump blood into blood vessels branching into smaller vessels that extend to other organs. Members of Phylum Annelida, Cephalopoda and all the vertebrates have closed circulatory systems.

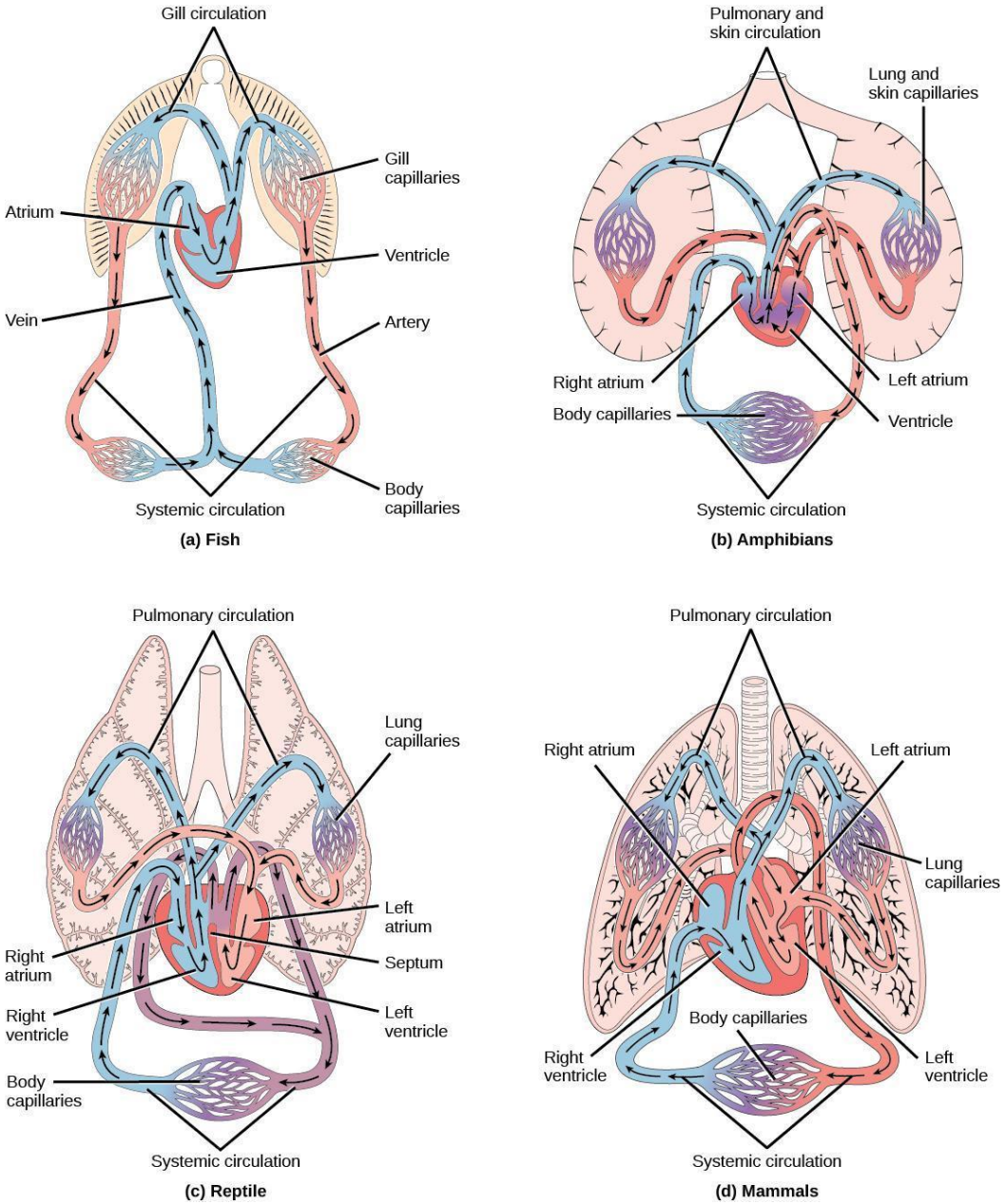

Figure 5. Overview of the Circulatory Systems of different animals.
(https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(OpenStax)/7%3A_Animal_Structure_and_Function/40%3A_The_Circulatory_System/40.1%3A_Overview_of_the_Circulatory_System licensed by CC-BY-NC-SA 3.0)

NAVIGATE (8 mins)

1. Complete the table below with the necessary information about the advantages and/or disadvantages of the different types of circulatory system. **This is a non-graded activity.**

Table 1. Comparing the three adaptations in animal circulation.

Type of circulatory system	Features and Advantages

Cardiovascular Cavity	
Open Circulatory System	
Closed Circulatory System	

Table 2. Comparing the circulatory systems of three organisms

Organism	Important parts/ organs	General path of circulation	Advantages and disadvantages
Sea jelly			
Spider			
Fish			
Frog			
Alligator			

Horse			

KNOT (3 mins)

Organisms have different adaptations with regards to circulation and transport of essential materials. We have learned that simpler organisms use diffusion to gather the needed materials from their surroundings, while more complex ones evolved to have a circulatory system or a vascular system that facilitates the transport and exchange of materials in and out of their systems. The efficiency, specificity and the range of complexity of these processes really highlight the one thing that makes our study of Biology interesting – variation.

References/Sources:

Circulatory Systems (n/d.) https://www.tes.com/lessons/mXjVH9Wpc49srQ/circulatory

Overview of the Circulatory System (2019) https://bio.libretexts.org/Bookshelves/Introductory_and_General_Biology/Book%3A_General_Biology_(OpenStax)/7%3A_Animal_Structure_and_Function/40%3A_The_Circulatory_System/40.1%3A_Overview_of_the_Circulatory_System

Urry, L. A., Cain, M. L. 1., Wasserman, S. A., Minorsky, P. V., Reece, J. B., & Campbell, N. A. (2017). Essential biology. Eleventh edition. New York, NY: Pearson Education, Inc.

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