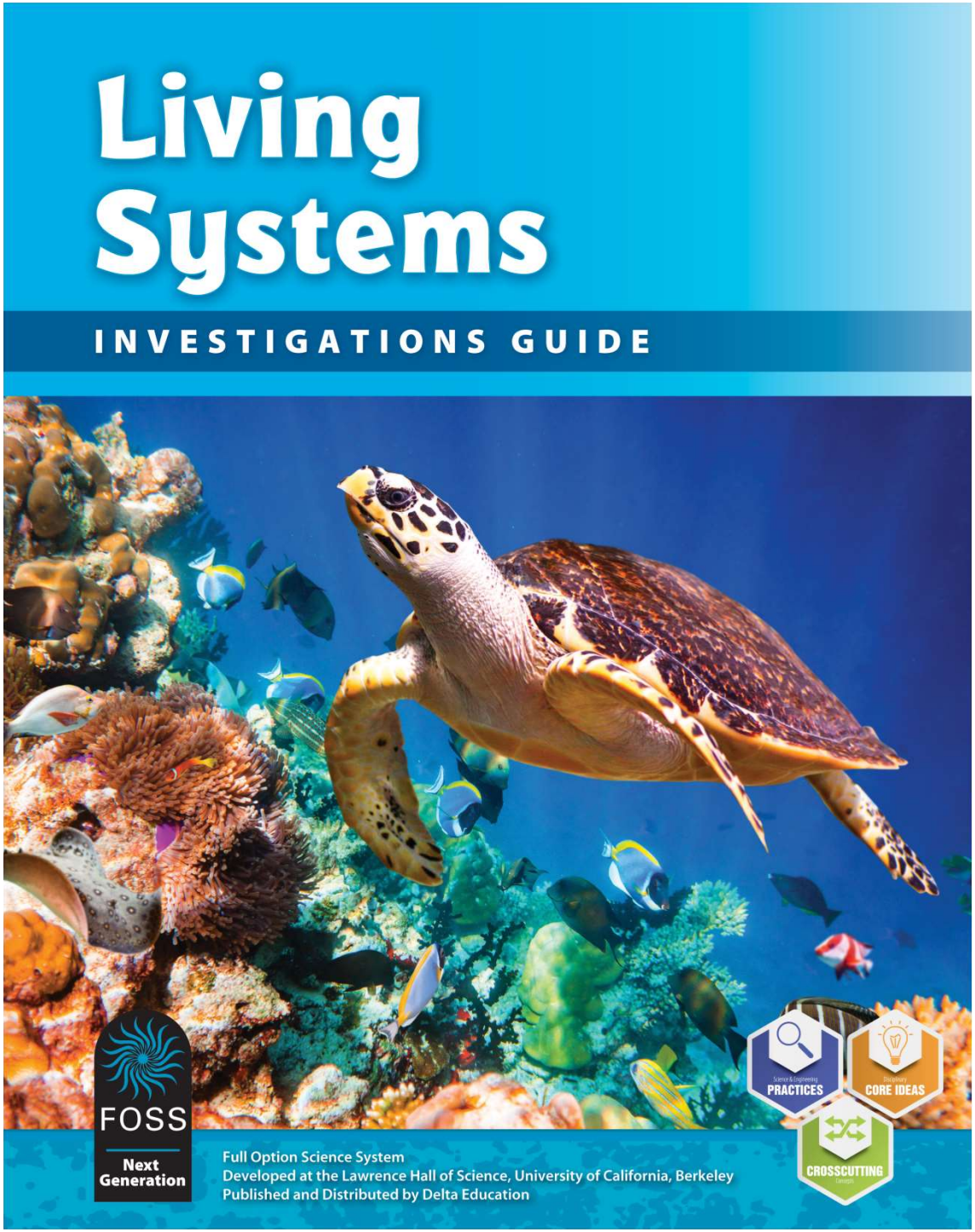


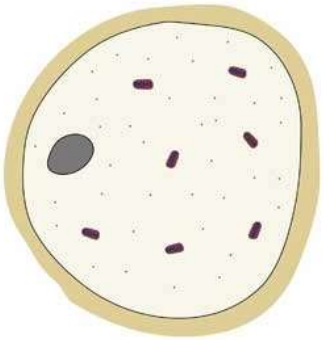
Investigation 2 – Nutrient Systems

PART 3:
Animal Nutrition

NGSS Standards:
5-PS3.D
5-LS1.C
5-LS2.B

3 sessions

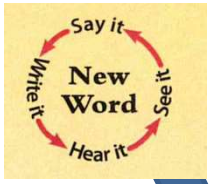
Single-celled Organisms vs. Multi-cellular Organisms



Yeast Cell

Student to read aloud:

*Because yeast is **single-celled,** it can get all of the nutrients it needs from its own watery environment. It simply takes in nutrients through its cell membrane. The waste gas, carbon dioxide, is a **by-product** of the processing of nutrients.*



*Animals are **multi-cellular** organisms. They are made of thousands and thousands of cells. Every cell needs nutrients to stay alive and perform its functions. We need to figure out how all those cells get their nutrients.*

How do animals get the nutrients they need?

*In this Investigation we will be using **painted lady butterfly larvae**. Butterfly larvae are alive. They are not dormant. They are an immature stage in the butterfly's life cycle.*

***YOUR TASK**: Over the next week or two, your job will be to observe these animals, to determine what functions they engage in, and to gather data concerning how they acquire and get nutrients to their **millions of cells**.*

Observation Schedule & Expectations:

Every day or two, your group will observe the larvae center (one group at a time).

- Touching or damaging the center is never allowed.
- You will take notes about the activities the larvae are engaging in and look for evidence of anything you may not observe directly.
- Detailed observations in your notebook are expected.

Setting Up:

Butterfly larvae will arrive in a container like this. The container is full of food. The larvae will advance through their ***entire larval stage without ever leaving the container!***

About ***3 weeks*** *after the larvae arrive, we will have adult butterflies that need food.*

There are two ways to feed the adult butterflies:

1. ***Juice from sweet fruits (like tangerines , watermelons or oranges)***

2. ***Assemble a nectar fountain that looks like a real flower.***

Getting Nutrients

All animals, fungi, and many bacteria consume other organisms to get the nutrition they need to live and survive. These organisms are called heterotrophs. Plants, algae, and some bacteria produce their own food, so they do not need to eat other organisms. These producers are called autotrophs. Heterotrophs get their nutrients by eating other organisms or parts of organisms, alive or dead, for food.

Food is important for two reasons. It provides building blocks for growth, development, and system repair. And food is the source of energy that organisms need to live.

Autotrophs produce their own food.

Heterotrophs consume plants and other animals.

TIME TO READ

Partner Read "**Getting Nutrients**" pages 27 – 31.

First read: Preview photographs, captions, diagrams.

Second read: Answer questions in your notebook.

Getting Nutrients

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An adult butterfly

Butterfly Nutrition

Butterflies start life as a tiny egg. When the egg hatches, the tiny larva, called a caterpillar, must eat. Every kind of butterfly has a particular kind of plant that it uses for food. Painted lady larvae feed on mallow plants. The mallow plant is an autotroph. It produces food from carbon dioxide (CO_2), water, and sunlight. The leaves are made of **carbohydrates**, lipids, and proteins, nutrients that the caterpillar needs to live. The caterpillar nibbles off bits of leaf with its biting jaws and swallows them. The caterpillar's gut digests the leaf bits. **Digestion** releases the nutrients that the caterpillar uses to grow. The caterpillar grows and grows, laying in a supply of fat.

When the caterpillar reaches full size, it finds a proper location, attaches itself, hangs down, and pupates. Inside its protective covering, the caterpillar changes into its flying phase. The insect does not eat during this change. It uses energy and matter stored in its body to construct wings, legs, and a new system for feeding.

Butterfly life cycle

After a couple of weeks, the hard outer **membrane** splits. The adult butterfly climbs out and flexes its wings. After pumping fluid into the wing veins, the new painted lady can fly. The adult needs to feed in order to survive. The painted lady's **digestive system** has changed completely. The painted lady no longer has biting jaws for nibbling on leaves. Its mouth has changed into a long, thin tube called a proboscis. The tube is used to suck sweet nectar from flowers. Nectar is a good source of sugar. Sugar provides energy for the butterfly. Flying requires a lot of energy, so access to an energy-rich food source improves the butterfly's chances of survival.

While the butterfly is going about its business, all of the other organisms in the ecosystem are going about their business, too. Animals in the ecosystem are looking for food. The blue jay is always alert for his next meal. If he spots a painted lady larva munching on a mallow leaf, he will likely swoop down and gobble it up.

Blue jays eat butterflies.

Human Nutrition

How do *you* get your food? You are a player at all levels of a food pyramid. When you eat spinach, carrots, apples, or green beans, you are eating producers. Animals that eat producers are primary consumers, like humans and cattle. When you eat a piece of roast beef, you are eating a primary consumer.

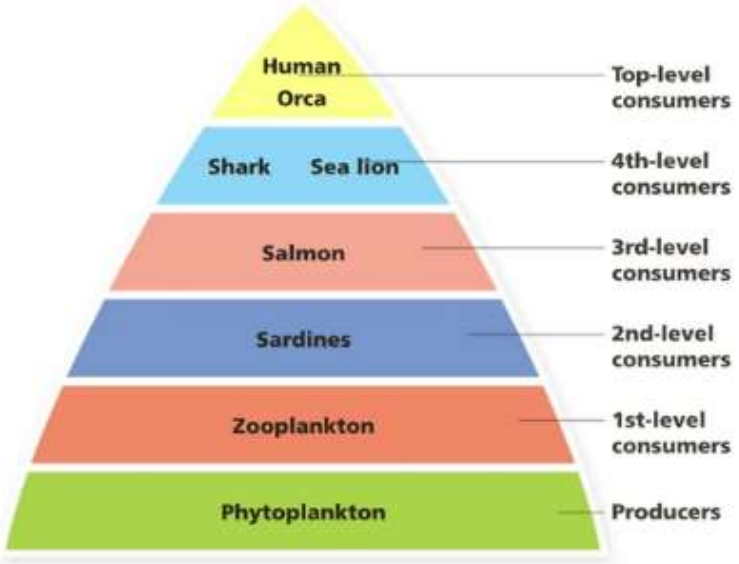
When you eat a sardine, you are eating a secondary consumer. Secondary consumers eat primary consumers. Sardines eat little primary consumers called zooplankton such as copepods and fish and crab larvae. Zooplankton eat producers called phytoplankton. If you have a piece of salmon, you are eating a third-level consumer. The salmon eats the sardine (a secondary consumer). So, when you eat the salmon, you are acting as a fourth-level consumer.

Humans eat at many consumer levels.

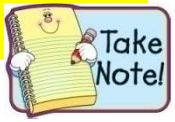
A food pyramid

Humans are aggressive top consumers, like tigers, sharks, orcas, and eagles. But unlike those animals, we can also eat lower on the food pyramid.

How do you extract the nutrients you need from your food? You eat to feed the trillions of living cells that make up your body. The process of breaking human food into nutrients for cells is called digestion. Cells get energy and raw materials from three groups of nutrients. They are carbohydrates, fats, and proteins.



TASK: Discuss questions and record your responses in your notebooks.



"Getting Nutrients" Review

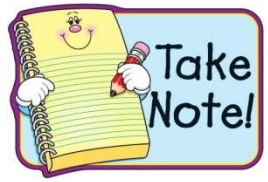
1. What is the difference between heterotrophs and autotrophs?
2. What does food provide for organisms?
3. A food pyramid describes levels in a feeding relationship involving producers, consumers, and decomposers. What information does a food pyramid describe that a food web might not?
4. What level of consumer are humans?

https://www.youtube.com/watch?v=h3ychzika4U

https://www.youtube.com/watch?v=0KbA8pFW3tg

End session

"Getting Nutrients" Review



1. What is the difference between heterotrophs and autotrophs?

Autotrophs are producers and make their own food; hetertrophs get their nutrients by consuming other organisms.

2. What does food provide for organisms?

Food is the source of nutrients that provide for growth, development and repair of organisms.

3. A food pyramid describes levels in a feeding relationship involving producers, consumers, and decomposers. What information does a food pyramid describe that a food web might not?

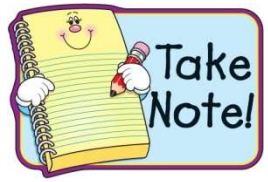
A food pyramid puts the consumers into categories to describe whether they are primary consumers, secondary consumers, or top consumers. It also shows that a very large base of producers is needed to support just a few top consumers.

4. What level of consumer are humans?

It depends on what you eat. If you eat producers such as fruit, vegetables and grains you are a primary consumer. If you eat hamburger, chicken or meats, you are a secondary consumer which eats producers. If you eat fish, you are a third-level consumer because fish eat other fish that are secondary consumers.

Food Chains

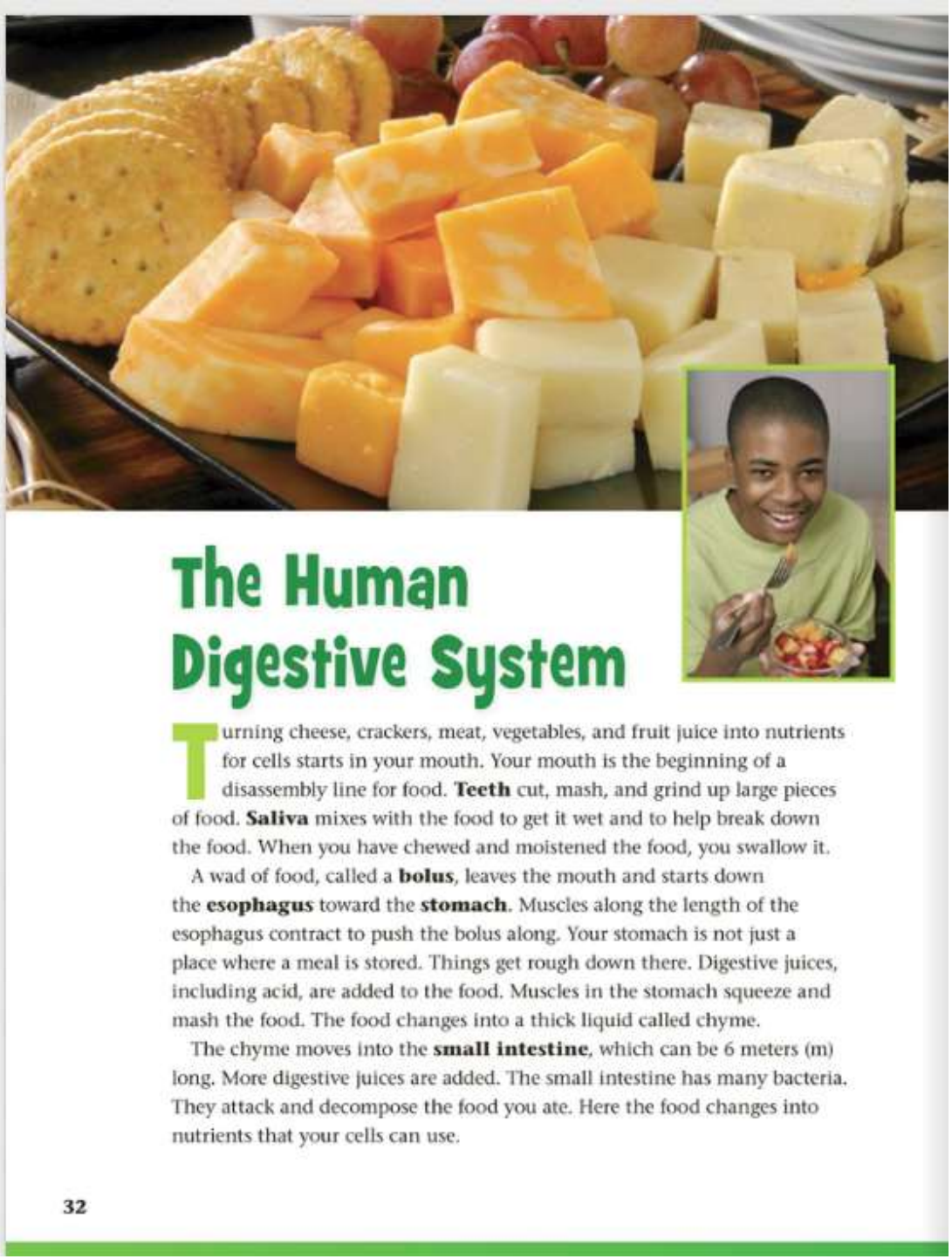
https://www.fossweb.com/video?videoID=D2882135



As we watch the video, listen for information that confirms or extends what you already have learned about food chains and animal nutrition.

This video has 7 chapters. **Actively listen and take notes as you watch**.

Chapter 1: Introduction to Food Chains.
Chapter 2: Food Chains: Producers, Consumers, Decomposers, and the Sun.
Chapter 3: The Importance of Decomposers in a Food Chain.
Chapter 4: Food Chains in Terrestrial and Aquatic Ecosystems .
Chapter 5: The Relationship Between Food Chains and the Energy Pyramid.
Chapter 6: Food Webs.
Chapter 7: Threats to the Environment Affect Food Webs.



The Human Digestive System

Turning cheese, crackers, meat, vegetables, and fruit juice into nutrients for cells starts in your mouth. Your mouth is the beginning of a disassembly line for food. **Teeth** cut, mash, and grind up large pieces of food. **Saliva** mixes with the food to get it wet and to help break down the food. When you have chewed and moistened the food, you swallow it.

A wad of food, called a **bolus**, leaves the mouth and starts down the **esophagus** toward the **stomach**. Muscles along the length of the esophagus contract to push the bolus along. Your stomach is not just a place where a meal is stored. Things get rough down there. Digestive juices, including acid, are added to the food. Muscles in the stomach squeeze and mash the food. The food changes into a thick liquid called chyme.

The chyme moves into the **small intestine**, which can be 6 meters (m) long. More digestive juices are added. The small intestine has many bacteria. They attack and decompose the food you ate. Here the food changes into nutrients that your cells can use.

32

TIME TO READ

Partner Read "**The Human Digestive System**" pages 32 - 33.

First read: Preview photographs, captions, diagrams.

Second read: Answer questions in your notebook.

The Human Digestive System

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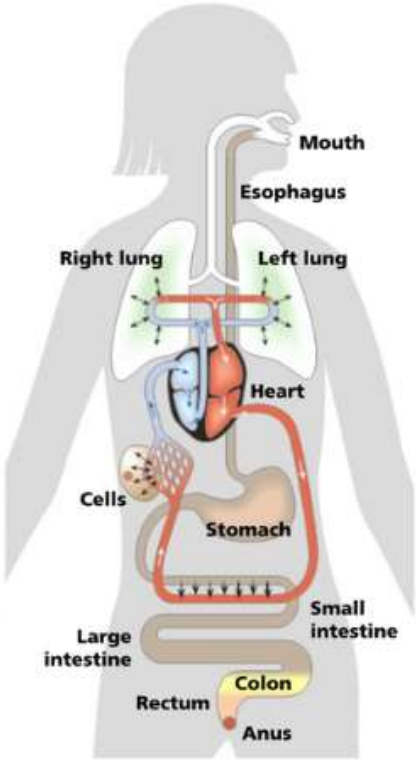
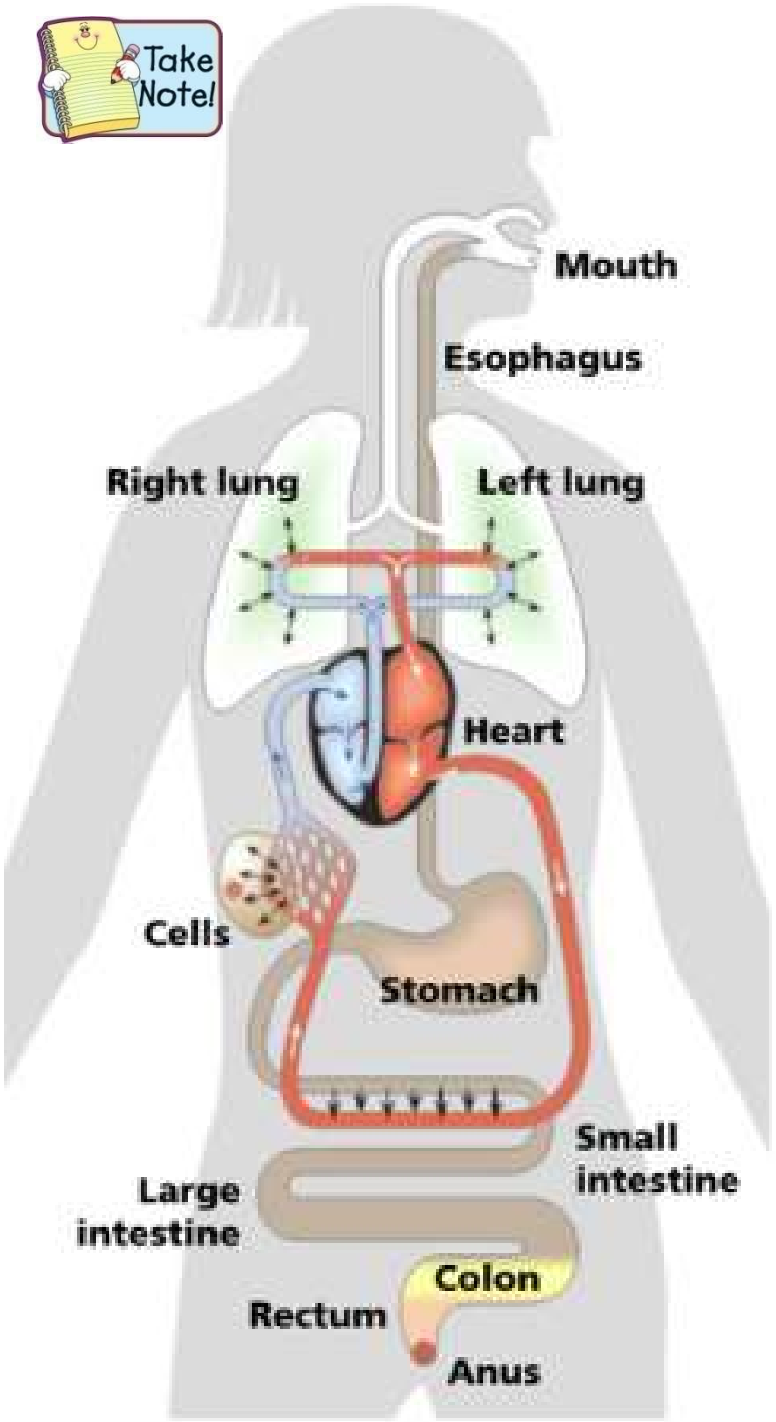
The small intestine is lined with millions of **capillaries**. Nutrients pass through the walls of the intestine into the capillaries. The blood carries the nutrients throughout your body, providing building blocks and energy for cells.

The last bits of the food move from the small intestine into the **large intestine** and **colon**. By this time, most nutrients are gone. Bacteria in the colon break down the remaining usable food. Water is extracted also. The remaining material contains fiber, other indigestible material, and dead bacteria. It is called feces. The feces moves into the rectum and is eliminated through the anus.

Because humans are animals, we cannot make our own food. We have to eat food to get our nutrients. Every cell in **multicellular organisms** needs nutrients. The digestive system breaks complex food sources into simple chemicals (nutrients). Those simple chemicals enter the blood and are transported to all the cells.

Food provides the nutrients our bodies need to survive.





TASK: Discuss questions and record your responses in your notebooks.

"The Human Digestive System" Review

1. What is digestion?

1. The process of breaking down food into simple chemicals called nutrients.

2. How might the human and painted lady butterfly digestive systems be similar?

2. Both have stomachs and intestines populated with bacteria to assist with food digestion.

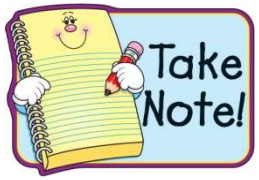
3. Why do you think the digestive system is called a system?

3. The digestive system is made up of interacting parts that transform food into nutrients. The mouth, stomach, intestines are all subsystems.

End session

Human Digestion

https://www.fossweb.com/video?videoID=D2881740



As we watch the video, listen for information that confirms or extends what you already have learned about the human digestive system.

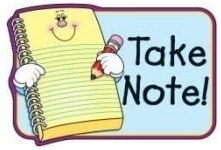
This video has 8 Chapters: **Actively listen and take notes as you watch**.

Chapter 1: Introduction.
Chapter 2: Digestive System: Mouth, Salvia, and Esophagus.
Chapter 3: Digestive System: Stomach.
Chapter 4: Investigation. Chemical Digestion in the Stomach.
Chapter 5: Digestive System: Small Intestines.
Chapter 6: Digestive System: Large Intestines .
Chapter 7: Excretory System.
Chapter 8: Conclusion.

Experiment on Chemical Digestion in the Stomach

The students in the video conducted an experiment to find out what happens to food (hard-boiled egg white) in different environments. Talk in your groups about this experiment.

1. What was the question?
2. What was controlled, and what changed in the experiment?
3. What were the results?
4. What was the conclusion?



1.What is responsible for breaking down food in the stomach?

Hydrochloric acid, pepsin (an enzyme), the acid and pepsin together (gastric juice)

2. The students controlled the variable of type and amount of food, temperature, and time. They changed the mix of chemicals.

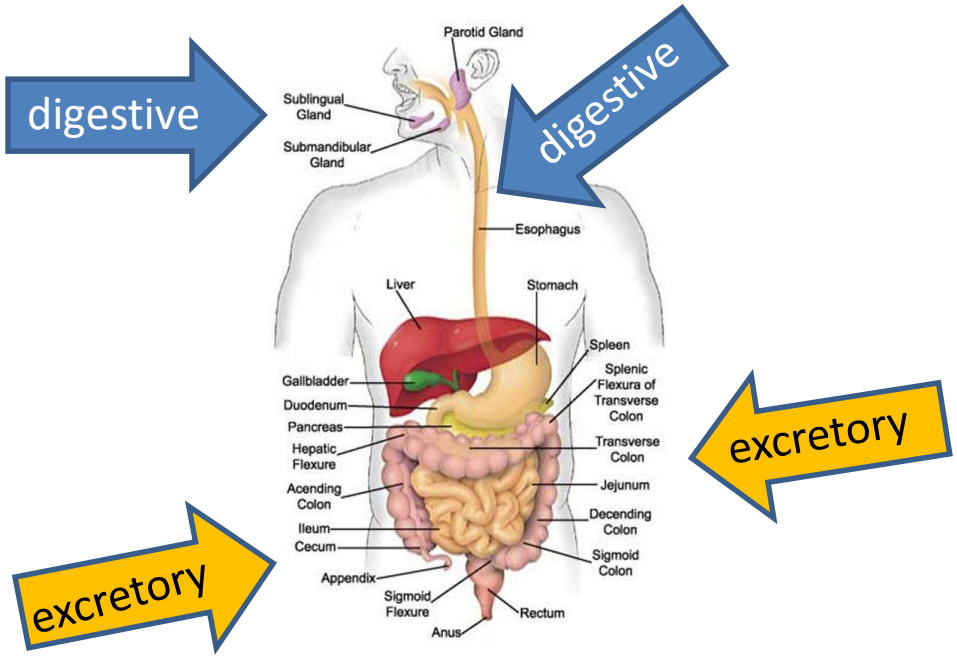
3. Only the egg white in the gastric juice (pepsin and acid) broke down. The others didn't.

4. Gastric juice is responsible for breakdown of food in the stomach.

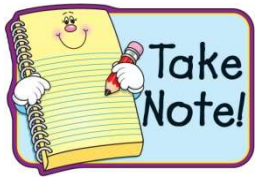
End session

KEY CONCEPTS

Human subsystems	Interacting parts	Structure/action produced	Interesting facts
Digestive system	Mouth, teeth, saliva, esophagus, stomach, digestive juices, small intestines, capillaries	Breaks complex food sources into simple chemicals (nutrients) that enter the blood and are transported to the cells	Stomach muscles squeeze and mash food Small intestines can be 6 meters long
Excretory system	Large intestine, liver, kidneys, bladder, colon, bacteria, rectum, anus	Removes waste from the body	We have two kidneys but can function with only one



KEY CONCEPTS

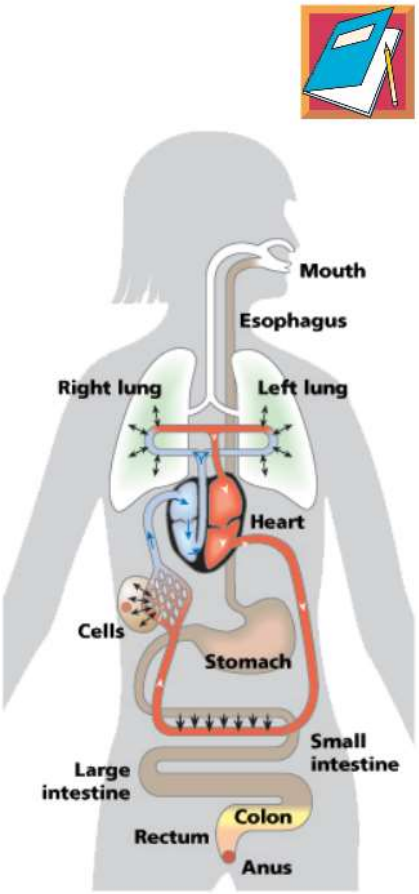


Investigation 2, Part 3

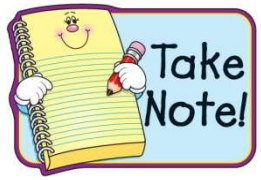
Vocabulary Review

Full Option Science System FOSS

- The digestive system disassembles food into nutrients that cells can use.
- The mouth and teeth moisten and crush food before it moves through the **esophagus** to the **stomach**.
- Digestive juices, added to the food in the stomach, **small intestine**, and **large intestine**, help release nutrients into the **bloodstream**.
- The **colon** compacts and dehydrates food waste.
- The **kidney** filters cellular waste from the blood and turns it into **urine**, which is stored in the **bladder**.



KEY CONCEPTS



1. **How do cells in humans get nutrients they need?**

   The digestive system reduces food to nutrients. Nutrients pass out of the digestive system into the bloodstream for transport to all the cells.

2. **How does the digestive system work?**

   Physical and chemical processes break complex food into simple substances at it progresses from the mouth through the esophagus to the stomach and small intestines.

3. **How are cellular wastes removed from the blood?**

   Blood filters through the kidneys, which remove cellular wastes, convert them into urine and store them in the bladder.

4. **Think about yeast and plants and animals we have studied. What is similar and different in how they get nutrients they need to survive?**

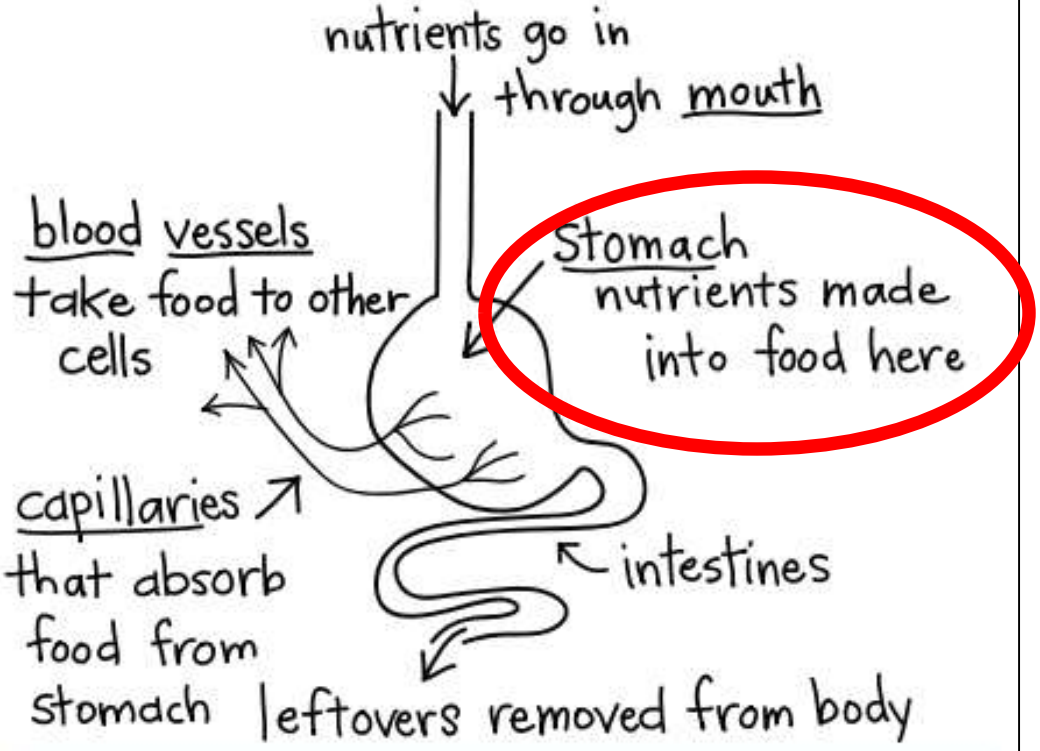
   They both take in nutrients and make something new. Yeast takes in nutrients through the cell membrane. Plants produce food through photosynthesis. Animals digest food and the nutrients enter the blood stream.

End session

Response Sheet—Investigation 2

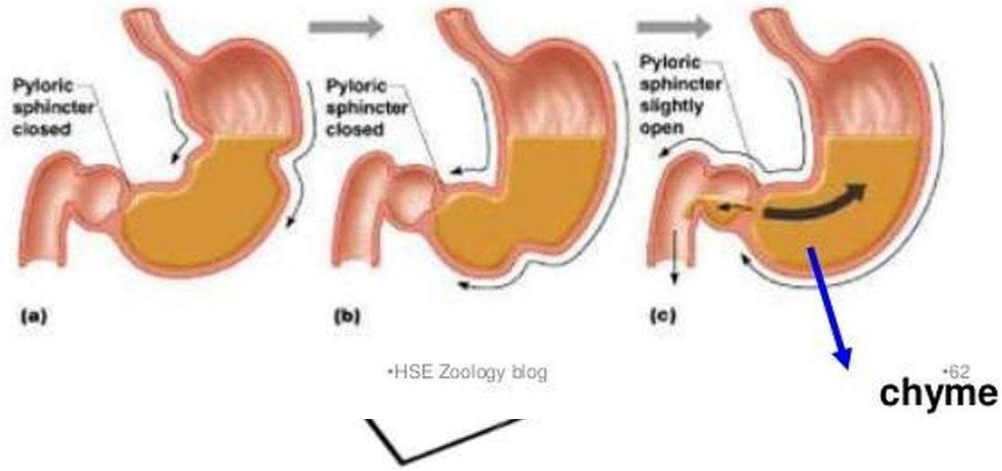
A student said, "I have a model of how digestion works! In the stomach, nutrients are made into food. The food is then used by the cells for energy."

Do you agree with this student? If not, what information can you provide to this student to clarify his understanding of digestion?



DIGESTION

- The stomach stores the food 4-5 hrs. The food mixes thoroughly with acidic gastric juice to form paste.- **Chyme**



In the stomach, food is transformed into a thick liquid (chyne)

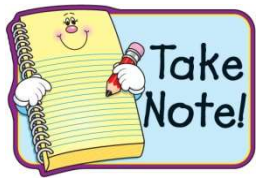
Record your observations of the butterflies in their pupal stage.

As you continue to observe the butterflies, make special note of how they obtain the nutrients that their thousands of cells need for life.

How did the painted ladies get their nutrients throughout their life cycle?

Where does the food go when the butterfly eats it?

What happens to food when it goes into the stomach?



• **Chlorophyll** is the green pigment that absorbs sunlight in the cells of producer organisms.

• Green plant cells make **sugar** (food) from **carbon dioxide** and **water** in the presence of **sunlight** and release oxygen.

• A **nutrient** is a substance, such as sugar or starch, that is **used by a cell to produce the energy** needed to perform the functions of life.

• Plants make their own food by **photosynthesis**. Animals obtain food by eating other organisms.

• **Digestion** is the process used by animals to break down complex food items into simple nutrients.

Investigation #2

by-product– a secondary result made by something else.

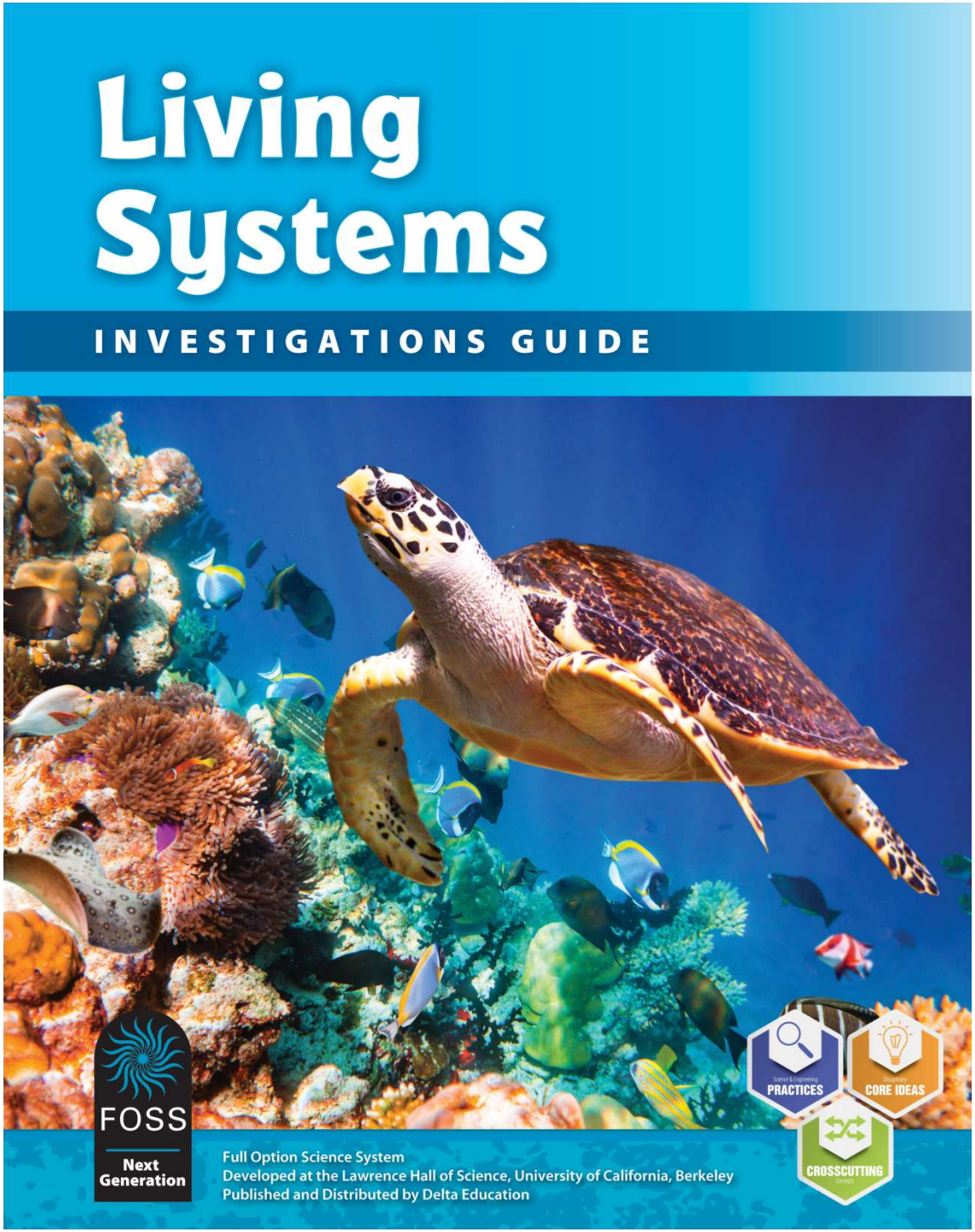
heterotrophs– *get their nutrients by consuming other organisms.*

autotrophs– producers, that make their own food.

carbohydrates– a nutrient, such as sugar and starch that provides energy.

digestion– the process of breaking down food into nutrients that can be used by cells.

digestive system– the organs that digest food. *Includes:* ***teeth, mouth, esophagus, stomach, small & large intestine,*** *and* ***colon***



Investigation 2 – Nutrient Systems

Interdisciplinary Extensions

NGSS Standards:
5-PS3.D
5-LS1.C
5-LS2.B

X sessions

Name: _____

The Digestive System

The digestive system begins in your **mouth** where the tongue and teeth work together to break up the food. A watery liquid called **saliva** makes the food wet and soft, and it has a chemical that helps digest the food.

As you swallow the food goes down a tube called the **esophagus**. This tube goes into your **stomach**. The stomach is a large muscle that stirs up the food. More liquids and chemicals help digest the food.

After the food has been ground and stirred in the stomach it moves to the **intestines**. The intestines are very long and coiled up. If you stretch them out, they would be longer than you are tall. Adults intestines are almost twenty-seven feet long. The narrow part of the intestine is called the **small intestine**. The bigger part is called the **large intestine**.

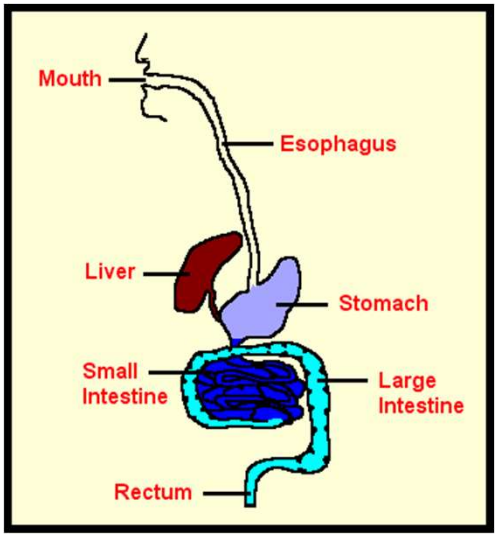
In the small intestine, the food is mixed with more chemicals and liquids. The pieces of food become very small; too small to see. These very small pieces are called **nutrients** and are absorbed into the blood. The **blood carries these nutrients to all parts of the body**.

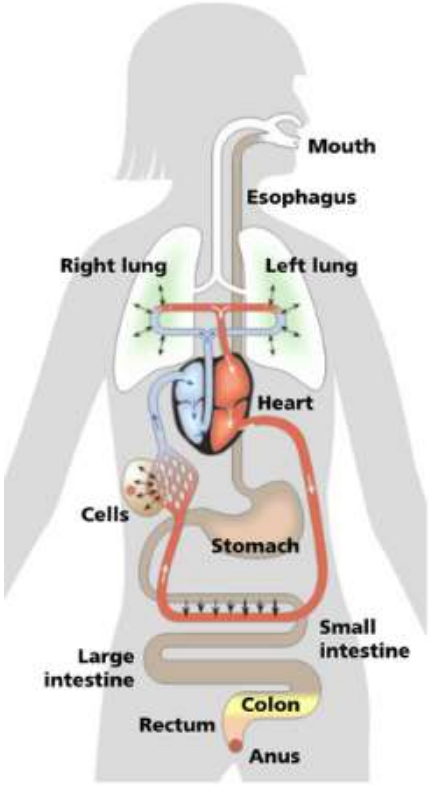
Blood passes through the body and goes through another organ in the **digestive system**. This organ is called the **liver.** It is on the right side of the body near the lowest rib. One job of the liver is to clean the blood. The liver also sends liquids and chemicals to the small intestine.

Some of the food is left in the small intestine and cannot be digested. It is then passed to the large intestine. It leaves the body through a little hole called the anus when you go to the bathroom.

The liquids the body does not use are also carried away. **Blood carries good nutrients and waste through the body**. The waste goes through two organs called the **kidneys**. The kidneys help clean the blood. The watery liquid not used is called urine. The urine goes into a little bag called the **bladder**. Urine leaves the bladder when it is pushed out of the bladder through a tube called the urethra.

TURN OVER FOR QUESTIONS





Name: _____

The Digestive System

Where does the digestive system begin?	○ intestines ○ stomach ○ mouth
What is saliva?	○ a watery liquid ○ a nutrient ○ a waste
What is the name of the tube food goes down when you swallow?	○ stomach ○ intestine ○ esophagus
The stomach is a large	○ cell ○ muscle ○ intestines
Food leaving the stomach goes to the	○ intestines ○ liver ○ esophagus
About how long is an adult's intestines?	○ 12 feet ○ 27 feet ○ 2 feet
Where is the liver located?	○ near the heart ○ left side of body ○ right side of body
Where does unused food leave the body?	○ anus ○ large intestine ○ right side of body
What is the watery waste not used by the body called?	○ intestines ○ kidney ○ urine

What do kidneys do?	○ swallow ○ digest ○ clean the blood
What is the name of the little bag that holds the urine?	○ bladder ○ small intestine ○ esophagus
What is the name of the tube urine leaves the body through?	○ urethra ○ small intestine ○ esophagus

Total Score: ____ /12 points