SCIENCE CHAMPION

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5 Student Book

Builds conceptual understanding, reasoning skills, and critical thinking through science learning

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Science Champion – Student Book 5

Preface

is a science learning book specially designed to help pupils acquire scientific knowledge and understanding, develop skills, values, and attitudes. The scope of topics discussed at each level is arranged according to the science syllabus at the elementary level.

uses a very systematic learning method through the Inquiry approach that has been tested and proven to be an effective approach at improving student's competences in mastering science. The inquiry approach is used by Singapore to improve students' competences which is proven through their consistency as the top rank at PISA (Program for International Student Assessment) and TIMSS (Trends in Mathematics & Science Studies). The development of material for each topic is arranged in stages, starting from the easiest material to more complex material (spiral progression).

gives special emphasis on developing conceptual understanding and critical thinking skills to build a firm foundation in science. After the introduction of new concepts, students are invited to apply what they have learned in collaborative science activities. This book is equipped with a number of activities that will stimulate students' interest in the topic and consolidate their knowledge and understanding.

makes science learning meaningful and fosters a love of science learning in children with the use of colorful and engaging visuals as well as age-appropriate language.

Be a science champion!

Using This Book

SCIENCE CHAMPION has some special features that guide children to understand science concepts through systematic stages. Use them to help you learn as you use this book.

Learning Goal sets the learning objective of each lesson.

1

Explore is designed to access the pupils' prior knowledge.

2

4

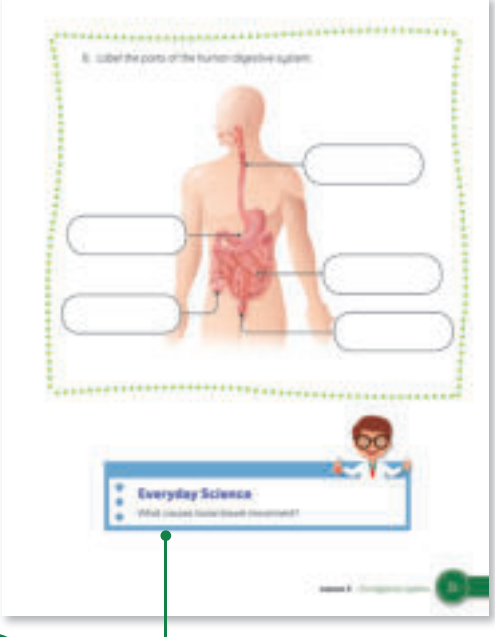
Science at Work enables the pupils to explore, discover, and acquire knowledge and skills through simple yet stimulating exercises that they can do at home.

3

Science Bank presents information that enriches the pupils' knowledge and understanding of the concepts in focus.

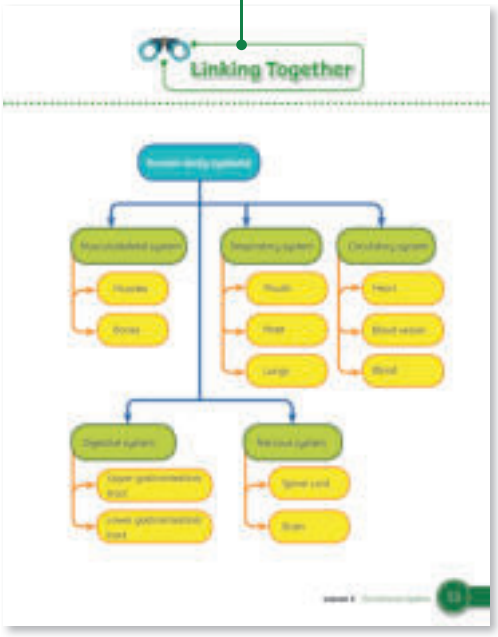
Looking Over allows the pupils to review the concepts presented in the lesson.

Enhance Your Skills contains exercises designed to further develop the pupils' science skills.



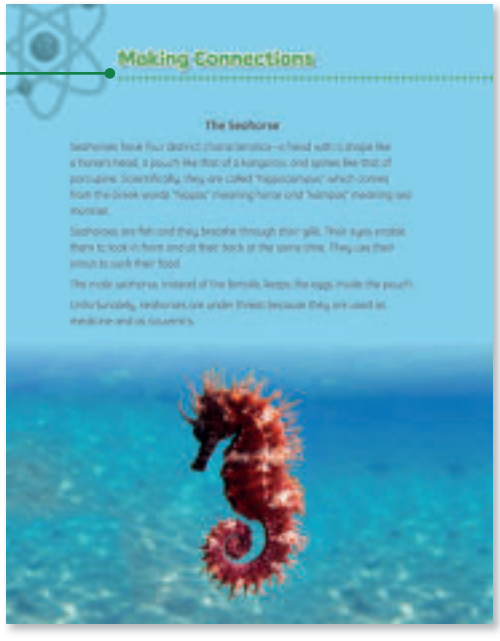
Everyday Science offers simple and practical application of science concepts to the pupils' real-life experiences.

8 **Linking Together** presents a visual summary of the science concepts presented in the chapter.



9 **Chapter Test** allows the pupils to evaluate their understanding and mastery of science concepts and processes.

10 **Making Connections** presents knowledge and issues, and relates them to the role of science in daily life, society, and the environment.



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Chapter 9 Earthquakes and Volcano Eruptions

CHAPTER 1

Human Body Systems

We get energy and nutrients from the food that we eat. Food, with the use of oxygen from the air that we breathe, provide energy when broken down by the digestive system. Different organs in our body perform specific functions in order for us to live and do our daily activities.

When playing, your brain works as you think. Your brain also works when you respond to your friend or when you feel emotions. Your lungs work as you breathe. Your bones and muscles work as you move. The human body is composed of complex organs, which you are going to explore in this chapter.

Lesson 1

Learning Goals

- Demonstrate understanding on how organs of the human body work together to form the musculoskeletal system
- Explain the functions of the musculoskeletal system
- Identify some diseases and disorders of the musculoskeletal system

The Musculoskeletal System

When playing soccer, how do bones and muscles work to make us run fast and kick the ball?

Muscles attached to bones work together every time we move and even while we rest.

Find out how muscles and bones work together.

Explore!

How many bones do you have?

Science Bank

A human adult has 206 bones, and about 600 muscles are connected to them.

The Musculoskeletal System and Its Functions

Have you ever visited a construction site where workers assemble steel pieces into a rigid frame for a building? Like a building, your body has a framework.

The **skeleton**, which is composed of bones and tissues such as **ligaments** and the **cartilage** that connect them, serves as the framework of the body. Just as a building would fall without a frame, you would collapse without your skeleton. Bones work with muscles in order for the body to move.

The bones and the muscles of the girl work together to help her jump.

Bones such as the skull and ribs protect the brain and lungs, respectively. The movement of the muscles found between the ribs, in the neck, and in the abdomen, enables the lungs to keep the air needed by the body.

Skeletal muscles maintain the posture and shape of the body.

The Skeletal System

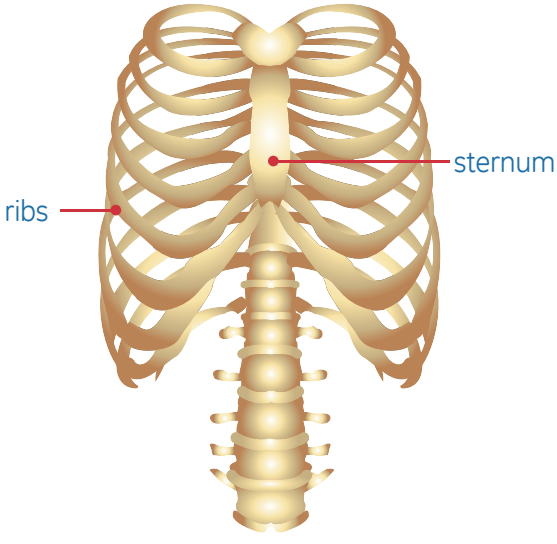
The skeletal system gives **framework** and **shape** to the body, protects **organs**, produces **blood cells**, stores **calcium**, and enables **movement**. In adults, the skeletal system is composed of 206 bones classified as either belonging to the **axial skeleton** or **appendicular skeleton**.

Characteristics and composition of a bone

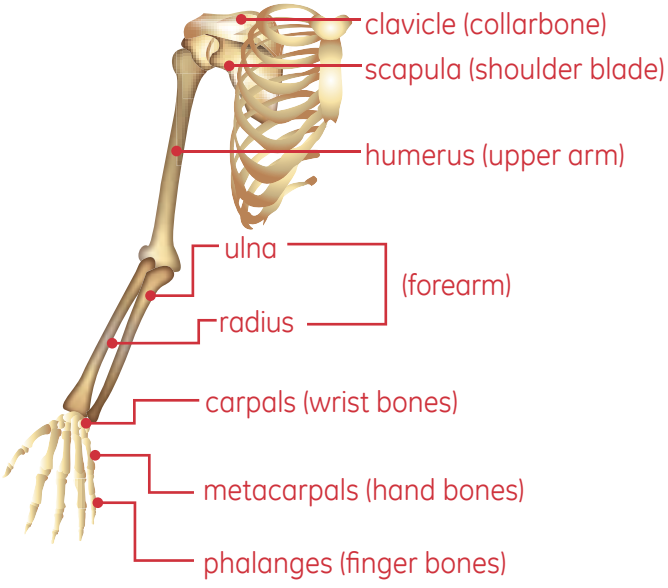
The **axial skeleton** is composed of the cranial and facial bones, sternum, ribs, and vertebrae.

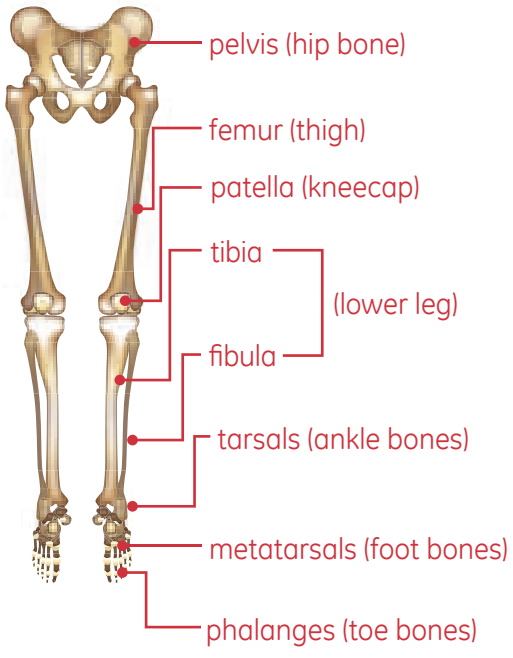
The **skull** consists of the cranium and the facial bones that protect and enclose the brain and special sense organs like the eyes, nose, and ears.

The **ribs** and the **sternum** or breastbone, protect the lungs and the heart.



The **vertebrae** make up the trunk or torso of the axial skeleton. They protect the spinal cord.

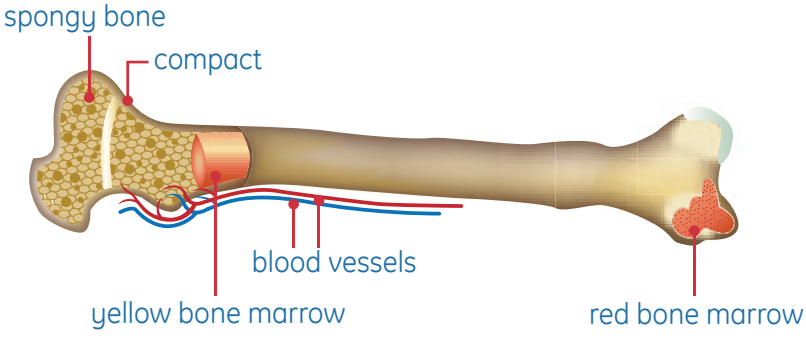




The **appendicular skeleton** consists of the bones in the upper limbs: collarbone, shoulder blade, upper arm, forearm, wrist, hands, and fingers.

It also consists of the bones of the lower limb: hip bone, thigh, kneecap, lower leg, ankle, foot, and toes.

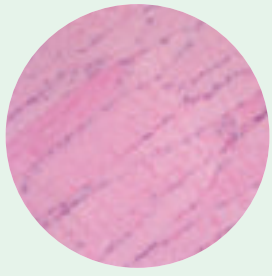
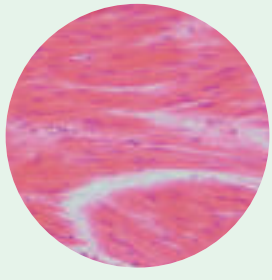
Bones are complex living structures that grow, repair, and develop by themselves. They are also strong and lightweight. Bones are made up of tissue, blood vessels, and nerves. There are two structures of a bone: the compact bone and the spongy bone. The **compact bone** is hard, dense, and contains minerals that give the bone its strength. Small canals in the compact bones carry blood vessels and nerves from the bone surfaces and their living cells.



The **spongy bone** is the small space under the compact bone. It has a soft component called **bone marrow**. The red bone marrow produces most of the blood cells and the yellow bone marrow stores fat.

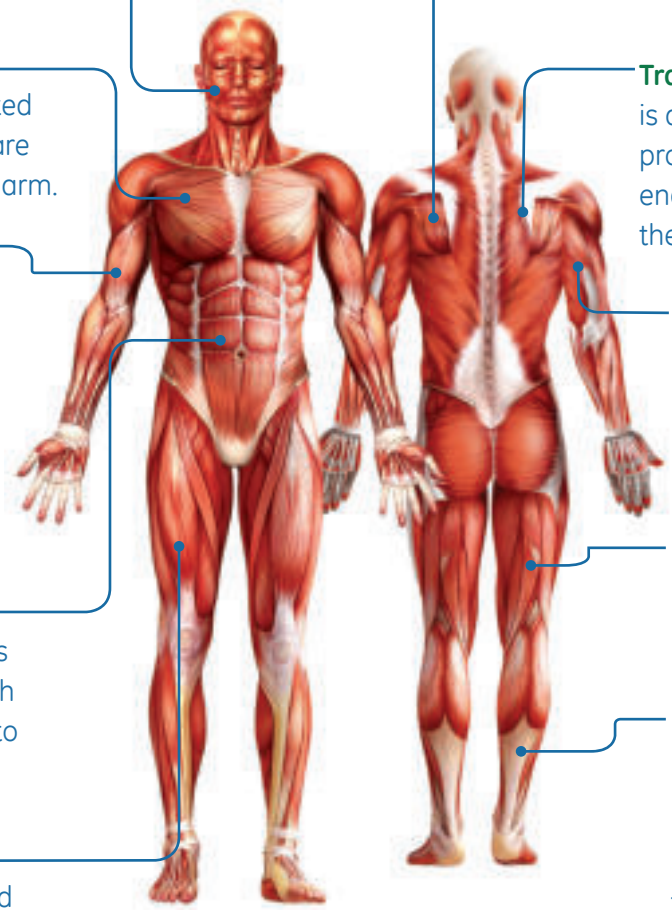
The Muscular System

The **muscular system** helps the body move, produce heat, and maintain posture. It is made up of all the muscles in your body. Not all muscles in your body are the same. Muscles have three types: skeletal, cardiac, and smooth.

Type of Muscle	Description and Function	Appearance
Skeletal	• attached to the skeleton • produces voluntary action • responsible for the movement of the body	
Smooth	• present in the gastrointestinal tract, respiratory tract, reproductive tract, and walls of blood vessels • produces involuntary action • makes up organs, ducts, and vessels	
Cardiac	• located in the heart • produces involuntary action • pumps blood to the different parts of the body	

What are the different muscles in the body responsible for movement?

The muscles attached to the bones are connected by fibrous connective tissues called **tendons**.



Masseter
is a facial muscle used in chewing.

Pectorals
are muscles located in the chest and are connected to the arm.

Biceps
are muscles located between the upper arms and elbow, and are used to flex the elbow and rotate the forearm.

Abdominals
are also known as belly or abs, which enable the torso to twist left or right, and to bend.

Quadriceps
are muscles found in front of the thigh and enable us to walk, kick, and sit.

Deltoids
are muscles in the shoulder that enable us to shrug.

Trapezius
is a muscle at the back that protects the vertebrae and enables us to bend and move the scapula.

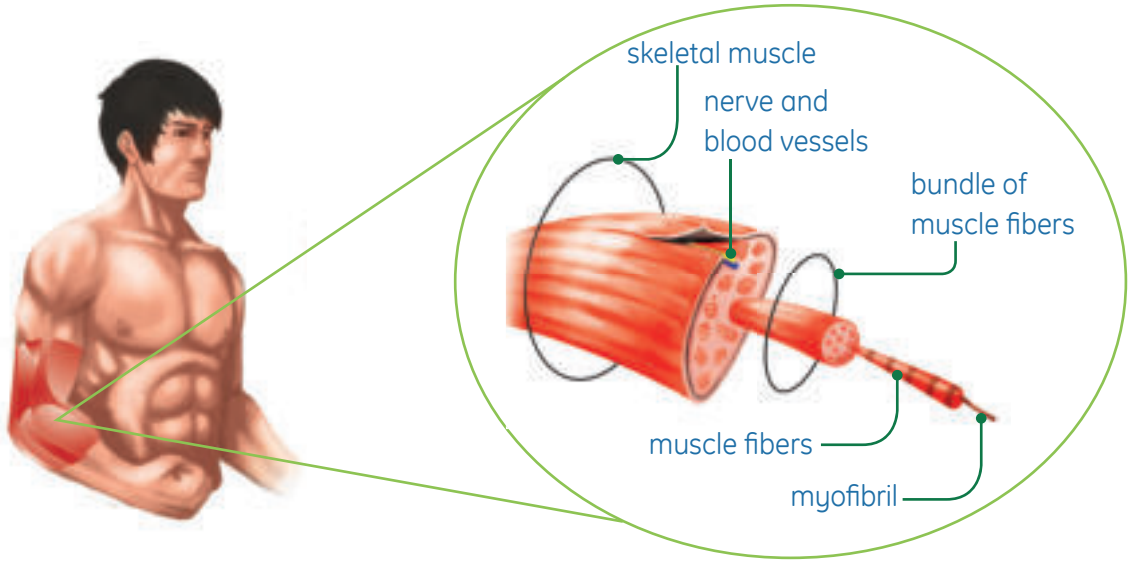
Triceps
are muscles at the back of the upper arm, and work with the biceps.

Biceps femoris
is located at the back of the thigh and works together with the quadriceps.

Triceps surae
is located at the back of the lower leg and functions whenever we walk, run, and jump. It is also responsible for making the ankle stable.

Composition of a muscle

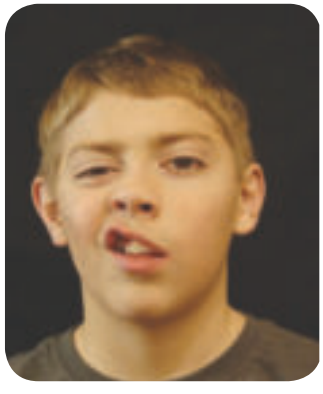
A muscle is composed of **muscle fibers** bundled together. Each muscle fiber is composed of **myofibrils** bundled together. Myofibrils are composed of protein strands called **sarcomere**, which allow contraction and make the muscle move. Muscles come in pairs and pull in opposite directions.



Common Diseases and Disorders of the Musculoskeletal System

- **Osteoporosis** is the condition when the bone mass becomes depleted in such a way that the skeleton cannot withstand stress.
- **Arthritis** is a joint disorder characterized by inflammation and pain in the affected area.
- **Duchenne muscular dystrophy (DMD)** is usually identified with children at 3 years of age. This is characterized by slow motor development with progressive weakness of the muscles.
- **Muscle fatigue** is a condition in which muscles cannot exert their normal force due to excessive exercise.
- **Muscle spasm** is a sudden, involuntary contraction of a muscle or a group of muscles. It commonly refers to a muscle cramp which is often accompanied by a sudden burst of pain, but it is usually harmless and ceases after a few minutes.

Science Bank



Levator labii superioris alaeque nasi is a small muscle with a long name. It is the muscle which enables us to move the upper lip and the side of the nose.

Science at Work

Let's Keep Moving!

What You Need

- bread
- clothespin
- stopwatch

What You Need to Do

1. Create three stations in the room.
2. At the first station, place pieces of bread. Eat a piece of bread and write down how the bread feels going down your throat and into your stomach.
3. At the second station, feel and squeeze the clothespin as many times as possible for 15 seconds.
4. At the third station, count your heartbeat for 15 seconds and record. Do jumping jacks for 45 seconds. After jumping, count your heartbeat again and record. Take note of the difference.

Station	Observation
First	
Second	
Third	

Questions

1. What are the three different types of muscles involved for the activity in each station?

   _____

2. What are the bones involved for each activity in each station?

   _____

3. How does the muscular system function in each activity?

   _____

Looking Over

- The **musculoskeletal system** is composed of skeletal and muscular systems.
- The skeletal system gives framework and shape to the body, protects organs, produces blood cells, stores calcium, and enables movement.
- The **axial skeleton** consists of the cranium and the facial bones, sternum, ribs, and vertebrae.
- The **appendicular skeleton** is composed of the skeletons of the upper and lower limbs.
- The **muscular system** helps the body move, produce heat, and maintain posture. It pumps blood throughout the body.
- The three types of muscle tissue are **skeletal**, **smooth**, and **cardiac muscles**.
- Some common diseases and disorders of the musculoskeletal system are osteoporosis, arthritis, Duchenne muscular dystrophy (DMD), muscle fatigue, and muscle spasm.

Enhance Your Skills

A. Circle the letter that corresponds to the correct answer.

1. Which of the following is arranged from the largest to the smallest structure?
   a. muscle > myofibril > muscle fiber > sarcomere
   b. muscle > muscle fiber > myofibril > sarcomere
   c. sarcomere > muscle > muscle fiber > myofibril
   d. sarcomere > myofibril > muscle fiber > muscle
2. _____ is a condition in which the bone mass is depleted.
   a. Arthritis
   b. DMD
   c. Osteoporosis
   d. Muscle spasm
3. Which of the following does not belong to the axial skeleton?
   a. clavicle
   b. cranial
   c. ribs
   d. sternum
4. The skeletal system is responsible for the production of _____.
   a. carbon
   b. copper
   c. blood cells
   d. muscle fibers
5. Which of the following is a correct pair?
   a. heart: ribs
   b. heart: cranium
   c. lungs: clavicle
   d. lungs: cranium

B. Classify the activities or processes inside the box according to the type of muscle involved.

Activities/Processes

smiling
beating of the heart
digestion
jumping
swallowing of food

Cardiac	Smooth	Skeletal

Everyday Science

What are the kinds of food that you need to eat to keep your bones and muscles healthy?

Lesson 2

Learning Goals

- Demonstrate understanding of how organs of the human body work together to form the respiratory system
- Explain the functions of the respiratory system and its organs
- Trace the pathway of air throughout the respiratory system
- Identify some diseases and disorders of the respiratory system

The Respiratory System

What do you think happens to our lungs while we blow the balloons? What will happen if we keep on blowing the balloons for 5 minutes? How does the air we breathe enter and exit our bodies?

Explore!

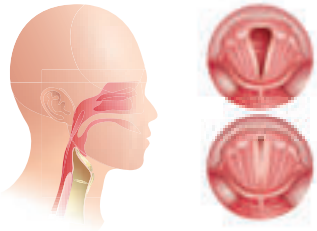
How do you feel when you take a deep breath and do not release the air for a few seconds?

The Respiratory System and Its Functions

The **respiratory system** is the body system that helps humans breathe. It is responsible for the filtration of dirt in the air that we breathe and the exchange of oxygen and carbon dioxide between our body and the environment. The respiratory system is also responsible for voice production and intake of **oxygen**, a gas needed by our body to obtain energy from the food we eat.

Take a slow deep breath. How do carbon dioxide and oxygen gas travel throughout the respiratory system?

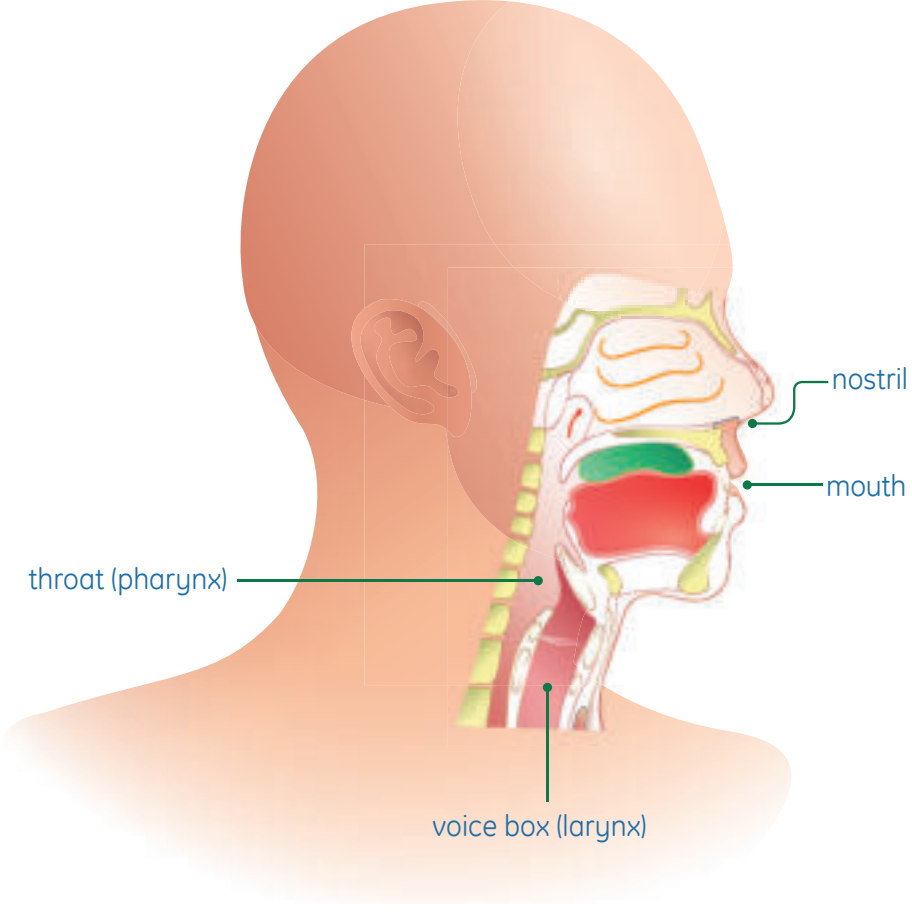
Science Bank



The larynx closes whenever you hold your breath. It opens when you inhale, and it vibrates when you speak, hum, or sing.

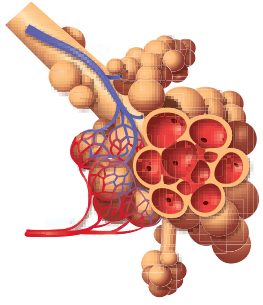
Pathway of Air in the Respiratory System

The path of air starts when we breathe or take in air through the nose and/or mouth. The process of taking air into our body is called **inhalation**. The air enters the **nostrils**, which are the openings of the nose. The hairs and the sticky substance called **mucus** inside the nose filter and trap the dirt present in the air. From the nose, air passes into the **pharynx**, the tube that allows the passage of food and air. From the pharynx, air passes through the **larynx**, which vibrates to produce sound. The larynx is also called the **voice box**.



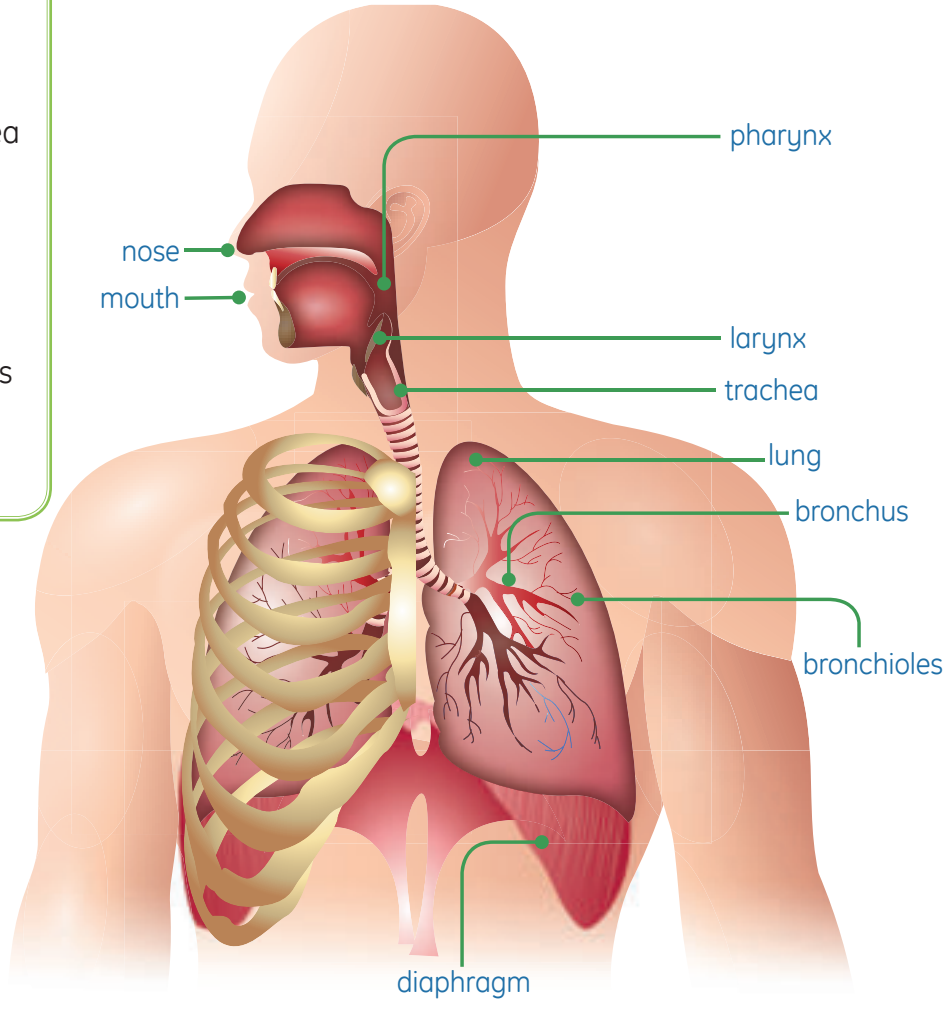
From the larynx, air moves down to the **trachea**, which branches out into two tubes called the **left bronchus** and the **right bronchus** (plural, bronchi).

Science Bank

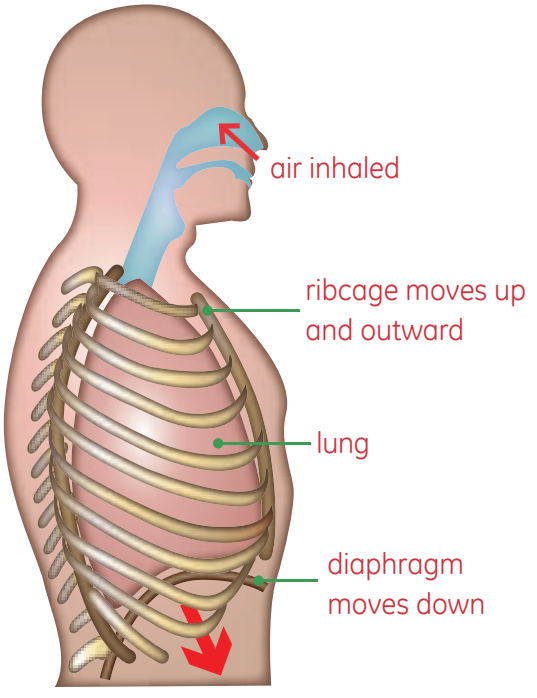


There are about 300 million alveoli in two adult lungs. They provide a surface area of about 160 m^2. If all of the air sacs are flattened, their area is almost equal to a single area of a tennis court and 80 times the area of our skin.

From the bronchi, the air enters the **left** and **right lungs** through branched out, smaller tubes of bronchi called **bronchioles**. The left lung is smaller than the right lung to give an extra space for the heart. The lungs have tiny air sacs called **alveoli**. It is in the alveoli where oxygen from the inhaled air is transferred to the blood, and the carbon dioxide from different organs of the body is kept and will be released through the process called **exhalation**.

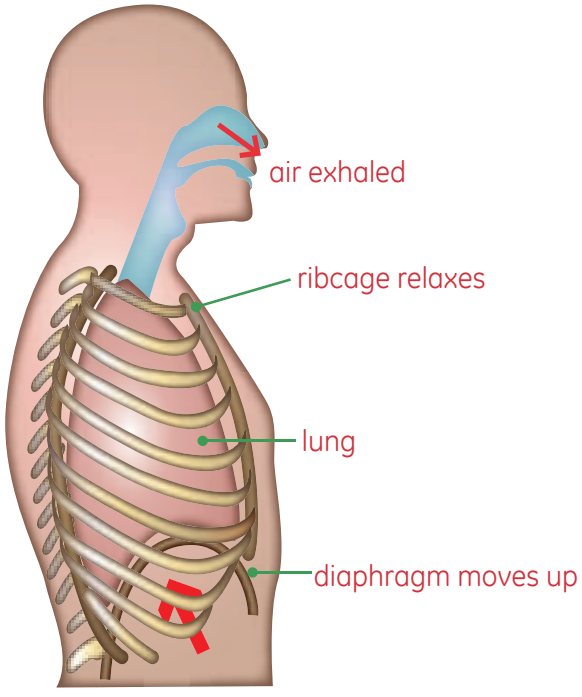


Normal quiet breathing is supported by the rib cage, chest muscles, and the diaphragm. The **diaphragm** is the primary muscle for respiration.



inhalation

The diaphragm contracts and moves down, which gives more space for the air when you inhale. At the same time, the rib cage moves up and outward to give space for the expansion of the lungs.



exhalation

The diaphragm relaxes and moves up to push the air when you exhale. At the same time, the rib cage relaxes and the lungs return to their original size.

Common Diseases and Disorders of the Respiratory System

Respiratory infections can be mild or very damaging. Some are caused by bacteria or viruses, while others are the result of an unhealthy lifestyle.

- **Pneumonia** is an infection of the alveoli. It may be caused by many kinds of bacteria or viruses.
- **Asthma** is a periodic constriction of the bronchi and bronchioles that results in breathing difficulty. Attacks of asthma can be triggered by airborne irritants such as chemical fumes, cigarette smoke, and particles to which the patient is allergic.
- **Chronic bronchitis** happens when air passages are clogged by mucus, which leads to a persistent cough.

Science at Work

Let's Count Your Breathing!

What You Need

- timer
- paper
- pen

What You Need to Do

1. Sit down and breathe normally. Count the number of times you inhale and exhale for 1 minute. Record your data.
2. Jog in place for 1 minute. Count the number of times you inhale and exhale for 1 minute. Record your data.
3. Do jumping jacks for 1 minute. Ask a friend to count the number of times you inhale and exhale while doing the activity. Record your data.

Activity	Number of Times I Inhale
Sitting	
Jogging in place	
Jumping jacks	

Questions

1. How can you relate the number of times you inhale and exhale in the activity you do?

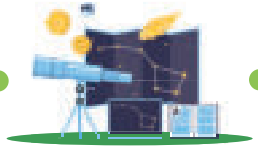
   _____

   _____

2. Which activity requires greater number of inhalation and exhalation? Why do you think so?

   _____

   _____



Looking Over

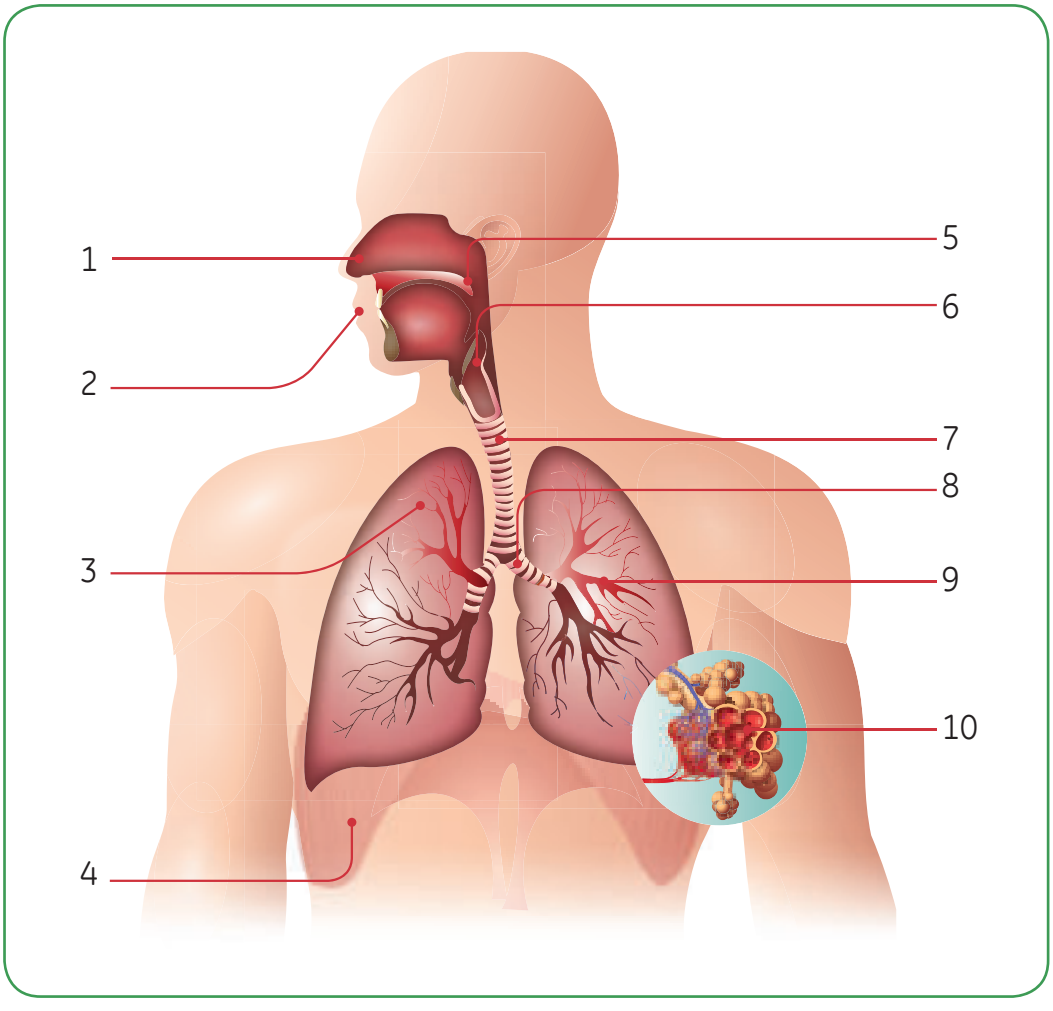
- The **respiratory system** is composed of the mouth, nose, pharynx, larynx, trachea, bronchi, bronchioles, and lungs.
- The respiratory system functions for the filtration of dirt in the air, removal of carbon dioxide, voice production, and intake of oxygen gas.
- **Alveoli** are tiny air sacs in the lungs.
- Some common diseases and disorders of the respiratory system are pneumonia, asthma, and chronic bronchitis.

Enhance Your Skills

A. Circle the letter that corresponds to the correct answer.

1. Which of the following is not a part of the respiratory system?
   a. bronchioles
   b. lungs
   c. mouth
   d. oxygen
2. What happens to the diaphragm when you exhale?
   a. the diaphragm relaxes
   b. the diaphragm expands
   c. the diaphragm contracts
   d. nothing happens to the diaphragm
3. Breathing in is to oxygen while breathing out is to _____.
   a. fumes
   b. carbon dioxide
   c. nitrogen
   d. water
4. What part of the respiratory system is responsible for gas exchange?
   a. alveoli
   b. bronchioles
   c. diaphragm
   d. nose
5. _____ is a disease that can be caused by irritants like chemical fumes and smoke.
   a. Asthma
   b. Pneumonia
   c. Lung cancer
   d. Chronic bronchitis

B. Name the following parts of the respiratory system.



Everyday Science

Why do we yawn?

Lesson 3

Learning Goals

- Demonstrate understanding of how organs of the human body work together to form the digestive system
- Explain the functions of the digestive system and its organs
- Trace the pathway of food throughout the digestive system
- Identify some diseases and disorders of the digestive system

The Digestive System

What is your favorite food? How many times do you eat in a day?

Do you know the path that food takes in your digestive system? Let's take a look at the journey of the food we eat and explore the digestive system.

Explore!

What happens to the food that you eat?

The Digestive System and Its Functions

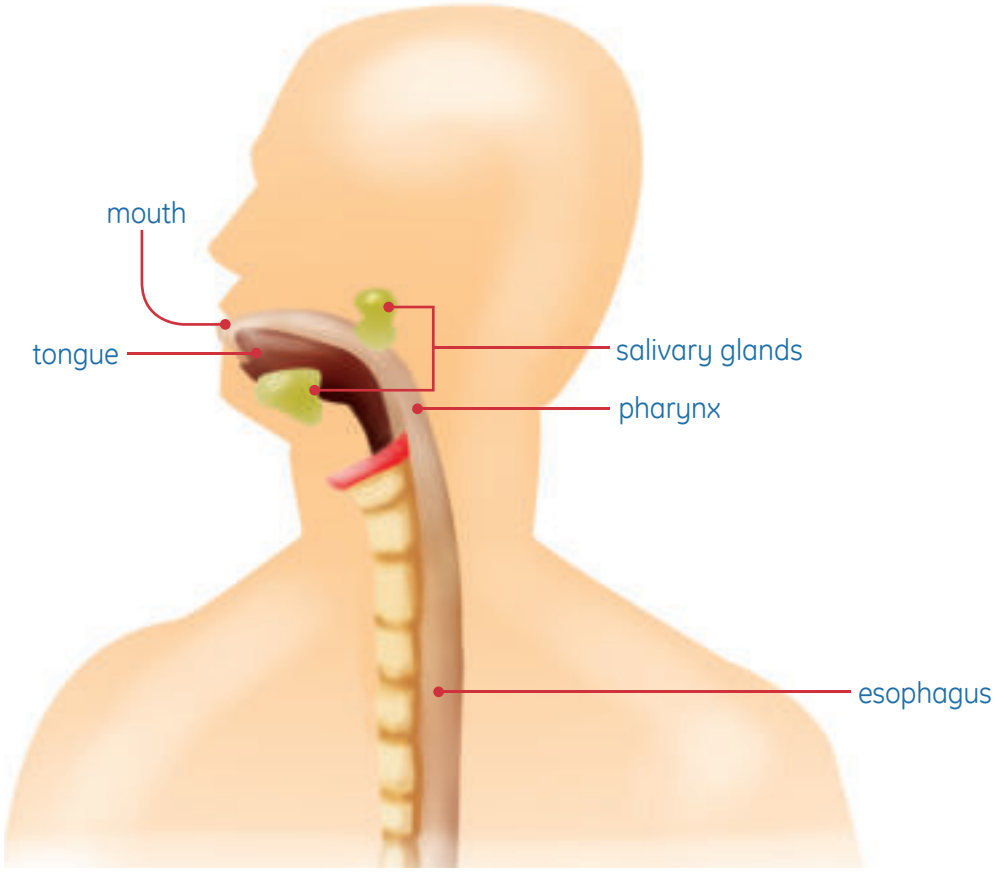
The **digestive system** is the body system responsible for breaking down food and extracting nutrients which are needed by the body. The digestive system is also responsible for the absorption of nutrients and elimination of waste from the body. It is composed of the upper and lower gastrointestinal tract and the accessory organs which help in the process of digestion.

Digestion is the process of breaking down food into smaller pieces and turning these into a form that can be absorbed by the body. The process of digestion may be fast or slow. The time it takes for the food to be completely digested depends on the kind of food and the person's level of activity.

Digestion may either be mechanical or chemical. **Mechanical digestion** is a process in which the food is broken down into smaller pieces. **Chemical digestion** is a process in which small pieces of food are either turned into a soupy substance called **chyme**, or into a smaller form that can enter the cells.

Science Bank

Humans cannot digest fiber from fruits and cereals. However, fibers facilitate the movement of undigested food for they allow the contraction of the muscular wall, making it easier to defecate.



Pathway of food in the upper gastrointestinal tract

The upper gastrointestinal tract consists of the esophagus, stomach, and the first section of the small intestine. The accessory organs of the mouth are the teeth, tongue, and salivary glands. How do these organs work to digest food?

The food, which is taken through the **mouth**, is initially broken down by the **teeth** when chewing. The **salivary glands** secrete the saliva, which initiates the chemical digestion of carbohydrates present in the food. The **tongue** pushes the food backward and down to the long tube called **esophagus** when swallowing.

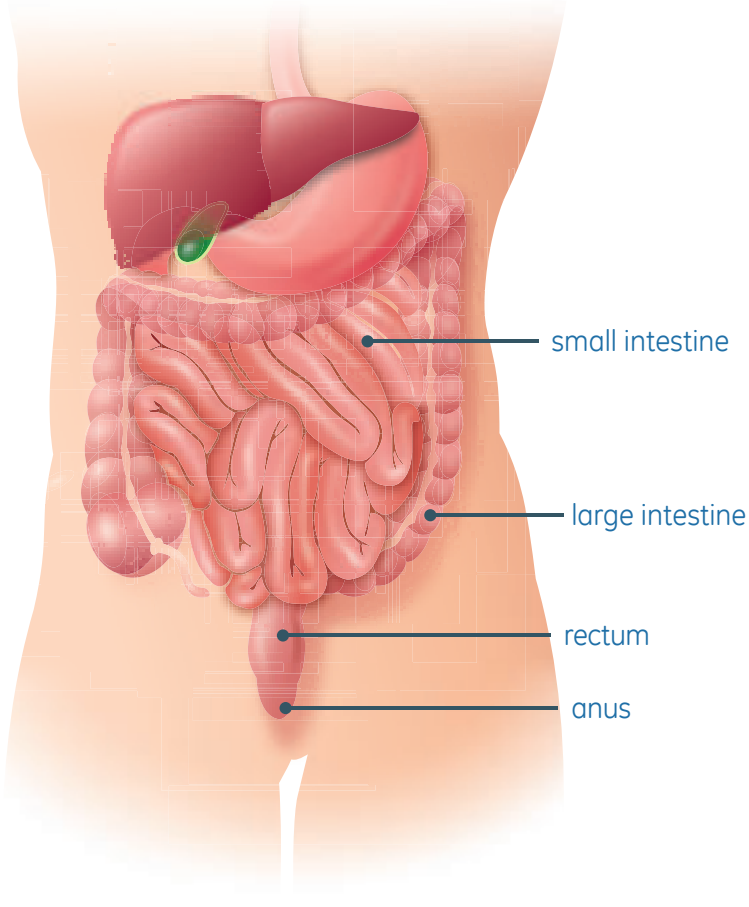
The food in the **esophagus** moves down to the **stomach** through **peristalsis**, a series of wave-like muscular movements. Gastric juices produced by the stomach wall further digest the food, which becomes chyme.

Science Bank

Peristalsis is a series of wave-like muscular movements that push the food from the esophagus to the stomach. It happens after swallowing and takes about 7–9 seconds.

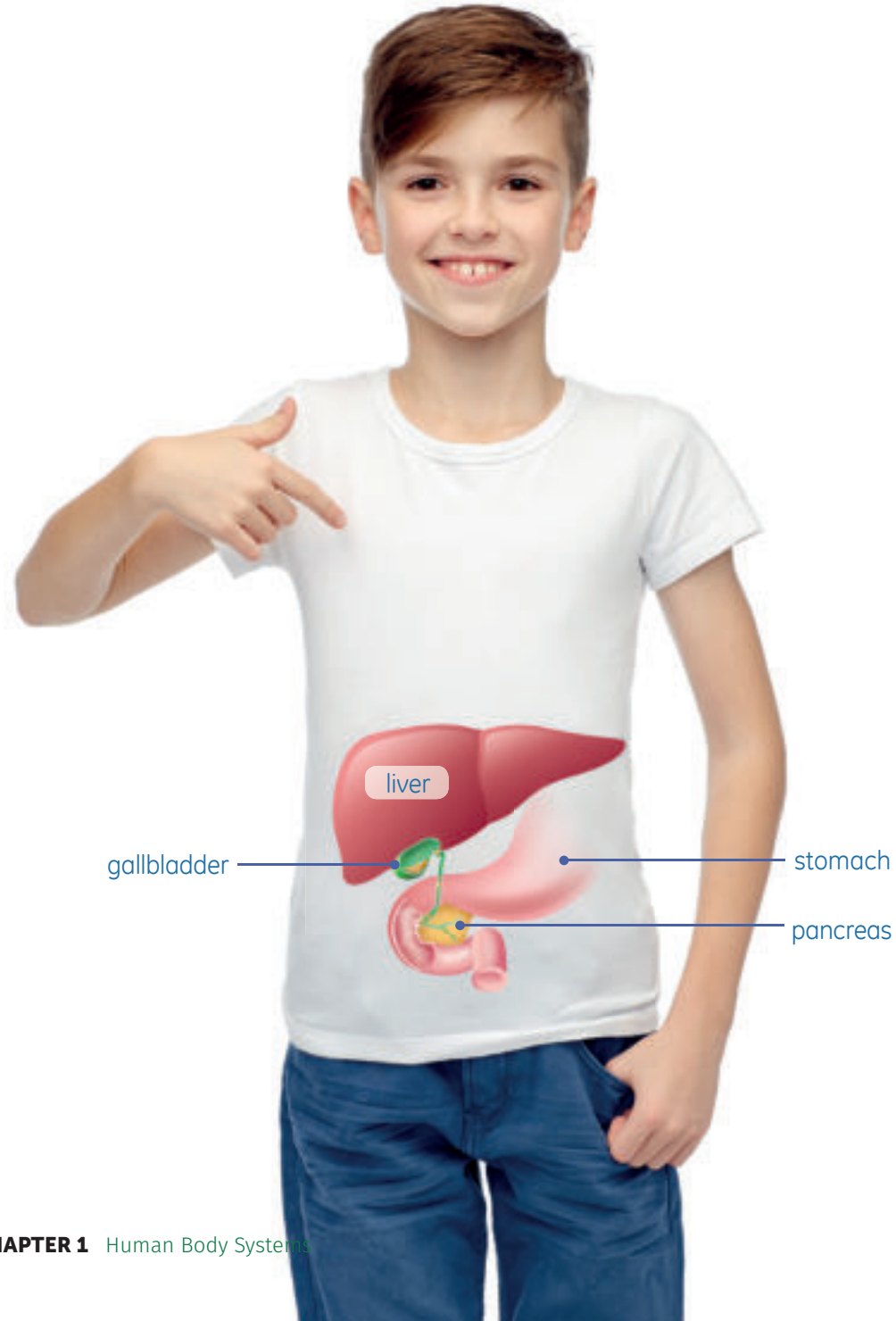
Pathway of food in the lower gastrointestinal tract

Chyme enters the lower gastrointestinal tract, which is composed of the small intestine, large intestine, rectum, and anus. Chyme is moved into the **small intestine** where the final breakdown of food occurs. The small intestine is the main site of nutrient absorption. The undigested food from the small intestine is delivered to the **large intestine**. The large intestine absorbs excess water, leaving the undigested food behind. The undigested food travels through the large intestine into the **rectum**, which regulates the elimination of feces through the **anus**.



Other accessory organs

The liver, the gallbladder, and the pancreas are accessory organs located around the stomach. The **liver** produces **bile** which breaks down fats from the food we eat. The **gallbladder** stores bile. The **pancreas** produces and secretes a liquid called **pancreatic juice**. Pancreatic juice contains chemicals called **enzymes** that digest fats, proteins, and carbohydrates from food.



Common Diseases and Disorders of the Digestive System

- **Peptic ulcers** are scratches in the lining of the stomach. Most cases of peptic ulcer are the result of infection caused by the bacterium, *Helicobacter pylori*.
- **Gastritis** is an inflammation or irritation of the stomach lining.
- **Liver cirrhosis** is a major disease of the liver. It is characterized by liver damage, which leads to the loss of normal liver function.
- **Hepatitis** is an inflammation of the liver that is caused by excessive alcohol consumption or by an infection caused by a virus.
- **Enteritis** is a chronic inflammatory condition affecting a part of the small intestine. The cause of this condition is unknown.

How can you keep your digestive system healthy?

Usually, a person with digestive disease or disorder experiences stomach ache.

Science at Work

Simple Digestive System

What You Need

- 3 pieces of crackers or a piece of bread
- 1 cup of orange juice
- 1 resealable plastic bag
- 3 pieces of sponge

What You Need to Do

1. Drop all the crackers or bread into the resealable plastic bag.
2. Break the food using your hands. Record your observations.
3. Pour a small amount of orange juice into the bag. Record your observations.
4. Squeeze the bag for one minute. Record your observations.
5. Drop one piece of sponge inside the plastic bag. Let it absorb liquid for 3 seconds.
6. Remove the sponge. Record your observations.
7. Repeat steps 5 and 6 for the other two pieces of sponge.

Step	What Happens to the Food?
2	
3	
4	
6	

Questions

1. What is the importance of orange juice in the activity?

   _____

   _____

2. How can you relate each step to the digestion of food?

   _____

   _____

Looking Over

- The **digestive system** functions for food intake, breaking down of food, absorption of nutrients, and elimination of wastes.
- **Mechanical digestion** is the process in which the food is broken down into smaller pieces.
- **Chemical digestion** is the process in which small pieces of food are either turned into a chyme or a smaller form that can enter the cell.
- **The upper gastrointestinal tract** is composed of the esophagus, stomach, and the first section of the small intestine.
- **The lower gastrointestinal tract** includes the small intestine, large intestine, rectum, and anus.
- The accessory organs of the digestive system are the teeth, tongue, salivary glands, liver, gallbladder, and pancreas.
- Some common diseases and disorders of the digestive system are peptic ulcers, gastritis, liver cirrhosis, hepatitis, and enteritis.

Enhance Your Skills

A. Circle the letter that corresponds to the correct answer.

1. Where does the removal of excess water from undigested food take place?
   a. esophagus
   b. large intestine
   c. small intestine
   d. stomach

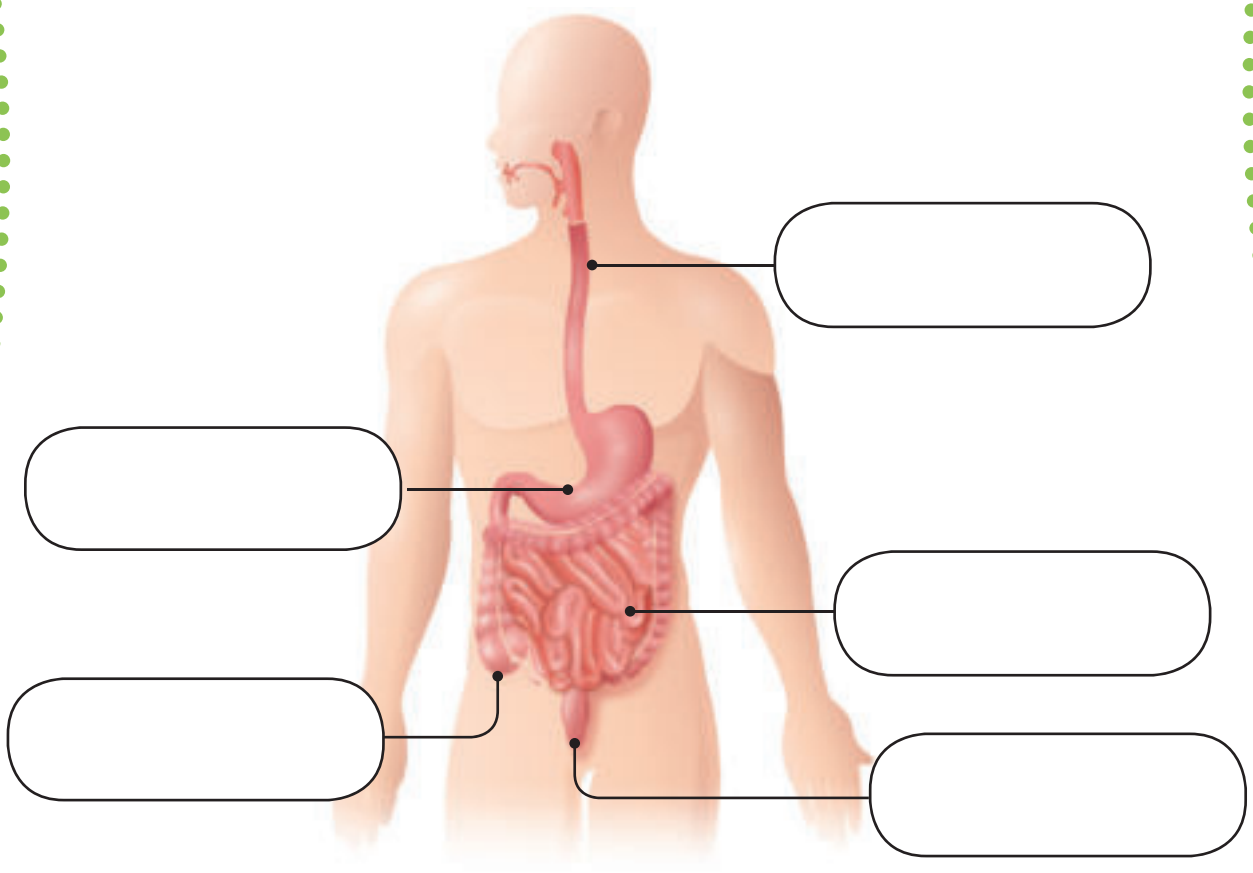
2. Which of the following is an accessory organ of the digestive system?
   a. esophagus
   b. large intestine
   c. liver
   d. stomach

3. The anus is to excretion while the small intestine is to _____.
   a. absorption
   b. defecation
   c. excretion
   d. lubrication

4. Which is not a function of the digestive system?
   a. secretion
   b. digestion
   c. respiration
   d. taking of food

5. _____ is characterized by an inflammation of the liver resulting from excessive alcohol consumption or viral infection.
   a. diarrhea
   b. gastritis
   c. hepatitis
   d. peptic ulcers

B. Label the parts of the human digestive system.



Everyday Science

What causes loose bowel movement?