

Model Textbook of



**NOT FOR
SALE**



General Science

5

Based on National Curriculum 2022-23

**National Curriculum Council Secretariat
Ministry of Federal Education and Professional Training,
Government of Pakistan**



**National Book Foundation
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روشن پاکستان

وزیر اعلیٰ گلگت بلتستان کا پیغام

مسخام گلگت بلتستان

عزیز طلبہ!

میرے لئے یہ نہایت اعزاز کی بات ہے کہ میں گلگت بلتستان کے تائبناک مستقبل، یعنی کہ طلباء و طالبات سے خطاب ہوں۔ بحیثیت وزیر اعلیٰ گلگت بلتستان، میں آپ کو نئے تعلیمی سال کے آغاز پر دلی مبارکباد پیش کرتا ہوں اور نیک تمناؤں کا اظہار کرتا ہوں۔

یہ بات مدد و روشن کی طرح عیاں ہے کہ تعلیم ہماری حکومت کی اولین ترجیح رہی ہے اور اس بات پر بھی یقین ہے کہ نوجوان نسل ہی قوموں کی ترقی اور کامیابی کا محور و مرکز ہوتے ہیں۔ لہذا آپ کا جوش و ولولہ، تجسس اور عزم و ہنیادی ستون ہیں جن کے دم پر ہم گلگت بلتستان کا مستقبل تشکیل دے رہے ہیں۔

میں چاہتا ہوں کہ آپ اس بات کو سمجھیں کہ تعلیم کی سب سے زیادہ اہمیت ہے۔ یہ وہ اڈا ہے جس کی مدد سے آپ نہ صرف اپنی بلکہ اس خطے کی بھی تقدیر بدل سکتے ہیں۔ تعلیم آپ کو با اختیار بنا کر علم اور سر کے دروازے آپ پر داکرتی ہے اور اس قابل بناتی ہے کہ آپ حقیقی اور تنقیدی ذاد یہ نگاہ سے دنیا کو پرکھ سکیں تاکہ آپ مشکلات اور مصائب کا ٹکڑ کر سکیں۔ تعلیم آپ کو اس امر کے لئے بھی تیار کرتی ہے کہ آپ اپنی عملی زندگی میں دانشمندانہ فیصلہ سازی کرنے کے قابل بنیں اور ایک بہتر معاشرے کی تشکیل میں ایک کارآمد فرد کی حیثیت سے اپنا اثبوت کر داکر سکیں۔ اس وقت گلگت بلتستان میں ہم پر عزم ہے کہ آپ کو بین الاقوامی معیار کے مطابق تعلیمی مواقع فراہم کر دے جائیں۔ اس کے لئے حکومت اس وقت سکولوں کی تعمیر و مرمت اور اساتذہ کی پیشہ ورانہ تربیت پر سرمایہ لگا رہی ہے۔ نیز اس بات کو بھی یقینی بنایا جا رہا ہے کہ سکولوں میں جدید طریقہ ہائے تدریس کو فروغ دیا جائے تاکہ طلبہ کو بہترین تعلیمی ماحول میسر ہو۔

میری خواہش ہے کہ آپ ان مواقع سے بھرپور فائدہ اٹھائیں اور جتنو کو اپنا اڈا بنا چھوٹا بنائیں، سوال پوچھیں اور جواب ڈھونڈھیں تاکہ آپ اپنی دلچسپیوں کو دریافت کر سکیں۔ کیونکہ تعلیم کا مقصد صرف اچھے نمبر حاصل کرنے تک محدود نہیں ہے بلکہ یہ آپ کو اپنی صلاحیتوں کو پر دان چھانلنے اور ایک دانشور بنا کر دینے میں مدد دیتی ہے۔

مزید برآں، میں آپ کو تائید کرتا ہوں کہ آپ اپنے اقدار کو پورے دل سے اپنائیں اور رواداری، تحوق پسندی اور برادری کے اس احساس پر عمل پیرا ہوں، جو ایک قوم کو جوڑے رکھتی ہے۔ نیز گلگت بلتستان کے مستقبل کے رہنما و مفید شہری ہونے کی حیثیت سے اس متنوع آبادی والے علاقے میں ہم آہنگی اور اتحاد و اتفاق کو فروغ دینے کی اہم ذمہ داری آپ کے کندھوں پر عائد ہوتی ہے۔

یاد رکھیں کہ کامیابی صرف محنت، لگن اور استقامت کے ثل پر ملتی ہے۔ مشکلات سے کبھی مایوس نہ ہوں بلکہ مشکلات اور رکاوٹوں کو اپنے لئے سیکھنے کا ذریعہ سمجھیں اور آگے بڑھتے رہیں۔ آپ کے خوابوں اور آرزوں کا حصول ناممکن نہیں ہے کیونکہ ہم آپ کے خوابوں کو پورا کرنے میں آپ کے ساتھ کھڑے ہیں۔ میں اپنے علاقے میں اور اس سے باہر کی دنیا میں آپ کی کامیابیوں اور خدمات کے تذکرے سننے کا شغف رکھتا ہوں گا۔ کیونکہ آپ کی کامیابی ہماری کامیابی ہے، اور مل جل کر ہی ہم ایک خوشحال اور روشن گلگت بلتستان کو پر دان چھان سکتے ہیں۔

میں ایک بار پھر آپ کو نئے تعلیمی سفر کا آغاز کرنے پر مبارکباد پیش کرتا ہوں اس دعا کے ساتھ کہ آپ کا یہ تعلیمی سفر کامیابیوں سے بھرپور ہو۔

آپ کا خیر اندیش
حاجی گلبرحان
وزیر اعلیٰ گلگت بلتستان

Model Textbook of

GENERAL SCIENCE

5

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**Model Textbook of General Science
for Grade 5**



Authors

Jawaid Mohsin Malik, Muhammad Ali Shahid

Neelofar Shaheen , Mian Imran Khaliq

Supervision

Dr. Mariam Chughtai

Director, National Curriculum Council Secretariat
Ministry of Federal Education and Professional Training, Islamabad

Internal Review Committee

Dr. Munazza Faheem, Federal Directorate of Education, Islamabad.
Ambreen Tassawar, Army Public School and College System, Rawalpindi.
Shabana Asghar (Rtd), Federal Directorate of Education, Islamabad.
Muhammad Ali, Beaconhouse School System, Islamabad.
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M. Nawaz Aslam, Knowledge Platform.

Abdul Rauf, Federal Government Educational Institutions (Cantt/Garrison), Rawalpindi.
Dr. Shehnaz Perveen, Federal Government Educational Institutions (Cantt/Garrison), Rawalpindi.

National Review Committee

Muhammad Sabir, Elementary and Secondary Education, Azad Government of the State of Jammu & Kashmir.
AminUllah Kakkar, Bureau of Curriculum and Extension Center, Balochistan.
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Zeba Naureen, Federal Government Educational Institutions (Cantt/Garrison), Rawalpindi.

Desk Officer

Mrs. Zehra Khushal (Assistant Educational Advisor), NCC Secretariat

Management: National Book Foundation

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**TEST
EDITION**

PREFACE

Rapid developments in Science and Technology have revolutionized our lives. Advancement in the field of science have led to many benefits manifested in increased yields of crops for human consumption, genetically modified animals, faster means of communication and transportation and more life saving drugs, to name a few. These developments have been coupled with leaps in technological advancements, which have brought communication and information to the palms of a vast majority of the population through smart phones and many other portable devices. Within this age of technological sophistication it is imperative to have learners develop understanding and conceptual clarity in science to provide a strong foundation for future learning in this field. Such an outlook is particularly important for developing nations to bringing their population at par with the trends in the global community.

This model textbook of **General Science Grade 5** has been developed by NBF according to the National Curriculum of Pakistan 2022, in the light of standards for quality textbooks. It has been developed with the aim of providing a strong foundational basis of general science concepts upon which subsequent learning of the students will be built. Offering an improved design with attractive graphics, comprehensive content and interactive elements, this textbook aims to make learning for students of grade-5 an interesting and rewarding activity. The material has been developed with a keen eye to establishing real life links for the learners so that their education process enriches them through better conceptual understanding and the ability to apply their learning. The increased emphasis on activities and project work is for steering children away from rote memorization to developing critical thinking and analytical skills.

This textbook has been aligned with TIMSS (Trends in International Mathematics and Science Study). Structured Questions are included in each chapter's exercise. These questions are internationally used to assess student's reasoning, analyzing and problem solving skills.

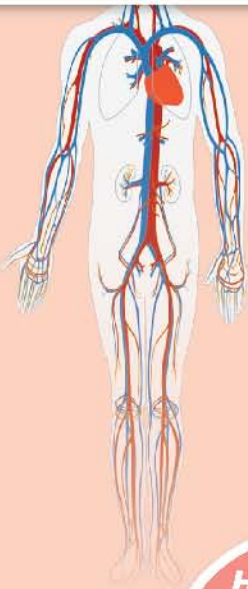
The National Book Foundation is always striving for improvement in the quality of its books. The present book features an improved design, better illustration and interesting activities relating to real life to make it attractive for young learners. However, there is always room for improvement and the suggestions and feedback of students, teachers and the community are most welcome for further enriching the subsequent editions of this book.

Dr. Raja Mazhar Hameed
Managing Director

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Chapter 01



How do the lungs and respiratory system work?

How do your all body cells, get oxygen?

How do the digestive, respiratory system are integrated

Structure and Function - Human Body Systems

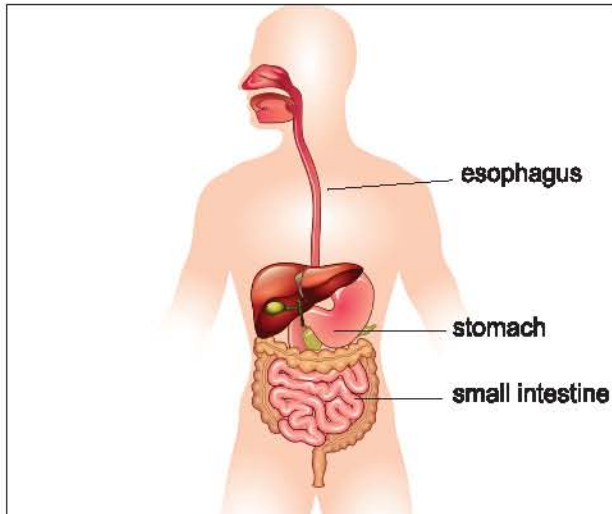
Students' Learning Outcomes

After studying this chapter, the students will be able to:

1. Know that the human body has a number of systems, each with its own function.
2. Recognize the integration of the different systems (digestive, respiratory, and circulatory) in carrying out life processes.
3. Use a model to describe how we receive different types of information through our senses, process the information in our brain and respond to the information in different ways.
4. Describe the human respiratory system in terms of oxygen from the air moving into the blood in the lungs and know that many vertebrates have a similar respiratory system.
5. Identify by name the main parts of the Human Circulatory System, and describe briefly the functions of the heart, blood vessels and blood.
6. Know that many animals have a circulatory system similar to humans.

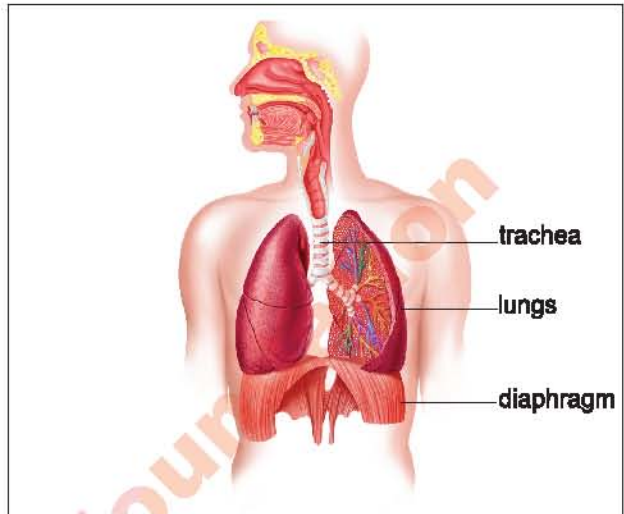
1. Organs to Organ System

Human beings have tissues and organs. A group of tissues make an organ and the group of organ are linked to form organ system. Each of these systems in turn performs one or more specific functions.



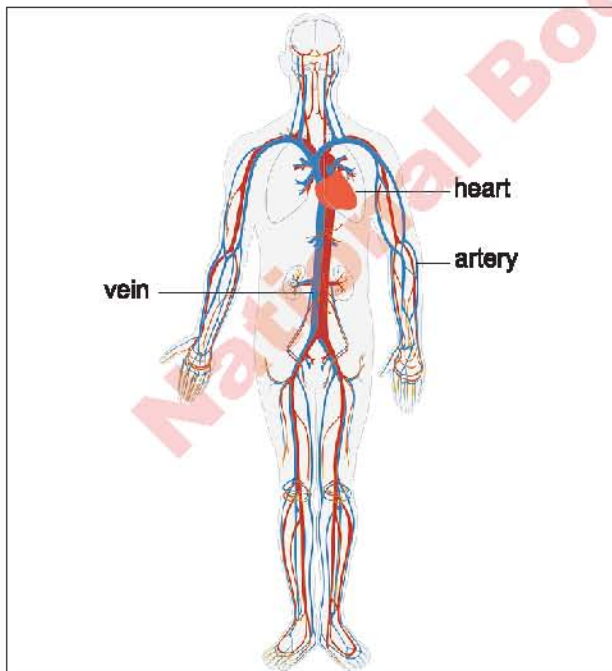
Digestive system

Breaks down food into simpler forms which can be absorbed into the bloodstream.



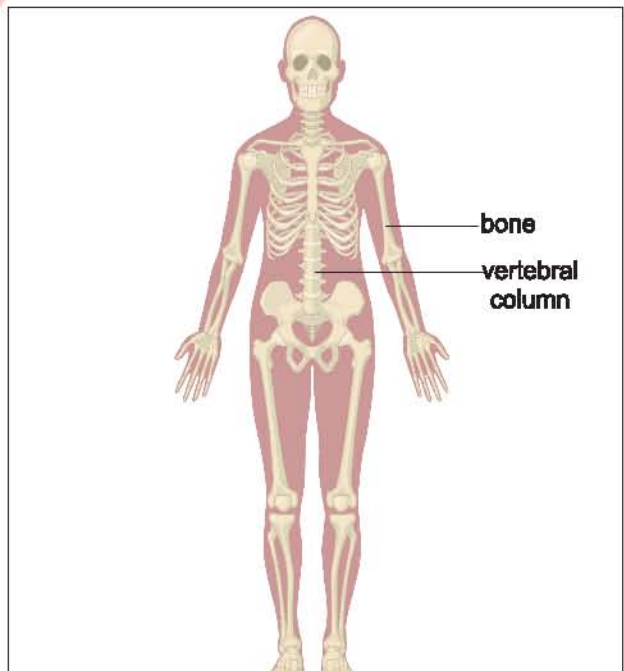
Respiratory system

Enables exchange of gases between the body and the external environment.



Blood Circulatory system

Transports digested food, oxygen, carbon dioxide etc., to various parts of the body.

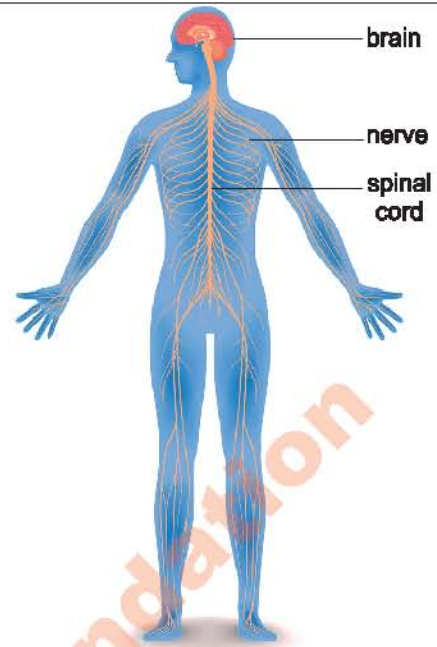


Skeletal system

Supports the body and gives it shape. Works with the muscle and to enable movement.



Muscular system
Enables movement



Nervous system
Controls the activities of the body. Enables the body to respond to changes.

2. Integration of Different Systems in Carrying out Life Process

We have just seen the various systems of the human body and their functions. Actually, all the systems are integrated. We will see how the digestive; respiratory and circulatory system are integrated.

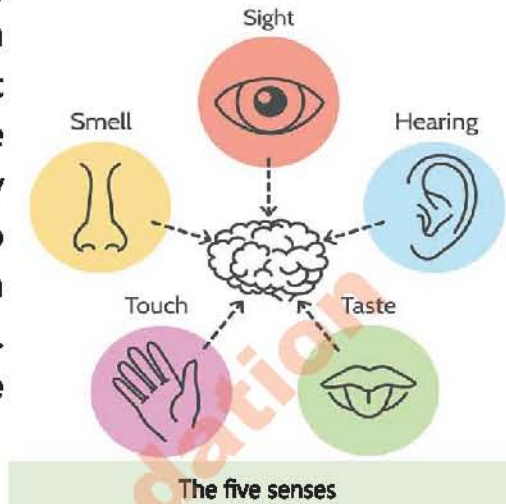
The digestive system gets nutrients from the food. Then passes the nutrients to the blood and circulatory system. The circulatory system carries the nutrients to the various parts of the body.

Breathing is the moving air into and out of the lungs through nostrils. Air contains oxygen, which is needed for respiration. Oxygen is taken up by the blood which is carried to all the cells of the body through circulatory system. The body cells produce carbon dioxide which is taken up by the blood and transport to the lungs by circulatory system. From lungs the air having more carbon dioxide is moved out of the body through nostrils.

Thus digestive, respiratory and circulatory systems are closely linked and dependent on each other to carry out life processes. As we have just seen that digestion of food, would be of little value without a circulatory system.

3. Receiving Information

The survival of all animals, depends on sensing the changes in the surroundings. Any changes in the surroundings that causes an organism to react is called information. The reaction of the organism to information is called response. Every organism has some senses that help it respond to the environment. You receive information from the environment through your sense organs. Sense organs includes eyes, ears, nose, tongue and skin. Eyes are the organs of sight. Ears are the organs of hearing. Nose is the organ of smell. Tongue is the organ of taste. Skin is the organ of touch. Nervous system consists of brain and nerves. The sense organs are attached to the brain through nerves. Sense organs contain special receptors that are actually nerve endings. When a receptor receives an information, a message travels along a nerve to the brain. The brain interprets the message. Each type of receptor can only sense a certain kind of information. For example in our eyes there are light detecting cells that respond to the things we see. Likewise we can hear a sound, smell a flower, taste an orange and feel the cold air.



Do you know?

The other two senses are movement and body position. Sense of movement helps us stay upright when we sit, stand and walk, Body position is the body awareness sense, which tells us that our body parts are relative to each other.

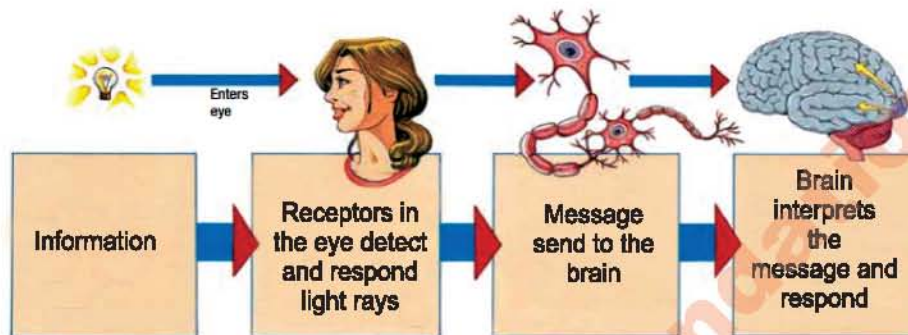
So how does this all come together? Here is an example of sensory integration while playing cricket.

In the picture a boy is holding the bat while playing cricket

- i. The touch sense helps the boy to hold his bat correctly.
- ii. Sense of body position helps him to know his body position is in correct position.
- iii. Balance and movement information help him stay upright while swinging his bat. His sense of sight and hearing also helps him to hit the cricket ball.



Through the brain our body responses in different ways. Some example of information and response in humans are: 1. In bright light our eyes close. 2. Our bodies start sweating to cool itself. 3. While running to get more oxygen we breathe deeper. 4. We shiver to heat up our body temperature when it gets too cold. 5. You are hungry so you eat some food. 6. You are cold so you put on a jacket. 7. When it is hot you sit in a shade. 8. It starts raining so you take out an umbrella.



Activity 1.1

1. The teacher will show videos/ text on different animals and how they sense different information and react accordingly e.g., frogs with their amazing sense of hearing; chameleons with a unique sense of sight. Some bats, whales, and dolphins use echolocation to find their prey, etc.
2. The teacher will ask students to share what they know about the human sense organs and what sort of information they gather.
3. The teacher will explain that our eyes, ears, nose all help to gather sensory information. Each organ has special structures that collect information and then send it to the brain. The brain in turn tells us how to act. Brain is part of the nervous system. The nervous system also includes the spinal cord with miles of nerves spread throughout the body.
4. The teacher will ask students to prepare a scientific poster showing their understanding of the sensory receptors.

4. Human Respiratory System

When wood burns it combines with the oxygen in air. In this process energy in the form of heat and light is released. Likewise in the cells of human body food combines with oxygen to produce energy. This process is called respiration. Through respiration cells use oxygen to release the energy stored in food.

The human respiratory system consists of two lungs and the air passage leading to the lungs. The air passage consists of nose, throat, trachea and bronchi.

Nose

Air enters body through nose. As air passes through the nasal passage it is filtered, warmed and moistened.

Throat

Air passes from the nose to the back of your throat. The throat divides into two tubes. Food and water pass through the, the esophagus. Air passes through the, the windpipe or trachea. The trachea is covered by a small lid. When you swallow the trachea is closed as the lid prevents food from entering trachea. When you speak or breathe, the trachea is open.

Trachea

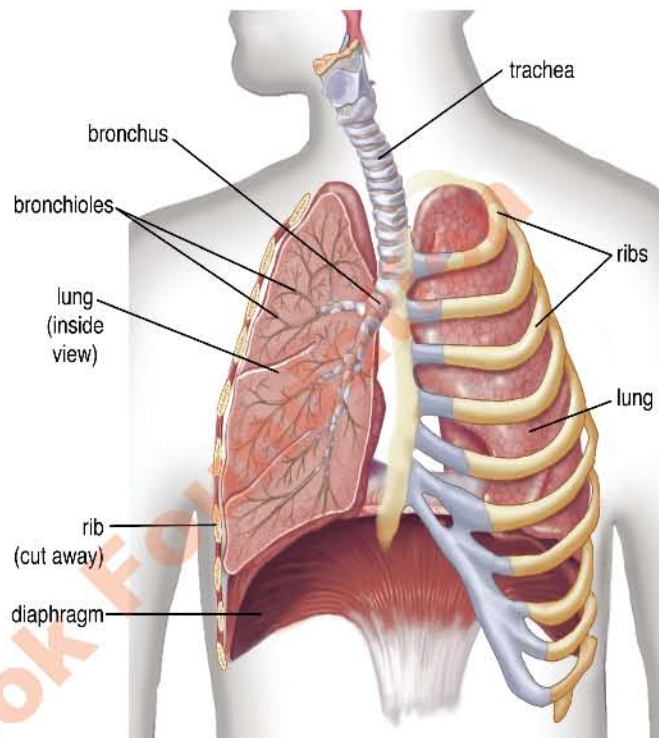
Trachea is supported by C-shaped rings of cartilage. These cartilage rings keep the trachea open.

Bronchi

Air from the trachea passes into bronchus. Bronchus divides into two bronchi. The bronchi are tubes that carry air into the lungs.

Lungs

There are two lungs in the chest cavity. The lungs are spongy and pinkish in colour. Once inside the lungs the two bronchi divide into smaller and smaller tubes (bronchioles). At the end of the smallest tube are the air sacs. The lungs look like sponges due to presence of air sacs. The air sacs have network of thin blood vessels. The exchange of oxygen and carbon dioxide takes place between the air sacs and thin blood vessels. Oxygen from the air sacs passes into the blood. At the same time



Human respiratory system

Do you know?

Larynx is a hollow tube which contains voice box. The vocal cords are flexible bands. When we speak air moves from the lungs and causes the vocal cords to vibrate. This vibration enables you to produce sound.

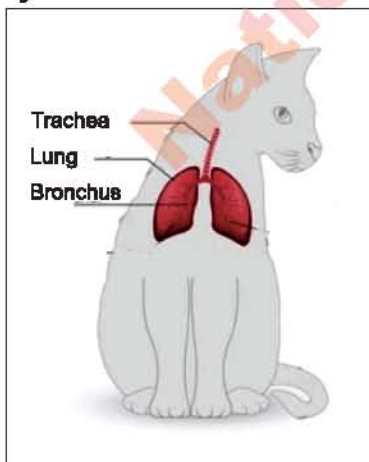
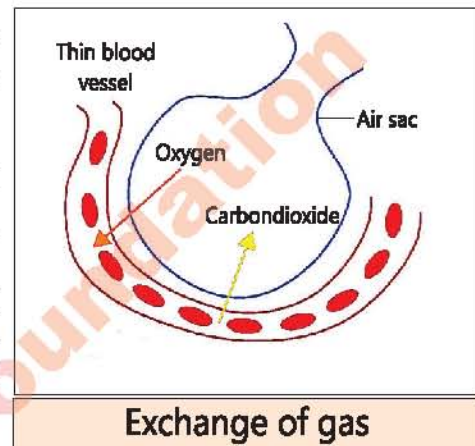
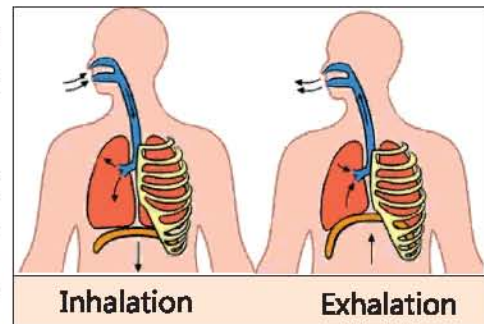
carbon dioxide from the cells passes out of the blood into the air sacs. The blood having oxygen is carried from the lungs to the heart.

Lungs contract and expand to move air into and out of your body. So how does the air get into your lungs? Moving of air into and out of the body is called breathing. The two structures that enable to breathe are the rib muscles and diaphragm. A sheet of muscles that separates the chest and the abdomen is called diaphragm.

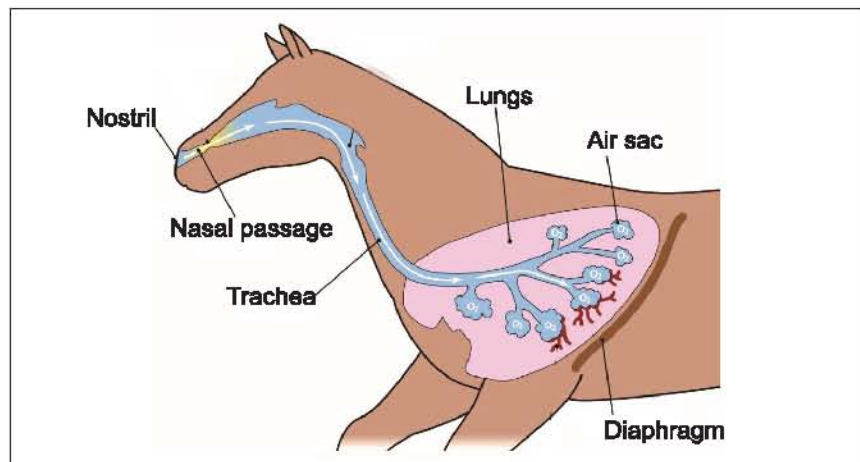
Inhalation: It is the process of breathing, in which we inhale or breath in i.e., air is taken into the lungs. During inhalation the diaphragm flattens and moves downwards. The ribs move upward and outwards. The lungs expand. The air enters the lungs.

Exhalation: It is the part of breathing in which we exhale or breath out air i.e., air is taken out of the lungs. During exhalation the diaphragm relaxes and moves upwards. The ribs move downwards and inwards. The lungs are compressed. Air is given out from the lungs to the surroundings.

Most of vertebrates, such as elephant, lion, dog, cow, cat, horse, goat, bird have lungs in their chest cavities like human being. So these vertebrate have similar respiratory system to human.



Respiratory system of cat



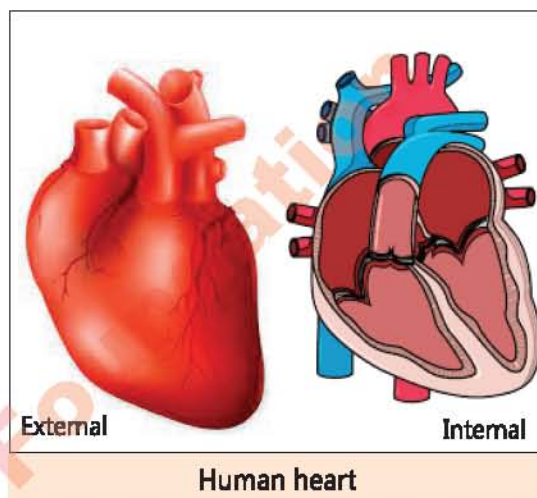
Respiratory system of horse

5. Human Circulatory System

Why do you need a circulatory system? All the cells of body need oxygen from the lungs. Carbon dioxide has to be removed from the lungs. So we have a system of internal transport called circulatory system. This system transports oxygen, carbon dioxide, nutrients, water, minerals etc. The human circulatory system consists of heart, blood vessels and blood.

Heart

The human heart is somewhat a cone shaped organ. It is located in the chest between the two lungs. The heart is about the size of a fist. The heart functions as a pump. The heart has two pumps that lie side by side. The right pump is separated from the left pump by a muscular wall. The heart consists of four chambers. The heart is responsible for the circulation of blood through the blood vessels.



Human heart

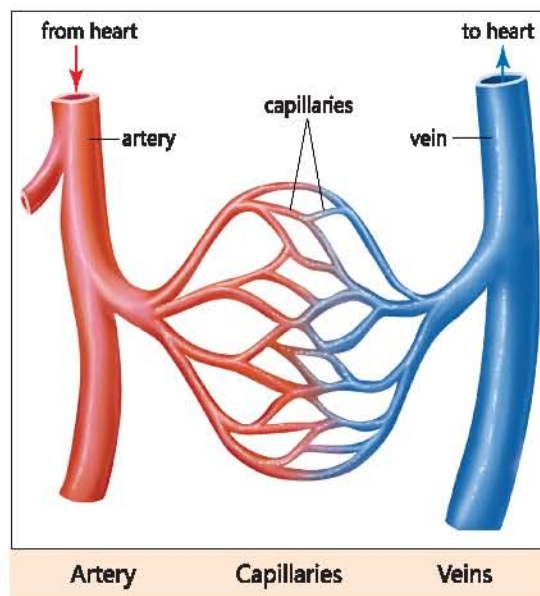
Blood vessels

The three types of blood vessels are, the arteries, capillaries and veins.

Arteries: Arteries are blood vessels that carry blood away from the heart. The walls of the arteries are very elastic. As the heart contracts, it pumps blood through the arteries.

Capillaries: The capillaries are the smallest blood vessels. They form a network in all parts of the body. The exchange of materials such as oxygen, carbon dioxide, glucose etc., takes place between the blood and body cells through the capillaries.

Veins: Veins are blood vessels in which the blood flows from the body towards the heart. They carry carbon dioxide and other wastes. The wall of the vein is thin.



Artery

Capillaries

Veins

Do you know?

The expansion and contraction of the arteries can be felt as pulse. Place your finger on an artery in the neck or wrist, you will feel the pulse.

**Activity 1.2**

A large diagram of the circulatory system (including capillaries) could be drawn by the teacher with chalk, on a large outdoor surface. Students then move around the diagram, following the arteries, capillaries and veins like a one-way road system. Balls of different colours can be used to represent nutrients, oxygen and carbon dioxide. Students pick up nutrients at the intestine, swap carbon dioxide for oxygen at the lungs, and swap oxygen and nutrients for carbon dioxide at the muscles.

Blood

Blood is a circulatory fluid. It consists of plasma, and blood cells.

Plasma: It is the liquid portion of the blood.

Blood cells: These are suspended in the plasma. The three types of blood cells are: (a) red blood cells (b) white blood cells (c) Platelets.

Red blood cells: The red blood cells are disc shape. They have no nucleus. They exist for about 120 days in the blood stream. They contain a pigment hemoglobin. They transport oxygen to all cells.

White blood cells: They have nucleus. There are five types of white blood cells. Their main function is to protect the body against pathogens.

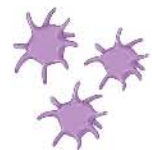
Platelets: These are the fragments of cells. Platelets play an important role in blood clotting.



Red blood cells



White blood cells

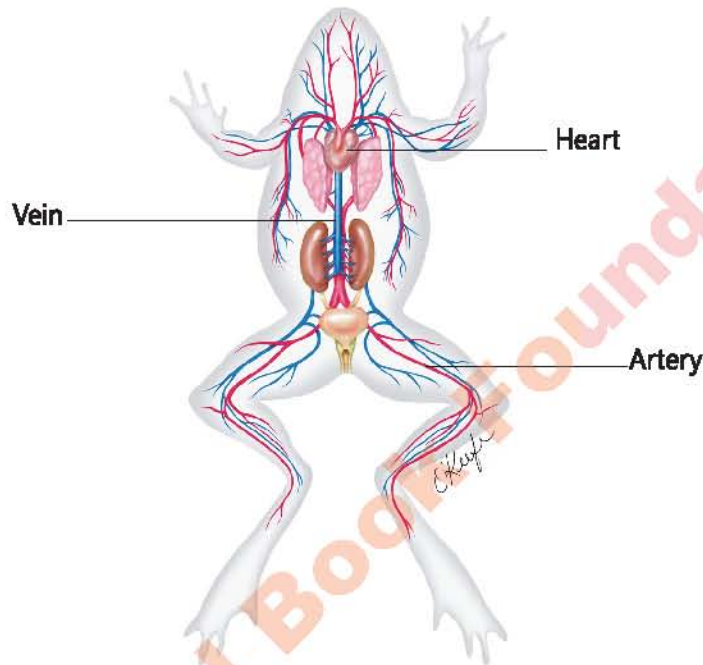


Platelets

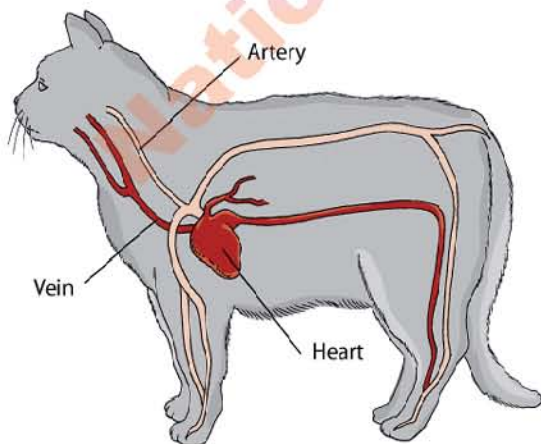
Do you know?

White blood cells are not white in colour but are colourless. To distinguish from red blood cells these are called white blood cell.

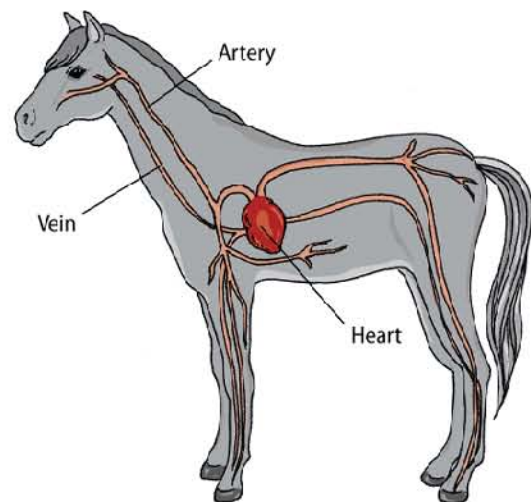
Many Animals have circulatory system similar to humans, having heart, arteries, veins and blood. The animals are frog, lizard, crocodile, bird, cat, goat, cow, horse etc.



Circulatory system of frog



Circulatory system of cat



Circulatory system of horse

Activity 1.3

The teacher will show to the student a video (or animation) of the human circulatory system and ask students to note the main parts of the system and what they do. Discuss: *What does the heart do? What are the different types of blood vessels and what do they do?* Students can do research to find out different ways they can keep their hearts healthy. Students can use secondary sources to find answers to their questions. Students will demonstrate their understanding of circulatory systems by drawing (or using) the circulatory systems of a range of different animals (e.g., mouse, cat, bat, fish). STEM/ STEAM Simple pumps can be used to model the heart. The pump can be attached to pipes with different diameters to model the flow of blood through different types of blood vessels. The teacher will ask students which parts of the model worked well. The teacher will ask students to use the model to explain how blood transports oxygen, nutrients and waste.

Key Points

1. The human body have a number of organ systems such as: Digestive system, respiratory system, circulatory system, skeletal system, muscular system, and nervous system etc.
2. Digestive, respiratory and circulatory system are integrated to carry out life processes.
3. We receive information from the environment through sense organs The sense organs are eyes, ears, nose, tongue and skin.
4. Eyes are the organs of sight. Ears are the organs of hearing. Nose is the organ of smell. Tongue is the organ of taste. Skin is the organ of touch.
5. The nerve endings are receptors. Each type of receptor can only sense a certain kinds of information, such as light, sound, hot, cold etc.
6. Message from the sense organs travels in along a nerve to the brain. The brain interprets the message.
7. Through the brain our body responses in different ways.
8. Respiration is the process by which oxygen combines with sugar to release energy.
9. The organs involved in gas exchange consist of two lungs and the air passage.

10. The air passage consists of nose, throat, trachea, and bronchi.
11. Breathing is the process of moving air in and out of the lungs for gas exchange.
12. The process that moves air into the lungs is called inhalation. The process of giving air out of the lungs is called exhalation.
13. Diaphragm is a sheet of muscle that separates the chest and abdomen.
14. Breathing takes place with the help of rib muscles and diaphragm.
15. Many vertebrates have similar respiratory system to humans such as elephant, goat, cat, horse, lizard and bird etc.
16. The human circulatory system transports oxygen, carbon dioxide, nutrients, water, minerals etc.
17. Circulatory system consists of heart, blood vessels and blood.
18. The cone shaped heart is located in the chest between the two lungs. The hearts pump the blood through the blood vessels.
19. Arteries, veins and capillaries are the blood vessels.
20. Blood consists of plasma, red blood cells, white blood cells and platelets.
21. Many animals have a circulatory system similar to human.

Key Vocabulary

arteries	diaphragm	oxygen
blood	digestive system	pulse
blood cells	exhalation	receptors
brain	exhale	respiratory system
breathing rate	gas exchange	sense organs
breathing	heart rate	sensory
bronchi	inhalation	trachea
capillaries	inhale	veins
circulate	life processes	vessels
circulatory system	nervous system	waste
	nutrients	



Weblinks: Use the following weblinks to enhance your knowledge about the topics in this chapter.

Human Respiratory System	https://my.clevelandclinic.org/health/articles/21205-respiratory-system
Human Circulatory System	https://www.nhlbi.nih.gov/health/lungs/respiratory-system

Exercise

Tick (✓) the correct answer.

- i. Which system controls the activities of the body?
(A) nervous system (B) digestive system
(C) skeletal system (D) muscular system
- ii. Which system enables the movement in the body
(A) muscular system (B) nervous system
(C) respiratory system (D) digestive system
- iii. The respiratory system consists of the lungs, the trachea and the:
(A) liver (B) diaphragm
(C) pancreas (D) esophagus
- iv. When you breathe in air, you bring oxygen into your lungs and give out.
(A) oxygen (B) hydrogen
(C) carbon monoxide (D) carbon dioxide
- v. When you inhale your lungs will:
(A) expand (B) become hard
(C) contract (D) become spongy
- vi. The trachea is also called the
(A) lung (B) diaphragm
(C) wind pipe (D) air passage way
- vii. How many chambers does the human heart have?
(A) two (B) three
(C) four (D) five
- viii. The movement of blood through the human heart and body is called:
(A) circulation (B) locomotion
(C) ventilation (D) heart pump

- ix. Which type of blood vessels carries blood away from the heart?
- (A) veins (B) arteries
(C) capillaries (D) arteries and veins

2. Write the short answers.

- i. Name only four organ systems found in human beings.
- ii. How respiratory and circulatory system are integrated?
- iii. How specific information is received by human body?
- iv. How does a human body response when a specific information received?
- v. Name the parts of human respiratory system?
- vi. Why the lungs are spongy?
- vii. Describe the exchange of gases in human lungs.
- viii. How does inhalation and exhalation takes places?
- ix. Why do you need a blood circulatory system?
- x. Describe and write function of the following .
(a) heart (b) blood (c) blood vessels
- xi. Write the functions of!
(a) Red blood cells (b) White blood cells (c) Platelets

3. Constructed response questions:

- I. Why is breathing so important?
- ii. What do animals need from air?
- iii. What is contained in exhaled air?

4. Investigate:

- I. How does air move in our body?
- ii. How do the lungs work?

5. Project:

Make a model of lungs and explain how does the model work?

Materials Required

Plastic bottle with screw top cap

Straws x 2-3

Rubber Bands x 2

Tape

Balloons x 2

Plastic Wrap

Scissors

Step 1: Cut the Bottom Off Your Plastic Bottle



Take a 2 liter plastic water bottle, Pierce your plastic bottle. Then you can cut around the bottom of your bottle with scissors or a knife.

Step 2: Carefully Cut/screw a Hole in Your Bottle Cap



Cut a hold roughly the size of your straw.

Step 3: Cut Your Straws to Be Your Windpipe



Use 2 or 3 straws for this step. First, if you have bending straws, cut them slightly after the bend in the straw, so you are still able to bend it. Once you have the point use your scissors and put one blade inside the straw and cut about 1 to 1.5 inch up. Repeat for the other side.

You should now have a slit to place the smaller straw pieces into. Make sure the smaller pieces fit the way you want and that air can be blown through one and go out of both ends.

Finally lightly tape the pieces together so there is no excess air able to go through the slits. Remember not too tight, or it will constrict air flow.

This structure will be our trachea, or windpipe, that brings air into the body. It divides into the left and right bronchi continuing the air travel into our lungs.

Step 4: Prepare Your Balloons to Be Your Lungs

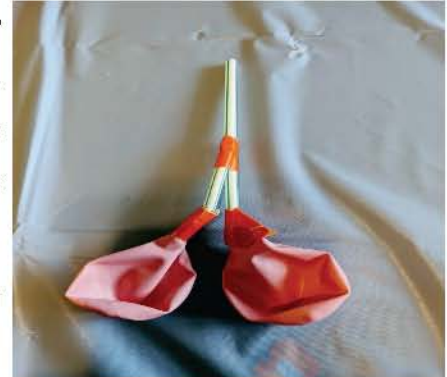


Take your two balloons and use your scissors to cut the top of the balloon off.

Step 5: Attach Your Lungs to Your Windpipe

Next, take one balloon and put one side of your windpipe (straw) into the balloon and, using tape, lightly wrap the balloon around the straw making sure there is no obstruction to air flow. Repeat with the other balloon and side of the windpipe.

This way air will be able to travel safely through each bronchus and into the air sacs.



Step 6: Put Your Lungs Into Your Bottle



Now you are ready to insert your lungs into your bottle. You will want to do so by inserting your lungs straw side up into the bottle. Now take your lid and put the top of your windpipe (straw) through the hole. If you have difficulty, try folding the top of the straw to squeeze it into the lid. Once your straw is through the lid screw the lid back onto the bottle and lightly tape around the hole so there isn't excess air.

Step 7: Prepare Your Plastic Wrap to Be Your Diaphragm



Cut a square of plastic wrap large enough to cover the bottom of your bottle. Then, using your rubber bands, secure the plastic wrap around your bottle. In our model this plastic wrap represents the diaphragm.

Step 8: Attach a Tab to Help Control Your Diaphragm

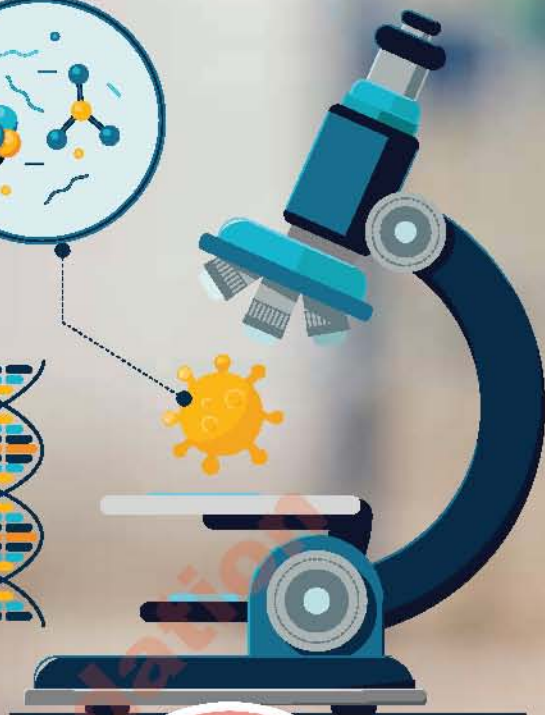
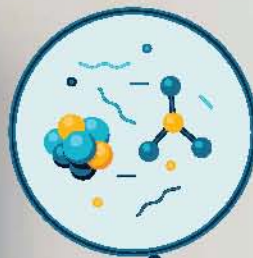
Use extra tape or an extra rubber band and tape to create a pull tab for your diaphragm. Simply, fold the tape over on itself, so it creates a rope. Then tape then rope to the bottom of your model.

**Step 9: Make and Observe Your Lungs Inhale and Exhale!**

Pull your plastic wrap down to contract the diaphragm and make your lungs inhale the air. Relax the plastic wrap quickly or slowly and see what happens.

The air is exhaled!

Chapter 02



Are all organisms just those which we see?

Are all the invisible organisms harmful?

Why is it necessary to brush the teeth after meals?

Microorganisms and Diseases

Students' Learning Outcomes

After studying this chapter, the students will be able to:

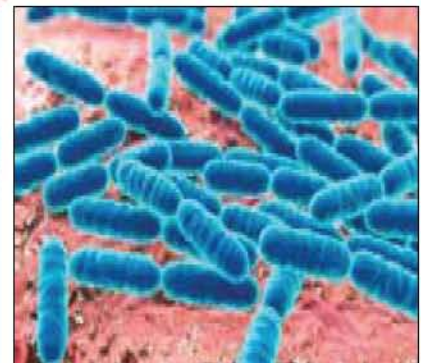
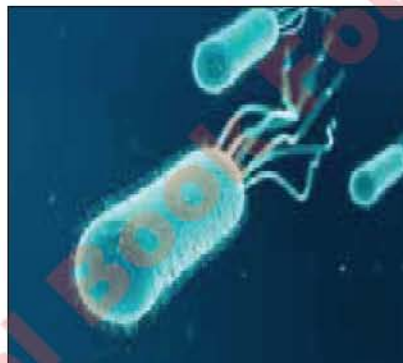
1. Define and describe main groups of microorganisms (bacteria, virus and fungi) and give examples of each.
2. Recognize some common diseases of each group (bacteria, virus and fungi) caused by microorganisms.
3. Recognize that microorganisms get transmitted into humans and spread infectious diseases.
4. Differentiate between infectious and non-infectious diseases and relate the transmission of common infectious diseases to human contact and explain some methods of preventing their transmission. Describe ways to avoid being bitten by insects.
5. Recognize the advantages of microorganisms.
6. Investigate the role of microorganisms in producing or breaking down/ decomposing materials.
7. That humans have defense mechanisms against infectious disease, including skin, stomach acid, and mucus.
8. The effects of too much sugar in their diet, and how it can lead to health problems.
9. Use a first aid box to dress a wound.

You must have observed dust particles in the beam of light that enters a dark room. Have you ever thought that we cannot see very tiny objects with naked eyes? In order to see organisms that we cannot see with our naked eyes, we need a special instrument called microscope. The objects that cannot be seen by human eyes are visible as large and clear objects under the microscope.



Microorganisms

All those tiny organisms that can only be seen under the microscope are called microorganisms. They are present everywhere in our surroundings.



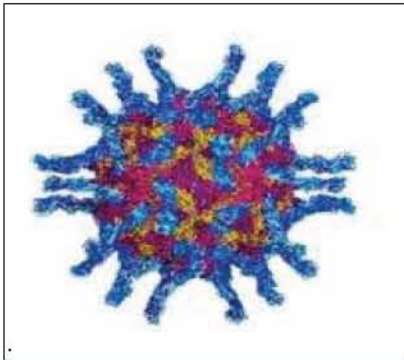
Microorganisms

1 Main Groups of Microorganisms

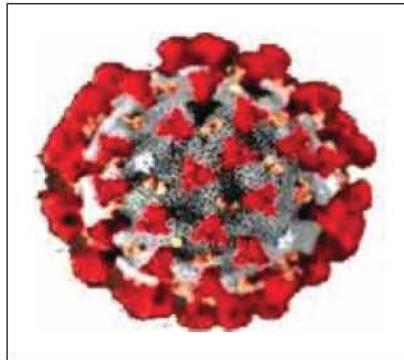
There are many types of microorganisms. They are divided into various groups on the basis of their size and structure etc. Virus and bacteria are the main groups of microorganisms. Some fungi are very small and these are also included in microorganisms.

I. Virus

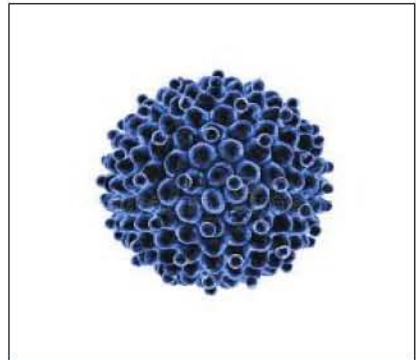
Viruses are very tiny infectious particles. They are the link between living and nonliving things. They can reproduce only within an organism. Out of the body of organism, they are nonliving. Viruses are very harmful to living organisms. They cause diseases in human beings, animals and plants.



Polio virus



COVID-19 virus



Flu virus

Viruses

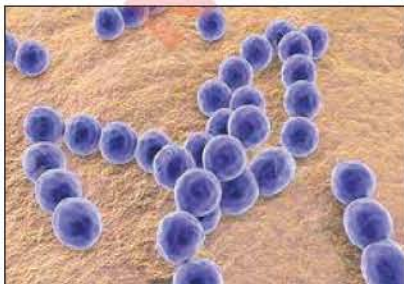
ii. Bacteria

Bacteria are single-celled organisms. They are found in air, water, soil and inside living things. Few bacteria are harmful to organisms. They cause diseases in plants, animals and human beings. A large number of bacteria are useful for humans. Some bacteria help in the digestion of food and absorption of food components in our small intestine.

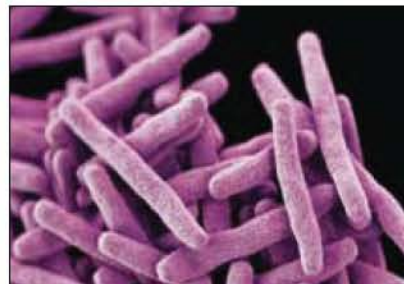
Interesting Information

1. The bacteria which are beneficial for us are called useful bacteria. The number of harmful bacteria is very less.
2. The number of bacteria in a small spoon of soil is almost equal to the number of the people living in the continent Africa.

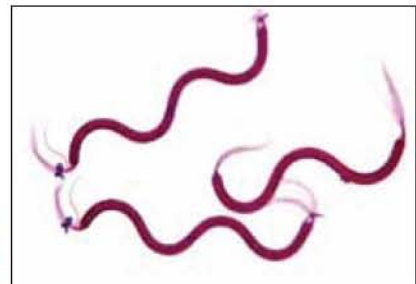
On the basis of shape, bacteria are divided into three types: round, rod-shaped and spiral.



Round



Rod-shaped



Spiral

Shapes of bacteria

Differences between viruses and bacteria

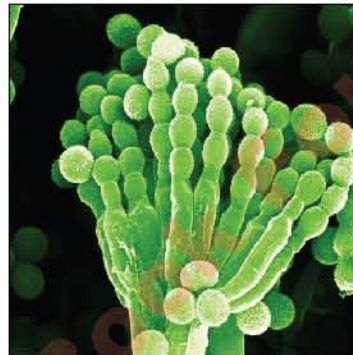
Bacteria are single cells that can survive inside or outside the body of the host. Viruses cause infection by entering and reproducing inside the cells of the host. Viruses cannot reproduce outside the body of the host.

iii. Fungi

Fungi are simple organisms that are neither like plants nor like animals in their characteristics. They cannot make their own food as they have no chlorophyll. They often grow on dead organisms or decaying matter. They decompose dead matter into simple materials. Then they absorb these simple materials as their food. Some fungi obtain their food from living plants and animals and cause diseases in them. Mold, *Penicillium* and yeast are the examples of microscopic fungi.



Mold on orange

*Penicillium*

Yeast

Fungi

2. Diseases Caused by Microorganisms

Many microorganisms cause diseases in plants and animals. The microorganisms that cause diseases in their hosts are called pathogens. The diseases that occur due to them are called infections or infectious diseases. These infectious diseases can spread quickly from one organism to the others through air, water etc.

Diseases caused by viruses:

Hepatitis, Flu, Polio, COVID-19, Measles, Mumps, etc.

Diseases caused by bacteria:

Pneumonia, Typhoid, Cholera, Tuberculosis, etc.



Measles



Mumps

Diseases caused by fungi:

Ringworm, Athlete's foot, Smut, Rust etc.



Rust



Smut



Athlete's foot



Ringworm

Diseases caused by fungi

3. Spread of infectious Diseases and Transmission to Humans

The five main ways for the transmission of infectious diseases are air, water, food, animals and direct contact.

a. Airborne Diseases

When a patient of any particular infectious disease coughs, sneezes or talks then some pathogens are released out of his mouth and dispersed in the air. When a healthy person breathes, these pathogens enter the body and the person becomes sick. Such infectious diseases are called airborne diseases e.g., COVID 19, flu and TB.

b. Waterborne Diseases

The pathogens of some diseases are transmitted through water. Such disease occur when someone uses polluted water for drinking and in cooking. Diarrhea, typhoid, some diseases of eyes and skin are waterborne diseases.

c. Food-borne Diseases

Pathogens of some diseases are present in contaminated food. On eating such types of food these pathogens enter human body and cause diseases e.g., cholera, hepatitis, typhoid, etc.

d. Animal-borne Diseases

Some animals also transmit pathogens from one human to other. For example, when a mosquito bites and sucks blood of a patient of malaria or dengue, it takes pathogens from the patient. When it bites a healthy person, it transmits those pathogens into the healthy person.

e. Transmission of Diseases through Direct Contact

Some diseases are transmitted by shaking hands or by touching things used by the patient. COVID-19, flu and hepatitis are examples of such diseases.

Activity 2.1

Would you like to know how far germs can travel on coughing and sneezing? For this, you need a balloon, tiny pieces of paper or glitters. Put the tiny pieces of papers inside the balloon. Inflate the balloon and close the mouth of the balloon tightly with two fingers. Then open the mouth of the balloon. What happened?

The pieces of paper scattered out of the balloon. In the same way, germs spread on coughing or sneezing.



4. Transmission and Prevention of Infectious Diseases

Health is a great gift of Almighty Allah. We realize the importance of health when we are sick. There may be many causes of a disease, for example germs, scarcity of food and air pollution etc. It is important to observe the symptoms of a disease to diagnose. Have you ever observed fever, cough and flue?

The normal human body temperature is 98.6°F or 37°C. If our body temperature rises from this limit it is called fever. Cough is an instant response of our body. It is due to the soreness and scratchiness in the throat.

Do you know?

1. Fever is not a disease but a symptom of disease.
2. The human body temperature is measured by a thermometer.
3. The body temperature of humans is usually measured in Fahrenheit degrees, which is written as °F. It can also be measured in Celsius which is written as °C
4. The coughing removes obstruction of windpipe, such as mucus of windpipe.
5. The viruses and bacteria present in the nose are expelled out due to sneezing.
6. Flu is a disease as well as symptom of many diseases.

		
Fever	Flu	Coughing

There are two types of diseases: infectious and non infectious.

Infectious Diseases

If any of your classfellows has flu then usually the teacher advises him to take rest at home. Why does the teacher say this? The teacher advises because the other children may not get flu. Flu is a disease which is transmitted from one person to another.

A disease which can be transmitted from one person to another is called infectious (contagious) disease. Flu, polio, TB, hepatitis and COVID-19 etc., are the examples of infectious diseases. The flu patient complains about congested or runny nose and headache.

Polio is caused by a particular type of germ called virus. This virus settles in the throat and intestine of human being. It paralyzes the legs permanently. There is no treatment of this disease. Polio virus is transmitted through food, water and air.

Tuberculosis (TB) is caused by a particular type of germ called bacteria. It usually affects the lungs.

TB, flu and COVID-19 are transmitted from one person to another through coughing, sneezing, use of articles of the affected person and conversation.

The inflammatory condition of the liver is called hepatitis. The germs of this disease are viruses, which are transmitted through polluted water, food and blood.



A polio patient

Interesting Information

The cause of COVID-19 is a virus, which is called corona virus. It affects the entire body including lungs. In 2019-2020 this virus has affected the entire world and due to which millions of people died. It is transmitted from one person to another through social contacts and respiration.

Non-Infectious Disease

Non-Infectious disease is not transmitted from one person to another, e.g., diabetes and cancer.

In diabetes the sugar level in the blood increases. The common symptoms of diabetes are excessive thirst and hunger, urination, fatigue and weight loss. It affects the several organs such as heart, kidneys and eyes etc.

Cancer can attack any part of the body e.g., liver, stomach, intestine and blood. In cancer, there is uncontrolled increase in the number of cells in the affected organ. It may remain confined to any particular organ or may spread in the whole body.

Interesting Information

For the treatment of cancer there are hospitals in many cities of Pakistan. Kiran (Karachi), Nori (Islamabad), Shaukat Khanum Memorial Hospital (Lahore, Peshawar, Karachi), Inmol (Lahore), Baitulskoon (Karachi) are major hospitals of Pakistan.



Inmol










Shaukat Khanum Memorial Hospital

5. Prevention of Infectious Diseases

Good personal hygiene is one of the best ways to protect yourself from getting infectious diseases. Personal hygiene includes washing hands, brushing teeth twice a day, covering mouth and nose with tissue or your sleeve when sneezing or coughing. Avoid touching your eyes, nose and mouth, as these are the points for germs to enter your body. Stay at home if you have signs and symptoms of an infection. In this way you can take rest and prevent others from infection. We will learn about washing hands, wearing mask and vaccination some of the ways to remain safe from infectious diseases.

Washing Hands

We should wash our hands thoroughly for at least 20 seconds with soap before and after meals. We should also wash hands after using the toilet.

	
1. Rub hands palm to palm.	2. Rub the back of both hands.
	
3. Palm to palm with the finger interlock.	4. Back of fingers to opposing palm, with interlocked fingers.
	
5. Rub thumb in a rotating manner followed by the area between index finger and thumb. Repeat for both the thumbs.	6. Rub the finger tips into palm of your opposite hand. Repeat for both hands
	<p>Do you know?</p> <p>Global hand washing day is celebrated on 15th October every year.</p>
7. Rub both wrists in a rotating manner, rinse and dry thoroughly.	

Wearing Medical Mask

Do you know about a mask as a protection against COVID-19? Do you know the proper way to wear the mask? What are the benefits of wearing a mask? Mask is a protective barrier between your nose, mouth and environment. It does not allow germs to enter the body through the nose and mouth. Do not wear a used mask. Dispose off the use mask in a proper way.



Vaccination

Do you know about vaccination? In vaccination the weak or dead germs of a disease are injected into the body. The antibodies are produced against the weak or killed germs in the blood. These antibodies remain in the body to fight against the germs. Polio is a dangerous disease, which may cause lifelong disability.

Government of Pakistan has launched a campaign, to administer polio drops for prevention of this disease. Polio drops should be administered to the children up to the age of five years. Have you been given polio drops?



Vaccination

6. Prevention against insect bites

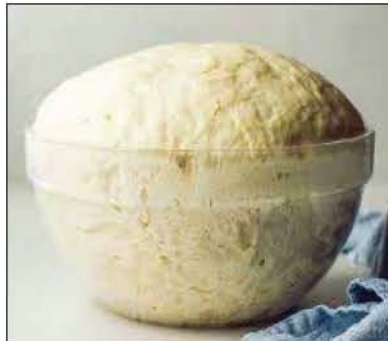
The ways to avoid being bitten by insects are: Use insect repellent, wear appropriate clothing to protect your skin. Sleep under a mosquito net. Use screen or net on windows and doors.

7. Useful Role of Microorganisms

All microorganisms are not harmful. Here are some benefits of microorganisms in everyday life:

i. Making Food Items

Bacteria and Yeasts are used in making food items. Yeasts are used to make bread and cheese. Bacteria are used in making yoghurt.



Use of yeast to rise the dough



Use of bacteria in making yoghurt

Activity 2.2

1. Take flour in a pot. Add yeast, sugar and water in it to make a dough.
2. Take same quantity of flour in another pot. Add sugar and water only to make a dough.
3. Note the quantity of flour in both pots and leave them for an hour.
4. After one hour, observe the quantity of flour in both pots.
5. In which pot did, the dough rise? What is its reason? Why was sugar added along with yeast?



ii. Cleaning of Environment

You know that some bacteria can decompose dead bodies. Such bacteria can also be used to decompose toxic materials present in sewage and industrial water waste.



Cleaning of environment

Activity 2.3**Infections and Diseases**

- 1 The teacher will show a charts and ask students: What diseases do they know about? What causes them? How are they spread?
- 2 The teacher will explain that our body systems work together to perform important life functions. How you can keep their body organs healthy?

Activity 2.4**Research**

- 1 The teacher will introduce the terms infection and infectious diseases and ask students to carry out research, using secondary information sources.
- 2 Students will prepare fact cards or Scientific posters for some common diseases, including what causes them and how they are spread.
- 3 Digital etiquettes - Students will be reminded to mention the source of the information collected.

Activity 2.5**Grouping Common Infectious Diseases**

- 1 The teacher explain that infectious diseases are one of the leading causes of death across the world.
- 2 The teacher will ask students to group the diseases that they are familiar with in different ways e.g., What causes the disease? How does it spread? How can it be prevented? etc.

Activity 2.6**Research Project**

The teacher will ask the students to do research to find out:

- 1 How are microorganisms used to make yogurt?
- 2 How are microorganisms important in the human digestive system?
 - (a) History of penicillin
 - (b) The teacher will ask the students to share their findings in the form of presentations or scientific posters.

Activity 2.7

- 1 What does the term 'pandemic' mean?
- 2 The teacher will ask students to prepare a mind map regarding what they all know about COVID 19 and how it spread and still spreading around the world.
- 3 Share newspaper articles by WHO on COVID 19 pandemic.
- 4 The teacher will ask students to note down key points from the report regarding how the virus spreads and the role of vaccines.
- 5 The teacher will ask students to carry out surveys in their local area to find out what percentage of individuals are vaccinated. Students can prepare 'Public service messages' to raise awareness on the importance of vaccines.

iii. Making of Medicines

Many microorganisms are used for making medicines. Fungi and bacteria are used to make antibiotics. These medicines are used to kill or inhibit the growth of disease causing bacteria.

Activity 2.8

1. Take a deep plate and pour water so that one inch of your finger dips into it.
2. Sprinkle some black pepper powder on the water.
3. Dip your finger into the water. The black pepper will stick to your finger.
4. Put a good quantity of soap on your finger. Again dip the finger into water. This time, the black pepper will move away from your finger.
5. Soap repels the germs in this manner.

**Do you know?**

Penicillin was the first antibiotic. It was derived originally from a type of fungi, known as *Penicillium*.



8. Role of Microorganisms as Decomposers

Activity 2.9

Put the things given below in separate bags and leave them for a week. Observe it after a week. Have any changes taken place?



Wood



Bread



Water



Leather



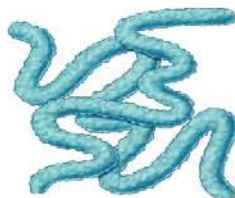
Stone



Fruit

Why is it appropriate to bury dead bodies and peel of vegetables? In fact dead bodies are converted into simple components by bacteria and fungi. If you throw bread, rice, meat, fruits and vegetables on the ground then you will see they have disappeared after decomposition.

Decomposition is the breakdown of dead organism and waste matter into simple substance. Bacteria and fungi are important decomposers. They help to recycle nutrients in the environment.



Bacteria



Fungi

During decomposition, bacteria and fungi break the organic molecules of food and dead bodies into simple components. The organisms which carry out decomposition are called decomposers. The rate of decomposition increases with the increase in temperature, humidity and oxygen. Sometimes, this process becomes troublesome for us. But this process is also useful to us.

Do you know?

National Cleanliness Day: Cleanliness day is observed on 30th January. This day creates awareness among people to keep their home, workplace, road and public places clean.

Useful Effects of Decomposition

By decomposition, the complex organic matter present in the dead bodies of plants and animals breaks into simple components. During this process of decomposition, carbon dioxide and nitrogen gases are released back to the environment. The producers e.g., plants use these simple materials again to make their food. In this way, decomposers recycle the matter of nonliving and living components of the environment. If decomposers do not exist then it is impossible to breakdown dead organisms into their simple components to make these a part of ecosystem again.

Point to Ponder!

What if there were no decomposers in the world?

Harmful Effects of Decomposition

Microorganisms damage food and wood by the process of decomposition. Because of them milk is spoiled, bread gets mold, fruit and vegetables are decomposed.



Harmful effects of decomposition

9. Defense Mechanism Against Infectious Diseases

Human body has the ability to defend itself against infectious diseases caused by microorganism. One way to defend the body is to provide barriers to entry of the microbes.

Barring entry

Skin and mucous membrane lining the respiratory, digestive and urinary tracts serve as barriers to the entry by the microbes. There are oil glands on the skin. Their secretions contain chemicals that weaken or kill bacteria on skin. The mucus in the nasal passage traps the bacteria and prevents their entry into lungs. The stomach has an acidic environment, which inhibits the growth of many types of bacteria.

Activity 2.10

- 1 Discussion with a physician or specialist in infectious diseases (if possible).
- 2 Students can prepare questions (regarding what causes the disease and how it can be prevented) to ask specialists in the field.

Activity 2.11**Investigating Sneeze – A Defense Mechanism**

- 1 The teacher will explain that scientists use models to study a phenomenon and will ask students to investigate through a model how far a sneeze travels.
- 2 The teacher will provide students with coloured water in a spray bottle the teacher will ask them to press the bottle and mark how far the coloured water is sprayed. Measure and record the distance. Students will repeat the process a number of times and record how far the coloured water drops spread.
- 3 The students will plot a graph of their findings. Discuss sneezing as a defense mechanism of the body.

10. Effects of too much sugar in food

The effect of intake of too much sugar in food are: higher blood pressure, inflammation, weight gain, diabetes and liver diseases. All of these are linked to an increased risk of heart attack and stroke.

Use of first aid box to dress a wound

1. Wash your hands with soap and water before handling any wound.
2. Clean out a fresh cut with a guaze or clean cloth. Proper cleaning helps prevention of microorganisms.
3. Apply elastoplast or bandage when the bleeding has stopped. It will protect the wound by preventing bacteria.



Putting elastoplast on a wound



First aid box

Key Points

1. All tiny organisms that can be seen under the microscope only are called microorganisms.
2. Viruses, bacteria and fungi are the major groups of microorganisms.
3. Viruses are very tiny infectious particles.
4. Bacteria are single-celled microorganisms found in all types of environment.
5. Fungi are simple unicellular or multicellular organisms.
6. Diseases caused by viruses are hepatitis, flu, polio etc.
7. Diseases caused by bacteria are typhoid, cholera etc.
8. Diseases caused by fungi are ring worm, athlete's foot, rust etc.
9. The disease transmitted from one person to another are called infectious disease e.g., TB, polio, COVID-19 etc.
10. Non- infectious disease is not transmitted from one person to another, e.g., diabetes, cancer etc.
11. The humans have barrier mechanism against the entry infectious diseases that includes skin, stomach acid and mucus.
12. Preventive measures that can be taken to avoid infectious diseases are washing hands, wearing mask getting vaccinated, and prevention against insects bite.
13. Vaccination improves immunity of the body. The process of vaccination is done by administering weak or killed germs through drops or injection.
14. There are five major sources of transmission of infectious diseases: air, water, animals, food and direct contact.
15. Many microorganisms are used for making medicines.
16. Some microorganisms do decomposition. They breakdown the complex matters of dead bodies into simple components.

Key Vocabulary

bacteria	fungi	microorganisms	stomach acid
control measures	germs	microscopic	transmitted
COVID 19	hygiene	mucus	vaccine
defense	infectious	mold	virus
diseases	mechanism	skin	vaccination

 **Weblinks:** Use the following weblinks to enhance your knowledge about the topics in this chapter .

Microorganisms	1. https://www.nationalgeographic.org/media/misunderstood-microbes/
Yeast	2. https://kidsdiscover.com/teacherresources/science-of-yeast-for-kids/

Exercise

1. Tick (✓) the correct answer.

- i. If you have flu, what you will do to keep others safe from infection?
- (A) will exercise (B) will sleep for more time
(C) will sit in the sun (D) will wear mask
- ii. Which one of the following causes polio?
- (A) bacteria (B) virus
(C) house fly (D) mosquito
- iii. Mainly protection against infectious diseases is done by :
- (A) wearing mask, washing hand, vaccination
(B) wearing mask, washing hand, sunbathing
(C) washing hands, sunbathing, sleeping more
(D) vaccination, washing hand, staying indoors
- iv. To which group of microorganisms mushrooms belong?
- (A) virus (B) fungi
(C) bacteria (D) protozoa
- v. Penicillium is an example of which group?
- (A) protozoa (B) fungi
(C) bacteria (D) virus
- vi. Which one of the following contaminates food?
- (A) moisture (B) microorganisms
(C) air (D) heat

vii. Which one of the following is not a microorganism?

- (A) bacteria (B) virus
(C) protozoa (D) ant

viii. What is the one way that bacteria can be helpful?

- (A) they lived on spoiled food.
(B) they can make us sick.
(C) they help to break down dead leaves, in soil.
(D) they like to eat sweet foods.

ix. Microorganisms can be found

- (A) in water (B) in air
(C) all around us (D) in animals

x. Microorganisms also help in production of food like

- (A) bread (B) fruits and seed
(C) vegetables (D) pulses

2. Write short answers.

- i. Define microorganisms.
- ii. What are main groups of microorganisms? Give examples of each group.
- iii. Write the name of diseases caused by Virus, Bacteria, and Fungi.
- iv. How do microorganisms get transmitted into humans?
- v. How do infectious diseases spread?
- vi. Differentiate between infectious and non-infectious diseases.
- vii. What are the methods of preventing the transmission of infectious diseases?
- viii. How does vaccine protect us from diseases?
- ix. How does skin, mucus, stomach acid prevent the entry of microbes into the human body?
- x. Write the advantages of microorganisms.

- xi. Write two benefits and two harmful effects of bacteria.
- xii. Describe the role of microorganisms as decomposers.
- xiii. Describe the defence mechanism against infectious diseases.

3. Constructed response questions:

The soil of forests in a hot climate is always hot and moist, whereas the soil of forests in a cold climate is cold and dry. Out of these two areas where the decomposition of fallen leaves will take place faster? Explain.



Forest of hot climate



Forest of cold climate

4. Investigate:

- i. "All microorganism are harmful and cause diseases". Prove this idea as incorrect.
- ii. Many people use antibacterial soap to kill the bacteria present on their hands. However due to excessive use of soap, the chance of getting infection increases instead of decreasing. Why does it happen?

5. Project:

The effect of quantity of sugar on the release of carbon dioxide from yeast.

Materials Required:

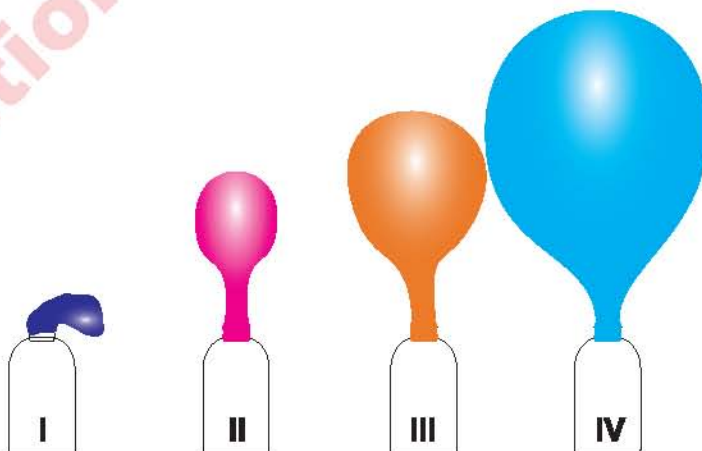
- | | | |
|---|-----------------|------------------|
| i. Teaspoon | ii. Rubber band | iii. Balloons |
| iv. Four transparent bottles of one litre | v. Marker | |
| vi. Yeast | vii. Sugar | viii. Warm water |

Procedure

- i. Take four transparent plastic bottles and label them as I, II, III and IV. Add a teaspoon of yeast in each bottle.
- ii. Add sugar in each bottle as per given table. Do not add sugar in the first bottle.

Bottle	Amount of Sugar (Teaspoons)
I	0
II	1
III	2
IV	3

- iii. Pour half cup of hot water in each bottle. Immediately, put a balloon at the mouth of each bottle and bind it strongly with rubber band.
- iv. Shake each bottle strongly to mix its contents completely.
- v. Leave all the bottles in this condition for twenty minutes.
- vi. Then observe:
 - a. Which balloon gets inflated the most?
 - b. In which bottle, most carbon dioxide gas is produced?



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