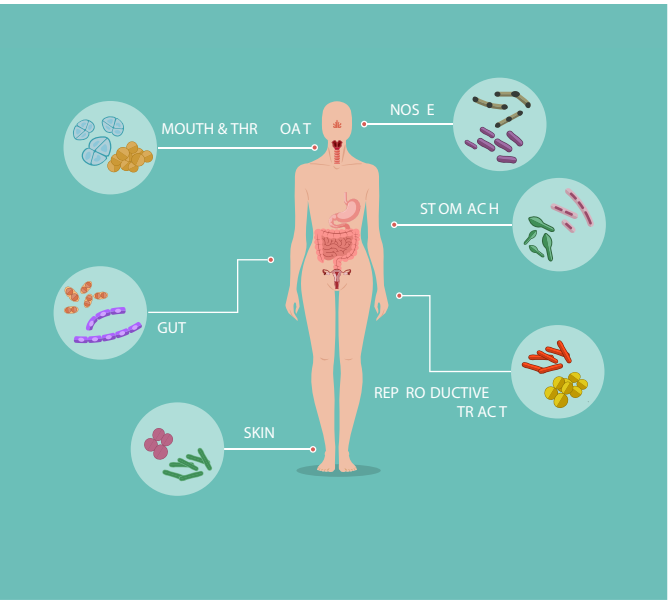
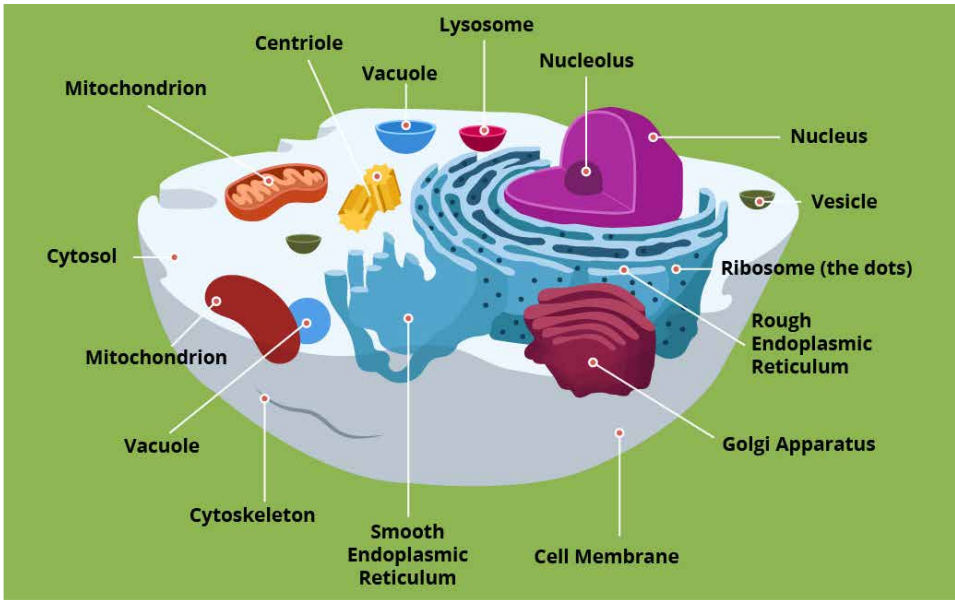
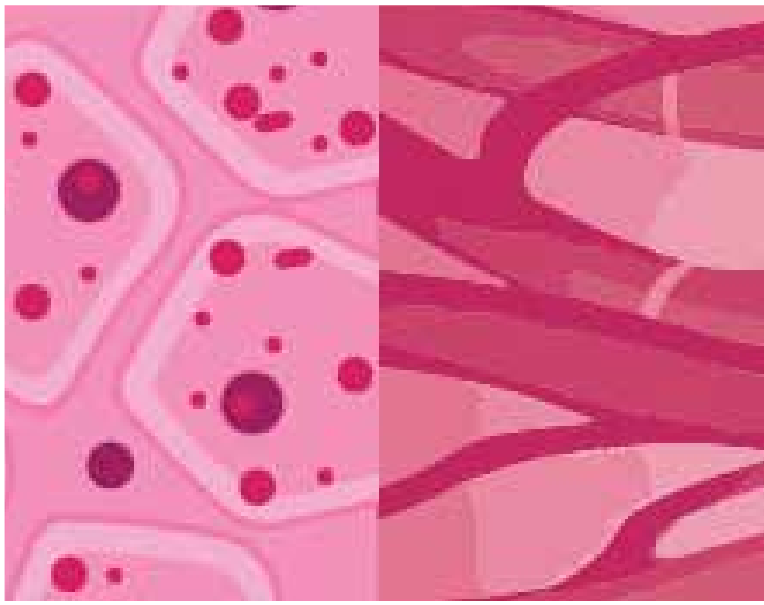
THE WHYNAUTS:

Episode 2: The Human Body

EDUCATOR GUIDE SUGGESTED GRADE LEVELS 6-8







The whynauts

Per[o]t
Museum of Nature and Science

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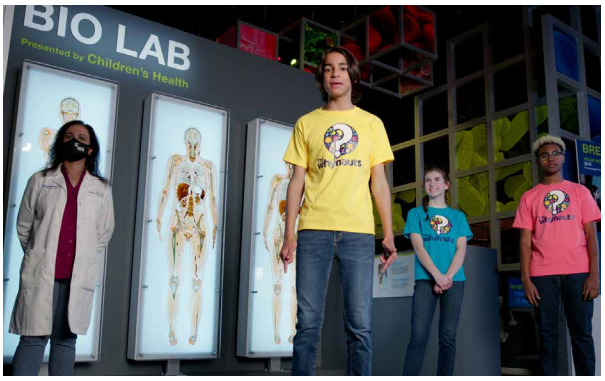
INTRODUCTION

HOW TO USE THIS GUIDE



The Whynuats **"The Human Body"** Video explores levels of organization within the human body, the main structures and functions of human body systems, and how students can keep their bodies healthy. This guide is designed to help you incorporate the video into a complete learning experience for your students. It is composed of three main sections:

The **Viewing Strategies and Tools** section includes suggested discussion questions and a pre- and post-assessment to track student learning. These materials can be printed out or completed digitally.

The **Supplemental Activities** section includes options for both hands-on and virtual learning. You can choose to use the activities in any order or combination that works best for you.

The **Additional Resources** section includes a glossary and links to continue learning.

LEARNING OBJECTIVES

Students will be able to:

- Describe the levels of organization within the human body, from organelles to organisms.
- Identify structures and functions of human body systems and explain how different body systems work together to keep them alive.
- Recognize the importance of diet and exercise in keeping their body healthy.

TEKS ALIGNMENT

6.13A. Describe the historical development of cell theory and explain how organisms are composed of one or more cells, which come from pre-existing cells and are the basic unit of structure and function.

7.13A. Identify and model the main functions of the systems of the human organism, including the circulatory, respiratory, skeletal, muscular, digestive, urinary, reproductive, integumentary, nervous, immune, and endocrine systems.

7.13B. Describe the hierarchical organization of cells, tissues, organs, and organ systems within plants and animals.

NGSS ALIGNMENT

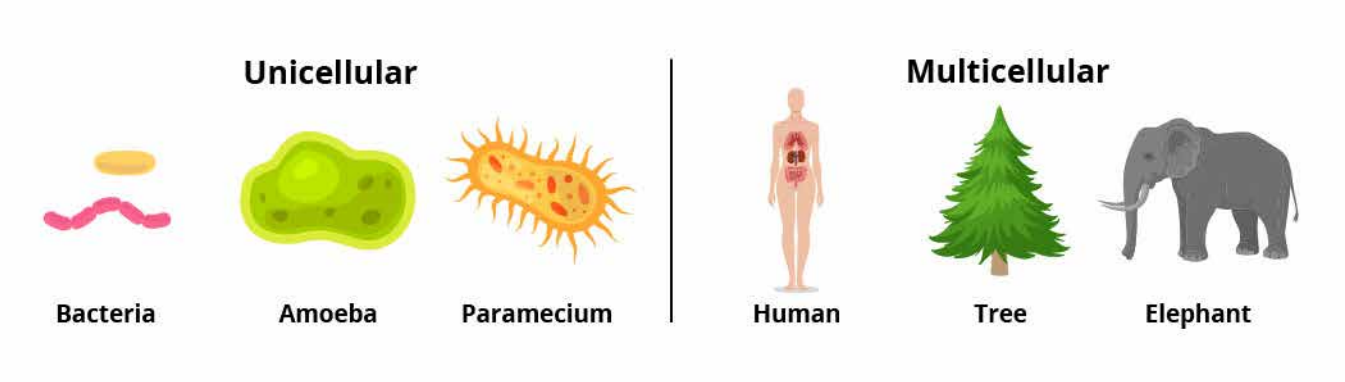
MS-LS1-1. Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells

MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells

BACKGROUND INFORMATION

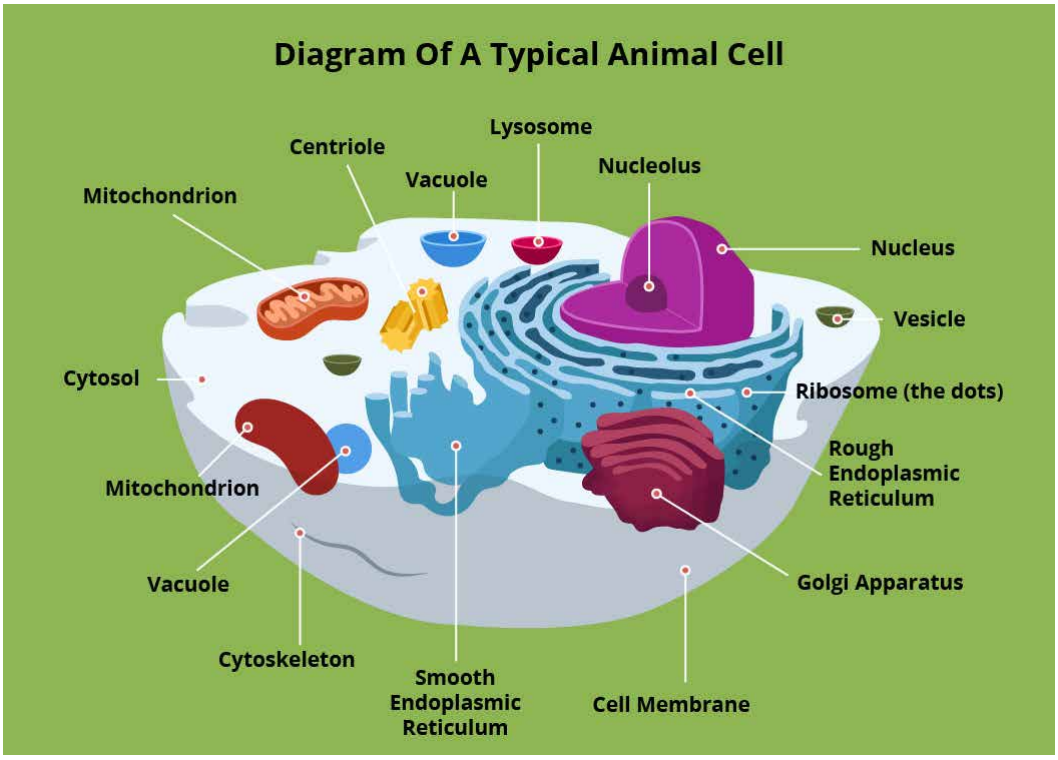
LEVELS OF ORGANIZATION WITHIN THE HUMAN BODY

All living things are made up of one or more **cells**. **Unicellular** organisms consist of only a single cell. **Multicellular** organisms are made up of more than one cell. Complex organisms, like humans, contain many different types of cells.



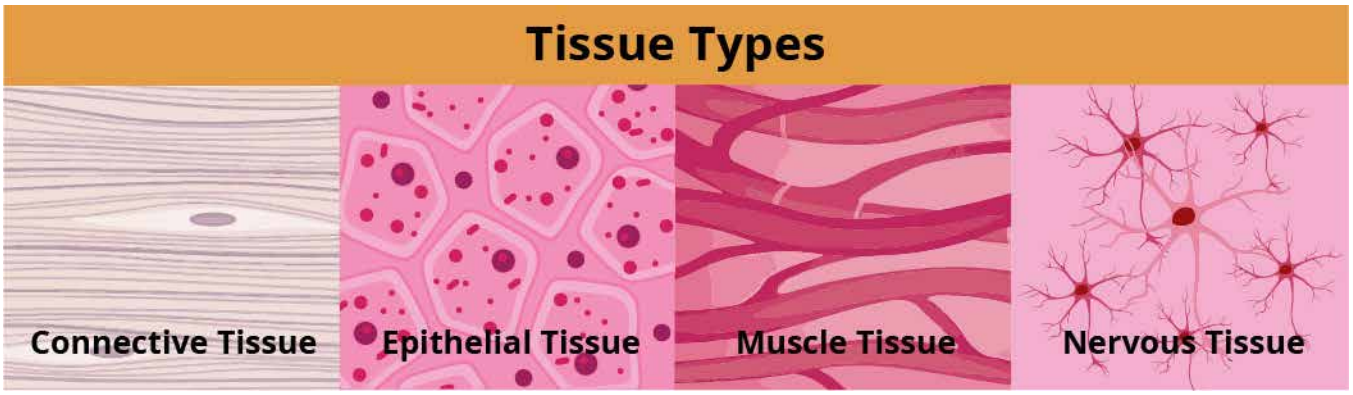
Plant and animal cells are made up of structures called **organelles** that carry out particular functions. Some examples of organelles in human cells include:

- **Cell membrane** – outer boundary that protects the cell and controls movement of substances in and out.
- **Nucleus** – large structure that stores genetic information (DNA) and provides instructions on how the cell should function.
- **Cytoplasm** – jelly-like substance that fills the cell and surrounds the other organelles.
- **Mitochondria** – rod-shaped structures that convert energy in food into energy the cell can use.
- **Vacuoles** – small sacs that store food, water, or waste.



Cells that have a similar function are organized into **tissues**. There are four types of tissues in the human body:

- **Epithelial tissue** – covers the interior and exterior boundaries of the body. Examples include the lining of the digestive system and the skin.
- **Connective tissue** – binds, supports, and protects the parts of the body. Examples include bone, tendon, cartilage, and blood.
- **Muscular tissue** – skeletal muscle contracts to initiate movement. Other types of muscle are cardiac and smooth.
- **Nervous tissue** – sends and receives electrochemical signals. Examples include the gray and white matter of the brain.



Organs are made up of two or more types of tissue working together to serve a particular function. The body is made up of many organs, such as the heart, brain, stomach, and skin.

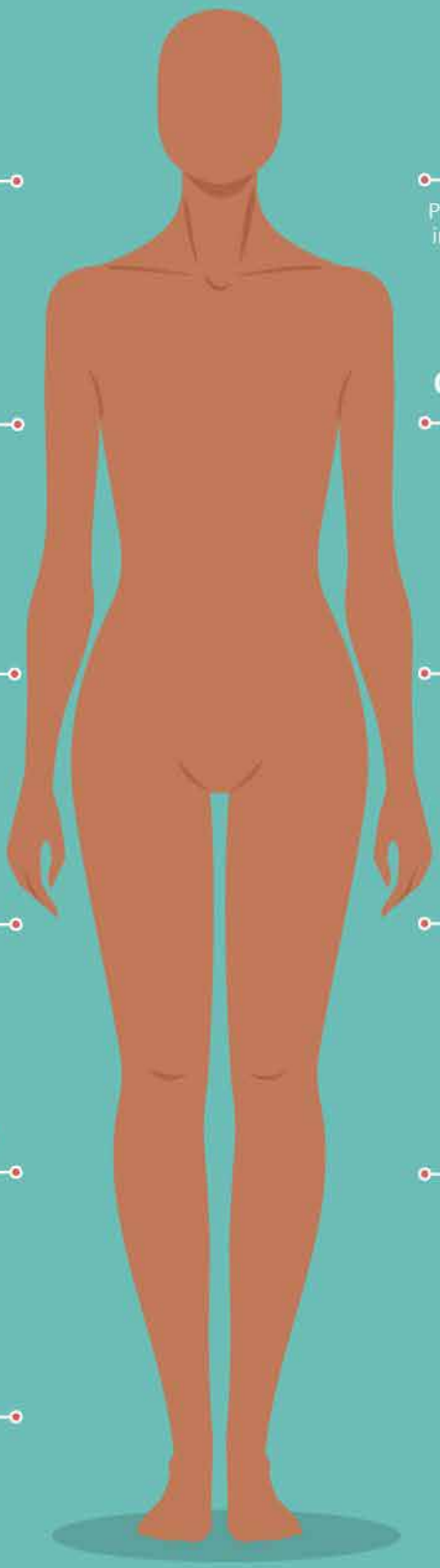
Most organs contain all four tissue types. For example, much of the heart is made of cardiac muscle tissue that pumps blood throughout the body. This muscle tissue is surrounded and protected by layers of connective tissue, and the inner chambers of the heart are lined with epithelial tissue. Nerve tissue also runs through the heart, signaling when the muscle tissue should contract and relax.

Organs that work together to carry out a complex function form an **organ system**. For example, the brain, spinal cord, nerves, and sensory organs form the nervous system, and they work together to help the body process and communicate information.

Finally, organ systems come together to form an **organism**, like you! Even though each organ system in your body has a particular function, they all interact and work together to help you survive. For example, when your body needs energy, the nervous system communicates that you are hungry. Once you eat, the muscular system and digestive system work together to break down the food. Then, the circulatory system delivers energy and nutrients to the cells of your body.

At every level of organization – cells, tissues, organs, and organ systems – **structure** is related to **function**. For example, a nerve cell, which sends information, is shaped very differently than a muscle cell, which allows for movement. Similarly, the brain, which processes information, is shaped very differently than the heart, which pumps blood.

Human Body Systems

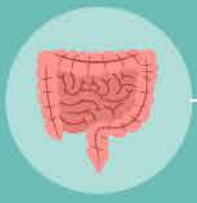


ENDOCRINE

Reglation of body processes through hormone production

RESPIRATORY

Gas exchange between the internal and external environment



DIGESTIVE

Physical and chemical breakdown of food to allow absorption of nutrients

REPRODUCTIVE

Production of reproductive cells that will generate offspring

INTEGUMENTARY

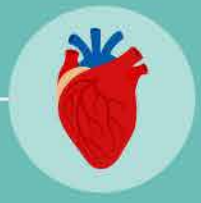
Protects against the external environment and regulation of temperature

MUSCULAR

Voluntary and involuntary movement

NERVOUS

Processing center for sensory input, using the input to elicit appropriate responses

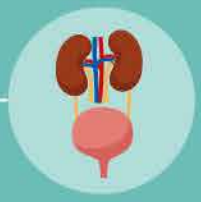


CARDIOVASCULAR

Circulation of blood, which transports gases, nutrients, hormones, and wastes

LYMPHATIC

Circulation of lymph, which maintains fluid balance and helps fight infection



URINARY

Filtration of blood and excretion of wastes from the body

SKELETAL

Support and protection of many internal organs

HEALTH AND WELLNESS

In order to keep your body heathy, it is important to eat well. This is partly because what you eat actually changes what kind of bacteria live in your body. You may think that all bacteria make you sick, but your body is home to a mix of both harmful and helpful **bacteria**. They live both inside and outside of you – like in your mouth, in your gut, and on your skin. Scientists refer to the collection of bacteria and other microbes in and on your body as a **microbiome**.

Eating healthy foods like fruits and vegetables increases the amount of helpful or 'good' types of bacteria in your microbiome. These bacteria help you digest food and nutrients, improve your immune system, and protect against buildups of harmful types of bacteria. They can also benefit your mental health and brain function.

Exercise is another important way to keep your body healthy. Exercising every day makes your muscles stronger, lowers your risk of some diseases, helps you sleep better, and can even improve your mood.

There are many STEM professionals whose careers focus on studying the human body and keeping people healthy. These include research scientists, doctors, nurses, pharmacists, biomedical engineers, nutritionists, physical therapists, imaging technicians, and many others.

DISCUSSION QUESTIONS

■ SECTION 1: LEVELS OF ORGANIZATION [BEGINNING - 4:04]

1. The video compares the organization of the human body to an amusement park. What analogy would you use?

2. How does your analogy describe how parts of the body are organized from the least to the most complex?

3. How does your analogy describe how different parts of the body work together?

4. Are there any aspects of your analogy that don't work very well? Please explain.

■ SECTION 2: HUMAN BODY SYSTEMS [4:04 – 7:33]

1. Were you playing along with the "Name That Function" game show? Which functions did you know right away?

2. Which functions stumped you?

3. Choose a body system. How do the structures that make up the system relate to its function?

■ SECTION 3: STEM CAREER SPOTLIGHT [7:33 – END]

1. How would you explain the saying "you are what you eat"?

2. Do you agree with Dr. Mirpuri that poop is cool? Why?

3. What part of the human body would you choose to study? Why?

Pre- and Post-Video Assessment

1. Which of the following correctly orders the organization within the human body from least to most complex?

A) Tissue - Cell - Organ - Organ System

B) Cell - Organ - Tissue - Organ System

C) Organ System - Organ - Tissue - Cell

D) Cell - Tissue - Organ - Organ System

2. Match each human body system to its main function:

_____	**1.** Circulatory system	**A.**	Exchange oxygen and carbon dioxide
_____	**2.** Respiratory system	**B.**	Produce sex cells and offspring
_____	**3.** Skeletal system	**C.**	Body's first line of defense
_____	**4.** Muscular system	**D.**	Remove liquid waste
_____	**5.** Digestive system	**E.**	Transport oxygen and nutrients
_____	**6.** Excretory system	**F.**	Process and communicate information
_____	**7.** Reproductive system	**G.**	Process food for energy and nutrients
_____	**8.** Integumentary system	**H.**	Provide the body structure and support
_____	**9.** Nervous system	**I.**	Enable movement
_____	**10.** Endocrine system	**J.**	Produce hormones

3. Describe an example from your day when two or more body systems were working together:

4. Why is it important to eat a healthy diet?

ANSWER KEY

Pre- and Post-Video Assessment

1. Which of the following correctly orders the organization within the human body from least to most complex?

A) Tissue - Cell - Organ - Organ System

B) Cell - Organ - Tissue - Organ System

C) Organ System - Organ - Tissue - Cell

D) Cell - Tissue - Organ - Organ System

2. Match each human body system to its main function:

E	**1.** Circulatory system	**A.** Exchange oxygen and carbon dioxide
A	**2.** Respiratory system	**B.** Produce sex cells and offspring
H	**3.** Skeletal system	**C.** Body's first line of defense
I	**4.** Muscular system	**D.** Remove liquid waste
G	**5.** Digestive system	**E.** Transport oxygen and nutrients
D	**6.** Excretory system	**F.** Process and communicate information
B	**7.** Reproductive system	**G.** Process food for energy and nutrients
C	**8.** Integumentary system	**H.** Provide the body structure and support
F	**9.** Nervous system	**I.** Enable movement
J	**10.** Endocrine system	**J.** Produce hormones

3. Describe an example from your day when two or more body systems were working together:

Answers will vary. Examples could include:

- Skeletal and muscular system working together to walk to school
- Muscular and digestive system working together to break down breakfast
- Nervous system and circulatory system working together to keep heart beating

4. Why is it important to eat a healthy diet?

Answers will vary. Examples could include:

- To have enough energy for your body to do all it needs to do
- To prevent certain diseases
- To ensure you have enough 'good' bacteria in your body

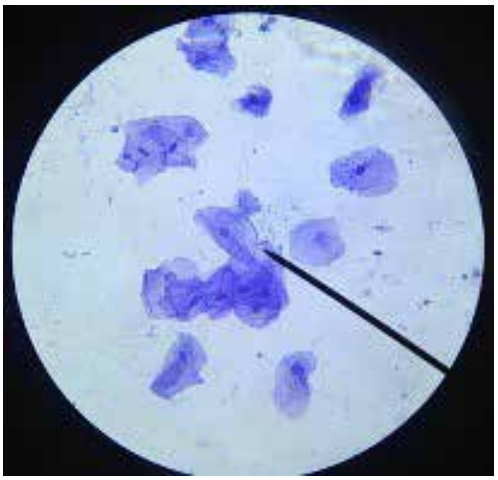
Cheek Cell DNA Extraction

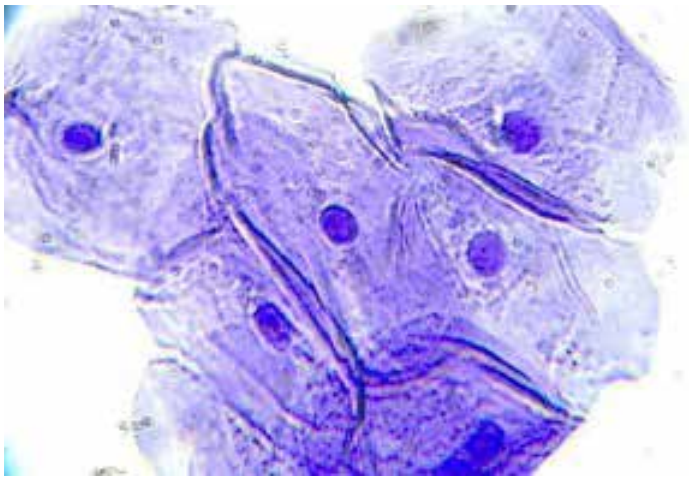
CAN YOU SEE YOUR OWN DNA?

INTRODUCTION:

DNA, or deoxyribonucleic acid, is the genetic material found in humans and most other living things. With the exception of red blood cells, every **cell** in your body contains DNA.

In this activity, you will extract DNA from your own cheek cells. Take a look at the images of human cheek cells below. What do you observe?





One thing you may have noticed is the dark blue circle towards the center of each cell. These cells have been stained so that the **nucleus** appears dark blue. In your cells, most DNA is found in the nucleus, but some is also found in the **mitochondria**.

The extraction process you will use is very similar to the procedure scientists use to extract DNA in the lab. It happens in 3 basic steps:

1. **Collection –** collect your cheek cells.
2. **Lysis –** break up the **cell membrane** and the membrane around the nucleus, releasing their contents, including DNA.
3. **Precipitation –** cause the DNA to come out of solution and form a solid you can see.

Materials:

- 2 cups water
- 1 tablespoon table salt
- Dish soap
- Rubbing alcohol (works best if chilled)
- 2 clear plastic cups or glasses
- Tablespoon
- Measuring cup

Procedure:

1. Prepare the salt water solution in one of the cups by mixing 2 cups of water with 1 tablespoon of table salt. Stir until the salt is dissolved.
2. Measure out 1/4 cup of the salt water solution and put it into the other cup. Swish the contents around in your mouth for 1 minute.
3. Spit your mouthwash solution back into the empty cup.
4. Add 2 drops of dish soap.
5. Gently swirl the contents for 1 minute. Be careful not to create any bubbles.
6. Tilt the cup, and slowly add 3 tablespoons of rubbing alcohol down the side so that it forms a layer on top.
7. Wait 1 minute. Do you see a cloud of bubbles forming at the bottom layer of the alcohol? The bubbles are attached to your DNA.
8. Keep observing for 5 minutes. Record your observations after each minute.

Record your observations:

TIME	OBSERVATIONS
1 MIN	
2 MIN	
3 MIN	
4 MIN	
5 MIN	

QUESTIONS

1. What do you think was the role of the salt?

2. What do you think was the role of the soap?

3. What do you think was the role of the rubbing alcohol?

4. A single strand of DNA is so small that you can only see it using an electron microscope. How do you think you can see your DNA with this procedure?

ANSWER KEY

1. What do you think was the role of the salt?
   The salt helps loosen cells from the surface of your cheeks. It also neutralizes the negative charge of DNA, causing it to be less soluble in water.

2. What do you think was the role of the soap?
   The soap breaks up the membranes of the cell and the nucleus and frees the contents, including DNA.

3. What do you think was the role of the rubbing alcohol?
   DNA is soluble in water, but not in alcohol. The rubbing alcohol helps the DNA precipitate out of solution and form a solid.

4. A single strand of DNA is so small that you can only see it using an electron microscope. How do you think you can see your DNA with this procedure?
   Your sample contains more than a single strand of DNA. The wad of DNA you see is made up of thousands of tiny DNA strands clumped together.

Body Systems Review Game

IT'S TIME TO REVIEW! DO YOU KNOW YOUR BODY SYSTEMS?

INTRODUCTION:

Organs that work together to carry out a complex function form an **organ system**. Organ systems come together to form an **organism**, like you! Even though each organ system in your body has a particular function, they all interact and work together to help you survive.

Studies have shown that playing is a great way to learn. In "The Human Body" episode, the Whynauts play *Name That Function!*, a quick and easy game show to review the body's systems and functions. Now it's your turn!

Materials:

- *Name that Function!* Cards (optional)
- Timer (optional)

Procedure:

Create your own game based on your favorite card game, board game, or game show. Be creative with how you ask the game participants to answer the questions. Examples of possible game styles include *Go Fish, Memory, Heads Up!, Monopoly, Candyland, Chutes and Ladders, or Jeopardy!*

Game Guidelines:

- Your game must incorporate at least 6 of the following body systems:
  - Circulatory system
  - Respiratory system
  - Skeletal system
  - Muscular system
  - Digestive system
  - Excretory system
  - Reproductive system
  - Integumentary system
  - Nervous system
  - Endocrine system
- Participants should be able to describe the functions or identify primary organs of the body systems in their answers.
- You can use the cards provided or create your own.
- Your format should take into account the intended number of participants.
- Choose a catchy name for your game.
- Write instructions for your game that make it easy for players to understand how to play.

Challenge! Incorporate how two or more body systems work together in the design of your game.

QUESTIONS

1. Describe how you came up with the idea for your game.

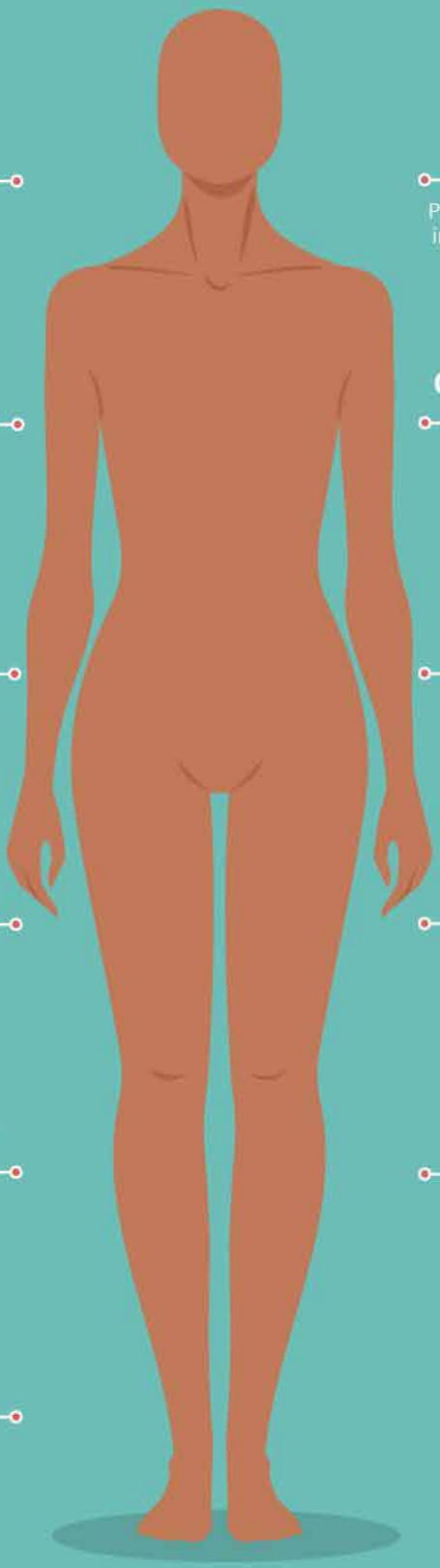
2. Which body systems did your game incorporate?

3. Explain how your game reviews the structures and functions of these systems.

4. Did you find a way to incorporate how two or more body systems work together? If so, how?

5. Ask the players for feedback after playing the game. What did they say? How would you change the game based on this feedback?

Human Body Systems

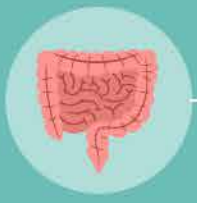


ENDOCRINE

Reglation of body processes through hormone production

RESPIRATORY

Gas exchange between the internal and external environment



DIGESTIVE

Physical and chemical breakdown of food to allow absorption of nutrients

REPRODUCTIVE

Production of reproductive cells that will generate offspring

INTEGUMENTARY

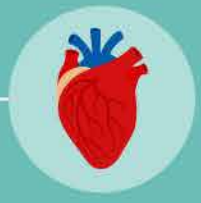
Protects against the external environment and regulation of temperature

MUSCULAR

Voluntary and involuntary movement

NERVOUS

Processing center for sensory input, using the input to elicit appropriate responses

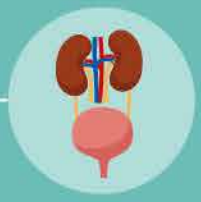


CARDIOVASCULAR

Circulation of blood, which transports gases, nutrients, hormones, and wastes

LYMPHATIC

Circulation of lymph, which maintains fluid balance and helps fight infection



URINARY

Filtration of blood and excretion of wastes from the body

SKELETAL

Support and protection of many internal organs

NAME THAT FUNCTION! CARDS

NAME THAT FUNCTION! CARDS

Produce hormones to regulate body processes	**Respiratory**
Muscular	Brain, spinal cord, nerves, sensory organs (eyes, ears, tongue, skin, nose)
Gas exchange, deliver oxygen and remove carbon dioxide	**Integumentary**
Endocrine	Adrenal gland, pituitary gland, pancreas, thyroid
Bones, cartilage, tendons, ligaments	Mouth, salivary glands, esophagus, stomach, liver, gallbladder, pancreas, small intestine, large intestine

NAME THAT FUNCTION! CARDS

NAME THAT FUNCTION! CARDS

Heart, blood vessels, blood	Mouth, nose, pharynx, larynx, trachea, bronchi, lungs, diaphragm
Kidneys, ureters, bladder, urethra	Voluntary and involuntary movement
Digestive	Skin, hair, nails
Break down foods for energy and nutrients	Skeletal, smooth, and cardiac muscles
Excretory	Produce sex cells and offspring

NAME THAT FUNCTION! CARDS

NAME THAT FUNCTION! CARDS

Body's first line of defense, help regulate body temperature	**Skeletal**
Nervous	Filter blood and remove liquid waste
Provide structure and support, protect internal organs, make red blood cells	Process and communicate information to regulate body activity
Reproductive	**Circulatory**
Female: Vagina, uterus, fallopian tubes, ovaries Male: Testes, duct system, accessory glands, penis	Deliver oxygen and nutrients to cells, transport carbon dioxide waste away

Exercise Exploration

HOW DOES YOUR BODY RESPOND TO EXERCISE?

INTRODUCTION:

Exercise is one of the best ways to keep your body healthy. Exercising every day makes your body stronger, lowers your risk of some diseases, helps you sleep better, and can even improve your mood.

When you use your muscles, they become stronger. This helps them better support your joints and prevent injuries. Aerobic exercise strengthens your heart and lungs, which makes them better at getting oxygen to all parts of your body. Stretching is also an important component of exercise, as flexibility allows your muscles and joints to move more easily.

During exercise, your body requires more energy, which means it needs more oxygen and produces more carbon dioxide. This increased demand causes changes in your body in order to maintain **homeostasis** – the tendency to have a stable, relatively constant internal environment. In this investigation, you will determine how exercise affects your heart rate, breathing rate, and other conditions.

Materials:

- Stopwatch or timer

Before You Begin:

1. How do you think exercising will affect your heart rate?

2. How do you think exercising will affect your breathing rate?

3. How else do you think your body will change in response to exercising?

Procedure:

- Determine Your Resting Heart Rate:
  Use your pointer and middle fingers of one hand to find your pulse on the opposite wrist, just below the base of your thumb. Gently press down and count how many pulses you feel in 15 seconds. Record this number in the data table. Multiply by 4 to calculate your heart rate in beats per minute.
- Determine Your Resting Breathing Rate:
  Count how many breaths you take in 15 seconds. Record this number in the data table. Multiply by 4 to calculate your breathing rate in breaths per minute.
- How Does Your Body Respond to Exercise?
  1. Perform an exercise, such as doing jumping jacks, for 1 minute.
  2. As soon as you are done, count how many times your heart beats for 15 seconds. Record this number in the data table and calculate your heart rate.
  3. Count how many breaths you take for 15 seconds. Record this number in the data table and calculate your breathing rate.
  4. How do you feel? For example, do you feel tired? Do you feel warmer? Are you sweating? What else do you notice? Record your observations.
  5. Repeat this process until you have exercised for a total of 4 minutes.
  6. After your 4 minutes of exercise, rest for 1 minute. Record your heart rate, breathing rate, and observations.

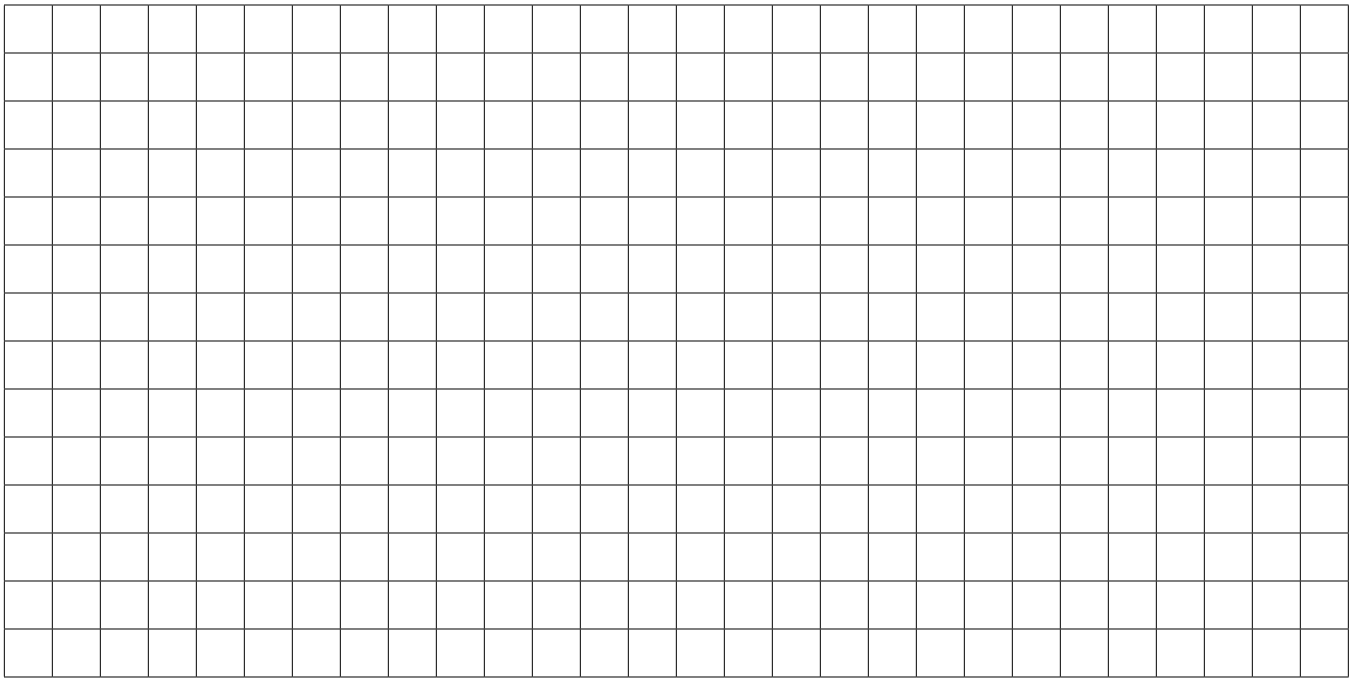
Note: If you start to feel dizzy or unwell, stop exercising right away. Use a friend's data to continue the investigation.

RESULTS AND OBSERVATIONS:

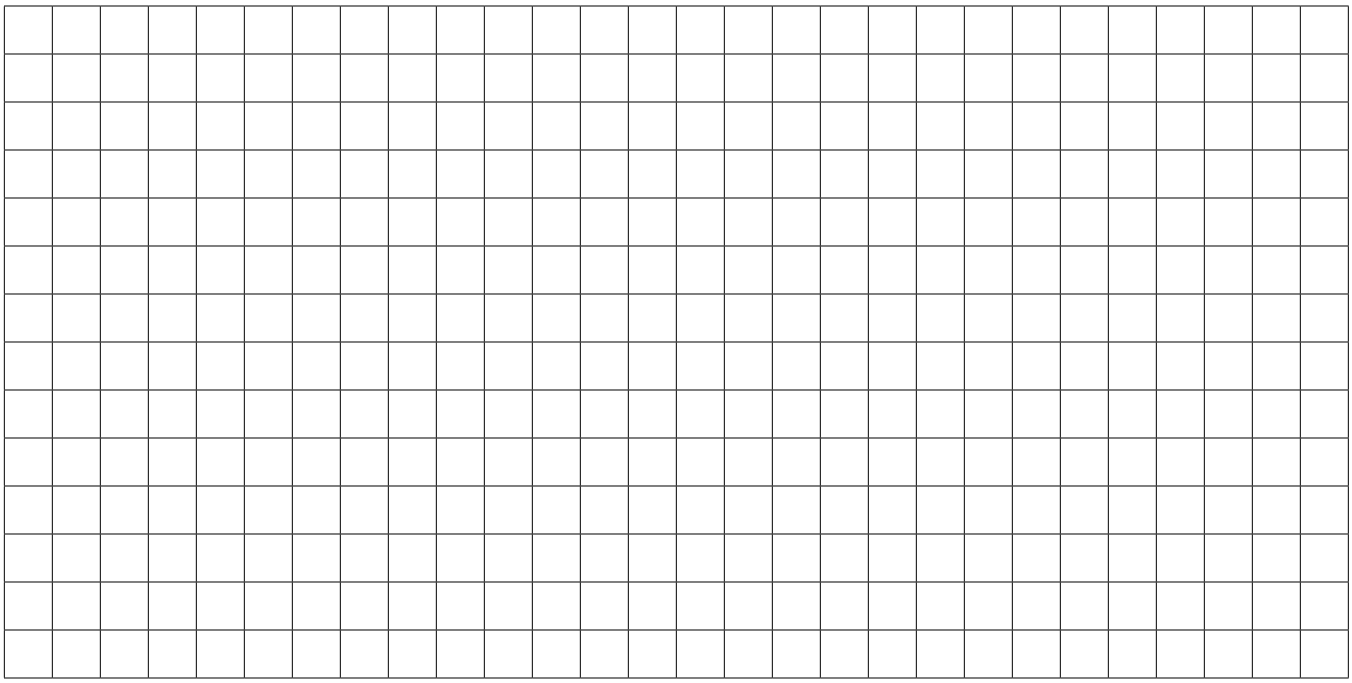
My exercise: _____

TIME	# HEART BEATS IN 15 SECONDS	HEART RATE (BEATS/ MIN)	# BREATHS IN 15 SECONDS	BREATHING RATE (BREATHS/ MIN)	OBSERVATIONS – HOW DO YOU FEEL?
REST (0 MIN)					
1 MIN					
2 MIN					
3 MIN					
4 MIN					
REST 1 MIN					

Graph how your heart rate changed in response to exercise:



Graph how your breathing rate changed in response to exercise:



QUESTIONS

1. How did exercising affect your heart rate? Why do you think this happened?

2. How did exercising affect your breathing rate? Why do you think this happened?

3. How else did your body change in response to exercising? Why do you think this happened?

4. Do your results agree with your predictions? Why or why not?

5. Explain how at least 3 different body systems were involved in your response to exercise. How do these systems work together?

ANSWER KEY

1. How did exercising affect your heart rate? Why do you think this happened?
   Heart rate increases with exercise. During exercise, your muscles require more energy and more oxygen. Your heart beats faster so that more blood, and therefore more oxygen, is delivered to your muscle cells.

2. How did exercising affect your breathing rate? Why do you think this happened?
   Breathing rate also increases with exercise. During exercise, your muscles require more oxygen and produce more carbon dioxide. You have to breathe in more oxygen and breathe out more carbon dioxide to meet this increased demand.

3. How else did your body change in response to exercising? Why do you think this happened?
   Answers will vary, but may include an increase in temperature or sweating. When you exercise, your muscles convert stored energy into heat energy, raising your body temperature. You start sweating because evaporating sweat cools your body down.

4. Do your results agree with your predictions? Why or why not?
   Answers will vary.

5. Explain how at least 3 different body systems were involved in your response to exercise. How do these systems work together?

- Circulatory system – increased heart rate to deliver more oxygen to cells.
- Respiratory system – increased breathing rate to bring more oxygen into the body and release more carbon dioxide.
- Integumentary system – increased sweating to regulate temperature.
- Muscular system – increased muscle temperature, may have started to get tired.
- Nervous system – coordinated response of different body systems, including heart rate and breathing rate.
- Answers will vary. For example – when you inhale, the diaphragm (a muscle) contracts allowing the lungs to enlarge and take in air. The right side of the heart pumps oxygen-poor blood from your veins to your lungs to pick up this oxygen and get rid of carbon dioxide. The left side of your heart receives this oxygen-rich blood from your lungs and then pumps it through your arteries to the rest of your body (including to your muscles).

You Are What You Eat

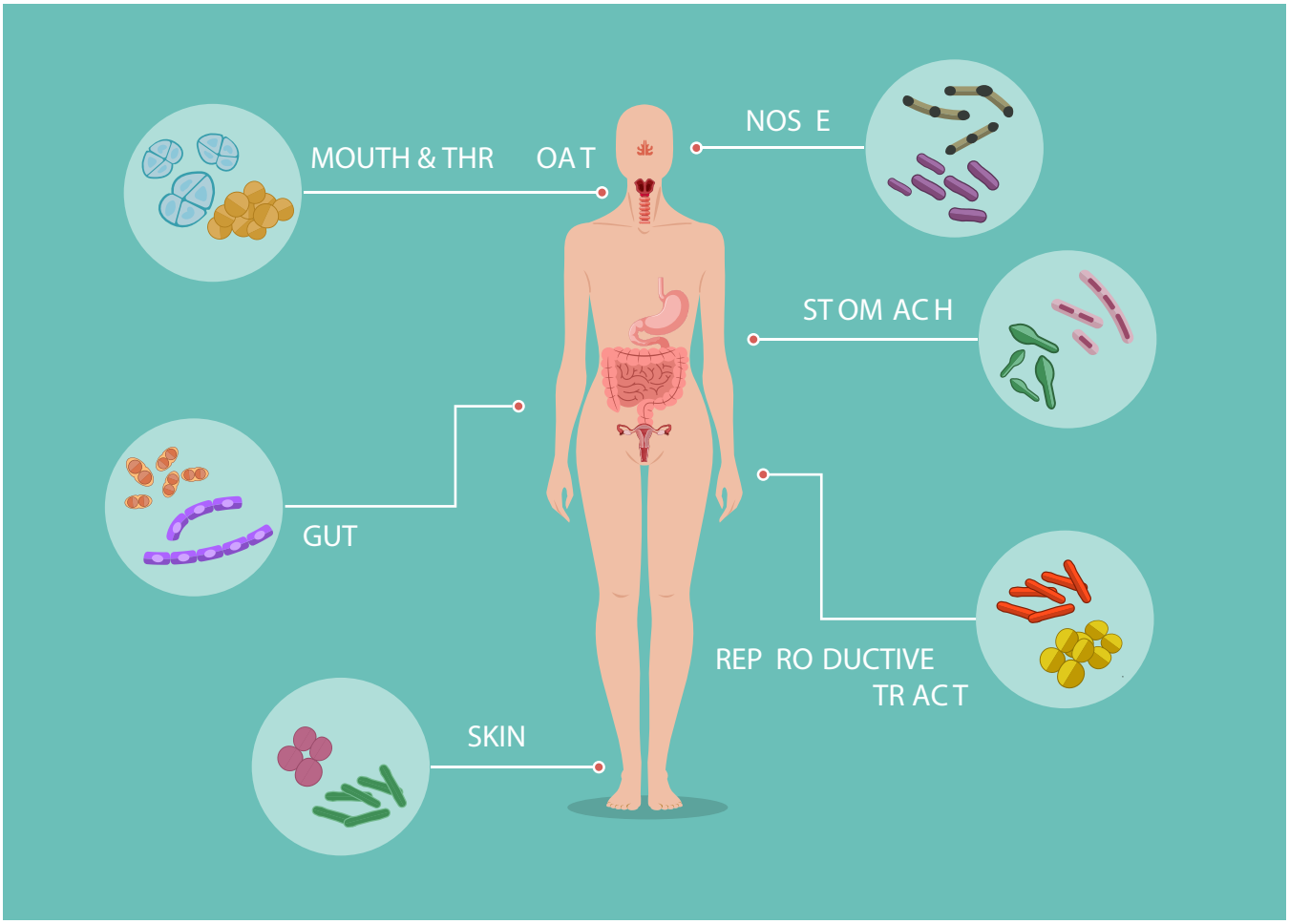
WHY DOES YOGURT CONTAIN LIVE BACTERIA?

INTRODUCTION:

In order to keep your body healthy, it is important to eat well. This is partly because what you eat actually changes what kind of **bacteria** live in your body. You may think that all bacteria make you sick, but your body is home to a mix of both harmful and helpful bacteria. They live both inside and outside of you – like in your mouth, in your gut, and on your skin. Scientists refer to the collection of bacteria and other microbes in and on your body as a **microbiome**.

Helpful or 'good' types of bacteria in your microbiome help you digest food and nutrients, improve your immune system, and protect against buildups of harmful types of bacteria. They can also benefit your mental health and brain function.

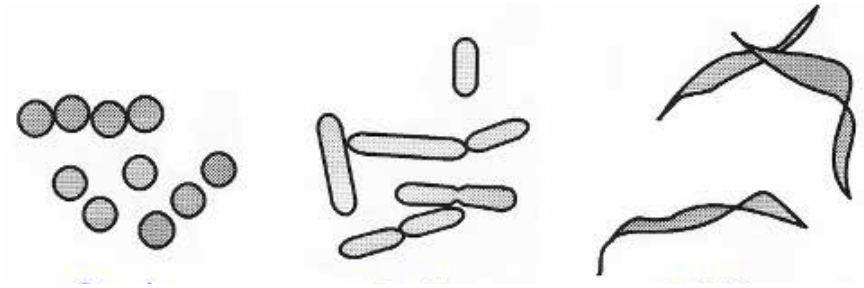
WHERE MICROBES ARE FOUND IN THE HUMAN BODY:



Some foods contain live 'good' bacteria, which we call **probiotics**. These foods include yogurt, some types of cheeses, and even some pickles! In this investigation, you will look for evidence of probiotic bacteria in a sample of yogurt.

Bacteria come in three basic shapes:

- Spheres (cocci)
- Rods (bacilli)
- Spirals (spirilla)



Cocci **Bacilli** **Spirilla**

"Bacteria Shapes" by CKRobinson is licensed under CC BY-SA 4.0

Yogurt can contain many different types of bacteria. Two of the most common types are *Lactobacillus bulgaricus* and *Streptococcus thermophilus*. Based on their names, what shape do you think these bacteria are?

Look at the nutrition information and ingredients listed on your yogurt container. What live cultures does it contain?

How many different shapes of bacteria do you think you will find?

Materials:

- Compound light microscope
- Plain yogurt with active cultures
- Toothpick
- Glass slide and coverslip
- Distilled water
- Dropper
- Paper towel

Procedure:

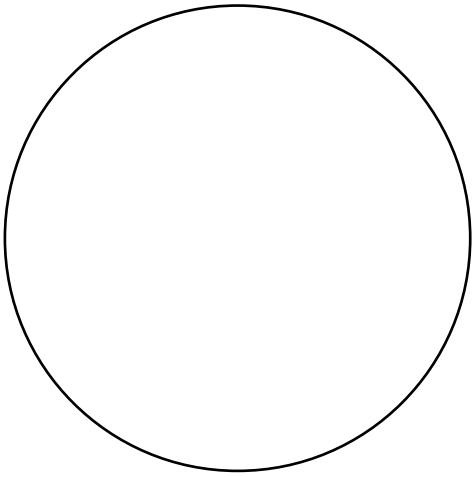
1. Use the toothpick to place a small amount of yogurt onto the slide and spread it into a thin layer.
2. Add one drop of water to the yogurt and place the cover slip on top. Remove excess water with a paper towel.
3. Use the microscope at low magnification to find an area where the yogurt is very thin.
4. Switch to a higher magnification to look for bacteria. They will appear small even at high magnification. Tip: look for something that is moving.

Observations:

Sketch and record your observations for different magnifications:

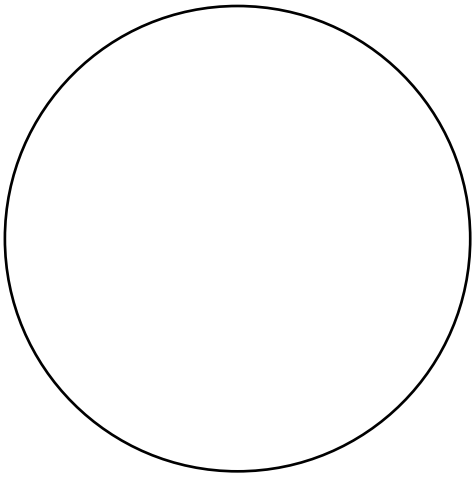
Magnification: ____

Observations:



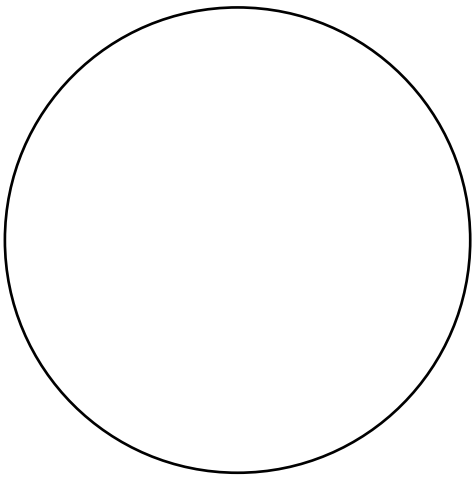
Magnification: ____

Observations:



Magnification: ____

Observations:



How many different types of bacteria did you find?

How can you tell the difference?

THE HUMAN MICROBIOME:

Research the human microbiome and how it affects our health.

Some resources you may want to check out:

- Interactive: Your Microbial Friends
- Website: The Microbiome and Disease
- Science Articles:
  - How Do Bacteria in the Gut Control the Brain
  - We Are Never Alone: Living with the Human Microbiota
  - The Intestinal Universe—Full of Gut Heroes Who Need Sidekicks
  - Happy Gut Bacteria, Happy Brain: The Microbiota-Gut-Brain Axis
  - What Are Poop Transplants and How Do They Work?

QUESTIONS

1. What roles do 'good' bacteria play in the human body?

2. What roles do 'bad' bacteria play in the human body?

3. What kinds of foods are good for your microbiome?

4. What kinds of foods are not good for your microbiome?

ANSWER KEY

1. What roles do 'good' bacteria play in the human body?

Answers may include:

- Break down food we can't digest on our own
- Produce vitamins
- Protect against the buildup of harmful bacteria
- Control blood pressure
- Decrease inflammation
- Maintain the protective barrier of the skin
- Support brain development

2. What roles do 'bad' bacteria play in the human body?

Some bacteria can cause diseases, like strep throat or pneumonia. They can also cause food poisoning and dental cavities. Bacteria have also been linked to acne, asthma, skin problems, diabetes, depression, and many other conditions.

3. What kinds of foods are good for your microbiome?

- Foods high in fiber, such as fruits, vegetables, beans, high fiber cereals, and dark breads
- Foods containing probiotics, such as yogurt, kombucha, and other fermented foods

4. What kinds of foods are not good for your microbiome?

- Foods high in refined sugar, such as cake, brownies, sugary cereals, and white bread
- Foods high in saturated fat, such as fatty meats, butter, and fried food

RESOURCES

GLOSSARY

Bacteria - a class of unicellular organisms. Some bacteria are harmful to the human body, while other bacteria help it function

Cell - the basic unit of all living things

Cell membrane - outer boundary of an animal cell that protects it and controls movement of substances in and out

Cytoplasm - jelly-like substance that surrounds the organelles in plant and animal cells

DNA (deoxyribonucleic acid) - the genetic material of humans and most other living things

Function - the role or job of a particular structure

Homeostasis - the tendency to resist change in order to maintain a stable, relatively constant internal environment

Microbiome - the collection of microorganisms in a particular environment, such as the body; can also refer to the combined genetic material of the microorganisms in a particular environment

Mitochondria - rod-shaped structures within a cell that convert energy in food into energy the cell can use

Multicellular - consisting of two or more cells

Nucleus - large structure inside a plant or animal cell that stores genetic information and provides instructions on how the cell should function

Organ - two or more tissues that work together to serve a particular function

Organelle - a small structure that makes part of a cell and performs a specific function

Organism - an individual living thing, such as a plant, animal, or bacterium

Organ system - a group of organs that work together to carry out a complex function

Probiotic - bacteria that support the heath of the gut and other parts of the body; these are often called 'good' or 'friendly' bacteria

Structure - an arrangement of parts, such as an organelle that makes up a cell or an organ that makes up the human body

System - a set of parts interacting and working together

Tissue - a group of cells that are similar in structure and perform a similar function

Unicellular - consisting of a single cell

Vacuole - small sacs inside a plant or animal cell that store food, water, or waste

Human Body Systems:

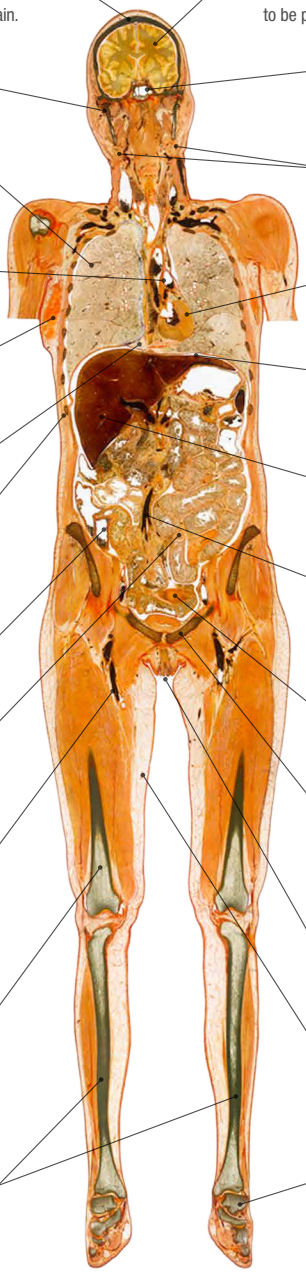
ORGAN SYSTEM	FUNCTION	ORGANS, TISSUES, AND STRUCTURES INVOLVED
Circulatory	Deliver oxygen and nutrients to cells, transport carbon dioxide waste away	Heart, blood vessels, blood
Respiratory	Gas exchange, deliver oxygen and remove carbon dioxide	Mouth, nose, pharynx, larynx, trachea, bronchi, lungs, diaphragm
Skeletal	Provide structure and support, protect internal organs, make red blood cells	Bones, cartilage, tendons, ligaments
Muscular	Voluntary and involuntary movement	Skeletal, smooth, and cardiac muscles
Digestive	Break down foods for energy and nutrients	Mouth, salivary glands, esophagus, stomach, liver, gallbladder, pancreas, small intestine, large intestine
Excretory	Filter blood and remove liquid waste	Kidneys, ureters, bladder, urethra
Reproductive	Produce sex cells and offspring	Female: Vagina, uterus, fallopian tubes, ovaries Male: Testes, duct system, accessory glands, penis
Integumentary	Body's first line of defense, help regulate body temperature	Skin, hair, nails
Nervous	Process and communicate information to regulate body activity	Brain, spinal cord, nerves, sensory organs (eyes, ears, tongue, skin, nose)
Endocrine	Produce hormones to regulate body processes	Adrenal gland, pituitary gland, pancreas, thyroid

Organ Diagram

'SPECIMEN A' FROM PEROT MUSEUM'S *BEING HUMAN HALL*

Specimen A

This series of specimens all came from the same female donor. This front-view slice comes from slightly before the center of the body.



SKULL
Made of several fused bones, your skull forms a protective cavity for the brain.

BRAIN
The loosely folded structure of the brain allows for more tissue to be packed into your skull.

JAWBONE (MANDIBLE)
This bone moves up and down as you talk or eat.

SPHENOID SINUS
Located deep within the skull, this cavity allows mucus to drain into your nose.

LUNGS
Your lungs take in oxygen, which blood vessels (the tiny dark spots) carry to the body.

SALIVARY GLANDS
These glands produce saliva for your mouth. They can become infected with the virus that causes mumps.

ASCENDING AORTA
This is the first part of the aorta, the largest artery in your body.

HEART
Part of the strong heart muscle is just visible here.

BREAST TISSUE
This part of the woman's breast mainly consists of muscle and fatty tissue.

PLEURAL SPACE
Normally filled with a small amount of fluid, this space allows your lungs to expand when you inhale.

DIAPHRAGM
As this muscle contracts and expands, it moves air into and out of your lungs.

LIVER
The liver, your largest internal organ, cleans the blood and produces bile and cholesterol.

RIBS
The ribcage supports your chest and protects your internal organs.

ILIAC ARTERIES
These two large arteries branch off the aorta and supply blood to the lower part of your body.

LARGE INTESTINE (COLON)
This organ absorbs water and turns undigested food into waste.

WOMB (UTERUS)
In pregnant women, this organ protects and nourishes a developing baby.

SMALL INTESTINE
Folded and packed into your abdominal cavity, just below the stomach, the small intestine absorbs nutrients from digested food.

PUBIC BONES
Part of the hip, these bones bear the weight of your upper body when you sit and stand.

FEMORAL ARTERY
This large artery supplies blood to your legs. Doctors insert catheters here to reach the heart, lungs and brain.

VAGINA
This is the exterior portion of the birth canal in women.

THIGH BONE (FEMUR)
The femur is one of your body's strongest bones. Only the very end of it, near the knee, is visible here.

SUBCUTANEOUS FAT
This type of fat is stored just under your skin.

LOWER LEG BONE (TIBIA)
This is one of two bones that make up the lower leg.

ANKLE AND FOOT BONES
A group of bones called the tarsals and metatarsals give your foot great flexibility.

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IfThenCollection.org/Julie

PERSONAL STATEMENT

Hi I'm Julie Mirpuri. My motto in life has always been: "do what you love and success will follow". I have followed my heart in choosing and developing my career. I fell in love with the idea of being able to care for people when I was a child. And my love for biology and the mystery of the human body led me to medicine. When I was in medical school, I realized I loved taking care of children, and when I was training in Pediatrics, I fell in love with babies, and pursued further training in neonatology.

During my training in neonatology, I was offered the opportunity to do research on probiotic bacteria and how they affect the intestine. I remember going into the laboratory and being so excited to pick up that pipette, an amazing device that allows precise measurement of liquid. The idea of being able to ask questions in the hospital with unclear answers, and then test solutions for those questions in the laboratory was immensely stimulating. I was truly in love.

I continued training in the laboratory, focusing on understanding techniques to study immune cells and how they interact with bacteria. We now know that how we are colonized can influence our susceptibility to disease as children and as adults. I want to be able to find ways to change how babies colonize with bacteria to maximize their health.

There is nothing more satisfying to me than sending a previously sick baby home with his or her parents. And the best part of my job is that I will always get to play with babies!

So what do you love? And how will you use your passion to make every day of your life gratifying and successful?

https://drive.google.com/file/d/1DKIWVHYd21yWIjJIBiSfreCd0m6n8NAR/view

BIOGRAPHY

A doctor and a scientist, Julie Mirpuri has dedicated her life to saving newborn babies. A board-certified pediatrician, Julie underwent advanced training to specialize in neonatal care and as a scientist who can study immune cells and how they interact with bacteria. When she is not in the hospital taking care of sick babies, she works in her laboratory to develop new therapies to impact more babies' lives. She has authored several original research publications and has received several awards in recognition of her contributions to neonatal research.

Julie believes the key to preventing disease in babies lies in their poop. By studying how newborn babies become colonized with bacteria ➔

she hopes to be able to manipulate their bacteria to protect them from developing disease. She collects stool from newborn babies and mice to understand how the environment before and after birth affects bacterial gut colonization. In her world, stool is cool.

Julie trained in neonatology at Emory University in Atlanta. She now lives in Dallas, Texas with her husband and 2 sons. She practices medicine and does her research at UT Southwestern Medical Center.

SPEAKER TOPICS

1. The mysteries of the bacteria in your body and how food affects it. Target: Anyone.

SEGMENT PITCHES

What's in your freezer? What is the most valuable thing inside it?

In our lab, one of the most valuable items in our freezer is...poop! Yes that's right. It holds the secrets to understanding what makes babies sick, what makes them grow and what keeps them healthy. It even has the potential to lead us to new cures and treatments for sick preterm babies!

The human body harbors trillions of bacteria and the bacteria you have can have a significant impact on your physical and emotional health. Even newborn babies need to have good bacteria in their intestine. Preterm babies that have a high number of bacteria known as "Proteobacteria" in their gut have an increased risk of getting inflammation of their intestines and dying. Our laboratory is focused on studying how babies' gut microbiomes develop and what immune cells can modify it in the hopes of preventing this disease called necrotizing enterocolitis, or NEC.

In our laboratory, we even believe that there are changes that can happen even before a baby is born that can have an effect on how they colonize bacteria after birth. A pregnant woman's diet while pregnant may be exposing her baby in utero to different compounds that result in the immune system being more or less likely to colonize with certain bacteria. We collect stool from babies, both humans and mice, to find clues on how this is occurring, in the hopes of finding a treatment for NEC. And all these priceless samples are stored right here in our freezers!

Can you imagine being able to provide supplements to mothers that can help boost their babies' immune system so they will be more likely to colonize with "good" bacteria after they are born? We think that would be amazing!

ONLINE RESOURCES

PEROT MUSEUM

- Amaze Your Brain at Home – Sports Science

THE HUMAN BODY

- National Cancer Institute – Introduction to the Human Body
- National Institute of General Medical Sciences – Cells
- Science with the Amoeba Sisters – Biology Course Playlist
- SciGen Teacher Dashboard – Cells Teaming Up
- TeensHealth from Nemours – Body Basics Library
- U.S. National Library of Medicine Digital Collections
- U.S. National Library of Medicine Medline Plus – reliable health information in English and Spanish

HEALTH AND WELLNESS

- Frontiers for Young Minds – an open-access scientific journal written by scientists and reviewed by a board of kids and teens
  - We Are Never Alone: Living with the Human Microbiota
  - The Intestinal Universe—Full of Gut Heroes Who Need Sidekicks
  - Happy Gut Bacteria, Happy Brain: The Microbiota-Gut-Brain Axis
  - What Are Poop Transplants and How Do They Work?
- Learn.Genetics from the University of Utah – The Human Microbiome
- National Institute of Diabetes and Digestive and Kidney Diseases – Take Charge of Your Health: A Guide for Teenagers
- Science Journal for Kids and Teens – peer-reviewed science research adapted for students and their teachers
  - How do bacteria in the gut control the brain?
- TeensHealth from Nemours – Food & Fitness
- USDA – Nutrition for Teens

STEM CAREERS

- IF/THEN Collection
  - Dr. Julie Mirpuri, UT Southwestern Medical Center
  - Dr. Danielle Robertson, UT Southwestern Medical Center
  - Dr. Nina Niu Sanford, UT Southwestern Medical Center
  - Dr. Kirsten Tulchin-Francis, Scottish Rite for Children
- National Institute of General Medical Sciences – Being a Scientist
- Skype a Scientist

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