



Organization of Multicellular Organisms

Submitted by: April Mullikin, 6th-12th Grade Science
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Target Grade: 6th- 12th grade science

Time Required: 70 minutes

Standards

Next Generation Science Standards (NGSS):

- HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
- MS-LS1-3: Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells.

Lesson Objectives

Students will:

- Create models of the levels of organization of multicellular organisms by building from (listed from inside to outside): cells, organs, organ system, and the entire organism.
- Be able to explain the relationship between the different levels of systems within an organism.
- Understand that cell types are different based on their role or job within an organism.

Central Focus

For this lesson, students will be investigating multicellular organisms and their interactions. Students will collaborate to organize different biological systems. As a class, the students will fill in a human body with all the different working systems.

Key terms: biology, anatomy, cells, organs, graphic organizer, partners, cell tissue, organism

Background Information

In this lesson, students will be building on prior knowledge of cells and organisms. Students will also need the prior knowledge of ecosystem, communities, populations, and organisms. If students need context on ecosystem, communities, and populations, teacher may also show the students this video: [Populations, communities, and ecosystems \(video\) | Khan Academy](#). If students are unfamiliar or need to recall the terms, review the following terms:



- **Ecosystems:**
An ecosystem is a geographic area where plants, animals, and other organisms, as well as weather and landscapes, work together to form a bubble of life.
(<https://education.nationalgeographic.org/resource/ecosystem>)
- **Communities:**
A community is a group of different species living in the same area.
([Populations, communities, and ecosystems \(article\) | Khan Academy](#))
- **Populations:**
A population is a group of the same species living in the same area.
([Populations, communities, and ecosystems \(article\) | Khan Academy](#))
- **Organisms:**
Organisms interact with both living and nonliving parts of their ecosystem. Organisms depend on these interactions in order to survive and have offspring.
([Populations, communities, and ecosystems \(article\) | Khan Academy](#))

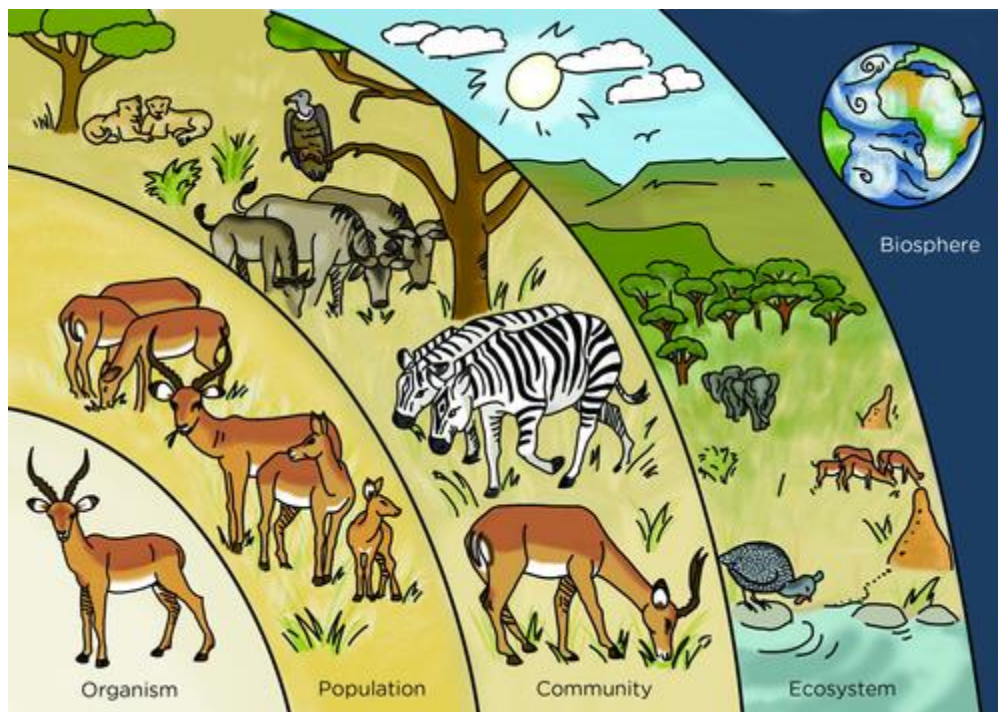


Figure 1: <https://socratic.org/questions/can-you-define-population-community-ecosystem-and-biosphere-how-are-they-each-re>

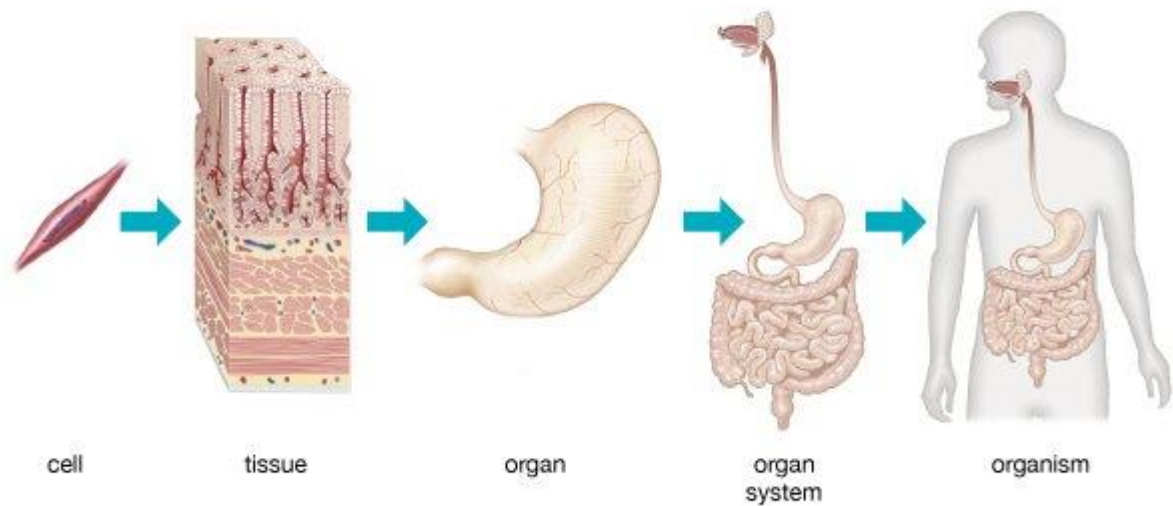
Students will need to understand the difference between plant and animal cells and how all organisms are made up of cells. Key vocabulary words are the following:

- **Cells:** are the basic building blocks of all living things.
- **Tissue:** any of the distinct types of material of which animals or plants are made, consisting of specialized cells and their products.



- Organ: the body's recognizable structures (for example, the heart, lungs, liver, eyes, and stomach) that perform specific functions.
- Organ system: is a group of organs that work together as a biological system to perform one or more functions.
- Organism: an individual animal, plant, or single-celled life form.

Levels of organization



© Encyclopædia Britannica, Inc.

Figure 2: <https://www.britannica.com/science/human-body>

This lesson is used for students to understand biological systems and processes. Teachers can use this lesson to help students understand connections of different parts of systems and the effect they have on each other by examining the human body. This lesson will provide a very basic understanding of system and functions of the human body. The list of system and functions that the teacher should be familiar with are listed at the [bottom of this lesson](#).

Materials

- Card sort
- Graphic Organizer printed on both side of the paper (Levels of Organization Pyramid)
- Organ Group Activity
- Human Body (cutout for board)
- Summarizer Activity – Choice Board/Rubric
- Internet access (ipads, chromebooks, computers, etc.)
- Life Science PowerPoint
- If needed for differentiation activity: Levels of Biological Organization worksheet



Instruction

Engage:

- Give students the sorting cards. While using the PowerPoint have the students complete the following:
 - Ask the students to sort the cards with no set parameters. Then have some of the students volunteer to share why they sorted the cards in a certain way.
 - Then ask students to break them into ecosystem, communities, populations, and organisms - drawing on prior knowledge. Have the students do a pair-share with a partner.
 - Last, have a class discussion to organize the cards into sets: ecosystem, communities, populations, and organisms.

Explore:

- Following the PowerPoint, reflect on prior knowledge of cells and organisms.
- Have students answer the following prompts in their notes:
 - Think of all the things that might exist in the organization of an animal organism. Start with the smallest thing, the cell, and end with an organism
 - Draw a diagram or a flowchart of what that might look like from smallest to largest – least to most complex (see example below)

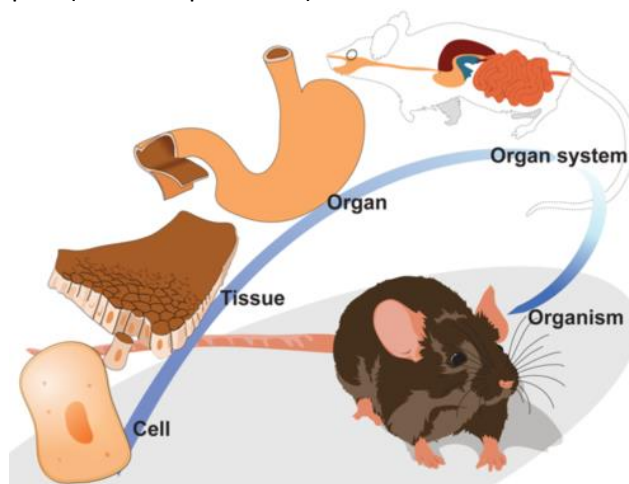


Figure 3: <https://flowvella.com/s/3eeo/Cell-theory-flow-chart>

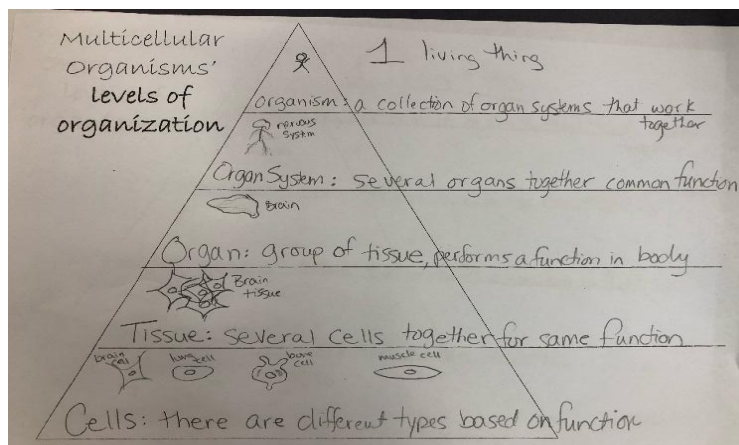
- Have students share their responses to a partner and defend their reasoning. The teacher will walk around the room to listen to the students responses and ask questions that will promote their thought process such as:
 - Would this be different for each animal? If so, how?



- If the students are done, ask them:
 - Would this be different for plants? If so, how would it look?
- If the students are struggling, ask them:
 - Why did you put (insert what they put) here?
 - Think about your own body. Where is the cell?

Elaborate:

- Show the students the following video while they make modifications to their diagram or flow chart and take additional notes.
 - <https://youtu.be/ZRFykdf4kDc>
 - This video is about the levels of organization in a human body. The video talks about the levels in order from inside to outside: cells, tissue, organ, and organ system.
- Have the students share with their partner what they changed or added. As a class, collaborate to complete the *Graphic Organizer* on one of the sides (see example below). The graphic organizer helps the students see the flow of the level of organization from the cell to the organism. Include the following terms:
 - Organism
 - Cell
 - Tissue
 - Organ System
 - Organ



- Now have the students write the final version of the levels of organization on the other side of the graphic organizer. Create a basic version on the board and as a class review the level of organization based on the partner and class discussion.



- Next, using the *Organ Group Activity* (see attachment below) assign students to an organ (there are 27 cards) and have them research and write down:
 - Its function
 - What type of cell/tissue it is made of
 - Which organ system it belongs to
 - Other organs that are included in this particular system
- Then have students find other students in the room who represent an organ within the same organ system. If there are cards left over, put them on the board, so that the students can pick up the card if they think that the card belongs in the same organ system.
- Once together, have them share their notes about each organ and compare what each does for the system.
- Next, in their group, they will write their organ on a post-it note, group them together, and put them on the “human body” on the board.
 - Prior to the lesson draw or print the human body outline and place on front board.
- Lead a class discussion answering the following questions:
 - Why do the cells that make up different types of tissues have a different shape?
 - In the respiratory system, if your left lung failed to perform, what implications (or effects) would this have on the organism?
 - How would the organism be effected if the organ system that is responsible for waste removal stopped working?
- Have students write in their notebook how each part of the organizational level is part of a larger system. In other words, have the students reflect on the relationship between each organizational level. Then, have some of the students share what they wrote down.
 - They should explain the role of each level in the survival of the organism. The levels are (these are defined above):
 - Organism
 - Cell
 - Tissue
 - Organ System
 - Organ

Closure:

- Using the *Summarizer Choice Board* have students chose one activity to show mastery of the lesson standard. Students can choose any of the following activities:
 - Absent student letter: be the teacher and explain the standard/concept to someone who missed class
 - Classroom Poster: make a poster that is larger than a standard piece of paper
 - PowToon video: use the free software to create a video (Technology)
(<https://www.powtoon.com>)
 - PowToon is a website where students can create a video and/or animation.



- Analogy: use the idea of connectedness and relate the levels of organization to another system that you know
- Review the *Summarize Choice Board* rubric with students.

Differentiation

- English Language Learners:
 - Allow students to work with an upper-level partner throughout the activities.
 - Provide students with a vocabulary sheet that contains pictures of each term and a copy of the presentation in their language.
 - Allow students to use online translators.
- Students with disabilities:
 - Group students intentionally with others that can support them.
 - Give extra support during the group/partner activities.
 - Ask these students questions during the group work to make sure they understood the material from the presentation.
 - Give these students a structured template of the biological organization: Levels of Biological Organization worksheet (attached below).
- Advancement:
 - Ask students questions to promote their thinking as listed throughout the lesson above.
 - Have the students complete further research into the organizational level of plants.
- Grouping:
 - Students could be grouped in ways that have varied levels in each group. This can help the students collaborate with each other. With different levels in a group, students can help and support each other, especially with the research and the activities.
- Timing:
 - For the students who finish early, have them reflect back on the lesson and vocabulary in their own words.
 - For the students who are slower, since the students are in their groups or partners for some of the lesson, the workload could be divided for timing purposes.
 - Lesson can be extended over two days if needed.

Assessment

Formative assessment:

- Class discussion will allow the teacher to gauge where students are in their learning process.
- Students will use verbal peer feedback during partner and group discussions to assess and evaluate their understanding.

Teacher will be walking around the classroom during group and partner discussions to assess the students understanding and ask questions that will also assess their learning.



Summative assessment:

- The teacher can collect the graphic organizer (The Level of Organization pyramid) to assess their understanding of the levels of organization: organism, cell, tissue, organ system, and organ.
- The summarization activity will allow the teacher to gauge student's mastery of the given content by using the attached rubric.
- The teacher can collect the individual students' research of the *Organ Group Activity*. This can allow the teacher to assess the students understanding of the organ.



Glossary

System and Functions of the Organs

➤ Bone:

The bones are rigid body tissue consisting of cells embedded in an abundant hard intercellular material. The functions of the bone include:

- Structural support for the mechanical action of soft tissues, such as the contraction of the muscles and the expansion of lungs
- Protection of soft organs and tissues, as by the skull
- Provision of a protective site for specialized tissues such as that blood-forming system (bone marrow)
- A mineral reservoir, whereby the endocrine system regulates the level of calcium and phosphate in the circulating body fluids

[\(bone | Definition, Anatomy, & Composition | Britannica\)](#)

➤ Tendon:

A tough cord made of dense white fibrous connective tissue that ties a muscle with another part (such as a bone) and transmits the force which the muscle exerts.

[\(Tendon Definition & Meaning - Merriam-Webster\)](#)

➤ Ligament:

A ligament is a tough fibrous band of connective tissue that serves to support the internal organs and hold bones together in proper articulation at the joints.

[\(Ligament | Definition, Function, Types, & Facts | Britannica\)](#)

➤ Cartilage:

A cartilage is a connective tissue forming the skeleton of mammalian embryos before bone formation begins and persisting in parts of the human skeleton into adulthood. It is composed of a dense network of collagen fibers embedded in a firm, gelatinous ground substance with the consistency of plastic. This allows the cartilage to bear weight while retaining greater flexibility than bone.

[\(cartilage | Description, Anatomy, & Function | Britannica\)](#)

➤ Brain:

The brain is a mass of nerve tissue. The brain integrates sensory information and directs motor responses.

[\(brain | Definition, Parts, Functions, & Facts | Britannica\)](#)



➤ Spinal Cord:

The spinal cord is a major nerve tract of vertebrates extending from the base of the brain through the canal of the spinal column. It is made of nerve fibers that starts the reflex actions and transmit impulses to and from the brain.

([spinal cord | anatomy | Britannica](#))

➤ Nerves:

The nerve is a glistening white cordlike bundle of fibers, surrounded by a sheath, which connects the nervous system with other parts of the body. The nerves conduct impulses toward or away from the central nervous mechanism.

([nerve | Definition, Facts, & Examples | Britannica](#))

➤ Eyes:

The eye is a specialized sense organ capable of receiving visual images, which are then carried to the brain.

([human eye | Definition, Anatomy, Diagram, Function, & Facts | Britannica](#))

➤ Intestines:

The intestine is a tubular part of the alimentary canal that extends from the stomach to the anus. The intestine is the site of most chemical digestive processes and the place where digested food materials are either absorbed for use by the body or collected into feces for elimination.

([intestine | anatomy | Britannica](#))

➤ Stomach:

The stomach is a saclike expansion of the digestive system, between the esophagus and the small intestine. The function of the stomach is a temporary storage and mechanical distribution of food before it is passed into the intestine.

([stomach | Definition, Function, Structure, Diagram, & Facts | Britannica](#))

➤ Gall Bladder:

The gallbladder is a muscular membranous sac that stores and concentrates bile, a fluid that is received from the liver and is important in digestion.

([gallbladder | anatomy | Britannica](#))



- **Liver:**

The liver is the largest gland in the body, a spongy mass of wedge-shaped lobes that has many metabolic and secretory functions. The liver secretes bile, a digestive fluid; metabolizes proteins, carbohydrates, and fats; stores glycogen, vitamins, and other substances; synthesizes blood-clotting factors; removes wastes and toxic matter from the blood; regulates blood volume; and destroys old red blood cells.

([liver | anatomy | Britannica](#))
- **Heart:**

The heart is an organ that serves as a pump to circulate the blood.

([heart | Structure, Function, Diagram, Anatomy, & Facts | Britannica](#))
- **Lungs:**

The lung is either of the two large organs of respiration located in the chest cavity and responsible for adding oxygen and removing carbon dioxide from the blood.

([lung | Definition, Function, & Facts | Britannica](#))
- **Arteries:**

The artery is any of the vessels that, with one exception, carry oxygenated blood and nourishment from the heart to the tissues of the body. Arteries are muscular and elastic tubes that must transport blood under a high pressure exerted by the pumping action of the heart.

([artery | anatomy | Britannica](#))
- **Veins:**

The vein is any of the vessels that, with four exceptions, carry oxygen-depleted blood to the right upper chamber (atrium) of the heart.

([vein | blood vessel | Britannica](#))
- **Hair:**

The hair is the characteristic threadlike outgrowths of the outer layer of the skin (epidermis) that form an animal's coat, or pelage.

([hair | anatomy | Britannica](#))
- **Nails:**

The nail is the plate that grows on the back of each finger and toe at its outer end. The nail is a platelike, keratinous, translucent structure that consists of highly specialized epithelial cells.

([nail | anatomy | Britannica](#))



- **Skin:**
The skin is the covering of the body's surface that both provides protection and receives sensory stimuli from the external environment.
([human skin | Definition, Layers, Types, & Facts | Britannica](#))

- **Exocrine Glands:**
The exocrine gland secretes substances through a duct opening in a gland onto an external or internal body surface.
([exocrine gland | physiology | Britannica](#))

- **Mouth:**
The mouth is a orifice through which food and air enter the body. The mouth opens to the outside at the lips and empties into the throat at the rear.
([mouth | Definition, Anatomy, & Function | Britannica](#))

- **Nose:**
The nose is the prominent structure between the eyes that serves as the entrance to the respiratory tract and contains the olfactory organ. It provides air for respiration, serves the sense of smell, conditions the air by filtering, warming, and moistening it, and cleans itself of foreign debris extracted from inhalations.
([nose | Description, Functions, & Facts | Britannica](#))

- **Larynx:**
The larynx is a hollow, tubular structure connected to the top of the windpipe (trachea); air passes through the larynx on its way to the lungs. The larynx also produces vocal sounds and prevents the passage of food and other foreign particles into the lower respiratory tracts.
([larynx | anatomy | Britannica](#))

- **Trachea:**
The trachea is a tube or system of tubes that carries air. The trachea serves as passage for air, moistens and warms it while it passes into the lungs, and protects the respiratory surface from an accumulation of foreign particles.
([trachea | anatomy | Britannica](#))

- **Visceral Muscle:**
The visceral muscle is the internal organs of the body, especially those in the abdominal cavity.
([Visceral Muscle Tissue - Anatomy Pictures and Information \(innerbody.com\)](#))



➤ Cardiac Muscle:

The cardiac muscle is one of three major muscle types, found only in the heart. The cardiac muscle exhibits rhythmic contractions and is not under voluntary control. The rhythmic contraction of cardiac muscle is regulated by the sinoatrial node of the heart, which serves as the heart's pacemaker.

[\(cardiac muscle | Definition, Function, & Structure | Britannica\)](#)

➤ Skeletal Muscle:

The skeletal muscle is the most common of the three types of muscle in the body. It is attached to the bones by tendons, and they produce all the movements of body parts in relation to each other.

[\(skeletal muscle | Definition & Function | Britannica\)](#)

Life Science



Sort the cards!

- Use your prior knowledge to sort your stack of cards however you believe they should be.
- Be ready to justify your reasoning.

Use these categories

- What cards would you include in each of these?

Ecosystem

Community

Population

Organism

- Sort the cards into each of these categories.
- Pair-share with a partner.



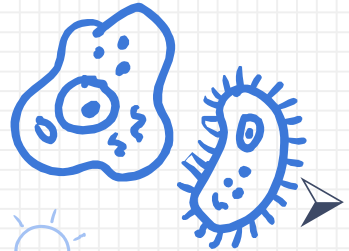
What do we know?

- Cells – The basic building blocks of life
- Organisms – Humans, dogs, fish, sloths



In your journal

- Think of all the things that might exist in the organization of an animal organism. Start with the smallest thing – ~~A~~the CELL – ~~A~~and end with an ORGANISM.
- Draw a diagram of what that might look like from smallest to largest – ~~A~~east to most complex.



Share Your Idea

- Share with your table partner and be ready to defend your reasoning!

Video

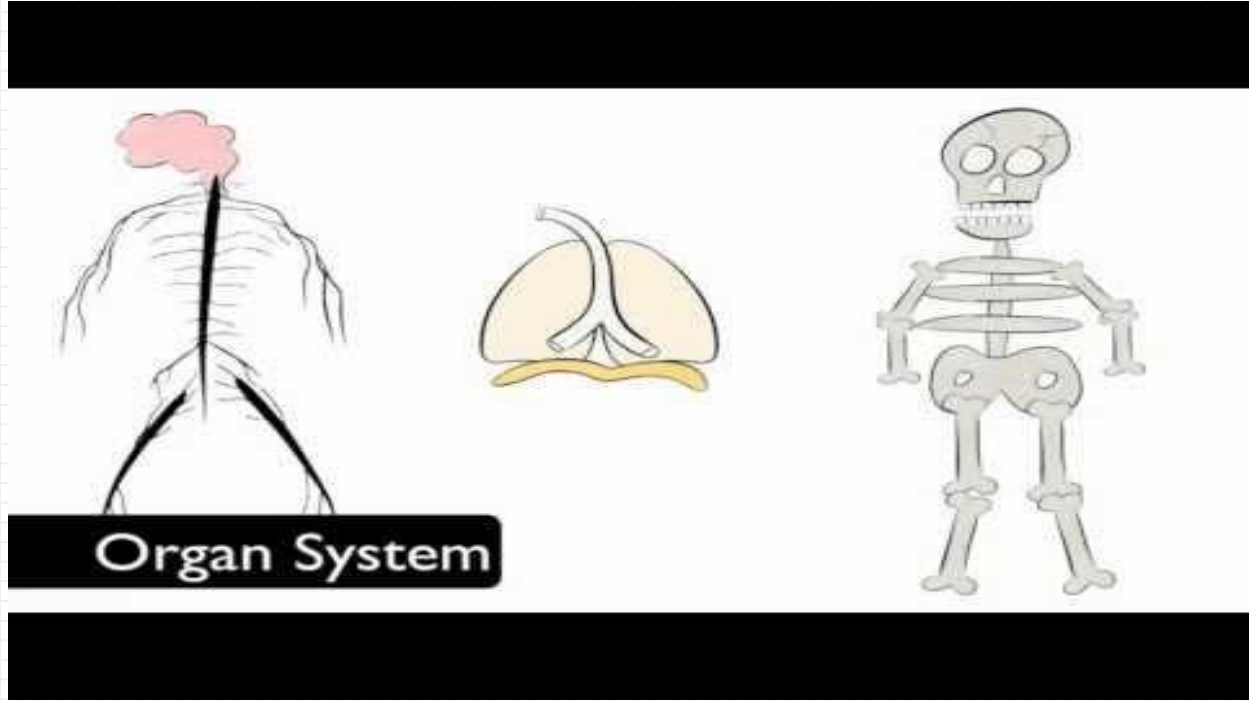
As we watch the video:

- Make modifications to your model as needed.
- Take any additional notes that are relevant.

PAIR-SHARE with your other table partner – Tell them what you changed/added.



Video



Why does this matter?

How does knowing this help us in real life?

- Each of you will be assigned an organ.
- Research your organ and fill out the table.



Get a sticky-note!



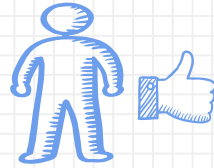
- Write the name of your organ on a sticky-note
- Gather all the organs from your system
- SEND ONE PERSON FROM YOUR GROUP! - Place them on the **BODY** up front



Thinking ?'s

- Why do the cells that make up different types of tissues have a different shape?
- In the respiratory system, if your left lung failed to perform, what implications (or effects) would this have on the organism?
- How would the organism be effected if the organ system that is responsible for waste removal stopped working?

Write in your notebook how each part of the organizational level is part of a larger system. Explain the role of each level in the survival of the organism.



Summarize!

Choose one activity on the summarizer choice board to show mastery of the standard.

Review the rubric to know what is required.

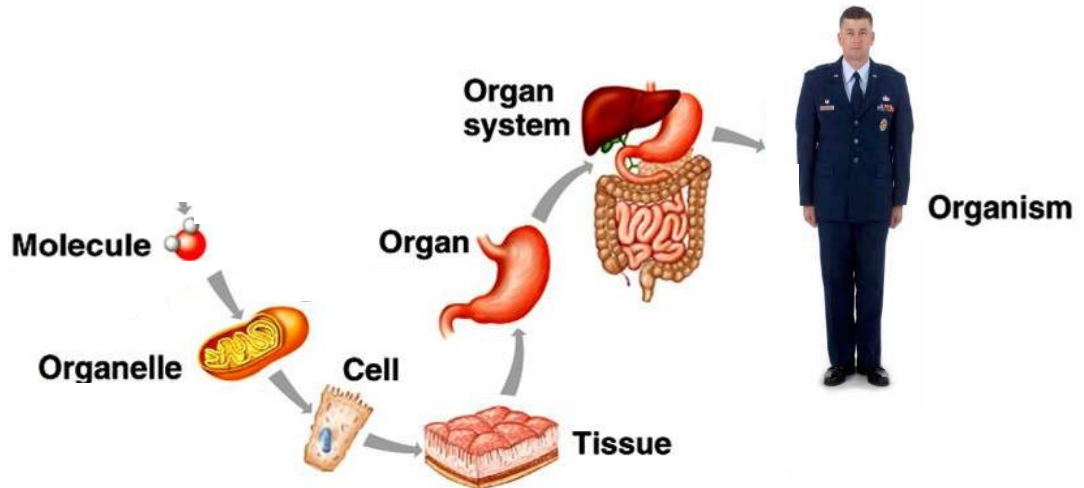


Name: _____

Per: _____ Date: _____

Levels of Biological Organization

Background: In unicellular (single-celled) organisms, the single cell performs all life functions. It functions independently. However, multicellular (many-celled) organisms have various levels of organization within them. Individual cells may perform specific functions and also work together for the good of the entire organism. The cells become dependent on one another.



Activity 1: Use the descriptions on your handout to determine which level of organization (organelle, tissue, organ, system, etc.) is being described. Write the level of organization in the parentheses provided above the picture.

Activity 2: After reviewing the different levels of organization, use your handout to help you fill in the following chart by selecting the example that meets the requirement listed. (Hint: You will need to use “epithelial tissue” twice to complete the chart).

	Organelle	Tissue	Organ	System
Protects by forming a selective barrier				
Breaks down food for energy				
Removes waste				
Provides means of transportation				
Gives structural support				
Controls and coordinates actions				

Cell Membrane (_____)



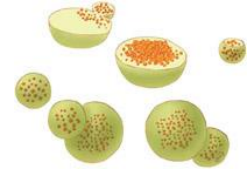
This organelle is a selectively permeable barrier that controls what goes in and out of the cell.

Bladder (_____)



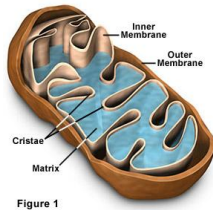
The bladder is a hollow, muscular organ that collects urine excreted by the kidneys before disposal by urination.

Lysosomes (_____)



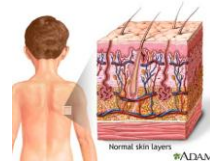
Lysosomes are organelles that contain enzymes to break down and remove waste in the cell.

Mitochondria (_____)



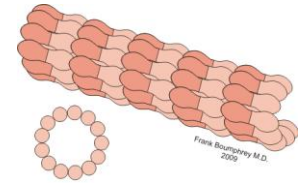
Mitochondria are the site of cellular respiration in which sugar molecules are broken down to release energy.

Skin (_____)



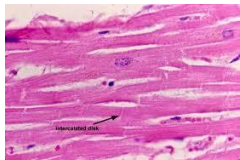
The skin is the largest organ of the integumentary system. It protects the underlying muscles, bones, and organs as well contributing to heat regulation and sensory perception.

Microtubules (_____)



Microtubules serve as part of the cell's system of structural support. They are also involved in the process of cellular division.

Cardiac (_____)



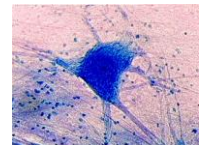
Coordinated contractions of cardiac tissue in the heart pump blood throughout the body.

Digestive (_____)



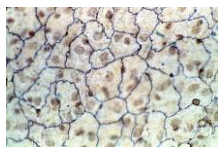
Although digestive systems take many forms in organisms throughout the world, the main function of digestion is to break down food so that it can be used for energy by the body.

Nervous (_____)



Nervous tissue is the main component of the brain and spinal cord which regulate and control body functions.

Epithelial (_____)



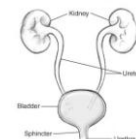
Epithelial tissue is located on the very outside of an organism (i.e. skin) as well as in the lining of hollow organs such as the bladder. Its purposes include protection and secretion.

Skeletal (_____)



The skeletal system is a rigid framework to which the softer tissues and organs of the body are attached. It provides protection and structural support for the body.

Urinary (_____)



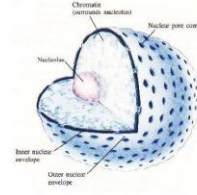
The urinary system produces, stores, and eliminates urinary waste. Through this process, the body is able to regulate electrolyte balance as well as maintain a healthy pH level.

Bones (_____)



Bones are rigid organs that form part of the endoskeleton of vertebrates. They help to move, support and protect the body as well as producing red and white blood cells.

Nucleus (_____)



This organelle contains the cell's genetic material (DNA) and therefore controls the cell's activities.

Brain (_____)



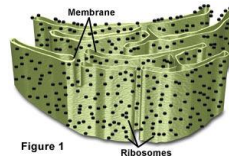
In most vertebrate animals, the brain is the central organ of the nervous system. It controls the other systems of the body by either activating muscles or releasing chemicals.

Heart (_____)



The heart is a muscular organ found in all animals with a circulatory system. It is responsible for pumping blood throughout the body through the use of coordinated contractions.

Endoplasmic Reticulum (_____)



The endoplasmic reticulum is an organelle that forms an interconnected network of tubules that serve to transport newly synthesized proteins.

Stomach (_____)



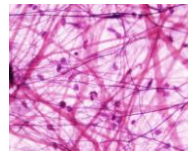
The stomach is a muscular, hollow organ that works with the digestive system. It releases enzymes and strong acids that help to break down food to release useable energy.

Circulatory (_____)



This system transports nutrients (gases, hormones, etc.) carried in blood and lymph throughout the body. It is powered by the involuntary contractions of the heart.

Connective (_____)



Connective tissue is made of a network of protein fibers that provide structural support. Bone, blood, cartilage, and fat are the four main types of connective tissue.

Nervous (_____)



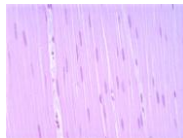
This system contains a network of specialized cells called neurons that coordinate actions by transmitting signals throughout the body.

Integumentary (_____)



The integumentary system consists of the skin and its appendages (hair, feathers, nails, etc.). It serves to protect the body as well to detect pain, sensation, and pressure.

Smooth Muscle (_____)



Smooth tissue is able to contract on its own without a signal from the brain. These involuntary contractions help organs such as the stomach and intestines to break down and move food through the digestion process.

Organ Group Activity

<p style="text-align: center;">What is the name of your organ?</p>	<p style="text-align: center;">What organ system does it belong to?</p>
<p style="text-align: center;">What type of cell/tissue is it made of?</p>	<p style="text-align: center;">What other organs belong to this system?</p>
<p style="text-align: center;">What is the purpose/function of this organ?</p>	<p style="text-align: center;">Draw a sketch of your organ!</p>

BONE	TENDON	LIGAMENT	CARTILAGE
BRAIN	SPINAL CORD	NERVES	EYES
INTESTINES	STOMACH	GALL BLADDER	LIVER

Organ Group Activity

HEART	LUNGS	ARTERIES	VEINS
HAIR	NAILS	SKIN	EXOCRINE GLANDS
MOUTH	NOSE	LARYNX	TRACHEA
VISCERAL MUSCLE	CARDIAC MUSCLE	SKELETAL MUSCLE	

Summarizer Activity – Choice Board/Rubric

Summarizer Activity Choices (Cross-curricular connection)	FULL CREDIT	PARTIAL CREDIT	NO CREDIT
Absent Student Letter – be the teacher and explain the standard/concept to someone who missed class (ELA)	<ul style="list-style-type: none"> • Full explanation of the topic • Neat, organized • Uses pics/diagrams 	<ul style="list-style-type: none"> • Content partially explained • Minimal pics/diagrams 	<ul style="list-style-type: none"> • Poor explanation • No pic/diagram • Messy, hard to read
Classroom Poster – make a poster that is larger than a standard piece of paper (Art)	<ul style="list-style-type: none"> • Full explanation of the topic • Neat, organized • Uses pics/diagrams 	<ul style="list-style-type: none"> • Content partially explained • Minimal pics/diagrams 	<ul style="list-style-type: none"> • Poor explanation • No pic/diagram • Messy, hard to read
PowToon video – use the free software to create a video (Technology)	<ul style="list-style-type: none"> • Full explanation of the topic • Thoughts well organized • Uses pics/diagrams 	<ul style="list-style-type: none"> • Content partially explained • Disorganized thoughts • Minimal usage of pics 	<ul style="list-style-type: none"> • Poor explanation • No pic/diagram
Analogy – use the idea of connectedness and relate the levels of organization to another system that you know (Sociology)	<ul style="list-style-type: none"> • Well-explained connection to lesson • Neat, organized • Uses pics/diagrams 	<ul style="list-style-type: none"> • Connection partially explained • Minimal pics/diagrams 	<ul style="list-style-type: none"> • Poor explanation • No pic/diagram • Messy, hard to read



Desert



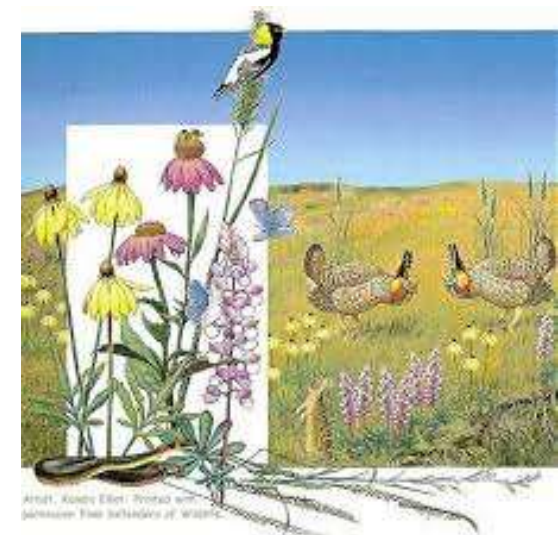
Forest



Prairie



CORAL REEFS





Multicellular Organisms'
Levels of
Organization

