

Microorganisms

Course

Medical
Microbiology

Unit V

Microorganisms

**Essential
Question**

What are
Microorganisms
and how do they
affect humans?

TEKS

130.207(c)4BD,
5ABC

**Prior Student
Learning**

History of
Microbiology

Estimated time

3-5 hours

Rationale

Many microorganisms are pathogenic, however some are beneficial.

Objectives

Upon completion of this lesson, the student will be able to:

- Define the different types of microorganisms
- Describe the physical structure of the different microorganisms
- Categorize the different microorganisms

Engage

Assign each row or group of students a type of microorganism. Allow them to choose from the ones covered below and develop a catchy name or cartoon to represent them. After the lecture discussion on the details of the different microorganisms have each group of students teach back to the class the things needed to complete the chart.

Key Points

- I. Bacteria – Can be defined as single celled organism lacking a nucleus and made of simple structures.
 - A. Characteristics include: Prokaryotes, having a cell wall and cell membrane (helps determine how they will stain). Prokaryotes are single celled and have no central nucleus; the DNA is in a single circle. They vary in size from 0.4um to 2.0um and are found in three basic shapes: cocci (spherical); bacilli (rod-shaped); and spirochetes (helical or spiral shaped).
 1. For diagnostic purposes we often focus on a bacteria being gram positive or gram negative, and that refers to how they appear in a gram stain. The gram stain is a very basic test that is done to make bacteria more visible under a microscope, and help identify characteristics about them like shape, size and cell wall/membrane structure. The reason some bacteria stain gram positive or negative has to do with the structure and thickness of their cell wall and cell membrane. Explain to students the difference using the diagram in the power point.

2. Modes of transmission include fecal-oral (ingesting contaminated food, water or bad hygiene), contact, droplet, air-born, blood and sexual contact.
- II. Rickettsias – A group of bacteria that are obligate intracellular parasites transmitted by arthropods from the host or reservoir.
 - A. Characteristics include: Prokaryotes and often seen looking like gram negative bacteria inside cells. About 0.8-2.0um in size.
 - B. Mode of transmission is often a vector like a tick, flea, louse or mite passing on the bacteria from the host animal by a bite.
 - III. Viruses – Nonliving, metabolically inert infectious agents that are ultramicroscopic in size.
 - A. Characteristics include: Being made up of genetic material, protein capsid and some have a bilipid envelope layer.
 - B. Mode of transmission include fecal-oral, contact, droplet, air-born, blood and sexual contact.
 - IV. Fungi
 - A. Yeast – single celled fungi that reproduce by budding. Characteristics include: being able to convert sugar to CO₂ and alcohol.
 - B. Molds – Multicelled fungi often with a real hyphe creating a fuzzy appearance. Characteristics include asexual and sexual reproduction and they have hyphea.
 - C. Dimorphic – Fungi that may exist in a yeast state at warm or body temperatures and mold state at cool or room temperatures. Mode of transmission includes contact, air-born, blood and environmental sources.
 - V. Protozoa – Single celled microscopic organisms; most are parasitic in nature.
 - A. Characteristics include – Eukaryotic; some have flagella or cilia facilitated movement. Each species has a specific life cycle often involving different stages like host carrier or cyst stage. Reproduction can be asexual or sexual.
 - B. Mode of transmission includes fecal-oral, contact, blood and vectors.
 - VI. Beneficial microbes
 - A. Normal Flora – term used to describe the bacteria that normally inhabit a human (or other species) that play beneficial or nonpathogenic role to the host. Examples include skin Staphylococcus, intestinal enterobacteriaceae and genital yeast. Normal flora can be affected by antibiotics taken for other infections in the body, and, as a result, their absence changes body chemistry, and can result in side effects like diarrhea or yeast infections. Normal flora can also be come pathogenic if the patient

becomes immunocompromised or has their immune system repressed.

- B. Useful organisms – Many bacteria and fungi play beneficial roles to humans, for example *Penicillium sp.* Fungi helped develop penicillin the antibiotic. Countless yeast, bacteria and other molds are used in baking, cheese making, and fermentation of wine, beer and spirits.

VII. Diseases caused by microorganisms

- A. Bacteria: *Streptococcus pyogenes* (group A) -- Strep throat, *E. coli*, *Shigella sp.*, *Salmonella sp.* can cause diarrhea. *Mycobacterium tuberculosis* -- tuberculosis.
- B. Rickettsias: *Rickettsia rickettsii*-- Rocky mountain spotted fever, *Coxiella burnetii*-Q fever, *Rickettsia prowazekii* and *typhi* – Typhus.
- C. Human Immunodeficiency Virus(HIV) –AIDS, *Varicella Zoster Virus* – chicken pox, *Influenza A or B* –flu, *Rhinovirus* – cold, *Human Papilloma Virus (HPV)* – genital warts and cervical cancer.
- D. *Candida sp.* – yeast infections, thrush, *Tinea pedis* -- Athletes foot, *Tinea sp.* – ringworm (yes- just a fungus -- not a real ‘worm’)
- E. *Entamoeba histolytica* and *Giardia lamblia* – Diarrhea (some traveler’s), *Naegleria fowleri* – parasitic meningitis/encephalitis, *Plasmodium sp.* – malaria.

VIII. Identification – laboratory identification of a microorganism infection can involve many different methodologies that vary greatly depending on the size and specialty of the lab.

- A. Culture: agarose media (like special jello) is often used for fungi and bacteria. Cell culture (living cells) can be used for viruses and rickettsia species.
- B. Stains: gram stain is the most common and used for all bacteria. India Ink stains are used for yeast. Immunofluorescent stains can be used to identify viruses and rickettsia in cell culture. Fecal concentration slides are made and stained for many protozoa and helminthes. Gemsa Wright stain is used in malaria and other blood protozoa slides. Fungi maybe viewed unstained or with blue or brown coloring.
- C. Antibody testing: Enzyme or chemiluminescence labeled testing is done on viruses, and antibodies to viruses, rare bacteria, fungi and rickettsia.
- D. Direct observation: concentration slides of fecal material are made to try and catch many protozoan and helminthes infections by observing eggs, cysts and active organisms. Fungi must often be directly observed to get the species identified.
- E. Molecular testing: PCR, Amplification techniques and fluorescent or chemiluminescence are often used for things that will not grow in culture like viruses, select bacteria, mycobacteria, and some fungi.

Activity

- I. Complete the Microorganism Groups Laboratory Investigation
- II. Complete the Microorganisms Worksheet and discuss answers in cooperative groups
- III. Participate in the Microorganisms Game

Assessment

Team Work Rubric
Laboratory Investigation Rubric

Materials

3x5 index cards
Pens, markers
Prepared slides of microorganisms
Microscopes
Gloves
Laboratory coat or apron
Goggles
Biohazard containers
Surface disinfectant
Paper towels

Accommodations for Learning Differences

For reinforcement, the student will design a poster to depict the physical characteristics of microorganisms.

For enrichment, the student will read and review on a movie or book.

National and State Education Standards**National Standard**

NS.9-12.3 Life Science

As a result of their activities in grades 9-12, all students should develop understanding of: the cell, molecular basis of heredity, biological evolution, interdependence of organisms, organization in living systems, and behavior of organisms.

Texas Essential Knowledge and Skills

130.207(c)(4) (B) identify chemical processes of microorganisms;
130.207(c)(4)(D) explain pathogenic and non-pathogenic microbes in the human body;
130.207(c) (5)(A) outline the infectious process;
130.207(c) (5)(B) classify microorganisms using a dichotomous key; and

130.207(c) (5)(C) categorize diseases caused by bacteria, fungi, viruses, protozoa, rickettsias, arthropods, and helminthes.

Texas College and Career Readiness Standards

Biology – Structure and Function of cells

2. Explain how cells can be categorized into two major types: prokaryotic and eukaryotic, and describe major features that distinguish one from the other.

E. Classification and Taxonomy 1. Know ways in which living things can be classified based on each organism's internal and external structure, development, and relatedness of DNA sequences.

Microorganism Worksheet

	Definition	Characteristics	Mode of Transmission	Diseases Caused	Identification	Beneficial/ Harmful
Bacteria						
Rickettsias						
Viruses						
Fungi						
Protozoa						

Microorganism Worksheet **KEY**

	Definition	Characteristics	Mode of Transmission	Diseases Caused	Identification	Beneficial/Harmful
Bacteria	Single celled organism made of simple structures	Prokaryotes, having cell wall & cell membrane – three basic shapes	Fecal/oral, contact, droplet, air-born, blood & sexual contact	(encourage research) Ex: Strep throat, Gangrene, Diarrhea	Culture on agar media, gram stain, some molecular tests available	Both
Rickettsias	Group of bacteria that are obligate intracellular parasites transmitted by arthropod vectors from the host to the reservoir	Prokaryotes; often look like gram negative bacteria inside WBCs; about 0.8-2.0 microns in size	Often a vector like a flea, tick, louse or mite passing bacteria by a bite	Rocky Mountain Spotted Fever, Q fever, Typhus	Antibody testing, immune-fluorescence (IFA), growth on special media	Harmful to humans but not the arthropod hosts
Viruses	Nonliving, metabolically inert infectious agents	Ultra microscopic in size; made up of genetic material, protein capsid and some have bilipid envelope	Fecal/oral, contact, droplet, airborne, blood & sexual contact	Influenza, colds, hepatitis, cancer, AIDS, chicken pox	PCR & other molecular methods, cell culture, IFA	Harmful to humans
Fungi	Yeast – single celled fungi that reproduce by budding; Molds – multicelled fungi often 'fuzzy' due to areal hyphe	Yeast – able to convert sugar to CO ₂ and alcohol; Molds – asexual and sexual reproduction they have hyphe	Contact, airborne, blood & environmental sources	Thrush, swimmers ear, athlete's foot, ringworm, histo-plasmosis	Direct examination, culture on media, PCR or molecular	Both <i>Diamorphic</i> – those fungi that exist in yeast state at body temp & mold state at room temp
Protozoa	Single celled microscopic organisms; most are parasitic in nature	Eukaryotic; some have flagella or cilia to facilitate movement; each species has a specific life cycle; reproduction can be sexual or asexual	Fecal/Oral, contact, blood & vectors	Malaria, traveler's diarrhea, tricha-moniasis,	Ova & parasite exam to include slides of fecal concentration and different stains, some molecular or antibody methods	Harmful or non-parasitic

Microorganism Game

Question Development

1. Divide class into teams and assign each team a microorganism (bacteria, fungi, viruses, protozoa, rickettsias).
2. Each team will prepare questions about significant facts for their assigned group.
3. Group will create cards with questions and correct answers and assign point values from 100-1000.

Game

Computerized Jeopardy Template

1. Reassign the class into mixed abilities teams.
2. During the game a caller will ask questions to each team. Teams will choose from microorganisms (bacteria, fungi, viruses, protozoa, rickettsias) and will be asked the question for that particular point value.
3. Game is conducted similar to a “Jeopardy Game.”

NOTE:

Students will get loud during this activity!

MICROORGANISMS LABORATORY INVESTIGATION

NAME: _____ DATE: _____

PURPOSE:

In this laboratory investigation, the student will examine and study prepared slides of microorganisms.

BACKGROUND INFORMATION:

MATERIALS:

Prepared slides of microorganisms
Microscope
Gloves
Laboratory coat or apron
Goggles
Biohazard containers
Surface disinfectant
Paper towels

PROCEDURE:

1. Wash hands and put on gloves and goggles.
2. Assemble equipment and materials.
3. Prepare work area.
4. View prepared slides of microorganisms
5. Clean work area with surface disinfectant. Remove goggles and gloves; wash hands.

DATA:

Draw and label microorganisms

Maybe add a chart of the different stains...

CONCLUSION:

1. Compare and contrast the microorganisms.
2. Under what situations can beneficial organisms become harmful?
3. Explain how microbes are used in food and industry.

Team Work Rubric

Student: _____ Date: _____

Scoring criteria	4. Excellent	3. Good	2. Needs Some Improvement	1. Needs Much Improvement	N/A
Participates in group discussions and encourages others to join the conversation.					
Effectively works to keep the discussion moving in a rapid progression to achieve goals.					
Actively shares ideas and thoughts while offering helpful criticism and recommendations to others.					
Gives credit to others for their ideas and understands the feelings and thoughts of others.					
Involves others by asking questions or requesting input to reach an agreement.					
Clearly and effectively expresses ideas and thoughts.					

NOTE: N/A represents a response to the performance which is "not appropriate."

Laboratory Investigation Rubric

Student: _____ Date: _____

Scoring Criteria	4 Excellent	3 Good	2 Needs Some Improvement	1 Needs Much Improvement	N/A
Problem is appropriately identified.					
Problem is precise, clear, and relevant.					
Association between the problem and the predicted results is direct and relevant.					
All variables are clearly operationalized.					
Demonstrates comprehension of the use of scientific concepts and vocabulary.					
All significant data is measured.					
Data is recorded effectively and efficiently.					
Data table is well designed to the task requirements.					
All graphs are appropriate.					
All data accurately plotted.					
Graph visually compelling; highlights conclusions of the study.					
Conclusion relates directly to hypothesis.					
Conclusion has relevancy in resolution of the original problem.					
Conclusion relates the study to general interest.					