



Activity Description and Estimated Class Time

Throughout the guide teaching tips are in red.

In this two-day activity, students will sort microbe cards with images and information about viruses, bacteria, protists, and fungi based on criteria of their own choosing. After sharing their classifications, they will be given lists of characteristics of the four types of organisms. Students will then choose to which group each microbe card belongs – viruses, bacteria, protists, or fungi – and provide evidence for their decisions.

Objectives

Students will develop an understanding of:

- The basic characteristics of viruses, bacteria, protists, and fungi,
- How diseases spread,
- How to treat and prevent different types of diseases.

Correlations to North Carolina Science Standards

8.L.1 Understand the structure and hazards caused by agents of disease that effect living organisms.

8.L.1.1 Summarize the basic characteristics of viruses, bacteria, fungi and parasites relating to the spread, treatment and prevention of disease.

8.L.1.2 Explain the difference between epidemic and pandemic as it relates to the spread, treatment and prevention of disease.

Brief Science Background

In this activity, students will group organisms according to their characteristics. In doing so, students will develop an understanding of some characteristics of viruses, bacteria, protists, and fungi. This exercise is a starting point for exploring such questions as:

- How do the groups compare and contrast?
- What are some of the diseases caused by the different groups?
- How do the diseases spread?
- What are ways to treat and/or prevent certain diseases?

Refer to BLM-1 for specific science background on viruses, bacteria, protists, or fungi.

Part 1 – Microbe Cards (50 minutes)

Materials for the whole class

Materials

- Project BLM-1 Microbe Characteristics
- Project BLM-2 Microbe Cards Answer Key

**Procedure****Materials for groups of 2 or 3 students**

- Pack of Microbe cards, 18 cards per pack
- Copy of BLM-1 Microbe Characteristics

1. Hand out cards to groups of students. Ask them to look at the images and read the information, and then sort them into groups using criteria of their own choosing. Explain that the criteria can use both visual and written information, but do not suggest any criteria.

Possible criteria students may use: size, shape, cilia or not, free-living or not, disease-causing or not, presence or absence of organelles. Let the students come up with criteria on their own.

2. If students have difficulty, review techniques that scientists use for classifying objects or organisms, perhaps with an example.
 - a. Sub-groups shouldn't be too large (dividing 18 cards into groups of 17 and 1 probably wouldn't be appropriate).
 - b. Distinguishing characteristics should be clear.
 - c. All cards must fit somewhere.
 - d. Cards should fit into only one group.
3. After sorting is completed, have groups look at each other's work and try to figure out the sorting criteria that the other team used.
4. Lead a brief discussion. Have each pair report to the class their criteria for sorting the cards. Also, ask the class which cards were difficult, and why. Last, ask the class to comment which cards were most interesting.
5. Explain to the class that the microbe cards will need to be sorted based on a classification system designed by scientists. Hand out BLM-1 to each group.
6. Allow each pair sufficient time to complete the assignment. If they are unsure where an individual card fits, have them write where they think it fits and why.
7. After all the students have completed the task and before revealing the answers, ask students to report which cards were most difficult to classify. Have them provide reasons.
8. Project BLM-2, revealing the answers one at a time. Before you reveal the answer for each card, ask the students to share their predictions and, more importantly, what evidence they have for their choices. If students disagree, allow them to debate.

Wrap-Up – 10 minutes

Direct a discussion focused on basic characteristics of viruses, bacteria, protists, or fungi. It is also important to discuss how different diseases spread, and how to prevent and treat the different groups of diseases. For example, students should know that antibiotics kill bacteria but have no effect on viruses or other groups. Students should also know about vaccines and how they are used to prevent viral diseases.

• Viruses

- o Viruses have genetic material, either DNA or RNA (but not both).
- o The genetic material (DNA or RNA) is enclosed in a protein coat.
- o Viruses are not alive (though some might argue otherwise).
- o A virus must infect a living cell in order to use the cell's materials and metabolic machinery to reproduce more viruses.
- o Vaccines are used to prevent infection caused by viruses.
- o Many viruses mutate, or change, so new vaccines are needed.
- o Viruses do not take in or process energy from their surroundings.
- o Size range—10 - 1,000 nm (1 nanometer = 1 nm = 1 billionth of a meter) (1,000 nm = 1 μ m = 1 micrometer)

• Bacteria, Cyanobacteria

- o Bacteria are single-celled organisms, but some form chains or clumps of independent cells that are strongly attached to each other.
- o The genetic material is not contained in a nucleus.
- o Bacteria do not have internal compartments or organelles.
- o Bacteria reproduce by binary fission—one cell divides into two cells.
- o The cell contents are surrounded by a cell membrane and a cell wall. In some cases, such as *E. coli*, they have a second membrane. (The cell wall is made of different material than the cell walls of plants.)
- o Antibiotics are used to treat bacterial infections.
- o Size range—generally 1-2 μ m in diameter, though some get larger; and some, with their flagella, get much longer. (1 micrometer = 1 μ m = 1 millionth of a meter) (μ is the lower case Greek letter mu and stands for micro.)

• Protists

- o Most protists are single-celled organisms, but some are multi-cellular.
- o Protists have a distinct nucleus containing genetic material.
- o Protists have a variety of other organelles enclosed in membranes (including some or all of the following: vacuoles for food digestion or water regulation, mitochondria for energy metabolism, chloroplasts for photosynthesis, and so on).
- o Protists may have multi-stranded cilia or flagella that have a whip-like action.
- o There are three major groups of protists.
 - Plant-like forms (algae) that get energy through photosynthesis.
 - Animal-like forms (protozoa) that move through their environment and eat other organisms or decaying parts of other organisms.
 - Fungus-like forms (decomposers) that absorb nutrients from their environment.
- o Size range—10 - 1,000 μ m (the ones represented on the cards) up to 100 m (!) for some of the kelp (brown algae).

• Fungi

- o Fungi are multi-cellular organisms. Each cell of a fungus has a cell wall.
- o Fungi reproduce through spores, which are cells that grow into a new organism.
- o Fungi play a key role in decomposition in the environment. Without fungi, the Earth would be covered in waste material.
- o Fungi can resemble plants; however they lack chlorophyll that plants use to convert sunlight into energy, and their cell walls contain chitin and no cellulose.
- o Fungi are beneficial in the production of bread and cheeses.
- o Fungi can cause plant diseases such as the Irish potato famine, which resulted in 250,000 deaths.
- o Fungi are responsible for common diseases such as: jock itch, athlete's foot, and ringworm. Most fungal diseases are treated with antifungal medicines and creams.
- o Size: the spore producing bodies in athlete's foot fungi are about 15 micrometers long, and the threads of fungus that produce them can be much longer. The spore producing bodies of the fungus that caused the Irish potato famine are about 50-60 micrometers long, arranged along much longer threads.

1. Bacteria: *Anabaena* sp. (cyanobacterium or blue-green bacterium)
2. Virus: Ebola (hemorrhagic fever)
3. Virus: Human Immunodeficiency Virus (HIV)
4. Protist: *Giardia lamblia* (intestinal parasite)
5. Protist: *Amoeba proteus* (free-living)
6. Bacteria: *Escherichia coli* (digestive tract bacterium)
7. Virus: Influenza A (respiratory flu)
8. Protist: *Paramecium caudatum* (free-living)
9. Protist: *Stentor igneus* (free-living)
10. Bacteria: *Borrelia burgdorferi* (Lyme disease)
11. Bacteria: *Streptococcus pneumoniae* (bacterium, causes pneumonia)
12. Virus: Bacteriophage lambda (attacks bacteria like *E. coli*)
13. Bacteria: *Treponema pallidum* (spirochete, causes syphilis)
14. Protist: *Euglena granulata* (free-living)
15. Virus: Tobacco mosaic virus (attacks plants)
16. Protist: *Volvox aureus* (colonial)
17. Fungi: *Trichophyton rubrum* (Athlete's foot)
18. Fungi: *Alternaria solani* (early blight disease) caused Irish potato famine, 1843-1852