BACTERIA AND VIRUSES

We have all heard of bacteria. But what are bacteria and how do they affect our lives? Write your ideas to this question in your Neuron Notes (Journal).

Did you say that they make you sick? Many people think that bacteria only cause disease. But that is not the only thing that bacteria do. We will find out about other things as we read this packet and do the activities suggested.

LIVING VS. NONLIVING

What is bacteria? Many people think that they are just tiny particles that are everywhere. They are so tiny that they are difficult to see when magnified 500x's in a light microscope. But with a more powerful microscope we can see that they are more than just tiny particles. They are very simple living things that are made of cells. Here are some drawings of bacteria:

Think back to what you know about living things. What five things must all living things do?

1.______________________________________________________
2.______________________________________________________
3.______________________________________________________
4.______________________________________________________
5.______________________________________________________

Evidence of the Life Processes:

1. **Bacteria need to get and use energy.** Evidence of this is that when they make us sick, they are getting energy from our bodies. They also get energy from milk when you make yogurt.
2. **Bacteria get rid of wastes.** We have evidence of this because some of their wastes are poisonous to us and make us sick when they produce it in our bodies. Waste from yogurt bacteria turn milk into yogurt.
3. **Bacteria reproduce.** People have seen them split in two. A few bacteria in milk can soon multiply into many. We see the result of this when they make the milk sour or turn it into yogurt.
4. After bacteria reproduce, they grow and develop.
5. We know that bacteria respond to change because some bacteria move towards the light. We will see when we make yogurt how bacteria respond more in warm temperatures than in cold.
BACTERIA AND MOLD
Many people confuse bacteria with mold because they both grow on food and spoil it. Both are living, but they are different types of living things. Bacteria is NOT mold. Here is a comparison of bacteria and molds.

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Molds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domain: Eu (True) bacteria Or Archea (old) Bacteria</td>
<td>Eukaryote (with a nucleus)</td>
</tr>
<tr>
<td>Cell wall or Cell mem: Cell Wall</td>
<td>Cell Wall</td>
</tr>
<tr>
<td>Nucleus: None</td>
<td>Nucleus present</td>
</tr>
<tr>
<td>One cell or Many: Always One</td>
<td>Almost always many celled</td>
</tr>
<tr>
<td>Make or get food: Can make or get food</td>
<td>Get food</td>
</tr>
<tr>
<td>Move: Some can</td>
<td>Only one kind can move</td>
</tr>
</tbody>
</table>

BACTERIA CAN BE HELPFUL

1. BACTERIA AND FOOD
Many people think that bacteria only make you sick. But bacteria do many helpful and essential things in our world. Bacteria are used to flavor many kinds of foods including pickles, tabasco sauce, soy sauce, pekoe tea, cheese, cottage cheese, sour cream, yogurt, vinegar and sauerkraut. Bacteria is even used in the production of chocolate! To make pickles, cucumbers are used, but bacteria is needed to change them to pickles. Other flavoring, such as dill, may also be added. To make sauerkraut, you start out with cabbage and bacteria changes the flavor to that of sauerkraut.

Making yogurt is a fun way to see how bacteria reacts with milk and changes it into yogurt. We will make one batch as a class demonstration and eat it on the day of the bacteria party.

Yogurt Production
1. Mix two heaping Tablespoons of dry milk with one liter of whole, 2%, 1% or skim milk. Heat the mixture until it is scalded (90 degrees Celsius).
2. Cool the milk to 45 degrees Celsius. Add 2-3 Tablespoons of unpasteurized plain yogurt (make sure that it has active, live cultures of bacteria).
3. Keep the mixture at 45 degrees Celsius until the milk solidifies (about 4-5 hours). A hot water bath in a cooler works well.
4. Refrigerate the yogurt until ready to eat.
5. Add flavorings such as jam or granola and enjoy!

2. DECOMPOSITION
Another beneficial task performed by bacteria is that of decomposition or breaking down dead things so the material in them can be recycled. Without decomposing bacteria, there would be dead things lying all around and living things wouldn't have enough new materials to make their bodies. For example, leaves fall from trees every year. Imagine what it would be like to have one hundred years of leaf-fall around a tree. Draw a picture of what this might look like on the top of the next page.
Without the nutrients from decomposed leaves, the tree would probably die (if it hadn’t already been killed by being submerged under a pile of leaves.)

3. **DIGEST FOOD**

Bacteria are also helpful in other ways. Bacteria live in our intestines and help us to digest food. Without these bacteria we would not be able to digest many kinds of food and could even die.

It is estimated that for every cell in your body, you support 10 bacterial cells. They are much smaller than our cells, so they take up less space and weigh less. The latest research suggests that they also make vitamin B12 and K for us and “good” bacteria can actually protect us from “bad” ones.

4. **FIXING NITROGEN**

Bacteria are also helpful by changing or "fixing" nitrogen. Most of the air we breathe is nitrogen, but most plants and animals can't use the form of nitrogen in the air. But bacteria that live in bumps on the roots of some plants such as clover, peas, beans, and alfalfa can. They change the nitrogen in the air to a form that can be used by plants which are then eaten by animals. An analogy would be to compare this to trying to use French francs in the United States. Francs are money and worth something, but they can't be used in the U.S. in their current form. The owner must go to the bank and exchange them for U.S. dollars. The French francs would be like the nitrogen in the air, the bank like the clover plant, the bank teller like the nitrogen "fixing" bacteria, and the U.S. dollars like the nitrogen that plants and animals use.

What would happen if all the nitrogen-fixing bacteria in a field of alfalfa were killed by disease? Be specific.
5. GENETIC ENGINEERING

Genetic Engineering is a new way that humans have harnessed bacteria to work for us. By putting a new gene into the bacteria cell we can have bacteria make chemicals for us that can be very helpful. For instance, a human gene to make insulin has been put in bacteria and the bacteria makes human insulin. This is given to diabetics who cannot make insulin on their own and would die without insulin. Vitamins and human growth hormone are also made by bacteria that have been genetically engineered. The pictures below show how humans use bacteria to make human growth hormone.

What other products might we use genetically engineered bacteria to make for us?
___________________________________________________
___________________________________________________

Think back to how bacteria can help us. Name the five main ways.
1. ___________________________________________________
2. ___________________________________________________
3. ___________________________________________________
4. ___________________________________________________
5. ___________________________________________________
BACTERIA CAN BE HARMFUL

1. DISEASES
We have learned that Bacteria are helpful to us. But, as you probably wrote in your journal, bacteria can also be harmful by making us sick. Here are some diseases caused by bacteria. Highlight any that you have had.

Strep throat  Some pneumonias  Tuberculosis
Diphtheria  Pertussis (Whooping cough)  Tetanus
Scarlet Fever  Salmonella
Lyme Disease  Many ear infections

2. SPOILING FOOD
Bacteria can also spoil food. If we eat food with too many harmful bacteria, it can make us sick. What can we do to keep harmful bacteria from growing in food? (Hint: Where do we keep food when we are not eating it and what do we do with foods to preserve it?) Also put down how each procedure keeps bacteria from growing.

1. ______________________________________________________________________
2. ______________________________________________________________________
3. ______________________________________________________________________
4. ______________________________________________________________________
5. ______________________________________________________________________
6. ______________________________________________________________________
**VIRUSES**
Write down some other illnesses you have had.

________________________________________________________________________

You may have had a cold, the flu, chicken pox, mumps, measles, mononucleosis, and heard about West Nile virus, polio, AIDS, and hepatitis. These diseases are all caused by viruses not bacteria. Some examples of viruses look like this:

![Viruses](image)

What do they look like to you?

________________________________________________________________________

They do not have a cell wall or membrane, a nucleus, chromosomes or organelles. Are they cells?______________

They do not use energy, respond to change or grow. Are they living?______________

Viruses do reproduce though. They can only reproduce in a living cell. When you have a cold, cold viruses are reproducing in your cells. They tell your cells to make new viruses. The cell then bursts and the new viruses infect other cells. This is what makes you sick. So living bacteria are not the only things to make a person sick. Viruses also make people sick. Viruses, however, do not do anything helpful for people like bacteria do. They **only** make us sick.
KEEPING BACTERIA AND VIRUSES FROM HARMING US

1. ANTIBIOTICS

   Bacteria and viruses can be controlled. Since bacteria are living, one way you can control them is to kill them. This can be done by taking antibiotics such as penicillin or tetracycline. The word antibiotic means "against living things" and they only kill living things.

   Since viruses are not living, can they be killed? 

   Would a doctor use an antibiotic against a virus? Why?

   What might a doctor give you to treat Lyme disease and why? (Hint: Is Lyme disease caused by a bacteria or a virus?)

   What might a doctor give you to treat a cold and why? (Hint: Is a cold caused by a bacteria or a virus?)

2. DISINFECTANTS AND ANTISEPTICS

   Bacteria can be controlled in other ways also. What products do you use around the house to get rid of "germs"? Think of things that you use in the kitchen, the bathroom and on and in your body.

   These disinfectants and antiseptics kill bacteria that are outside our body so they cannot harm us. (If we took disinfectants and antiseptics inside our body they would kill our cells too!) They do not kill viruses, but they destroy the outer covering of viruses so that they cannot enter our cells to make us sick.

   Think of at least three situations where it would be important to use a disinfectant or antiseptic to kill bacteria or destroy the virus' outer coat before they get in our body.

   1.

   2.

   3.
3. **VACCINES**

We can keep viruses and bacteria from hurting us by means of vaccines. They prevent us from getting sick, so we get them before we get sick. Dead or weak bacteria or partly destroyed viruses are injected into an animal. These substances are not strong enough to give the person the disease, but the animal's body starts making antibodies (the body's "army") to fight off the invaders. If a living bacteria or weakened virus later gets into the body, the antibodies fight them off so the animal does not get the disease.

What kind of vaccines have you received? (Ask your parents or guardians if you do not know.)

________________________________________________

When does a doctor give a person a vaccine, before or after they get the disease?

________________________________________________

Why do you think there are many people over fifty years old who have had polio (caused by a virus), but very few under fifty years of age that have had it?

________________________________________________

What are two ways to keep us from getting a disease caused by a virus?

________________________________________________

How is this different from controlling bacteria?

________________________________________________
**Review:** *(Each answer must include some specific reference to bacteria or viruses.)*

1. How have your ideas about bacteria changed during the course of this unit?

2. How have your ideas about viruses changed during the course of this unit?

3. Are bacteria made of cells (or one cell)? Explain.

4. Are bacteria living? Explain telling how they do at least three of the five life processes.

5. What would the world be like if bacteria did not exist? List at least three things.
   a. 
   b. 
   c. 

6. Would you still be able to eat and enjoy pizza if there wasn't bacteria? Explain your prediction.
7. Why do we put leftovers in the refrigerator after a meal? (Remember to refer to bacteria.)

8. Why are thermometers placed in alcohol after they are used to take your temperature? (Remember to refer to bacteria.)

9. Your dog licked the last of your spaghetti off your plate. Why might you wash it in bleach water? (Remember to refer to bacteria.)

10. A rabbit was killed on a country road. How would bacteria be helpful in this situation?

11. A farmer plants corn (which does not have nitrogen fixing bacteria) year after year without adding fertilizer. What problems might result and why? (Refer to p.3)

12. Suppose you took a strong antibiotic to treat lyme disease. You then started have problems with your digestive system. How are these two related? (Refer to p.3)

13. You have pneumonia caused by a virus. What remedy would the doctor prescribe and why? (Refer to p.7)
Construct a concept map using the words below. You might want to start out with bacteria and viruses on the top and use broad headings such as "helpful", "harmful", "living", "nonliving", and "controls."

- genetic engineering
- yogurt
- cheese
- disease
- do 5 life processes
- disinfectants
- control
- freeze
- virus
- rest
- don't do 5 life processes

- bacteria
- pickles
- helpful
- antibiotics
- decompose
- antiseptics
- strep throat
- dry
- cold
- nonliving
- cells
- sauerkraut
- helpful
- harmful
- living
- nitrogen fixers
- spoil food
- salmonella
- boil
- flu
- no cells