**BIOLOGY 2020 -21 March 10, 2021**

**Today’s Agenda (Day 122)**

1. HOMEWORK CHECK

🡪 Virtual Activity – Virus Explorer

1. CLASS ACTIVITY

* **CONT’D: Activity – Identifying Bacteria – answers**

**🡪** BEGIN: Chapter 19 PPT Review

1. Section 19.1 – Introduction to Protists
2. Section 19.2 – Protozoans—Animal-like Protists
3. Section 19.3 – Algae—Plant-like Protists
4. Section 19.4 – Fungus-like Protists

🡪 THURSDAY: A. Lab: Bacteria Take Over

B. Lab: Bacteria – Spice It Up

HOMEWORK:

* READ: Chapter 19 - Protists
* STUDY: Ch 19 Test

http://novella.mhhe.com/sites/0078695104/student\_view0/unit2/chapter9/index.html

Chapter 19 – Protists

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| --- | --- | --- | --- | --- | --- |
| acrasin | alternation of generations | bioluminescent | colony | contractile vacuole | microsporidium |
| pellicle | plasmodium | protozoan | pseudopod | test | trichocyst |

REMINDERS:

* **TEST**: Chapter 19 → **March 16, 2021 note new date!**

**BIOLOGY 2020 -21 Activity**

BACTERIA TAKE OVER

**Problem**: How does bacteria grow? Can bacteria be visible? What areas have the most and least bacteria?

**Background**: Germs are EVERYWHERE!!! This is something that you most likely have heard. Quite often illnesses and diseases can be caused by the transmittance of some sort of microorganism. These different microorganisms could vary from some sort of virus, fungi, or bacteria. Bacteria, in particular, are single celled microbes. The cell structure is simpler than that of other organisms as there is no nucleus or membrane bound organelles. Instead, their control centre containing the genetic information is contained in a single loop of DNA. These little invaders use the nutrient rich and warm human body to prosper and to replicate themselves (Alberts, Johnson, & Lewis). An example of a harmful bacteria is E Coli. When E Coli is found in food or water it can be harmful to our bodies.

**Hypothesis**:

#1 How does Bacteria Grow? I believe that… \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Because, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

#2 Can bacteria be visible? I believe that… \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Because, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

#3 What areas have the most and least bacteria? I believe that… \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Because, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Materials**:

- petri dishes (1-2 per group)

- Nutrient agar powder (or agar powder and beef boulion cube)

- heater or incubator

- cotton swabs

- hand sanitizer

- marker for labeling

- liquid bleach

- lab safety gloves

- miscellaneous metals

**Safety**:

- Wearing lab safety gloves, goggles, and an apron or lab coat

- Make sure that bacteria is dead before disposing of it by washing it down the sink. This can be done by using bleach.

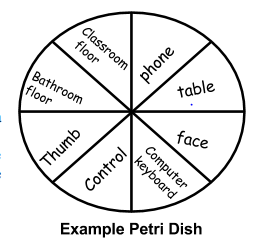
- Make sure that all bacteria is contained and that hands are always washed after working with samples.

**Procedure**:

1. Acquire 1-2 agar plates. Plate cover should not be removed until instructed to do so.

2. Take these petri dishes and turn upside down. Label each section with the area you indent to introduce bacteria for. An example of a plate is to the right. Make sure that one section of your plate is a “control” section where no bacteria will be plated (the areas to take bacteria from to the right are only suggestions. You should test the areas that you and your group members hypothesize in your third hypothesis on the first page.

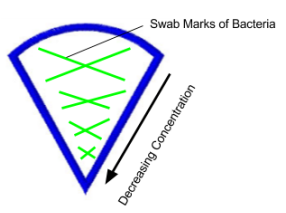
3. Use a cotton swab and wipe it along a surface that your group has chosen to test thoroughly.



\*\*Note: The next few steps(4-6) should be done quickly in order to ensure the least amount of contamination\*\*

4. Lift the lid off of one of your petri dishes. (Do not set down on the countertop. You will replace as soon as you are done introducing the bacteria)

5. Using the cotton swab that you swiped your surface with, swipe the appropriate section of the dish without breaking the agar. A diagram is given below of a petri dish section with how to introduce bacteria into your plate in order to gradually decrease the concentration of the bacteria on your plate.



6. Quickly replace the lid of your petri dish

7. Repeat steps 4-6 in order to fill all the sections of your petri dish except for the control which should be empty to see if any bacteria were airborne and introduced through the opening and closing of the petri dish.

8. After you have finished adding all your bacteria replace the tops to the appropriate petri dishes, as an extra precaution to prevent contamination, you can place each petri dish in a zipper-lock bag. This will provide an extra layer of protection against any hazardous bacteria colonies that may develop, but will still allow you to view the contents of the petri dish.

9. Record your Day 1 observations on the Data Sheet attached.

10. Place the petri dishes in a warm, dark place as instructed by your teacher(incubation system is ideal). Leave the petri dishes in a warm, dark place where the bacteria can develop, undisturbed, for several days. The ideal temperature for growing bacteria is around 980 F (37 0C)... Similar to human body temperature!.

11. Leave the petri dishes in their warm dark place for 4-6 days, checking on them each day and writing down and drawing observations based of their appearance, smell, and size on the Data Sheet.

12. After the 4-6 days record your final observations and compare your results with other classmates and complete the discussion and conclusion questions attached to this lab.

Data Sheet: Day 2: DiagramObservationsDay 3: DiagramObservationsDay 4: DiagramObservationsDay 5: DiagramObservationsDay 6: DiagramObservations

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| --- | --- | --- |
| **Day 1**  Diagram  Observations | **Day 2**  Diagram  Observations | **Day 3**  Diagram  Observations |
| **Day 4**  Diagram  Observations | **Day 5**  Diagram  Observations | **Day 6**  Diagram  Observations |

**Discussion Questions:**

1. How extensive was the growth of the “control” section of your petri dishes? Did this surprise you? Explain.

2. What area has the most and least bacteria based off of the classroom data? Explain why you think this might be.

3. Was their bacteria growth in the “control” section of your petri dish?

4. What do you believe is the ideal “microbiome” is?

5. Does all the bacteria look the same? Did the bacteria all grow in a certian pattern? If yes what are the main characteristics of it? If no what are some of the differing characteristics of it?

6. Do you believe that you have grown different varieties or species of bacteria?… yes bacteria are living things!

7. What do you believe the purpose of antibacterial soap and hand sanitizers are? Do you think they are important? Explain why.

**Conclusion Questions:**

1. What is the difference between sexual and asexual reproduction?

2. What is binary fission?

3. How would the temperature of the environment affect the growth of these bacteria?

4. What in the bacteria’s environment gave it the ability and energy to grow?

5. What is an example of a helpful and harmful bacteria that is not mentioned in this lab?

6. What is the difference between viruses and bacteria?

7. What are some components that must be present in order for bacteria to grow?

8. What are some potential areas of error in this lab experiment?

9. If you were to do this lab over again what would you do differently?

**Extensions:**

- Explore some different methods of inhibiting bacterial growth. Try plating bacteria using these different methods and see if it affects your bateria growth.

- How well does toothpaste kill bacteria on your teeth? Swab bacteria onto a plate before and after brushing your teeth to see if there's a difference.

- Metals are often used in medicine. Try using petri dishes to plate bacteria and introduce different metals into their environment to see how it affects the growth and development of the bacteria.

- Complete research to try and identify the bacteria you have grown.

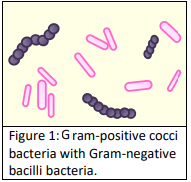
- Using a microscope use the link below to identify the bacteria you have grown. http://microbiologyonline.org/teachers/observing-microbes/observing-bacteria-in-a-petri-dish

**BIOLOGY 2020 -21 Activity**

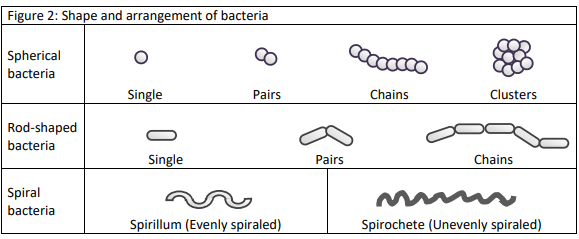
**Identifying Bacteria**

**OVERVIEW** Scientists can identify bacteria by observing their physical and chemical characteristics. In this activity you will practice identifying bacteria based on four characteristics: Gram stain, cell shape, arrangement, and motility.

**GRAM STAIN** The Gram stain is a method of sorting bacteria into two groups based on the composition of the cell wall. The Gram stain detects the amount of peptidoglycan in the cell wall. Cells with high amounts of peptidoglycan are stained dark purple and are called “Gram-positive” cells. Cells with only a small amount of peptidoglycan will appear light pink and are called “Gram-negative” cells.



**CELL SHAPE AND ARRANGEMENT** Bacteria come in a variety of shapes. The most common bacterial shapes are spherical (cocci), rod-shaped (bacilli), and spiral (spirilli). Cocci are typically arranged as single individuals, pairs, chains, or clusters. Bacilli can be arranged as single individuals, pairs, or chains. Spirilli usually occur as single individuals and can be found in two forms. Spirillum are rigid and evenly spiraled while spirochetes are flexible and can twist unevenly.



**MOTILITY** Some bacteria do not move, but others can move towards stimuli using one or more flagella. Cocci typically lack flagella. Single bacilli and some spirilli can have one or more flagella.

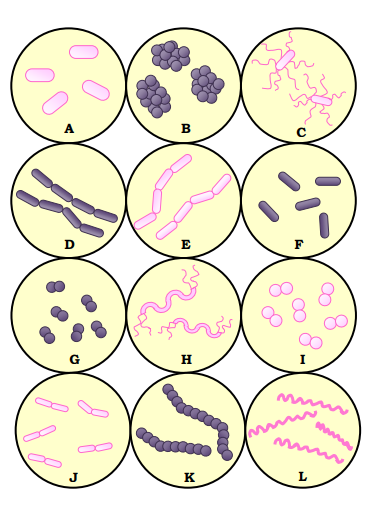
**Bacteria Identification Data Sheet**

Use the dichotomous key to identify the 12 bacterial species provided. Record the scientific name and a short description of each species in the table below.

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| **Bacteria** | **Specific Name** | **Description** |
| **A** | Klebsiella pneumoniae | Gram-negative, bacillus, no flagella, present as single individuals. |
| **B** |  |  |
| **C** |  |  |
| **D** |  |  |
| **E** |  |  |
| **F** |  |  |
| **G** |  |  |
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**Bacteria Dichotomous Key** Use the dichotomous key below to identify the 12 bacterial species provided. Begin with Step 1 and continue as directed. Read each characteristic carefully. Once you have determined the scientific name of the bacteria, record your results in the data table.

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| **Bacteria** | **Characteristic** | **Description** |
| **1** | 1a. Gram-positive… go to step 2  1b. Gram-negative… go to step 6 |  |
| **2** | 2a. Bacilli… go to step 3  2b. Cocci… go to step 4 |  |
| **3** | 3a. Arranged in chains…………….…………………..…..  3b. Present as single individuals……………………… | Bacillus cereus  Clostridium botulinum |
| **4** | 4a. Arranged in pairs or chains… go to 5  4b. Arranged in clusters………………………………….… | Staphylococcus aureus |
| **5** | 5a. Arranged in pairs…………………………………………  5b. Arranged in chains…………………………….……….. | Streptococcus pneumoniae Streptococcus pyogenes |
| **6** | 6a. Spirilli … go to step 7  6b. Bacilli or Cocci… go to step 8 |  |
| **7** | 7a. Spirillum with flagella……………………….…………  7b. Spirochete without flagella…….….……………… | Spirillium voltans  Leptospira interrogans |
| **8** | 8a. Bacilli… go to step 9  8b. Cocci arranged in pairs………………….…………... | Neisseria gonorrhoeae |
| **9** | 9a. Present as single individuals… go to step 10  9b. Arranged in pairs or chains... go to step 11 |  |
| **10** | 10a. Have flagella…………………………………………….  10b. Do not have flagella………………………………… | Salmonella enterica  Klebsiella pneumoniae |
| **11** | 11a. Arranged in pairs………………………………………  11b. Arranged in chains……………………………………. | Moraxella lacunata Streptobacillus moniliformis |



**BIOLOGY 2020 -21 Virtual Activity**

*To use this document, first read the* [*Instructions and FAQs*](https://docs.google.com/document/d/1yXJCV3nyrI8o8YuDuVICXz13nWeJKOrlampQ8ifLkG0/edit)*. This document is licensed by the Howard Hughes Medical Institute under a* [*Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International license*](https://creativecommons.org/licenses/by-nc-sa/4.0/)*. No rights are granted to use HHMI’s or BioInteractive’s names or logos independent from this document or in any derivative works. Using this document, you agree to use this document in accordance with these terms.*

# INTRODUCTION

What do the flu, HIV, and coronaviruses have in common, and how are they different? You’ll learn more about these and other viruses in the [*Virus Explorer*](https://www.biointeractive.org/classroom-resources/virus-explorer)Click & Learn. In the Click & Learn, you can explore the structures and biology of 10 different viruses, as well as how these viruses impact humans and other organisms.

# PROCEDURE

Follow the instructions as you proceed through the Click & Learn, and answer the questions in the spaces provided.

1. Open the [*Virus Explorer*](https://www.biointeractive.org/classroom-resources/virus-explorer)Click & Learn and click on the “About” tab at the bottom. Use the information in this tab to answer the following questions.
   1. List **four** ways in which viruses can differ from each other.

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* 1. In the table below, describe what each abbreviation in this Click & Learn means.

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| **Abbreviation** | **Description** |
| nm |  |
| bp |  |
| ss |  |
| ds |  |

1. Close the “About” tab and return to the main page. Find the “**i**” icon next to each viral characteristic across the top. Click on each icon to learn more about that characteristic, then answer the associated question below.
   1. **Envelope:** The envelope is an outer layer that some, but not all, viruses have. How does an envelope form?

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* 1. **Host(s):** From the virus’s perspective, why is the host important?

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* 1. **Genome Type:** What are **four** characteristics of viral genomes that may vary among viruses?

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* 1. **Transmission:** Define the terms “vector” and “zoonotic.”

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* 1. **Vaccine Availability:** What is one advantage of being vaccinated against a particular virus?

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1. Click the viral characteristics across the top of the main page to classify and learn more about the viruses. Use what you learn to answer the following questions.
   1. What is one difference between the rabies virus and the influenza A virus?

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* 1. Of the 10 viruses shown, which is the only one that infects plants?

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* 1. List **three** characteristics that adenoviruses, T7 virus, and papillomaviruses have in common.

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* 1. As of 2020, a new coronavirus called SARS-CoV-2 has been in the news. There have been many efforts to develop a vaccine for this coronavirus. Why is this virus of particular concern?

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* 1. Which **two** viruses infect all the vertebrates included in the Click & Learn?

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* 1. Of the 10 viruses shown, which is the only one that infects bacteria?

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* 1. List **four** specific characteristics that human immunodeficiency virus (HIV) and Ebola virus have in common.

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* 1. List **four** specific characteristics that HIV and Ebola virus do *not* share.

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1. Find the **+** icon next to each virus’s name. Click on each icon to learn more about that virus, then answer its associated question(s) below.
   1. **Rabies:** People often think that you get the rabies virus from dogs. Why is this understanding incomplete?

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* 1. **Influenza A:** Influenza viruses have a segmented genome. Why is having a segmented genome an advantage for these viruses?

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* 1. **HIV:** HIV infects cells in the immune system. Why is this a disadvantage for the infected person?

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* 1. **Ebola:** What animal is associated with Ebola virus outbreaks?

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* 1. **Tobacco mosaic virus (TMV):** Name one characteristic of TMV that none of the other viruses in the Click & Learn have.

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* 1. **Adenovirus:** What are **three** of the many conditions that adenoviruses can cause in humans?

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* 1. **T7 virus:** The replication cycle of T7 virus has several things that none of the other virus replication cycles include. What is one of these things?

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* 1. **Papillomavirus:** What is the common name for papillomas?

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* 1. **Zika:** Why is Zika virus of great concern to pregnant women?

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* 1. **Coronavirus:** What are the names of two coronaviruses that caused outbreaks in humans *before* 2020?

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# EXTENSION: Size, Scale, and Proportion (How Big Is a Virus Anyway?)

Click on the “Show Relative Sizes” button at the bottom of the main page in the [*Virus Explorer*](https://www.biointeractive.org/classroom-resources/virus-explorer) Click & Learn. Use the diagram that is shown to answer Question 1. Note you will need a calculator for some later questions.

1. The white scalebar at the bottom of the diagram represents 100 nanometers (nm). Use this scalebar to make the following estimates.
   1. About how long (tall) is TMV?

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* 1. What is the approximate diameter of human immunodeficiency virus (HIV)?

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* 1. What is the approximate diameter of Zika virus?

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How big are these viruses compared to other things? To find out, we’ll calculate how big different things are when measured in nanometers, then compare them to the sizes of these viruses. First, read through the following example, then answer the questions below.

**Example**A small paperclip measures about 3 centimeters (cm) in length. Let’s calculate the length of the paperclip in several different units.

How long is the paperclip in **millimeters (mm)**? There are 10 mm in 1 cm. So, the paperclip’s length in mm is:

How long is the paperclip in **micrometers (µm)**? There are 1,000 µm in 1 mm. So, the paperclip’s length in µm is:

Finally, how long is the paperclip in **nanometers (nm)**? There are 1,000 nm in 1 µm. So, the paperclip’s length in nm is:

So, a paperclip that measures 3 cm in length is 30,000,000 nm long — much bigger than the viruses you measured!

1. A single grain of salt measures 0.5 mm in width. Calculate this width in the following units. Show your work.
   1. micrometers (µm)

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|  |

* 1. nanometers (nm)

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1. The average human skin cell measures 30 µm in diameter. Calculate this diameter in the following units. Show your work.
   1. millimeters (mm)

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* 1. nanometers (nm)

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1. If you lined up human skin cells side by side, how many would fit along the length of the paperclip in the example above? Justify your answer by showing your calculations. (*Hint:* Use your response to Question 3.)

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1. If you lined up TMV particles end to end, how many would fit along the length of the same paperclip? Justify your answer by showing your calculations. (*Hint:* Use your response to Question 1.)

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1. If you lined up TMV particles end to end, how many would fit across the diameter of the average human skin cell? Justify your answer by showing your calculations. (*Hint:* Use your responses to Questions 1 and 3.)

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1. An individual virus binds to the surface of a cell, hijacks the cellular machinery inside, and replicates itself, sometimes thousands of times. Based on what you’ve learned about the size, scale, and components of a virus, explain how a virus is able to accomplish this. Justify your answer with scientific reasoning.

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