Name	Date

PRACTICE MoSL: Sample Responses

Student directions: Read the following sections and answer each question using your knowledge of science and the information provided.

Part 1: Background Text

Each year, many NYC school children miss school because they get sick from bacteria and viruses that are left behind by their classmates at school. Bacteria and viruses are living organisms that cause diseases, like the common cold or influenza. They are so small that you would need a microscope to see them.

Ms. Contona knows that bacteria and viruses can travel through the air, and they get into the air easily. When someone sneezes or coughs, tiny water or mucous droplets filled with viruses or bacteria to spread quickly. Inhaling (breathing in) these viruses or bacteria can spread coughs, colds, and flu.

Ms. Contona understands that warm, crowded conditions with poor air circulation can promote (cause) the spread of bacteria and viruses. Some bacteria and viruses thrive (live longer) and circulate through overheated and poorly maintained building ventilation systems. Warm, damp, and humid air can increase the survival rate of viruses indoors.

Ms. Contona also knows that most often, the human occupants of a home or school are the source of infectious diseases like the cold and flu. Effective ventilation, or air flow, may help keep bacteria, viruses and other pollutants out of the indoor air. Research shows that air flow and ventilation can affect how diseases spread



Bacteria cells as seen through a microscope, made bigger 400x.

indoors. Keeping a room cooler by opening the windows may limit the growth of bacteria and viruses because most types of bacteria and viruses like it warm. The more stagnant (still) and warm the air is, the more likely diseases are to spread.

Ventilation, or opening windows so air can flow, can also limit moisture. Damp indoor spaces allow the growth and spreading of viruses and bacteria. Controlling moisture indoors can limit the spread of these infectious diseases and also limit mold, dust mite and cockroach growth.

Because of her knowledge of how bacteria and viruses spread, Ms. Contona keeps the windows open in her classroom. She thinks this may have something to do with why she only had one cold this winter and Ms. Shepard, who keeps her windows closed, had 4 colds this winter!

Text adapted from: http://www.lung.org/healthy- air/home/resources/bacteria-and-viruses.html



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Ms. Contona is curious about how keeping a classroom cooler affects the number of bacteria that grow. Ms. Salvaggio said she would help collect and record data. To collect the bacteria Ms. Contona and Ms. Salvaggio used plastic containers called petri dishes that have special food inside of them that the bacteria like to eat. This food is called "agar." They collected their samples at the end of the day on a Friday from 4 desks in each room. Ms. Contona made sure the cotton swabs came from a freshly opened package and that all of her petri dishes had been sealed before she opened them.

Ms. Contona's Experimental Design

Research Question: What makes bacteria grow?

Procedure:

- 1. Record the temperature and humidity levels in room 222 when the windows are
- 2. Record the temperature and humidity levels in room 219 when the windows are closed.
- 3. Using a clean cotton swab, rub the surface of 4 desks in room 222. Rub each cotton swab on a different petri dish. Make sure to label these petri dishes "222."
- 4. Using a clean cotton swab, rub the surface of 4 desks in room 219. Rub each cotton swab on a different petri dish. Make sure to label these petri dishes "219."
- 5. Store the petri dishes in a warm, dark place for 1 week.
- 6. After 1 week, count the number of bacterial colonies that grow in each petri dish.

TABLE 1:Ms. Contona's Data

Room,	Number of Bacterial Colonies				
temperature, and humidity level	Desk 1	Desk 2	Desk 3	Desk 4	Average number of colonies
222	3 bacterial	5 bacterial	2 bacterial	3 bacterial	3.3
Temperature:	colonies	colonies	colonies	colonies	bacterial
65 F					colonies
Humidity: 30%					
219	6 bacterial	8 bacterial	10 bacterial	15 bacterial	9.8
Temperature:	colonies	colonies	colonies	colonies	bacterial
80 F					colonies
Humidity: 40%					

Ms. Contona's Conclusion

After looking at her data, Ms. Contona concluded that bacteria grow more in classrooms that are hot and humid.

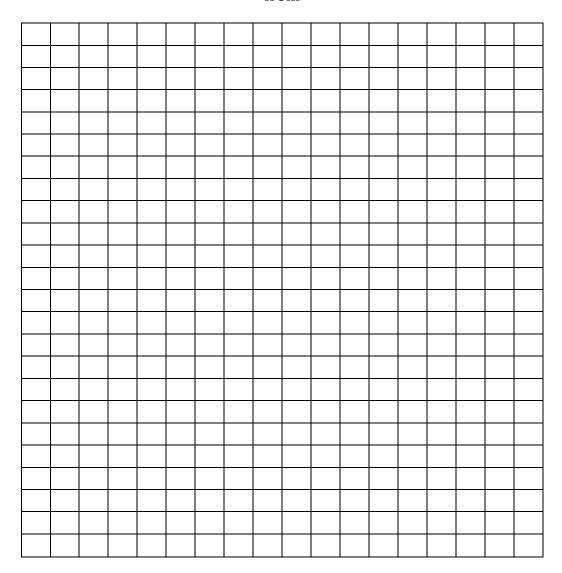
Ms. Salvaggio says, "Wait, I'm not sure we can conclude that yet." Ms. Salvaggio reminds Ms. Contona that Gabby helped disinfect the desks in room 222 at lunch on Wednesday. The desks in room 219 did not get disinfected on Wednesday.

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Part 1-Organize and Present Data	
1. Use the data in Table 1 to const	ruct a bar graph that shows the relationship
between the number of bacterial	colonies and the location the bacteria was

☐ Mark the scale numbers on the x-axis and the y-axis on the graph. Create the bars on the graph.

taken from. Be sure to:

Relationship of number of bacterial colonies and location they were taken from



Location of Bacterial Colonies

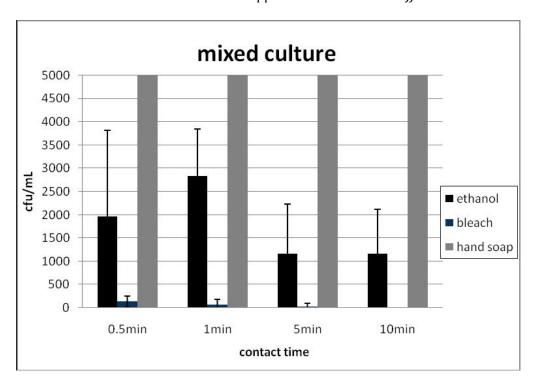
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2a. Wha	: Analyze and Construct Explanations nat can you conclude about the number on? Use evidence from the data table an	
bacteria EVIDEN 65° and	: The number of bacterial colonies in room 2 ial colonies in room 219. NCE: The average number of colonies in roo d a humidity level of 30%, was 3.3. The aver had a temperature of 80° and a humidity lev	m 222, which had a temperature of age number of colonies in room 219,
-	ny do you think there was that number once from the text to explain your answer	
circulat favorab	NING: According to the text, locations with a tion are more likely to grow more bacteria which ble for bacteria growth. According to the datantly more bacterial growth (9.8 colonies)	due to the conditions that are ta this is true because room 219 had
□ I	In 2a: Did you provide a CLAIM based on the of In 2a: Did you cite EVIDENCE from the data ta In 2b: Did you explain the REASONING for this	ble and/or graph?
Before N	- Critique a Hypothesis Ms. Contona began her investigation of the I the following hypothesis:	bacteria in 222 and 219, she
t (Ms. Contona hypothesized that since room a the time, that there would be less bacteria g Contona made this hypothesis based on her crowded conditions with poor air circulation and viruses."	growing in 222 than in 219. Ms. research, which states that "warm,
hypothe	teacher asks you to identify the strengths a lesis. Be sure to use information and eviden e background information in your explanat	ice from the provided experiment
formulat guess. Or sure that	ength of Ms. Contona's hypothesis is that it is ba ated an informed hypothesis based on an article One weakness of her hypothesis is that in her exp at BOTH rooms were disinfected before the expe acteria in room 222, therefore altering the resul	she read. Her hypothesis was not just a perimental design, she did not make riment began. This could have killed
	Did you identify 1 strength of the hypothesis? Did you identify 1 weakness of the hypothesis Did you provide information and evidence to you identified?	?

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Part 4- Design an Investigation

Ms. Contona learned that bacteria grows under certain conditions and that hand sanitizer may affect the growth of the bacteria. Ms. Contona became curious about how effective different types of cleaners would be on the amount of bacteria that would grow on the desks in 222. She did some more research.

Figure 1 shows that hand soap allowed for the most bacteria to grow, ethanol allowed for less and bleach appeared to be the most effective.



How does ethanol kill bacteria?

According to http://scienceline.ucsb.edu/getkey.php?key=2160, "Ethanol kills bacteria mainly through 2 mechanisms: protein destruction and dissolving the lipid membrane.

Proteins, the machinery of the cell, must be dissolved in water in order to properly function. When one puts a protein in ethanol, the protein can not function properly and becomes denatured (destroyed). Also, bacteria are surrounded by a lipid membrane (fatty acids). The membrane is held together because the alkane chain of a fatty acid is hydrophobic, and thus buries itself amongst other lipids. However, the lipids will freely dissolve in ethanol, causing a disruption of the bacterial membrane. This ruptures the bacteria so it can no longer live."

How does bleach kill bacteria?

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According to http://www.livescience.com/3069-bleach-kills-bacteria.html, "At high temperatures, proteins begin to lose their three-dimensional molecular structure and start to clump together and form large, insoluble aggregates, just like when you boil an egg," said study lead author Jeannette Winter, one of Jakob's postdoctoral researchers. Like a boiled egg, those proteins can never revert to their previous state, and the stressed cells eventually die.

Jakob and her team found that a particular chemical in chlorine bleach, hypochlorite, has a very similar effect on proteins as heat stress does. Just like heat, hypochlorite causes the proteins to clump together.

"Many of the proteins that hypochlorite attacks are essential for bacterial growth, so inactivating those proteins likely kills the bacteria," said study team member Marianne Ilbert, also a postdoctoral researcher in Jakob's lab."

How does hand soap kill bacteria?

According to http://www.quora.com/Does-soap-kill-bacteria-or-just-clean-off-bacteria-andviruses-How-does-the-hand-washing-process-really-work. "Soap does indeed kill bacteria and viruses, although it is not as effective as other compounds. Soaps and detergents contain fatty acids (hydrocarbon chains with negatively charged groups at the end), which are chemically similar to the fatty acids found in the membranes of bacterial cells and viral coats. Soaps insert themselves into these membranes and disrupt them. This kills bacteria, and causes viruses to fall apart. Hot water greatly enhances (improves) the effectiveness of this process.

Bacteria do vary in their susceptibility to soap. But the biggest factor in the effectiveness of hand washing is not whether a soap with antibacterial agents is used, but how long and how thoroughly one washes ones hands."

Ms. Contona needs your help! Please design an experiment to investigate which type of cleaner would be most effective for teachers to use to prevent BELL Academy students and staff from becoming sick.

Question

Design your experiment to answer the following question:

Which cleaner would allow the least amount of bacteria to grow on the desks in room 222?

Investigation

In this investigation:

- Compare the types of cleaners and the amount of bacteria each allow to
- Conduct at least 3 trials for each type of cleaner used.
- Be sure you have a clear way of measuring the amount of bacteria that grow.

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4. State a hypothesis for your investigation.

If bleach is used to clean the desks, then more bacteria will be killed because according to the text, bleach destroys the structure of the bacteria which causes it to die. Additionally, according to the graph, the least amount of bacteria grew when bleach was used as a cleaner.

- ☐ Did include the IV and DV in the hypothesis?
- ☐ Did you provide a rationale (reason) for your hypothesis?
- ☐ Is the rationale for your hypothesis based on a text or experimental data?

5. Design an experiment to investigate which cleaner allows the least amount of bacteria to grow.

∕[∪]Variables:

- ✓ **The Independent Variable** is the factor you choose to test: the type of cleaner.
- ✓ **The Dependent Variables** are the variables you measure as a result of what you test; the amount of bacteria that grow.
- ✓ **The Control Variables** are those that must remain constant; the location of the bacteria, the amount of cleaner used, the length of time the bacteria are allowed to

✓ **Identify additional materials** for the investigation and explain how they will be used. Some materials are listed below to help you get started. You need to add to the list.

- ✓ Petri dishes
- ✓ Sterile Cotton Swab
- ✓ Other materials: 4 desks, 8oz each of bleach, hand soap, and ethanol, paper towels, paper towels

Design and explain your procedure (You may include labeled drawings to help support your design.)

- 1. Make sure that all desks have NOT been disinfected for at least 1 week before beginning your investigation.
- 2. Label your petri dishes like this: "bleach," "ethanol," "hand soap," "no cleaner."
- 3. Clean 1 desk with bleach, then immediately take a sterile cotton swab and wipe it on the desk back an forth 4 times, then rub it four times on the petri dish. Close the petri dish and seal it.
- 4. Clean a second desk with ethanol, then immediately take a sterile cotton swab and wipe it on the desk back an forth 4 times, then rub it four times on the petri dish. Close the petri dish and seal it.
- 5. Clean a third desk with hand soap, then immediately take a sterile cotton swab and wipe it on the desk back an forth 4 times, then rub it four times on the petri dish. Close the petri dish and seal it.
- 6. DO NOT clean the fourth desk. Take a sterile cotton swab and wipe it on the desk back an forth 4 times, then rub it four times on the petri dish. Close the petri dish and seal it.
- 7. Repeat steps 2-7 on 2 more sets of desks for a total of 3 trials.
- 8. Place all petri dishes in a warm, dark place and allow the bacteria to grow for 1 week.
- 9. Count the bacterial colonies that grew in each petri dish and record your data in a data table.

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Explain how your data will be collected.

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Count the bacterial colonies that grew in each petri dish and record your data in a data table. The colonies will be clumped together and may be different colors. An average of each desk will be calculated after the data is collected.

Show how your data will be organized in a data table.

	Number of Bacterial Colonies			
Type of Cleaner	Desk 1	Desk 2	Desk 3	Average
Bleach				
Ethanol				
Hand Soap				
No Cleaner				

Explain how you will interpret or analyze your data.

After I collect my data, I will create a bar graph to show a visual representation of my data. This will show a comparison amongst the number of bacterial colonies that grown from each of the levels of my IV. After I create a bar graph, I will write a discussion which will include a claim about a pattern I observe, evidence from my data table to support my claim, and a scientific reason for why I observed this data based on a scientific text I have read.

6. Explain how the investigation that you designed will help you to test your hypothesis. Be sure to include why your investigation will likely yield (produce) reliable data and why the variables are isolated and controlled.

Did you choose only ONE Independent Variable?
Do you have an accurate way of measuring your data?
Did you choose appropriate controlled/constant variables to insure a fair
test/reliable data?

The investigation I designed will help to test my hypothesis because I chose only 1 independent variable, which is the type of cleaner. I will make sure that all desks are NOT disinfected before I collect my data, this is one of my constant variables. I will also make sure to rub the sterile cotton swab on the desk and the petri dish the same number of times for each level. I will make sure to count the number of colonies that grow in each petri dish and find the average. Setting up my experiment like this will allow me to have reliable data because I will make sure to only change ONE variable and I will account for possible sources of error by keeping the conditions of the desks the same before I start and rubbing the cotton swab on the desks and petri dishes the same number of times. This will ensure that the data I collect will be a result of my chosen IV, not another change that I didn't plan for.