Name _____

HANDWASHING LAB

Exercise 2

Introduction

Humans are blessed with hands that can play a concert piano, wave to a friend, or perform a delicate surgery. Unfortunately these wonderful appendages are also ideal sources of contaminating microorganisms. Every time we touch a door knob, shake hands, put on our shoes, etc., our hands are exposed to a large variety of microbial species. Because these microbes are temporary and can be removed by handwashing, they are called **transient flora**. In addition, there are species of microorganisms that live naturally and permanently on our skin, which are called **resident** or **normal flora**. Although handwashing will not completely remove resident flora, it will decrease their numbers temporarily.

By removing transients and reducing residents from our hands we can diminish the chances of transmitting disease. For example, experimental studies have shown that handwashing is one of the most effective means of saving you from catching or passing colds during the cold and flu season. For safety before you leave lab for home or for a break, you should always wash your hands to remove any microbes you might have picked up in the laboratory. (Be certain to read all of the other safety regulations listed in Appendix A.)

In hospitals, health care professionals must wash their hands frequently to protect themselves and their patients. A **nosocomial** infection is defined as a disease acquired during hospitalization. In other words, this is a disease that the patient did not have before entering the hospital. Infectious disease experts agree that even with all of the sophisticated technology of modern medicine, the single most important procedure for prevention of nosocomial infections is proper handwashing.

In this exercise, you have the opportunity to design your own experiment to answer questions about handwashing. Work with a partner or better yet a group of classmates. This will give you a chance to increase the sample size of your experiment, brainstorm with more brains, and meet some potential study partners.

Materials

Per Student

1. 1 enriched agar plate

Methods

1. List the names of the members of your research team. (If you want to start a study group, you might record their phone numbers or email addresses somewhere too.)

2. There are a number of questions you could explore with your experiment. Is soap better than just water? Is antibacterial soap any more effective than regular soap? How long should a person wash their hands? Is it better to use paper towels or air dry? There are many other questions your group might come up with too. As a group, decide on just one question for your experiment. Write your question here.

3. In science we answer questions by testing a hypotheses. The **hypothesis** is a logical prediction or educated guess as to the answer to your question. For example, suppose our question was, "Is hot water better than cold water for washing hands?" The hypothesis might be written as, "Since hot water dissolves things better than cold, we think washing hands with warm water will be more effective at removing microbes." This is a testable prediction. Write a hypothesis for your experiment.

4. To answer our question or test our hypothesis we will change some condition and then see if it makes a difference. For example to test the hypothesis above we could change the temperature of the water and compare the diversity of microbes on our hands after washing with warm water versus cold water. The condition we changed (i.e., increasing the temperature of the water) is called the **experimental variable**. The hands that are subjected to the change (warm water) are members of the **experimental group**. The unchanged group that we compare against is called the **control group** of our experiment. So we compare the microbes of our experimental group (hands washed with warm water) to the unchanged control group (hands washed with cold water). Everything should be identical between the experimental group and the control group, except for the experimental variable. If other variables have also changed (like we used different soaps or times of washing), then we won't know which variable is responsible for our results. Describe your experimental variable below. Then list several variables that you will control (keep the same) in your control group.

   Experimental Variable:

   Controlled Variables:

5. When comparing the results of experimental vs. control groups, the larger the groups, the more reliable the results. If you have several members in your research team, you might be able to design your experiment to include more than one repetition of your experiment. For example, if there were three students on your team, each of you could perform the same experiment so that you get three sets of results. Why do you think larger experimental and control groups would produce more reliable results?

6. Next we need to design the steps or protocol of our experiment. Keep it simple. We can do a simple check for the number and variety of microbes on our hands by rolling the tips of our fingers on the agar plate. The microbes that are deposited onto the agar will grow into colonies that we can see and count by the next lab period. For our supplies in this exercise we have one agar plate available per student. You can divide your agar plate into halves, thirds or quarters by marking on the bottom of the plastic Petri dish. (Why would it be a bad idea to mark the lid this way?) Using numbered steps, describe below the protocol for your experiment. Your overall experiment should be kept simple, but the description of your steps should be detailed enough that another group of students could replicate your experiment after reading your protocol.

Results

1. Including all the students in your research team, how many sets of results did you obtain (i.e. how many repetitions of your experiment)?

2. The different kinds of microbes that grow on your plates can often produce colonies that differ in color, shape and texture. Researchers often use a table to record and organize the data from an experiment. So make a table below to compare and contrast the number of kinds of colonies you found from your control and experimental groups. (We are not looking for the total number of colonies here, just how many different kinds of colonies you see.) Across the top of your table, label the columns with the names of your control and experimental groups. For example you might just have two columns like "Control—Washed Without Soap" and "Experimental—Washed With Soap"; or your experiment might require more columns like "Control—Unwashed Hands," "5 Second Wash," "10 Second Wash," etc. Each set of results can be recorded in a separate row of your table. For example, if you had four people in your research team and each of you repeated the experiment, then you would have four rows in your table and along the left side of the table you could label each row with the name of the team member.

Discussion

1. Results and Conclusions are two different things in science. **Results** refer to the actual data that you collect, like the number of colonies we obtained after washing our hands a certain way. Our **Conclusions** are the logical judgement or analysis we make from our Results, like "This way of handwashing is more effective than that one." What Conclusions can you make from your experiment? Did your experiment support your hypothesis or refute it?

2. Often when researchers perform an experiment the first time, they see ways that the protocol could be improved. Perhaps they discover another variable that they hadn't thought of and didn't control for. Maybe they obtained some unexpected results that give them an idea for another experiment. What are some ideas for improvements or further research you could suggest after your experiment?

3. In medical research double blind controls are often used. From your lecture, text or other source, define this term and explain why it is important.

4. List 5 possible sources of microorganisms that you have touched in the last hour.

5. What is the difference between normal flora and transient flora? Describe an experiment to differentiate between resident species and transient species on your hands.

6. Define nosocomial infection and describe how handwashing can help decrease the probability of these infections.

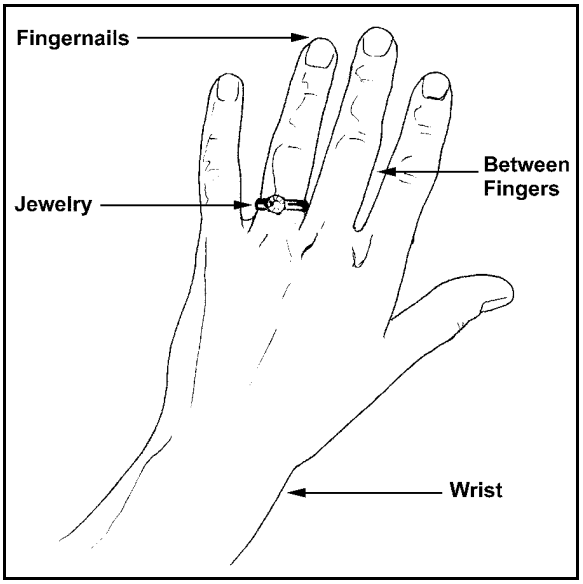

Figure 2.1 Microbial Hot Spots

7. The hot spots shown above usually contain the highest numbers of microorganisms. Why do you think that might be true?

Scientific Inquiry

- What percent of people wash their hands after using the restroom? Are there differences between Men's and Women's Restrooms? Between science area and humanities area restrooms. Do most people perform a thorough hand washing or merely a fingertip rinse?