**EXERCISE 1: DATA INTERPRETATION**

The pH scale is used to quantitatively assess how acidic or basic a solution is. The pH scale ranges from 0 – 10, with lower pH being more acidic and higher pH being more basic. A pH of 7 is considered neutral (neither acidic nor basic). The pH of the sur- rounding environment can have a great effect on what microbes are able to grow. Examine the data in Table 4, which shows the pH of culture media and the number of microbial colonies observed growing in each culture. Then, answer the questions below.

**Table 4: pH Versus Number of Microbial Colonies**

**Data Interpretation**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **pH** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| **Number of Colonies Observed** | 0 | 2 | 6 | 24 | 36 | 124 | 268 | 296 | 213 | 98 | 34 |

1. What patterns do you observe based on the information in Table 4?
2. Develop a hypothesis relating the pH level of the culture media to the number of microbial colonies observed in each cul- ture.
3. What would your experimental approach be to test this hypothesis?
4. What would be the independent and dependent variables?
5. What would be your control?
6. What type of graph would be appropriate for this data set? Why?
7. Graph the data from Table 4.

8. Interpret the data from the graph you made in Question 7.

**EXERCISE 2: TESTABLE OBSERVATIONS**

Below are several observations that can inform a testable hypothesis. For each of the following observations:

* Determine if the observation is qualitative or quantitative.
* Write a hypothesis and a null hypothesis.
* What would be your experimental approach?
* What are the dependent and independent variables?
* What are your controls - both positive and negative?
* How will you collect your data?
* How will you present your data (e.g., chart, graph)?
* How will you analyze your data?

**OBSERVATIONS**

1. Fresh-baked bread develops mold more quickly than bread bought from the store.
2. Sally comes to work sick; two days later, three of her coworkers are also sick.
3. You accidentally left a carton of milk on the counter all night, and you notice that the milk tastes worse than it usually does when it is stored in the refrigerator.

**Intro EXERCISE 3: ACCURACY AND PRECISION**

Determine whether the following statements are accurate, precise, both, or neither. Circle your answer.

1. Four new students are learning how to count bacteria colonies. They all count the same plate, and the first student counts 98 colonies, the second counts 115 colonies, the third counts 103 colonies, and the fourth counts 93 colonies. The professor tells them there are actually 107 colonies on the plate.

**Accurate Precise Both Neither**

1. You want to make sure your incubator is operating at the correct temperature of 37 ̊C, so you place a thermometer inside the incubator and check it every hour for five hours. You record readings of 36.9 ̊C, 36.9 ̊C, 37.1 ̊C, 37.0 ̊C, and 37.1 ̊C.

**Accurate Precise Both Neither**

1. You aren’t sure whether or not your pH meter needs to be calibrated, so you put it in a solution that you know has a pH of 7. You take four separate readings, which are reported as 5.5, 8.6, 7.2, and 9.4.

**Accurate Precise Both Neither**

1. Your lab is working on sequencing a new plasmid. Before starting you all decide to guess how many base pairs the new plasmid has. The lab members’ guesses are 4,005; 4,006; 4,007; and 4,010. It turns out the plasmid has 7,968 base pairs.

**Accurate Precise Both Neither**

1. You measure out 5 mL of water by eye into five different test tubes. When you go back and check, you find the amount of water in each tube is 4.8 mL, 5.3 mL, 5.2 mL, 4.8 mL, and 4.7 mL.

**Accurate Precise Both Neither**

**EXERCISE 4: SIGNIFICANT DIGITS AND SCIENTIFIC NOTATION**

**Part 1:** Determine the number of significant digits in each number, and write the specific significant digits.

1. 405000  
2. 0.0098  
3. 39.999999 4. 13.00  
5. 80,000,089 6. 55,430.00 7. 0.000033 8. 620.03080

**Part 2:** Convert each number into scientific notation.

1. 70,000,000,000 2. 0.000000048  
3. 67,890,000  
4. 70,500

5. 450,900,800

6. 0.009045 7. 0.023

**EXPERIMENT 1: DESIGN AN EXPERIMENT**

*Saccharomyces cerevisiae* is a species of yeast that is commonly used in food production. Under optimal environmental con- ditions, *S. cerevisiae* undergo aerobic fermentation, a by-product of which is carbon dioxide (CO2). Therefore, measuring the production of CO2 can serve as a proxy for measuring aerobic fermentation. There are many factors that can affect aerobic res- piration, including temperature, nutrient availability, and exposure to pollutants/toxins. In this lab, you will examine the effect of different environmental conditions on aerobic fermentation in *S. cerevisiae*. As a reference, the typical method of activating yeast (starting aerobic fermentation) is incubating 1 tsp. of yeast in 120 mL warm water with 1 tsp. sugar. Whatever your experimental design, be sure to include controls, both positive and negative, and make sure it is reproducible!

**PROCEDURE**

1. Identify ten variables that may affect aerobic fermentation in yeast. Record the variables in Table 5.
2. From your list of variables, select three to test. Form a hypothesis regarding how each variable may affect aerobic respira-

tion in yeast.

1. Determine the positive and negative controls for your experiment.
2. Line up five clear cups (if you do not have five cups, you can perform experiments sequentially, washing the cup thoroughly

between each treatment), and label each cup with one treatment or control type.

1. Place a predetermined amount of yeast and the corresponding treatment in each experimental cup, and set up your con-

trols. Be sure you have enough yeast for each treatment. Let the yeast incubate in the treatment for 15 minutes.

1. Using a ruler, measure the height of the foam created by the output of CO2. Take this measurement by aligning the 0 of the

ruler with the top of the waterline and measuring up to the top of the foam. Record this measurement for each treatment.

1. After completion of data collection, create a table including a title, units, and any other useful information.
2. Select the appropriate type of graph, and report the data you collected.
3. Write a lab report for this experiment.

**Introduction to Science**