***Presenting Data***

To seek answers to problems or questions they have about the world, scientists typically perform many experiments in the laboratory. In doing so, they observe physical characteristics and processes. It is important to record the data precisely - even if the results of an investigation appear to be wrong. And it is extremely important to keep in mind that developing laboratory skills and data analysis skills is actually more valuable to you than simply arriving at the correct answers. If you analyze your data correctly - even if the data is not perfect - you will be learning to think as a scientist thinks. And that is the purpose of this exercise in the biology course. Creating and filling data tables, finding averages, determining rates, and making drawings are four skills useful in presenting data that will be covered here.

**Materials:** for each team

Birthday candle Test tubes (4) prepared slide (blood, paramecium)

 Match Eyedroppers compound microscope

 Ruler Test tube rack Wet mount of elodea slide

 Watch bottle of phenolphthalein (10ml) meterstick

 Solutions (4) that are as follows and are in test tubes:

 one at a pH of 1, one at a pH of 2, one at a pH of 4, one at a pH of 6.

**Data Tables:**

When scientists conduct various experiments they collect vast amounts of data. **To communicate and interpret this information, it must record it in an organized fashion**. Scientists use data tables for this purpose.

You will be responsible for constructing and filling out data tables for many of the laboratory investigations this year. Each column in a data table has a heading. The column headings explain where particular data are to be placed. The completed data tables will help you interpret the information you collected and answer the questions found at the end of each laboratory investigation.

To begin we will start simple. With the following information complete the data table below. Then interpret the data by answering the six questions that follow. **One item we wish to remind you of from your math course is that all numbers must have units behind them or they have no meaning.** It is also customary to place the independent variable on the left vertical of the table and the dependent items on the top horizontal part of the table. To determine independent and dependent variables ask yourself the question what depends on what. In the example below does 15-20 people mean that they have brown hair? Or does having brown hair determine the number of people? The second question is true so hair color in independent and the number of people is dependent.

**Information:** The following hair colors were found among three classes of students:

Class 1: brown hair- 18 people black hair - 0 people blond hair- 6 people

Class 2: brown hair- 20 people black hair - 1 people blond hair- 4 people

Class 3: brown hair- 15 people black hair - 4 people blond hair- 5 people

**Data Table:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Hair color | Class 1 | Class 2 | Class 3 | Total |
| Brown |  |  |  |  |
| Black |  |  |  |  |
| Blond |  |  |  |  |

1. What type of information is being gathered? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. Which type of color occurs most often? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. From the information in the data table, give the number of boys with black hair? \_\_\_\_\_\_\_\_\_\_

4. What information can you give about the number of students with black hair? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. Which class has the highest number of blond students? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6. How many students make up the entire student population? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

7. What type of graph would you use for this data? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 8. Graph this information on a sheet of graph paper.

Now you try making a data table. Given the following information, organize the data into a table. Use the blank space provided below to draw in the necessary columns and rows (**Be sure to use a ruler**).

**Information:** A scientist wanted to see if there is a relationship between the temperature and the heart rate of frogs. During his experiment he collected the following data. First determine the independent and dependent variables. Set up your table and fill it in. Construct the correct type of graph. Hint: could you use this information to determine the heart rate on temperature not tested? Is there a pattern to the plotted points?

 **Data:** at 00 Celsius the heart rate was 4bpm; at 160C it was 245bpm; at 100C it was 136bpm; at 200 it was 320bpm; at 40C it was 68bpm; at 140C is was 230bpm; at 180C it was 278bpm; at 20C it was 30bpm; at 120C it was 195bpm; at 60C it was 98bpm; and at 80C it was 120bpm. Bpm stands for beats per minute.

1. Is there a relationship (correlation) between temperature and heart rate? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. Which type of graph are you going to use? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. From the information recorded, can you determine the heart rate at 250C? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. Was there any outliers (points not close to the line, outside the pattern). What temperature was it? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. How many temperatures were counted? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Now we would like to have you collect information and put it into a table that you have constructed correctly. The information that we would like to have you collect is the height of a candle as time passes. If you would collect the height of the candle at the following time intervals: time-0 (height of candle before being lit), 30 seconds, 60 seconds (1 minute), 90 seconds, 120 seconds (2 minutes), 150 seconds, 180 seconds (3 minutes). Use the space below to make your table.

Again, for practice we would like to collect data on how many drops of NaOH (sodium hydroxide) it will take to make each solution to turn red. Each test tube is labeled with the pH of the solution inside of it. Make a table comparing the number of drops necessary to change the color to the pH of the solution

**Averages:**

Occasionally you will be required to find the average of data gathered from an investigation. To find an average, add the items in the group together and then divide the total by the number of items. For example, if there were five students of different ages – 12 years, 13 years, 14 years, 17 years, and 19 years old - how would you find the average age of the group? Add the five ages together and divide the total by 5, which is the number of items (students) in the group. What is the average age of this group of students? You answer should be 15 years old. On your answers below, do not forget to **put units behind each number**.

In a garden the heights of six sunflowers are 135cm, 162.5cm, 180cm, 235cm, 185cm, and 167.5cm. What is the average height of the sunflowers?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 Find the average for the following group of data. Then use the results to answer the questions that follow.

In an experiment on plant growth and overcrowding, plants of the following heights are in three equal-sized containers:

Flowerpot 1: Two plants that are 13cm and 17cm

Flowerpot 2: Four plants that are 10cm, 11cm, 12.3cm, and 10cm

Flowerpot 3: Six plants that are 6cm, 7.2cm, 6cm, 7cm, 5.4cm , and 7cm

1. What is the average height of the plants in each flowerpot? 1. \_\_\_\_\_\_\_\_\_\_\_\_\_ 2.\_\_\_\_\_\_\_\_\_\_\_\_\_

3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. In which flowerpot did the plants grow the tallest? Explain. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. What is the average height of the students in your class? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Find the averages for the following group of data. Express your answer to the nearest tenth.

In a sample group of students, the number of breaths per minute (bpm) was taken at rest and after exercise. The results were as follows:

 At rest: Males: 10 bpm,12 bpm,13 bpm,10.4 bpm, 13.2 bpm, 11.9 bpm

 Females: 10.5 bpm, 12.9 bpm, 12 bpm, 11.8 bpm, 10.4 bpm, 12.7 bpm

 After Exercise: Males: 18.9 bpm, 23.7 bpm, 22.6 bpm, 21.3 bpm, 19.2 bpm, 20.6 bpm

 Females: 25 bpm, 26.7 bpm, 29 bpm, 35.5 bpm, 33.1 bpm, 31.7 bpm

1. What is the average number of breaths per minute for males at rest? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. What is the average number of breaths per minute for males after exercise? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. What is the average number of breaths per minute for females after exercise? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. How many students make up the sample group? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. Do males or females take more breaths per minute at rest? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6. Do males or females take more breaths per minute after exercise? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Rates:**

Occasionally you will be required to find the rate based on data gathered from an investigation. To find a rate you divide the **change** in what you are measuring by the **change** in time. The units of rates are expressed as ?/time. For example: in an experiment your reading at the 2 minute mark was 2.2ml and at the 5 minute mark it was 8.2ml. The rate would be calculated by taking the difference of readings (8.2ml - 2.2ml = 6.0ml) and then dividing it by the difference in time (5min.- 2min. = 3min.) or 6.0ml/3min. = 2ml/minute (the rate). Δ - means the change, therefore Δml/Δt would mean the change in ml over the change in time.

To practice we would like you to do the following problems.

1. What would be the rate if the reading changed from 20% at the 2 minute mark to 40% at the

 6 minute mark?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. What would be your heart rate if you counted 24 beats at the 30 second mark and 84 beats at the 60second mark?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 Using the following information answer the questions.

 Time (sec) 0 10 20 30 40 50 60

 Product formed (mg) 0.00 0.25 0.60 0.70 0.80 0.85 0.85

4. What is the initial rate? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

(Hint: initial rate is determined by the first two reading (time zero is usually the first one)

5. What is the rate after 50 seconds? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6. What is the rate between 10 and 40 seconds? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

7. What is the rate at 30 to 50 seconds? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

8. What would be the initial rate of the candle burned in the exercise that you did earlier? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

9. What was the rate of the candle consumed at the 2 minute mark? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

10. What was the highest rate that the candle burned according to your data? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Drawings:**

Laboratory drawings can be made using several methods, depending on a particular laboratory investigation. Some drawings are made in circles that represent the viewing field of a microscope or another type of magnifier. When completing these drawings, be sure to include: the identification of the object being viewed, the magnification at which you viewed the object, and the object should also be drawn proportional in the circle on your paper as it appears in the field of view through the microscope. Other laboratory drawings are representative of entire organisms or parts of organisms. These drawings show the relative size, shape, and location of anatomical structures. When completing the drawings make the structures as clear and as accurate as possible.

Most laboratory drawings are labeled. Using the following guidelines to help make your laboratory drawings clear and legible.

Draw the object proportional to the size that it appears through the microscope.

Use a ruler to draw label lines.

Label lines should point to the center of the structure being labeled.

Do not write on the label lines.

Print all labels horizontally.

Label the right-hand side of the drawing, if possible.

Do not cross label lines.

Use the highest possible magnification that still lets you see the whole object clearly.

Strongly recommended to use a pencil.





1. Use the prepared slide provided by you teacher of an organism and make a drawing of the specimen. Your teacher may suggest a page to turn to so that you can label the parts of the organism.



2. Why did you use power that you did to draw the specimen? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. Use the prepared slide of a tissue provided by your teacher and make a drawing. Your teacher may suggest a page to turn to in order

 for you to label the parts of the cells in your drawing.

