Name _____ Date _____ Class _____

WORKSHEET

1.9 SCIENCE PROCESS SKILLS

Evaluating Data

One way to learn about nature is to perform experiments. In most experiments, you observe an event and then collect information about it. For example, you might watch a toy race car slide down a track from different heights and see how far the car travels each time. Suppose you measure the distance the car travels after being released from each height. These measurements are called *data.* Any information that you collect in an experiment is considered to be data.

Organizing your data

In most experiments, your data will be a list of measurements that you have made. However, data is hard to interpret if you leave it in this form. You will often need to convert your data into other forms, such as graphs or charts. These other forms make it easier to see relationships between numbers.

Examine the data table below. As you read the numbered sections, follow the instructions to find a pattern in the experimental data.

Suppose you performed the experiment described above and made the following measurements:

Height	Distance traveled
15 cm	25 cm
30 cm	46 cm
45 cm	72 cm
60 cm	85 cm
75 cm	126 cm
90 cm	152 cm
105 cm	176 cm

1. Plotting Data Points

To begin evaluating your data, you must plot each data point given in the table above onto the graph on the next page. Be sure to put *height* measurements on the *x*-axis, and *distance* measurements on the *y*-axis.

2. Finding a Pattern

Next you must determine whether most of the data points can be made into a line or a smooth curve. In some cases, a few data points may not fit into the pattern formed by the rest of your measurements. This is often the result of an experimental error. In our example, you could have made a mistake measuring the distance, given the car a push when releasing it, or accidentally released the car from the wrong height. Any of these mistakes would be an experimental error.

3. Showing the Pattern

Next, you must draw a straight line or smooth curve, passing through or close to as many points as possible. Don't try to fit every single data point into your curve or line. Avoid points that do not seem to fit the pattern of the majority of your measurements.

4. Evaluating Data

Finally, you must evaluate your results. The number of data points that do not fit the pattern of your measurements should be small compared with the total number of measurements. For example, one or two errors out of ten measurements is acceptable, but five out of ten is not.

To count errors, only include data points that are far from the line or curve. Do *not* count data points that fall close to the line or curve. These are probably correct measurements that are slightly inaccurate due to the limitations of your measuring device.

If you have too many errors or cannot find a general pattern in an experiment, check with other classmates or repeat the experiment to see if you have performed it incorrectly.

On the lines below, explain why your data seems acceptable or why you might need to repeat the experiment.

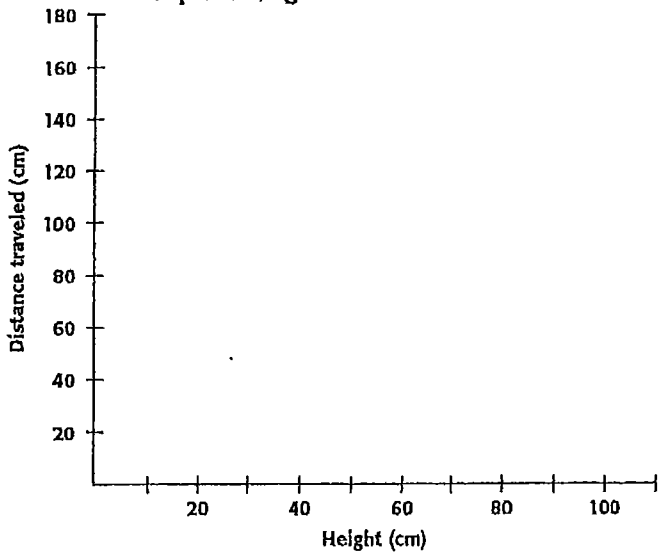
_____

_____

_____

_____

Graph of Height Versus Distance Traveled



Name _____ Date _____ Class _____

WORKSHEET

6.1 GRAPHING AND ORGANIZING DATA

Making and Interpreting Tables

How tables are useful

Data organized into a table is more useful than unorganized data. A table helps you recognize the relationships among data and evaluate the data more effectively. Tables can be organized in many different ways, depending on what relationships you wish to examine.

Tables can be a first step toward more complex ways of organizing data, such as charts or graphs. Once your data is organized into a table, it is easier to evaluate and to determine if a chart or a graph would be helpful. Also, a table makes it easier to put data into a chart or a graph.

Why data needs to be organized

Suppose that you are selling two different kinds of magazines for a school fund-raiser. You keep track of your sales for one week, and at the end of the week, you have the following numbers: Monday: 6 fashion magazines and 2 sports magazines; Tuesday: 6 fashion and 3 sports; Wednesday: 8 fashion and 5 sports; Thursday: 6 fashion and 3 sports; Friday: 2 fashion and 4 sports; Saturday: 3 fashion and 1 sports; and Sunday: 2 fashion and 1 sports.

As you can see, even though all of the information has been recorded, it is difficult to interpret. On what day were the most magazines sold? Do people buy more sports or fashion magazines? Are more magazines sold on weekends? These are questions that are hard to answer by simply looking at the paragraph above. However, if your data were organized into a table, you could easily answer questions like these.

As you read each numbered paragraph, follow the instructions on the right to make a table of the data found in the paragraph above.

1. **Determining what data should go into the table**
   In the paragraph above, the numbers indicating how many magazines were bought on different days should go into your table.

   Go back to the paragraph above and circle all the data that belongs in your table.

2. **Determining how the table will be organized**
   Next, you must decide what the layout of the table will be. A useful question to ask yourself is: "What categories do I need to describe all of the data?" For example, each number in the data above indicates how many of each kind of magazine were sold on a specific day of the week. To have a place for each piece of data, you need a category for each day of the week and a category for each kind of magazine.

   After you have determined your categories, divide them into two groups. Categories that describe the same kind of data should be grouped together. For example, the categories "fashion" and "sports" describe what kind of magazine was sold. So these two categories should be grouped together.

   On a separate piece of paper, make a list of all of your categories. Then divide the categories into two groups.

3. Making the table and filling in the data

Once you have grouped your categories, the next step is to make the table and fill in the data. Count the number of categories in each of your groups. Add 1 to the number of categories in the first group. This is the number of rows your table should have. Then add 1 to the number of categories in your second group. This is the number of columns your table should have.

4. Interpreting the data in the table

Now that you have organized your data into a table, you can interpret it easily. At a glance, you can answer the questions from the beginning of the worksheet.

a. On what day were the most magazines sold?

_____

b. Do people buy more fashion magazines or more sports magazines?

_____

c. Do people buy more or fewer magazines on weekends?

_____

In the space below, draw a table with the appropriate number of rows and columns. Leave the top-left box blank. Going down the far-left column, write the names of your categories in one group in the boxes. Then, going across the top row, write the names of the categories in the other group. Complete the table with the data you have circled.

Use your table to answer items a–c.

Table of Magazines Sold

Name _____ Date _____ Class _____

WORKSHEET

6.2 GRAPHING AND ORGANIZING DATA

Making a Line Graph

Making a graph helps you see how two factors called variables are related. For example, suppose you spent the day at a public swimming pool, and every hour you counted how many people were there. Your two variables are the time of day and the number of people at the pool. You can make a graph to see how pool attendance and time of day are related.

A line graph (also called a Cartesian graph or an x-y graph) has a horizontal x-axis and a vertical y-axis. The basic steps in making this type of graph are listed below.

As you read each numbered paragraph, follow the instructions on the right to make a graph of the data found in the table on the next page.

1. Assigning the Axes

When you start to make a graph, you decide how to plot the data. Should the time of day be from left to right on the x-axis, or up and down on the y-axis? At the pool, you decide *when* to count people, so time is your independent variable, the one you control more directly. Usually this one is put on the x-axis.

The number of people at the pool, on the other hand, changes with time. It is a dependent variable that changes due to the time. So you would write "time" on the x-axis and "number of people" on the y-axis.

Mark on your table which column of data represents the x-axis and which represents the y-axis. Then, label the axes on your graph to match the table.

2. Scaling the Axes

Now you need to decide how low and how high your numbers will go on each axis. You must include all of the data points. But allowing as much space as possible on each axis will make the graph easier to read.

Suppose you were at the pool from 10:00 A.M. to 7:00 P.M., and the number of people you counted ranged from 11 to 53. You would probably want to number the x-axis from 10:00 A.M. to 7:00 P.M. and the y-axis from 0 to 60.

Choose a scale for each axis. Make a set of evenly spaced marks to divide each axis, and number these marks.

3. Plotting Data

Each time you counted the people at the pool, you collected the data for one point on your graph. That point has an x value (time of day) and a y value (number of people).

To plot the data from the table, find the value on the x-axis that matches the x value of the first data point. Find the y value of the same point on the y-axis.

Using your graph paper as a guide, imagine a line going straight up from your x value. (Draw a very light line using a ruler if it helps.) Imagine (or draw) another line going to the right from your y value. Draw a dot where these two lines meet for your first data point. Repeat these steps to plot the rest of your data.

Using the table, plot all of the pool data on your graph.

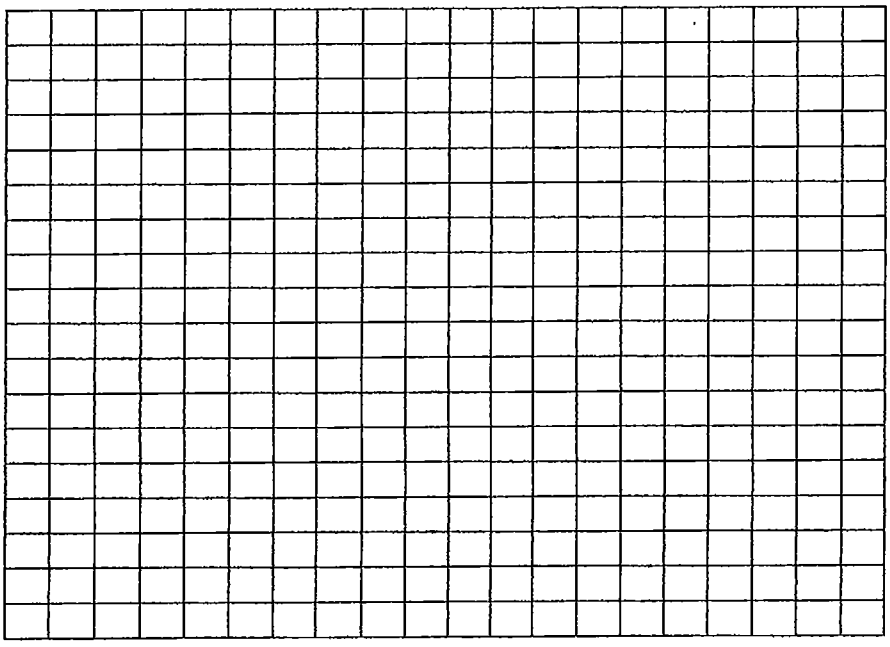
4. Making the Line or Curve

After you have plotted all of your data in this way, examine the points with the help of a ruler. Do the points look like they should form a straight line? If so, use the ruler to draw a line through as many points as possible on the graph.

If the points do not appear to form a line, do they look like they should form a smooth, continuous curve? If they do, carefully draw a smooth curve that goes through as many of the points as possible. If they do not, draw a curve that bends as necessary to connect all of the points.

Draw the line or curve that best fits the points on your graph.

Time of day	Number of people
10:00 A.M.	11
11:00 A.M.	23
12:00 (noon)	42
1:00 P.M.	53
2:00 P.M.	47
3:00 P.M.	41
4:00 P.M.	33
5:00 P.M.	42
6:00 P.M.	38
7:00 P.M.	22



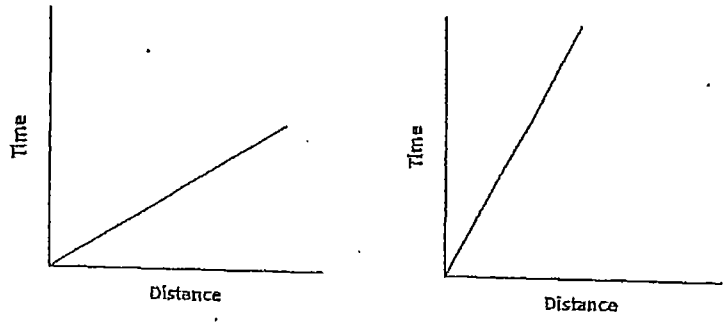
Name_____ Date_____ Class_____

WORKSHEET

6.5 GRAPHING AND ORGANIZING DATA

Slope of a Line

A line graph is a useful way of examining the relationship between different variables. For example, suppose that you often ride your bicycle to your friend's house. On two of these rides you record how much distance you cover every 30 s. When you graph your data, you have the following:



Both graphs show the same two variables, but the line on the right is much steeper than the one on the left. This difference tells you something about the relationship between the x and y variables in the two graphs.

Steepness of a line shows the rate of change

The lines in each graph represent distances covered in certain time intervals. Distance is measured along the y-axis, and time is measured along the x-axis. If more distance (y) is covered in the same amount of time (x), then the line must rise higher on the y-axis in the same distance on the x-axis.

In other words, the steepness of the line shows how quickly the variable on the y-axis changes relative to the variable on the x-axis. If the line is steep, the y variable changes quickly.

This rate of change is called *slope*

A line's steepness is called its *slope*. The slope of a straight line can be found by dividing the change in the y-axis by the change in the x-axis.

Math Skills

What is the slope of a line that runs through the points (3,2) and (5,9)?

Solution

1. Write the equation. As indicated above, the slope is equal to the change in the y coordinates divided by the change in the x coordinates. The Greek letter Δ is often used for the words "change in," so Δy should be read as "change in y."

$$slope = \frac{\Delta y}{\Delta x}$$

Name_____ Date_____ Class_____

2. Substitute known values in for the variables. To find the change in y, subtract the first y coordinate from the second one. Similarly, to find the change in x, subtract the first x coordinate from the second one.

$$slope = \frac{\Delta y}{\Delta x} = \frac{(9-2)}{(5-3)}$$

3. Simplify the equation.

$$slope = \frac{(9-2)}{(5-3)} = \frac{7}{2}$$

Math Skills

In any equation of the form $y = mx + b$, m is equal to the slope of the line. Find the slope of the line given by the equation $3y - 12x = 9$.

Solution

1. Rearrange and simplify the equation to the form $y = mx + b$.

$$3y - 12x = 9 \qquad 3y = 12x + 9$$

$$y = \frac{12x + 9}{3} \qquad y = 4x + 3$$

2. Compare your equation to the equation $y = mx + b$. The number that corresponds to the m in $y = mx + b$ is the slope of the line. In the equation $y = mx + b$, m is the number by which x is multiplied. In the equation $y = 4x + 3$, 4 is the slope of the line.

Practice

1. Find the slope of a line that runs through the points (1,2) and (6,3).

_____

2. Suppose you have a line graph with kilometers on the y-axis and minutes on the x-axis. If your line indicates that in 2.0 minutes you travel 0.4 km and in 5.0 minutes you travel 1.0 km, what is the slope of the line?

_____

3. What common term can be used to describe the slope of the line you found in problem 2? (Hint: The slope of the line in problem 2 is an indication of how much distance is traveled in a certain amount of time.)

_____

The Scientific Method