Making Observations

CK12 Editor

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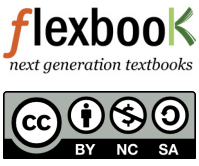

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CONCEPT 1 Making Observations

Lesson Objectives

The student will:

- explain the importance of observations.
- define qualitative and quantitative observations.
- distinguish between qualitative and quantitative observations.
- explain the importance of using quantitative observations in measurements where possible.

Vocabulary

observation using the senses to gather information about the natural world

qualitative observation observation that yields descriptive, nonnumerical results

quantitative observation observation that yields meaningful, numerical results

Introduction

Observation is very important when using scientific methods to investigate phenomena. **Observation** involves using the senses to gather information about the natural world. Science depends on keeping records of observations for later interpretations. These interpretations may lead to the development of scientific theories or laws. Without accurate observations, scientists cannot make any interpretations and therefore cannot draw conclusions.

Take out a piece of paper and record a chart similar to the one shown in **Table** 1.1. A chart is a useful tool that can help us record and organize our observations. Look up from this text and scan the room. Write down what you see around you in as much detail as you feel necessary in order for you or someone else to picture the room.

TABLE 1.1: Record of Observations

Item	Observation
1.	
2.	
3.	

One summer evening, Scott and Brenda came home from work to find their house in shambles. Neighbors, friends, and colleagues were baffled by the strange occurrence. Inside the house, they found the television turned on. Food on the table was ready to be eaten. All of Scott's coin collections, his precious metals, and Brenda's prized possession – her statue of Galileo – were gone. Foul play is suspected.

Here is a simple test for you. Pretend you are visiting a forensic scientist, hired to investigate the scene of the crime.

You are asked to only analyze the observations gathered by the other investigators at the scene. You must try to make as few assumptions as possible and make your decision based on the data at hand. The lead investigator gives you the following observations gathered from the scene and the suspects:

Observations at Scene

a. Blood type = B
b. Fiber sample = polyester
c. Powder found = white
d. Shoe print found = work boot

TABLE 1.2: Suspect Information

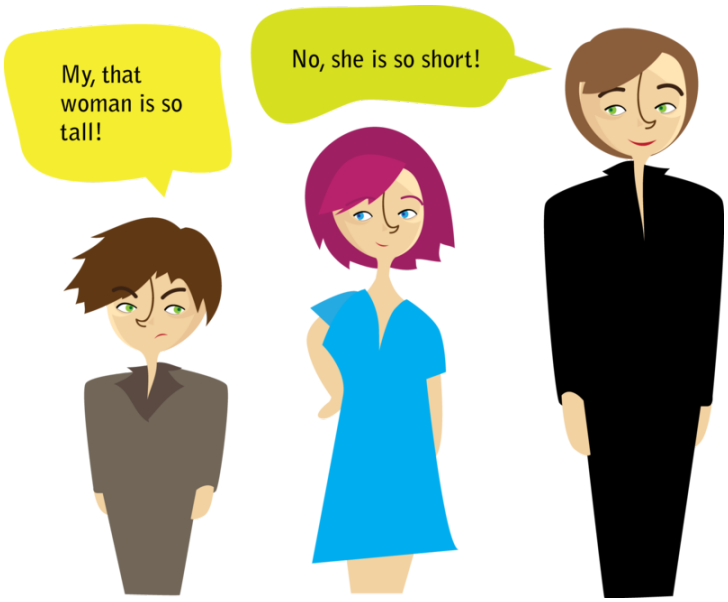
Suspect 1: 180 lb male	**Suspect 2: 220 lb male**	**Suspect 3: 120 lb female**
Blood type = B	Blood type = B	Would not comply
Sweater = polyester	Blazer = wool knit	Pants = polyester
Works in sugar factory	Pastry chef	Automobile sales woman

From **Table** 1.2, can you deduce who might have been involved in the alleged crime? Do you need more information? How detailed do the observations need to be in order for you, the scientist, to make accurate conclusions? What will you base your decision on? What other information do you need? Remember that if you guess randomly, an innocent person could be convicted.

Quantitative and Qualitative Observations Defined

There are two types of observations: quantitative and qualitative. **Quantitative observations** involve measurements or estimates that yield meaningful, numerical results. **Qualitative observations** yield descriptive, nonnumerical results. Although all the observations we can make on a phenomenon are valuable, quantitative observations are often more helpful than qualitative ones. Qualitative observations are somewhat vague because they involve comparative terms. Quantitative observations, on the other hand, have numbers and units associated with them and therefore convey more information. Even an estimated number is more valuable than no number at all.

A qualitative observation would be, for example, "The attendance clerk is a small woman." If the observer is 6 feet 4 inches tall, he might find a woman who is 5 feet 8 inches tall to be "small." If the observer reported this to someone who is 5 feet 2 inches tall, however, the listener would not acquire a good idea of the attendance clerk's height because he would not think a woman who is 5 feet 8 inches tall is small. The description "a small woman" could refer to any woman whose height was between 3 feet and 6 feet, depending on who made the observation, as illustrated in the image below.



Similarly, "a small car" could refer to anything from a compact car to a child's toy car. The word "small" is a comparative term. The same is true for all words like tall, short, fast, slow, hot, cold, and so forth. These words do not have exact meanings. Under various circumstances, temperatures of 90°F, 110°F, 212°F, and 5000°F could all be described as "hot." The word "hot" does not convey as much information as the numerical description. Even observations of colors are not exact because there are many shades of each color. Two people may both be wearing red shirts, but the colors of the shirts may not be exactly the same. Exact descriptions of colors would require reporting the frequency or wavelength of the color.

Quantitative and Qualitative Observations Compared

TABLE 1.3: Comparison of Qualitative and Quantitative Observations

Qualitative (words only)	Quantitative (words and numbers)
The girl has very little money.	The girl has 85 cents.
The man is short.	The man is 5 feet 2 inches tall.
Use a small test tube.	Use a test tube that is 12 centimeters long.
It is a short walk to my house.	It is about 1 mile to my house.

You can see from the last example in **Table** 1.3 that even if the number is an estimate, a quantitative observation contains more information because of the number associated with the observation. Some people might think that a 1-mile walk is short, while others may not. If an actual measuring device is not available, the observer should always try to estimate a measurement so that the observation will have a number associated with it.

While estimated measurements may not be accurate, they are valuable because they establish an approximate numerical description for the observation. "The car is small" is an observation that provides us with certain information. We know that the object is some kind of car (perhaps real or perhaps a toy), and we know that it is probably smaller than a limousine because almost no one would describe a limousine as small. Suppose instead that the observation is: "The car is about 3 feet tall, 3 feet long, and 2 feet wide." While these estimated measurements are not accurate, we now know that are not dealing with a compact automobile, nor are we dealing with a toy car. With these estimated measurements, we know that we are dealing with a car about the size of a tricycle. It is not a problem if we discover later that the car was actually 2 feet tall instead of 3 feet tall, because we knew the original

measurement was an estimate. Estimates are excellent observations if we do not have the ability to measure the object accurately and still qualify as quantitative observations.

Example Questions:

Pick out the quantitative and qualitative observations from each phrase.

a. 3.0 grams of NaCl dissolve in 10 milliliters of H_2O to produce a clear solution.
b. The spider on the wall has only seven legs remaining but is still big and hairy.
c. When 0.50 milliliter of a solution is put into a flame, the flame turns a brilliant green.

Solutions:

a. Quantitative: 3.0 grams and 10 milliliters; Qualitative: clear solution
b. Quantitative: seven legs; Qualitative: big and hairy
c. Quantitative: 0.50 milliliter; Qualitative: brilliant green

Lesson Summary

- Observation involves using the senses to gather information about the natural world.
- There are two types of observations: qualitative and quantitative.
- Scientists gather information by making both qualitative and quantitative observations.
- Qualitative observations yield descriptive, nonnumerical results.
- Quantitative observations yield meaningful, numerical results.
- Observations, either qualitative or quantitative, are used by scientists as tools to make representations and interpretations about the surroundings.

Further Reading / Supplemental Links

This website helps to build your observation skills.

- http://www.mrsoshouse.com/pbl/observe/indexobserve.htm

Review Questions

Label each observation as qualitative or quantitative.

1. The temperature of this room is 25°C.
2. It is comfortably warm in this room.
3. Most people have removed their coats.
4. The building is 25 stories high.
5. It is a very tall building.
6. The building is taller than any nearby trees.
7. The bottle is green.
8. The bottle contains 250 milliliters of liquid.
9. Robert bought his son a small car.

10. The car is smaller than his hand.
11. The car is about three inches long.
12. The race is about 27 miles long.