

Laboratory #1, The Scientific Method

INTRODUCTION

Science is much more than an enormous collection of facts. Science is also a way of learning about the world. Although there really is no one, simple, cookbook type of scientific method, in general the method relies upon **observing** a phenomenon (directly or indirectly), formulating an idea about the phenomenon (the **hypothesis**) and setting up a test of the hypothesis (the **experiment**). The results of the experiment may **a)** completely support the original idea or hypothesis **b)** partially support the original hypothesis or **c)** give no support for the original hypothesis. In the case of complete support then further testing is usually needed in order to verify and obtain even greater support for the original idea. In the case of partial support, then the original hypothesis is modified and a new test of the modified hypothesis is stated and subsequently tested. In order for the most unbiased test of a hypothesis to be made, certain rules must be followed when planning an experiment.

TERMINOLOGY

Hypothesis	prediction
Scientific method	table
Dependent variable	line graph
Independent variable	procedure
Controlled variable	pulse rate
Replication	respiration rate
Control	negative control
Positive control	assumption

A **hypothesis** is an explanation for observations that are used to make a **prediction**. For example, if Staci is in good physical condition, then her pulse rate will return to resting very quickly after the exercise is over.

A **table** is a way of depicting scientific information derived from an experiment. A **line graph** is another way of depicting scientific information by graphing intersecting points on a graph.

The **independent variable** is the variable that you are controlling. A variable is something that is changeable.

The **dependent variable** is what you measure. It depends upon how you change the independent variable. In this experiment you will measure the pulse rate and the respiratory rate.

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The **pulse rate** (beats per minute) can be obtained by palpating the artery on the wrist, down from the thumb for fifteen seconds and multiplying the number of pulsations by 4. The **respiration rate** is obtained by counting how many "breathes per minute" the person is exhibiting.

A **controlled variable** is another factor which could affect the dependent variable and therefore is controlled.

Replication is a fancy term for repeating the same experiment in order to increase the accuracy of the results.

A **control** is the part of the experiment that you know exactly what the results are going to be. It is a method of determining if your procedure works properly. In this experiment, if a person did not do the aerobics and remained calm, you would expect little to no change in pulse or respiration rate. This would be called a **negative control**. A **positive control** is when you test a variable and you obtain a positive result. In other words, the result is not zero, but some predictable number.

PURPOSE

The purpose of this laboratory is to practice the "scientific method." You are trying to learn something about how the cardiovascular system adapts to a stimulus and returns to homeostasis (maintaining a steady state).

MATERIALS

Steps or a platform, or you can run in place.
A watch with a second hand.

BACKGROUND

Cardiovascular fitness can be determined by measuring a person's pulse rate and respiration rate before and after a given time of aerobic exercise. A person who is more fit may have a relatively slower pulse rate and a lower respiratory rate after exercise, and his or her pulse rate should return to normal more quickly than a person who is less fit. Your assignment is to investigate the impact of some well-defined, measurable, controlled independent variable on cardiovascular fitness.

PROCEDURE

- 1) Formulate a hypothesis for this experiment. For example, Staci's sister, Ellen is overweight, smokes, and hasn't exercised in years. **IF** Ellen participates in this experiment **THEN** it will take her longer to return to a resting pulse and respiration rate than someone who is well-conditioned. Use "IF.....THEN" statements to describe your hypothesis.
- 2) The subject (you or someone who has volunteered to be your subject) steps up and down a low platform or runs up and down a staircase for a period of 3 **minutes**.
- 3) The subject's pulse and respiration rate are measured before the test and at 1-minute intervals after the test.
- 4) The subject's recovery time (time to return to a normal pulse rate) is recorded.
- 5) Once recovery has occurred, stop measuring.
- 6) Repeat this procedure 2 more times for a total of 3.

PRESENTATION OF DATA

- 1) Compose a Table depicting the measurements and then average all 3. An example is provided below.
- 2) Now present the same information on a line graph. The independent variable always goes on the x-axis, while the dependent variable (the average beats per minute) on the y-axis.
- 3) The independent variable in this experiment is time, while the dependent variable is beats per minute (the pulse rate).
- 4) Make a second table and graph for respiration rate.
- 5) NOTE: your table and line graph should have a title. The x and y axis should be labeled.

Results of Cardiovascular Exercise on Pulse Rate

		PULSE RATE (beats/min)			
		Trial 1	Trial 2	Trial 3	Average Pulse Rate
	Before	68	72	68	
After	1 min	120	116	120	
	2min	100	96	100	
	3min	80	80	76	
	4min	72	72	72	
	5min	72	68	72	

BIO 168 Lab #1 Quiz

Matching

- 1) The variable that you measure in an experiment _____.
- 2) What you do to test the hypothesis _____.
- 3) Repeating the experiment many times to increase the accuracy of the results _____.
- 4) An educated guess that attempts to explain observations _____.
- 5) The part of the experiment where you know what the results are going to be _____.
- 6) Other factors besides the dependent variable that could affect the outcome of the experiment _____.
- 7) Variables that are not measured in an experiment, are not controlled, and are assumed not to affect the outcome of an experiment are known as _____.
- 8) Emphasizes general principles over specific details or examples _____.
- 9) Type of study that examines the relationship between two variables, for example, time studying and grades _____.
- 10) Emphasizes specific details over general principles _____.

Matching Choices – note, not all choices are utilized

- | | |
|------------------------|-------------------------|
| a) Control | j) Inductive Reasoning |
| b) Assumptions | k) Independent Variable |
| c) Replication | L) Line Graph |
| d) Deductive Reasoning | m) Table |
| e) Experiment | |
| f) Controlled Variable | |
| g) Correlation | |
| h) Hypothesis | |
| i) Dependent | |

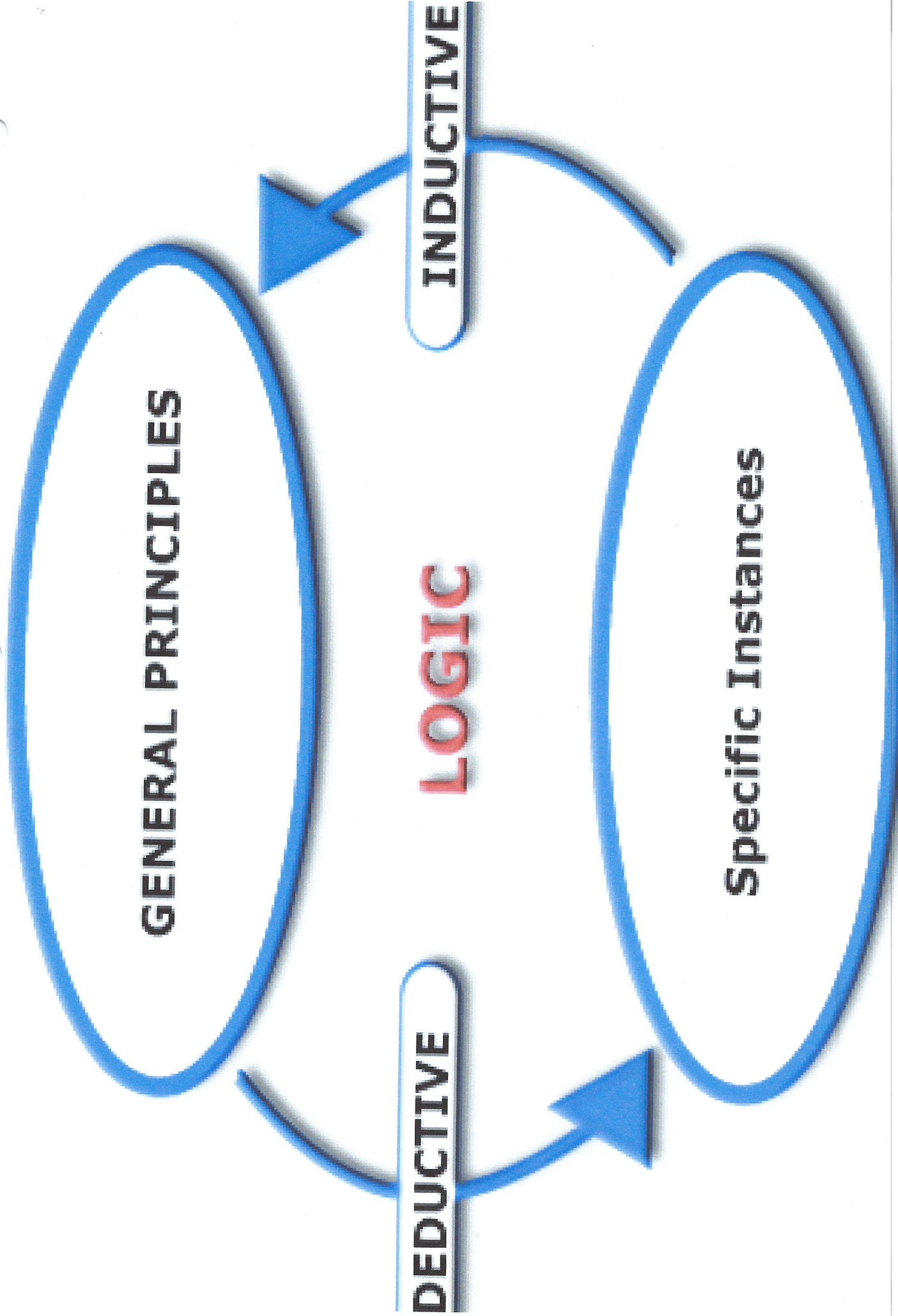
GENERAL PRINCIPLES

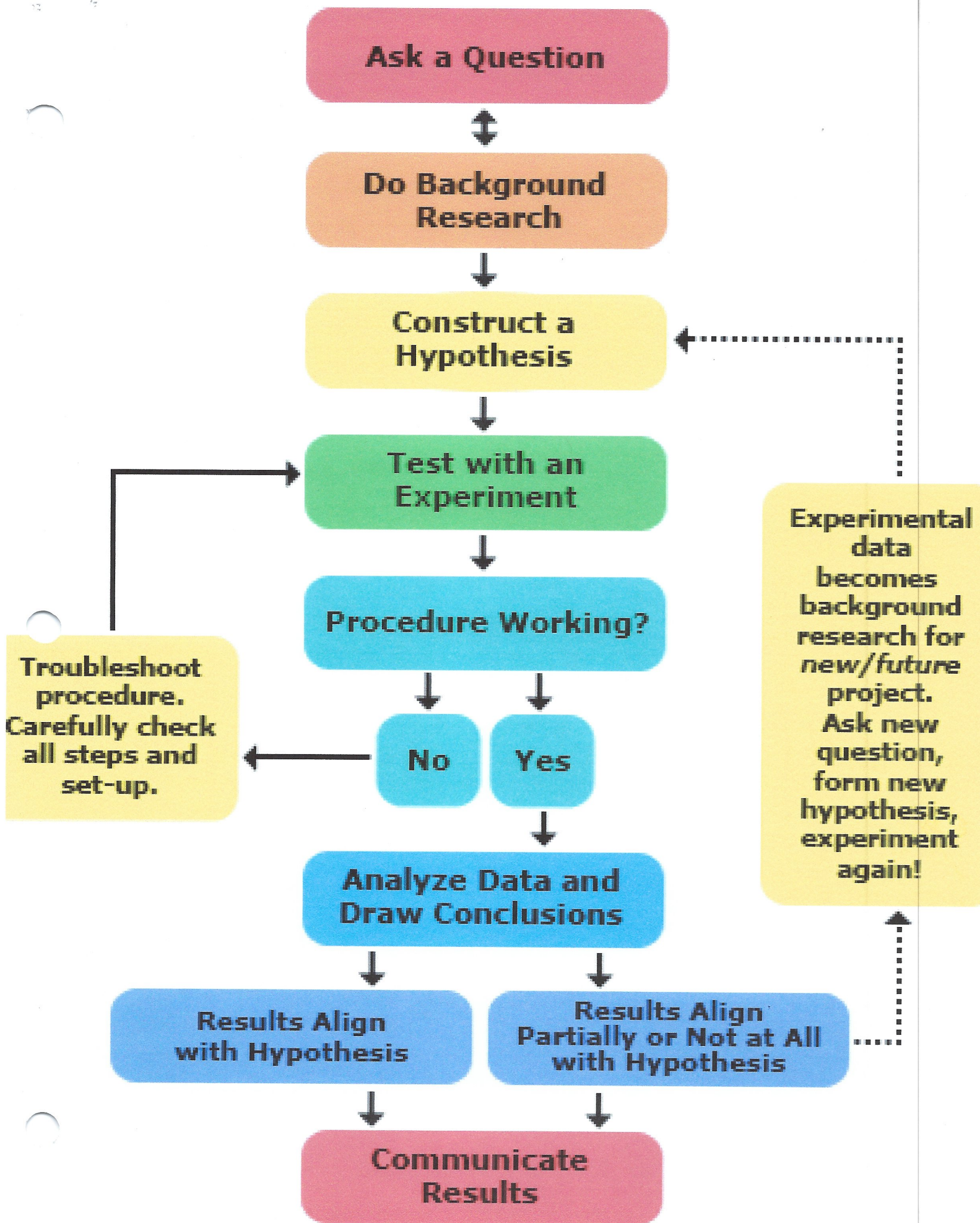
DEDUCTIVE

LOGIC

INDUCTIVE

Specific Instances

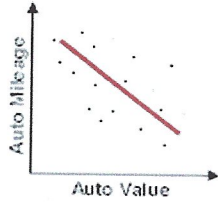




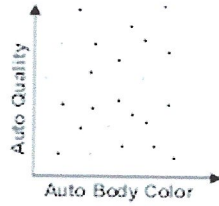
Correlation

Relationship Between Two Quantities
Such That When One Changes, the Other Does

Negative



Zero



Positive

