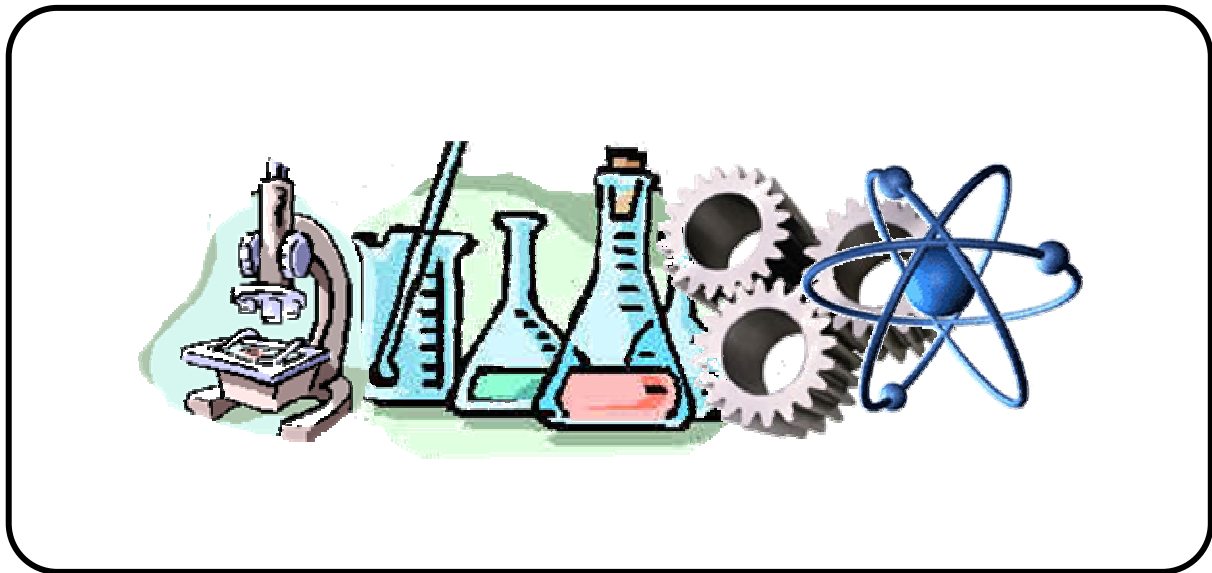


Project EASE

(Effective and Alternative Secondary Education)

INTEGRATED SCIENCE I



MODULE 3



BUREAU OF SECONDARY EDUCATION

Department of Education
DepED Complex, Meralco Avenue
Pasig City



Module 3

Developing Science Skills and Processes

While the second module focused on exercises to help you sharpen your mathematical and analytical skills, this module focuses on your manner of solving a particular problem.



What this module is about

Learning to become a scientist is interesting and exciting. Many scientific skills are being developed in the process of acquiring science concepts in the classroom, in performing experiments in the laboratory, and in doing household chores.

Scientists are detectives: they investigate various parts of our universe and gather many pieces of information. Their goal is to piece all these data together to form theories – big ideas that can explain whole sets of facts.

This module will bring you to the world of scientists. How do scientists work? How do they solve problems? In most cases, scientists solve problems by making thorough investigations. They follow a logical method of solving problems called the scientific method. This method minimizes the chances of making mistakes. You will study the following lessons in this module:

Lesson 1 - Identifying a Problem and Formulating Hypothesis

Lesson 2 - Experimentation, Observation and Gathering Data

Lesson 3 - Making Conclusions and Generalizations



What you are expected to learn

After going through the module, you are expected to be able to:

1. identify a problem
2. formulate a hypothesis
3. design a procedure to test the hypothesis
4. collect data and present them in appropriate format

5. observe trends and patterns
6. make generalizations and conclusions
7. identify limitations and make recommendations



How to learn from this module

Here's a simple guide for you in going about this module:

1. Take your time in reading the instructions.
2. Follow the instructions very carefully.
3. Before working on the activities, answer the 7-item test in order to determine how much you know about the lessons in this module.
4. Check your answers with the given answer key at the end of this module.
5. Be very honest in answering the test items so you may gauge the previous knowledge you have.
6. Read each lesson and do activities about the science processes that are provided for you.
7. Perform all the activities diligently to help and guide you in understanding the topic.
8. Take the self-tests after each lesson to determine how much you understood the topic.
9. Answer the post-test to measure how much you have gained from the lessons.

Good Luck and have fun!



What to do before (Pretest)

For Questions 1 – 7, refer to the situation below. Write the letter of the best answer on the space provided before each item. Each question is worth 1 point.

Using a medicine dropper and water, a student determines the number of water drops that different sizes of coins can hold. He gathers the data and records them in the table below

Number of Water Drops

No. of Trials	10-peso	5 - peso	1-peso	25-centavo
1	45	53	34	15
2	47	52	30	17
3	48	54	32	17
Average	47	53	32	16

1. What is the problem of the student in this experiment?
 - a. size of the coins
 - b. total amount of coins
 - c. type of medicine dropper
 - d. amount of water drops that different sizes of coin can hold
2. By looking at the data, which coin holds the greatest number of water drops?
 - a. a 10-peso coin
 - b. a 5-peso coin
 - c. a 1-peso coin
 - d. a 25 centavo coin
3. Which factor do you think has something to do with the differences in the number of water drops a coin can hold?
 - a. distance of medicine dropper from the coin
 - b. sizes of the coins
 - c. diameter of the dropper
 - d. all of the above
4. If you want to verify whether the size of the coins affects the number of water drops that a coin can hold, which of the following hypothesis will you test?
 - a. The farther the distance of the dropper, the more water drops the coin can hold.
 - b. The bigger the diameter of the dropper, the more water drops the coin can hold
 - c. The bigger the size of the coin, the more water drops it can hold.
 - d. The bigger the water drops, the more each coin can hold.
5. Proving the hypothesis “the bigger the size of the coin, the more water drops it can hold”, which of the following variables will remain unchanged?
 - a. amount of pressure on the rubber of the medicine dropper
 - b. distance of the dropper from the coin
 - c. size of the medicine dropper used
 - d. size of the coins

6. Which of the following can you identify as the responding variable?
 - a. number of water drops
 - b. size of the coin
 - c. diameter of the dropper
 - d. kind of medicine dropper

7. Where should you base your conclusion or generalization?
 - a. gathered data
 - b. results of the series of experiment performed
 - c. direct observations
 - d. all of the above



Key to answers on page 21

Lesson 1 Identifying a Problem and Formulating a Hypothesis

When you were a child, what was the thing that you looked for in a playground? Probably your answer is a set of movable bars or a see-saw. Have you ever wondered how a see-saw works? Many questions in our minds have now been answered by Science and Technology. Through Science and Technology, we have been able to produce all comforts and convenience in life and managed our environment to acquire our needs. We have improved our ways of communication, transportation, household facilities, recreation and upgraded our medical equipment.

Scientists follow step-by-step procedures before arriving at a conclusion. In this module, you will do what scientists do in identifying and solving problems. You will solve problems, think critically, make decisions, find answers and satisfy your curiosity.

Solutions to problems start with the formulation of a hypothesis. A hypothesis is an educated guess based on one's observation. It is a tentative explanation for a behavior, event or phenomenon that will occur. A hypothesis maybe rejected or accepted.

Formulating a hypothesis is the same as predicting. It is made about future events on the basis of ordered data. From the hypothesis, solutions to the problem can be sought.

In the following article taken from *Science and Technology I SEDP Series, DECS pp. 3 – 4*, you can answer your questions on how these inventions and discoveries have been made usable.



What you will do

Activity 1.1 The story of Thomas Alva Edison

Read the article and answer the self-test given after reading the article.

The Story of Thomas Alva Edison

“Thomas Alva Edison once noticed that when electricity flowed through a piece of iron wire, the iron wire became red hot. The wire glowed brightly, but not bright enough to light a room. When he used a thinner piece of iron wire and allowed electricity to pass through, the wire glowed. But he wanted greater brightness. He tried other metals. Finally he discovered that a thin piece of tungsten wire could actually glow so bright that it could light up a room.

But he also saw the glow did not last long. After a few minutes, the wire had burned to ashes. He wondered why. He knew that oxygen is needed in burning. Using a machine he pumped out all the air inside the bulb. He enclosed the tungsten wire in what he thought was already an oxygen-free bulb. He tested the bulb. The bulb glowed longer than before. What he wanted was a bulb to glow longer and give light steadily, so he continued with his experiment.

He pumped out all the air or gases inside the tube and test the bulb. He repeated this steps over and over again getting several bulbs busted in the process. He did not lose hope. He continued with the experiment until finally the tungsten wire glowed steadily and brighter. He knew that he succeeded. He invented the incandescent light bulb.

Source: Science and Technology I, SEDP Series, DECS pp. 3-4.



What you will do

Self-Test 1.1



Key to answers on page 21

Answer the following questions. Write the letter that corresponds to the right answer before the number. Check your Answers on page 19.

- _____ 1. What was the problem of Thomas Alva Edison in his experiment?
- Where does electricity come from?
 - What makes an iron glow?
 - How to make a wire glow brighter?
 - How to make a light enough to lit a room using a wire?

- _____ 2. What was his hypothesis in making the wire glow brighter?
- The thinner the wire, the brighter will be the bulb.
 - Tungsten wire can produce more brightness than ordinary wire.
 - Tungsten wire can light longer in oxygen-free bulbs.
 - The more oxygen in the bulb, the less glow is produced.
- _____ 3. What was the basis of the hypothesis?
- What is produced when electricity is allowed to pass through a piece of iron wire?
 - What reaction tungsten wire has compared to the piece of iron wire?
 - What would it be like when there is no electricity?
 - Which type of metal glow brighter?
- _____ 4. Which of the following methods of solving a problem is applied to Edison's case?
- popular method
 - trial and error method
 - serendipity
 - scientific method
- _____ 5. What personal trait helped Thomas Edison invent the incandescent bulb?
- persistence
 - resourcefulness
 - patience
 - All of these



Key to answers on page 21



What you will do

Activity 1.2

Read the following situations and answer the questions given to test whether you fully understood the processes of identifying a problem and formulating hypothesis:

1. *Your house is located in a congested residential area in Manila. The place is so congested. You have a neighbor who owns a piggery. Knowing the characteristics of this business, and being one of the members of the community, what should you do? Will you complain against the owner? Why or why not?*

- State the problem.
 - Give ways on how to solve the problem without resorting to quarrel.
- Write your answer here:

2. *Mario graduated valedictorian in one of the prestigious public high schools in Manila. Naturally when he got to college, he was expected to do well and graduate with honors. But Mario got hooked on network games and surfing the internet. Soon enough, his grades suffered and he did not do well as expected. What do you think caused his poor performance in school?*

- a. Formulate your hypothesis as many as possible.
Write your Answer in the box below.



Key to answers on page 21

Lesson 2 Experimentation, Observation and Data-gathering

Experimentation is a cause-and-effect test between two variables. All processes may be involved. This can begin with setting a problem to be solved, identifying variables to be controlled, making operational definitions, devising the test to be carried out and following the prescribed procedure or steps.

Controlling variables involves the process of deciding which variables or factors will influence the outcome of an experiment, situation or event and deliberately controlling all recognized variables in a systematic manner.

Certain methods are used over and over to develop and test scientific ideas. One of these methods is so basic to all sciences that there can be no science without it. This method is called **observation**. This involves obtaining information about objects, situations, or events using as many senses as possible. Observation may be qualitative or quantitative in nature. Observing provides both basis for new inferences or hypotheses. **Inferring** means

suggesting more about a set of conditions that is observed. These are based on observed data and past experience.

Data-gathering or collecting data is the most essential step in scientific method. It involves the processes of measurement, classifying, comparing, estimating and other steps of doing an experiment. **Measurement** is a process of quantified observation using measuring devices. It is a process of comparing an unknown quantity with a known quantity or standard. **Classifying** involves the grouping of objects, concepts or events on the basis of observable properties to show similarities, differences and inter-relationships.

These three processes are very important in the work of a scientist and therefore cannot be omitted in doing an analysis to solve a problem.



What you will do
Activity 1.2

Perform the following activities:

A. Go out and look for a place where you can find different kinds of leaves

- Draw the shape of the leaves in column 1
- Use your senses – sight, touch (texture or color), smell to observe
- Record your observations in the table provided below.
- Fill up the table properly

Observations of Unknowns

Shape of the Leaf	Appearance/Color	Texture	Smell
A			
B			
C			
D			

Guide Questions:

Use the data you gathered during this investigation to help you answer the following questions:

1. Which of your senses gave the most information about the samples?

2. Which of your senses helped you the most in distinguishing the samples?

3. All your senses have limitations. Name several scientific instruments that help you overcome the limitations of each of your senses

Sight: _____

Touch _____

Smell _____

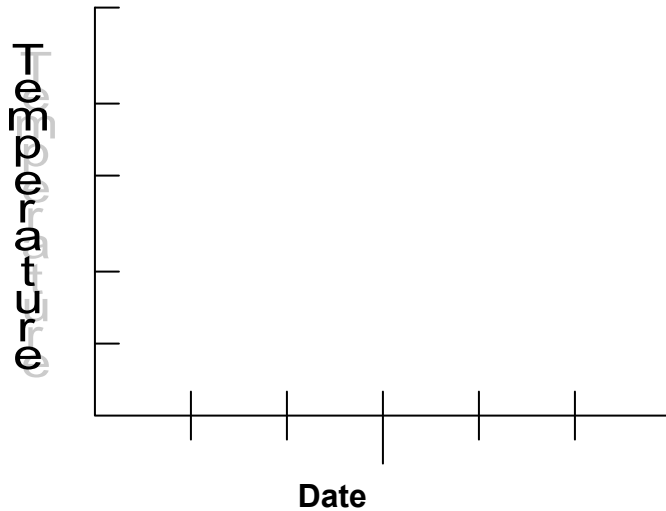
Taste _____

4. Suppose you waited until you have finished on all five substances before you recorded the data. What might have happened to the record of your observations?

5. Is it important that a scientist record his data immediately? Why or why not?

B. Do the following using a thermometer

- Record the outdoor temperature on five consecutive mornings. Graph the data with the temperature on the Y-axis and the date on the x-axis.



Can you use the graph to know what will be the temperature in the next 5 days? Why or why not?

C. Do the following using 5 textbooks and a ruler:

- Measure the thickness of each of these five textbooks in millimeters. Do not include the covers.
- Count the number of pages in each of the 5 textbooks.
- Record your data in the table provided for:

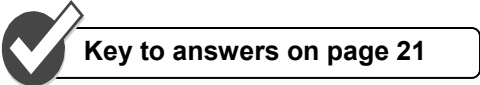
Textbook	Thickness	Pages

- Plot the data on a graph with the thickness on the Y-axis and the number of pages on the X-axis

הפעילות

Number of pages

What are the different science processes demonstrated in the activities performed?





What you will do Self-Test 2.1

Can you tell which of the following statements are true? Read each statement. If it is true, write a **T** and if it is false, write an **F** in the blank before the statement. Write in the blank following the statement how would you change the underlined word or phrase to make the statement True.

- _____ 1. Observation is the act of gathering information using the five senses.

- _____ 2. A scientific data explains why things happen. _____
- _____ 3. Of all the ways to solve a problem using scientific method, prediction on the basis of a trend is the most effective and accurate. _____
- _____ 4. Inferring means looking for what objects have in common or looking for their differences. _____
- _____ 5. The statement “Mercury is denser than water” is a generalization.

- _____ 6. During experiment, one tries to form a theory as quickly as possible. This process is called hypothesizing. _____
- _____ 7. Repeating and performing similar experiments can verify a solution to a problem.

- _____ 8. A scientist would most likely find a solution to problem by survey technique.

- _____ 9. A qualitative data is numerical in nature. _____
- _____ 10. Little by little you uncover several patterns during an experiment. This process is called data gathering. _____



Key to answers on page 21

Lesson 3 Making Conclusions and Generalizations

The processes of **formulating conclusions or generalizations** include the interpretation of data gathered. In this process, a scientist uses his sense of observations in forms of inferences, generalizations or explanations. It is usually a direct response to the problem under investigation and therefore includes judgments about the interpretation to fit the proposed hypothesis and the formulation of the new knowledge. Also, formulation of conclusion is the process of organizing and processing data gathered. It involves organizing “rough” data into a more compact and meaningful way to solve a particular problem. It is the formation of direct evidences as performed in the series of experiment.

One of the most important steps in scientific method is choosing a solution to the original problem. Unless you consider all available data, you will end up choosing a wrong one.



What you will do

Activity 3.1

Perform the following activity:

1. Given the following materials:
 - empty aluminum can (soft drinks can)
 - soft plastic bag
 - rubber band
 - alcohol lamp
2. Assemble the materials:
 - Place the soft plastic on the lid of the aluminum can.
 - Wrap it around the lid with a rubber tightly.
3. You are going to heat the aluminum can with an alcohol lamp, but before doing so, formulate your hypothesis. Write as many as you can. (*Be careful in heating the can. See to it that the flame will not touch the plastic.*)

4. Now heat the can for about 2 minutes. Observe what happens. Record your observations.

5. Are all your hypotheses correct? _____

6. What conclusion can you make out of the experiment you have performed? Formulate your conclusion.

As you perform this investigation, you will:

- become familiar with the steps of the scientific method
- use the scientific method of thinking to solve a problem.

Answer the following questions and write your answers on the space provided after each number.

1. The first step of a scientific method is to identify the problem you wish to solve. What is the problem in this activity?

2. After you identify the problem, it is time to make observations. What do you see?

3. Next the data from your observations must be organized. What factors do you think play a part in your observations?

4. What's your answer?

5. Verify your answer or solution by repeating the experiment if you wish to.



Key to answers on page 21



What you will do

Activity 3.2

Try the activity given in the pre-test to verify the answers:

Perform the experiment using the same materials, 5 coins of different sizes – 10-peso, 5-peso; 1-peso and a 25-centavo coin.

Do the following procedure:

- Lay the coins one by one on a table.
- Get a medicine dropper
- Fill the medicine with water.
- Drop the water in each coin one at a time.
- Count the number of water drops needed to fill the coins. Stop dropping when the water spills over the coin.
- Do the same procedure with the other coins.
- Record the data on the Table provided for.

Number of Water Drops

No. of Trials	10-peso	5 - peso	1-peso	25-centavo
1				
2				
3				
Average				

- Answer the following questions.

1. What is the problem in this activity?

2. Formulate your hypothesis. (List down as many as possible)

3. Analyze your results. Which coin holds the greatest number of water drops?

- a. a 10-peso coin
- b. a 5-peso coin
- c. a 1-peso coin
- d. a 25 centavo coin

4. What factor do you think has something to do with the differences in the number of water drops a coin can hold?
 - a. distance of medicine dropper from the coin
 - b. sizes of the coins
 - c. diameter of the dropper
 - d. all of the above

5. Which of the following can you identify as the responding variable?
 - a. number of water drops
 - b. size of the coin
 - c. diameter of the dropper
 - d. kind of medicine dropper

6. Where should you base your conclusion or generalization?
 - a. gathered data
 - b. results of the series of experiment performed
 - c. direct observations
 - d. what others say about it.



Key to answers on page 21



What you will do
Self-Test 3.1

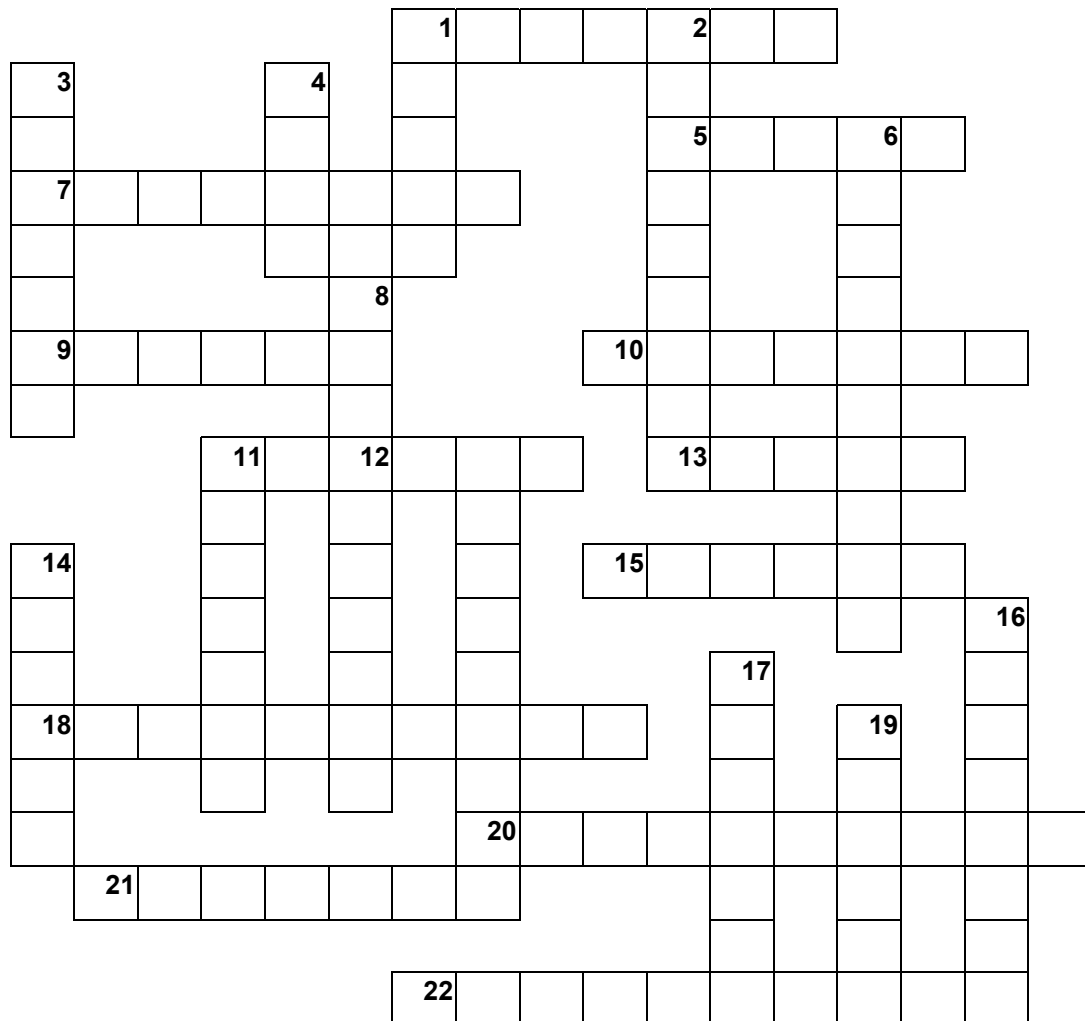
Use the terms from this module (Lessons 1 – 3) to complete the crossword puzzle:

Across

1. to tell future consequences of an event based on observations or patterns of changes
- 5 . a chart that organizes numerical data
7. an answer to the problem
9. to test repeatedly
10. characteristics of information in critical thinking
11. ____g an act of carefully controlling arrangement for testing a hypothesis
13. in science, the _____ should always prevail
15. a verified data; it has been tested several times
18. gathering of data and information to test the hypothesis
20. the answer to the problem being tested
21. to compare an unknown quantity with a standard
22. the step-by-step method used by scientists in solving a problem

Down

1. a basis for accepting a fact or principle
3. to gather data and information using the five senses
4. a set of information
6. a place where scientists usually perform experiments
8. a scientific or educated guess
11. scientist performs experiment to solve this
12. a mental leaning or inclination; an act of giving correct and intelligent guess from a set of observations
14. _____ data - a set of gathered information leading to the conclusion
16. solving a problem scientifically is _____ in nature
17. to gather data
19. C_____ - to group materials of the sama properties or characteristics



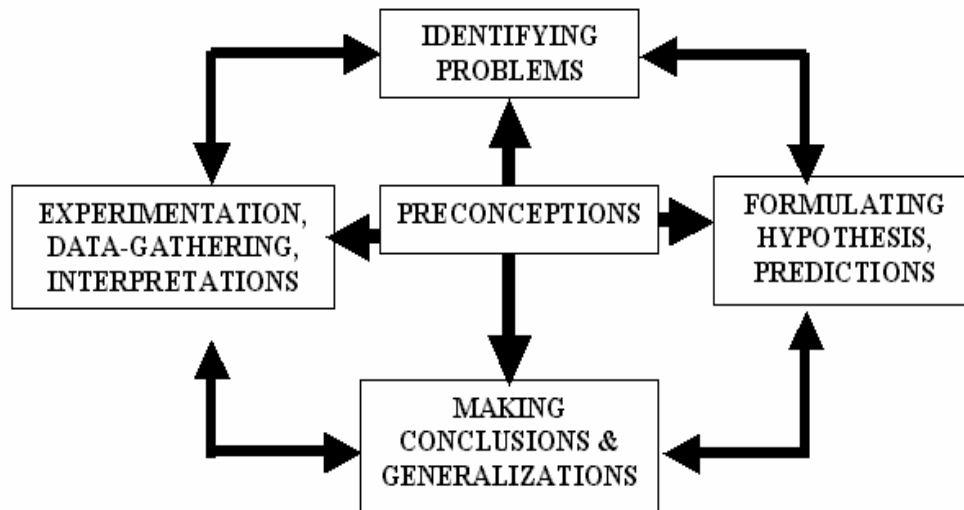
Key to answers on page 22



Let's summarize

- **Scientific Method involves the following processes and skills:**

1. Identifying a problem
2. Formulating a hypothesis
3. Designing a procedure to test the hypothesis
4. Collecting data and presenting them in appropriate format
5. Observing trends and patterns
6. Interpreting data gathered
7. Making generalizations and conclusions
8. Identifying limitations and making recommendations



9. Scientific Method is a continuous process used to collect observations, form and test hypothesis, make predictions, and identify patterns in the physical world.

 *Posttest*

A. Multiple Choice. Choose the letter of the correct answer. Write your answers on a separate sheet.

1. How is a hypothesis tested?
 - a. by using the hypothesis to make predictions about a system.
 - b. by comparing observations in nature with predictions
 - c. by doing a series of experiment and looking for results
 - d. All of the above

2. Which of the following statements would be true of the scientific method?
 - a. People structure their lives on the principle of scientific method.
 - b. The scientific method is a continuous process by which people learn about his world.
 - c. Scientists report the experimental results, but not the experimental designs.
 - d. When the results of the experiment do not fit the hypothesis, a scientist may discard the results and stop the experiment.

3. Suppose your mother sent you to the market to buy fruits and vegetables. How would you choose good quality fruits and vegetables?
 - a. Ask the vendor to choose it for you.
 - b. Examine the fruit if it is free from insect bites and the smell of insecticide
 - c. Just get any kind and pay right away.
 - d. Tell your mother that you do not know how to buy good quality fruits and vegetables.

4. When scientists wish to communicate the results of their research, they are most likely to do which of the following?
 - a. immediately repeat the research
 - b. call a press conference
 - c. write a concise report with complete results and proofs to the experiments performed and formulate conclusions
 - d. sell their findings to other researchers

5. During an experiment about a coin and feather that were dropped at the same time, it was found that the coin reached the ground first. One student said: "Maybe, the coin is heavier than the feather." What do you call this kind of statement?
 - a. a problem
 - b. a hypothesis
 - c. an interpretation
 - d. a conclusion

B. Identification. For Numbers 6 – 10, identify what science processes are revealed in the following statements: Write your answer on the space provided after the number.

6. The girl is standing in an open field. There was no shadow formed because it is 12 noon. _____

7. The blue litmus paper turned red when it was dipped into an unknown liquid. _____

8. The liquid in number 7 is an acid. _____

9. The radio is not functioning anymore. Maybe the battery got discharged. _____

10. The metal turned rusty. What made it that way? _____



Key to answers on page 22



Key to Answers

Pretest

1. d 2. b 3. d 4. c 5. c 6. a 7. d

Self-test 1.1

1. d 2. a 3. a 4. b 5. d

Self-Test 2.1

 T 1. Observation is the act of gathering information using the five senses.

 T 2. A scientific data explains why things happen.

 F 3. Of all the ways to solve a problem using scientific method, prediction on the basis of a trend is the most effective and accurate. **EXPERIMENTATION**

 F 4. Looking for what objects have in common, looking for their differences is called inferring. **COMPARING**

 F 5. The statement “Mercury is denser than water” is a generalization. **HYPOTHESIS**

 T 6. During experiment, one tries to form his theory as quickly as possible. This process is called hypothesizing. _____

 T 7. Repeating and performing similar experiments can verify a solution to a problem.

 F 8. A scientist would most likely find a solution to problem by survey technique. **SCIENTIFIC METHOD**

 F 9. A qualitative data is numerical in nature. **QUANTITATIVE**

 T 10. Little by little you uncovered several patterns during an experiment. This process is called data gathering.

Self-Test 3.1

Crossword Puzzle

					P ¹	R	E	D	I ²	C	T						
O ³				D ⁴	R				N								
B				A	O				T ⁵	A	B	L ⁶	E				
S ⁷	O	L	U	T	I	O	N		E			A					
E				A		F			R			B					
R					H ⁸				P			O					
V ⁹	E	R	I	F	Y			O ¹⁰	R	D	E	R	E	D			
E					P				E			A					
				P ¹¹	R	O	V	I ¹²	N		T ¹³	R	U	T	H		
				R		T		N							O		
M ¹⁴				O		H		F			T ¹⁵	H	E	O	R	Y	
O				B		E		E								Y	
D				L		S		R				C ¹⁷				E	
E ¹⁸	X	P	E	R	I	M	E	N	T			O		L ¹⁹		T	
L				M		S		N				L		A		H	
S								C ²⁰	O	N	C	L	U	S	I	O	N
	M ²¹	E	A	S	U	R	E					E		S		D	
												C		I		I	
								S ²²	C	I	E	N	T	I	F	I	C
														Y		A	
																L	

Posttest

- A. 1. d 2. b 3. b 4. c 5. b
- B. 6. interpretation 7. observation 8. generalization
- 9. formulating hypothesis 10. identifying a problem

Congratulations if you got 7 perfect points!

Try again if your score is 3 and below

-End of Module-

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