

Module 1

Physics: The Basic Science



What this module is about

The study of science has two branches namely, the life sciences and the physical sciences. The life sciences include biology, zoology and botany. The physical sciences branch into areas such as geology, astronomy, chemistry and physics. However, physics is more than part of physical sciences because it does not only deal with matter and energy but it also deals with the other basic concepts like motion, forces, heat, sound, light, electricity, magnetism and the composition of atoms.

Science has different fields and yet physics is considered the basic science. Why do you think so? How does physics help improve our lives? How does physics help produce the different technologies that are introduced in society? How do physicists come up with the principles, theories, laws, and inventions, which are instrumental in providing the comforts of life? Do you want to be clarified on these questions? Then read and work on the activities presented in this module.

Module 1 includes the following lessons:

- **Lesson 1 - Nature of Physics**
- **Lesson 2 - Physics Connections: Technology and Society**
- **Lesson 3 - The Physicists: Their Role in Society**
- **Lesson 4 - Thinking Physics: The Scientific Method**



What you are expected to learn

After going through this module, you are expected to:

1. describe the nature of physics and explain its relationship to other sciences;
2. relate physics to technology and society;
3. give some contributions of physicists and technologists;
4. use the scientific method to solve problems;
5. perform the activities systematically; and
6. appreciate the roles of physics in the modern world.



How to learn from this module

Below are guidelines for you in going about the module:

1. Read and follow instructions very carefully.
2. Answer the pre-test to determine how much you already know about the lessons in this module.
3. Check your answers against the given answer key at the end of this module.
4. Read each lesson and do the activities that are provided for you.
5. Perform all the activities diligently to help you understand the topic.
6. Take the self-test after each lesson to determine how much you understand the topic.
7. Answer the posttest to measure how much you have gained from the lessons.

Good luck and have fun!



What to do before (Pretest)

A. Select and write in a separate sheet of paper the letter of the best answer.

1. All of the following are physical sciences except
 - a. physics
 - b. chemistry
 - c. botany
 - d. astronomy
2. Which of the statements below is a scientific hypothesis?
 - a. Seawater is denser than freshwater
 - b. Physics is the study of matter and energy.
 - c. Atoms are the smallest particles of matter.
 - d. Albert Einstein is the greatest physicist of the twentieth century.
3. Which step in the scientific method involves giving a tentative answer to the problem?
 - a. interpreting data
 - b. formulating hypothesis
 - c. predicting
 - d. experimenting

4. Which of the following is a positive impact of technology on society?
- a. pollutes the air
 - b. improves industry
 - c. alters nature
 - d. changes the values of man
5. Suppose you performed an experiment on specific heat of metals but you forgot to record the initial temperature of the metal. Which of the following ways of action would you take?
- a. Present data that are not based on the experiment.
 - b. Start over again as soon as you realize your mistake.
 - c. Copy the data of the other groups who worked on the same activity.
 - d. Continue with the experiment to see if the mistake makes any difference.
6. Which of the following is the application of science?
- a. law
 - b. theory
 - c. technology
 - d. principle
7. To avoid accidents in performing a laboratory activity, you should
- a. ignore the scientific method.
 - b. follow precautionary measures.
 - c. talk with your friends as you work.
 - d. skip the procedures that require the use of breakable materials.
8. All of the following statements describe science EXCEPT one. Which is it?
- a. It is a logical way of thinking.
 - b. It seeks to discover the truth about events.
 - c. It is a body of knowledge that could not be questioned.
 - d. It is a search for order in many different areas on nature.

Below are the processes of the scientific method. Arrange these steps chronologically from numbers 9-15.

- a. make predictions
- b. formulate hypothesis
- c. identify and state the problem
- d. accept hypothesis or theory conditionally
- e. gather observations, facts, and data
- f. test predictions by experiments
- g. pass all tests / fail all tests completely or partially

- 9.
- 10.
- 11.

- 12.
- 13.
- 14.

15.

B. Classify whether each item represents technology or pure science.

16. improvised Boyle's Law apparatus
17. improved procedure on determining the relative density of solids
18. the density of water is 1 g/cc
19. devices for measuring length
20. mass is the quantity of matter



Key to answers on page 19

Lesson 1 Nature of Physics

As mentioned in the early part of this module, physics falls under physical sciences and it is more than just a body of laws and facts. It deals with motion, forces, energy, heat, sound, light, electricity and magnetism, and the composition of atoms. Physics is a unique activity of each physicist. It is a continuing activity that sometimes leads to discovery. It discusses the basic nature of matter and the various ways by which different forms of matter interact with one another.

Another form of study, which falls under physical science, is chemistry. It is a branch of science, which deals with how matter is put together, to make up the different things that are around us. On the other hand, biology is a life science, which deals with living organisms. The interrelationship between physics and biology has given birth to a new field of study known as *biophysics*. Similarly, the interrelationship between biology and chemistry has led to the emergence of biochemistry. The ideas of physics are basic to these fields of sciences, that is why physics is considered the most basic science, which simply means that you can understand other sciences better if you understand physics.

In addition, physics helps us develop the different traits of scientists. The experiments conducted in physics could provide students not only with the needed skills in operating laboratory equipment but also with the discipline to work systematically.

Finally, the principles and laws of physics have practical applications in the home, transportation, industry, in communication, in amusements and many others.



What you will do
Activity 1.1

Below are examples of technology that operate on the principles, laws and theories of physics. Identify which of them have practical applications in the following areas: home, transportation, industry, communication and information technology, and amusement.

	Technology	Area of Application
Ex.	1. videoke	amusement
	2. car	_____
	3. computer	_____
	4. fax machine	_____
	5. light-rail transit system (LRT)	_____
	6. refrigerator	_____
	7. generator	_____
	8. TV sets	_____
	9. fluorescent lamps	_____
	10. air conditioning units	_____



Key to answers on page 20



What you will do
Self-Test 1.1

1. What is physics?
2. Why is physics considered the basic science?
3. What field of study links physics to biology?
4. How does physics relate to chemistry?



Key to answers on page 20

Lesson 2 Physics Connections: Technology and Society

We could not deny the fact that we live in a technological society and we live comfortably because of these products of science. All these technologies were made possible by breakthroughs in scientific research. But what is the difference between science and technology? *Science* is a body of systematized knowledge, which is based on observations, tests and experiments while *technology* is an applied science. This means that if science ideas are put into practice, then that is technology, which could be a gadget, an instrument, an appliance, or an improved procedure made on the existing product.

Knowledge of physics helps us understand our environment. Many of the things we do right at home involve physics. Say for example, knowledge of heat and thermodynamics improves our understanding of the process of cooking and ironing clothes. How do you think the introduction of pressure cooker in the market affect society and what physics principle is applied in the operation of the pressure cooker? A pressure cooker allows us to cook food at a shorter time. This technology has a tight-fitting lid that does not allow steam to escape. As vapor builds up inside the pressure cooker, pressure on the surface of the liquid is increased and this results to an increase in the boiling point of water. The increased temperature of water cooks food faster.



What you will do

Activity 2.1

Fill out the table below to show the connection of physics to technology and society.

Physics Concepts	Technology	Society
Ex. Radiowaves, Electronics	cellphone	Use as means of communication
1. _____	thermos	2. _____
3. _____	car	4. _____
5. _____	meterstick	6. _____



Key to answers on page 20



What you will do

Self-Test 2.1

Identify which of the following represents pure science and which are technologies.

1. light travels in a straight line
2. acceleration is the rate of change in velocity
3. construction of hydroelectric power plant
4. the speed of sound is 331.5 m/s at 0^o C
5. developing colored pictures



Key to answers on page 20

Physics Appreciation

Knowledge of physics helps us understand our environment. You cannot dissociate yourself from the world of physics. As even the simple activities we do at home involve physics. Say for example, we apply the knowledge on heat and thermodynamics in understanding the process of cooking, ironing clothes, boiling water, and ice making.

Outside our home, all the activities that we do involve the application of physics principles such as the concept of motion in running an automobile, electricity in the operation of light-rail transit, the coefficient of expansion and pressure in the construction of bridges and dams, Bernoulli's principle in flying an airplane, and the concept of energy transformation in the roller coaster, radio, television, and other means of modern day communication.


An understanding of physics is needed in the study of other subject areas like biophysics, chemical physics, and astrophysics.

Physics helps an individual develop scientific attitudes and solve problem systematically.


The experiments in physics provide students the needed practice and training in the manipulation of instruments, which serve as basis for operating more complicated machines like computers.

One who is skillful in the field of physics can either be a physics teacher, a laboratory technician, a mechanic, a meteorologist, an engineer, or a science researcher.

Thus, the principles and laws of physics are applied practically in all our activities. Physics is applied in the home, in transportation, communication, amusement, sports, and industry. Everything you see, hear or feel has links with physics.

 *What you will do*
Activity 2.2


Cut some pictures from newspapers and magazines, which show applications of physics. Discuss each picture briefly.

 **Key to answers on page 21**

 *What you will do*
Self-Test 2.2

Classify whether the following technologies/events/processes of physics apply to the home, transportation, industry, sports, amusement or communication.

Technology / Process / Event	Area
1. boat	transportation
2. gym	_____
3. hydroelectric power plant	_____
4. radio	_____
5. melting	_____

 **Key to answers on page 21**

Lesson 3 The Physicists: Their Role in Society

Do you want to know who are the people behind the development of physics? What do you think are the different traits these people exhibit while working on their inventions/discoveries? The succeeding discussion will give you answers to these queries.

1. He studied the behavior of falling bodies and formulated laws covering the behavior of these objects.



Galileo Galilei
(1564-1642)

2. He discovered that the planets move in an elliptical orbit. The laws of Kepler are used in calculating the flight paths of today's space vehicle.



Johannes Kepler
(1571-1630)

3. He formulated Boyle's law, which states that at constant temperature the volume of gas is inversely proportional to pressure.



Robert Boyle
(1627-1691)

4. He formulated the laws of motion and the universal law of gravitation.



Sir Isaac Newton
(1642-1727)

5. He is noted for his experiments on electricity. His renowned kite experiment to study lightning led him to the invention of the lightning rod.



Benjamin Franklin
(1706-1790)

6. His invention was the generator, which worked on the principle that magnets can be used to produce electric current.



Michael Faraday
(1791-1867)

7. He worked on electromagnetism and made important contributions to the development of the kinetic theory of gases.



James Maxwell
(1831-1870)

8. He discovered x-rays in 1895. Studies on radioactivity led to the development of nuclear physics.



Wilhelm Roentgen
(1845-1923)

9. He discovered radioactivity in 1896. Just like Roentgen's discovery, his study led to the development of nuclear physics.



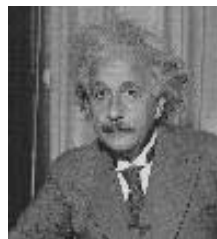
Henri Becquerel
(1851-1908)

10. A German physicist who formulated the quantum theory, which is the basis of quantum mechanics.



Max Planck
(1858-1947)

11. He formulated the theory of relativity and his famous equation, $E = mc^2$.



Albert Einstein
(1879-1955)

Getting to know our Filipino scientists

1. Arturo Alcaraz was responsible for the discovery of geothermal energy in the country.
2. Melecio Magno worked as an atmospheric physicist. He studied how the principles of physics are applied to the study of weather elements. Further, he explained how the laws of thermodynamics explain the different phase changes.
3. Christopher Bernido provided the rationale for the unification of the four fundamental interactions of elementary particles.
4. Henry Ramos is famous for his first plasma experimental device, which can produce gases that can be manipulated for the generation of energy.
5. Benjamin Almeda is known as the Thomas Edison of the Philippines. He invented the automatic cooler and the electric grinder.
6. Gregorio Zara is the inventor of an aircraft engine using alcohol as fuel with an airplane propeller that is made of local materials. He also invented the video telephone.
7. Aluminada dela Rosa conducted a study on the use of agriculture cellulose waste materials for energy production. Her study won her the third prize in the 1982 NSTA-DOST most outstanding research award.
8. Linda Posadas researched on the applications of lasers in communications, medicine, defense, architecture, space, science and entertainment.

Do you want to be one of these physicists/scientists? Do you ever know that the success of science has more to do with the attitudes common to scientists? What do you think are these traits? These scientific attitudes are as follows.

- **Curiosity**

A scientist is a curious person. He/She asks questions as to the causes of some events, which are not yet known; he/she keeps on reading to find information.

- **Open-mindedness** A scientist is an open-minded person who considers suggestions and accepts criticism, shares ideas with others, and considers several possibilities when investigating a problem.
- **Questioning Attitude** A scientist questions the inconsistencies in statements and conclusions, and makes decisions after collecting all-important facts. Also, a scientist challenges the validity of unsupported statements.
- **Respect for Evidence** A scientist is one who checks consistency of observations, considers and evaluates ideas presented by others, and consults available data before drawing a conclusion.
- **Believing in Cause-and-Effect Relationship** A scientist believes that for every effect there is a corresponding cause and accepts a statement as fact only if supported by evidence.
- **Honesty** A scientist reports the data truthfully, gives comments as situations demand, and acknowledges the work done by others.
- **Humility** A scientist shows awareness of one's shortcomings and indicates willingness to ask help from someone who can assist him/her.
- **Patience and Determination** A scientist carries out investigations in spite of limited time, keeps working in spite of several failures, and remains firm even in the face of criticisms.
- **Resourcefulness and Creativity** A scientist makes optimum use of equipment and suggests substitutes for material that are not available in the school or in the community.
- **Intellectual Responsibility** A scientist performs assigned tasks dutifully, shows willingness to do extra work if necessary, and accepts failures if any are made during an investigation.

Try to develop the above scientific attitudes and who knows you will be the Albert Einstein of the Philippines someday.



What you will do Activity 3.1

Match column A with column B.

A. Scientists

1. Sir Isaac Newton
2. Albert Einstein
3. Michael Faraday
4. Robert Boyle
5. Galileo Galilei
6. Henry Ramos
7. Linda Posadas
8. Gregorio Zara
9. Benjamin Almeda
10. Arturo Alcaraz

B. Contributions

- a. Invented the lightning rod
- b. Law of universal gravitation
- c. $PV = K$
- d. $E = mc^2$
- e. Invented the generator
- f. Plasma experiment device
- g. Thomas Edison of the Philippines
- h. Discovered geothermal energy in the Philippines
- i. Inventor of aircraft engine
- j. Research on applications of laser
- k. Studied the behavior of falling bodies



Key to answers on page 21



What you will do Self-Test 3.1

Write the letter of the best answer for numbers 1-2.

1. A student demonstrates honesty when he
 - a. recognizes conclusions as tentative.
 - b. looks for inconsistencies in statements.
 - c. reports the data truthfully.
 - d. challenges the validity of unsupported statements.
2. A person exhibits open-mindedness when he
 - a. discusses his ideas with others.
 - b. agrees with the ideas presented by others.
 - c. evaluates ideas, which do not agree with his/her ideas.
 - d. asks others to provide evidences to support their arguments.

3-5. Give at least three scientific attitudes and describe each trait.



Key to answers on page 21

Lesson 4 Thinking Physics: The Scientific Method

We know that some scientific concepts were discovered by accident, which we call serendipity. However, most of these science ideas are the results of carefully planned investigation by scientists. Scientists solve scientific problems through a systematic approach.

Below are the processes of the scientific method applied to every scientific investigations.

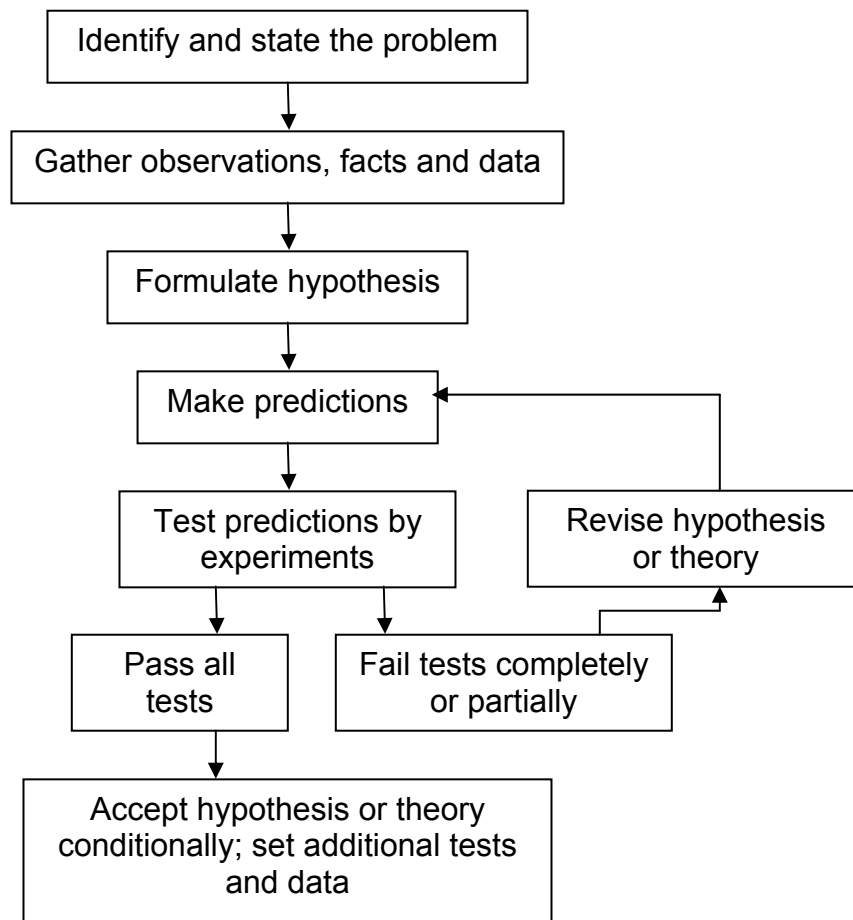


Fig. 4.1 An Outline of the Scientific Method

Several important points should be remembered about the scientific method:

1. Science does not demand that we have no ideas when we engage on the processes of the scientific method, only that we be ready to change those ideas if the evidence forces us.

2. Scientists can and have started their work by making extensive observations, but they can also start with a theory and test it. It makes no difference where you enter the cycle because the scientific process takes you all the way round.
3. Scientific results must be reproducible.
4. The cycle is continuous, it has no end. Science does not provide final answers; nor is it a search for ultimate truth.
5. Finally, the steps of scientific method shouldn't be thought of as a kind of rigid cookbook style set of steps to follow.

To give you a specific situation where the problem is solved scientifically, consider the case below:

The electric fan in your classroom is out of order. You tried investigating why it does not work. Observations on the wiring, on the chord, the plug and the outlet were done. You formulated a hypothesis on why it does not function. Series of testing were conducted to prove your hypothesis. Finally, you were able to find out that the main cause is a defective outlet. In this situation, you have followed a series of steps in solving the problem. Do you think you have followed the steps of scientific method?



What you will do

Activity 4.1

Cite a given problem where you can apply the steps of scientific method.



Key to answers on page 22



What you will do

Self-Test 4.1

What are the steps of scientific method and describe each step.



Key to answers on page 22



Let's summarize

1. Physics is considered the basic science because physics could explain science ideas in both chemistry and biology, which simply means that other sciences could be understood better if you understand physics.
2. Principles and laws of physics are applied in the home, in transportation, industry, communication, amusement, and information technology.
3. Technology is an application of science.
4. The following scientists contributed much to the development of physics:
 - Galileo Galilei
 - Johannes Kepler
 - Robert Boyle
 - Sir Isaac Newton
 - Benjamin Franklin
 - Michael Faraday
 - James Maxwell
 - William Roentgen
 - Henri Becquerel
 - Max Planck
 - Albert Einstein
5. The Filipino scientists who did a lot in the development of physics in the Philippines are as follows:
 - Melecio S. Magno
 - Christopher Bernido
 - Henry Ramos
 - Benjamin G. Almeda
 - Gregorio Zara
 - Aluminada Dela Rosa
 - Linda S. Posadas
6. The following are the scientific attributes which are exhibited by scientists:
 - Curiosity
 - Open Mindedness
 - Questioning Attitude
 - Respect for Evidence
 - Believing in Cause-and-Effect Relationship

- Honesty
 - Humility
 - Patience and Determination
 - Resourcefulness and Creativity
 - Intellectual Responsibility
7. Scientists worked on their investigations / experiments following the steps of the scientific method which are as follows:
- Identify and state the problem.
 - Gather observations, facts, and data.
 - Formulate hypothesis.
 - Make predictions.
 - Test predictions by experiments.
 - Accept hypothesis or theory conditionally; set additional tests and data.



Write only the letter of the best answer.

1. Which of the following fields of study is a physical science?
 - a. biology
 - b. botany
 - c. zoology
 - d. physics

2. When you perform an experiment, what is the next step to do after defining a problem?
 - a. gather relevant data
 - b. formulate the hypothesis
 - c. test the hypothesis
 - d. formulate a conclusion

3. Jose saw big crabs crawling on the sand. He wondered where they came from so he started investigating. What scientific attitude did Jose show?
 - a. open-mindedness
 - b. resourcefulness
 - c. curiosity
 - d. patience

4. All of the following are positive effects of technology on society EXCEPT one. Which is it?

- a. improves industry
- b. pollutes the environment
- c. gives comfort to man
- d. makes work easier

5. Which of the statements below is a scientific hypothesis?

- a. Energy is the capacity to do work.
- b. Physics deals with matter and energy.
- c. The higher the temperature of the substance the faster its molecules move.
- d. Matter is anything that occupies space and has mass.

6. Which of the following steps involves giving an educative guess to the problem?

- a. making predictions
- b. gathering observations
- c. stating the problem
- d. formulating hypothesis

Arrange the different processes of the scientific method chronologically from numbers 7-13.

- a. Formulate hypothesis.
- b. Make predictions.
- c. Accept hypothesis or theory conditionally.
- d. Identify and state the problem.
- e. Gather observations, facts, and data.
- f. Pass all tests / fails completely or partially.
- g. Test predictions by experiments.

- 7.
- 8.
- 9.
- 10.
- 11.
- 12.
- 13.

14. Who formulated the laws of motion?

- a. Sir Isaac Newton
- b. Robert Boyle
- c. Albert Einstein
- d. Benjamin Franklin

15. Who was responsible for the discovery of geothermal energy in the country?

- a. Melecio S. Magno
- b. Christopher Bernido
- c. Arturo P. Alcaraz
- d. Henry Ramos

Give 5 scientific attitudes that scientists possess (16-20):

- 16.
- 17.
- 18.

- 19.
- 20.



Key to answers on page 22



Key to Answers

Pretest

A.

- 1. c
- 2. c
- 3. b
- 4. b
- 5. b
- 6. c
- 7. b
- 8. c
- 9. c
- 10. e
- 11. b
- 12. a
- 13. f
- 14. g
- 15. d

B.

- 16. technology
- 17. technology
- 18. pure science
- 19. technology
- 20. pure science

Lesson 1

Activity 1.1

1. videoke – amusement
2. car – transportation
3. computer – information technology
4. fax machine – communication
5. LRT – transportation
6. refrigerator – home
7. generator – industry, home
8. TV set – home
9. fluorescent lamps – home, industry
10. air conditioning unit – home, industry

Self-Test 1.1

1. Physics deals with matter and energy.
2. Physics is considered the basic science because the principles, laws and theories of physics are needed in understanding other fields of sciences like chemistry, biology, geology and astronomy.
3. Biophysics
4. Physics deals with matter and energy while chemistry also deals with matter specifically the interaction between the atoms and the properties of the substances.

Lesson 2

Activity 2.1

1. It reduces the loss of heat by conduction, convection and radiation.
2. Humans need hot water for mixing hot water with milk or coffee.
3. Motion
4. People need cars to travel longer distances at the shortest possible time. It is a means of transportation.
5. Measurement
6. People need meterstick for measuring the length precisely and accurately.

Self-Test 2.1

1. pure science
2. pure science
3. technology
4. pure science
5. technology

Activity 2.2

Example: Picture of moving electric fan. In this picture, transformation of energy is shown from electrical energy to mechanical energy and heat.

Note: Students' collection of pictures may vary.

Self-Test 2.2

1. boat – transportation
2. gym – sports
3. hydroelectric power plant – industry
4. radio – communication
5. melting - industry

Lesson 3

Activity 3.1

1. b
2. d
3. e
4. c
5. k
6. f
7. j
8. i
9. g
10. h

Self-Test 3.1

1. c
2. a
3. Resourceful and Creative. He suggests a substitute for materials that are not available in the school or in the community.
4. Humble. He does not belittle others whom he thinks do not meet his standards.
5. Responsible. He performs his assigned tasks dutifully; shows willingness to do extra work if necessary.

Note: Students' answer may vary for items 3-5.

Lesson 4

Activity 4.1

Ex. My grade in physics in the second grading period is much lower than the first grading. I would like to improve my class standing in the subject so I decided to list down the possible reasons of getting low grades in physics. I came up with the following possible reasons:

- a. I spend so much time watching TV at night.
- b. I only spend a little time studying physics compared with the time spent in other subjects.
- c. I do not answer my assignment in physics regularly.

Then I tried to reduce the number of hours watching TV program, answered assignment promptly and have spent more time studying physics than in other subjects. Finally, when all these ways were tried in a month, I have noticed that my grade improved. Thus, I have found out that improving one's study habit is a way of getting a good grade in the subject.

Posttest

1. d
2. a
3. c
4. b
5. c
6. d
7. d
8. e
9. a
10. b
11. g
12. f
13. c
14. a
15. c
16. curiosity
17. open-mindedness
18. questioning attitude
19. humility
20. resourcefulness and creativity

Note: Students may have varied answers for item numbers 16-20.

-End of Module-

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