

CHAPTER 1

BACKGROUND OF THE STUDY

For a large part of recorded history, science had little or no bearing on people everyday lives. Scientific knowledge was gathered for the own sake, and it had few practical application. However with the dawn of the industrial revolution in the 18th century, this rapidly changed. Today science has a profound effect on our everyday life activities largely through technology.

The fact cannot be downplayed that the prosperity of a nation and indeed her continues progress demands that she becomes scientifically empowered technological inclined; the study of which forms the basis for inventions, for manufacturing for implementing production and for simple logical thinking.

Reference is always made to the Soviet Union, the United State of America, the United Kingdom, China or Japan as developed countries. Any moment from now, if it is heard of the Soviet Union making the moon, a place of living, the United States of America making the Mars a dwelling place, China pushing the sea away so as to extend their boundaries, or Japan building suspended mansions in the sky, it is no baffling news.

Although Ghana is operating from zero in science and technology, is no exception and therefore cannot afford to trail behind other countries in her development in this era of rapid global scientific and technological advancement. Science has been used as the vehicle of communication, transportation, industrialization, aviation, national defence, navigation, education, medicine, psychology, architecture, construction, Agriculture, entertainment, art etc. This explains the strategic position that the subject occupies in the dealings or

transactions of the people of the world and for that matter Ghana. For these reasons, the teaching syllabus for integrated science (primary 4-6) is designed to help pupils to:

- a. develop the spirit of curiosity, creativity and critical thinking ability.
- b. develop an enquiry attitude to life.
- c. explore and show appreciation of their environment.
- d. develop the ability to communicate scientific ideas.
- e. acquire basic scientific skills and concepts.
- f. live a healthy, quality life.

It is in pursuit of the above objective that the integrated science syllabus for primary schools encourages teachers to make their lessons more practically oriented by making effective use of different activities. The principal thrust of education in recent times in the country is to get pupils and students to be more action oriented, to be more analytical and critical, to develop the capacity to do things, to plan, design and create things a new.

In effect, science is vital and prudent for our educational development and so to ensure that these abilities are attained, the subject should be taught and learnt thoroughly to make for appropriable proficiency. The teaching and learning of science require the teacher to equip the pupils with skills in the area of experimentation.

It is transparent that science as a subject must be approached with all the senses of the pupils in which case they need to see (but are deprived of), touch (but are denied of), smell and even taste when necessary.

It is transpired that this skills have absolutely zero attention in about the last two decades or where about. The low level of performance of learners in science at all levels of

education is attributed to a greater extent, the inability of the learners to learn and understand science at this upper primary level.

This could be attributed to inadequate attention paid by the teachers of the subject. The practical aspect of science has suffered neglect, to a greater extent, because teachers of the subject seemed to exhibit no mastery and competence in the subject.

Walking into most schools, some teachers re identified even by the casual observers to be lacking this competence in handling science completely as a subject probably because they were awarded certificates through instrumental learning. These teachers who as a defensive mechanism wears scowls on their faces that does not welcome pupils questions to be asked, let alone promoting their understanding on scientific concepts when they realize that the topic under discussion is difficult or challenging. The investigator was an eye witness to one of such incidence in his observation. In the observation, one pupil who was not scared in spite of a teacher's measure but dared to asked a question, "Does it mean it is light energy alone that travels rectilinearly?", was counteract by the teacher's response, "This is a deliberate attempt to waste time".

More or less these teachers creates the impression in the pupils mind that, "Science is difficult at unintelligible to the average pupil". So in moving from the basic schools, no superficial accumulation of knowledge will suffice to remove the misconception that they have developed about science, the fear that imprisons so many of them when it is a science instructional time or even the hatred that some of the pupils develops for science teachers in general. Those teachers who are competent but do not have equipment at their disposal too do not devout themselves in buying them; neither do they improvise. Some teachers who

delve into the area of activity oriented method or experimentation just writes the experimentation procedure on the chalkboard and instructs the pupils to copy them into their note books to meet the work output requirements.

Like the attitudes of pupils towards mathematics, science pupils have always exhibited very little enthusiasm – mostly because there can be no stories to tell to enliven the boring nature or analysis of practicals in science;

Yet teachers of the subject have worked under the assumption that pupils are obliged to learn science and therefore there is no need to make them want to learn it or have the zeal for it. The situation is compounded when the majority of the teachers of the subject teach it as a reading subject at the upper primary level.

Nevertheless, there are real grounds for optimism, should pragmatic measures to help pupils develop the affinity for it are employed. The school (Pano Presbyterian Primary) under the investigation is located on the out-skirts of Kibi town, constituting only a tiny fraction of the Kibi town and a predominantly farming community. Since pupils are obliged to work with their parents, truancy is rampant. A survey of the community of Pano indicated that the inhabitants have a zero interest in education.

Most of the parents and guardians, when called for Parent Teachers' Association meetings, they do not report and therefore little do they know about on-going instances too, when called for communal labour to keep the school surroundings clean, some of them would be malingering and consequently, the pupils are resorted to.

Frankly there are no educative figures like the architects, extension officers, security personnel, doctors, engineers etc. Even the teachers in the school who would have been the

role models for the community, children and pupils lives outside the town, among most of the people, superstition is reigning; others believe education is a preserve for people in the urban areas; while very few do conceptualize education as a fount of all knowledge.

STATEMENT OF THE PROBLEM

Obviously, every individual is characterized by innate potentialities, which when developed can help the individual realize his potentials. It is in this vein that the investigator is optimistic that learners in basic stage five should be capable of understanding some phenomena at that level with little or no teacher's interference. Nevertheless, it is becoming overwhelming for most school learners at this level to carry out simple instructions in science such as the experiment to demonstrate the rectilinear propagation of light and recording their findings. The single reason assigned for this lapse is the probability that though science is a practical and experimental subject which cannot be understood abstractly, teachers are not strategically employing the appropriate measures to amend the anomaly.

In basic schools, the lecture method or the teacher-centered method of delivering science lessons is obviously erroneous and will end up channeling most pupils' interest into reading subjects by which lessons they can understand better provided they follow it with the eyes of their mind. In the investigator's observation of science lessons, most especially that on the topic "Light energy" and "Rectilinear propagation of" taught by the class five teacher, it was a real sight to behold; the teacher neglected the fundamentals of teaching science in basic schools which are the activity, discovery, demonstration method or the

improvisation. The pupils were even not grouped in any of the lessons, charts were not displayed and lastly chalkboard illustration constituted a little aspect. The pupils sat down with arms folded a while the teacher droned on.

At the end of the day, the investigator observed that the learners could not respond to both the oral and written evaluation questions because they could not comprehend the phenomenon; and could not comprehend because I was abstractly taught. This then instigated the investigation because it is envisaged that the viable alternative to present science more realistically is for the teachers to methodically employ the appropriate teaching methodology and ‘Apparatus’ to redress the situation and to assist their learners work with renewed vigour and enthusiasm in science

PURPOSE OF THE STUDY

The purpose of the study is to enquire into the degree of pupils’ thinking acuity and ability to express themselves perfectly and self reliantly using scientific terms and keywords.

It also has the purpose to help learners have smooth transition from one level of chapter to another thereby paving the way for scientific understanding.

In addition, the study is purported to acquaint pupils with the chronological arrangement of scientific collection and handling of data with methods which may include observation, analysis, synthesis and evaluation/conclusion. It will amplify the methodology, accentuate and provide a repetition of basic principles so vital to effective teaching and

bring to sharp focus the fine points that are often worrisome to pupils and teachers of the subject as a whole.

RESEARCH QUESTIONS

What are the causes of the poor performance of the pupils of Pano Presbyterian Primary five in rectilinear propagation of light?

What are some of the strategies that can be employed to teach Pano Presbyterian Primary five pupils on the concept of rectilinear propagation of light?

How should methodology and ‘apparatus’ be used to improve the poor performance of the pupils of Pano Presbyterian Primary five on the concept of rectilinear propagation of light?

SIGNIFICANCE OF THE STUDY

The study will be of immense help to pupils, tutors, authors and the Ghana Education Service for the rationale that the erroneous method of teaching science as a reading subject will be a thing of the past.

The study provides suggestions which when implemented could be an antidote to pupils’ fear of science lessons. It will also catalyze the pupils ability to manipulate the subject and then be in the appropriate position to think critically and answer questions during examination and when necessary. Based on the findings of this study, the Ghana Education Service can organize in-service training course for tutors of science to equip them with multiple techniques which when employed can hopefully make science realism.

Lastly the study will make authors aware of what kind of methods to recommend to tutors of the subject for use in their lessons and consequently provide a framework for further investigation.

LIMITATION

One of the principal limitations of this study is that the topic selected by the investigator had not been investigated on and also sources of materials to deal with the topic were extremely scarce.

Moreover, the pupils had inchoate awareness of rectilinear propagation of light and also the issue of using ‘apparatus’ as an effective instrument for enhancing its understanding.

Nevertheless, the investigator was interested in breaking new grounds and decided to mount on with the proposed topic unabated. The pupils exhibited extreme reluctance of participation in lessons for fear of making mistakes and been laughed at because the few pupils who contributed during the discharge of the pre-test exercise were victimized leading to their inactive participation till the end of the intervention exercise.

Throughout the period of intervention, one-fourth of the pupils were not available at school due to truancy, hence information that could have been got proved futile.

In spite of these hurdles, the investigator was not challenged to abort the intervention but was convinced that experimenting on the topic “Rectilinear propagation of light” would contribute significantly to the improvement of pupils’ mastery competence on the concept of light as energy and science as a whole.

DELIMITATION

Ideally, the project would have covered all basic five pupils or basic learners in Pano Presbyterian Primary, the investigator spelled out and conducted the study on primary five pupils of Pano Presbyterian Primary owing to proximity, financial constraints due to lack of funds, the school's limitation to primary six and above all, the research is time-bound, making it impossible to marshal the requisite facts, ideas, and information for the projects from beyond the prime target (primary five)

ORGANISATION OF THE STUDY

The first chapter of the action research project report of which the introduction forms part has addresses the under-listed issues;

- Background to the study
- Statement of the problem
- Purpose of the study
- Research questions
- Significance of the study
- Limitations
- Delimitations
- Organisation of the study.

The second chapter of the action research project has the heading, 'Review of related literature' which offered a combination of: what has already been written on the

topic with regard to theories or concepts and empirical evidence (Scientific research studies). The overall goal of clarifying how the present study intends to address the gap, silence or inherent weakness in the existing literature therein.

This third chapter highlighted on the methodology of the ‘action research’ project report. It described the research design and procedures employed in obtaining data for the study and vividly described the processes involved in the actual conduct of the research.

The whole chapter four briefly surveys the description, presentation, analysis and interpretation of the data obtained from the pre-intervention and intervention exercise executed.

Lastly, the chapter five of the action research project reports the summary of the entire ‘action’ research project, conclusion and the recommendations.

CHAPTER 2

REVIEW OF RELATED LITERATURE

INTRODUCTION

This chapter highlights on theories or concept and empirical evidence apropos of the topic (Light as Energy) under investigation.

Day by day the word Science is passed through the ears of man and anybody capable of reasoning and thinking is aware of it. However when the issue of defining it become a subject, it is a ‘tag of war’.

Most scholars of the subject see it from different perspectives. According to Microsoft Encyclopedia Encarta (2006), the word Science is derived from the Latin word ‘Scire’ meaning “to know” and furthered that, “Science is the systematic study of anything that can be examined.” This means, unexaminable thing that is studied is not scientific. However it may be accepted as beliefs or as an act of faith.

In Middleton's view (1966), "Science originally means knowledge; knowledge of composition and behaviour of the whole universe of which the earth is only a tiny part". The universe refers to the whole of space and everything in it including the earth, the planet and the stars (Oxford Dictionary: 1309). Middleton's ideology pertaining science supercedes a study on earth alone. Science therefore seeks to procure information that is not confined to the earth alone. The explanation of Middleton gives a lucid explanation into three issues that comes into play:

- 1) Science is knowledge-based
- 2) Science involves a collection of facts.
- 3) Science procures about what nature is made of.

The main question that baffles people is that; why all these knowledge? From the perspective of Middleton therefore, "The main motive is to satisfy curiosity; another is to achieve mastery over nature, with freedom from toil and want".

Curiosity about the earth in which man lives as well as the universe provides the basis as well as the motive power for the search for knowledge and the exercise of reason in turn weaves this knowledge into a coherent pattern and there-from provides the means for recording it.

By mastery achievement is to execute a perfect control over natural tendency. For instance, the Wright Brothers from America (1901) executed a complete control over the force of gravity when they invented the first aircraft.

To be free from toil and want is to freed oneself from "I wish I could... but..." through procuring. For instance in carriage mechanism, sea, distance, time and space is no

more a barrier in human life situation as far as sophisticated machines, technology, communication networks are concerned.

According to Langley (1960), “Science is a knowledge generating activity”. That is to say that science is defined by knowledge; which is also gained through activity that can not be attributed to inherited behaviour or growth.

Foreman (1970) put his idea concerning Science this way, “Science is the accumulation of knowledge through study, observation and classification of facts with the establishment of veritable general laws or truths.” This means that there is a free and open discussion of scientific problems and the publication of results of its investigation. The instrument by which a study can be considered scientific is study, observation and classification of reservoir of facts that can be subject to confirmatory test

Secondly, Foreman’s definition attest the fact that there is an ethic of Science which makes discussion and publication obligatory. For instance Benjamin Franklin who founded in Philadelphia a society for the discussion of the problems of his time, imposed upon its members an oath, part of which may be paraphrase as follows: “I swear diligently to seek the truth, and having found it, to impart it to others (cited in M.L. Oliphant 1970:18)”. “Science is learning new things” and is “Problem solving” (Scott and Foreman: 1989: xii). The world is littered and enveloped with giant problems that are in ascendancy. Science is the indispensable tool by which these problems can be overcome. Science is a challenge, science is a dare!

According to Prentice Hall (1998:536-537) “Science is a process that involves research, experimentation and the development of theories that can hold great explanatory and predictive power”.

There is always an authentic explanation behind any process of research and experimentation before it is assimilated.

According to Oliphant, M.L. (1970:16), “Science is the body of knowledge which can be communicated to others and which can be verified by anyone willing to make the effort to do so”, “There are other kinds of knowledge”, he added, “Arising for instance from emotional or religi experience which are essentially personal and which cannot readilky be communicated to others or be verified by them. Undoubtedly this personal knowledge plays an important part in the lives of individuals, but it can only affect the people as a whole if they are willing to accept the experiences of others as an act of faith. There are fashions in Science, just as there are in art or literature, but there are never any dogmas, and every part of the knowledge it represents is constantly sifted and checked; ideas which prove to be wrong are discarded ruthlessly”.

In the opinion of Burton et al. (1999) it is not easy to give a short definition of science. They argue that, “Science may be defined by listing its principal features” which are;

- Science is empirical; its information comes from observation, experiment and not just from thinking and imagining.
- Systematic: it is organized around a larger conceptual frame of work.
- Open Progressive: and has the potential to grow without limit.

- Logical and based on instrument of science, may be and no matter how much it depends on sophisticated mathematics, it uses human basic reason. Their explanation gives a lucid explanation into three issues that comes into play;
 - 1) There are never dogmas, and every knowledge it represent is periodically sifted and checked; ideas which prove to be wrong are discarded ruthlessly.
 - 2) It is not limited by ideas.
 - 3) Rely chiefly on human cognizance.

In effect, science is a search of knowledge, it enquires into already treasured facts (confirms), involves the ability to breakdown composite problems to differentiate unstated assumptions and logical fallacies and also recognize inferences from facts (analysis). It also involves the ability to fuse parts together to form a new whole. These include the ability to combine, compile, compose, devise, plan, revise, design, organize, create, generate (synthesis).

Finally, Science is evaluative: it has the potential to appraise, compare features of different things and make comments or judge, contrast, criticize, dustify, support, discuss, conclude, make recommendation etc.

IMPORTANCE OF SCIENCE

For a large part of recorded history, science had little bearing on people's everyday lives. Scientific knowledge was gathered fo its own sake and it had few practical applications. However, with the drawn of industrial revolution in the 18th Century, this rapidly changed. Today, science has a profound effect on the way we live, largely through

technology. Some fields of science also play an important role in the things we use or consume everyday. Research in food technology has created a vast range of plastics and other synthetic materials which have thousand of uses in the homes and in the industry. Synthetic materials are easily formed into complex shapes and can be used to make machines, electrical and automotive parts. Scientific and industrial instruments, decorative objects, containers etc. (Microsoft Encarta Encyclopedia, 2006).

Some fields of science have moved into the control of weeds, herbs by weedicide and herbicides respectively as well as other chemicals to kill trees without relying on manpower. Insecticides renders tremendous help in the control of locust, averting hunger in especially African countries.

Agricultural Engineering has developed technologies to artificially incubate millions of poultry eggs for mass production. Close plant species such as orange and tangerine can be carried through budding or grafting to produce disease-resistant and sweet, tasty citrus. Hydponics promote agriculture in countries without fertile lands.

In fisheries, their sexes can be change also for mass production. Technology in science made live easier through cars, ship, etc. and it seems that was not enough for man. In 1901, the Right Brothers in America invented the first aircraft to make traveling more quicker and convenient and above all explore beyond the earth. Through this stepping stone, Russia made the first exploration of the moon by sending Yuri Gargarine (19...).

Computers, telephone, have networked the world and have put the entire world into one's palm and now information can circulate the world within a twinkle of an eye. Along side these achievements science has also brought about technology that help save human

life. The kidney dialysis machine enables many people to survive kidney diseases that would once have proved fatal and artificial valves allows sufferers of Coronary heart (Cardiac) disease to return to active living (Microsoft Encarta Encyclopedia, 2006).

Surgeons can now change successfully the phenotype of humans. The x-ray machine permits fractured bones to be identified and re-located and can detect unusual object in the body. Tissues of human body can be grafted too.

Science has eliminated the ideas of superstition from people, societies and the world at large. Gone were those days when diseases and sicknesses of which mention can be made of tuberculosis and fever were attributed to witchcraft. Unfortunately for parents of twins, their young ones were thrown into evil forests and left at the mercy of God for survival after which the couples must divorce. For ignorance of division of one sperm twins were killed and ignorance of incomplete division of twins, Siamese twins were not welcomed. These diabolical and treacherous practices are now things of the past and are no more brought to mind because of empirical evidence for the possibility of twins and Siamese twins. “Biological research is responsible for the anti-biotic and vaccination that protect us from infectious diseases and for a wide range of other drugs used to combat health problems. As a result, the majority of people on the planet now live longer than ever before (Microsoft Encarta Encyclopedia, 2006)”.

Knowledge on blood group also prevents human life termination through successful transfusion of blood without agglutination. Biological scanning helps embryo to be repositioned well in the maternal womb. All these assertions in the light of the contribution of

science can be defended that, science is an indispensable tool in the world of work and therefore the life-blood of the world.

LIGHT ENERGY

The Christian Religion posits the existence of light as present from the onset of creation. “In the beginning, God created heaven and earth. Now the earth was a formless void, there was darkness over the deep, with a divine wind sweeping over the waters.” God said, “Let there be light” and there was light (New Jerusalem Bible, 1990:5)

From the perspective Macmillan English Dictionary, “Light is the brightness from the sun or from a light which allows us to see things (2002:825)” Along side this definition, the Longman dictionary of English language and culture describes light as, “The natural force that takes away darkness so that objects can be seen (2001:501)”. These explain that light is the medium through which vision is made possible.

Nelkon and Parker in Advance level Physics explain light as, “.....a form of energy which stimulates our sense of vision. One of the early theories of light about 400BC suggested that particles were emitted from the eyes when an object was seen (.... : 440)”

From the above explanations it is transpired that light is a form of energy called luminous and it is that energy that causes a sensation of vision, enabling us to see.

PROPERTIES OF LIGHT

The main properties of light are reflection and refraction. Reflection is the phenomenon which light after falling on a hard smooth surface, is bounced off to take a

different direction without changing the amplitude, frequency and wavelength of the light. The change in direction of light changes its velocity but its speed remains unaltered.

Refraction is the bending of a light ray as it crosses the boundary between two media of different densities, thus causing a change in its direction. The phenomenon of refraction of light is responsible for the following observation:

- The bottom of a clear pond appears to be shallower than it really is.
- A stick or a road appears bent or broken when it is partially immersed in water or any liquid.
- Letters in print seem to be nearer when a thick block of glass is placed over them

WAVE THEORY OF LIGHT

Light is a form of energy which stimulates our sense of vision. One of the early theories of light about 400BC, suggested that particles were emitted from the eye when an object was seen. It is realised however that, something is entering the eye when a sense of vision is caused, and about 1660 Newton proposed that particles or corpuscles, were emitted from the luminous object. The corpuscles theory of light was adopted by many scientist of the day owing to the authority of Newton, by Huygens, an eminent Dutch Scientist, proposed about 1680 that, light energy traveled from one place to another by means of wave motion. If the wave theory of light was correct, light should bend around a corner, just as sound travels round a corner. The experimental evidence for the wave theory in Huygens' time was very small, and the theory was drop for more than a century.

In 1801 however, Thomas Young obtained evident that light could produce wave effects and he was among the first to see clearly the close analogy between sound and light waves. As the principles of the subject became understood other experiment were carried out which use that light could spread round corners and Huygens' wave theory was revived.. Newton's corpuscular theory was rejected since it was incompatible with experimental observation. The wave theory of light has played, and it is still playing, an important part in the development of the subject.

In 1905, the eminent mathematical physicist Einstern suggested that the energy in light could be carried from place to place by 'particles' whose energy depended on the wavelength of the light. This was a return to a corpuscular theory, though it was completely different from that of Newton, as we see later. Experiment carried out show that Einstern's theory was true and the particles of light energy are known as 'photons'. It is now considered that, either the wave theory or the particle theory of light can be used in the problem of light, depending on the circumstances of the problem (Nelkon and Parker, : 440).

SPEED OF LIGHT

According to Frederick, J. B. (1989:58), "The speed of light varies from material to material. Light travels fastest in vacuum, where its speed is $C = 2.998 \times 10^8 \text{m/s}$. Its speed in air is $c/1.0003$. In water its speed is $c/1.33$ and in ordinary glass it is about $c/1.5$ (page 318)"

VELOCITY OF LIGHT

For many centuries, the velocity of light was taught to be infinity large; from about the end of the seventeenth century, however, evidence began to be obtained which showed the speed of light, though enormous, was a finite quantity.

Galileo, in 1600, attempted to measure the velocity of light by covering and uncovering a lantern at night, and timing how long the light took to reach an observer a few miles away. Owing to the enormous speed of light, however, the time was too small to measure and the experiment was failure. The first successful attempt to measure the velocity of light was made by Romer, a Danish Astronomer, in 1676. (Nelkon and Parker... : 449). From his experiment the speed was determined to be $c = 3 \times 10^{11} \text{m} / 16.5 \times 60 \text{s} = 3 \times 10^8 \text{ms}^{-1}$ (approx.)

SOURCES OF LIGHT

There are various sources of light. For example, the sun, the stars are natural source of light. Artificial sources of light are the candles, electric torch, the electric lamp, incandescent and arc lights and fluorescent.

Self luminous or luminous sources of light are those that generate and emits light by themselves. E.g. are the stars, sun, fireflies and some deep sea fishes, and the artificial light sources.

Non-luminous bodies depend on natural or artificial light sources to illuminate them. They are seen only when they reflect the light from a luminous body. For e.g. light from a car lamp falling on a road sign in the night, causes the sign to throw back part of this

light into the eyes of the car-driver thereby enabling the road sign to be seen. The road sign is a non-luminous body, the headlamp is a luminous body, an artificial luminous body. Examples of non-luminous bodies are a page of a book, a person's face, a brick and the moon. The sun's rays illuminate the moon and make it to appear luminous in the night.

TRANSMISSION OF LIGHT

Light is an electromagnetic wave. It can pass through a vacuum and through a material medium. If light shines on a body, part of the light is transmitted through the body, the rest is reflected. The amount of light passing through a body depends on the nature of the body. If a large percent of light falling on a body passes through it, the body is said to be transparent. Examples of transparent bodies are glass and water. Because light is easily transmitted through these transparent bodies, we can see object through them easily. Some object like frosted glass and tissue paper allow some small amount of light to pass through them. Such objects are called translucent objects. Because the amount of light passing through translucent bodies is small, objects cannot be seen clearly through them. These are called opaque objects. Examples are wood, block, wall, metal sheets etc.

RAYS AND BEAMS OF LIGHT

A light ray is the direction or path along which light energy flows. Such rays are indicated in diagrams by fine lines with arrow heads which indicate the direction of travel of the light.

A collection of rays is called a beam. Three types of beams are recognized.

- a) Parallel beam: is one in which the light rays are parallel to one another. Search-lights give off parallel beam of light.
- b) Convergent beam: is one in which the rays converge or meet at a point. A hand lens can be used to produce such a beam.
- c) Divergent beam: is one in which the light rays all come from a point and spread out or diverge from the source. Lamp produces a divergent beam of light.

RECTILINEAR PROPAGATION OF LIGHT

Light energy travels in straight lines as can be shown by the following simple demonstration using two cardboard pipes, one straight and the other bent. If we place a candle flame on one end of each pipe and view through the other end, light from the candle flame of each pipe will be seen clearly on the end of the straight pipe but no light will be seen at the end of the bent pipe. This phenomenon of light traveling in straight lines is known as rectilinear propagation of light.

Alternatively, a demonstration of rectilinear propagation of light is the following simple experiment:

We punch a tiny hole in the centre of each three equally sized cardboards which are then arranged in a straight line in front of each other. A string is passed through the holes and pulled taut to ensure that the holes are aligned in a straight line. Light from a candle is then placed at one end of the row of cards. When we look through the other end of the row, we will see the light from the candle flame through the holes. If either cardboard is slightly shifted out of the straight line position, the light is cut off. Two natural effects that result

from the rectilinear propagation of light are formation of shadows and eclipses. The principle of co-operation of the pin-hole camera also depends on the fact that light travels in straight lines.

A shadow is an area in which light rays from a source cannot reach. A shadow is produced by the obstruction of light by an opaque object. The shade under a tree or a canopy, on a bright sunny day is a shadow produced by the opaque tree or canopy which obstructs light rays from the sun and prevent them from getting to the area of a shade.

Ghana experienced her first and second eclipse on 28th February, 1947 and 29th March, 2006 respectively. An eclipse, a spectacular scene, is a result of a shadow cast by a heavenly body on another. While the sun is a luminous body, the moon and the earth are both non-luminous. The moon revolves round the earth and the earth in turn revolves round the sun.

At certain times during these movements, the three bodies all align themselves. If the moon falls between the sun and the earth, the shadow of the moon will be cast on the earth's surface. If we were living in the part of the earth that is in the moon's shadow, the light from the sun is cut off from view and we are in darkness. Since we cannot see the sun, we call that eclipse of the sun or solar eclipse. Annular and lunar eclipses also occur.

CONCEPT OF ENERGY

Energy is given to an object when a force does work on it. The amount of energy given to the object equals the work done. Further, when an object does work. It loses an amount of energy equals the work it does. Because energy and work can be converted in this way, they have the same units, Joules. An object that is capable of doing work possesses energy (Frederick, J.B., 1989:58).

According to Peter Nolan (1995:189), “the fundamental concept that connect all of the apparently diverse areas of natural phenomenal such as mechanics, heat, sound. Light, electricity, magnetism, chemistry and other, is the concept of energy.

Energy can be sub- divided into well defined forms such as mechanical, heat, electrical, chemical and atomic energy. In any process that occurs in nature, energy may be transformed from one form to another. The history of technology is one of a continuing process of transforming one type of energy into another. Some examples include the light bulb, generator, motor, microphone and loud speaker”. Energy by definition in Peter Nolan’s view, “is the ability of a body or system of bodies to perform work”. (a system is an aggregate of two or more particles that is treated as an individual; unit