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* **Definitions of science?**

The word ‘science’ is derived from the Latin word, ‘scientia’ which means ‘Knowledge’ (Eneh: 2000). On the simplest level, science has been defined as the knowledge of the world of nature (The New Encyclopaedia Britannica:1995).The above definition however does not exhaustthe full meaning of science. So it is difficult to define it. However, science generally is regarded in three main ways as (Nwala: 1997):

1. A body of knowledge.

2. A method for acquiring knowledge or studying and understanding the world.

3. An institution.

* ***Science as a body of knowledge***

What does the word ‘body’ tell you? The bodies of knowledge generally regarded as science include, chemistry, biology, physics, mathematics, microbiology, pharmacy and medicine. These bodies of knowledge differ from other forms of knowledge such as religion and art in both content and form. You will study about these differences in a subsequent section.

* ***Science as a method for* acquiring *knowledge***

Science has well-known procedures for obtaining knowledge. The two branches of science, which are empirical and formal sciences, use what is called the scientific method. The 2 steps of that method include observation, problem hypothesis formulation, experimentation, conclusion and theory formulation. Formal science utilizes concepts, rules and theories, and expresses them in quantitative and statistical manner. You will understand the meanings of empirical, *concepts, rules and theories in the subsequent section and units. Anybody that uses* the scientific method or the method of formal sciences to obtain knowledge is said to be involved in science.

* ***Science as an institution***

Science can be viewed as an institution which comprises millions of experts. These experts engage in the study and development of human knowledge. The experts or scientists can be found in various research and educational institutions, industries, hospitals, companies, etc. The cooperation and interaction among them make the development of science possible and reliable.

**SCIENTIST VIEWS OF SCIENCE.**

1. Empiricism
2. Rationalism
3. Relativism
4. **Empiricism:** Aristotle (384 – 347) introduced empiricism and the notion that universal truths can be arrived at via observation and induction thereby laying the foundation of scientific method.
5. **Rationalism:** Rationalism was introduced by Plato (470 – 399) as a scientific method adopted through the use of reasoning. Either deductive reasoning or inductive reasoning.
6. **Relativism:** Relativism is the belief that truth is not always and generally valid, but can be judged only to in relation to other things. I.e. personal situation.

* Philosophical views of science?

1. Empiricism
2. Epistemology
3. Induction
4. Deduction
5. Parsimony
6. Falsification
7. Demarcation problem
8. Paradigm shifts and scientific revolutions

For most everyday purposes, this gives us a fairly complete picture of what science is and is not. However, there is an entire field of rigorous academic study that deals specifically with what science is, how it works, and the logic through which we build scientific knowledge. This branch of philosophy is handily called the philosophy of science. Many of the ideas that we present in this write up are a rough synthesis of some new and some old ideas from the philosophy of science .Despite its straightforward name, the field is complex and remains an area of current inquiry. Philosophers of science actively study such questions as:

What is a law of nature? Are there any in non-physical sciences like biology and psychology?

What kind of data can be used to distinguish between real causes and accidental regularities?

How much evidence and what kinds of evidence do we need before we accept hypotheses?

Why do scientists continue to rely on models and theories which they know are at least partially inaccurate (like Newton's physics)?

Though they might seem elementary, these questions are actually quite difficult to answer satisfactorily. Opinions on such issues vary widely within the field (and occasionally part ways with the views of scientists themselves who mainly spend their time doing science, not analyzing it abstractly). Despite this diversity of opinion, philosophers of science can largely agree on one thing: there is no single, simple way to define science!  
Though the field is highly specialized, a few touchstone ideas have made their way into the mainstream. Here's a quick explanation of just a few concepts associated with the philosophy of science, which you might (or might not) have encountered.

**Epistemology:** branch of philosophy that deals with what knowledge is how we come to accept some things as true, and how we justify that acceptance.

**Empiricism:** set of philosophical approaches to building knowledge that emphasizes the importance of observable evidence from the natural world.

**Induction:** method of reasoning in which a generalization is argued to be true based on individual examples that seem to fit with that generalization. For example, after observing that trees, bacteria, sea anemones, fruit flies, and humans have cells, one might inductively infer that all organisms have cells.

**Deduction:** method of reasoning in which a conclusion is logically reached from premises. For example, if we know the current relative positions of the moon, sun, and Earth, as well as exactly how these move with respect to one another, we can deduce the date and location of the next solar eclipse.

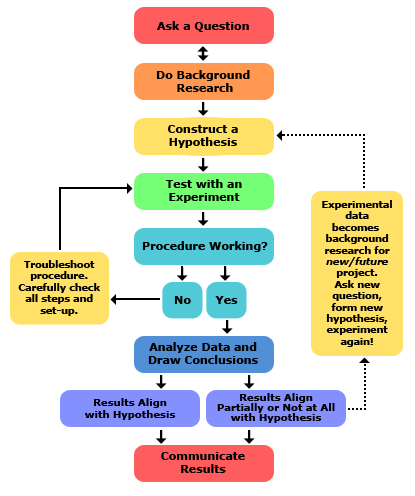
**Parsimony:** idea that all other things being equal, we should prefer a simpler explanation over a more complex one.

**Demarcation problem:** the problem of reliably distinguishing science from non-science. Modern philosophers of science largely agree that there is no single, simple criterion that can be used to demarcate the boundaries of science.

**Falsification:** the view, associated with philosopher Karl Popper, that evidence can only be used to rule out ideas, not to support them. Popper proposed that scientific ideas can only be tested through falsification, never through a search for supporting evidence.

**Paradigm shifts and scientific revolutions**: a view of science, associated with philosopher Thomas Kuhn, which suggests that the history of science can be divided up into times of normal science (when scientists add to, elaborate on, and work with a central, accepted scientific theory) and briefer periods of revolutionary science. Kuhn asserted that during times of revolutionary science, anomalies refuting the accepted theory have built up to such a point that the old theory is broken down and a new one is built to take its place in a so-called "paradigm shift".

* Scientist method



The ‘scientific method’ merely refers to a broad framework for studying and learning more about the world around us in a scientific manner. It is not so much a series of absolute, unchangeable steps as a guideline to the method that must be used when trying to reach a scientifically acceptable theory about a subject matter. Therefore, it is not possible to provide a finite number of steps or an exact procedure for following the scientific method. However, the scientific method steps detailed below describe the main steps that scientists commonly take when conducting a scientific inquiry.

Steps of the Scientific Method:

**1. Make an Observation:** Scientists are naturally curious about the world. While many people may pass by a curious phenomenon without sparing much thought for it, a scientific mind will take note of it as something worth further thought and investigation.

**2. Form a Question:** After making an interesting observation, a scientific mind itches to find out more about it. This is in fact a natural phenomenon. If you have ever wondered why or how something occurs, you have been listening to the scientist in you. In the scientific method, a question converts general wonder and interest to a channeled line of thinking and inquiry.

**3. Form a Hypothesis:** A hypothesis is an informed guess as to the possible answer of the question. The hypothesis may be formed as soon as the question is posed, or it may require a great deal of background research and inquiry. The purpose of the hypothesis is not to arrive at the perfect answer to the question but to provide a direction to further scientific investigation.

**4. Conduct an Experiment:** Once a hypothesis has been formed, it must be tested. This is done by conducting a carefully designed and controlled experiment. The experiment is one of the most important steps in the scientific method, as it is used to prove a hypothesis right or wrong, and to formulate scientific theories. In order to be accepted as scientific proof for a theory, an experiment must meet certain conditions – it must be controlled, i.e. it must test a single variable by keeping all other variables under control. The experiment must also be reproducible so that it can be tested for errors.

**5. Analyze the Data and Draw a Conclusion:** As the experiment is conducted, it is important to note down the results. In any experiment, it is necessary to conduct several trials to ensure that the results are constant. The experimenter then analyses all the data and uses it to draw a conclusion regarding the strength of the hypothesis. If the data proves the hypothesis correct, the original question is answered. On the other hand, if the data disproves the hypothesis, the scientific inquiry continues by doing research to form a new hypothesis and then conducting an experiment to test it. This process goes on until a hypothesis can be proven correct by a scientific experiment.

The whole process is collaborative and is conducted in a clearly documented manner to help other scientists who are doing research in the same field. Throughout history, there are instances where scientists have stopped their research before completing all the steps of the scientific method, only to have the inquiry taken up and solved by another scientist interested in answering the same question.

* ***Science in service to man.***

1. Usefulness of science advancement to man.

**Importance of Science.**

A world without science; no vaccines or cures for diseases, wouldn’t life be joyless and extremely hard? However, with science on our side, it’s an entirely different story. This simply depicts the importance of science in our daily lives. We are handicapped without the presence of science. Right from the day when man began to eat, wear clothes, and light fire, science became an inseparable part of life. And since then, several advancements have continuously been evolved to make life a little less painful for humankind. The world’s become a smaller place to live in. Time and distance have been empowered by science. Within a few hours, we are on the other side of the globe. Farms product has been improved with the use of fertilizer which has been scientifically proven to aid the growth of plants, improved seedling, in essence that there are some perennial crops that their maturity period has been shorten, to improve continuous availability of food and its preservation for human consumption.

**Usefulness of science advancement to man.**

**Medicine**

Science has helped man to study and grow his knowledge on the human body and contribute towards saving millions of lives worldwide. Various incurable diseases can now be treated with the development and invention of new medicines. Horrible diseases have now found a place in the list of curable or preventive diseases. Further, studies and researches are continuously performed hoping to find solutions for as-yet-incurable diseases. For instance, malaria was an epidemic disease before the discovery of new anti-malarial drugs

**Communication**

The invention of internet and mobile phones are perhaps two of the most significant contributions of science to humankind, with respect to communication. At the press of a few buttons, you are able to talk to your near and dear ones residing across oceans. Further, to catch a glimpse of them, you can switch on to chat rooms and enjoy live conversations. To add to this, meetings and conferences have become less tiring and cost effective with the development of video conferencing facilities.

**Space Exploration**

Scientists are continuously in the race of exploring and understanding the working of the earth that we live on and the entire physical world, in general. Different occurrences taking place in nature are analyzed through countless experiments. These include studying the nature of the stars, learning the size of the universe, discovering other planets and their nature, and, moreover, understanding the age of the earth.

**Electricity**

The traditional methods of generating electricity through burning coal have now been replaced by new conventional methods. Thermal plants have been established even in the remotest areas of the world, providing the basic electricity needs to every household. To add on, electricity is used to draw water from oceans and rivers to supply to homes, so that no home is without light and water. It is through electricity that we do not feel hot during summers and cold during winters. Certainly, science has a large piece of share in the electricity section as well.

**Agriculture**

Various procedures have been developed to convert barren lands and deserts into fertile fields that can be used for cultivating crops and providing food for more people. Tractors have taken over the traditional bullock carts and ploughs, thereby reducing farmers’ job of concentrating over a particular area at one time.

**Entertainment**

Television, radio, theater, mobile phones, CD players, iPods, and music systems have been a major source of entertainment to human race. Without science, these would not have been available to us. At the click of a button or key, we can update ourselves with the latest news and developments taking place anywhere across the world. Slice in a CD and you have a discotheque ready at your home. Switch your mobile phone to the music player mode and you can listen to your choice of songs anywhere anytime. A movie is about to release this week. Book your tickets in advance through internet or phone and you are at the theater for its premier.

1. **Scientist discoveries that change the world.**

There have been many momentous occasions when an individual, group or generations ended up discovering some hidden nuggets of wisdom floating in the lap of nature. Many such discoveries changed the world forever. While some of these discoveries are well-known to most people, several others are quite subtle that get easily overlooked usually because their applications or outcomes appear obvious to the modern world. Here is the list of top 10 amazing discoveries that changed the world forever.

**1. Gunpowder:** In the recorded history, there is no clear mention of the people who discovered gunpowder. It is believed that Chinese alchemists, during a series of experiments ended up discovering a powder that that could change the nature of warfare and hunting forever. While the discovery of gunpowder almost certainly resulted in the death of millions over the past few decades, it has also helped the mankind to enter Space.

**2. Anatomy:** It is the field of anatomy that today helps medical professionals all over the world to understand and treat the human body. Diagnosis or treatment of various conditions would have been nearly impossible if the mankind had no knowledge of the anatomy. Although ancient texts on some anatomy topics date back to 1600 BC in Egyptian history and 5000 BC in Vedic history, it was only in the year 1543 that Andreas Vesalius started discovering the human body in fresh light. He created the modern text that laid the foundation of thousands of treatment methods, accessible to billions of people on the planet today.

**3. Electricity generation:** It is impossible to imagine a life without electricity today. Everything – yes, everything in our day to day lives is depended on fundamental principles of ‘flow of electricity’ and ‘electricity generation.’ It was Michael Faraday who discovered the profound scientific relation in magnetism and electricity. The first electric generator could be created after the discovery that electricity could be generated by moving a metallic wire around a magnet. Rest, as we know, is history!

**4. Oxygen – the fine air:** Even an 8 year old knows about oxygen today. When it was first discovered in the year 1772, it was known by the name ‘fine air.’ It was known to be a gas that accelerates combustion. The discovery laid the foundation of high-end combustion engines that now power vehicles, motors and other devices. When the discoverer of Oxygen, Carl Wilhelm demonstrated the action of oxygen to a French scientist, he successfully went on to discover that oxygen was also responsible for supporting the respiration in all animals!

5**. Photosynthesis:** It was Joseph Priestley who first established ‘indirectly’ through a series of experiments that animals consumed the gas which is produced by plants. It was Jan I., an Austrian scientist, who later defined the process of photosynthesis. It was a discovery that made people all over the world aware of how plants were restoring the balance by converting carbon dioxide into oxygen. We could have, otherwise, wiped out all forests by now!

**6. Penicillin:** Penicillin was discovered accidently by a famous biologist Sir Alexander Fleming. The biologist was particularly famous for being absent-minded on most occasions as he paid great attention to small ‘changes’ taking place around him. It was the habit of close observation that helped this absent minded biologist to discover the principle that one set of micro-organisms could kill or restrict the growth of other microorganisms. Over the next several decades, the newly discovered drug, known as penicillin, saved millions of lives.

**7. Vaccination:** Vaccination is perhaps one of the greatest and most amazing discoveries that changed the world forever largely because it has helped saving the lives of millions ever since it was tried as an experiment in 1796. Had it not been for the sustained efforts of Edward Jenner, many would have lost their lives even in their infancy to diseases like small pox. Jenner inoculated a young boy using matter from the cowpox lesions of a dairymaid and then introduced the smallpox virus to the boy but he was not infected. The word vaccination traces its origin to the Latin word ‘vacca’ meaning cow.

**8. Earth is not flat; its round**: While you know it to be so obvious today, you couldn’t have guessed it so easily few hundred years ago! There was a time (not a thousand years ago, really), when people believed their boats in the ocean would fall off the edge if they went too far! Many scientists had to lose their lives only because they said ‘earth was round,’ and some guys at authoritarian churches thought it was ‘outrageous and blasphemous’ to say so!

**9. Wheel:** There is no record of how discovered the wheel. It was one of those discoveries that probably laid the foundation of human civilization! Without wheels, we could not have moved beyond few hundred kilometers. There would have been no exchange of knowledge, language, commodities etc. The discovery of the round object, which experienced the least amount of friction, was nothing short of a miracle or a boon for the mankind.

**10. Fire:** Nothing could have been possible if some unknown caveman hadn’t literally ‘played with fire’. The discovery of fire is one of the greatest ones done in the history of mankind. We have come a long way indeed from producing fire by rubbing two stones. The way fire is produced and the carriers of it have extended over thousands of years but fire, being an element of Earth, remains what it was since time immemorial. Of all things it has helped us in accomplishing, fire is the reason we love our food. We owe a lot to that caveman. Fire indeed deserves to top the list of most amazing discoveries.

* ***Nature vs. science.***

1. Throughout history, many people have often become wary of the steps science has taken; perhaps believing that man has taken on the power of God to control life and death, even to control nature itself. More recently, cloning and genetic selection have been seen as man trying to “play God” by creating or altering life. The short story “The Birthmark” by Nathaniel Hawthorne is the tale of a man obsessed with science and power. His idea of perfection through science becomes a war against the power of nature. Aylmer, “a man of science”, has fallen in love with and married the beautiful Georgiana. She is a woman that Aylmer considers perfect…except for a small red birthmark on her cheek. This “imperfection” to an otherwise perfect woman soon turns into Aylmer’s obsession. He no longer sees her beauty when he looks at her, but only sees her flaws. In this story, Hawthorne demonstrates that taunting the power of Nature may have disastrous results.
2. Another typical example is what happen in our country here in Nigeria, the former first lady who want to correct nature by working on her obsession, she embark on a body surgery of been changing from fat to slim, in Switzerland, which later lead to her death by the act.
3. Another area of nature vs. Science is the area of the climate when the scientist tries to figure out why and how to control the rain. They even do it to the level of want to predict the nature which some time, it is not accurate because sometimes their predict is valid why some it is not valid. The example is the prediction of weather and so on.

* How science has addresses natural disaster.

It is not a surprise or alarming situation when you heard of natural disaster like landslides, flooding earthquake and after all this are sometimes man made or nature induced.

1. A good in sight is that it was science that discovered many things , year ago that there are precious mineral resources like crude-oil, diamond, coal, and other even the deforestation of man for the wanting of more industrial estate, relaxation, centre market place and several other government parastatals were build through the exploration of different gift of nature, which it’s a normal thing not come today natural disaster struck every now and there, to the extent that the science that came some year back that the exploration of our mineral resources is good now clamoring for its reduction because of its rate to struck natural disaster which are threatening to the existence of human races.
2. Science has been looking into the preparedness, mitigation and even resilience of the major disastrous location in the world.  
   Many tools are used today to evacuate, warn, search or stop disaster through the help of science. Tools like “fire extinguisher” can be used to reduce the impact of fire disaster; early warning “Alarm system” has been provided to inform the inhabitants of a particular place when there is certain disastrous. There are many more other ways in which science has been trying to stop natural disaster whether man-made or nature induced.
3. A typical example is the NEPAL installs earthquake early warning system, alerts 10-20 scored in advance.
4. Ambulance bus, fire fighter cars, drone, the rain gauge, forecasting of atmosphere condition many other which are aim to provide coherent scientific support in these areas and has been contributing to building a sound knowledge on relevant if disaster risk management.
5. Pure drinking water is a precious resource after a disaster. And while there are numerous filters on the market, the ease and simplicity of Chinese engineer Chao Gao's C-Water prototype, which took second place in Designboom's 2010 Incheon International Design Awards, makes it great for an emergency. Placed on the ground or in water, Gao's lightweight collapsible device accumulates water vapor inside its filter. The sun then heats the vapor—which eventually condenses on the roof of C-Water—and purifies it. Two days later—after exposure to the sun has killed nearly all the microbes—the H20 is safe to consume.
6. Industrial designer Rahim Bhimani created the Disaster Relief Toilet after witnessing the horrors of people having nowhere to dispose of their personal waste during the 2010 Chilean earthquake. His easy-to-assemble "comfort station" consists of an 18-inch-high flat-pack toilet, an encompassing tent for privacy, and a waste-disposal system that includes an easy-to-remove cart and a biodegradable drawstring bag. A person can piece together the plastic toilet with a coin or a butter knife, and it's ready for use.

***References.***

1. Eneh: 2000.
2. In Designboom's 2010 Incheon International Design Awards.
3. My biography by Olusegun Obasanjo 2009.
4. Nwala: 1997
5. The New Encyclopaedia Britannica: 1995.
6. The short story “The Birthmark” by Nathaniel Hawthorne.