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## UNIT I. GENERAL CONCEPTS AND HISTORICAL ANTECEDENTS OF SCIENCE AND TECHNOLOGY

### Overview

Science and technology are connected in society, people began to deal with science and technology since ancient times. They used and experienced science and technology in the community since then, starting from old ages until now in the modern ages. Reflected on the historical development and the progress in science and technology too. The science and technology that evolved in society were based on their needs and demands, hence, Science and technology shaped society. This unit will help the student understands the factors of how science and technology changed over time. Moreover, students will become aware of some basic terminologies included in this unit, they will learn the different factors that affect the science and technological advancements in the Philippines and to the other countries.

### Learning Objectives:

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At the end of the unit, the students should be able to:

1. explain the interrelatedness of science, technology, and society;
2. discuss the role of science and technology in the environment and society;
3. identify some important persons and significant events throughout the history of science and technology; and
4. discuss the history of science and technology in the World and Philippine settings.

### Lesson Proper

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#### Introduction to Science and Technology

**Science** includes the systematic study of the structure and behavior of the physical and natural world through observation and experiment, meanwhile, **technology** is the application of scientific knowledge for practical purposes (*Oxford Reference*).

#### Historical Antecedents of Science and Technology in The World

People believed that science and technology began in ancient times up to the present. Progress in science and technology exist over time as reflected in its historical advancement as shown as follows [Ang, R., Cruz, J., et al. (2018)]:

#### ANCIENT AGE

The Three–Age System Under the Ancient Age

1. Stone Ages

2. Bronze Ages

3. Iron Ages

The "Three-Age System"

A System of classifying ancient ages based on tool developmental stages.

The person behind this "Three-Age System" is named Christian Jurgensen Thomsen

### **1. Stone Ages**

**These are the Substantial Event During the Stone Age:**

- Period of weapons made of stone, wood, bone, or other materials aside from metals.
- Shown cultural evolution of tools from chipped to polished stones

According to John Lubbock, The Two (2) Divisions of the Stone Age Are:

- Paleolithic Periods
- Neolithic Periods

### **Paleolithic Periods**

- Central Event During Palaeolithic Periods:
- Began Approximately 2 Mya and Ended Between 40,000 – 10,000 years. ago
- Longest Phase of Human History
- People Live in Small Bands
- Used Tools Made of Stones, Flints, Bones, And Even Antlers
- Humans were hunter-gatherers
- The successive divisions of Palaeolithic periods are: Lower, Middle, and Upper Palaeolithic Periods

**These are the Cultural Features of the Lower Palaeolithic Periods:**

- Marked the Age of Human Evolution
- Had Development of Simple Tools Like Stone Chopper
- Tools Used in Food Hunting/Gathering/Cutting Edge
- Australopithecus which unearthed from Olduvai Gorge, Tanzania
- 100,000 – 500,000 years old stone tools made by Homo Erectus (Discovered in various places like Africa, Europe, and European Sites)

**These are the Cultural Features of the Middle Palaeolithic Periods:**

- Early Human Ancestor, Called Neanderthal Man
- Existed 40,000 – 100,000 Yrs. Ago
- Cavemen Existed
- Evidence of Painting the Dead Before Burial Practiced During This Period

**These are the Cultural Features of the Upper Palaeolithic Periods:**

The period was known for communal hunting, extensive fishing, cloth sewing, sculpture, painting, and making personal ornaments out of bone, horn, and ivory.

- Manmade dwellings called pit houses
- Arts arose
- Had to have highly refined weapons like flint, obsidian projectile points, and blades
- Variety of cultures of homo sapiens group (ex. Cro-Magnon man, Grimaldi man)

**These are the cultural features of the Mesolithic periods:**

- People began to learn to fish along rivers and lake shores
- Make pottery and use the bow
- In the gradual transition from food hunting to agriculture they used tools called microliths

These are the cultural features of the Neolithic periods:

- Wide domestication of plants and animals
- Used stone tools and pottery and weaving in numerous settled villages
- Had cultural and technological development in agriculture

**2. Bronze Ages**

- During 3000 BC – 1200 BC
- The period is marked by the introduction of metal tools in these cultures.
- Tools and weapons were already made with copper and bronze
- Metal extractions were achieved from ore (a process known as smelting)
- Alloys of metals exist
- Large early trading centers existed
- Bronze used to make tools and weapons
- Farm tools and weapons were being made
- New metal was expensive to make

**3. Iron Ages**

- 1500 BC – 450 A.D
- Articles made of iron.

Subdivided into two (2) smaller groups:

1. Dark (450- 1000 A.D)

2. High middle ages (1000 – 1450 A.D)

**These are some of the inventions during Iron Ages in the country of China:**

- |   |                      |
|---|----------------------|
| 1. Papers   | 11. Printing press   |
| 2. Seismograph  | 12. Magnetic compass |
| 3. Animal harness   |                      |
| 4. Water – power  |                      |
| 5. Mechanical clock   |                      |
| 6. Wheelbarrow  |                      |
| 7. Hydraulic engineering works<br>(waterway control & irrigation) |                      |
| 8. Gun powder   |                      |
| 9. Guns   |                      |
| 10. Cannons   |                      |

**These are some of the inventions during the Iron Ages in Europe:**

1. Magnetic compass
  2. Watermill and windmill
  3. Lenses with spectacles
  4. Gunpowder and cannon
  5. Paper and printing
  6. Medicine
    - involved magic, faith, charm, prayer, and herbs
- poor hygiene and sanitation in general

**The following are some of the inventions during the iron ages in India:**

1. Medicine/science/ mathematics
  - information on diseases and drugs.
  - information on astronomical bodies was gathered.
2. know solving square roots and linear equations.
3. metallurgy was developed (material science and engineering that studies the physical and chemical behaviors of metallic elements)

**SCIENTIFIC REVOLUTION**

Period with great scientific intellectual achievements that led to radical changes in scientific inquiries. Some of these are:

- **Universe Model by Nicholas Copernicus**

Describes the sun as the center of the universe; and that the earth and other planets revolve around it in circles.

- **Law of Planetary Motion by Johannes Kepler** – all planets revolve around the sun in elliptical, not circular, orbits, and the closer planets to the sun move faster than the others.
- **Work of Motion By Galileo Galilei** - involves the discovery of the relations among distance, velocity, and acceleration and the law of inertia using scientific approaches.
- **The law of universal gravitation by Isaac Newton** - states that the particles use a force that is directly proportional to the product of their masses and inversely to the square of the distance between their centers.

**INDUSTRIAL REVOLUTION**

Some of the highlights during this period are:

- Industrial Revolution (from 1750 to 1895 A.D)
- With complex technological inventions that replaced human and animal forces.
- Covers the complex technological innovations that lead to the substitution of machines and inanimate power for human skills and animal forces.
- Remarkable technological advancement:
- Textile, coal and iron and steel, transportation, communication, lighting, and agriculture.
- Some of the inventions are Radio, telephone, electric telegraph, gas lighting, Bunsen burners, electric light, seed drill, steamships, steamboats, blast furnaces and fly-shuttle and cotton gin, etc.

## **18<sup>th</sup> TO 19<sup>th</sup> CENTURY**

The connection between science and technology was very minimal. Science, technology, and industry united at a common ground and cause.

*Some of the inventions and inventors are:*

- Cell or battery – Alessandro Volta
- Discovery of x-ray – Wilhelm Roentgen
- Mercury thermometer – Daniel Gabriel Fahrenheit
- Atomic theory – John Dalton
- Discovery of electron- Joseph John Thomson
- Discovery of cell – Robert Hooke
- Introduced binomial nomenclature of classifying species – Carolus Linnaeus
- Discovered cell nucleus – Robert Brown
- Vaccine against rabies – Louis Pasteur

## **20<sup>th</sup> CENTURY TO DATE**

Some of the highlights during this period are:

- Science and technology had structurally and methodologically changed.
- Many scientific theories were introduced and influenced technological works in this century.
- Physics, biology, astronomy, chemistry, earth science, biotechnology, communication, defense, energy, entertainment, medicine, transportation, information, and computer technology.

*Some of the inventions and inventors are:*

- Theory of Relativity – Albert Einstein
- Discovery of Neutron – James Chadwick
- First Walk on The Moon – Neil Armstrong and Buzz Aldrin
- Paper Chromatography – Mikhail Tsvet
- DNA Structure – James Watson & Francis Crick
- Sheep Cloning (named Dolly) – Ian Wilmut
- Discovery of Stratosphere – Leon Philippe Teisserenc De Bort
- Discovery of Earth's Crust and Mantle Boundary – Andrija Mohorovicic
- Continental Drift Theory – Alfred Wegener
- Theory of Seafloor Spreading - Harry Hess
- Biosensors, DNA fingerprinting, gene cloning, synthetic skin, radio, cellular phone, and fiber optics. Tear gas, army tanks, atomic bombs, neon lights, nuclear power plants, solar power, calculator, computer floppy disk, video cassette, Betamax video system, colored tv, laser printer, internet, artificial heart, mammography, pacemaker, test tube baby, x-ray laser, airplane, helicopter, jet engine, and space shuttle, etc.

## INFORMATION AGE

Sometimes called the digital age, new media age, or information age. Coupled with the birth of personal computers an era with easy access to any piece of information. The period is characterized by the change from traditional industry to an economy that is founded on the computerization of information. Johannes Gutenberg, in Europe, was a German blacksmith and publisher who introduced “movable type printing” [Ang, R., Cruz, J., et al. (2018)].

### **The Pre - Gutenberg World**

Some of the highlights during this period are:

- The printing press was not yet around
- Information could be processed in a tedious manner
- Books were written and produced by hand
- Made on the surface of clay, wax, papyrus, and parchment
- Books are restricted only to the elite group of people.
- Information was only relayed to others through a word-of-mouth channel.
- Began with the introduction of movable printing.
- Books were initially written in Latin.
- Books contained religious texts of the medieval period.

### **The Gutenberg Revolution**

Some of the highlights during this period are:

- The local languages were used and medical books were also published.
- Era can be described as the emergence of the Internet and the world wide web.
- Paved the way to the possible uploading and downloading of all forms of media instruments such as video, audio, and images.
- The passing of information is much faster and easier
- People publish or spread information

**The Post- Gutenberg World-** the rise of the digital age printing presses are not the only tools used in spreading information. Computers, cell phones, digital cameras, and computer printers are now available.

## SCIENCE AND TECHNOLOGY IN THE PHILIPPINES

### **PRECOLONIAL PERIOD**

*Some of the highlights during this period are:*

- Period before 1521
- Early settlers called modern man (Homo Sapiens)
- They make simple tools and produced seashells ornaments & pottery of various designs.
- Few reliable written materials information available (*early traders and narratives from first Spanish missionaries were the sources*)
- Filipinos made use of boats for coastal trade like the caracao.

- Gradually they learned to manufacture tools made of copper, gold, bronze, and iron.
- Filipino traded beeswax, cotton, pearl, cloth, iron pots, colored glass beads, iron needles, and tin. Meanwhile, Vietnam and China traded porcelains.
- Filipino traded with Borneo, Mallaca, and other Malay Peninsula.
- Cultural and technological influences reached and diffused in the Philippines.
- Filipinos were believers in superstitions.
- They had their writing and measuring systems and counted the years by moons and from one harvest to another.
- -Coastal areas made more sophisticated technology compared to other areas due to their exposure to foreign trade and cultural influences.
- -Filipino were still hunter-gatherers (remote areas)
- -They knew agriculture, raising farm animals, producing wine, vinegar, salt, and bee products & mining.
- Filipino lived in wood, bamboo, or nipa houses with more colorful clothes, self-made jewelry, and even teeth ornamented with gold

## **SPANISH REGIME**

*These are some of the highlights during this period:*

- Period of birth of modern science and technology in the Philippines.
- Religious orders had great influence.
- They had education and politics.

### **Politics**

- Barangay was headed by Datu (*the lowest level of local government*)
- The tax was imposed and collected
- Compulsory labor services were enforced among the native Filipinos.
- Compulsory sales of local products to the government were implemented,

### **Education**

- Primary education was mainly religious.
- Established with the help of religious orders.
- Higher education is mostly accessible to the elite of the society.
- Higher education was initially offered for the priesthood and clerical positions in the government.

### **Agriculture**

- Exporter of agricultural products
- In 1887, established Manila (show of agriculture) to promote agricultural development in the country.

### **Economy**

- Galleon Trade (Manila to Acapulco during 1565-1813)
- Weaving, embroidery, hat making, cigar, & cigarette making
- Water work system
- Banking system
- Rope making

- Stream tramway, electric lights
- Newspaper

### **Economy**

- Due to a lack of support, Philippine native industries did not survive the foreign imported products.

### **Medicine**

- Mostly used herbal plants
- In 1871, schools of pharmacy and medicine were opened at the University of Sto. Tomas
- Leon Ma. Guerrero is known as the Father of Philippine Pharmacy (The First BS Pharmacy graduate, worked extensively on Phil. Medicine Plants).
- Perform biochemical analyses for public health purposes and specimen examination for clinic and medico-legal cases.

## **AMERICAN REGIME**

- The rapid advancement of science & technology in the Philippines

*Some of the developments were the following:*

- Encouragement and support of the government were seen. Evolved of the extensive public educational system.
- Scholarship grants in science and engineering.
- Organization and establishment of science research agencies.
- Establishment of science-based public services.
- Used English as the medium of instruction.
- Enacted the Private School Act (Act. No. 2076 in 1917)
- In 1901, created the Bureau of Government Laboratories by the Philippine Commission renamed as Bureau of Science.

### **Bureau of Science**

- Served as the primary research institution until the end of World War II.
- 1933, NRCP, established the National Research Council of the Philippine Islands.
- The Philippines remained an exporter to the U.S.A of various crops & raw materials.

Moreover, the following offices were organized in the country and contributed to the development of its scientific researchers:

- a. Bureau of Health
- b. Bureau of Mines
- c. Bureau of Forestry
- d. Bureau of Agriculture
- e. Weather Bureau
- f. Bureau of Coast and Geodetic Survey
- g. Bureau of Plant Industry
- h. Bureau of Animal Industry

## **COMMONWEALTH PERIOD**

*Some of the momentous events were the following:*



- The former Philippine President during this time was Manuel L. Quezon and the Vice-President was Sergio Osmeña.
- Expansion of the public school system.
- Numerous government corporations were formed to perform various functions in the country.
- More Industrial and Scientific research was also performed.
- Foreign trade policies are still controlled by the American government
- In 1941, the Japanese troops came into the country.
- Destruction of various institutions built for the country's science and technological development.
- In 1941 (Dec. 8, 1941), when imperial Japan occupied the Commonwealth of the Philippines.
- From 1941 to 1945 World War II happened.

### **PERIOD SINCE INDEPENDENCE**

*Some of the developments were the following:*

- In 1946, the Philippines regained its Independence
- Continued support for scientific research and development through education.
- Private universities & colleges were established/ recognized since then supervised by the Department of Education and Culture (DEC).
- Birth and increase various science agencies of the government
- Act of 1958 (R.A 2067), created the NSDB (National Science Development Board). Responsible for making science developmental policies and coordinating the activities of various science institutions.
- In 1982, NSDB reorganized becoming NSTA (National Science and Technology Authority)
- In January 1987, NSTA (National Science and Technology Authority) converted to DOST (Department of Science & Technology)

### **Department of Science and Technology (DOST):**

Before named as:

- Institute of Science (1947)
- Institute of science and technology
- National science development board (1982)
- National science and technology authority
- Department of science and technology (1987)

**Now,** DOST (Department of science and technology)

### **Role of the Department of Science and Technology (DOST)**

- Plays a role in pursuing the declared state policy of supporting local scientific and technological efforts.
- Developing local capability for technological self-reliance.

- Encouraging greater private sector participation in national research & development.

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