STS

First Semester | A.Y. 2024-2024

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COURSE OUTLINE

SCIENCE EDUCATION IN THE PHILIPPINES

Concept

- ➔ **TEACHING SCIENCE** involves developing ways on how to effectively teach Science. This means exploring pedagogical theories and models in helping teachers teach scientific concepts and processes.
- ➔ **LEARNING SCIENCE** includes both pedagogy and the most interesting aspect, which is helping students understand and love science.
- ➔ **UNDERSTANDING SCIENCE** implies developing and applying science-process skills and using science literacy in understanding the natural world and activities in everyday life.
- ➔ **SCIENCE EDUCATION** is about equipping students fundamental scientific skills and helping them understand the word around them. This will prepare them to be critical thinkers who can make wise decisions and judgement regarding the applications of scientific knowledge in different fields.
- ➔ **JOHN DEWEY (2001)** He stressed the importance of utilizing the natural environment to teach students. Accordingly, nature must indeed furnish its physical stimuli to provide wealth of meaning through social activities and thinking. It is not surprising therefore that science education is important.
- ➔ **MARX (1994)** opines that science is going to be one of the **most important school subjects in the future.**

AIM

- ➔ **SCIENCE EDUCATION**Science education focuses on teaching, learning, and understanding science. It involves exploring effective teaching methods, students developing a love for science, and application of scientific skills and literacy to understand the natural world and everyday activities. It makes every individuals curious, creative, and have a positive attitude toward scientific inquiry, while preparing students to apply scientific principles to real-world challenges.
- ★ ***Key term*** *- definition*
- ★ ***made by lane!***

IMPORTANCE

- ★ ***Knowledge***
- ★ ***Technology & Development***
- ★ ***Boost Critical Thinking***
- ★ ***Holds the key to the Future***
- ★ ***Growing demand for STEM students***

EARLY MAJOR PROJECT ACTIVITIES

- ➔ **UNESCO** United Nations Educational, Scientific and Cultural Organization
- ➔ **UNICEF** United Nations International, Childrens Emergency Fund
- ➔ **NSB** National Science Board
- ➔ **BSCS** Biological Sciences Curriculum Study
- ➔ **PhilAAST** Philippine Association for the Advancement of Science and Technology

EARLY EFFORTS TO IMPROVE SCIENCE EDUCATION

- ➔ In 1950's scientists in the Philippines recognized the inadequate teaching of science in schools. They initiated efforts to improve education, including making science compulsory in 1957 and establishing the **National Committee for Science Education in 1958**. They also adopted the BSCS curriculum materials and established **Science Teaching Center at UP in 1964.**

PHILIPPINE ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

- ➔ The Philippine Association for the Advancement of Science and Technology (PhilAAST), established in 1952, is a professional organization in the Philippines aimed at promoting science, technology and innovation, fostering scientific knowledge, encouraging research, and contributing to the country's development.
- ➔ In 1957, the Philippine government made the teaching of science compulsory in all elementary and secondary.

NATIONAL COMMITTEE FOR SCIENCE EDUCATION

- ➔ The National Committee for Science Education, established in 1958, aimed to improve science teaching at all levels by enhancing curricula, teacher training, and classroom resources. Its mission was to meet contemporary educational needs, enhance students' scientific literacy, and prepare them for future challenges.
- ➔ In 1957, the Philippines government made the teaching of science compulsory in all elementary and secondary.

AREAS OF IMPROVEMENT

1. Intergration of Science with Classroom Instruction: This involves embedding science concepts within other subjects to create a more interdisciplinary approach, making science more relevant and applicable to students.
2. Acquisition of More Science Equipment and Tools: Schools need sufficient and modern equipment to facilitate hands-on learning experiences in science, which enhancing understanding and engagement.
3. Coordination of Efforts with Other Agencies: Collaborating with various educational and governmental agencies can enhance resource sharing, professional development, and curriculum alignment.
4. Negotiation for a Science Institute for Teachers: Establishing specialized training institutes can provide educators with advanced knowledge and teaching strategies specifically tailored for science education.
5. National Science Talent Search and Fellowship: Programs aimed at identifying and supporting talented students in science can help foster future scientists innovators.
6. Higher Salaries of Science and Mathematics Educators: Competitive salaries can attract and retain qualified teachers in science and mathematics.

CLARK HUBLER

- ➔ Known for his contribution to science education, gained valuable insights during his time as a **Fulbright Fellow** in the Philippines from 1963 to 1964. His experiences allowed him to observe and analyze various aspects of science education, with a particular focus on language barriers as a significant challenge.

THE BIOLOGICAL SCIENCES CURRICULUM STUDY (BSCS) ADAPTATION PROJECT

- ➔ The establishment of a national committee in science education by the Secretary of Education was an initiative aimed at enhancing science teaching at the elementary, secondary, and tertiary levels. The committee's task was to set objectives and recommend improvements in several critical areas of science education, including:

1. SUBJECT MATTER COMPETENCE OF TEACHERS

- ➔ Knowledge and understanding of science subjects that enable effective teaching.

2. CURRICULUM MATERIALS

- ➔ Instructional resources like textbooks and activities that support science education

3. LABORATORY EQUIPMENT AND SCIENCE FACILITIES IN SCHOOLS

- ➔ Tools and spaces needed hands-on experiments, enhancing practical learning.

★ Important Note

- ➔ The survey conducted by the committee created by the National Science and Development Board (NSDB) examined the status of science teaching in the Philippines and in the US. It identified common weaknesses across all levels of science instruction - elementary, secondary, and tertiary. The key findings highlighted the following issues:
    1. Adequate equipment and facilities in the laboratories.
    2. Up-to-date and adequate text, publications and reference materials.
    3. Qualified and imaginative teachers.
    4. Provision for systematic upgrading of teachers.
    5. In 1957, the Philippines government made the teaching of science compulsory in all elementary and secondary.
- ➔ In 1960's, a group of biological educators at the University of the Philippines collaborated to adapt the Biological Science Curriculum study (BSCS) Green Version, aiming to

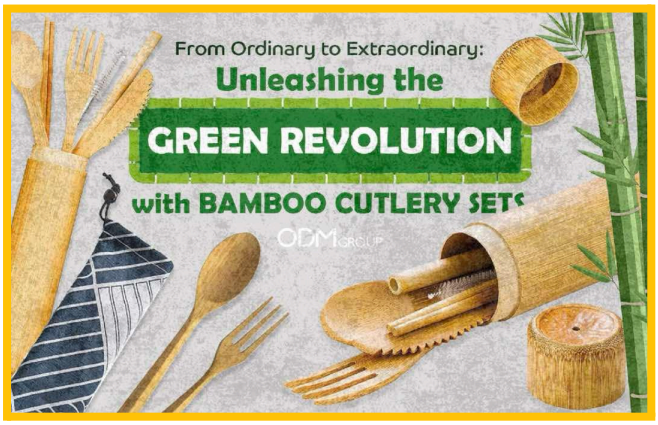
introduce students to the living world and provide them with necessary biological information.

➔ **1962 -** Adaptation on green version laboratory manual.
- BSCS donated 1,600 copies of the BSCS green version textbook, experimental edition.
- Green version laboratory manual was tried out in ten public highschools for a full school year

1962 – ADAPTATION ON GREEN VERSION LABORATORY/MANUAL

➔ Science laboratory manual that emphasizes environmentally friendly practices and reduces waste.

➔ This can include factors like:
1. **Reduced waste:** using fewer resources or minimixing waste production.
2. **Energy Efficiency**: using less energy to operate.
3. **Sustainable materials:** using materials that are sourced responsibly or can be recycled.
4. **Reduced pollution:** producing less pollution or emissions.



THE BSCS ADAPTATION

➔ Collaborative effort to develop a new science curriculum. It involved a team of experts, including:
1. **Writer-specialists:** These individuals were subject matter experts in biology who helped create the content and structure of the curriculum.
2. **Classroom Teachers**: Teachers who provided insights into the needs and experiences of students, ensuring that the curriculum was relevant and practical for classroom use;
3. **Administrators:** School administrators who helped guide the project and ensure that the curriculum aligned with educational goals and policies.
4. **Illustrators and biology educators:** These individuals worked together to create engaging and informative visuals to support the curriculum content.

ESTABLISHING THE SCIENCE EDUCATION CENTER

➔ **Dr. Carlos P. Romulo:** Submitted to the Ford Foundation a request grant for operational and staffing costs of the Science Teaching Center, for one foreign advisor for a 2-year science consultant, for advance training of teachers and supervisors for books.

➔ **Harry Case:** Head of the Ford Foundation, recognised the Philippines educational leaders for the remarkable degree cooperation in the establishment of the Science Teaching Center at the University of the Philippines.

SUMMER INSTITUTES

➔ In the Philippines, are intensive short-term programs that offer specialized training and professional development opportunities, typically held during the summer months. These programs are designed for teachers, educators, or professionals in various fields, to enhance their skills, knowledge, and expertise.

OTHER NATIONAL ACTIVITIES

➔ **Philippine Association of Science Teachers (PAST):** organization that represents science teachers.

➔ **The Science Education Project (SEP):** program aimed at improving science education in the Philippines.

➔ **Masters of Arts in Teaching (MAT):** postgraduate degree program to enhance a teaching skills and knowledge.

THE FIVE REGIONAL SCIENCE TEACHING CENTER (RCTS's)

➔ **Notre Dame Univeristy in Marbel, Cotabato**

➔ **Ateneo de Davao College in Davao del Sur**

➔ **Silliman Univeristy in Dumaguete**

➔ **St. Louis Univeristy in Baguio City**

➔ **Aquinas University or Univeristy of Santo Tomas in Legazpi City**

SCIENCE EDUCATION IN BASIC AND TERTIARY EDUCATION

BASIC EDUCATION

- **Curriculum Breadth:** In basic education, science curriculum covers a broad range of topics including physical, life, earth, and space sciences. The aim is to provide a foundational understanding of various scientific principles.
- **Teaching Methods:** Teaching methods often include hands-on activities, experiments, and demonstrations to engage students to make learning interactive.
- **Assessments:** Assessments are typically more frequent and varies, including quizzes, tests, projects, and lab reports.
- **Objectives:** The primary goal is to develop basic scientific literacy and critical thinking skills. Curriculum Breadth: In basic education, science curriculum covers a broad range of topics including physical, life, earth, and space sciences. The aim is to provide a foundational understanding of various scientific principles.

TERTIARY EDUCATION

- **Specialization:** At tertiary levels, students often specialize in a specific field of science such as biology, chemistry, physics, or engineering. The curriculum is more focused and in-depth.
- **Teaching Methods:** Instruction includes lectures, seminars, lab work, and field studies. There is a greater emphasis on independent research and critical analysis.
- **Assessments:** Assessments are less frequent but more comprehensive, often including major exams, research papers, and practical projects.
- **Objectives:** The goal is to prepare students for professional careers or advanced studies in their chosen field.

SCIENCE HIGH SCHOOLS IN THE PHILIPPINES

1. **Philippine Science High School (PSHS) System:** The Philippine Science High School (PSHS) is a research-oriented and specialized public high school system in the Philippines that operates as an attached agency of the Philippine Department of Science and Technology. PSHS is considered as the top science high school in the Philippines and is viewed to be among the best in the ASEAN region on 2016.
2. **Special Science Elementary Schools (SSES)** A Special Science Elementary School (SSES) is a type of public elementary school in the Philippines that offers an enriched curriculum focused on science and mathematics. The program was launched by the Department of Education (DepEd) in 2007 to nurture gifted and talented students by providing them with advanced learning opportunities in these subjects.
3. **Quezon City Regional Science High School:** Quezon City Science High School (also referred as QueSci or Kisay) is the Regional Science High School for the National Capital Region. It is the premier science high school of Quezon City and is regarded as among the prestigious science triumvirate of the Republic of the Philippines. It is founded on September 17, 1967 and was appointed as the Regional Science High School for the National Capital Region since 1998.
4. **Manila Science High School (MSHS):** Manila Science High School, colloquially known as MaSci, is a public science high school in the Philippines. It was established on October 1, 1963, and is the first science high school in the Philippines.
5. **Central Visayan Institute Foundation:** The Central Visayan Institute Foundation (CVIF) in Jagna, Bohol is home to the Dynamic Learning Program, a synthesis of classical and modern pedagogical theories adapted to foster the highest level of learning, creativity, and productivity.

6. **Rizal National Science High School:** The Rizal National Science High School, also known as RNSHS is a public science high school. It was established in 1998 to provide an advanced secondary education program with a strong emphasis on science and technology.
7. **Antipolo City National Science and Technology High School:** Antipolo City National Science and Technology High School (ACNSTHS), is a public science and technology high school located in Sitio Cabading, Barangay San Jose, Antipolo City, Philippines ACNSTHS aims to provide high-quality education with a strong emphasis on science and technology, preparing students for future careers in these fields.

LIFELONG LEARNING SKILLS

- ➔ Creativity
- ➔ Problem-Solving Skills
- ➔ Critical Thinking Skills
- ➔ Leadership
- ➔ Communication
- ➔ Cooperation
- ➔ Information Management
- ➔ Adaptability
- ➔ Curiosity
- ➔ Reflection

LIFELONG LEARNING SKILLS

- ➔ **Science education** deals with the teaching and learning of science and in helping the public develop science literacy.
- ➔ This is important in the promotion and development of science and technology in the country.
- ➔ Science education deals with the development of people in science, which is the heart of science, technology and society.

THE HUMAN PERSON's FLOURISHING IN TERMS OF SCIENCE, TECHNOLOGY AND SOCIETY

FLOURISHING

➔ goes beyond mere happiness; it involves living a meaningful life, achieving personal goals, and experiencing positive relationships.

HUMAN-FLOURISHING

➔ refers to the realization of an individual's potential, well-being, and overall fulfillment in life.
- It encompasses emotional, social, intellectual, and physical well-being.

ACCORDING TO PLATO

➔ All human beings naturally desire eudaimonia or human flourishing.
- He believed that to flourish, one must have moral thoughts and virtuous actions.

ACCORDING TO PLATO, A HUMAN CAN DEVELOP VIRTUE BY:

1. **Examining things and thinking more:** Plato emphasizes the importance of reflection and reasoning. He believed wisdom comes from thinking deeply, and without wisdom, humans cannot flourish.
2. **Masterly using reason:** When we limit our reasoning, negative consequences can arise. By mastering reason, we can control ourselves, act for the common good, and flourish.
3. **Living by the four cardinal virtues:** Plato's virtues — wisdom, courage, moderation, and justice—lead to a harmonious and fulfilling life. Living by these virtues promotes human flourishing.

THE HUMAN PERSON FLOURISHING IN TERMS OF SCIENCE AND TECHNOLOGY

Technology's role in human flourishing

➔ Technology has always been defined as a "means to an end" and "being a human activity."
- as a means to an end underscores its role in addressing human needs such as inventions that made human life easier and convenient
- recognizing it as a human activity emphasizes our creative and ethical responsibilities.

For Plato and Aristotle, they called flourishing life

EUDAIMONIA

➔ which is equated with happiness.
- happiness results from Eudaimonia or (another term of) Human Flourishing.

Eudaimonia or Human Flourishing = Happiness

HAPPINESS

➔ In **psychology**, happiness is a mental or emotional state of well-being

➔ To **behaviorists**, happiness are emotions we experience when we do something good or positive.

➔ To **neurologists,** happiness is the experience of a flood of hormones released in the brain as a reward for behavior.

➔ The **hedonistic view** of well-being is that happiness is the polar opposite of suffering, the presence of happiness indicates the absence of pain.

➔ The **eudaimonia view** defines happiness by challenging themselves intellectually or by engaging in activities that make them spiritually richer people.

EUDAIMONIA

- ➔ Greek word that can be rendered as **"happiness," "well-being,"** or **"flourishing."**
    - combines the Greek words for **"good"** and **"spirit"** to describe the ideology. Eudaimonia defines happiness as the pursuit of becoming a better person.
- ➔ In Aristotle's ethics, eudaimonia refers to a state of living well, reaching one's potential, and achieving flourishing. It is frequently related with the concept of leading a virtuous life and reaching personal greatness.

ARISTOTLE

- ➔ was born 304 B.C.
- ➔ philosophy scientist
- ➔ contributed so much to the science, technology, political theory, and aesthetics world; followed that knowledge of the world begins by looking and examining that which exists.
- ➔ proposed that we should build good character in order for our souls to flourish, a state that goes beyond superficial bliss.
- ➔ The concept of Aristotelian virtue ethics is based on the assumption that all men have the capacity for virtue and character excellence. **"good spirited"** you are going to be a good person

PRINCIPLES OF HUMAN FLOURISHING

- ➔ **Dignity of the Human Person** - it demands respect for all people regardless of their social class, wealth, etc.
- ➔ **Common Good** - sacrificing self-interest to provide for the basic human needs of everyone so that the whole community will flourish.
- ➔ **Preferential Option for the poor** - when a decisions are made by first considering the poor.
- ➔ **Subsidiarity** - when all those affected by a decision are involved in making it.
- ➔ **Universal Purpose of Goods** - the earth's resources serve every person's needs, regardless of who 'owns' them.
- ➔ **Promotion of peace** - everyone has the duty to respect and collaborate in personal relationships, and at national and global levels.
- ➔ **Participation** - everyone has the right and the duty to take part in the life of a society.
- ➔ **Global Solidarity** - recognition that we are all interconnected.

DIFFERENT CONCEPTIONS OF HUMAN FLOURISHING

HUMAN FLOURISHING IN CHRISTIAN PERSPECTIVE

- ➔ **St. Augustine of Hippo and St. Thomas Aquinas** proposed that eudaimonia or human flourishing requires one to have knowledge of God.
- ➔ **John Locke,** who derived fundamental principles of his philosophy from the Bible, stressed that happiness is pursued through prudence.
- ★ ***"Prudence"*** *means maalam o maingat in terms to thought of the future.*

OLD TESTAMENT

- ➔ The concept of human flourishing in the Old Testament is best described by the word **"shalom"**, which, according to theologians, means peace, harmony, and completeness. It is a sense of wholeness involving an individual's relationship with God and His creations.

NEW TESTAMENT

- ➔ The concept of human flourishing is captured in the Bible's New Testament through the Beatitudes. These are the eight blessings preached by Jesus to his followers in Matthew 5:1-12. Each beatitude begins with the Greek word

makarios (plural makarioi) meaning **"blessed" or "happy."**

- ➔ The word beatitude comes from the Latin word beautus meaning **“blissful”, “happy”, “fortunate”, and “flourishing”**. From Matthew 5:1-12, it says here “In these verses, Jesus identified attributes that He and His Father possess that lead to true happiness in this life and in the life to come.”
- ➔ In classical Greek, makar from makarios refers to the state of living a life of happiness without struggles and difficulties. Makarios is commonly used as a synonym for eudaimonia because both connote happiness, peace of mind, joy, and the good life.
- ➔ According to the Bible, Jesus preached that human flourishing can be achieved by placing God at the center of one's life.
- ➔ Scot McKnight highlighted in his discussion of the Beatitudes that "the entire philosophy of 'the good life' and the late-modern theory of 'happiness' are at work when [Jesus] says, 'Blessed are...' (2013)"

SOCIO PSYCHOLOGICAL PERSPECTIVE

- ➔ Science and technology clearly affect the human experience and human understanding of happiness. Advancements in science and technology, having made life easier, greatly influence the way people view what a good life is.
- ➔ According to Carol Ryff (1995), a psychology professor, studied different models and theories of happiness in different subfields of psychology. She
    1. **Personal growth** this includes (learning new skills, embracing changes, overcoming challenges) which all leads to oneself betterment.
    2. **Self-acceptance,** it's about acknowledging who you are, our laws and all, and choosing to accept yourself unconditionally.
    3. **Autonomy** refers to the ability to make independent decisions and act freely, without undue influence or control from others. Ika nga nila “Just Do you”, do what your gut tells you or what makes you happy without depending on what other will think about you.
    4. **Environmental mastery** refers to a person's ability to understand, appreciate, and interact effectively with their environment.
    5. **Positive relationship** simply means a connection between two or more people in positive mutual respect and understanding.
    6. **Purpose in life**, this for sure we all know what is the meaning of “purpose in life”. Can anyone explain the meaning of this?
- ➔ Anthony Bradley (2013), a professor at the King's College in New York, echoed Ryff's idea in his article "The New Legalism" where he wrote:
- ➔ “An emphasis on human flourishing, ours and others', becomes important because it is characterized by a holistic concern for the spiritual, moral, physical, economic, material, political, psychological, and social context necessary for human beings to live according to their design.”

CONSEQUENCES OF HUMAN FLOURISHING

- ➔ In order to come up with technological innovations, humanity has taken control of the environment to take advantage of its natural resources. Modernization advances science, technology, and the human future at the cost of nature's degradation.
    - According to Gerd Leonhard, there would be **"an avalanche of technological changes that could reshape the very essence of humanity and every aspect of life on our planet (2016, i)."**
- ➔ Scientists like Stephen Hawking, Stuart Russell, Max Tegmark, and Frank Wilezek

published an open letter in The Independent in May 2014 stating that the emergence of artificial intelligence poses a great danger to humanity. They pointed out the possibility that such technology can outsmart humans in termsof business and research, manipulate human leaders, and develop dangerous and highly advanced weapons.

➔ For that reason, AI's have the potential to outsmart human in terms of:
- Business and Research: Data analysis, automation, and innovation.
- Manipulation: Psychological profiling
- Weapons: Autonomous weapons, bioweapons, and cyberweapons.

➔ While AI offers significant benefits, it also presents significant risks that must be carefully managed.

➔ The impact of rapidly developing technologies such as artificial intelligence goes beyond the present condition. It affects not only humans but also the environment.

INFORMATION AGE

INTRODUCTION

- ➔ The attempt of humans to address the three limitations of communication or exchange of information led to new technologies.
- ➔ These technologies affected the social, political and economic role of information leading to the so-called **Information Revolutions.**
- ➔ The start of the information revolution was made possible by the invention of **language**, **writing** and **printing**.

HISTORY OF INFORMATION AGE

- ➔ The invention of **language, writing and printing** greatly improved how human exchange information and communicate.
- ➔ From these, early and primitive forms of information and communication technology were developed.
- ➔ The following were ways of exchanging information in the past: drum rolls, fire signals, hand signals, use of pigeons, use of flags and papyrus. Many of them are still in use today. However, they remain to have limitations.

FIRST INFORMATION REVOLUTION

- ➔ Information Revolutions aimed to address the limitations of communication. The **first Information Revolution** began in the **mid-nineteenth century** with the invention of the telegraph, telephone and radio. It lasted until the 1950s.
- ➔ American inventor **Samuel Morse** was credited for developing the first operational model of the **telegraph**. His prototype was patented in 1940, but was first used in 1945.
- ➔ The use of the telegraph became widespread in America and then in Europe. It increased the connection between people separated by great distances.
- ➔ The telegraph played an important role during the **American Civil War**. It was used by the US Government to communicate military information, command, and intelligence reports to its troops.
- ➔ **Telegraphs** were also used by diplomatic offices in Europe to communicate with other countries. This enabled easier communication and linkage among countries.
- ➔ After the invention of the telegraph, the **telephone** was invented. The first telephonic device was developed by **Johann Philip Reis**. However, **Alexander Graham Bell** was credited for the invention of the telephone in 1876. Unlike telegraphs, telephones can send sound waves.
- ➔ After its invention, the telephone became very popular in the US and eventually, in Europe. Networks of telephone communication were established. It impacted businesses, military, foreign affairs and many other human activities.
- ➔ The **radio** is another important technology of the First Information Revolution. It was **Guglielmo Marconi** who invented and patented the first radio. However, his radio can only send Morse codes. It was **Reginald Fessenden** who discovered how to send voice and music through the radio.
- ➔ **Radio networks and stations** were eventually established in the US and in Europe. Radios were used by the military during the World Wars. After the wars, the radio played a key part in the development of the broadcasting (news) and the music industries.

SECOND INFORMATION REVOLUTION

- ➔ The **Second Information Revolution** began in the **1950s until the 1980s.**

- ➔ The Second Information Revolution further improved communication due to the invention of the **television, early generation computers, and satellites.** This revolution made the "world smaller".
- ➔ The **television** was actually developed in the 1920s based on the work of 3 inventors.
- ➔ **Farnsworth** invented the **process of image scanning. Zworykin** invented the **iconoscope tube** and the **kinescope television tube. Dumont** invented the **receiver picture tube.**
- ➔ However, the television's immense improvement and wide use happened after World War II. Until now, televisions are ubiquitous and have significant global impact.
- ➔ The development of the early **computers were due to the needs of the military. John Vincent Atanasoff** was credited for developing the first electronic digital computer in 1939. **Alan Turing** developed the **first working digital computer,** the '**Collossus**'. It was used during World War II to decode Nazi war codes.
- ➔ In 1946, **J. Presper Eckert** and **John Mauchly** developed **ENIAC** or **Electronic Numerical Integrator And Calculator**. The problem with ENIAC and other first-generation computers was that they used vacuum tubes which generated a lot of heat causing overheating or burning out.
- ➔ The problem on overheating led to the development of **transistors by William Shockley, Walter Brattain, and John Bardeen.** The use of transistors are the basis for the second-generation computers. The **second-generation computers** were smaller, faster and more reliable.
- ➔ The invention of **integrated circuits** led to the development of the **third-generation computers.**
- ➔ The development of the early computers is significant as it demonstrated the synergy from the collaboration among the government, the military and the industry in doing innovation.
- ➔ Early computers made it easier to manipulate, transmit, process, and store data. It helped in linking people, industries and governments together.
- ➔ Early computers were replaced by modern, more advanced models. To-date, the impact of computers to society continues to be remarkable.
- ➔ In order to transmit telephone and television signals in a global scale, **satellites** were developed. Satellites enabled global communication.
- ➔ **Sputnik 1** was the first artificial satellite. It was developed by then Soviet Union and was launched in 1957. This marked the beginning of the so-called **Space Age**. In the US, the military launched its first satellite, the **SCORE** or **Signal Communications by Orbiting Relay Equipment**, in 1958.
- ➔ The development of satellites were initially done by the military for military purposes. Eventually satellites were developed by civilians for non-military use.
- ➔ **Syncom III** was the first civilian telecommunications satellite. It was launched into orbit in 1964. It was developed by NASA and was used to broadcast the 1964 Summer Olympics.
- ➔ **Intelsat I** or the '**Early Bird**' was the first commercial communications satellite. It was launched in 1965 and was developed by Hughes Aircraft Company (now Boeing Satellite Systems).
- ➔ Later on, satellite technologies were further improved and developed. This enabled global communications, and the rise of television networks, and telecommunications companies.
- ➔ Satellites allowed governments and companies to send information with privacy, reliability and timeliness.

THIRD INFORMATION REVOLUTION

- ➔ The technologies of the first two Information Revolutions paved the way for more technologies and innovations which led to the **Third Information Revolution.**
- ➔ The main technologies of the Third Information Revolution are:
  - advanced semiconductors
  - advanced computers
  - fiber optics
  - cellular technology
  - satellite technology
  - advanced networking
  - improved human-computer interaction
  - digital transmission and digital compression.
- ➔ **Semiconductors** are the most significant technology that significantly increased the ability of storing, processing, and transmitting information.
- ➔ Because of semiconductors, memory storage increased dramatically from **10,000 bits of information in 1978** to **160 trillion bits of information in 2017.**
- ➔ Microprocessors were also rapidly developed. In the 1980s, a microprocessor contained around 10,000 transistors. In 2018, microprocessors with 6.9 billion transistors were developed.
- ➔ The **fourth generation computers** were made possible by the development of **computer chips** that have hundreds of thousands of components.
- ➔ The **fifth generation computers** used multiple processing units allowing the simultaneous processing of data. Supercomputers were part of the fifth generation. Advanced computers allowed easier and faster transmission of voices, photos, digital data and other forms of information. Processing and storage of data were made better and more efficient.
- ➔ Cable television, telephone and telegraph use **copper wires** or **coaxial cables**. The problem with copper wires is that they are prone to attenuation and leakage. Also, copper wires and coaxial cables have limitations on the data that they can handle.
- ➔ The invention of **fiber optics** addressed these problems. Fiber optics are extremely thin glass fibers that can carry information from one source to another.
- ➔ It is faster in terms of transmission of information. **Copper wires** can transmit **hundreds of thousands of bits of information** while **fiber optics** can transmit **billions of bits of information.**
- ➔ Transmitters and receivers are usually large, heavy and difficult to carry or move. The development of **cellular technology** solved the problem. Cellular technologies led to the development of cellular phones which made communication easier among individuals.
- ➔ **Cellular phones** can also store and process data. Its widespread use started in the 1970s.
- ➔ Today, cellular phones are not only being used for communication but also for other purposes such as photography, music, videos, navigation, and eLearning among others.
- ➔ **Satellite technologies** helped build the global communication infrastructure. They are being used for telephone, television, radio and even weather and climate equipment.
- ➔ This Photo by Unknown Author is licensed under CC BY-SA
- ➔ Satellites enabled the global broadcast of events, shows, international teleconferencing, international phone calls and other forms of global connectivity.
- ➔ **Networking or advanced networks** enhanced the connectivity and communication worldwide. The largest form of advanced network is the **INTERNET**. The use of the Internet is so widespread, more than half of the world's population is using it. There are at least 1.6 billion websites worldwide.

- ➔ The **Internet** made possible the development of social media, online libraries, electronic mail, video calls, e-learning and e-commerce.
- ➔ Today, the goal is to develop a fully integrated, high-speed, high-capacity network.
- ➔ Initially, one key challenge in the use of computers is the lack of "**good human-computer interaction**". Previous models of computers were not user-friendly; they were complex to operate.
- ➔ Today, with advancement in technologies and industrial design, major progress were made in terms of human-computer interaction.
- ➔ The increase in the **data processing capacity** of computers led to the simplification of user interphase.
- ➔ Today, computers are easy to use and also have become more affordable. This allowed the democratization of access to computers and even to other gadgets that use similar technologies.
- ➔ In order to further improve communication, **digital transmission** was developed. It used digital signals instead of analog signals. **Digital signals** are more efficient and effective. The use of digital signals allowed the development of **digital compression** or the **lowering of the size of data or information.**
- ➔ Digital compression allowed more data storage, which resulted to easier and faster data transmission.
- ➔ Digital technologies are so ubiquitous nowadays. They are widely used and relevant in almost all aspects of human life.

THE THIRD INFORMATION REVOLUTION RESULTED TO THE FOLLOWING:

- ➔ increase in the speed of information transmission
- ➔ greater capacity to transmit information
- ➔ more flexibility in the flow of information greater access to information by the people, institutions and businesses
- ➔ heightened demand for more new technologies or improvements in the current ones

IMPACT OF INFORMATION REVOLUTION

- ➔ The Information Age has the following positive impacts:
  1. **It enabled greater connectivity of people around the world.** Citizens in Japan or in Spain would know what is happening in Argentina or Australia. Overseas Filipino Workers in the Middle East can talk to their families in the Philippines because of online video calls.
  2. **It made many aspects of day to day life more convenient.** In getting government documents, online portals can now be used. Shopping can now be done online. Job applications can be done online. Online education is now also possible.
  3. **It created online communities.** Information technologies made possible the creation of online communities. People with common interests such as hobbies, expertise, and advocacies can now communicate, share ideas, and "meet" online.
  4. **It made information more accessible.** Almost all information can be accessed through the Internet. Never in human history has so much information become so accessible at so much speed. However, it is important to validate the source of information and to critically analyze the information.

- ➔ The Information Age also has the the following downsides:
    1. **Many information are false and misleading.** Sharing and access to information in the Internet is difficult to regulate. This leads to proliferation of false information like 'fake news'. This can result to many serious negative social, political and economic implications.
    2. **It allowed the conduct of crimes and illegal activities.** Information technologies were also used for crimes and illegal activities. Online sharing of dirty and pornographic materials, illegal trading, phishing, hacking and identity theft in social media, and cyber bullying became possible.
    3. **It created a 'Digital Divide'.** Divide refers to the non-physical boundary between those who have access and are literate on information technologies versus those who are not. Those who have access can take advantage of the benefits of the information age, while those who don't have access are further deprived of opportunities.
    4. **It affected human's productivity and flourishing.** Many human skills are being replaced by information technology, hence workers face the constant threat of losing jobs. On one hand, many individuals are also addicted to online media, online games, and other online activities that take away time from having real human interactions.

NANOTECHNOLOGY

- Nano- Derived from the Greek word **“nános”** which means **“dwarf”**. When it comes to unit of measure, it is equivalent to one billionth of a meter or 0.000000001 meter or 10^-9.
- Technology- Derived from the Greek word **“Techne”** which means **“craft” or “skill”** and the “-logy” suffix which means “the study of” or “the science of”.
- The manipulation of materials on an atomic or molecular scale especially to build microscopic devices (such as robots)
- Nanotechnology refers to the science, engineering, and application of materials and devices on a nanometer scale, typically 1 to 100 nanometers.
- Silver nano platform for using silver-nanoparticles as an antibacterial agent, nanoparticle-based transparent sunscreens, and carbon nanotubes for stain-resistant Textiles.
- Nanotechnology is the science of creating, engineering, and construction of an object at a nanometer (nm) scale.

HISTORY OF NANOTECHNOLOGY

- The first concept ever was made by an American physicist **Richard Feynman** in 1959.
- The term **“Nanotechnology”** was coined by a Japanese scientist **Norio Taniguchi** in 1974.
- In 1981, **Gerd Binnig and Heinrich Rohrer** were awarded the 1986 Nobel prize for developing the **first working Scanning Tunneling Microscope (STM).** This device is used to control and see an object at a nanometer scale.

HOW DOES STM WORK?

- STM works by scanning a conductive sharp metal tip very close to the surface of the sample. When the tip is close enough to the sample, a voltage is then applied to the tip and the sample. By doing this, we can make a high-resolution image at the size of an atom.

TOOLS AND TECHNIQUES

- Microscopes
  - It is a scientific instrument used to view
  - objects that are too small to be seen with
  - the naked eye. It uses lenses to magnify
  - the object, making it appear larger.
- Types of Microscope
  - Scanning Electron Microscope (SEM)
  - Transmission electron microscope (TEM)
  - scanning tunnelling microscope (STM)
  - Atomic force microscope (AFM)

MECHANISM

- **SEM:** Scans a focused electron beam across the surface of the sample, detecting secondary and backscattered electrons.
- **TEM:** Directs a beam of electrons through a very thin sample, detecting the transmitted electrons.
- **STM:** Tunneling current flows between the probe and the surface.
- **AFM:** Mechanical probe interacts with the surface atoms.

WHY IS IT IMPORTANT?

- Microscopes have played a vital role in shaping our understanding of the world and have led to countless advancements in various fields. Microscopes are indispensable tools for nanotechnology research and development, providing

essential information about the properties, structure, and interactions of nanomaterials.

APPROACHES

BOTTOM-UP APPROACH

➔ Different materials and devices are constructed from molecular components of their own. They chemically assemble themselves by recognizing the molecules of their own breed.

TOP-UP APPROACH

➔ Nano objects and materials are created by larger entities without bouncing its atomic reactions usually top-down approach is practiced less as compared to the bottom-up approach.

KEY ASPECTS OF NANOTECHNOLOGY

➔ **Materials science:** Creating new materials or enhancing existing ones by manipulating atoms and molecules.
➔ **Nanodevices:** Building devices with applications in medicine, electronics, and environmental science that operate at the nanoscale.
➔ **Applications:** 1st Medicine, 2nd Electronics, 3rd Energy

EXAMPLE OF NANOTECHNOLOGY

➔ Nanotechnology continues to evolve with applications in various sectors, from electronics to medicine, with future possibilities like nanobots and molecular manufacturing still under exploration.
➔ Nanotechnology today has revolutionized multiple industries, from medicine to electronics, materials science, and energy. Here are some notable examples of nanotechnology applications currently in use:

1. Medicine and Healthcare
2. Electronics
3. Energy
4. Environmental Applications
5. Textiles and Clothing
6. Cosmetics
7. Food and Agriculture

➔ Nanotechnology continues to advance across various sectors, offering new capabilities and efficiency, with further potential to transform industries in the coming years.