1. **What is Biotechnology?**

Biotechnology, from the word itself, is the combination of “bio” which means life, and “technology” referring to the application of science for a certain purpose. This means it is the application of science to manipulate living organisms or systems for human use, with a focus on improving human health and society. It has existed since the beginning of civilization with the domestication of plants and animals and, encompasses the use of living cells to develop new products and methods.

1. **Describe Biotechnology**

Biotechnological innovations are already part of our daily lives and we find them in pharmacies and supermarkets, among many other places. Biotechnology will therefore play a crucial role in the society of the future in preventing and containing potential pathogens. But this is just one of its many applications.  
  
Today, the five branches into which modern biotechnology is divided — human, environmental, industrial, animal and plant — it help us fight hunger and disease, produce more safely, cleanly and efficiently, reduce our ecological footprint and save energy.

1. **History of Biotechnology.**  
     
   Biotechnology began at least 6,000 years ago with the agricultural revolution. This early era was characterized by exploiting living organisms in their natural forms or modifying their genetic makeup through selective breeding.  
     
   Around the same time, humans learned to harness the biological process of fermentation to produce bread, alcohol and cheese.  
     
   Selective breeding works by breeding parents with desirable characteristics to express or eliminate certain genetic characteristics in their offspring. Over time, species that are selectively bred evolve to be different from their wild ancestors.  
     
   Biotechnology remained limited to these slow, agricultural methods until the 19th century when biologist **Gregor Mendel** discovered the basic principles of heredity and genetics.

Also, during that era, scientists **Louis Pasteur** and **Joseph Lister** discovered the microbial processes of fermentation.

Here are some of the following discoveries and advancement over the last 100 years or so:

**1919** - Hungarian scientist Karl Ereky coins the term biotechnology.  
  
**1928** - Scottish bacteriologist Alexander Fleming discovers penicillin, the first true antibiotic  
**1943** - Canadian scientist Oswald Theordore Avery proves DNA carries genetic information.  
  
**1953** - Biologists James Watson and Francis Crick discover the double helix structure of DNA.

**1960s** - Insulin is synthesized to fight diabetes, and vaccines for measles, mumps and rubella are developed.

**1969** - The first synthesis of an enzyme in vitro, or outside the body, is conducted.

**1973** - Herbert Boyer and Stanley Cohen develop genetic engineering with the first insertion of DNA from one bacteria into another.

**1980s** - The first biotech drugs to treat cancer are developed.

**1990** - The United States Supreme Court rules that a "live human-made microorganism is patentable subject matter," meaning GMOs can be intellectual property.

**1982** - A biotech-developed form of insulin becomes the first genetically engineered product approved by the U.S. Food and Drug Administration (FDA).

**1983** - The first genetically modified plant is introduced.

**1990** - The United States Supreme Court rules that a "live human-made microorganism is patentable subject matter," meaning GMOs can be intellectual property.

**1993** - GMOs are introduced into agriculture with the FDA approval of growth hormones that produce more milk in cows.

**1997** - Scientists introduce the world to Dolly the sheep, the first mammal is cloned.

**1998** - The first draft of the Human Genome Project is created, giving scientists access to over 30,000 human genes and facilitating research on treatment of diseases such as cancer and Alzheimer's.

**2010** - A group of researchers from the J. Craig Ventere Institute creates the first synthetic cell

**2013** - The first bionic eye is created.

**2020** - MRNA vaccine and monoclonal antibody technology is used to treat the SARS-CoV-2 virus.

1. **Describe some of the application areas of Biotechnology**

The use and commercialization of modern biotechnology often fall into four main fields: environment, medicine, industry and agriculture.

**Environment**  
The aim of environmental biotechnology is to develop sustainable environmental practices that reduce pollution and waste. The following are examples of environmental biotech:

* Phytoremediation uses genetically engineered microorganisms to purify soils of heavy metals and other pollutants.
* Bioremediation introduces microorganisms into waste sites in order to organically break down non - recyclable waste.
* Plastic-eating bacteria breaks down waste such as plastic in soils and water.
* GMO foods stay fresher longer and reduce food waste.
* Genetic restoration attempts to restore endangered species such as the American chestnut tree.
* Cover-crops such as corn are used as biofuels, replacing traditional fuel sources that produce greenhouse gas emissions when extracted and used.

**Medicine**Medical biotechnology, also known as biopharma, aims to fight and prevent disease and improve healthcare. Biotechnology and biomedical research are the basis of the modern pharmaceutical industry. Uses include the following:

* stem cell research that helps replace or repair dead or defective cells;
* antibiotics development;
* gene therapies for diseases such as leukemia;
* research into dangerous pathogens and the antibodies that fight them;
* 3D printing or growing of organs and bones in labs;

**Industry**  
Industrial biotechnology involves using microorganisms to produce industrial goods. Examples include the following:

* fermentation and the use of enzymes and microbes to streamline chemical manufacturing and reduce operational costs and chemical emissions;
* biofuels that use renewable crops such as corn to produce combustible fuel instead of natural, nonrenewable fossil fuel resources, such as petroleum and oil;
* biodegradable garments and textiles made from the proteins of living organisms, such as the silk proteins of spiders.

**Agriculture**  
Agricultural biotechnology genetically engineers plants and animals to produce more efficient agriculture, increase nutritional value and reduce food insecurity. Some examples of agricultural biotechnology are the following:

* biologically produced pesticides and herbicides that are less harmful to humans than chemical ones;
* drought-resistant crops;
* minimal space-resilient crops;
* meat grown in labs or using 3D printers;
* gluten-free grains friendly to sufferers of celiac;
* selective breeding that produces healthier, bigger livestock and crops;
* nutrient supplementation that infuses food with added nutrients to improve diets and medical treatments.

1. **Explain how Biotechnology works in different focus area**

Like the stripes of the rainbow, the different biotechnology applications are grouped generally into seven colors or research and development areas. In this section, we highlight the most relevant of each of them.

Types of Biotechnology:

* Red biotechnology. This is the health branch and responsible, according to the Biotechnology Innovation Organization (BIO), for the development of more than 250 vaccines and medications such as antibiotics, regenerative therapies and the production of artificial organs.
* Green biotechnology. It is used by more than 13 million farmers worldwide to fight pests and nourish crops and strengthen them against microorganisms and extreme weather events, such as droughts and frosts.
* White biotechnology. The industrial branch works to improve manufacturing processes, the development of biofuels and other technologies to make industry more efficient and sustainable.
* Yellow biotechnology. This branch is focused on food production and, for example, it carries out research to reduce the levels of saturated fats in cooking oils. Its main function is to genetically improve products so that there is a higher quantity or quality of food
* Blue biotechnology. This exploits marine resources to obtain aquaculture, cosmetics and health care products. At the environmental level, the aim is to preserve marine species and ecosystems. In addition, it is the branch most widely used to obtain biofuels from certain microalgae.
* Grey biotechnology. Its purpose is the conservation and restoration of contaminated natural ecosystems through, as mentioned above, bioremediation processes.
* Gold biotechnology. Also known as bioinformatics it is responsible for obtaining, storing, analyzing and separating biological information, especially that related to DNA and amino acid sequences.

1. **Is there Biotechnology in the Philippines?**

<https://ovcre.uplb.edu.ph/press/features/item/108-biotech-36-and-beyon> (para sa history ng biotech sa pelepens)

1. **Pros and Cons of Biotechnology**The benefits of biotechnology are tangible, but at the same time some warn of its possible adverse effects on the environment, health and ethics. The advantages of BIO are as follows:

* Creating healthier, stronger and more-sustainable food products that boost nutrition and combat food insecurity.
* Designing medicine to boost the health and longevity of people, animals and plants.
* Cutting costs of farm supplies such as pesticides, while increasing crop yields and profits.
* reducing pollution and waste to reverse catastrophic climate change and environmental damage.
* treating diseases in children before they are born by altering their genomes.

Biotechnology also comes with disadvantages and misuse. The main disadvantages include the following:

* **Biological warfare** - The potential exists for the development of pathogens and epidemics that could be used in a conflict zone to infect populations.
* **Loss of soil fertility** - Bio-enhanced plants require more nutrients from soil and yield more crops. This can drain soil of fertile nutrients, devastate farmland and require the use of environmentally harmful fertilizers to make up for the nutrient shortfall.
* **High costs** - Biotechnology products often cost more than traditional products and have the potential to raise pricing structures in various industries.
* **Ethical considerations** - Gene manipulation raises a range of ethical issues, such as the genetic engineering of humans.
* **Safety questions** Various groups have raised safety concerns about the health risks of GMOs and biotech-related medical developments, such as mRNA vaccines.

references:

<https://www.iberdrola.com/innovation/what-is-biotechnology?fbclid=IwAR3POZDJyHxxaiBzX9Mq07cPATew77rtiBAr4ghLC39VCsrueEieUjVfO3Q>  
  
<https://www.techtarget.com/whatis/definition/biotechnology?fbclid=IwAR1C8mqrjGHd9uo_bAqwidsAd6cgL2JhQFfTpD87JXv73hrabe7gyzDgsT0>  
  
<https://www.mdis.edu.sg/blog/biotechnology-definition-history-career-and-courses/?fbclid=IwAR0WaqP5eX4Jyvgb1IsDQrd-d48vyVhaVIopCpTjFc5gPo4aPv1npaDdtrE>  
  
<https://www.bio.org/what-biotechnology?fbclid=IwAR3ao6QbHlQX8F5Z1q46mY885e55DStFdVV5FPIXjzzksyvJWThTivzQiEE>