

2024 PSBR Middle School Essay Contest
2nd Place

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Biomedical research is an area of science involving observing and expanding the knowledge base of the biological process and causes of disease. The research process consists of observation, hypothesis, experimentation, and finalizing a conclusion. The goal of biomedical research is to find new ways to prevent and cure illnesses, create new medicines, and develop new products. Due to the broad area of this field, a typical research team might include doctors, veterinarians, computer scientists, engineers, technicians, and a variety of scientists from different areas of life science.

There are two different types of research: basic and applied. Basic research increases fundamental scientific knowledge and expands the understanding of how organisms develop and function. Furthermore, basic research studies foundational theories, which are the building blocks of biomedical sciences. Applied research is directed toward specific goals and discoveries. It uses knowledge gained from basic research and methodically expands the knowledge to address an issue.

Primary techniques are in vitro tests, epidemiological studies, and clinical studies. In vitro tests use lab-grown bacteria, cell, tissue, and organ cultures as test subjects. "In vitro" itself means "in the glass" in Latin. Epidemiology is the study of the distribution of diseases compared to the amount of exposure a population has received. There are three ways to study epidemiology. Cross-sectional studies collect data by determining the amount of exposure and outcomes at one point. Cohort studies identify study groups based on exposure and study the outcomes, while case-control studies identify the study groups based on the outcomes and then study the amount of exposure. Clinical research is developed through clinical trials. Clinical trials take place in a hospital or clinical setting and involve experiments on informed human volunteers. These tests are used to gauge the safety and effectiveness of new medical drugs, procedures, or medical devices. Although there are many questions on the ethics of human experimentation, in research there is both a moral and legal requirement that the subjects are truly volunteers. The participants are willingly contributing themselves to experiments.

Although there are human subjects, testing on animals is the primary means of experimentation, using subjects called "animal models". Almost ninety-five percent of all animal models in the U.S. are rats, mice, and other rodents bred specifically for laboratory research. Rabbits, guinea pigs, and sheep have a similar anatomic structure to humans and are good alternatives. Unfortunately, living organisms must be used as nothing can substitute the complex functions of a live entity. However, there are strict rules and regulations on animal experimentation. Researchers avoid the use of animals whenever possible and adhere to the three R's (reduction, refinement, and replacement). Reduction refers to methods that use fewer animals in experimentation. Refinement concerns how the animals are treated.

Researchers constantly experiment with new and more effective anesthetics and analgesics, species-appropriate housing, and enrichment activities. Replacement means using methods that do not involve animals so that animals can be spared whenever possible. In addition, the Animal Welfare Act protects lab animals from unnecessary harm. Most studies don't even cause significant pain or distress. Furthermore, research can benefit animals too! Animal research furthered knowledge on cancer, influenza, and vaccines for animals. Scientists are still finding ways to substitute animals with computer simulations and models. These computers can process large amounts of data at one time and predict possible outcomes, without running actual experiments.

Biomedical research has made major contributions to medicine and life expectancy since its formation. In 1950, there was a major development in treating fungal infections, followed shortly after by the first understanding of brain cell communication, clinical trials in lithium, the first successful treatment of child OCD, and many more. In the 2000s, there was a breakthrough in combating Alzheimer's disease, and advancement in the HIV vaccine, among others. Many of the discoveries about the COVID-19 virus and vaccine were made by biomedical researchers! As technology and science continue to advance, biomedical research will keep on contributing to society, and make our lives better and safer.

Works Cited

What is Biomedical Research? - California Biomedical Research Association

The Essential Need for Animals in Medical Research - The Foundation for Biomedical Research

Casey's Awakening - California Society for Biomedical Research

National Association for Biomedical Research

Disease Fact Sheets - California Society for Biomedical Research

Dogs in Research – FASEB

National Library of Medicine