2023 New Jersey Middle School Essay Contest
2nd Place

Grace Y.
Millburn Middle School
Millburn, NJ

Biomedical research is a study of science dealing with discovering information applied to diseases and conditions. It aims to manufacture medicine and create therapies to benefit humans and animals.

The typical methodology involves observation, hypothesis, experimentation, and conclusion. Basic research expands on scientific foundations, such as the development of living organisms. These foundations are crucial to applied research that expands knowledge focusing on a goal or discovery. There are multiple types of models: animal models and alternatives.

The primary source of laboratory animals is from vendors who raise specially bred animals for research. The most common animal model is a mouse or a rat considering that they closely resemble a human's genetic material. Rodents can be genetically altered to be transgenic when a foreign gene is artificially added to the egg nucleus. Knockout is when a gene is physically disabled, allowing scientists to study the progression of diseases. Rodents have a shorter life span, so it is easier to measure experiment results. Other animals ranging from monkeys to marine, freshwater animals, share varied similarities with the human body, specializing them for different types of experimentation. For example, dogs have uncovered methods of heart and artery surgery.

There are regulations to treat animals ethically and humanely known as the three r's: reduction, refinement, and replacement, which apply to the usage of laboratory animals. Researchers aim to reduce the number of animals needed to acquire new information, refine pain, supply better conditions, and replace unnecessary animals with alternatives. The Institutional Animal Care and Use Committee (IACUC) monitors the animal care programs and approves proposed animal experiments. The experiment explanation summarizes the number of animals needed, the importance of a specific species, and a plan to prevent suffering. Furthermore, there is a government-passed Animal Welfare Act concerning the environmental standards of laboratory animals, except for rodents, birds, and cold-blooded species. Additionally, it requires the use of pain-relieving drugs such as anesthesia. These laws are enforced by the United States Department of Agriculture, which inspects the environment of institutions on unannounced dates and reports.

Alternative research methods are still under development to answer as many questions as possible but cannot fully duplicate a body's interactivity. Computer models are limited to past information, revealing gaps. In vitro research with cells from animals or humans on test tubes and dishes cannot demonstrate the interactive system but help further design experiments. Ex vivo research includes tissues taken outside of an organism to serve as a model. Multiple models must be tested for repeated accuracy.

In order to ensure a medicine or procedure's effectiveness and safety to the public, forms of clinical research are done during pre-clinical and clinical trials. Pre-clinical and clinical research are forms of in vivo research done in a whole body. Pre-clinical trials requiring animals must be done before clinical trials, which need approval from the U.S. Food and Drug Administration since it involves human volunteers. Animals are used before humans since it is widely perceived as unethical to risk the health of human subjects. Clinical Trials contain three phases spanning over several years, the first with healthy humans to study the safety of drugs. Then, on small numbers of patients for effectiveness and dosage levels. Ultimately, many patients are tested to build more knowledge on side effects, safety, dosage levels, and effectiveness. The FDA approves the drug based on experiment information.

Epidemiological studies manage health problems from studies on the distribution and source of health events in specific populations. The covid pandemic has been ongoing for the past three years, killing millions of people. Biomedical scientists have analyzed the cases, enhancing knowledge about the virus, and assisting in the rapid development of new testing methods, vaccines, and treatments. These vaccines have reduced the severity of the virus, saving children to elders. Slowly, the world is recovering from the devastating disease.

Already, scientists have developed treatments for many well-known conditions, such as asthma inhalers and insulin from animal research. My grandmother suffered from bradycardia. Thanks to studies on dogs' irregular heartbeat, the pacemaker and a safe process of heart surgery was invented.

Throughout history, biomedical research has saved millions through newly developed medicines and procedures for both humans and beloved pets. In the future, scientists aim to research conditions such as heart disease, blindness, and stroke using advanced stem cells based on mice stem cells. Science has widely reduced suffering, building a more meaningful, safe, and enjoyable lifestyle for humans.

Bibliography

"What is Epidemiology?" *Centers for Disease Control and Prevention*, www.cdc.gov/careerpaths/k12teacherroadmap/epidemiology.html. Accessed 12 Mar. 2023.

Cody, Colleen, et al. *Casey's Awakening*. Accessed 12. Mar. 2023.

Cook, Nakela L., and Michael S. Lauer. "Biomedical Research COVID-19 Impact Assessment: Lessons Learned and Compelling Needs." *National Academy of Medicine*, 26 July 2021, nam.edu/biomedical-research-covid-19-impact-assessment-lessons-learned-and-compelling-nee ds/. Accessed 12. Mar. 2023.

"The Use of Animals in Biomedical Research: Improving Human and Animal Health." *American Association for Laboratory Animal Science*, www.psbr.org/images/Educational_Materials/aalas_improve_human_animal_health.pdf. Accessed 12 Mar. 2023.

"The Essential Need for Animals in Medical Research." *PSBR.org*, www.psbr.org/images/Educational_Materials/fbr_essential_need_species_sheets.pdf. Accessed 12 Mar. 2023.

"Facts About Animal Research." *Americans for Medical Progress*, www.psbr.org/images/Educational_Materials/amp_facts_about_research.pdf. Accessed 12 Mar. 2023.

"What is Biomedical Research?" *California Biomedical Research Association*, www.psbr.org/images/Educational_Materials/cbra_factsheet_biomedical_research.pdf. Accessed 12 Mar. 2023.

"Fact vs. Myth." *Foundation for Biomedical Research*, www.psbr.org/images/Educational_Materials/fbr_fact_vs_myth.pdf. Accessed 12 Mar. 2023.

"Animal Research Benefits Us- And Animals Too." *Understanding Animal Research*, www.psbr.org/images/Educational_Materials/uar_animal_research_benefits.pdf. Accessed 12 Mar. 2023.

"Medical Research with Animals." *National Institutes of Health*, www.psbr.org/images/Educational_Materials/nih_research_with_animals.pdf. Accessed 12 Mar. 2023.

"Super Scientists." *California Society for Biomedical Research*, www.psbr.org/images/Educational_Materials/csbr_mice_helping_scientists.pdf. Accessed 12 Mar. 2023.

"General Overview." *Pennsylvania Society for Biomedical Research*, www.psbr.org/programs-18/essay-contest. Accessed 12 Mar. 2023.