Restraint vs Scientific Advancement in Biomedical Engineering

By Mark Csoros

***Resolved: In the field of biomedical engineering, restraint ought to be prioritized over scientific advancement.***

2020 was a strange, trying year. It was a year full of adjustment, disappointment, uncertainty, difficulty, and angst. For some, it was a time of unspeakable sorrow, loss, isolation, and struggle. However, those of us who have lived through the events of *anno Domini* two thousand and twenty have borne witness to a period of rare historical significance. We have seen firsthand the best and worst of humanity, have found within ourselves extraordinary resilience, and have been blessed with an indelible reminder of our own mortality. We have found it necessary to reconsider some of our most deeply held beliefs and assumptions and to address with new urgency vital questions that reach the very core of our identities.

I have no doubt that this year’s Stoa LD resolution is—at least in part—inspired by the events of 2020, primarily because the topic area and its philosophical quandaries closely parallel the topics and philosophical conundrums raised by the COVID-19 pandemic. Put simply, this is a highly relevant resolution. In a world of ever-increasing technological advancement, a world facing ever-evolving threats and challenges, we must ask ourselves difficult and complicated questions about the moral frameworks with which we approach those issues. This year’s resolution facilitates those questions, which is why it’s one of the most important topic areas (if not *the* most important topic area) that I’ve come across in my speech and debate career. Forensics competition is meant to help equip you for the real world, to help teach you how to apply clear, convincing logic and evidence in complex, murky, sensitive scenarios where the stakes are too high to ignore.

This resolutional overview is designed to help acquaint you with biomedical engineering and give you a starting point from which to research this resolution further. Part I covers the plain definitions of biomedical engineering, Part II discusses what those definitions mean in practice, and Part III investigates the potential for broad and narrow interpretations of this resolution’s topic area.

# Part I: Definitions

To start off, let’s take an unfiltered look at two dictionary definitions of biomedical engineering.

Oxford Dictionaries. “Biomedical Engineering” [https://www.lexico.com/en/definition/biomedical\_engineering](https://www.lexico.com/en/definition/biomedical_engineering%09%09%09%09)

“The application of the principles and techniques of engineering science to biomedical systems and problems; an interdisciplinary branch of science dealing with this.”

Merriam-Webster. “Biomedical Engineering” <https://www.merriam-webster.com/dictionary/biomedical%20engineering>

“The application of engineering principles, practices, and technologies to the fields of medicine and biology especially in solving problems and improving care (as in the design of medical devices and diagnostic equipment or the creation of biomaterials and pharmaceuticals).”

The Oxford definition is quite succinct, essentially telling us that biomedical engineering is a distinct but interdisciplinary branch of science that relates to biomedicine. That is accurate and helpful, but it leaves out some information. Fortunately, the Merriam-Webster definition helps to pick up some slack here by explaining that biomedical engineering relates to medicine and biology, clarifying that this type of engineering aims to improve care and listing some examples of how biomedical engineering seeks to accomplish that aim. To clarify and expand our understanding even further, we can turn to definitions of “biomedical” and “biomedicine.”

Collins English Dictionary. “Biomedical.” <https://www.collinsdictionary.com/us/dictionary/english/biomedical>

“Of or relating to biology and medicine or biomedicine.”

Collins English Dictionary. “Biomedicine.” <https://www.collinsdictionary.com/us/dictionary/english/biomedicine>

“The aspects of medicine that derive from, or relate to, the natural sciences, esp. biology, biochemistry, and biophysics.”

In sum, these definitions provide a solid conceptual framework for this resolution’s topic area. Biomedical engineering seeks to solve problems and improve care in areas where biology and medicine overlap by applying scientific approaches along with interdisciplinary knowledge and techniques.

# Part II: Understanding in Practice

Now that we have a general understanding of biomedical engineering, we need to dig a little deeper. We need to understand, to the best of our abilities, what biomedical engineering means in a practical sense. Just like the dictionary definition of “computer” wouldn’t really help you operate or understand one, dictionary definitions of “biomedical engineering” can’t provide the depth or nuance needed to effectively debate this resolution. So, let’s examine two longer-form explanations of biomedical engineering, which will help us ground our definitional knowledge in real-world understanding.

Michigan Tech University. “What Is Biomedical Engineering?”; Michigan Technological University Department of Biological Engineering. <https://www.mtu.edu/biomedical/department/what-is/>

“Biomedical engineering focuses on the advances that improve human health and health care at all levels. Biomedical engineers differ from other engineering disciplines that have an influence on human health in that biomedical engineers use and apply an intimate knowledge of modern biological principles in their engineering design process. Aspects of mechanical engineering, electrical engineering, chemical engineering, materials science, chemistry, mathematics, and computer science and engineering are all integrated with human biology in biomedical engineering to improve human health, whether it be an advanced prosthetic limb or a breakthrough in identifying proteins within cells. There are many subdisciplines within biomedical engineering, including the design and development of active and passive medical devices, orthopedic implants, medical imaging, biomedical signal processing, tissue and stem cell engineering, and clinical engineering, just to name a few.”

U.S. Bureau of Labor Statistics, April 2021. “Occupational Outlook Handbook, Bioengineers and Biomedical Engineers”; U.S. Department of Labor. (Article last modified April 9, 2021). <https://www.bls.gov/ooh/architecture-and-engineering/biomedical-engineers.htm#tab-2>

“Biomedical engineers focus on advances in technology and medicine to develop new devices and equipment for improving human health. For example, they might design software to run medical equipment or computer simulations to test new drug therapies. In addition, they design and build artificial body parts, such as hip and knee joints, or develop materials to make replacement parts. They also design rehabilitative exercise equipment.”

There’s no need for me to recap all the practical applications of biomedical engineering that were listed as examples in the previous two pieces of evidence, but you’re probably seeing a pattern by now. There are various arenas, all related to health and health care, in which biomedical engineers operate, with the goal of improving outcomes and bettering patient health.

# Part III: Broad and Narrow

It’s important to bear in mind, especially early in the year, that bioengineering and biomedical engineering are not quite the same thing. Many potential sources of evidence discuss the ethics of restraint and scientific advancement in the context of bioengineering. Some of these sources are applicable to the resolution’s topic area of biomedical engineering, some of them are not, and some of them are applicable depending on how broadly we define biomedical engineering.

The University of California Riverside. “What’s the Difference Between Bioengineering vs. Biomedical Engineering?”; U.C. Riverside https://engineeringonline.ucr.edu/blog/whats-the-difference-between-bioengineering-vs-biomedical-engineering/

“Bioengineering and biomedical engineering might roll off the tongue similarly, but in practice there are notable differences between the two. Bioengineering is the study of applied engineering practices in general biology. It is the more broad topic when compared to biomedical engineering; bioengineering covers topics such as agriculture, pharmaceuticals, natural resources and foodstuffs, among others. In addition, it covers general medical practices, though biomedical engineering focuses more on this field than general bioengineering will. Bioengineering practices are applied to many different industries, including health care, but biological engineering practices are not explicitly for medical purposes. Biomedical engineering is a more specialized version of bioengineering, utilizing many of the discipline’s principal theories and putting them to practice to improve human health. The field is focused on the production of new tools and processes that can be used in various health care contexts. Of all the fields of engineering, a biomedical engineer is likely to have one of the largest impacts on a person’s life. Biomedical engineers commonly work to solve issues that are present in the life sciences; those that work on prosthetics or the emerging field of cybernetics (more formally known as biomechatronics) may also be referred to as biomechanical engineers. Items like the pacemaker, artificial heart and cochlear implant are all results of biomedical innovation. Medical and surgical tools such as specialized robotic surgery suites also fall under their purview. Biomedical engineers also work to advance the efficacy of natural processes through biotechnology, such as tissue regeneration and cell diffusion.”

The Encyclopedia Britannica’s entry on bioengineering is also helpful here because it demonstrates how slight definitional adjustments can create significant changes in whether we classify a field of study as resolutionally topical or not. The Encyclopedia lists seven subcategories within the larger field of bioengineering.

Encyclopedia Britannica. “Bioengineering”; Written by The Editors of the Encyclopedia Britannica. <https://www.britannica.com/technology/bioengineering>

Medical engineering. Medical engineering concerns the application of engineering principles to medical problems, including the replacement of damaged organs, instrumentation, and the systems of health care, including diagnostic applications of computers.

Agricultural engineering. This includes the application of engineering principles to the problems of biological production and to the external operations and environment that influence this production.

Bionics. Bionics is the study of living systems so that the knowledge gained can be applied to the design of physical systems.

Biochemical engineering. Biochemical engineering includes fermentation engineering, application of engineering principles to microscopic biological systems that are used to create new products by synthesis, including the production of protein from suitable raw materials.

Human-factors engineering. This concerns the application of engineering, physiology, and psychology to the optimization of the human–machine relationship.

Environmental health engineering. Also called bioenvironmental engineering, this field concerns the application of engineering principles to the control of the environment for the health, comfort, and safety of human beings. It includes the field of life-support systems for the exploration of outer space and the ocean.

Genetic engineering. Genetic engineering is concerned with the artificial manipulation, modification, and recombination of deoxyribonucleic acid (DNA) or other nucleic acid molecules in order to modify an organism. The techniques employed in this field have led to the production of medically important products, including human insulin, human growth hormone, and hepatitis B vaccine.

The evidence from UC Riverside, coupled with the Encyclopedia Britannica’s list of bioengineering subdisciplines, sets us up to ask some interesting questions about which arguments and applications we can count as resolutional. For instance, imagine that a team of scientists use gene editing to create a new, more advanced strain of bacteria. These bacteria are very similar to the type found in human and animal digestive systems but are able to increase an organism’s gut health by more effectively breaking down enzymes. The team then develops a chemical process for efficiently growing these bacteria in mass quantities and develops a self-guided and digestible capsule that, after being swallowed, places the bacteria in the optimal section of a person’s (or animal’s) gut. Such an invention could, when administered to livestock, increase human health by decreasing disease among farmed animals, and when administered to human patients could decrease their susceptibility to various gut infections and diseases.

Is this hypothetical an example of genetic, biochemical, medical, agricultural, or biomedical engineering—or all of the above? Is it specific enough to count as biomedical engineering, or so general that it counts as bioengineering, and thus is not resolutional? The answer: it depends. It depends on how specifically you define the terms of the resolution, and whether your resolutional analysis allows for more or less flexibility. Just be aware that not everyone will agree on the precise boundaries between biomedical engineering and separate but related fields, and be prepared to defend your reasoning

# Conclusion

I’m very excited for this year of LD competition, and I hope that this overview has communicated some of that excitement to you. We get to debate about some very cool things this year, about technologies that would be incomprehensible just a few years ago, about ethics that truly impact lives, and about values that touch on the very nature of humanity. So, go research, prepare, dig deep, and enjoy what promises to be a spectacular season of competition.