

## Chapter 3

# Artistic Biotechnology: A Design Thinking Platform for STEAM Praxis

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### ABSTRACT

*Biotechnology, the use of organisms or parts of organisms as tools to support and innovate human wants or needs, plays an extensive role in our daily lives. However, biotechnology is minimally addressed in K-12 educational environments. An issue with the lack of biotechnology in curricula is that we, as end-users, are becoming increasingly defined and dependent on biotechnological innovations. We should be able to think critically and form educated decisions about our medical care, the food we eat, and the biotechnological products we do or do not use. The end-user's acceptance of biotechnological solutions to solve a human want or need also may hinge on the ability of the problem-solver to be artistically creative. This chapter introduces artistic biotechnology and provides three exemplars of K-12 classroom lessons anchored in the Design Thinking Model (DTM) with purposeful art integration. The DTM guides instructors and students through solving ill-defined problems for end-users with artistic biotechnological solutions.*

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## INTRODUCTION

Throughout history, humans have depended on the natural world to take care of our needs. The herbalist employed the medicinal properties of plants to care for the sick, the herdsman selectively bred animals to create new generations with desirable characteristics, and the baker and the brewer incorporated yeast that yielded food and drink. A significant similarity amongst the herbalist, the herdsman, the baker, and the brewer are their intentional uses of organisms (plants, animals, and microorganisms) as *tools* for fulfilling human wants or needs.

Fast forward to the 21<sup>st</sup> century, and we still use plants, animals, and microorganisms to improve the human experience. The research, development, and commercialization of these practices are situated in the STEM-focused field of biotechnology, which has exponentially become ingrained into our daily lives. How we take care of ourselves (i.e., penicillin-class antibiotics), what we eat (i.e., genetically modified foods), and how we power transportation (i.e., biofuels) have been revolutionized with biotechnological solutions. However, contemporary society has long been uninformed of the benefits and complications of continuously using and innovating the natural world to take care of our wants and needs (Ball, 2013; Hoban, 1998; McCaughey et. al., 2019).

Educators are tasked to prepare students for making informed decisions about their health, food, and lifestyle that are contingent on biotechnological capabilities, yet educators often do not address biotechnology curricula in the classroom (Gelamdin, Alias, & Attaran, 2013). We argue that through the implementation of design thinking, educators are better positioned to prepare students in what ways we can continue to make informed decisions through creative, innovative, and resourceful biotechnological approaches. The purpose of this chapter is to provide specific examples of design thinking in STEAM through the lens of biotechnology education. And art integration The authors address the following topics within the chapter: (a) provide evidence of biotechnology as an interdisciplinary field that integrates science, technology, engineering, art, and mathematics; (b) operationally define *artistic biotechnology* as a purposeful integration of art into biotechnology curricula; (c) anchor three artistic biotechnology lessons within the DTM; and (d) provide tools for educators to evaluate cognitive processes (i.e., creative thinking, critical thinking, design thinking). These lessons are based on the teaching experiences of one of the authors who implemented artistic biotechnology activities with K-12 students.

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