

Agricultural Cyberbiosecurity

Biomanufacturing

Introduction

Biomanufacturing is where science, nature, and business collide! Are you curious about how plants can make rocket fuel? Are you interested in how farming could help slow down climate change? There is an effort by businesses and schools to find naturally occurring ways to make the things we all use. These and many more careers are found in **biomanufacturing**.

Biomanufacturing 1.0 - Fermentation

Fermentation is a natural process where bacteria make new chemicals called enzymes. This happens all the time! It makes things like soy sauce, cheese, and wine. A great example is bread. A baker adds yeast to bread dough. Yeast is a type of bacteria that eats sugar and makes bubbles. Those bubbles help the bread rise!



Figure 1. Freshly baked loaf of bread.
“Bread baking” by fancycrave1 freely available via Pixabay Content License.

Key terms

- **Antibiotic:** A medicine that kills or prevents the growth of pathogens
- **Enzyme:** A molecule that speeds up a chemical reaction
- **Biotechnology:** The application of biology to an industrial process

Biomufacturing 2.0 - Antibiotics

When cells find harmful bacteria, they make medicine called **antibiotics**. The process cells use to make **antibiotics** can be used by us to make medicine. A famous example of an **antibiotic** is **penicillin**. A doctor discovered **penicillin** when he forgot about an experiment and went on vacation. When he got back, the experiment was moldy. Instead of throwing it away, he wondered how the mold stopped the bacteria from growing.

Now we have **antibiotics** for all kinds of things. Our **veterinarians** give our dogs and cats **antibiotics** when they feel sick. Sometimes you might get **antibiotics** in a shot or pill from your doctor. Farmers give their cows **antibiotics** to keep them safe—all thanks to someone who forgot their homework.

Biomufacturing 3.0 - Proteins

Large molecules like **insulin** and **enzymes** are more complicated than **antibiotics**. Until the 1970s, we couldn't make them. Scientists tricked a type of bacteria called E. coli into making insulin. **Insulin** is a type of protein that we all make naturally. Sometimes, that process stops working, and people need **insulin**. This process helped to provide **insulin** to those who needed it. This method has been used to make other things, like medicine and farming enzymes. Have you ever seen a piece of an apple turn brown? Some scientists think they can make an enzyme to stop that from happening!



Figure 2. Insulin vials.
Image by "https://www.freepik.com/free-photo/vaccine-recipients-composition-table_11175643.htm#query=insulin%20vial&position=10&from_view=search&track=ais"

Biomufacturing 4.0 - The future

The future of biomufacturing is still being shaped by the scientists of today and tomorrow. We have yet to learn much about what the future will hold, but scientists are starting to explore some exciting problems. Can we use plants to make old ideas better? Can we grow chicken tenders in the lab? What will the future of medicine look like? All these questions still need answers. But, in the end, a new scientist will find a solution. To find those answers, our scientists must know about cybersecurity, biology, and agriculture—the next scientist maybe you.

Career connections

Business, Management, &
Administration

Agriculture

Engineering

Communication & Education

Information Science

Resource Management

Economics

Law & Policy

Biotechnology

Did you know? The College of Agriculture and Life Sciences at Virginia Tech has nearly 70 program options! Find your career connections at cals.vt.edu or email applytoCALS@vt.edu



CAIA

Scientist Spotlight

Dr. Laura Strawn is a food scientist. Her research and extension program focuses on reducing foodborne pathogen contamination throughout the supply chain. To do this, she uses both field and laboratory experiments. Discovery from these projects is disseminated directly to the public through different education and outreach activities. Her program empowers individuals to make risk-based decisions for their operations by providing them with science-based information and practical solutions to limit contamination events. Laura is a CAIA Affiliate Faculty.



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