



Developing Modules for Bioindustrial Manufacturing Workforce Readiness

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Agenda

- › Introduction to the Bioindustrial Manufacturing Workforce
- › Overview of Pilot Modules
- › Module Review and Revision
- › Group Discussion
- › Opportunities to Engage

About BioMADE

BioMADE launched in 2021 and is an independent non-profit, public-private partnership sponsored by the U.S. Department of Defense. In partnership with our members, we are securing America's future through biomanufacturing innovation, education, and collaboration by:

- › Propelling new biotechnology products from the laboratory to the commercial market
- › Creating a more robust and resilient supply chain and helping the U.S. become more self-sufficient
- › Ensuring that the workforce of the future is prepared and ready to fill new jobs
- › Bringing together a range of member organizations to bridge the gap between lab-scale research and at-scale manufacturing



What is Bioindustrial Manufacturing?

Bioindustrial manufacturing uses living organisms such as bacteria, yeast, and algae to make new products or replacements for current products that are more sustainable and environmentally friendly than current processes

By harnessing the power of biology, bioindustrial manufacturing can make myriad products that Americans use every day

Bioindustrial manufacturing is key part of the bioeconomy, which could have an economic impact of up to \$4 trillion annually within the next 10–20 years

Applications

- › Novel and performance-driven chemicals, materials, catalysts, sensors, probiotics, and more
- › Compounds that go into footwear, ink, and engine coolant
- › Fibers that become coffee capsules, diapers, cups, and electronics
- › Skincare products
- › Growable concrete and on-site production of fuels, lubricants, and other critical materials

NSF Project

- › Goal 1: Formalize the Community of Practice (CoP) for workforce agencies, academic institutions, and industry/commercial entities to inform local, regional, and national workforce efforts in bioindustrial manufacturing.
- › Goal 2: Develop, test, and finalize Key Bioprocessing Concept education modules that meet performance benchmarks for bioindustrial manufacturing.
- › Goal 3: Increase capacity of a diverse and inclusive workforce ecosystem and career entry through deployment of curricular materials and through dissemination efforts such as industry-driven workshops, government interagency collaboration, and expanded CTE curriculum adoption.

Delgado Community College's Goals

- › Integrate curriculum into seven Biotechnology Courses
 - ~50 students per semester
- › Integrate curriculum into six Chemical Technology Courses
 - ~10 students per semester
- › One instructor trained with curriculum in summer 2024
- › Five instructors trained with curriculum beginning summer 2025
- › Site visits to see scale up/exposure to equipment
- › Student and faculty feedback for evaluation



Proposed Modular Content

- › Bioindustrial manufacturing technicians need skills to work safely in both the laboratory and on the plant floor.
- › Operational experience with scaling up the process to produce larger kilogram and metric ton quantities is currently lacking in training programs.
- › New learning materials should emphasize safely conducting process scale up, monitoring, sample collection, sample preparation, and maintenance and troubleshooting.

Proposed Bioprocess Modules

Each module will target roughly 6-12 hours of instructional time including content presentations, learning assessments, and laboratory exercises.

Culture Scale-up and Monitoring

- › Perform microbial culture scale up.
- › Prepare media at multiple scales.
- › Monitor fermentation using sensors, displays, and trend charts.

Clean and Sterilize Fermentation Equipment

- › Clean fermentation equipment at multiple scales.
- › Perform clean out of place and clean in place procedures.
- › Describe setup of Clean in Place and Steam in Place skids.

Product Separation and Purification

- › Separate and purify product using centrifugation.
- › Separate and purify product using filtration.
- › Discuss product-specific purification methods used in bioindustrial manufacturing

Proposed Bioprocess Modules

Each module will include roughly 6-12 hours of instructional time to include content presentations, learning assessments, and laboratory exercises (as relevant)

Sample Collection and Preparation

- › Collect sanitary samples from process.
- › Interpret and communicate results.
- › Complete batch records.
- › Prepare samples for analysis.

Analytics

- › Analyze samples for contamination and product specifications.
- › Analyze samples using spectrophotometry and microscopy.

Instrumentation and Process Control

- › Monitor process parameters using sensors, displays, and trend charts.
- › Use organizational hardware and software to monitor and respond to processes.
- › Apply basic principles of process control.

Proposed Bioprocess Modules

Each module will include roughly 6-12 hours of instructional time to include content presentations, learning assessments, and laboratory exercises (as relevant)

Maintenance and Troubleshooting

- › Troubleshoot equipment safely and in accordance with organizational system or process.
- › Conduct preventative maintenance on equipment and instruments.

Documentation and Safety

- › Follow Standard Operating Procedures.
- › Complete batch records.
- › Follow organizational regulations.
- › Follow organizational safety procedures.
- › Explain elements of quality standards.

Module Review & Revision

- › Review Product Separation and Purification in more detail
- › Critique module and identify questions you have.
- › Identify modifications you would make to implement the module in your context. Consider:
 - › Your program or course objectives
 - › Local industry connections
 - › Specific characteristics or interests of your learners
 - › Equipment and material limitations or opportunities

Product Separation and Purification

› Module Objectives:

- Explain the purpose of separation and purification as unit operations in bioindustrial manufacturing.
- Operate a model disc stack centrifuge to separate product from broth.
- Operate a model tangential flow filtration system to purify product.

› Review module together

Group Discussion

- › Share critiques and questions about Product Separation and Purification.
- › Share any modifications you would make or strategies you would use to implement the module in your teaching context.



Community Participation



Contribute to Development

- ✓ NSF ATE PI Conference, October 2023
- ✓ Educator Workshop, July 2024
 - Prioritized San Francisco Bay Area Educators
- NSF ATE PI Conference, October 2024
- Educator Workshop, January 2025
 - Prioritizing San Francisco Bay Area Educators
- Delgado Community College, June 2025

Beta Testing

- Delgado Community College
- Southeast Community College

Thank you!

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