A Paradigm Shift: Combining Economic Development, Industry Research and Education

Susan Szathmary, M.D.,Ph.D.
Executive Director

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US Bioeconomy & US Healthcare Expenses

2021 US Bioeconomy: $1 trillion

https://www.schmidtfutures.com/our-work/task-force-on-synthetic-biology-and-the-bioeconomy/

2021 US Healthcare spending: $4.3 trillion

- $12,900/person
- 4.8% average growth per year
- 18.3% of the GDP
- 25% of federal taxes are spent on healthcare
- 16.9% of population cannot afford healthcare

https://www.cms.gov

Exponential Increase in Chronic Diseases

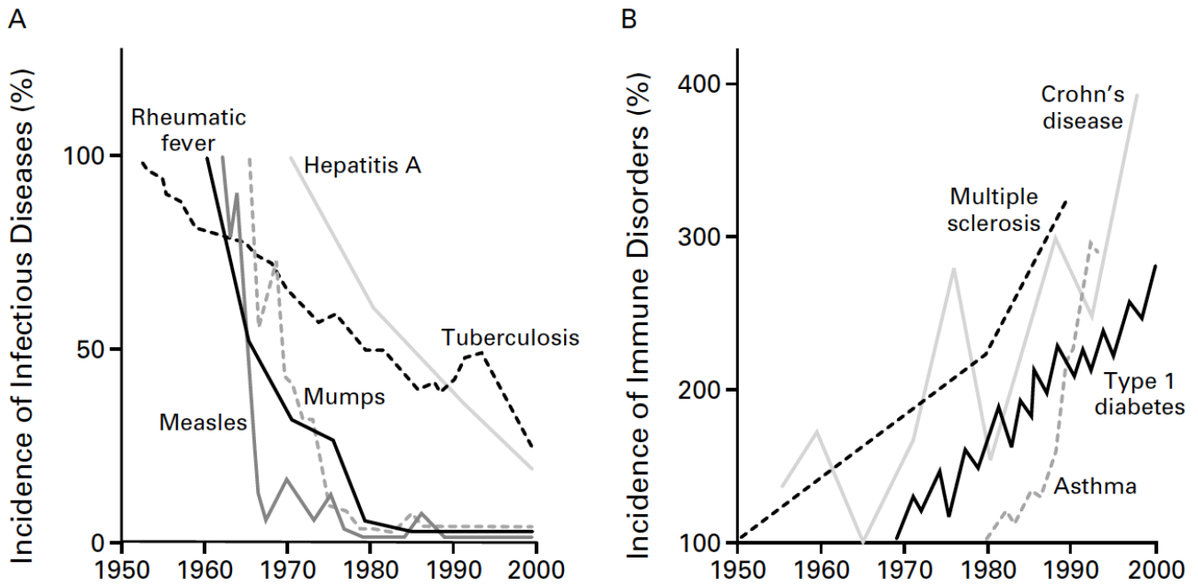


Figure 1. Inverse Relation between the Incidence of Prototypical Infectious Diseases (Panel A) and the Incidence of Immune Disorders (Panel B) from 1950 to 2000.

In Panel A, data concerning infectious diseases are derived from reports of the Centers for Disease Control and Prevention, except for the data on hepatitis A, which are derived from Joussemet et al.[12] In Panel B, data on immune disorders are derived from Swarbrick et al.,[10] Dubois et al.,[13] Tuomilehto et al.,[14] and Pugliatti et al.[15]

Bioeconomy - Creation of a Healthier Society

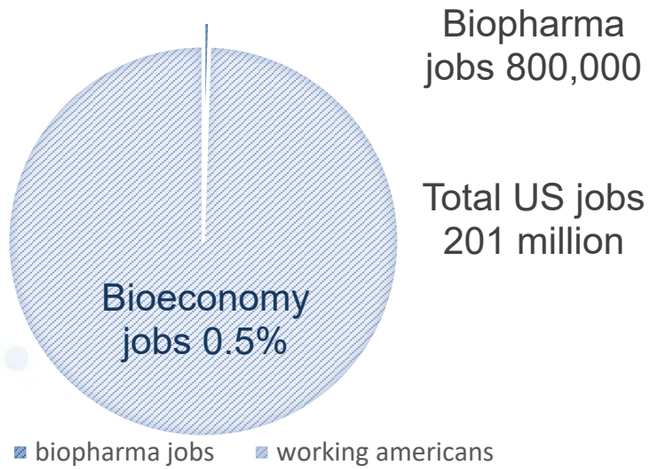
It is not about making more and more expensive drugs - It is about:

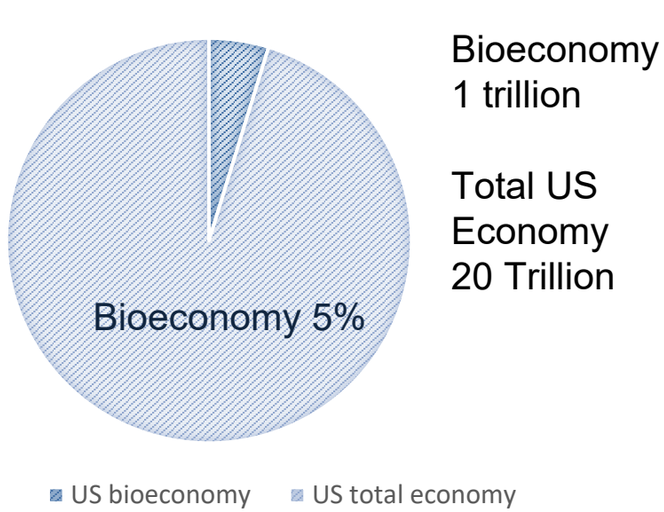
- Physical and mental health
- Healthy environments
- Nutritious food
- Positive lifestyle habits, and
- Safe, accessible medicines

"*Healthy soil cultivates healthy plants, which in turn nourish healthy animals and people*."

We must amplify our workforce development efforts in biomanufacturing including environment, agriculture, food, biomedical and information sciences.

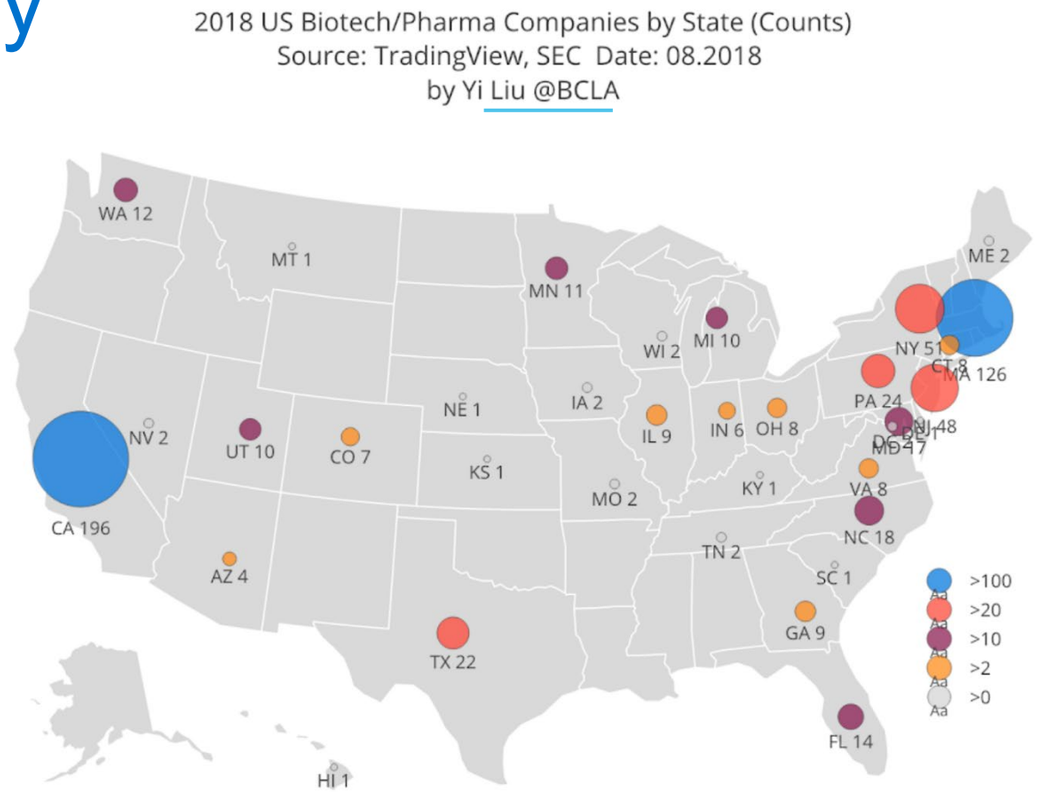
Biopharma Jobs Contribution to the US Economy





https://www.forbes.com/sites/johncumbers/2022/09/12/white-house-inks-strategy-to-grow-trillion-dollar-us-bioeconomybe544b135e10
https://www.bls.gov/news.release/vet.nr0.htm
https://www2.deloitte.com/us/en/pages/life-sciences-and-health-care/articles/us-economic-impact-biopharmaceutical-industry.html

Bioeconomy


2018 US Biotech/Pharma Companies by State (Counts)
Source: TradingView, SEC Date: 08.2018
by Yi Liu @BCLA
WA 12
MT 1
MN 11
ME 2
MI 10
WI 2
NY 51
CT 8
MA 126
PA 24
NE 1
IA 2
IL 9
IN 6
OH 8
NJ 48
DE 1
MD 17
NV 2
UT 10
CO 7
KS 1
MO 2
KY 1
VA 8
CA 196
NC 18
TN 2
AZ 4
SC 1
GA 9
TX 22
FL 14
HI 1
>100
>20
>10
>2
>0

High Wage Jobs in the Life Sciences Industry

U.S. median wage for all occupations: $41,950

As of May 2020, according to the Bureau of Labor Statistics

Life, physical, and social science occupations median wage: $69,760

As of May 2020, according to the Bureau of Labor Statistics

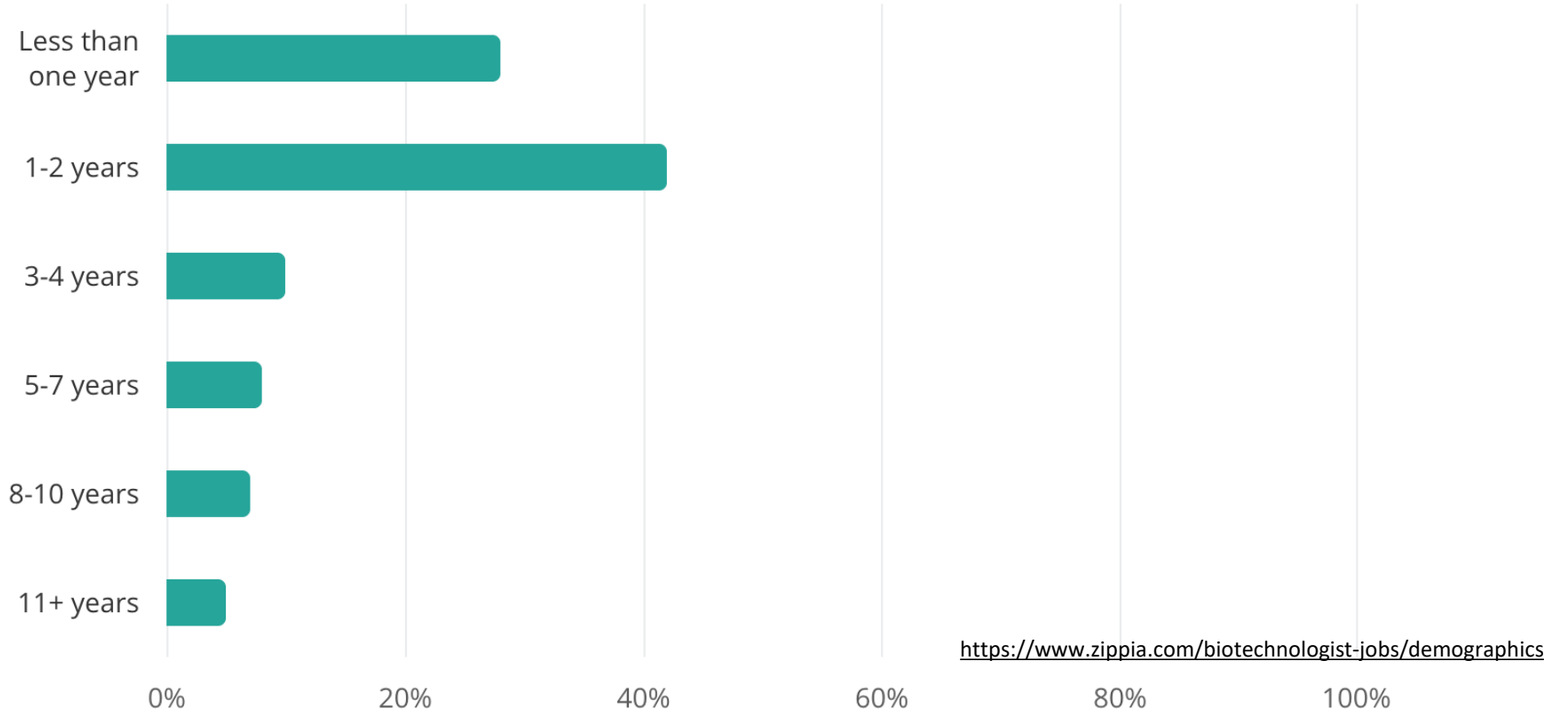
The average salary in biotechnology was $86,000

According to PayScale

Benefits of High Wage Jobs

- Supporting individuals and families
- Contributing to local economies
- Reducing income inequality
- Enhancing job satisfaction

The Average Years in a Biotech Job



https://www.zippia.com/biotechnologist-jobs/demographics

The Cost of Hiring of a New Employee

Entry level salary $65,000

The real cost of hiring: $195,000

Hard cost 40%

Soft cost 60%

According to new benchmarking data from the Society for Human Resource Management (SHRM) and E.L. Goldberg SHRM Foundation chair-elect and co-author of the book The Inside Gig (LifeTree, 2020).
https://www.bamboohr.com/blog/cost-of-onboarding-calculator

The current model of *“up or out”* does not work anymore.

Successful Carrier Path – 3P

PAY **P**URPOSE **P**ROGRESS

You matter - You matter here - and Here's why

Learning Path for Employees

Workforce development is not merely teaching specific tasks. It’s about holistic strategies, policies, and programs that prepare individuals with the skills to meet labor market demands. Importantly, it offers robust education and career progression opportunities, imbuing workers’ careers with a sense of purpose.

Why Workforce Development Matters

- Skill Development
- Enhancing Employee Morale and Retention
- Boosting Company Performance
- Economic Impact

Workforce Development Model

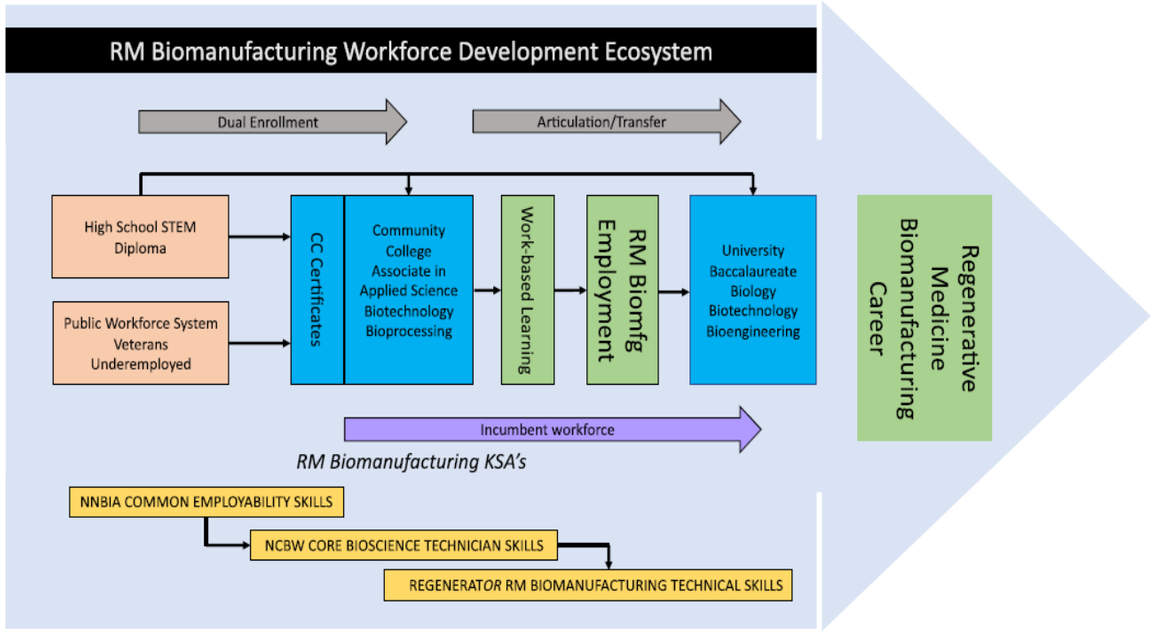
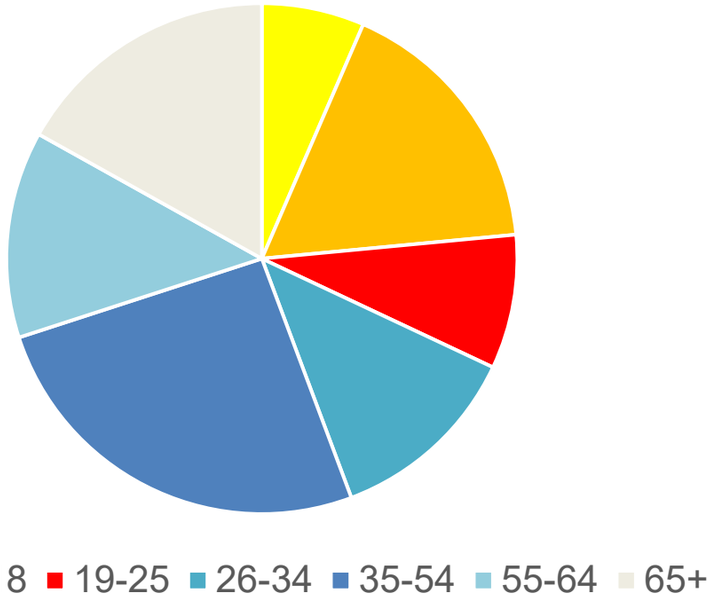


FIGURE 2 Depicts a model of the educational ecosystem for the skilled technical workforce for regenerative medicine biomanufacturing including the educational continuum from K-12 to university, the connectors that close the seams in the educational pathway (dual enrollment and articulation), and the defined KSAs that guide curricula

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8459631/

US Population - Percentage by Age Groups



https://www.census.gov/data/datasets/time-series/demo/popest/2020s-national-detail.html

Skills Biotech Employers are Seeking

- Complex problem solving,
- Teamwork and communication,
- Investigative mindset,
- Attention to detail,
- Innovative thinking, and
- Risk-based analytical skills.
- **Experience**, even in entry-level positions

Results of Project-Based Learning

- Improved Learning Comprehension
- Developing Real-World Skills
- Encouraging Teamwork
- Nurturing Innovation
- Innovative thinking, and
- Experience
- Risk-based analytical skills
- 90+% employment rate - (Innov*ATE*BIO Chander Aurora, PhD and Parvenah Mohammadian PhD, as presented at HI TEC 2022)

open biopharma training

Open Biopharma Research and Training Institute, CA 501(c)3

CDMO and Training Services



Our Mission

Our goal is to drive innovation that reduces the cost of biomanufacturing and to make the biggest impact in the live of people and as an educational institution to ensure the training of life sciences professionals in the newest biomanufacturing and related technologies.

Susan Szathmary, M.D. Ph.D.
Executive Director

Open Biopharma Research and Training Institute is a CA 501(c)3 entity

The Future of Biomanufacturing

GMP-Ready Production Area

45,000 sft state-of-the-art facility was designed and built in 2020 by CRB Engineering based on the Future Facility Concept

2 x 1,400 sft Ballroom suites, 3 x 500 sft suites and support areas

Cell culture and microbial suits

- 2 large cleanroom ballrooms with 4 production trains in each
- 3 small manufacturing suites
- Cleanroom for sampling in receiving area
- Gowning areas
- Utility mezzanine
- Over $2 million worth production, analytical and research equipment

Facility

Production Area Corridor

Training

Laboratory Area

Analytical lab

Development labs

Cell Culture lab

Fermentation lab

Over $2 million worth analytical and research equipment

Training

Training

Training

Classroom Training

1 large training room
2 smaller training rooms
1 dry lab demo area
1 wet lab demo area

Large Training Room

Training

Training

Ideas. Innovation. Impact.

- Fundamental research in biomanufacturing – environmental, food and medicine
- Catalyze novel manufacturing approaches and technologies
- Develop new transformative biomanufacturing processes to reduce cost
- Education of future and active workforce
- Reduce scientific, technological, educational, economic and social barriers in biomanufacturing
- Include all stakeholders in the development of bioproducts – farmers, nutritionists, physicians and patient advocates

Experienced Multidisciplinary Team

Broad range of experience in process development and production of:

- Biopharmaceuticals
- Vaccines
- Diagnostics
- Food and food safety
- Technology Transfer
- Quality Control
- Regulatory Support
- AI Support
- **Patient Advocacy**
- Education

Strong Workforce Development Partnerships

- Industry Collaborations
- Collaboration with industry groups – PDA, ISPE
- Collaborations with Community Colleges – training and sharing of technologies
- Collaboration with Universities and Advanced Cell Therapy Core Facilities
- CIRM trainings

Benefits

- Strengthen connections between employers and educational organizations
- Provide hands-on training programs in biomanufacturing environment
- Include a diverse range of students and other workforce participants
- Involved in biotech pathway for disabled students
- Increase economical growth in CA in underserved communities

Industry Partner Events

PDA, ISPE, Corporate Technology Demonstration and Training Events

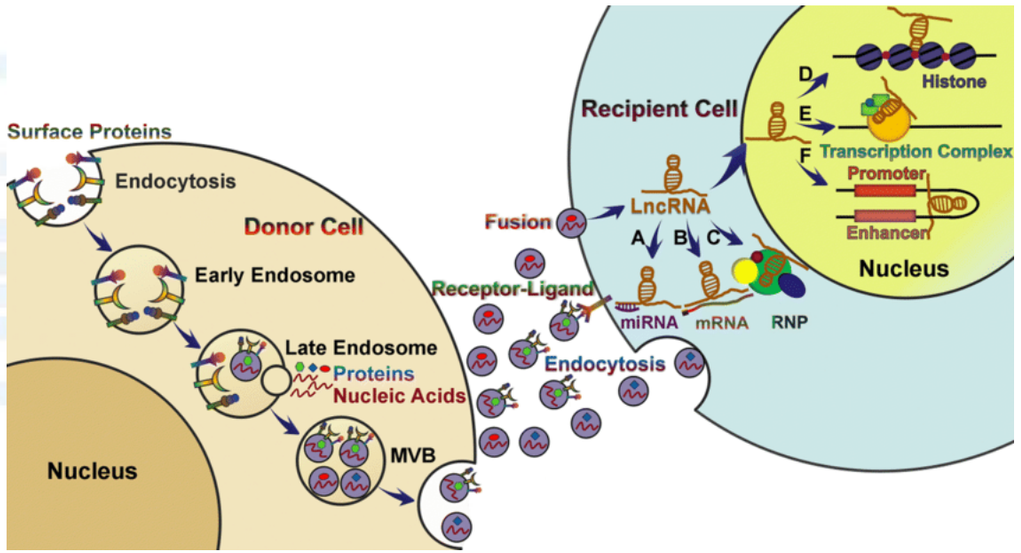
Focus on Key Areas of Biomanufacturing

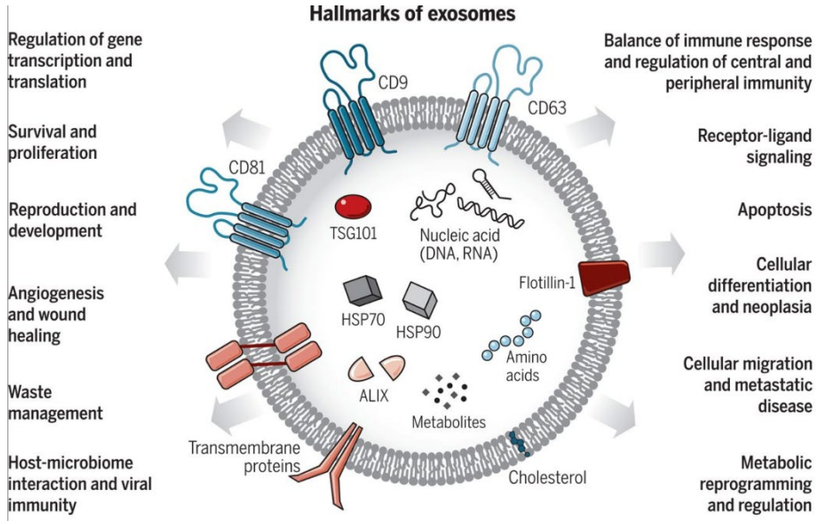
- Offering community resources for preclinical and biomanufacturing companies to reduce the manufacturing cost of novel medicines and other bioproducts.
- Providing project-based learning in cutting-edge science and technologies, including informatics and aiming to connect students with their future employers.
- Collaborating with employers to upskill their employees and implement new biomanufacturing technologies.
- Creating and testing effective training curriculums that can be utilized by others.

Dual Track Education

- Good examples – it works!
- 3-4 weeks per semester
- 8 weeks in the summer
- 14 weeks in the last semester
- Structured and rotation

Extracellular Vesicles – the “FedEx Truck” of the Body





DOI:10.1007/s00018-019-03018-3 https://www.creative-biostructure.com

AI - Data Management and Informatics

https://www.youtube.com/watch?v=Sqa8Zo2XWc4

ChatGPT’s Potential Application in Training

- In the project on exosomes, the students run a parallel summary with Zotero+ChatGPT
- For each of their Annotated Bibliographies, the tool will create a parallel one
- Weekly comparing the summaries, use extension programs with the API, not simply the chatbot feature
- Summaries will then be collected in a co-authored literature review, which will be analyzed to see how each contributing author added to the Literature.
- How to integrate Generative AI into our projects, training, and analysis, to demystify it, and encourage appropriate use.
- This includes a robust education of the privacy and data security concerns.
- This small project runs alongside our existing project.

Industry project-based learning needs

- Apprenticeship and internship for students – *hopefully* dual track with school credit?
- Biomanufacturing training for Ph.D. and MD
- Continuous education for educators – summer?
- Continuous education and upskilling for the active workforce – micro credits? and sabbaticals?

Next Steps

- **Core facility** for biomanufacturing
- **Upskilling** HR professionals
- Develop standardized descriptions of skill requirements and credentials
- Develop **life-long learning and continuous education** training models and **micro credentials** to include a diverse range of students, educators and other workforce participants
- Explore better integration with **transitioning veterans/spouses** into biomanufacturing training

Bioeconomy of the Future

As we plan for the future, we must remember that 21st-century infrastructure isn't just about physical roads and bridges. It's also about developing the bioeconomy roads and bridges across the nation, a critical component of our economic growth. We're at the cusp of scientific discovery and medical, food and environmental innovation, let's lead in developing our most valuable resource — our people.

Thanks to our partners

MIRACOSTA COLLEGE
Keau Wong,
Terri Quenzer,
Mike Fino and others

CALIFORNIA COMMUNITY COLLEGE'S CHANCELLOR'S OFFICE

CIRM

STRADA EDUCATION NETWORK

Innnov*ATE*Bio

Our biotech partners and industry organizations

Students

We are open to partner

Contact Us

1958 Kellogg Ave
Carlsbad, CA 92008

(858) 529-7827

learn@openbiopharma.org

openbiopharma.org