

Making Neuroengineering Accessible:

Creating an Open Textbook for the Next Generation



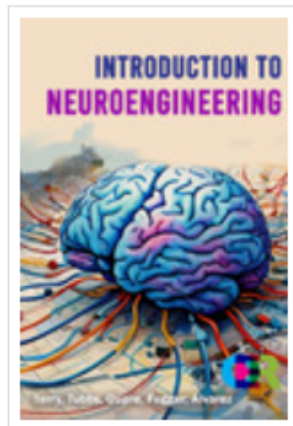


Enrique Alvarez Vazquez

Biomedical Engineering

University of North Dakota

OPEN EDUCATIONAL RESOURCES



Introduction to Neuroengineering

[Mercedes Terry](#)
[Abigail Tubbs](#)
[Blair Dupre](#)
[Brandon Fugger](#)
[Enrique Alvarez Vazquez](#), *University of North Dakota*

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Description

"Introduction to Neuroengineering" serves as a comprehensive



Mercedes
Terry



Abigail Tubbs



Blair Dupre



Brandon
Fugger



Enrique
Alvarez
Vazquez

THE START

How does BME UND run classes?

THE START

IBL

INNOVATION BASED LEARNING

<https://engineering.und.edu/academics/biomedical/ibl.html>

PRINCIPLES of IBL

- 1. Student-Centric Learning** The student drives their own learning journey, with autonomy to choose projects aligned with their personal goals and passions, fostering ownership and intrinsic motivation.
- 2. Culture of Value Creation** The learning environment is built around the mindset that students should always be creating something of worth — not just consuming information — instilling an innovator's identity.
- 3. Assessment Based on External Value** Student work is evaluated by the real-world impact and value the project creates outside the classroom, not just traditional grades or academic metrics.
- 4. Longitudinal Relevance (Freshman to Grad School)** IBL runs as a continuous thread throughout the entire academic career, building progressively in complexity and impact from freshman year through graduate school.
- 5. Real-World Problem Solving through Interdisciplinary Collaboration** Students tackle authentic industry or societal challenges alongside peers from different academic backgrounds, mirroring how innovation actually happens in the professional world.

THE START

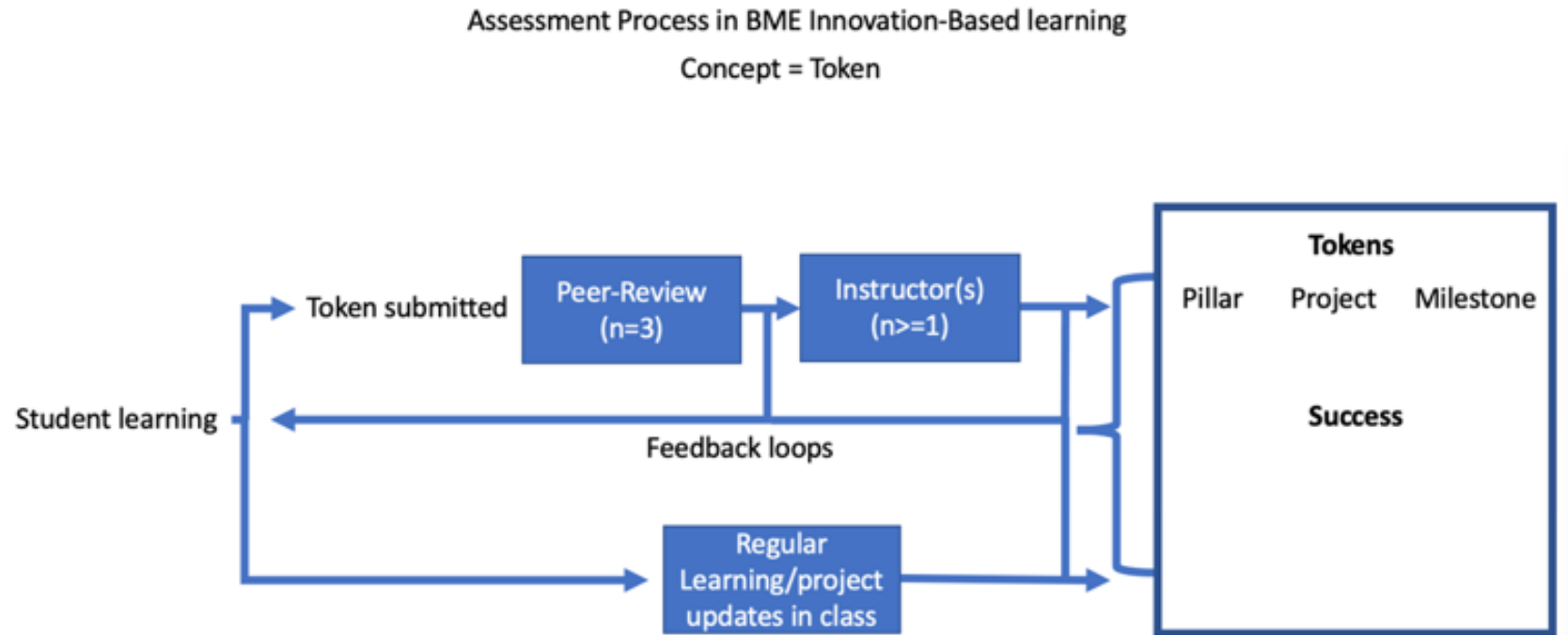
BME 422 Pillar Concepts:

Pillar #	Description
1	Neurons and the nervous system
2	Neural modeling
3	Neural Data analysis
4	EEG MEG
5	fMRI <u>fNIRs</u>
6	BCI: brain-computer interface BMI: brain-machine interface
7	TMS: transcranial magnetic stimulation DBS: deep brain stimulation
8	Neural disorders: epilepsy, Parkinson's, Huntington's, Alzheimer's, dementia
9	The visual system
10	Virtual reality devices applied in biomedical engineering
11	Eye trackers
12	The auditory system Cochlear Protheseses

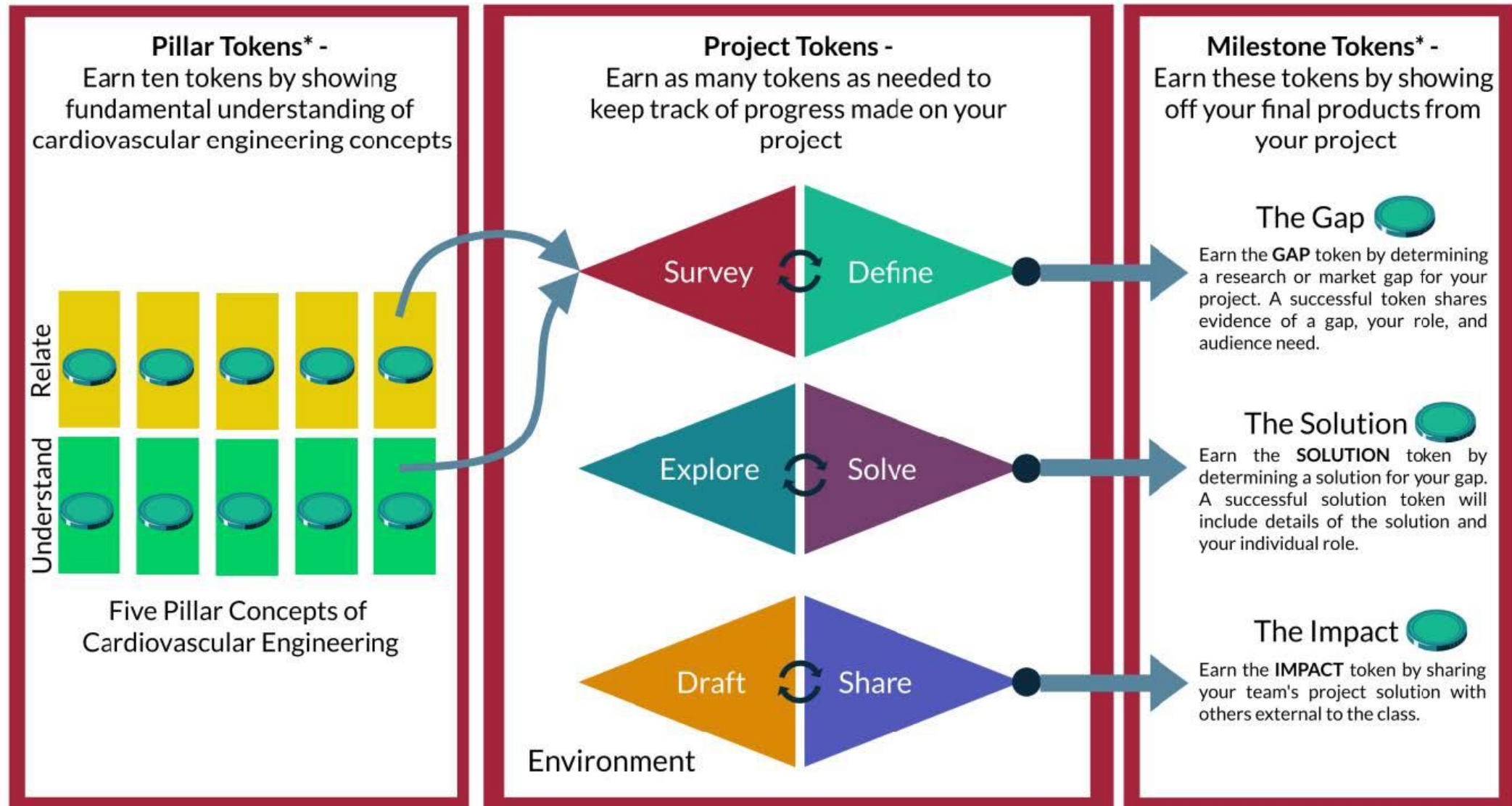
+ PROJECT

= IMPACT

THE START

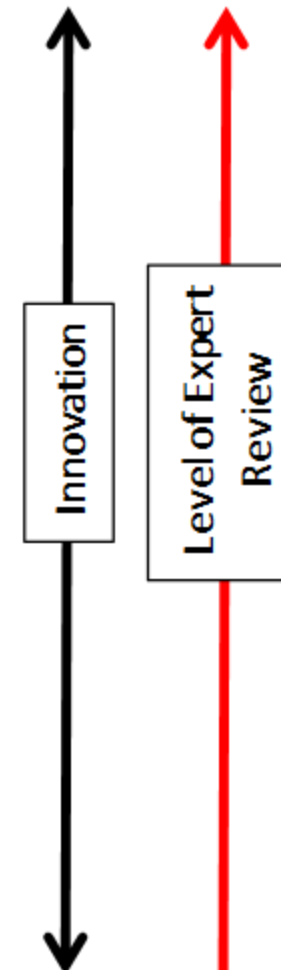


Making Neuroengineering Accessible



*Review Needed to Earn Tokens

Impacts Society <i>(patents, companies, businesses)</i>
Impacts Academia - Extensive <i>(large conferences, journal publications)</i>
Impacts Academia - Limited <i>(small conferences, conference publications)</i>
Impacts College/Community Outreach <i>(organizations, departments, college symposiums)</i>
Impacts Group <i>(peers, class, research group)</i>





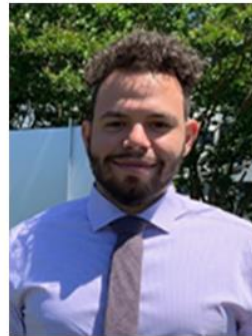
THE IMPORTANT PEOPLE



Mercedes
Terry



Abigail Tubbs



Blair Dupre



Brandon
Fugger



Enrique
Alvarez
Vazquez



Mercedes
Terry

- PhD Candidate in Biomedical Engineering, focused on Parkinson's Disease
- Co-founder of MindMend Biotech, developing wearable Parkinson's monitoring technology
- Bridges research, clinical practice, and innovation
- Committed to improving access to neurological care
- Passionate about merging science and compassion in healthcare



Abigail Tubbs

- PhD Candidate in Biomedical Engineering at the University of North Dakota
- Specializes in AI, Machine Learning, and Biomedical Informatics
- Builds scalable data pipelines and predictive models on complex healthcare datasets
- Designs intelligent systems to transform clinical data into actionable insights
- Focused on equitable healthcare delivery through data-driven solutions



Blair Dupre

- PhD Student with an MSc in Chemical Engineering and a background in Engineering Physics
- Associate Director of Operational Excellence at GSK, driving process improvement and risk reduction
- 4+ years in Lean Six Sigma and Process Engineering with a Black Belt certification
- Former Lead Investigator and Operational Excellence Partner at AstraZeneca
- Passionate about continuous improvement and innovation in biopharma



Brandon
Fugger

- PhD Student in Biomedical Engineering at the University of North Dakota
- MSc in Biomedical Engineering from Wayne State University
- Forensic Scientist at Accident Research and Biomechanics, Inc. (2021 – Present)
- Specializes in Accident Reconstruction and Injury Biomechanics
- Based in the Los Angeles Metropolitan Area, California

THE WHY

Materials – Text, Readings, Supplementary Readings

Required OER: [Introduction to neuroengineering](#)



Suggested: Computational Neuroscience

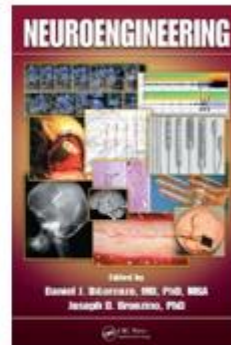
Chris Eliasmith, C. H. Anderson

ISBN: 9780262050715



Suggested: Neuroengineering
Daniel J. DiLorenzo, Joseph D. Bronzino

ISBN: 0849381746



Suggested: Neural Engineering
Bin He

ISBN: 9780306486098



Materials – Text, Readings, Supplementary Readings

Required OER: [Introduction to neuroengineering](#)



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Chris Eliasmith, C. H. Anderson

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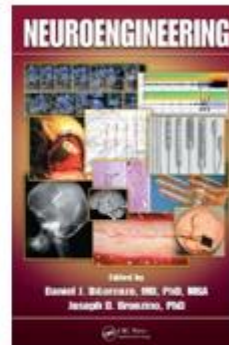
\$55



Suggested: Neuroengineering
Daniel J. DiLorenzo, Joseph D. Bronzino

ISBN: 0849381746

\$110



Suggested: Neural Engineering
Bin He

ISBN: 9780306486098

\$236



Materials – Text, Readings, Supplementary Readings

Required OER: [Introduction to neuroengineering](#)

INTRODUCTION TO

Suggested: Computational

H. Anderson
0715

\$55



Suggested: Neuro
Daniel J. DiLorenzo
Bronzino
ISBN: 084938174

Engineering
\$098



\$401

\$110

\$236

THE WHY

\$401

25 students * \$401 = \$10,025

THE START

\$401

25 students * \$401 = \$10,025

ONE YEAR!!

THE START

\$401

25 students * \$401 = \$10,025

<< \$3000 (from grant)



UND LEADS

A STRATEGIC VISION FOR UND

Mission:

To provide exceptional educational experiences that enrich the lives of North Dakotans and the global community through excellence in teaching, innovative research, and meaningful engagement.

WHY OER

- **Free global access** — no paywalls or cost barriers for students
- **Fills a gap** — specialized neuroengineering texts are scarce and expensive
- **Always up to date** — easily revised as the field evolves
- **Student development** — gives grad students a citable, public contribution
- **Accelerates the field** — open knowledge speeds up research and innovation
- **Aligns with open science** — consistent with NSF/NIH dissemination values
- **Greater visibility** — open books get more adoptions and citations

WHY OER



- ~15,000 ND residents live with Alzheimer's — with 19,000 unpaid family caregivers bearing the burden
- Dementia cases expected to double by 2060 — 66% of ND adults already have at least one cognitive decline risk factor
- Parkinson's risk is 170% higher for farmers — making rural, agricultural ND a high-risk zone for the fastest-growing neurological disease
- 2,387 strokes in ND in 2021 — many patients are hours from the nearest neurologist (only 63 in the entire state)
- Suicide rate of 22.5/100,000 — well above the national average of 14.1, driven by rural isolation and mental health care deserts
- Native Americans in ND: suicide rate of 45.1/100,000 — over 3× the national average
- \$190 million/year in ND Medicaid spending on Alzheimer's alone — projected to grow 13%+ with no intervention
- **Neuroengineering bridges the gap — remote EEG, wearable tremor monitors, DBS teletherapy, and AI diagnostics can reach patients without leaving their communities**

THE HOW

Making Neuroengineering Accessible

OER @ UND

Jackson Harper

MLS

OER Librarian, Chester Fritz Library

Contact Info

Email: jackson.harper@UND.edu

Office: 701.777.4801

Dept: 701.777.4629

Office Address

Chester Fritz Library, Room 240
3051 University Avenue Stop 9000
Grand Forks, ND 58202-9000



Annual OER grant

CHESTER FRITZ LIBRARY

SMHS LIBRARY RESOURCES

THORMODSGARD LAW LIBRARY

University of North Dakota / Research Guides / Chester Fritz Library / Open Educational Resources (OER) / Open Educational Resources

Open Educational Resources (OER)

Provides information on open educational resources

Open Educational Resources

Grant Applications

Open Educational Resources

OER Tools

Related Topics

Where to Find OER

Events & Workshops

Open Pedagogy

Associations and Initiatives

Bibliography

Contacts & Consultations

OER Showcase

Grant Applications

OER grants are available to help instructors create or adapt OERs for use in their classes.

We have funding available for OER adoption and creation. The Open Educational Resources (OER) Implementation Grant has closed for 2026. We are currently reviewing the applications.

To learn more about the UND grant, please see our FAQs on the [Open Educational Resources Grant webpage](#).

Open Educational Resources

Open Educational Resources

[Creative Commons](#)

[Handbooks & Guides](#)

Open Educational Resources (OER) = teaching, learning, and research resources that are free for use and re-purposing by others. Open educational resources include full courses, course materials, modules, textbooks, streaming videos, tests, software, and any other tools, materials, or techniques used to support access to knowledge.

The 5 Rs-- OERs allow users to:

- Retain -- users have the right to make, archive, and own copies of the content



HOW WE DID IT

PHASE 1

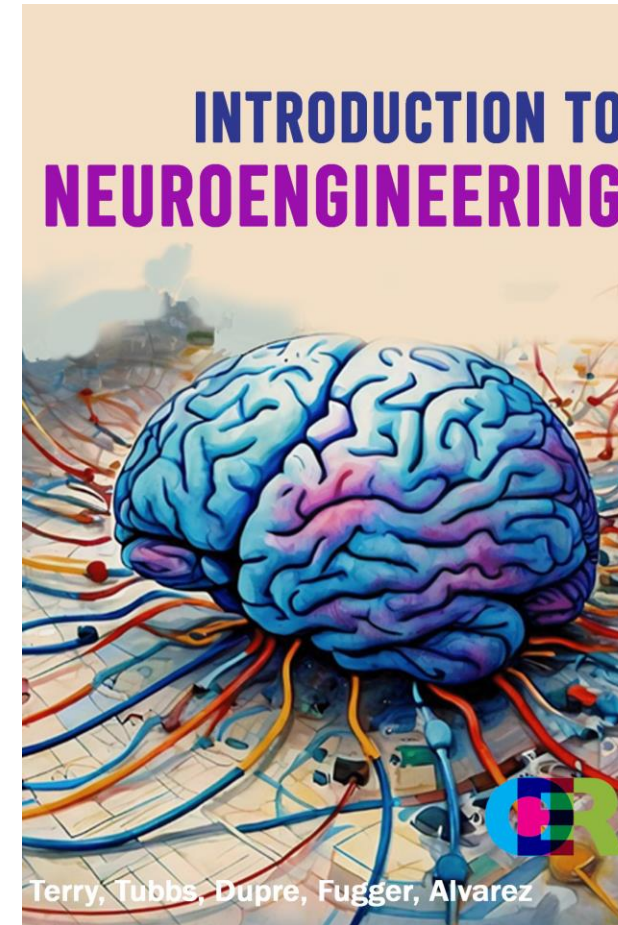
THE BOOK

12 Chapters

532 pages

294 references

A lot of effort!



HOW WE DID IT

Chapters

Each chapter organized as:

- Introduction and learning objectives
- Content of the topic
Active learning activities
- 2 examples of labs that relate to the content of the chapter

Chapter 1 – Decoding Neurons: Structure, Function and Connectivity

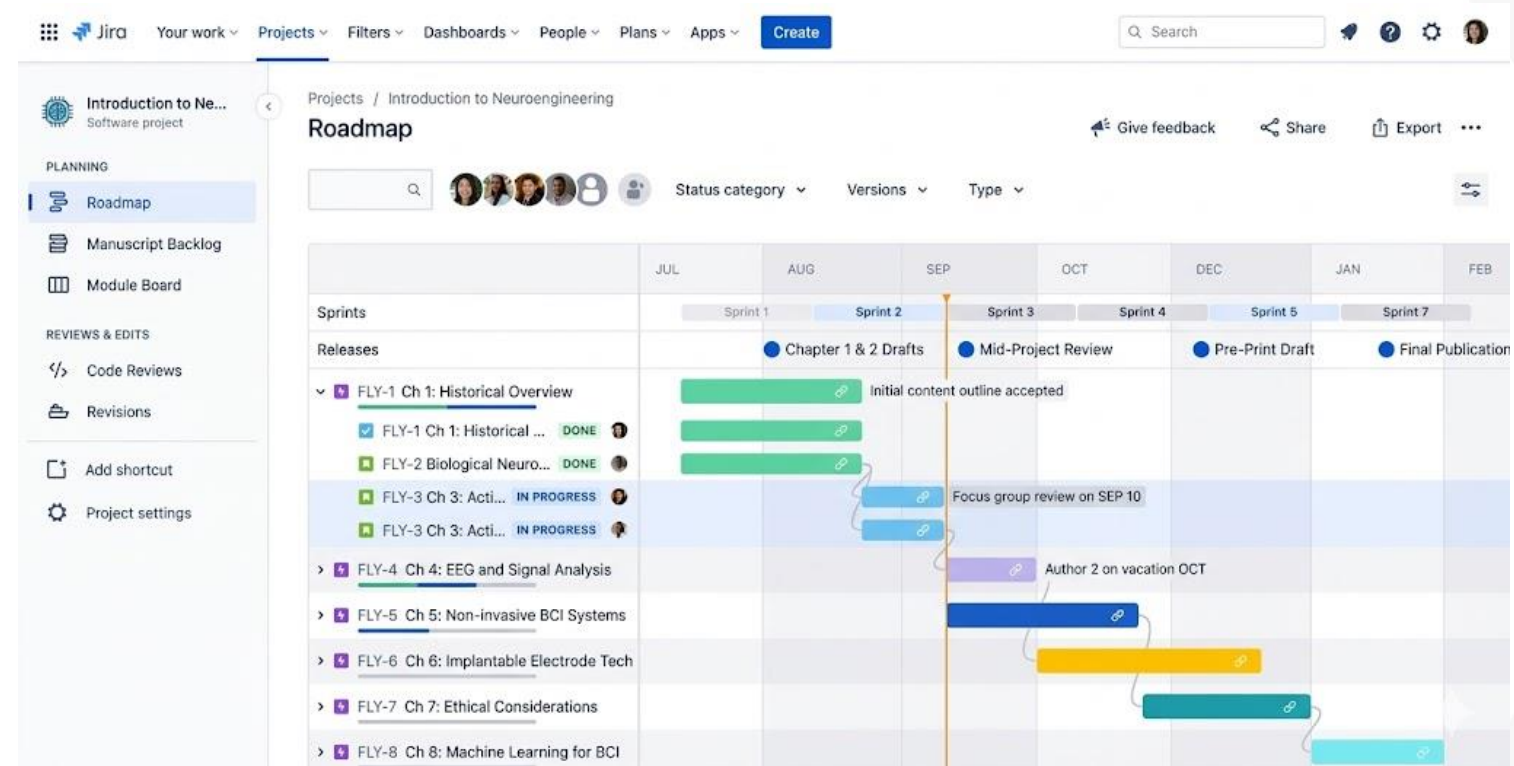
Chapter 1 – Learning Activities

Chapter 1 – Laboratories

Making Neuroengineering Accessible

HOW WE DID IT

Tasks for everybody
as engineers



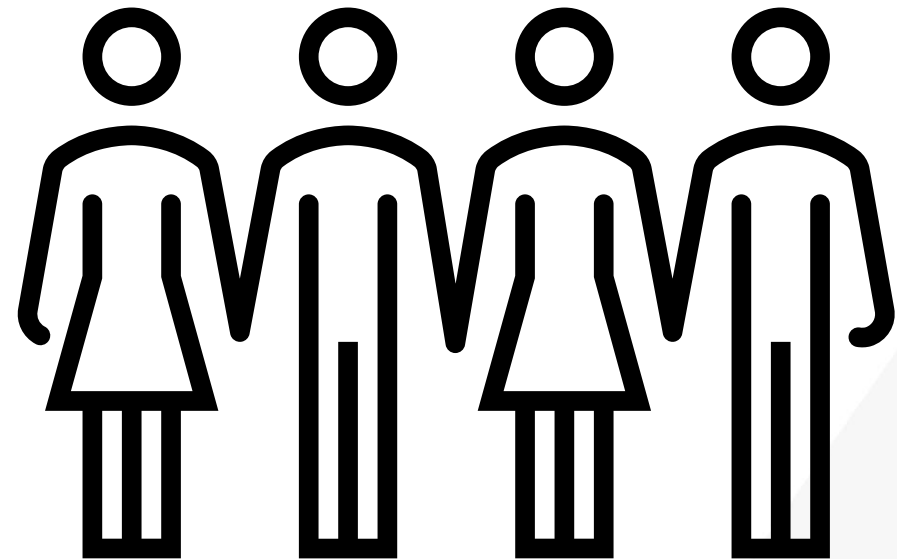
HOW WE DID IT

CC BY-NC-ND, which means:

BY – Credit must be given to the original creator

NC – No Commercial use allowed

ND – No Derivatives — you cannot modify or build upon the work

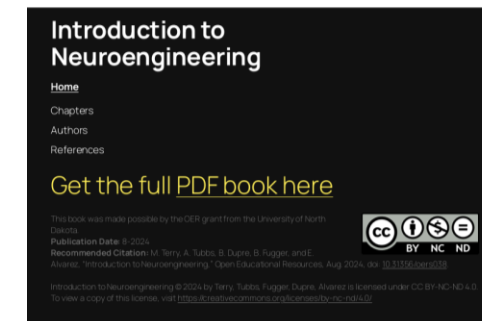
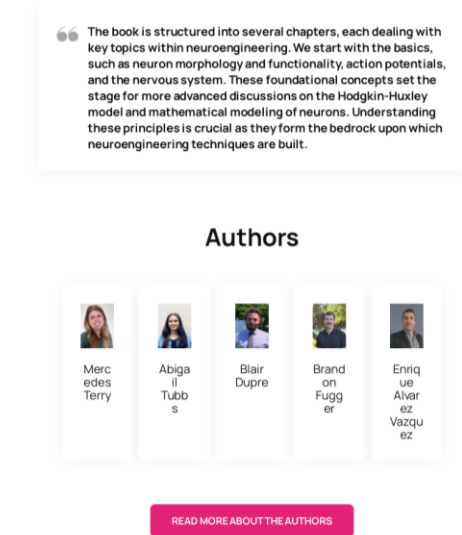
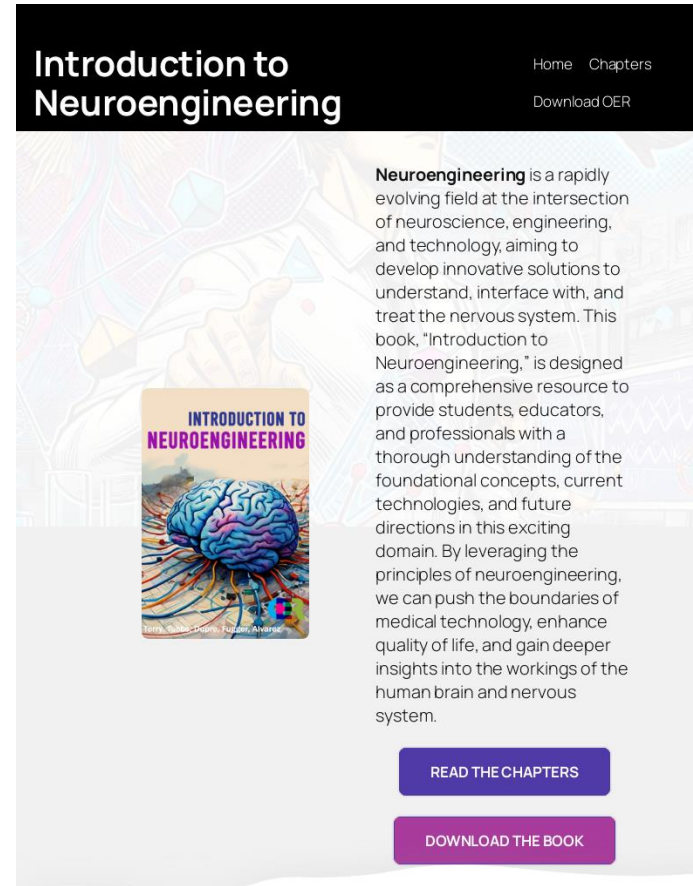


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HOW WE DID IT

PHASE 2

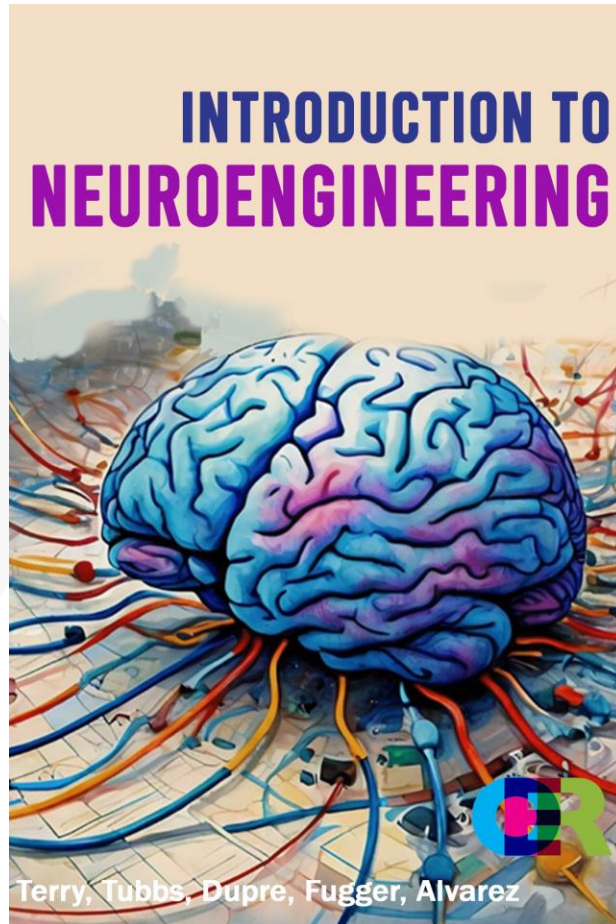
- website to promote and edit new chapters and
- 532 pages
- 294 references
- A lot of effort!



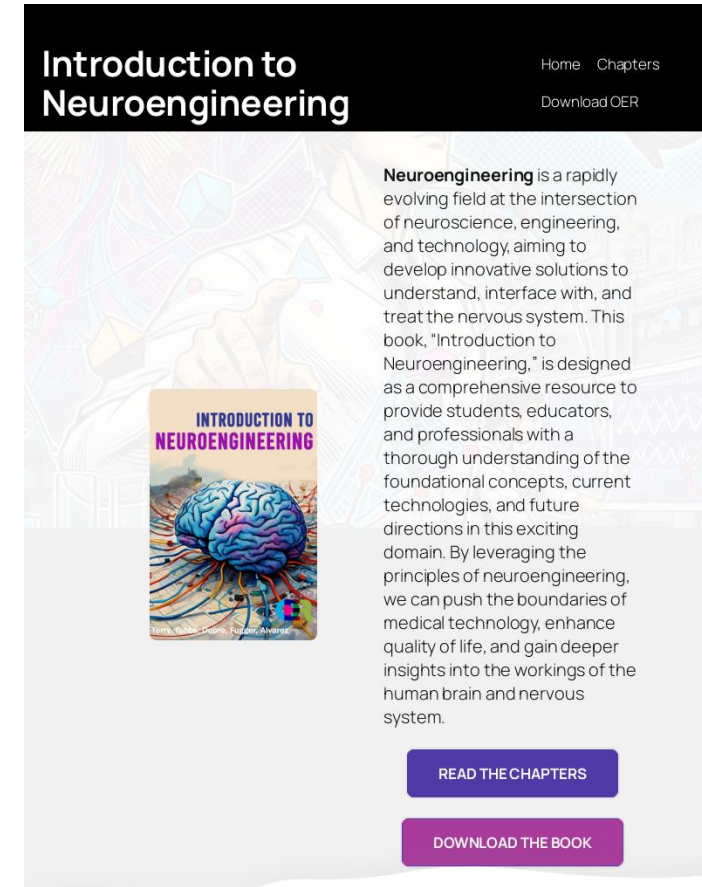
THE RESULT

Making Neuroengineering Accessible

WHAT WE DID



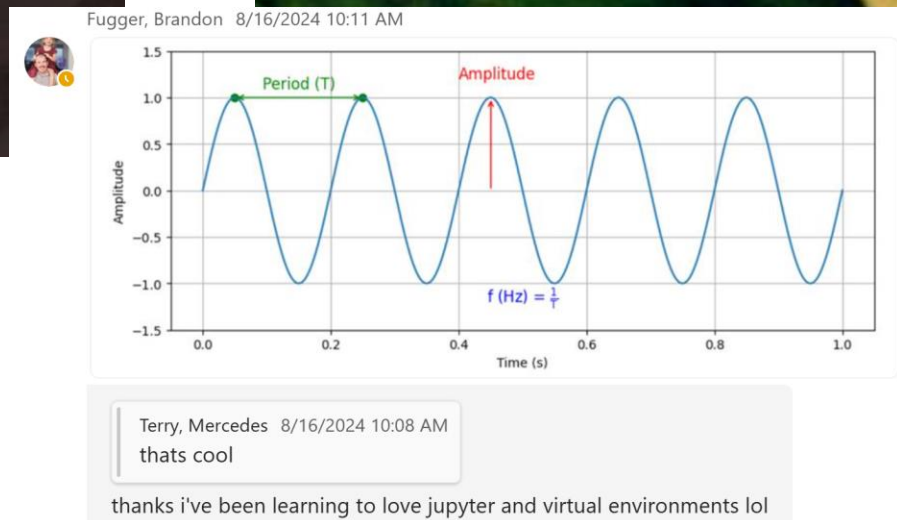
BOOK



WEBSITE

Making Neuroengineering Accessible

WHAT WE DID

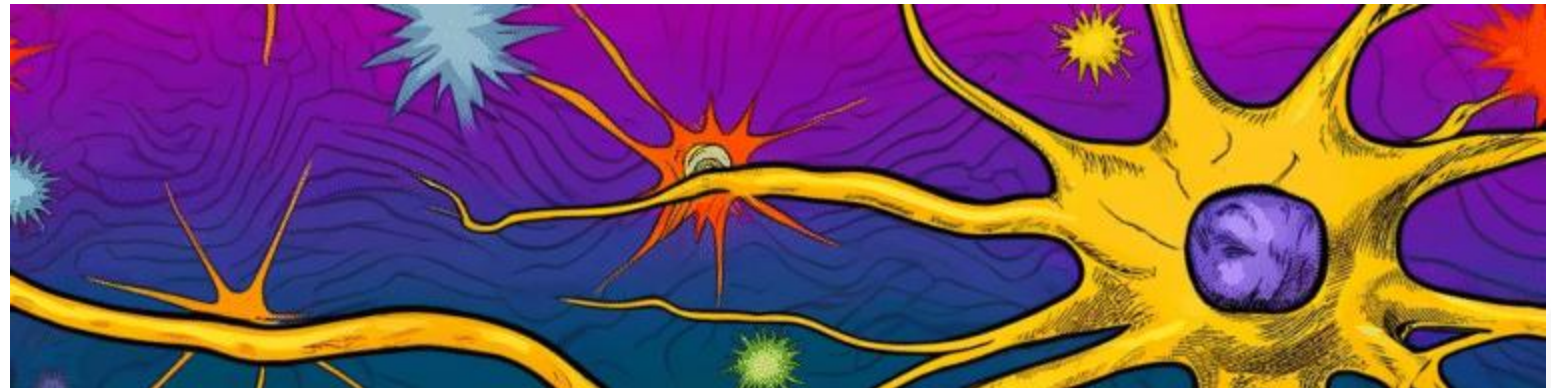


FUTURE WORK

FUTURE WORK

UPDATE
WEBSITE TO
INCLUDE NEW
CHAPTERS

- New lab experiences
- Online interactions
- Expand the impact



FUTURE WORK

UND IBL undergraduate fellows

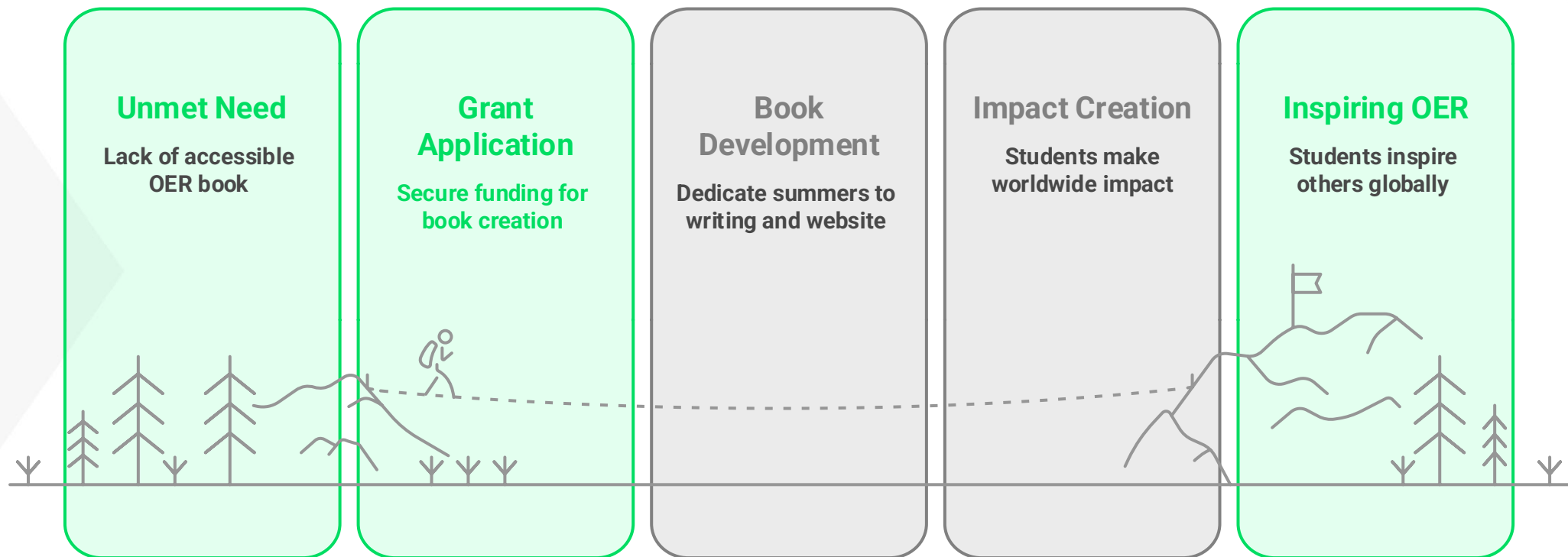
One Project -> to make an
OER for BME 180 – 45-55
freshmen /year



SUMMARY

SUMMARY

OER Book Creation





THANK YOU



<https://neuroengineeringbook.com/>