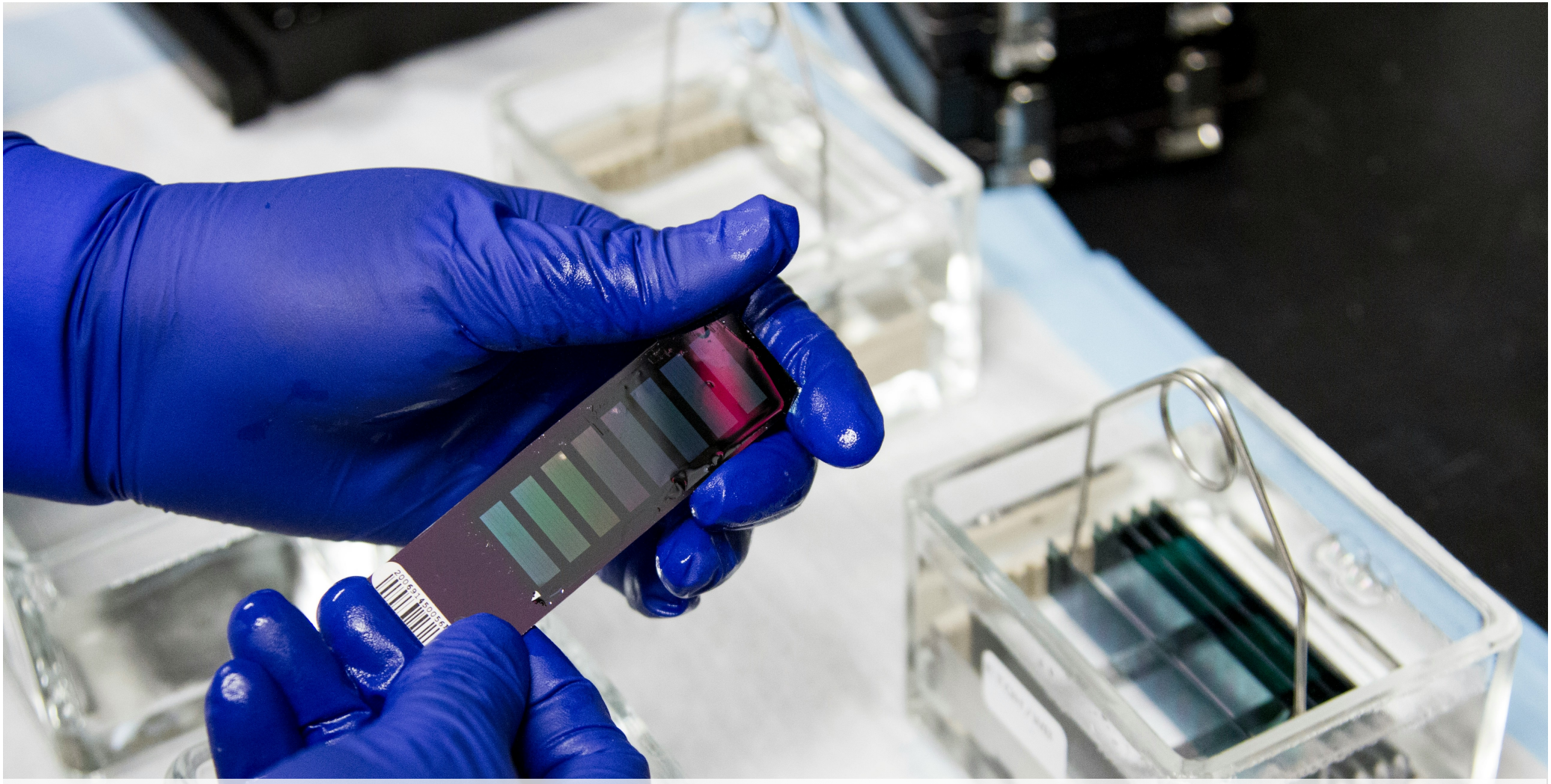


RI-INBRE Workforce Development & Training

Final Report

Sharon O'Connor, MBA, MS

August 2023

Photo by National Cancer Institute on Unsplash

Center for Program Design & Evaluation
CPDE at Dartmouth College

RI-INBRE WDT Program (Summer 2023)

The RI-INBRE Workforce Development and Training (RI-INBRE WDT) program[1] provides intensive, hands-on biomedical skills training to RI-INBRE's summer undergraduate research students in the RI-INBRE Centralized Research Core Facility (CRCF).

Mission: RI-INBRE WDT provides trainees with biomedical skills that are valuable to the biotechnology industry.

Aim: Train undergraduate student trainees in the theory and practice of operating advanced biomedical research instrumentation so they will be preferred candidates for positions in chemical and biotechnology companies after graduation.

Methods: University of Rhode Island faculty and staff conducted eight intensive 2.5-day training modules (each offered in two or three sessions) for small groups of trainees, allowing instructors to provide significant individual attention for each WDT participant.[2] Sessions were held from June 21 through August 9, 2023.

Evaluation: The Center for Program Design & Evaluation (CPDE) at Dartmouth College conducted an independent evaluation of the RI-INBRE WDT.

A survey link was emailed to the 65 trainees on August 10, 2023 to assess their opinions, experiences, and the degree to which they found the session useful. The survey also solicited free-form comments about their key take-aways and specific skills they acquired from the module they attended. Up to three reminders were sent periodically to non-responders and the survey was closed on August 19, 2023.

[1] RI-INBRE WDT is supported by the Rhode Island Department of Labor and Training (RI-DLT).

[2] Source documentation on https://web.uri.edu/riinbre/workforce-development-and-training-program/ Accessed 2023.

RI-INBRE WDT Program (Summer 2023)

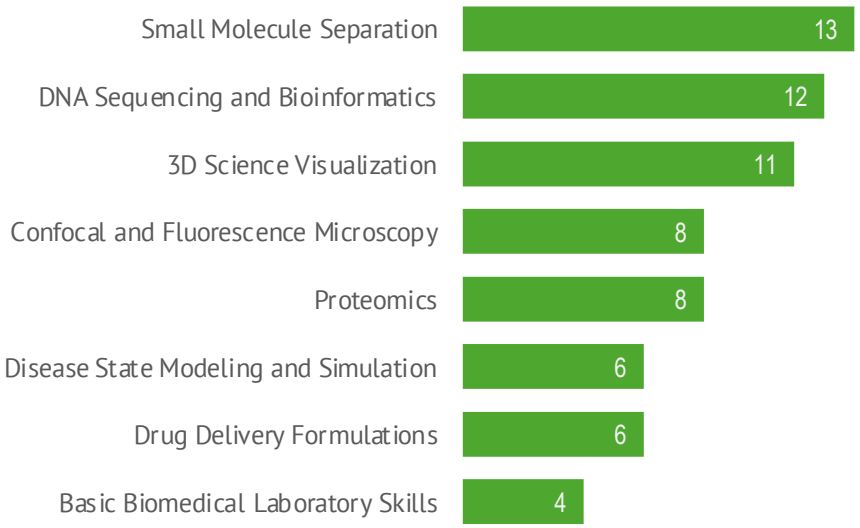
Of the **65** trainees who were invited to take the survey,

44 completed enough of it for analysis and reporting, for a

68% response rate.

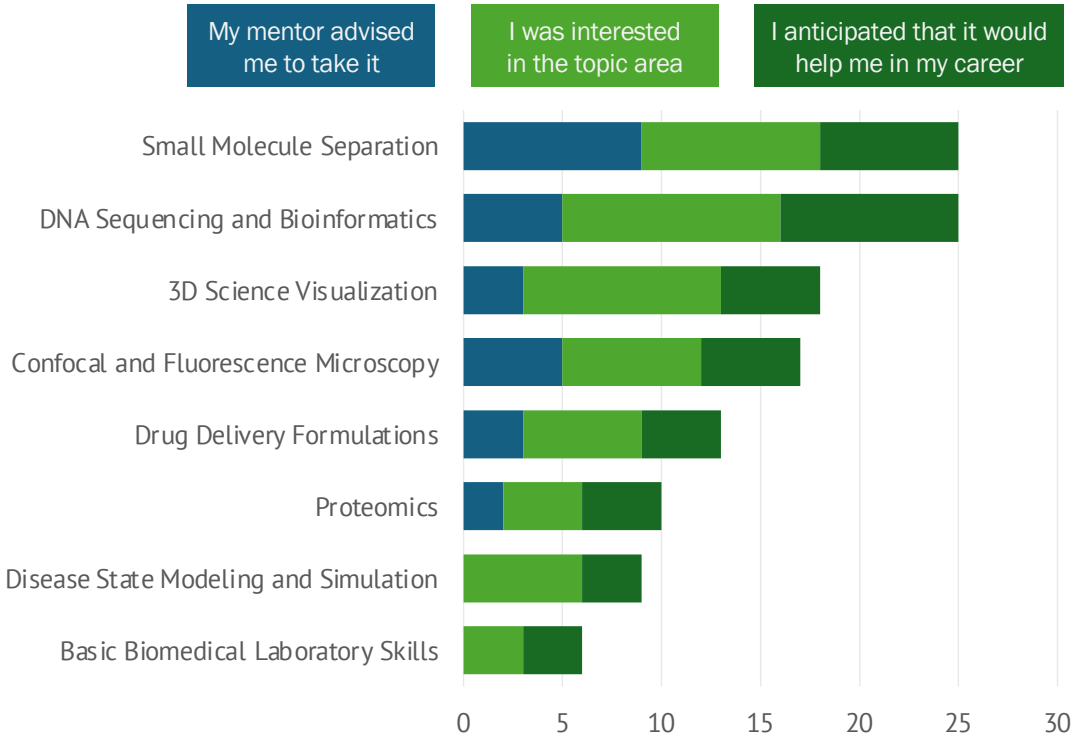
24 respondents attended one module, 20 attended two modules, and 4 attended three modules.

Chart shows number of respondent attendees for each module.



Most often, students signed up for a module because they were interested in the topic area.

Question: Why did you take each of the training module(s) you attended?



Number of respondents who chose each option for each module (multiple selections allowed).

CPDE

RI-INBRE WDT Program (Summer 2023)

We asked respondents to share any other reasons why they attended a WDT session.

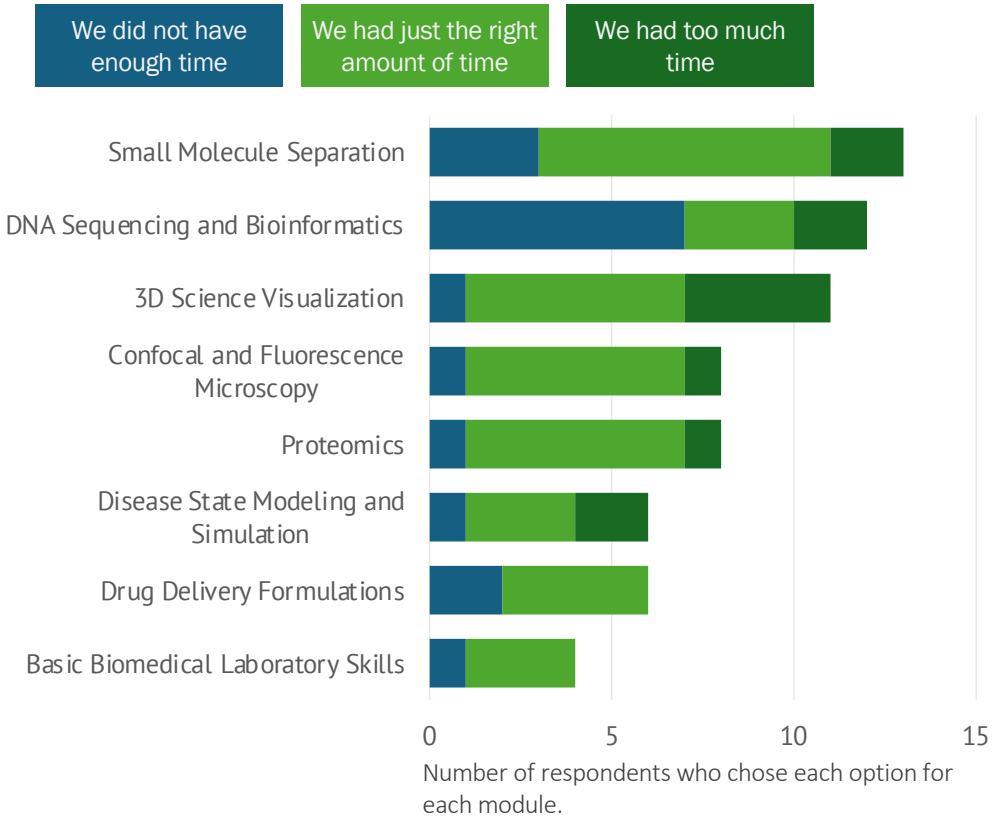
Here is a summary of the 13 responses:

Response	Modules
Plan to become a physician; helpful to attend a module to aid my understanding of diseases and how to care for it in a simulation	Disease State Modeling and Simulation
No background in any of the modules; interested in learning out of personal interest and to use what I learn in a career	3D Science Visualization, DNA Sequencing and Bioinformatics, Proteomics
3D visualization is a growing field as 3D printing expands; visuals always help in understanding so getting familiar with these programs is useful	3D Science Visualization
Wanted to learn more about the process of sequencing samples at the INBRE GSC; also working with RNA-seq data and wanted to learn about other peoples' bioinformatic pipelines	DNA Sequencing and Bioinformatics
Previously worked in a lab that used confocal fluorescence microscopy and wanted to see if there were applications that would benefit my entire lab group	Confocal and Fluorescence Microscopy
Currently working with DNA sampling of soils so it seemed like a good course to take to learn more	DNA Sequencing and Bioinformatics
These modules could help me with projects we are working on in our lab	Small Molecule Separation, 3D Science Visualization, Proteomics
To enhance my knowledge of bioinformatics, using computer programs (R and Python), and help me in my summer research topic	DNA Sequencing and Bioinformatics
Small Molecule Separation was useful for my current research; no exposure to proteomics so that module was a chance to learn a lot and explore further interests and future career paths	Small Molecule Separation, Proteomics
Helped me in complete my SURF project and improved the quality of my data analysis	Confocal and Fluorescence Microscopy
Small Molecule Separation helped me in my research lab as we work with micro and nano particles – it introduced me to more instruments and techniques that we may use	Small Molecule Separation, 3D Science Visualization
Disease State Modeling and Simulation really intrigued me because I wanted to experience a real situation with a patient in the pharmacy field to reassure myself that pharmacy is something that I definitely want to do	Small Molecule Separation, Disease State Modeling and Simulation
The modules helped me in my current research; they were about topics I had not learned about	DNA Sequencing and Bioinformatics, Proteomics

RI-INBRE WDT Program (Summer 2023)

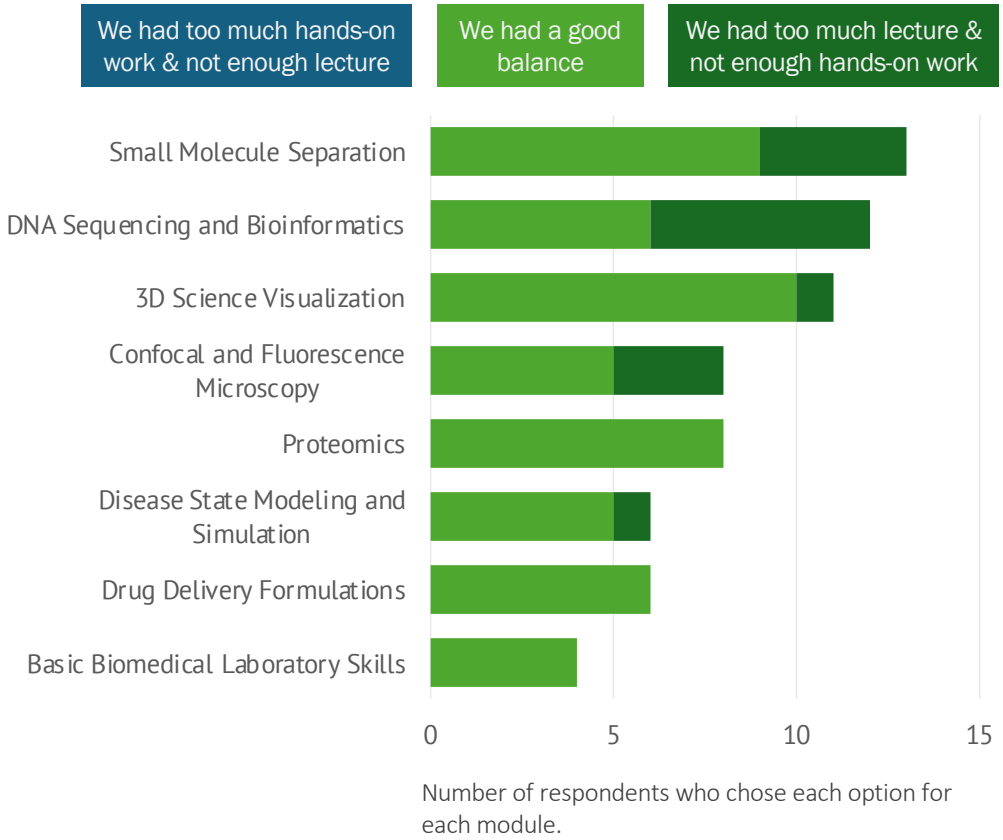
Most respondents felt that the right amount of time was allocated to the sessions they attended.

Question: How was the time allotment for the training module(s) you attended?



Respondents overwhelmingly thought they experienced a good balance of lecture and hands-on work.

Question: How was the balance of hands-on work vs. lecture for the training module(s) you attended?

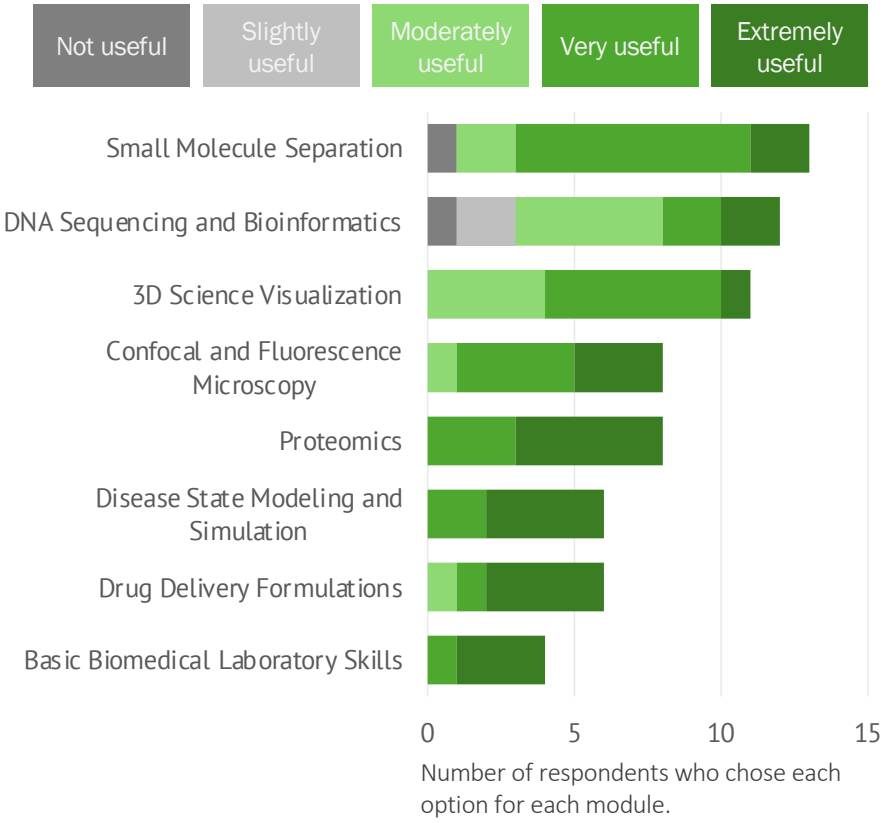


CPDE

RI-INBRE WDT Program (Summer 2023)

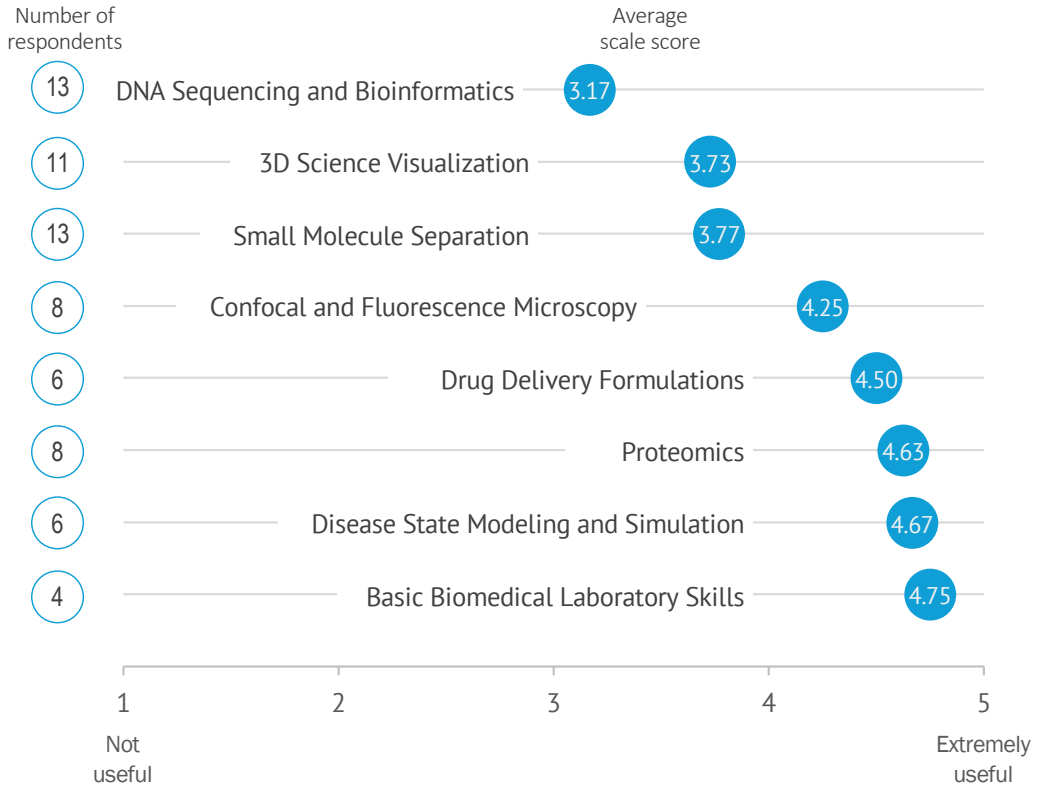
Most modules were thought to be at least moderately useful by all respondents, based on a 5-point Likert scale.

Question: How useful was each of the training module(s) you attended?



Basic Biomedical Lab Skills had the highest average scale score but was rated by only 4 respondents. Modules with the fewest attendees got the higher scores.

Question: How useful was each of the training module(s) you attended?



CPDE

RI-INBRE WDT Program (Summer 2023)

Respondents who rated a module as not useful or only slightly useful were asked to share their thoughts about what would improve the module.

Here is a summary of the 3 responses:

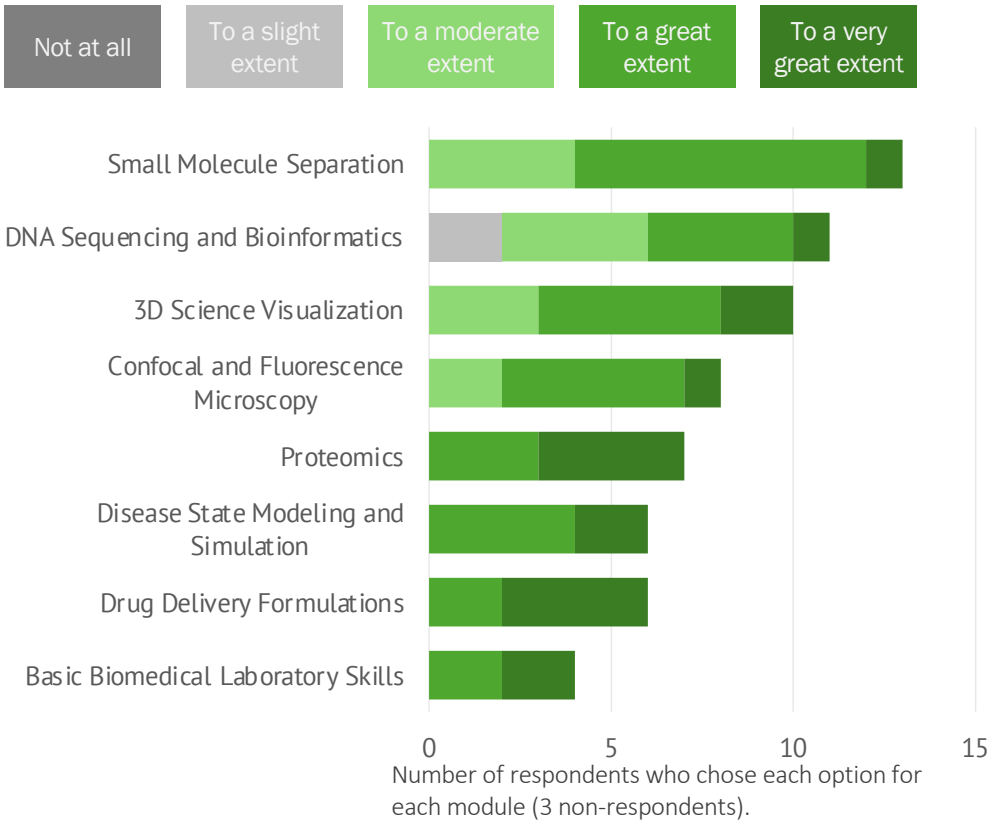
Response	Rating	Module
Module was targeted more for undergraduates with little lab experience; I wish there was a graduate section of these classes with more advanced techniques and more in-depth lecture content	Slightly useful	DNA Sequencing and Bioinformatics
Module was not about how to actually use bioinformatics – it was teaching us what it was and how it could be used; little practice time and the lab did not correspond with the lecture material	Not useful	DNA Sequencing and Bioinformatics
Module was mostly lecture with little to no hands-on experience; very small details were covered but not the big picture or explanation of why we were using the machines; some of the machines weren't ready or working so the teacher ran it and just showed us so we didn't know what happened	Not useful	Small Molecule Separation

> "These modules were about topics that I have not had the opportunity to learn about, and for which few classes are offered at URI. Thus, without the modules, I would have had to learn about these topics myself, and so I looked forward to the structured modules."
>
> WDT respondent (DNA Sequencing & Bioinformatics; Proteomics)

RI-INBRE WDT Program (Summer 2023)

All modules met respondents' expectations, most to a great or very great extent.

Question: To what extent did the training module(s) you attended meet your expectations?



Respondents who rated a module as not meeting or only slightly meeting their expectations were asked to indicate how the module could have been better.

Here is a summary of the 2 responses:

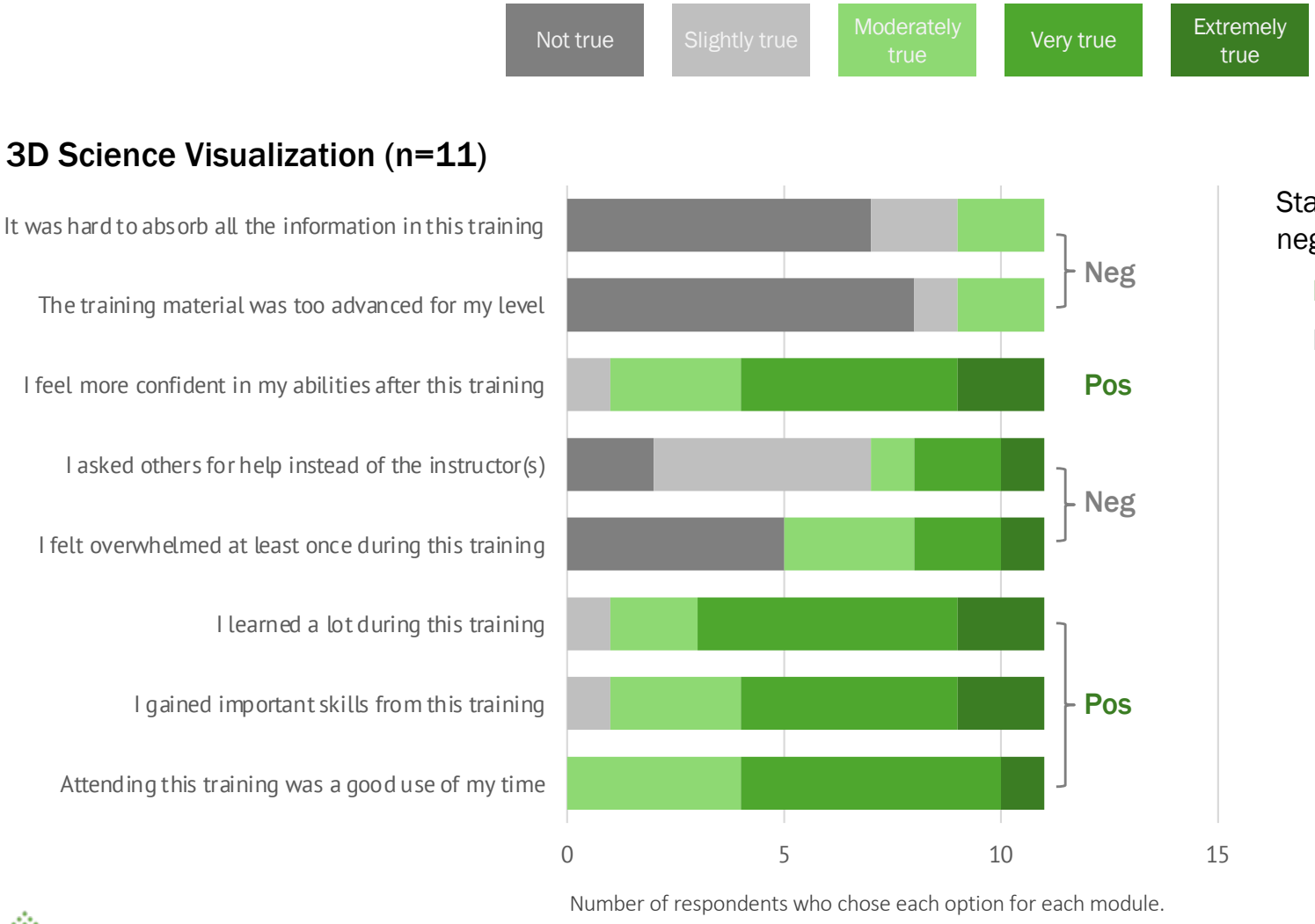
Response	Rating	Module
Useful training for teaching us what bioinformatics is and what it's used for, but expected more training on how to use some of the software we learned about (I wouldn't be able to do any of this work on my own if need be)	Met expectations to a **slight** extent	DNA Sequencing and Bioinformatics
Expected this module to help with my research and teach me how to apply bioinformatics skills to my own project	Met expectations to a **slight** extent	DNA Sequencing and Bioinformatics

CPDE

RI-INBRE WDT Program (Summer 2023)

In reference to the module listed below, this figure shows responses to the question:

To what extent is each of the following statements true for you, regarding your experience in the training module?



Statements have either a positive or negative valence:

Positive (dark green is better)

Negative (dark gray is better)

CPDE

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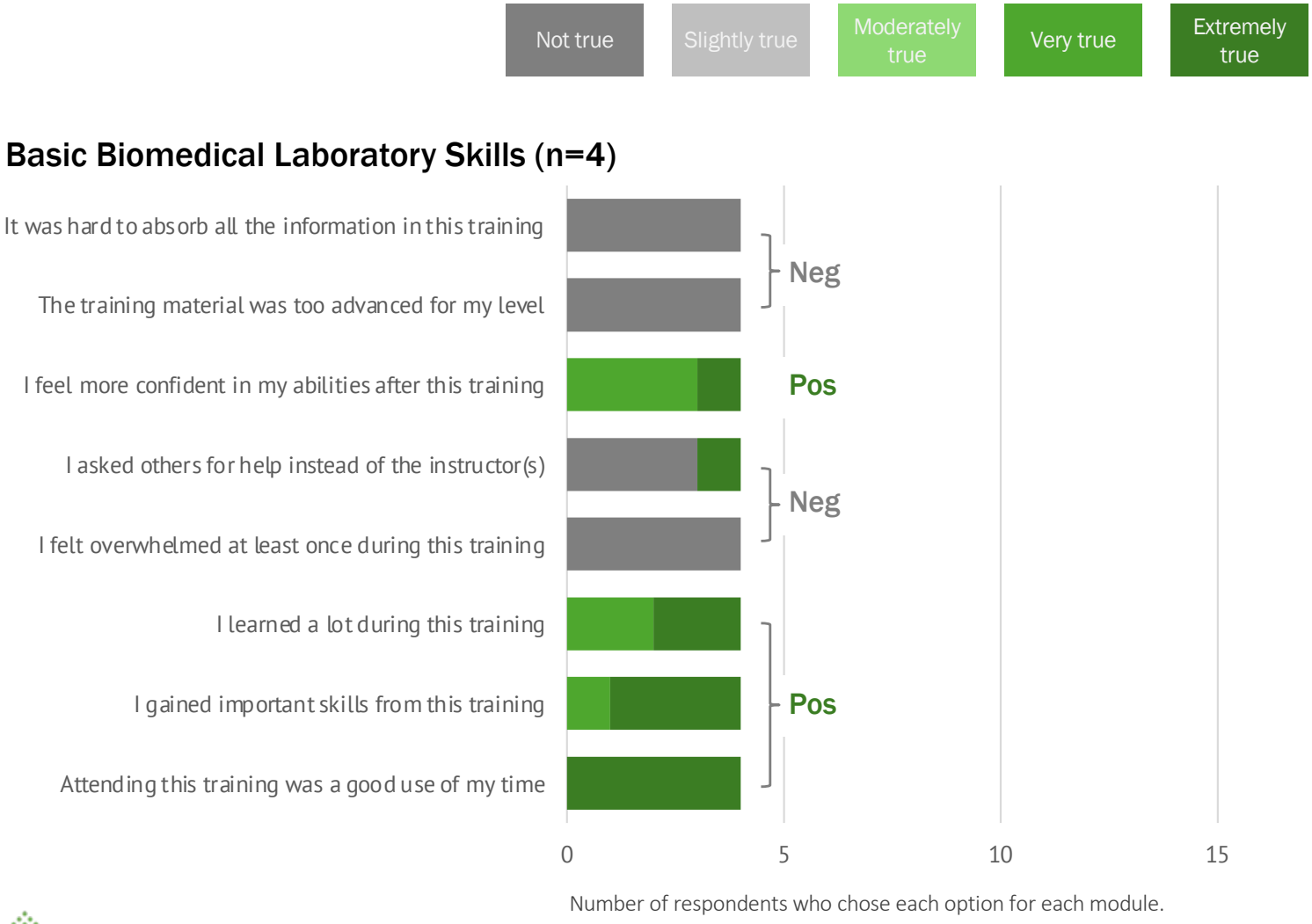

CPDE

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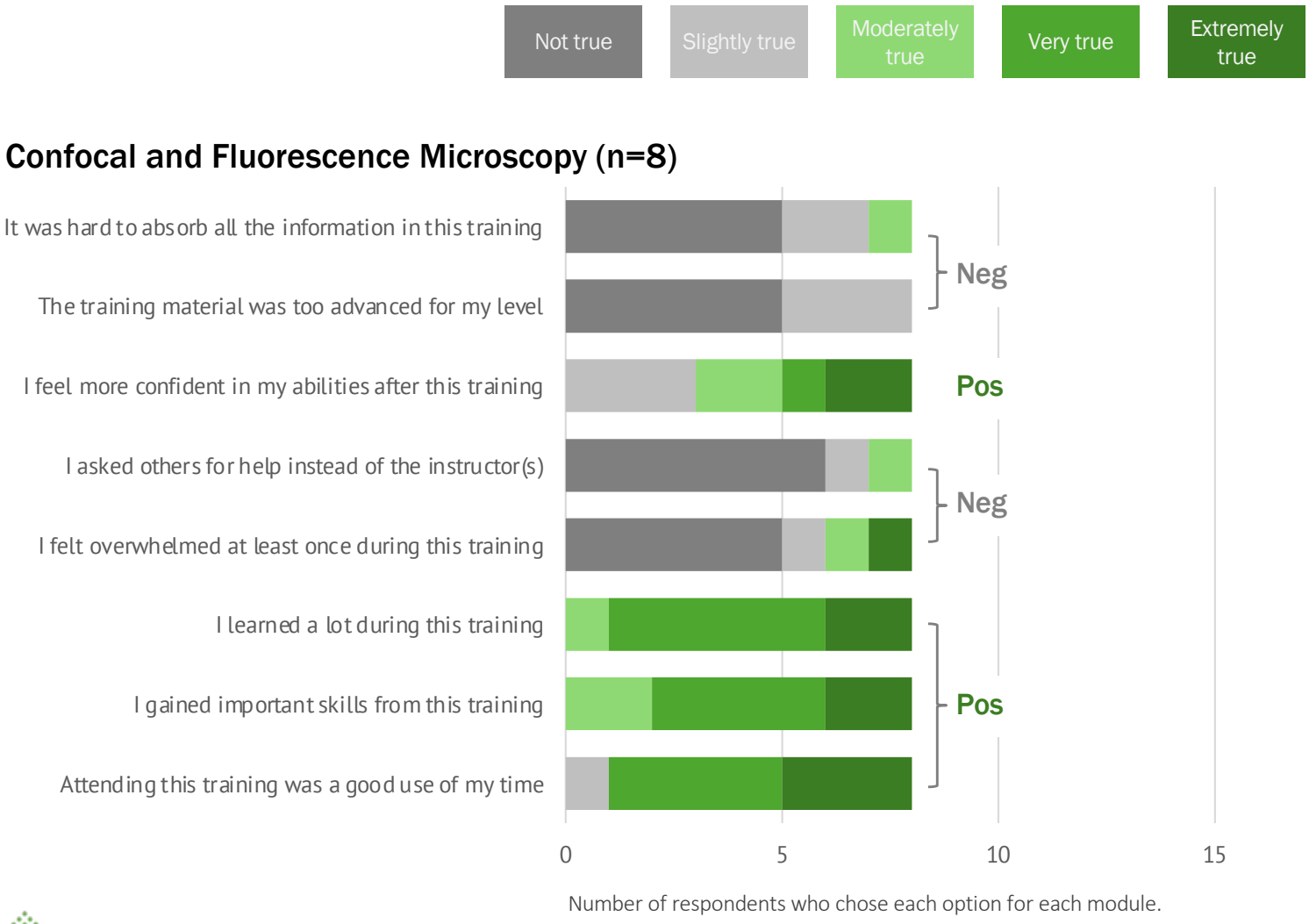

CPDE

RI-INBRE WDT Program (Summer 2023)

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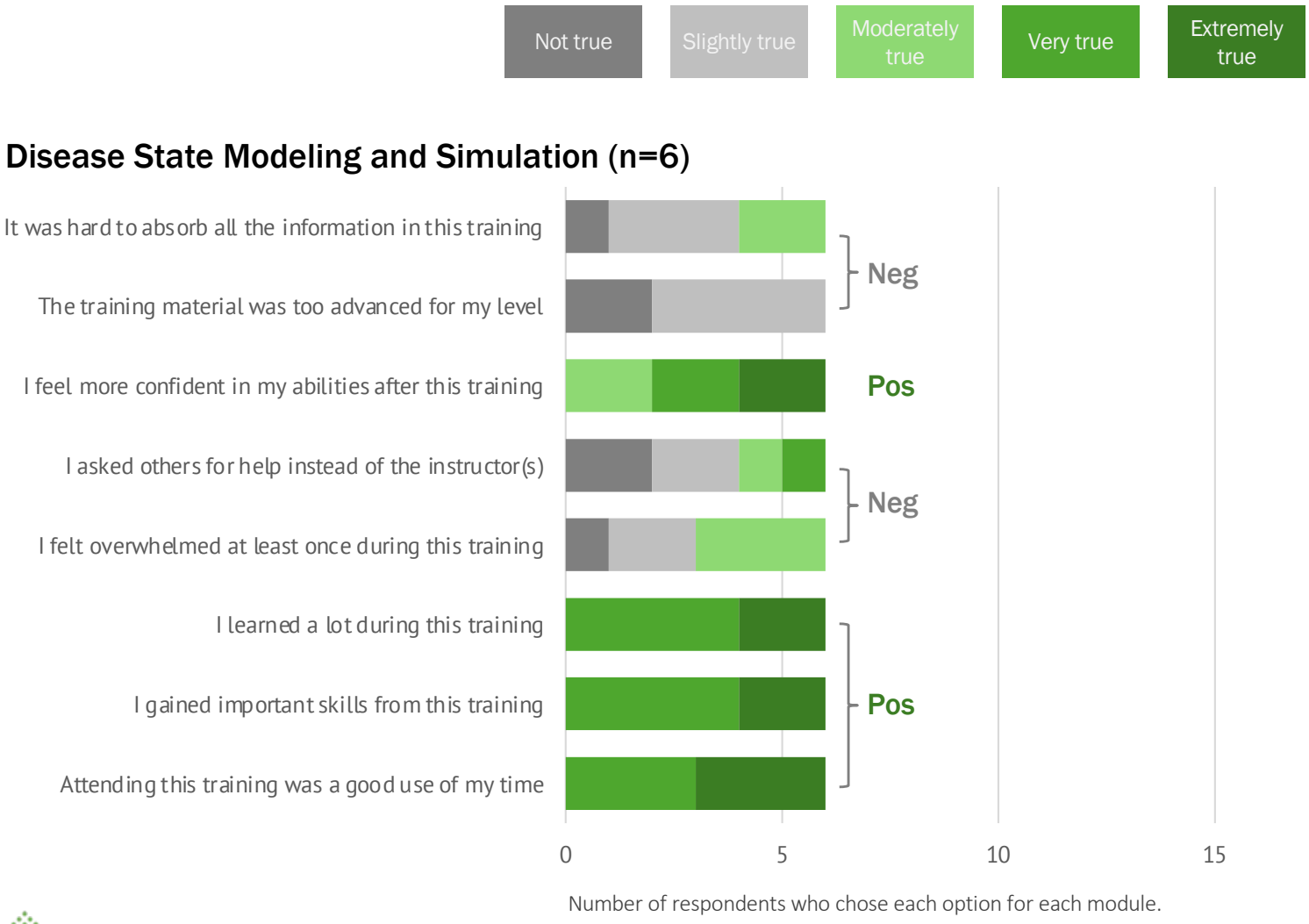

CPDE

RI-INBRE WDT Program (Summer 2023)

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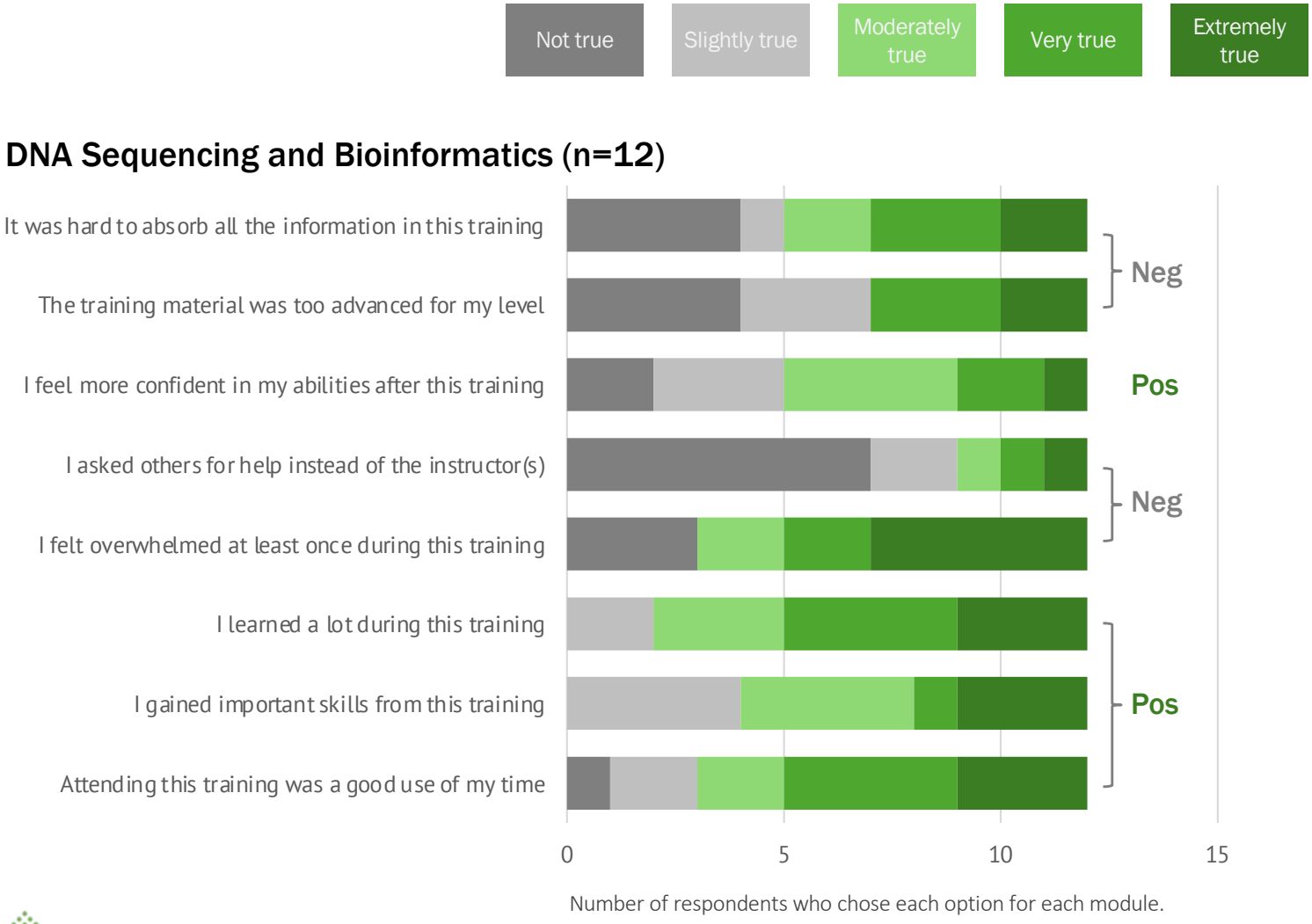

CPDE

RI-INBRE WDT Program (Summer 2023)

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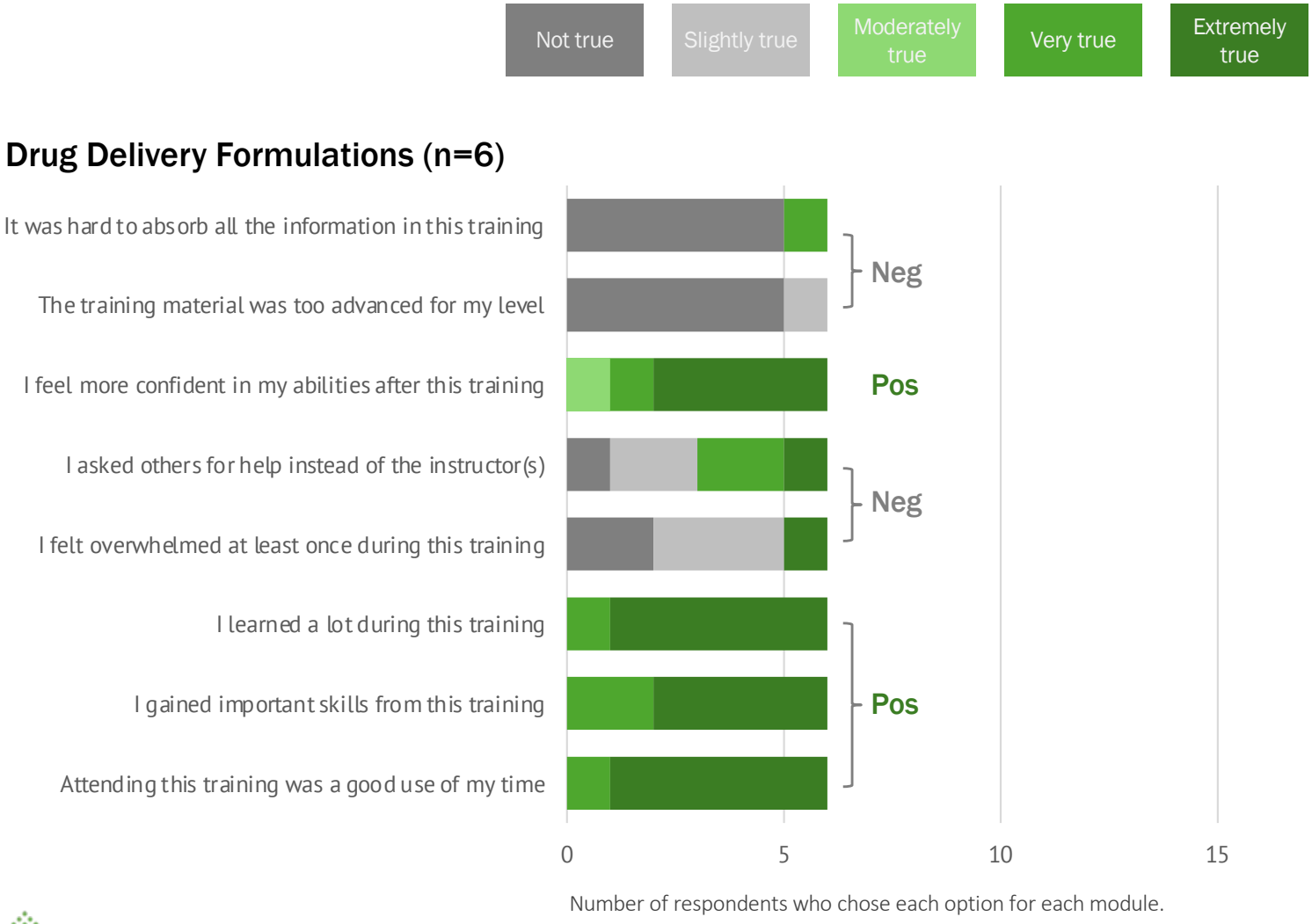
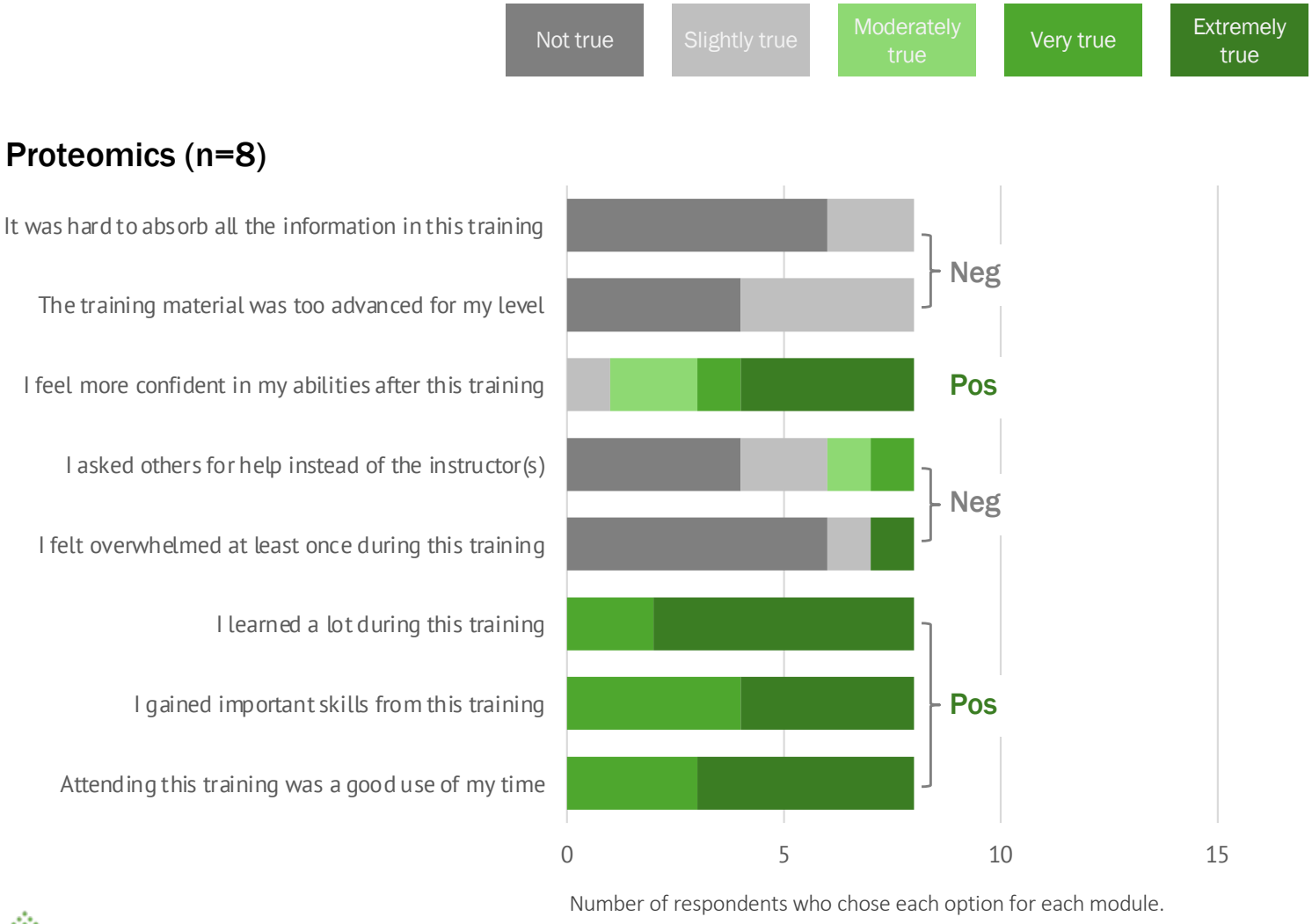


CPDE

RI-INBRE WDT Program (Summer 2023)

In reference to the module listed below, this figure shows responses to the question:

To what extent is each of the following statements true for you, regarding your experience in the training module?

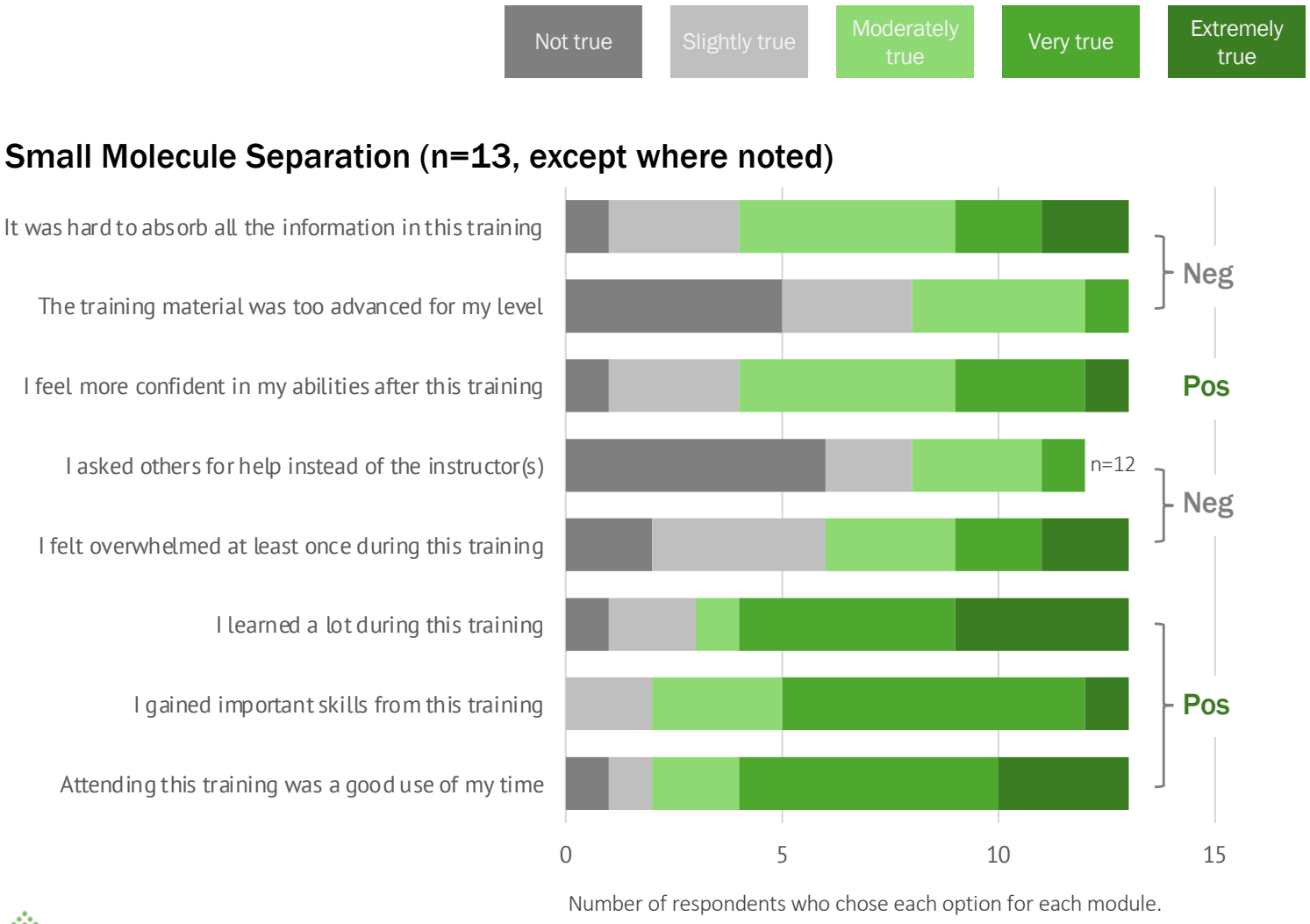


CPDE

RI-INBRE WDT Program (Summer 2023)

In reference to the module listed below, this figure shows responses to the question:

To what extent is each of the following statements true for you, regarding your experience in the training module?

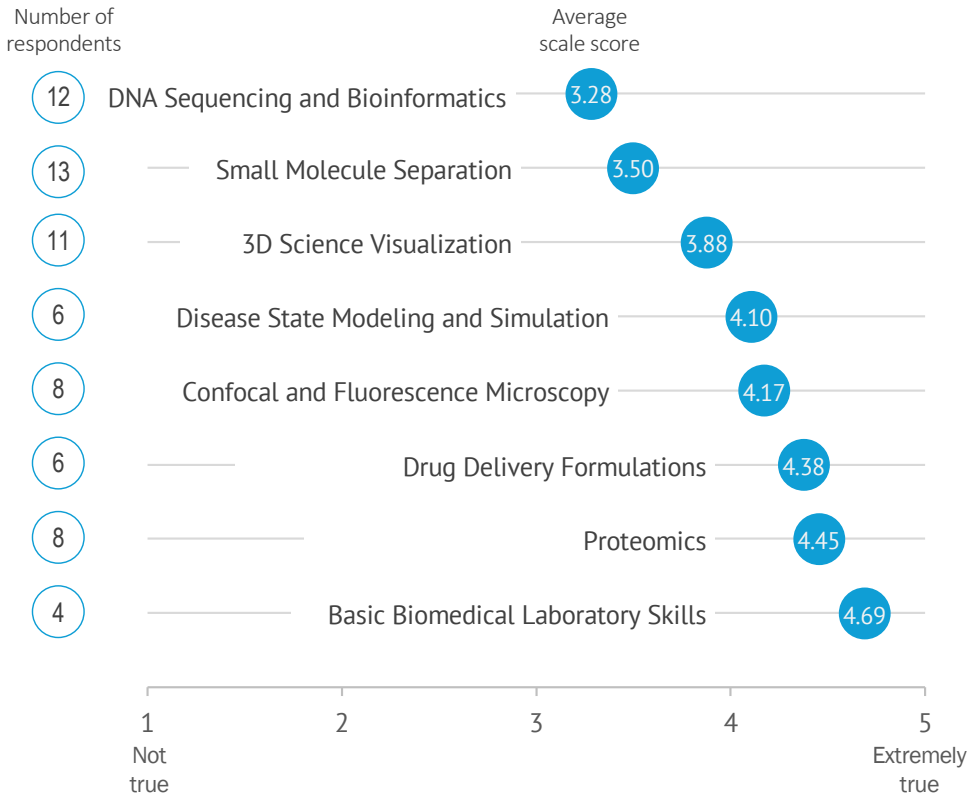


CPDE

RI-INBRE WDT Program (Summer 2023)

This figure shows the average sum of scale score for the question “To what extent is each of the following statements true for you, regarding your experience in the training module?” This is a composite view of the responses shown in the previous eight pages.

The negatively worded statements have been reverse-coded, so they are aligned with the other statements. For this figure, the higher the number (closer to 5), the more favorable the responses for that module.



> This was a great training experience that gave me insights into confocal and fluorescence microscopy and proteomics. I would have never had an opportunity like this if it weren't for RI INBRE. I enjoyed my time very much and believe I can use what I've learned to the full extent in the future.
>
> WDT respondent (Confocal and Fluorescence Microscopy; Proteomics)

RI-INBRE WDT Program (Summer 2023)

Respondents answered the question:

"Please list 2 or 3 of the skills that you learned in the module(s) you attended."

Responses are listed to the right and on the following pages, grouped by module.

3D Science Visualization:

3D printing and computer work

3D science visualization was helpful for me understanding proteins and what they do which is useful when looking at many cell cultures.

Chimera software for 3d printing, Nanome software

Formatting for 3D printing and also a better understanding of how to use virtual reality for learning

I learned the applications of machine learning in research as well as the different modeling software that are used in research and the advantages of these softwares to other methods

Alphafold software, 3D printing techniques, and how to display models for the best imaging

modifying and preparing a molecule for 3D printing with Chimera software, rotating and adjusting a 3D structure in a virtual reality program, creating and altering a 3D structure in a computer program

Protein drug interactions simulation, researching global protein database

Using new software, 3D printing

3D print preparation, VR model setup, Protein analysis

Protein Modeling, Use of PubChem

Basic Biomedical Laboratory Skills:

Agar gel preparation, pipetting, cell cultures

I learned to correctly pipette, the process of growing bacteria/counting colonies, and dissecting research papers.

Measuring, microscopy

Pipetting, electrophoresis, serial dilution

RI-INBRE WDT Program (Summer 2023)

“Please list 2 or 3 of the skills that you learned in the module(s) you attended.”

Confocal and Fluorescence Microscopy:

1) Proper procedure for starting and taking "paper-worthy" images. 2) Pitfalls and how to avoid them in the fluorescence microscopy process. 3) ImageJ analysis of images and common characterizations for papers.

How to open and close microscope procedures. How to analyze images with different cell lines

How to operate a fluorescence and confocal microscope, how to take images, how to get clearer imaging.

Look Up Tables, Thresholding

Microsope image analysis, optimizing conditions on the microscope, navigating Nikon software

problem-solving, ethical manipulation of images

Understanding how light works in a microscope, operating the microscope program, how to apply to current research

Use of the microscope and software

Disease State Modeling and Simulation:

Creating a Case Study, Evaluating patient vitals, CPR

data collection, reporting, making a case

Practice cpr, diagnose patients, learned about drugs

Understand pathophysiology pathways of diseases. Interpret data from literature and how it would help in the patient simulation.

how to identify basic pathophysiology, how to prepare a clinical scenario, and how drugs work in the body (pharmacodynamics and pharmacokinetics)

Modeling Diseases, CPR BLS

RI-INBRE WDT Program (Summer 2023)

“Please list 2 or 3 of the skills that you learned in the module(s) you attended.”

DNA Sequencing and Bioinformatics:

Ability to understand basic terms and concepts, which enables me to do further reading; how to access resources to practice the skills learned in the workshop; how to choose sequencing technologies, based on the needs of the project

about multiomics, dna extraction and sequence analysis varios methods and how to utilize the codes and programs and to use the National Institute of General Medical Sciences Cloud Learning Modules

How to interpret bioinformatic data. How to choose what type of "omics" to run based on what your research questions are.

SNAKE

understanding DNA sequencing/analysis pipelines, tools and resources for achieving the same

Using Google Cloud services, using workflow managers like Snakemake

working in IPA and the modules on Github were useful

DNA Seq taught me how DNA analysis is conducted.

Running PCR Tests, Running Bioinformatics Software

Understating pipelines, how to apply to research, using AI to sort through sequencing

Using Jupiter Notebook, Using Github as Coding source

RI-INBRE WDT Program (Summer 2023)

"Please list 2 or 3 of the skills that you learned in the module(s) you attended."

Proteomics:

How a MS works, how samples are prepped for MS, how to analyze data from the MS scanner.

Mass spec, Gel pipe type tips, how to analyze data in excel

SAMPLE PREP AND PROTEOMIC DATA ANALYSIS

Sample preparation and analysis using mass spectrometry; proteomics data analysis with Excel and other specific software; ability to understand the interpretations made with proteomics data, allowing me to understand research which uses proteomics

Understand LC-MS workflow, Mass-spec analysis

UPLC analysis, spectronaut, pathway analysis

Cell digestion, prep for LCMS, protein analysis

I learned how to process cell cultures and run them through analysis which can be compared over a network of existing data.

Drug Delivery Formulations:

drug release studies, drug delivery, microparticle synthesis and nanoparticle synthesis

Nanoparticle development, Drug delivery methods, and how to use new instruments in the lab for analysis

Drug Release, Nano/Micro/Macro particle preparation, cell culture

Pipetting, dilutions

Using different instruments such as DLS and EVOS, how to use Excel for data collection

RI-INBRE WDT Program (Summer 2023)

"Please list 2 or 3 of the skills that you learned in the module(s) you attended."

Small Molecule Separation:

Different way of separating small molecule operation. Connections with other research groups and what they are doing across RI

how and why chemical separate; and the different kind of machines use to separate them such as HPLC and NMR.

How to read NMR data, the different parts of HPLC and how to use it

HPLC analysis, sample preparation, NMR analysis

Lab skills, about NMR

NMR, Mass Spec, HPLC setup

preparing a sample for use in an HPLC instrument, operating an HPLC instrument, setting up and operating NMR studies

Preparing and loading samples for HPLC, preparing and loading samples for NMR

Sample prep for HPLC, operating HPLC, HPLC analysis

Sample Preparation, HPLC analysis

Using HPLC, Interpreting NMR result

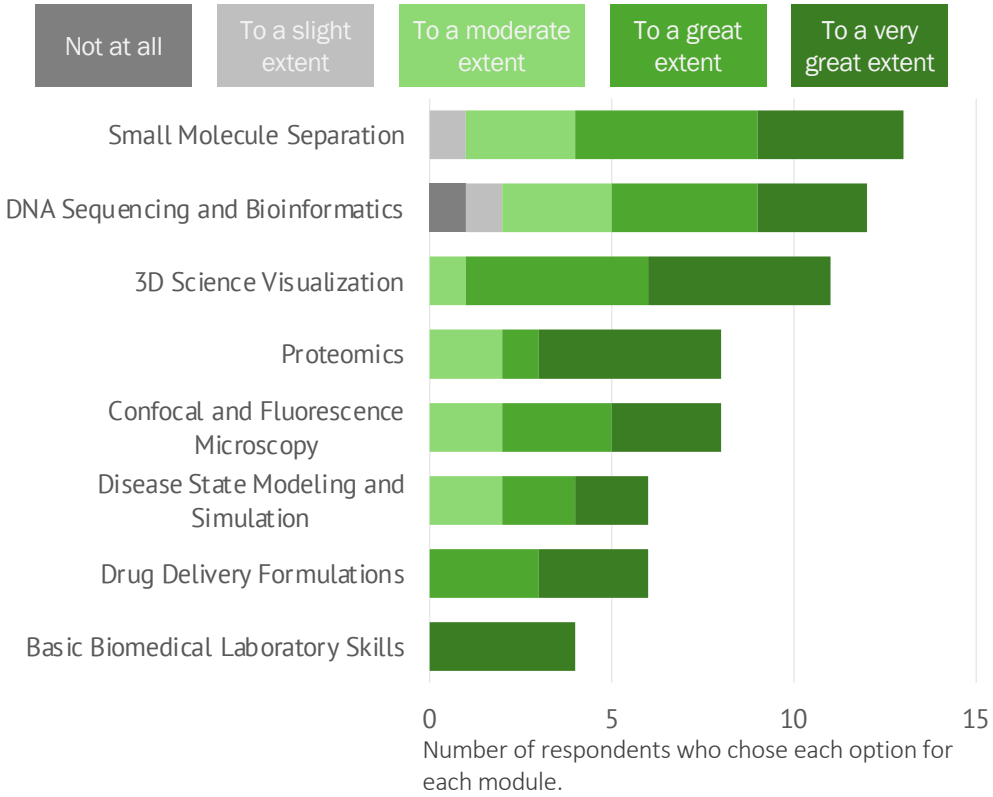
We learned the basics for working an NMR machine and HPLC machine, I feel slightly confident using the machines but since we didn't use the machines ourselves I would need more practice

Mainly learned about the NMR, HPLC, and mass spectrometer

RI-INBRE WDT Program (Summer 2023)

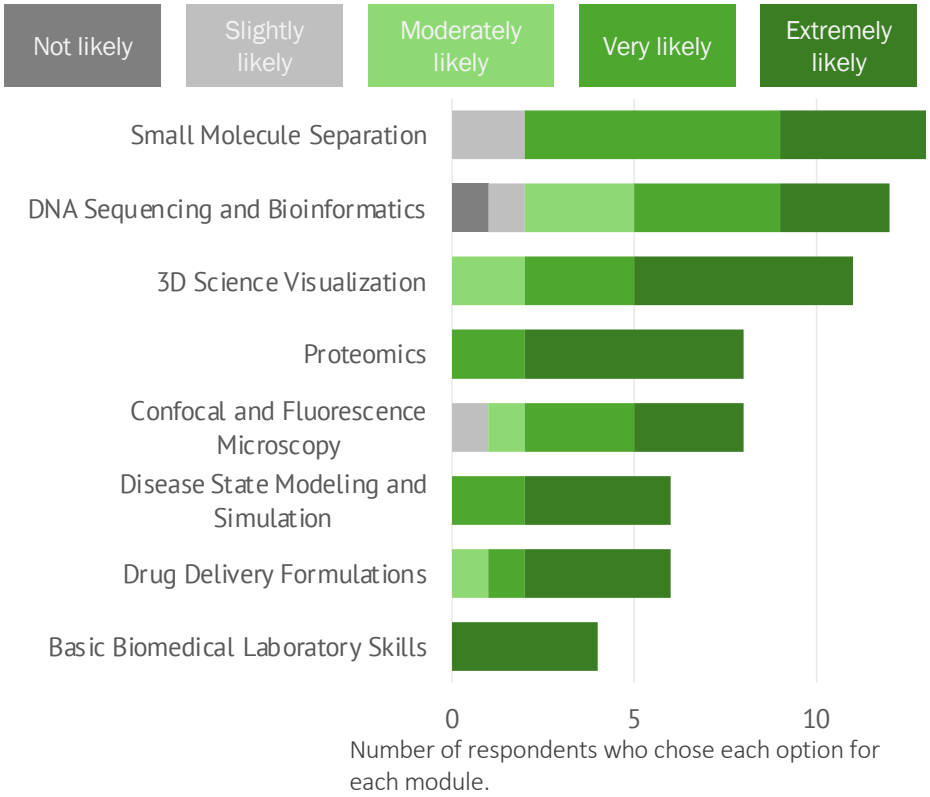
Almost all respondents thought their instructor(s) effectively guided hands-on learning.

Question: To what extent did the instructor(s) actively guide your hands-on learning during the training module(s) you attended?



Respondents would be likely to recommend the WDT training to other students, with very few exceptions.

Question: Overall, how likely are you to recommend the training module(s) you attended to other students?



CPDE

RI-INBRE WDT Program (Summer 2023)

Respondents who were not likely or only slightly likely to recommend a training module were asked to provide suggestions for improvement.

Here is a summary of the 4 responses:

Response	Rating	Module
It was all over the place; I didn't take much from it and it wasn't that useful; we were the first session so hopefully it got better after	Slightly likely	Small Molecule Separation
Not recommended for someone with a basic understanding of what bioinformatics is; recommended for someone with **no** bioinformatics training or knowledge	Slightly likely	DNA Sequencing and Bioinformatics
Would be interesting if you actively use the skill (in the training)	Slightly likely	Confocal and Fluorescence Microscopy
It was a lot of material for two and a half days and I didn't learn anything; would be better as a one-day-a-week course over the whole summer; the lab should be about practicing the coding not DNA extraction	Not likely	DNA Sequencing and Bioinformatics

> "I thought that these modules were valuable sessions that broadened my knowledge on new techniques and instruments that I could use in future studies. I like how the lecture part of the sessions explained the inner workings of the instruments that we used later on for hands on studies. I feel that having an understanding of the concept of the instruments allows for better understanding on how to work the machine, so this was very helpful."
>
> WDT respondent (Small Molecule Separation)

RI-INBRE WDT Program (Summer 2023)

Many respondents offered suggestions for 2024 sessions – these have been grouped together and are listed below in descending order.

Question: Thinking ahead to next year's program, what additional skill-based training or topic areas would be helpful to you?

- More sessions per module, or allow for attending >2 modules (e.g., beginner + advanced options)
- Liquid chromatography/mass spec
- More hands-on time (in general)
- Basic lab skills
- Genetics, genetic sequencing
- Coding (more applied bioinformatics)
- Flow Cytometry and Blotting
- Animal dissecting
- Chem/biochem
- FTIR Spectroscopy
- Direct pharma skills
- Skills related to carbon nanotubes
- Other microscopy (WDS, EDS, SEM)
- Coding Virtual Reality
- Cell cultures
- Statistics
- qPCR

> "[One session was] easier because we all had [the same level of experience in the] topic compared to another module where everyone was at different points of experience. It may have helped if the two sessions were [organized] by experience level. Overall, I definitely learned a lot including more theory about the topic I was already working on, and my interest was piqued in the module that was unfamiliar to me, which helped expand my interests."
>
> WDT respondent (Small Molecule Separation; Proteomics)