Why would I want a PhD in Computational Biology?

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March 11, 2022
- Often pay for the program
  - Partial tuition covered via teaching or research jobs
- Class-oriented
- Potential opportunity to conduct research during the program and write a Master’s thesis
- Historically, fewer Master’s programs in Computational Biology, but growing

- Any and all strong PhD Programs will pay you
  - Tuition is covered
  - Receive a stipend for your work
  - May need to teach as part of stipend (varies)
- Research-focused & more job-like
- **Class-oriented**: geared towards building skills through coursework
- Research **can** be a component
  - Tackle smaller projects
  - Introduction to research

- **Focused on research**
- Embark on a more time-intensive question
- **YOUR** project
What IS research?

Isabel’s definition of research:

Explore a question that doesn’t have an answer

✦ Choose a question (or a series of questions) that do not have a clear answer

✦ Gather data to explore the question

✦ Statistical/mathematical analyses to understand the data

✦ Piece together a story that the data tells you
What IS research?

Isabel’s definition of research:

Explore a question that doesn’t have an answer

Research is making a contribution towards understanding
- **Class-oriented**: geared towards building skills through coursework
- Research can be a component
  - Tackles smaller projects
  - Introduction to research

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- Embark on a more time-intensive question
- **YOUR** project
There are multiple paths to a PhD degree

Artwork by: Diana Tripp
CompBio students have diverse paths to the PhD

N = 28 students
What does a PhD journey entail?

Typical PhD degrees range from 5 - 6 years

**Disclaimer: General experience based on CompBio at Berkeley — details may change according to program**

Year 1: Coursework & Rotations

Year 2: Coursework, Qualifying Exam, & settling into lab

Year 3: Teaching experience & diving into your research project

Year 4: (More) Teaching experience & research

Year 5 & 6: Research and wrapping up projects
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- Figure out what questions interest you
- Gain new skills to tackle interesting questions
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Course requirements

Become a PhD Candidate (This is a big win!) 🎉
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- Gain teaching experience
- Make a plan for how to answer the questions
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• Make a plan for how to answer the questions

Teaching requirement
Understand project better
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• Start the analyses on your project

• Focus on developing scientific intuition
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Begin asking questions and feel more comfortable with analyses

**Image source:** Uptown Acorn
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• Bring together your scientific story
• Share your science with others
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- Bring together your scientific story
- Share your science with others
  - Finish analyses
  - Share the information with others
  - Write a thesis dissertation
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Year 5 & 6: Research and wrapping up projects

Other:
- Travel to conferences
- Meet other scientists and make friends
- Live in a new area
- A lot of free, nice food
How to prepare for a PhD program?

Class Preparation
✦ Build skills and a foundation in relevant coursework
✦ Visit program website pages of interest

Research Experience
✦ Be exposed to the scientific method – asking questions and seeing approaches
✦ Explore questions that interest you
✦ Apply skills that you learned in class
✦ **Figure out if you like research**

Attend Conferences
✦ Practice communicating your science via presentation
✦ Engage in scientific conversation
✦ Interact with the science community – build a support system and peer network
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Apply to travel grants!

General Science - Large conference
Regional Conferences
How to prepare for a PhD program?

Explore what science is! (Figuring out why the PhD)

✦ Figure out what questions interest you
✦ Determine if research is a passion
✦ Identify the aspects and applications of science that inspire and motivate you
What is Computational Biology?

Blueprint → Copy → Product

Tree of life image source
Technological advancement allowed for the production of high amounts of data at a low cost.
Explosion of biological data

Blueprint

Image source: NCBI
What is Computational Biology?

Blueprint

Copy

Product

There’s a lot of unknown processes in these arrows
What is Computational Biology?

- Blueprint (Genomics)
- Copy (Epigenomics)
- Product (Transcriptomics)
- (Ribosome profiling)
- (Proteomics)

And then some ….
What is Computational Biology?

Data for so many different questions:
- Ecology
- Cellular biology
- Microbiology
- Metabolomics
- Population genetics
What is Computational Biology?
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The goal of computational biology is to “apply and advance computational and statistical methods”
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- Data analysis/Data science
- Method Development
What is Computational Biology?

Computational Biology

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The goal of computational biology is to “apply and advance computational and statistical methods”

- Data analysis/Data science
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Technology → Data → Analyses
How to prepare for a Computational Biology PhD program?

Class Preparation

✧ Relevant coursework includes:
  ✧ Upper division courses in at least two of the CompBio pillars: statistics/mathematics, biology, and computer science
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Image by Stacy Li
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✧ Understand the goals of your project
✧ Communicate your contributions to the overall goal
✧ Discuss the implications and future directions of your work
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When do I start thinking about all of this?
✦ Classes: Map out your courses to integrate extra classes – give yourself 1.5 - 2 yrs
✦ Research: at least two years of experience
How to prepare for a Computational Biology PhD program?

Specify your research passions

✧ You **DO NOT** need to know the exact question you want to answer in graduate school beforehand

✧ Identify a few sources of inspiration

✧ What topics interest you in class?
✧ What projects have you been excited to engage in?
✧ What don’t you like?
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Identify a few “sticking points” that you want to make sure remain in your research
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It’s okay if your interests shift!

Identify a few “sticking points” that you want to make sure remain in your research
What opportunities are there for research experience?

During the school year

✧ Research opportunities at CSUF
✧ Email professors and be persistent

✧ They may be busy so no response doesn’t mean no
✧ Keep your email concise yet intentional – know what you like (generally) about their research
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**Summer**
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[Link to Extensive List of REU Programs](#)
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After undergrad
- Postbac programs: research for 1 - 2 years
- Master’s programs with a thesis component

Links:
- Link to Extensive List of REU Programs
- Link to NIH Postbacs (Rolling basis apps)
- Link to Postbac Research Education Programs
- Link to WashU Postbacs
- Link to Harvard Postbac Programs
What can you do with a degree in Computational Biology?

- 11 alums in Industry
- 3 alums in Academia
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- Academia: 3 alums
- Industry: 11 alums

Companies: Amazon, AncestryDNA, Immunai, Patch Biosciences, 23andMe, Uber
What can you do with a degree in Computational Biology?

- 11 alums in Academia
- 3 alums in Industry

- Data Scientists
- Computational Biologists
- Senior Scientists
- Machine Learning Engineers
What can you do with a degree in Computational Biology?

- **Academia**: 3 alums
- **Industry**: 11 alums

- Therapeutics division
- Gene therapies
- Understanding the immune system
- Algorithm development

Companies: Amazon, AncestryDNA, Immunai, Patch Biosciences, 23andMe, Uber
Lessons learned along the way:

✦ You DO NOT need to be an expert in the field already
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Student

Employee

Develop skills via classes, workshops, etc.
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✦ You DO NOT need to be an expert at conducting science

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Lessons learned along the way:

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✧ You DO NOT need to be an expert at conducting science

Learn the science process and how to “think like a scientist”

Develop skills via classes, workshops, etc.
Lessons learned along the way:

- The most important skill is learning how YOU learn
If questions and comments come to mind later – feel free to contact us!

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