

# Pablo Cárdenas Ramírez

Cambridge, MA, USA (citizen of Colombia, F1 visa status)

[pablo-cardenas.com](http://pablo-cardenas.com) • [pablocarderam@gmail.com](mailto:pablocarderam@gmail.com) • [pcardenasramirez@mgm.harvard.edu](mailto:pcardenasramirez@mgm.harvard.edu)

 0000-0001-7015-0512 •  [pablocarderam](#) •  [pcr-guy](#) •  [pcr\\_guy](#)

I develop experimental and computational methods to engineer and study biology across scales, from the molecular to the population level. I will use these tools to research and teach synthetic biology, infectious disease, and evolution in a bottom-up, quantitative, and predictable manner.

I foster dedicated teaching and mentorship practices to build student-focused, inclusive training environments in which to practice community-oriented science.

## Education

**Massachusetts Institute of Technology (MIT)** — Cambridge, MA, USA

Sep 2024

PhD Candidate, Department of Biological Engineering; Advisor: Jacquin C. Niles; GPA: 5.0/5.0

Graduate Teaching Certificate, MIT Teaching and Learning Lab (received 2023)

**Universidad de los Andes (Uniandes)** — Bogotá, Colombia

Mar, 2018

Bachelor of Science *Summa Cum Laude* in Microbiology, minor in Bioinformatics (GPA: 4.84/5.0)

## Research

**Ragon Institute of MGH, MIT, & Harvard** — Boston, MA, USA

Postdoctoral Research Fellow, [Schmidt Lab](#)

Sep 2024 ++

→ Researching influenza A immunity and evolution (Prof. Aaron Schmidt)

**Department of Biological Engineering (BE), MIT** — Cambridge, MA, USA

Graduate Research Assistant, [Niles Lab](#)

Sep 2018 – Sep 2024

→ Created an [epidemiological modeling framework for pathogen population genetics and evolution](#), and applied it to [the study of pathogen evolution across fitness valleys](#) (self-led collaboration)

→ Constructed molecular and computational tools for transcriptional control, [functional genomics](#), [systems biology](#), and pharmaceutical development in *Plasmodium falciparum* malaria parasites (Prof. Jacquin Niles)

**Department of Systems Biology, Harvard Medical School** — Boston, MA, USA

Visiting Undergraduate Researcher, [Paulsson Lab](#)

Feb – Jul 2018

→ Applied microfluidics and microscopy to study bacterial physiology and persistence (Prof. Johan Paulsson)

**Eligo Bioscience, S.A.** — Paris, France

Research Intern in Synthetic Biology, [Eligo Bioscience](#)

Aug 2017 – Jan 2018

→ Screened and engineered synthetic phage against bacterial strains (supervisor Dr. Jesús Fernández R.)

**Mathematical & Theoretical Biology Institute, Arizona State University** — Tempe, AZ, USA

Visiting Undergraduate Researcher, [MTBI \(now QRLSSP\)](#)

Jun – Jul 2017

→ Created a [3D, spatially explicit computational model](#) of bacterial resistance to antibiotics in a biofilm

**Department of Biological Engineering, MIT** — Cambridge, MA, USA

Visiting Undergraduate Researcher, [Niles Lab](#)

May – Aug 2016

→ Assembled CRISPR-Cas9 constructs for gene editing in the malaria parasite (Prof. Jacquin Niles)

**Department of Biological Sciences, Uniandes** — Bogotá, Colombia

Undergraduate Researcher, [CIMIC](#) and [BCEM Labs](#)

May 2015 - Aug 2017

→ Designed and experimentally tested an [ODE model of phage-host dynamics](#) (Prof. Martha Vives)

## Publications

### Peer-reviewed research:

\*Contributed equally to the work

†Corresponding author

- Genomic epidemiological models describe pathogen evolution across fitness valleys* **2022**  
**P. Cárdenas**<sup>†</sup>, V. Corredor, M. Santos-Vega  
*Science Advances*. doi: [10.1126/sciadv.abo0173](https://doi.org/10.1126/sciadv.abo0173)
- GeneTargeter: automated, in silico design for genome editing in the malaria parasite, P. falciparum* **2022**  
**P. Cárdenas**, L.Y. Esherrick, G. Chambonnier, S. Dey, C.V. Turlo, A.S. Nasamu, J.C. Niles<sup>†</sup>.  
*The CRISPR Journal*. doi: [10.1089/crispr.2021.0069](https://doi.org/10.1089/crispr.2021.0069)
- Preventing antibiotic-induced dysbiosis with an engineered live biotherapeutic* **2022**  
A. Cubillos-Ruiz, M.A. Alcantar, N.M. Donghia, **P. Cárdenas**, J. Ávila-Pacheco, J.J. Collins<sup>†</sup>.  
*Nature Biomedical Engineering*. doi: [10.1038/s41551-022-00871-9](https://doi.org/10.1038/s41551-022-00871-9)
- Resolving drug selection and migration in an inbred South American Plasmodium falciparum population with identity-by-descent analysis* **2022**  
M. Carrasquilla\*, A.M. Early\*, A.R. Taylor, A. Knudson, D.F. Echeverry, T.J.C. Anderson, E. Mancilla, S. Aponte, **P. Cárdenas**, C.O. Buckee, J.C. Rayner, F.E. Sáenz, D.E. Neafsey<sup>†</sup>, V. Corredor<sup>†</sup>  
*PLoS Pathogens*. doi: [10.1371/journal.ppat.1010993](https://doi.org/10.1371/journal.ppat.1010993)
- dCas9 regulator to neutralize competition in CRISPRi circuits* **2021**  
H.-H. Huang\*, M. Bellato\*, Y. Qian, **P. Cárdenas**, L. Pasotti, P. Magni, D. Del Vecchio<sup>†</sup>.  
*Nature Communications*; doi: [10.1038/s41467-021-21772-6](https://doi.org/10.1038/s41467-021-21772-6).
- Host resistance, genomics and population dynamics in a Salmonella Enteritidis and phage system* **2019**  
A.V. Holguín, **P. Cárdenas**, C. Prada-Peñaranda, L. Rabelo Leite, C. Buitrago, V. Clavijo, G. Oliveira, P. Leekitcharoenphon, F. M. Aarestrup, & M.J. Vives<sup>†</sup>  
*Viruses*. doi: [10.3390/v11020188](https://doi.org/10.3390/v11020188)

### Preprints & submitted work:

†Corresponding author

- CRISPR spacer acquisition is a rare event in the human gut microbiome* —  
A. Zhang, J.M. Gaston, **P. Cárdenas**, S. Zhao, X. Gu, & E.J. Alm<sup>†</sup>  
*In review*.
- Using Big Data to inform decision-making on COVID-19 in Colombia: a framework of micro-territorial experimental design for urban interventions and policy evaluation* **2022**  
A. Feged-Rivadeneira<sup>†</sup>, F. González-Casabianca, A. Parra-Salazar, J. Salcedo-Ortiz, F. Andrade-Rivas, **P. Cárdenas**, A. Morales, J.M. Damelines-Pareja, D.S. Ríos-Oliveros, C. Salazar, S. Usma, M. Muñoz, L.H. Patiño, N. Ballesteros, J.D. Ramírez, A. Ángel, T. Rodríguez, J. Cascante, H. Galindo-Silva, S. Majerowicz, & V. Corredor.  
doi: [10.21203/rs.3.rs-2148358/v1](https://doi.org/10.21203/rs.3.rs-2148358/v1)

### Manuscripts in preparation:

\*Contributed equally to the work.

†Corresponding author

- Orthogonal, synthetic transcriptional control in the malaria parasite Plasmodium falciparum* —  
**P. Cárdenas**, Sebastian Smick, & J.C. Niles<sup>†</sup>  
Manuscript shared for private viewing with author permission [here](#).
- An essential, multifunctional lipocalin from P. falciparum with heme-related antioxidant functions* —  
M. Nakashima, K. T. Osman, S.J. Saha, A.S. Nasamu, A.M. Goren, **P. Cárdenas**, C.L. Drennan, & J.C. Niles<sup>†</sup>

### Technical reports:

\*Contributed equally to the work

- Cheating the cheaters: spatial dynamics in the evolutionary stability of antibiotic resistance* **2017**  
D. Akman\*, L. Callaway III\*, **P. Cárdenas**\*, J. Nieve-Silva\*, J. Chen, B. Espinoza, L. Arreola, & C. Castillo-Garsow  
Technical report available from MTBI, Arizona State University (PDF link dead, [document here](#)).

**Reviews and commentary:**

- Starting from scratch: a workflow for building truly novel proteins* **2021**  
**P. Cárdenas**. *Synthetic Biology* 6(1), ysab005, doi: [10.1093/synbio/ysab005](https://doi.org/10.1093/synbio/ysab005)
- Designing for durability: new tools to build stable, non-repetitive DNA* **2020**  
**P. Cárdenas**. *Synthetic Biology*, 5(1), ysaa016, doi: [10.1093/synbio/ysaa016](https://doi.org/10.1093/synbio/ysaa016)

## Research Talks & Seminars

**Invited talks:**

- A synthetic transcriptional control platform for genomics and engineering in malaria parasites* **10 Oct 2023**  
 Short talk for the MIT BE Department Retreat (Boston, MA, USA)
- Genomic models describe epidemiological determinants of pathogen evolution* **20 Apr 2023**  
 1 h invited seminar for the [Max Planck Institute for Infection Biology](#), Berlin, Germany (online)
- Opqua, a tool for modeling genomic epidemiology* **20 Feb 2023**  
 1 h invited seminar for [Novodan Ltd.](#) & the [Department of Biotechnology and Biomedicine, Danmarks Tekniske Universitet \(DTU\)](#), Kgs. Lyngby, Denmark (online)
- Opqua, a tool for genomic epidemiological modeling* **13 Jan 2023**  
 1 h invited seminar at [Global Pervasive Computational Epidemiology NSF Expedition in Computing, University of Virginia Biocomplexity Institute](#) (online)
- Computational models describe parasite evolution across fitness valleys* **17 Oct 2022**  
 30 min invited seminar for the Boston Area Parasitology Seminar (Cambridge, MA, United States)

**Contributed talks:**

- Synthetic transcriptional control in the malaria parasite Plasmodium falciparum* **Sep 2024**  
 15 min contributed talk at the [XXXV Molecular Parasitology Meeting](#) (Woods Hole, MA)
- Genomic models describe epidemiological determinants of pathogen evolution* **25 Jan 2024**  
 20 min contributed talk at the [First Andean School on Host-Pathogen Dynamics](#) (Bogotá, Colombia)
- Genomic models describe epidemiological determinants of pathogen evolution* **3 Aug 2023**  
 15 min contributed talk at the [Gordon Research Conference on Dynamics of Ecological and Evolutionary Change](#) (Smithfield, RI, United States)
- Genomic models describe epidemiological determinants of pathogen evolution* **30 Jul 2023**  
 20 min contributed talk at the [Gordon Research Seminar on Dynamics of Ecological and Evolutionary Change](#) (Smithfield, RI, United States)
- Genomic models describe epidemiological determinants of pathogen evolution* **28 Feb 2023**  
 20 min contributed talk at the [Society for Mathematical Biology's](#) conference on Mathematical Epidemiology and Population Dynamics, Ecology, & Evolution ([SMB Epi-PDEE](#)) (online)

## Academic Service

- Peer reviewer for *Evolution* (Oxford University Press) **Aug 2023**
- Peer reviewer for *Nucleic Acids Research* (Oxford University Press) **Apr 2022**
- Peer reviewer for *Wellcome Open Research* (F1000; open review [available here](#)) **Jun 2021**

## Awards & Fellowships

**Graduate:**

- Siebel Scholar in Bioengineering, Class of 2024* (Siebel Scholars Foundation) **Sep 2023**  
 Awarded to outstanding graduate students in four fields across 16 universities to fund their final year of studies (total 35,000 USD)

- Cornell 2023 FIRST Future Faculty Scholar* (Dept. of Microbiology, Cornell University) **Aug 2023**  
 Awarded by competition to researchers planning to go on the academic job market in the next few years.  
 Symposium training on job search and information on the [Cornell FIRST Program](#) (Sep 2023)
- Best Talk* (*Gordon Research Seminar on Dynamics of Ecological and Evolutionary Change*) **Jul 2023**  
 Voted best of 10 contributed talks at the seminar by attendees.
- Teaching Development Fellowship* (*Teaching and Learning Lab, MIT*) **Jul 2022**  
 Awarded to 21 applicants to develop training and support for graduate student teaching (2000 USD)
- Social Justice in Infectious Disease Award* (*EEID Conference*) **May 2022**  
 Travel award for applicants to the 2022 Ecology and Evolution of Infectious Disease Conference (Atlanta, GA) combining research and social justice in their work
- S. & P. Eurnekian Biotechnology Fellowship* (*Office of Graduate Education, MIT*) **Apr 2021**  
 Awarded to one MIT student pursuing research in biotechnology per year  
 (1 semester tuition, insurance, stipend; ≈43,000 USD)
- Teaching Assistant Excellence Award* (*Department of Biological Engineering, MIT*) **Dec 2020**  
 Awarded to the best teaching assistant in the department during the Fall 2019 (1000 USD)
- Viterbi Graduate Fellowship* (*Department of Biological Engineering, MIT*) **Sep 2018**  
 Awarded at admission to select students in the MIT Biological Engineering PhD program  
 (1 semester tuition, insurance, stipend; ≈42,000 USD)

### Selected Undergraduate:

- Summa Cum Laude* (*Faculty of Sciences, Uniandes*) **Mar 2018**  
 Awarded to top 1% of historic graduates in the Faculty of Sciences who also show strong community service
- Best Saber Pro Graduate National Exam, Biology* (*Ministry of Education, Colombia*) **Nov 2017**  
 Awarded to nation-wide top scores on the Colombian ICFES-Saber Pro exam for university graduates
- Excellence Distinction (8)* (*Uniandes*) **Mar 2014–Oct 2017**  
 For the highest semester GPA in Microbiology (4x), Biomedical Engineering (1x), and Biology (3x)
- Alberto Magno Award* (*Uniandes*) **Oct 2013**  
 Given to the top ten application scores among admitted students university-wide in a semester

## Teaching, Mentorship, & Community

### Teaching and Learning Lab, MIT — Cambridge, MA, USA

- Teaching Development Fellow*, [MIT Teaching and Learning Lab](#) **Sep 2022 – Jun 2023**  
 → Developed resources to support teaching and mentorship skills for graduate students across MIT  
 → Designed and conducting teaching and mentorship workshops and recitation class observations

- Teaching Track Certificate*, [MIT Teaching and Learning Lab](#) **Jul 2022 – Nov 2022**  
 → Certified courses on Subject Design, Lesson Planning, Microteaching, and Inclusive Teaching  
 → Designed and rehearsed an original course, "[Fighting, Harnessing, and Reshaping Evolution](#)"

### Department of Biological Engineering (BE), MIT — Cambridge, MA, USA

- Guest Lecturer in Evolution, Malaria Biology, and Genomics* **2022**  
 → Prepared and taught a lecture on malaria biology and genomics for a course of ≈30 undergraduates for the MBIO2304 *Parasitology* course at Uniandes taught by Prof. Camila González (Jan 2022)  
 → Prepared and taught a lecture on designing for evolution in infectious disease for a course of ≈15 senior undergraduates; course 20.380 *Senior Design Course in Biological Engineering* taught by Prof. Christopher Voigt, Instructors Dr. Sean Clarke and Dr. Prerna Bhargava (Nov 2022)

- Coding Fellow*, [Biological Engineering Data Lab](#) **Mar 2020 – May 2024**  
 → One of the inaugural fellow at the [Biological Engineering Data Lab](#), created to support computational teaching and learning in bioscience at MIT during the COVID-19 pandemic lockdown and beyond

- Provided 1-on-1 coaching for programming and biological data analysis to undergraduates, graduate students, and postdocs; >80 sessions done to date
- Designed and conducted workshops for 10–40 students on Introductory Python, Ordinary Differential Equation Modeling, and Statistical Curve Fitting (taught each one three times)
- Mentored an undergraduate student through a semester-long individual project in SARS-CoV-2 phylogenomics as an Experiential Learning Opportunity course (student: Dawit Girma; graduating 2024)

**Teaching Assistant, *Principles of Molecular Bioengineering***

**Sep – Dec 2019**

- Helped design and grade assignments and exams, conducted review lecture sessions, and provided one-on-one tutoring for 40 students (Prof. Ernest Fraenkel and Prof. Alan Jasanoff)
- Received an overall instructor rating of 6.9/7.0 (18 responses) with student feedback including “*really tried to help us understand not just get the problem set done [sic]*”, “*has a fantastic grasp of the material*”, and “*hands-down one of the best TAs I have ever had*”
- Awarded best Fall 2019 teaching assistant at MIT BE (out of 25) based on student and faculty input

**Graduate Research Assistant, *Niles Lab***

**Mar 2019 – Sep 2024**

- Trained incoming postdoc Dr. Shubhra Saha in parasite tissue culture and molecular cloning
- Mentored four first-year graduate students in 6- or 8-week experimental research rotation projects, students: Mirna Kheir Gouda (MIT Biological Engineering), Allison Rojas (MIT-Harvard Health Science and Technology), Alyssa Haynes (MIT Microbiology)

**Peer Counselor, *BE Resources for Easing Friction and Stress (REFS)***

**Jan 2019 – Jun 2023**

- Provided 1-on-1 confidential counseling for graduate students at MIT BE as a member of [BE REFS](#)
- Co-developed and conducted workshops on different graduate school milestones and experiences
- Worked with the MIT BE Department leadership, Graduate Student Board, and BE working groups on Diversity, Equity, & Inclusion to improve student experience and PhD program policy
- Underwent a week-long training course on conflict coaching and support resources for grad students, including training from the office of the Institute Discrimination & Harassment Response (IDHR)

**Department of Biomedical Engineering, Uniandes — Bogotá, Colombia**

**Teaching Assistant, *Quantitative Human Physiology I and II***

**Jan – Dec 2016**

- Designed and graded assignments, provided review sessions, and taught main lectures during two professor absences for ≈100 students (Prof. Juan Manuel Cordovez)

**Department of Student Affairs, Uniandes — Bogotá, Colombia**

**Teaching Assistant, *Social Practice Program***

**Jul – Dec 2015**

- Trained, guided, and evaluated 60 Uniandes students serving as tutors for low-income high school students in Bogotá (Instructors David Parga and María del Pilar Pérez)

**Volunteer Tutor, *Social Practice Program***

**Jan – Jun 2015**

- Provided academic tutoring and review 3 h/week for 10 low-income high school students in Bogotá

**Department of Biological Sciences, Uniandes — Bogotá, Colombia**

**Teaching Assistant, *Parasitology Laboratory***

**Jan – Jun 2015**

- Provided review sessions and tutoring, helped develop and grade assignments, and prepared and presented microscopy slides for various human pathogens (Prof. Camila González)

**Association of Students with Financial Aid (ANDAR), Uniandes — Bogotá, Colombia**

**Co-leader, *First Year Mentorship Program***

**Jul 2016 – May 2017**

- Designed integration and counseling activities, helped develop student housing networks
- Coordinated eight teams of Uniandes students mentoring 20 incoming students receiving financial aid

**First Year Mentor & Academic tutor**

**Jul – Dec 2015**

- Mentored 20 first-year students receiving financial aid through their first semester (with a second co-mentor), helping navigate access to academic, financial, and social resources when needed