

EDUCATION

Doctor of Philosophy, Chemistry and Biochemistry | **PI:** Nicholas V. Hud | GPA 4.0 Fall 2022

Graduate Certificate in Astrobiology

Tech to Teaching Certificate

Georgia Institute of Technology, Atlanta, GA

Defense Topic:

Prebiotic Formation of Plausible Proto-Nucleosides: Investigations into the Origins of Nucleotides with Ribose and Pairing Bases

Graduate Study, Earth Sciences | **PI:** Jan P. Amend 2012–2014

University of Southern California, Los Angeles, CA

Completed 34 units of Graduate Study in Earth, Biological, and Ocean Sciences

Bachelor of Arts, Molecular Biology | **PI:** Clarissa M. Cheney | GPA 3.5 2012

Pomona College, Claremont, CA

Thesis: Function of N-Terminal Acetylation in GDI

PEDAGOGICAL EXPERIENCE

Visiting Assistant Professor, Trinity University, San Antonio, TX 2022–present

- Mentored students extensively in classroom, small-group, and one-on-one environments to ensure knowledge transfer
- **Biochemistry:** Utilized and improved upon flipped-classroom method for better student engagement and greater achievement of learning outcomes
- **Biochemistry Laboratory:** Executed laboratory instruction by training and managing up to twelve students in advanced instrumental techniques
- **Advanced Chemical Principles:** Engaged students in critical thinking exercises designed to ensure accurate and precise chemical measurements

Astrobiology Fellow, Georgia Institute of Technology, Atlanta, GA 2021–2022

Astrobiology Undergraduate Minor Development

- Developed and began implementation of an undergraduate minor in Astrobiology modeled off successful graduate certificate in Astrobiology
- Determined required and suggested courses from among a mix of interdisciplinary options
- Obtained counsel and approval from multiple departments for inclusion of courses in the minor

Co-Teacher, Biochemistry I, Georgia Institute of Technology, Atlanta, GA 2021–2022

- Developing and delivered two lectures as part of Tech to Teaching Certificate Capstone course
- Will implement teaching strategies and lesson plan ideas developed in previous Tech to Teaching coursework taken over two semesters

Teaching Assistant, Georgia Institute of Technology, Atlanta, GA

Survey of Biochemistry Fall 2021

- Developed content and lectured for a survey course covering a variety of biochemical topics
- Facilitated a hybrid learning environment using both in-person and virtual communications
- Guest-taught two lectures on the topics of Carbohydrates and Prebiotic Sugars
- Wrote examination questions for open-resource, multiple choice exams

Quantitative Analysis with Laboratory 2017–2018

- Responsible for aiding in adaptation of laboratory courses for undergraduate students
- Taught 4.5-hour sections of laboratory work including demonstration
- Responsible for safety measures and proper handling protocols for various chemical materials
- Contributed to ongoing development of automated grading system using digital spreadsheets
- Engaged in one-on-one teaching in office hours

RESEARCH EXPERIENCE

Graduate Research Assistant, Georgia Institute of Technology, Atlanta, GA 2017–2022

PI: Nicholas V. Hud

- Managed my dissertation project in an efficient and productive manner: completed a demanding Ph.D. with 3 publications in 5 years
- Analyzed complex reaction mixtures containing small molecules using liquid chromatography-mass spectrometry (LC-MS), proton (^1H) and carbon (^{13}C) nuclear magnetic resonance (NMR) spectroscopy, and circular dichroism (CD)
- Designed novel experiments, maintained meticulous lab records, and executed a project across multiple institutions involving four senior collaborators
- Formulated and analyzed prebiotic carbohydrate metabolic pathways and executed one-pot syntheses of desired compounds
- Investigated non-canonical nucleoside and nucleotide compounds and their supramolecular and base-pairing properties under varying pH conditions

Graduate Research Assistant, University of Southern California, Los Angeles, CA 2012–2014

PI: Jan P. Amend

- Cultivated sulfur-reducing hyperthermophilic archaea in anaerobic systems, including use of an anaerobic glove box, media preparation, and microscopic analysis
- Gained experience in cultivating microbes in chemostat fermenter systems, focusing on growth rate and steady-state in- and outflow

Undergraduate Researcher, Pomona College, Claremont, CA 2011–2012

PI: Clarissa M. Cheney

- Designed primers for, cloned, and expressed a modified GDI (GDP dissociation inhibitor) protein in order to prevent N-terminal acetylation to determine phenotypic result in flies
- Maintained multigenerational *Drosophila* genetic lines, including obtaining trait-linked modifications to specific genes
- Utilized analytical techniques including western blots, fluorescence microscopy, and PCR to detect changes to *Drosophila* proteins post-modification

Research Intern, Saban Research Institute, Los Angeles, CA 2010

PI: David Warburton

- Investigated the effects of amniotic fluid stem cells on induced lung fibrosis in living systems (mice)
- Performed genotypic analysis using DNA extraction and rt-PCR amplification
- Contributed to lung fixing and sectioning for organ damage observation

OTHER WORK EXPERIENCE

Technical Expert, Apple, San Diego, CA 2015–2017

Location: Apple Store UTC

- Engaged in thorough problem-solving utilizing established SOPs, deviating when necessary to address anomalous issues
- Solved software-related issues of mobile and desktop devices while minimizing interruption in customer use time
- Progressed from Technical Specialist to the first class of Technical Experts, a new role at the time that involved expanded responsibility from mobile to desktop devices as well as peer mentorship responsibility
- Managed expectation while maintaining customer satisfaction while resolving issues with customers' personal devices

Student Helpdesk Supervisor, Pomona College, Claremont, CA 2009–2012

- Solved technical issues of personal and work computers for students, faculty and staff
- Supervised other helpdesk consultants in order to efficiently resolve tickets, including handing off in-progress items
- Performed frequent maintenance and resupply of printers across campus while limiting printer downtime

LEADERSHIP EXPERIENCE

- Secretary**, ExplOrigins Executive Board, Georgia Institute of Technology 2021–2022
- Contributed to maintenance of the Georgia Tech Astrobiology website (<https://astrobiology.gatech.edu>)
 - Maintained active roster and took meeting minutes
 - Coordinated multiple events including socials, public talks, and the annual ExplOrigins Colloquium
- Chair**, Gordon Research Seminar (GRS): Origins of Life (Canceled due to COVID-19 pandemic) 2020–2022
- Selected as one of two co-chairs to organize the next Origins of Life GRS
 - Responsible for obtaining funding, creating a title, theme, description, and planning the conference
 - Maintained conference plan and information for future implementation despite late-term cancellation
- External Organizer**, Astrobiology Graduate Conference, Salt Lake City, UT 2019
- Organized and carried out a Proposal Writing Retreat, managing curriculum and hosting 20–30 students
 - Planned logistics for food, lodging, and scheduling for the retreat, including sorting applicants and constructing viable teams
 - Aided students in proposal writing challenge in real-time, including sourcing information, providing guidance, and judging completed proposals

OUTREACH EXPERIENCE

- Center for Chemical Evolution**, Georgia Institute of Technology 2017–2020
- Aided in the creation and implementation of both science demonstrations and media activities aimed at engaging students of various ages in the fields of astrobiology and STEAM, including events:
- Dekalb County Library Evening of Wonder
 - Hands on Future Tech
 - Atlanta Science Festival
 - Mableton Middle School STEAM Night

PUBLICATIONS

1. **T. P. Roche**, D. M. Fialho, P. J. Nedumpurath, B. N. Lindgren, S. Mangalath, G. B. Schuster, N. V. Hud. Prebiotic Reactivity of Noncanonical Nucleosides. In prep.
2. **T. P. Roche**, D. M. Fialho, C. Menor-Salván, R. Krishnamurthy, G. B. Schuster, N. V. Hud. A Plausible Path to Nucleosides: Ribosides and Related Aldosides are Generated from Ribulose, Fructose, and Similar Abiotic Precursors. *Chem. Eur. J.*, Accepted Author Manuscript.
3. L. E. Rodriguez, T. Altair, N. Y. Hermis, T. Z. Jia, **T. P. Roche**, L. H. Steller, J. M. Weber. Chapter 4: A Geological and Chemical Context for the Origins of Life on Early Earth, in *Astrobiology Primer 3.0* special issue, edited by M. Schaible, N. Szeinbaum, and G. Tan. *Astrobiology*, in revision.
4. D. M. Fialho, **T. P. Roche**, N. V. Hud. Prebiotic Syntheses of Noncanonical Nucleosides and Nucleotides. *Chem. Rev.* **120**, 4806–4830 (2020).
5. O. Garcia, G. Carraro, G. Turcatel, M. Hall, S. Sedrakyan, **T. Roche**, S. Buckley, B. Driscoll, L. Perin, D. Warburton. Amniotic fluid stem cells inhibit the progression of bleomycin-induced pulmonary fibrosis via CCL2 modulation in bronchoalveolar lavage. *PLOS ONE* **8**(8): e71679 (2013).

SCIENTIFIC POSTERS AND PRESENTATIONS

1. **T. P. Roche**, P. J. Nedumpurath, D. M. Fialho, G. B. Schuster, N. V. Hud. Prebiotic Reactivity of Noncanonical Nucleobases. ExplOrigins Colloquium (2022), Georgia Tech, Atlanta, GA (Poster)
2. **T. P. Roche**, D. M. Fialho, C. Menor Salván, R. Krishnamurthy, G. B. Schuster, N. V. Hud. Robust Ribonucleosides: A Pathway to Ribose from Simple Sugars via Ketose Intermediates. AbGradCon (2021) Virtual, (<https://www.youtube.com/watch?v=fVZaOfYDK7Q>)
3. **T. P. Roche**, D. M. Fialho, C. Menor Salván, R. Krishnamurthy, G. B. Schuster, N. V. Hud. Ketoses: The Key to Prebiotic Nucleoside Formation? Prebiotic Chemistry and Early Earth Environments Seminar Series (2021), Virtual (<https://www.youtube.com/watch?v=xwOHUG1WSDc>)

Tyler P. Roche, Ph.D.

4. **T. P. Roche**, D. M. Fialho, C. Menor-Salván, R. Krishnamurthy, G. B. Schuster, N. V. Hud. Origins of Life: What Role did Sugars Play? ExplOrigins Colloquium (2021), Georgia Tech, Atlanta, GA (Poster)
5. **T. P. Roche**, D. M. Fialho, G. B. Schuster, N. V. Hud. Prebiotic Relevance of Ketose Sugars to the Origin of Aldose Nucleosides. American Chemical Society Spring Meeting (2020), Virtual (Digital Slide Presentation)
6. **T. P. Roche**, D. M. Fialho, G. B. Schuster, R. Krishnamurthy, N. V. Hud. Robust Ribonucleosides: A Pathway to Ribose from Simple Sugars via Ketose Intermediates. Gordon Research Conference: Origins of Life (2020), Galveston, TX (Poster, also presented at ExplOrigins Colloquium 2020)
7. **T. P. Roche**, D. M. Fialho, G. B. Schuster, R. Krishnamurthy, N. V. Hud. Prebiotic Relevance of Ketose Sugars to the Origin of Aldose Nucleosides. Astrobiology Science Conference (2019), Bellevue, WA (Oral Presentation)
8. **T. P. Roche**, D. M. Fialho, G. B. Schuster, R. Krishnamurthy, N. V. Hud. Sugars and the Origin of Life: Unlocking Ribose with Ketose Sugars. ExplOrigins Colloquium (2019), Georgia Tech, Atlanta, GA (Poster)
9. **T. P. Roche**, D. M. Fialho, R. Krishnamurthy, N. V. Hud. The Condensation of a Model Proto-RNA Nucleobase with Ribulose: A Prebiotic Pathway to RNA. Astrobiology Graduate Conference (2018), Georgia Tech, Atlanta, GA (Poster, updated from below)
10. **T. P. Roche**, D. M. Fialho, R. Krishnamurthy, N. V. Hud. The Condensation of a Model Proto-RNA Nucleobase with Ribulose: A Prebiotic Pathway to RNA. Georgia Tech Astrobiology Colloquium (2018), Atlanta, GA (Poster)

AWARDS, FELLOWSHIPS, AND HONORS

- Georgia Tech Astrobiology Fellowship 2021
Georgia Institute of Technology—College of Sciences Sutherland Dean’s Chair
- President’s Fellowship 2017–2021
Georgia Institute of Technology
- William Emerson Outstanding Second Year Seminar Award 2018
Georgia Institute of Technology—School of Chemistry & Biochemistry
- Provost’s Ph.D. Fellowship 2012–2014
University of Southern California
- Eagle Scout Award 2008
Boy Scouts of America

PROFESSIONAL MEMBERSHIPS

- Origin of Life Early Career Network
<https://oolen.org/>