# Tyler P. Roche

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## EDUCATION

**Doctor of Philosophy,** Chemistry and Biochemistry *expected* 2022
Graduate Certificate in Astrobiology
Georgia Institute of Technology, Atlanta, GA
**PI:** Nicholas V. Hud
Thesis Topic: Formation of Proto-RNA via Ketose sugars and Noncanonical Nucleobases

**Graduate Study,** Earth Sciences 2012–2014
University of Southern California, Los Angeles, CA
**PI:** Jan P. Amend
Completed 34 units of Graduate Study in Earth, Biological, and Ocean Sciences

**Bachelor of Arts,** Molecular Biology 2012
Pomona College, Claremont, CA
**PI:** Clarissa M. Cheney
Thesis: Function of N-Terminal Acetylation in GDI

## RESEARCH EXPERIENCE

**Graduate Research Assistant,** Georgia Institute of Technology, Atlanta, GA 2017–present
**PI:** Nicholas V. Hud

- Assessed reactivity of prebiotic nucleobases with a variety of electrophiles
- Investigated isomerization of sugars in aqueous solutions and their reactions with prebiotic nucleobases
- Developed expertise in $^{1}H$ and $^{13}C$ NMR (1D and 2D), and in LC-MS and UV-based analysis of polar and nonpolar compounds
- Contributed to SOPs for above analytical procedures as well as producing code for data-processing programs

**Graduate Research Assistant,** University of Southern California, Los Angeles, CA 2012–2014
**PI:** Jan P. Amend

- Cultivated *Archaeoglobus fulgidus* 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

- Investigated protein modification and its role in development in *Drosophila melanogaster*
- Maintained multigenerational *Drosophila* genetic lines, including obtaining trait-linked modifications to specific genes
- Designed DNA primer sequences for bacterial plasmid creation and cloning using *Escherichia coli* transformation techniques

- 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), resulting in a publication (*see below*)
- Performed genotypic analysis using DNA extraction and rt-PCR amplification
- Contributed to lung fixing and sectioning for organ damage observation

## PEDAGOGICAL EXPERIENCE

**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

**Teaching Assistant,** Georgia Institute of Technology, Atlanta, GA
Courses:
**Survey of Biochemistry** Fall 2021
- 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
- Hosted 4 office hours per week with consistent student attendance

**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

**Teaching Assistant,** University of Southern California, Los Angeles, CA 2012–2013
Courses:
**Climate Change**
- Conducted lab- and revision-style sections for lecture-based course on climate change
- Implemented activities and lessons designed specifically for the non-major students, aiming to increase engagement and interest in the topic
- Taught 2-hour sections of 20-25 students new and review material
- Designed, proctored, and graded quizzes and further assessments
- Held office hours resulting in multiple one-on-one review sessions with students

## 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) and ExplOrigins sub-page

- Maintained active roster and took meeting minutes
- Acted as a member of the ExplOrigins executive board to coordinate multiple events including socials, public talks, and the annual ExplOrigins Colloquium

**Chair**, Gordon Research Seminar (GRS): Origins of Life (Canceled) 2020–2022

- Selected as one of two co-chairs to organize the next Origins of Life GRS, an early-career supplement to the Origins of Life Gordon Research Conference (GRC)
- Responsible for obtaining funding, creating a title, theme, description, and planned schedule for the conference
- Maintained conference plan and information for future implementation despite late-term cancellation

**Social Chair**, Leadership and Outreach Committee, Center for Chemical Evolution (CCE) 2018–2020

- Organized and executed social events to promote community and teambuilding among members of the CCE
- Planned and executed combined outreach/social events including trivia nights and demo booths as part of the Atlanta Science Festival

**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

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. Ketose Sugars: A Robust Prebiotic Source of Ribose and Ribo-nucleosides. In prep.
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,** 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)
2. **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)
3. **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 Institute of Technology, Atlanta, GA (Poster)
4. **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)
5. **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)
6. **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)
7. **T. P. Roche**, D. M. Fialho, G. B. Schuster, R. Krishnamurthy, N. V. Hud. Solving the Ribose Problem: Ketose Interconversion is Key. Center for Chemical Evolution Annual Meeting (2019), Chattanooga, TN (Poster)
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 Institute of Technology, Atlanta, GA (Poster)
9. D. M. Fialho, **T. P. Roche**, G. B. Schuster, R. Krishnamurthy, N. V. Hud. Synthesis and Self-Assembly of Noncanonical Nucleotides in Water: The Origin of Primitive Genetic Polymers. Center for Chemical Evolution Annual Meeting (2018), Georgia Institute of Technology, Atlanta, GA (Poster)
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. Astrobiology Graduate Conference (2018), Georgia Institute of Technology, Atlanta, GA (Poster, updated from below)
11. **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*
- William Emerson Outstanding Second Year Seminar Award 2018
  *Georgia Institute of Technology—School of Chemistry & Biochemistry*

- Best Group Proposal 2018
  *AbGradCon 2018 Proposal Writing Retreat*
- President's Fellowship 2017–present
  *Georgia Institute of Technology*
- Provost's Ph.D. Fellowship 2012–2014
  *University of Southern California*