

BETUL KACAR

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Current Positions

Assistant Professor, University of Arizona, Tucson, AZ

Associate Professor (Adjunct), Tokyo Institute of Technology, Tokyo, Japan

Education

Ph.D. Emory University Biomolecular Chemistry, 2010
B.Sc. Marmara University Chemistry, 2004

Honors and Scholarships

RCSA Heising-Simons Foundation and Kavli Foundation, Scialog Fellow, 2020
UN Women, Generation Equality Scholar Europe & Central Asia, 2020
UNICEF and UNFPA, Day of the Girl Children Delegate, 2020
University of Arizona Foundation, Inaugural Early Faculty Research Award, 2019
NASA Early Career Faculty Award, NASA Science Mission Directorate, 2019
National Academy of Sciences, Science Exchange Program, Selected Participant, 2017
NASA-National Science Foundation Joint Origins of Life Ideas Lab, Selected Participant, 2017
The Library of Congress, NASA Astrobiology Program Lecturer, 2017
Science Club for Girls, Way Cool Scientist, 2016
VWR Excellence in Research Award, 2015
NASA Postdoctoral Fellowship, 2012 – 2015
NASA Astrobiology Early Career Collaboration Award, 2011
NASA Astrobiology Graduate Student Research Focus Group Proposal, 1st place, 2010
NASA Astrobiology Institute, Scholarship, 2010
HHMI Curriculum Development Fellowship, Emory University, Atlanta, GA, 2008
National Science Foundation K12 Teaching Fellow, Atlanta, GA, 2006 – 2007
American Society for Biology and Molecular Biology, Scholarship, 2006
HHMI Summer Undergraduate Research Scholarship, Emory University, Atlanta, GA, 2003

Research Interests

Translation Machinery – origin and evolution
RuBisCO – evolution and impact on the carbon isotope fractionation across eons
Nitrogenases – evolution of metal dependence across geologic time
Origins of Life – emergence of the Last Universal Common Ancestor, abiotic-biotic transition
Astrobiology – ancient biosignatures and implications on exoplanetary habitability

Research Experience and Appointments

University of Arizona,

Assistant Professor, Department of Molecular and Cellular Biology, (2017 – present)
Assistant Professor, Department of Astronomy and Steward Observatory, (2017 – present)
Adjunct Faculty, Lunar and Planetary Laboratory, Planetary Sciences (2019 – present)
Adjunct Faculty, Graduate Interdisciplinary Program, Genetics Division (2019 – present)
Member, Bio5 Institute (2020 – present)

Tokyo Institute of Technology,
Associate Principal Investigator (Adjunct), Earth-Life Science Institute, (2016 – present)
Global Science Coordinator, Earth-Life Science Origins Network (2015 – 2018)

Harvard University,
Research Associate, Edwards Lab, (2015 – 2018)
Project Leader, Department of Organismic and Evolutionary Biology, (2016 – 2018)
Associate, Harvard Origins Initiative, (2016 – 2018)

National Aeronautics and Space Administration, (NASA),
Astrobiology Institute Co-Investigator, Reliving the Past Node, CAN7 (2016 – 2020)
Postdoctoral Fellow, Astrobiology Program (2012 – 2015)

Visiting Research Associate,
Uppsala University, Hughes & Andersson Labs (as a part of NASA Postdoctoral Program) (2015)
Michigan State University, Lenski Lab (as a part of NASA Collaboration Award) (2012)

Postdoctoral Associate, School of Biology (2011-2012)
Georgia Institute of Technology, School of Biology

Graduate Student, Department of Chemistry (2004 – 2010)
Emory University. Thesis research: Emory Medical School, Department of Biochemistry

HHMI Summer Undergraduate Research Scholar, (2003)
Emory University, School of Medicine, SURE Program, Atlanta, GA

Research Funding (since 2012, since 2017 at UA, BK is PI unless otherwise noted, Total raised: 8.3M)

NASA, Interdisciplinary Consortia for Astrobiology Research (ICAR)
“What life wants? Exploring the natural selection of elements” (2021 – 2026, \$6,035,714)

NASA Astrobiology Institute, Reliving the Past Node, CAN7
“How did early metabolic networks evolve” (2020, \$10,000)

NASA, Early Career Collaboration Award
“Exploration of the evolution of the bacterial translation machinery”, Fellow: Katie McGrath
(UA), Collaborator: S. Sanyal (Uppsala) (2020, \$5,000)

University of Arizona Foundation Small Grants Program
“Astrobiology and metabolic origins: Resurrection of ancient nitrogen fixation” (2020, \$19,538)

NASA, Science Mission Directorate, Early Career Faculty Award, 80NSSC19K1617
“Reconstruction and functional analysis of Precambrian nitrogenase” (2019 – 2022, \$100,000)

John Templeton Foundation, Big Questions in Life Sciences, 61239
“Molecular insights into historical constraints on evolution II” (2018 – 2019, \$357,843)

NASA, Astrobiology Program, NPP Fellowship

“The deep history of nitrogenases: Connecting the geochemical record of nitrogen fixation to isotopic signatures”, Fellow: Amanda Garcia (UA) (2018 – 2020, \$126,000)

National Science Foundation, Emerging Frontiers, 1724090

“Biochemical, genetic, metabolic, and isotopic constraints on an ancient thiobiosphere” (2017 – 2021, \$353,276)

NASA, Exobiology Program, H006201406

“Understanding translation through experimental evolution” (2017 – 2020, \$183,933 to BK, (co-I), \$1,200,000 total, PI: Mike Travisano, UMinnesota)

University of Arizona Technology and Research Initiative Fund

“Start-up Fund” (2017 – 2022, \$1,576,980)

Harvard Origins Initiative, Faculty Small Grants Program

“Reconstructing ancient enzymes to decipher life’s geologic record” (2016, \$8,000)

Tokyo Institute of Technology, Earth-Life Science Institute, Seed Funding

“Towards reconstructing ancient Rubisco enzymes in the laboratory” (2016, \$10,000)

John Templeton Foundation, Big Questions in Life Sciences, 58562

“Molecular insights into historical constraints on evolution I” (2015 – 2017, \$452,014)

NASA, Astrobiology Institute “Research Aid”, Junior Researcher Award,

“Experimental evolution of engineered E. coli bacteria” (2014, \$15,000)

NASA, Exobiology and Evolutionary Biology Program, NNX13AI08G (BK is the Science-PI)

“Combining experimental evolution and resurrected ancestral genes to study historical contingency and determinism” (2013 – 2016, \$482,000)

NASA, Postdoctoral Program, NASA Astrobiology Institute

“The role of chance and necessity in evolution: An experimental model system to discover life's solutions” (2012 – 2015, \$210,000)

Publications (*denotes corresponding, +denotes equal contribution)

Peer-reviewed

1. **Kacar B***, Garcia A.K., Anbar A.D. 2020. Evolutionary history of bioessential elements can guide search for life in the universe. *ChemBioChem*, (21):1-7
2. Venkataram S., Monasky R., Hajizadeh S., Kryazhimskiy S*, **Kacar B***. 2020. Evolutionary stalling in the optimization of the translation machinery. *Proc Nat Acad Sci*, 117(31):18582-18590
3. Garcia A.K., McShea H., Kolaczowski B., **Kacar B***. 2020. Reconstructed ancient nitrogenases suggest Mo-specific ancestry. *Geobiology*, 20;00:1-18
4. Liberles D., Chang D., Geiler-Samerotte K., Goldman A., Hey J., **Kacar B.**, Meyer M., Murphy W., Posada D., Storfer A. 2020. Emerging frontiers in the study of molecular evolution, *J Mol Evol* 20:1-16
5. Garcia A.K., **Kacar B***. 2019. How to resurrect ancestral proteins as proxies for ancient biogeochemistry. *Free Radic Biol Med*, 140:260-269
6. Adam Z.R., **Kacar B.**, Som S.S., Lynch K., Walther-Antonio M., Wilford K. 2019. Metazoan origins as microbial host volumes in Neoproterozoic oligotrophic seas. *PeerJ* 6:e27173v1
7. Adam Z.R., Fahrenbach A., **Kacar B.**, Aono M. 2018. Prebiotic geochemical automata at the intersection of radiolytic chemistry, physical complexity and systems biology. *Complexity* (18)e9376183

8. Bains W., Cronin L., DasSarma S., Danielache S... **Kacar B.**, & others. 2018. Exoplanet Biosignatures: Future Directions. *Astrobiology* 18(6):779-824
9. **Kacar B***, Guy L, Smith E, Baross J. 2017. Resurrecting ancient biosignatures in modern bacteria. *Phil Trans A Roy Soc* 375(2109)
10. **Kacar B***, Hanson-Smith V, Adam Z.R., Boekelheide N. 2017. Reconstruction and dynamic modeling of ancestral Rubisco proteins. *Geobiology* 15(5):628-640
11. **Kacar B***, Garmendia E⁺, Tuncbag N, Andersson D.I., Hughes D. 2017. Replacement of an essential gene with its ancient and modern homologs. *mBio* 8(4)e01276-17
12. **Kacar B***, Ge X., Sanyal S, Gaucher E.A. 2017. Experimental evolution of *Escherichia coli* harboring an ancient translation protein. *J Mol Evol* 81:1-16 (Journal cover)
13. **Kacar B***, Gaucher EA. 2013. Experimental evolution of protein-protein interaction networks. *Biochem J* 453(3), 311-319
14. **Kacar B***, Gaucher E.A. 2012. Towards the recapitulation of ancient history in the laboratory. *Artificial Life* (13)11-18
15. **Kacar B.**, Boyd E.S., Dolci W.W., Dodson E., Boldt M., Pilcher C.B. 2011. Workshop without walls: Broadening science access around the world, *PLoS Biology* 9(8):e1001118
16. **Kacar B**, Aldeco M⁺, Edmondson D.E. 2011. Catalytic and inhibitor binding properties of zebrafish Monoamine Oxidase (zMAO): Comparisons with human MAO A and MAO B. *Comp Biochem* 159(2):78-83 (equal contribution)
17. **Kacar B.**, Edmondson D.E. 2010. Expression of zebrafish (*Danio rerio*) Monoamine Oxidase (MAO) in *Pichia pastoris*: Purification and comparison with human MAO A and MAO B. *Protein Exp Purif.* 70(2):290-297

White Papers

18. **Kacar B.**, Anbar A., Garcia A.K., Seefeldt L.C., Adam Z.R., Konhauser K. 2020. Synthesizing abiotic and biotic systems for the search and detection of life in the Universe. *National Academy of Sciences Planetary Sciences Decadal White-Paper 2023-2033*
19. Mainzer A., Abell P, Barbee B, Bottke B, Britt, Brozović M, ..., **B. Kacar** & others. 2020. The future of planetary defense in the era of advanced surveys. *A white paper commissioned by SBAG for the 2023-2032 Planetary decadal survey*
20. Domagal-Goldman S., Kiang N.Y., Parenteau N., Catling D.C., DasSarma S... **B. Kacar** & others. 2017. Life Beyond the Solar System: Remotely Detectable Biosignatures. arXiv:1801.06714, *NASA white paper submitted to the National Academy of Sciences*

Book Chapters/Primers

21. **Kacar B.** 2017. Rolling the dice twice: Evolving reconstructed ancient proteins in extant organisms. in *Chance in Evolution* pp 265-276, C. Pence and G. Ramsay, eds, University of Chicago Press
22. **Kacar B.** 2016. What is LUCA? What does the tree of life tell us about how life has evolved? *Astrobiology Primer 2.0* S. Domagal-Goldman and Wright K, eds, *Astrobiology* 16(8):561-653

Keynote and Plenary Lectures (all invited)

1. Biophysical Society Annual Meeting, Origin of Life Symposia, San Diego, CA, February 2020, "Ancient Proteins to Understand the Biophysical Underpinning of the Origins of Life"
2. Gordon Research Conference, Applied Microbiology, Keynote Lecture, Holyoke, MA, July 2019, "Reconstructed Enzymes as Proxies for Ancient Biogeochemical Intermediaries"
3. Evolution of Complexity Symposium, Georgia Research Center, Atlanta, GA, May 2019, "Mechanisms Driving Evolutionary Innovations"
4. Rocky Mountain Geobiology Symposium, Boulder, CO, April 2019, "Recapitulating Ancient History in the Laboratory with The Methods of Evolutionary Synthetic Biology"
5. The Library of Congress, NASA Astrobiology Program Lecture, Washington DC, August 2017

“Life As It Could Be: Astrobiology, Synthetic Biology, and the Future of Life”

6. U.S. State Department, Community Development Lecture, Brčko, Bosnia and Herzegovina, July 2017 “How did we get here? Astrobiology and Life in the Universe”
7. Astrobiology Science Conference (Day 3 Opening Lecture), Phoenix, AZ, April 2017, “New Developments in the Origins of Life Field”
8. Harvard SACNAS Scientific Excellence Through Diversity Lecture, January 2017, “Exploring Evolution and Distribution of Life in The Universe”
9. MIT, Earth and Planetary Sciences, IAP Lecture Series, 2015, “Engineering Modern Microbes with Ancestral Genes to Explore Ancient Life”
10. Oxford University St Anne’s College, Science, Progress and History Lecture Series, 2014, “Evolution and Historical Explanation: Contingency, Convergence, and Teleology”
11. World Summit on Evolution, University of San Francisco de Quito, Galápagos, June 2014, “Beagle in a Flask: Experimental Evolution of Ancient Proteins”

Symposia and Conference Lectures

12. WIDS Women in Data Science Conference, Tucson, AZ, April 2020, “How can solving life's origins guide our search for finding life in the universe?” (invited)
13. Arizona Science Lecture 2020, “Catalyst: Life Beyond Earth”, February 2020 (invited)
14. University of Connecticut, Mansfield, CT, May 2017, “Biogeochemical Dating in Deep Time using Ancient RuBisCO Sequences” (invited)
15. Harvard University, Natural Intelligence Proto-computation and Proto-life Workshop, Cambridge, MA, Dec 2016, “Decoding the coder: Lessons from the translation machinery”
16. Michigan State University, BEACON Center Annual Symposium, East Lansing, MI, July 2016 (invited), “Experimental evolution of E. coli with a perturbed translation machinery”
17. Astrobiology Science Conference, Chicago, IL, June 2015 (Invited), “Biophysical underpinnings of the origins of life”
18. Carnegie Institute of Washington, “Re-conceptualizing the Origins of Life”, March 2015, “Evolution of RuBisCO” (invited)
19. Geological Society of America, Denver, CO, September 2016, “Constraining the Great Oxidation Event using ancient genes”.
20. ASM Symposium on Microbial Evolution, Washington DC, June 2014 (invited), “Experimental evolution of bacteria harboring an ancient gene” (invited)
21. Gordon Research Conference, Origins of Life, Galveston, TX, January 2014 (invited)
22. Gordon Research Conference, Microbial Population Biology, Andover, NH, July 2013 (invited)
23. International Conference on the Synthesis and Simulation of Living Systems, MI, June 2012, “Combining synthetic biology with experimental evolution”
24. NASA Workshop Without Walls: Rewinding the Tape of Life, April 2011 “Revisiting Gould’s tape of life”
25. University of Colima, Excellence in Education Conference, Colima, Mexico, January 2008, “Problem-based learning for K12 education in a model classroom in Atlanta, Georgia”

Departmental Seminars and Colloquiums (all invited) (excluding talks at the University of Arizona)

1. Stanford University, Earth, Energy & Environmental Sciences (webinar), November 2020
2. Montana State University, Chemistry and Biochemistry (webinar), October 2020
3. Bristol University, Geobiology and Geomicrobiology Division, (webinar) October 2020
4. NASA Ames Synthetic Biology Core (webinar), September 2020
5. University of North Carolina Chapel Hill, Department of Biology, Durham, NC, October 2019
6. Harvard University, Origins Forum, Cambridge, MA, September 2019
7. Arizona State University, BEYOND Center, Phoenix, AZ, March 2019
8. University of Washington, Astrobiology Colloquium, November 2018

9. Princeton University, Department of Earth Sciences, October 2017
10. University of Arizona, Department of Molecular and Cellular Biology, February 2017
11. Harvard Medical School, Department of Genetics, December 2016
12. NASA Executive Council Annual Meeting, Flathead Lake, MT, September 2016
13. Harvard University Origins Initiative Chalk Talk, May 2016
14. McGill University Space Institute, Montreal, Canada, April 2016, "Lessons from the past: Synthetic biology and experimental evolution for space exploration".
15. Dalhousie University, Biochemistry and Molecular Biology, Nova Scotia, March 2016, "Tempus fugit: Design, construction and evolution of ancestor-descendant hybrid organisms in the laboratory".
16. Uppsala University, Department of Microbiology, Uppsala, Sweden, September 2015
17. Tokyo Institute of Technology, ELSI Origins Lecture, Tokyo, Japan, May 2015
18. Tokyo Institute of Technology, Synthetic Biology Core Unit, Tokyo, Japan, May 2015
19. The Smithsonian Institution Human Origins Hall, "The Scientists Are In", Washington, DC, March 2014
20. University of New Hampshire, Biology Department, Durham, NH, March 2015
21. Oberlin College, Department of Biology, Oberlin, OH, March 2014
22. California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA, November 2013
23. Tokyo Institute of Technology, ELSI Earth-Life Science Institute, Tokyo, Japan, September 2013
24. The Smithsonian Institution, "The Scientist is In", Washington, DC, February 2011

Community and Public Outreach Talks (all invited)

25. Brand Week Istanbul, November 2020
26. Lifelong Learning in Retirement at the Highlands in Arizona, LLRH, October 2020
27. UNICEF, UN Women, UNFPA: International Day of the Girl Child, Panelist, October 2020
28. SAGANet Online: Talk to an Astrobiologist, May 2020
29. UA Lifelong Learning Center, Astronomy and Geology Lecture Series, March 2020
30. Women in Science Lecture Series, Tucson Science Café, Tucson, AZ, November 2018
31. Flandreau Planetarium, Exoplanets Community Lecture Series Speaker, 2018
32. National Academy of Sciences, The Science Exchange, Manhattan, NY, December 2017
33. Cambridge Science Festival, Science Club for Girls, Cambridge, MA, April 2017
34. Somerville Public Library Community Lecture, Somerville, MA, April 2017
35. NOVA Science Café, Boston, MA, April 2016
36. Coretta Scott King Young Women's Leadership Academy, Atlanta, GA, March 2014
37. Atlanta Science Tavern, Atlanta, GA, February 2011

Invited Workshops

Signatures of Life in the Universe, Research Corporation for Science Advancement, March 2021
 NASA Executive Council Meeting, Atlanta, GA, January 2020
 John Templeton Foundation, Trends in Evolution Workshop, Biosphere 2, Tucson, AZ, April 2019
 Origins of Life Workshop, Santa Fe Institute, November 2018
 NASA, Agnostic Life Workshop, Washington DC, March 2017
 NSF-NASA Ideas Lab "Origins of Life", Bethesda, MD, September 2016
 NASA-NEXSS for Exoplanet System Science "Exoplanet Biosignatures", Seattle, WA, June 2016
 NSF NESCENT, "Experimental Evolution", Durham, NC, March 2015
 ASU-BEYOND "Thermodynamics, Entropy and Life" Workshop, Phoenix, AZ, September 2014
 NSF NESCENT, "Astrobiology, Synthetic Biology, Evolution", Durham, NC, November 2011

Teaching Experience

University of Arizona: "Astrobiology and the Molecular History of Life" (MCB 445/545) (Spring 2021, 30-students); "Molecular Biology and Evolution of Star Trek" (MCB 184A) (Fall 2019, Spring

2021, 20-students); *“Science Communication and Science Writing”* (MCB 575) (Fall 2018 with R. Gutenkunst, Fall 2018 with N. Horton) (15-students). Harvard University: OEB 258 *“Chance versus Determinism: Is Evolution Predictable?”* (Graduate seminar co-facilitator, Lead: J. Losos) (Fall 2016).

Guest Lecturer: University of California Berkeley: *“Introduction to Astrobiology”* (ASTRON9, Summer 2020); University of Arizona: *“Introduction to Biology”* (MCB 181R, Fall 2018), *“Seminar in Bioinformatics”* (ECOL 268B, Spring 2019), *“Life in the Universe”* (ASTR 202, Fall 2018), *“Recent Advances in Genetics”* (GENE 670, Fall 2018), *“Science in the News”* (JOUR 772/572, Spring 2020); Georgia Institute of Technology: *“Prokaryotic Molecular Genetics”* (Fall 2013, BIOL 4608/6608), *“Molecular Evolution”* (BIOS 4225, Spring 2014), *“Evolutionary Biology”* (BIOS 3600, Fall 2014), *“Origins of Complex Life”* (BIOS 4550, Fall 2014).

Contributor: Bard College: *“Advanced Evolution”* (BIO 315L, Fall 2017), Undergraduate-level laboratory, experimentally evolution and analyses of the *E. coli* strains harboring a phylogenetically inferred gene, generated in my laboratory (co-developed with G. Perron).

Other Teaching: Santa Fe Institute MOOC *“Origins of Life and Phylogenetic Thinking”*. Origins of Life Lecture Series supported by the National Science Foundation. Recorded: April 2019, Released: November 2019.

Education and Outreach Proceedings

- Som S.M., Walker S.I., Miller E., Anbar M., **Kacar B.**, Forrester JH. 2014. Evaluating virtual STEM mentoring programs: The SAGANet experience. American Geophysical Union, ID: ED31B-3439
- **Kacar B.**, Som S.M., DeMarines J., Illangkoon H. 2013. Mentoring elementary school students through virtual media: SAGANet Mentorship Program. Impact and Effectiveness of Developmental Relationships. UNM Mentoring Institute Press.

Popular Science Articles

- **Kacar B.** 2020. What if we are alone in the Universe? Ought we do something about it? Aeon Magazine. (In press)
- **Kacar B.**, Womack, Y. 2018. Future shaped by pasts that could have been. Journal of Design and Science 10.21428, MIT Press
- **Kacar B.** 2013. Teaching evolution in Turkey: SAGAN Education Platform. Astrobiology Magazine.

Advising

Postdoctoral advising: **Amanda Garcia** (2018-present, recipient of a NASA Postdoctoral Fellowship); **Sandeep Venkataram** (2018-2019, co-advised, Kryazhimskiy Lab, UCSD); **Mati Kedzior** (2020-present).

Lab Manager/Technician: **Sky Dominguez** (Ecology and Evolutionary Biology, 2019-present), **Ross Monasky** (Microbiology, 2017-2019), Harvard University: **Brett Enos** (Microbiology, 2016).

Doctoral students: **Andrew Wheeler** (Ph.D. student, Genetics, 2020-present); **Evrin Fer** (Ph.D. student, Genetics, 2019-present); **Katie McGrath** (Ph.D. student, Molecular and Cellular Biology, 2019-present).

Master’s students: **Cathryn Sephus** (Accelerated master’s program, Galileo Scholar, Astrobiology, Spring 2018-present); **Alex Rivier** (Accelerated master’s program, Microbiology, Fall 2019-present).

Doctoral and master’s committees: **Matt Miller** (Molecular and Cellular Biology, 2019), **Jared Sivinski** (Biochemistry, 2020), **Bradey Stuart** (Molecular and Cellular Biology, 2020, Master’s).

Examiner at Other Universities: Ph.D. Thesis Examiner, **Sophie Wendel** (DTU Novo Nordisk, Synthetic Biology, Denmark, 2016).

Current undergraduate students/independent study: **Brooke Carruthers** (Honors) (MCB, 2019-present, Galileo Scholar), **Emily Peñaherrera** (MCB, 2018-present, Blue Marble Space Young Scientist Fellow).

Previous undergraduate students/ independent study: **Alyks Odell** (2020), **Sam Hinn** (2019), **Sofia Jacobson** (Honors) (2018-2019). Harvard University: **Hanon Mcshea** (Senior Thesis 2017-2018, Ph.D. Student, Stanford University), **Ryan Ward** (Senior Thesis 2017-2018, Fulbright Scholar, École Normale Supérieure), **Alex Pleša** (Senior Thesis 2016-2017, Ph.D. Student, Harvard Medical School), **Anna Donovan** (Senior Thesis 2016-2018, Associate Manager, Evolved by Nature).

Visiting students: **Sarah Schwartz** (Ph.D. Student, MIT, Earth, Atmospheric and Planetary Sciences, 2020); **Leonardo Sandrini** (Ph.D. Student, University of Milan, 2019); **Azen Koç** (Undergraduate, Bilkent University, 2019); **Aonuma Keito** (University of Tokyo, 2020), Harvard University: **Divjot Kaur** (Undergraduate, 2017, Ph.D. Student, Oxford University), **Stuart Brown** (Undergraduate, 2017 University of Sussex), **Ulku Uzun** (Master's Thesis, 2017, Ph.D. Student, Oxford University), **Gökçe Senger** (Undergraduate, 2015, Ph.D. Student, European Oncology Institute).

High school interns: **Ryan Conant** (KEYS High School Summer Intern, UA, 2019), **Bouchra Benghomari** (Science Club for Girls Intern, Harvard, 2016).

Service

University of Arizona

Astronomy Department, *Grad Admissions Committee*, 2020 – 2021
Genetics GIDP Program, *Student Progress Committee*, 2020 – present
Arizona Wonder House, *Lecturer*, 2020
ABBS Graduate Program, *Review Committee*, 2019 – 2020
Genetics GIDP Graduate Program, *Review Committee*, 2020
Biosciences ABBS Graduate Student Recruitment Week, *Speaker*, 2019
Astrobiology Initiative, *Steering Committee*, 2019 – present
MCB Program, *Undergraduate Award Committee*, 2018 – present
ABBS Program, *Graduate Student Award Committee*, 2018 – present
Minority Women Faculty, *Member*, 2018 – present
Ecosystem Genomics Initiative, *Cluster Faculty Hiring Committee*, 2019
MCB Program, *Graduate Student Award Committee*, 2018 – present

National Boards and Committees

NASA Nexus for Exoplanet System Science, NExSS, *Member*, 2020 – present
National Science Foundation RCN Origins of Life, *Steering Committee*, 2018 – present
Santa Fe Research Institute, Santa Fe, NM, *Member*, 2018 – present
Engineering Biology Research Consortium, *Junior Faculty Member*, 2019 – present
NASA Center for Origins of Life, COOL, *Member*, 2019 – present
NASA Origins of Life Research Focus Group, *Member*, 2012 – 2015.

International Boards, Service and Outreach

European Union, International Women's Day, *Ask a Scientist* (Turkey Delegate), 2020
Sabanci University Gender and Women's Studies Center of Excellence, *Board*, 2017 – present
SAGANet Astrobiology Mentorship and Outreach Network, 2011 – Co-Founder (with S. Som, J. Demarines, S.I. Walker)

Symposia and Conferences Organized

- AAAS Annual Meeting 2021, “Astrobiology and Origins of Life: From Chemical Networks to Living Ecosystems”, Moderator and Organizer (2021) (with D. Baum)
- AbSciCon 2021, “Origins Exploration: From Stars to Cells”, Local Organizing Committee (2021)
- “Machina ex Machina”, Templeton Workshop, Tucson, Arizona, Organizer and Chair, (2019) (with Z. Adam, D. Apai)
- American Society for Microbiology Microbe General Meeting, “Exobiology and Origins of Life” Plenary Session, Co-Organizer (2018) (with J. Lennon, J. Glass)
- Tokyo Institute of Technology, “Universal Biology Workshop”, Co-Organizer (2017) (with C. Mariscal, P. Hut, N. Goldenfeldt, M. Voytek)
- Harvard University “Intelligence and Proto-computation” Workshop, Co-Organizer (2016) (with M. Aono, Z. Adam)
- American Society for Microbiology 2nd Conference on Experimental Microbial Evolution, Co-Organizer (2016) (with F. Rosenzweig, G. Sherlock)
- Gordon Research Seminar Microbial Population Biology, Chair (elected) (with G. Perron) (2013)
- ASM Conference on Experimental Microbial Evolution, Co-Organizer (2014) (with F. Rosenzweig)
- Local Organizing Committee, AbSciCon 2012, Exploring Life: Past, Present, Near, Far (2012) (Lead: L. Williams, N. Hud)
- Organizer, NASA Workshop Without Walls: Rewinding the Tape of Life (2010) (with L. Williams, J. Peters, M. Kirven-Brooks, W. Dolci, C. Pilcher)

Reviewer Activities

Panel Chair: NASA Exobiology Program: Evolutionary Biology (2018).

Panel Member: NASA Planetary Science Division (2020); NASA Exobiology and Evolutionary Biology Review Panel II (2018); National Science Foundation CAREER Panel, National Science Foundation Molecular and Cellular Biosciences, (2017).

Ad Hoc Reviewer: National Science Foundation: Molecular and Cellular Biology (2017-2019), Division of Environmental Biology (2019), Genetic Mechanisms (2018, 2019), Geobiology & Low Temp. Geochemistry (2017); National Aeronautics and Space Administration: Internal Scientist Funding Model for Planetary Science Division (2020), Exobiology and Evolutionary Biology Program (2017-2018, 2020), Space Biology, NASA Earth and Space Science Fellowship (2016, 2018-2019), NASA Postdoctoral Program (Astrobiology, Space Biology, Astronomy) (2016-2019); John Templeton Foundation: Life Sciences Program Genetics (2018, 2019), Science of Purpose (2020).

Journal/Referee Activities: Molecular Biology and Evolution, Science, Science Advances, BMC Biology, Journal of Molecular Evolution, Free Radical Biology and Medicine, Geobiology, PLOS One, PLOS Biology, npj Nature Microgravity, Frontiers in Microbiology, Current Biology, ChemBioChem, The Quarterly Review of Biology.

Editorial Boards: Journal of Molecular Evolution (Assistant Editor, 2018-present), Faculty 1000 (Junior Editor, 2019-present).

Press and Media Coverage (Selected)

Interviews

Bill Nye’s Great Big World of Science, August 2020

United Nations, UN Women Europe and Central Asia, March 2020

Arizona Public Radio, Catalysts of Change, College of Science Lecturers Conversation, February 2020

Turkish National TV and Radio, CNN Turk, NTV, Biosignatures and Life in the Universe, January 2020
Five Questions for Betül Kacar, John Templeton Foundation Highlighted Grantee, December 2019
Lunar Planetary Institute, Exploring early Earth using DNA by Marc Kaufman, September 2019
NPR Arizona, Science Friday, Topic: Origins of Life, June 2019
Fearless Women of Tucson, Arizona Daily Star, May 2019
PLoS Blogs, Looking for the origins of life using synthetic biology, by Kostas Vavitsas, October 2018
NPR Arizona, Science Friday, Topic: Synthetic Biology and Experimental Evolution, September 2017
Belmont TV, Reconstructing Evolution, Production by Yvonne Stapp, February 2016
SETI Podcast, Cells and Planets Season 2, Episode 4, Moderator: Paul Carr, August 2014
Popular Science, Splicing a 500-million-year-old gene into modern bacteria, April 2013

News Coverage related to research publications

The Scientist, "Scientists Bring Ancient proteins back to life" by Amber Dance, July 2018
New Scientist, Resurrected gene allows travel to an Earth before oxygen, by Bob Holmes, May 2017
Quanta Magazine, Biologists Invoke the Past in Modern Bacteria, by Emily Singer, April 2015
MIT Technology Review, Biologists replay million years evolution in the lab, September 2013
BBC Focus Magazine: Ancient DNA brought back to life, September 2012
Wired, Ancient Gene Inserted in E. coli., July 2012

Documentary

PBS NOVA Science Documentary, "Into the Origins", Production: January 2014, Self.
Currently used as a part of Montana Public School Education Curriculum.

Comic Books

NASA Astrobiology Comic Book: Origins of Life (self), Author: Aaron Gronstal, Published: June 2019
Lunar and Planetary Institute: Mars Now! For Girls (self), Published: September 2011

Professional Societies

American Society for Microbiology
Geobiological Society
NASA Astrobiology and Exobiology Program
Engineering Biology Research Consortium

Synergistic Activities

I frequently give seminars for the general public on topics including origins of life, molecular evolution, and astrobiology (e.g., Boston Science Café, Tucson Science Café, NASA TV) and contribute to interviews/videos for public television and media (e.g., "Into the Origins" for PBS, "Reconstructing Life" for Belmont TV), contribute to K-12 teacher workshops, and give lectures at local K-12 schools, e.g., using candies to build phylogeny and predict ancestors, visiting Coretta Scott King Women's High School in Atlanta. Moreover, I participate in international outreach and education activities, I started an online open-access education platform named SAGANet, building lectures and resources that are readily available for the use of students across all United States.

My research on experimental evolution is transformed into college curriculum by Bard College, and into high school curriculums at the national level, distributed by PBS Media. I was featured as a cartoon hero for the Lunar Planetary Institute (LPI) for underprivileged girls age 9-12 in a project title Mars Now!, was named Way Cool Scientist by the high school student members of the Science Club for Girls (Cambridge, MA) and was featured by the NASA Exobiology Comic Book with my work on ancient RuBisCO enzymes; a comic book distributed all across the United States middle and high schools. A large portion of my advising efforts involve working with undergraduate students, including minorities and women, encouraging them to fully participate in developing and completing their own research projects. I typically have 3-5 undergraduates working in my laboratory.