

# STEPHANIE L. OLSON

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Purdue University  
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## RESEARCH INTERESTS

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Earth system evolution, marine biogeochemistry, astrobiology, exoplanet life detection

## EDUCATION

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- 2018**            **PhD, Geochemistry**  
University of California, Riverside
- 2013**            **MS, Geosciences**  
Pennsylvania State University
- 2011**            **BS Geology, BS Geophysics**  
University of Minnesota

## APPOINTMENTS

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- 2020**            **Assistant Professor**  
Department of Earth, Atmospheric, and Planetary Science  
Purdue University
- 2018-  
2020**            **T.C. Chamberlin Postdoctoral Fellow**  
Department of the Geophysical Sciences  
University of Chicago

## SELECTED HONORS & AWARDS

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- Chancellor's Distinguished Fellow, University of California, 2013
- Outstanding Teaching Assistant, University of Minnesota, 2011
- Ralph and Jayne McMillen Scholarship in Geoscience, 2010
- H. Walter and E. Joyce Rembold Institute of Technology Honors Scholarship, 2009-11
- Richard Clarence Dennis Scholarship in Geoscience, 2009

## FUNDING (\$1,129,606 total)

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- 2020-  
2023**            *Assessing Atmospheric Seasonality as an Exoplanet Biosignature*  
**NASA Exobiology** | Role: PI | Total amount: \$450,459

- 2020-2023**      *Oceanographic Considerations for the Oxygenation of Habitable Worlds: Lessons from Early Earth*  
**NASA Habitable Worlds** | Role: PI | Total amount: \$507,867
- 2018-2020**      *T.C. Chamberlin Postdoctoral Fellowship*  
**UChicago DoGS** | Total amount: \$171,280

### **PEER REVIEWED PUBLICATIONS** (\*denotes student mentee)

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- Forthcoming**      20. **Olson S.L.**, Jansen M.F., Halevy I., Goldblatt C., Abbot D.S. Ocean Salinity and Climate in Light of the Faint Young Sun. *Submitted*.
21. Komacek T., Kang W., Lustig-Yaeger J., **Olson S.L.** Leveraging Models to Constrain the Climates of Rocky Exoplanets (invited review), *submitted*.
- 2020**                19. Reinhard CT, **Olson SL**, Kirtland Turner S, Palike C, Kanzaki Y, Ridgwell A. (2020) Oceanic and Atmospheric Methane Cycling in the cGENIE Earth System Model. *Geoscientific Model Development*.
18. \*Salazar A., **Olson S.L.**, Komacek T., Stephens H., Abbot D.S. (2020) The Effect of Substellar Continent Size on the Ocean Dynamics of Proxima Centauri b. *Astrophysical Journal Letters* 896: L16
17. **Olson SL**, Jansen M, Abbot DS. (2020) Oceanographic Considerations for Exoplanet Life Detection. *Astrophysical Journal* 895: 19.
16. \*Alcubes ODN, **Olson SL**, Abbot DS (2020) Robustness of Gaian Feedbacks to Climate Perturbations. *Monthly Notices of the Royal Astronomical Society* 492: 2572-2577.
15. Ostrander CM, Kendall B, **Olson SL**, et al. (2020) An expanded  $\delta^{98}\text{Mo}$  record permits recurrent shallow marine oxygenation during the Neoproterozoic, *Chemical Geology* 532: 119391.
- 2019**                14. Checlair JH, **Olson SL**, Jansen MF, Abbot DS (2019). No Snowball on Habitable Tidally Locked Planets with a Dynamic Ocean. *Astrophysical Journal Letters* 884: L46.
13. Gregory DD, Mukherjee I, **Olson SL** et al. (2019). The formation mechanisms of sedimentary pyrite nodules determined by trace element and sulfur isotope microanalysis. *Geochimica et Cosmochimica Acta* 259: 53-68.
12. Schwieterman E.W., Reinhard C.T., **Olson S.L.**, Harman C.E., Lyons T.W. (2019) A limited habitable zone for complex life. *Astrophysical Journal* 878: 19.

11. Schwieterman E.W., Reinhard C.T., **Olson S.L.**, Ozaki K., Harman C, Lyons T.W. (2019) Rethinking CO "Anti-Biosignatures" in the Search for Life Beyond Earth. *Astrophysical Journal* 874: 9.
10. **Olson SL**, Ostrander C, Gregory DD, Roy M, Anbar AD, Lyons TW. (2019) Volcanically modulated pyrite burial and ocean-atmosphere oxidation. *Earth and Planetary Science Letters* 506: 417-427.
- 2018**
  9. **Olson SL**, Schwieterman EW, Reinhard CT, Ridgwell A, Meadows VS, Lyons TW. (2018) Atmospheric seasonality as an exoplanet biosignature. *Astrophysical Journal Letters* 858: L14.
  8. Schwieterman EW, Kiang NY, Parenteau MN, ... , **Olson SL, et al.** (2018) Exoplanet Biosignatures: A Review of Remotely Detectable Signs of Life, *Astrobiology* 18: 663-708.
  7. **Olson SL**, Schwieterman EW, Reinhard CT, Lyons TW (2018). Earth: Atmospheric Evolution of a habitable planet, in Deeg HJ & Belmonte JA (eds), *Handbook of Exoplanets*.
  6. Krissansen-Totton J, **Olson SL**, Catling D (2018). Disequilibrium biosignatures on Earth through time and implications for remote life detection, *Science Advances* 4: eaao5747.
- 2017**
  5. Reinhard CT, **Olson SL**, Schwieterman EW, Lyons TW (2017) False Negatives for Remote Life Detection on Ocean-Bearing Planets: Lessons from the Early Earth. *Astrobiology* 17:287–297.
- 2016**
  4. **Olson SL**, Reinhard CT, Lyons TW (2016b) Cyanobacterial Diazotrophy and Earth's Delayed Oxygenation. *Frontiers in Microbiology* 7:1526.
  3. **Olson SL**, Reinhard CT, Lyons TW (2016a) Limited role for methane in the mid-Proterozoic greenhouse. *Proceedings of the National Academy of Sciences* 113:11447–11452.
  2. Reinhard CT, Planavsky NJ, **Olson SL**, Erwin DH, Lyons TW (2016) Earth's oxygen cycle and the evolution of animal life. *Proceedings of the National Academy of Sciences* 113:8933–8938.
- 2013**
  1. **Olson SL**, Kump LR, Kasting JF (2013) Quantifying the areal extent and dissolved oxygen concentrations of Archean oxygen oases. *Chemical Geology* 362:35–43.

## SEMINARS & COLLOQUIA

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- 2020** Oceanographic Considerations for Exoplanet Life Detection  
*NASA Goddard Exoplanet Seminar*  
October, 2020 [virtual]

Oceanographic Considerations for Exoplanet Life Detection  
*Ocean, Atmosphere, and Climate Lunch Seminar,*  
*Department of Earth, Atmospheric, and Planetary Sciences, MIT*  
 September 2020 [virtual]

Atmospheric Seasonality: The Pulse of an Alien Biosphere?  
*EcoLunch Seminar, Department of Biological Sciences, Purdue University*  
 September 2020 [virtual]

**2019** Exo-oceanography and the Search for Life in Uncharted Waters  
*Department of the Geophysical Sciences, University of Chicago*  
 Chicago, IL, October 2019

Resolving Ambiguities in the Search for Life in the Universe  
*Earth and Ocean Sciences, University of Victoria*  
 British Columbia, Canada, March 2019

Resolving Ambiguities in the Search for Life in the Universe  
*Earth, Atmospheric, and Planetary Sciences, Purdue University*  
 West Lafayette, IN, February 2019

**2018** Characterizing Ozone Detectability and Seasonality on Weakly Oxygenated  
 Terrestrial Exoplanets: Lessons from Early Earth.  
*LUVOIR Seminar, NASA Goddard, April 2018 [virtual]*

Atmospheric Seasonality as an Exoplanet Biosignature  
*Center for Space and Habitability, University of Bern*  
 Bern, Switzerland, February 2018

Leveraging Earth Science in the Search for Life Elsewhere  
*Department of the Geophysical Sciences, University of Chicago*  
 Chicago, IL, January 2018

## KEYNOTES & INVITED CONFERENCE TALKS

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**2020** Salt: an essential ingredient for modeling exoplanet climates.  
**Invited**, TRAPPIST Habitable Atmosphere Intercomparison (THAI)  
 Workshop. [virtual]

Exo-oceanography and the Search for Life in Uncharted Waters  
**Invited**, *What makes a planet uninhabitable?* [virtual]

**2019** Exo-oceanography and the Search for Life in Uncharted Waters  
**Keynote**, *Goldschmidt 2019*. Barcelona, Spain

Distinguishing biological and geological methane  
**Invited**, *Sagan Workshop 2019*, Pasadena, CA

Higher ocean salinity significantly warms Archean climate  
**Invited**, *NASA AbSciCon 2019*, Seattle, WA

- 2018** Co-evolution of Oceanic and Atmospheric Chemistry  
*Invited*, *Comparative Climatology of Terrestrial Planets III*, Houston, TX
- 2016** Nutrient-O<sub>2</sub> feedbacks and Proterozoic pO<sub>2</sub> regulation  
*Invited*, *Goldschmidt 2016*, Yokohama, Japan
- 2014** Oxygen oases before and after the GOE: insights from metals and models  
*Invited*, *AGU Fall Meeting 2014*, San Francisco, CA

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**CONTRIBUTED ABSTRACTS** (\*denotes student mentee)

Checlair JH, Hayworth BPC, **Olson SL**, Komacek TD, Villanueva G, Popovic P, Yang H, Abbot DS. (2020) Non-detection of O<sub>2</sub>/O<sub>3</sub> informs frequency of Earth-like planets with LUVOIR but not HabEx. *AGU Fall Meeting* [virtual]

\*Barnett M, **Olson SL** (2020) High orbital obliquity promotes planetary oxygenation. *AGU Fall Meeting* [virtual]

Liu X, **Olson SL** (2020) Modelling Early Earth Ocean Mixing Timescales: Implications for the Oxygenation of Habitable Worlds. *LPSC*. [virtual]

Schwieterman E, **Olson S**, Reinhard C (2020) Chemical consequences of high CO<sub>2</sub> on temperate terrestrial planets in the habitable zone. AAS 235, Honolulu, HI.

\*Barnett M, **Olson SL** (2019) Nutrient Cycling in Exoplanet Oceans. *AGU Fall Meeting*, San Francisco, CA.

\*Alcabes ODN, **Olson SL**, Abbot DS (2019) Typical Climate Perturbations Unlikely to Disrupt Gaia Hypothesis. *AGU Fall Meeting*, San Francisco, CA.

Checlair J, Abbot DS, Jansen MF, Menou K, **Olson SL**, Paradis A, Salazar A (2019) The Snowball Bifurcation on Tidally Locked Planets. *AGU Fall Meeting*, San Francisco, CA.

Abbot DS, Alcabes ODN, Checlair J, Hayworth B, Komacek TD, **Olson SL**, Popovic P (2019) What HabEx and LUVOIR can tell us about Habitability, Inhabitation, and Biosigning. *AGU Fall Meeting*, San Francisco, CA.

**Olson SL**, Checlair J, Abbot DS (2019) Ocean Heat Transport and Glaciation Dynamics on Tidally Locked Planets. *Goldschmidt*, Barcelona, Spain.

Schwieterman EW, Reinhard CT, **Olson SL**, Harman CE, Lyons TW (2019) A Limited Habitable Zone for Complex Life. *Goldschmidt*, Barcelona, Spain.

**Olson SL**, Jansen M, Abbot DS (2019) Exo-oceanography and the Search for Life in Uncharted Waters. *NASA AbSciCon*, Seattle, WA.

Lyons TW, **Olson SL**, Reinhard CT, Schwieterman EW (2019) How Earth's Early Oceans and Atmosphere Help Guide the Search for Life Beyond our Solar System. *NASA AbSciCon*, Seattle, WA.

- Schwieterman EW, Reinhard CT, **Olson SL**, Harman CE, Lyons TW (2019) A Limited Habitable Zone for Complex Life. *NASA AbSciCon*, Seattle, WA.
- Olson SL**, Droser ML, Gehling J, Lyons TW (2018) Ediacaran oxygen oases and the emergence of bilaterian burrowing. *Midwest Geobiology Symposium*, Evanston, IL.
- Olson SL**, Schwieterman EW, Reinhard CT., Ridgwell A, Meadows VS, Lyons TW (2018) Atmospheric Seasonality as an Exoplanet Biosignature. *Goldschmidt*, Boston, MA.
- Krissansen-Totton J, **Olson SL**, Garland R, Irwin P, Catling D (2018) Disequilibrium Biosignatures on the Early Earth and their Detectability with the James Webb Space Telescope. *Goldschmidt*, Boston, MA.
- Schwieterman EW, **Olson SL**, Reinhard CT, Lyons TW (2018) The Importance of Ozone and UV Capability in Detecting Biosignatures on Planets with Intermediate Oxygenation States. *Goldschmidt*, Boston, MA.
- Olson SL**, Droser ML, Gehling J, Lyons TW (2018) Benthic Oxygen Oases and Early Animal Evolution. *Southern California Geobiology Symposium*, Riverside, CA.
- Olson SL**, Schwieterman EW, Reinhard CT, Ridgwell A, Meadows VS, Lyons TW (2017) Atmospheric seasonality on early Earth and Earth-like exoplanets. *AGU Fall Meeting*, New Orleans, LA.
- Olson SL**, Schwieterman EW, Reinhard CT, Ridgwell A, Lyons TW (2017) Atmospheric seasonality on Earth: Implications for remote life detection. *Goldschmidt*, Paris, France.
- Olson SL**, Droser ML, Gehling J, Lyons TW (2017) Ediacaran trace fossils map benthic oxygen oases. *Geobiology*, Banff, AB.
- Olson SL**, Droser ML, Gehling J, Lyons TW (2017) Ediacaran trace fossils map benthic oxygen oases. *NASA AbSciCon*, Mesa, AZ.
- Krissansen-Totton J, **Olson SL**, Catling DC (2017) Atmospheric Disequilibrium Biosignatures on Earth Through Time. *NASA AbSciCon*, Mesa, AZ.
- Schwieterman EW, **Olson SL**, Reinhard CT, Lyons TW (2017) Evaluating N<sub>2</sub>O as an Exoplanet Biosignature: Combining Biogeochemical, Photochemical, and Spectral Models. *NASA AbSciCon*, Mesa, AZ.
- Reinhard CT, **Olson SL**, Schwieterman EW, Lyons TW (2017) False Negatives for Remote Life Detection on Ocean-Bearing Planets: Lessons from the Early Earth. *NASA AbSciCon*, Mesa, AZ.
- Olson SL**, Reinhard CT, Lyons TW (2016) Nutrient-O<sub>2</sub> feedbacks and Proterozoic pO<sub>2</sub> regulation. *Southern California Geobiology Symposium*, Pasadena, CA.
- Olson SL**, Reinhard CT, Lyons TW (2015) Biosignature blind spots: lessons from early Earth. *ExSoCal*, Pasadena, CA, USA.

- Olson SL**, Roy M, Ostrander C, Lyons TW, Anbar AD (2015) Inorganic hints of Archean oxygenation in the ~2.7 Ga Roy Hill Shale. *Goldschmidt*, Prague, CZ.
- Olson SL**, Reinhard CT, Lyons TW (2015) A mid-life crisis for Earth's greenhouse. *NASA AbSciCon*, Chicago, IL, USA.
- Olson SL**, Reinhard CT, Lyons TW (2015) A mid-life crisis for Earth's greenhouse. *Southern California Geobiology Symposium*, Riverside, CA.
- Olson SL**, Reinhard CT, Lyons TW (2014) Exploring the effects of oxidant availability on the early methane cycle. *Goldschmidt*, Sacramento, CA.
- Olson SL**, Kump LR, Kasting JF (2013) Quantifying the areal extent and dissolved oxygen concentrations of Archean oxygen oases. *NASA AbGradCon*, Montreal, QC.
- Olson SL**, Kump LR, Kasting JF (2012) Quantifying the areal extent and dissolved oxygen concentrations of Archean oxygen oases. *NASA AbSciCon*, Atlanta, GA.

## WHITE PAPERS & REPORTS

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- Unterborn CT, Byrne PK, ... **Olson SL**, *et al.* (2020) Exogeoscience and Its Role in Characterizing Exoplanet Habitability and the Detectability of Life. [arXiv:2007.08665](https://arxiv.org/abs/2007.08665) [astro-ph.IM]
- Reinhard C.T., Planavsky N.J., Cole D.B., ... , **Olson S.L.**, *et al.* (2020) Environmental drivers of increasing biological complexity on Earth.
- Olson S.L.** & Schwieterman E.W. (2019) Leveraging planetary seasonality to recognize habitability and to detect the pulse of a biosphere. *LUVOIR Report*, Appendix A.16
- Lisman D., Schwieterman E.W., Seager S., ... , **Olson S.L.**, *et al.* (2019) The Occulting Ozone Observatory (O3) Mission.
- Lisman D, Schwieterman EW, Reinhard CT, **Olson SL**, *et al.* (2019) Surveying the solar neighborhood for ozone in the UV at temperate rocky exoplanets. *Bulletin of the American Astronomical Society*.
- Krissansen-Totton J, Arney G., Catling C., ... , **Olson SL**, *et al.* (2019) Atmospheric disequilibrium as an exoplanet biosignature: Opportunities for next generation telescopes. *Bulletin of the American Astronomical Society*.
- Arney G, Batalha N, Britt AV, ... , **Olson SL**. *et al.* (2019) The Sun-like Stars Opportunity. *Bulletin of the American Astronomical Society*.
- Reinhard CT, Schwieterman EW, **Olson SL**, *et al.* (2019) The remote detectability of Earth's biosphere through time and the importance of UV capability for characterizing habitable exoplanets. [arXiv:1903.05611](https://arxiv.org/abs/1903.05611) [astro-ph.EP]

Checlair JH, Abbot DS, ... , **Olson SL**, *et al.* (2019) A Statistical Comparative Planetology Approach to Maximize the Scientific Return of Future Exoplanet Characterization Efforts. arXiv:1903.05211, 2019 [astro-ph.EP]

Schwieterman EW, Reinhard CT, **Olson SL**, Lyons TW (2018) The Importance of UV Capabilities for Identifying Inhabited Exoplanets with Next Generation Space Telescopes. arXiv:1801.02744 [astro-ph.EP]

## SHORT COURSES & WORKSHOPS

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- Sagan Workshop 2019: Astrobiology for Astronomers, Caltech.
- Rossbyalooza 2018: Understanding Climate Through Simple Models, University of Chicago.
- Searching for Life Across Space and Time, National Academy of Sciences, 2016.
- Josep Comas i Solà International Summer School in Astrobiology, Santander, Spain, 2016.
- Building a Habitable Earth, University of Tübingen, Germany, 2016.
- Upstairs Downstairs: Consequences of Internal Planet Evolution for the Habitability and Detectability of life on Extrasolar planets, Arizona State University, AZ, 2016.
- Beyond Habitability: Life and the Early Earth, Smithsonian Institution, DC, 2014.

## TEACHING

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### Teaching assistant for:

- *Geochemistry of Natural Waters*, UCR, 2015, 17;
- *Oceanography*, UCR, 2014-16;
- *Earth and Life: Origin and Evolution*, PSU, 2012;
- *The Earth System*, PSU, 2011;
- *Earth and its Environments*, UMN, 2010-11

## STUDENT MENTORSHIP

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### **Darya Corry, 2020—present**

Undergraduate, Aeronautics and Astronautics, Purdue University

### **Jonathan Jernigan, 2020—present**

Undergraduate, Applied Math & Environmental Engineering, Purdue University

### **Megan Barnett, 2019—present**

PhD student, Geophysical Sciences, University of Chicago (primary advisor: Fred Ciesla)

### **Camilla Liu, 2019—present**

PhD student, Geophysical Sciences, University of Chicago (primary advisor: Nicolas Dauphas)



**Andrea Salazar, 2019-2020**

Undergraduate, Physics, University of Chicago; now a PhD student in Earth & Planetary Science at Harvard.

**Olivia Alcabes, 2018-2019**

Undergraduate, Physics, University of Chicago

**Haynes Stephens, 2018-2019**

PhD student, Geophysical Sciences, University of Chicago

**Elise Darragh-Ford, 2018**

Undergraduate, Astrophysics, University of Chicago; now a PhD student in Physics at Stanford.

**SYNERGYSTIC ACTIVITIES**

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- Steering Council, NASA Nexus for Exoplanet System Science (NExSS), 2020—
- Co-Lead, NExSS Life Detection Science Working Group, 2020—
- Scialog Fellow, 2020—
- NASA panelist (x3)

**Session organizer/convener for:**

- 2019** Astrobiogeochemistry: Modelling biology and its co-evolution with the environment on Earth and implications for exoplanets. *NASA AbSciCon 2019*, Seattle, WA
- Astrobiogeochemistry: Emerging links between Earth Sciences, Astrophysics, and the Search for Habitability and Life. *Goldschmidt 2019*, Barcelona, Spain
- 2018** Leveraging Earth Science Approaches in the Search for Life in the Universe. *Goldschmidt 2018*, Boston, MA
- 2017** The Co-Evolution of Life and Its Environment during the Precambrian: The Rise of Oxygenic Photosynthesis and the Great Oxidation Event. *Geological Society of America 2017*, Seattle, WA
- 2014** The Co-evolution of Life and its Environments from the GOE to the Rise of Complex Life. *AGU Fall Meeting 2014*, San Francisco, CA

**Reviewer for:**

*American Journal of Science, Astronomical Journal, Astrophysical Journal Letters, Chemical Geology, Communications Earth and Environment, Earth and Planetary Science Letters, Geobiology, Geochimica et Cosmochimica Acta, Geology, Interface Focus, Nature, Nature Geoscience, Paleoceanography and Paleoclimatology, Planetary Science Journal, Science Advances*

## SERVICE

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- Member, Purdue EAPS Computing Committee, 2020–
- Member, Purdue EAPS Graduate Committee, 2020–
- Organizer, UChicago Geo & Astro Exoplanet Journal Club, 2019-2020
- Member, T.C. Chamberlin Postdoctoral Fellowship Search Committee, 2018, 2019

## OUTREACH

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- Mentor, Ossining Science Research Program, 2019
- Volunteer instructor, Python Club at Noble Academy, 2018
- Mentor, Summer Experience in Earth and Mineral Sciences/Upward Bound Math & Science, 2012

## SELECTED MEDIA COVERAGE

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- 2019** Exoplanets could have better conditions for life than Earth, study says, *CNN*, August 2019
- Alien Life on Exoplanets May be 'More Abundant and Active' Than on Earth, Say Scientists, *Forbes*, August 2019
- Alien Planets Could be Better Suited for Life than Earth: Study, *Fox News*, August 2019
- Earth 2.0: same same, but better, *Cosmos Magazine*, July 2019
- Extraterrestrial life could be scarcer than first thought, study says, *Fox News*, June 2019
- 2018** The clues to finding alien life could lie in Earth's deep past, *New Scientist* September 2018
- Seasonal changes in exoplanet's atmosphere could signal alien life, *Fox News*, May 2018
- The search for life on other planets could get a boost from biosignatures, *Los Angeles Times*, Jan. 2018
- 2017** Finding Signs of Alien Life Might be Harder Than We Thought. Here's Why, *NBC News*, April 2017