

Julia D. Plummer

Professor of Science Education
Pennsylvania State University
Department of Curriculum & Instruction
149 Chambers Building; University Park, PA 16802
jdp17@psu.edu; (814) 863-8922

EDUCATION

UNIVERSITY OF MICHIGAN, ANN ARBOR 2006
Ph.D. in Astronomy and Educational Studies (Student initiated, combined degree program)
Dissertation: *Students' Development of Astronomy Concepts across Time*
Committee: Joseph Krajcik (co-chair), Mario Mateo (co-chair), Scott Paris, Matthew Linke
NARST Outstanding Doctoral Dissertation Award for 2007

UNIVERSITY OF MICHIGAN, ANN ARBOR 1999
M.S. in Astronomy

WASHINGTON STATE UNIVERSITY, PULLMAN 1997
B.S. in Physics
Minors: Math and Philosophy

PROFESSIONAL EXPERIENCE

PENNSYLVANIA STATE UNIVERSITY (UNIVERSITY PARK) 2011 - present
Professor of Science Education (2021 -)
Associate Professor of Science Education (2012 – 2021)
Visiting Assistant Professor (2011-2012)

ARCADIA UNIVERSITY 2006 – 2012
Assistant Professor of Science Education

UNIVERSITY OF MICHIGAN 1997- 2006
Graduate Student Instructor, Department of Astronomy (1997-2003); School of Education (2006)
Curriculum Developer, Center for Curriculum Materials in Science (2003-2006)
Planetarium Educator at the Exhibit Museum of Natural History (1997-2006)

WASHINGTON STATE UNIVERSITY 1994-1997
Planetarium Educator, Program in Astronomy

FUNDING AND HONORS

COMPLETED GRANTS AND PROJECTS

Pennsylvania State University, College of Education – Faculty Research Initiation Grant 2019-2020
Support for Spatial Thinking through Children's Storybooks
Principal Investigator \$9000

- National Science Foundation – Discovery Research K-12 Award 2015-2019
Thinking Spatially about the Universe: A Physical and Virtual Laboratory for Middle School Science
 Co-Principal Investigator \$1,387,378 (PSU subaward: \$323,246; PI: Alyssa Goodman, Harvard University)
- National Science Foundation – Advancing Informal Science Education Award 2012-2018
My Sky Tonight: Early Childhood Pathways to Astronomy
 Co-Principal Investigator, \$2,499,917 (PSU subaward: \$219,244; PI: Suzanne Gurton, Astronomical Society of the Pacific)
- National Science Foundation – Targeted Math and Science Partnership 2010-2016
Middle Grade Earth and Space Science Education
 Senior Researcher (2013-2016), Director of Research (2012-2013); \$9,181,723 (PI: Tanya Furman, PSU)
- Penn State Center for Online Innovation in Learning – Research Initiation Grant 2015-2016
Development of a Web-Platform to Engage Local and Global Communities of Learners around the Science of Human-Environment Interactions
 Co-Principal Investigator, \$37,516 (PI: Neil Brown, Department of Geography)
- National Science Foundation – Developing Assessments to Validate and Study Learning Progressions 2011
A Workshop on Developing Learning Progressions for Astronomy Education Researchers
 (Sub-award: \$2500; PIs: R. Duncan & J. Krajcik)
- Arcadia University – Steve Goldberg Award 2010
Scientific Reasoning and Attitudes Towards Science: Girls Participating in an Aerospace and Technology Program
 Principal Investigator, \$1300
- Arcadia University – Ellington Beavers Faculty Award for Intellectual Inquiry 2007-2009
Elementary Students’ Development of Apparent and Actual Celestial Motion Concepts
 Principal Investigator, \$3000
- National Science Foundation – Math and Science Partnership of Greater Philadelphia 2007-2008
Astronomy in the Greater Philadelphia Area: Teacher Preparation and the State Standards
 Sub-award, \$18,636

HONORS

- NATIONAL SCIENCE FOUNDATION – TEACHING & LEARNING VIDEO SHOWCASE 2018
 Presenters’ Choice Award. *My Sky Tonight: Early Childhood Pathways to Astronomy*
- NSTA SUMMER READING LIST FOR TEACHERS 2010
 Plummer (2009). Early elementary students’ development of astronomy concepts in the planetarium. One of three articles from the *Journal of Research in Science Teaching* selected to be promoted by the National Science Teacher Association (NSTA); nominated by the National Association for Research in Science Teaching (NARST)
- EARLY CAREER RESEARCHER CONSORTIUM 2010
 Participant, NSF-funded competitive workshop, International Conference of the Learning Sciences (ICLS)
- OUTSTANDING DOCTORAL DISSERTATION AWARD 2007
 National Association for Research in Science Teaching (NARST)

REFEREED JOURNAL ARTICLES

* = graduate student co-author

** = undergraduate student co-author

+ = K-12 teacher and/or planetarium educator co-author

Cho, K., & **Plummer, J. D.** (2022). Teacher support and children's science experience in a play for 'doing science'. *Korean Journal of Early Childhood Education*, 42(1), 285-309.

Plummer, J. D., Udomprasert, P., *Vaishampayan, A.M., Sunbury, S., *Cho, K., *Houghton, H., Johnson, E., *Wright, E., Sadler, P.M. & Goodman, A. (2022). Learning to think spatially through curricula that embeds spatial training. *Journal of Research in Science Teaching*. Online ahead of print. DOI: 10.1002/tea.21754

Plummer, J. D., Cho, K., Palma, C., Barringer, D. F., Gleason, T., & *Nolan, K. (2021). Assessing preservice elementary teachers' enactment of science practices using children's astronomy storybooks. *Astronomy Education Journal*, 1(1), 1-11. doi: 10.32374/AEJ.2021.1.1.002

Plummer, J.D., Tanis Ozcelik, A. & +Crowl, M. (2021). Informal science educators' methods of engaging preschool-age audiences in science. *International Journal of Science Education, Part B*. 11(2), 91-109. <http://dx.doi.org/10.1080/21548455.2021.1898693>

Plummer, J.D., +Crowl, M., & *Tanis Ozcelik, A. (2021). Informal science educators: Understanding their goals for preschool-age audiences. *Research in Science Education*. 51(5), 1269-1286. <https://doi.org/10.1007/s11165-019-09868-y>

Bradley, H., **Plummer, J.D., Palma, C., & *Teuber, M. (2020, June). Design considerations for a seasonal constellations planetarium program: Comparison of embodied design and computer visualizations. *Planetarian*, 49 (2), 30-38.

Plummer, J.D., Palma, C., *Rubin, K., *Flarend, A., *Ong, Y.S., *Ghent, C., *Gleason, T., McDonald, S., **Botzer, B., & Furman, T. (2020). Evaluating a learning progression for the Solar System: Progress along gravity and dynamical properties dimensions. *Science Education*, 104 (3), 530-554.

+Schwarz, K., *Ghent, C., & **Plummer, J.D.** (2019). Why do they come? The motivation behind field trips to the planetarium. *Planetarian*, 48 (1), 20-22.

Plummer, J.D. & +Small, K.J. (2018). Using a planetarium fieldtrip to engage young children in three-dimensional learning through representations, patterns, and lunar phenomena. *International Journal of Science Education, Part B*, 8(3), 193-212.

*Barringer, D., **Plummer, J.D.**, Kregenow, J., & Palma, C. (2018). A gamified approach to teaching introductory astronomy online. *Physical Review Physics Education Research*, 14(1), 010140.

Palma, C., **Plummer, J.D.**, *Rubin, K., *Flarend, A., *Ong, Y.S., McDonald, S., *Ghent, C., & **Gleason, T. (2017). Have astronauts visited Neptune? Student ideas about how scientists study the Solar System. *Journal of Astronomy and Earth Science Education*, 4(1), 63-74.

+Hurst, A., **Plummer, J.D.**, +Gurton, S., & +Schatz, D. (2017). Preparing for the eclipse: How to safely observe the Sun with young children. *Science & Children*, 54 (7), p. 52-57.

Plummer, J.D., *Bower, C.A., & Liben, L.S. (2016). The role of perspective taking in how children connect reference frames when explaining astronomical phenomena. *International Journal of Science Education*, 38(3), 345-365.

Plummer, J.D. & *Tanis Ozcelik, A. (2015). Preservice teachers developing coherent inquiry investigations in elementary astronomy. *Science Education*, 99(5), 932-957.

Plummer, J.D., Palma, C., *Flarend, A., *Rubin, K., *Ong, Y.S., **Botzer, B., McDonald, S., & Furman, T. (2015). Development of a learning progression for the formation of the Solar System. *International Journal of Science Education*, 37(9), 1381-1401.

Plummer, J.D. (2015). Embodying the Earth's place in the Solar System: Students investigating seasonal constellations. *Science & Children*, 53(4), 52-61.

Price, C.A., Lee, H.-S., **Plummer, J.D.**, SubbaRao, M., & Wyatt, R. (2015). Position paper on use of stereoscopy to support science learning: Ten years of research. *Journal of Astronomy & Earth Science Education*, 2(1), 17-26.

Plummer, J.D. & +Maynard, L. (2014). Building a learning progression for celestial motion: An exploration of students' reasoning about the seasons. *Journal of Research in Science Teaching*, 51(7), 902-929.

Plummer, J.D. (2014). Spatial thinking as the dimension of progress in an astronomy learning progression. *Studies in Science Education*, 50, 1-45.

Plummer, J.D., *Kocareli, A., & +Slagle, C. (2014). Learning to explain astronomy across moving frames of reference: Exploring the role of classroom and planetarium-based instructional contexts. *International Journal of Science Education*, 36, 1083-1106.

*Rubin, K., **Plummer, J.D.**, Palma, C., *Flarend, A., +Spotts, H., McDonald, S., & *Ong, Y.S. (2014). Assessing student progress along a Solar System learning progression. *Science Scope*, 38, 27-33.

*Rubin, K., **Plummer, J.D.**, Palma, C., Spotts, H., & *Flarend, A. (2014). Planetary properties: A systems perspective. *Science Scope*, 37, 68-72.

+Small, K.J. & **Plummer, J.D.** (2014). A longitudinal study of early elementary students' understanding of lunar phenomena after planetarium and classroom instruction. *Planetarian*, 43(4), 18-21.

Plummer, J.D. & +Small, K. (2013). Informal science educators' pedagogical choices and goals for learners: The case of planetarium professionals. *Astronomy Education Review*, 12(1), 010105-1–010105-16.

Plummer, J.D., *Wasko, K., & +Slagle, C. (2011). Children learning to explain daily celestial motion: Understanding astronomy across moving frames of reference. *International Journal of Science Education*, 33(14), 1963-1992.

Plummer, J.D. & Krajcik, J.S. (2010). Building a learning progression for celestial motion: Elementary levels from an Earth-based perspective. *Journal of Research in Science Teaching*, 47(7), 768-787.

Plummer, J.D., *Zahm, V. & *Rice, R. (2010). Inquiry and astronomy: Preservice teachers' investigations in celestial motion. *Journal of Science Teacher Education*, 21, 471-493.

+Small, K.J. & **Plummer, J.D.** (2010). Survey of the goals and beliefs of planetarium professionals regarding program design. *Astronomy Education Review*, 9(1), 010112-1–010112-10. <http://dx.doi.org/10.3847/AER2010016>

Plummer, J.D. & *Zahm, V. (2010). Covering the standards: Astronomy teachers' preparation and beliefs. *Astronomy Education Review*, 9(1), 010110-1–010110-28. <http://dx.doi.org/10.3847/AER2009077>

Plummer, J.D. (2009). Early elementary students' development of astronomy concepts in the planetarium. *Journal of Research in Science Teaching*, 46(2), 192-209.

Plummer, J.D. (2009). A cross-age study of children's knowledge of apparent celestial motion. *International Journal of Science Education*, 31(12), 1571-1606.

Secker, J., Harris, W.E., & **Plummer, J.D.** (1997). Dwarf galaxies in the Coma Cluster. II. Photometry and analysis. *Publications of the Astronomical Society of the Pacific*, 109, 1377-1393.

Hunter, D. & **Plummer, J.D.** (1996). Sextans A: A case study of star formation and gas densities in irregular galaxies, *Astrophysical Journal*, 462, 732-739.

REFEREED BOOK CHAPTERS

Plummer, J.D. (2017). Core Idea ESS1: The Earth's place in the Universe. In Duncan, R., Krajcik, J. & Rivet, A. (Eds.), *Disciplinary Core Ideas: Reshaping Teaching and Learning*, pp. 185-203. Washington, D.C., NSTA Press.

Plummer, J.D. (2012). Challenges in developing and validating an astronomy learning progression. In A. Alonzo and A.W. Gotwals (Eds.), *Learning progressions in science: Current challenges and future directions*, pp. 77-100, Sense Publishers: Rotterdam, The Netherlands.

Mohan, L., & **Plummer, J.D.** (2012). Exploring challenges to defining a learning progression. In A. Alonzo and A.W. Gotwals (Eds.), *Learning progressions in science: Current challenges and future directions*, pp. 139-150, Sense Publishers: Rotterdam, The Netherlands.

REFERRED CONFERENCE PROCEEDINGS

Plummer, J.D., *Nolan, K., Cho, K., & *Botch, M. (2022, in press). Young children's use of spatial sensemaking practices as mediators of spatial skills during informal STEM programs. J. Oshima, T. Mochizuki, & U. Hayashi (Eds.) *Proceedings of the International Conference of the Learning Sciences*. Hiroshima, Japan: International Society of the Learning Sciences.

Plummer, J.D., *Cho, K., & *Botch, M. (2021). The use of narrative in the development of spatial sensemaking practices. de Vries, E., Hod, Y., & Ahn J. (Eds.), *Proceedings of the 15th International Conference of the Learning Sciences - ICLS 2021*, pp. 1009-1010, Bochum, Germany: International Society of the Learning Sciences.

Plummer, J.D. & *Cho, K. (2020). Integrating narrative into the design of preschool science programs. In Gresalfi, M. & Horn, I. (Eds.), *The Interdisciplinarity of the Learning Sciences*, The 14th International Conference of the Learning Sciences (ICLS), pp. 1585-1589, Nashville, TN. (55% acceptance rate for short papers).

*Ong, Y. S., Duschl, R. A., & **Plummer, J. D.** (2020). Scientific argumentation as an epistemic practice: Secondary students' critique of science research posters. In Teo, T. W., Tan, A.-L., & Ong, Y. S. (Eds.) *Re-searching science education: Same issues from different lenses*, pp. 81-93. Springer Nature.

*Vaishampayan, A., **Plummer, J.D.**, Udomprasert, P., & Sunbury, S. (2019). Use of spatial sensemaking practices in spatial learning. In Lund, K., Niccolai, G., Lavoué, E., Hmelo-Silver, C., Gweon, G., and Baker, M. (Eds.), *A Wide Lens: Combining Embodied, Enactive, Extended, and Embedded Learning in Collaborative Settings*, 13th International Conference on Computer Supported Collaborative Learning (CSCL), pp. 887-888, Lyon, France. (49.3% acceptance rate for posters).

*Ong, Y. S., Duschl, R. A., & **Plummer, J. D.** (2018). Students' critique of epistemic decisions in scientific inquiry. In O. Finlayson, M. E., S. Erduran, & P. Childs (Eds.), *Proceedings of the ESERA 2017 Conference. Research, Practice and Collaboration in Science Education, Part 7: Strand 7* (pp. 1015–1025). Dublin: Dublin City University. Retrieved from https://www.dropbox.com/s/dtoivuqc9f1m3x3/Part_7_eBook.pdf?dl=0

Plummer, J.D. & *Ricketts, A. (2018). Preschool-age children practicing science: Intersections of explanations, modeling, and gesture use. In Kay, J. and Luckin, R. (Eds.), *Rethinking Learning in the Digital Age: Making the Learning Sciences Count*, 13th International Conference of the Learning Sciences, pp. 929-932, London, UK. (27% acceptance rate for short papers).

Plummer, J.D. & +Agan, L. (2010). Reasoning about the seasons: Middle school students' use of evidence in explanations. In Gomez, K., Lyons, L., & Radinsky, J. (Eds.), *Learning in the Disciplines: Proceedings of the 9th International Conference of the Learning Sciences*, pp. 464-465, Chicago, IL.

JOURNAL EDITING

Bailey, J. M., & **Plummer, J. D.** (2018, Co-Editors). Focused Collection: Astronomy Education Research. *Physical Review Physics Education Research*, 14(1), 010004.

CURRICULA

Starr, M., **Plummer, J.D.**, Smith, D., Holt, L., Best, S., Krajcik, J., & Linke, M. (2009). Astronomy. In *Project-based inquiry science* (J. Kolodner, J. Krajcik, D. Edelson, B. Reiser, and M. Starr, Eds.). It's About Time: Armonk, NY.

Starr, M. L., Casella, F., Fortus, D., Krajcik, J., Nordine, J., **Plummer, J.**, Rogat, A., & Switzer, A. (2009). Energy. In *Project-based inquiry science* (J. Kolodner, J. Krajcik, D. Edelson, B. Reiser, and M. Starr, Eds.). It's About Time: Armonk, NY.

MANUSCRIPTS IN PROGRESS

Plummer, J.D. & Ricketts, A. (in review). Preschool-age children's early steps towards evidence-based explanations and modeling practices.

Plummer, J. D. & Cho, K. (in progress). The role of narrative in the design of science learning environments for preschool-age children.

OTHER PAPERS, BOOK CHAPTERS, AND PROCEEDINGS

Plummer, J.D. (accepted). Stars in Mind: How planetariums offer diverse opportunities to engage a broad audience in STEM. To appear in J. Diamond and S. Rosenfeld (Eds.) *Amplifying Informal Science Learning*.

Plummer, J.D. (accepted). Connecting fieldtrips to classroom learning. To appear in S. Jeong, D. Tippins, L. Bryan, and C. Sexton (Eds.), *Cases in Science Teaching and Learning: Exploring Complexities, Promises and Dilemmas*.

Udomprasert, P., Goodman, A., Ladd, E., Offner, S., *Houghton, H., Johnson, E., Sunbury, S., **Plummer, J.**, Wright, E., Sadler, P., Rosenfield, P., & Wong, C. (2020). WorldWide Telescope in Education. In C. Impey & S. Buxner (Eds.), *Astronomy Education - A Practitioner's Guide to the Research*, pp. 9-1 – 9-22. Bristol, UK: IOP Publishing.

Plummer, J.D., *Ghent, C., +Crowl, M., Callanan, M., +Gurton, S., +Hurst, A., Jipson, J., & Palmquist, S. (2016). *My Sky Tonight: Inspiring and engaging activities for 3- to 5-year-old audiences*. *Planetarian*, 45(4), 40-43.

Plummer, J.D. (2015). Methods of engaging preschool-age children in science practices during astronomy activities. In G. Schultz, S. Buxner, L. Shore, and J. Barnes, Eds. *Celebrating Science: Putting Education Best Practices to Work*. ASP Conference Series, 500, 61-66.

Plummer, J.D., +Schmoll, S., +Yu, K.C., & *Ghent, C. (2015). A guide to doing educational research in the planetarium. *Planetarian*, 44(2), 8-24, 30.

Plummer, J.D. & +Small, K.J. (2014). Integrating planetarium and classroom instruction to engage children in the practices of science. In J.G. Manning, J.B. Jensen, M.K. Hemenway, and M.G. Gibbs (Eds.) *Ensuring STEM literacy: A national conference on STEM education and public outreach*. ASP conference series, Vol. 483, pp. 407-410.

Massachusetts Department of Elementary and Secondary Education (**J. Plummer** one of 6 contributors to the white paper) (2010, November 15). Earth and space science: Concept and skill progressions. Retrieved July 16, 2011 from: <http://www.doe.mass.edu/omste/ste/default.html>

Price, A., et al. (**J. Plummer** included in list of 18 authors) (2007). Astronomy education research charter and symposium report, *Astronomy Education Review*, 6(2).

Plummer, J.D., (2006). *Students' development of astronomy concepts across time*, Unpublished doctoral dissertation, University of Michigan, Ann Arbor, MI.

INVITED KEYNOTES/PLENARIES AT CONFERENCES

Plummer, J.D. (2021). Learning in the Planetarium: Perspectives on Current Research Themes. *Brazilian Planetarium Association Meeting*, Brazil, September 30, 2021. [Keynote Speaker]

Plummer, J.D. (2021). Qualitative research methods in astronomy education research. Invited contribution to the Astronomy Education Research 101 session at the *3rd Shaw-IAU Workshop on Astronomy for Education*, Virtual Conference, October 12 -15, 2021.

Plummer, J.D. (2019). Mediating children's use of science practices through drawing during informal astronomy programs. *Art, Visualization, and the Cosmos in Education*, Melbourne, Australia, December 5, 2019. [Keynote Speaker]

Plummer, J.D. (2017). Curricular design for spatial thinking: Embedded support for spatially-complex phenomena in K-12 astronomy curricula. *Thinking Within: Immersive Technologies for Education* symposia, University Park, PA. [Keynote Speaker]

Plummer, J.D., Palma, C., *Ghent, C., *Gleason, T., *Ong, Y., *Flarend, A., *Rubin, K., & McDonald, S. (2016). Evaluating a learning progression for the Solar System: Progress along the gravity and dynamical properties dimensions. Annual conference of the *Korean Association for Science Education*, Daegu, South Korea. [Keynote Speaker]

Plummer, J.D., Palma, C., *Ghent, C., *Gleason, T., *Ong, Y., *Flarend, A., *Rubin, K., & McDonald, S. (2016). Student progress in gravity and dynamics through an astronomy curriculum. Annual conference of the *American Association of Physics Teachers*, New Orleans, LA. [Invited Talk]

Plummer, J.D. & +Small, K.J. (2015). Connecting field trips to classroom learning: Using the planetarium to support students' engagement in science practices. Annual conference of the *Great Lakes Planetarium Association*, Grand Rapids, MI. [Keynote Speaker]

Plummer, J.D. (with Shore, L., Cheung, C., & Carlson, J.) (2014). The Next Generation Science Standards: How to support students, teachers, and districts. Presented at the *Astronomical Society of the Pacific's Annual Education and Public Outreach Conference*, Burlingame, CA. [Invited Talk]

Plummer, J.D. (2012). Methods of supporting student learning in the planetarium. American Association for Physics Teachers, Philadelphia, PA. [Invited Talk]

INVITED PRESENTATIONS FOR DEPARTMENTS AND OTHER ORGANIZATIONS

Plummer, J.D. (2019). Spatial learning in the planetarium: Methods that engage audiences through embodied design. Rio Tinto Alcan Planetarium, Montreal, Canada, April 25, 2019.

Plummer, J.D. (2019). Supporting students' spatial thinking as they learn astronomy. Université du Québec à Montréal, Montreal, Canada, April 24, 2019.

Plummer, J.D. (2019). Getting started with educational research in the planetarium. Planetarian's Web Seminar Series (International Planetarium Society), March 29, 2019.

Plummer, J.D. (2018). A Solar System learning progression: Evaluation of the gravity and dynamical properties dimensions. Università Delgi Studi Di Napoli Federico II, Dipartimento Di Fisica, Naples, Italy, May 29, 2018.

Plummer, J.D. (2018). Supporting young children's capacity to develop scientific models and explanations in astronomy. Osservatorio Astronomico Di Capodimonte, Naples, Italy, May 30, 2018.

Plummer, J.D. (2018). Thinking spatially about astronomy: Embedding support for spatial learning through curriculum design. Temple Institute for Learning & Education Sciences colloquium series, Temple University, Philadelphia, PA.

Plummer, J.D. (2018). Designing for spatial thinking: Embedded support for spatially-complex phenomena in astronomy instruction. Department of Astronomy & Astrophysics, Pennsylvania State University, Colloquium series, University Park, PA.

Plummer, J.D. (with +A. Enevoldsen, +A. Hurst Schmit, & J. Jipson) (2014). Astronomy in Early Childhood. Presented as part of an online web seminar for CosmoQuest. Archived online: <http://cosmoquest.org/x/educatorszone/learning-space/>

Plummer, J.D. (2013). NGSS core ideas: Earth's place in the universe. Presented as an online web seminar for the National Science Teacher Association. Archived online: <https://sas.illuminate.com/p.jnlp?psid=2013-11-05.1339.M.2DD67B0B6EAE914732D0D871BCE4B.vcr&sid=2256>

Plummer, J.D. (2012). Using spatial knowledge as a framework for a learning progression in astronomy. Michigan State University, East Lansing, MI.

PEER-REVIEWED CONFERENCE PRESENTATIONS

Plummer, J.D., & *Nolan, K. (2022). Social and material resources mediating young children engagement in spatial sensemaking during summer engineering camp. Presented at NARST: A Worldwide Organization for Improving Science Teaching and Learning through Research annual conference, Vancouver, BC, March 27-30, 2022.

Cho, K. & **Plummer, J.D.** (2021). Playing with shadows: Understanding preschool-age children's gesture use and body movements in play-based science learning. Presented at the 11th International Conference of Korean Society for Early Childhood Education, October 2, 2021.

*Cho, K., *Botch, M., & **Plummer, J. D.** (2021). Developing preschool-age children's spatial sensemaking practices through a story-driven investigation. Presented at NARST: A Worldwide Organization for Improving Science Teaching and Learning through Research annual conference [virtual conference], April 7, 2021.

Plummer, J.D. & *Cho, K. (2020). A cross-storybook analysis of how story-driven investigations engage preschool-age children in science practices. Presented at NARST: A Worldwide Organization for Improving Science Teaching and Learning through Research annual conference, Baltimore, MD, March 15-18, 2020. (Conference canceled)

*Cho, K. & **Plummer, J.D.** (2020). Applying conjecture mapping to analyze children's use of science practices in story-driven investigations. Presented at NARST: A Worldwide Organization for Improving Science Teaching and Learning through Research annual conference, Baltimore, MD, March 15-18, 2020. (Conference canceled)

Plummer, J.D. (Presider), Anthony, L., *Cho, K., +Crowl, M., *McKinley, Z., Pattison, S., Stofer, K., Svarovsky, G., Wallace, J., and Bell, P. (2019). Illuminating strategies that support science and engineering practices in informal settings. Symposium organized for the NARST: A Worldwide Organization for Improving Science Teaching and Learning through Research annual conference, Baltimore, MD, March 31 – April 2, 2019.

*Cho, K. J., & **Plummer, J. D.** (2018, October). Supporting young children's co-construction of evidence-based explanations using children's storybooks. Poster presentation for the Learning Sciences Graduate Student Conference, Nashville, TN, October 12-13.

*Vaishampayan, A.M., **Plummer, J.D.**, *Cho, K., Udomprasert, P., Johnson, E., Sunbury, S., *Houghton, H., *Wright, E., Zhang, H., & Goodman, A. (2018, March). Thinking Spatially: Improving middle-school students' Use of perspective taking through and astronomy curriculum. Paper presented at the NARST: A Worldwide Organization for Improving Science Teaching and Learning through Research annual conference, Atlanta, GA, March 10-13, 2018.

Plummer, J.D., Palma, C., *Gleason, T., & *Barringer, D. (2018, March). Assessing preservice elementary teachers understanding of science practices using dual-purpose children's storybooks. Presented at the NARST: A Worldwide Organization for Improving Science Teaching and Learning through Research annual conference, Atlanta, GA, March 10-13, 2018.

*Cho, K.J. & **Plummer, J.D.** (2018, March). Using science storybooks to support preschool-age children's development of evidence-based explanations during museum-based programming. Presented at the NARST: A Worldwide Organization for Improving Science Teaching and Learning through Research annual conference, Atlanta, GA, March 10-13, 2018.

Plummer, J.D., & *Ricketts, A. (2017). Scientific phenomena in museum programs: Using video to observe young children's explanations. Presented at the American Educational Research Association annual conference, San Antonio, TX, April 27-May 1, 2017.

*Gleason, T.G., **Plummer, J.D.**, *Ghent, C., & Palma, C. (2017). Students learning about science practices in astronomy: The role of telescopes in astronomical investigations. Presented at the NARST: A Worldwide Organization for Improving Science Teaching and Learning through Research annual conference, San Antonio, TX, April 22-25, 2017.

*Vaishampayan, A.M., **Plummer, J.D.**, *Cho, K., Udomprasert, P., Johnson, E., Sunbury, S., *Houghton, H., *Wright, E., Zhang, H., & Goodman, A. (2017). The role of perspective taking in how middle school students explain lunar phases. Presented at the NARST: A Worldwide Organization for Improving Science Teaching and Learning through Research annual conference, San Antonio, TX, April 22-25, 2017.

Plummer, J.D., Palma, C., *Rubin, K., *Flarend, A., *Ong, Y.S., *Ghent, C., *Gleason, T., McDonald, S., **Botzer, B., & Furman, T. (2016). The Role of Instruction in Defining a Solar System Learning Progression. Presented as part of the *Methodological Approaches to the Development of Earth and Space Science Learning Progressions* symposium at the NARST annual conference, Baltimore, MD.

Plummer, J.D. & *Ricketts, A. (2016). Engaging preschool-age children in multimodal evidence-based explanations for astronomy phenomena during museum programs. Presented at the NARST: A Worldwide Organization for Improving Science Teaching and Learning through Research annual conference, Baltimore, MD, April 14-17, 2016.

*Ghent, C., **Plummer, J.D.**, *Gleason, T., Palma, C., & *Ong, Y.S. (2016). How astronomers investigate the universe: Student ideas about astronomical practices before and after instruction. Presented at the NARST annual conference, Baltimore, MD, April 14-17, 2016.

Plummer, J.D. (2015). Preschool-age children engaged in science practices through astronomy experiences at a museum. Presented at the *National Association for Research in Science Teaching* annual conference, Chicago, IL.

*Crowl, M. & **Plummer, J.D.** (2015). Informal science educators' enactment of goals with preschool audiences. Presented at the *National Association for Research in Science Teaching* annual conference, Chicago, IL.

Palma, C., **Plummer, J.D.**, *Rubin, K., *Flarend, A., *Ong, Y.S., McDonald, S. (2015). Have astronauts visited Neptune? Student ideas about how astronomers study the Solar System. Presented at the *National Association for Research in Science Teaching* annual conference, Chicago, IL.

Plummer, J.D. & +Small, K.J. (2014). Elementary students engaged in science practices through a planetarium field trip. Presented at the *National Association for Research in Science Teaching* annual conference, Pittsburgh, PA.

*Bower, C., **Plummer, J.D.**, & Liben, L. (2014). The role of perspective taking skills in children's explanations of astronomical phenomena. Presented at the *National Association for Research in Science Teaching* annual conference, Pittsburgh, PA.

*Crowl, M. & **Plummer, J.D.** (2014). Informal science education professionals' goals for and beliefs about working with preschool audiences. Presented at the *National Association for Research in Science Teaching* annual conference, Pittsburgh, PA.

McDonald, S., **Plummer, J.D.**, Rivet, A., Delgado, C., Kastens, K., *Flarend, A., *Rubin, K., Bembenic, M., Pickard, M., & Anderson, C. (2014). Integrating crosscutting themes, practices, and core ideas: Learning progressions in Earth and space sciences. Presented at the *National Association for Research in Science Teaching* annual conference, Pittsburgh, PA.

Plummer, J.D. (2013). Spatial reasoning as the dimension of progress in an astronomy learning progression. Presented at the *American Education Research Association*, San Francisco, CA.

*Bower, C., **Plummer, J.D.**, Liben, L., & +Small, K. (2013). The role of perspective-taking skills in children's learning of astronomical phenomena. Presented at the *Society for Research in Child Development*, Seattle, WA.

Plummer, J.D., Palma, C., *Flarend, A., *Rubin, K., & *Botzer, B. (2013). Development of a learning progression for the formation of the solar system. Presented at the *National Association for Research in Science Teaching* annual meeting, Rio Grande, PR.

*Ozcelik, A.T. & **Plummer, J.D.** (2013). Preservice elementary science teachers' reflections on teaching extended inquiry investigations. Presented at the *National Association for Research in Science Teaching* annual meeting, Rio Grande, PR.

Plummer, J.D. & *Ozcelik, A.T. (2013). Elementary students designing investigations in astronomy. Presented at the *National Association for Research in Science Teaching* annual meeting, Rio Grande, PR.

Plummer, J.D., Palma, C., *Flarend, A., & Petula, J. (2012). Dimensions of a learning progression for the formation of the solar system. Poster presented at the *Physics Education Research* annual conference, Philadelphia, PA.

Plummer, J.D. & *Ozcelik, A.T. (2012). Preservice elementary teachers' pedagogical content knowledge of inquiry-based astronomy education. Presented at the *National Association for Research in Science Teaching* annual meeting, Indianapolis, IN.

Plummer, J.D. & *Kocareli, A. (2012). Children learning to explain astronomy across moving frames of reference: Kinesthetic and visualization strategies. Presented at the *National Association for Research in Science Teaching* annual meeting, Indianapolis, IN.

Plummer, J.D. & *Kocareli, A. (2011). Learning to reason across moving frames of reference: Children navigating counterintuitive explanations in astronomy. Presentation was part of a symposium at the *Biennial Meeting of the Cognitive Development Society*, Philadelphia, PA.

Plummer, J.D., *Kocareli, A., & +Slagle, C. (2011). Children developing an ability to move between frames of reference in astronomy: Towards a learning progression in celestial motion. Presented at the Annual Meeting of the *Jean Piaget Society*, Berkeley, CA.

Plummer, J.D. & +Small, K. (2011). Informal science educators' pedagogical choices and goals for learners: The case of planetarium professionals. Paper presented as part of a symposium at the *American Educational Research Association* annual conference, New Orleans, LA.

Plummer, J.D. (Presider), Krajcik, J., Bell, P., Duncan, R., Kenyon, L., & Songer, N. (2011). Examining learning progressions beyond content: Strands of scientific proficiency. Symposium presented at the *National Association for Research in Science Teaching* annual conference, Orlando, FL.

Plummer, J.D. & *Kocareli, A. (2011). Exploring pedagogical content knowledge in astronomy: Impact of professional development on elementary teachers. Presented at the *Association for Science Teacher Education* annual conference, Minneapolis, MN.

Plummer, J.D. & +Agan, L. (2010). Towards a learning progression addressing the seasons: A comparison of two learning trajectories with middle school students. Presented at the *Annual Meeting of the National Association for Research in Science Teaching*, March 21-24, Philadelphia, PA.

Plummer, J.D. & +Slagle, C. (2009). A learning progression approach to teacher professional development in astronomy. Presented at the *Learning Progressions in Science* conference, June 24-26, Iowa City, IA.

Plummer, J.D. & +Slagle, C. (2009). Children explaining celestial motion: Development of a learning progression. Presented at the annual meeting of the National Association for Research in Science Teaching, April 20, Garden Grove, CA.

Plummer, J.D., *Rice, R. & *Zahm, V. (2008). Inquiry and astronomy: Investigations in celestial motion. Presented at the *Annual Meeting of the National Association for Research in Science Teaching*, March 30-April 2, Baltimore, Maryland.

Plummer, J.D. & Krajcik, J.S. (2008). A learning progression for celestial motion. Presented at the *Annual Meeting of the National Association for Research in Science Teaching*, March 30-April 2, Baltimore, Maryland.

Plummer, J.D. (2007). Developing students' understanding of astronomy in the planetarium. Presented at the *Annual Meeting of the National Association for Research in Science Teaching*, April 15-18, New Orleans, Louisiana.

Plummer, J.D. (2006). Kinesthetic learning techniques in the planetarium. Presented at the *Annual Meeting of the Association for Science and Technology Centers*, October 28-30, Louisville, Kentucky.

WORKSHOPS

Plummer, J.D., Cho, K., & Botch, M. (2020). Building on stories to engage children in spatial thinking. Presented at the *Astronomical Society of the Pacific's Annual Education and Public Outreach Conference*, virtual conference.

Plummer, J.D. & *Ghent, C. (2016). My Sky Tonight: Inspiring and engaging activities for 3–5 year-old audiences. Presented at the *International Planetarium Society* meeting, Warsaw, Poland.

Plummer, J.D., +Schmoll, S., +Yu, K.C., & *Ghent, C. (2016). Conducting research in the planetarium. Presented at the *International Planetarium Society* meeting, Warsaw, Poland.

Plummer, J.D. (2014). Developing astronomy instruction that supports the goals of the NGSS. Presented at the *Astronomical Society of the Pacific's Annual Education and Public Outreach Conference*, Burlingame, CA.

Plummer, J.D. & +Gould, A. (2014). Publishing your research in the *Journal and Review of Astronomy Education and Outreach*. Presented at the *Astronomical Society of the Pacific's Annual Education and Public Outreach Conference*, Burlingame, CA.

+Hurst, A., **Plummer, J.D.**, +White, V., +Enevoldsen, A., +Gurton, S., & +Schultz, G. (2014). My Sky Tonight: Developmentally-appropriate activities for engaging preschool children in astronomy. Presented at the *Astronomical Society of the Pacific's Annual Education and Public Outreach Conference*, Burlingame, CA.

+Enevoldsen, A., +Hurst, A., **Plummer, J.D.**, Jipson, J., Snider-Bryan, C., et al. (2013). Preschoolers in astronomy: Successful techniques for engaging in astronomy and in the planetarium. Workshop presented at the *Astronomical Society of the Pacific annual educational and public outreach conference*, San Jose, CA.

Plummer, J.D. & **Small, K.J. (July, 2012). Interacting with your audience using a modular planetarium program. Workshop presented at the *International Planetarium Society meeting*, Baton Rouge, LA.

Fraknoi, A., Hemenway, M., & **Plummer, J.D.** (August, 2011). *Publishing your research and ideas in Astronomy Education Review: A hands-on workshop for new and veteran authors*. Workshop presented at the *Astronomical Society of the Pacific annual education and public outreach conference*, Baltimore, MD.

Duncan, R. G., Krajcik, J., Fortus, D., McNeill, K.L., & **Plummer, J.D.** (April, 2011). Developing and assessing learning progressions in science. Workshop presented at the annual meeting of the *National Association for Research in Science Teaching*, Orlando, FL.

Plummer, J.D. & +Slagle, C. (March, 2010). Using children's observations to guide explanations in astronomy. Presented at the *Annual Meeting of the National Science Teachers Association*, March 18-20, Philadelphia, PA.

OTHER PRESENTATIONS

Palma, C. & **Plummer, J.** (2019). Using a children's storybook assignment to assess pre-service teachers' knowledge of science practices in astronomy. *Innovative Teaching at Penn State seminar*, University Park, PA.

Plummer, J.D. & Palma, C. (2015). Engaging undergraduate education majors in the practice of astronomy through a coherent science content storyline course. Presented at the *International Astronomical Union triennial conference*, Honolulu, HI.

Palma, C., **Plummer, J.**, *Ghent, C., *Gleason, T., *Ong, Y.S., & McDonald, S. (2015, January). Have Astronomers Been to Neptune? Results of a Study of High School Students' Ideas about How Astronomers Study the Solar System. In *American Astronomical Society Meeting Abstracts* (Vol. 225), Seattle, WA.

Palma, C., Petula, J., **Plummer, J.**, *Flarend, A., & +Goldsborough, G. (2012). First step in building an astronomy learning progression: Analyzing student conceptions of astronomical phenomena. Poster presented at the *219th Meeting of the American Astronomical Society*, Austin, TX.

Plummer, J.D. (2011). Evidence for the importance of interactive planetarium programs: Research on kinesthetic strategies with elementary students. Presented at the *Live Interactive Planetarium Symposium*, Bremerton, WA.

Plummer, J.D. (2011). Preservice teachers' first experiences teaching astronomy: Challenges in designing and implementing inquiry-based astronomy instruction for elementary students in after school programs. *Proceedings of the Astronomical Society of the Pacific's Annual Education and Public Outreach meeting: Connecting People to Science*, Baltimore, MD.

PARTICIPATION IN PROFESSIONAL ORGANIZATIONS

PROFESSIONAL SERVICE

NARST: A Worldwide Organization for Improving Science Teaching and Learning through Research
 Outstanding Doctoral Research Award, member 2021-2024
 Program committee: Co-Strand Coordinator 2019-2021
 Strand 2 - Science Learning Contexts, Characteristics, and Interactions
 Selected reviewers, made decisions on proposal acceptance, organized sessions and presiders
 Early Career Research Award, Member (2014-2015), Co-Chair (2015-2017) 2014-2017
 Publications Advisory Committee member 2011-2014
 Program committee: Co-Strand Coordinator 2009-2011
 Strand 1 - Science Learning, Understanding and Conceptual Change
 Selected reviewers, made decisions on proposal acceptance, organized sessions and presiders

INTERNATIONAL SOCIETY OF THE LEARNING SCIENCES

Program committee: Senior Reviewer 2021-2022

ASTRONOMICAL SOCIETY OF THE PACIFIC

NSF-Funded *Project Planet* – Research Advisor 2018-2020
 Annual Education & Public Outreach Conference Planning Committee 2011, 2014

INTERNATIONAL PLANETARIUM SOCIETY

Education Committee, Research-subcommittee member 2014 – present

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE – PROJECT 2061 2010
 Advisory panel member – Weather & Climate

MASSACHUSETTS DEPARTMENT OF ELEMENTARY & SECONDARY EDUCATION 2010
 Research consultant to the revision panel for the MA Science and Technology/Engineering Curriculum Framework

GRANT REVIEWS

National Science Foundation – Research on Learning in Formal and Informal Settings (DRL)
 Panel Review member (2017, 2018)

Department of Education – Institute of Education Sciences
 Principal member (2012-2015)
 Rotating member (2011-2012)
 NASA ROSES EPOESS (2011)

EDITORSHIPS AND JOURNAL REVIEWS

Editor

Planetarian, Research Editor (2020 – present)
 Physical Review Physics Education Research, Guest Editor for special issue (2016-2018)

Editorial Boards:

International Journal of Science Education [Editorial Board] (2022 – present)]

International Journal of Science and Mathematics Education [Editorial Board (2021 – present)]
Journal of Research in Science Teaching [Editorial Board (2010-2013), (2016-2019)]
Journal of Astronomy and Earth Science Education, Board of Reviewers (2014 – present)
Journal and Review of Astronomy Education and Outreach, Editorial Board (2014 – 2015)

Adhoc Reviews:

Astronomy Education Review
Connected Science Learning
Digital Earth
Educational Psychology
Frontiers in Psychology
International Journal of Science Education
International Journal of Science and Mathematics Education
Journal of Science Education and Technology
Journal of Science Teacher Education
Journal of Teacher Education
Revista Latino-Americana de Educação em Astronomia
Review of Educational Research
Science & Education
Science Education

CONFERENCE REVIEWS

National Association for Research in Science Teaching (Strand 1, 2, and 6) (2006-present)
International Conference of the Learning Sciences (2009, 2013, 2018, 2019)
Senior Reviewer (2021 – present)
Association for Science Teacher Education (2010-2011)

PROFESSIONAL AFFILIATIONS

Astronomical Society of the Pacific (1992-present)
International Society of the Learning Sciences (2009-present)
NARST (2006-present)
National Science Teachers Association (2006-2011)

CONTRIBUTIONS TO THE UNIVERSITY

PENNSYLVANIA STATE UNIVERSITY: COMMITTEES AND SERVICE

*Elected positions

University

Earth & Mineral Science Museum & Art Gallery, Advisory Board	2011 - 2020
*Faculty Senate – Member, Senate Committee for Curricular Affairs	2015 - 2019
STEM Museum Planning Committee - Member	2015 – 2017
Center for Excellence in Science Education, College of Science, Advisory Board	2012 - 2017

College

Workload Committee	2021 - 2022
Sabbatical Review Committee	2021 - 2022
Strategic Planning Committee	2020 - 2021
*Curricular Affairs Committee, College of Education – Senate Rep. (2015-2018), C&I Director	2015 - present
*Faculty Council, College of Education – Member (2013-2015), Senate Rep. (2015- 2018)	2013 – 2018
Graduate Student Grants and Fellowships committee, College of Education – Member	2013 - 2015
Place committee	2018 - 2019
Website committee	2018 - 2019

Curriculum & Instruction Department

Director of Curriculum	2018 - present
Elementary Science Methods Coordinator	2012 –present
Promotion & Tenure Committee (Non-tenure line)	2022
*Promotion & Tenure Committee (Tenure line)	2019 – 2020, 2021 – 2023
Waterbury Chair in STEM Education faculty search, Member	2019 - 2020
Elementary Science Education fixed term faculty search, Co-Chair	2017, 2019
Science Education and the Learning Sciences faculty search, Member	2017 - 2018
Elementary Math/Science Education faculty search, Behrend campus – Member	2013
Elementary Science Education faculty search – Co-Chair	2012-2013

DOCTORAL ADVISING at Pennsylvania State University

1. Michele Crowl (Ph.D.) – Defended, 2016, “The influence of professional development on informal science educators’ engagement of preschool-age audiences in science practices.”
2. Yann Shiou Ong (Ph.D.) – Defended, 2018, “Developing secondary school students’ epistemic practices through student-centered critique in scientific inquiry.” (Co-chair with Dr. Richard Duschl)
3. Fariha Salman [Learning & Performance Systems] (Ph.D.) – Defended, 2018, “Embodied engagement: Examining learning interactions within ubilearn experiences for design-focused STEM education.” (Co-chair with Dr. Roy Clariana)
4. Julianne Snider (Ph.D.) – Defended, 2019, “Scientific observation in geoscience: Geoscientists’ conceptualizations of learning, teaching, and using geological observation”
5. Abha Vaishampayan (Ph.D.) – Defended, 2020, “The role of sensemaking practices in supporting spatial cognition.”
6. Kyungjin Cho (Ph.D.) – Defended, 2021, “How do young children learn science through narrative, embodiment, and play?”
7. Chrysta Ghent – Dissertation chair, “Online professional development supporting a community of practice for planetarium educators,” in progress
8. Madison Botch (3rd year) – Advisor

9. Katie Nolan (2nd year) – Advisor
10. Emily Olsen (1st year) – Advisor

PH.D. COMMITTEES at Pennsylvania State University

1. Brian Seely [Learning & Performance Systems] (2015)
2. Arzu Tanis Ozcelik [Curriculum & Instruction] (2016)
3. Victoria Raish [Learning & Performance Systems] (2016)
4. Alice Flarend [Curriculum & Instruction] (2017)
5. Denise Turso [Learning & Performance Systems] (2017)
6. Cori Bower [Psychology] (2018)
7. Colleen Epler-Ruths [Curriculum & Instruction] (2019)
8. Madha Bagher [Geography] (in progress)

MASTERS THESES (M.S.) supervised at Pennsylvania State University

1. Elizabeth Crowe (2019) “Understanding factors that influence STEM graduate student teaching assistant buy-in to pedagogical training.”
2. Margaret Teuber (2020) “The use of mobile applications to increase environmental awareness and citizen science participation among users.”

MASTERS PAPERS (M.Ed.) supervised at Pennsylvania State University

Danny Barringer (2017), Krista Farner (2018), Tim Gleason (2018), Samantha Kemmerling (2018), Lamoya Northcutt (2018), Cassandra Peters (2018), Alexandra Agar-Pratt (2019), Margaux Brandt (2019), Elizabeth Young (2019), Timothy Straub (2020), Marissa Capobianco (2020), Chrysta Ghent (2020), Nichole Dunn (2020), Shannon Kidd (2020), Morgan Campbell (2021), Nicholas Ciambro (2021), Austin Storm (2021)

HONORS ADVISEES at Pennsylvania State University

Undergraduates graduated: Tim Gleason (2017), Heather Bradbury (2019)

COURSES TAUGHT AT Pennsylvania State University (2011-present)

Undergraduate Education Courses:

SCIED 458 – Teaching Science in the Elementary School
ASTRO/SCIED 116 – Introduction to Astronomy for Educators

Graduate Education Courses:

SCIED 550 – Curriculum in Science Education
SCIED 552 – Science Teaching and Learning
SCIED/LDT 583 – Learning Sciences Research Frameworks and Methods
SCIED 597 – Special topics: Teaching and Learning about Spatial Reasoning
SCIED 597 – Special Topics: Engaging Children in the Practices of Science

ARCADIA UNIVERSITY: ADVISOR FOR MASTERS DEGREE CULMINATING PROJECTS

Advised 23 Masters projects from 2006-2010.

COURSES TAUGHT AT ARCADIA (2006-2011)

Undergraduate Education Courses:

ED 324 – Elementary Science Methods

ED 341 – The Processes of Learning in the Classroom
ED 343 – Refining and Integrating Curricular Practices

Graduate Education Courses:

ED 552 – Science Methods for Elementary Teachers
ED 553 – Science Methods for Secondary Teachers
ED 555 – Instructional Materials for Teaching Science
ED 558 – Special Seminar for Science Educators
ED 561 – Summer Institute for Astronomy Educators
ED 561 – Project-Based Learning in Math and Science

Undergraduate Science Courses

PH 224 – Frontiers in Astronomy
HN 309/US 213 – Astrobiology: Life in the Universe
FY 103 – The Night Skies of Pennsylvania