

# Child Care & Early Education RESEARCH CONNECTIONS

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## Science in Early Care and Education: Research-to-Policy Resources

Science is increasingly being recognized as a critical domain in early childhood education. Children display a natural curiosity about their surroundings and research demonstrates that children entering school have considerable knowledge of the natural world and have the capacity to think conceptually and begin to develop scientific reasoning skills (National Research Council, 2007). Building on this natural interest and creating early experiences that foster investigation promotes children's ability to engage in scientific inquiry. Further, research indicates that children who engage with science from an early age develop positive attitudes towards science which in turn relates to their later science achievement and increases the likelihood that they will pursue a career in science (McClure et al., 2017). A recent study also found that children's kindergarten knowledge of physical, social and biological sciences predicted their first-grade knowledge of these topics which in turn predicted their science achievement from third to eighth grade (Morgan, Farkas, Hillemeier, & Maczuga, 2016). Therefore, early science experiences play a significant role in children's later learning. Additionally, incorporating science into early education is particularly important given that research has demonstrated that children from different socioeconomic backgrounds enter kindergarten with considerable differences in science and math knowledge and that these differences can continue and grow over time (Early Childhood STEM Working Group, 2017).

In defining science education for young children, a report from the National Academy of Sciences highlights the importance of focusing on scientific exploration and inquiry rather than on facts and information (Institute of Medicine (U.S.), & National Research Council (U.S.), 2015). As the report notes, engaging children in scientific inquiry not only supports their knowledge of science but also supports school readiness in other domains such as mathematics, and language and literacy. One paper on science in early childhood classrooms defines scientific inquiry as a process "involving prediction, planning, collecting, and recording data; organizing experiences; and looking for patterns and relationships that eventually can be shared and from which new questions may emerge" (Worth, 2010, p. 4). However, currently most young children are not exposed to high quality science experiences in the early childhood classroom as most early educators do not spend much time on science related activities whether planned or spontaneous (Nayfeld, Brennenman, & Gelman, 2011). One reason is that early educators often lack time, space, materials, as well as content knowledge and confidence in teaching



science content and methods (Greenfield, Jirout, Dominguez, Greenberg, Maier, & Fuccillo, 2009). This lack of confidence may stem from inadequate preparation in early childhood preservice and in-service professional development programs, as many of these programs do not focus on preparing educators to provide science instruction (Brenneman, Boyd, & Frede, 2009). In order to ensure that scientific inquiry is integrated into the early childhood classroom there is a need to better prepare early childhood educators in science content, methods, and pedagogy.

This resource list identifies resources from 2010 to 2017 that highlight resources on science in early care and education under the following categories:

- 1) Policy resources
- 2) Promising practices
- 3) Professional development and teacher preparation

### **Policy Resources**

Bishop-Josef, S. J., Doster, S., Watson, S. D., & Taggart, A. (2016). *STEM and early childhood--when skills take root: Pennsylvania businesses and the military warn of STEM workforce skills gap and urge greater access to pre-k*. Washington, DC: Council for a Strong America.

Brenneman, K. (2014). *Science in the early years*. (The Progress of Education Reform Vol. 15, No. 2). Denver, CO: Education Commission of the States.

Early Childhood STEM Working Group. (2017). *Early STEM matters: Providing high-quality STEM experiences for all young learners: A policy report by the Early Childhood STEM Working Group*. Chicago, IL: UChicago STEM Education.

McClure, E. R., Guernsey, L., Clements, D. H., Bales, S. N., Nichols, J., Kendall-Taylor, N., & Levine, M. H. (2017). *STEM starts early: Grounding science, technology, engineering, and math education in early childhood*. New York, NY: Joan Ganz Cooney Center.

Strategies for Children. (2014). *High-quality early learning promotes success in science and math*. Boston: Strategies for Children.

### **Promising Practices**

Aldemir, J., & Kermani, H. (2016). Integrated STEM curriculum: Improving educational outcomes for Head Start children. *Early Child Development and Care*, 1-13.

Hong, S., & Diamond, K. E. (2012). Two approaches to teaching young children science concepts, vocabulary, and scientific problem-solving skills. *Early Childhood Research Quarterly*, 27(2), 295-305.

Kermani, H., & Aldemir, J. (2015). Preparing children for success: Integrating science, math, and technology in early childhood classroom. *Early Child Development and Care*, 185(9), 1504-1527.

Nayfeld, I., Brenneman, K., & Gelman, R. (2011). Science in the classroom: Finding a balance between

autonomous exploration and teacher-led instruction in preschool settings. *Early Education and Development*, 22(6), 970-988.

Vandermaas-Peeler, M., McClain, C., & Elon University. (2015). The green bean has to be longer than your thumb: An observational study of preschoolers' math and science experiences in a garden. *International Journal of Early Childhood Environmental Education*, 3(1), 8-27.

### **Professional Development and Teacher Preparation**

Brenneman, K. (2011). Assessment for preschool science learning and learning environments. *Early Childhood Research & Practice*, 13(1).

Brenneman, K., Boller, K., Atkins-Burnett, S., Stipek, D. J., Forry, N. D., Ertle, B., French, L., & et al. (2011). *Measuring the quality of early childhood math and science curricula and teaching*. In M. Zaslow, I. Martinez-Beck, K. Tout, & T. Halle (Eds.), *Quality measurement in early childhood settings* (pp. 77-103). Baltimore: Paul H. Brookes.

Hollingsworth, H., & Vandermaas-Peeler, M. (2017) 'Almost everything we do includes inquiry': Fostering inquiry-based teaching and learning with preschool teachers. *Early Child Development and Care*, 187(1), 152-167.

Kalchman, M., & Kozoll, R. (2016). Dis-integrating mathematics and science in early childhood methods courses: Encouraging discrete content-area proficiency. *Journal of Early Childhood Teacher Education*, 37(1), 61-75.

Kinzie, M. B., Whittaker, J., Kilday, C. R., & Williford, A. P. (2012). *Designing effective curricula and teacher professional development for early childhood mathematics and science*. In C. Howes, B. Hamre & R. Pianta (Eds), *Effective early childhood professional development: Improving teacher practice and child outcomes* (pp. 31-59). Baltimore: Paul H. Brookes.

Maier, M. F., Greenfield, D. B., & Bulotsky-Shearer, R. J. (2013). Development and validation of a preschool teachers' attitudes and beliefs toward science teaching questionnaire. *Early Childhood Research Quarterly*, 28(2), 366-378.

Mongillo, M. (2017). Creating mathematicians and scientists: Disciplinary literacy in the early childhood classroom. *Early Child Development and Care*, 187(3-4), 331-341.

Pendergast, E., Lieberman-Betz, R. G., & Vail, C. O. (2017). Attitudes and beliefs of prekindergarten teachers toward teaching science to young children. *Early Childhood Education Journal*, 45(1), 43-52.

Piasta, S. B., Logan, J., Pelatti, C., Capps, J. L., & Petrill, S. A. (2015). Professional development for early childhood educators: Efforts to improve math and science learning opportunities in early childhood classrooms. *Journal of Educational Psychology*, 107(2), 407-422.

Piasta, S. B., Pelatti, C., & Miller, H. (2014). Mathematics and science learning opportunities in preschool classrooms. *Early Education and Development*, 25(4), 445-468.

Roehrig, G. H., Dubosarsky, M., Mason, A., Carlson, S., & Murphy, B. (2011). We look more, listen more, notice more: Impact of sustained professional development on Head Start teachers' inquiry-based and culturally-relevant science teaching practices. *Journal of Science Education and Technology*, 20(5), 566-578.

Sackes, M., Flevares, L., Gonya, J., & Trundle, K. (2012). Preservice early childhood teachers' sense of efficacy for integrating mathematics and science: Impact of a methods course. *Journal of Early Childhood Teacher Education*, 33(4), 349-364.

Torquati, J. C., Cutler, K. M., Gilkerson, D., & Sarver, S. (2013). Early childhood educators' perceptions of nature, science, and environmental education. *Early Education and Development*, 24(5), 721-743.

Watts, M., Salehjee, S., & Essex, J. (2017). But is it science? *Early Child Development and Care*, 187(2), 274-283.

Whittaker, J., Kinzie, M. B., Williford, A. P., & DeCoster, J. (2016). Effects of MyTeachingPartner--Math/Science on teacher-child interactions in prekindergarten classrooms. *Early Education and Development*, 27(1), 110-127.

## References

- Brenneman, K., Boyd, J., & Frede, E. (2009). *Mathematics and science in preschool: Policy and practice*. New Brunswick, NJ: National Institute for Early Education Research.
- Early Childhood STEM Working Group. (2017). *Early STEM matters: Providing high-quality STEM experiences for all young learners: A policy report by the Early Childhood STEM Working Group*. Chicago, IL: UChicago STEM Education.
- Greenfield, D. B., Jirout, J., Dominguez, X., Greenberg, A., Maier, M. F., & Fuccillo, J. (2009). Science in the preschool classroom: A programmatic research agenda to improve science readiness. *Early Education and Development, 20*(2), 238-264.
- Institute of Medicine (U.S.), & National Research Council (U.S.). (2015). *Transforming the workforce for children birth through age 8: A unifying foundation*. Washington, DC: National Academies Press.
- McClure, E. R., Guernsey, L., Clements, D. H., Bales, S. N., Nichols, J., Kendall-Taylor, N., & Levine, M. H. (2017). *STEM starts early: Grounding science, technology, engineering, and math education in early childhood*. New York, NY: Joan Ganz Cooney Center.
- Morgan, P. L., Farkas, G., Hillemeier, M. M., & Maczuga, S. (2016). Science achievement gaps begin very early, persist, and are largely explained by modifiable factors. *Educational Researcher, 45*(1), 18-35.
- National Research Council. (2007). *Taking science to school: Learning and teaching science in grades K-8*. Washington, DC: The National Academies Press.
- Nayfeld, I., Brenneman, K., & Gelman, R. (2011). Science in the classroom: Finding a balance between autonomous exploration and teacher-led instruction in preschool settings. *Early Education and Development, 22*(6), 970-988.
- Worth, K. (2010). *Science in early childhood classrooms: Content and process*. Champaign, IL: University of Illinois at Urbana-Champaign, Early Childhood and Parenting Collaborative.

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