

**George Mason University
College of Education and Human Development
Early Childhood Education**

ECED 516.001 Science for Diverse Young Learners
3 Credits, Fall 2019

8/26 – 12/18, Tuesdays & Thursdays/ 1:30 – 2:45 pm
Thompson Hall L018, Fairfax Campus

Faculty

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Prerequisites/Corequisites

ECED 403 or 503

University Catalog Course Description

Examines ways to foster development of science in preschool to third-grade children. Covers construction of science lessons and hands-on experiences that promote learning in children with diverse abilities and cultural and linguistic backgrounds.

Course Overview

Not applicable

Course Delivery Method

This course will be delivered using a lecture and discussion format.

Learner Outcomes or Objectives

This course is designed to enable students to do the following:

1. Explain how knowledge, skills, and practices in the four core science disciplines (i.e., Earth sciences, biology, chemistry, and physics), as defined in *Virginia's Foundation Blocks for Early Learning: Comprehensive Standards for Four-Year-Olds* and the *Virginia Science Standards of Learning*, provide a sound foundation for teaching science in prekindergarten through third grade.
2. Describe the nature of science and scientific inquiry, including the function of research design and experimentation, and the role of science in explaining and predicting events and phenomena.
3. Describe the practices required to provide empirical answers to research questions, including data collection and analysis, modeling, argumentation with evidence, and constructing explanations.
4. Discuss the reliability of scientific knowledge and its constant scrutiny and refinement; self-checking mechanisms used by science to increase objectivity, including peer review; and assumptions, influencing conditions, and limits of empirical knowledge.

5. Describe and organize key science content in Earth science, biology, chemistry, and physics content into meaningful units of instruction that actively engage students in learning; integrate processes and crosscutting concepts into planning and implementing in the interdisciplinary context; and promote the application of key science principles to solve practical problems and develops a “systems” understanding of the natural world.
6. Describe the role of family and community knowledge, experience, and resources in planning and implementing science content in the curriculum.
7. Plan instruction on Earth science, biology, chemistry, and physics that (a) uses a variety of instructional techniques to meet the needs of diverse young learners; (b) incorporates instructional technology to enhance learner performance; (c) ensures learner competence in science; and (d) is informed by the *Virginia’s Early Learning Foundation Building Blocks*, the *Virginia Standards of Learning for Science*, and the *New Generation Science Standards*.
8. Evaluate, select, and adapt a variety of instructional materials, technologies, and teaching strategies to engage diverse young learners in science.
9. Develop science activities for young children using the scientific process with an emphasis on describing, analyzing, and quantitatively presenting findings.
10. Conduct formative and summative assessments of students’ learning of science concepts.
11. Describe and use the knowledge, skills, and practices to implement classroom, field, and laboratory safety rules and procedures and ensure students take appropriate safety precautions.
12. Describe and use the knowledge, skills, and practices needed to conduct research projects and experiments, including applications of design process and technology, and systematic field investigations using the school grounds, the community, and regional resources.
13. Explain the contribution and significance of science, including (a) its social, cultural, and economic significance; (b) the relationship of science to mathematics, the design process, and technology; and (c) the historical development of scientific concepts and scientific reasoning.
14. Exhibit standards of professionalism, ethical standards, and personal integrity with children, families, and professionals in the field and in interactions with classmates, the instructor, and others.
15. Use writing as an instructional and assessment tool to generate, gather, plan, organize, and to communicate for a variety of purposes; integrate correct written conventions (i.e., grammar, usage, mechanics, and spelling); and format using current APA style.

Professional Standards – Virginia Professional Studies Competencies, Virginia Early Childhood Special Education Endorsement Competencies, Virginia Early/Primary Education PreK-3 Endorsement Competencies, Interstate Teacher Assessment and Support Consortium (InTASC) Standards, Council of Exceptional Children (CEC) and Division of Early Childhood (DEC) Standards, and National Association for the Education of Young Children (NAEYC) Standards

Upon completion of this course, students will have met the following professional standards:

Virginia Early/Primary Education PreK-3 Endorsement Competencies

Methods

Knowledge and Skills: Science

Required Texts

American Psychological Association. (2010). *Publication manual of the American Psychological Association* (6th ed.). Washington, DC: Author.

Achieve Inc. (2013). *Next generation science standards*. Washington, DC: Author.

<http://www.nextgenscience.org>

Shillady, A. (ed.) (2013). *Spotlight on young children: Exploring science*. Washington, DC: National Association for the Education of Young Children.

Peters, J. M., & Stout, D. L. (2011). *Science in elementary education: Methods, concepts, and Inquiries* (11th ed.). Boston: Pearson.

http://www.doe.virginia.gov/testing/sol/standards_docs/index.shtml

Virginia Department of Education. (2010). Science standards of learning.

http://www.doe.virginia.gov/testing/sol/standards_docs/index.shtml

Virginia Department of Education. (2010). Science curriculum framework.

http://www.doe.virginia.gov/testing/sol/standards_docs/index.shtml

Course Performance Evaluation

Students are expected to submit all assignments on time in the manner outlined by the instructor (e.g., Blackboard, Tk20, hard copy).

Assignments	Due Dates	Points
Attendance and Participation	Ongoing	25
Personal Journal		10
Part 1	Sept 3	
Part 2	Dec 17	
Science Activity Share	Variable	15
Enriching Science Inquiry with Literature	Sept 26	10
6E/PBL Lesson Plan	Oct 17	15
Science Lesson Implementation and Reflection		25
Planning the Lesson	Oct 29	10
Collecting Data	Oct 29	5
Reflecting on the Lesson	Nov 26	10
TOTAL		100

- **Assignments and/or Examinations**

NOTE: *With exclusion of the personal journal, each of the major assignments for this course should focus on a different science area: physical science, life science, earth/space science, or engineering (i.e., no two assignments should focus on the same area.)*

Personal Journal (Part 1=5 points; Part 2=5 points)

Part 1: To initiate class experiences, students will write a critical reflection on their personal experiences as a learner of science (2 pages). They will use the following prompts to help guide their reflection process.

- Begin with your earliest memories (give examples) and reflect until the present as a graduate student in a teacher preparation program.
- Reflect on your experiences in school, out of school, in the context of your family, etc.

- How do you think your social, cultural, and economic background played a role on your experiences as a science learner?
- How do you see yourself as a science learner?
- Why do you think you feel that way?
- How do you think these experiences will shape you as a teacher of science? In other words, what positive impacts or challenges on your teaching practice do you foresee from your prior experiences or self-conception?

Part 2: In conclusion of the course, students will revisit their initial thoughts in their first journal entry and reflect on how their thoughts and/or self-conception have changed, if at all (2 pages). They will use the following prompts to help guide their reflection process.

- What have you learned in the course?
- Do you view yourself as a science learner differently than you did before?
- Is there a concept you learned in the course that really stuck out for you? (Include references to course readings, as necessary.)
- Is there a particular reading, handout, or material from class that you found particularly helpful or eye-opening? (Include references to course readings, as necessary.)
- Articulate the kind of early childhood science teacher you plan to be. Will something you learned in the course be included in your guiding principles?

Science Activity Share (15 points)

Students will choose a science content area from the four core science areas, including Earth sciences, biology, chemistry, and physics, during the first class session in which to present an activity. Three students will sign up per content area: one person will focus on PreK, one on K-Grade 1, and one on Grades 2-3. Individual students will prepare a lesson plan using the template provided and lead an informative and interactive center that actively engages students in learning in their science content area to a small group of classmates. During the center, each student will include the following:

- An overview of the topic, including the key ideas or content and the importance of the topic to students' science learning
- An overview of relevant state and national content standards at the appropriate grade level(s), noting consistencies (or inconsistencies, if the case may be)
- A description of classroom and behavior management strategies that would increase the effectiveness of the implementation of the activity and contribute to creating and maintaining a safe environment
 - Materials appropriate to the activity (bring or borrow from the instructor)
 - Modeling of how to engage in the activity
 - An opportunity for classmates to engage in the activity with guidance from the student leading the activity
 - Preparation for how to adapt the center activity for a range of learners
 - A list of at least three resources related to teaching the topic that could include children's literature, websites, manipulatives or materials, or other teacher resources (at least one must be a relevant developmentally appropriate picture book and one must be an article from a practitioner journal on the topic)

Enriching Science Inquiry With Literature: A Focus on Reading and Writing (10 points)

To place the core scientific disciplines of Earth science, biology, chemistry, and physics in an appropriate interdisciplinary context, students will identify a focused science concept area and compile a chart of at least 10 literature resources, including fiction, non-fiction, digital, and non-digital forms, that promote children’s engagement in the science concept. The chart will provide a brief summary of the text, identify possible literacy experience(s) for the resource (e.g., read aloud, guided reading, exploration center, research text, independent reading, as a resource to promote writing, etc.), and identify possible 6E entry points for the resource (i.e., engage, explore, explain, elaborate, evaluate).

6E/PBL Lesson Planning (15 points)

Students will use both an **inquiry-based** (6E model) and a **problem-based** approach to develop a detailed 6E (engage, explore, explain, extend, evaluate, e-learning/incorporate technology) lesson plan for one of the following science areas: physical science, life science, chemistry, Earth/space science, or engineering as defined by *Virginia’s Foundation Blocks of Early Learning*, the *Virginia Science Standards of Learning*, and the *Next Generation Science Standards*. Students will integrate questioning, curiosity, and active engagement, with real materials in the lesson whenever possible. Students will include plans for classroom and behavior management and building community. They will also include how they will create and maintain a safe environment. They will use the lesson plan format provided by the instructor. In addition, students will develop the student sheets and any other supporting materials needed for their lesson. Students will create an assessment of student learning for their lesson and a rubric for the assessment.

Science Lesson Implementation and Reflection (25 points)

In two-person partnerships, students will choose a developmentally appropriate science lesson in one of the four core science areas as defined by Virginia’s Foundation Blocks of Early Learning, the Virginia Science Standards of Learning, and the Next Generation Science Standards from either the VA Department of Education or *Picture-Perfect Science Lessons* series (NSTA Press). They will implement the lesson during one of two “Afternoons of STEM Learning” at the Mason Child Development Center (CDC) to multiple groups of preschool children, making necessary modifications and taking reflective notes (*dates TBD*). Students will bring any necessary materials for the lesson. Students will visit the CDC two consecutive times. One partner will teach the lesson while the other partner takes anecdotal notes during the lesson iterations; the next week the partners will switch roles. Students will submit a written reflection in two parts.

- **Planning the Lesson (10 points).** The first part of the reflection will be due before the experience and will include how the lesson was selected; how course readings support the selection of the lesson plan; what adaptations were made, if any, to the lesson plan and why; and how the students prepared to implement the lesson. Students will include plans for classroom and behavior management, building community, and creating and maintaining a safe environment. In this part, students will be assessed on their preparation of all of the necessary materials for the lesson, including being prepared to implement the lesson upon arrival at the CDC. Partners will write and submit this reflection collaboratively. (2 to 3 double-spaced pages)

- **Collecting Data (5 points).** The second part of the reflection will be due before the experience and will include (a) a statement about their ethical considerations as they planned for the data collection and (b) a plan for collecting quantitative and qualitative data. Partners will develop an observational tool for the observing partner to use to collect data about the children's engagement in the lesson. They will also identify work samples (may be photos) they will collect and how they will be scored and analyzed to determine children's learning of the concept. Partners will write and submit this reflection collaboratively.
- **Reflecting on the Lesson (10 points).** The second part will be due after the experience and will include a presentation and analysis of the qualitative and quantitative data collected as well as a reflection on how the lesson went (what went well, what could have been done differently/better for next time), key learnings, and "aha" moments. Students will use the analyzed data and their own observations to reflect on both teacher learning (themselves) and children's learning during the lesson. Students will also reflect on their classroom and behavior management and how they built community. Students will provide specific linkages to course readings and research examined for the inquiry into evidence-based practices. They will conclude the reflection by posing a compelling question about next steps for supporting children's understandings. Partners will engage in reflective discussions about their analysis of the data and the implementation of the lesson, but will submit written reflections independently. (3 double-spaced pages)
- **Other Requirements**

Attendance and Participation (25 points)

Because active participation and engagement are imperative for optimal learning, preparation for and participation in in-class and online activities will be evaluated based on the following criteria:

- Students attend class, arrive on time, and stay for the entire class period.
- Students use laptops and personal devices for instructional purposes only.
- Students complete readings and prepare for class activities prior to class as evidenced by their ability to discuss and write about the concepts presented and examined in the texts as well as participate fully in related activities.
- Students are actively involved in in-class and online learning experiences as evidenced by (a) participating in all activities, (b) engaging in small- and large-group discussions, (c) completing written work related to the activities, and (d) supporting the participation and learning of classmates.
- Students show evidence of critical reflective thinking through in-class and online discussions, activities, and written reflections.
- Students display professional dispositions at all times while interacting with the instructor and other students.
- Students complete participation activities across the semester that complement the scheduled course topic. Instructors will periodically collect artifacts from the activities. Students in attendance and who actively engage in the learning experience will receive credit for their efforts. Graded participation activities are not announced and are implemented at the discretion of the instructor.

Written Assignments

All formal written assignments will be evaluated for content and presentation. The American Psychological Association, Sixth Edition (APA) style will be followed for all written work. All written work unless otherwise noted must be completed on a word processor and should be proofread carefully. (Use spell check!) If students are not confident of their own ability to catch errors, they should have another person proofread their work. When in doubt, they should check the APA manual. Portions of the APA manual appear at the Style Manuals link on the Mason library web at <http://infoguides.gmu.edu/content.php?pid=39979>. Students may consult the Writing Center for additional writing support.

Students will do the following:

1. Present ideas in a clear, concise, and organized manner. (Avoid wordiness and redundancy.)
2. Develop points coherently, definitively, and thoroughly.
3. Refer to appropriate authorities, studies, and examples to document where appropriate. (Avoid meaningless generalizations, unwarranted assumptions, and unsupported opinions.)
4. Use correct capitalization, punctuation, spelling, and grammar.
5. Type the paper with double spacing, indented paragraphs, 1-inch margins all around, and 12-point Times New Roman font.

• Grading

A = 95-100 A- = 90-94 B+ = 87-89 B = 80-86 C = 70-79 F = <70

Incomplete (IN): This grade may be given to students who are passing a course but who may be unable to complete scheduled coursework for a cause beyond reasonable control.

All CEHD students are held to the university grading policies as described in the Academic Policies section of the current catalog, which can be accessed at <http://catalog.gmu.edu>. Those students seeking Virginia initial teaching licensure must earn a B- or better in all licensure coursework.

Professional Dispositions

Students are expected to exhibit professional behaviors and dispositions at all times. See <https://cehd.gmu.edu/students/policies-procedures/>.

Class Schedule

Date	Topics	Readings & Assignments
Week 1 Aug 27	Four Core Science Disciplines <ul style="list-style-type: none">• Earth sciences, biology, chemistry, physics• Understanding of the nature of science and scientific inquiry	Peters & Stout, Chapter 1

Aug 29	<p>Foundations for Teaching Science in Early Childhood Education for Diverse Young Learners</p> <p>Classroom, Field, and Laboratory Safety</p> <ul style="list-style-type: none"> • Rules and procedures <p>Ensuring students take appropriate safety precautions</p>	
Week 2 Sep 3	<p>Role and Nature of Theory</p> <ul style="list-style-type: none"> • Explaining events and phenomena, including learning theories undergirding pedagogical approaches for teaching science <p>Contribution and Significance of Science</p> <ul style="list-style-type: none"> • Social, cultural, and economic significance 	<p>Peters & Stout, Chapter 2 Spotlight on Science, pp. 2-10</p> <p>Due to Bb – Personal Journal Part 1</p>
Sep 5	<p>Role of Family and Community Knowledge, Experience, and Resources in Planning and Implementing Science Content</p>	
Week 3 Sep 10	<p>Historical Development of Scientific Concepts and Scientific Reasoning</p> <p>Knowledge, Skills, and Practices for Conducting an Active Early Childhood Science Program</p>	<p>Peters & Stout, Chapter 3 Spotlight on Science, pp. 48-54, 55-60, 72-73</p> <p>National and State Science Learning Standards</p>
Sep 12	<p>Application of Key Science Principles to Solve Practical Problems</p> <ul style="list-style-type: none"> • Problem-based learning (PBL) (continued) <p>Standards</p> <ul style="list-style-type: none"> • Virginia standards (<i>Virginia's Foundation Blocks for Early Learning: Comprehensive Standards for Four-Year-Olds, Virginia Science Standards of Learning</i>) <p>National standards (<i>Next Generation Science Standards</i>)</p>	

Week 4 Sep 17	Integrating the Four Core Scientific Disciplines Across Content Areas <ul style="list-style-type: none"> Integrate processes and crosscutting concepts in an appropriate interdisciplinary context 	Spotlight on Science, pp. 48-54 & 68-71 <u>On Blackboard:</u> <i>Blending In-Using an Adaptation Activity to Integrate Math and Science</i>
Sep 19	Disciplines Across Content Areas <ul style="list-style-type: none"> Relationship of science to mathematics, design process, and technology 	
Week 5 Sep 24	Formative and Summative Assessments of Student Learning	Peters & Stout, Chapter 4 Due to Bb – Enriching Science Inquiry with Literature
Sep 26	Practices Required for Empirical Answers to Research Questions data collection and analysis, modeling, argumentation with evidence, constructing explanations	
Week 6 Oct 1	Application of Key Science Principles to Solve Practical Problems	Peters & Stout, Chapter 5
Oct 3	Reliability of Scientific Knowledge <ul style="list-style-type: none"> scrutiny, refinement, and self-checking mechanisms objectivity, such as peer review assumptions, influencing conditions, limits of empirical knowledge 	
Week 7 Oct 8	Plan Instruction on Earth Science, Biology, Chemistry, and Physics <ul style="list-style-type: none"> Using the goals of the <i>Virginia Standards of Learning</i> and the National Science Standards Using variety of instructional technology to support learner competence 	Spotlight on Science, pp. 41-47, 61-67
Oct 10	Inquiry-Based Approach to Teaching Science 5E/6E model Science Activity Share – Physical Science I	

Week 8 Oct 15 Fall Break – No class meeting		Peters & Stout, Inquiry Unit 1 Spotlight on Science, pp. 29-35 Due to Bb – 5E/6E/PBL Lesson Plan
Oct 17	Core Science Discipline: Physics and Chemistry Research Projects and Experiments Classroom and Field Safety Rules and Procedures Science Activity Share – Physical Science II	
Week 9 Oct 22	Evaluate, Select, and Adapt Instruction and Materials to Meet the Needs of Diverse Learners	Peters & Stout, Chapter 6 Spotlight on Science, pp. 55-60 <u>On Blackboard:</u> <i>Science Success for Students with Special Needs</i>
Oct 24	Science Inquiry Invitations for Family Explorations Science Activity Share – Life Science I	
Week 10 Oct 29	Core Science Discipline: Biology Engaging Diverse Young Learners in Science Experiences <ul style="list-style-type: none"> • Field investigations using school grounds, the community, and regional resources: Mason Apiary and Greenhouse • Science activities using scientific process: describing, analyzing, using quantitative methods for findings • Knowledge, skills, practices to conduct research projects and experiments Science Activity Share – Life Science II	Peters & Stout, Inquiry Unit 2 Spotlight on Science, pp. 11-16, 23-28 Due to Bb – Science Lesson Reflection (Part 1)

Oct 31 Online Class	Alternative Online Assignment	
Week 11 Nov 5	Design Process and Engineering Science Lesson Implementation	Peters & Stout, Chapter 7 Spotlight on Science, pp. 36-40 <u>On Blackboard:</u> <i>They Can't Spell Engineering but They Can Do It</i>
Nov 7	STEAM in Early Childhood Classrooms Science Activity Share – Engineering	
Week 12 Nov 12	Core Science Discipline: Earth Science Science Activity Share – Earth and Space Science I	Peters & Stout, Inquiry Unit 3 Spotlight on Science, pp. 61-67 <u>On Blackboard:</u> <i>Teaching with Play-An Introduction to Environmental Stewardship for Preschoolers</i>
Nov 14	Environmental Education and Conservation	
Week 13 Nov 19	Core Science Discipline: Space Science Science Activity Share – Earth and Space Science II	<u>On Blackboard:</u> <i>Representation of the Moon in Children's Literature</i>
Nov 21	Technology to Enhance Student Performance in Science	
Week 14 Nov 26	Evaluating Instructional Materials, Technologies, and Teaching Practices Science Lesson Implementation	Spotlight on Science, pp. 68-71, pp. 17-22 Due to Bb – Science Lesson Reflection (Part 2)
Nov 28 No Class		
Week 15 Dec 3	Professional Development in Support of Inquiry Self-Reflections on Filling the Role of Science teacher for Diverse Young Learners	Peters & Stout, Chapter 8 Spotlight on Science, pp. 77-80
Dec 9-10	Reading Days – No class meeting	
Week 16 Dec 17	Exam Period – No class meeting	Due to Bb – Personal Journal Part 2

Note: Faculty reserves the right to alter the schedule as necessary, with notification to students.

Core Values Commitment

The College of Education and Human Development is committed to collaboration, ethical leadership, innovation, research-based practice, and social justice. Students are expected to adhere to these principles: <http://cehd.gmu.edu/values/>.

GMU Policies and Resources for Students

Policies

- Students must adhere to the guidelines of the Mason Honor Code (see <https://catalog.gmu.edu/policies/honor-code-system/>).
- Students must follow the university policy for Responsible Use of Computing (see <http://universitypolicy.gmu.edu/policies/responsible-use-of-computing/>).
- Students are responsible for the content of university communications sent to their Mason email account and are required to activate their account and check it regularly. All communication from the university, college, school, and program will be sent to students **solely** through their Mason email account.
- Students with disabilities who seek accommodations in a course must be registered with George Mason University Disability Services. Approved accommodations will begin at the time the written letter from Disability Services is received by the instructor (see <http://ods.gmu.edu/>).
- Students must follow the university policy stating that all sound emitting devices shall be silenced during class unless otherwise authorized by the instructor.

Campus Resources

- Support for submission of assignments to Tk20 should be directed to tk20help@gmu.edu or <https://cehd.gmu.edu/aero/tk20>. Questions or concerns regarding use of Blackboard should be directed to <http://coursessupport.gmu.edu/>.
- For information on student support resources on campus, see <https://ctfe.gmu.edu/teaching/student-support-resources-on-campus>.

For additional information on the College of Education and Human Development, please visit our website: <https://cehd.gmu.edu/students/>.