



This course supports the assessments for AVC1 and AVT1. The course covers 4 competencies and represents 2 competency units.

Introduction

Overview

Did you know that there is a higher incidence of math anxiety among elementary education majors than individuals in any other college major? Research also indicates that these same teachers are passing their math anxiety along to their students resulting in two-thirds of Americans fearing and loathing math (Burns, 1998). As an early childhood teacher you have a unique opportunity to reverse this trend by becoming a skilled and enthusiastic math and science teacher.

Mathematics and science are exciting content areas for young children because they provide a natural context for curiosity and creativity as young children discover and explore their world. You will learn to spark children's interest and engage them in inquiry about the world around them. When curiosity is encouraged, the inherent need to know deepens. Each learning experience changes the brain in a way that allows for a greater capacity of learning and motivation toward more complex investigations.

Competencies

This course provides guidance to help you demonstrate the following 4 competencies:

- **Competency 607.5.7: Foundations of Math and Science Pedagogy in Early Childhood**
The graduate draws on research and knowledge of developmentally appropriate practice to design and create environments and learning opportunities that support early math and science development in infants, toddlers, and young children.
- **Competency 607.5.8: Mathematical Concept Development**
The graduate utilizes concepts, tools, and structures of mathematics and developmentally appropriate practice in the design and implementation of mathematics instruction for young children.
- **Competency 607.5.9: Mathematics Instruction in the Early Grades**
The graduate uses concepts, tools, and structures of mathematics and developmentally appropriate practice in the design and implementation of mathematics instruction for young children.
- **Competency 607.5.10: Science and Nature Instruction**
The graduate utilizes concepts, tools, and structures of developmentally appropriate science education in the design of learning experiences for young children.

Teaching Dispositions Statement

Please review the [Statement of Teaching Dispositions](#).



Course Instructor Assistance

As you prepare to successfully demonstrate competency in this subject, remember that course instructors stand ready to help you reach your educational goals. As subject matter experts, mentors enjoy and take pride in helping students become reflective learners, problem solvers, and critical thinkers. Course instructors are excited to hear from you and eager to work with you.

Successful students report that working with a course instructor is the key to their success. Course instructors are able to share tips on approaches, tools, and skills that can help you apply the content you're studying. They also provide guidance in assessment preparation strategies and troubleshoot areas of deficiency. Even if things don't work out on your first try, course instructors act as a support system to guide you through the revision process. You should expect to work with course instructors for the duration of your coursework, so you are welcome to contact them as soon as you begin. Course instructors are fully committed to your success!

Preparing for Success

The information in this section is provided to detail the resources available for you to use as you complete this course.

Learning Resources

The learning resources listed in this section are required to complete the activities in this course. For many resources, WGU has provided automatic access through the course. However, you may need to manually enroll in or independently acquire other resources. Read the full instructions provided to ensure that you have access to all of your resources in a timely manner.

Automatically Enrolled Learning Resources

You can access the learning resources listed in this section by clicking on the links provided throughout the course. You may be prompted to log in to the WGU student portal to access the resources.

VitalSource E-Texts

The following textbooks are available to you as e-texts within this course. You will be directly linked to the specific readings required within the activities that follow.

- Davis, G. A., & Keller, D. J. (2008). *Exploring science and mathematics in a child's world*. Upper Saddle River, NJ: Pearson. ISBN-13: 9780130945228.
- Geist, E. (2008). *Children are born mathematicians: Supporting mathematical development, birth to age 8*. Upper Saddle River, NJ: Pearson. ISBN-13: 9780131116771.
- Harlan, J. D., & Rivkin, M. S. (2007). *Science experiences for the early childhood years: An integrated affective approach* (9th ed.). Upper Saddle River, NJ: Pearson. ISBN-13: 978013157309

Note: These e-texts are available to you as part of your program tuition and fees, but you may purchase hard copies at your own expense through a retailer of your choice. If you choose to do so, please use the ISBN listed to ensure that you receive the correct edition.



Teachscape

You will access video modules from Teachscape at the activity level within this course. The Teachscape modules include video lectures, exercises, and interactive elements.

Foundations of Math and Science Pedagogy in Early Childhood, Part I

You will begin learning what comprises an effective math and science curriculum. The national standards for teaching math and science are a guide to creating developmentally appropriate environments that encourage young children to naturally gain important foundational math and science concepts.

This topic addresses the following competency:

- **Competency 607.5.7: Foundations of Math and Science Pedagogy in Early Childhood**

The graduate draws on research and knowledge of developmentally appropriate practice to design and create environments and learning opportunities that support early math and science development in infants, toddlers, and young children.

Developmentally Appropriate Environments for Math and Science

What do developmentally appropriate practices (DAP) in early childhood math and science look like? Can you create an environment that promotes developmentally appropriate practices? What elements of developmentally appropriate practices do you recognize in your PCE placement?

These following are questions every early education professional should be able to answer.

- What are the guidelines for teachers in creating a culture of caring in the classroom, including safety issues, the role of play, emotional security, and being responsive to children's ideas and approaches to learning?
- What are the national standards for mathematics and science and how do they apply to early childhood education?

Guidelines for Creating a Culture of Caring That Encourages Naturalistic Exploration and Learning

Complete the following chart using your three texts as resources:



List the 5 guiding principles from Children are Born Mathematicians , pages iv–v	List the 6 ingredients for learning from Science Experiences for the Early Childhood Years , pages 3–8	List the 8 guiding principles for creating context for curiosity, creativity, and discovery from Exploring Science and Mathematics in a Child's World , pages 1–5
<ol style="list-style-type: none"> 1. 2. 3. 4. 5. 	<ol style="list-style-type: none"> 1. 2. 3. 4. 5. 6. 	<ol style="list-style-type: none"> 1. 2. 3. 4. 5. 6. 7. 8.

Access the following Teachscape module:

- ["Early Childhood Mathematics"](#)

In "3. Implementing Focused Mathematics Lessons," click on "Visit the Classroom" and view the videos.

This is the first of three times you will consider these videos in this course. Each time you watch them you will be watching for a different aspect of early childhood mathematics. This first time, you observe the videos, place a checkmark beside each of the listed principles you observe in the chart you have constructed.

As a final step in this section, think about how you will describe your math or science classroom environment to a future employer based on the principles you explored in the three readings outlined above. Share your ideas with other students on the message board in the "Classroom Environment" discussion thread.

National Standards for Mathematics

To become familiar with the National Standards for Mathematics, visit the following section of NCTM's website.

- ["Standards Overview"](#)

On the left-hand navigation, you should see links for the standards of different grade levels. Click on those links, and you will see a list of specific standards for each grade level; the links will take you into charts with more detailed information about the specific standards.

Then complete the following items:

- What are the similarities and difference between the standards for pre-K through second grade and third grade through fifth grade?
- Are there standards that span the pre-K through second grade and the third grade



through fifth grade levels?

- Visit the [National Council of Teachers of Mathematics website](#) and find out what resources are available for teachers. Make a note of what you found in your study notes for future reference.
- Write a synopsis of what you have learned in your study notes.

National Standards for Science

Review the National Science Standards at the following website:

- ["National Science Education Standards: An Overview" website.](#)

What resources are available for teachers? Make a note in your study notes for future reference.

Barriers to Effective Math and Science Instruction

View the video "Meet the Specialists" found in the introduction.

Reflect on the key challenges facing quality early childhood math instruction. Share your thoughts in the "Key Challenges of ECE Mathematics" discussion thread on the message board.

Read the following pages from the *Children Are Born Mathematicians* text.

- [pages 38-39 of chapter 2 \("Building a Knowledge Base and Learning to Reflect"\)](#)

List your greatest concerns about teaching math or science. Identify at least one strategy that you can commit to in order to overcome each of your anxieties prior to becoming an early childhood educator.

Foundations of Math and Science Pedagogy in Early Childhood, Part II

You have selected your curriculum to be in alignment with national standards—now what? How will you know which kinds of activities to implement to really motivate children to engage in math and science thinking?

You will know an activity is developmentally appropriate when children's natural curiosity and enthusiasm for learning are activated. This section covers developmentally appropriate environments that encourage young children to naturally engage with their environment to learn important foundational math and science concepts.

Naturalistic Exploration and Learning

You will gain a better understanding of how children naturally develop problem-solving skills.

- What is naturalistic exploration and learning?
- How do teachers encourage children to ask questions and to be curious about their world?



- What are problem-solving skills that encourage children to solve authentic problems?

This topic addresses the following competency:

- **Competency 607.5.7: Foundations of Math and Science Pedagogy in Early Childhood**

The graduate draws on research and knowledge of developmentally appropriate practice to design and create environments and learning opportunities that support early math and science development in infants, toddlers, and young children.

Exploration as the Basis of Learning

Exploration as a basis for learning is grounded in several well-known theories and approaches. You have been introduced to the constructivist theory, learning styles, and multiple intelligences in prior courses, but do these theories and approaches to learning apply to math and science?

Read the following excerpts from *Children Are Born Mathematicians*:

- "[Constructivist Theory](#)," pages 49—57
- "[Multiple Intelligences](#)," pages 57—59
- "[Learning Styles](#)," pages 59—61

Read more about creating curious children by reading the following pages in *Exploring Sciences and Mathematics in a Child's World*:

- [pages 28-35 of chapter 2 \("Nurturing Child Development - Environments That Promote Learning"\)](#)

Consider the following questions:

- How is the constructivist theory, multiple intelligences, or learning styles approach similar to or different from your own experience learning math?
- Have you had an opportunity to observe a classroom demonstrating any or all of these theories and approaches?
- If you have children, do you see any of these approaches being used as they are engaged in math or science learning?

Share your thoughts with your peers in the message board in the "ECE Learning Theories" discussion thread.

Developing Questioning Strategies

Access the following Teachscape module:

- "[Early Childhood Mathematics](#)"

Review the videos in the "Visit the Classroom" subsection, available in the "3. Implementing Focused Mathematics Lessons" section.



What examples can you identify in the videos of constructivist theory, multiple intelligences, or learning styles? What science concepts do you see being taught during these math lessons? Check with peers to see if they noticed the same science concepts as you did.

Read "Developmentally Appropriate Questioning and Discussion Strategies" on the following pages of your *Sciences Experiences in the Early Childhood Years* text.

- [pages 35-46 of chapter 3 \("Guiding Science Learning"\)](#)

Now, watch the videos again while considering the following questions:

- What questioning and discussion strategies did you observe? Were there additional opportunities to instigate discovery, elicit predictions, probe for understanding, promote reasoning, or encourage creative thinking?
- Can you identify five additional opportunities that the teachers in the video could have pursued to increase children's understanding of a math or science concept by using some of the questioning strategies covered in your reading?

Post your five extension ideas in the "Developing Questioning Strategies" discussion thread in the message board. What did you learn from the your peers' ideas?

Developmentally Appropriate Math Curriculum and Assessment

If a child counts to five, does that child have an understanding of "fiveness"? Or is the child just rote counting? A skilled early education teacher knows how to recognize the difference. In this section you will learn how to teach math concepts at a developmental level and assess student success by investigating the following questions:

- What are the components of a developmentally appropriate mathematics curriculum for infants, toddlers, and young children?
- How do you assess what a child knows to determine learning needs?
- How does assessment inform instruction?
- Why is play an essential part of developing mathematical concepts?
- How can technology be used in a developmentally appropriate way to support math or science learning objectives?

Developmentally Appropriate Mathematics Curriculum

What can infants learn about math? What about toddlers and preschool-age children? These young children cannot add or subtract, so how do you prepare them to be successful mathematicians?

There is so much great research about effective math instruction. However it might be very different from your own math experiences. Keep an open mind and remember to consider the child's perspective.



This topic addresses the following competency:

- **Competency 607.5.8: Mathematical Concept Development**

The graduate utilizes concepts, tools, and structures of mathematics and developmentally appropriate practice in the design and implementation of mathematics instruction for young children.

Developmentally Appropriate Math Concepts

Begin by reading the following pages of the *Children Are Born Mathematicians* text.

- [pages 101 – 114 of chapter 4 \("Creating a Constructivist Classroom"\)](#)

In your study notes, reflect on the chart on page 111 and honestly evaluate where you currently fit on the child-centered/behaviorist continuum. What do you need to learn to become more child centered?

Create a summary of the continuum of developmentally appropriate mathematical concepts for infants, toddlers, preschoolers, and early, school-age children. Do you know what all the concept terms mean?

Concepts	Infants	Toddlers	Preschoolers	School Age
Pattern				
Sequence				
Seriation				
Spatial relationships				
Object permanence				
Sorting				
Comparing				
Classifying				
One-to-one correspondence				

Are there other concepts you should add to this chart? Keep a copy of this important summary document in your study notes to refer back to in the future.

Also add to your study notes a brief definition of each of the math concepts so that you can use professional language when talking with your PCE host teacher and other colleagues.

When you are satisfied that this chart is a good representation of the developmentally appropriate practices continuum for early childhood, post your chart in your professional portfolio in the Early Childhood Mathematics section.

Developmentally Appropriate Math Assessments



Before you can know how best to use assessment to support learning, it is important to understand the vocabulary associated with assessment.

Read the following pages of your *Children are Born Mathematicians* text:

- [pages 174-179 of chapter 5 \("Infants and Toddlers"\)](#)

You have already covered these terms in a previous course. Make certain you understand each assessment term in light of mathematical concepts.

- What is the difference between standardized and authentic assessment?
- What is formal vs. informal assessment?
- What is formative vs. summative assessment?
- When are anecdotal records an appropriate assessment tool?
- How can a running record or time sample be an effective assessment tool?

Summarize each concept in your study notes for future reference.

Complete the following activities.

- Interview your PCE host teacher and find out how your host teacher assesses the learning of the students? What formative and summative assessment tools does your host teacher use? Does your host teacher keep anecdotal records? How does your host teacher use assessment when planning instruction?
- Report what you learned about assessment from your PCE host teacher to the "DAP Assessment" discussion thread in the message board.

Developmentally Appropriate Use of Technology to Support the Math Curriculum

Read the following articles:

- ["Using Technology in the Early Childhood Classroom"](#)
- ["Technology in Early Childhood Education: Finding the Balance"](#)

Post your opinion about using technology in early childhood classrooms in the [Diigo wiki on technology in early childhood](#). Share any resources on the topic you may have found at. Have you seen technology used effectively in your PCE setting?

Developmentally Appropriate Mathematics Instruction

What if you discovered that you could not use any worksheets when teaching mathematics? How would you teach mathematical concepts? What is meant by interactive methods rather than passive methods? Manipulatives are important tools for helping young children think about mathematics.

You will discover that children are much more enthused about learning from manipulatives than from worksheets. Manipulatives are much like play — they tap into children's natural way of



learning.

Preparing the Learning Environment

You will learn to prepare your students' learning environment to encourage learning.

This topic addresses the following competency:

- **Competency 607.5.9: Mathematics Instruction in the Early Grades**

The graduate uses concepts, tools, and structures of mathematics and developmentally appropriate practice in the design and implementation of mathematics instruction for young children.

Classroom Arrangement

Read the following pages in your *Children are Born Mathematicians* text.

- [pages 115-129 of chapter 4 \("Creating a Constructivist Classroom"\)](#)

Create a map of your ideal classroom arrangement for teaching math and science.

Add the map to your portfolio and include descriptive notes as to why you chose to arrange the room in this particular way.

Selecting Materials

Access the following Teachscape module:

- ["Early Childhood Mathematics"](#)

Click "4. Weaving Mathematics Purposefully Into Daily Routines" and read "Set up a Math Center."

Make a copy of the list of materials suggested for beginning a math center. Keep this list in your study notes and add to it as you observe classrooms as part of your PCE experience.

Math Delivery Methods

What is the difference between informal and formal teaching? Can learning centers by themselves be an effective strategy to teach mathematics? What are other ways to include math activities throughout the day?

This section covers two different ways of implementing math instruction in the early childhood classroom (i.e., weaving mathematics into daily routines and implementing focused mathematics lessons). Then you will reflect on the qualities of excellence in early childhood math instruction.

This topic addresses the following competency:

- **Competency 607.5.9: Mathematics Instruction in the Early Grades**

The graduate uses concepts, tools, and structures of mathematics and developmentally



appropriate practice in the design and implementation of mathematics instruction for young children.

Weaving Mathematics Into Daily Routines

Recognizing good instructional strategies grounded in developmentally appropriate practices is the first step towards creating your own developmentally appropriate lessons.

Access the following Teachscape module:

- ["Early Childhood Mathematics"](#)

Complete the following subsections of "4. Weaving Mathematics Into Daily Routines."

- "View Commentary"
- "Explore Math Throughout the Day"
- "Integrate Mathematics Into Read Alouds"

In your study notes, list the ways the teachers were able to integrate mathematics throughout the day.

- Complete the "Check Yourself" activity to see if you have mastered the key concepts of weaving mathematics into daily routines.

Next, select "2. About Math in Early Childhood."

As you read and study this section, take note of how good instructional strategies are grounded in developmentally appropriate practices. Pay particular attention to the following subsections:

- "Read About Mathematics in Early Childhood"
- "Defining Mathematics Content in Pre-Kindergarten"
- "View Commentary"

Implementing Focused Mathematics Lessons

Access the following Teachscape module:

- ["Early Childhood Mathematics"](#)

Complete the following subsections of "3. Implementing Focused Mathematics Lessons".

- "Learn About This Section"
- "Read About Focused Mathematics Lessons"
- "Visit the Classroom"
- "View Commentary 1"
- "View Commentary 2"
- "Check Yourself"



Take notes on each of the following items:

- Identify one learning activity that helps build a foundation in geometry for young children. What are the foundational skills for infants and toddlers? (Check [Children Are Born Mathematicians](#).)
- Identify a developmentally appropriate instructional strategy or activity to promote mathematical reasoning or problem solving for a given objective.
- Give an example of how the lessons that comply with a specified element of the joint statement regarding mathematics from the National Council of Teachers of Mathematics (NCTM) and the National Association for the Education of Young Children (NAEYC).
- Identify an appropriate strategy, activity, or instructional tool that increased children's fluency with specified mathematical language or symbols.
- Describe how a developmentally appropriate strategy or activity helped young children develop initial understanding of a specified mathematical concept.
- Give an example of a developmentally appropriate strategy to help young children use tools to measure length, volume, weight, area, or time.

Share your answers to these questions with your peers in the "Excellent Teaching Practices" discussion thread.

Creating Developmentally Appropriate Mathematics Instruction

Are you ready to be a great math and science teacher? You have been introduced to the national math and science standards, you have learned about developmentally appropriate practices and how children learn best, and you have a chance to observe master teachers at work. Now it is your turn to apply what you have learned as a first step towards becoming a highly skilled math and science teacher. An important step for all new teachers is to make the transition from learning to application.

In this section you will have the opportunity to apply what you have been learning about developmentally appropriate practices and effective mathematics instruction.

Creating Developmentally Appropriate Math Activities

Now you are ready to try out designing a developmentally appropriate activity.

This topic addresses the following competency:

- **Competency 607.5.9: Mathematics Instruction in the Early Grades**

The graduate uses concepts, tools, and structures of mathematics and developmentally appropriate practice in the design and implementation of mathematics instruction for young children.

Developmentally Appropriate Math Activities

For each of the two topics presented, create a developmentally appropriate mathematics activity to share with your peers in the "DAP Math Activity" discussion thread on the message board.



- Topic 1: Help young children understand, represent, or compute (or a combination of the three) commonly used simple fractions.
- Topic 2: Help young children recognize the attributes of length, volume, weight, area, or time.

Keep these points in mind as you create your lessons.

- Be very clear about why the topic and content are developmentally appropriate for the age group you have selected as the participants.
- Use the TaskStream lesson planner for developing your math activity.
- Read the wide variety of examples in your [Children Are Born Mathematicians](#) text.
- Talk with your PCE host teacher for additional ideas and resources.

Science and Nature

A sense of inadequacy about science can be a real limitation to science teaching. The best way to address these concerns is to try out the experiments and activities before presenting them to your students.

In this section you will have an opportunity to learn more about developmentally appropriate practices in science education and you will have the chance to create science learning experiences for young children so that you can become a confident teacher of science.

The Guided Science Approach

As you engage in this section of the course you will explore the following questions:

- What is guided discovery science?
- What are the reasons for guided discovery science?
- How do teaching styles impact guided learning?
- What is the difference between direct and indirect teaching?

This topic addresses the following competency:

- **Competency 607.5.10: Science and Nature Instruction**
The graduate uses concepts, tools, and structures of developmentally appropriate science education in the design of learning experience for young children.

Understanding the Guided Science Approach

Read and take notes on the following chapter from the *Science Experiences for the Early Childhood Years* text.

- chapter 3 ("[Guiding Science Learning and Assessments in the Early Years](#)")

Make sure you understand the basic concepts of the guided science approach by addressing each of the following questions in your study notes.

- What is guided discovery science?



- What are the reasons for guided discovery science?
- How do teaching styles impact guided learning?
- What is the difference between direct and indirect teaching?

Designing a Science-Rich Environment

With naturalistic experiences, the adult's role is to provide an interesting and rich environment for the child. What are the tools and resources needed to create a science-rich environment for young children?

This topic addresses the following competency:

- **Competency 607.5.10: Science and Nature Instruction**
The graduate uses concepts, tools, and structures of developmentally appropriate science education in the design of learning experience for young children.

Materials for Your Guided Science Classroom

Read the following article:

- "[Why Teach Science in Early Childhood?](#)"

Then, complete the following:

- Make a copy of the suggested materials list so that you can begin collecting items that will enhance your science literacy program.
- Create a learning center materials list to incorporate into environments that encourage the exploration of a child's world for each of the centers listed below.
- Share your ideas with your peers in the "Science Center Ideas" discussion thread on the message board.

Use your [Science Experience for the Early Years](#) text and your [Exploring Science and Mathematics in a Child's World](#) text as resources to supplement your materials list. Listed below are some examples of the items from your books you could add to your lists:

- simple tools (e.g., wheels, pulleys, gears, screws)
- life cycles of living organisms
- five senses
- principles of physics (e.g., force and motion, light, color)

Science and Nature Lesson Design

Imagine you are two years old. You are fascinated by the world around you. Every chance you get, you experiment on the environment around you. You are constantly forming hypotheses and checking them out. Now, imagine you are four years old. You are now using your language to help you learn. You ask why the sky is blue. How do birds fly? Who put all the rocks here? Now, imagine you are now six years old. You build sand castles on the beach, watch the waves erode them, and then build them up again. You employ the principles of the scientist every chance you get.



Children are amazing scientists. Your responsibility as an early childhood educator will be to enhance the natural curiosity and tendency for exploration of young children through excellent science teaching. You have gathered your resources, you have read about the guided science approach, now it is time to begin designing developmentally appropriate learning experiences.

Creating Developmentally Appropriate Science Activities

Now you are ready to try out designing a developmentally appropriate activity.

This topic addresses the following competency:

- **Competency 607.5.10: Science and Nature Instruction**

The graduate utilizes concepts, tools, and structures of developmentally appropriate science education in the design of learning experiences for young children.

Creating a Guided Science Activity

Select two of the following topics and create a developmentally appropriate science activity that models the guided science approach. Use the TaskStream lesson planner to develop your science activity. Share your activity with your peers in the "DAP Science Activity" discussion thread.

- Topic 1: plants or animals
- Topic 2: life cycles of organisms
- Topic 3: principles of physics (motion, light, color)
- Topic 4: space

As you create your activity, be very clear on why the topic and content are developmentally appropriate for the age group you have selected as the participants.

Read the wide variety of examples in your two science texts and talk with your PCE host teacher for additional ideas and resources.

Final Review

Congratulations on completing the activities in this course! This course has prepared you to complete the assessments associated with this course. If you have not already been directed to complete the assessments, schedule and complete your assessments now.