ECHOS®

Early Childhood Hands-On Science

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Overview

The Institute for Education Sciences funded the Phillip and Patricia Frost Museum of Science, in partnership with the University of Miami, to develop a comprehensive early child-hood science curriculum, assessment tools and professional development program.

The overall goal of Early Childhood Hands-On Science (ECHOS®) is to investigate science as a domain for enhancing overall school readiness and to demonstrate that very young children can learn fundamental science concepts and the process skills associated with developing scientific habits of mind.

Science Process Skills

ECHOS® is designed to intertwine conceptual learning goals with teaching process skills and practices needed to do science. Units are connected through process skills that function across lessons in preparation for what children should know and be able to do when they enter kindergarten.

Observing
Identifies object properties
Uses senses to observe concrete, familiar objects
Differentiates between models and the real thing
Uses measurement tools to record observations
Uses tools to observe objects or events
Describing
Describes key attributes of objects
Creates drawings or models depicting objects
Describes changes in objects
Discusses changes in variables that affect an investigation
Categorizing
Notices similarities and differences
Sorts objects into groups using one attribute at a time
Establishes own sorting criteria and provides reasoning for grouping objects
Sorts objects using multiple attributes
Provides reasoning for grouping objects
Predicting
Verbalizes thinking about predictions
Recognizes and extends patterns
Makes simple predictions
Makes predictions based on observations
Uses estimation to make quantitative predictions
Experimenting
Investigates models of objects/phenomena
Manipulates materials
Identifies factors that might affect the outcome of an experiment
Participates in collecting data
Interprets data using symbols or graphs
Performs trial-and-error investigations
Drawing Conclusions
Makes verbal interpretations of observations
Finds patterns from data collected
Connects findings from an investigation

E-I-E-I-O Learning Framework

The 36 ECHOS® lessons follow a project-designed learning sequence that provides teachers with a logical structure to deliver lessons that promote learning by thinking and doing. It combines direct instruction with guided inquiry-based science experiences and exploration.

Framework	Teacher Behavior
Excite… to spark curiosity and wonder	• Creates interest. • Generates curiosity. • Selects topics of interest to children.
Introduce… the investigation	• Elicits children's prior knowledge about a concept or topic. • Uses positive and negative examples to introduce new vocabulary/key concepts. • Clarifies and corrects misconceptions.
Explore… to deepen understanding	• Structures learning environment (tools, time, space) for exploration. • Encourages children to use senses to investigate. • Models how to explore (pose questions, make predictions, look for patterns, record data, check predictions).
Interact… as needed to respond to individual strengths and needs	• Observes and listens actively. • Differentiates and adapts instruction to meet children's individual needs. • Encourages interaction between children. • Promotes collaborative work.
Outcomes… observe evidence of learning	• Poses questions to elicit descriptions of and feelings about the investigation. • Connects children's ideas. • Determines need to re-teach key concepts.

Curriculum

The curriculum consists of nine thematic units focused on Life, Earth and Physical Science, and are delivered over a one-month period. Units are sequenced to present progressively more complex science process skills, and combine direct instruction with guided inquiry-based science experiences. Each unit contains an overview, teacher background, four lessons, and twelve integration activities. Read-aloud storybooks connect key concepts to unit themes.

Beginning Botanist

Learn the parts of a plant. Remove a plant from a pot to investigate its root system. Observe water traveling through a straw to learn how the parts of a plant work. Compare seeds and leaves using one attribute at a time. Germinate seeds to investigate how plants grow.

Feathered Friends

Observe pictures and models to learn distinguishing characteristics of birds. Sort animals into two categories: *birds* and *not birds*. Use toy binoculars to find pictures of camouflaged birds in the classroom. Investigate which wings and feet work best in different habitats.

Busy Buzzing Bees

Make models to learn the parts of a bee. Use dramatic play to investigate how a bee uses its proboscis to sip nectar and antennae to distinguish scents. Use sight, smell and touch to observe honeycomb models. Learn a bee dance to communicate *near* and *far*.

*i*Cards

While the teacher conducts a science lesson with a small group, the teacher assistant or classroom volunteer utilizes *i*Cards to engage the other children in related activities in language and literacy, math and creative arts.

Now available in Spanish!

Water Play

Compare containers of various sizes and find out how many cups of water it takes to fill a bottle; chart predictions and results. Conduct an experiment to understand what makes objects *sink* or *float*. Predict buoyancy based on weight and shape; record results.

Astonishing Air

Distinguish between *inflated* and *deflated* objects to identify the presence of air. Collect air from different parts of the room to learn that air is all around us. Launch a balloon rocket to observe that air can move things. Contrast *fast*- and *slow*-moving wind and the direction it blows.

Magnificent Magnets

Test objects for magnetic properties and classify them as *magnetic* or *nonmagnetic*. Explore magnets and measure their magnetic strength. Learn about the push and pull of magnetic force and conduct an investigation to see how magnetic force can work from a distance.

Use senses to explore rain. Explore weather-protective clothing. Observe and draw changing weather conditions. Distinguish between materials that *absorb* and *repel* water; investigate which materials keep us dry. Observe how rain makes puddles or is absorbed into soil.

Create a beach model to learn about ocean waves at a beach. Observe shells and describe their attributes: *rough* and *smooth, large* and *small*. Classify shells using multiple attributes at the same time. Use clay models to investigate how shells protect mollusks.

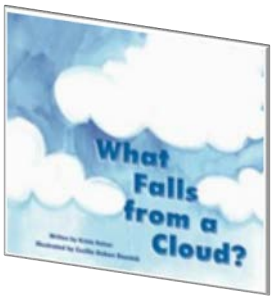
Learn comparison words to describe length and height. Use nonstandard units of measurement (blocks) to measure and compare which objects are *long* or *longer, tall* or *taller*. Build block speedways to investigate the effect of a ramp's height on the distance a toy car will travel.

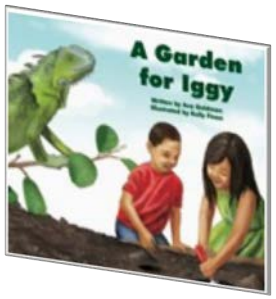
Home Connections

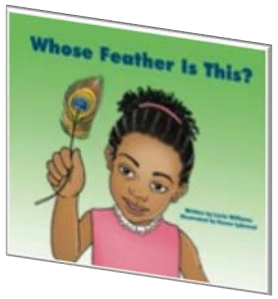
Ask-Me-About stickers prompt family members to find out what their children are learning.

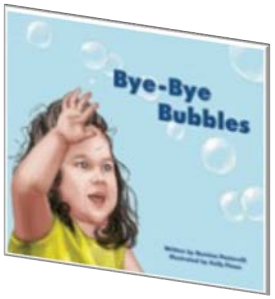
Unit Storybooks

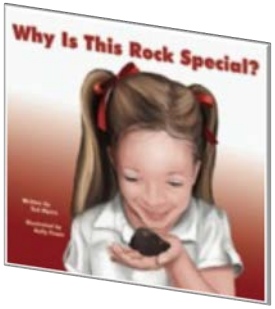
The curriculum includes a set of storybooks. The books are designed to be used during specific lessons within the curriculum and help make connections to new vocabulary words and key concepts.









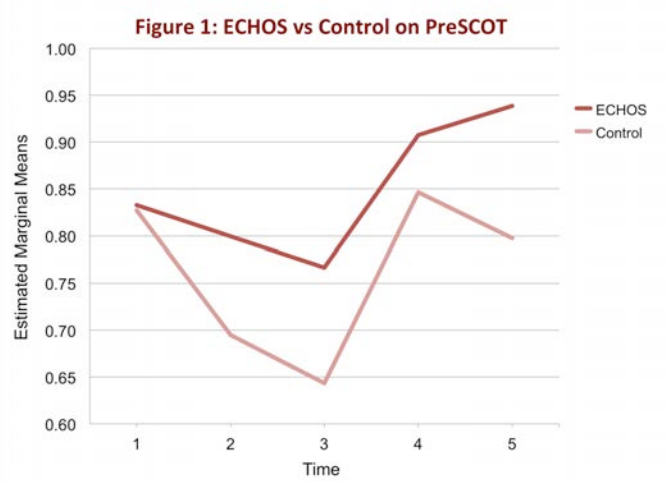


Full-Scale Efficacy Study

From 2011 to 2013, the Institute for Education Sciences (IES) provided funding for Frost Science, in partnership with the University of Miami, to conduct a two-year randomized controlled trial in 91 Head Start classrooms (45 ECHOS, 46 Control) in Miami-Dade County to examine the efficacy of the ECHOS® professional development model. Approximately ten children from each classroom were randomly selected and stratified by age and gender, to be assessed on their science skills. The program served primarily African-American (48%) and Hispanic (51%) children, ages 3-5.

Does ECHOS improve preschool teachers' science teaching?

Using the Preschool Science Classroom Observation Tool (PreSCOT), teachers were observed in Spring 2011 (prior to random assignment to ECHOS and Control conditions) presenting a science lesson of their choice. The first time point baseline prior to random assignment to Treatment (ECHOS versus Control) shows the equivalence of the two groups (.79 versus .81). Analysis of the four subsequent time points after random assignment and the beginning of the ECHOS program (Winter 2011, Spring 2012, Fall 2012, Spring 2013) were conducted using SPSS version 21 with the GLM procedure using a repeated measure design. Treatment (ECHOS versus Control) served as a between subject variable and time as a within subject variable. These data are shown in Figure 1 below. ECHOS teachers had a higher mean PreSCOT score across these 4 time periods compared to Control teachers (.85 versus .74). This difference was **statistically significant**, F(1,64) 4.43, p = .039.



For more information regarding the research, please see www.frostscience.org/stem-professionals/echos/research

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