Early Childhood Science Inquiry is a Journey (Not a Series of Unrelated Activities): Learning from the research

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naeyc
National Association for the Education of Young Children

The NAEYC Early Childhood Science Interest Forum

Purpose and scope of presentation

- We will see how a science inquiry is more than a single activity.

An activity can extend into inquiry when teachers provide open exploration for students and deepen it through children's reflection on their exploration. Adding materials to prompt focused exploration and providing ways to share their understanding supports children's science learning.

Purpose and scope of presentation

- We will identify science and engineering practices in an early childhood exploration.

Practices of science and engineering (NGSS identified)
1. Asking questions (for science) and defining problems (for engineering).
2. Developing and using models.
3. Planning and carrying out investigations.
4. Using mathematics and computational thinking.
5. Analyzing and interpreting data.
6. Constructing explanations (for science) and designing solutions (for engineering).
7. Engaging in argument from evidence.
8. Obtaining, evaluating, and communicating information.

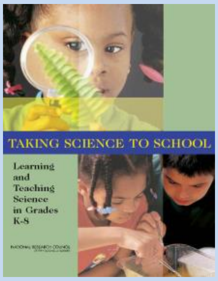
Purpose and scope of presentation

- We will decide next steps for implementing the principles and declarations of the NSTA Position Statement on Early Childhood Science Education in our program, whether we are administrators, child care providers, teachers, educators in an informal setting or have another role in early childhood education.
- Take home a list of resources for further learning.

"The National Science Teachers Association affirms that learning science and engineering practices in the early years can foster children's curiosity and enjoyment in exploring the world around them and lay the foundation for a progression of science learning in K–12 settings and throughout their entire lives…"

NSTA Early Childhood Science Education Position Statement

Taking Science to School: Learning and Teaching Science in Grades K-8



"… research shows that children's thinking is surprisingly sophisticated…. Children can use a wide range of reasoning processes that form the underpinnings of scientific thinking, even though their experience is variable and they have much more to learn."

Executive Summary
National Research Council. 2007.
Duschl, R.A., & Shouse, A.W., eds.
Washington, DC: National Academy Press

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Ready, Set, SCIENCE!: Putting Research to Work in K-8 Science Classrooms

"The Importance of Teaching Science Well

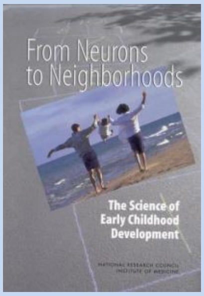
Knowledge of science can enable us to think critically and frame productive questions. With out scientific knowledge, we are wholly dependent on others as "experts." With scientific knowledge, we are empowered to become participants rather than merely observers."

Michaels S., Shouse A. W. and
Schweingruber H. A. 2008.
Washington, DC: National Academy Press

From Neurons to Neighborhoods: The Science of Early Childhood Development

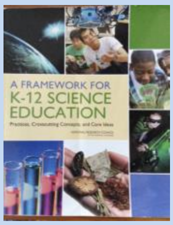
“How can society use knowledge about early childhood development to maximize the nation's human capital and ensure the ongoing vitality of its democratic institutions…?

[From Neurons to Neighborhoods: The Science of Early Childhood Development (2000)](#) Shonkoff J. P., and D.A. Phillips, eds. Executive Summary



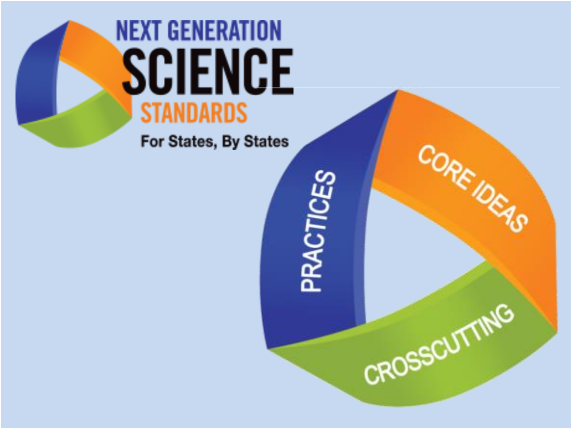
A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas

- Focus on core ideas, cross-cutting concepts, and practices
- Incorporates a *learning progressions* approach
- Emphasizes relationships across STEM disciplines
- **Uses the idea of “Science and Engineering Practices” rather than “process skills”**



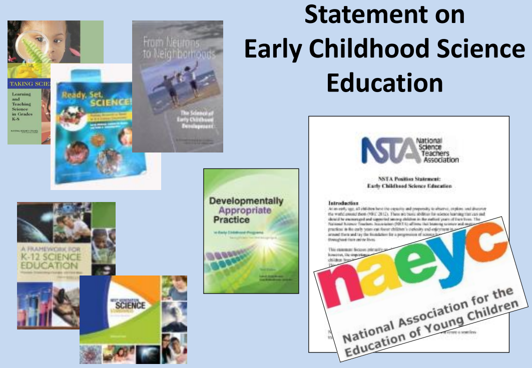
3-Dimensional Learning: *Next Generation Science Standards,* for students in grades K-12

- Based on *A Framework* and other earlier research
- Focus on core ideas, cross-cutting concepts, and practices
- Incorporates a *learning progressions* approach
- Emphasizes relationships across STEM disciplines

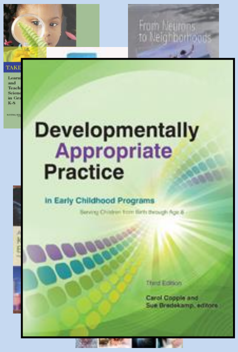


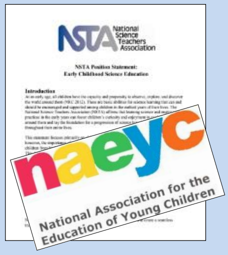
Poll

NSTA Position Statement on Early Childhood Science Education



Developmentally Appropriate Practice





NSTA Position Statement on Early Childhood Science Education

The National Science Teachers Association identifies the following key principles to guide the learning of science among young children:

- Children have the capacity to engage in scientific practices and develop understanding at a conceptual level.
- Adults play a central and important role in helping young children learn science.
- Young children develop science skills and knowledge over time.
- Young children develop science skills and learning by engaging in experiential learning.

NSTA Position Statement on Early Childhood Science Education

What does this look like in early childhood programs?

All children are participating in science inquiry:
…exploring and discovering,
…able to make changes and see what happens,
…able to repeat the experiences over time,
…develop science skills and learning by having experiences,
…talking with adults about what they observe and what they think.

“Scientific inquiry refers to the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work.”

“Inquiry also refers to the activities of students in which they develop knowledge and understanding of scientific ideas,
as well as an understanding of how scientists study
the natural world.”

How are activities different from science inquiry?

- Inquiry connects activities about a single concept (i.e. what are the properties of matter), and builds conversations around the collected data (drawings, photographs, and writing) while asking for evidence. (“How do you know?” or, “What makes you think that?”)

How are activities different from science inquiry?

➢Activities are good for introducing children to a wide range of materials. Not every activity develops into an on-going inquiry about a science concept.



Activities introduce children to a wide range of materials and phenomena.

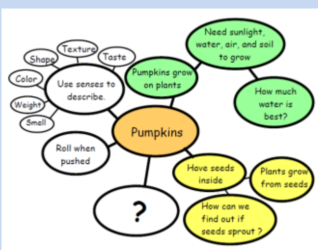

Activities can inspire questions that may develop into a science inquiry in search of answers.

Inquiry connects activities about a single concept and conversations around the collected data to reflect on evidence.


Inquiry connects activities about a single concept and conversations around the collected data to reflect on evidence.

Science inquiry often leads to additional questions that children are interested in pursuing.

Science activities are most productive when they are part of an exploration into a phenomena or an investigation into a question rather than around a theme.



As you plan, ask yourself if the activity will support the children's investigation.

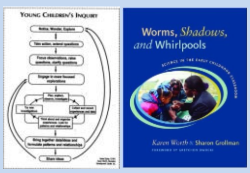
There are many fun activities but not all lead to deeper understanding.

Eight indicators of effective PreK–3 curriculum:

- •Children are active and engaged
- •Goals are clear and shared by all
- •Curriculum is evidence-based
- •Valued content is learned through investigation, play, and focused, intentional teaching
- •Curriculum builds on prior learning and experiences
- •Curriculum is comprehensive
- •Professional standards validate the curriculum's subject-matter content
- •Research and other evidence indicates that the curriculum, if implemented as intended, will likely have beneficial effects

The National Association for the Education of Young Children (NAEYC) and the National Association of Early Childhood Specialists in State Departments of Education (NAECS/SDE)

Worms, Shadows and Whirlpools **is my favorite resource for early childhood science investigations and inquiry.**



What does science inquiry look like in a classroom as children follow an inquiry cycle* ?

open exploration

getting ready

focused exploration

sharing/reflecting

*Inspired by *The Young Scientist Series* by Ingrid Chalufour and Karen Worth

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There is not just one "scientific method" used by children or by scientists.

- Purpose
- Hypothesis
- Research
- Materials
- Procedure
- Data
- Results
- Conclusion

The Office of Head Start (OHS)

Worms, Shadows and Whirlpools by Sharon Grollmann and Karen Worth

Engaging children in inquiry helps children develop:

•Understanding of scientific and engineering concepts.

•Appreciation of "how we know" what we know in science.

•Understanding of the nature of science—how science “works”.

•Skills necessary to become independent inquirers about the natural world.

Poll

More Than Standards

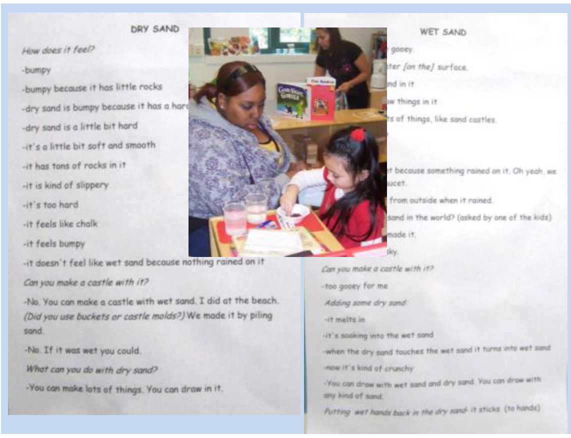
Children learn best when they feel safe.

How can we create a classroom culture in which it is safe to ask questions?

2.Structure and Properties of Matter
Students who demonstrate understanding can:

2-PS1-1.	**Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.**[Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]
2-PS1-2.	**Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.*** [Clarification Statement: Examples of properties could include, strength, flexibility, hardness, texture, and absorbency.] [*Assessment Boundary: Assessment of quantitative measurements is limited to length.*]
2-PS1-3.	**Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object.** [Clarification Statement: Examples of pieces could include blocks, building bricks, or other assorted small objects.]
2-PS1-4.	**Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.** [Clarification Statement: Examples of reversible changes could include materials such as water and butter at different temperatures. Examples of irreversible changes could include cooking an egg, freezing a plant leaf, and heating paper.]

Exploring the properties of matter, wet and dry, and how small pieces come together to form a larger object.



DRY SAND

How does it feel?

-bumpy

-bumpy because it has little rocks

-dry sand is bumpy because it has a har

-dry sand is a little bit hard

-it's a little bit soft and smooth

-it has tons of rocks in it

-it is kind of slippery

-it's too hard

-it feels like chalk

-it feels bumpy

-it doesn't feel like wet sand because nothing rained on it

Can you make a castle with it?

-No. You can make a castle with wet sand. I did at the beach. *(Did you use buckets or castle molds?)* We made it by piling sand.

-No. If it was wet you could.

What can you do with dry sand?

-You can make lots of things. You can draw in it.

WET SAND

gooey.

ter *[on the]* surface.

nd in it

w things in it

s of things, like sand castles.

t because something rained on it. Oh yeah, we

ucet.

from outside when it rained.

sand in the world? (asked by one of the kids)

made it.

ky.

Can you make a castle with it?

-too gooey for me

Adding some dry sand:

-it melts in

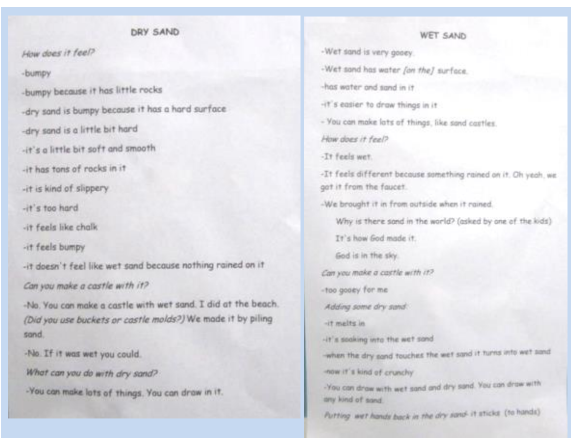
-it's soaking into the wet sand

-when the dry sand touches the wet sand it turns into wet sand

-now it's kind of crunchy

-You can draw with wet sand and dry sand. You can draw with any kind of sand.

Putting wet hands back in the dry sand- it sticks (to hands)



DRY SAND

How does it feel?

-bumpy

-bumpy because it has little rocks

-dry sand is bumpy because it has a hard surface

-dry sand is a little bit hard

-it's a little bit soft and smooth

-it has tons of rocks in it

-it is kind of slippery

-it's too hard

-it feels like chalk

-it feels bumpy

-it doesn't feel like wet sand because nothing rained on it

Can you make a castle with it?

-No. You can make a castle with wet sand. I did at the beach. *(Did you use buckets or castle molds?)* We made it by piling sand.

-No. If it was wet you could.

What can you do with dry sand?

-You can make lots of things. You can draw in it.

WET SAND

-Wet sand is very gooey.

-Wet sand has water *[on the]* surface.

-has water and sand in it

-it's easier to draw things in it

- You can make lots of things, like sand castles.

How does it feel?

-It feels wet.

-It feels different because something rained on it. Oh yeah, we got it from the faucet.

-We brought it in from outside when it rained.

Why is there sand in the world? (asked by one of the kids)

It's how God made it.

God is in the sky.

Can you make a castle with it?

-too gooey for me

Adding some dry sand:

-it melts in

-it's soaking into the wet sand

-when the dry sand touches the wet sand it turns into wet sand

-now it's kind of crunchy

-You can draw with wet sand and dry sand. You can draw with any kind of sand.

Putting wet hands back in the dry sand- it sticks (to hands)


Next Generation Science Standards: Grade 2 Endpoint Performance Expectation

Students who demonstrate understanding can: Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.[Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]

Disciplinary Core Ideas:

PS1.A: Structure and Properties of Matter

Different kinds of matter exist and many of them can be either solid or liquid, depending on temperature. Matter can be described and classified by its observable properties.

Crosscutting Concepts:

Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted.

Science and Engineering Practices: Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in K–2 **builds on prior experiences and progresses to simple investigations, based on fair tests,** which provide data to support explanations or design solutions.
Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence to answer a question.

Using the science and engineering practices in early childhood.

The eight practices of science and engineering that the Framework identifies as essential for all students to learn:
1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information.

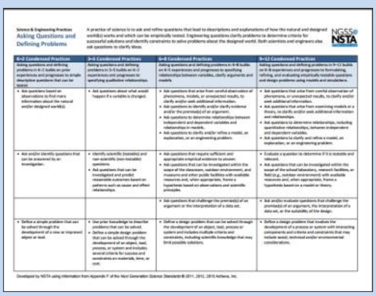
NSTA Position Statement:
Early Childhood Science Education

Declarations, NSTA recommends that teachers and other education providers who support children's learning in any early childhood setting should :

- **emphasize the learning of science and engineering practices**, including asking questions and defining problems; developing and using models; planning and carrying out investigations; analyzing and interpreting data; using mathematics and computational thinking; constructing explanations and designing solutions; engaging in argument from evidence; and obtaining, evaluating, and communicating information (NRC 2012, NGSS Lead States 2013);

The National Science Teachers Association matrix of NGSS science and engineering practices: a way to see where our children are headed

http://nstahosted.org/pdfs/ngss/MatrixOfScienceAndEngineeringPractices.pdf



The National Science Teachers Association matrix of NGSS science and engineering practices: a way to see where our children are headed

http://nstahosted.org/pdfs/ngss/MatrixOfScienceAndEngineeringPractices.pdf

K–2 Condensed Practices	3–5 Condensed Practices
Asking questions and defining problems in K–2 builds on prior experiences and progresses to simple descriptive questions that can be tested.	Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships.
• Ask questions based on observations to find more information about the natural and/or designed world(s).	• Ask questions about what would happen if a variable is changed.
• Ask and/or identify questions that can be answered by an investigation.	• Identify scientific (testable) and non-scientific (non-testable) questions. • Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships.
• Define a simple problem that can be solved through the development of a new or improved object or tool.	• Use prior knowledge to describe problems that can be solved. • Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.

Science process or inquiry skills	**Practices of science and engineering (NGSS identified)**
Engages, notices, wonders, questions.	1. Asking questions (for science) and defining problems (for engineering).
Records and represents experience.	2. Developing and using models.
Begins to explore, investigates.	3. Planning and carrying out investigations.
Collects data.	
Records and represents experience.	4. Using mathematics and computational thinking.
Reflects on experience, synthesizes, and analyzes data from experiences.	5. Analyzing and interpreting data 6. Constructing explanations (for science) and designing solutions (for engineering).
Uses language to communicate findings.	7. Engaging in argument from evidence. 8. Obtaining, evaluating, and communicating information.

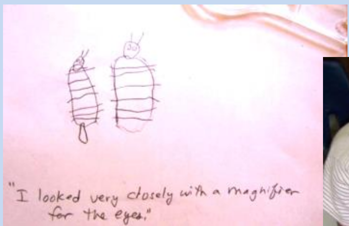
Asking questions and defining problems


Developing and using models.

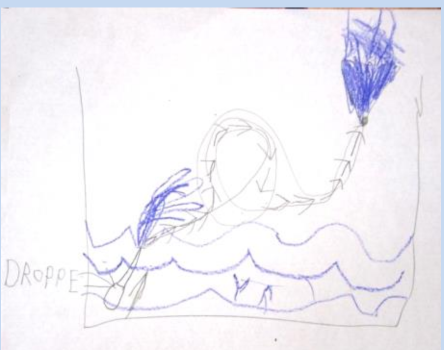

Planning and carrying out investigations.


Analyzing and interpreting data.


Using mathematics and
computational thinking.



Constructing explanations
and designing solutions.



Engaging in argument from evidence.

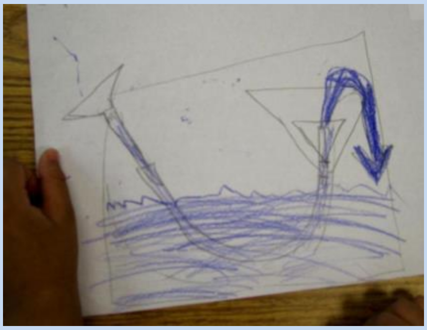
Obtaining, evaluating, and communicating information.

Challenge yourself!
Use the list of science and engineering practices from the *Framework* and *NGSS* and identify which of the 8 practices you see in the following photographs.

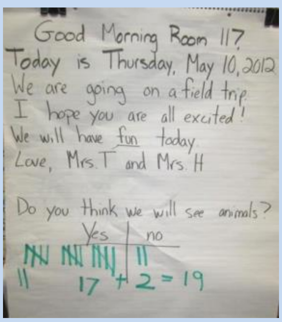
APPENDIX F – Science and Engineering Practices in the NGSS

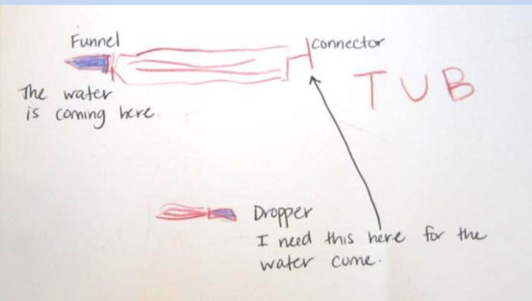
1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Rationale

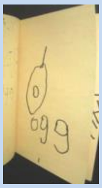


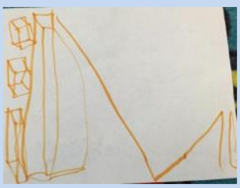

Have you touched a worm?
Yes
Not yet
ASA
ZACH

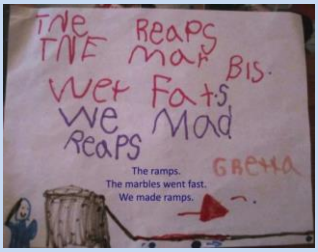

Good Morning Room 117
Today is Thursday, May 10, 2012
We are going on a field trip.
I hope you are all excited!
We will have fun today.
Love, Mrs. T and Mrs. H
Do you think we will see animals?
Yes
no
17 + 2 = 19


Funnel
Connector
TUB
The water
is coming here.
Dropper
I need this here for the
water come.


RAINBARREL







Your Next Steps: Implementing science inquiry through the principles and declarations of the NSTA Position Statement on Early Childhood Science Education

I will:

a) talk about the ideas in this webinar with my colleague.
b) see how my K-5 program's learning standards align with the NGSS.
c) plan a series of activities around a single science concept for children to begin exploring when school begins.
d) revise my weekly schedule to allow children to re-visit and re-engage with their ideas over time.
e) Search out additional resources such as visiting the National Science Teachers Association's Learning Center or becoming a member in NSTA or NAEYC.

Poll

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