Early Childhood Indicators of Progress: Minnesota's Early Learning Standards

Introduction to Scientific Thinking Domain

"I am eleven months old and I am a scientist and an investigator. I use my senses to explore the world around me. Today, I want to get to those interesting and inviting toys on the shelf across the carpet so I crawl as fast as I can while my caregiver, Ernestine, sits nearby. I pull a basket from the bottom shelf and several different-sized balls and beanbags fall onto the floor. I sit and try to pick up the balls but every time I reach out for them, they roll away from me. I laugh and smile and bat at them, clapping as they roll even further away. Ernestine rolls them back towards me. I watch the motion of the colored plastic as it moves across the rug and try to predict where the ball will roll but I'm not always right. Then, I pick up a beanbag. The corduroy fabric is soft in my hand and I feel the bumpy texture of the beans inside. I shake the bag and hear the sound of the beans. Ernestine shakes a bag too, then, pulls down a drum from another shelf and shows me how to pound on it to make a sound. I pound on the drum with the beanbag still in my hand, alternating between pounding and shaking, and squeal with delight at the sounds I make."

From birth, children are scientists. They are driven by their innate curiosity. Babies use their senses to take in information about their world, whether it's the smell of their mother's skin, the pitch of their father's voice, the feel of a soft blanket, or the taste of breast milk. Children's development of scientific thinking and inquiry begins in the very first months of life and continues to grow and expand as they interact with others and with the world around them. The world of mobile infants and toddlers expands so that they can crawl and walk across fresh, green grass or splash in a puddle. They explore the properties of objects and materials as they manipulate toys to make sounds or put things together. Preschoolers take their investigations further. They notice differences and similarities in both the natural and physical world. They try to figure out how something works. And they begin to make predictions and give explanations.

The indicators in the Scientific Thinking domain that are set out in the Minnesota Early Indicators of Child Progress (ECIPs) reflect the new thinking in the science education field: that for young learners, scientific inquiry is more beneficial than occasional and unconnected science activities. Therefore, the focus for this domain is on scientific processes more than specific science content with the idea that this approach will lay the foundation for developing ways of thinking that support more rigorous academic study in the Scientific Thinking domain in the elementary school years. The ECIPs provide guidance so that teachers and providers can know appropriate expectations for young learners and understand how best to support children so that they have the necessary foundation for later learning.

The Scientific Thinking and Inquiry domain includes three components:

- Component STPS 1-2: Discover
- Component STPS 3-4: Act
- Component STPS 5-6: Integrate

The sub-components and indicators identified for the ages of birth through kindergarten entry address the specific expectations across the developmental spectrum.

- For infants, indicators focus on how children observe and respond to external stimuli, show interest in exploring, and begin to recognize familiar items, people, and situations.
- For toddlers, the indicators reflect that they seek out items of interest, begin to use objects as tools, use simple strategies to carry out ideas, and build on past experiences.
- For preschoolers, the indicators show the ways they seek to gain knowledge and formulate questions, making plans and predictions, and verbally expressing their ideas and thoughts.

This broad view of the Scientific Thinking domain allows for ease of integration with other domains in the ECIPs. As children follow their curiosity in exploration, they build on their approaches to learning. As they discover new things, they are delighted and motivated to continue trying new things and learning more. Using the language of scientific inquiry, children's vocabulary is expanded. And, mathematical understanding of measurement and representation of quantity is often a part of scientific investigations.

Many in education are linking science and technology in what are called "STEM" initiatives. STEM stands for science, technology, engineering, and mathematics. Some researchers and public and private leaders relate the very future of our country to STEM:

> "The nation's capacity to innovate and thrive in the modern workforce depends on foundation of math and science learning. . . . A sustained, vibrant democracy is dependent upon this foundation in STEM." (Sneiderman 2013, 1)

In early childhood education, STEM is a way to integrate other domains with scientific thinking. Teachers and providers can tap into the natural curiosity of young explorers so that science experiences are filled with learning opportunities that integrate skills from multiple domains.

Resource:

Sneiderman, Joshua M. 2013. "Engaging Children in STEM Education Early!" Natural Start Alliance, December. North American Association for Environmental Education. http://naturalstart.org/feature-stories/engaging-children-stem-education-early

Scientific Thinking

Components ST1-2: Discover

Subcomponent	0-1 year	1-2 years	2-3 years	3-4 years	4-5 years, K Readiness	K Alignment
ST1 Observe and question: Child demonstrates awareness and engagement with phenomena, materials, and environment	**ST1.1** Observes and responds to external stimuli **ST1.2** Indicates surprise, curiosity, or hesitancy when presented with unfamiliar items, people, situations	**ST1.3** Indicates interest by looking, pointing or verbalizing	**ST1.4** Asks questions readily	**ST1.5** Notices differences or similarities among materials, objects and phenomena **ST1.6** Uses experiences to stimulate questions	**ST1.7** Verbally identifies obvious differences and similarities **ST1.8** Expresses curiosity and/or formulates questions of complex concepts	**K1.1.2.1** Use observation to develop an accurate description of natural phenomena and compare one's observational and descriptive with those of others **K2.1.1.1** Sort objects in terms of color, size, shape and texture and communicate reasoning for the sorting system
ST2 Investigate: Child actively shows wonder by demonstrating curiosity of self, others and surroundings	**ST2.1** Explores people and objects using senses	**ST2.2** Seeks out and explores objects and items with apparent interest	**ST2.4** Engages with objects of interest – whether familiar or new- for extended periods of time	**ST2.7** Seeks to gain additional knowledge in areas of interests	**ST2.10** Starts with a useful, general approach to investigation even if details may be lacking **ST2.11** Uses discernment to inform exploration	**K1.1.2.1** Use observation to develop an accurate description of natural phenomena and compare one's observational and descriptive with those of others

Subcomponent	0-1 year	1-2 years	2-3 years	3-4 years	4-5 years, K Readiness	K Alignment
		ST2.3 Begins using objects as tools	**ST2.5** Explores properties of objects/materials to gain understanding **ST2.6** Identifies and uses some tools for their intended purpose	**ST2.8** Explores with the intention of finding out something specific **ST2.9** Uses many tools as designed	**ST2.12** Uses tools in new and novel ways	**K4.1.1.1** Observed compare plants and animal

Component ST3-4: Act

Subcomponent	0-1 year	1-2 years	2-3 years	3-4 years	4-5 years, K Readiness	K Alignment
ST3 Experiment: Child develops and completes a process based on a question, interest or anticipated outcome, adjusting as needed.	**ST3.1** Demonstrates recognition of familiar items, people, and situations **ST3**.2 Persists in looking for missing object(s)	**ST3.3** Demonstrates willingness to try new things **ST3.4** Uses simple strategies to carry out ideas **ST3.5** Demonstrates ability to focus on one element of a situation **ST3.6** Persists in actions or attempts to affect environment or objects	**ST3.7** Approaches situations with intent to achieve a simple outcome **ST3.8** Uses a variety of strategies to carry out ideas **ST3.9** Demonstrates ability to focus on multiple elements of a situation **ST3.10** Demonstrates resilience in trial and error process	**ST3**.11 Makes a simple plan in advance to see what will happen **ST3.12** Uses a greater variety of strategies to carry out ideas **ST3.13** Attempts to make a prediction of an expected outcome	**ST3.14** Makes a plan in advance with an intended outcome **ST3.15** Demonstrates awareness that different circumstances, materials and variables impact strategies and outcomes **ST3.16** Makes a prediction when prompted **ST3.17** Changes a plan or refines actions when outcome is not as expected	**K4.2.1.1** Observe a natural system or its model and identify living and nonliving components of the system

Component ST3-4: Act

Subcomponent	0-1 year	1-2 years	2-3 years	3-4 years	4-5 years, K Readiness	K Alignment
ST4 Evaluate: Child analyzes, examines, critiques, and synthesizes outcomes in order to draw conclusions	**ST4.1** Shows a preference for certain materials, people or situations **ST4.2** Indicates surprise when outcome is not as expected	**ST4.3** Associates objects that belong together **ST4.4** Asks "what happened?" or "where did it go?" as a result of an experiment	**ST4.5** Recognizes obvious differences among like objects **ST4.6** Makes guesses at possible explanations or conclusions	**ST4.7** Describes all parts of an outcome by comparing, sorting, classifying and/or organizing **ST4.8** Open to more than one solution or answer to a problem **ST4.9** Begins to rely on or expect evidence, things seen or experienced directly, as reasons for results obtained	**ST4.10** Offers critique of an experience based on examination of outcomes **ST4.11** Sees outcomes as the result of one's behavior or actions **ST4.12** Reflects upon evidence and draws reasonable conclusions using data gathered	**K1.1.2.1** Use observations to develop accurate descriptions of a natural phenomena and compare one's observations and descriptions with others **K3.2.2.2** Identify the sun as a source of heat and light **K3.2.2.1** Monitor daily and seasonal changes in weather and summarize changes

Understanding Component ST5-6: Integrate

Subcomponent	0-1 year	1-2 years	2-3 years	3-4 years	4-5 years, K Readiness	K Alignment
ST5 Communicate: Child effectively verbalizes thinking and share thoughts, ideas, conclusions with self and others	**ST5.1** Vocalizes in response to stimuli or individual needs **ST5.2** Seeks out/initiates interactions from others in service of own needs	**ST5.3** Uses gestures, body language or a few words to express emotions related to an activity, person or experience **ST5.4** Invites others to observe actions and results	**ST5.5** Describes details associated with an experience such as materials, possible causes and effects **ST5.6** Listens to others ideas and points of view **ST5.7** Shares stories and related experiences with others unprompted **ST5.8** Scribbles or draws to show and/or share ideas	**ST5.9** Verbally expresses ideas/thought process **ST5.10** Seeks input from others regarding an experience **ST5.11** Verbalizes possible explanations for an outcome **ST5.12** Uses drawing, writing, models, or other creative expressions to present ideas	**ST5.13** Retells/describes own actions in process of experimenting **ST5.14** Talks with others about questions, actions, ideas, observations or results **ST5.15** Articulates and shares aloud explanations based on reasoning and evidence **ST5.16** Uses more detailed drawing, writing, models, or creative expressions to present ideas	**K1.1.2.1** Use observations to develop accurate descriptions of a natural phenomena and compare one's observations and descriptions with others **K2.1.1.1** Sort objects in terms of color, size, shape and texture and communicate reasoning for the sorting system

Component ST5-6: Integrate

Subcomponent	0-1 year	1-2 years	2-3 years	3-4 years	4-5 years, K Readiness	K Alignment
ST6 Apply: Child leverages and uses knowledge unprompted or in a new situation.	**ST6.1** Finds comfort in familiar people and objects	**ST6.2** Revisits and builds on past experiences	**ST6.3** Generalizes knowledge gained from one situation to another **ST6.4** Recognizes relevant attributes to inform the development of a rule	**ST6.5** Recalls and uses information in new/ different experiences **ST6.6** Generates new and more complex questions **ST6.7** Uses prior experience to identify details that may be relevant	**ST6.8** Compares findings to predictions or expected results **ST6.9** Identify what to look for, measure, or test to answer questions **ST6.10** Develops and applies rules **ST6.11** Determines approach to situation, problem or challenge based on previous experience	**K1.2.1.1** Sort objects into two groups: those that are found in nature and those that are human made **K2.1.1.1** Sort objects in terms of color, size, shape and texture and communicate reasoning for the sorting system