Three Rivers Community College
ECE K109 Science and Math for Children
Course Materials

INDEPENDENT STUDY

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Phone Number: 860-383-5214
Office Number: C110

Course Description:
Prerequisite: ENG* K101 eligibility and ECE K101 or permission of the Program Coordinator based on ECE work experience. ECE K182 is recommended.
In this course, students will acquire an understanding of the materials and methods of working with young children. The focus will be on math and science and their integration into the early childhood curriculum. Emphasis will be placed on understanding these areas from a child development perspective. Active participation working with children will be required.

Required Texts:
Charlesworth, Rosalind Karen Lind. Math and Science for Young Children (7th Ed.). Thompson Delmar Learning. 2013. ISBN: 9781111833398

Additional readings will be assigned throughout the semester.

Course Objectives:
- Provide students with an opportunity to apply theories of child development to learning experiences with young children.
- Offer child-orientated experiences in order to stimulate children's curiosity.
- Support the young child's natural desire to explore and learn.
- Discover how to make simple low-cost materials in order to teach science and math concepts.
- Discover strategies that aid in the development of problem-solving skills of young children.

General Education Goals:
- Candidates will develop the skills and abilities to communicate effectively in writing.
- Candidates will develop information literacy to assess what information is needed to answer questions and to retrieve, evaluate, and use that information effectively.

Course Outcomes:
- Candidates will reflect on the major theoretical approaches that include Piaget, Vygotsky, Gardner, and Kamii. (NAEYC 1.a.)
- Candidates will understand what young children are like and what the multiple influences are on their development and learning. (NAEYC Standard 1.a. and 1.b.)
- Candidate will learn integrative approaches to curriculum by designing a web which includes learning experiences ample lesson plans written in a specific format. (NAEYC Standard 4.b. and 4.c.)
- Candidate will apply developmentally appropriate practices in math and science lessons. (NAEYC Standard 1.a., 1.b. and 5.a.)
- Candidates will analyze the importance of being a continuous and collaborative learner. (NAEYC Standard 6.c.)

Policies:
Candidates are expected to complete assigned readings prior to meeting and come prepared to discuss them. Candidates **must utilize the Blackboard Learning System**, to review course materials, and view articles and other materials for the course. Throughout the course there will be other written assignments to help guide your studies which will be handed in and counted as part of your participation grade.

Regular meetings with the instructor are required.

Candidates are urged to devote their time and energy to fulfilling stated class requirements. Please note that a credit hour 'work expectation' equates to one hour of classroom or direct faculty instruction and a minimum of two hours of out of class candidate work. **So for this three credit course you should expect to spend a minimum of three in class and six out of class hours (total of nine hours) per week on this course.**

Extra credit points may be considered if a candidate is active in the Early Childhood Education Club, participates in early childhood events, or tutors / supports another classmate in their understanding of course content. Additionally, with prior permission, there may be an opportunity to redo and resubmit an assignment. These opportunities will be decided on a one-on-one basis.

It is assumed that all assignments will be completed and turned in on time.

Spelling and grammar will be included as part of the grade for all written work. Thus, proper spelling and careful proofreading are important. A candidate's written work is expected to be original and done independently unless otherwise indicated. Citations and references must be used to **acknowledge the source and avoid plagiarism**. Violations of academic integrity will be referred to the dealt with in accordance with the college policy.

As part of the course, candidates may be required to spend additional time observing and/or working with children in actual or simulated child development settings.

If you have problems with the course or material, please see me or call to arrange for an appointment. Candidates who are not able to complete the course need to speak to me immediately as we will try to work together to have you complete the class successfully.

Candidates with disabilities who may need academic accommodations should discuss options with the instructor as early as possible. You will need to provide written documentation of your disability to the Candidate Services Counselors (Disabled Candidate Counselor). Appropriate accommodations will be provided to candidates who have completed this procedure.

TRCC does not follow the local school closing schedule. The TRCC website offers the most updated information about school closings and / or early dismissals. It is recommended that all candidates sign up for the electronic notification system to receive instant alerts and messages. In the event that class is cancelled, separate from the college, the instructor may notify candidates using the Blackboard messaging system and / or the email contact available through TRCC. Please be sure the college has your updated contact information.

Please refer to the Institutional Policies available in the Office of the Dean of Candidate Development and Services as well as on line, which include regulations regarding candidate conduct and the disciplinary code.

This syllabus is subject to change. Any changes will be announced.

Points given for requirements are as follows:
Please use this as a tool to keep a record of your progress in this course.

Assignment	Points	Due Date	Grade Received
Science Portfolio Assignment	100		
Math Portfolio Assignment	100		
Science Learning Experience Plan	100		
Math Learning Experience Plan	100		
Literary Review (Textbook, State standards, etc.)	50		
Special Topic Research review	50		
Total	**500**		

Final Grade:
To determine your final grade take the total number of points and divide by five.

		A	93 - 100	A-	90 - 92
B+	87 - 89	B	83 - 86	B-	80 - 82
C+	77 - 79	C	73 - 76	C-	70 - 72
D+	67 - 69	D	63 - 66	D-	60 - 62
F	under 59				

Three Rivers Community College
ECE K109 Science and Math
Resource List

Jennifer DeFrance Ed.D.

_____ . (2012). Connecticut standards for math practice, Kindergarten. DOE.
_____ . (2012). Connecticut standards for math practice, First grade. DOE.
_____ . (2012). Connecticut standards for math practice, Second grade. DOE.
_____. (2000). *Children as mathematicians [Focus issue]*. *Teaching Children Mathematics, 6.*

Chalufour, Ingrid & Karen Worth. *Building structures with young children.* Young Scientist Series. NAEYC. Pages 73 - 79.
Charlesworth, R. (2013). *Math and science for young children.* (7th ed.). Cengage Learning.

Clements, D. H. (2001). *Mathematics in the preschool. Teaching Children Mathematics, 7*, 270–275.

Clements, D. H., & Sarama, J. (2000). *The earliest geometry. Teaching Children Mathematics, 7*, 82–86.

Clements, D. H., & Sarama, J. (2000). *Standards for preschoolers*. *Teaching Children Mathematics*, *7*, 38–41.

Cutler, K. M., Gilkerson, D., Parrott, S. & Bowne, M. T.. *Developing math games based on children's books*. Teaching Young Children magazine. Vol 2, Number 2.

DelCampo, D. & DelCampo, R. (2006). *Taking sides: Clashing views in childhood and society.* (6th ed.). McGraw-Hill.

Derman-Sparks, L. & Edwards, J. O.. (2010). *Anti-Bias education for young children and ourselves*. Washington, DC: NAEYC.

Elkind, David. *The power of play: Learning what comes naturally.* Da Capo Books, 2007. Pages 119 - 144.
Epstein, Ann. *The intentional teacher: Choosing the best strategies for young children's learning*. NAEYC. July 2007.
Flick, L., & Lederman, M. (2004). *Scientific Inquiry and Nature of Science*. Boston, MA: Kluwer Academic Publishers.

Gallagher, K. C. (2005). Brain research and early childhood development: A primer for developmentally appropriate practice. *Spotlight on Young Children.* Washington DC: NAEYC.

Jacobs, H. H. (2010). *Curriculum 21: Essential education for a changing world*. ASCD Publications.

Lederman, N. & Lederman, J. (2004). *Revising instruction to teach nature of science: Modifying activities to enhance students' understanding of science.* The Science of Teacher, November.

Matricardi, J. & McLarty, J. (2005). *Math activities A to Z.* Delmar Cengage Learning.

Matricardi, J. & McLarty, J. (2005). *Science activities A to Z*. Delmar Cengage Learning.

National Research Council. (2012). *A framework for K-12 science education: Practices, crosscutting concepts, and core ideas*. Washington, DC: The National Academy Press.

Sanders, S. (2005). *Active for life*. Washington, DC: NAEYC.

Voltz, D., Sims, M. J. & Nelson, B. (2010). *Connecting teachers, students and standards: Strategies for success in divers and inclusive classrooms.* ASCD.

Three Rivers Community College
ECE K109 Science and Math for Young Children
Science Portfolio Assignment

Course Objectives:
Offer child-orientated experiences in order to stimulate children's curiosity.
Support the young child's natural desire to explore and learn.
Discover how to make simple low-cost materials in order to teach science concepts.
Discover strategies that aid in the development of problem-solving skills of young children.

General Education Goals:
Candidates will develop the skills and abilities to communicate effectively in writing.
Candidates will develop information literacy to assess what information is needed to answer questions and to retrieve, evaluate, and use that information effectively.

Course Outcomes:
Candidates will understand what young children are like and what the multiple influences are on their development and learning. (NAEYC Standard 1.a. and 1.b.)
Candidate will apply developmentally appropriate practices in math and science lessons. (NAEYC Standard 1.a., 1.b. and 5.a.)
Candidates will analyze the importance of being a continuous and collaborative learner. (NAEYC Standard 6.c.)

It is important that when you work with young children that you understand child development and state standards. The most common way we promote this development is through the environment and interactions with children. To become a better early care educator you should be prepared with a wide range of resources to use with young children that are age and developmentally appropriate. *Be sure to use any resources available to you, including your textbooks, on line, libraries, etc.*

For each section, as appropriate, you will need to identify materials for a variety of different aged children (infant, toddler, preschooler, kindergartener and primary school) we will be exploring in class. You may also chose to focus on a specific age group, targeting the age group you plan to work with in the future, but there should be materials identified as appropriate for a variety of different skills and developmental abilities relevant to that age / grade.

I. Overview
This should include your name, intended purpose of this resource, age group(s) focused on and why, as well as the basic premise you have for how you will use this information in the future. You need to develop a summary of the resources included in the assignment. I want to know what was the direction you used? challenges? supports? and overall opinion of the process you went through completing this assignment.

II. Curriculum, frameworks and standards
In this section you will need to include **at least five sources** of information that would allow you to identify age, development and culturally appropriate science curriculum for children. For each entry you will list the source and include a narrative.

The entry will need to include all the necessary bibliographical information. Must use either APA or MLA format.
You then write a brief narrative which includes:
(a) where you found this resource, (b) the reason you chose this source, (c) age group appropriate for and why, (d) identification of the specific science skills the source includes and (e) possible ways you would use this source.

III. Science curriculum resources
In this section you will need to include **at least ten sources** of information that would allow you to plan an appropriate science lesson. For each entry you will list the source and include a narrative. These resources can be places, websites, textbooks, people, etc. But they must be educational in nature and include a wide variety of different resources.

The entry will need to include all the necessary bibliographical information. Must use either APA or MLA format.
You will need to write a brief narrative that identifies:
(a) the reason you picked this book / site / etc., (b) a quick overview of the material(s) and, (c) age group appropriate for and (d) identifies the science topic being promoted.

You cannot duplicate authors or different books in a series. Your textbook will help you here. Again, be creative and remember the key is quality.

IV. Science articles
In this section you will need to include **at least ten articles** about science, goals of this topic and / or science related information. You need to include a variety of articles, please be sure to consider the many ways articles are useful as they can be used to support learning (give to students), inform parents, develop new curriculum ideas, research for support with classroom techniques, etc.

For each entry you will include the article and a narrative. You will include the actual article or direct link so I can access it online in your paper. For each you will need to show where you collected the material from, providing all the necessary bibliographical information. If printing it from the internet then be sure the link is on the page, if copying from a book or text resource, write the citation on the first page. These resources can be places, websites, textbooks, people, etc. But they must be educational in nature and include a wide variety of different resources.

The entry will need to include all the necessary bibliographical information. Must use either APA or MLA format.
You will need to write a brief narrative that identifies:
(a) the reason you chose this article, (b) target audience (children, parent, colleague, administrators or for planning), (c) possible ways you would use this article, and (d) identification of the specific science skills, if appropriate.

You cannot include the articles you have been given in class.

V. Activities
In this section you will need to include **at least five activities** that show you can identify some age, development and culturally appropriate science curriculum ideas for children. For each entry you will list the source and include a narrative. These resources can be places, websites, textbooks, people, etc. But they must be educational in nature and include a wide variety of different resources.

You will then need to write a brief narrative that identifies:
(a) the source of the curriculum idea or activity, (b) the standard, framework, goal of the activity specific to science, (c) age group it would be appropriate for, (d) a quick overview of the activity (if appropriate, a small part of the activity), (e) areas of the classroom where materials, play equipment, etc. will be added, and (f) the reason you included the activity.

You cannot duplicate resources.
Be creative, you must include the many different types of science activities available (activity, songs, physical activities, experiments, gross motor game, etc).

ECE K109 Science and Math
Science Portfolio Grading Rubric

	Exceeds Expectations (5)	Meets Expectations (4)	Needs Improvement (3)	Insufficient (2)
Overview and basic assignment	Well organized, submitted on time and was well written without any grammatical errors. Neatly typed, interesting presentation. The overview was complete. Utilized correct MLA citation format. Included electronic links that could be accessed easily.	Assignment was turned in on time, had some minor grammatical errors and was presented in a readable style. Some parts were formatted differently and were missing some information.	Assignment was incomplete and had some grammatical errors. Missing critical information and some relevant details. Format was difficult to follow.	Assignment was incomplete, had numerous grammatical errors and wasn't formatted correctly.
Curriculum, Frameworks and Standards	Included all relevant information about the source in the citation. Identified correctly an appropriate age group as well as the science skill being promoted. Choices were complete and included a wide range of sources. Went beyond resources included in the textbook. Utilized a variety of different sources for finding the standards, frameworks and standards. Choices showed an awareness of meeting the needs of a diverse learning population.	Cited reference information, with minor errors. Most selections identified appropriate science components as it pertains to the selected age group. Selections were taken from a variety of sources and most were high quality.	Citations were incomplete. Only included resources that were included through in class and course materials. Missing relevant information. Sources weren't very diverse.	Citations were missing and / or incomplete. Not enough information provided to show awareness of standards.
Science Curriculum	Included all relevant information about the resource in the citation. Identified correctly the appropriate age group(s) and range of science skills that the resource could be used for. Choices were of high quality as displayed through the variety of standards identified, specific to state and accreditation requirements. Choices showed an awareness of curriculum development designed for a diverse learning population.	Cited reference information, with minor errors. Descriptions include details that identify the reasons why the resource was chosen and appropriate science components as it pertains to the selected age group. Selections were taken from a variety of sources and most were high quality.	Citations were incomplete. Descriptions weren't clear or didn't identify the science component for curriculum development. Goals weren't specific to the age group(s) identified. Didn't include enough information.	Citations were missing and / or incomplete. Not enough information provided to show awareness of curriculum.

	Exceeds Expectations (5)	Meets Expectations (4)	Needs Improvement (3)	Insufficient (2)
Articles	Included all relevant information about the article in the citation. Choices were of high quality as displayed through the variety of topics identified within science development. Included articles for a wide variety of purposes, including children, as a practitioner and for use with parents. Utilized a variety of different sources for finding the articles.	Formatting of the citation was appropriate. Choices included a variety of science topics and could be used with a variety of populations. Utilized a variety of different sources for finding the articles.	Citations were incomplete. Articles were outdated, inappropriate or showed a lack of understanding of developmentally appropriate practices. Choices included a few different science topics.	Provided a limited number of articles, many were missing citations. Some were not science based.
Science Activities	Included all relevant information about the source of the activity in the citation. Clearly identified specific and diverse science goals for children incorporating the wide range of developmental needs of children. Choices were creative, innovative and of high quality as displayed through the variety of developmental domains covered through the curriculum materials. Utilized a variety of different sources for finding the resources.	Cited reference information, with minor errors. Noted and applied some appropriate science components as it pertains to the selected age group. Selections were taken from a variety of sources and most were high quality. The range of developmental skills targeted was appropriate.	Citations were incomplete. Choices didn't reflect the understanding of the different methods of science development in the curriculum.	Didn't include enough variety or information to meet the curriculum requirement.

Grading: As this assignment is out of a possible 25 points to figure your total grade (out of 100 points as noted in the syllabus) you can multiply your points by 4 so it equates to the total points out of 100.

Three Rivers Community College
ECE K109 Science and Math for Young Children
Math Portfolio Assignment

Course Objectives:
Offer child-orientated experiences in order to stimulate children's curiosity.
Support the young child's natural desire to explore and learn.
Discover how to make simple low-cost materials in order to teach science concepts.
Discover strategies that aid in the development of problem-solving skills of young children.

General Education Goals:
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Candidates will develop information literacy to assess what information is needed to answer questions and to retrieve, evaluate, and use that information effectively.

Course Outcomes:
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Candidate will apply developmentally appropriate practices in math and science lessons. (NAEYC Standard 1.a., 1.b. and 5.a.)
Candidates will analyze the importance of being a continuous and collaborative learner. (NAEYC Standard 6.c.)

It is important that when you work with young children that you understand child development and state standards. The most common way we promote this development is through the environment and interactions with children. To become a better early care educator you should be prepared with a wide range of resources to use with young children that are age and developmentally appropriate. *Be sure to use any resources available to you, including your textbooks, on line, libraries, etc.*

For each section, as appropriate, you will need to identify materials for a variety of different aged children (infant, toddler, preschooler, kindergartener and primary school) we will be exploring in class. You may also chose to focus on a specific age group, targeting the age group you plan to work with in the future, but there should be materials identified as appropriate for a variety of different skills and developmental abilities relevant to that age / grade.

I. Overview
This should include your name, intended purpose of this resource, age group(s) focused on and why, as well as the basic premise you have for how you will use this information in the future. You need to develop a summary of the resources included in the assignment. I want to know what was the direction you used? challenges? supports? and overall opinion of the process you went through completing this assignment.

II. Curriculum, frameworks and standards
In this section you will need to include **at least five sources** of information that would allow you to identify age, development and culturally appropriate mathematics curriculum for children. For each entry you will list the source and include a narrative.

The entry will need to include all the necessary bibliographical information. Must use either APA or MLA format.
You then write a brief narrative which includes:
(a) where you found this resource, (b) the reason you chose this source, (c) age group appropriate for and why, (d) identification of the specific mathematics skills the source includes and (e) possible ways you would use this source.

III. Math activity resources
In this section you will need to include **at least ten sources** of information that would allow you to plan an appropriate math lesson. For each entry you will list the source and include a narrative. These resources can be places, websites, textbooks, people, etc. But they must be educational in nature and include a wide variety of different resources.

The entry will need to include all the necessary bibliographical information. Must use either APA or MLA format.
You will need to write a brief narrative that identifies:
(a) the reason you picked this book / site / etc., (b) a quick overview of the material(s) and, (c) age group appropriate for and (d) identifies the math topic being promoted.

You cannot duplicate authors or different books in a series. Your textbook will help you here. Again, be creative and remember the key is quality.

IV. Math articles
In this section you will need to include **at least ten articles** about math, goals of this topic and / or math related information. You need to include a variety of articles, please be sure to consider the many ways articles are useful as they can be used to support learning (give to students), inform parents, develop new curriculum ideas, research for support with classroom techniques, etc.

For each entry you will include the article and a narrative. You will include the actual article or direct link so I can access it online in your paper. For each you will need to show where you collected the material from, providing all the necessary bibliographical information. If printing it from the internet then be sure the link is on the page, if copying from a book or text resource, write the citation on the first page. These resources can be places, websites, textbooks, people, etc. But they must be educational in nature and include a wide variety of different resources.

The entry will need to include all the necessary bibliographical information. Must use either APA or MLA format.
You will need to write a brief narrative that identifies:
(a) the reason you chose this article, (b) target audience (children, parent, colleague, administrators or for planning), (c) possible ways you would use this article, and (d) identification of the specific math skills, if appropriate.

You cannot include the articles you have been given in class.

V. Activities
In this section you will need to include **at least five activities** that show you can identify some age, development and culturally appropriate mathematics curriculum ideas for children. For each entry you will list the source and include a narrative. These resources can be places, websites, textbooks, people, etc. But they must be educational in nature and include a wide variety of different resources.

You will then need to write a brief narrative that identifies:
(a) the source of the curriculum idea or activity, (b) the standard, framework, goal of the activity specific to mathematics, (c) age group it would be appropriate for, (d) a quick overview of the activity (if appropriate, a small part of the activity), (e) areas of the classroom where materials, play equipment, etc. will be added, and (f) the reason you included the activity.

You cannot duplicate resources.
Be creative, you must include the many different types of math activities available (activity, songs, physical activities, experiments, gross motor game, etc).

ECE K109 Science and Math
Mathematics Portfolio Grading Rubric

	Exceeds Expectations (5)	Meets Expectations (4)	Needs Improvement (3)	Insufficient (2)
Overview and basic assignment	Well organized, submitted on time and was well written without any grammatical errors. Neatly typed, interesting presentation. The overview was complete. Utilized correct MLA citation format. Included electronic links that could be accessed easily.	Assignment was turned in on time, had some minor grammatical errors and was presented in a readable style. Some parts were formatted differently and were missing some information.	Assignment was incomplete and had some grammatical errors. Missing critical information and some relevant details. Format was difficult to follow.	Assignment was incomplete, had numerous grammatical errors and wasn't formatted correctly.
Curriculum, Frameworks and Standards	Included all relevant information about the source in the citation. Identified correctly an appropriate age group as well as the math skill being promoted. Choices were complete and included a wide range of sources. Went beyond resources included in the textbook. Utilized a variety of different sources for finding the standards, frameworks and standards. Choices showed an awareness of meeting the needs of a diverse learning population.	Cited reference information, with minor errors. Most selections identified appropriate math components as it pertains to the selected age group. Selections were taken from a variety of sources and most were high quality.	Citations were incomplete. Only included resources that were included through in class and course materials. Missing relevant information. Sources weren't very diverse.	Citations were missing and / or incomplete. Not enough information provided to show awareness of math standards.
Math Curriculum	Included all relevant information about the resource in the citation. Identified correctly the appropriate age group(s) and range of math skills that the resource could be used for. Choices were of high quality as displayed through the variety of standards identified, specific to state and accreditation requirements. Choices showed an awareness of curriculum development designed for a diverse learning population.	Cited reference information, with minor errors. Descriptions include details that identify the reasons why the resource was chosen and appropriate math components as it pertains to the selected age group. Selections were taken from a variety of sources and most were high quality.	Citations were incomplete. Descriptions weren't clear or didn't identify the math component for curriculum development. Goals weren't specific to the age group(s) identified. Didn't include enough information.	Citations were missing and / or incomplete. Not enough information provided to show awareness of curriculum.

	Exceeds Expectations (5)	Meets Expectations (4)	Needs Improvement (3)	Insufficient (2)
Articles	Included all relevant information about the article in the citation. Choices were of high quality as displayed through the variety of topics identified within math development. Included articles for a wide variety of purposes, including children, as a practitioner and for use with parents. Utilized a variety of different sources for finding the articles.	Formatting of the citation was appropriate. Choices included a variety of science topics and could be used with a variety of populations. Utilized a variety of different sources for finding the articles.	Citations were incomplete. Articles were outdated, inappropriate or showed a lack of understanding of developmentally appropriate practices. Choices included a few different math topics.	Provided a limited number of articles, many were missing citations. Some were not math based.
Math Activities	Included all relevant information about the source of the activity in the citation. Clearly identified specific and diverse science goals for children incorporating the wide range of developmental needs of children. Choices were creative, innovative and of high quality as displayed through the variety of developmental domains covered through the curriculum materials. Utilized a variety of different sources for finding the resources.	Cited reference information, with minor errors. Noted and applied some appropriate math components as it pertains to the selected age group. Selections were taken from a variety of sources and most were high quality. The range of developmental skills targeted was appropriate.	Citations were incomplete. Choices didn't reflect the understanding of the different methods of math development in the curriculum.	Didn't include enough variety or information to meet the curriculum requirement.

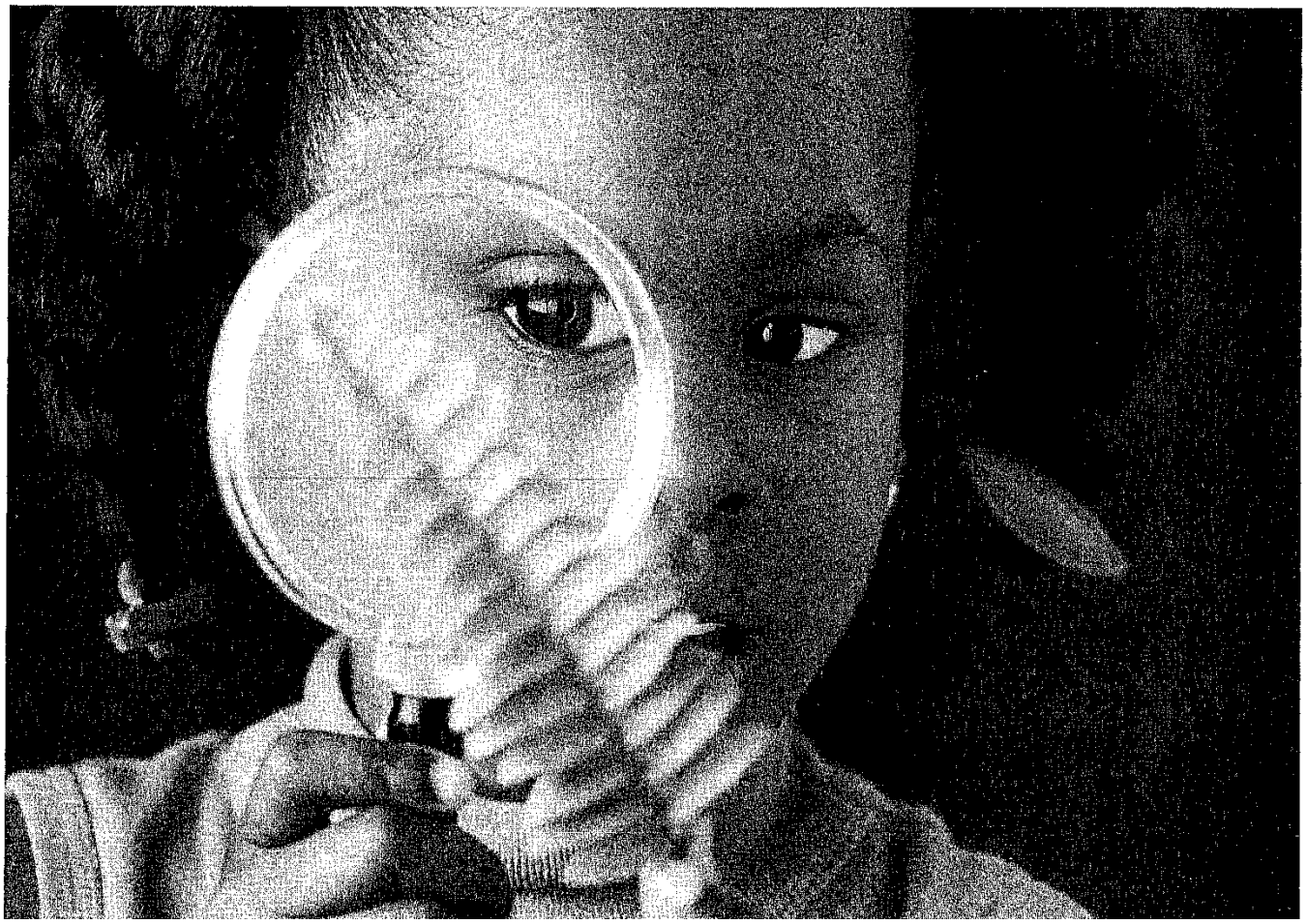
Grading: As this assignment is out of a possible 25 points to figure your total grade (out of 100 points as noted in the syllabus) you can multiply your points by 4 so it equates to the total points out of 100.

SCIENCE 7

"Young children are cognitively prepared and eager to learn about the surrounding world. Their commonly observed approach to learning - active, experiential, open-ended exploration – makes science an ideal domain for early childhood education."

Bowman, Donovan and Bums, 2001

HELPFUL TERMS
CURRICULUM DEVELOPMENT
DEVELOPING CURIOSITY
DEVELOPING INQUIRY
MAKING CONNECTIONS
SAMPLE CURRICULUM



HELPFUL TERMS

Discovery Approach	A teaching strategy that encourages children to find answers and information related to their interests and questions.
Divergent Questions	An approach to questioning that is open-ended and used to generate several ideas to solve a problem.
Inquiry	A process of studying and developing knowledge and understanding of scientific ideas and the natural world. We do this by observing, questioning, investigating, analyzing and predicting.
Logico-Mathematical Knowledge	Knowledge that is gained when the learner creates relationships among materials.
National Science Sciences Standards	The outline developed by the National Academy of of what students should know, understand and be able to do to be scientifically literate at different grade levels.
Science	A way of thinking and gaining knowledge that includes: becoming aware of a problem; wondering why, proposing possible ideas and explanations; finding out through experimentation and observation; and sharing results.

CURRICULUM DEVELOPMENT

In early childhood education, science curriculum allows children to investigate their world and to search for answers to questions that begin with words such as What? How? Why? and When? Science curriculum can develop the child's innate ability to wonder, to discover new ideas, and to explore the world he or she lives in. In quality classroom environments, where science is an integral curriculum component, early childhood teachers:

- observe, listen, facilitate and question;
- recognize that learning is the process of exploring;
- believe that the goal of teaching is not about right answers, but rather about the development of independent thinking and problem-solving dispositions;
- know that children need time to explore and to take risks;
- recognize that learning must be hands-on and minds-on;
- provide learners of all abilities with opportunities to experience the wonder of questioning and discovery by making accommodations to the environment and to expectations;
- model enthusiasm for science and discovery so children can see how exciting these pursuits are;
- balance child-initiated activities with teacher-prompted ideas; and
- create relationships with families that encourage involvement in science at home.

The National Academy of Sciences has developed National Science Education Standards for early childhood science curriculum as a comprehensive guide for educators and policymakers. The standards call for more than "science as process," where students learn the skills of observing; inferring and experimenting. They suggest that, while these process skills are appropriate in early childhood science curriculum, there is also worthy and achievable science content for young children to learn in preschool. (National Research Council, 1996)

This chapter includes:

a. discussion of the teacher's role in developing curiosity, including strategies and tips on preparation of the environment;
b. an overview on the process of developing inquiry, including thinking skills and problem-solving abilities; and
c. making connections with the Connecticut Core Science Curriculum Framework, PreK-10 and Connecticut's Preschool Curriculum Framework, including ideas for age-appropriate investigations.

DEVELOPING CURIOSITY

Curiosity can be described as the disposition to know. From birth infants seek understanding, trying to grasp objects, exploring their environments and gathering information. Both environments and experiences affect children's dispositions to be curious. A safe and encouraging atmosphere motivates young children to take risks, explore and discover. Questioning children is a strategy adults - educators and parents - can use to encourage curiosity. Questions may be either open-ended, encouraging divergent thinking and brainstorming, or closed, motivating the learner to gather specific information.

Effective questions stimulate and expand children's thinking or promote comparison, sorting or further experimentation. Questions may be used to:

- Initiate discovery: "How can we learn more about this machine?"
- Elicit predictions: "What will happen if this powder is mixed in the water?"
- Probe for understanding: "Why do you think that block worked better in the ramp construction?"
- Promote reasoning: "Why is this side a different color than that side?"
- Serve as a catalyst: "What would you do differently?"
- Encourage creative thinking: "If you could be any animal, which one would it be and why?"
- Reflect on feelings: "Is this your best work?"

A carefully prepared environment also promotes the development of curious children. The teacher, through observation, knows children's abilities and interests, understands their developmental growth patterns, and uses this information to create a classroom that provides safe, interesting and satisfying challenges. Creating the typical science table with unusual items contributed by children and teacher is not enough. The science center must be an area of investigation. This is accomplished by keeping in mind the main theme in the science curriculum, "hands-on and minds-on."

A "hands-on and minds-on" area is:

- attractive;
- organized;
- stocked with items chosen to support current interests and encourage investigation;
- an area that invites exploration, touching and manipulation;
- filled with real items from the child's world; and
- safe.

Teachers must carefully observe and reflect on children's interests and abilities, prepare challenges with appropriate materials and questions, then stand back and guide from the side, participating only when needed. Materials should be chosen with specific intention for investigations. The teacher should determine, in advance, what content information may be conveyed, what thinking skills might be encouraged, and what questions the children might realize as they explore. The goal is for children of all abilities to experience the inquiry process. (See Chapter 3 for a list of potential materials for an investigation table.)

DEVELOPING INQUIRY

Inquiry is a process of studying and developing knowledge. This process closely parallels the leaming behaviors as defined by Piaget. The inquiry process typically includes behaviors such as:

- observing and questioning: using the sense to collect information;
- communicating: sharing information representing orally or on paper;
- drawing conclusions: comparing similarities and differences while examining and manipulating materials and events;
- organizing: ordering information gathered so it becomes useful;
- relating: formulating and testing ideas and hypotheses;
- inferring and predicting: using information to create hypotheses and solutions; and
- experimenting and applying: using knowledge and skills to solve problems an learn more (Bredekamp & Rosegrant, 1995).

The chart that follows presents a sequence of sample teacher strategies and suggested experiences that support each of the inquiry behaviors.

Observing And Questioning

Teacher Strategies	Suggested Experiences
Use children's questions to illustrate how their ideas can become investigations.	"Yesterday I saw my shadow on the playground. Now I can't." Use this opportunity to prompt: "I wonder why."
Model asking good questions by avoiding those that only require one answer. Allow the children to see you as curious and thoughtful. Provide time and plan for opportunities for children to ask questions.	"I wonder where all the water went that was on our playground yesterday." "In how many different ways could we figure out how heavy our guinea pig is?"
Provide experiences for children to ask: who, what, where, why and how.	It looks like you are trying to figure out why the water is not going through that tube very fast."
Set the stage, present a problem or question, challenge the children to think	"When you are in blocks today, see if you can figure out how to make the cars go faster on the track."
Spend time encouraging children to use their senses to investigate.	Provide opportunities to touch, look, listen, smell and taste. Encourage understanding that information is gained when we investigate with our senses.
Encourage children to see beyond the obvious: to look for details and ask questions. As a guide you can help them see meaning in what they observe.	"What else did you notice? Look again. What words describe the water as it travels through the tube when you hold it like that?"

Inferring And Predicting

Teacher Strategies	Suggested Experiences
Use the language of science with the children. Encourage them to predict, estimate and to figure out how to test their ideas.	"Can you estimate how many cups of sand you think will fill this bucket? If we use this cup (different size) do you predict it will take more or fewer?"
Provide various materials that will stimulate children to investigate and predict.	Experiment with ice: What will happen to it? How can we try to slow the melting? Water? Salt? A blanket? A covered pot?
Provide opportunities for children to explain their thinking. Use the word *why* often.	"Why do you think that will happen? Why did you move it in that direction?"

Experimenting And Applying

Teacher Strategies	Suggested Experiences
Encourage children to test their ideas.	"That's a great idea, Colleen. What other tools can you use to measure the guinea pig?"
Provoke new ideas; encourage children to think in different ways.	"What are some other ways we could move the water from the water table to the sand table?"
Support the idea that we gather information in many ways: from our own work, from our peers, from books, and from experiences both in the classroom and at home.	Model processes such as asking, watching others, looking at books.

Drawing Conclusions

Teacher Strategies	Suggested Experiences
Point out that we must think carefully and look at all the information before reaching conclusions.	Use questions such as Why? What does this mean? What happened? What do we know now? What might you do differently?
Use classroom surveys and graphs for Children to illustrate their information. Show how we compare information to answer our questions.	One large-group and small-group sessions to analyze information from charts in a variety of ways.

Communicating Findings

Teacher Strategies	Suggested Experiences
Provide opportunities for children to represent their ideas and findings.	Use group time to model charts, record-keeping and other ways of showing what we know and have discovered.
Provide a variety of media for reflecting and representing work: clay, wire, paint, blocks, etc.	The children will grow to rely on each other as resources during investigations.

MAKING CONNECTIONS

Connecticut's Preschool Curriculum Framework includes the following performance indicators for logico-mathematical thinking:

Preschool children will:

- *ask questions* about and comment on *observations* and *experimentations;*
- *collect, describe* and *record* information;
- *use equipment* for *investigation;*
- make and verify *predictions* about what will occur;
- *compare* and *contrast* objects and events;
- *classify* objects and events based on self-selected criteria;
- *use language* that shows understanding of scientific principles to explain why things happen; and
- *engage* in a scientific experiment with a peer or with a small group.

Teachers suggest ideas that young children may find interesting and/or that may arise in typical classroom experiences. Teachers must rely on children's observations, ideas and questions. Typically, a class discussion can provide the setting where the teacher poses questions and challenges children's ideas. After time for discussion and brainstorming, children often are motivated to continue the inquiry. Suggested problems may spark interest and suggest investigative tasks children may wish to pursue.

The Connecticut State Department of Education's *PreK-10 Core Science Curriculum Framework* offers suggestions in the selection of content material for investigations. It is organized into the following strands:

Context of Science: nature of science, history of science, science and technology

Earth/Space Science: astronomy, geology and nature resources, oceanography, meteorology, earth history and dynamics

Life Science: characteristics of living thing: cells, genetics, evolution, ecosystems, human biology, issues in bioethics

Physical Science: structure of matter, reactions and interactions, force and motion, energy sources and transformations, heat and temperature, magnetism and electricity, sound and light

SAMPLE CURRICULUM

The sample curriculum plans that follow on pages 103 - 106 use topics chosen from the earth/space, life and physical science strands. Each plan is organized in the format described in the curriculum chapter, including appropriate performance indicators. In addition, each plan has been expanded to include suggested questions to provoke inquiry, possible challenges for investigation and suggested materials.

Project/Thematic Approach
Earth/Space: Water

Performance Indicators	Ask questions about and comment on observations and experimentations. Make and verify predictions about what will occur. Use language that shows understanding of scientific principles to explain why things happen.
Concepts/Content	Water has weight, helps things to float, dings to other materials, moves into other materials, and can evaporate, melt, boil and freeze.
Experiences	Children will experiment at the water table with containers and water. Children will engage in discussion at meetings about the various forms of water, i.e., ice and steam. Children will become aware of and discuss the properties of water in the class environment and at home.
Context, Environment	Water table, outdoors, investigation center
Teacher Strategies	**Co-construct with experiments** If you have a full container of water and put it in the freezer what will happen? Does it take up the same amount of space in the container? Do you think we could make some vehicles that could move on the water? What do you think we will need? How will these vehicles move? Stay afloat? **Facilitate with questions** What happens to water when we touch it or add materials to it? Is water heavy? How can we find out? What happened to this tray of ice? What happened to this dish of water from yesterday? How do you know? When you paint on boards with water what happens? What will happen if this cloth, this paper, gets water on it? Where does the water go? How many drops of water can you put on the stick? On the penny? What happens when it is full? Where did the water go in the sand table? Where does the water go on the playground after it rains? What do drops of water do on waxed paper?
Materials/Changes to Environment	Food coloring, paint brushes, salt, various-sized containers, assorted objects, cloth, sponges, cooking oil, thermos, salt, sawdust, flour, seeds, soap, salt, cornstarch, liquid soap, cotton, measuring cups, plastic eyedroppers, waxed paper.

Project/Thematic Approach
Life Sciences: Animals

Performance Indicators	Ask questions about and comment on observations and experimentations. Collect, describe and record information. Ask questions during investigations. Use language that shows understanding of scientific principles to explain why things happen. Use equipment for investigations. Compare and contrast objects and events. Demonstrate 1:1correspondence. Retell information from a story.
Concepts/Content	There are many kinds of animals. They all move in different ways, eat different foods, have different needs, look different, take care of their babies in different ways, and need us to help take care of them sometimes. Data analysis, sequence/comprehension of concepts first, next, last.
Experiences	Children will discuss at group time various animals visiting the classroom and pets they may have at home. Children will observe and discuss the characteristics of the animals in the classroom and at home. Children will learn how to take care of the needs of the animals in the classroom. Children will listen to fiction and nonfiction stories about animals; discuss the text; and share thoughts and opinions. Children will develop with the teacher a list of what they know about a specific animal and what they want to know. Children will brainstorm ways of learning more about animals.
Context, Environment	Library, investigation center, home, literacy centers.

(Continued on next page)

Teacher Strategies	**Facilitate and Question** How does your favorite animal move? How do we know if our class pets are growing? What kinds of foods do they like? Do they have a favorite food? How do we know? Can we explore our playground for animals and their homes? Why does a bird make a nest and a cat sleep under a porch? What do animals do in the winter for food, water and a home? **Support and Guide** Take responsibility for caring and feeding the animals in our class. How can we get food to the animals outside (birds, squirrels)? Observe and draw our class pets. Weigh, feed and measure them. **Demonstrate and Teach** Use nonfiction resources and children's involvement with the animals.
Materials/Changes to Environment	Insects worms, classroom pets, cages, magnifying glasses, animal food, literacy, writing materials and reading resources

Project/Thematic Approach
Physical Sciences: Simple Machines

Performance Indicators	Ask questions about and comment on observations and experimentations. Collect, describe and record information. Use language that shows understanding of scientific principles to explain why things happen. Engage in a scientific experiment with a peer or with a small group.
Concepts/Content	Levers help us lift, ramps help us move, and wheels tum and make moving easier.
Experiences	Children will discuss at group time problems in the block area moving items from one end of the center to another. Children will observe and discuss comparisons with the ways construction crews solve problems. Children will observe and discuss the possible uses for different materials presented at meeting time and in the investigation area. Children will discuss their solutions, listen *to* others and evaluate their ideas.
Context, Environment	Investigation center, block center.
Teacher Strategies	**Facilitate with Questions** How is a dump truck like a ramp? How do gears make things work? What is a lever? How can we lift, move this box? **Scaffold and Challenge** Using these wheels, pulleys and a rope, how can you create something to carry this container across the block area? What type of machine can you create with these gears? What will it do? How fast can you make this car move down the ramp without pushing it? What did you do differently to the ramp? Scaffold and challenge children to think further. Which ramp worked better? **Co-Construct with Experiments** Can you make a vehicle/wagon using a box? Take apart this typewriter or can opener. What pieces do you recognize? How do you think it works? How can we get these nails out of this piece of wood?
Materials/Changes to Environment	Wheels, pulleys, ropes, hooks, flat pieces of wood for levers and ramps, dump trucks, jars, screws, jars and screw tops, paper towel rolls, casters, Legos, gear toys, water wheels, nails, hammers.

BEST PRACTICES

It is recommended that early childhood educators consider for implementation the following best practices in the discipline of science.

- Science should not be taught in isolation.
- Look for opportunities to integrate with literature, mathematical thinking, classroom projects or themes, and interests of the children.
- Experiment with and investigate materials before bringing them to the children. Recognize the value and usefulness of materials for provoking, engaging and sustaining children's thinking.
- Recognize that time is essential when investigations are proceeding. Plan within the weekly schedule for long blocks of uninterrupted work time.
- Collect unusual and typical materials. Explore various approaches to motivating and stimulating ideas in the science area and at the sand or water tables. Provide real tools to support the seriousness of the children's work, recognizing that more supervision may be necessary. Ask yourself these questions when choosing materials:
  - Will the children be interested?
  - Will I be interested in exploring these ideas with the children?
  - Will these engage children in experimentation and manipulation?
  - Will the experiences encourage social interaction and problem solving?
  - Will these materials lead to exploration of valuable content?
- Plan for the children to be immersed in the activities which are minds-on and hands-on.
- Use the outside_environment for exploration and investigation. Even a walk around a city block can stimulate issues to examine.
- Provide adaptations and accommodations for children who may need more time, assistance with materials, or a more directed experience.
- Share information with parents on the various skills the children are developing as they experiment and investigate.
- Observe and listen. When the questions stop, the children need you to focus their investigation, provide new materials, guide new challenges or motivate new projects.
- Resist the urge to integrate the study or project into every center of the room. Keep it grounded by the children's questions.
- Keep engagement high. Support sustained interest by making connections to experts, field trips and/or literature.

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Prekindergarten – Grade 8
Curriculum Standards
And Assessment Expectations

SCIENCE

2010 EDITION

Connecticut State Department of Education 2010 — Bureau of Teaching and Learning

Introduction

The 2010 edition of *Prekindergarten-Grade 8 Science Curriculum Standards* is a resource that adds detail to the content and inquiry standards in the 2004 Core Science Curriculum Framework. It includes Grade-Level Concepts (GLCs), Grade-Level Expectations (GLEs) and Key Concept Words that provide clear guidelines for developing curriculum and planning instructional activities.

GLCs describe what students should know in order to understand the broad idea expressed by each Framework content standard. They define the conceptual boundaries of the learning unit, identifying subconcepts that should be included and those that can be excluded. GLCs are organized in a suggested learning sequence that can be used as a unit pacing guide. Each GLC is typically the focus of one to three class sessions. The Key Concept Words highlight the "science talk" that students and teachers should use fluently in oral and written discourse about their learning. Many of the GLCs are assessed on the science portion of the Connecticut Mastery Test (CMT).

GLEs are examples of what students should be able to do to demonstrate their understanding of science concepts. They are measurable learner outcomes that can provide evidence of learning that is richer than merely memorized facts or terminology. The GLEs reflect a range of performances for all students, including outcomes such as describing, explaining, comparing, summarizing, evaluating and creating. Some scientific inquiry expected performances have been integrated within GLEs as examples of how students use scientific inquiry, literacy and numeracy practices to understand science content. Teachers have flexibility to modify, prioritize and enhance GLEs to reflect their curriculum and their students' learning needs. GLEs can be useful for establishing measurable unit outcomes, designing learning activities, developing common formative and summative assessments, or for documenting and reporting student progress. While some of the GLE outcomes are assessed on the Science CMT, most are intended as school-based assessment opportunities.

The **Expected Performances** in the 2004 science framework continue to be the basis for developing questions for the science CMT. However, these Expected Performances represent only the selected content that could be assessed on this state test that covers multiple years of science learning. Narrowing the curriculum to include only those concepts that are tested on the CMT is likely to limit students' abilities to make sense of science and retain what they learn. A coherent curriculum that aligns instruction with the content outlined in GLCs, GLEs and Key Concept Words will provide students with opportunities to achieve the broader goals of scientific literacy and preparation for advanced study as well as high achievement on state assessments.

Connecticut science educators, RESC science specialists and university scientists contributed to the development of the GLCs and GLEs. The Leadership and Learning Center (formerly the Center for Performance Assessment) reviewed the curriculum standards and GLEs for science. Recommendations were made and are reflected in this document. The following is a summary of the center's comparative analysis of the Connecticut Prekindergarten-Grade 8 Science Curriculum Standards:

> "The [*Connecticut Prekindergarten-Grade 8 Science Curriculum Standards*] present the science content and inquiry abilities that students need in order to be science literate. The Curriculum Standards are comparable to the National Science Education Standards

(National Research Council, 1996) and the Benchmarks for Science Literacy (AAAS, 1993), as well as to the science standards of two states (South Carolina and California) whose standards have been identified by the Thomas B. Fordham Institute's State of the State Science Standards 2005 as being exemplary."

Prekindergarten-Grade 8 Science Curriculum Standards is intended to raise interest and achievement in science in all Connecticut schools by supporting local curriculum development, selection of instructional materials, design of content-rich professional development, and instructional methods aligned with Connecticut's 2004 Core Science Curriculum Framework.

Scientific knowledge is created and communicated through students' use of the following skills. All of the inquiry skills described below should be utilized by PK-2 students as they learn the content described by each Content Standard on the pages that follow.

Grades PreK-2 Core Scientific Inquiry, Literacy and Numeracy *How is scientific knowledge created and communicated?*
Expected Performances
A INQ.1 Make observations and ask questions about objects, organisms and the environment.
A INQ.2 Use senses and simple measuring tools to collect data.
A INQ.3 Make predictions based on observed patterns.
A INQ.4 Read, write, listen and speak about observations of the natural world.
A INQ.5 Seek information in books, magazines and pictures.
A INQ.6 Present information in words and drawings.
A INQ.7 Use standard tools to measure and describe physical properties such as weight, length and temperature.
A INQ.8 Use nonstandard measures to estimate and compare the sizes of objects.
A INQ.9 Count, order and sort objects by their properties.
A INQ.10 Represent information in bar graphs.

Properties of Matter — How does the structure of matter affect the properties and uses of materials? **PREKINDERGARTEN**			
PK.1 - Objects have properties that can be observed and used to describe similarities and differences			
Core Science Curriculum Framework	**Preschool Curriculum Framework**	**Grade-Level Expectations** *Students should be able to:*	**Preschool Assessment Framework**
PK.1.a. Some properties can be observed with the senses, and others can be discovered by using simple tools or tests**.**	Cognitive Development: Logical-Mathematical/Scientific Thinking - 1. Ask questions about and comment on observations and experimentation; 2. Collect, describe and record information; 3. Use equipment for investigation; 4. Use common instruments to measure things; 5. Demonstrate understanding of one-to-one correspondence while counting; 6. Order several objects on the basis of one attribute; 7. Sort objects by one or more attributes and regroup the objects based on a new attribute; 8. Engage in a scientific experiment with a peer or with a small group.	1. Use senses to make observations of objects and materials within the child's immediate environment. 2. Use simple tools (e.g., balances and magnifiers) and nonstandard measurement units to observe and compare properties of objects and materials. 3. Make comments or express curiosity about observed phenomena (e.g., "I notice that…" or "I wonder if…"). 4. Count, order and sort objects (e.g. blocks, crayons, toys) based on one visible property (e.g., color, shape, size). 5. Conduct simple tests to determine if objects roll, slide or bounce.	**COG 1** Engages in scientific inquiry **COG 3** Sorts objects **COG 5** Compares and orders objects and events **COG 6** Relates number to quantity

Heredity and Evolution — What processes are responsible for life's unity and diversity? **PREKINDERGARTEN**			
PK.2 — Many different kinds of living things inhabit the earth.			
Core Science Curriculum Framework	**Preschool Curriculum Framework**	**Grade-Level Expectations** ***Students should be able to:***	**Preschool Assessment Framework**
PK.2.a. Living things have certain characteristics that distinguish them from nonliving things, including growth, movement, reproduction and response to stimuli.	**Cognitive Development: Logical-Mathematical/Scientific Thinking** 1. Ask questions about and comment on observations and experimentation; 2. Collect, describe and record information; 3. Sort objects by one or more attributes and regroup the objects based on a new attribute; 4. Compare and contrast objects and events. **Personal and Social Development** 1. Identify themselves by family and gender. 2. State at least two ways in which children are similar and two ways in which they are different.	1. Use the senses and simple tools to make observations of characteristics and behaviors of living and nonliving things. 2. Give examples of living things and nonliving things. 3. Make observations and distinguish between the characteristics of plants and animals. 4. Compare attributes of self, family members or classmates, and describe how they are similar and different.	**COG 1** Engages in scientific inquiry **COG 3** Sorts objects **COG 5** Compares and orders objects and events **P & S 9** Recognizes similarities and appreciates differences

Energy in the earth's Systems — How do external and internal sources of energy affect the earth's systems? **PREKINDERGARTEN**			
PK.3 — Weather conditions vary daily and seasonally.			
Core Science Curriculum Framework	**Preschool Curriculum Framework**	**Grade-Level Expectations** ***Students should be able to:***	**Preschool Assessment Framework**
PK.3.a. Daily and seasonal weather conditions affect what we do, what we wear and how we feel.	**Cognitive Development: Logical-Mathematical/Scientific Thinking** 1. Ask questions about and comment on observations and experimentation; 2. Collect, describe and record information; 3. Demonstrate an understanding of sequence of events and time periods; 4. Make and verify predictions about what will occur. **Personal and Social Development** 1. Use self-help skills	1. Use the senses to observe and describe evidence of current or recent weather conditions (e.g., flags blowing, frost on window, puddles after rain, etc.) 2. Notice weather conditions and use words and numbers to describe and analyze conditions over time (e.g., "it rained 5 times this month".) 3. Identify the season that corresponds with observable conditions (e.g., falling leaves, snow vs. rain, buds on trees or greener grass). 4. Make judgments about appropriate clothing and activities based on weather conditions.	**COG 1** Engages in scientific inquiry **PHY 3** Cares for self independently

Science and Technology in Society — How do science and technology affect the quality of our lives? **PREKINDERGARTEN**			
PK.4 — Some objects are natural, while others have been designed and made by people to improve the quality of life.			
Core Science Curriculum Framework	**Preschool Curriculum Framework**	**Grade-Level Expectations** ***Students should be able to:***	**Preschool Assessment Framework**
PK.4.a. Humans select materials with which to build structures based on the properties of the materials.	**Cognitive Development: Logical-Mathematical/Scientific Thinking** 1. Ask questions about and comment on observations and experimentation; 2. Sort objects by one or more attributes and regroup the objects based on a new attribute; 3. Make and verify predictions about what will occur; 4. Engage in a scientific experiment with a peer or with a small group; **Personal and Social Development** 1. Demonstrate the ability to use a minimum of two different strategies to attempt to solve a problem; **Creative Expression/Aesthetic Development** 1. Use a variety of art materials and activities for sensory experience and exploration.	1. Observe, describe and sort building materials by properties such as strength, weight, stiffness or flexibility. 2. Pose questions and conduct simple tests to compare the effectiveness of different building materials (e.g., blocks of wood, plastic, foam or cardboard) for constructing towers, bridges and buildings. 3. Make judgments about the best building materials to use for different purposes (e.g., making the tallest tower or the longest bridge). 4. Invent and explain techniques for stabilizing a structure. 5. Compare block structures to pictures and to real structures in the neighborhood.	**P & S 1** Shows self-direction with a range of materials **COG 1** Engages in scientific inquiry **COG 2** Uses a variety of strategies to solve problems **COG 3** Sorts objects **COG 7** Demonstrates spatial awareness **CRE 1** Builds and constructs to represent own ideas

Properties of Matter — How does the structure of matter affect the properties and uses of materials? **KINDERGARTEN**			
K.1 - Objects have properties that can be observed and used to describe similarities and differences			
Core Science Curriculum Framework	**Grade-Level Concepts** *Students should understand that ...*	**Grade-Level Expectations** *Students should be able to…*	**Assessment**
K.1.a. Some properties can be observed with the senses, and others can be discovered by using simple tools or tests.	1. Humans have five senses that they use to observe their environment. A specific sense organ is associated with each sense. 2. Objects have properties that can be observed using the senses. Examples include size, weight, shape, color, texture, transparency, etc. An object's observable properties do not include the object's name or its uses. 3. Sorting objects into groups based on one (or more) of their properties makes it possible to observe and describe their similarities and differences. 4. Placing objects in order based on their size or weight makes it possible to observe patterns and describe relationships among the objects in a group. 5. Objects can be described and sorted based on the materials from which they are made (for example, wood, paper, fabric, plastic, glass or metal). Objects can be made of a mixture of materials. 6. Objects can be described and sorted based on the results of simple tests. Simple tests include actions such as bending, squeezing, holding it near a magnet or putting it in water. Objects can be described as magnetic/nonmagnetic, flexible/not flexible, hard/soft, a floater/sinker, etc. 7. The heaviness of objects can be compared using the sense of touch. Balances and scales are measurement tools that allow people to observe and compare the heaviness of objects more accurately. 8. The temperature of the air, water or bodies can be compared using the sense of touch. A thermometer is a measurement tool that allows people	1. Match each of the five senses with its associated body part and the kind of information it perceives. 2. Make scientific observations using the senses, and distinguish between an object's observable properties and its name or its uses. 3. Classify organisms or objects by one and two observable properties and explain the rule used for sorting (e.g., size, color, shape, texture or flexibility). 4. Use simple tools and nonstandard units to estimate or predict properties such as size, heaviness, magnetic attraction and float/sink. 5. Describe properties of materials such as wood, plastic, metal, cloth or paper, and sort objects by the material from which they are made.	**A1.** Use the senses and simple measuring tools, such as rulers and equal-arm balances, to observe common objects and sort them into groups based on size, weight, shape or color. **A2.** Sort objects made of materials such as wood, paper and metal into groups based on properties such as

	to compare temperatures more accurately. 9. Objects can be sorted into groups based on measurements of their size. Nonstandard units for measuring size include hands, footsteps, pennies or paper clips. **KEY CONCEPT WORDS**: senses, observe, observation, property, sort, classify, material, float, sink, flexible, heavy, magnetic, nonmagnetic, thermometer	6. Count, order and sort objects by their observable properties.	flexibility, attraction to magnets, and whether they float or sink in water. **A3.** Count objects in a group and use mathematical terms to describe quantitative relationships such as: same as, more than, less than, equal, etc.

Heredity and Evolution — What processes are responsible for life's unity and diversity? **KINDERGARTEN**			
K.2 — Many different kinds of living things inhabit the earth.			
Core Science Curriculum Framework	**Grade-Level Concepts** *Students should understand that…*	**Grade-Level Expectations** *Students should be able to…*	**Assessment**
K.2.a. Living things have certain characteristics that distinguish them from nonliving things, including growth, movement, reproduction and response to stimuli.	1. Things in our environment can be classified based on whether they are alive, were once alive or whether they were never alive. 2. Growing, responding to stimuli, and breathing are characteristics of many living things. Many living things move, but movement alone is not evidence of life. For example, cars and the wind both move, but they are not alive. 3. Reproduction is a characteristic of living things. Living things can be classified into groups based on the different ways they reproduce. For example, some living things lay eggs, while others produce seeds or give birth. 4. Living things can be classified as plants or animals. Plants have characteristics (such as roots, stems, leaves and flowers) that animals do not have. Animals have characteristics (such as body parts and body coverings) that plants do not have. 5. Animals can be classified into groups based on generally similar characteristics such as number of legs, type of body covering, or way of moving. Some animal groups are reptiles, insects, birds, fish and mammals. 6. Offspring generally resemble their parents but are not identical to them. 7. Members of the same group of animals can look and act very differently from each other. For example, goldfish and sharks are both fish, but there are distinct differences in their size, color and lifestyle. In addition, all goldfish are not identical to each other and neither are all sharks.	1. Observe and describe differences between living and nonliving things in terms of growth, offspring and need for energy from "food." 2. Sort, count, and classify living and nonliving things in the classroom, the schoolyard and in pictures. 3. Use nonstandard measures to estimate and compare the height, length or weight of different kinds of plants and animals. 4. Observe and write, speak or draw about similarities and differences between plants and animals. 5. Match pictures or models of adults with their offspring (animals and plants). 6. Classify varied individuals of the same species by one and two attributes (e.g., rabbits or cats with different fur colors;	**A4**. Describe the similarities and differences in the appearance and behaviors of plants, birds, fish, insects and mammals (including humans). **A.5** Describe the similarities and differences in the appearance and behaviors of adults and their offspring. **A6**. Describe characteristics that distinguish living from nonliving things.

	8. Plants can be classified into groups based on similarities in the appearance of their leaves, stems, blossoms or fruits. Some plant groups are grasses, vegetables, flowering plants and trees. 9. Members of the same group of plants can look and act very differently from each other. For example, although oaks and palms are both trees, their size, shape, leaves and growth habits are very different. In addition, all oak trees are not identical to each other and neither are all palms. **KEY CONCEPT WORDS**: classify, reproduce, offspring, characteristics, reptile, insect, mammal	rabbits or dogs with upright or floppy ears, etc.).	

Energy in the earth's systems — How do external and internal sources of energy affect the earth's systems? **KINDERGARTEN**			
K.3 — Weather conditions vary daily and seasonally.			
Core Science Curriculum Framework	**Grade-Level Concepts** *Students should understand that…*	**Grade-Level Expectations** *Students should be able to…*	**Assessment**
K.3.a. Daily and seasonal weather conditions affect what we do, what we wear and how we feel.	1. The sun is the source of heat and light that warms the land, air and water. Variations in the amount of sunlight that reaches the earth cause the weather. 2. Weather conditions can be observed and described as sunny, cloudy, rainy, foggy, snowy, stormy, windy, hot or cold. Weather observations can be made based on how we feel, what we see or hear, or by using weather measurement instruments such as thermometers. 3. Changes in weather conditions can be recorded during different times of day, from day to day, and over longer periods of time (seasonal cycle). Repeated observations can show patterns that can be used to predict general weather conditions. For example, temperatures are generally cooler at night than during the day and colder in winter than in spring, summer or fall. 4. Weather influences how we dress, how we feel, and what we do outside. 5. Weather affects the land, animals and plants, and bodies of water. 6. When the temperature is below "freezing," water outside freezes to ice and precipitation falls as snow or ice; when the temperature is above freezing, ice and snow melt and precipitation falls as rain. 7. Clouds and fog are made of tiny drops of water. Clouds have different shapes, sizes and colors that can be observed and compared. Some cloud types are associated with precipitation and some with fair weather.	1. Use the senses to observe daily weather conditions and record data systematically using organizers such as tables, charts, picture graphs or calendars. 2. Analyze weather data collected over time (during the day, from day to day, and from season to season) to identify patterns and make comparisons and predictions. 3. Observe, compare and contrast cloud shapes, sizes and colors, and relate the appearance of clouds to fair weather or precipitation. 4. Write, speak or draw ways that weather influences humans, other animals and plants. 5. Make judgments about appropriate clothing and activities based on weather conditions.	**A7**. Describe and record daily weather conditions. **A8**. Relate seasonal weather patterns to appropriate choices of clothing and activities.

	8. Wind is moving air. Sometimes air moves fast and sometimes it hardly moves at all. Wind speed can be estimated by observing the things that it moves, such as flags, tree branches or sailboats. **KEY CONCEPT WORDS:** weather, season (winter, spring, summer, fall), thermometer, precipitation, freeze, melt		

Science and Technology in Society — How do science and technology affect the quality of our lives? **KINDERGARTEN**			
K.4 — Some objects are natural, while others have been designed and made by people to improve the quality of life. *This content standard is an application of the concepts in content standard K.1 and should be integrated into the same learning unit.*			
Core Science Curriculum Framework	**Grade-Level Concepts** *Students should understand that…*	**Grade-Level Expectations** *Students should be able to…*	**Assessment**
K.4.a. Humans select both natural and man-made materials to build shelters based on local climate conditions, properties of the materials, and their availability in the environment.	1. People need shelters to keep warm or cool, dry and safe. Shelters are made of materials whose properties make them useful for different purposes. 2. People in different regions of the world build different kinds of shelters, depending on the materials available to them, the local climate and their customs. 3. Traditionally, people have built shelters using materials that they find nearby. Today, people build houses from materials that may come from far away. a. People who live in forested regions have traditionally built shelters using wood and/or leaves from nearby trees. b. People who live in regions with clay soils have traditionally built shelters using bricks or adobe made from clay. c. People who live in snowy regions have traditionally built shelters using snow and ice. d. People who live in regions with large animals have traditionally built shelters using animal skins. 4. Although they may look quite different, most shelters have walls, roofs and an entrance/exit; some shelters have doors, windows and floors. Walls, roofs and windows are made of materials that have specific properties. For example, walls require materials that are rigid, windows require materials that are transparent, and roofs require materials that are	1. Conduct simple tests to compare the properties of different materials and their usefulness for making roofs, windows, walls or floors (e.g., waterproof, transparent, strong). 2. Seek information in books, magazines and pictures that describes materials used to build shelters by people in different regions of the world. 3. Compare and contrast the materials used by humans and animals to build shelters.	**A9**. Describe the types of materials used by people to build houses and the properties that make the materials useful.

	water-resistant. 5. Animals build shelters using materials that are easily available to them. The materials they use have properties that help the animals stay warm or cool, dry and safe. **KEY CONCEPT WORDS:** shelter, rigid, transparent		

Forces and Motion — What makes objects move the way they do? **GRADE 1**			
1.1 — The sun appears to move across the sky in the same way every day, but its path changes gradually over the seasons.			
Core Science Curriculum Framework	**Grade-Level Concepts** *Students should understand that…*	**Grade-Level Expectations** *Students should be able to…*	**Assessment**
1.1.a. An object's position can be described by locating it relative to another object or the background. **1.1.b.** An object's motion can be described by tracing and measuring its position over time.	**GRADE-LEVEL CONCEPT 1.1.a.** 1. An object's **relative position** can be described by comparing it to the position of another stationary object. One object can be *in front of, behind, next to, inside of, above or below* another object. 2. The sun's position in the daytime sky can be described relative to stationary objects on Earth. For example, the sun can be "just above the treetops," "high or low in the sky," or "on the other side of the school." 3. The description of an object's position from one observer's **point of view** may be different from that reported from a different observer's viewpoint. For example, a box of crayons between two students is near Susan's left hand but near John's right hand. 4. When an observer changes position, different words may be needed to describe an object's position. For example, when I am sitting on the bench the sun is "behind" me; when I move to the slide, the sun is "in front of" me. 5. The same object when viewed from close up appears larger than it does when viewed from far away (although the actual size of the object does not change.) For example, a beach ball held in one's arms appears larger than it does when viewed from across the playground. 6. An object's position can be described using words ("near the door"), numbers (10 centimeters away from the door) or labeled diagrams. **GRADE-LEVEL CONCEPT 1.1.b.** 1. Things **move** in many ways, such as spinning, rolling, sliding, bouncing,	1. Compare and contrast the relative positions of objects using words (in front of, behind, next to, inside of, above or below) and numbers (by measuring its distance from another object). 2. Apply direct and indirect pushes and pulls to cause objects to move (change position) in different ways (e.g., straight line, forward and backward, zigzag, in a circle). 3. Classify objects by the way they move (e.g., spinning, rolling, bouncing). 4. Conduct simple experiments and evaluate different ways to change the speed and direction of an object's motion. 5. Observe, record and predict the sun's position at different times of day (morning, noon, afternoon or night). 6. Conduct simple investigations	**A10**. Describe how the motion of objects can be changed by pushing and pulling. **A11**. Describe the apparent movement of the sun across the sky and the changes in the length and direction of shadows during the day.

	flying or sailing. 2. Motion can be caused by a push or a pull. A push or pull is called a force. Pushes and pulls can start motion, stop motion, speed it up, slow it down or change its direction. 3. An object is in **motion** when its position is changing. Because the sun's position changes relative to objects on Earth throughout the day, it <u>appears</u> to be moving across the sky. 4. Changes in the sun's position throughout the day can be measured by observing changes in shadows outdoors. 5. Shadows occur when light is blocked by an object. An object's shadow appears opposite the light source. Shadow lengths depend on the position of the light source. **KEY CONCEPT WORDS:** position, motion, shadow, push, pull, force	of shadows and analyze how shadows change as the relative position of the sun (or an artificial light source) changes.	

Structure and Function — How are organisms structured to ensure efficiency and survival? **GRADE 1**			
1.2 — Living things have different structures and behaviors that allow them to meet their basic needs.			
Core Science Curriculum Framework	**Grade-Level Concepts** *Students should understand that…*	**Grade-Level Expectations** *Students should be able to…*	**Assessment**
1.2.a. Animals need air, water and food to survive. **1.2.b.** Plants need air, water and sunlight to survive.	**GRADE-LEVEL CONCEPT 1.2.a.** 1. All living things (organisms) need air, water and food to stay alive and grow; they meet these needs in different ways. 2. Most animals move from place to place to find food and water. Some animals have two legs, four legs, six legs or more for moving. Other animals move using fins, wings or by slithering. 3. Animals get air in different ways. For example, humans breathe with lungs, while fish breathe with gills. 4. Animals get food in different ways. Some animals eat parts of plants and others catch and eat other animals. 5. Animals get water in different ways. Some animals have special body parts, such as noses, tongues or beaks that help them get water. 6. Fictional animals and plants can have structures and behaviors that are different than real animals and plants. **GRADE-LEVEL CONCEPT 1.2.b.** 1. Plants absorb sunlight and air through their leaves and water through their roots. 2. Plants use sunlight to make food from the air and water they absorb. 3. Plants have various leaf shapes and sizes that help them absorb sunlight and air. 4. Plant roots grow toward a source of water.	1. Infer from direct observation and print or electronic information that most animals and plants need water, food and air to stay alive. 2. Identify structures and behaviors used by mammals, birds, amphibians, reptiles, fish and insects to move around, breathe and obtain food and water (e.g., legs/wings/fins, gills/lungs, claws/fingers, etc.) 3. Sort and classify plants (or plant parts) by observable characteristics (e.g., leaf shape/size, stem or trunk covering, flower or fruit). 4. Use senses and simple measuring tools to measure the effects of water and sunlight on plant growth. 5. Compare and contrast	**A12**. Describe the different ways that animals, including humans, obtain water and food. **A13**. Describe the different structures plants have for obtaining water and sunlight. **A14**. Describe the structures that animals, including humans, use to move around.

	5. Plant stems grow toward sunlight. **KEY CONCEPT WORDS:** organism, plant, animal, energy, breathe, lungs, gills, absorb	information about animals and plants found in fiction and nonfiction sources.	

Structure and Function — How are organisms structured to ensure efficiency and survival? **GRADE 1**			
1.3 — Organisms change in form and behavior as part of their life cycles.			
Core Science Curriculum Framework	**Grade-Level Concepts** *Students should understand that…*	**Grade-Level Expectations** *Students should be able to…*	**Assessment**
1.3.a. Some organisms undergo metamorphosis during their life cycles; other organisms grow and change, but their basic form stays essentially the same.	1. Plants and animals have life cycles that include a predictable sequence of stages: they begin life, develop into adults, reproduce and eventually die. 2. Plants and animals produce offspring of their own kind. Offspring closely resemble their parents, but individuals vary in appearance and behavior. 3. Animals are either born alive (for example, humans, dogs and cows) or hatched from eggs (for example, chickens, sea turtles or crocodiles). 4. Animals change during their life cycle. Many animals begin life as smaller, less capable forms of the adult. As they develop, they grow larger and become more independent (for example, humans, dogs or robins). 5. Some animals change dramatically in structure and function during their life cycle in a process called metamorphosis. 6. Frogs are amphibians that undergo metamorphosis during their life cycle. As they grow, frogs develop different structures that help them meet their basic needs in water and then on land: a. Tadpoles hatch from eggs, live in water, breathe using gills, and swim using a tail. As they metamorphose into frogs, tadpoles lose their gills and their tails. b. Adult frogs live on land and in water. They breathe air using lungs and develop webbed feet and hinged legs for	1. Explain that living things experience a life cycle that includes birth, growth, reproduction and death. 2. Distinguish between animals that are born alive (e.g., humans, dogs, cows) and those that hatch from eggs (e.g., chickens, sea turtles, crocodiles). 3. Compare and contrast the changes in structure and behavior that occur during the life cycles of animals that undergo metamorphosis with those that do not. 4. Analyze recorded observations to compare the metamorphosis stages of different animals and make predictions based on observed patterns.	**A15**. Describe the changes in organisms, such as frogs and butterflies, as they undergo metamorphosis. **A16**. Describe the life cycles of organisms that grow but do not metamorphose.

	swimming in water and hopping on land. After a female frog mates, she lays her eggs, and the cycle begins again. 7. Butterflies are insects that undergo metamorphosis during their life cycle. As they go through egg, larva, pupa and adult stages, butterflies develop different structures that help them meet their basic needs on land and in the air: a. Caterpillars hatch from eggs, live on plants, get food by chewing leaves and move about using legs. As they metamorphose into butterflies inside a chrysalis, they develop wings, antennae and different mouth parts. b. Butterflies live on land and in the air. They get food by sucking nectar from flowers and move around primarily using wings to fly. After a female butterfly mates, she searches for the proper host plant to lay her eggs, and the cycle begins again. 8. Comparing the life cycle stages of different organisms shows how they are alike in some ways and unique in other ways. **KEY CONCEPT WORDS:** life cycle, egg, metamorphosis, structures (body parts), amphibian, tadpole, gills, lungs, insect, caterpillar		

Science and Technology in Society — How do science and technology affect the quality of our lives? **GRADE 1**			
1.4 — The properties of materials and organisms can be described more accurately through the use of standard measuring units. *This content standard should be integrated within <u>all</u> PK–5 standards.*			
Core Science Curriculum Framework	**Grade-Level Concepts** *Students should understand that…*	**Grade-Level Expectations** *Students should be able to…*	**Assessment**
1.4.a. Various tools can be used to measure, describe and compare different objects and organisms.	1. Observations can be expressed in words, pictures or numbers. Measurements add accuracy to observations. 2. Objects and organisms can be described using nonstandard measurement units, such as hand-lengths, pencil-lengths, handfuls, etc. 3. Standard measurement units are more accurate than nonstandard units because they have consistent values agreed on by everyone. For example, "My caterpillar is one finger long" is much less accurate than "My caterpillar is 4 centimeters long." 4. Scientists and nonscientists all over the world use the metric system of measurement. In the United States, the customary measurement system is used in daily life. Equivalent values between the two systems can be estimated (for example, 1 inch is a little more than 2 centimeters). 5. Specific tools are used to measure different quantities: a. Metric rulers are used to measure length, height or distance in centimeters and meters; customary rulers measure length, height or distance in inches, feet or yards. b. Balances and scales are used to compare and measure the heaviness of objects. Grams and kilograms are units that express mass; ounces and pounds are units that express weight. c. Graduated cylinders, beakers and measuring cups are tools used to measure the volume of liquids. Volume can be expressed in milliliters (mL), liters (L), cups or ounces.	1. Use nonstandard and standard measurements to describe and compare the weight, length, and size of objects and organisms. 2. Show approximate size of a centimeter, meter, inch, foot and yard using referents such as a finger, a hand or a book. 3. Select appropriate tools for measuring length, height, weight or liquid volume. 4. Use metric and customary rulers to measure length, height or distance in centimeters, meters, inches, feet and yards. 5. Use balances and scales to compare and measure the heaviness of objects and organisms in kilograms, grams, pounds and ounces. 6. Use graduated cylinders, beakers and measuring cups	**A17**. Estimate, measure and compare the sizes and weights of different objects and organisms using standard and nonstandard measuring tools.

	d. Thermometers are tools used to measure temperature; thermometers can indicate temperature in degrees Celsius or degrees Fahrenheit, or both. **KEY CONCEPT WORDS:** centimeter, meter, gram, kilogram, milliliter, liter, graduated cylinder, thermometer, Celsius, Fahrenheit	to measure the volume of liquids in milliliters, liters, cups and ounces. 7. Use thermometers to measure air and water temperature in degrees Celsius and degrees Fahrenheit. 8. Make graphs to identify patterns in recorded measurements such as growth or temperature over time.	

Properties of Matter — How does the structure of matter affect the properties and uses of materials? **GRADE 2**			
2.1 — Materials can be classified as solid, liquid or gas based on their observable properties.			
Core Science Curriculum Framework	**Grade-Level Concepts** *Students should understand that…*	**Grade-Level Expectations** *Students should be able to…*	**Assessment**
2.1.a. Solids tend to maintain their own shapes, while liquids tend to assume the shapes of their containers, and gases fill their containers fully.	1. Materials can be classified as solid, liquid or gas. All forms of matter have weight and take up space, but each form has unique properties. 2. Solids are the only form of matter that have a definite shape. A solid's shape can be changed by hammering, twisting or stretching, but its weight remains the same. Solids can be hard, soft, bouncy, stretchy or grainy. 3. Solids take up a definite amount of space (volume); the volume does not change if the solid is placed in different containers. 4. Liquids do not have a definite shape; they flow to the bottom of a container and take on the shape of the part of the container they occupy. Liquids pour and flow from a higher point to a lower point; some liquids flow faster than others. 5. Liquids have a definite volume. When a liquid is poured into different containers, the shape of the liquid may change, but the volume does not. 6. Gases are made of particles too small to see, but they still take up space and have weight. Gases do not have a definite shape; they take on the shape of whatever container they occupy. For example, the air in an inflated balloon can be squeezed and reshaped. 7. Gases do not have a definite volume; they spread out in all directions to fill any size container, or they keep spreading in all directions if there is no container. For example, blowing even a small amount of air into a balloon immediately fills the entire balloon; the smell of baking bread eventually fills the entire house and even outside. **KEY CONCEPT WORDS:** property, classify, matter, state of matter, solid, liquid, gas, volume	1. Compare and contrast the properties that distinguish solids, liquids and gases. 2. Classify objects and materials according to their state of matter. 3. Measure and compare the sizes of different solids. 4. Measure and compare the volume of a liquid poured into different containers. 5. Design a fair test to compare the flow rates of different liquids and granular solids.	**A18**. Describe differences in the physical properties of solids and liquids.

Structure and Function — How are organisms structured to ensure efficiency and survival? **GRADE 2**			
2.2 — Plants change their forms as part of their life cycles.			
Core Science Curriculum Framework	**Grade-Level Concepts** *Students should understand that…*	**Grade-Level Expectations** *Students should be able to…*	**Assessment**
2.2.a. The life cycles of flowering plants include seed germination, growth, flowering, pollination and seed dispersal.	1. Flowering plants progress through a sequenced life cycle. First, seeds sprout (germinate), then seedlings grow into adult plants with leaves and flowers. If the flowers are pollinated, seeds develop that will grow into new plants to continue the life cycle. 2. Roots, stems, leaves, flowers and seeds are structures that develop during different stages of the plant's life cycle. 3. Seeds contain the beginnings of a new plant (embryo) and the food (energy source) the new plant needs to grow until it is mature enough to produce its own food. Different plant varieties produce seeds of different size, color and shape. 4. Environmental conditions, such as temperature, amount of light, amount of water and type of soil, affect seed germination and plant development. 5. A plant's seed will grow into a new plant that resembles but is not identical to the parent plant or to other new plants. For example, marigold plants produce marigold seeds that grow into new marigold plants. Individual marigolds, however, vary in height, number of leaves, etc. 6. Seedlings are young plants that produce the structures that will be needed by the plant to survive in its environment: Roots and leaves begin to grow and take in nutrients, water and air; and the stem starts to grow towards sunlight. 7. Adult plants form more leaves that help the plant collect sunlight and air to make its food. They produce flowers that are the	1. Use senses and simple tools to observe and describe the roots, stems, leaves, flowers and seeds of various plants (including trees, vegetables and grass.) 2. Use magnifiers to observe and diagram the parts of a flower. 3. Describe the functions of roots, stems, leaves, flowers and seeds in completing a plant's life cycle. 4. Record observations and make conclusions about the sequence of stages in a flowering plant's life cycle. 5. Compare and contrast how seeds of different plants are adapted for dispersal by water, wind or animals. 6. Conduct a fair test to explore factors that affect seed germination and plant growth.	**A19**. Describe the life cycles of flowering plants as they grow from seeds, proceed through maturation and produce new seeds. **A20**. Explore and describe the effects of light and water on seed germination and plant growth.

	structures responsible for reproduction. 8. Flowers have structures that produce pollen, attract pollinators and produce seeds that can grow into new plants. Some flowers have structures that develop into fruits, berries or nuts that contain the seeds that can grow into new plants. 9. Some seeds fall to the ground and germinate close to the parent plan other seeds are carried (dispersed) by wind, animals, or water to place far away. The structure of the seed is related to the way it is dispersed. **KEY CONCEPT WORDS:** life cycle, structures (body parts), seed, germinate, reproduce, flower, pollen, pollinator, seed dispersal		

The Changing Earth — How do materials cycle through the earth's systems? **GRADE 2**			
2.3 — Earth materials have varied physical properties that make them useful in different ways.			
Core Science Curriculum Framework	**Grade-Level Concepts** *Students should understand that…*	**Grade-Level Expectations** *Students should be able to…*	**Assessment**
2.3.a. Soils can be described by their color, texture and capacity to retain water. **2.3.b.** Soils support the growth of many kinds of plants, including those in our food supply.	**GRADE-LEVEL CONCEPT 2.3.a.** 1. Soil is a mixture of pieces of rock (particles), living and once living things (humus), water and air. The components of soil can be separated using sieves and settlement tests. 2. There are different types of soil that vary from place to place. Soil properties can be observed and compared. Soils can be classified by properties such as color, particle size, or amount of organic material (humus). Digging a deep hole shows that soils are often found in layers that have different colors and textures. 3. The size of the particles in soils gives the soil its texture. Soils can be classified by how they feel: Sandy soils feel gritty, silty soils feel powdery, clay soils feel sticky, and soils with small rocks feel rough and scratchy. 4. The broken rocks that make up soils can be tiny (silt and clay), medium (sand), or large (pebbles). Soils can be classified by the size of their particles. 5. A soil's texture affects how it packs together; soils that pack together tightly hold less air and water than soils that stay loosely packed. 6. There are different types of soil that vary from place to place. Some soil types are suited for supporting the weight of buildings and highways; other soil types are suited for planting food crops or forest growth.	1. Use senses and simple tools (e.g., sieves and settlement tests) to separate soil into components such as rock fragments, water, air and plant remains. 2. Classify soils by properties such as color, particle size (sand, silt or clay), or amount of organic material (loam). 3. Explain the importance of soil to plants, animals and people. 4. Evaluate the quality of different soils in terms of observable presence of air, water, living things and plant remains. 5. Conduct fair tests to investigate how different soil types affect plant growth and write conclusions supported by evidence.	**A21**. Sort different soils by properties, such as particle size, color and composition. **A22**. Relate the properties of different soils to their capacity to retain water and support the growth of certain plants.

	GRADE-LEVEL CONCEPT 2.3.b. 1. Many plants need soil to grow. Soil holds water and nutrients that are taken in (absorbed) by plant roots. 2. Soil is a habitat for many living things. Some organisms live in the soil and others live on the soil. Worms and other underground animals create spaces for air, water and plant roots to move through soil. 3. Plants we eat ("crops") grow in different soil types. Plant height, root length, number of leaves, and number of flowers can all be affected by how much water, air and organic material the soil holds. 4. To support the growth of different plants, people can change the properties of soils by adding nutrients (fertilizing), water (irrigating) or air (tilling). **KEY CONCEPT WORDS:** soil, property, classify, mixture, particle, humus, sand, silt, clay, texture, nutrients		

Science and Technology in Society — How do science and technology affect the quality of our lives?

GRADE 2

2.4 — Human beings, like all other living things, have special nutritional needs for survival.

This content standard is an application of the concepts in content standard 2.3 and should be integrated into the same learning unit.

Core Science Curriculum Framework	**Grade-Level Concepts** *Students should understand that…*	**Grade-Level Expectations** *Students should be able to…*	**Assessment**
2.4.a. The essential components of balanced nutrition can be obtained from plant and animal sources. **2.4.b.** People eat different foods in order to satisfy nutritional needs for carbohydrates, proteins and fats.	**GRADE-LEVEL CONCEPT 2.4.a.** 1. People need to eat a variety of foods to get the energy and nutrients they need to grow, move and stay healthy. Foods are classified as grains, fruits, vegetables, dairy, meats and beans, and oils. 2. Some foods people eat come from plants that grow wild or are planted by farmers as crops. A fruit is the ripened ovary of a flower; vegetables are the roots, stems, leaves or flowers of plants. 3. Some foods people eat come from animals that are wild or are raised on ranches. Meat, fish, dairy products and eggs all come from animals. 4. The types of crops that can grow in an area depend on the climate and soil. Some foods are grown and sold by local farms, and some foods are grown far away and transported to local grocery stores. **GRADE-LEVEL CONCEPT 2.4.b.** 1. All people need the same basic nutrients to grow, move and stay healthy; different cultures satisfy these needs by consuming different foods. 2. The level of energy and nutrients individuals need depends on their age, gender and how active they are. 3. Most foods contain a combination of nutrients. Labels on food packages describe the nutrients contained in the food and how much energy the food provides (calories).	1. Explain that food is a source of carbohydrates, protein and fats —nutrients that animals (including humans) convert to energy they use to stay alive and grow. 2. Classify foods into groups based on their source, and relate common foods to the plant or animal from which they come. 3. Give examples of ways people can improve soil quality and crop growth (e.g., irrigation, fertilizer, pest control). 4. Compare and contrast how different cultures meet needs for basic nutrients by consuming various foods. 5. Evaluate the nutritional value of different foods by analyzing package labels.	**A23**. Identify the sources of common foods and classify them by their basic food groups. **A24**. Describe how people in different cultures use different food sources to meet their nutritional needs.

	4. Breads, cereals, rice and pasta are sources of carbohydrates, which provide energy. 5. Meat, poultry, fish, beans, eggs and nuts are sources of protein, which keeps the body working properly. 6. Fruits and vegetables are sources of vitamins and minerals, which keep the body healthy. 7. Nuts, meats and fish are sources of fats and oils, which provide energy. **KEY CONCEPT WORDS:** nutrient, crop, grain, carbohydrate, protein, dairy, fats, oils, energy		

MATHEMATICS 6

"Teachers of young children should be aware of the impressive informal mathematical strengths of many children in the early years and recognize that it does make sense to involve them in a variety of mathematical experiences."

Baroody, 2000

HELPFUL TERMS
CURRICULUM DEVELOPMENT
PROCESS STANDARDS
CONTENT STANDARDS
BEST PRACTICES
EXAMPLES OF PLANNING

HELPFUL TERMS

Analysis	The process of breaking something down into its parts.
Estimating	The math term for guessing or predicting the answer to a problem.
Geometry	The area of mathematics that involves using shape, size, position, direction and movement to describe and classify objects in the physical world.
Number	The amount or quantity used to group items.
Number Sense	Good intuition about numbers and their relationships.
One-to-One Correspondence	The understanding that one group has the same number of things as another.
Pattern	An arrangement of objects, numbers or shapes that repeats itself and can be extended.
Spatial Awareness	The ability of children to think of themselves or objects in relation to the people and objects around them.
Statistics	The study of data involving processes such as collecting, sorting, representing, analyzing and interpreting information.

CURRICULUM DEVELOPMENT

From ages 3 through 6, children begin to solve problems by moving and experimenting with real objects. Mathematics is everywhere and children are intensely interested in concepts such as number, size and comparison. "They are self-motivated to investigate patterns, shapes, measurement, the meaning of numbers, and how numbers work, but they need assistance to bring these ideas to an explicit level of awareness. Such awareness is an essential component of mathematical knowledge" (Clements and Sarama, 2001).

In their search for meaning children naturally explore and solve, communicate and connect ideas using mathematics. Early childhood teachers should capitalize on these interests by providing curriculum that challenges and engages children. As noted in earlier sections, curriculum is more than activities; it is developed with thoughtful regard to children's needs and abilities through the selection of appropriate performance standards, processes, experiences and environments for the purpose of helping children learn.

Good early childhood mathematical learning experiences require:

- skillful adults to provide guidance, intervention and scaffolding when needed;
- interactions with teachers and peers;
- time to explore, investigate, manipulate, observe, discover and reflect;
- opportunities for children to express themselves, listen, ask for clarification and practice new skills;
- active, hands-on experiences; and
- opportunities to reorganize, reinvent and represent their learning (Wortham, 2002).

Mathematical experiences provide children with opportunities to problem solve rather than merely engage in activities. An important goal of mathematical curriculum planning is for children to learn to make sense of the information they have and to develop their abilities to use this knowledge in future projects (Copley, 2000).

Research shows that differences in math achievement in later school years may be caused, in part, by differences in young children's informal math knowledge before they enter school. Equity in math opportunities is a crucial concern (Clements and Sarama, 2001). The challenge is to provide for all children a mathematical curriculum that is both broad and deep.

Mathematics curriculum for the pre-kindergarten years is not elementary curriculum watered down. Rather, it is a planned, systematic approach to developing broad concepts, integrating experiences, and developing attitudes and dispositions around problem solving and mathematical content. To be effective, it must not be a collection of unrelated activities, nor should it be based on an assumption that children will learn what they need merely through play experiences.

Effective mathematics programs include intentionally organized learning experiences that build children's understanding over time. Depth is best achieved when content and process are considered with equal weight. The following standards for pre-kindergarten through Grade 2 are endorsed by the National Council of Teachers of Mathematics.

Process Standards

- problem solving
- reasoning
- communicating
- connecting
- representing

Content Standards

- number sense and operations
- measurement
- geometry
- algebra
- data analysis and probability

Opportunities for exploration in each of the concepts is not enough. Teachers must supply children with mathematical language, engage children in questioning and conversation, and focus their exploration. To do this successfully teachers must know which concepts and relationships the children are ready and able to explore (Bredekamp & Rosengrant, 1995). Connecticut standards for mathematics for preschool and the Connecticut Mathematics Curriculum Framework, Grades PreK-12, are consistent with these concepts.

Preschool Performance Standards

- *Demonstrate* understanding of one-to-one correspondence while counting.
- *Show* curiosity and independent interest in number-related activities.
- *Show* spatial awareness by demonstrating an understanding of position and order.
- *Use* common instruments to measure things.
- *Recognize* simple patterns and duplicate or extend them.
- *Create* and duplicate patterns and shapes using a variety of materials.
- *Estimate* and verify the number of objects.

- *Collect,* describe and record information.
- *Collect,* organize and display information.

Connecticut Mathematics Curriculum Framework

- algebraic reasoning: patterns and functions
- numerical and proportional reasoning
- geometry and measurement
- working with data: probability and statistics

The National Association for the Education of Young Children (NAEYC) and the National Council of Teachers of Mathematics (NCTM) suggest that 3-to-6 year-olds should be introduced to the key content areas of **number sense, operations, geometry and measurement**. This guide illustrates how the above content areas and other topics: patterns, estimation and data analysis, and probability and statistics, can be integrated within the daily curriculum. In order to help teachers to be purposeful and intentional in their planning, two guidance sections - one on process standards, the second on content standards- are presented. Strategies to assist teachers in planning instruction around the mathematical processes are included.

PROCESS STANDARDS

Learning happens over time. Children must move through the stages of learning from awareness to exploration to inquiry to utilization. Teachers must plan multiple experiences that help children become comfortable with all five mathematical processes: problem solving, reasoning, communicating, connecting and representing.

Problem Solving

Problem solving is the ability to get involved in a task in pursuit of a solution. In problem solving, children develop dispositions for persisting, testing, focusing and risk taking. They develop flexibility, confidence and motivation to look at life's experiences and wonder. To encourage these characteristics teachers should use the following strategies:

- provide uninterrupted time for investigation and exploration;
- use questioning strategies with children that encourage open-ended, creative thinking; and
- guide children to make connections between prior learning and new experiences.

Reasoning

Reasoning is the ability to explain and analyze the possibilities for problem solving. It includes recognized patterns and guessing what comes next, asking why and creating individual hypotheses. To promote reasoning skills teachers should use the following strategies:

- encourage children to think about hypotheses and talk about process as well as information;
- promote the habit of guessing, hypothesizing and evaluating work; and
- create a classroom where abundant questioning, investigation and discovery are norms.

Communicating

Explaining hypotheses helps to organize and connect learning. Encouraging children to explain why or how to teachers and peers deepens their learning. Conflicting opinions, approval and encouragement from others promote further understanding and consolidation concepts. Teachers play important roles as observers, questioners, clarifiers and supporters. To help children develop communication skills in this area, teachers should use the following strategies:

- relate mathematical ideas to pictures a diagrams;
- take the time to model and encourage flection on ideas and experiences; and
- relate activities and experiences to mathematical terms and symbols.

Connecting

Children are engaged in exploring mathematical concepts throughout their preschool years. Classroom experiences enable the child to connect life experiences with formal mathematical concepts. A key role of teachers is guiding children to see connections between their life experiences and the other content areas. To help children make such connections, teachers should use the following strategies:

- find relationships among classroom act ties and mathematical reasoning;
- use math vocabulary and processes in areas of the curriculum; and
- discuss connections to science, literature, family and cultural background.

Representing

Representation is a means of communicating. Learners should be encouraged to represent their thinking by using clay, blocks, drawing, language, diagrams, charts and eventually number symbols. Merely writing number symbols should not be a primary focus. The experience of conveying thoughts becomes a tool for making relationships in mathematics. Children remember what they were thinking, rethink new possibilities and make connections to new and old ideas. Representation is an opportunity to revise and make thoughts clearer to ourselves and to others. To encourage development of representation skills, teachers should use the following strategies:

- encourage representation as a continuous journey rather than as discrete projects that are finished and never addressed again;
- make learning an ongoing series of investigations that are all connected and integrated by the learner; and
- encourage children to visually and physically represent math ideas with blocks, manipulatives, in drawing and in many media forms.

CONTENT STANDARDS

This section presents broad concepts that should be included in a preschool mathematics curriculum. Each concept includes appropriate performance standards, a brief description of the topic area, skills to be cultivated, suggested teacher strategies, and ideas for maintaining a home-school connection.

Number Sense and Operations

Performance Standards

- *Demonstrate understanding of one-to-one correspondence while counting.*
- *Show curiosity and independent interest in number-related activities.*

Number sense is the ability to think and work with numbers, and to understand their uses and relationships. This ability includes:

- distinguishing between small and large groups;
- understanding the relationship between and among quantities;
- using one-to-one correspondence; and
- understanding operations such as adding and subtracting.

Research indicates that the development of number sense is the most important element in preschool mathematics (NCTM, 2000). The development of number sense and the understanding of operations provides the foundation for much of what is taught in mathematics. Young children come to preschool with many informal mathematical experiences, for example those of quantity or comparison. Their existing knowledge must be connected with the language, symbols and operations of mathematics (Griffin and Case, 1998; Gelman and Gallistel, 1978).

In teaching preschool mathematics, the focus should not only be counting, reading and writing numbers. It is more important that children spend time creating a mental structure for number concepts. Encouraging thinking, making decisions and talking about quantity is the main goal (Kamii, 2000). Consider the experience of preparing a snack. Instead of giving specific directions such as, *Please get 15 napkins,* try asking children to gather *enough napkins for everyone* (Kamii, 2000). This encourages problem solving. The child may count the children; use trial and error with a random number; or create a one-to-one correspondence with the children or chairs. Whatever process is chosen, the experience of thinking and doing results from purposeful teaching that helps children learn to use numbers rather than just count.

Understanding quantity is central to developing one's mathematical thinking abilities. Multiple experiences in counting help children understand that the last number in a counting sequence represents the entire quantity. As children come to understand quantity, they begin to understand part and whole relationships and to see many ways to use and represent numbers. (For example: "*There are 10 children here today. Four of them are girls.")* This gradually leads to the child's ability to see relationships around increasing and decreasing quantities (Ginsburg, Greenes and Belfanz, 2003).

Teacher Strategies: Number Sense	Suggested Experiences
Create an environment where questions about quantity and comparison are frequent.	Instead of asking children to count items, suggest that they consider whether there are enough for everyone. Ask them to estimate. Ask, "*How do you know? Why do you think that?*" (Reasoning) Count often. Count anything. Ask, "*If I have three and add one more how many will I have?*" (Problem solving, communicating)
Create numerous opportunities for 1:1 matching and counting.	Ask questions when children are sorting objects. "*Do you have the same number of red blocks as green?*" (Communicating, connecting)
Model approaches for representing number or quantity: tally marks, use of fingers, dots, pictures and graphs.	Using various materials, suggest that children show different ways to make 10, 8, etc. (Connecting, representing)
Integrate literacy with mathematics curriculum.	Include items that represent mathematical concepts such as: telephones, menus, calculators and docks in the dramatic play center. (Connecting, representing)

(Kamii, 2000; NCTM, 2000; National Research Council, 2001; Forman and Kuschner, 1983; Singer and Revenson, 1978; Ginsburg, 1977.)

Geometry And Spatial Relationships

Performance Standard

- *Show spatial awareness by demonstrating an understanding of position and order.*

Children learn geometry when they explore:

- shapes;
- patterns; and
- spatial sense.

Children love to explore materials and objects in their environments. As a result they develop informal knowledge of shape, symmetry and objects in space, including their own bodies. Early childhood teachers must build on these experiences by engaging children in exploring two- and three-dimensional objects, and by providing children with language and vocabulary about shapes (Copley, 2000). For example: "*That is called a circle. It is round and has no corners. There are many things in our classroom that look like circles.*"

Experiences where children move objects as well as their own bodies help to develop the understanding of concepts such as boundaries, position and arrangement (Bredekamp & Rosegrant, 1995). Music and movement activities, and following and giving directions, provide children with experience of position and direction. "*I am in front of you. You are in back of her. The blocks are in the corner of the shelf. I will put the legos on the side of the block building.*"

Take advantage of the environment. Focus children's thinking on shapes and their features. The ideas children form during these early years will help them throughout their elementary schooling (Clemeni and Sarama, 2000).

Teacher Strategies: Geometry	Suggested Experiences
Provide numerous opportunities to touch, feel and describe shapes.	Locate and compare shapes found in the environment. (Problem solving, reasoning) Play mystery-bag games where children can reach in to feel, manipulate and describe shapes. (Problem solving) Encourage children to describe their building and art creations using positional and shape vocabulary. (Communicating)
Provide specific materials that engage children in geometric concepts.	Provide attribute blocks, pattern blocks, tanagrams and large, sturdy geoboards. (Problem solving, Representing)
Provide opportunities for children to use their bodies to understand space and directionality concepts.	Play music and movement games such as a direction game with large cardboard boxes. (Problem solving)
Use vocabulary to locate and describe: in, on top of, on the side, in between.	Provide motivation for comparative discussions such as this blue square is as big as the front of this blue box. (Reasoning, Communicating)

(Clements and Sarama, 2001; NCTM, 2000; Bredekamp and Rosengrant, 1995.)

Measurement

Performance Standards

- *Use common instruments to measure things.*
- *Use equipment for investigation.*
- *Compare and contrast objects and events.*

Measurement involves:

- understanding length, width, distance and time;
- placing objects in a series; and
- being able to classify and compare objects.

Children love to compare, to see who has more, who can jump the farthest, and who can build the tallest building. The ability to grasp concepts of time and distance is based on children's experiences and cognitive development. Children may think, for example, that it took a long time to get there so it must be far away. A long time ago, may mean yesterday (Singer and Revenson, 1978). The goal for preschool children is to come to understand measurement by thinking about size and comparing lengths, weights and amounts. Making accurate measurements is not the objective. Early childhood teachers must carefully observe and interact with children while the children explore. Over time, multiple and varied experiences help children gradually develop measurement concepts.

Teacher Strategies: Measurement	Suggested Experiences
Provide real materials for investigation and problem solving.	Use cooking activities for estimation and actual measuring. Engage children in problem solving how to make twice the amount of play dough or enough cookies so everyone can have two. (Problem solving) Engage children at the water/sand table with questions: About how many cups will it take to fill that? Which cup would you guess would fill the bowl faster? (Problem solving, reasoning)
Encourage children to think about size and comparison.	Encourage children to use nonstandard units such as their arms, legs and feet to measure. (Reasoning, connecting)
Frequently use questions that encourage discussion about how far, which is heaviest, etc.?	Encourage children to weigh items using balance scales. Measure, record and compare their results. (Problem solving, reasoning) Count and measure the length of children's names. Whose name is longer? (Connecting)
Use *time talk:* after, before, today, yesterday, tomorrow, minutes, hours.	Use docks for periods of the day to measure time. (Connecting)

(Copley, 2000; NCTM, 2000; Hiebert, 1986.)

Patterns

Performance Standards

- *Recognize simple patterns and duplicate or extend them.*
- *Create and duplicate patterns and shapes using a variety of materials.*

A pattern is an arrangement of objects, shapes or actions that repeats itself or grows in size. Children are already aware of many patterns in their environments. Gradually they learn through experiences about relationships that create patterns. Opportunities to recognize and create patterns are opportunities for higher-level thinking.

They help children develop skills to predict, order and create. As their knowledge grows, children transfer this information to the real world to make generalizations about numbers, counting and problem solving. Early childhood teachers must frequently identify patterns because of their importance, and encourage children to notice and talk about them throughout the day.

Teacher Strategies: Estimation	Suggested Experiences
Provide a trusting atmosphere so children are disposed to guess without undue concern over the "right" answer.	Engage children at the water/sand table to guess the number of cups it will take to fill a container. Encourage estimating which might be heavier or how many blocks it would take to finish the road. (Problem solving)
Use words such as: about, near, approximately, in between, around, more than, fewer.	Provide opportunities to play games involving estimating how many items in the jar, how much it will take, etc. *Do you think there are more than five or less than five?* (Reasoning)
Make predictions using language such as possible, impossible, likely, unlikely.	Find opportunities, such as circle time or reading with children, to prompt discussion using these terms. They help children become comfortable with estimating and predicting.

(NCTM, 2000)

Probability, Statistics And Data Analysis

Performance Standards

- *Collect, describe and record information.*
- *Collect, organize and display information.*

Young children and teachers love to chart information, graph results of counting and tally numbers. Such experiences help children to develop skills for successful problem solving. They help children practice higher order thinking and learn the importance of representing their knowledge so it can be organized and used for predicting, estimating, making inferences and coming to decisions. Analysis and synthesis of information are necessary tools for comparing, reflecting on and discussing ideas.

Teacher Strategies: Probability	Suggested Experiences
Encourage children to gather information.	Ask questions such as: "How many windows are in your bedroom? How many people are wearing sneakers?" (Reasoning, communicating)
Encourage children to think about the information they have gathered, to come to conclusions and develop further questions.	Review the data that has been collected with question What have you found out? What was our original question? Why do you think this number is higher? (Reasoning)
Present graphs, tally sheets and other representational data analysis.	Graph snack choices, the means by which children an staff members come to school, etc. (Communicating, representing)
Model the usefulness of information in graphs and charts.	Encourage children to reach conclusions using the information in their graphs. (Representing, connecting)

(Copley, 2000; Bredekamp and Rosegrant, 1995.)

BEST PRACTICES

Early childhood teachers are encouraged to review and implement the following best practices in the discipline of mathematics.

- Work with children to develop interests and projects related to mathematical ideas.
- Do not limit math to a specific day or time.
- Extend daily activities, building on interests.
- Provide opportunities for manipulation, discovery, reflection and problem solving. Ask open-ended questions as children explore materials.
- Be prepared to introduce and develop math ideas and skills within daily activities.
- Talk about numbers and math concepts using appropriate vocabulary.
- Use concrete materials, not worksheets, that require abstract thinking. Remember that children learn through hands-on experiences where they can construct mental relationships that lead to understanding mathematical concepts.
- Design activities that can accommodate varying abilities and interests.
- Use planning time to integrate content areas so children can better connect information.
- Use children's literature for problem solving and concept development. Create projects based on children's interests.
- Build on prior experiences, cultural backgrounds and abilities for planning and instruction.
- Regularly ask yourself if you are providing experiences that encourage children to think, solve problems, communicate and represent their ideas.

Do You Have...?

1. props in dramatic play areas that are related to mathematical ideas and functions;
2. enough blocks of varying sizes and shapes for at least three children to build successfully;
3. puzzles, games and materials that encourage counting, comparing, classifying and patterning;
4. literature that provokes discussion of mathematical ideas and vocabulary;
5. sand and water materials for collecting and measuring;
6. woodworking tools, various measurement units, scales and thermometers; and
7. materials that promote spatial sense and understanding of geometric and measuring concepts, e.g., rods, blocks, solid shapes and containers.

Math Talk: Having Conversations With Children

- How many crackers can each child take?
- How many children are at the table?
- Count the empty chairs.
- How many children are here today? How many are missing? How do you know? How did you figure that out? How could we decide?
- Why did you choose these shapes in your block-building?
- What are you noticing when you put these two blocks next to or on top of each other?
- Estimate how tall your building is.
- Do we have enough?
- Are there any extras?
- How are these shapes alike, different?
- How can we find out?
- Do we have more of _____ or more of _____?
- How did you figure that out?
- How can you share these materials with a friend?
- Can you estimate how many steps it will take to get there?
- Can you get just enough napkins so everyone will have one?
- What would have happened if?
- Can you go over the box? Under it? Get on top of it?
- Can you bring me one? Lots of?
- How many children are supposed to be in this area? What does the sign say? What should we do?
- How can we organize these so the longest is on this side and the shortest is over here?
- All of you are children and some of you are big brothers and sisters. Which number is more?
- Are you sure? How do you know?
- I wonder how this could be changed.
- What would the pattern be?

- How about if you sketch your building before taking it down so we can see how many different blocks you have used.
- How many more do you need?
- What number comes after___?
- About how many do you think are in that basket? More than three? Less? Why do you think that?
- What do I need to make my design look like yours?
- Where else have you seen this shape?
- Do you think this block will roll? Why? Why not?
- Can you make a triangle with these shapes?
- Will this cup be large enough to hold your juice?
- Which size paper do you need to draw your picture?
- What size shoes will fit you best in the dramatic play area?
- Which is heavier? Lighter? How can you tell?

EXAMPLES OF PLANNING

Play-Based Learning Centers With A Focus On Mathematical Content	
Performance Indicators	Sort objects by one or more attributes and regroup the objects based on a new attribute. Demonstrate understanding of one-to-one correspondence while counting. Collect, organize and display information. Attend to a story.
Concepts/Content	Number sense and operations Geometry and spatial relationships Data analysis
Experience	To integrate content in various learning centers, provide a variety of collections both from home and those found in school (buttons, sticks, stones, parquetry blocks, cars, etc). The children will be encouraged to examine, find similarities, begin to sort, classify, discuss and work with various objects. This experience will be introduced and repeated during morning meetings as a means to expose children to counting and estimating, and as a way of provoking the use of materials to represent our thinking in the art center.
Context, Environment	Morning meetings, art, math, science and other investigation centers
Teacher Strategies	**Facilitate** and **demonstrate** how sorting and rule-making can be done with collections. **Question** children as they sort and make patterns to arrive at a rule for others to follow. **Encourage** children to use language, such as impossible, certain, likely and unlikely, as they listen to stories.

(Continued on next page)

	Prompt children to use probability terms in examining their collections, e.g. *It is likely this group has more.* **Partner** with the children to create pictures using collections. **Scribe** for the children descriptions of their collection pictures.
Materials/Changes to Environment	Provide collections of various items in **art, math** and **science** investigation centers. Prepare large sheets for collage and collection displays in the **art** center and **writing** area. Collect a nd display various books in the **library** area on counting and collecting, and stones that are suitable for estimating and probability discussions.

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Connecticut Standards for Mathematics (CCSS)

Standards for Mathematical Practice
Kindergarten

Kindergarten Standards for Mathematical Practice The K-12 Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. This page gives examples of what the practice standards look like at the specified grade level.	
Standards	***Explanations and Examples***
Students are expected to: **1. Make sense of problems and persevere in solving them**.	In Kindergarten, students begin to build the understanding that doing mathematics involves solving problems and discussing how they solved them. Students explain to themselves the meaning of a problem and look for ways to solve it. Younger students may use concrete objects or pictures to help them conceptualize and solve problems. They may check their thinking by asking themselves, "Does this make sense?" or they may try another strategy.
Students are expected to:. **2. Reason abstractly and quantitatively.**	Younger students begin to recognize that a number represents a specific quantity. Then, they connect the quantity to written symbols. Quantitative reasoning entails creating representation of a problem while attending to the meanings of the quantities.
Students are expected to: **3. Construct viable arguments and critique the reasoning of others.**	Younger students construct arguments using concrete referents, such as objects, pictures, drawings, and actions. They also begin to develop their mathematical communication skills as they participate in mathematical discussions involving questions like "How did you get that?" and "Why is that true?" They explain their thinking to others and respond to others' thinking.
Students are expected to: **4. Model with mathematics.**	In early grades, students experiment with representing problem situations in multiple ways including numbers, words (mathematical language), drawing pictures, using objects, acting out, making a chart or list, creating equations, etc. Students need opportunities to connect the different representations and explain the connections. They should be able to use all of these representations as needed.
Students are expected to: **5. Use appropriate tools strategically.**	Younger students begin to consider the available tools (including estimation) when solving a mathematical problem and decide when certain tools might be helpful. For instance, kindergarteners may decide that it might be advantageous to use linking cubes to represent two quantities and then compare the two representatives side-by-side.
Students are expected to: **6. Attend to precision.**	As kindergarteners begin to develop their mathematical communication skills, they try to use clear and precise language in their discussions with others and in their own reasoning.
Students are expected to: **7. Look for and make use of structure.**	Younger students begin to discern a pattern or structure. For instance, students recognize the pattern that exists in the teen numbers; every teen number is written with a 1 (representing one ten) and ends with the digit that is first stated. They also recognize that $3 + 2 = 5$ and $2 + 3 = 5$.
Students are expected to: **8. Look for and express regularity in repeated reasoning**.	In the early grades, students notice repetitive actions in counting and computation, etc. For example, they may notice that the next number in a counting sequence is one more. When counting by tens, the next number in the sequence is "ten more" (or one more group of ten). In addition, students continually check their work by asking themselves, "Does this make sense?"

Kindergarten Pacing Guide

Unit Title	Pacing	Standards
1. Counting and Matching Numerals 0-5 with Comparing	4 weeks	K.CC.1 K.CC.5 K.MD.3 **K.CC.3** **K.CC.6** **K.CC.4** K.CC.7
2. Counting and Match Numerals 6-10 with Comparing	3 weeks	K.CC.1 K.CC.5 K.MD.3 **K.CC.3** **K.CC.6** **K.CC.4** K.CC.7
3. Counting and Matching Numerals 11 - 20	4 weeks	K.CC.1 **K.CC.4** K.CC.2 K.CC.5 **K.CC.3**
4. Fluency with Addition & Subtraction within 5	4 weeks	K.CC.1 K.CC.4 K.OA.2 K.CC.2 K.CC.5 **K.OA.3** **K.CC.3** **K.OA.1** **K.OA.5**
5. Exploring Addition & Subtraction within 10	4 weeks	K.CC.1 K.CC.4 K.OA.2 K.CC.2 K.CC.5 **K.OA.3** **K.CC.3** **K.OA.1** K.OA.4 **K.OA.5**
6. Teen Numbers (11 – 19) & Counting to 100	4 weeks	K.CC.1 K.CC.5 K.CC.2 **K.OA.1** **K.CC.4** K.NBT.1
7. Identify and Describe 2-D and 3-D Shapes	2 weeks	K.MD.3 K.G.3 **K.G.1** **K.G.4** K.G.2 **K.G.5**
8. Compare, Analyze, and Compose 2-D and 3-D Shapes	2 weeks	**K.MD.2** K.G.3 K.G.6 **K.G.1** **K.G.4** K.G.2 **K.G.5**
9. Measurement by Direct Comparison	4 weeks	K.MD.1 **K.MD.2**

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Connecticut Curriculum Design Unit Planning Organizer
Kindergarten Mathematics
Unit 9 – Measurement by Direct Comparison

Pacing: 4 weeks (plus 1 week for reteaching/enrichment)

Mathematical Practices
Mathematical Practices #1 and #3 describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning. *Practices in bold are to be emphasized in the unit.* **1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** 3. Construct viable arguments and critique the reasoning of others. **4. Model with mathematics.** 5. Use appropriate tools strategically**.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**
Domain and Standards Overview
<u>Counting and Cardinality K.CC</u> • Know number names and the count sequence. • Count to tell the number of objects. • Compare numbers.

Connecticut Standards for Mathematics (CCSS)

Standards for Mathematical Practice
Grade One

Grade One Standards for Mathematical Practice The K-12 Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. This page gives examples of what the practice standards look like at the specified grade level.	
Standards	***Explanations and Examples***
Students are expected to: **1. Make sense of problems and persevere in solving them**.	In first grade, students realize that doing mathematics involves solving problems and discussing how they solved them. Students explain to themselves the meaning of a problem and look for ways to solve it. Younger students may use concrete objects or pictures to help them conceptualize and solve problems. They may check their thinking by asking themselves, "Does this make sense?" They are willing to try other approaches.
Students are expected to:. **2. Reason abstractly and quantitatively.**	Younger students recognize that a number represents a specific quantity. They connect the quantity to written symbols. Quantitative reasoning entails creating a representation of a problem while attending to the meanings of the quantities.
Students are expected to: **3. Construct viable arguments and critique the reasoning of others.**	First graders construct arguments using concrete referents, such as objects, pictures, drawings, and actions. They also practice their mathematical communication skills as they participate in mathematical discussions involving questions like "How did you get that?", "Explain your thinking," and "Why is that true?" They not only explain their own thinking but listen to others' explanations. They decide if the explanations make sense and ask questions.
Students are expected to: **4. Model with mathematics.**	In early grades, students experiment with representing problem situations in multiple ways including numbers, words (mathematical language), drawing pictures, using objects, acting out, making a chart or list, creating equations, etc. Students need opportunities to connect the different representations and explain the connections. They should be able to use all of these representations as needed.
Students are expected to: **5. Use appropriate tools strategically.**	In first grade, students begin to consider the available tools (including estimation) when solving a mathematical problem and decide when certain tools might be helpful. For instance, first graders decide it might be best to use colored chips to model an addition problem.
Students are expected to: **6. Attend to precision.**	As young children begin to develop their mathematical communication skills, they try to use clear and precise language in their discussions with others and when they explain their own reasoning.
Students are expected to: **7. Look for and make use of structure.**	First graders begin to discern a pattern or structure. For instance, if students recognize *12 + 3 = 15,* then they also know*3 + 12 = 15. (Commutative property of addition.)*To add*4 + 6 +4, the first two numbers can be added to make a ten, so 4 +6 +4 = 10 +4 = 14.*
Students are expected to: **8. Look for and express regularity in repeated reasoning**.	In the early grades, students notice repetitive actions in counting and computation, etc. When children have multiple opportunities to add and subtract "ten" and multiples of "ten" they notice the pattern and gain a better understanding of place value. Students continually check their work by asking themselves, "Does this make sense?"

Grade One Pacing Guide

Unit Title	Pacing	Standards
1. Fluency with Addition and Subtraction within 10	5 weeks	**1.OA.1** 1.OA.4 1.OA.8 1.OA.2 1.OA.5 **1.NBT.1** **1.OA.3** **1.OA.5** 1.MD.4 1.OA.4 **1.OA.7**
2. Exploring Addition & Subtraction within 20	3 weeks	**1.OA.1** 1.OA.4 1.OA.8 1.OA.2 1.OA.5 **1.NBT.1** **1.OA.3** **1.OA.5** 1.MD.4 1.OA.4 **1.OA.7**
3. Counting and Place Value	5 weeks	**1.NBT.1** 1.NBT.3 1.MD.4 **1.NBT.2** 1.NBT.5
4. Exploring Addition and Subtraction within 100	5 weeks	**1.OA.3** **1.NBT.1** **1.NBT.4** 1.OA.5 **1.NBT.2** **1.NBT.6** **1.OA.7**
5. Defining Attributes of 2-D and 3-D Shapes	2 weeks	**1.G.1** **1.G.2**
6. Partitioning Circles and Rectangles	2 weeks	1.G.3
7. Measuring Length with Non-Standard Units	2 weeks	**1.MD.1** **1.MD.2**
8. Time to the Hour and Half-Hour	2 weeks	**1.MD.3** 1.G.3

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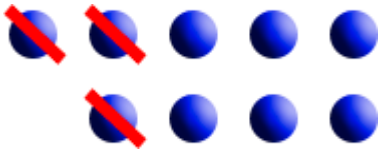
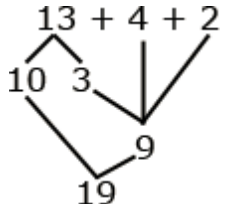
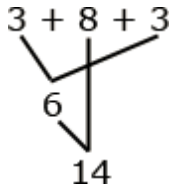
Note that all standards are important and are eligible for inclusion on the large scale assessment to be administered during the 2014-15 school year. The Standards were written to emphasize correlations and connections within mathematics. The *priority* and *supporting* standard identification process emphasized that coherence. Standards were identified as *priority* or *supporting* based on the critical areas of focus described in the CT Standards, as well as the connections of the content within and across the K-12 domains and conceptual categories. In some instances, a standard identified as *priority* actually functions as a supporting standard in a particular unit. **No stratification or omission of practice or content standards is suggested by the system of organization utilized in the units.**

Pacing: 5 weeks (plus 1 week for reteaching/enrichment)

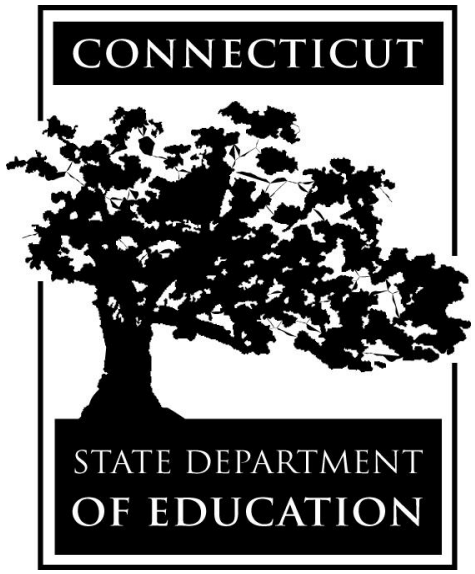
Mathematical Practices
Mathematical Practices #1 and #3 describe a classroom environment that encourages thinking mathematically and are critical for quality teaching and learning. *Practices in bold are to be emphasized in the unit.* **1. Make sense of problems and persevere in solving them.** **2. Reason abstractly and quantitatively.** **3. Construct viable arguments and critique the reasoning of others.** **4. Model with mathematics.** **5. Use appropriate tools strategically.** **6. Attend to precision.** **7. Look for and make use of structure.** **8. Look for and express regularity in repeated reasoning.**
Domain and Standards Overview
<u>Operations and Algebraic Thinking 1.OA</u> • Represent and solve problems involving addition and subtraction. • Understand and apply properties of operations and the relationship between addition and subtraction. • Add and subtract within twenty. • Work with addition and subtraction equations

Priority and Supporting **CCSS**	**Explanations and Examples***
1. OA.1. Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.	**1. OA.1.** Contextual problems that are closely connected to students' lives should be used to develop fluency with addition and subtraction. Table 1 describes the four different addition and subtraction situations and their relationship to the position of the unknown. Students use objects or drawings to represent the different situations. • *Take-from* example: Abel has 9 balls. He gave 3 to Susan. How many balls does Abel have now?  • *Compare* example: Abel has 9 balls. Susan has 3 balls. How many more balls does Abel have than Susan? A student will use 9 objects to represent Abel's 9 balls and 3 objects to represent Susan's 3 balls. Then they will compare the 2 sets of objects. Note that even though the modeling of the two problems above is different, the equation, 9 - 3 = ?, can represent both situations yet the compare example can also be represented by 3 + ? = 9 (How many more do I need to make 9?) **Continued on next page** **1. OA.1.** Continued It is important to attend to the difficulty level of the problem situations in relation to the position of the unknown. • *Result Unknown* problems are the least complex for students

Priority and Supporting **CCSS**	**Explanations and Examples***
	followed by *Total Unknown* and *Difference Unknown*. • The next level of difficulty includes *Change Unknown, Addend* • *Unknown,* followed by *Bigger Unknown*. • The most difficult are *Start Unknown, Both Addends Unknown,* and *Smaller Unknown.* Students may use document cameras to display their combining or separating strategies. This gives them the opportunity to communicate and justify their thinking.
1. OA.2. Solve word problems that call for addition of three whole numbers whose sum is less than or equal to 20, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.	1. OA.2. To further students' understanding of the concept of addition, students create word problems with three addends. They can also increase their estimation skills by creating problems in which the sum is less than 5, 10 or 20. They use properties of operations and different strategies to find the sum of three whole numbers such as: •Counting on and counting on again (e.g., to add 3 + 2 + 4 a student writes 3 + 2 + 4 = ? and thinks, "3, 4, 5, that's 2 more, 6, 7, 8, 9 that's 4 more so 3 + 2 + 4 = 9." • Making tens (e.g., 4 + 8 + 6 = 4 + 6 + 8 = 10 + 8 = 18) • Using "plus 10, minus 1" to add 9 (e.g., 3 + 9 + 6 A student thinks, "9 is close to 10 so I am going to add 10 plus 3 plus 6 which gives me 19. Since I added 1 too many, I need to take 1 away so the answer is 18.) **Continued on next page**

Priority and Supporting **CCSS**	**Explanations and Examples***
	1.OA.2. Continued • Decomposing numbers between 10 and 20 into 1 ten plus some ones to facilitate adding the ones  .• Using doubles  Students will use different strategies to add the 6 and 8. • Using near doubles (e.g.,5 + 6 + 3 = 5 + 5 + 1 + 3 = 10 + 4 =14) Students may use document cameras to display their combining strategies. This gives them the opportunity to communicate and justify their thinking.

Connecticut Standards for Mathematics (CCSS)



Standards for Mathematical Practice
Grade Two

Grade Two Standards for Mathematical Practice The K-12 Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. This page gives examples of what the practice standards look like at the specified grade level.	
Standards	***Explanations and Examples***
Students are expected to: **1. Make sense of problems and persevere in solving them**.	In second grade, students realize that doing mathematics involves solving problems and discussing how they solved them. Students explain to themselves the meaning of a problem and look for ways to solve it. They may use concrete objects or pictures to help them conceptualize and solve problems. They may check their thinking by asking themselves, "Does this make sense?" They make conjectures about the solution and plan out a problem-solving approach.
Students are expected to: **2. Reason abstractly and quantitatively.**	Younger students recognize that a number represents a specific quantity. They connect the quantity to written symbols. Quantitative reasoning entails creating a representation of a problem while attending to the meanings of the quantities. Second graders begin to know and use different properties of operations and objects.
Students are expected to: **3. Construct viable arguments and critique the reasoning of others.**	Second graders may construct arguments using concrete referents, such as objects, pictures, drawings, and actions. They practice their mathematical communication skills as they participate in mathematical discussions involving questions like "How did you get that?", "Explain your thinking," and "Why is that true?" They not only explain their own thinking, but listen to others' explanations. They decide if the explanations make sense and ask appropriate questions.
Students are expected to: **4. Model with mathematics.**	In early grades, students experiment with representing problem situations in multiple ways including numbers, words (mathematical language), drawing pictures, using objects, acting out, making a chart or list, creating equations, etc. Students need opportunities to connect the different representations and explain the connections. They should be able to use all of these representations as needed.
Students are expected to: **5. Use appropriate tools strategically.**	In second grade, students consider the available tools (including estimation) when solving a mathematical problem and decide when certain tools might be better suited. For instance, second graders may decide to solve a problem by drawing a picture rather than writing an equation.
Students are expected to: **6. Attend to precision.**	As children begin to develop their mathematical communication skills, they try to use clear and precise language in their discussions with others and when they explain their own reasoning.
Students are expected to: **7. Look for and make use of structure.**	Second graders look for patterns. For instance, they adopt mental math strategies based on patterns (making ten, fact families, doubles).
Students are expected to: **8. Look for and express regularity in repeated reasoning**.	Students notice repetitive actions in counting and computation, etc. When children have multiple opportunities to add and subtract, they look for shortcuts, such as rounding up and then adjusting the answer to compensate for the rounding. Students continually check their work by asking themselves, "Does this make sense?"

Grade Two Pacing Guide

Unit Title	Pacing	Standards
1. Fact Strategies (+,-) Up to 20	2 weeks	**2.OA.1** **2.OA.2** **2.NBT.9**
2. Place Value to 1,000	4 weeks	**2.NBT.1** **2.NBT.2** **2.NBT.4** 2.NBT.3
3. Fluency with Addition & Subtraction within 100	3 weeks	**2.NBT.5** **2.NBT.9** 2.NBT.1 2.OA.1 2.NBT.6 2.MD.5 2.MD.6
4. Exploring Addition & Subtraction within 1000	3 weeks	**2.NBT.8** **2.NBT.9** 2.NBT.1 2.NBT.7
5. Money	3 weeks	**2.MD.8**
6. Reasoning with Shapes	2 weeks	**2.G.1** 2.G.3
7. Linear Measurement with Standard Units	3 weeks	**2.MD.1** **2.MD.2** 2.MD.3 2.MD.4
8. Time to the Nearest 5-Minutes	2 weeks	**2.MD.7** **2.NBT.2** 2.G.3

Unit Title	Pacing	Standards
9. Representing, Analyzing & Interpreting Data	2 weeks	**2.OA.1** 2.MD.9 2.MD.10
10. Exploring Multiplication	2 weeks	**2.NBT.2** **2.G.2** 2.OA.3 2.OA.4

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