INTRODUCING: PRESCHOOL MATH

Having fun with Early Math Learning!
Lisa Hales, M. Ed.
M A T H
Mental Abuse to Humans
GROUND RULES AND EXPECTATIONS

Please Turn off Your Mobile Phones
OBJECTIVES:

- We will:
  - Explore opportunities and strategies for building number sense and mathematical understandings in the early education years.
  - Explore the developmental progression of number sense, as well as methods to develop skills in subitizing, counting, one-to-one correspondence, cardinality and hierarchical inclusion.
  - Share ideas and activities that can be used in classrooms to support mathematics.
RESOURCES AND REFERENCES


▪ Carrie Cole and Side by Side Consulting resources

▪ Montana Early Learning Standards (2014)

"Rithmetic would be a lot easier if it didn’t have all those different numbers."
GETTING ACQUAINTED- WHO’S IN THE ROOM?

Group activity

Discussion
The Montana Early Learning Standards (MELS) are organized into four domains of learning that make up 47 standards outlining a continuum of development to ensure children from birth to age five develop the skills and knowledge they need to achieve success as they transition into kindergarten and beyond. During these early years learning is multidimensional and children learn and develop new skills, adding to their prior knowledge which crosses over to other areas of development. While all of the skills outlined in the standards are important for continued growth and development, there is evidence that some skills are more predictive than others for future success in school and for lifelong learning. The 16 standards listed below are meant to help early educators prioritize instruction and assessment practices.

<table>
<thead>
<tr>
<th>Emotional and Social</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emotional Development</td>
</tr>
<tr>
<td>1. Self-Efficacy: Children demonstrate a belief in their abilities. (MELS 1.5)</td>
</tr>
<tr>
<td>2. Self-Regulation: Children manage their internal states, feelings and behavior, and develop the ability to adapt to diverse situations and environments. (MELS 1.6)</td>
</tr>
<tr>
<td>Social Development</td>
</tr>
<tr>
<td>3. Interactions with Peers: Children interact and build relationships with peers as they expand their world beyond the family and develop skills in cooperation, negotiation, and showing empathy. (MELS 1.9)</td>
</tr>
</tbody>
</table>

| Physical                              |
| 4. Sensorimotor: Children use all the senses to explore the environment and develop skills through sight, smell, touch, taste, and sound. (MELS 2.3) |
| 5. Gross Motor: Children develop large muscle strength, coordination, and skills. (MELS 2.2) |
| 6. Fine Motor: Children develop small muscle strength, coordination, and skills. (MELS 2.1) |

| Communication and Language Development |
| 7. Receptive Communication: Children use listening and observation skills to make sense of and respond to spoken language and other forms of communication. Children enter into the exchange of information around what they see, hear, and experience. They begin to acquire an understanding of the concepts of language that contribute to further learning. (MELS 3.1) |
| *Focus on the meaning of words to enhance understanding and build vocabulary. |
| 8. Expressive Communication: Children develop skills in using sounds, facial expressions, gestures, and words for a variety of purposes, such as to help adults and others understand their needs, ask questions, express feelings and ideas, and solve problems. (MELS 3.2) |
| *Rapid Automated Naming (RAN) – The ability to quickly name random letters, numbers, colors, or objects. |

| Literacy                              |
|                                       |
▪ Math & Numeracy

▪ 16. Number sense and Operations: Children develop the ability to think and work with numbers, to understand their uses, and describe numerical relationships through structured and everyday experiences. (MELS 4.10)

▪ Subitizing: Rapidly and automatically able to count objects

▪ Cardinality: Recognition of total quantity

- *
CORE VALUES-#1 MATH LEARNING IS FOR EVERYONE

- A creative, meaning-making endeavor, empowering individuals to become problem-solvers.
- Result of effort and equitable instruction.
- We can all enjoy mathematics and achieve a level of success.

(From the Erikson Institute Early Math collaborative @ http://earlymath.erikson.edu)
#2 MATH LEARNING IS CRUCIAL IN EARLY CHILDHOOD

- Begins with simple concepts which are the building blocks for more complex mathematics.
- Building children’s self-concept around math skills at early ages supports learning as they learn and grow.
- Early math achievement is highly predictive of later school success in both mathematics and reading.
#3 Math learning follows developmental progressions

- Learners construct big ideas from math differently.
- Different strands of mathematical ideas develop in parallel – and sometimes unevenly – before getting connected.
- Different learners may take different pathways to reach the same mathematical understanding or skill.
#4 MATH LEARNING DEPENDS ON EFFECTIVE TEACHING

- Focuses on the most important mathematical concepts and skills and why.
- Values existing ideas learners have about concepts and makes connections to new or different ideas.
- Provides ongoing opportunities for learners to engage in mathematical practices deepening understanding.
STRENGTHS & POLISHERS - CORE VALUES

- Strengths
- Polishers
FIRST THINGS FIRST... What children learn BEFORE they begin to develop math skills:

- Attributes
- Comparison
- Change
- Pattern
Properties or qualities that allow us to describe and classify the world around us.

Attributes can be used to group.

We perceive attributes of the world around us through our senses.

Language allows us to describe attributes with increasing precision.
COMPARISON

- Noticing sameness and difference.
- Depends on recognizing attributes.
- Recognizing attributes makes it possible to notice sameness and difference.
- Noticing sameness and difference allows for matching, sorting, ordering and problem-solving.
CHANGE

- Change means something becomes different. It involves both Attributes and Comparison.

- Change may be qualitative or quantitative.

- The difference may be the result of joining, separating, or of transforming.

- To respond to change, the difference between the initial condition and the changed condition must be recognized.
Pattern involves rhythm, sequence, and regularity that at some point allows for prediction. It involves attributes, comparison and change.

A pattern involves a set of defining elements.

Regularity occurs when the defining elements recur in sequence.

When a regular sequence begins, there is an expectation that it will include the defining elements.
▪ One’s ability to understand what numbers mean, perform mental mathematics, and look at the world and make comparisons (Hinton, Stroizer, & Flores, 2016).

▪ A child’s “fluidity and flexibility with numbers” (Gersten & Chard, 2001).

▪ “The ability to understand the quantity of a set and the name associated with that quantity” (Brownwell, Chen, Ginet, Hynes-Berry, Itzkowich, Johnson & McCray, 2017)
How do you teach number sense?

A large body of research has shown that number sense develops gradually, over time, as a result of exploration of numbers, visualizing numbers in a variety of contexts, and relating to numbers in different ways.
 WHY NUMBER SENSE MAKES SENSE

- Number sense is linked to future math achievement in a manner similar to the way phonological awareness has been linked to reading achievement. (Kosanovich, Weinstein, & Goldman 2009)

- Number sense is the foundation for all math learning which develops gradually over time as a result of exploring, visualizing and relating to numbers in a variety of ways. (Devlin, 2017)
Uses of Numbers:

- Numbers are used many ways, some more mathematical than others.

Ex: Cardinal, Ordinal, Nominal, Referential

Numerosity:

- Quantity is an attribute of a set of objects, and we use numbers to name specific quantities.

- The quantity of a small collection can be intuitively perceived without counting. (Subitizing)
NUMBER SENSE TRAJECTORY

- Subitizing
- Comparison
- Counting
- One-to-One Correspondence
- Cardinality
- Hierarchical Inclusion
- Number Conservation

Created by Graham Fletcher, video link: https://gfletchy.com/2017/03/26/the-progression-of-early-number-and-counting/
# LEARNING PROGRESSION

## Counting and Beginning Number Sense

<table>
<thead>
<tr>
<th>Subitizing</th>
<th>Comparison</th>
<th>Counting</th>
<th>One-to-One Correspondence</th>
<th>Cardinality</th>
<th>Hierarchical Inclusion</th>
<th>Number Conservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Being able to visually recognize a quantity of 5 or less</td>
<td>Being able to compare quantities by identifying which has more and which has less</td>
<td>The rote procedure of counting, includes both verbal counting and object counting. The actual meaning attached to counting is developed through one-to-one correspondence</td>
<td>Being able to connect one number with object and then count each object with understanding</td>
<td>Begin able to tell how many objects are in a set—understanding that the last word in the counting sequence names the quantity for that set</td>
<td>Understanding numbers are nested inside each other and the number grows by one each count. For example, 3 is inside 4 or 4 is the same as 3+1 more</td>
<td>The number of objects remains the same when they are rearranged spatially. For example, 5 can be... 4 and 1 OR 3 and 2 OR 2 and 3, etc.</td>
</tr>
</tbody>
</table>

Making Sense Series
the progression of early number & counting

created by Graham Fletcher
@gfletchy
www.gfletchy.com
SUBITIZING

- Being able to visually recognize a quantity of 5 or less without counting.
COMPARISON

- Ability to compare quantities by identifying which has more and which has less.
COUNTING

- The rote procedure of counting.
- Includes both verbal counting and object counting.
- The actual meaning of counting is developed through one-to-one correspondence.
ONE-TO-ONE CORRESPONDENCE

- Ability to connect one number with one object then count each object with understanding.
Ability to tell how many objects are in a set, understanding that the last word in the counting sequence names the quantity for that set.
Understanding numbers are nested inside each other and the number grows by one each count.

3 + 1 = 4
4 + 1 = 5
The number of objects remains the same when they are rearranged spatially. For example:

5 can be:
4+1 or
3+2 or
2+3, etc
LET'S PRACTICE SUBITIZING

▪ Watch the following slides and notice how many dots you see on each slide.
▪ Notice the patterns & placement.
▪ Share your thoughts
LET'S TALK ABOUT SETS

BIG IDEAS of SETS:

- Attributes are used to sort collections into sets
- Sets can be sorted in different ways
- Sets can be compared and ordered
SORTING BY ATTRIBUTES

- Children begin to match items by like attributes, such as color and shape
- Find the item that matches the item on the right:
MULTIPLE WAYS TO SORT A SET

- Differs from matching because it involves reorganizing a whole collection or set, into two or more subsets

- Items sorted by single attribute into subsets, for example all the blue stars are sorted from the remaining colors (binary sort)
Subsets are often compared, often by which attribute is preferred.

Subsets are compared by quantity, including “more than,” “less than,” and “equal to.”
Changing Sets:
- Sets can be changed by joining or separating objects.

Comparing Sets:
- Sets can be compared using the attribute of numerosity, and ordered by more than, less than or equal to.

Number Composition:
- A quantity (whole) can be decomposed into equal or unequal parts; the parts can be composed to form the whole.
LET’S TAKE A BREAK...
"It's important to learn math because someday you might accidentally buy a phone without a calculator."
Activities for Exploring Sets

- Exact Matching: Recognizes a total sameness to make an exact match

- Sorting by a Single Attribute: Applies matching skills to make a set

- Binary Sort: Uses one attribute to change a collection into two sets, uses yes/no rule

- Multiple Set Sort: Uses one or more attribute to change a single set into many sets

- Compare Sets: Asks “what’s more?” and may represent comparisons with a graph or chart
Five Creatures Read Aloud

Five Creatures
by Emily Jenkins
WE CAN ALL AGREE...
ACTIVITY: PEOPLE SORT

- 5 Volunteers
- Two defined areas
- Binary Sort: Sort by observable attribute

- Extension Activity: Table sorts, have group use rules of sorting to come up with as many sets as possible in 5 minutes.....

Ready......GO!
FIVE CREATURES IN ACTION
MORE ABOUT COUNTING AND WHY EARLY MATH MATTERS

- https://youtu.be/KdxEAt91D7k

- l'

- https://www.youtube.com/watch?v=rsKNrnlfXt4&t=79s
COUNTING

- So much more than:

“One- Two-Three-Four-Five-Six-Seven-Eight...”
<table>
<thead>
<tr>
<th>Embedded</th>
<th>Support children with many opportunities for counting throughout each day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Practice</td>
<td>Provide many opportunities to count together with children, and also allow children to count independently</td>
</tr>
<tr>
<td>Actions</td>
<td>Use songs and movements to help children learn the counting sequence</td>
</tr>
<tr>
<td>Objects</td>
<td>Give children objects to count</td>
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</table>

**SUPPORTING THE COMPLEXITY OF COUNTING (LEARNING THE NUMBER SEQUENCE)**
1. Stable Order
2. One-to-one Correspondence
3. Cardinality
4. Abstraction
5. Order Irrelevance

First three are the “HOW”
Last two are the “WHAT”

(Gelman and Galistel, 1978)
Stable Order

- Understanding the verbal sequence of counting; being able to say the number names in sequential order.

- One-Two-Three-Four-Five-Six-Seven-Eight-Nine-Ten
Understanding that when saying the names of the numbers in sequence, each object receives one count and only one count.
CARDINALITY

- Understanding that the last number spoken in a counting sequence names the quantity for that set
ABSTRACTION

- Understanding that it doesn’t matter what you count, how we count stays the same.
- For example, any sets of objects can be counted as a set, regardless of whether they are the same color, shape, size, etc.
Knowledge that the order items are counted is irrelevant—left to right, right to left, in a random fashion—as long as every item is given one count and only one count.
• Help children learn about change in quantities using sets.
• Comparing amounts in sets builds understanding of differences.
• Develop understanding of hierarchical order when one can see large sets can have smaller sets within the set.
• Mentally modeling real situations are examples of number operations.
• © Erikson Institute’s Early Math Collaborative
# Learning the Number Sequence

<table>
<thead>
<tr>
<th>Children’s Understanding</th>
<th>Examples</th>
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</thead>
<tbody>
<tr>
<td>Knows some number words, not the sequence</td>
<td>1,5,3,4,3,1</td>
</tr>
<tr>
<td>Knows some number words and partial sequence, not fixed sequence</td>
<td>First count: 1,2,3,7,5,4</td>
</tr>
<tr>
<td></td>
<td>Second count: 1,2,3,5,8,7</td>
</tr>
<tr>
<td>Knows number words and partial sequence, fixed sequence</td>
<td>First count: 1,2,3,4,5,7,9</td>
</tr>
<tr>
<td></td>
<td>Second count: 1,2,3,4,5,7,9</td>
</tr>
<tr>
<td>Knows number words, sequence and sequence is fixed to at least 6</td>
<td>First count: 1,2,3,4,5,6</td>
</tr>
<tr>
<td></td>
<td>Second count: 1,2,3,4,5,6</td>
</tr>
<tr>
<td>Knows that later numbers in the sequence are formed by repeating aspects of the previously used sequence</td>
<td>1,2,3,4,5,6,7,8,9,10,8,9,10,8</td>
</tr>
</tbody>
</table>
What did you notice? What is Logan’s level of understanding with the number sequence?
Developing one-to-one principle is not all or nothing.

Even after it appears children have an understanding, they develop a deeper understanding as they begin to understand the one-to-one process.
TURN AND TALK

- What did you notice about children who are developing one-to-one principle in the videos?
- How can you support development of one-to-one correspondence?
## Learning the Cardinal Principle

<table>
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<tr>
<td>States a random number; does not name the last number stated when counting</td>
<td>Counts the collection and last word is six, but responds “4”</td>
</tr>
<tr>
<td>Uses a non-number word to respond</td>
<td>Counts the collection and responds “lots”</td>
</tr>
<tr>
<td>Never states how many in a collection, only counts using number sequence and one-to-one correspondence</td>
<td>Recounts the collection again, last number word is 11. Counts and recounts but never says 11 in collection.</td>
</tr>
<tr>
<td>States the last number counted, but count is incorrect due to an error in the counting sequence or one-to-one correspondence</td>
<td>Counts the collection and last number is nine, responds “9” but there are only 7 objects.</td>
</tr>
<tr>
<td>States the last number counted and the count is correct</td>
<td>Counts the collection and last number said is eleven, responds “11” and there are eleven objects.</td>
</tr>
</tbody>
</table>
3.13 Fina 8 Rocks

3.14 Leonardo counts 15 bears
Organizing a collection helps support children as they develop counting principles.

Children often begin with counting objects in a pile, which may appear to be unsystematic to adults.

What is important is that the organization scheme the child uses makes sense to them.

Children need to understand the goal of organizing their collections.

Working with organization is an individualized experience for each child and it takes time to develop.
3.18 Christian
The counting principles develop concurrently and in relation to children’s experiences and existing understandings.

The counting principles do not develop in a set order or in the same ways for all children.
ACTIVITY

Recap what you learned about counting, write down 5 takeaways to try when helping children learn to count.

1.
2.
3.
4.
5.
"At my house #1 and #2 mean something else."
Strategic Teaching Practices that are deeply embedded in our pedagogical methods.

Five Key Strategic Teaching Practices
“Mathematize” is a term used to express the importance of helping children engage with the mathematics that is all around us.

Teachers use opportunities to “see” math around them and help children to “see” the math around them in their daily experiences.

This helps support developing problem solving skills by using meaningful situations to help children think about math.

Example: Counting items found on the playground, sorting items at lunch, using every opportunity to point out math concepts naturally.
#2-Make Math More Than Manipulatives (Gulp)

- Manipulatives are a great tool to use with children BUT we must help use them for mathematical purposes
- Math must be more than just “hands on” because math is an abstract concept
- Math should be represented in multiple ways, including: concrete experiences, symbols, pictures and language.
Receptive versus productive understanding

For example: A child may be able to compare two bowls and select the one with four items in it but may not be able to count out four items when presented with a bowl full of items.

While the child can find the bowl with four (receptive understanding) they cannot create it (productive understanding)
Consider the abstractions associated with math, many of the descriptive words used are attributes, rather than things (big, little, five, etc). These words focus on a quality, “the ball is big” or “there are five balls” describes a quality.

Math words also can be used to compare, such as: bigger, smaller, shorter, longer, heavier, etc. These, too, describe a relationship between objects.
#4-GET MATHEMATICS INTO CHILDREN’S EYES, EARS, HANDS AND FEET

- Multimodal Learning - Learning through engaging multiple sensory and action systems of the learner. Examples include: singing, dancing, jumping, storytelling.

- Research confirms the more modes the learner accesses the deeper the learning.
▪ Ensure children are experiencing favorite stories and routines many times as children enjoy these.

▪ Consider if the activity results in a positive experience for the child, each time it is repeated it will be a “value added” effect. If there are no new twists with the activity there are no opportunities to celebrate the learning that builds with each opportunity.

▪ When new ideas are presented in many different ways the child’s brain forms more connections.
Constructivist approach to supporting math learning. Teachers use children’s natural curiosity to build on their knowledge and develop problem solving skills.

Teachers guide daily experiences and opportunities and support children enjoy sharing their ideas with peers and you.
SUPPORTING MATH IN ROUTINES, & TRANSITIONS

- Provides opportunities for teachers to orchestrate engagement with counting and numbers.
- Provides opportunities for teachers to observe and learn about children’s thinking over time.
- Four primary areas to consider:
  1. Taking Attendance
  2. Returning Library books
  3. Lining Up
  4. Meals and snacks
ATTENDANCE

- Allow children the opportunity to count the number of children who are present.
- Expand on this as the year progresses by having children create sets (Example, how many children are wearing long sleeves?)
Encourage children to count the books they return each week.

(If you do not send books home with children create sets of random items and ask children to count them as they arrive)
Consider all the times children are required to line up each day and implement a variety of strategies you can use.

- Count together as child lines up
- Have child say their number as they get in line
- Count the total number of children in line after they have lined up
MEALS AND SNACKS

- Count together with children as they serve themselves
- Ask counting questions about food quantities
- Use meals as an opportunity to use effective questioning
GAMES TO SUPPORT MATH

- Shake and Build Game
- The Objects in a Pail Game
- Turn & Talk- What games have you tried and used successfully? Share your story.
The Shake and Build Game

Give children the cubes and a large die and have them roll the die then build a tower with the cubes that represents the number on the die.

As children get more comfortable ask questions that prompt math thinking skills, such as comparisons, creating sets, making patterns, etc.

Allow children to come up with their own “rules” and ask them to describe what they are creating and why.

Include math games in the classroom so children can play during center time.
PRETEND PLAY AND MATH

- Dramatic play offers many opportunities for practicing math skills
- Using tools during dramatic play, such as ten frames on cookie sheets
- Asking meaningful “how many” questions
• Quantities, how many, comparing, etc. are all supported in block area
• Engage children’s math thinking in ways that allow children to count collections
• Ask problem-solving questions
SMALL AND WHOLE GROUPS & MATH

- Bring math into story time, sample books will be shared
- Counting collections
- Children engage in counting, rather than watching the teacher
- Songs and movement activities that involve counting
LETS SHARE!

- Do you have any ideas or activities you would like to share?
- Review the materials shared.
- Discuss online resources, mini math books.
SUMMARY AND WRAP UP

- Math concepts should be embedded into every day routines and experiences.
- Math skills develop differently for each child, be patient and remember to individualize learning for each child.
- There are many great resources online, including The Erikson Institute, Graham Fletcher, Christina Tonddevold, and Build Math Minds to name a few.
MATH
Making Amazing Thinking Happen
Today’s Trivia: Who knows the name of the black dots on these dice?
Thank you!

Request for Power Point: lhales@mt.gov
MORE MATH TERMS TO BE FAMILIAR WITH