! Working in groups and developing tricks around barriers provides constructivist opportunity

1. Where does math fit in **this student's life** ---

for this year and as an ***ultimate destination***.

What the youth can do this year	Potential math ability
Short term goals: fractions, place value, number sense	**Long term or overarching goal** - functional math skills
NOW	**SOME DAY**

2. What is math and how does it help a student? It is not really multiplying, dividing, adding, subtracting and algebraic equations.

It is **the study of pattern and the use of patterns to solve problems.** It is embedded in life - and in life skills. Independent living is dependent upon having or achieving "math sense." It is so much a part of our lives that we don't think about it until we see someone who is missing it. Perhaps a student can't make change for a dollar. Possibly the youth doesn't know what size of container to get for the leftovers, can't double a recipe. For that matter, perhaps the student doesn't know the difference between a fractional and metric wrench.

3. What does math ability look like? Math success occurs when youngsters have the tools to:

form and remember associations	understand basic relationships
make simple generalizations	see and use patterns

From National Council of Supervisors of Mathematics

Math is an important art of living an independent life. It is important for students to feel successful while taking math classes - and it is important for them to have success in preparing for the myriad of ways that numbers, relationships, using patterns and problems solving. These are critical steps for insuring math success.

I. Assess the student's math skills.

Placement scores from the district or State achievement tests are a good start. Once a general level of numeracy is established, it is important to work, one-on-one with the student. Set up tasks that will allow observation of the way the student approaches a problem, and when possible, have the youth talk about what s/he is thinking as a task is performed.

At the fundamental levels, look for **classification** --  Emily (our imaginary student for this discussion) classifies coins by size and cannot overcome the notion that dimes really are worth less than pennies.

Ordering is difficult for many youngsters. It involves seeing a pattern and using it consistently, then being able to turn around and apply a different rule and rearrange materials to fit the changed rules. Emily can put clothes together by color, but she cannot make the leap to hot or cold climate apparel. She can match socks,

two by two, but cannot then put them in the drawer according to dressy or daily. She can make a row of X blocks or a row of O blocks, but putting them X O X O X O is too hard.

One-to-one correspondence is emerging. She can count blocks for about five items, and then she begins to group blocks and say one number, skip a block while counting, or say two numbers before changing to a new block. It comes as no surprise when we check on conservation skills, to find that they are not yet present. Emily can be fooled into drinking a smaller amount of soda by offering her a tall thin glass instead of a low fat glass of liquid. Her sisters do it all the time. Since these are emerging skills, and Emily has not yet mastered them, our conference with her will focus on math readiness. We can insist that she learn addition and subtraction facts, use flash cards or jump rope games to get her to learn the drills, but we cannot hope to build a math castle without a foundation. Basic skills are still our focus, because that is the point where Emily can have success -- and it is the area where she is motivated to push and press and learn.

The next areas for testing include the **underpinnings** for successfully completing and understanding operations - addition, subtraction, multiplication, division -- and basic axioms -- associative, commutative, distributive properties and inverse operations. These tap into the ability to recognize and use **patterns** and to generalize the patterns and associations from one set of experiences to another. Remember those basics for success in math?

Computation adds another dimension. This is where rigor, drill, practice, and order fit into math. Many youngsters see relationships and make generalizations, but the way they process information makes math success uncertain. When a student repeatedly gets the same kind of problem wrong, it is often the result of not knowing HOW to do the problem. Listen to a Bob's discussion while he solves the problem.

In this problem, 32 + 47, Bob says, "Three and two are five and four and seven are eleven, so the answer is 16." Bob does not see 32 as a distinct number and there is much work ahead, including teaching tens and units.
On the other hand, Mark says, "Thirty-two and forty-seven, hmmm. In the first column, the sum is 12 - put down a two and carry the ten over. . ." Ask further and it becomes clear that Mark reversed the two in his mind and saw it as a five. Mark has the necessary mathematical understanding, but it won't show up until he finds the tools to recognize when reversals are occurring and sets up a system to prevent this from occurring.

Both students get the problem wrong, but the reasons for errors are critical. We can see, by talking with the boys -- using informal assessment and determining the thinking that is occurring, that what we do for Bob will be completely different from what we help Mark learn to do for himself.

Assessment in Math

	Assessment is finding a way to tease out the background from the foreground. We know when a student is not understanding, but finding out why --- that is the piece that is so vital. Of course, we can use formal and informal assessments, but it will not give us as much insight as *. . . Asking the student what is working and what is not --- it actually helps them to identify that* *. . . and listening to the student as s/he self talks (what are you thinking while you work) and works out a math problem.*

Steps in math assessment usually include:

General readiness	those basics - relationships, 1:1, conservation, ordering or sequencing
Understanding of operations	conservation, commutative, associative, distributive
Specific skills	knows math facts, recalls and uses steps in computation, understands the processes

Problem solving sees the relationships and utilizes them in real life, in word problems, in verbal exchanges

Fluency and accuracy does the process correctly over and over again, can use speed, almost like solving the problems is second nature, consistently gets the right answers.

Using Timed Tests

"NO-NO"

Tests usually give us information about power or speed.

Power tests give students plenty of time to show ability and are looking for understanding. Speed tests assume that the student is already able to do the work, and just check for fluency.

Using timed tests to measure depth of student mastery is great.

Using timed test to determine power may "shut down" a student's ability to think and work, and contribute to math anxiety, decreasing student motivation to work and succeed in math.

A little adrenaline goes a long way..... 

It is important to understand brain function. Anxiety shuts down the cognitive processes and puts the entire body on alert status. When we use timed tests, it needs to be something the student chooses.

II. Honor the developmental nature of learning to understand math.

Piaget, Vygotsky, and many modern educators believe that being able to understand and utilize math is developmental. At the same time, there are a number of children who seem to have a knack for "knowing" or seeing patterns, relationships, generalizations in an age defying way, and without formal training.

Who didn't feel a sense of astonishment when the male character in "Rainman" (the movie) knew how many toothpicks fell on the floor? Who could help but be astounded when the boy in "Little Man Tate" (the movie) instantly knew answers to questions stumping other "genius" youth? Some students have a knack for understanding math, just like some children seem to be instantly successful at reading, while others struggle with each step forward.

Developmentally appropriate practice supports understanding that students need to be **ready** to take full advantage of material. We can promote that growth by getting students ready in every way possible. We cannot take the cognitive leap for a student. If we go on as though the leap occurred, we ultimately waste time, or worse, may make the tasks seem so impossible that the child's mind shuts down. Math anxiety occurs when a student feels forced to see what has not been "viewable" in previous attempts.

What we want to do is prepare the student, so when that moment of readiness appears, we can take full advantage of the energy and excitement that comes along with the cognitive leap. We want to utilize all the other ways to support the breakthrough by providing math worthy experiences that include patterns, opportunities for problem solving, counting, game playing, manipulating, until the "Ah-Ha" arrives.

Math for Emily and students who are not yet ready for an hour of formal "book" math each day or who are developmentally delayed can strengthen skills with game playing such as:

Bingo **Connect Four** **Tic tac toe** **Yahtzee with dice counting**

Board games with money counting, space counting, one to one correspondences
Adding and subtracting face values on cards
Following recipes for fractions, including doubling the ingredients for addition
Dominos for recognition of space, counting, estimating, memory
Nintendo games that require logic and keeping track of time and space
Computer games that emphasize rhythm, timing, speed, using numbers.

We also find that dance or dance exercise promotes rhythm, awareness of timing and counting. Opportunities to buy things using money, to count and recount money in the process of waiting for "enough" to purchase something can be very stimulating and facilitates memory for coins and numbers. Remember to use the phone, too. Many students love to communicate with the phone, and the play phone has a great number pad. We can use puzzles, dot to dot, music and singing to enhance her movement toward cognitive readiness to use numbers as separate entities. Emily, like so many others in high school, has an adult looking body, but her mind takes its own time to grow into math.

Recipe file of methods to help with math

Here are a potpourri of ideas, gleaned from many sources.

1. **Ruler use**

Measures 1,5,7,9, and 12 within 1/4 of an inch.
Converts the amounts in each to centimeters, correct to within 3 centimeters.

2. Popcorn Math

a. Measure 1/2 cup of raw unpopped corn
b. Estimate how many kernels of corn are in that 1/2 cup.
c. Count the kernels. There are _____ kernels.
d. Were you over or under? _____
e. Estimate how many cups of popped corn you will get.
f. Pop the corn, then measure it.
g. Cups of corn, popped _____.
h. Were you over or under? _____
i. How long a strand of corn can be made from this?
j. String the corn.
k. Measure in feet _____, yards ____ inches _____, meters _____.

3. French Fry Sort

a. The students are asked to sort out the three sizes of fries, brought in by them or a teacher.
b. The number of fries in each is counted.
c. The number of fries in each is weighed.
d. Students determine the average weight of one fry _____ ounces; grams _____
e. Students compare amounts in each and determine the cost of each fry in the different package sizes.
f. Students try different ways of determining the proportion of fries from one size to another.

4. **Hershey Bar Happiness** (milk chocolate, no almonds)
   a. Measure the candy bar in inches and centimeters.
      Length in inches_____ in centimeters _____
      Width in inches_____ in centimeters _____
   b. Count the sections _____.
   c. Write on a piece of paper, the fraction that tells how much you prefer, 1/2 or 1/10.
   d. Teacher comes around and gives each student the piece size they chose.

5. **Hershey Bar II**
   a. Break the bar in half
   b. How many sections are in each half _____ ?
   c. How many sections are in each 1/4 _____?
   d. Measure one square or section _____ inches _____ centimeters
   e. One section is 1/____ of the whole bar.
   f. Break the sections all up and put them in a row.
   g. Measure the row _____ inches _____ centimeters.

Eat two sections. Measure the remainder _____ inches _____ centimeters.

Remember some of the following as worthy practice:

1. We all grow - and we continue to grow most of our lives, so if the student isn't ready today, practice patience.

2. Growth has it's own individual calendar and one of the best ways to enhance growth is safety. When we feel safe, we reach out for stimulation. When we feel anxious, we tend to retreat.

3. Play is one of the natural tools for growth. It is appealing and motivating, so it supports many hours of on-task practice and experiences.

4. In that same way, role-playing is powerful. Asking a child to "be teacher" is a powerful way to involve the creative energy and focus of the child toward "understanding" so they can relay the ideas to others.

5. The child probably does not really "know" what is best for the self, but attending to the nonverbal cues, natural excitement, and things the child is drawn to can help us make the most supportive plan for growth.

6. Good timing, snacks and exercise can support learning. We utilize them in earlier grades, and often forego them as children get older and have better physical discipline, but they are still very powerful.

7. Feeling powerful and "in control" is part of feeling safe. When students are empowered to learn, to set times and tasks rather than being forced, they learn much faster. When children feel trusted and supported, they can give us their best. When they feel important and valued, respond in kind. If a child is not responding positively, it is crucial to model those responses so the youth can learn.

III. Honor the individual.

In the second grade, students seem to have a lot of persistence, motivation, belief that they can accomplish, joy in learning, need to know. It is often necessary for a teacher to bandage up blistered hands, for children who are learning to swing on the monkey bars will go back out and defy the painful blisters in order to master the skills. This type of single-minded focus is the hall mark of developmentally appropriate practices. When a student has that kind of intensity and focus, the right things are being taught. If that is not the response we are getting, we should seriously search for that "magic"