Chicago HOPES for Kids Math Programming

We want to keep students engaged both in the short-term during program hours, and also in the long-term by helping develop confidence not just in their own intelligence, but also in their ability to succeed and overcome the combined challenges of school and homelessness.

TIPS FROM FORMER SITE-COORDINATORS:

- **Make an effort to be trauma-informed.** Many students in our programs have experienced significant traumas. People cope with traumatic experiences and the psychological after-effects in various ways. Behavior that you consider inappropriate should be considered with this in mind. Trauma can have significant and lifelong effects on working memory, ability to shift focus, and executive function among many other mental and emotional tasks.

- **Be positive about the subject.** Many people have negative experiences with math. Be careful not to pass these negative sentiments on to students. It might seem that sharing your negative experiences with math could help them feel better about having trouble, but passing this negativity along may hinder them in the future.

- **Don't give them the answer**: Instead, break problems into smaller pieces. Ask questions that could spark an 'a-ha moment.' We can encourage students to make an investment in their own learning process by asking open-ended questions that provoke creative thinking (see below).

- Use hands-on manipulatives to model the problem. For example, if we have 3 + 5, get a group of 3 paper clips and add 5 more. Count to get the result.

- Point out the similarities between homework problems and **real life situations**. Try to involve **their personal interests** in math homework help sessions. Active listening and open-ended questions can help provide material for this.

- Remember that different students will have **different ages, ability levels,** and **learning styles**. If one approach doesn't work, try another.

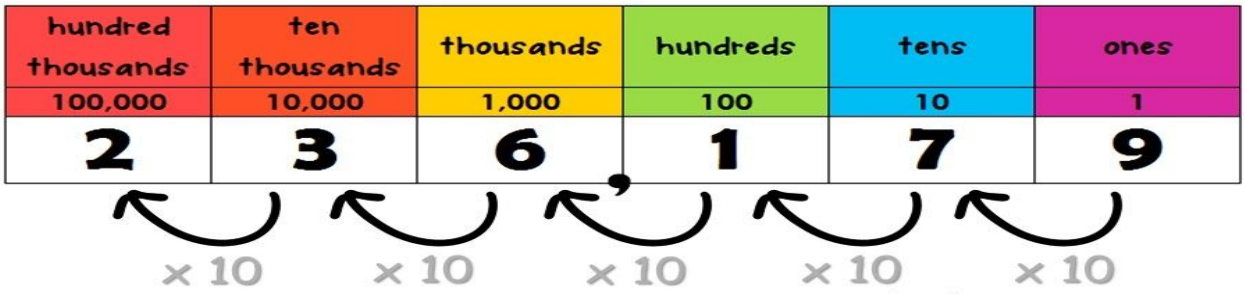
- If you have problems with the subject matter, **talk with your site coordinator during debrief.**

TOOLS / RESOURCES:

You will have reference materials available on-site to use as visual aids for math homework. These will include a number line, a times-table, a hundreds chart, a place value chart, a clock face. Other materials can be provided upon request.

FOUNDATIONAL CONCEPTS IN K-5 MATH:

Place Value: The idea of *place value* is the basis for our system of writing numbers. Most ways of solving problems involve place value more or less directly. Our number system is called *base-10* because each place takes the value of a power of 10. This is why it is so convenient to do arithmetic with 1s, 10s, 100s etc.



Composition and Decomposition: Work smarter, not harder. It might be hard to add 232+462 but if you decompose the large numbers into groups of ones, tens and hundreds it might be easier to work with. Below is an example:

238+467 = (200+400) + (30+60) + (8+7) = 600 + 90 +15 = 705

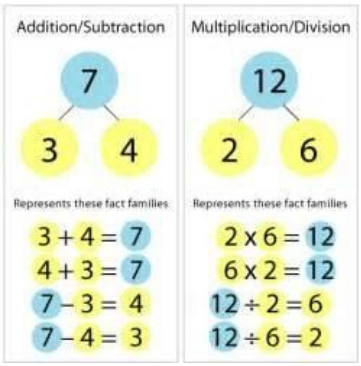
Techniques such as this also reinforce an understanding of place value. In the previous example, we added the hundreds tens and ones separately.

Contextualizing and Decontextualizating: An important ability is to see a problem as an instance of a more general type of problem. In order to practice this, it may be helpful to use examples relating to real life or to the student's personal interests.

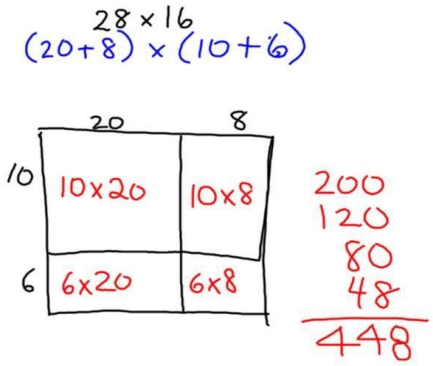
Arithmetic Fluency: Fluency with simple arithmetic is a good foundation for solving more difficult problems. The less a student has to focus on calculating, the more a student can focus on gaining a deeper understanding of the material (again, see *How to Ask Questions* below.) A good way to build the foundations for fluency in arithmetic is to practice skip-counting. For example, finding 7x8 will be easy if we know how to count by 7s.

The Connections Between Geometry and Arithmetic: Most concepts in arithmetic have analogous concepts in geometry. A good example is multiplication. If we take advantage of the fact that the area of a rectangle is equal to the length times the width (a = l x w), then when we are faced with a multiplication problem we can imagine a rectangle to get started.

APPROACHES FOR WORKING ON FOUNDATIONS:



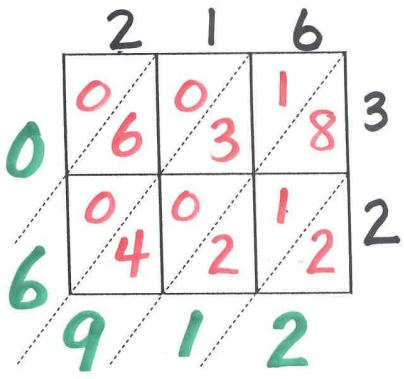
Number Bonds: A simple way to visually model composition and decomposition by both addition/subtraction and multiplication/division. Along with skip-counting, number bonds are a good way to build basic number sense.



Box Method Multiplication: A good example of a useful connection between arithmetic and geometry. Seeing connections like this will make both subjects easier.

Step 1) Decompose numbers to be multiplied into ones and multiples of ten (and hundreds if the required.)
Step 2) Draw a rectangle and partition it according to how you decomposed the previous numbers
Step 3) Solve the simpler sub-problems
Step 4) Add the results of step 3.

'Lattice' Multiplication: A creative, but slightly more advanced place-value strategy for multiplication.



Step 1) Set up an *a x b array*, were *a* is the number of digits in the first number to be multiplied, and *b* is the number digits in the other number to be multiplied. Fill in the numbers themselves at the heads of rows/columns.
Step 2) Draw diagonal lines through the boxes as shown to the left. Each diagonal region will have a *place value* at the end.
Step 3) Multiply rows and columns to fill in the boxes, placing the 10s value on the left side of the diagonal and the 1s value on the right side (for example, the bottom right box represents 2x6=12).
Step 4) Add the numbers from the diagonal regions, carrying tens from one diagonal to the other as in regular addition (for example, see the 2nd and 3rd diagonals *from the right* in the example)

Step 5) The right-most diagonal zone is the 1s place, increasing by factors of 10 as we move to the left.

Adding Up Subtraction: The "adding up" method helps students develop an intuitive, visual idea of subtraction. The number line is a good tool for this type of problem. Developing this type of basic intuition creates a strong foundation for learning the old-fashioned methods (those which involving borrowing, etc.) To find the *difference*, we start with the *subtrahend* (number to be subtracted) and strategically add numbers until we reach the *minuend* (number from which the subtrahend is to be subtracted.)

A = 72 , B = 56

Step 1) Start with the number *to be subtracted (A).* In this case, 56.
Step 2) Add 4 to reach 60, a multiple of 10.
Step 3) Add multiples of 10 until you get near (*B*), the number *to be subtracted from*. In this case, 72.
Step 4) The sum of all the previous steps is the *difference,* in this case 16.

Skip-Counting: Skip-counting is a good foundation for arithmetic fluency. For example, if we know how to count by 7s, then we know that 7x12 is just the 12th term in the sequence. Skip-counting internalizes these patterns so that when we learn to calculate multiplication problems we are working with familiar territory. A good way to practice this is to color in skip=counting patterns on a hundreds chart.

counting by fours

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Skip counting by fives

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

counting by Sevens

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

SOME TUTORING SUGGESTIONS:

Structure your session:

1. Say hello. Let the child talk about their interests and their day. Gently shift topic to homework. This is important because it allows the child time to shift gears. This also provides a great opportunity to learn some about the student's personal interests.
2. Set Goals for the session. This sets you up to provide feedback and gives direction to the session. These goals can be used to show students that they are progressing toward something.
3. Work on Homework
4. Debrief: talk with the child about how they think the session went.
5. If there's time, talk with them about something other than homework.

Numeracy

Numeracy compliments literacy and can be thought of as "numerical literacy." Therefore, some of what you know about literacy can cross-apply to math. Considering for the following elements may help determine what the student needs to practice.

1. Decoding - does the child understand what the symbols stands for?
2. Fluency - does the child interpret the meaning of symbols in sequence?
3. Comprehension - does the child understand the meaning of a sequence of symbols, or do they simply read through them?

An example: the Equals Sign, a standard from First grade.

In first grade, a child is expected to understand the meaning of the equals sign. This requires that a student first be able to Decode the symbol. They must recognize the symbol and what it indicates. After a child can successfully decode the symbol, they must see how it functions in context. This means that, for example, a child who decodes “2+4=6” means that when you have 2, and you add 4, you get 6. ‘Comprehension’ refers to a child’s deeper understanding of the expression. To check for this, you might ask the student to explain in words what the symbol means. Does the child understand what would happen if the symbol were replaced with another, or if it were moved to a different place in the expression? For example, does the child understand that ‘1+1=2’ and ‘2=1+1’ have the same meaning?

Scaffolding

Scaffolding as a tutoring technique means giving students support to build towards independent understanding. We help do this by reinforcing and deepening what they are learning. Steps for this might include includes 1) checking to make sure we have a good understanding of vocabulary necessary to engage the problem 2) connecting this terminology to previous knowledge and understanding and finally 3) making a picture. Try this approach when a child is starting to feel frustrated to make good use of the student’s limited patience and enthusiasm.

1. Review or Learn the Vocabulary: Sometimes a student might already have an idea of what they are trying to say, but simply lack the vocabulary to express it. Other times, a child might be unclear on the meaning of a key term. Check to make sure that you and the child having a mutual understanding of important vocabulary. This will help a child with *decoding* the symbols, which is necessary to attain the *fluency* which would allow a child to practice and learn the material on the level of *comprehension*.
2. Connect the problem to previous knowledge. Given the inter-relational nature of mathematics, which is emphasized in the Common Core curriculum, this is an important step for establishing deeper levels of *comprehension.*
3. Make a picture to represent the problem. Once we have a picture drawn, the student can rest their *working memory*. We can take a step back and ponder the situation, possibly noticing things that we hadn’t noticed before such as real-world connections.

TIPS FOR ASKING QUESTIONS AND ACTIVE LISTENING

"Judge someone by their questions rather than by their answers." - Voltaire

When you ask a question, you need and idea of what answer you are looking for. Do you want a piece of information? An opinion? A judgment? Remember that the form of your question will determine the type of answer you get. We should keep in mind that our objective is to *guide the student along a path that will lead to understanding.* Be an active listener by being mindful of your facial expression and body language, and by not interrupting. You can take notes while they are talking if you need to in order to not forget ideas you had while they were talking.

1) **Ask open-ended questions, not yes/no questions.**

- Answering open-ended questions require engaging with the question. Closed-ended questions only have one correct answer. There are multiple disadvantages to this sort of questioning. They require a person to pause, think, and reflect.

- When using open-ended questions, the control of the conversation switches over to the person being asked the question, which begins an exchange between the people. If the control of the conversation stays with the person asking questions, you are asking closed-ended question.

2) "Funnelling questions"

- Funnelling questions are questions that begin very specific, such as "is 42 and odd or even number" and then gradually become more open-ended.

- This makes sure the student is on track before encouraging creative thought, thus increasing the chance that the creative thought will be focused and productive.

3) Clarifying Questions

- If you aren't sure what a child is talking about, ask them to clarify. Use open-ended questions to hear more of their thought-process and closed-ended questions to guide them to important points. For example, we might ask open-ended questions until we come to realize that a student misunderstands a certain key term, at which point we will ask them a yes/no question regarding that term.

- Even if they are understanding quite well, clarifying questions allow students to develop their own understanding more deeply on their own terms.

4) Follow up Questions

- Ask follow up questions. For example, "What did you mean by that?"
- Be comfortable letting the student think quietly for a few moments.