

GENERAL MATH STRATEGIES

Move from Concrete to Abstract

Regardless of what types of approaches are used, learners need to move through the four basic levels of understanding.

- **Concrete:** On this level we are appealing to the senses, and the learner is able to see, touch, and move objects (“I have \$5 in one hand and \$10 in the other. I am holding \$15”)
- **Semi-concrete:** Here we move from real objects in front of us (dollars) to a pictorial representation of the real objects. There must be a transfer step from what is physically present (concrete) to the representative drawing (semi-concrete).
- **Semi-abstract:** As soon as we introduce symbols, we have moved into the beginning of the abstract level. We have a symbol for 5 dollars, 5 pencils, etc. We use the symbol “5” no matter which objects we are representing. This is the abstraction.
- **Abstract:** The fourth level is the true abstract level. For example, *two times anything plus four times anything* will always be *six times anything*: $2a + 4a = 6a$.

Before introducing a skill, move through these levels of understanding. If learners don’t understand a concept, let them experience it concretely first (e.g. clothespins on a hanger, poker chips, dice). Let learners communicate orally, becoming comfortable with the language, and let them demonstrate the problem before solving it (“2 clothespins plus 3 clothespins equal how many clothespins?”).

Use Manipulatives

- Slows down the process of explanation so learners have more time for understanding; learners control the pace of the work.
- Provides memory cues for different kinds of learning; reinforces the meaning of operations.
- Helps every learning style (visual, auditory, tactile-kinesthetic)
- Ensures learners almost always get the right answer; rather than having to deal with an error, you can work on extending understanding, or helping your learner articulate the concepts.

Encourage Discovery with Questioning

Encourage learners to find patterns and make connections about how they found answers. Questioning enables learners to discover errors on their own and helps with self-monitoring.

- How do you...?
- What patterns did you find in...?
- How do you use ... in everyday life?
- Explain in your own words what ... means.
- What would the problem look like in a picture?
- What is another way that you could have found the answer?

Reinforce the Language of Math

- Learners may want to make a personal math dictionary; they have background knowledge on specific vocabulary words common in mathematics. However, some terms may be unfamiliar or confusing to them. A chart or notebook of words with their own definitions, pictures, connections, and examples that make sense to them can help.

- Use synonyms for math terms during your discussions (your learner may be most comfortable at first with “take away,” but gradually introduce *subtract*, *difference*, *fewer*, *how many more*, *minus*, *left*, etc.). The terms are much less intimidating if they’re introduced during discussion.

Use Mnemonic Devices

These can improve initial learning and later recall. Make sure learners understand the vocabulary used in the steps. It may be helpful for learners to write the mnemonic steps on an index card to serve as a cue during initial attempts at using the strategy.

Model Self-Monitoring

Encourage learners to monitor their own math work, recognize errors or answers that do not make sense, and then begin to self-correct their mistakes. Doing this greatly increases the likelihood that learners will be able to apply their math learning beyond the classroom environment. Some learners respond well to checklists they can follow for computations with many steps.

Facilitate Goal-Setting

- Guide learners through a self-evaluation of their progress.
- Listen to ideas; if necessary, lead learners to revise their goals realistically by asking open-ended questions.
- Encourage learners to set easy, average, and difficult goals.
- Map the long-term goal and steps so learners can track their progress and adjust as necessary.

Provide Advance Descriptions

Descriptions provided at the beginning of a math lesson help learners prepare for instruction. Explain what the lesson is going to be about, provide a rationale for learning the content, and tie the current lesson to previous learning.

Model Strategies

While showing how to solve a problem, verbalize what you’re thinking; this “think aloud” helps learners understand the cognitive process. “To solve this problem, I’m going to read it first and try to remember the answer. 15 take away 9... hmmm... I can’t remember the answer so I’d better use my counting-up strategy. To use this strategy, I look at the bottom number, 9, and count up until I get to 15. I’ll keep track of how many numbers I count to get to 15 by drawing tally marks. 10, 11, 12, 13, 14, 15. I drew six tallies, so my answer must be six. I think I’ll do this one more time to be sure I’m right.” This gives learners a method for determining unknown answers and reinforces the importance of self-checking for accuracy.

Give Specific Feedback

Use positive comments to reinforce when learner does something correctly, note specific error patterns, then discuss and demonstrate how to complete the problem using a strategy (maybe a different strategy if the current one clearly isn’t working).

Create Real-Life Problems

Share real-life word problems with your learner as often as possible (“I have to stop at the grocery store after our lesson, but need to be home by 4 p.m. If it takes me 30 minutes to get home, how much time will I have to shop?”) Doing an application problem is a great test to see if learners have thoroughly mastered a concept and helps learners recognize the value of math.

Start with Warm-Up Activities

Before teaching a new concept, review the pre-requisites with a few easy problems or a verbal check to make sure learners have a foundation before moving forward. If learners struggle, spend time reviewing and reinforcing before progressing.

Use Relationships of Numbers

Explain these while teaching concepts. If a learner understands the relationship between multiplication and division, knowing multiplication facts can assist in determining the answer to division facts.

Use Explicit Instruction

1. Provide clear explanation (I DO)

- Introduce the strategy and its steps
- Discuss the rationale of the strategy
- Connect with previous learning

2. Model the learning process (I DO)

- Model the skill by doing—correctly, clearly, concisely
- Model using think-aloud

3. Engage in scaffolded practice (WE DO and YOU DO)

- Engage in short practice exercises with feedback
- Check on understanding and use of skills
- When learner shows 80% accuracy with new skill, transition to YOU DO with independent practice
- This is when learners can fully develop the skill on their own

4. Provide effective feedback

- Must be immediate, positive, and corrective throughout

Quick Tips for Teaching Math:

- Avoid memory overload by assigning manageable amounts of work for practicing skills
- Teach one new rule, concept, or strategy at a time
- Reduce the amount of information on a page
- Isolate steps to make sure learners focus on one step at a time
- Relate activities to prior learning as well as real-life situations
- Use visual representations such as manipulatives, pictures, drawings, charts, or graphs
- Use uncluttered worksheets or tools such as graph paper to keep numbers aligned
- Explore different approaches to problem solving and learning math facts
- Move through the basic levels of understanding: Concrete to Abstract
- Teach specific problem-solving strategies

Fostering Mathematical Mindsets

- Encourage learners to constantly look for patterns and connections, play with numbers, talk, question, and predict.
- Focus on work, effort, struggle and persistence
 - Realize that hard work is the key to success, not natural ability
- Choose challenging tasks and focus on strategies rather than end outcome. Reflect on strategies that work and don't work
- Face setbacks. See mistakes or dead ends as opportunities to learn more. Mistakes grow your brain!
- Encourage questioning
 - Ask yourself, "WHY does this make sense? Does it work in other cases?"
- Give homework that promotes reflection
 - Exit Interviews/Homework Questions
 - What was the main idea you learned today?
 - What is something you're struggling with or still have questions about?
 - How can you use the ideas you learned about today in real life?
 - Three things I learned today
 - Two things I found interesting
 - One question I have

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The Power of YET

I can't do this...*YET*

I'm not good at this...*YET*