The Mathematical Habits of Mind
A Guide for Families

West Virginia math4life

There are ways of thinking, or habits of mind, that students need to develop and use when talking about the problems they are solving and the math they are learning. These habits help the student make sense of the content and support the mathematics used in everyday situations. The Mathematical Habits of Mind (MHM) are important because solving problems and making sense of math gives students an advantage when seeking employment or higher education.

MHM1. Make sense of problems and persevere in solving them.
There are several important behaviors to look for to meet this habit of mind. When a student encounters a problem that is unfamiliar or challenging they employ multiple strategies and work through the problem. Students should be encouraged to remember similar problems or build on what they already know to keep working. Parents should encourage them to think through the problem, break it down into smaller parts, create a picture or diagram, or use objects to help them "see" the problem. If one strategy does not work, they try another.

Questions families can ask their child to help develop this skill:

- Can you think of the problem in a different way?
- Can you think of a problem that you have solved before that is like this one?
- How will you go about solving the problem? What is your plan? Are you making progress toward solving the problem? Should you try a different plan?
- How can you check your answer? Can you check using a different method?

MHM2. Reason abstractly and quantitatively.
When students "reason quantitatively" they use different strategies to help them make sense of numbers. They may create a model with objects to explain their thinking. They may make a chart or a table to figure out if there is a pattern or other familiar connections. Students must also be able to think logically about the numbers and symbols in the problem. To do this, they need to know the meaning of the mathematical symbols and how those symbols are connected. If students are working on a word problem, they should be able to represent it with pictures, diagrams, an expression or an equation. If they are working on a numbers-only problem, students should be able to think of a situation the numbers could represent: 2 + 3 = 5: Mary has two cookies and Bill has three cookies, together they have five cookies.

Questions families can ask their child to help develop this skill:

- Can you write or recall an expression or equation to match the problem situation?
- Can you say the problem in words and numbers?
- To what do the numbers or variables in the equation refer?
- What's the connection among the numbers and the symbols or variables in the equation?

MHM3. Construct viable arguments and critique the reasoning of others.
Students are expected to make and defend a mathematical statement. They justify their conclusions, are able to communicate to others what they think and explain their reasoning. They also must be good listeners. Students should listen to and think through other students' reasoning when solving problems and determine whether the reasoning makes sense or leaves questions. Students ask questions of others to clarify their thinking. A viable argument in mathematics is based on evidence, data, and processes in thinking.

Questions families can ask their child to help develop this skill:

- Tell me what your answer means.
- How do you know that your answer is correct?
- When provided a problem with an incorrect answer, how would you question another person's thinking and explain your understanding of the problem?
- How can you share your thinking in a respectful and logical manner?

MHM4. Model with mathematics.
Students are able to apply mathematics to a real-life situations. They can apply proportional reasoning to help plan a dinner or party or analyze a problem in the community. They know the important quantities in a situation and can devise a mathematical problem or equation to get an answer. Students should be able to explain their thinking and the strategies they used to solve the problem.

Questions families can ask their child to help develop this skill:

- How can you use math to solve this problem?
- What connection to the situation applies to the numbers in the problem?
- Is your answer reasonable? How do you know?
- Can you use this same thinking to solve a similar problem?

MHM5. Use appropriate tools strategically.
Students have multiple tools at their disposal to help with mathematics. They can use drawings, tables, charts, graphs, and/or words to help them find solutions. They should consider which tool might help them as they solve the problem. Some tools are more efficient. Students may experiment with different tools to help them solve the problem until they find the tool that will help them find the solution.

Questions families can ask their child to help develop this skill:

- What tools can you use to solve this problem? How can each one help you?
- Which tool is more useful for this problem? Explain your choice.
- Why is this tool (the one selected) better to use than (another tool mentioned)?
- Before you solve the problem, can you estimate the answer?

MHM6. Attend to precision.
Students are precise (a) in their communication so others understand what they mean; (b) in their calculations; and (c) in their explanations of what the work or data they are presenting means. They use the precise language of mathematics, use terms accurately, and label their work with care.

Questions families can ask their child to help develop this skill:

- What do the symbols that you used mean?
- What units of measure are you using?
- Explain the terms you are using. What do they mean?
- How do you know your work is precise?

MHM7. Look for and make use of structure.
Students look closely at a problem to determine if there is a pattern or structure that will help them. Mathematical structures include the number sequence, the place value system, properties of operations, and patterns that can be generalized, such as the formulas for finding area or the inverse relationships of addition and subtraction and of multiplication and division. They ask themselves questions like, "Would making parallel lines help with a geometry problem?", "Are these all square numbers?", or "What do I know about equivalence that could help me with this fraction problem?"

Questions families can ask their child to help develop this skill:

- What do you notice about the answers to the exercises you've just completed?
- What do different parts of the expression or equation you are using tell you about the possible correct answers?
- Do you notice patterns or connections to other problems?

MHM8. Look for and express regularity in repeated reasoning.
Looking for and expressing regularity in repeated reasoning is closely related to making use of structure. Students look for the results that happen over and over again and/or figure out how to generalize a shortcut. They can recognize similarities and patterns that emerge in repeated trials.

Questions families can ask their child to help develop this skill:

- What shortcut can you think of that will always work for these kinds of problems?
- What pattern(s) do you see? Can you make a rule or generalization?
- Does this reasoning apply to math you have previously learned?