Standards for Mathematical Practice - Fifth Grade Specific

Mathematical Practices are listed with each grade's mathematical content standards to reflect the need to connect the mathematical practices to mathematical content in instruction.

The Standards for Mathematical Practice describe varieties of expertise that mathematics educators at all levels should seek to develop in their students. These practices rest on important "processes and proficiencies" with longstanding importance in mathematics education. The first of these are the NCTM process standards of problem solving, reasoning and proof, communication, representation, and connections. The second are the strands of mathematical proficiency specified in the National Research Council's report *Adding It Up*: adaptive reasoning, strategic competence, conceptual understanding (comprehension of mathematical concepts, operations and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately), and productive disposition (habitual inclination to see mathematics as sensible, useful, and worthwhile, coupled with a belief in diligence and one's own efficacy).

Students are expected to:

1. Make sense of problems and persevere in solving them.
Students solve problems by applying their understanding of operations with whole numbers, decimals, and fractions including mixed numbers. They solve problems related to volume and measurement conversions. Students seek the meaning of a problem and look for efficient ways to represent and solve it. They may check their thinking by asking themselves, "What is the most efficient way to solve the problem?", "Does this make sense?", and "Can I solve the problem in a different way?"

2. Reason abstractly and quantitatively.
Fifth graders should recognize that a number represents a specific quantity. They connect quantities to written symbols and create a logical representation of the problem at hand, considering both the appropriate units involved and the meaning of quantities. They extend this understanding from whole numbers to their work with fractions and decimals. Students write simple expressions that record calculations with numbers and represent or round numbers using place value concepts.

3. Construct viable arguments and critique the reasoning of others.
In fifth grade, students may construct arguments using concrete referents, such as objects, pictures, and drawings. They explain calculations based upon models and properties of operations and rules that generate patterns. They demonstrate and explain the relationship between volume and multiplication. They refine their mathematical communication skills as they participate in mathematical discussions involving questions like "How did you get that?" and "Why is that true?" They explain their thinking to others and respond to others' thinking.

4. Model with mathematics.
Students experiment with representing problem situations in multiple ways including numbers, words (mathematical language), drawing pictures, using objects, making a chart, list, or graph, creating equations, etc. Students need opportunities to connect the different representations and explain the connections. They should be able to use all of these representations as needed. Fifth graders should evaluate their results in the context of the situation and whether the results make sense. They also evaluate the utility of models to determine which models are most useful and efficient to solve problems.

5. Use appropriate tools strategically.
Fifth graders consider the available tools (including estimation) when solving a mathematical problem and decide when certain tools might be helpful. For instance, they may use unit cubes to fill a rectangular prism and then use a ruler to measure the dimensions. They use graph paper to accurately create graphs and solve problems or make predictions from real world data.

6. Attend to precision.
Students continue to refine their mathematical communication skills by using clear and precise language in their discussions with others and in their own reasoning. Students use appropriate terminology when referring to expressions, fractions, geometric figures, and coordinate grids. They are careful about specifying units of measure and state the meaning of the symbols they choose. For instance, when figuring out the volume of a rectangular prism they record their answers in cubic units.

7. Look for and make use of structure.
In fifth grade, students look closely to discover a pattern or structure. For instance, students use properties of operations as strategies to add, subtract, multiply and divide with whole numbers, fractions, and decimals. They examine numerical patterns and relate them to a rule or a graphical representation.

8. Look for and express regularity in repeated reasoning.
Fifth graders use repeated reasoning to understand algorithms and make generalizations about patterns. Students connect place value and their prior work with operations to understand algorithms to fluently multiply multi-digit numbers and perform all operations with decimals to hundredths. Students explore operations with fractions with visual models and begin to formulate generalizations.

Teaching Math: A Video Library, 5-8

Fraction Tracks

Video Overview

Hilory Paster explains the "Fraction Tracks" game to her fifth–grade class. Students draw fraction cards from a deck and move markers on their game boards, trying to get them all from zero to one. In the game, students often have to rename the fraction they draw as the sum of two or more fractions. They also use equivalent fractions.

Ms. Paster walks around the room as the students play, helping them when they get stuck and asking them questions. At the end of the lesson, students share strategies they used in the game.

Prior to this lesson, students studied fractions and equivalent fractions. They made giant fraction number lines that are posted around the room.

An Exploration for Teacher Workshops

Materials: fraction tracks (below), dice or number cubes, six markers per pair

Work in pairs to play—for at least a few turns—a version of the fraction tracks game. The rules are in the box at left.

Some Questions

1. When do you have to use equivalent fractions?
2. In what situations can't you move? What would be a good rule to use for such a situation?
3. What other techniques could you use to generate fractions?
4. This game has no tenths (the one in the video does). Does that create any problems? Are there advantages or disadvantages to having tenths?

Additional Discussion Topics

Here are some additional ideas for discussion that arise in the video:

- Some students might use the fraction track sheet itself to find equivalent fractions. Is that a crutch or a path to understanding?
- How does Ms. Paster interact with the students? What questioning strategies does she use?
- Discuss the role of correct mathematical terminology and how Ms. Paster does or does not encourage its use in this video.

Assessment

- How does Ms. Paster check for understanding as she moves around the room?
- Discuss the role of student presentations from an assessment point of view.
- During presentations, Ms. Paster sometimes has students rephrase each others' explanations. She says that having students rephrase others' statements acts "as an assessment for myself." What do you suppose she means by that?
- Students were asked to write "two to three possible moves" for each turn on their strategy sheets. Can you use these sheets as assessment tools? What could you learn from them? What is another kind of recording you might have students do as an assessment?

Discussion Questions

These questions appear at the end of the video. Here are some follow–up ideas and prompts to help get a discussion going.

What are the pros and cons of using cooperative games?

There are really two issues to consider: using games at all, and whether to use cooperative, rather than competitive games.

First, the games: Ms. Paster used an entire period playing this game and discussing it. She could have done a more traditional lesson with more structure and practice. Was the game worth that much time? When are games appropriate? Did Ms. Paster learn anything about her students she would not have learned otherwise? Do games help all students equally?

Second, cooperation: You could play the fraction track game with the goal of being the first to get your pieces to 1. Some teachers say that competition, carefully managed, gives students additional motivation. What do you think?

How do materials such as fraction pieces enhance student understanding?

At one point, some students used fraction pieces to find fractions that add up to 7/8. Later, some students studied 9/10 using fraction pieces. What specifically do fraction pieces help students to understand? Did you have any insights about fractions (or students) watching the segments with fraction pieces?

These students knew the fraction pieces were available in the room and decided on their own to use them. Discuss management strategies for open access to materials.

How could this lesson be extended?

One way to generate extensions is to vary elements in the activity. What if you used different denominators? Different cards? Decimals and percents on the cards? Decimals on the number lines? Describe how you would use each extension. Can you think of extensions to make the activity simpler or easier?

Ms. Paster planned to play the game again with a number line that extended from 0 to 2. Is that a significant extension? From what you know about students learning fractions, what additional problems will they face? What else will they learn?