

# THE GUIDING PRINCIPLES FOR WRITING QUESTIONS AND INSTRUCTIONAL MATERIALS

Problem solving items written will:

- Emphasize conceptual understanding and the meaning of rates
  - By building on student intuition
  - By having important, useful mathematics embedded in it.
  - Since students build understanding by reflecting, connecting, and communicating, the problems will encourage them to use these processes.
  - Critical concepts and skills will be covered and have the potential to engage students in making sense of mathematics.
- Teach a variety of strategies
  - Use a variety of time and distance units so that students develop a clear understanding of the fundamental structural relationship.
  - Continued practice should use skills and procedures in situations that connect to ideas that students have already encountered.
  - Finding a unit rate as one method
- Regularly involve mental math
  - And help students understand when it is appropriate use mental computation.
  - To require students to think logically about a problem and their answer.
  - Students need to know how and when to use paper-and pencil algorithms, mental computation, calculator procedures, and estimation strategies.
  - They need to recognize when an exact answer is required and when an approximate answer is sufficient, and they need a variety of methods for finding an answer.
  - In some situations an approximate answer is sufficient and in these situations a paper-and-pencil algorithm may not be the most efficient (or practical) method.
- “Smuggle in” other Illinois Learning Standard objectives
  - By including fractions and decimals.
  - Work on the problem should promote skillful use of mathematics and opportunities to practice important skills.
- Utilize dimensional analysis with understanding as the cornerstone
  - Thinking about the problem logically.
  - Use the units and label everything.
- Be written so that they are understandable by the everyday citizen
  - So that students understand them thoroughly.
  - In able to show the students that it is a skill needed in the ‘real world.’
  - It is important to allow students time to struggle with the underlying challenges.

- Introduce students to a wide variety of applications from agriculture to zoology
  - To get their interest and teach them real-world applications.
- Be in an applied context
  - The mathematical content of the problem will connect to other important mathematical ideas.
  - Immediate practice should be related to the situations in which the ideas have been developed and learned.
- Be cross curricular
- Often ask the student to make an informed decision
  - Meaning the solution of the problem will require higher-level thinking and problem solving.
- Avoid a formulaic/"cookie cutter" approach by students by providing
  - Mixed practice
    - So they can learn to look at a problem independently of others and adapt to each problem.
    - To allow ideas, concepts and procedures to reach a high level of fluency of use in familiar and unfamiliar situations and to connect to other concepts and procedures.
  - Extra information in the problem
    - To teach students to "weed out" unnecessary information in problems.
  - Problems which do not directly follow the pattern in the previous problem or worked example
    - To help students adapt to problems as they come.
  - Situations in which the smaller number is divided by the larger number
    - This temptation to always divide the larger number by the smaller number is induced by many other experiences in the teaching and learning of multiplication and division.
    - To introduce that solving problems involving rates are not a "one size fits all" approach.