



IDENTIFYING PROFESSIONAL DEVELOPMENT NEEDS IN MATHEMATICS

A Planning Tool for Grades 3–7



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IDENTIFYING PROFESSIONAL DEVELOPMENT NEEDS IN MATHEMATICS

A Planning Tool for Grades 3–7

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PROFESSIONAL DEVELOPMENT**

BACKGROUND: THE NEEDS ASSESSMENT TOOL

The Needs Assessment Tool for Mathematics Professional Development (grades 3–7) was created for Regional Comprehensive Centers and other technical assistance agencies, as well as state departments of education, as they help others make decisions about the allocation of professional development resources and identify the mathematics content areas and skills that need substantial professional support.

The needs assessment tool is based on the 2008 National Mathematics Advisory Panel Report. It draws extensively from the organization used by the panel to frame its report, and provides a direct correlation to the report in terms of terminology, language, and structure. This will make it easier for states, districts, and schools to consider the “benchmarks for the critical foundations” recommended by the panel and set professional development priorities. These benchmarks appear in Table 2 of the panel’s report. This table appears in full on the next page because it may be a useful reference as you become familiar with the needs assessment tool and begin the process of obtaining and entering information about goals, standards, and performance data and begin recognizing your staff’s professional development needs.

In preparing its report, the National Mathematics Advisory Panel reviewed 16,000 research publications and policy reports and received public testimony from more than 100 individuals. In addition, they reviewed written commentary from 160 organizations and individuals and analyzed survey results from 743 active teachers of algebra. The panel worked as a committee of the whole but largely worked in five task groups and subcommittees, synthesizing information about: conceptual knowledge and skills, learning processes, instructional practices, teachers and teacher education, and assessment.



Benchmarks for the Critical Foundations

Fluency With Whole Numbers

- 1) By the end of Grade 3, students should be proficient with the addition and subtraction of whole numbers.
- 2) By the end of Grade 5, students should be proficient with multiplication and division of whole numbers.

Fluency With Fractions

- 1) By the end of Grade 4, students should be able to identify and represent fractions and decimals, and compare them on a number line or with other common representations of fractions and decimals.
- 2) By the end of Grade 5, students should be proficient with comparing fractions and decimals and common percent, and with the addition and subtraction of fractions and decimals.
- 3) By the end of Grade 6, students should be proficient with multiplication and division of fractions and decimals.
- 4) By the end of Grade 6, students should be proficient with all operations involving positive and negative integers.
- 5) By the end of Grade 7, students should be proficient with all operations involving positive and negative fractions.
- 6) By the end of Grade 7, students should be able to solve problems involving percent, ratio, and rate and extend this work to proportionality.

Geometry and Measurement

- 1) By the end of Grade 5, students should be able to solve problems involving perimeter and area of triangles and all quadrilaterals having at least one pair of parallel sides (i.e., trapezoids).
- 2) By the end of Grade 6, students should be able to analyze the properties of two-dimensional shapes and solve problems involving perimeter and area, and analyze the properties of three-dimensional shapes and solve problems involving surface area and volume.
- 3) By the end of Grade 7, students should be familiar with the relationship between similar triangles and the concept of the slope of a line.

This table is taken from *Foundations for Success: The Report of the National Mathematics Advisory Panel*, and is identified as Table 2 in that document. The complete document can be found at www.ed.gov/about/bdscomm/list/mathpanel/index.html.

HOW THE NEEDS ASSESSMENT TOOL IS ORGANIZED

The needs assessment document is organized to assist users as they (a) align the benchmarks for the critical foundations with current academic content standards and related test items and (b) examine student performance data relative to the new benchmarks. This tool comprises a series of working charts, one for each grade from grades three to seven, that will help educators address both of these tasks.

In each chart, the columns serve the following purposes:

- **Column A** lists **Benchmarks for the Critical Foundations**: Fluency with Whole Numbers, Fluency with Fractions, and Geometry and Measurement. Below these broad foundations we have listed the specific benchmarks for each grade level and two subsequent grade levels. Due to the sequential nature of mathematics, the additional benchmarks are listed so that users can consider the prerequisite competencies necessary that lead up to the required benchmark for the following years. There is no empirical research on the placement of these benchmarks, but the panel made these recommendations for state frameworks and school districts.
- In **Column B: Related State Content Standards**, users of the tool will enter state content standards, indicators, or objectives that relate to the benchmark.
- In **Column C: Related Test Items**, users will name the relevant state test items or other formative test items relevant to the critical foundation.
- In **Column D: Student Performance Data**, results will be recorded from state tests, quarterly assessments, or achievement tests pertinent to the standard represented.
- In **Column E: Focus of Professional Development**, users will pinpoint the area of professional development that is needed.



HOW TO USE THE NEEDS ASSESSMENT TOOL

On the Center on Instruction website, you will find two versions of this tool. The first, a PDF document, is fully designed, and includes all of the background material along with the tool itself. However, this version cannot be used practically. We have provided a second document, in Word, that you can use to type information as needed, and the columns will expand to accommodate any amount of text.

To begin, download both of these documents from the COI website (www.centeroninstruction.org) and save them on your computer. The Word document will be your “working file,” where you will establish professional development priorities by completing one table for each grade level (3–7) using the following steps:

- **Review each of the benchmarks.** Think about and talk with others about the essential conceptual knowledge students will need to reach this expectation.
- **Look at the first benchmark.** Examine your state’s content standards to determine which ones align with the benchmark for the critical foundation or identify the specific indicators or objectives related to it. If the benchmark for the critical foundation is for a grade level beyond the current grade, (e.g., third grade for a fifth grade critical foundation), determine a reasonable standard, indicator, or objective that will lead students toward acquiring this expectation.
- **Name the relevant test item(s)** that aligns with the first benchmark or document other test data they may have relevancy to that benchmark. Place this information in Column C: Related Test Items.
- **Examine student performance data** using state tests, quarterly assessments, or achievement tests to determine if most students are meeting the standard, some students are meeting the standard, or few students are meeting the standard. Depending on the determination, enter the number 1, 2, or 3 in Column D: Student Performance Data.
- **Pinpoint the area of needed professional development** by reviewing the information in Column D. A rating of 2 or 3 will indicate that professional development is required. Talk with your colleagues to decide

if the needs will require work with teachers in developing their content or pedagogical knowledge or what further needs analysis is necessary to make decisions about professional development.

Other considerations

- The goals set for professional development should be based on **multiple data sets** including results from student work, content knowledge surveys from teachers, and teachers' expressed needs.
- **Specificity** is important when using this tool. Details help with preparation and next steps.
- When using the tool consistently for planning, remember that regional centers and states have **systematic methods for planning professional development**. Regional centers and states should review this document periodically and use its data to make ongoing decisions about professional development.
- Linking related state content standards and test items to the benchmarks for the critical foundations is time consuming and tedious work, and, therefore, should be completed **only once every few years** or as standards or test items change.



REFERENCES

- Schnackenberg, H.L., Luik, K., Nisan, Y., & Servant, C. 2001. A Case Study of Needs Assessment in Teacher In-Service Development (Special issue). *Educational Research and Evaluation*, 7(2–3), 137–160).
- National Mathematics Advisory Panel. *Foundations for Success: The Final Report of the National Mathematics Advisory Panel*, U.S. Department of Education: Washington, DC, 2008.



NEEDS ASSESSMENT TOOL FOR MATHEMATICS PROFESSIONAL DEVELOPMENT

Grades 3–7



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Needs Assessment Tool for Mathematics Professional Development

Grade 3

A. Benchmarks for the Critical Foundations	B. Related State Content Standards	C. Related Test Items	D. Student Performance Data	E. Focus of Professional Development
			1 = Most meet standard 2 = Some meet standard 3 = Few meet standard	The highest score in Column D indicates the highest need for professional development.
Fluency with Whole Numbers: By the end of Grade 5 or 6, children should have a robust sense of number. This sense of number must include an understanding of place value and the ability to compose and decompose whole numbers. It must clearly include a grasp of the meaning of the basic operations of addition, subtraction, multiplication, and division. It must also include use of the commutative, associative, and distributive properties; computational facility; and the knowledge of how to apply the operations to problem solving. Computational facility requires the automatic recall of addition and related subtraction facts, and of multiplication and related division facts. It also requires fluency with the standard algorithms for addition, subtraction, multiplication, and division. Fluent use of the algorithms not only depends on the automatic recall of number facts but also reinforces it. A strong sense of number also includes the ability to estimate the results of computations and thereby to estimate orders of magnitude, e.g., how many people fit into a stadium or how many gallons of water are needed to fill a pool.				
1. By the end of grade 3, students should be proficient with the addition and subtraction of whole numbers. This includes developing a robust sense of place value, composing and decomposing whole numbers, and use of the commutative and associative properties. Computational facility and estimation is expected.				
2. By the end of grade 5, students should be proficient with multiplication and division of whole numbers. This includes the understanding and use of the distributive property, developing a robust sense of place value, computational facility and how the operations are interconnected.				

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Needs Assessment Tool for Mathematics Professional Development

Grade 3 (continued)

A. Benchmarks for the Critical Foundations	B. Related State Content Standards	C. Related Test Items	D. Student Performance Data	E. Focus of Professional Development
			1 = Most meet standard 2 = Some meet standard 3 = Few meet standard	The highest score in Column D indicates the highest need for professional development.
Fluency with Fractions: Before they begin algebra course work, students should have a thorough understanding of positive as well as negative fractions. Understanding of fraction concepts begins in primary and intermediate grades. Middle school students should be able to locate positive and negative fractions on a number line; represent and compare fractions, decimals, and related percent; and estimate their size. They need to know that sums, differences, products, and quotients (with nonzero denominators) of fractions are fractions, and they need to be able to carry out these operations confidently and efficiently. They should understand why and how (finite) decimal numbers are fractions and know the meaning of percent.				
1. By the end of grade 4, students should be able to identify and represent fractions and decimals, and compare them on a number line or with other common representations of fractions and decimals. This includes understanding how changing the unit makes the fractional value of a given amount different.				
2. By the end of Grade 5, students should be proficient with comparing fractions and decimals and common percents, and with the addition and subtraction of fractions and decimals.				

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Needs Assessment Tool for Mathematics Professional Development

Grade 3 (continued)

A. Benchmarks for the Critical Foundations	B. Related State Content Standards	C. Related Test Items	D. Student Performance Data	E. Focus of Professional Development
			1 = Most meet standard 2 = Some meet standard 3 = Few meet standard	The highest score in Column D indicates the highest need for professional development.
Geometry and Measurement: Middle grade students should be able to analyze the properties of two- and three-dimensional shapes using formulas to determine perimeter, area, volume, and surface area. They should also be able to find unknown lengths, angles, and areas. Understanding of geometry and measurement concepts begins in primary and intermediate grades.				
1. By the end of grade 5 students should be able to solve problems involving perimeter and area of triangles and all quadrilaterals having at least one pair of parallel sides (i.e., trapezoids). This includes understanding multiplication and its conceptual connections to area.				



Needs Assessment Tool for Mathematics Professional Development

Grade 4

A. Benchmarks for the Critical Foundations	B. Related State Content Standards	C. Related Test Items	D. Student Performance Data	E. Focus of Professional Development
			1 = Most meet standard 2 = Some meet standard 3 = Few meet standard	The highest score in Column D indicates the highest need for professional development.
Fluency with Whole Numbers: By the end of Grade 5 or 6, children should have a robust sense of number. This sense of number must include an understanding of place value and the ability to compose and decompose whole numbers. It must clearly include a grasp of the meaning of the basic operations of addition, subtraction, multiplication, and division. It must also include use of the commutative, associative, and distributive properties; computational facility; and the knowledge of how to apply the operations to problem solving. Computational facility requires the automatic recall of addition and related subtraction facts, and of multiplication and related division facts. It also requires fluency with the standard algorithms for addition, subtraction, multiplication, and division. Fluent use of the algorithms not only depends on the automatic recall of number facts but also reinforces it. A strong sense of number also includes the ability to estimate the results of computations and thereby to estimate orders of magnitude, e.g., how many people fit into a stadium or how many gallons of water are needed to fill a pool.				
1. By the end of grade 5, students should be proficient with multiplication and division of whole numbers. This includes the understanding and use of the distributive property, and developing a robust sense of place value, computational facility, and how the operations are interconnected.				

(continued)



Needs Assessment Tool for Mathematics Professional Development

Grade 4 (continued)

A. Benchmarks for the Critical Foundations	B. Related State Content Standards	C. Related Test Items	D. Student Performance Data	E. Focus of Professional Development
			1 = Most meet standard 2 = Some meet standard 3 = Few meet standard	The highest score in Column D indicates the highest need for professional development.
Fluency with Fractions: Before they begin algebra course work, middle school students should know that sums, differences, products, and quotients (with nonzero denominators) of fractions are fractions, and they need to be able to carry out these operations confidently and efficiently. They should understand why and how (finite) decimal numbers are fractions and know the meaning of percent. Beyond computational facility with specific numbers, the subject of fractions, when properly taught, introduces students to the use of symbolic notation and the concept of generality, both being integral parts of algebra.				
1. By the end of grade 4, students should be able to identify and represent fractions and decimals, and compare them on a number line or with other common representations of fractions and decimals. This includes understanding how division and fractions are related and the part/whole nature of fractions.				
2. By the end of Grade 5, students should be proficient with comparing fractions and decimals and common percent, and with the addition and subtraction of fractions and decimals. This includes the part/whole nature of fractions verses the part/part or part/whole nature of ratios.				

(continued)



Needs Assessment Tool for Mathematics Professional Development

Grade 4 (continued)

A. Benchmarks for the Critical Foundations	B. Related State Content Standards	C. Related Test Items	D. Student Performance Data	E. Focus of Professional Development
			1 = Most meet standard 2 = Some meet standard 3 = Few meet standard	The highest score in Column D indicates the highest need for professional development.
3. By the end of grade 6, students should be proficient with multiplication and division of fractions and decimals. This includes understanding generalizations such as the multiplication of rational numbers less than one but greater than 0 produces a smaller product.				
4. By the end of grade 6, students should be proficient with all operations involving positive and negative integers.				

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Needs Assessment Tool for Mathematics Professional Development

Grade 4 (continued)

A. Benchmarks for the Critical Foundations	B. Related State Content Standards	C. Related Test Items	D. Student Performance Data	E. Focus of Professional Development
			1 = Most meet standard 2 = Some meet standard 3 = Few meet standard	The highest score in Column D indicates the highest need for professional development.
Geometry and Measurement: Middle grade students should be able to analyze the properties of two- and three-dimensional shapes using formulas to determine perimeter, area, volume, and surface area. They should also be able to find unknown lengths, angles, and areas. Understanding of geometry and measurement concepts begins in primary intermediate grades.				
1. By the end of grade 5, students should be able to solve problems involving perimeter and area of triangles and all quadrilaterals having at least one pair of parallel sides (i.e., trapezoids, rhombus). This includes visualizing how a composite shape decomposes into others shapes.				
2. By the end of grade 6, students should be able to analyze the properties of two-dimensional shapes and solve problems involving perimeter and area, and analyze the properties of three-dimensional shapes and solve problems involving surface area and volume.				



Needs Assessment Tool for Mathematics Professional Development

Grade 5

A. Benchmarks for the Critical Foundations	B. Related State Content Standards	C. Related Test Items	D. Student Performance Data	E. Focus of Professional Development
			1 = Most meet standard 2 = Some meet standard 3 = Few meet standard	The highest score in Column D indicates the highest need for professional development.
Fluency with Whole Numbers: By the end of Grade 5 or 6, children should have a robust sense of number. This sense of number must include an understanding of place value and the ability to compose and decompose whole numbers. It must clearly include a grasp of the meaning of the basic operations of addition, subtraction, multiplication, and division. It must also include use of the commutative, associative, and distributive properties; computational facility; and the knowledge of how to apply the operations to problem solving. Computational facility requires the automatic recall of addition and related subtraction facts, and of multiplication and related division facts. It also requires fluency with the standard algorithms for addition, subtraction, multiplication, and division. Fluent use of the algorithms not only depends on the automatic recall of number facts but also reinforces it. A strong sense of number also includes the ability to estimate the results of computations and thereby to estimate orders of magnitude, e.g., how many people fit into a stadium or how many gallons of water are needed to fill a pool.				
1. By the end of grade 5, students should be proficient with multiplication and division of whole numbers. This includes the understanding and use of the distributive property, and developing a robust sense of decimal place value, computational facility, and how the operations are interconnected.				

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Needs Assessment Tool for Mathematics Professional Development

Grade 5 (continued)

A. Benchmarks for the Critical Foundations	B. Related State Content Standards	C. Related Test Items	D. Student Performance Data	E. Focus of Professional Development
			1 = Most meet standard 2 = Some meet standard 3 = Few meet standard	The highest score in Column D indicates the highest need for professional development.
Fluency with Fractions: Before they begin algebra course work, middle school students should have a thorough understanding of positive as well as negative fractions. They should be able to locate positive and negative fractions on a number line; represent and compare fractions, decimals, and related percent; and estimate their size. They need to know that sums, differences, products, and quotients (with nonzero denominators) of fractions are fractions, and they need to be able to carry out these operations confidently and efficiently. They should understand why and how (finite) decimal numbers are fractions and know the meaning of percent. They should encounter fractions in problems in the many contexts in which they arise naturally, for example, to describe rates, proportionality, and probability. Beyond computational facility with specific numbers, the subject of fractions, when properly taught, introduces students to the use of symbolic notation and the concept of generality, both being integral parts of algebra.				
1. By the end of Grade 5, students should be proficient with comparing common fractions and decimals and common percent, and with the addition and subtraction of fractions and decimals. This includes the part/whole nature of fractions versus the part/part or part/whole nature of ratios.				
2. By the end of grade 6, students should be proficient with multiplication and division of fractions and decimals. This includes understanding generalizations such as the multiplication of two rational numbers less than one but greater than 0 produces a smaller product.				

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Needs Assessment Tool for Mathematics Professional Development

Grade 5 (continued)

A. Benchmarks for the Critical Foundations	B. Related State Content Standards	C. Related Test Items	D. Student Performance Data	E. Focus of Professional Development
			1 = Most meet standard 2 = Some meet standard 3 = Few meet standard	The highest score in Column D indicates the highest need for professional development.
3. By the end of grade 6, students should be proficient with all operations involving positive and negative integers.				
4. By the end of grade 7, students should be proficient with all operations involving positive and negative fractions.				
5. By the end of grade 7, students should be able to solve problems involving percent, ratio, and rate and extend this work to proportionality. This includes understanding that fractions and percents are one type of part/whole ratio where as rates are not part/whole.				

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Needs Assessment Tool for Mathematics Professional Development

Grade 5 (continued)

A. Benchmarks for the Critical Foundations	B. Related State Content Standards	C. Related Test Items	D. Student Performance Data	E. Focus of Professional Development
			1 = Most meet standard 2 = Some meet standard 3 = Few meet standard	The highest score in Column D indicates the highest need for professional development.
Geometry and Measurement: Middle school students should be able to analyze the properties of two- and three-dimensional shapes using formulas to determine perimeter, area, volume, and surface area. They should also be able to find unknown lengths, angles, and areas.				
1. By the end of grade 5, students should be able to solve problems involving perimeter and area of triangles and all quadrilaterals having at least one pair of parallel sides (i.e., trapezoids, rhombus). This includes visualizing how a composite shape decomposes into others shapes.				
2. By the end of grade 6, students should be able to analyze the properties of two-dimensional shapes and solve problems involving perimeter and area, and analyze the properties of three-dimensional shapes and solve problems involving surface area and volume.				
3. By the end of grade 7, students should be familiar with the relationship between similar triangles and the concept of the slope of a line.				



Needs Assessment Tool for Mathematics Professional Development

Grade 6

A. Benchmarks for the Critical Foundations	B. Related State Content Standards	C. Related Test Items	D. Student Performance Data	E. Focus of Professional Development
			1 = Most meet standard 2 = Some meet standard 3 = Few meet standard	The highest score in Column D indicates the highest need for professional development.
Fluency with Fractions: Before they begin algebra course work, middle school students should have a thorough understanding of positive as well as negative fractions. They should be able to locate positive and negative fractions on a number line; represent and compare fractions, decimals, and related percent; and estimate their size. They need to know that sums, differences, products, and quotients (with nonzero denominators) of fractions are fractions, and they need to be able to carry out these operations confidently and efficiently. They should understand why and how (finite) decimal numbers are fractions and know the meaning of percent. They should encounter fractions in problems in the many contexts in which they arise naturally, for example, to describe rates, proportionality, and probability. Beyond computational facility with specific numbers, the subject of fractions, when properly taught, introduces students to the use of symbolic notation and the concept of generality, both being integral parts of algebra.				
1. By the end of grade 6, students should be proficient with multiplication and division of fractions and decimals. This includes understanding generalizations such as the multiplication of rational numbers less than one but greater than 0 produces a smaller product.				
2. By the end of grade 6, students should be proficient with all operations involving positive and negative integers.				

(continued)



Needs Assessment Tool for Mathematics Professional Development

Grade 6 (continued)

A. Benchmarks for the Critical Foundations	B. Related State Content Standards	C. Related Test Items	D. Student Performance Data	E. Focus of Professional Development
			1 = Most meet standard 2 = Some meet standard 3 = Few meet standard	The highest score in Column D indicates the highest need for professional development.
3. By the end of grade 7, students should be proficient with all operations involving positive and negative fractions.				
4. By the end of grade 7, students should be able to solve problems involving percent, ratio, and rate and extend this work to proportionality. This includes understanding that fractions and percents are one type of part/whole ratio where as rates are not part/whole. Students should also recognize the invariant and covariant nature of both equivalent fractions and proportions.				

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Needs Assessment Tool for Mathematics Professional Development

Grade 6 (continued)

A. Benchmarks for the Critical Foundations	B. Related State Content Standards	C. Related Test Items	D. Student Performance Data	E. Focus of Professional Development
			1 = Most meet standard 2 = Some meet standard 3 = Few meet standard	The highest score in Column D indicates the highest need for professional development.
Geometry and Measurement: Middle grade experience with similar triangles is most directly relevant for the study of Algebra: Sound treatments of the slope of a straight line and of linear functions depend logically on the properties of similar triangles. Furthermore, students should be able to analyze the properties of two-and three-dimensional shapes using formulas to determine perimeter, area, volume, and surface area. They should also be able to find unknown lengths, angles, and areas.				
1. By the end of grade 6, students should be able to analyze the properties of two-dimensional shapes and solve problems involving perimeter and area, and analyze the properties of three-dimensional shapes and solve problems involving surface area and volume.				
2. By the end of grade 7, students should be familiar with the relationship between similar triangles and the concept of the slope of a line.				



Needs Assessment Tool for Mathematics Professional Development

Grade 7

A. Benchmarks for the Critical Foundations	B. Related State Content Standards	C. Related Test Items	D. Student Performance Data	E. Focus of Professional Development
			1 = Most meet standard 2 = Some meet standard 3 = Few meet standard	The highest score in Column D indicates the highest need for professional development.
Fluency with Fractions: Before they begin algebra course work, middle school students should have a thorough understanding of positive as well as negative fractions. They should be able to locate positive and negative fractions on a number line; represent and compare fractions, decimals, and related percent; and estimate their size. They need to know that sums, differences, products, and quotients (with nonzero denominators) of fractions are fractions, and they need to be able to carry out these operations confidently and efficiently. They should understand why and how (finite) decimal numbers are fractions and know the meaning of percent. They should encounter fractions in problems in the many contexts in which they arise naturally, for example, to describe rates, proportionality, and probability. Beyond computational facility with specific numbers, the subject of fractions, when properly taught, introduces students to the use of symbolic notation and the concept of generality, both being integral parts of algebra.				
1. By the end of grade 7, students should be proficient with all operations involving positive and negative fractions.				
2. By the end of grade 7, students should be able to solve problems involving percent, ratio, and rate and extend this work to proportionality. This includes understanding that fractions and percents are one type of part/whole ratio where as rates are not part/whole. Students should also recognize the invariant and covariant nature of both equivalent fractions and proportions.				

(continued)



Needs Assessment Tool for Mathematics Professional Development

Grade 7 (continued)

A. Benchmarks for the Critical Foundations	B. Related State Content Standards	C. Related Test Items	D. Student Performance Data	E. Focus of Professional Development
			1 = Most meet standard 2 = Some meet standard 3 = Few meet standard	The highest score in Column D indicates the highest need for professional development.
Geometry and Measurement: Middle grade experience with similar triangles is most directly relevant for the study of Algebra: Sound treatments of the slope of a straight line and of linear functions depend logically on the properties of similar triangles. Furthermore, students should be able to analyze the properties of two-and three-dimensional shapes using formulas to determine perimeter, area, volume, and surface area. They should also be able to find unknown lengths, angles, and areas.				
1. By the end of grade 7, students should be familiar with the relationship between similar triangles and the concept of the slope of a line.				



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