Current Policy

Title 28
EDUCATION

Part CXIX. Bulletin 1955—Louisiana Content Standards, Benchmarks, and Grade Expectations for Mathematics

Chapter 1. General

§101. Introduction

A. The Louisiana Content Standards Task Force has developed the following foundational skills which should apply to all students in all disciplines:

1. Communication—a process by which information is exchanged and a concept of "meaning" is being created and shared between individuals through a common system of symbols, signs, or behavior. Students should be able to communicate clearly, fluently, strategically, technologically, critically, and creatively in society and in a variety of workplaces. This process can best be accomplished through use of the following skills: reading, writing, speaking, listening, viewing, and visually representing;

2. Problem Solving—the identifying of an obstacle or challenge and the application of knowledge and thinking processes which include reasoning, decision making, and inquiry in order to reach a solution using multiple pathways, even when no routine path is apparent;

3. Resource Access and Utilization—the process of identifying, locating, selecting, and using resource tools to help in analyzing, synthesizing, and communicating information. The identification and employment of appropriate tools, techniques, and technologies are essential to all learning processes. These resource tools include pen, pencil, and paper; audio/video material, word processors, computers, interactive devices, telecommunication, and other emerging technologies;

4. Linking and Generating Knowledge—the effective use of cognitive processes to generate and link knowledge across the disciplines and in a variety of contexts. In order to engage in the principles of continual improvement, students must be able to transfer and elaborate on these processes. Transfer refers to the ability to apply a strategy or content knowledge effectively in a setting or context other than that in which it was originally learned. Elaboration refers to monitoring, adjusting, and expanding strategies into other contexts; and

5. Citizenship—the application of the understanding of the ideals, rights, and responsibilities of active participation in a democratic republic that includes working respectfully and productively together for the benefit of the individual and the community; being accountable for one's choices and actions and understanding their impact on oneself and others; knowing one's civil, constitutional, and statutory rights; and mentoring others to be productive citizens and lifelong learners.

NOTE: These foundation skills are listed numerically in parentheses at the end of each benchmark.

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HISTORICAL NOTE: Promulgated by the Board of Elementary and Secondary Education, LR 31:2834 (November 2005).

§103. Information Literacy Model for Lifelong Learning

A. Students must become competent and independent users of information to be productive citizens of the 21st century. They must be prepared to live in an information-rich and changing global society. Due to the rapid growth of technology, the amount of information available is accelerating so quickly that teachers are no longer able to impart a complete knowledge base in a subject area. In addition, students entering the workforce must know how to access information, solve problems, make decisions, and work as part of a team. Therefore, information literacy, the ability to recognize an information need and then locate, evaluate, and effectively use the needed information, is a basic skill essential to the 21st century workplace and home. Information literate students are self-directed learners who, individually or collaboratively, use information responsibly to create quality products and to be productive citizens. Information literacy skills must not be taught in isolation; they must be integrated across all content areas, utilizing fully the resource of the classroom, the school library media center, and the community. The Information Literacy Model for Lifelong Learners is a framework that teachers at all levels can apply to help students become independent lifelong learners.

1. Defining/Focusing. The first task is to recognize that an information need exists. Students make preliminary decisions about the type of information needed based on prior knowledge.

2. Selecting Tools and Resources. After students decide what information is needed, they then develop search strategies for locating and accessing appropriate, relevant sources in the school library media center, community libraries and agencies, resource people, and others as appropriate.

3. Extracting and Recording. Students examine the resources for readability, currency, usefulness, and bias. This task involves skimming or listening for key words, "chunking" reading, finding main ideas, and taking notes.

4. Processing Information. After recording information, students must examine and evaluate the data in order to utilize the information retrieved. Students must interact with the information by categorizing, analyzing, evaluating, and comparing for bias, inadequacies, omissions, errors, and value judgments. Based on their findings, they either move on to the next step or do additional research.

5. Organizing Information. Students effectively sort, manipulate, and organize the information that was retrieved. They make decisions on how to use and communicate their findings.

6. Presenting Findings. Students apply and communicate what they have learned (e.g., research report, project, illustration, dramatization, portfolio, book, book report, map, oral/audio/visual presentation, game, bibliography, hyperstack).

7. Evaluating Efforts. Throughout the information problem solving process, students evaluate their efforts. This assists students in determining the effectiveness of the research process. The final product may be evaluated by the teacher and also other qualified or interested resource persons.

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§105. Philosophy

A. In mathematics classrooms in Louisiana, each student actively participates in a learning environment guided by a capable teacher and supported by the home and community. The student values mathematics and is confident and competent in his or her ability to use mathematics in an ever-changing world. The student develops mathematical understanding through individual and group instruction that includes investigating, discovering, communicating, and reasoning. Assessment, an integral part of the teaching and learning process, is carefully integrated with instructional practices.

B. Need and Context for Reform

1. Rationale for Change. The rational for change in mathematics education is driven by the implications of the evolving ages of technology and information and their implications for future societal and work force needs. "In tomorrow's word, the best opportunities for jobs and advancements will go to those best prepared to cope confidently and competently with mathematical, scientific, and technological issues" (Everybody Counts, 1989). To adequately prepare students for the future, mathematics education must change to include the following:

a. the student as an active participant in learning rather than a passive recipient of knowledge;

b. equitable access for all students to manipulatives and state-of-the-art technologies, including electronic networking; and

c. the incorporation of a variety of individual and group activities that use real-life experiences to develop critical thinking.

2. Because the demands of the workplace are changing, our efforts to prepare students for the workplace must continually change. Schools must prepare students to adapt productively to change by focusing on the process of lifelong learning. The nation's business leaders agree that to become productive workers and informed citizens in today's society, students must develop the ability to:

a. reason critically and understand concepts;

b. work with others;

c. communicate ideas effectively;

d. understand and interpret statistical information;

e. become lifelong learners; and

f. adapt to a dynamic work environment.

3. Implications for Curricula Change. The processing of vast amounts of numerical information available through modern technology makes more imperative than ever the ability to synthesize mathematical information as a basis for rational decision making. Thus, quantitative thinking is becoming more pervasive in virtually all aspects of the workplace and everyday life experiences. School mathematics must remain attuned to the needs of students, adjusting to include the handling and understanding of data; the appreciation, recognition, and use of numerical and geometrical patterns, and the integration and synthesis of information leading to creative problem solving. The basic facts of addition, subtraction, multiplication, and division are important; however, technology, specifically the development of calculators, allows all students to expand and extend much of traditional school mathematics far beyond the basic math facts and repeated drill and practice. Students should concentrate on understanding ideas, reasoning, solving problems, communicating, and making connections within mathematics and between mathematics and its growing applications in other fields. Numbers and a sense of numbers are of greater value than ever before. Number sense, the intuitive, meaningful use of numbers in mental computation, estimation, problem solving, and applications, is vital. It is essential for students to develop this intuitive sense in order to determine, for example, if a number in a news account, on a printout, or on a display screen is appropriate and acceptable.

4. National Direction. In the 1980s after reports concerning the low performance of American students on international assessments, several publications emerged that directly addressed the urgent national need to revitalize mathematics education. The nation recognized that to be competitive in a global economy, American students had to be prepared to work competently and confidently in the age of technology and information. The most significant publications include the following:

a. Curriculum and Evaluation Standards for School Mathematics 1989). National Council of Teachers of Mathematics;

b. Everybody Counts: A Report to the Nation on the Future of Mathematics Education (1989). National Research Council;

c. Reshaping School Mathematics: A Philosophy and Framework for Curriculum (1990). Mathematics Sciences Education Board;

d. Professional Standards for Teaching Mathematics (1991). National Council of Teachers of Mathematics;

e. Mathematics Assessment (1991). National Council of Teachers of Mathematics;

f. Assessment Standards for School Mathematics (1995). National Council of Teachers of Mathematics.

NOTE: The Louisiana Mathematics Framework is based on the direction reflected in these and other reform-based publications.

5. Collaborative Systemic Reform. In 1990, the National Science Foundation (NSF) solicited for Statewide Systemic Initiatives (SSI) Programs. In its program solicitation, the NSF described the proposals eligible for funding, stating, that the initiatives "...must involve all those who have a responsibility to the system or to particular parts of it

whether at the state or local level." It further stated that partners involved in the initiatives must include "state leaders; teachers and other school system leaders; university faculty; leaders in science-rich institutions, including business and industry; and leaders of parent groups and other community based organizations." The change to funding "systemic" efforts to involve all major stakeholders in education was a major shift by NSF to affect reform of mathematics and science education throughout the nation. The reform effort in Louisiana began with a successful application to establish a NSF-funded statewide systemic initiative. A broad-based coalition of Louisianans worked to secure a five-year, $10 million grant for the Louisiana Systemic Initiatives Programs (LaSIP). Louisiana provided matching funds from the Louisiana Board of Elementary and Secondary Education (LBESE) and the Louisiana Board of Regents (LBoR) for colleges and universities to support the reform of mathematics and science education. The Louisiana Department of Education (LDE) was awarded a Dwight D. Eisenhower National Program for Mathematics and Science Education grant from the United States Department of Education. This grant enabled the LDE, in collaboration with LaSIP, to develop the Louisiana Mathematics and Science Curriculum and Assessment Frameworks.

6. Framework Development Process. Using recommendations from statewide leaders in mathematics, panel members were selected to assist in the development of the Louisiana Mathematics and Science Frameworks. The panel was divided into subpanels for mathematics and science, consisting of approximately 40 members each. Membership consisted of: LDE personnel; LaSIP staff; educators from both public and private schools; educators who had expertise in working with students with disabilities; educators with expertise in working with minorities and underserved populations; and university faculty from mathematics, the sciences, and education. After assessing the current state of affairs in Louisiana in light of national reform, the mathematics subpanel began the development of a strategic plan to reform mathematics curricula in Louisiana. Two 15-member Mathematics Framework Steering Committees, consisting of LDE staff, LaSIP staff, university faculty, supervisors, and classroom teachers, were formed to oversee the writing of the framework and grade-level handbooks. As drafts of the frameworks were completed, extensive reviews were conducted by state educational stakeholders and national leaders in mathematics reform. In collaboration with the steering committee, exemplary classroom teachers helped write grade-level handbooks. Drafts of the handbooks were reviewed by classroom teachers from across the state.

C. Purpose. This framework document was formulated to articulate the shared vision of the mathematical, business, professional, and vocational communities of Louisiana concerning mathematics education. It provides a unifying structure which encompasses instructional methodologies and course content, while maintaining sufficient flexibility to permit adaptability, within local districts. The framework should guide the teacher in designing a comprehensive program that assists in the development of the mathematical power of each student. Using national mathematics standards as a guide, the framework forms the foundation of a comprehensive mathematics educational program upon which state mathematics assessment can be based.

1. Intended Audience. The Louisiana Mathematics Framework is intended for a broad audience: teachers, curriculum supervisors, school and district administrators, school boards, business and industry leaders, parents, college, university, and state education agency staff and policy makers. With the framework as a common reference point, it will be possible for these varied groups to work to achieve a shared vision of what and how mathematics should be taught in Louisiana schools.

2. Intended Use. The Louisiana Mathematics Framework serves as a guide for curriculum and instruction and as a general reference to the basic principles of mathematics education. Intended uses for this framework include the following:

a. for teachers, a guide for planning curriculum, instruction, and assessment;

b. for parents, a means for assessing the effectiveness of their children's mathematics education;

c. for administrators and school board members, a vision for mathematics education and a basis for planning resource allocations, materials purchases, local curriculum development, and teachers' professional development;

d. for policy makers and state education staffs, a basis for developing laws, policies, and funding priorities to support local reforms;

e. for staff developers, a basis for creating professional development materials and strategies designed to increase teachers' knowledge of mathematics content, teaching methodologies and assessment strategies;

f. for assessment specialists and test developers, a guide to establishing tools and strategies that effectively assess students' mathematics understanding and ability;

g. for colleges and universities, a guide for content and design of teacher preparation programs; and

h. for business and industry leaders and governmental agencies, a basis for developing effective partnerships and local reforms for funding instructional materials and professional development.

D. Framework Criteria

1. The following criteria, which provided the foundation for the development of the framework, are critical to strengthen, support, and sustain mathematics education.

a. The Louisiana Mathematics Framework reflects national standards in defining K-12 curricula.

b. A National Validation Team consisting of nationally recognized mathematics educators and mathematicians reviewed the documents during development to ensure content validity.

c. The Louisiana Mathematics Framework is equitable for all students.

2. In addition to involving representatives from under represented groups in the development process, a Louisiana Equity Review Team, consisting of state leaders representing the following groups, reviewed the documents: students with learning disabilities, students with special education needs (including disabled and gifted students), minorities, students who speak English as a second language, and women. Professional development activities for framework implementation will include specific strategies to assist the teacher in addressing the needs of all students.

a. Classroom teachers are significantly involved in the development of the Louisiana Mathematics Framework.

3. Through the organizational structures of the Louisiana Department of Education (LDE) and the Louisiana Systemic Initiatives Program (LaSIP), the drafts of the documents were reviewed by over 2,000 mathematics teachers from throughout the state.

a. The Louisiana Mathematics Framework includes a comprehensive, well-developed structure that demonstrates cohesiveness and continuity from kindergarten through 12th grade.

4. University faculty were an integral part of the framework development process. Classroom teachers from grades K-4, 5-8, and 9-12 were involved in the development of all components of the framework.

a. The Louisiana Mathematics Framework demonstrates the relevance of mathematics to real-life activities.

5. The framework and handbooks have a pervasive theme of interconnectedness to real-life situations. The classroom activities included in the handbooks engage students in mathematical activities that are relevant and genuinely motivating. The documents were reviewed by representatives from Louisiana business and industry to ensure their relevance to activities in which specific mathematical principles are applied.

a. The Louisiana Mathematics Framework reflects national trends in assessment by thoroughly integrating assessment and instruction.

6. The handbooks include grade-level alternative assessment samples for both classroom and large-scale assessment. Several nationally recognized leaders in student assessment reviewed the documents.

a. The Louisiana Mathematics Framework is dynamic and easily adaptable to future changes that better prepare both teachers and students to be lifelong learners.

7. Representatives from the LDE and the Louisiana Association of Teachers of Mathematics (LATM) will convene each year, as needed at the annual LATM meeting to review the framework to ensure that it remains dynamic. Revisions will be transmitted electronically to each district.

E. Pervasive Themes

1. The vision of mathematics education in this framework is expressed through five pervasive and thoroughly interwoven themes, which encompass the strands of school mathematics.

a. Mathematics as Problem Solving

i. Classroom instruction should focus on more diverse and complex problem-solving situations that arise from relevant, real-life circumstances. Students should be able to design problems and generate appropriate solutions. For a given problem, teachers must actively encourage students to find alternative approaches to the problem, as well as using formal procedures.

b. Mathematics as Numerical Intuition

i. Students should develop a common-sense approach to using numbers, an intuitive feel for numbers including various uses and meanings, an appreciation for different levels of accuracy needed, and the ability to determine the reasonableness of answers.

c. Mathematics as Reasoning

i. Students should use critical thinking skills in questioning, elaborating, validating, and justifying.

d. Mathematics as Connections

i. Topics within mathematics should be interconnected rather than taught in isolation. Additionally, problems and procedures should be connected to other subject areas and to real-life, relevant situations that are challenging and motivating to the student.

e. Mathematics as Communication

i. Students should be provided opportunities to express their mathematical ideas through speaking, writing, demonstrating, and modeling.

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§107. Educational Environment

A. Vision of Teaching

1. The teacher must have the content knowledge and skills to be an instructor and facilitator of mathematical learning. The teacher must have the necessary supplies and materials to encourage individual and group explorations by the students. The teacher allows time for students to investigate mathematical ideas or tasks and encourages the use of models, materials, and technology. The teacher ensures an environment that encourages risk-taking, questioning, discovering, and cooperation. The teacher listens and values all students' ideas and encourages students to construct understandings based on their personal learning style and prior experiences.

2. The teacher demonstrates the connectedness of mathematics by utilizing instructional activities that encompass benchmarks from several strands. These activities may require several days or weeks to complete, depending on grade-level appropriateness. While some exercises or independent problems will be used, they are embedded in large problems or issues that are relevant to the student.

B. Vision of Learning

1. The classroom experience envisioned in this document is a dynamic one in which students become autonomous learners, while capable and empowered teachers guide them in taking charge of their own quest for knowledge. Students work independently, in small groups, or in large groups on problem-solving investigations. They have the materials and appropriate manipulatives to explore problems. They become risk takers through exploring ideas, forming questions, making and supporting conjectures, and learning to communicate and reason mathematically.

2. With problem solving at the heart of the curriculum, students develop an understanding of relevant problem-solving strategies including, but not limited to, the following: draw a picture or diagram; develop a chart, list, or table;

guess and check; work backwards; simplify problems; use manipulatives, etc. Both student-generated and teacher-generated strategies are explored in developing an understanding of the various approaches to solving a problem.

C. Equity

1. Regardless of ability level, all students in Louisiana must be exposed to a challenging and motivating mathematics curriculum based on relevant problem-solving situations. Traditionally, high-achieving students have participated in activities that required critical thinking and reasoning, whereas students working at or below grade level spent large amounts of time in drill-and-practice activities. One of the myths identified in *Mathematics Assessment*, (NCTM, 1991) that abounds in mathematics education in that "problems and applications come only after mastery of skills." Research supports the position that students learn skills and content in the context of challenging and motivating problems. The Louisiana Framework advocates a common core of significant mathematics that actively and interestingly engages all students.

2. In addition to having access to the common core curriculum, all students should have equal access to resources, qualified teachers, and quality instructions. The teacher is instrumental in creating an environment that encourages and facilitates each student's mathematical development. Problem-solving situations should reflect and build upon real-life experiences of all students and should reflect diverse cultures.

3. The ability to learn mathematics is not determined by one's socioeconomic level, gender, or ethnic origin. The teacher models the belief that all students can learn and demonstrates an appreciation and understanding of cultural diversity and varied learning styles. By challenging all students, the teacher creates the environment in which all students learn to approach mathematics with enthusiasm and confidence.

D. Technology

1. In the past decades, the classroom environment was a reflection of the workplace. Employees at factories worked independently on routing assembly lines to construct products, while mathematics classrooms consisted of rows of students working independently on routine practice problems. The age of technology has dramatically changed the workplace environment. Employees now work cooperatively and use a variety of techniques to solve real, nonroutine problems. Classrooms must reflect these changes to prepare students for the 21st century.

2. The relevance of technology is expressed in the following underlying beliefs.

a. Calculators and computers are basic tools of today's mathematics just as paper, pencil, and slide rules were basic tools of past years.

b. Calculators and computers have reduced the need to make precise calculations by hand, but in doing so they have increased the importance of acquiring a well-developed number sense (Goldsmith, 1992).

c. Appropriate calculators and computers should be available for all students.

d. Appropriate use of technology should be naturally integrated into the teaching of mathematics to assist the student to investigate and solve problems, not simply to check answers or to practice skills.

e. As resources become available via telecommunications, they should be used in the mathematics classroom to support standards-based instruction.

E. Support Structures

1. The collaborative effort of all stakeholders is imperative if significant change is to occur in Louisiana schools. Support of mathematics reform must be demonstrated by teachers, students, administrators, school boards, parents, business and industry, elected officials, the media, community organizations, etc. The state and local communities must commit to long-range planning to schedule time for appropriate staff development, to ensure funds for necessary resources, and to provide appropriate learning environments and facilities for students. A professional development model, with an accompanying dissemination plan, has been designed by the LDE and LaSIP to support teachers as they implement the framework.

2. Louisiana is developing a state school improvement plan to address content, performance, and opportunity-to-learn standards in all subject disciplines. The Mathematics Framework will be a critical component of the state school improvement plan. As each local district develops its mathematical curriculum, the new curriculum should be aligned with the state Mathematics Framework and should become a part of the local school improvement plan.

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§109. Assessment

A. Purpose

1. Assessment in mathematics is a process through which evidence is gathered about a student's understanding and ability to apply that understanding. The changes in mathematics content and in the way mathematics is taught must be reflected through accompanying changes in assessment. Assessment is an ongoing, dynamic process which is both diagnostic and prescriptive in nature. It communicates, illustrates, and identifies the mathematics that is most important for students to learn and enhances mathematics learning. Assessment and instruction must be intertwined so that each supports the other in promoting the development of mathematical power for all students. Various assessment techniques should be used for:

a. improve teaching and learning;

b. evaluate student progress;

c. assist in making decisions regarding individual student performance;

d. provide information on the effectiveness of educational programs;

e. provide data relative to the progress toward established educational goals;

f. address accountability issues; and

g address the appreciation and understanding of various cultural differences and learning styles.

B. Classroom Assessment

1. Educational purposes for assessment may be as varied as assessment techniques. Assessment is the link between teaching and learning and provides information for making instructional decisions, monitoring student progress, and communicating student progress to appropriate audiences.

2. Assessment is moving away from the use of a single type of instrument to assess students' understanding and toward the use of a wide range of assessment techniques that require students to demonstrate critical thinking skills. Combinations of the following techniques, integrated with instruction, can provide a comprehensive assessment of student understandings: observations, oral questions, journals, portfolios, multiple choice tests, projects, activities, concept maps, presentations, etc.

C. Large-Scale Assessment

1. Large-scale assessment refers to assessment at the district, state, and national level. This type of assessment is used as an external monitoring of student progress on criteria established outside the classroom but with teacher input.

2. When external monitoring is aligned with the curriculum and teaching strategies, it has a positive impact on mathematics education. Appropriate use of external monitoring will enhance learning by providing external support for the teacher's own monitoring of student progress. The monitoring of student progress externally through established performance standards can provide the following:

a. a measurement of student performance on a dynamic, authentic curriculum;

b. information for decision makers;

c. a measure of pupil progression;

d. a criterion for graduation;

e. information for education program evaluation;

f. demographic data;

g. system-wide data; and

h. data for national comparisons.

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§111. Content Strands

A. The six content strands translate the vision of the new mathematics curriculum: Number and Number Relations (N); Algebra (A); Measurement (M); Geometry (G); Data Analysis, Probability, and Discrete Math (D); and Patters, Relations, and Functions (P). Each of the strands is introduced with a focus statement followed by the standard and benchmarks for that strand.

B. The strands are intended to be thoroughly interwoven, providing rich connections at all grade levels. There should be deliberate reinforcement of concepts throughout the school year.

C. Although the content is delineated by strands, it is not a recipe to be followed line by line. Instead, the content provides the building blocks upon which a dynamic, cohesive, and comprehensive mathematics program can be built. It supports student explorations and investigations that relate objectives from several strands. The very nature of the content implies that concepts and understandings should not be taught in isolation.

D. To assist teachers, a handbook that contains sample classroom activities has been developed. The handbook will assist the teacher to translate the content into standards-based classroom instruction. Three or four activities are included for each grade level. The framework and sample activities should assist the teacher in developing curriculum and instruction that enhance the mathematical power of all students.

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Chapter 3. Strand One: Number and Number Relations

§301. Number and Number Relations

A. Focus. Developing an intuitive, common-sense approach to number relationships and operations is of primary importance and should permeate every area of the mathematics curriculum. Number sense involves the use of "friendly easy numbers" and of actively seeking alternative ways of making computations. Number sense is not a topic to be taught as a unit, but is a prevailing theme throughout all mathematics. All students should develop a conceptual understanding of number magnitude and number operations through participation in hands-on investigative activities. These activities should provide many opportunities for students to discover and develop problem-solving strategies. Student involvement in these activities should assist in the development of estimation skills (particularly when an approximate answer is sufficient) and other mental arithmetic skills (when an exact answer is required). When the numbers are not manageable for mental arithmetic and an exact answer is required, calculators or paper and pencil should be used. Parallel with the need to develop an understanding of the methods and usage of various computational techniques is the students' need for an informal development of mathematical language and symbolism. Inherent in our increasing dependence on technology is the danger of accepting machine answers at face value. A well-developed number sense can combat this danger. Furthermore, number sense leads naturally to the development of symbol sense necessary for use with technology, such as graphing calculators and symbolic manipulators. This developing mathematical power will allow the students to function and communicate more effectively and with greater confidence in real-life experiences.

B. Standard. In problem-solving investigations, students demonstrate an understanding to the real number system and communicate the relationships within the system using a variety of techniques and tools.

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§303. Benchmarks K-4

A. Students in Grades K-4 use estimate, mental arithmetic, number lines, graphs, appropriate models, manipulatives, calculators, and computers as they investigate problems involving whole numbers. As a result, what they know and are able to do includes:

1. N-1-E: Constructing number meaning and demonstrating that a number can be expressed in many different forms (e.g., standard notation, number words, number lines, geometrical representations, fractions, and decimals) (1, 2, 4);

2. N-2-E: Demonstrating number sense and estimation skills, giving particular attention to common equivalent reference points (i.e., 1/4= 25% = .25; 1/2 = 50% = .5; $1 = 100%, etc.) (1);

3. N-3-E: Reading, writing, representing, comparing, ordering, and using whole numbers in a variety of forms (e.g., standard notation, number line, and geometrical representations) (1, 4);

4. N-4-E: Demonstrating a conceptual understanding of the meaning of the basic arithmetic operations (add, subtract, multiply, and divide) and their relationships to each other (1);

5. N-5-E: Selecting appropriate operation(s) (add, subtract, multiply, and divide) for a given situation) (2, 3, 4);

6. N-6-E: Applying a knowledge of basic math facts and arithmetic operations to real-life situations (2, 4, 5);

7. N-7-E: Constructing, using, and explaining procedures to compute and estimate with whole numbers (e.g., mental math strategies) (1, 4);

8. N-8-E: Selecting and using appropriate computational methods and tools for given situations involving whole numbers (e.g., estimation, mental arithmetic, calculator, or paper and pencil) (2, 4);

9. N-9-E: Demonstrating the connection of number and number relations to the other strands and to real-life situations (1, 4, 5).

NOTE: The foundation skills addressed by each benchmark are listed numerically in parenthesis after the benchmark.

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§305. Benchmarks 5-8

A. Students in Grades 5-8 use estimation, mental arithmetic, number lines, graphs, appropriate models, manipulatives, calculators, and computers as they extend their investigations of problems involving rational numbers. As a result, what they know and are able to do includes:

1. N-1-M: Demonstrating that a rational number can be expressed in many forms, and selecting an appropriate form for a given situation (e.g., fractions, decimals, and percents) (1, 2, 4);

2. N-2-M: Demonstrating number sense and estimation skills that describe, order, and compare rational numbers (e.g., magnitude, integers, fractions, decimals, and percents) (2, 4);

3. N-3-M: Reading, writing, representing, and using rational numbers in a variety of forms (e.g., integers, mixed numbers, and improper fractions) (1);

4. N-4-M: Demonstrating a conceptual understanding of the meaning of the basic arithmetic operations (add, subtract, multiply and divide) and their relationships to each other (1, 2);

5. N-5-M: Applying an understanding of rational numbers and arithmetic operations to real-life situations (1, 2, 3, 4);

6. N-6-M: Constructing, using, and explaining procedures to compute and estimate with rational numbers employing mental math strategies (1, 2, 3, 4);

7. N-7-M: Selecting and using appropriate computational methods and tools for given situations involving rational numbers (e.g., estimation, or exact computation using mental arithmetic, calculator, computer, or paper and pencil) (2, 3, 4);

8. N-8-M: Demonstrating a conceptual understanding and applications of proportional reasoning (e.g., determining equivalent ratios, finding a missing term of a given proportion) (2, 4).

NOTE: The foundation skills addressed by each benchmark are listed numerically in parenthesis after the benchmark.

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HISTORICAL NOTE: Promulgated by the Board of Elementary and Secondary Education, LR 31:2840 (November 2005).

§307. Benchmarks 9-12

A. Students in Grades 9-12 use estimation, mental arithmetic, number lines, graphs, appropriate models, manipulatives, calculators, and computers as they extend their investigations of problems involving real numbers. As a result, what they know and are able to do includes:

1. N-1-H: Demonstrating an understanding of the real number system (1, 2, 4);

2. N-2-H: Demonstrating that a number can be expressed in many forms, and selecting an appropriate form for a given situation (e.g., fractions, decimals, percents, and scientific notation) (1, 4);

3. N-3-H: Using number sense to estimate and determine if solutions are reasonable (2, 4);

4. N-4-H: Determining whether an exact or appropriate answer is necessary (2, 3, 4);

5. N-5-H: Selecting and using appropriate computational methods and tools for given situations (e.g., estimation, or exact computation using mental arithmetic, calculator, symbolic manipulator, or paper and pencil) (3);

6. N-6-H: Applying ratios and proportional thinking in a variety of situations (e.g., finding a missing term of a proportion) (2, 4);

7. N-7-H: Justifying reasonableness of solutions and verifying results (1, 2, 4).

NOTE: The foundation skills addressed by each benchmark are listed numerically in parentheses after the benchmark.

AUTHORITY NOTE: Promulgated in accordance with R.S. 17.6; R.S. 17:24.4; R.S. 17:154.
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Chapter 5. Strand Two: Algebra

§501. Algebra

A. Focus. Algebra is much more than the study of generalized forms of arithmetic. It is a powerful language used to interpret real-world experience. This language is a communication tool used to analyze and describe relationships and mathematical structures. Beginning at the elementary level, the school mathematics curriculum should integrate the use of the language of algebra throughout all strands of the curriculum to enable students to shift progressively from informal to formal concepts and from concrete to symbolic representations. The middle school mathematics curriculum should integrate the use of this language throughout all strands of the curriculum to enable students to progressively shift from the concrete to the symbolic. At this level, algebra should be conceptual and intuitive, not formally computational. It should involve actively seeking easy and alternative ways of looking at problems. These transitions should be powered by investigations involving the use of appropriate manipulatives, models, and technology, and should encourage the development of communication, reasoning, and problem-solving skills. Algebra, in the K-8 classrooms, refers to informal explorations and understandings of symbolism. It is beneficial to introduce the algebraic terminology (equation, inequality, variable, etc.) in the early grades. In this way high school students will be able to understand algebra as a natural outgrowth of their study of various number properties. The high school curriculum should continue the development of symbolic representatives. The use of modern technology frees teachers and students from the need to develop complicated pencil and paper manipulative skills in algebra. More classroom time in now allowed to apply algebra in solving challenging real-world problems. This will allow students to recognize the worth, importance, and power of the mathematics of abstraction and symbolism.

B. Standard. In problem-solving investigations students demonstrate an understanding of concepts and processes that allow them to analyze, represent, and describe relationships among variable quantities and to apply algebraic methods to real-world situations.

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§503. Benchmarks K-4

A. Students in Grades K-4 use manipulatives, models, graphs, tables, technology, number sense, and estimation as they investigate problems involving the concepts and application of algebra. As a result, what they know and are able to do includes:

1. A-1-E: Demonstrating a conceptual understanding of variables, expressions, equations, and inequalities (e.g., use letters or boxes to represent values; understand $=$, $\neq$, $<$, and symbols) (1, 4);

2. A-2-E: Modeling and developing strategies for solving equations and inequalities (1, 2, 3, 4);

3. A-3-E: Recognizing the connection of algebra to the other strands and to real-life situations (e.g., number sentences or formulas to represent real-world problems) (4, 5).

NOTE: The foundation skills addressed by each benchmark are listed numerically in parentheses after the benchmark.

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§505. Benchmarks 5-8

A. Students in Grades 5-8 use manipulatives, models, graphs, tables, technology, number sense, and estimation as they extend their investigations of problems involving the concepts and application of algebra. As a result, what they know and are able to do includes:

1. A-1-M: Demonstrating a conceptual understanding of variables, expressions, equations, and inequalities (e.g., symbolically represent real-world problems as linear terms, equations, or inequalities) (1, 2, 4);

2. A-2-M: Modeling and developing methods for solving equations and inequalities (e.g., using charts, graphs, manipulatives, and/or standard algebraic procedures) (2, 3, 4);

3. A-3-M: Representing situations and number patterns with tables, graphs, and verbal and written statements, while exploring the relationships among these representations (e.g., multiple representations for the same situation) (1, 4);

4. A-4-M: Analyzing tables and graphs to identify relationships exhibited by the data and making generalizations based upon these relationships (2, 3, 4);

5. A-5-M: Demonstrating the connection of algebra to the other strands and to real-life situations (1, 2, 3, 4, 5).

NOTE: The foundation skills addressed by each benchmark are listed numerically in parentheses after the benchmark.

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§507. Benchmarks 9-12

A. Students in Grades 9-12 use manipulatives, models, graphs, tables, technology, number sense, and estimation as they extend their investigations of problems involving the concepts and application of algebra. As a result, what they know and are able to do includes:

1. A-1-H: Demonstrating the ability to translate real-world situations (e.g., distance versus time relationships, population growth, growth functions for diseases, growth of minimum wage, auto insurance tables) into algebraic expressions, equations, and inequalities and vice versa (1, 2, 4);

2. A-2-H: Recognizing the relationship between operations involving real numbers and operations involving algebraic equations (2, 4);

3. A-3-H: Using tables and graphs as tools to interpret algebraic expressions, equations, and inequalities (1, 3);

4. A-4-H: Solving algebraic equations and inequalities using a variety of techniques with the appropriate tools (e.g., hand-held manipulatives, graphing calculator, symbolic manipulator, or pencil and paper) (2, 3).

NOTE: The foundation skills addressed by each benchmark are listed numerically in parentheses after the benchmark.

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Chapter 7. Strand Three: Measurement

§701. Measurement

A. Focus. Measurement is the connection between numbers and the real word and as such is a vital component of an attempt to organize the world. It allows one to communicate effectively and make decisions. It relates geometry and algebra, as well as geometry and numbers, in both intuitive and formal ways. It is also a connecting theme between such diverse fields as athletics, music, travel, astronomy, and engineering. The study of measurement should consist of active investigations based on real-world problems in both individual and group format. These explorations should include the appropriate use of manipulatives and technology and should encourage the development of communications, reasoning, and problem-solving skills. Students need to learn the effect of unit choice on mathematical entities, such as the shape of graphs and the magnitude of answers. Secondary students should become so adept with the use of units that they are comfortable with the use of compound units (foot-pounds, miles per second) and specialized units (atmospheres, millennia, gigabytes) as they occur in real-world problems.

B. Standard. In problem-solving investigations, students demonstrate an understanding of the concepts, processes, and real-life applications of measurement.

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§703. Benchmarks K-4

A. Students in Grades K-4 use number sense, estimation, appropriate manipulatives, tools, and technology as they investigate problems involving measurement. As a result, what they know and are able to do includes:

1. M-1-E: Applying (measure or solve measurement problem) the concepts of length (inches, feet, yards, miles, millimeters, centimeters, decimeters, meters, kilometers), area, volume, capacity (cups, liquid pints and quarts, gallons, milliliters, liters), weight (ounces, pounds, tons, grams, kilograms), mass, time (seconds, minutes, hours, days, weeks, months, years), money, and temperature (Celsius and Fahrenheit) to real-world experiences (1, 2, 3, 4, 5);

2. M-2-E: Selecting and using appropriate standard and non-standard units of measure (e.g., paper clips and Cuisenaire rods) and tools for measuring length, area, capacity, weight/mass, and time for a given situation by considering the purpose and precision required for the task (1, 2, 3, 4);

3. M-3-E: Using estimation skills to describe, order, and compare measures of length, capacity, weight/mass, time, and temperature (1, 2, 3, 4);

4. M-4-E: Converting from one unit of measurement to another within the same system (customary and metric); comparisons between systems should be based on intuitive reference points, not formal computations (e.g., a meter is a little longer than a yard) (2, 3, 4);

5. M-5-E: Demonstrating the connection of measurement to the other strands and to real-life situations (2, 4, 5).

NOTE: The foundation skills addressed by each benchmark are listed numerically in parentheses after the benchmark.

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§705. Benchmarks 5-8

A. Students in Grades 5-8 use number sense, estimation, appropriate manipulatives, tools, and technology as they extend their investigations of problems involving measurement. As a result, what they know and are able to do includes:

1. M-1-M: Applying the concepts of length, area, surface area, volume, capacity, weight, mass, money, time, temperature, and rate to real-world experiences (2, 3, 4);

2. M-2-M: Demonstrating an intuitive sense of measurement (e.g., estimating and determining reasonableness of measures) (1, 2, 4);

3. M-3-M: Selecting appropriate units and tools for tasks by considering the purpose for the measurement and the precision required for the task (e.g., length of a room in feet rather than in inches) (2, 3, 4);

4. M-4-M: Using intuition and estimation skills to describe, order, and compare formal and informal measures (e.g., ordering cup, pint, quart, gallon; comparing a meter to a yard) (1, 2, 4);

5. M-5-M: Converting from one unit of measurement to another within the same system (Comparisons between systems, customary and metric, should be based on intuitive reference points, not formal computation.) (2, 4);

6. M-6-M: Demonstrating the connection of measurement to the other strands and to real-life situations (1, 2, 3, 4, 5).

NOTE: The foundation skills addressed by each benchmark are listed numerically in parenthesis after the benchmark.

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§707. Benchmarks 9-12

A. Students in Grades 9-12 use number sense, estimation, appropriate manipulatives, tools, and technology as they extend their investigations of problems involving measurement. As a result, what they know and are able to do includes:

1. M-1-H: Selecting and using appropriate units, techniques, and tools to measure quantities in order to achieve specified degrees of precision, accuracy, and error (or tolerance) of measurements (3);

2. M-2-H: Demonstrating an intuitive sense of measurement (e.g., estimating and determining reasonableness of results as related to area, volume, mass, rate, and distance) (1, 2, 4);

3. M-3-H: Estimating, computing, and applying physical measurement using suitable units (e.g., calculate perimeter and area of plane figures, surface area and volume of solids presented in real-world situations) (1, 3, 4);

4. M-4-H: Demonstrating the concept of measurement as it applied to real-world experiences (1, 2, 3, 4, 5).

NOTE: The foundation skills addressed by each benchmark are listed numerically in parentheses after the benchmark.

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Chapter 9. Strand Four: Geometry

§901. Geometry

A. Focus. Geometry is the study of the physical shapes of the word in which we live. It provides a natural environment for the use of inductive and deductive reasoning. It is not only basic to design, construction, and engineering, but also to law, medicine, and other fields that depend on critical deductive thinking skills. It provides models for representing many numerical and algebraic concepts. In Grades K-4, students must have opportunities to examine, manipulate, and construct geometric models using concrete materials. These activities should take place in a setting where students may freely explore and discuss ideas in order to develop and use appropriate vocabulary. After such first-hand experiences, many students should be able to progress to pictorial and abstract representations. The study of geometry should center around cooperative group investigations designed to promote the discovery of geometric concepts and principles and should encourage the development of communication, reasoning, and problem-solving skills. Secondary students should develop coordinate and transformational geometry as well as the usual axiomatic geometry. They should develop deductive reasoning skills by way of written proofs in a variety of formats. In the study of geometry, students should have access to appropriate manipulatives, technology, and construction materials to enhance their investigations.

B. Standard. In problem-solving investigations, students demonstrate an understanding of geometric concepts and applications involving one-, two-, and three-dimensional geometry, and justify their findings.

NOTE: The foundation skills addressed by each benchmark are listed numerically in parentheses after the benchmark.

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§903. Benchmarks K-4

A. Students in Grades K-4 use number sense, estimation, models, drawings, manipulatives, and technology as they investigate problems involving geometric concepts. As a result, what they know and are able to do includes:

1. G-1-E: Determining the relationships among shapes (1, 2, 3, 4);

2. G-2-E: Identifying, describing, comparing, constructing, and classifying two-dimensional and three-dimensional geometric shapes using a variety of materials (1, 2, 3, 4);

3. G-3-E: Making predictions regarding combinations, subdivisions, and transformations (slides, flips, turns) of simple plane geometric shapes (1, 2, 4);

4. G-4-E: Drawing, constructing models, and comparing geometric shapes, with special attention to developing spatial sense (1, 2, 4);

5. G-5-E: Identifying and drawing line and angles and describing their relationships to each other and to the real world (1, 4, 5);

6. G-6-E: Demonstrating the connection of geometry to the other strands and to real-lie situations (1, 2, 3, 4, 5).

NOTE: The foundation skills addressed by each benchmark are listed numerically in parentheses after the benchmark.

AUTHORITY NOTE: Promulgated in accordance with R.S. 17.6; R.S. 17:24.4; R.S. 17:154.
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§905. Benchmarks 5-8

A. Students in Grades 5-8 use number sense, estimation, models, drawings, manipulatives, and technology as they extend their investigations of problems involving geometric concepts. As a result, what they know and are able to do includes:

1. G-1-M: Using estimation skills to describe, order, and compare geometric measures (1, 2);

2. G-2-M: Identifying, describing, comparing, constructing, and classifying geometric figures and concepts (1, 2, 3);

3. G-3-M: Making predictions regarding transformations of geometric figures (e.g., make prediction regarding translations, reflections, and rotations or common figures) (1, 4);

4. G-4-M: Constructing two- and three-dimensional models (3);

5. G-5-M: Making and testing conjectures about geometric shapes and their properties (1, 2, 3, 4);

6. G-6-M: Demonstrating an understanding of the coordinate system (e.g., locate points, identify coordinates, and graph points in the coordinate plane to represent real-world situations) (1, 3, 4);

7. G-7-M: Demonstrating the connection of geometry to the other strands and to real-life situations (e.g., applications of the Pythagorean Theorem).

NOTE: The foundation skills addressed by each benchmark are listed numerically in parentheses after the benchmark.

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§907. Benchmarks 9-12

A. Students in Grades 9-12 use number sense, estimation, models, drawings, manipulatives, and technology as they extend their investigations of problems involving geometric concepts. As a result, what they know and are able to do includes:

1. G-1-H: Identifying, describing, comparing, constructing, and classifying geometric figures in two and three dimensions using technology where appropriate to explore and make conjectures about geometric concepts and figures (1, 2, 3, 4);

2. G-2-H: Representing and solving problems using geometric models and the properties of those models (e.g., Pythagorean Theorem or formulas involving radium, diameter, and circumference) (1, 2, 3);

3. G-3-H: Solving problems using coordinate methods, as well as synthetic and transformational methods (e.g., transform on a coordinate plane a design found in real-life situations) (2);

4. G-4-H: Using inductive reasoning to predict, discover, and apply geometric properties and relationships (e.g., patty paper constructions, sum of the angles in a polygon) (1, 2, 4);

5. G-5-H: Classifying figures in terms of congruence and similarity and applying these relationships (4);

6. G-6-H: Demonstrating deductive reasoning and mathematical justification (e.g., oral explanation, informal proof, and paragraph proof) (1, 2, 4).

NOTE: The foundation skills addressed by each benchmark are listed numerically in parentheses after the benchmark.

AUTHORITY NOTE: Promulgated in accordance with R.S. 17.6; R.S. 17:24.4; R.S. 17:154.
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Chapter 11. Strand Five: Data Analysis, Probability, and Discrete Math

§1101. Data Analysis, Probability, and Discrete Math

A. Focus. Data analysis is the collecting, organizing, presenting, and analyzing of numerical information using appropriate statistical methods. Discrete mathematics is the branch of mathematics that involves finite sets and structured sets, including matrices and graph theory. Probability is that branch of mathematics that deals with uncertainty and the likelihood of events occurring or not occurring. These three subjects are closely interwoven. Concepts from these subjects should develop gradually through many varied experiences based on students' natural interests. These concepts are essential to help students relate mathematical thinking to real-life situations, such as weather, games, sports, newspapers, and business. Classroom explorations involving these concepts should encourage the development of communication, connections, reasoning, and problem-solving skills and should effectively incorporate the use of appropriate models, manipulatives, and technology. Talking and writing should be of particular importance in this strand as students learn to analyze information and express similarities, differences, and patterns based on their investigations. The concepts studies will enable students to effectively communicate information in an organized and graphic manner that will enhance problem-solving skills.

B. Standard. In problem-solving investigations, students discover trends, formulate conjectures regarding cause-and-effect relationships, and demonstrate critical thinking skills in order to make informed decisions.

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§1103. Benchmarks K-4

A. Students in Grades K-4 use collection and organizational techniques, number sense, estimation, manipulatives, and technology as they investigate problems involving data. As a result, what they know and are able to do includes:

1. D-1-E: Collecting, organizing, and describing data based on real-life situations (1, 3, 4, 5);

2. D-2-E: Constructing, reading, and interpreting data in charts, graphs, tables, etc. (1, 2, 3, 4);

3. D-3-E: Formulating and solving problems that involve the use of data (2, 3, 4);

4. D-4-E: Exploring, formulating, and solving sequence-of-pattern problems involving selection and arrangement of objects/numerals (2, 3, 4);

5. D-5-E: Predicting outcomes based on probability (e.g., make predictions of same chance, more likely, or less likely; determine fair and unfair games);

6. D-6-E: Demonstrating the connection of data analysis, probability, and discrete math to other strands and real-life situations (1, 2, 3, 4, 5).

NOTE: The foundation skills addressed by each benchmark are listed numerically in parentheses after the benchmark.

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§1105. Benchmarks 5-8

A. Students in Grades 5-8 use collection and organizational techniques, number sense, estimation, manipulatives, and technology as they extend their investigations of problems involving data. As a result, what they know and are able to do includes:

1. D-1-M: Systematically collecting, organizing, describing, and displaying data in charts, tables, plots, graphs, and/or spreadsheets (1, 2, 3, 4);

2. D-2-M: Analyzing, interpreting, evaluating, drawing inferences, and making estimations, predictions, decisions, and convincing arguments based on organized data (e.g., analyze data using concepts of mean, median, mode, range, random samples, sample size, bias, and data extremes) (1, 2, 3, 4, 5);

3. D-3-M: Describing informal thinking procedures (e.g., solving elementary logic problems using Venn diagrams, tables, charts, and/or elementary logic operatives to solve logic problems in real-life situations; reach valid conclusions in elementary logic problems involving "and, or, not, if/then") (2, 3);

4. D-4-M: Analyzing various counting and enumeration procedures with and without replacement (e.g., find the total number of possible outcomes or possible choices in a given situation (2, 4);

5. D-5-M: Comparing experimental probability results with theoretical probability (e.g., representing probabilities of concrete situations as common fractions, investigating single-event and multiple-event probability, using sample spaces, geometric figures, tables, and/or graphs) (2, 3, 4);

6. D-6-M: Demonstrating the connection of data analysis, probability, and discrete math to other strands and to real-life situations (1, 2, 3, 4, 5).

NOTE: The foundation skills addressed by each benchmark are listed numerically in parentheses after the benchmark.

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§1107. Benchmarks 9-12

A. Students in Grades 9-12 use collection and organizational techniques, number sense, estimation, manipulatives, and technology as they extend their investigations of problems involving data. As a result, what they know and are able to do includes:

1. D-1-H: Designing and conducting statistical experiments that involve the collection, representation, and analysis of data in various forms (Analysis should reflect an understanding of factors such as: sampling, bias, accuracy, and reasonableness of data.) (1, 2, 3, 4);

2. D-2-H: Recognizing data that relate two variables as linear, exponential, or otherwise in nature (e.g., match a data set, linear or non-linear, to a graph and vice versa) (1, 2, 3, 4);

3. D-3-H: Using simulations to estimate probabilities (e.g., lists and tree diagrams) (1, 2, 3, 4);

4. D-4-H: Demonstrating an understanding of the calculation of finite probabilities using permutations, combinations, sample spaces, and geometric figures (1, 3);

5. D-5-H: Recognizing events as dependent or independent in nature and demonstrating techniques for computing multiple-event probabilities (1, 2, 4);

6. D-6-H: Recognizing and answering questions about data that are normally or non-normally distributed (1, 2, 4);

7. D-7-H: Making inferences from data that are organized in charts, tables, and graphs (e.g., pictograph; bar, line, or circle graph; stem-and-leaf plot or scatter plot) (1, 3, 4);

8. D-8-H: Using logical thinking procedures, such as flow charts, Venn diagrams, and truth tables (2, 3, 4);

9. D-9-H: Using discrete math to model real-life situations (e.g., fair games or elections, map coloring) (1, 2, 3, 4, 5).

NOTE: The foundation skills addressed by each benchmark are listed numerically in parentheses after the benchmark.

AUTHORITY NOTE: Promulgated in accordance with R.S. 17.6; R.S. 17:24.4; R.S. 17:154.
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Chapter 13. Strand Six: Patterns, Relations, and Functions

§1301. Patterns, Relations, and Functions

A. Focus. The concepts of patterns, relations, and functions play a central role in modern mathematics. These concepts arise naturally from observations of the world. Business people, social scientists, and physical scientists use mathematics to make predictions following their study of patterns and relationships found among the quantities measured in their respective fields. In Grades K-8, students should use informal investigations to observe patterns created by nature and man (flowers, leaves, insects, music, predictable literature, wallpaper, fabric). Students should continue to use the study of patterns to explore mathematical relationships as they verbalize, complete, create, and analyze patterns. This gradual transition from the concrete to the symbolic provides a foundation for the study of functions. Not only does the high school curriculum contain in the formal study of functions and inverse relations, it also uses functions and inverse relations as modeling tools for the study of relationships found in our world. This study of functions and how things change leads naturally to powerful analytic techniques, which are collectively called calculus.

B. Standard. In problem-solving investigations, students demonstrate an understanding of patterns, relations, and functions that represent and explain real-world situations.

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§1303. Benchmarks K-4

A. Students in Grades K-4 use number sense, estimation, manipulatives, drawings, tables, graphs, formulas, and technology as they investigate problems involving patterns, relations, and functions. As a result, what they know and are able to do includes:

1. P-1-E: Recognizing, describing, extending, and creating a wide variety of numerical (e.g., skip counting of whole numbers), geometrical, and statistical patterns (1, 2, 3, 4);

2. P-2-E: Representing and describing mathematical relationships using tables, variables, open sentences, and graphs (1, 2, 4);

3. P-3-E: Recognizing the use of patterns, relations, and functions in other strands and in real-life situations (2, 3, 4, 5).

NOTE: The foundation skills addressed by each benchmark are listed numerically in parentheses after the benchmark.

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§1305. Benchmarks 5-8

A. Students in Grades 5-8 use number sense, estimation, manipulatives, drawings, tables, graphs, formulas, and technology as they extend their investigations of problems involving patterns, relations, and functions. As a result, what they know and are able to do includes:

1. P-1-M: Describing, extending, analyzing, and creating a wide variety of numerical, geometrical, and statistical patterns (e.g., skip counting of rational numbers and simple exponential number patterns) (1, 2, 3, 4);

2. P-2-M: Describing and representing relationships using tables, rules, simple equations, and graphs (1, 3, 4);

3. P-3-M: Analyzing relationships to explain how a change in one quantity results in a change in another (e.g., change in the dimensions of a rectangular solid affects the volume) (1, 2, 4);

4. P-4-M: Demonstrating the pervasive use of patterns, relations, and functions in other strands and in real-life situations (1, 4, 5).

NOTE: The foundation skills addressed by each benchmark are listed numerically in parentheses after the benchmark.

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§1307. Benchmarks 9-12

A. Students in Grades 9-12 use number sense, estimation, manipulatives, drawings, tables, graphs, formulas, and technology as they extend their investigations of problems involving patterns, relations, and functions. As a result, what they know and are able to do includes:

1. P-1-H: Modeling the concepts of variables, functions, and relations as they occur in the real world and using the appropriate notation and terminology (1, 3, 4);

2. P-2-H: Translating between tabular, symbolic, or graphic representations of functions (1, 3, 4);

3. P-3-H: Recognizing behavior of families of elementary functions, such as polynomial, trigonometric, and exponential functions, and, where appropriate, using graphing technologies to represent them (3, 4);

4. P-4-H: Analyzing the effects of changes in parameters (e.g., coefficients and constants) on the graphs of functions, using technology whenever possible (2, 3);

5. P-5-H: Analyzing real-world relationships that can be molded by elementary functions (1, 3, 4).

NOTE: The foundation skills addressed by each benchmark are listed numerically in parentheses after the benchmark.

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Chapter 15. Grade Level Expectations

§1501. Prekindergarten

A. Number and Number Relations: Strand One

1. GLE 1: Count by ones to 10 (PK-CM-N3) (N-1-E) (N-3-E).

2. GLE 2: Count a set of 5 or fewer objects by establishing a 1-to-1 correspondence between number names and objects (PK-CM-N2) (N-1-E).

3. GLE 3: Identify an object's position as first or last (PK-CM-G3) (N-1-E).

4. GLE 4: Identify numerals 1 to 5 (PK-CM-N5) (N-1-E) (N-3-E).

5. GLE 5: Compare sets of objects using the words same/different and more/less/fewer (PK-CM-N1) (N-3-E) (N-7-E).

B. Measurement: Strand Three

1. GLE 6: Use comparative vocabulary in measurement settings (e.g., long/longer, short/shorter, more/less, hotter/colder, heavier/lighter, bigger/smaller) (PK-CM-M3) (M-1-E) (M-2-E) (M-3-E).

2. GLE 7: Use words such as day, week, month, schedule, morning, noon, night (PK-CM-M1) (M-2-E).

C. Geometry: Strand Four

1. GLE 8: Identify rectangles, squares, circles, and triangles using concrete models (G-2-E).

2. GLE 9: Sort concrete objects by an attribute (e.g., shape, size, color) (PK-CM-D1) (G-2-E) (D-1-E).

3. GLE 10: Use words that indicate direction and position of an object (e.g., up, down, over, under, above, below, beside, in, out, behind) (PK-CM-G3) (G-3-E).

4. GLE 11: Recognize and manipulate an object's position in space (e.g., blocks, assembling puzzles) (PK-CM-G3) (G-3-E) (G-4-E).

D. Data Analysis, Probability, and Discrete Math: Strand Five

1. GLE 12: Arrange objects or pictures of objects to make an object or picture graph (PK-CM-D2) (D-4-E).

E. Patterns, Relations, and Functions: Strand Six

1. GLE 13: Recognize and copy repeated patterns (e.g., concrete objects, songs, rhymes, and body movements) (PK-CM-P1) (PK-CM-P2) (P-1-E) (P-3-E).

NOTE: The benchmarks addressed by each GLE are listed in parentheses after the GLE.

AUTHORITY NOTE: Promulgated in accordance with R.S. 17.6; R.S. 17:24.4; R.S. 17:154.
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§1503. Kindergarten

A. Number and Number Relations: Strand One

1. GLE 1: Count by ones to 20 (N-1-E) (N-3-E).

2. GLE 2: Count a set of 20 or fewer objects by establishing a 1-to-1 correspondence between number names and objects (N-1-E) (N-3-E) (A-1-E).

3. GLE 3: Use the ordinal numerals 1st through 10th to discuss positions in ordered lists (N-1-E).

4. GLE 4: Identify the numerals for the numbers 0 through 20 (N-1-E) (N-3-E).

5. GLE 5: Using a number line or chart, identify the numbers coming before/after a given number and between 2 given numbers (N-1-E) (N-3-E) (A-1-E).

6. GLE 6: Identify pennies, nickels, and dimes and their values using the cent sign (¢) (N-1-E) (N-2-E) (N-6-E) (M-1-E).

7. GLE 7: Count forward and backward from a given number between 1 and 10 (N-3-E).

8. GLE 8: Compare sets containing 20 or fewer objects using the words *same/different* and *more/less/greater/fewer* (N-3-E) (N-1-E).

9. GLE 9: Use concrete objects to model simple real-life addition and subtraction problems (N-4-E).

10. GLE 10: Use operational vocabulary (*add, subtract, join, remove, take away, put together*) to explore sets of objects (N-5-E).

B. Algebra: Strand Two

1. GLE 11: Use the words *same*, *different*, *equal*, *not equal, greater than*, and *less than* while using concrete objects for comparative models (A-1-E).

2. GLE 12: Model and act out story problems, physically or with objects, to solve whole number sentences with sums less than or equal to 6 (A-2-E).

C. Measurement: Strand Three

1. GLE 13: Use vocabulary such as: *yesterday, today, tomorrow, hours, weeks,* names of days, names of months; sequence events; and identify calendars and clocks as objects that measure time (M-1-E) (M-2-E) (M-5-E).

2. GLE 14: Measure and estimate length and capacity using non-standard units (e.g., sticks, paper clips, blocks, beans) (M-2-E) (M-3-E).

3. GLE 15: Use comparative and superlative vocabulary in measurement settings (e.g., longest, shortest, most, hottest, heaviest, biggest) (M-3-E) (M-1-E) (M-2-E).

D. Geometry: Strand Four

1. GLE 16: Name and identify basic shapes using concrete models (e.g., circles, squares, triangles, rectangles, rhombuses, balls, boxes, cans, cones) (G-2-E) (G-1-E) (G-4-E) (G-5-E).

2. GLE 17: Compare, contrast, and sort objects or shapes according to two attributes (e.g., shape and size, shape and color, thickness and color) (G-2-E).

3. GLE 18: Use words that indicate direction and position of objects and arrange an object in a specified position and orientation (e.g., between, behind, above) (G-3-E).

4. GLE 19: Investigate the results of combining shapes (using paper shapes, pattern blocks, tangrams, etc.) (G-3-E) (G-1-E).

5. GLE 20: Draw circles, squares, rectangles, and triangles (G-4-E).

E. Data Analysis, Probability, and Discrete Math: Strand Five

1. GLE 21: Collect and organize concrete data using tally mark charts (D-1-E).

2. GLE 22: Collect and organize data in a simple bar graph using pictures or objects (D-1-E) (D-2-E).

3. GLE 23: Sort, represent, and use information in simple tables and bar/picture graphs (D-2-E) (D-3-E).

F. Patterns, Relations, and Functions: Strand Six

1. GLE 24: Recognize, copy, name, create, and extend repeating patterns (e.g., ABAB, AABB, ABBA) using concrete objects, shapes, pictures, numbers, and sounds (P-1-E).

NOTE: The benchmarks addressed by each GLE are listed in parentheses after the GLE.

AUTHORITY NOTE: Promulgated in accordance with R.S. 17.6; R.S. 17:24.4; R.S. 17:154.
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§1505. First Grade

A. Number and Number Relations: Strand One

1. GLE 1: Count to 100 by 1s, 5s, 10s, and 25s (N-1-E) (N-3-E) (N-4-E).

2. GLE 2: Read and write numerals to 100 (N-1-E).

3. GLE 3: Write number words for 0 to 19 (N-1-E) (N-3-E).

4. GLE 4: Use ordinal numbers through 31st as they relate to the calendar (N-1-E).

5. GLE 5: Model and read place value in word, standard, and expanded form for numbers through 99 (N-1-E).

6. GLE 6: Use region models and sets of objects to demonstrate understanding of the concept of halves (N-1-E).

7. GLE 7: Identify quarters, half-dollars, and their values (N-1-E) (N-2-E) (M-1-E).

8. GLE 8: Find the value of a set of coins up to $1, using one denomination of coin (N-2-E) (N-6-E) (M-1-E) (M-5-E).

9. GLE 9: Apply estimation strategies to estimate the size of groups up to 20 (N-2-E) (N-8-E).

10. GLE 10: Using a number line or chart, locate, compare, and order whole numbers less than 100 and identify the numbers coming before/after a given number and between 2 given numbers (N-3-E) (A-1-E).

11. GLE 11: From a given number between 1 and 100, count forward and backward (N-3-E).

12. GLE 12: Know the basic facts for addition and subtraction [0s, 1s, counting on and back 2s, doubles, doubles + 1, then 10s fact, and related turn-around (commutative) pairs] and use them to solve real-life problems (N-4-E) (N-6-E) (N-8-E).

13. GLE 13: Recognize and apply addition and subtraction as inverse operations (N-4-E).

14. GLE 14: Add and subtract 2-digit numbers using manipulatives (N-4-E) (N-7-E).

15. GLE 15: Recognize real-life situations as addition or subtraction problems (N-5-E) (N-4-E).

16. GLE 16: Given a number and number line/hundreds chart, identify the nearest ten (N-7-E).

B. Algebra: Strand Two

1. GLE 17: Use the equal sign (=) to express the relationship of equality (A-1-E).

2. GLE 18: Use objects, pictures, and number sentences to represent real-life problem situations involving addition and subtraction (A-1-E) (A-3-E) (N-7-E).

3. GLE 19: Use objects, pictures, and verbal information to solve for missing numbers (A-2-E) (N-7-E).

C. Measurement: Strand Three

1. GLE 20: Measure length to the nearest inch and centimeter using appropriate tools (M-1-E) (M-2-E).

2. GLE 21: Tell time to the hour and half-hour, and identify date, day, week, month, and year on a calendar (M-1-E) (M-2-E) (M-5-E).

3. GLE 22: Select appropriate non-standard units for linear measurement situations (e.g., sticks, blocks, paper clips) (M-2-E).

4. GLE 23: Compare the measure of objects to benchmarks (e.g., the width of a child's thumb is about a centimeter , the weight of a loaf of bread is about a pound, and the mass of a textbook is about a kilogram) (M-2-E).

5. GLE 24: Measure capacity using cups (M-2-E) (M-3-E) (M-1-E).

6. GLE 25: Identify the thermometer as a tool for measuring temperature (M-2-E).

D. Geometry: Strand Four

1. GLE 26: Compare, contrast, name, and describe attributes (e.g., corner, side, straight, curved, number of sides) of shapes using concrete models [circle, rectangle (including square), rhombus, triangle] (G-1-E) (G-2-E) (G-4-E).

2. GLE 27: Connect the informal language used for 3-dimensional shapes to their proper mathematical name (e.g., a ball is a sphere, a box is a rectangular prism, a can is a cylinder) (G-2-E).

3. GLE 28: Determine if a shape has a line of symmetry for folding (G-2-E).

4. GLE 29: Visualize, predict, and create new shapes by cutting apart and combining existing 2- and 3-dimensional shapes (G-3-E) (G-1-E).

5. GLE 30: Identify congruent shapes (i.e., same size and shape) in a variety of positions and orientations (G-3-E) (G-2-E).

6. GLE 31: Draw line segments (G-5-E).

E. Data Analysis, Probability, and Discrete Math: Strand Five

1. GLE 32: Given a set of data, construct and read information from bar graphs and charts (D-1-E) (D-2-E).

2. GLE 33: Determine whether an object satisfies a simple logical classification rule (e.g., belongs and does not belong) (D-1-E).

3. GLE 34: Appropriately use basic probability vocabulary (e.g., *more likely to happen/less likely to happen, always /never, same as*) (D-5-E).

F. Patterns, Relations, and Functions: Strand Six

1. GLE 35: Identify, describe, and explain the patterns in repeating situations (adding the same number (e.g., 2, 5, 8, 11, or skip-counting) (P-1-E).

2. GLE 36: Explain patterns created with concrete objects, numbers, shapes, and colors (P-2-E).

NOTE: The benchmarks addressed by each GLE are listed in parentheses after the GLE.

AUTHORITY NOTE: Promulgated in accordance with R.S. 17.6; R.S. 17:24.4; R.S. 17:154.
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§1507. Second Grade

A. Number and Number Relations: Strand One

1. GLE 1: Model, read, and write place values for numbers through 999 in word, standard, and expanded form (N-1-E).

2. GLE 2: Model the concepts of thirds, fourth, fifths, and sixths using regions, sets, and fraction words (e.g., one-third, three-fourths, five-sixths) (N-1-E).

3. GLE 3: Make reasonable estimates of the number of objects in a collection with fewer than 100 objects (N-2-E).

4. GLE 4: Count and write the value of amounts of money up to $1 using ¢ and $ (N-2-E) (N-6-E) (M-1-E) (M-5-E).

5. GLE 5: Read, write, compare, and order whole numbers through 999 using words, number lines, and models (N-3-E) (N-1-E).

6. GLE 6: From a given number, count forward and backward and count to 100 by 2s (N-3-E) (N-1-E) (N-4-E).

7. GLE 7: Know all basic facts for addition and subtraction and use them to solve real-life problems (N-5-E) (N-6-E) (N-7-E) (N-8-E) (N-9-E).

8. GLE 8: Recognize, select, connect, and use operations, operational words and symbols (+, -) for addition (join, part/part/whole) or subtraction (take away, comparison, missing addend, and set/subset) situations (N-6-E) (N-5-E).

9. GLE 9: Add and subtract 1- and 2-digit numbers (N-6-E) (N-7-E).

10. GLE 10: Round numbers to the nearest 10 or 100 and identify situations in which rounding is appropriate (N-7-E) (N-9-E).

11. GLE 11: Use the concept of one-to-several correspondences to trade single items for a greater quantity of items with unequal value (1 nickel for 5 pennies, 1 dime for 2 nickels) (N-9-E).

B. Algebra: Strand Two

1. GLE 12: Use number sentences to represent real-life problems involving addition and subtraction (A-1-E) (A-2-E).

2. GLE 13: Find the missing number in an equation involving addition or subtraction (e.g., # + 4 = 7, 8 - # = 3) (A-2-E) (N-4-E).

C. Measurement: Strand Three

1. GLE 14: Measure and appropriately label measures of length and perimeter (i.e., inch, centimeter, foot), capacity (i.e., cup, quart, liter), and weight/mass (i.e., pound, kilogram) (M-1-E).

2. GLE 15: Read a thermometer in degrees in Fahrenheit and Celsius and interpret the temperature (M-1-E).

3. GLE 16: Tell time to the nearest 5 minutes, and identify the time one hour before or after a given time (M-1-E) (M-3-E).

4. GLE 17: Select and use appropriate tools and units to measure length, time, capacity, and weight (e.g., scales for pounds and kilograms; rulers for inches and centimeters; measuring containers for cup, quarts, and liters) (M-2-E).

5. GLE 18: Use non-standard units to cover a given region (M-2-E).

6. GLE 19: Estimate length in standard units (inch, foot, and centimeter) (M-3-E).

7. GLE 20: Compare units within the same system (inch is shorter than a foot, minute is shorter than an hour, day is shorter than a month, cup holds less than a quart) (M-3-E).

D. Geometry: Strand Four

1. GLE 21: Compare and contrast 3-dimensional shapes (i.e., sphere, cube, cylinder, cone, prism, pyramid) according to their attributes (e.g., number of faces, shape of faces) (G-2-E).

2. GLE 22: Identify a reduction or enlargement of a given shape (G-2-E).

3. GLE 23: Identify congruent 3-dimensional solids in a variety of positions and orientations (G-3-E) (G-4-E) (G-2-E).

4. GLE 24: Identify and draw horizontal and vertical line segments (G-5-E).

E. Data Analysis, Probability, and Discrete Math: Strand Five

1. GLE 25: Collect and organize data using observations, surveys, and experiments (D-1-E).

2. GLE 26: Construct and read line plots and tables (D-2-E).

3. GLE 27: Interpret pictographs in which each picture represents more than one object (D-2-E).

4. GLE 28: Generate questions that can be answered by collecting and analyzing data (D-3-E).

5. GLE 29: Solve logic problems involving two sets by using elementary set logic (i.e., and, or, and is/is not statements) (D-3-E).

F. Patterns, Relations, and Functions: Strand Six

1. GLE 30: Recognize, extend, create, and explain patterns of addition and subtraction as represented in charts and tables and in varied forms of skip-counting (P-1-E) (P-2-E).

2. GLE 31: Recognize, extend, create, and explain patterns that involve simple rotations or size changes with geometric objects (P-1-E) (P-2-E).

3. GLE 32: Recognize and apply patterns in problem-solving in other content areas and real-life situations (P-3-E) (N-9-E).

NOTE: The benchmarks addressed by each GLE are listed in parentheses after the GLE.

AUTHORITY NOTE: Promulgated in accordance with R.S. 17.6; R.S. 17:24.4; R.S. 17:154.
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§1509. Third Grade

A. Number and Number Relations: Strand One

1. GLE 1: Model, read, and write place value in word, standard, and expanded form for numbers through 9999 (N-1-E).

2. GLE 2: Read, write, compare, and order whole numbers through 9999 using symbols (i.e., <, =, >) and models (N-1-E) (N-3-E).

3. GLE 3: Use region and set models and symbols to represent, estimate, read, write, and show understanding of fractions through tenths (N-1-E) (N-2-E).

4. GLE 4: Use the concepts of associative and commutative properties of multiplication to simplify computations (N-4-E) (N-7-E).

5. GLE 5: Recognize and model multiplication as a rectangular array or as repeated addition (N-4-E) (N-7-E).

6. GLE 6: Recognize and model division as separating quantities into equal subsets (fair shares) or as repeated subtraction (N-4-E) (N-7-E).

7. GLE 7: Recognize and apply multiplication and division as inverse operations (N-4-E).

8. GLE 8: Recognize, select, connect, and use operations, operational words, and symbols (i.e., +, -, x, ÷) to solve real-life situations (N-5-E) (N-6-E) (N-9-E).

9. GLE 9: Know basic multiplication and division facts [0s, 1s, 2s, 5s, 9s, and turn-arounds (commutative facts), including multiplying by 10s] (N-6-E) (N-4-E).

10. GLE 10: Calculate the value of a combination of bills and coins and make change up to $5.00 (N-6-E) (M-1-E) (M-5-E).

11. GLE 11: Add and subtract numbers of digits or less (N-6-E) (N-7-E).

12. GLE 12: Round to the nearest 1000 and identify situations in which rounding is appropriate (N-7-E) (N-9-E).

13. GLE 13: Determine when and how to estimate, and when and how to use mental math, calculators, or paper/pencil strategies to solve addition and subtraction problems (N-8-E) (N-9-E).

B. Algebra: Strand Two

1. GLE 14: Use the symbols <, >, and ≠ to express inequalities (A-1-E).

2. GLE 15: Use objects, pictures, numbers, symbols, and words to represent multiplication and division problem situations (A-1-E).

3. GLE 16: Use number sentences to represent real-life problems involving multiplication and division (A-1-E) (N-4-E).

4. GLE 17: Analyze and describe situations where proportional trades or correspondences are required (e.g., trade 2 pieces of candy for 3 pieces for gum, make equivalent actions on pans to keep balance scale in equilibrium, plan for the number of pieces of bread needed for x sandwiches) (A-1-E).

5. GLE 18: Use letters as variables in mathematical statements that represent real-life problems (e.g., 2 x n = 8) (A-2-E).

C. Measurement: Strand Three

1. GLE 19: Measure length to the nearest yard, meter, and half-inch (M-1-E).

2. GLE 20: Measure capacity using pints and gallons (M-1-E).

3. GLE 21: Measure weight using grams and ounces (M-1-E).

4. GLE 22: Find the perimeter of a geometric shape given the length of its sides (M-1-E).

5. GLE 23: Find the area in square units of a given rectangle (including squares) drawn on a grid or by covering the region with square tiles (M-1-E).

6. GLE 24: Find elapsed time involving hours and minutes, without regrouping, and tell time to the nearest minute (M-1-E) (M-5-E).

7. GLE 25: Select and use the appropriate standard units of measure, abbreviations, and tools to measure length and perimeter (i.e., in., cm, ft., yd., m), area (square inch, square centimeter), capacity (i.e., cup, pint, quart, gallon, liter), and weight/mass (i.e., oz., lb., g, kg, ton) (M-2-E).

8. GLE 26: Order a set of measures within the same system (M-3-E).

9. GLE 27: Compare U.S. and metric measurement using approximate reference points without using conversions (e.g., a meter is longer than a yard) (M-3-E) (M-4-E).

10. GLE 28: Estimate length, weight/mass, and capacity (M-3-E).

D. Geometry: Strand Four

1. GLE 29: Classify and describe 2- and 3-dimensional objects according to given attributes (triangle vs. quadrilateral, parallelogram vs. prism) (G-2-E) (G-1-E) (G-4-E).

2. GLE 30: Apply concepts of congruence, similarity, and symmetry in real-life situations (G-2-E).

3. GLE 31: Draw or reconstruct figures from visual memory or verbal descriptions (G-3-E).

4. GLE 32: Recognize and executive specified flips, turns, and slides of geometric figures using manipulatives and correct terminology (including *clockwise* and *counterclockwise*) (G-3-E).

5. GLE 33: Construct and draw rectangles (including squares) with given dimensions (e.g., grid paper, square tiles) (G-4-E).

6. GLE 34: Fold a 2-dimensional net into a 3-dimensional object (G-4-E) (G-1-E).

7. GLE 35: Identify, give properties of, and distinguish among points, lines, line segments, planes, rays, and angles (G-5-E).

8. GLE 36: Identify and draw segments, rays, and lines that are perpendicular, parallel, and interesting (G-5-E).

9. GLE 37: Identify, describe, and draw intersecting, horizontal, vertical, parallel, diagonal, and perpendicular lines, rays, and right angles in the real world (G-5-E) (G-6-E).

10. GLE 38: Find the length of a path (that does not include diagonals) between two points on a grid (G-6-E).

E. Data Analysis, Probability, and Discrete Math: Strand Five

1. GLE 39: Identify categories and sort objects based on qualitative (categorical) and quantitative (numerical) characteristics (D-1-E).

2. GLE 40: Read, describe, and organize a two-circle Venn diagram (D-1-E) (D-2-E).

3. GLE 41: Explain the word *average* and use it appropriately in discussing what is "typical" of a data set (D-1-E).

4. GLE 42: Match a data set to a graph, table, or chart and vice versa (D-2-E).

5. GLE 43: Represent and solve problems using data from a variety of sources (e.g., tables, graphs, maps, advertisements) (D-3-E).

6. GLE 44: Discuss chance situations in terms of *certain/impossible* and *equally likely* (D-5-E).

7. GLE 45: Use manipulatives to discuss the probability of an event (e.g., number cubes, spinners to determine what is most likely or least likely) (D-5-E).

F. Patterns, Relations, and Functions: Strand Six

1. GLE 46: Identify and model even and odd numbers with objects, pictures, and words (P-1-E).

2. GLE 47: Find patterns to complete tables, state the rule governing the shift between successive terms, and continue the pattern (including growing patterns) (P-1-E) (P-2-E).

NOTE: The benchmarks addressed by each GLE are listed in parentheses after the GLE.

AUTHORITY NOTE: Promulgated in accordance with R.S. 17.6; R.S. 17:24.4; R.S. 17:154.
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§1511. Fourth Grade

A. Number and Number Relations: Strand One

1. GLE 1: Read and write place value in word, standard, and expanded form through 1,000,000 (N-1-E).

2. GLE 2: Read, write, compare, and order whole numbers using place value concepts, standard notation, and models through 1,000,000 (N-1-E) (N-3-E) (A-1-E).

3. GLE 3: Illustrate with manipulatives when a number is divisible by 2, 3, 5, or 10 (N-1-E).

4. GLE 4: Know all basic facts for multiplication and division through 12 x 12 and 144 ÷ 12, and recognize factors of composite numbers less than 50 (N-1-E) (N-6-E) (N-7-E).

5. GLE 5: Read, write, and relate decimals through hundredths and connect them with corresponding decimal fractions (N-1-E).

6. GLE 6: Model, read, write, compare, order, and represent fractions with denominators through twelfths using region and set models (N-1-E) (A-1-E).

7. GLE 7: Give decimal equivalents of halves, fourths, and tenths (N-2-E) (N-1-E).

8. GLE 8: Use common equivalent reference points for percents (i.e., 1/4, 1/2, 3/4, and 1 whole) (N-2-E).

9. GLE 9: Estimate fractional amounts through twelfths, using pictures, models, and diagrams (N-2-E).

10. GLE 10: Solve multiplication and division number sentences including interpreting remainders (N-4-E) (A-3-E).

11. GLE 11: Multiply 3-digit by 1-digit numbers, 2-digit by 2-digit numbers, and divide 3-digit numbers by 1-digit numbers, with and without remainders (N-6-E) (N-7-E).

12. GLE 12: Count money, determine change, and solve simple word problems involving money amounts using decimal notation (N-6-E) (N-9-E) (M-1-E) (M-5-E).

13. GLE 13: Determine when and how to estimate, and when and how to use mental math, calculators, or paper/pencil strategies to solve multiplication and division problems (N-8-E).

14. GLE 14: Solve real-life problems, including those in which some information is not given (N-9-E).

B. Algebra: Strand Two

1. GLE 15: Write number sentences or formulas containing a variable to represent real-life problems (A-1-E).

2. GLE 16: Write a related story problem for a given algebraic sentence (A-1-E).

3. GLE 17: Use manipulatives to represent the distributive property of multiplication over addition to explain multiplying numbers (A-1-E) (A-2-E).

4. GLE 18: Identify and create true/false and open/closed number sentences (A-2-E).

5. GLE 19: Solve one-step equations with whole number solutions (A-2-E) (N-4-E).

C. Measurement: Strand Three

1. GLE 20: Measure length to the nearest quarter-inch and mm (M-2-E) (M-1-E).

2. GLE 21: Describe the concept of volume, and measure volume using cubic in. and cubic cm and capacity using fl. oz. and ml (M-2-E) (M-3-E).

3. GLE 22: Select and use the appropriate standard units of measure, abbreviations, and tools to measure length and perimeter (i.e., in., cm, ft., yd., mile, m, km), area (i.e., square inch, square foot, square centimeter), capacity (i.e., fl. oz., cup, pt., qt., gal., l, ml), weight/mass (i.e., oz., lb., g, kg, ton), and volume (i.e., cubic cm, cubic in.) (M-2-E) (M-1-E).

4. GLE 23: Set up, solve, and interpret elapsed time problems (M-2-E) (M-5-E).

5. GLE 24: Recognize the attributes to be measured in a real-life situation (M-2-E) (M-5-E).

6. GLE 25: Use estimates and measurements to calculate perimeter and area of rectangular objects (including squares) in U.S. (including square feet) and metric units (M-3-E).

7. GLE 26: Estimate the area of an irregular shape drawn on a unit grid (M-3-E).

8. GLE 27: Use unit conversions within the same system to solve real-life problems (e.g., 60 sec. = 1 min., 12 objects = 1 dozen, 12 in. = 1 ft., 100 cm =1 m, 1 pt= 2 cups) (M-4-E) (N-2-E) (M-5-E).

D. Geometry: Strand Four

1. GLE 28: Identify the top, bottom, or side view of a given 3-dimensional object (G-1-E) (G-3-E).

2. GLE 29: Identify, describe the properties of, and draw circles and polygons (triangle, quadrilateral, parallelogram, trapezoid, rectangle, square, rhombus, pentagon, hexagon, octagon, and decagon) (G-2-E).

3. GLE 30: Make and test predictions regarding transformations (i.e., slides, flips, and turns) of plane geometric shapes (G-3-E).

4. GLE 31: Identify, manipulate, and predict the results of rotations of 90, 180, 270, and 360 degrees on a given figure (G-3-E).

5. GLE 32: Draw, identify, and classify angles that are acute, right, and obtuse (G-5-E) (G-1-E).

6. GLE 33: Specify locations of points in the first quadrant of coordinate systems and describe paths of maps (G-6-E).

E. Data Analysis, Probability, and Discrete Math: Strand Five

1. GLE 34: Summarize information and relationships revealed by patterns or trends in a graph, and use the information to make predictions (D-1-E).

2. GLE 35: Find and interpret the meaning of mean, mode, and median of a small set of numbers (using concrete objects) when the answer is a whole number (D-1-E).

3. GLE 36: Analyze, describe, interpret, and construct various types of charts and graphs using appropriate titles, axis labels, scales, and legends (D-2-E) (D-1-E).

4. GLE 37: Determine which type of graph best represents a given set of discrete data (D-2-E) D-1-E).

5. GLE 38: Solve problems involving simple deductive reasoning (D-3-E).

6. GLE 39: Use lists, tables, and tree diagrams to generate and record all possible combinations for 2 sets of 3 or fewer objects (e.g., combinations or pants and shirts, days and games) and for given experiments (D-3-E) (D-4-E).

7. GLE 40: Determine the total number of possible outcomes for a given experiment using lists, tables, and tree diagrams (e.g., spinning a spinner, tossing 2 coins) (D-4-E) (D-5-E).

8. GLE 41: Apply appropriate probabilistic reasoning in real-life contexts using games and other activities (e.g., examining fair and unfair situations) (D-5-E) (D-6-E).

F. Patterns, Relations, and Functions: Strand Six

1. GLE 42: Find and describe patterns resulting from operations involving even and odd numbers (such as even + even = even) (P-1-E).

2. GLE 43: Identify missing elements in a number pattern (P-1-E).

3. GLE 44: Represent the relationship in an input-output situations using a simple equation, graph, table, or word description (P-2-E).

NOTE: The benchmarks addressed by each GLE are listed in parentheses after the GLE.

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§1513. Fifth Grade

A. Number and Number Relations. Strand One

1. GLE 1: Differentiate between the terms *factor* and *multiple*, and *prime* and *composite* (N-1-M).

2. GLE 2; Recognize, explain, and compute equivalent fractions for common fractions (N-1-M) (N-3-M).

3. GLE 3: Add and subtract fractions with common denominators and use mental math to determine whether the answer is reasonable (N-2-M).

4. GLE 4: Compare positive fractions using number sense, symbols (i.e., <, =, >), and number lines (N-2-M).

5. GLE 5: Read, explain, and write a numerical representation for positive improper fractions, mixed numbers, and decimals from a pictorial representation and vice versa (N-3-M).

6. GLE 6: Select and discuss the correct operation for a given problem involving positive fractions using appropriate language such as *sum*, *difference*, *numerator*, and *denominator* (N-4-M) (N-5-M).

7. GLE 7: Select, sequence, and use appropriate operations to solve multi-step word problems with whole numbers (N-5-M) (N-4-M).

8. GLE 8: Use the whole number system (e.g., computational fluency, place value, etc.) to solve problems in real-life and other content areas (N-5-M).

9. GLE 9: Use mental math and estimation strategies to predict the results of computations (i.e., whole numbers, addition and subtraction of fractions) and to test the reasonableness of solutions (N-6-M) (N-2-M).

10. GLE 10: Determine when an estimate is sufficient and when an exact answer is needed in real-life problems using whole numbers (N-6-M) (N-5-M).

11. GLE 11: Explain concepts of ratios and equivalent ratios using models and pictures in real-life problems (e.g., understand that 2/3 means 2 divided by 3) (N-8-M) (N-5-M).

B. Algebra: Strand Two

1. GLE 12: Find unknown quantities in number sentences by using mental math, backward reasoning, inverse operations (i.e., unwrapping), and manipulatives (e.g., tiles, balance scales) (A-2-M) (A-3-M).

2. GLE 13: Write a number sentence from a given physical model of an equation (e.g., balance scale) (A-2-M) (A-1-M).

3. GLE 14: Find solutions to one-step inequalities and identify positive solutions on a number line (A-2-M) (A-3-M).

C. Measurement: Strand Three

1. GLE 15: Model, measure, and use the names of all common units in the U.S. and metric systems (M-1-M).

2. GLE 16: Apply the concepts of elapsed time in real-life situations and calculate equivalent times across time zones in real-life problems (M-1-M) (M-6-M).

3. GLE 17: Distinguish among the processes of counting, calculating, and measuring and determine which is the most appropriate strategy for a given situation (M-2-M).

4. GLE 18: Estimate time, temperature, weight/mass, and length in familiar situations and explain the reasonableness of answers (M-2-M).

5. GLE 19: Compare the relative sizes of common units for time, temperature, weight, mass, and length in real-life situations (M-2-M) (M-4-M).

6. GLE 20: Identify appropriate tools and units with which to measure time, mass, weight, temperature, and length (M-3-M).

7. GLE 21: Measure angles to the nearest degree (M-3-M).

8. GLE 22: Compare and estimate measurements between the U.S. and metric systems in terms of common reference points (e.g., l vs. qt., m vs. yd.) (M-4-M).

9. GLE 23: Convert between units of measurement for length, weight, and time, in U.S. and metric, within the same system (M-5-M).

D. Geometry: Strand Four

1. GLE 24: Use mathematical terms to classify and describe the properties of 2-dimensional shapes, including circles, triangles, and polygons (G-2-M).

2. GLE 25: Identify and use appropriate terminology for transformations (e.g., *translation* as *slide*, *reflection* as *flip*, and *rotation* as *turn*) (G-3-M).

3. GLE 26: Identify shapes that have rotational symmetry (G-3-M).

4. GLE 27: Identify and plot points on a coordinate grid in the first quadrant (G-6-M).

E. Data Analysis, Probability, and Discrete Math: Strand Five

1. GLE 28: Use various types of charts and graphs, including double bar graphs, to organize, display, and interpret data and discuss patterns verbally and in writing (D-1-M) (D-2-M) (P-3-M) (A-4-M).

2. GLE 29: Compare and contrast different scales and labels for bar and line graphs (D-1-M).

3. GLE 30: Organize and display data using spreadsheets, with technology (D-1-M).

4. GLE 31: Compare and contrast survey data from two groups relative to the same question (D-2-M).

5. GLE 32: Represent probabilities as common fractions and recognize that probabilities fall between 0 and 1, inclusive (D-5-M).

F. Patterns, Relations, and Functions: Strand Six

1. GLE 33: Fill in missing elements in sequences of designs, number patterns, positioned figures, and quantities of objects (P-1-M).

NOTE: The benchmarks addressed by each GLE are listed in parentheses after the GLE.

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§1515. Sixth Grade

A. Number and Number Relations: Strand One

1. GLE 1: Factor whole numbers into primes (N-1-M).

2. GLE 2: Determine common factors and common multiples for pairs of whole numbers (N-1-M).

3. GLE 3: Find the greatest common factor (GCF) and least common multiple (LCM) for whole numbers in the context of problem-solving (N-1-M).

4. GLE 4: Recognize and compute equivalent representations of fractions and decimals (i.e., halves, thirds, fourths, fifths, eighths, tenths, hundredths) (N-1-M) (N-3-M).

5. GLE 5: Decide which representation (i.e., fraction or decimal) of a positive number is appropriate in a real-life situation (N-1-M) (N-5-M).

6. GLE 6: Compare positive fractions, decimals, and positive and negative integers using symbols (i.e., $<$, $=$, $>$) and number lines (N-2-M).

7. GLE 7: Read and write numerals and words for decimals through ten-thousandths (N-3-M).

8. GLE 8: Demonstrate the meaning of positive and negative numbers and their opposites in real-life situations (N-3-M) (N-5-M).

9. GLE 9: Add and subtract fractions and decimals in real-life situations (N-5-M).

10. GLE 10: Use and explain estimation strategies to predict computational results with positive fractions and decimals (N-6-M).

11. GLE 11: Mentally multiply and divide by powers of 10 (e.g., $25/10 = 2.5$; $12.56 \times 100 = 1{,}256$) (N-6-M).

12. GLE 12: Divide 4-digit numbers by 2-digit numbers with the quotient written as a mixed number or a decimal (N-7-M).

13. GLE 13: Use models and pictures to explain concepts or solve problems involving ratio, proportion, and percent with whole numbers (N-8-M).

B. Algebra: Strand Two

1. GLE 14: Model and identify perfect squares up to 144 (A-1-M).

2. GLE 15: Match algebraic equations and expressions with verbal statements and vice versa (A-1-M) (A-3-M) (A-5-M) (P-2-M).

3. GLE 16: Evaluate simple algebraic expressions using substitution (A-2-M).

4. GLE 17: Find solutions to 2-step equations with positive integer solutions (e.g., $3x - 5 = 13$, $2x + 3x = 20$) (A-2-M).

C. Measurement: Strand Three

1. GLE 18: Measure length and read linear measurements to the nearest sixteenth-inch and mm (M-1-M).

2. GLE 19: Calculate perimeter and area of triangles, parallelograms, and trapezoids (M-1-M).

3. GLE 20: Calculate, interpret, and compare rates such as \$/lb., mpg, and mph (M-1-M) (A-5-M).

4. GLE 21: Demonstrate an intuitive sense of relative sizes of common units for length and area of familiar objects in real-life problems (e.g., estimate the area of a desktop in square feet, the average adult is between 1.5 and 2 meters tall) (M-2-M) (G-1-M).

5. GLE 22: Estimate perimeter and area of any 2-dimensional figure (regular and irregular) using standard units (M-2-M).

6. GLE 23: Identify and select appropriate units to measure area (M-3-M).

D. Geometry: Strand Four

1. GLE 24: Use mathematical terms to describe the basic properties of 3-dimensional objects (edges, vertices, faces, base, etc.) (G-2-M).

2. GLE 25: Relate polyhedra to their 2-dimensional shapes by drawing or sketching their faces (G-2-M) (G-4-M).

3. GLE 26: Apply concepts, properties, and relationships of points, lines, line segments, rays, diagonals, circles, and right, acute, and obtuse angles and triangles in real-life situations, including estimating sizes of angles (G-2-M) (G-5-M) (G-1-M).

4. GLE 27: Make and test predictions regarding tessellations with geometric shapes (G-3-M).

5. GLE 28: Use a rectangular grid and ordered pairs to plot simple shapes and find horizontal and vertical lengths and area (G-6-M).

E. Data Analysis, Probability, and Discrete Math: Strand Five

1. GLE 29: Collect, organize, label, display, and interpret data in frequency tables, stem-and-leaf plots, and scatter plots and discuss patterns in the data verbally and in writing (D-1-M) (D-2-M) (A-3-M).

2. GLE 30: Describe and analyze trends and patterns observed in graphic displays (D-2-M).

3. GLE 31: Demonstrate an understanding of precision, accuracy, and error in measurement (D-2-M) (M-2-M).

4. GLE 32: Calculate and discuss mean, median, mode, and range of a set of discrete data to solve real-life problems (D-2-M).

5. GLE 33: Create and use Venn diagrams with two overlapping categories to solve counting logic problems (D-3-M).

6. GLE 34: Use lists, tree diagrams, and tables to determine the possible combinations from two disjoint sets when choosing one item from each set (D-4-M).

7. GLE 35: Illustrate and apply the concept of complementary events (D-5-M).

8. GLE 36: Apply the meaning of *equally likely* and *equally probable* to real-life situations (D-5-M) (D-6-M).

F. Patterns, Relations, and Functions: Strand Six

1. GLE 37: Describe, complete, and apply a pattern of differences found in an input-output table (P-1-M) (P-2-M) (P-3-M).

2. GLE 38: Describe patterns in sequences of arithmetic and geometric growth and now-next relationships (i.e., growth patterns where the next term is dependent on the present term) with numbers and figures (P-3-M) (A-4-M).

NOTE: The benchmarks addressed by each GLE are listed in parentheses after the GLE.

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§1517. Seventh Grade

A. Number and Number Relations: Strand One

1. GLE 1: Recognize and compute equivalent representations of fractions, decimals, and percents (i.e., halves, thirds, fourths, fifths, eighths, tenths, hundredths) (N-1-M).

2. GLE 2: Compare positive fractions, decimals, percents, and integers using symbols (i.e., $<$, $\leq$, $=$, $\geq$, $>$) and position on a number line (N-2-M).

3. GLE 3: Solve order of operations problems involving grouping symbols and multiple operations (N-4-M).

4. GLE 4: Model and apply the distributive property in real-life applications (N-4-M).

5. GLE 5: Multiply and divide positive fractions and decimals (N-5-M).

6. GLE 6: Set up and solve simple percent problems using various strategies, including mental math (N-5-M) (N-6-M) (N-8-M).

7. GLE 7: Select and discuss appropriate operations and solve single- and multi-step, real-life problems involving positive fractions, percents, mixed numbers, decimals, and positive and negative integers (N-5-M) (N-3-M) (N-4-M).

8. GLE 8: Determine the reasonableness of answers involving positive fractions and decimals by comparing them to estimates (N-6-M) (N-7-M).

9. GLE 9: Determine when an estimate is sufficient and when an exact answer is needed in real-life problems using decimals and percents (N-7-M) (N-5-M).

10. GLE 10: Determine and apply rates and ratios (N-8-M).

11. GLE 11: Use proportions involving whole numbers to solve real-life problems (N-8-M).

B. Algebra: Strand Two

1. GLE 12: Evaluate algebraic expressions containing exponents (especially 2 and 3) and square roots, using substitution (A-1-M).

2. GLE 13: Determine the square root of perfect squares and mentally appropriate other square roots by identifying the two whole numbers between which they fall (A-1-M).

3. GLE 14: Write a real-life meaning of a simple algebraic equation or inequality, and vice versa (A-1-M) (A-5-M).

4. GLE 15: Match algebraic inequalities with equivalent verbal statements and vice versa (A-1-M).

5. GLE 16: Solve one- and two-step equations and inequalities (with one variable) in multiple ways (A-2-M).

6. GLE 17: Graph solutions sets of one-step equations and inequalities as points, or open and closed rays on a number line (e.g., $x = 5$, $x < 5$, $x \leq 5$, $x > 5$, $x \geq 5$) (A-2-M).

7. GLE 18: Describe linear, multiplicative, or changing growth relationships (e.g., 1, 3, 6, 10, 15, 21, …) verbally and algebraically (A-3-M) (A-4-M) (P-1-M).

8. GLE 19: Use *function machines* to determine and describe the rule that generates outputs from given inputs (A-4-M) (P-3-M).

C. Measurement: Strand Three

1. GLE 20: Determine the perimeter and area of composite plane figures by subdivision and area addition (M-1-M) (G-7-M).

2. GLE 21: Compare and order measurements within and between the U.S. and metric systems in terms of common reference points (e.g., weight/mass and area) (M-4-M) (G-1-M).

3. GLE 22: Convert between units of area in U.S. and metric units within the same system (M-5-M).

4. GLE 23: Demonstrate an intuitive sense of comparisons between degrees of Fahrenheit and Celsius in real-life situations using common reference points (M-5-M).

D. Geometry: Strand Four

1. GLE 24: Identify and draw angles (using protractors), circles, diameters, radii, attitudes, and 2-dimensional figures with given specifications (G-2-M).

2. GLE 25: Draw the results of reflections and translations of geometric shapes on a coordinate grid (G-3-M).

3. GLE 26: Recognize π as the ratio between the circumference and diameter of any circle (i.e., $\pi = C/d$ or $\pi = C/2r$) (G-5-M).

4. GLE 27: Model and explain the relationship between perimeter and area (how scale change in a linear dimension affects perimeter and area) and between circumference and area of a circle (G-5-M).

5. GLE 28: Determine the radius, diameter, circumference, and area of a circle and apply these measures in real-life problems (G-5-M) (G-7-M) (M-6-M).

6. GLE 29: Plot points on a coordinate grid in all 4 quadrants and locate the coordinates of a missing vertex in a parallelogram (G-6-M) (A-5-M).

7. GLE 30: Apply the knowledge that the measures of the interior angles in a triangle add up to 180 degrees (G-7-M).

E. Data Analysis, Probability, and Discrete Math: Strand Five

1. GLE 31: Analyze and interpret circle graphs, and determine when a circle graph is the most appropriate type of graph to use (D-2-M).

2. GLE 32: Describe data in terms of patterns, clustered data, gaps, and outliers (D-2-M).

3. GLE 33: Analyze discrete and continuous data in real-life applications (D-2-M) (D-6-M).

4. GLE 34: Create and use Venn diagrams with three overlapping categories to solve counting logic problems (D-3-M).

5. GLE 35: Use informal thinking procedures of elementary logic involving *if/then* statements (D-3-M).

6. GLE 36: Apply the fundamental counting principle in real-life situations (D-4-M).

7. GLE 37: Determine probability from experiments and from data displayed in tables and graphs (D-5-M).

8. GLE 38: Compare theoretical and experimental probability in real-life situations (D-5-M).

F. Patterns, Relations, and Functions: Strand Six

1. GLE 39: Analyze and describe simple exponential number patterns (i.e., 3, 9, 27 or 3^1, 3^2, 3^3) (P-1-M).

2. GLE 40: Analyze and verbally describe real-life additive and multiplicative patterns involving fractions and integers (P-1-M) (P-4-M).

3. GLE 41: Illustrate patterns of change in length(s) of sides and corresponding changes in areas of polygons (P-3-M).

NOTE: The benchmarks addressed by each GLE are listed in parentheses after the GLE.

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§1519. Eighth Grade

A. Number and Number Relations: Strand One

1. GLE 1: Compare rational numbers using symbols (i.e., $<$, $\leq$, $=$, $\geq$, $>$) and position on a number line (N-1-M) (N-2-M).

2. GLE 2: Use whole number exponents (0-3) in problem-solving contexts (N-1-M) (N-5-M).

3. GLE 3: Estimate the answer to an operation involving rational numbers based on the original numbers (N-2-M) (N-6-M).

4. GLE 4: Read and write numbers in scientific notation with positive exponents (N-3-M).

5. GLE 5: Simplify expressions involving operations on integers, grouping symbols, and whole number exponents using order of operations (N-4-M).

6. GLE 6: Identify missing information or suggest a strategy for solving a real-life, rational-number problem (N-5-M).

7. GLE 7: Use proportional reasoning to model and solve real-life problems (N-8-M).

8. GLE 8: Solve real-life problems involving percentages, including percentages less than 1 or greater than 100 (N-8-M) (N-5-M).

9. GLE 9: Find unit/cost rates and apply them in real-life problems (N-8-M) (N-5-M) (A-5-M).

B. Algebra: Strand Two

1. GLE 10: Write real-life meanings of expressions and equations involving rational numbers and variables (A-1-M) (A-5-M).

2. GLE 11: Translate real-life situations that can be modeled by linear or exponential relationships to algebraic expressions, equations, and inequalities (A-1-M) (A-4-M) (A-5-M).

3. GLE 12: Solve and graph solutions of multi-step linear equations and inequalities (A-2-M).

4. GLE 13: Switch between functions represented as tables, equations, graphs, and verbal representations, with and without technology (A-3-M) (P-2-M) (A-4-M).

5. GLE 14: Construct a table of *x*- and *y*-values satisfying a linear equation and construct a graph of the line on the coordinate plane (A-3-M) (A-2-M).

6. GLE 15: Describe and compare situations with constant or varying rates of change (A-4-M).

7. GLE 16: Explain and formulate generalizations about how a change in one variable results in a change in another variable (A-4-M).

C. Measurement: Strand Three

1. GLE 17: Determine the volume and surface area of prisms and cylinders (M-1-M) (G-7-M).

2. GLE 18: Apply rate of change in real-life problems, including density, velocity, and international monetary conversions (M-1-M) (N-8-M) (M-6-M).

3. GLE 19: Demonstrate an intuitive sense of the relative sizes of common units of volume in relation to real-life applications and use this sense when estimating (M-2-M) (G-1-M).

4. GLE 20: Identify and select appropriate units for measuring volume (M-3-M).

5. GLE 21: Compare and estimate measurements of volume and capacity within and between the U.S. and metric systems (M-4-M) (G-1-M).

6. GLE 22: Convert units of volume/capacity within systems for U.S. and metric units (M-5-M).

D. Geometry: Strand Four

1. GLE 23: Define and apply the terms measure, distance, midpoint, bisect, bisector, and perpendicular bisector (G-2-M).

2. GLE 24: Demonstrate conceptual and practical understanding of symmetry, similarity, and congruence and identify similar and congruent figures (G-2-M).

3. GLE 25: Predict, draw, and discuss the resulting changes in lengths, orientation, angle measures, and coordinates when figures are translated, reflected across horizontal or vertical lines, and rotated on a grid (G-3-M) (G-6-M).

4. GLE 26: Predict, draw, and discuss the resulting changes in lengths, orientation, and angle measures that occur in figures under a similarity transformation (dilation) (G-3-M) (G-6-M).

5. GLE 27: Construct polyhedra using 2-dimensional patterns (nets) (G-4-M).

6. GLE 28: Apply concepts, properties, and relationships of adjacent, corresponding, vertical, alternate interior, complementary, and supplementary angles (G-5-M).

7. GLE 29: Solve problems involving lengths of sides of similar triangles (G-5-M) (A-5-M).

8. GLE 30: Construct, interpret, and use scale drawings in real-life situations (G-5-M) (M-6-M) (N-8-M).

9. GLE 31: Use area to justify the Pythagorean theorem and apply the Pythagorean theorem and its converse in real-life problems (G-5-M) (G-7-M).

10. GLE 32: Model and explain the relationship between the dimensions of a rectangular prism and its volume (i.e., how scale change in linear dimension(s) affects volume) (G-5-M).

11. GLE 33: Graph solutions to real-life problems on the coordinate plane (G-6-M).

E. Data, Analysis, Probability, and Discrete Math: Strand Five

1. GLE 34: Determine what kind of data display is appropriate for a given situation (D-1-M).

2. GLE 35: Match a data set or graph to a described situation, and vice versa (D-1-M).

3. GLE 36: Organize and display data using circle graphs (D-1-M).

4. GLE 37: Collect and organize data using box-and-whisker plots and use the plots to interpret quartiles and range (D-1-M) (D-2-M).

5. GLE 38: Sketch and interpret a trend line (i.e., line of best fit) on a scatterplot (D-2-M) (A-4-M) (A-5-M).

6. GLE 39: Analyze and make predictions from discovered data patterns (D-2-M).

7. GLE 40: Explain factors in a data set that would affect measures of central tendency (e.g., impact of extreme values) and discuss which measure is most appropriate for a given situation (D-2-M).

8. GLE 41: Select random samples that are representative of the population, including sampling with and without replacement, and explain the effect of sampling on bias (D-2-M) (D-4-M).

9. GLE 42:Use lists, tree diagrams, and tables to apply the concept of permutations to represent an ordering with and without replacement, and explain the effect of sampling on bias (D-4-M).

10. GLE 43: Use lists and tables to apply the concept of combinations to represent the number of possible ways a set of objects can be selected from a group (D-4-M).

11. GLE 44: Use experimental data presented in tables and graphs to make outcome predictions of independent events (D-5-M).

12. GLE 45: Calculate, illustrate, and apply single- and multiple-event probabilities, including mutually exclusive, independent events and non-mutually exclusive, dependent events (D-5-M).

F. Patterns, Relations, and Functions: Strand Six

1. GLE 46: Distinguish between and explain when real-life numerical patterns are linear/arithmetic (i.e., grows by addition) or exponential/geometric (i.e., grows by multiplication) (P-1-M) (P-4-M).

2. GLE 47: Represent the n^{th} term in a pattern as a formula and test the representation (P-1-M) (P-2-M) (P-3-M) (A-5-M).

3. GLE 48: Illustrate patterns of change in dimension(s) and corresponding changes in volumes of rectangular solids (P-3-M).

NOTE: The benchmarks addressed by each GLE are listed in parentheses after the GLE.

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§1521. Ninth Grade

A. Number and Number Relations: Strand One

1. GLE 1: Identify and describe differences among natural numbers, whole numbers, integers, rational numbers, and irrational numbers (N-1-H) (N-2-H) (N-3-H).

2. GLE 2: Evaluate and write numerical expressions involving integer exponents (N-2-H).

3. GLE 3: Apply scientific notation to perform computations, solve problems, and write representations of numbers (N-2-H).

4. GLE 4: Distinguish between an exact and an approximate answer, and recognize errors introduced by the use of approximate numbers with technology (N-3-H) (N-4-H) (N-7-H).

5. GLE 5: Demonstrate computational fluency with all rational numbers (e.g., estimation, mental math, technology, paper/pencil) (N-5-H).

6. GLE 6: Simplify and perform basic operations on numerical expressions involving radicals (e.g., $2\sqrt{3}+5\sqrt{3}=7\sqrt{3}$) (N-5-H).

7. GLE 7: Use proportional reasoning to model and solve real-life problems involving direct and inverse variation (N-6-H).

B. Algebra: Strand Two

1. GLE 8: Use order of operations to simplify or rewrite variable expressions (A-1-H) (A-2-H).

2. GLE 9: Model real-life situations using linear expressions, equations, and inequalities (A-1-H) (D-2-H) (P-5-H).

3. GLE 10: Identify independent and dependent variables in real-life relationships (A-1-H).

4. GLE 11: Use equivalent forms of equations and inequalities to solve real-life problems (A-1-H).

5. GLE 12: Evaluate polynomial expressions for given values of the variable (A-2-H).

6. GLE 13: Translate between the characteristics defining a line (i.e., slope, intercepts, points) and both its equation and graph (A-2-H) (G-3-H).

7. GLE 14: Graph and interpret linear inequalities in one or two variables and systems of linear inequalities (A-2-H) (A-4-H).

8. GLE 15: Translate among tabular, graphical, and algebraic representations of functions and real-life situations (A-3-H) (P-1-H) (P-2-H).

9. GLE 16: Interpret and solve systems of linear equations using graphing, substitution, elimination, with and without technology, and matrices using technology (A-4-H).

C. Measurement: Strand Three

1. GLE 17: Distinguish between precision and accuracy (M-1-H).

2. GLE 18: Demonstrate and explain how the scale of a measuring instrument determines the precision of that instrument (M-1-H).

3. GLE 19: Use significant digits in computational problems (M-1-H) (N-2-H).

4. GLE 20: Demonstrate and explain how relative measurement error is compounded when determining absolute error (M-1-H) (M-2-H) (M-3-H).

5. GLE 21: Determine appropriate units and scales to use when solving measurement problems (M-2-H) (M-3-H) (M-1-H).

6. GLE 22: Solve problems using indirect measurement (M-4-H).

D. Geometry: Strand Four

1. GLE 23: Use coordinate methods to solve and interpret problems (e.g., slope as rate of change, intercept as initial value, intersection as common solution, midpoint as equidistant) (G-2-H) (G-3-H).

2. GLE 24: Graph a line when the slope and a point or when two points are known (G-3-H).

3. GLE 25: Explain slope as a representation of "rate of change" (G-3-H) (A-1-H).

4. GLE 26: Perform translations and line reflections on the coordinate plane (G-3-H).

E. Data Analysis, Probability, and Discrete Math: Strand Five

1. GLE 27: Determine the most appropriate measure of central tendency for a set of data based on its distribution (D-1-H).

2. GLE 28: Identify trends in data and support conclusions by using distribution characteristics such as patterns, clusters, and outliers (D-1-H) (D-6-H) (D-7-H).

3. GLE 29: Create a scatter plot from a set of data and determine if the relationship is linear or nonlinear (D-1-H) (D-6-H) (D-7-H).

4. GLE 30: Use simulations to estimate probabilities (D-3-H) (D-5-H).

5. GLE 31: Define probability in terms of sample spaces, outcomes, and events (D-4-H).

6. GLE 32: Compute probabilities using geometric models and basic counting techniques such as combinations and permutations (D-4-H).

7. GLE 33: Explain the relationship between the probability of an event occurring, and the odds of an event occurring and compute one given the other (D-4-H).

8. GLE 34: Follow and interpret processes expressed in flow charts (D-8-H).

F. Patterns, Relations, and Functions: Strand Six

1. GLE 35: Determine if a relation is a function and use appropriate function notation (P-1-H).

2. GLE 36: Identify the domain and range of functions (P-1-H).

3. GLE 37: Analyze real-life relationships that can be modeled by linear functions (P-1-H) (P-5-H).

4. GLE 38: Identify and describe the characteristics of families of linear functions, with and without technology (P-3-H).

5. GLE 39: Compare and contrast linear functions algebraically in terms of their rates of change and intercepts (P-4-H).

6. GLE 40: Explain how the graph of a linear function changes as the coefficients or constants are changed in the function's symbolic representation (P-4-H).

NOTE: The benchmarks addressed by each GLE are listed in parentheses after the GLE.

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§1523. Tenth Grade

A. Number and Number Relations: Strand One

1. GLE 1: Simplify and determine the value of radical expressions (N-2-H) (N-7-H).

2. GLE 2: Predict the effect of operations on real numbers (e.g., the quotient of a positive number divided by a positive number less than 1 is greater than the original dividend) (N-3-H) (N-7-H).

3. GLE 3: Define *sine, cosine*, and *tangent* in ratio form and calculate them using technology (N-6-H).

4. GLE 4: Use ratios and proportional reasoning to solve a variety of real-life problems including similar figures and scale drawings (N-6-H) (M-4-H).

B. Algebra: Strand Two

1. GLE 5: Write the equation of a line of best fit for a set of 2-variable real-life data presented in table or scatter plot form, with or without technology (A-2-H) (D-2-H).

2. GLE 6: Write the equation of a line parallel or perpendicular to a given line through a specific point (A-3-H) (G-3-H).

C. Measurement: Strand Three

1. GLE 7: Find volume and surface area of pyramids, spheres, and cones (M-3-H) (M-4-H).

2. GLE 8: Model and use trigonometric ratios to solve problems involving right triangles (M-4-H) (N-6-H).

D. Geometry: Strand Four

1. GLE 9: Construct 2- and 3-dimensional figures when given the name, description, or attributes, with and without technology (G-1-H).

2. GLE 10: Form and test conjectures concerning geometric relationships including lines, angles, and polygons (i.e., triangles, quadrilaterals, and *n*-gons), with and without technology (G-1-H) (G-4-H) (G-6-H).

3. GLE 11: Determine angle measurements using the properties of parallel, perpendicular, and intersecting lines in a plane (G-2-H).

4. GLE 12: Apply the Pythagorean theorem in both abstract and real-life settings (G-2-H).

5. GLE 13: Solve problems and determine measurements involving chords, radii, arcs, angles, secants, and tangents of a circle (G-2-H).

6. GLE 14: Develop and apply coordinate rules for translations and reflections of geometric figures (G-3-H).

7. GLE 15: Draw or use other methods, including technology, to illustrate dilations of geometric figures (G-3-H).

8. GLE 16: Represent and solve problems involving distance on a number line or in the plane (G-3-H).

9. GLE 17: Compare and contrast inductive and deductive reasoning approaches to justify conjectures and solve problems (G-4-H) (G-6-H).

10. GLE 18: Determine angle measures and side lengths of right and similar triangles using trigonometric ratios and properties of similarity, including congruence (G-5-H) (M-4-H).

11. GLE 19: Develop formal and informal proofs (e.g., Pythagorean theorem, flow charts, paragraphs) (G-6-H).

E. Data Analysis, Probability, and Discrete Math: Stand Five

1. GLE 20: Show or justify the correlation (match) between a linear or non-linear data set and a graph (D-2-H) (P-5-H).

2. GLE 21: Determine the probability of conditional and multiple events, including mutually and non-mutually exclusive events (D-4-H) (D-5-H).

3. GLE 22: Interpret and summarize a set of experimental data presented in a table, bar graph, line graph, scatter plot, matrix, or circle graph (D-7-H).

4. GLE 23: Draw and justify conclusions based on the use of logic (e.g., conditional statements, converse, inverse, contrapositive) (D-8-H) (G-6-H) (N-7-H).

5. GLE 24: Use counting procedures and techniques to solve real-life problems (D-9-H).

6. GLE 25: Use discrete math to model real life situations (e.g., fair games, elections) (D-9-H).

F. Patterns, Relations, and Functions: Strand Six

1. GLE 26: Generalize and represent patterns symbolically, with and without technology (P-1-H).

2. GLE 27: Translate among tabular, graphical, and symbolic representations of patterns in real-life situations, with and without technology (P-2-H) (P-3-H) (A-3-H).

NOTE: The benchmarks addressed by each GLE are listed in parentheses after the GLE.

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§1525. Eleventh and Twelfth Grade

A. Number and Number Relations: Strand One

1. GLE 1: Read, write, and perform basic operations on complex numbers (N-1-H) (N-5-H).

2. GLE 2: Evaluate and perform basic operations on expressions containing rational exponents (N-2-H).

3. GLE 3: Describe the relationship between exponential and logarithmic equations (N-2-H).

B. Algebra: Strand Two

1. GLE 4: Translate and show the relationships among non-linear graphs, related tables of values, and algebraic symbolic representations (A-1-H).

2. GLE 5: Factor simple quadratic expressions including general trinomials, perfect squares, difference of two squares, and polynomials with common factors (A-2-H).

3. GLE 6: Analyze functions based on zeros, asymptotes, and local and global characteristics of the function (A-3-H).

4. GLE 7: Explain, using technology, how the graph of a function is affected by change of degree, coefficient, and constants in polynomial, rational, radical, exponential, and logarithmic functions (A-3-H).

5. GLE 8: Categorize non-linear graphs and their equations as quadratic, cubic, exponential, logarithmic, step function, rational, trigonometric, or absolute value (A-3-H) (P-5-H).

6. GLE 9: Solve quadratic equations by factoring, completing the square, using the quadratic formula, and graphing (A-4-H).

7. GLE 10: Model and solve problems involving quadratic, polynomial, exponential, logarithmic, step function, rational, and absolute value equations using technology (A-4-H).

C. Measurement: Strand Three

1. GLE 11: Calculate angle measures in degrees, minutes, and seconds (M-1-H).

2. GLE 12: Explain the unit circle basis for radian measure and show its relationship to degree measure of angles (M-1-H).

3. GLE 13: Identify and apply the unit circle definition to trigonometric functions and use this definition to solve real-life problems (M-4-H).

4. GLE 14: Use the Law of Sines and the Law of Cosines to solve problems involving triangle measurements (M-4-H).

D. Geometry: Strand Four

1. GLE 15: Identify conic sections, including the degenerate conics, and describe the relationship of the plane and double-napped cone that forms each conic (G-1-H).

2. GLE 16: Represent translations, reflections, rotations, and dilations of plane figures using sketches, coordinates, vectors, and matrices (G-3-H).

E. Data Analysis, Probability, and Discrete Math: Strand Five

1. GLE 17: Discuss the differences between samples and populations (D-1-H).

2. GLE 18: Devise and conduct well-designed experiments/surveys involving randomization and considering the effects of sample size and bias (D-1-H).

3. GLE 19: Correlate/match data sets or graphs and their representations and classify them as exponential, logarithmic, or polynomial functions (D-2-H).

4. GLE 20: Interpret and explain, with the use of technology, the regression coefficient and the correlation coefficient for a set of data (D-2-H).

5. GLE 21: Describe and interpret displays of normal and non-normal distributions (D-6-H).

6. GLE 22: Explain the limitations of predictions based on organized sample sets of data (D-7-H).

7. GLE 23: Represent data and solve problems involving Euler and Hamiltonian paths (D-9-H).

F. Patterns, Relations, and Functions: Strand Six

1. GLE 24: Model a given set of real-life data with a non-linear function (P-1-H) (P-5-H).

2. GLE 25: Apply the concept of a function and function notation to represent and evaluate functions (P-1-H) (P-5-H).

3. GLE 26: Represent and solve problems involving *n*th terms and sums for arithmetic and geometric series (P-2-H).

4. GLE 27: Compare and contrast the properties of families of polynomial, rational, exponential, and logarithmic functions, with and without technology (P-3-H).

5. GLE 28: Represent and solve problems involving the translation of functions in the coordinate plane (P-4-H).

6. GLE 29: Determine the family or families of functions that can be used to represent a given set of real-life data, with and without technology (P-5-H).

NOTE: The benchmarks addressed by each GLE are listed in parentheses after the GLE.

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Chapter 17. Glossary and References

§1701. Definitions

Accuracy (see *Precision*)—refers to relative error, that is, the maximum allowable error (*tolerance*) of a measurement divided by the measurement. (For example, if a stick is measured to the nearest centimeter as 25 centimeters long, the accuracy of that measurement is one-half, the maximum error is half a centimeter, divided by 25, or 2 percent.)

Algebra—the branch of mathematics that is the symbolic generalization of the ideas of arithmetic.

Basic Facts—addition facts through 10 ($0 + 0$, $1 + 0$, … , $10 + 10$), subtraction facts which are the inverses of the addition facts ($20 - 10$, … , $1 - 0$, $0 - 0$), multiplication facts (1×1, 1×2, … , 10×10), and division facts which are the inverses of the multiplication facts ($1 \div 1$, $2 \div 1$, …, $100 \div 10$).

Coordinate Geometry—geometry based on the coordinate system.

Data Analysis—the collection, organization, and interpretation of numerical data arising in the real world.

Discrete Math—the branch of mathematics dealing with countable sets including matrices, graph theory, and counting procedures.

Experimental Probability—probability determined by collecting data from repeated trials of an experiment.

Function—a relationship between two sets of numbers (or other mathematical objects). Functions can be used to understand how one quantity varies in relation to another (e.g., the relationship between the number of cars and the number of tires). Once a member of the first set is chosen, the associated member of the second set is uniquely determined.

Integers—the set of numbers consisting of the counting numbers (i.e., 1, 2, 3, 4, 5, …), their opposite (i.e., negative numbers, -1, -2, -3, …), and zero.

Intuitive—perceived insight or awareness.

Magnitude—size of largeness.

Measurement—a way of quantifying the world in which we live.

Patty Paper—thin, waxy squares of paper used in geometric constructions (e.g., hamburger paper).

Precision—the precision of a measurement is determined by the size of the unit used. The smaller the unit, the more precise the measurement. Precision refers to the fineness of the measurement and is limited by the measuring instrument used.

Rational Number—a number that can be expressed in the form a/b, where a and b are integers and $b \neq 0$ (e.g., 3/4. 2/1. or 11/3). Every integer is a rational number, since it can be expressed in the form a/b (e.g., $5 - 5/1$). Rational numbers may be expressed as fractional or decimal numbers (e.g., 3/4 or .75). Finite decimals, repeating decimals, and mixed numbers all represent rational numbers.

Reflection (also called a *flip*)—a transformation which produces the mirror image of a geometric figure.

Relation—a correspondence between two sets of numbers.

Rotation (also called a *turn*)—a transformation which turns a figure about a point by a given number of degrees.

Sample Space—the portion of a population from which data is drawn.

Statistics—the branch of mathematics which is the study of the methods of collecting and analyzing data.

Symbolic Manipulator—technological tool (graphing calculator, computer) that performs traditional algebraic tasks, such as changing the form of expressions (e.g., factoring) and solving equations and inequalities.

Tolerance—the tolerance of a measurement is the largest possible error, generally half of the unit of measure.

Transformation—the process of changing one configuration or expression into another in accordance with a rule. Common geometric transformations include translations, rotations, and reflections.

Translation (also called a *slide*)—a transformation that moves a geometric figure by sliding. Each of the points of the geometric figure moves the same distance in the same direction.

Venn Diagrams—a method of illustrating sets and their properties using overlapping and non-overlapping circles and other plane geometric figures.

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