

Yuba River Charter School

MATH STANDARDS

Grades 1–8

1998

Yuba River Charter School Math Standards and Assessment Grades 1–8

The following document contains the standards and assessment for mathematics, grades 1 - 8, at the YRCS as developed by the YRCS Curriculum Committee, 1997-98. A great deal of study, research and exploration of the curricula of other Waldorf-Methods schools, state standards and national math standards have been merged with existing program goals and objectives to produce this YRCS document. The resulting compilation for grades 1 - 8 reflects both academic excellence and the aesthetic enlivening sought for in Waldorf-Methods schools.

MATH STANDARDS

The curriculum standards are formatted to display both the specific skills and their corresponding assessment scores on the same page. In this manner, teachers are able to quickly diagnose problem areas and design lessons to address specific needs. Six mathematical domains or standards hold the skills for each grade level.

- **Number Sense**
- **Computation and Procedures**
- **Patterns and Algebra**
- **Data Analysis, Statistics and Probability**
- **Geometry**
- **Measurement**

Each of these standards is in turn formatted in three columns. The far left column names the specific skills for the grade level. The center numerical rubric is the quantitative score of the student in the named skill. The rubric to the far right identifies the type of assessment utilized in determining the student's score.

Each grade level is preceded by a short narrative summarizing the nature of the students' learning and the curriculum approach of that grade level.

Problem solving and mathematical reasoning are not named as specific strands because they do not represent a content domain—they cut across all six strands and are needed to succeed in any of these six domains. This format is constructed, not to reduce the importance of problem solving and reasoning, but rather to encourage teachers to promote and establish this essential component in all areas of mathematical study. Extra attention to problem solving practice has been addressed by specific objectives in the Computation and Procedures strand of each grade.

ASSESSMENT

It has been observed through the 80-year history of Waldorf education and current research in Math Pedagogy that an inundation of unquestioned, cognitive information presented in fragmented skill drills leads to a one-sided or negative relationship with mathematics. Attempts have been made, therefore, to instill an appreciation to the realm of mathematics through the discovery of and interaction with interesting mathematical phenomena from the everyday world surrounding us. This includes, but is not limited to: rhythmical patterns in nature, musical and artistic correlations, and everyday practical experiences. These forms of curriculum implementation do not always easily lend themselves to traditional test forms for assessment. In addition, students in the early grades (particularly grade one) may not be proficient enough at reading to comprehend the test directions. Therefore, for these reasons, two additional means of assessment have been added. Below is an explanation of the forms of assessment.

Forms of Assessment

- OB Observation.** Visual and auditory observation of the standard named by the teacher or aide. Rating is an objective view of the student's success/ability.

- LB Lesson Book** entries. These are problems, exercises or constructions that the student performs in his or her lesson books in class with no outside help. Rating results from the teacher corrections.

- AT Assessment Test.** Any quiz, exam or standardized test given to measure the student's ability of any grade level skill.

In order for YRCS to have an objective "baseline-of-performance" for every student, a standard grade-level test, assessing each skill, will be administered. This document includes the assessment test for grades 1, 3 and 5. These are representative of the tests to follow. (Note that the test for grade 1 is administered by the teacher and based on her observations. As the tests move through the grades, they become more individually read and written by the student.)

However, it is **STRONGLY** felt that one test does **NOT** accurately represent a student's true ability or performance skill. A better assessment is derived from a compilation of the rubric scores gathered from various assessments (OB, LB, and AT) administered throughout the year.

Multiple assessments require time and care taken by the teacher for record keeping. A sample form for this weekly/monthly record keeping is included (Appendix 1). The rubric score checked on the standards page (Appendix 2) for each student will then reflect the average of the weekly/monthly rubrics. Finally, the year-end report (Appendix 3) will reflect the average rubric scores for all the skills under each standard.

Quantitative Rubric Scores

- 4** 85 - 100% of the criteria presented of the named skill performed correctly. **Mastery** level.
- 3** 60 - 84% of the criteria presented of the named skill performed correctly. **Partial Mastery** level. (Falls short of full understanding.) Student can reach mastery with additional work.
- 2** 25 - 59% of the criteria presented of the named skill performed correctly. **Fragmented Comprehension** level. (Significant gaps in understanding.) Student may be able to reach mastery with help and additional work.
- 1** Less than 24% of the criteria presented of the named skill performed correctly. **Limited Comprehension** level. (Little or no understanding of concepts involved.) Student would need considerable instruction to achieve mastery.

MATH STANDARDS

GRADE ONE

In first grade, math is taught through movement, drama, music, art, and storytelling. These multisensory approaches enliven the subject.

The qualitative aspects of whole numbers one through twelve are introduced using simple arithmetic stories and visual imaginations, as are the quantitative relations of numbers up to 100 using visual representations (patterns, pictures, simple geometric forms, and models). The idea that a whole can be divided into many parts is stressed. Manipulatives, handmade or gathered from nature, give the children an opportunity to explore these concepts.

The four arithmetic operations are presented through imaginative and concrete experiences. The natures, uses, and qualities of the four processes (addition, subtraction, multiplication, division) are stressed via personifications, stories, and pictures. Their interrelatedness is important, especially the ability to move from one operation to another.

Teaching often starts with archetypal number patterns from nature. Rhythmic movement exercises are used to strengthen the memory forces and activate the children's wills.

GRADE TWO

In second grade students largely continue and deepen the work begun in first grade. Where first grade was the foundation, second grade is the platform upon which the higher structures will be built.

The imaginative, personified quality which still lives strongly in the 7/8-year-old is used to fully develop inspiring pictures, with strong visual/narrative elements, of the operations involved in the four processes. The students are taught to differentiate between the processes and know when to use each one as well as to be able to work simple problems of each type in their head and on paper. (In written work, a strict orderliness should be remembered.)

The concepts and mechanics of carrying and borrowing are introduced with the use of manipulatives, imaginative pictures, and grouping and regrouping activities. The neat columnar writing of problems is stressed.

Review and practice of previous work is performed. The ability to write dictated and read written numbers 1-100 is firmly established before the students move on to place value. Counting by the various multiples is secured before moving on to written multiplication and division. In second grade, rhythmic counting is transformed into the times tables (2s, 3s, 4s, 5s, 10s).

Rhythmic and patterning work increase in sophistication, emphasizing the aesthetic and dynamic quality of the number line through arranging number families in various ways. Students are encouraged to consciously see order and beauty in number patterns. Visualizations of the counting patterns are introduced—string boards, group geometric forms in space, etc. Opening exercises can be built around number work—from group forms to simple computation games—and can include moving more geometric forms.

Word problems will continue as students write the simple algorithm that applies. Students solve written, oral story, and mental math problems using math concepts.

GRADE TWO

STANDARDS AND SKILLS

RUBRIC

ASSESSMENT

E. GEOMETRY

1. Knows right from left
2. Can order objects by shape, volume, and size
3. Can find patterns in geometric figures
4. Recognizes shapes in different orientations and in relationship to each other (symmetry and congruence) through form drawing

1 2 3 4

OB LB AT

F. MEASUREMENT

1. Uses non-standard units to measure length and width
2. Uses non-standard units to compare and order objects by length and width
3. Uses units of measurement in simple problem-solving situations
4. Estimates quantity

GRADE THREE

In third grade, the students begin to develop a basic sense for practical math and an appreciation for the work which numbers and the processes can do. This first practical picture of numbers can be introduced through the work with analog clocks and calendars as well as with counting money and making change.

All forms of counting (all number families) are firmly established. (Concerns should be raised regarding children who are still experiencing difficulty in this area.) Likewise, basic additive/subtractive number facts are memorized as well as the times tables (2, 3, 4, 5, 6, 8, 9, 11). Also, by year's end, place value is established and computations using multiple place value are developed. Long addition, subtraction, and multiplication will be mastered. Subtracting from zeroes can be introduced.

Students are introduced to various units of measurement, beginning with how the standards were derived from the human form. Length, liquid weight, and money are taught using concrete experiences of measurement and measuring tools.

Some students may find division difficult and for them, instruction proceeds methodically. Work begins with even quotients and moves on to remainders. Personifications are still useful. (Avoid two-digit divisors until the mechanics of division are secure and there is some sense of estimation.) Attention is paid to memorizing the steps and their repetitive nature, as well as keeping work neatly aligned. Checking (proving) one process by using the reverse process continues.

Continued emphasis is placed on the importance of informal guessing and estimating. Students are encouraged to problem solve using various strategies.

GRADE FOUR

As a fourth grade student advances in abstract reasoning ability, the experience of the fracturing of the whole into lawfully reconstructable parts can be explored. Fractions are introduced for the first time.

However, before fractions are introduced, the 9/10-year-old must have a good facility for working with whole numbers using all four processes in long form. Students will continue to refine their understanding of multiplication, division, and number relationship, and link these to the real world. Number facts must be in place. The memorization of the tables to 12 will be completed this year, and all third grade skills are reviewed and established.

Fractions are then introduced and brought to life through story problems, manipulatives, illustrations, and group projects. They are taught carefully and methodically, first breaking a whole into parts, moving from analysis to synthesis, and then introducing the concept of numerator and denominator, and methods for expanding and contracting fractions.

Problem-solving techniques/strategies are continued as are simple measurement and geometry.

GRADE FIVE

Fifth grade is the great period of review and consolidation. The curriculum includes all the skills gained so far. The student needs to have all times tables in place and be comfortable doing mental math using simple facts. They must be proficient in all operations with whole numbers and, by the end of the year, with fractions. Similarly, the students in need of ongoing remediation must have a firm sense that they can handle the challenges of work presented to them.

The general theme in fifth grade is fractions. The goal is that a student is able to move among whole numbers, common fractions, and decimal fractions, percents, ratios, and proportions, and to understand their relationship. All calculations involving both common and decimal fractions should be able to be done freely and easily. Calculations with inverse operations and reciprocals, brain twist-ers, humorous stories, and tough problems to crack, all arouse an appetite for discovery and train active forces of thinking.

In addition to reviewing all phases of mathematics introduced heretofore, extensive mental math, using sets and distribution will be worked with. A high degree of mastery with all types of computation is the goal. The communicative and associative properties can be brought as well as estimation as a tool.

The study of geometry is based on observation and imagination. The relationships of various elements of geometric form are rendered freely, without the use of instruments. Pictures of ancient Egypt/Chaldean geometry, and then Greek, are brought, as well as the relationship of area and perimeter (i.e., the square being the most efficient area/perimeter). The four-, six-, and eightfold divisions of the circle are made imaginatively, though tools may be introduced via the ancient compass (string and stick) on sand. The basic language of geometry—line, point, segment, angle, intersection, parallel, circle, polygon, etc.—is introduced. Radius, diameter, and circumference are defined. The Pythagorean theorem is introduced with the example of the equilateral right triangle. This study proceeds in a vivid manner by having students cut the proper triangles out of paper and prove by observation. The biography of Pythagoras and other Greek geometers may be told.

GRADE SIX

The instinctual sense of gain and profiteering is strong in the 11/12-year-old; to this can be added powers of discernment and judgment. Through the introduction of practical business operations that govern the flow of monies and commodities. This, of course, requires the student to move freely about in all arithmetic operations and that percentages and their practical application in business math have been mastered.

Review of previous skills continue: counting and rhythmic work; computations with fractions, decimals and primes; extensive mental math using sets; and all other mathematics previously introduced.

Students work very consciously with geometry, developing skill with the classic tools and building up concepts through orderly and pictorial proofs. The history of geometry as earth measure is reviewed, along with the biographies of famous geometers. Students will be able to recognize, name, and construct basic geometric polygons as well as be able to compute their perimeters and most of their areas, both pictorially and arithmetically. The modern tools—compass, straightedge, and protractor—can be introduced and used to divide circles ($1/4$ s, $1/6$ s, $1/8$ s) and to learn the number of degrees in various plane figures. Students will learn to copy and bisect an angle as well as construct parallel and perpendicular lines. Finally, the concept of pi is brought pictorially and arithmetically.

Introductory algebraic manipulations are gradually be introduced so that, by year-end, students exhibit a readiness for the subject when it is introduced in seventh grade. Such algebraic concepts might include: balance, equations, order of operations, negative numbers, roots, and exponents, as well as the commutative, associative, and distributive properties of addition and multiplication.

GRADE SEVEN

The general application and transformation of formulas and equations in practical life situations forms a central part of the seventh grade math curriculum. The students are beginning to encounter the practical laws of cause and effect, and with this, they can start working strongly with estimation in their computation. However, computational skills must be firmly established, or work with estimation will be difficult to verify. Extensive mental arithmetic, using sets and distribution as in $3(3+4)$, are used to challenge the students. Continued mastery of the four processes using whole numbers, fractions, decimals, measurements, and word problems are reinforced.

Work also continues in business math, solving budget, percentage, and discount problems. Ratio and simple proportion problems continue, as do problems with simple formulae ($P = BR$; $P = RT$; $A = lw$; etc.) Facility with simple algebraic equations and work with prime and square numbers is furthered. Absolute value, signed numbers, powers, and roots are introduced.

Conscious work with geometric proofs continues, building up through triangles and parallelograms to deductive proofs of the Pythagorean theorem. Familiarity and precision are developed with all basic geometric constructions.

During this time when thinking skills are active, word problems are worked with extensively. Appropriate discriminatory strategies and skills in analyzing word problems are further developed.

GRADE EIGHT

Eighth graders, 13/14-year-olds, are looking towards the future; some will be very sophisticated in their thinking skills, while others still will not have matured enough to handle multiple-step operations. Idealistic concerns are very real for this age, and as much of the beauty of mathematical operations as possible is brought to the students. A review of the numerical relations they explored in the early grades can be brought back to them as aesthetic exercises. For example, the Fibonacci series, introduced earlier, now can be traced to seashells and pinecones or represented visually in a geometric drawing.

The impending demands of high school must, however, be very real for all students, and course work should take these demands into account. Every student should graduate with a firm grasp of all arithmetic operations and their applications in the areas of percentage, business problems, computations with time, estimations, practical measurements of geometric figures, 3-part formulas, and algebra. If proportionate reasoning has not been firmly established in grades 5 and 6, problems will arise in algebra comprehension. A high level of mathematical aptitude is the goal.

Geometry continues with the construction of more complex polygons as well as the platonic solids. Computation of areas and volumes of planes and solids is developed as the concept of similarity and congruence in triangles and rectangles is furthered. Continued work with proofs of the Pythagorean theory can also be done.

In algebra, more complex aspects of algebraic equations are brought. A variety of techniques for solving linear equations, inequalities, and systems of equations in applied contexts are developed. Geometrical connections to algebraic and numerical situations are explored. Graphs and the graphing of functions are taught as well as proportional reasoning to solve practical and scale figure situations.

Word problems continue to be important—especially ones that test thinking against multistep problems and utilize analytical skills and strategies. Where possible, they involve real life situations.

Ideally, the curriculum strives towards teaching an Algebra I course as preparation for a high school level algebra course.

