

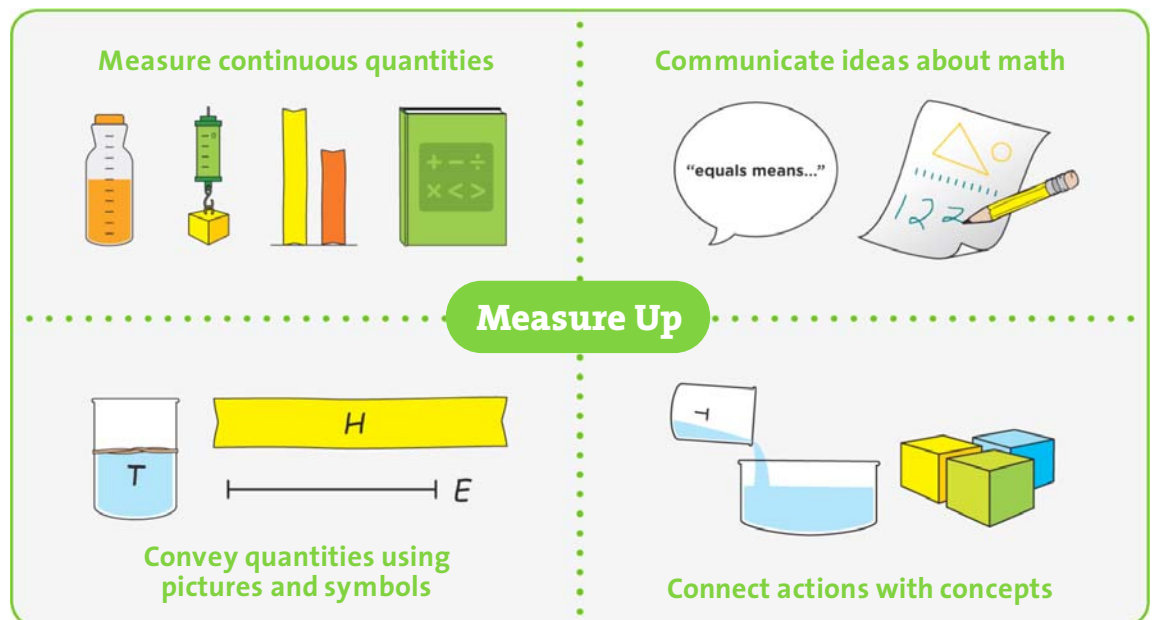
# Measure Up

*Measure Up* is an elementary mathematics research and development project of the Mathematics Section of the Curriculum Research & Development Group (CRDG) at the University of Hawai'i at Mānoa, College of Education. The project includes curriculum development, research on student learning, and professional development.

## Project Overview

Four characteristics guide the work in *Measure Up* to help young children become mathematical thinkers:

- 1 Students' experiences with continuous quantities of volume, mass, length, and area introduce them to mathematical ideas, laying the foundation for algebraic thinking.
- 2 An emphasis on communication engages students in talking about, listening to, and writing about mathematical ideas.
- 3 Students represent the mathematics with continuous quantities pictorially and symbolically. These representations are used interchangeably rather than sequentially.
- 4 Physical actions with continuous quantities allow students to make links to mathematical concepts being investigated.



## Project Overview

The University Laboratory School, also known as The Education Laboratory, a Hawai'i New Century Charter School, is operated by the CRDG under the College of Education. The school enrolls approximately 420 students in grades K–12 who are selected by lottery to create a student body that reflects the ethnic distribution of Hawai'i, includes a broad range of student academic achievement and family socioeconomic levels, and is evenly distributed by gender.

The elementary division comprises three classes: grades K–1, 2–3 and 4–5. Each combination class consists of 20 students, 10 at each grade level. Because of the research nature of Measure Up, students are separated by grade level for their mathematics instruction.



Students use a spring scale to measure units of mass of an object (left). A student carefully measures volume using units marked on the side of a container (right).

## First Grade

- **Generalized ideas rather than specific cases are the focus.**

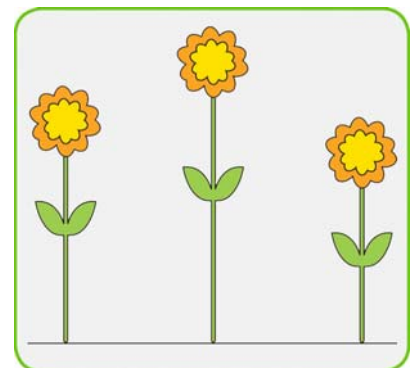
Students model relationships with quantities, build the notion of unit, and demonstrate actions of computational concepts before they are formally introduced to number.

- **Numbers are used to describe specific quantities, and the concept of unit is introduced.**

Students use numbers to describe how much a particular quantity is and to accurately describe how much should be added or removed from that quantity.

- **Mathematical language is emphasized.**

The use of appropriate and accurate vocabulary is introduced to students from the very start. This provides them with the means to communicate their thoughts when describing or explaining processes and/or concepts.

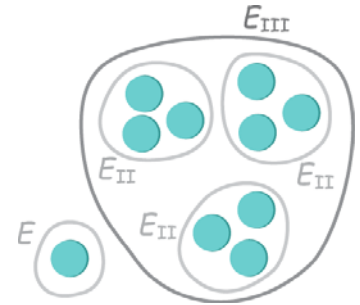


Comparison of length on a worksheet.

## Second Grade

- Different number systems are used in the development of the concept of place value.**

Students learn that each digit in a multi-digit number represents how many of that place value unit there are. The size of the place value unit depends on the number system and its place in the multi-digit number. Instruction begins with smaller bases so that the decimal (base ten) system becomes just another case in the general notion of place value to the students.



A student uses counters to model counting in the base three system.

- Addition and subtraction of multi-digit whole numbers are based on place value ideas.**

Students apply computational ideas from first grade to place value notions in second grade in order to perform addition and subtraction with regrouping. Quantities continue to be used as the context for these ideas.
- Writing prompts are introduced to elicit student thinking on paper and encourage extended responses in problem solving.**

In first grade students describe their reasoning orally. In second grade they begin to communicate their thoughts in writing.

Ernie said, "I think  $52_{\text{eight}} = 52_{\text{six}}$ ."

Bert said, "I disagree. I think  $52_{\text{eight}} > 52_{\text{six}}$ ."

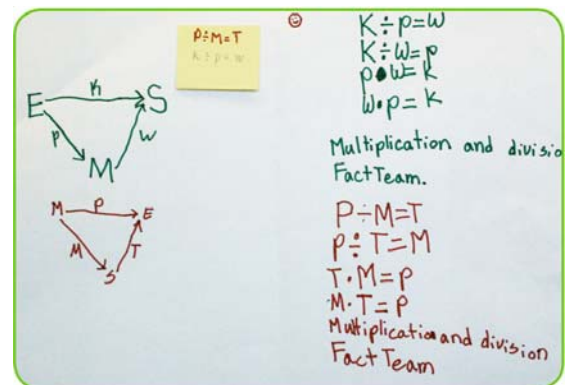
With whom do you agree? Explain why.

Sample of a Grade 2 writing prompt.

## Third Grade

- Multiplication and division are introduced through quantities using an intermediate unit.**

A three-way arrow notation structures the relationship between measuring with a unit, an intermediate unit, and a quantity. The relationships between the three are represented both numerically and non-numerically.
- Computational strategies and properties of operations build number sense and add meaning to calculations.**



Students explore multiplication and division fact teams.

Students develop agility solving numerical problems using strategies that build from their understanding of measurement relationships. Common strategies for multiplication, such as repeated addition and skip counting, are presented in a measurement context.

## Fourth Grade

- **Rigid motions from transformational geometry enhance spatial-visualization skills.**  
Students use translation, reflection, and rotation to explore geometric concepts such as congruence and symmetry.
- **Numbers less than 1 are introduced through place value notions and the use of a radix point.**  
Students first learn about rational numbers in “decimal” form, extending experiences with bases and place value from second grade. The concept of unit is extended to partial units. Addition and subtraction of rational numbers in this form are also studied.
- **Common fractions are introduced, and benchmark fractions are considered.**  
Common fractions are introduced as an alternate form of representing rational numbers.

Jackie's number is between  $10.1_6$  and  $11_6$ .

Find Jackie's number.

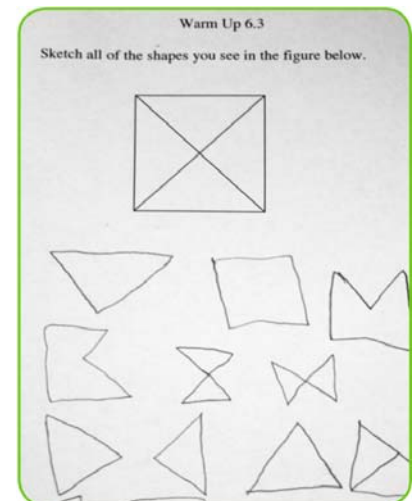
Sample from a Grade 4 student page.

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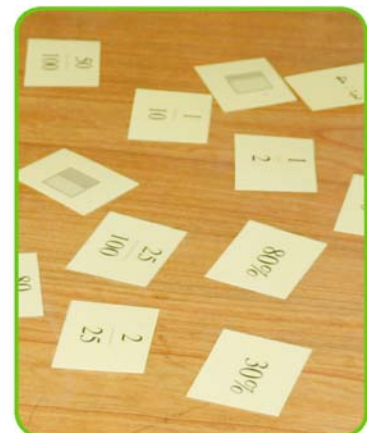
Common fractions are introduced as an alternate form of representing rational numbers.

## Fifth Grade

- **Combinations and probability are explored through continuous and discrete models.**  
Students apply their knowledge of quantities and rational numbers in investigations related to probability.
- **The concept of angle is developed from a transformational geometry perspective.**  
Students use rotation (introduced in grade 4) to investigate notions of angle. Graphing calculators enhance students' experiences and understandings.
- **Relationships between percents, fractions, and decimals are investigated.**  
Quantity models help students relate different forms of rational number representations.



Exploration of shape combinations.



Students use cards to match diagrams with equivalent fractions and percentages.