These connections are to be used as a resource to integrate and connect related concepts and skills that support and enrich the content standards.

Core Standard

4.1 Number and Operations: **Develop an understanding of decimals, including the connections between fractions and decimals.**

Content Standards

4.1.1 Extend the base-ten system to read, write, and represent decimal numbers (to the hundredths) between 0 and 1, between 1 and 2, etc.
4.1.2 Use models to connect and compare equivalent fractions and decimals.
4.1.3 Determine decimal equivalents or approximations of common fractions.
4.1.4 Compare and order fractions and decimals.
4.1.5 Estimate decimal or fractional amounts in problem solving.
4.1.6 Represent money amounts to $10.00 in dollars and cents, and apply to situations involving purchasing ability and making change.

Connections to the Standard

Key Connections to Prior Math Knowledge:

- Place value concepts are complex and are developed slowly over a long period of time. In grades K-3 students have had the opportunity to explore place value structure by exploring patterns within each period (ten, hundred, thousand, etc). In fourth grade the emphasis should be on exploring the progression of the periods (ones, thousands, ten thousand, hundred thousand, millions, billions) and the relationship among the periods using manipulatives such as base ten blocks, Cuisenaire rods, place value mats, and number cards. (2.1)

  Third grade was the first time students were formally introduced to the concept of fractions. The focus for third grade was on conceptual understanding of the part/whole relationship of fractions and representing fractions equal to or greater than one. They used model to represent, recognize, identify equivalent fractions, and added common fractions with like denominators. (3.1)

Key Connections to Future Math Knowledge

- In fifth grade, students will build on their understandings of fractions and decimals gained in 4th grade to generating strategies for adding and subtracting fractions and decimals through hundredths. Using their experiences with models in prior grades, students will be able to identify and use equivalent fractions and decimals. Due to the student's in-depth experience with models, they are able to use this understanding to shift from concrete to symbolic mathematical thinking. Develop an understanding of and fluency with addition and subtraction of fractions/decimals (5.1).
- They also use decimals in data analysis. Students will use decimal models and their understanding of place value to add and subtract decimals. (5.1.7)

***Key Connection(s) to Current Grade Level Math Standards*:**

- In fourth grade, students will move to understanding benchmark fractions and developing equivalent fractions. Therefore, by providing students with experiences that require that they find equivalent fractions and discover how equivalent fractions can be generated, students will have sufficient understanding to become fluent in doing so by the end of 4th grade. (4.1.2)

- The most important reference points for fractions are 0, $\frac{1}{2}$, and 1. Therefore, students should have many concrete experiences with manipulating fractional parts in reference to the benchmark fractions of 0, $\frac{1}{2}$, and 1. The goal is for students to begin to develop a sense of fractions. (4.1.1)
- Fourth grade is the first year students are introduced to the concept of equivalent forms of fractions. The indicator begins with the phrase "Apply strategies and procedures" which means that students should progress from developing strategies to find equivalent fractions to applying a procedure to find equivalent fractions. To help students understand equivalent fractions, they should have many experiences using concrete and pictorial models to find different names for a fraction. "When students understand that fractions can have different names, they should be challenged to develop a method for finding equivalent names. It might also be argued that students who are experienced at looking for patterns and developing schemes for doing things can invent an algorithm for equivalent fractions without further assistance." (Van de Walle, p. 155) (4.1.2)
- In Grade 4 this Core Standard emphasizes the relationship between fractions and decimals. (4.1.3)
- Students will extend their thinking to include the idea that fractions and decimals both represent equal parts of the whole, parts of a set, or points or distances on a number line. Students will recognize that sizes of fractional parts based on 10ths and 100ths can be expressed as decimal numbers. (4.1.1)

  Fourth grade is the first time students are introduced to the concept of decimals. Therefore, they should begin their work using concrete and pictorial models to identify decimals through hundredths. It is very important that students have a firm understanding of decimals and the place value system in order to make a shift from concrete to symbolic and to later work with fraction – decimal equivalencies. (4.1.2, 4.1.3)

  When working with decimals through hundredths, the emphasis for students is conceptual development. Students should have enough experiences with concrete and pictorial models to form visual images of decimals like 0.5 versus 0.05 when they see or hear the number. Also, when developing the concept through pictorial and concrete models, the decimal relationship to the whole should be stressed. Therefore, when students use symbols or words to make a value comparison, the comparison is made based on an in-depth understanding of the relative size of each decimal, rather than using a comparison process or mnemonic strategy. Using concrete and pictorial models, students should be able to identify place value, read, and compare decimals through hundredths. When comparing decimals, students should be comfortable using both comparison words *is less than, is greater than,* and *is equal to* and their respective symbols (<, >, = *)*. (4.1.4)

  Fourth grade students should identify and represent the common fraction-decimal equivalents $\frac{1}{2}$, =.5, $\frac{1}{4}$ =.25, $\frac{3}{4}$ =.75, multiples of $\frac{1}{10}$, and multiples of $\frac{1}{100}$. They should also identify the approximate fraction-decimal equivalents $\frac{1}{3} \approx .33$ and $\frac{2}{3} \approx .67$. It is important that students understand that a fraction and a decimal are two different ways of writing the same number. Students must have a good understanding of fractions and decimals, so it is easiest to begin with fractions of base ten (tenths and hundredths). By using tenths and hundredths grids (or another concrete model), students can see that shading $\frac{1}{10}$ as a fraction or a decimal is the same. By

having the students read both the fraction and decimal correctly, they can see that they are read with the same words.

Once students have a conceptual understanding of tenths and hundredths, they can begin to look at other common fraction-decimal equivalents (i.e. $\frac{1}{2}$ is the same as 0.5, $\frac{1}{4}$ is the same as 0.25, and $\frac{3}{4}$ is the same as 0.75). The students may need to use their skills with equivalent fractions to help see the common decimal equivalent (for example $\frac{1}{4} = \frac{25}{100}$, so the decimal is 0.25). It is important that students have a clear understanding that not all fractions have exact decimal equivalents. Therefore, asking students to use manipulatives to show fraction/decimal relationships such as $\frac{1}{3} \approx .33$ and $\frac{2}{3} \approx .67$ will generate interesting conversation and serve as the foundation for work with decimals in later grades. It is important that students understand that .33 and .67 are approximate equivalents and thus, the use of the *approximately equal to* sign. (4.1.3)

It is not the intent in fourth grade for students to memorize how to divide a fraction to get a decimal. Fourth graders need lessons (using concrete examples where possible) to become familiar with these common equivalents. It is more important for students to be able to relate fraction-decimal equivalents and approximate equivalents with everyday concepts with which they are familiar. For example, students can connect $\frac{1}{2}$, $\frac{1}{4}$, and $\frac{3}{4}$ to amounts of money (for example, if you ask students how much money is half a dollar, they know it is fifty cents and can be written 0.5 or 0.50. The same is true for a fourth of a dollar= 0.25 and three fourths of a dollar = 0.75. Although, student experiences with fraction/decimal equivalents should not be limited to the concept of money. It is difficult for a child, whose main identity with decimals is money, to form the flexibility needed to work with decimals such as 47.8 and 6.123. Therefore, it is wise not to initiate teaching of decimals with money. Money is an application of decimals, and should be taught after conceptual development of the ten to one relationship is in place. (4.1.6)

- Give students repeated opportunities to use fractions as they find linear and area measurements using standard units of inches, feet, yards, etc. (Example: 4 inches = 1/3 foot, or finding perimeter of rectangles that measure 2 ½ feet by 3 ½ feet, what fraction of this shape is shaded? (4.3)
- Give students repeated opportunities to use decimals as they find linear and area measurements using metric units of centimeters and meters. (Example: 100 cm = 1 meter, 1 cm = 0.01 meters, or finding lengths of objects to the nearest centimeter (4.3)

Key Connection(s) to Other Content Areas

- Science
  - Use the metric and standard systems for scientific measurement such as finding volume in a graduated cylinder, finding mass/weight with scales, using rulers to find length, etc.
  - Use fractions and decimals to make comparisons (Examples: speeds, life spans, weights, gestation periods, etc.)
  - Weather measurements of rain, snow, temperatures, wind speeds, etc.
- Social Studies (money and time)
  - Oregon history (Example: How far pioneers traveled, weight of provisions, amount of land grants, calendars, costs, etc.)

- Arts (measurement and time)
  - Reading music (quarter notes, half notes, etc.)
  - Building stage props for performances
  - Art projects that involve measurements (string art)
- Language Arts
  - *Phantom Tollbooth*
  - *Alexander Who Used to Be Rich Last Sunday*
- PE
  - Timing races, comparing times,
  - Use a stopwatch. How long does it take to do?? sit-ups, push-ups, jumping jacks?
  - Heart rate

Key Connection(s) to Real World:

- Cooking
  - Measuring for recipes, cooking times, shopping, doubling or halving a recipe, etc.
- Sewing
  - Measuring and cutting fabrics
  - Quilting
- Building
  - Cost to purchase materials
  - Measurements of building
- Money
  - Buying something and making change
  - Savings account (piggy banks)
  - Creating a budget
- Sports
  - Batting averages
  - Scoring (gymnastics, diving, ice skating, etc.)
  - Statistics (free throws, "How many shots made out of 10 attempts?" goals made compared to attempts, etc.)
  - Track and Field times and distances
- Technology
  - Cell phone minutes and cost
  - Computer and video games scoring systems
  - When downloading computer programs, bars are used to
  - Show what portion has been completed so far

Vocabulary:

common fraction	equivalent	hundredth	numerator
decimal	estimating	improper fraction	represents
denominator	fraction	number line	tenth
model	compare	order	approximation

***Language of Math*:**

- "And" means the decimal point.
- Read decimal numbers to show value, i.e., 0.15 is read *fifteen hundredths,* **not** *zero point one five.*
- Place a zero before the decimal point for numbers less than 1.

Common Mistakes and Associated Misconceptions:

- Student compares two fractions using different sized units.
  Possible misconception: They don't understand the need for equal parts.
- Students think a fraction with a larger number in the denominator must be bigger.
  Possible misconception: Fractions are counter-intuitive to previous number learning. Students do not understand that the bigger the denominator, the smaller the fractional part.
- Students confuse fraction notation with decimal notation. For example they read ½ as "one point two" when asked for decimal equivalency.
  Possible misconception: Students need many experiences with concrete models and practice with labeling them with correct fraction and decimal notations.
- Students think that only ½ is equivalent to ½.
  Possible misconception: Equivalency means fractions can be expressed in a part to whole relationship using a wide variety of numerators to denominators. For example ½ can be expressed as 2/4, 4/8 ...
- 1/2 is written as 2/1.
  Possible misconception: Students don't understand the meaning of the numerator is how many pieces you are focusing on and the denominator is the number the whole is divided into.
- Students think a decimal with a larger number must be bigger.
  Possible misconception: The student believes that less means fewer digits. Decimals are counter-intuitive to previous number learning. 0.5 is not less than 0.49.