

## SC READY Mathematics Grades 6-8 Data Review Report: Spring 2021

In fall 2021 the South Carolina Department of Education convened a panel of experts to review item data on the South Carolina College- and Career-Ready Assessments (SC READY) Mathematics Grades 6, 7, and 8 tests. The panel looked at items and data from the spring 2021 assessments. There were no state assessments in 2020 due to the global pandemic, thus there is no Data Review Report for spring 2020. However, there are still reports from previous years that contain relevant and useful suggestions for improving instruction. The discussions of this year's panel yielded the recommendations that follow. The panel recognizes the hard work of SC educators over the past two years and offers these suggestions as an addendum to those from previous years.

The SC READY Mathematics Blueprint is divided into five Reporting Categories that match the Key Concepts for each grade. This Data Review Report includes recommendations for two Reporting Categories from each grade.

### **Grade 6:**

#### **Expressions, Equations, and Inequalities (EEI):**

- When writing and evaluating numerical expressions with the Order of Operations focus on benchmark fractions. Exponents can be limited to squares and cubes. Students should be using fractions and decimals with exponents too. The standard allows for “positive rational number bases.” The number of operations may be limited to five or six in an item. Avoid using the fraction bar as a grouping symbol; this is in 7.EEI.3.
- The committee recommended having students write fractions with exponents in expanded form and then have them multiply the fractions together. Tie this understanding to how students first understood evaluating integer bases with exponents. Students and teachers should be wary of the following common errors
  - Students only exponentiate the numerator.
  - Students are not multiplying the denominators when multiplying fractions together.
  - Students multiply either the numerator, denominator, or both by the exponent itself.
- Items assessing the Order of Operations will typically be no-calculator items. Include nested grouping symbols when studying the Order of Operations.
- Typical teaching strategies for these standards include error analysis, white boards, and “my favorite no,” card sorts, and matching games.
- Specifically for the Order of Operations, the committee suggested providing students with a set of numbers and a given answer. Use the set of numbers to create an expression that results in the given answer. This allows for multiple correct answers and authentic mathematical discussions.
- Students are having difficulty writing expressions that represent real-world and mathematical situations. One suggested strategy was to scaffold the transition from verbal to mathematical expressions. For instance, give students the real-world situation and only have them identify the operations that will be used. Then, give students the verbal representation with some of the words replaced by mathematical operators. This could be turned into a manipulative or anchor chart.
- Practice with students may also include having the students write a story that matches a given expression. This will help students make the connections from mathematical to

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verbal and vice versa. This will also prepare students to interpret graphs and corresponding real-world situations later in 8<sup>th</sup> grade.

**Data Analysis and Statistics (DS):**

- Sixth grade students must be able to explain and calculate these measures of center: mean, median, and mode. The measures of variation students must be able to explain and calculate are range, interquartile range, and mean absolute deviation.
- Students should be asked to compare two measures of center or variation and justify which measures are the best to describe a data set. Students should use the shape of the distribution to justify their choice.
- Use small groups to work on internalizing the meaning of the measures of center and variation, how the shape of the distribution affects our choices, and what those measures tell us about the overall data set.
- The committee discussed the use of calculators within these standards. They agreed that for smaller data sets with ‘nice’ numbers students should be able to perform, by hand, the mechanics of finding all the measures of center and spread in this grade.
- Have students find measures of center and spread using data displays such as a box-and-whisker, histogram, or dot plot.
- Place statistics items in a context whenever possible. Have students give their answers back to the teacher in the same context.
- Some real-world situations that the committee suggested were giving students the temperatures for a week (Thanksgiving week, spring break, etc.) and asking them which measure of center is the best description for that week. Which measure of variation is the best for that week? Have students collect their own data and use it to find measures of center and variation. Use student data to create box plots and histograms.
- Instructional strategies suggested for these standards included task cards for vocabulary understanding, error analysis, individual or electronic whiteboards, and turn and talk. Some common errors to analyze are, using the minimum to represent the data set or using an inappropriate measure of center/variation to describe the data.
- Students tend to understand the process for finding statistics but have difficulty remembering which process to use when asked for a specific statistic. In other words, if asked to find the mean, students don’t know where to start. However, if they are prompted, they can finish out the calculations themselves. Ask students what they would do to find the mean or median. Perhaps give students a worked process and ask what statistic that process finds.
- The committee strongly suggested teaching all of the DS standards together. The ideas here overlap strongly. Teaching the standards together will allow for students to see the connections.
- The committee commented that SC READY does include the “easy” items where students are asked to simply find a measure of center in context. There are also items where students must select the most appropriate justification for a selecting a particular measure of center or spread.

## **Grade 7:**

### **Number System (NS):**

- Students need to work on relating the distance between two rational numbers on a number line to the absolute value of their distance. The committee suggested teaching this concept as an extension of adding and subtracting with a number line. This may also be a place to use levels of understanding such as novice, practitioner, and expert to make groups.
- Ask students to explain how it is that one can take a negative from a positive. What does  $14 - -4$  mean? Can students come up with a real-world item around this idea? This may be a place to involve small groups.
- The committee suggested a particular item for relating distance to the absolute value of the difference. An eagle is on a branch twenty feet above the surface of a lake and a fish is two and a half feet below the surface. Ask students what the meaning of zero is in this situation (this ties back to 6.NS.5) and have them plot the positions of the animals on a number line. Students can even draw the animals at their locations. Ask students what is the distance between the animals without the number line? Have them explain how they could figure this out using the integers and the number line.
- Work with students on their understanding of integers, rational numbers, and the four operations with integers and rational numbers. Students need this foundational understanding for their other work in this grade.
- Help students understand there are multiple representations of rational numbers. Students must be fluent in their conversion of rational numbers between percentages, fractions, and decimal numbers. The exclusion for this grade is converting repeating decimals to fractions, that is covered in 8<sup>th</sup> grade.
- Instructional suggestions included card sorts, matching, and having students fill in a three-column table labeled on the top with “Fraction, Decimal, Percentage.” Alternatively, give students statements such as  $0.36 = 36\% = 36/100$ , include both correct and incorrect statements. Have students identify the correct and incorrect statements. The committee wanted to emphasize that there are no denominator restrictions in grade 7. This standard is an extension of 6.NS.9 so students should be familiar with these ideas.
- The committee suggested giving students their grades as fractions and having them compute their own grade. Have them solve this without a calculator. This works for other ideas too, the grade could be the answer to an equation, area of a figure, a probability of an event, etc.

### **Ratios and Proportional Relationships (RP):**

- Students need more work finding unit rates. Students are having trouble writing unit rates with the same or different denominators and determining unit rates when there is a complex fraction.
- Counterintuitively, students were more successful in these standards without a calculator than with a calculator even though the committee felt the numbers used in calculator items were “easier numbers.” The committee suggested having students calculate items by hand and then using the calculator to verify the answer. Further, help students know when to use a calculator and when not to use a calculator even when one is available.
- Expose students to items using real-world applications, such as items involving recipes, rates, and distance. Consider items such as:

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- given a recipe and either double it to feed a sports team or half it to feed a small gathering,
  - a person earns \$25 in one and a half hours how much would they earn in one hour,
  - if there are 10.5 yards of fabric for 15 people to use how much would each person receive, or
  - give the distance and times for four friends and ask which one is traveling the fastest. Perhaps one is in a plane, one in a car, one on a bike, and one is walking, ask students which mode of transportation is most likely for each friend.
- Students need help both recognizing and calculating the constant of proportionality. Students may be asked to identify the constant of proportionality from equations, verbal descriptions, and graphs. They may be asked to calculate the constant of proportionality from tables, diagrams, and verbal descriptions.
- Exposing students to a variety of items in the RP standards is important. Items may have students use values for  $x$  and  $y$  to calculate the constant of proportionality and then have them find a missing value. Other items may ask students to find the constant of proportionality for two people to complete a task and then ask how long the task would take if we increased the number of people to 7 and they all worked at the same rate as the two people. The committee suggested giving students items that hit multiple parts of the RP standards.
- An instructional strategy suggested was the placemat strategy. For example, give students a constant of proportionality in the middle of a paper and then each student uses that to write either a table, graph, equation, or verbal situation that uses that constant of proportionality. Then have students discuss their work and try a different representation.
- Students seem to have trouble determining the constant of proportionality from graphs. They seem unsure of whether it is expressed as  $x/y$  or  $y/x$ . Relate the idea to their science class. Use correct vocabulary such as independent and dependent variables to help the discussion.

## **Grade 8:**

### **Number System (NS):**

- Students need a strong understanding of the number system. Focus on vocabulary when teaching these standards. Make sure students understand what is meant by “all real numbers.”
- Have students draw the number system as a Venn diagram and then ask them to draw another interpretation. Maybe their Venn diagram is more like a delivery van or rocket that contains the number system. Some students may need a manipulative. A marble in a plastic egg, in a hamster ball, in a box, etc.
- Students must understand the meanings of
  - decimal expansion
  - non-terminating
  - non-repeating
- Teach the above concepts and use this vocabulary while teaching the EEI standards too.
- Instructional strategies include card sorts, matching, and other types of interactive categorizing. All the strategies can also include a component where students move around the room as well. The committee was not suggesting work sheets.

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- Have students plot where on a number line numbers may be located. In addition, show students various forms of irrational numbers. Include square roots of imperfect squares, cube roots of imperfect cubes, and multiples of  $\pi$ . Additionally, include roots of fractions, some that will end up rational and others that are irrational. Students need to see a wide variety of both types of numbers. Lastly, ask them which numbers are real.

**Expressions, Equations, and Inequalities (EEI):**

- Students need more work on both square and cube roots. This work is much easier if students are familiar with common squares and cubes from earlier grades. Stress that these are inverse operations of the squaring and cubing process to help draw connections.
- The committee suggested giving students physical representations of squares and cubes. Give students several cubes (these could be dice) and then have them attempt to create cubes using various numbers of smaller cubes. For instance, give students 27 cubes and see if they can create a large cube. Try again with different numbers to help them understand the concept. Later, ask student, in a  $2 \times 2 \times 2$  unit box how many cubes can fit? Emphasize that if they are given the volume, then the cube root is an edge length.
- Revisit squares as well. For example, propose that a marching band wants to create a square on the field for a half-time show. If a marching band has 35 members, can they form a square?
- Use the words rational and irrational when discussing the square and cube roots.
- The committee felt that students are well served with both a strong conceptual understanding and fluency with these ideas. They suggested having students memorize the first twenty-five perfect squares and the first ten perfect cubes. Use squares and cubes as an exit or entrance ticket.
- Relate squares and cubes to a number line as well. Where on a number line would the cube root of forty be located? Where would the square root of 65 be located? Remember that students should be able to approximate values of both square and cube root equations, but just the positive values at this grade.
- Students need some help solving linear equations and inequalities in one variable. The committee suggested doing a real-world item with multiple steps where the variables cancel. Then ask the students what that means in terms of the context. Students need more than bare math when solving equations and inequalities.
- Some suggestions were to try the sage-scribe strategy, error analysis, and generally having students interact with the math and explain it to each other. Manipulatives such as Algebra tiles were suggested.
- Students need help simplifying equations, especially when distributing negative numbers. Teachers commented that students ask, “is that negative three  $x$  or minus three  $x$ .” Students should begin seeing these as the same thing. Their answer to that question is however they can best understand it at the time.