

SC READY Mathematics Grades 7-8 2019 Data Review Report

In October 2019 the South Carolina Department of Education convened a panel of experts to review item data on the SC READY grades 7 – 8 test. The panel looked at items with a high percentage of students answering correctly and items with a low percentage of students answering correctly. The discussions of that panel yielded the recommendations that follow. Teachers on this year’s panel felt that last year’s suggestions were still extremely relevant and that teachers should be reminded to look at last year’s Data Review Report (2018). The panel recognizes the hard work of SC educators and offers these suggestions as an addendum to those from last year.

General Suggestions:

The following are general suggestions that arose for multiple items.

- Have students use paper and pencil even though items may appear on a computer. The panel felt students should be showing work for every item. Make students responsible for their work. Math is not a spectator sport; students need to interact and play with mathematics before they will understand or appreciate it.
- The Mathematical Process Standards may be interwoven into any standard. This allows for creativity both on the part of the teachers and the students. Practice making items, tasks, or projects that weave the Mathematical Process Standards into the Academic Standards.
- Expose students to multi-select items. Students seem to stop after they find one or two solutions. On the mathematics portion of SC READY the multi-select items will have more than one correct answer, however they will **not** all be correct. Students need to practice checking, or at least thinking about, all the answer options.
- Use proper academic vocabulary all the time. Casually using mathematical terms seems to be impacting scores at higher grades. Treat mathematics as a foreign language for students. A mathematical term has a definition. Students should understand the definition and moreover be able to use, or read and understand, that term in a context. Students need consistent daily work on vocabulary, but not a special assignment. Rather this should be part of a teacher’s daily practice.
- The panel continued to suggest that teachers do less and have students do more. Have students define variables given a context. Give students graphs, data sets, geometric figures, equations, etc. Then have students tell each other, and the teacher, how they are alike and different. Give students difficult items and let them work. The panel expressed many times that teachers are “sanitizing the rigor.” Good items have multiple entry points, allow students time to find their own. In particular, the panel warned against always telling the students “Solve using [insert method here].” Many items simply ask for “an equivalent form of the equation” or just “Solve.” Items rarely direct students in which thought process they are to use. Allow students to use what they have been taught.
- Mathematical discussions are a great tool to use with students. Mathematical discussions can be whole class, small group, or even journaling about math. Having students interact daily with math in a novel way increases the likelihood that students will retain or deepen

their conceptual understanding. This could be as simple as having students explain why their answer is correct or why another answer is incorrect.

- The panel suggested strategies for helping students to answer the question that is asked by the item. One suggestion was to have students create a fill in the blank, including the context and units, for their numerical answer before beginning. Then when they put in their numerical answer they can evaluate if it makes sense in their sentence and answers the question asked.
- Students need more exposure to real-world items and moreover real-world situations. For instance, students have a difficult time recognizing the circumstances where a lower time is desirable. The panel recommended putting them in the situation. For instance, test their reflexes, the time for die-cast cars to go down a ramp, or distance from a target for paper helicopters. Then use this data in class to generate examples. The panel also recommended incorporating formative assessment lessons as classroom challenges for students in order to develop and extend mathematical thinking.
- The panel was concerned that students are learning too many processes and not enough number sense. Items on both the calculator and no calculator sections that could be easily solved with some number sense are missed too often. The panel wanted to remind teachers the South Carolina College- and Career-Ready Standards are not designated as calculator or no-calculator. Students should be able to work items both with and without a calculator.
- The panel wanted to strongly encourage teachers to use variables other than 'x' and 'y.' Students in these grades can begin defining their own variables.
- The panel also encouraged giving students a wide variety of strategies for tackling mathematical concepts. Students benefit from seeing multiple strategies even if they are not the most efficient strategy. Immediately going to the most efficient solution may not allow students to foster connections to previously taught concepts.
- Practice the Online Tools Training (OTT). The OTT is there to minimize test day stress. The OTT familiarizes students with the mechanics of the test and the tools that are there to help them.

Grade 7 Suggestions:

The following suggestions are specific to grade 7 items. They are organized by key concept.

Number System (NS):

- The panel recommended using estimation to help determine the reasonableness of answers.
- Help students to draw models and diagrams to help understand the item. One item involved spacing various length objects along a line and had mixed units of inches and feet. Drawing a picture of what was described made the item much easier to handle.
- Use correct and appropriate academic vocabulary. Students seem to be confusing the idea of “opposite” with “multiplicative inverse” and “additive inverse.” The panel stressed knowing vocabulary is more than just memorizing a definition. Students need to internalize these concepts in order to use them effectively.
- Be reminded that previously taught standards are used in test items. For instance, students still need to know the Order of Operations and basic measurement conversions. Expand upon the Order of Operations to include distributing with and over rational numbers.
- The panel questioned whether teachers are using enough fractions in their own classrooms. Teachers should be using fractions, both positive and negative, in items.
- The panel pointed out that this grade converts from fractions to repeating decimals, but not vice versa. That is covered in 8th grade.
- Remind students that distance is always positive. Students were asked how far is a [positive fraction] from a [negative fraction]? The brackets had two ‘easy’ fractions both with the same denominator. Some students picked the opposite of the correct answer. The panel thought avoiding tricks such as “going left on the number line is always negative” would help.
- Items may include both fractional and decimal representations of rational numbers in the same item. These items may also include multiple steps.
- Students are making mistakes with the remainder when dividing. For instance, if the item was to write $\frac{21}{5}$ as a decimal students incorrectly chose 2.1 thinking that the remainder is the value in the tenths place.

Ratios and Proportional Relationships (RP):

- The panel felt that students need the time to connect all of the ideas in the RP standards together. They suggested giving students time to work with ideas in multiple representations to foster connections. Give students multiple strategies in this key concept.
- The panel suggested ensuring students know how to effectively make use of tools such as graph paper and calculator.
- Students need to know how the slope of the graph, constant rate of change, unit rate, and the constant of proportionality relate to each other.

- Ask students to perform more than one percent increase or decrease in an item. For instance, a multiple choice items could ask, “Which item is discounted more than 15%?” Then, give the students four short scenarios of an original price with a discounted price. Now, have students must find the correct answer.
- Percent increase is more than just the formula. Students need to understand this in a context and be able to apply it without being told explicitly what to use. Additionally, allow students to see multiple strategies. Instead of adding the 10% tax as money, find 110% of the original cost.

Expressions, Equations, and Inequalities (EEI)

- Students should be careful to distribute to all terms in parentheses and not to terms that are added or subtracted after the parentheses. Further, students should be working with all rational numbers in items. This is especially true when furthering the understanding of the Order of Operations.
- Students need to know equivalent forms of equations and the steps that occurred during the process of rewriting an equation.
- Students are at times asked to create their own equations from a story item. Remind students to look for equivalent forms of their equation, especially if they cannot find their equation. Further, students need to know how to define their own variables given a story item.

Geometry and Measurement (GM):

- When working with circles include items that have multiple concepts in one item. Students should be comfortable working with diameter, radius, circumference, and area in one item.
- If students are being taught formulas then they need to understand those formulas conceptually as well. Students should be prepared to find the surface area of an object that is missing a side when looking at a real-world item.
- The panel recommended using solid 3D figures when discussing surface area to help students connect back to the 2D objects with which they are already familiar. This will also help students to visualize the unseen sides when they encounter 3D figures represented in 2D.
- The panel suggested that when working on scale models teachers use more hands on real-world examples. They suggested having students compare two objects and figure out the scale factor between them.
- Include comparative language throughout. For example, “which objects have a surface area less than 120 square centimeters” or “which circles have a radius greater than 4 units?”
- Students need to understand and be able to apply the Triangle Inequality Theorem. Students should be asked to justify if a triangle could exist in terms of the Triangle Inequality Theorem.

Data Analysis, Statistics, and Probability (DSP):

- Students need to know that probability ranges from zero to one. They should be able to understand probabilities as fractions, percents, and decimals. They should further understand how likely an outcome is based on the probability.
- Encourage students to draw the sample space in order to make sense of probabilities.
- Students should be comfortable with finding the complement of an event. Introducing this concept around the time students are beginning to learn about the basics of probability will help later when constructing probability tree diagrams.
- Teachers must ensure students can compute compound probabilities. When teaching compound probabilities the panel discussed using tree diagrams with the probabilities labeled on each branch. The committee suggested searching the internet for “probability tree diagrams” for help if teachers need an example.
- Give students more experience with unequal probabilities. Students need hands on experience with both equal and unequal probabilities. Students should understand common probability generators such as dice (or number cubes), spinners, pulling marbles from a bag, etc. Use these to practice equal and unequal probabilities. Use a probability tree diagram to find the theoretical probability, then use the probability generator to find the empirical probability. Have students compare these probabilities verbally and in written form.
- Our assessments use the term “number cube” when discussing “dice.” Students should be familiar with both terms. Students would benefit from understanding as many common sample spaces as possible. For instance, students should know that when rolling two six-sided dice the outcome (5, 6) is different from (6, 5).
- Make sure to compare sets of data. Collect, find, or make up data sets with ten or fewer data points. Then use these data sets to compare measures of center and variability. Finally, encourage mathematical discussions about the data sets and have students write complete sentences that draw inferences based on their comparisons.

Grade 8 Suggestions:

The following suggestions are specific to grade 8 items. They are organized by key concept.

Number System (NS):

- The panel wanted to remind teachers that eighth grade adds converting repeating decimals to fractions. They also recommended exposing students to multiple choice items where one option is too easy. For instance, if the repeating decimal is $0.\overline{27}$ then include $\frac{1}{27}$ as an answer option.
- The panel asked the question, “Do students truly understand that a fraction is a rational number?” Further, they wondered if students understood that pi is irrational while $\frac{22}{7}$, as an approximation for, pi is rational. Teachers could draw this out by using 3, as an integer approximation of pi as well. The relationship between number systems is a good topic for a mathematical discussion.
- The panel further recommended showing answers as both fractions and decimals to improve student understanding that those are just different representations of the same number.

Functions (F):

- Be sure to expose students to multiple representations of functions. Using domain and range as vocabulary will help prepare students for Algebra. Students should understand the vertical line test and how it determines if a relation is a function.
- Students are asked to recognize linear functions and understand their characteristics. For instance, both the ‘x’ and ‘y’ variables have degree one. Students should understand this both with and without nonlinear functions as a comparison in the item.
- Students were given a list of ordered pairs as a set. They were then asked what did or did not make the set a function. All of the answer choices were short sentences that gave reasons why the set was or was not a function.
- The panel cautioned against always having students solve for ‘y’ and then graphing using slope and y-intercept. Some items lend themselves to graphing by intercepts when they start in standard form.
- Students were asked to compare the rate of change from a graph with the rate of change from four different tables. Caution students that steepness and sign both matter when making this comparison. Students seem to have looked at the differences in the tables with no regard for whether they were increasing or decreasing differences.

Expressions, Equations, and Inequalities (EEI)

- The panel was concerned that students are being taught process over thinking. There were items involving operations using scientific notation that were easily solvable if the student had good number sense. The panel wanted to encourage students and teachers to slow down and think before jumping into a procedure to solve. Lastly, operations with scientific notation are not just between numbers written in scientific notation.

- Work with students on items involving exponents. Students need help understanding and working with the laws of exponents.
- Students should understand the relationship between unit rate, slope, and the constant of proportionality.
- When comparing proportional relationships it is ok to have them both in the same form at first. In addition, give students items that start with two different forms for the relationships when comparing proportional relationships.
- Emphasize the difference between proportional and linear relationships. Emphasize this both as a graph and an equation. Students are missing items that test this difference. Students are confusing proportional with having a pattern.
- Students need more exposure to items involving one, no, or infinite solutions. The panel thought an item where students filled in one or two of the numbers to make the equation have one, no, or infinite solutions was one way to have students explore this idea. They could then justify in writing or verbally why their choice of numbers creates that number of solutions.

Geometry and Measurement (GM):

- Real-world items involving the Pythagorean Theorem may not mention the Pythagorean Theorem by name. Moreover, an item of this type may not mention the presence of a right triangle. Students need exposure to real-world items where they must recognize the presence of a right triangle and then apply the Pythagorean Theorem. Lastly, students should understand that when asked for the shortest distance between two points, this is a line, regardless of the context of the item. This is another opportunity for a mathematical discussion.
- When investigating the geometric relationships the panel suggested using appropriate and accurate notation and vocabulary. For instance, using the vocabulary of ‘two parallel lines are cut by a transversal’ or ‘pre-image’ and ‘image’ when looking at transformations.
- Students should have a good understanding of the relationships between angles formed when two parallel lines are cut by a transversal. The panel suggested having students write equations to express these relationships.
- Eighth grade students must have a deep understanding of transformations. The panel was concerned that there is a reliance on formulas for transformations over conceptual understanding. Students should be using patty paper, tracing paper, or something similar to copy the original object and then physically perform the transformations. This is true of paper and digital resources.

Data Analysis, Statistics, and Probability (DSP):

- Students are expected to find and interpret the slope and y-intercept in terms of the given context for a data set. The panel suggested connecting this interpretation back to the students’ understanding of slope as change in y over change in x.
- Students need a conceptual understanding of the line of best fit for a set of data. There are many lines that would be an ‘okay’ fit for the data. Discuss with students what makes a line of best fit the best.

- The panel suggested that teachers give students a two-way table and ask them what they “see and wonder?” Have students make conjectures based on the two-way table. Encourage mathematical discussions before jumping into marginal probabilities. Once the relative frequencies have been found have another mathematical discussion about what students notice now.
- When teaching matrices, teachers are reminded to use proper notation as well as performing the actual operations.