CONTENT AND TASK DECISIONS

Grade Level
7th Grade

Description of Task
Compare and contrast different types of numbers using a card sort
Observe similarities and differences of all types of real numbers
Compare and order rational numbers using a number line
Observe patterns in the process of comparing rational numbers

Indiana Mathematics Content Standard
7.NS.3 - Know there are rational and irrational numbers. Identify compare and order rational and common irrational numbers ($\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$, $\prod$) and plot them on a number line.

Indiana Mathematics Process Standards
Practice 2: Reason abstractly and quantitatively
Practice 3: Construct viable arguments and critique the reasoning of others
Practice 5: Use appropriate tools strategically
Practice 6: Attend to precision

Mathematics Content Goals
Students will be able to classify real numbers (Whole, Integer, Rational, Irrational, Real)
Students will be able to compare and order rational and irrational numbers (using <, <, and =)
Students will be able to order rational and irrational numbers on a number line

Language Objectives
Rational Numbers - a number that can be written as a fraction
      Picture or other explanation: Write examples of rational numbers and their matching fractions (Ex: 7 → 7/1 and $\sqrt{25}$ → 5 → 5/1 and 1 ¾ → 7/4 and 4.1 → 4 1/10 → 41/10)
Irrational Numbers - a number that cannot be written as a fraction
      Picture or other explanation: Write examples of irrational numbers (Ex: $\prod$, $\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$)

Materials
Brown Bag
Index Cards
Real Numbers Chart
Number Line

THE LESSON

Before
Prepare brown bags for each group with different types of numbers inside - include positive whole numbers, negative whole numbers, positive and negative decimals, positive and negative fractions, repeating decimals, terminating decimals, square roots (perfect square and non-perfect squares)
Quick Write: What types of numbers have you worked with before?
What steps do you take when ordering numbers on a number line?
What challenges might you have when ordering numbers on a number line?

Before the activity, have students answer their quick write question listed on the back of their Real Numbers Chart. Students will brainstorm what types of numbers they know or are familiar with. Students may not have a name for these numbers but my come up with answers like "positive numbers", "decimals", and "fractions". Encourage excelling students to also list examples of the type of numbers they have described

After giving students 3-5 minutes to jot down their ideas, have them "turn and talk" about their findings. Have students check for similarities and differences in the types of numbers they have listed along with similarities and differences in their process for ordering numbers on a number line.

During
Activity 1:
Present the students with the bag of different numbers and ask students to create groups of numbers by finding similarities and differences in their numbers.
As starter questions:
   ● What new types of numbers do they see?
   ● What do the types of numbers have in common?
   ● How do the types of numbers differ?
   ● What symbols do you see? Are you familiar with these symbols?
Give the students 5-7 minutes to work in groups and separate their index cards into groups. Using the back of their Real Numbers Chart, have the students try to name their groups and list the numbers that go together.

Activity 2:
Using the same numbers on the index cards, have the students discuss their processes on how to order numbers on a number line. Then have them determine their final number line with index cards ordered from least to greatest. Using the back of their Real Numbers Chart, sketch the number line and where the numbers lie on their number line.
   ● What makes it easiest to compare and order rational numbers?

- What happens if the numbers don't look the same (fractions vs. decimals - whole numbers vs. square roots)?
- What process do you use to order the numbers on a number line?
- Is there more than one process used to order numbers on a number line?

Listen for productive mathematical conversations.

- Are students constructing viable arguments?
- Are students using reasoning to support their decisions?
- Are students able to critique the reasoning of others?

After

Activity 1:

Ask groups to determine a "speaker". Have the speaker from each group share their findings. Take pictures of each group's work and project each group's work while the leader is sharing their findings.

- What similarities do the groups have?
- What did each group name their set of numbers?
- Were there similarities in names of groups of numbers? Could the same group of numbers have more than one name?

Use the whiteboard, magnets, and a master copy of the index cards to come up with a class classification.

Ask the students where these numbers could go on the Real Numbers Chart.

- What do you all think is the most "basic" type of number?
- What can we add to the basic type of numbers?
- What can we conclude about the numbers listed in the bubble outside of the Rational Numbers circles?

Watch the video for Rational and Irrational Numbers in BrainPop.

Use the BrainPop to:

- Derive a definition of Rational and Irrational Numbers
- Name the types of numbers (Whole, Integer, Rational, Irrational, Real)
- Determine patterns in rational numbers
- Determine patterns in irrational numbers

Activity 2:

Use the whiteboard, magnets, and a master copy of the index cards to come up with a class number line ordered from least to greatest.

Have students share out how they ordered their numbers.

- What symbol did you look for first? Was there a symbol that determined smaller numbers vs larger numbers?
- Where in the number did you look to begin your ordering process?
- How do you know when you've successfully compared two numbers?
- How do you know when you've determined a smaller number? (Ex: 4.232323… and 4.22222…)

Overall, students should conclude that Real Numbers can be classified into Whole, Integers, Rational, and Irrational Numbers. Whole Numbers are any positive whole number and zero. Integers are negative whole numbers along with Whole Numbers. Rational Numbers are numbers that can be written as a fraction along with Whole Numbers and Integers. Rational Numbers can be in the form of positive and negative repeating decimal, positive and negative terminating decimal, positive and negative fractions, positive and negative perfect squares (as long as the negative is outside of the square root sign). Irrational Numbers are numbers that cannot be written as a fraction. Irrational Numbers can be in the form of the square root of numbers that are not a perfect square, pi, and decimals that do not repeat and do not terminate. When comparing numbers, negative numbers will always be less than positive numbers and zero. Rational numbers need to be expanded and compared until a digit differs. Terminating decimals can have zeros as place holders behind them to help with comparing.

Support:
Activity 1 Support:
Guide the students using familiar vocabulary and help student group their numbers
- What new types of numbers do they see?
- What do the types of numbers have in common?
- How do the types of numbers differ?
- What symbols do you see? Are you familiar with these symbols?
- What symbols are familiar to you?
- What symbols are unfamiliar to you?
- What would make it easier when comparing a fraction and a decimal?

Activity 2 Support:
- What makes it easiest to compare and order rational numbers?
- What happens if the numbers don't look the same (fractions vs. decimals - whole numbers vs. square roots)?
- What process do you use to order the numbers on a number line?
- Is there more than one process used to order numbers on a number line?
- What symbol did you look for first? Was there a symbol that determined smaller numbers vs larger numbers?
- Where in the number did you look to begin your ordering process?
- How do you know when you've successfully compared two numbers?
- How do you know when you've determined a smaller number? (Ex: 4.232323… and 4.22222…)

Extension:
Activity 1 Extension:
What happens when you have a negative in front of a perfect square? (Ex: $-\sqrt{9}$)
What happens when you have a negative in front of a number that is not a perfect square? (Ex: $-\sqrt{12}$)
What happens when you have a negative inside of a square root sign? (Ex: $\sqrt{-9}$ and $-\sqrt{12}$)
Can the product of the same number be negative? (4 x 4 and -4 x -4)

How can we classify these numbers that have a negative inside of a square root sign?

Activity 2 Extension:
How could you compare pi and 2pi?
Which out knowing the square root of 3 and the square root of 7, how can you compare them?
How could you plot the square root of 10 on a number line? What prior knowledge will you have to use?

Assessment
Use Quizlet Live as an opportunity for students to apply and showcase their knowledge. Reiterate to students that I need to "hear their thinking" instead of just saying the correct answers within their groups. I am looking for mathematical discussions instead of speed.
https://quizlet.com/_2ft6kh
Once the Quizlet Live is complete have students complete a ClassKick Exit Ticket where they are individually demonstrating their knowledge of Classifying Numbers.
app.classkick.com/#/assignments/AVf0Hk3qS1W0OiXFuSoHNg