Don't Be Irrational

Identifying and Classifying Numbers

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Grade Level	10th – 11th Grade	**Time Frame**	55-70 minutes
Subject	Mathematics	**Duration**	1-2 class period(s)
Course	Intermediate Algebra		

Essential Question

Why and how do we classify numbers?

Summary

This lesson introduces identifying and classifying numbers with an emphasis on the subsets of real numbers. Students will recall proper and improper fractions, repeating and terminating decimals, integers, and counting numbers. Students will learn about the symbols used to represent complex, real, rational, and natural numbers and integers and organize numbers into a graphic organizer.

Snapshot

Engage

Students describe groups of numbers with which they are already familiar.

Explore

Students explore categorizing numbers.

Explain

Students formalize descriptions of types of numbers and place examples in a graphic organizer.

Extend

Students determine which set(s) of numbers each given number belongs.

Evaluate

Students reflect on their learning by using the Muddiest Point strategy.

Attachments

- Classifying Numbers (Key)—Don't Be Irrational.docx
- Classifying Numbers (Key)—Don't Be Irrational.pdf
- Classifying Numbers—Don't Be Irrational - Spanish.docx
- Classifying Numbers—Don't Be Irrational - Spanish.pdf
- Classifying Numbers—Don't Be Irrational.docx
- Classifying Numbers—Don't Be Irrational.pdf
- Describing Numbers—Don't Be Irrational - Spanish.docx
- Describing Numbers—Don't Be Irrational - Spanish.pdf
- Describing Numbers—Don't Be Irrational.docx
- Describing Numbers—Don't Be Irrational.pdf
- Exploring Types of Numbers—Don't Be Irrational - Spanish.docx
- Exploring Types of Numbers—Don't Be Irrational - Spanish.pdf
- Exploring Types of Numbers—Don't Be Irrational.docx
- Exploring Types of Numbers—Don't Be Irrational.pdf
- Lesson Slides—Don't Be Irrational.pptx
- Naming Types of Numbers (Sample Response)—Don't Be Irrational.pdf
- Naming Types of Numbers—Don't Be Irrational - Spanish.pdf
- Naming Types of Numbers—Don't Be Irrational.pdf

Materials

- Lesson Slides (attached)
- Describing Numbers handout (attached; one per group; printed front only)
- Exploring Types of Numbers handout (attached; one per group; printed front only)
- Naming Types of Numbers handout (attached; one per student; printed front only)
- Naming Types of Numbers (Sample Response) document (attached; for teacher use)
- Classifying Numbers handout (attached; one per student; printed front only)
- Classifying Numbers (Key) document (attached; for teacher use)
- Pencils
- Colored pencils (optional)

10 minutes

Engage

Introduce the lesson using the attached **Lesson Slides**. Display **slide 3** to share the lesson's essential question with students. Go to **slide 4** to share the lesson's learning objective. Review each of these with students to the extent you feel necessary.

Let the students know that class is starting with a review challenge. Have students find a partner or assign students partners.

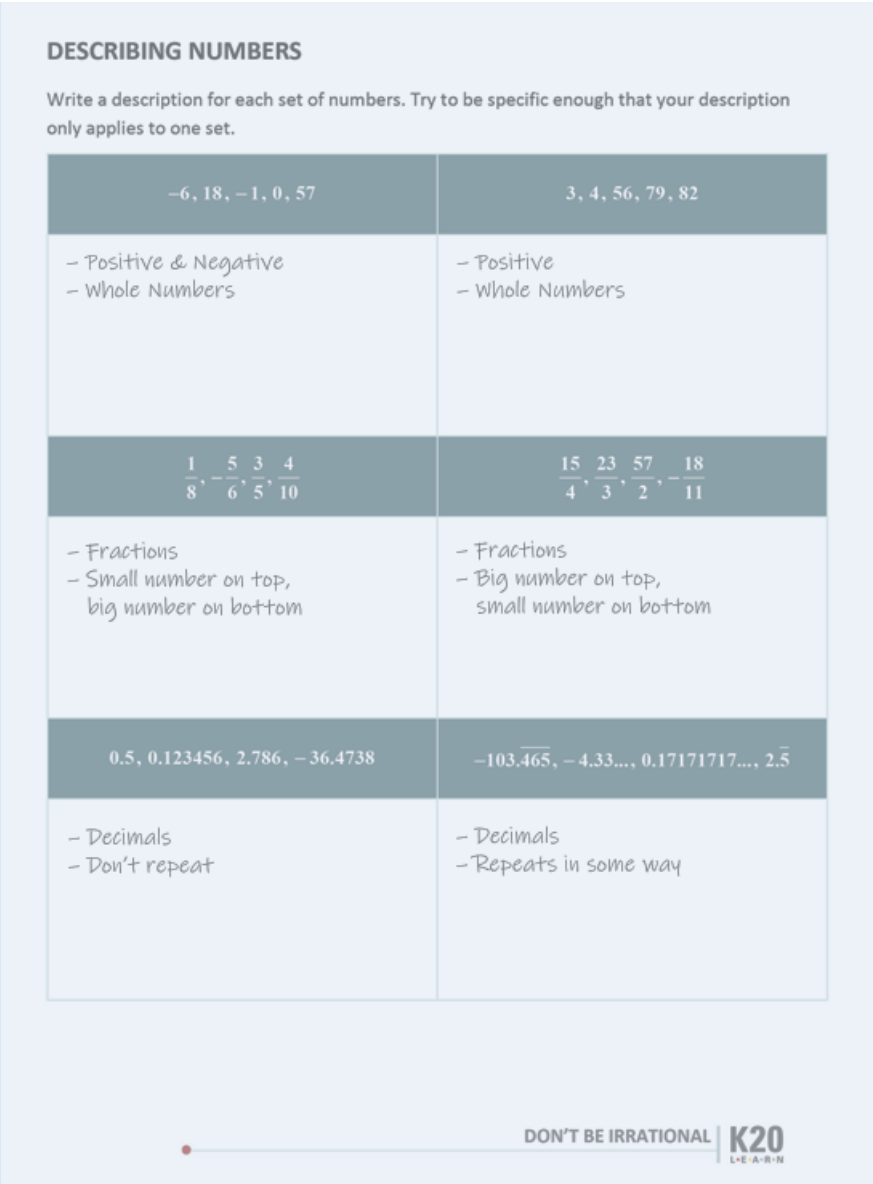
Display **slide 5** and distribute the **Describing Numbers** handout to each group. Direct pairs to write a description for each set of numbers and to be specific enough that their description only applies to that one set of numbers. Give them approximately 5 minutes to complete this task. Encourage students to do their best and to only work with their partner. Explain that this is the time for them to show you what they know.

As pairs work, circulate the room. Use student responses to determine how much time to spend sharing the sample responses on the following slides.

Show **slide 6** and have students compare their description with the description of *integers* on the slide. Remind students that what is on the slide is one of multiple right ways to describe that set of numbers.

Transition through **slides 7–11** and have students compare their descriptions for *counting numbers*, *proper fractions*, *improper fractions*, *terminating decimals*, and *repeating decimals* with what is on the slides.

Sample Student Response



DESCRIBING NUMBERS

Write a description for each set of numbers. Try to be specific enough that your description only applies to one set.

$-6, 18, -1, 0, 57$	$3, 4, 56, 79, 82$
– Positive & Negative – Whole Numbers	– Positive – Whole Numbers
$\frac{1}{8}, -\frac{5}{6}, \frac{3}{5}, \frac{4}{10}$	$\frac{15}{4}, \frac{23}{3}, \frac{57}{2}, -\frac{18}{11}$
– Fractions – Small number on top, big number on bottom	– Fractions – Big number on top, small number on bottom
$0.5, 0.123456, 2.786, -36.4738$	$-103.\overline{465}, -4.33..., 0.17171717..., 2.\overline{5}$
– Decimals – Don't repeat	– Decimals – Repeats in some way

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Here is a student example of describing the sets of numbers. As seen, there are some misconceptions and gaps of knowledge throughout. This is a great chance to see what your students do and do not know before continuing the lesson.

If time allows, ask for volunteers to share what important differences they noticed between what they have written and what is shown on the slides.

- What words did you use that were used on the slides as well?
- Even if the words used are different, did you still describe the set of numbers as precisely as what is shown on the slides?
- Where did you make some mistakes in your descriptions? How could you fix those mistakes without copying the description from the slides?

Sample Student Responses

Some students may point out that zero is specifically listed in the set of integers. Remind students that zero is not positive or negative, which is why it is written separately.

10 minutes

Explore

Display **slide 12** and pass out the attached **Exploring Types of Numbers** handout to each pair. Direct students to try their best to come up with three numbers for each type of number in the graphic organizer on the handout.

After a few minutes, have students share their examples with another pair, creating a small group, using the Inverted Pyramid strategy. Remind students that they will likely not have the same examples, but guide them to discuss why they selected the numbers they selected.

20 minutes

Explain

Teacher's Note: Handout Use

The Exploring Types of Numbers handout (used during the Explore portion) and the Naming Types of Numbers handout (used during the Explain portion) are very similar. They were designed with the purpose of the first one having space for students to try out categorizing numbers and make mistakes without having to erase before using the second handout as a place to record accurate categorization, which may be a transfer of information. The second handout also has the formal notation for the symbols of the different sets of numbers printed at the bottom.

The handouts are much like a brainstorming document and a final product and are recommended to be used in that way. However, to save paper, consider removing the directions from the Exploring Types of Numbers handout and giving additional time during the Explain portion of the lesson for students to write the descriptions for each set of numbers as shown on the Naming Types of Numbers (Sample Response) document.

Display **slide 13** and give each student a copy of the **Naming Types of Numbers** handout. Explain to students the symbols that are used to represent the sets: *complex numbers*, *real numbers*, *rational numbers*, *integers*, and *natural numbers*.

Teacher's Note: Notation

Help students understand that they will often see a bold **R** printed in a book to represent the set of real numbers, but that we write a “double-bar R,” also known as a “double-struck R” or “blackboard bold R,” for real numbers because it is more efficient than trying to write in a way that would make our handwritten letters appear “bold.”

It is less obvious why the letters **Q** and **Z** are used for the *set of rational numbers* and the *set of integers*, respectively. **Q** is used because rational numbers are a ratio or **quotient** of two integers. **Z** is used because it derives from the German word *Zahlen*, which means “number” or “to count.”

Direct students’ attention to the bottom of their handout and introduce the descriptions for the following sets of numbers: *natural numbers*, *whole numbers*, *integers*, *rational numbers*, *irrational numbers*, *real numbers*, *imaginary numbers*, and *complex numbers*.

Teacher's Note: Guiding the Lesson

Emphasize to students that zero is not a natural number and help them see why. Consider explaining to them a little history of the number zero: it did not always exist. The idea of representing nothing with something was a novel idea in early civilizations. Another example to share might be the idea of the natural use of numbers in trade: 3 sheep for 1 oxen, for example. One would not consider trading 0 sheep, because if one had 0 sheep, there would not be a discussion about sheep. In other words, civilizations did not feel a need for zero, so it is not in the set of natural numbers.

At this level, consider explaining to students that an imaginary number is the square root of a negative number and keep it that simple. In an Algebra 2 course students see the formal notation and definition for *i* (square root of negative one). That is also when students learn how to simplify square roots of negative numbers.

The importance here is for students to really understand the differences in the subsets of real numbers: *rational numbers*, *irrational numbers*, *integers*, *whole numbers*, and *natural numbers*.

Now that students have a description for each set of numbers, have students get back into their small groups to compare their Exploring Types of Numbers handout from earlier with these descriptions.

Continuing the Inverted Pyramid strategy, bring the class together for a whole class discussion. Starting with the set of natural numbers and working your way out, ask each group to give one example for each set of numbers. Have the class record these examples on their Naming Types of Numbers handout. Repeat this for the other sets of numbers. Complete the handout as a class by adding at least 3 examples for each set of numbers. Help students better understand the idea of subsets by writing the same number in more than one set. For example, 9 is a natural number and a rational number, so include it in both of those sets. Use the **Naming Types of Numbers (Sample Response)** document as a guide if needed.

Optional Addition

To make the different sets of numbers stand out in the graphic organizer, consider having students color each set of numbers a different color.

Have students add their completed Naming Types of Numbers handout to their math notebooks if that is a classroom norm.

10 minutes

Extend

Display **slide 14** and inform students it is time for them to apply what they have learned. Pass out a copy of the attached **Classifying Numbers** handout to each student.

Challenge students to work independently to determine to which set(s) each number belongs.

Teacher's Note: Guiding the Activity

If students struggle, encourage them to use their Naming Types of Numbers handout as reference. However, consider encouraging them to try it without referencing the graphic organizer, then check their work with their graphic organizer. Remind students that each row likely has more than one x.

5 minutes

Evaluate

Go to **slide 15**. Have students reflect on the lesson and their overall understanding of the content using the Muddiest Point strategy. Have students answer the following questions:

- Crystal Clear: What do you think is the easiest part of classifying numbers?
- Muddiest Point: What do you think is the most confusing part of classifying numbers?

You can collect responses in a variety of ways depending on your class. Sticky notes, pieces of paper, or digital posts are a few examples.

Resources

- K20 Center. (n.d.). Inverted pyramid. Strategies. https://learn.k20center.ou.edu/strategy/173
- K20 Center. (n.d.). Muddiest point. Strategies. https://learn.k20center.ou.edu/strategy/109