GRADE 7 MATH TEACHING GUIDE

Lesson 12: SUBSETS OF REAL NUMBERS

Prerequisite Concepts: whole numbers and operations, set of integers, rational numbers, irrational numbers, sets and set operations, Venn diagrams

Objectives
In this lesson, you are expected to:

1. Describe and illustrate the real number system.
2. Apply various procedures and manipulations on the different subsets of the set of real numbers.
   a. Describe, represent and compare the different subsets of real number.
   b. Find the union, intersection and complement of the set of real numbers and its subsets

NOTE TO THE TEACHER:

Many teachers claim that this lesson is quite simple because we use various kinds of numbers every day. Even the famous theorist of the Pythagorean Theorem, Pythagoras once said that, “All things are number.” Truly, numbers are everywhere! But do we really know our numbers? Sometimes a person exists in our midst but we do not even bother to ask the name or identity of that person. It is the same with numbers. Yes, we are surrounded by these boundless figures but do we bother to know what they really are?

In Activity 1, try to stimulate the students’ interest in the lesson by drawing out their thoughts. The objective of Activities 2 and 3, is for you to ascertain your students’ understanding of the different names of sets of numbers.

Lesson Proper:

A.

1. Activity 1: Try to reflect on these . . .

   It is difficult for us to realize that once upon a time there were no symbols or names for numbers. In the early days, primitive man showed how many animals he owned by placing an equal number of stones in a pile, or sticks in a row. Truly our number system underwent the process of development for hundreds of centuries.
Sharing Ideas! What do you think?

1. In what ways do you think did primitive man need to use numbers?
2. Why do you think he needed names or words to tell “how many”?
3. Was man forced to invent symbols to represent his number ideas?
4. Is necessity the root cause that led man to invent numbers, words and symbols?

**NOTE TO THE TEACHER:**

You need to facilitate the sharing of ideas leading to the discussion of possible answers to the questions. Encourage students to converse, to contribute and to argue if necessary for better interactions.
Activity 2: LOOK AROUND!
Fifteen different words/partitions of numbers are hidden in this puzzle. How many can you find? Look up, down, across, backward, and diagonally. Figures are scattered around will serve as clues to help you locate the mystery words.
Answer the following questions:
1. How many words in the puzzle were familiar to you? Expected Answers: Numbers, Fractions...
2. What word/s have you encountered in your early years? Expected Answer: Numbers...
   Define and give examples. Expected Answer: They are used to count things.
3. What word/s is/are still strange to you? Expected Answer: Irrational, ...

Activity 3: Determine what numbers/set of numbers will represent the following situations:
1. Finding out how many cows there are in a barn Counting Numbers
2. Corresponds to no more apples inside the basket Zero
3. Describing the temperature in the North Pole Negative Number
4. Representing the amount of money each member gets when “P200 prize is divided among 3 members Fraction, Decimal
5. Finding the ratio of the circumference to the diameter of a circle, denoted π (read “pi) Irrational Number

NOTE TO THE TEACHER:
You need to follow up on the preliminary activity. Students will definitely give varied answers. Be prepared and keep an open mind. Consequently, the next activity below is essential. In this phase, the students will be encouraged to use their knowledge of the real number system.

The set of numbers is called the real number system that consists of different partitions/ subsets that can be represented graphically on a number line.

II. Questions to Ponder
Consider the activities done earlier and recall the different terms you encountered including the set of real numbers and together let us determine the various subsets. Let us go back to the first time we encountered the numbers...

Let's talk about the various subsets of real numbers.
Early Years...

1. What subset of real numbers do children learn at an early stage when they were just starting to talk? Give examples.

   Expected Answer: Counting Numbers or Natural Numbers

   -1, 0, 1, -\frac{1}{2}, \frac{4}{3}, 0.25, 0.33..., \pi, e, \sqrt{3}, 10\%, 15\%, 25\%

   One subset is the counting (or natural) numbers. This subset includes all the numbers we use to count starting with "1" and so on. The subset would look like this: \{1, 2, 3, 4, 5...\}

In School at an Early Phase...

2. What do you call the subset of real numbers that includes zero (the number that represents nothing) and is combined with the subset of real numbers learned in the early years? Give examples.

   Expected Answer: Whole Numbers

   Another subset is the whole numbers. This subset is exactly like the subset of counting numbers, with the addition of one extra number. This extra number is "0". The subset would look like this: \{0, 1, 2, 3, 4...\}

In School at Middle Phase...

3. What do you call the subset of real numbers that includes negative numbers (that came from the concept of “opposites” and specifically used in describing debt or below zero temperature) and is united with the whole numbers? Give examples.

   Expected Answer: Integers

   A third subset is the integers. This subset includes all the whole numbers and their “opposites”. The subset would look like this: \{... -4, -3, -2, -1, 0, 1, 2, 3, 4...\}

Still in School at Middle Period...

4. What do you call the subset of real numbers that includes integers and non-integers and are useful in representing concepts like “half a gallon of milk”? Give examples.

   Expected Answer: Rational Numbers
The next subset is the **rational numbers**. This subset includes all numbers that "come to an end" or numbers that repeat and have a pattern. Examples of rational numbers are: 5.34, 0.131313..., \( \frac{6}{7}, \frac{2}{3}, 9 \)

5. What do you call the subset of real numbers that is not a rational number but are physically represented like **"the diagonal of a square"**?

**Expected Answer: Irrational Numbers**

Lastly we have the set of **irrational numbers**. This subset includes numbers that cannot be exactly written as a decimal or fraction. Irrational numbers cannot be expressed as a ratio of two integers. Examples of irrational numbers are:

\[ \sqrt{2}, \sqrt{101}, \pi \]

**NOTE TO THE TEACHER:**

Below are vital terms that must be remembered by students from here on. You, the other hand, must be consistent in the use of these terminologies so as not to puzzle or confuse your students. Give adequate examples and non-examples to further support the learning process of the students. As you discuss these terms, use terms related to sets, such as the union and intersection of sets.

*Important Terms to Remember*

The following are terms that you must remember from this point on.

1. **Natural/Counting Numbers** – are the numbers we use in counting things, that is \( \{1, 2, 3, 4, \ldots \} \). The three dots, called ellipses, indicate that the pattern continues indefinitely.
2. **Whole Numbers** – are numbers consisting of the set of natural or counting numbers and zero.

3. **Integers** – are the result of the union of the set of whole numbers and the negative of counting numbers.

4. **Rational Numbers** – are numbers that can be expressed as a quotient \( \frac{a}{b} \) of two integers. The integer \( a \) is the numerator while the integer \( b \), which cannot be 0 is the denominator. This set includes fractions and some decimal numbers.

5. **Irrational Numbers** – are numbers that cannot be expressed as a quotient \( \frac{a}{b} \) of two integers. Every irrational number may be represented by a decimal that neither repeats nor terminates.

6. **Real Numbers** – are any of the numbers from the preceding subsets. They can be found on the real number line. The union of rational numbers and irrational numbers is the set of real numbers.

7. **Number Line** – a straight line extended on both directions as illustrated by arrowheads and is used to represent the set of real numbers. On the real number line, there is a point for every real number and there is a real number for every point.
III. Exercises

1. Locate the following numbers on the number line by naming the correct point.

-2.66..., $-1 \frac{1}{2}$, -0.25, $\frac{3}{4}$, $\sqrt{2}$, $\sqrt[3]{11}$

Answer:

-2.66 $-1 \frac{1}{2}$ -0.25 $\frac{3}{4}$ $\sqrt{2}$ $\sqrt[3]{11}$

2. Determine the subset of real numbers to which each number belongs. Use a tick mark (√) to answer.
### Answer:

<table>
<thead>
<tr>
<th>Number</th>
<th>Whole Number</th>
<th>Integer</th>
<th>Rational</th>
<th>Irrational</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. -86</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>2. 34.74</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>3. $\frac{3}{7}$</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>4. $\sqrt{64}$</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>5. $\sqrt{11}$</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>6. -0.125</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>7. $-\sqrt{81}$</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>8. $e$</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>9. -45.37</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>10. -1.252525...</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

### B. Points to Contemplate

It is interesting to note that the set of rational numbers and the set of irrational numbers are disjoint sets; that is, their intersection is empty. The union of the set of rational numbers and the set of irrational numbers yields a set of numbers that is called the set of real numbers.

### Exercise:

a. Based on the stated information, show the relationships among **natural or counting numbers**, **whole numbers**, **integers**, **rational numbers**, **irrational numbers** and **real numbers** using the Venn diagram below. Fill each broken line with its corresponding answer.
REAL NUMBERS

RATIONAL

INTEGERS

WHOLE NUMBERS

COUNTING NUMBERS

IRRATIONAL

VENN DIAGRAM
b. Carry out the task being asked by writing your response on the space provided for each number.

1. Are all real numbers rational numbers? Prove your answer.

**Expected Answer:** No, because the set of real numbers is composed of two subsets namely, rational numbers and irrational numbers. Therefore, it is impossible that all real numbers are rational numbers alone.

2. Are all rational numbers whole numbers? Prove your answer.

**Expected Answer:** No, because rational numbers is composed of two subsets namely, Integers where whole numbers are included and non-integers. Therefore, it is impossible that all rational numbers are whole numbers alone.

3. Are $-\frac{1}{4}$ and $-\frac{2}{5}$ negative integers? Prove your answer.

**Expected Answer:** They are negative numbers but not integers. An integer is composed of positive and negative whole numbers and not a signed fraction.

4. How is a rational number different from an irrational number?

**Expected Answer:** Rational Numbers can be expressed as a quotient of two integers with a nonzero denominator while Irrational numbers cannot be written in this form.

5. How do natural numbers differ from whole numbers?

**Expected Answer:** Natural numbers are also known as counting numbers that will always start with 1. Once you include 0 to the set of natural numbers that becomes the set of whole numbers.
c. Complete the details in the Hierarchy Chart of the Set of Real Numbers.
NOTE TO THE TEACHER:
Make sure you summarize this lesson because there are many terms and concepts to remember.

Summary
In this lesson, you learned different subsets of real numbers that enable you to name numbers in different ways. You also learned to determine the hierarchy and relationship of one subset to another that leads to the composition of the real number system using the Venn diagram and hierarchy chart. You also learned that it was because of necessity that led man to invent number, words and symbols.