Grade Level	Content Area	Course Title *(For 9-12 Samples Only)*	Unit Title
Grade 8	**Mathematics**		Rational or Irrational? That is the question.

Length of Unit	Time of Year Taught	Expected Prior Knowledge
1 Week	Late Fall	Students should have prior experience using a Venn diagram as a way to organize information.

Unit Description This unit will cover the meaning of rational and irrational numbers.

Standards: Common Core State Standards for Mathematics	**Domain:** The Number System **Cluster:** Know that there are numbers that are not rational, and approximate them by rational numbers. **Standard**: #1 Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers show that the decimal expansion repeats eventually, and convert a decimal expansion, which repeats eventually into a rational number.
Summative Assessment *In addition to the description, include a copy of the summative assessment in the application package.*	In this assessment of **rational and irrational numbers**, students answer multiple-choice questions about **rational and irrational numbers**. Students complete 10 questions.
Scoring for Summative Assessment *In addition to the description, include a copy of the answer key and scoring rubric (if applicable) for the summative assessment in the application package.*	Mastery is set at 80%. Students must answer 8 questions correctly to reach mastery. (See answer key)
Materials/Resources Needed *Include all items for the entire unit.*	Rational and irrational number cards; overhead projector; Transparencies and markers.

	Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5
Instruction and Timeline Each lesson should last approximately 60 minutes	Pre-Assessment: The goal of this assessment is to determine how much students know about the real number system. • Ask students to write a set of their 10 favorite numbers. • Ask students to provide names (or labels) to represent the type of number for each number listed. Instruct students that they should use as many different names as they can for each number on their list. Circulate the room and look for names such as integers, whole numbers, rational (or fraction), irrational, prime, etc. If students appear to be stuck, provide a hint like, "Does anyone have any whole numbers? Can anyone name other types of numbers?" Do not provide answers. Invite students to share some of the names they used. Facilitate a discussion about the specific number types until most students have some familiarity with the number types you plan to use during the game. Key Vocabulary: Composite numbers Counting numbers Integers Irrational/Rational numbers Natural Numbers Negative/positive numbers Prime numbers Real numbers Whole numbers	Discuss with the students the definition of rational and irrational numbers. Discuss the examples and answer any questions the students might have about rational or irrational numbers. Give yourself and every student a number card. Ask all the students holding "rational numbers" to move to one side of the room, and all the students holding "irrational numbers" to move to the opposite side of the room. Check to be sure all students are on the correct side of the room. Ask all the students holding integers to go to the front of the room and line up in numerical order. Check to make sure the students have completed this step correctly. Now have each of the remaining students one at a time place themselves in their appropriate location on the number line. Discuss with students the number line and point out any mistakes that could easily of been made. For example, graphing the square roots and fractions. Provide problems on the board for students to practice skills covered.	Draw a table on one side of the board. "Somebody give me a fraction. Any fraction." Write the fraction on one side of the table. Then TSW work out the fraction to make it a decimal. Ask one of them to give you their answer and see if everyone else agrees. Once you find the correct decimal write it on the other side of the table. Repeat this process a couple of more times. (15 minutes) Can anyone find any similarities in these decimals? TTW try and get the students to find out that they either repeat or terminate. "Numbers that we can represent as a fraction a/b where a and b are integers, are called rational numbers. They can also be defined as numbers that when represented as decimals either terminate or repeat." (5 minutes) Ask, "If rational numbers are fractions, what else is there?" TTW make sure that the students write the definition in their notes. (5 minutes) Ask "Can anyone give me an example of an irrational number?" TTW write down any ideas that the students might have and explore them. (5 minutes) Ask, "Why can't we represent	Arrange the students in pairs. Give a copy of "Real Numbers" to each pair, and have them cut apart the numbers. Have the students sort the numbers in different unspecified sets. Circulate among the groups and ask them to explain the process they used to sort the numbers. Have a class discussion on the attributes of the sets of numbers. Hand out a copy of "Subsets of the Real Number System" to each group. Have the students cut out the subsets and arrange them in any order. Have the students sort the numbers into the different subsets. Discussion should take place here on numbers that could belong in more than one subset. Have a class discussion on the properties of each subset. Then, have the students sort the numbers as rational or irrational. Have the students arrange the rational numbers into rational numbers, integers, whole numbers, and/or natural numbers. Give a copy of "Venn Diagram of the Real Number System" to each group. Circulate among the students.	Introduction: The activity today is based on the television show Jeopardy. In the television show, individual contestants choose categories and are posed questions in the form of an answer. Here the contestants are an entire class, so they must be divided into teams. Moreover the questions are posed directly, instead of being given as answers. Construction of the Game Board 1. On a transparency, create a 5 × 5 grid with the categories labeled atop each column. 2. Enter the five questions for each category in their respective columns. The questions should be ordered from easiest to hardest, starting at the top row.. 3. Write the dollar values $100, $200, $300, $400, and $500 on 5 Post-its each, and cover the questions on the board. The students should be divided into 3-5 teams, keeping the number of students on each team minimal. The game begins by choosing a team at random to start the game. Then the game play proceeds as follows: • A member of the team chooses a category and dollar amount on the board, and the instructor lifts the Post-it on the square to reveal the question.

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	Direct students to focus on their list of 10 numbers from the pre-assessment activity or they may generate a new list. Decide and instruct accordingly. Instruct the students for playing the Number Game as follows: • Points are earned according to the list of numbers and the scoring criteria. • Questions may be asked at any time during the game. Inform students that unasked questions may result in lost points. • The game will be played more than once. Inform students that the more times they play, the better their scores will get. Create criteria based upon observations of students' understandings from the pre-assessment. For example, if no one labeled numbers as rational, then be sure to award significant points for rational numbers. **Sample criteria** that could be used to play the game based on number types for the first game: • 2 points for each integer in your list. • 2 points if the product of all numbers in your list is negative. • 5 points if the sum of the natural numbers is greater than		these numbers as fractions? Sure they don't terminate or repeat as decimals, but what does that mean?" Go over square roots. Some of these are irrational while others turn out to be integers. Review how to find the area of a square. Give them examples of squares in familiar places. Size of bases: 15 inches by 15 inches. Half a volleyball court: 29'6" x 29'6". Distance b/t bases(softball): 60ft. x 60ft. Ask, "What if we only know the area and we needed to know how long each of the sides are? (5 min.) Ask the students if they had their choice between a TV that was 14" x 14" or one that was 210 inch. squared, which one would they choose. Explore with them their ideas. Write them on the board and let them see if they work out or not. (3 minutes) Tell them what the "radical" is and make sure they can differentiate between that and a division symbol. (1 minute) Write some examples on the board for them to do on their calculators. When they answer, remind them what it is that they	When a group has the diagram completed correctly, have them glue or tape the names and numbers onto the paper. Have the students add one or two numbers in writing to each subset of the real number system on their diagram. *Evaluation/Assessment:* Circulate among students as they are arranging their numbers into the subsets. Assess the completed diagrams for each group. Have the students write a summary of the relationship among the subsets of the real number system.	• Every team works on the question just revealed, and the first team to answer the question correctly (within a reasonable time) receives the dollar amount on the Post-it added to its score. • Each team gets only one chance to answer a question, and if a team answers incorrectly, then the remaining teams can answer. • If no team answers a question correctly, then the team who last chose the question chooses another category and dollar amount, and this process repeats. • Teams are not penalized for incorrect answers, unlike the television game show Categories will include: 1. Fractions to Decimals 2. Square Roots 3. Vocabulary 4. Name That Number 5. Pot Luck *Evaluation/Assessment:* Teacher will observe students answers to Jeopardy Questions

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	500 • 9 points if the smallest whole number is included in your list. • 7 points for each prime number. • 2 point for each rational number. • 1 point for each number represented as a decimal. • 1 point for each number represented as a fraction. • 10 points for each irrational number (or alternately each real number that is not rational). Post-Assessment: Students must create a sample list of numbers that would earn a high score using the criteria and based on the concepts used. For this lesson the sample list would be a set of 10 numbers. Students must be sure to label numbers correctly with all of the number types that apply (e.g., -3 is an integer, rational number and is negative).		are telling you. (3 minutes) Go over "perfect squares." Give them some perfect squares to find on their calculators and write them up on the board. Have them copy these in their notes. These are the numbers that when you take the square root of them, the answer is an integer. It's very important to memorize these, so go over them on your own time as well. (5-10 minutes) Since we know the value of these perfect squares how can we find the square root of other numbers without using our calculators? Listen to their ideas and go over them with them. (3 minutes) Tell them that we can estimate the value of these by seeing which perfect squares that they are between. Draw a number line with only positives on the board. Directly above that, draw a square root number line. Describe what you are doing to the students. Show them how to do one, like 18. Tell the students exactly how you got the answer. Give them a number like 7 or 13 to try. When they come up with the correct answer, let them verify it with their calculators. (10 minutes) Put some harder ones up on the		

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			overhead for them to do individually. Walk around and see if they are having any problems and help them understand. (10 minutes) **Closure**: "Who can tell me what a perfect square is? List some perfect squares for me. Who can tell me what a radical is? Who can tell me what a square root is? When dealing with area, what is a square root used for? "What's the difference between rational and irrational numbers." We will be having a quiz next block so I hope everyone is ready. **Assessment/Evaluation:** Informal: The teacher will check over the students while they do their individual work on finding square roots during class. Formal: The teacher will grade problems out of the book given to students as homework. The grade will be recorded in the grade book.		

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Student Activities and Timeline	Pre-Assessment: Students will write a set of their 10 favorite numbers. Students will provide names (or labels) to represent the type of number for each number listed. Students will play "The Number Game". Students will write ten numbers and score their paper based on the criteria set by class. Students with the most points will win.	Students will recognize/identify types of numbers. Students will order rational/irrational numbers. Extension Activity: Students will discuss with family members important events that occurred before and after they were born. Then record the events on a number line using zero to stand for the year the student was born.	Students will work out fractions to make it a decimal. Students will discuss irrational numbers and their definition. Students will find square roots using a calculator.	Students will sort numbers in different unspecified sets. Students will cut out the subsets and arrange them in any order. Students sort the numbers into the different subsets. Students will sort the numbers as rational or irrational. Students will arrange the rational numbers into rational numbers, integers, whole numbers, and/or natural numbers. Students will place the names of the subsets in the appropriate boxes in the Venn diagram. Then, place the numbers in the appropriate subsets. **Extension** Students will create their own graphic organizer to illustrate the relationships among the subsets of the real number system.	Students will participate in Classroom Jeopardy.

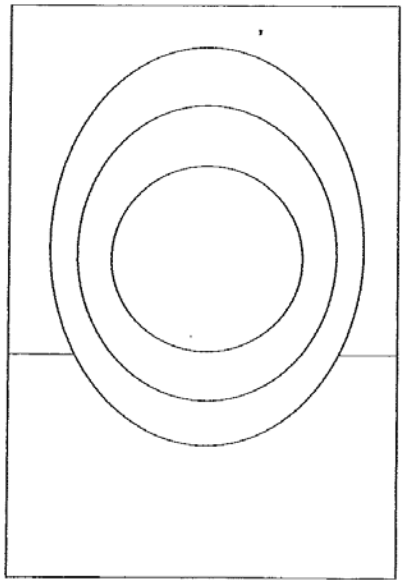
Real Numbers

0	$\frac{1}{2}$	0.7	1
-3	$\sqrt{2}$	-0.9	π
-4.267	$-\frac{5}{17}$	14.8	-8

Subsets of the Real Number System

Rational Numbers	Irrational Numbers
Integers	Whole Numbers
Natural Numbers	

Venn Diagram of the Real Number System



Final Assessment

Name: _____ Grade. Date:

Instructions:
Answer the following questions.

Question 1
An irrational number can not be expressed as a _____.
A. Decimal **B.** √
C. Fraction **D.** Negative number

Question 2
Which of the following numbers is sometimes called Pythagoras's constant?
A. 1 **B.** $\sqrt{3}$
C. $\sqrt{2}$ **D.** 3.14

Question 3
Find the correct statement out of the following options.
A. In decimal form irrational numbers repeats. **B.** In decimal form irrational numbers terminate.
C. In decimal form irrational numbers either repeat or terminate. **D.** In decimal form irrational numbers do not repeat or terminate.

Question 4
Which of the following is not a rational number?
A. -1 **B.** $\sqrt{3}$
C. 0 **D.** 3.6

Question 5
Which of the following is an irrational number?
A. 0.12357... **B.** 3.14
C. -1/9 **D.** -1

Question 6
Which of the following term describes $\sqrt{36}$?
A. Rational number **B.** Irrational number
C. Whole number **D.** Real number

Question 7
Which term describes ¾?
A. A whole number **B.** Prime number
C. Rational number **D.** Irrational number

Question 8
1 can be expressed as a _____.
A. Natural number **B.** Fractional number
C. Irrational number **D.** Composite number

Question 9
Is **3n2/2** a Rational Number?
A. Yes **B.** No
C. Depends on n^2 **D.** Only in positive forms

Question 10
n is actually a non-ending decimal and is _____.
A. An irrational number **B.** A rational number
C. A terminating decimal number **D.** A prime number

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Hide Answers

Question No	Answer
1	C
2	C
3	D
4	B
5	A
6	A
7	C
8	A
9	B
10	A