## Decimals

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## Introduction

According to the Common Core State Standards for Mathematics (NGA Center and CCSSO 2010, p.31), by the end of fourth grade students should "understand notation for fractions, and compare decimal fractions."

It's important that children gain a firm understanding of decimals because they appear all around us on a daily basis. A few of the situations in which we encounter decimals are when we-

- pay for goods;
- fill the car with gas;
- calculate mileage;
- look at batting averages;
- write checks and balance the checkbook;
- read the nutritional or ingredient information on food, toothpaste, medicine, and other products;
- step on a digital scale; and
- take measurements.

Our decimal system gives us the flexibility to write numbers as large or as small as we like. The keystone to the decimal system is the decimal point. Anything on the left of the decimal point represents a whole number, anything on the right of the decimal represents a value less than one (similar to a fraction). Moving from left to right, the value of each place on the right of the decimal point is one-tenth the value of the place immediately on the left.
whole number tenths hundredths thousandths

The following decimal games will help children gain understanding when comparing, adding, and subtracting decimals.

## Who Is Closer to One-Half?

In this game, each ten-frame card represents a tenth decimal value. The goal is to have a decimal value closer to one-half.

Comparing decimals to tenths Variation: Comparing decimals to hundredths

Grade 4: CCSS.4.NF.C. 7
Grade 5

## Two players

## Materials

- ten-frame cards with 0s and 10s removed, or standard deck with 10s and face cards removed
- "Who Is Closer to One-Half?" game board for each player



## How to play

The cards are shuffled and stacked facedown. Each player takes one card from the top of the stack and places it faceup on his game board. The players read their decimals to each other. The player with the decimal closer to one-half wins the round and takes both cards.

## Example

Player 1 turns over an 8 and says, "eight tenths." Player 2 turns over a 4 and says, "four tenths." Four-tenths is closer to one-half, so Player 2 takes both cards.

Be careful to use the correct language when reading decimals out loud. Always say the word "tenths" rather than "zero point"; for instance, "eight tenths" not "zero point eight."

If both players have values equidistant from one-half, a tie is declared.
To break the tie, each player draws a second card and puts it faceup on top of the first card. The player whose tenth value is closer to one-half takes all four cards.

Play continues until all the cards in the facedown stack have been drawn. The winner is the player with more cards.

## Questions

- Convince me that your value is closer to one-half than the other player's.
- How close to one-half are you? How did you figure it out?

Variation: "More 'Who Is Closer to One-Half?'" is played in a similar manner, but each player takes two cards and creates a value of hundredths that is as close to one-half as possible. For example, Player 1 draws a 6 and a 3 . The player can make . 63 or . 36 .
0. $\qquad$
$\qquad$
(tenths) (hundredths)

## Decimal Winner Takes All

The goal of this game is to create the greatest decimal possible.

# Comparing decimals to hundredths <br> Variation: Comparing decimals to thousandths 

Grade 4: CCSS.4.NF.C. 7
Grade 5

## Two players

## Materials

- ten-frame cards with 10 s removed, or standard deck with 10s and face cards removed
- "Decimal Winner Takes All" game board for each player


| 0. |  |  |
| :--- | :--- | :--- |
|  | (tenths) |  |
|  | (hundredths) |  |

## How to play

The cards are shuffled and stacked facedown. Player 1 takes one card. He places it faceup on the tenth or hundredth place as he chooses. It must be in place on the board before Player 2 can take her turn. Once the card is placed in position, it cannot be moved to a different space. Player 2 takes one card and proceeds in the same manner.
Player 1 takes a second card and turns it over, placing it on the empty space. Player 2 does the same. Players read their decimal values to each other.

Example: Player 1's first card is a 6. He places it on the tenths space of his game board. His second card is a 4, and he puts it on the hundredths space of his game board for 0.64. He says, "I have sixty-four hundredths."

Be very careful to model the correct language when reading decimals out loud. Always use the word "hundredths" rather than "zero point"; for instance, "sixty-four hundredths" not "zero point six four."

Players compare their decimals and decide which player has the greater decimal. The player with the greater decimal takes all four cards.
Play continues until all the facedown cards have been drawn. The winner is the player with more cards.

## Questions

- Did you find a strategy to help you make the greatest decimal possible?
- Can you prove to me that $\qquad$ is greater than $\qquad$ ?
- I see you have your tenths line open. What number are you hoping for? What are your chances of getting that number?

Variation: "Thousandths Decimal Winner Takes All" is played in a similar manner, but players each take three cards and create the greatest possible value of thousandths.

$$
0 . \quad \begin{array}{lll}
\hline 0 . & - \\
& \text { (tenths) } & \\
\text { (hundredths) } & \text { (thousandths) }
\end{array}
$$

## Read Me Your Number

The goal of this game is to create the greatest decimal number possible.

## Comparing decimals to hundredths

Grade 4: CCSS.4.NF.C. 7
Grade 5

## Two players

## Materials

- ten-frame cards with 10s removed, or standard deck with 10s and face cards removed
- pencils
- "Read Me Your Number" recording sheet for each player


| Round | 1,000 | 100 | 10 | 1 | 0.1 | 0.01 | Final Number |
| :---: | :--- | :--- | :--- | :--- | :--- | :--- | :--- |
| 1 |  |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |  |
| 5 |  |  |  |  |  |  |  |
| 6 |  |  |  |  |  |  |  |
| 7 |  |  |  |  |  |  |  |
| 8 |  |  |  |  |  |  |  |
| 9 |  |  |  |  |  |  |  |
| 10 |  |  |  |  |  |  |  |

## How to play

The cards are shuffled and stacked facedown. Player 1 draws a card and places it faceup for Player 2 to see. Both players must immediately write this number down on any place value position they choose on the Round 1 line of their game board. Once the number is written down, it cannot be changed to a different place value position.

Player 2 draws a card and places it faceup for Player 1 to see. As before, both players immediately write this number down on their game boards. Players continue to alternate drawing cards until all six place-value positions for round 1 are filled.

Players compare their numbers and read them aloud to each other.

Example
Player 1 has written on his recording sheet-

| Round | 1,000 | 100 | 10 | 1 | 0.1 | 0.01 | Final Number |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | $7(7,000)$ | $8(800)$ | $4(40)$ | 2 | $5(.5)$ | $3(.03)$ | $7,842.53$ |

Player 1 reads his number to the other player saying, "Seven thousand, eight hundred, forty-two, and fifty-three hundredths."
The player with the greater number earns ten points for that round. At the end of ten rounds, the player with more points wins the game.

## Questions

- At the end of round 1 ask, "Is there anything you will do differently in the next round?"
- What strategies have you discovered to be helpful in creating the largest possible number?
- What number are you hoping for? What are the chances that you will draw a $\qquad$ ?


## Decimal Dice

The object of the game is to add decimal numbers in order to have the greatest sum possible after ten turns.

Adding Decimals
Grade 4
Grade 5: CCSS.NBT.B. 7

## Two players

## Materials

- one die
- pencils
- "Decimal Dice" recording sheet for each player

| Turn | Whole number | Tenths value | Total |
| :---: | :--- | :--- | :--- |
| 1 |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |
| 4 |  |  |  |
| 5 |  |  |  |
| 6 |  |  |  |
| 7 |  |  |  |
| 8 |  |  |  |
| 9 |  |  | Sum |
| 10 |  |  |  |
|  |  |  |  |

## How to play

Player 1 rolls the die. The number rolled is the whole number. Player 1 writes the whole number on her recording sheet. She rolls the die a second time, and that number is the tenths value. She writes in the tenths value, and then the total number. She reads it aloud to Player 2.

## Example

Player 1's first roll is a 2; the second is a 6 . She writes 2.6 on her recording sheet and reads the decimal number aloud.

| Turn | Whole number | Tenths value | Total |
| :---: | :---: | :---: | :---: |
| 1 | 2 | .6 | 2.6 |



Player 2 proceeds in the same manner.
Players alternate rolling the dice until each player has had ten turns. Players add their ten total numbers together, exchange papers, and check each other's addition for accuracy. The player with the greater sum wins the game.

## Questions

- Was there any strategy involved in this game?
- Looking back at each turn, what helped you have the greater sum?

Variation: The game is played in the same way, but rather than using a die, numbers are determined using ten-frame cards 1 to 9 . Cards are shuffled and stacked facedown. Players draw two cards, one at a time. The first card is the whole number; the second is the decimal. Used cards are placed in a discard pile. When the facedown stack is depleted, the discard pile is shuffled and stacked, and play continues.

## Decimal Dice 2

The goal of the game is to get as close to 10 as possible in three rounds of play. Players must complete three rounds no matter how close they might be to 10 . This is not an "exact" game, so the sum may be over 10 .

Adding decimals
Grade 4
Grade 5: CCSS.NBT.B. 7

## Two players

## Materials

- two dice
- pencils
- "Decimal Dice 2" recording sheet for each player


| Round 1: | - |
| :--- | :--- |
| Round 2: | - |
| Round 3: | - |
| Sum: | - |

## How to play

Player 1 rolls both dice. She must decide which number will be the whole number and which will be the decimal.

## Example

Player 1 rolls a 2 and a 6. She can make either 2.6 or 6.2.

Player 1 records the number on her recording sheet for round 1 .
Player 2 rolls both dice and proceeds in the same manner.
Players alternate turns until each player has completed three rounds. Players add their numbers, and exchange papers to check each other's addition for accuracy. The player with the sum closest to 10 wins the round and earns one point.

## Example

Player 1's final sum is 9.4. Player 2's final sum is 10.2. Player 2's sum is closest to 10, so Player 2 wins one point.

After ten rounds, the player with the most points wins the game.

## Questions

- What is your strategy for getting as close to 10 as you can?
- How close to 10 are you?
- How did you figure out how close to 10 you are?
- Convince me that you are closer to 10 than the other player.


## Decimal Race to 500

The goal of the game is to be the first player whose sum equals 500 . This is not an "exact" game so the sum may be more than 500 .

## Adding decimals

Grade 4
Grade 5: CCSS.NBT.B. 7

## Two players

## Materials

- ten-frame cards with 10s removed, or standard deck with 10s and face cards removed
- paper
- pencils


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## How to play

Three-digit numbers are made according to the following rules:

- Even numbers are whole numbers.
- Odd numbers are decimals.

The cards are shuffled and stacked facedown. Player 1 draws three cards and arranges them any way he wants, following the odd-even rules. He writes the number at the top of his paper, and verbalizes the number to Player 2.

## Example

Player 1 draws 7, 4, and 9. He can make 4.79 or 4.97 . He chooses 4.97 and writes it at the top of his paper. He says to Player 2, "My number is four and ninety-seven hundredths."

Player 2 draws three cards and proceeds in the same manner.
Player 1 takes his second turn and proceeds in the same manner, but he adds the second number to his first number.

## Example

Continuing the above example, Player 1 draws 6, 2, and 5 . He can make 62.5 or 26.5. He writes 62.5 on his paper and adds it to his first number. He says to Player 2, "My number is sixty-two and five tenths. The sum of all my numbers is sixty-seven and forty-seven hundredths."

$$
4.97
$$

$+62.5$
67.47

Players continue to alternate turns until one player has a winning sum equaling 500 or more.

## Questions

- What numbers are you hoping to draw? Why?
- How close to 500 are you? How did you figure it out?
- What was easy about this game? Difficult?
- Can you think of a way to change this game so it is easier or more challenging?

Variation: "Decimal Race to 1,000 " is played exactly the same way, but the goal is to be the first player whose sum equals 1,000 . This game might be played over several days.

## Close to 0

The goal of this game is to be the player with a difference closer to 0 after ten turns.

## Subtracting decimals

Grade 4
Grade 5: CCSS.NBT.B. 7

## Two players

## Materials

- ten-frame cards with 10 s removed, or a standard deck with 10s and face cards removed
- paper
- pencils


## How to play

The cards are shuffled and stacked facedown. Both players write 100 at the top of their papers. Player 1 draws one card; this card is the whole number. She takes a second card; this is the tenth-place decimal.

## Example

Player 1 draws a 7 and a 4. She writes 7.4 under 100 on her paper, and subtracts it from 100.

Player 2 checks Player 1's subtraction for accuracy, and Player 1 puts her cards in a discard pile.
Player 2 draws two cards and play proceeds in the same manner. (When the cards in the facedown stack have all been used, the discard pile is shuffled, stacked, and play continues.)

Players alternate turns until each player has had ten turns. The player whose final difference is the lesser (closer to zero) wins the game.

## Questions

- How far from zero is your number? How did you figure it out?
- What was the most difficult part of playing this game?
- What numbers were you hoping to draw for the whole number? Why?
- Did it matter what number you drew for the decimal? Why?

Variation: "Three-Card Close to Zero" is played in a similar manner with players drawing three value; and the third card is the hundredths value. The number is subtracted from 100.


#### Abstract

cards at each turn. The first card is the whole number; the second card is the tenths


## Decimal Riddles

Players try to correctly answer as many riddles as possible.

## Comparing, adding, and subtracting decimals

Grade 4: CCSS.4.NF.C. 7
Grade 5: CCSS.NBT.B. 7

## Two or more players

## Materials

- paper
- pencils
- "Decimal Riddles" worksheet for each player more4


The riddles are provided as an introduction to the game. As children become familiar with the game and more adept at operations with decimal numbers, create new riddles, or let teams invent their own with which to challenge each other or the entire class.

## How to play

When introducing this game to students, it might be helpful to play it with the whole class or group. Students are paired into teams. The first riddle is posed, and the children talk and work together in their team to solve it. The teacher decides how much time to allot for solving this first riddle. (As the riddles get more complex, more time may be needed.)
When time is up, the teacher asks for a team volunteer to explain and defend their answer to the riddle. A whole-class discussion should ensue. The teacher might ask a second team with a different answer to explain and defend why they think their answer is correct. When the correct answer is proved, teams with that answer get one point.

Try to stay out of the conversation as much as possible. Guide it by asking questions, and only confirm the right answer at the very end of the discussion.

The game proceeds to the second riddle using the same process. When all the riddles have been answered, the team(s) with the most points is the winner.

At some point, to keep things interesting, have the children play the game against each other or in team against team. Another possibility is to hand out the complete worksheet of riddles, and let the children work on it for a predetermined amount of time. When time is up, players or teams compare and defend answers. They get one point for every correct answer. The player or team with the most points wins the game.

The game is easily adaptable for home play. Decide whether to pose the riddles one at a time or all at once. When the riddle has been figured out, ask your child to explain and defend his or her reasoning. Let your child do the talking. Ask questions, but don't confirm the right answer until the very end of the discussion.

## Questions

- What did you do to help yourself while working on these riddles?
- What was easy? What was more difficult? What do you need to practice?


## Target-3

The goal of this game is to be the closest to 3 after six rounds. Players must play six rounds no matter how close they might be to 3 . This is not an "exact" game, so sums may be more than 3.

## Multiplying decimals Adding decimals

Grade 4
Grade 5: CCSS.NBT.B. 7

## Two players

## Materials

- die
- paper
- pencils
- "Target-3" recording sheet for each player


| Round | Number Rolled $x .1, .2, .3, .4$, or .5 | Product |  |
| :---: | :---: | ---: | ---: |
| 1 | $x$ |  |  |
| 2 | $x$ | Sum |  |
|  | $x$ | Sum |  |
| 3 | $x$ |  |  |
| 4 | $x$ | Sum |  |
|  |  |  |  |
| 5 | $x$ | Sum |  |
| 6 |  |  |  |
|  |  | Total Sum |  |

## How to play

Player 1 rolls the die and then must decide by which decimal value-.1, .2, .3, .4, or .5-to multiply the number rolled so that he can be closer to 3 after playing six rounds. He writes the multiplication equation on his recording sheet.

## Example

Player 1 rolls a 2, and decides to multiply that by .3. He records it as-

| Round | Number Rolled $\times .1, .2, .3, .4$, or .5 | Product |
| :---: | :---: | :---: |
| 1 | $2 \times .3$ | .6 |

Player 2 checks Player 1's multiplication for accuracy. She then rolls the die and play proceeds in the same manner.
At the end of round 2, players add their products from rounds 1 and 2 to keep a running total of their sums.
After six rounds, the player whose sum is closer to 3 is the winner.

## Example

At the end of six rounds, Player 1's total is 3.6; Player 2's total is 2.1. Player 1's sum is closer to 3 than player 2's, so Player 1 is the winner.

## Questions

- After playing this game several times, have you developed any strategies that help you get as close to 3 as possible?
- How did you know you were the winner of the game?
- Who won? Player 1 who scored 3.1 or Player 2 who scored 2.9? Why?
- After five rounds your sum is 2.3 and you roll a 6 . What should you multiply the 6 by to be close to 3 ? How do you know?
- If your running total after five rounds is 1.8 and you roll a 6 , what should you multiply the 6 by to be close to 3? How do you know?

Variation: "Target-1" is played in a similar manner, but students multiply the number on the die by $.01, .02, .03, .04$, or .05 . The player who is closer to 1 after six rounds wins.
|

