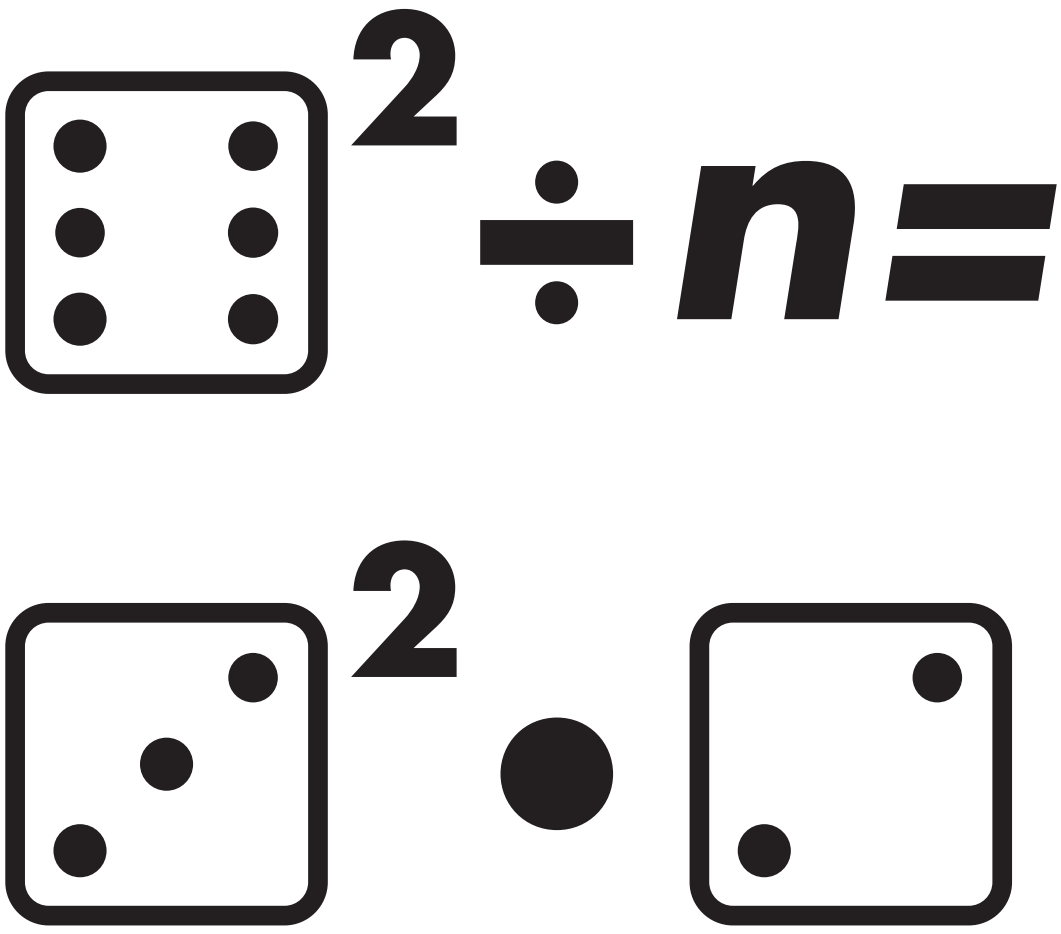
Dice Activities for Algebraic Thinking

Patterns • Relationships • Functions



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Directions for Hundred Chart and Operations Toss Activities

Objectives

- Recognize multiples, square numbers, and prime numbers.
- Apply the order of operations in creating equations.
- Generate equations using a random set of numbers.
- Employ mathematical reasoning.
- Identify the role of luck versus that of skill in an activity using dice.
- Develop communication and cooperation skills by working in teams of two students.

Introduce the ***Hundred Chart Activities*** by demonstrating on a smart board or overhead and playing against the class. Two teams with two students on a team are suggested. Teams give students an opportunity to discuss moves and strategies and provide a check on correct computation.

Materials

- One chart per team
- Recording chart (page 6) for equations
- Dice
- Colored tokens

Multiple Hundred Chart

How to Play

- The teams begin by listing square numbers, cube numbers, summations, and factorials for the numbers given in the top portion of their recording charts.
- The teams each toss a die. The team with the higher number goes first. Each team chooses a color token.
- The teams agree on a number (2, 3, 4, 5, 6, 7, 8, 9, or 10) as the focus for the activity and circle that number at the top of the chart.
- The team whose turn it is tosses 4 dice and **uses all 4 numbers** to create an equation that **equals a multiple of the circled number.** Example 1: The circled number is 6 and the team has tossed 5, 4, 2, 2. Using all 4 numbers, the team creates the equation $54 \bullet (2 \div 2) = 54$ and places a token on 54. Example 2: Using the same numbers (5, 4, 2, 2), the team creates the equation $5! - [4! + (\Sigma 2 \bullet 2)] = 90$ and places a token on 90. Or: $(5^2 - 4) \bullet 2 = 42$.
- Before a team places a colored token on the multiple, the opposing team must agree to the solution.
- Teams keep a record of the equations they have generated on their recording charts.
- After 10 tosses, the teams tally the numbers under their tokens. The team with the higher score wins.

Variations

- The teams choose more than one number from which to create multiples (for example, play includes all multiples of 3 and 5).
- Each team has a chart. The first team to cover all multiples of the circled number wins.
- Each team has a chart. Taking turns, the teams toss 6 dice and cover as many multiples as possible using all 6 dice. (Each die may be only used once in a turn.)

Not-a-Multiple Hundred Chart

This version is played in the same way as the ***Multiple Hundred Chart*** activity, except that the goal is to write equations that **do not** equal a multiple of the circled number or numbers. (For example, if the number circled is 2, the goal of play is to write equations that equal odd numbers—i.e., not multiples of 2.)

Square Number and Prime Number Hundred Charts

How to Play

- Teams share a chart.
- Taking turns, the teams each toss 4 dice. Using all 4 numbers, the team creates an equation that equals a square or prime number and places a token on that number.
- Before a team places a colored token on the number, the opposing team must agree to the solution.
- The teams keep a record on their recording charts of the equations they have generated.
- After all 10 square numbers or 25 prime numbers have been covered, the teams tally the numbers under their tokens. The team with the higher score wins.

Variations

- Each team has a chart. The first team to cover all 10 square numbers or all 25 prime numbers wins.
- Each team has a chart. Tossing 6 dice, each team covers as many square or prime numbers as possible using the 6 dice. (Each die may be only used once in a turn.)

Operations Toss Chart

Working from left to right in an equation, the order of operations is: parentheses, exponents, multiplication, division, addition, subtraction.

How to Play

- Teams share a chart.
- Each team tosses a die. The team with the higher number goes first. Each team chooses a color token.
- The teams think about the order of operations (parentheses, exponents, multiplication, division, addition, subtraction) as they do the activity.

$(2n)^2 + y$ or $2n^2 + y$

Red die = n Green die = y

- Taking turns, the teams toss a red die and a green die and place the number on the red die as n and the one on the green die as y in either of the following expressions:

$$(2n)^2 + y \quad \text{or} \quad 2n^2 + y$$

- The solution must be on the chart.
- The team places a token on the solution.
- The opposing team must agree to the solution. The teams keep a record on their recording charts of the equations they have generated.
- After 10 tosses, the teams tally the numbers under their tokens. The team with the highest score wins.

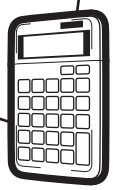
Variations

- The team with the most numbers covered after 10 tosses wins.
- The teams create their own order of operations equations for a Hundred Chart activity.

Prime Number Hundred Chart

How to Play

- *Each team tosses a die. Higher number goes first.*
- *Each team chooses a color token.*



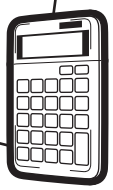
- Toss 4 dice. Using all 4 numbers, create an equation that equals a **prime number.** (Example: Toss 5, 4, 2, 2. Write the equation $5^2 - (4 \cdot 2) = 17$ and place a token on 17.)
- Before you place a colored token on the number, the opposing team must agree to your solution. Keep a record of your equations on your team's recording chart.
- After 10 tosses, each team tallies the numbers under their tokens. The team with the higher score wins.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Square Number Hundred Chart Activity

How to Play

- *Each team tosses a die. Higher number goes first.*
- *Each team chooses a color token.*

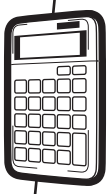


- Circle a number for this activity: 2, 3, 4, 5, 6, 7, 8, 9, or 10.
- Toss 4 dice. Using all 4 numbers tossed, write an equation that equals a **square number.** (Example: Toss 5, 4, 2, 2. Write the equation (2 ÷ 2) • 5 + 4 = 9 and place a token on 9.)
- Before you place a colored token on the number, the opposing team must agree to your solution. Keep a record of your equations on your team's recording chart.
- After 10 tosses, each team tallies the numbers under their tokens. The team with the higher score wins.

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

Operations Toss – $(2n)^2 + y$ or $2n^2 + y$

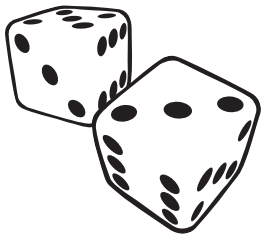
- *Each team tosses a die. Higher number goes first.*
- *Each team chooses a color token.*
- *Think about the order of operations!*



How to Play

- Toss a red die and a green die. Red die = n; green die = y.
- On the Operations Toss recording chart, compute $(2n)^2 + y$ or $2n^2 + y$. Chose either solution, and place a token on the solution on the chart below.
- The opposing team must agree to your solution.
- After 10 tosses, each team tallies the numbers under their tokens. The team with the higher score wins.

6	52	10	65	41	106	11	5	33	37
36	12	76	11	146	51	105	66	5	69
7	42	145	22	3	69	103	77	149	38
10	78	35	150	105	73	67	39	70	19
53	67	3	40	7	147	21	50	14	145
8	36	23	55	68	24	40	17	101	37
147	41	77	18	102	4	34	75	10	56
101	38	73	54	148	78	22	52	66	10
102	10	13	74	24	38	104	9	146	4
37	68	20	65	56	103	104	148	34	150



Operations Toss Recording Chart

Red die = n; Green die = y

$(2n)^2 + y =$	$2n^2 + y =$

Directions for Integer Activities

Objectives

- Develop a working knowledge of the mathematical concepts of adding, subtracting, and multiplying positive and negative integers.
- Practice computing the sums of positive and negative integers 1 through 6 with the goal of developing fluency and skill in applying to larger numbers.
- Identify the role of luck versus that of skill in an activity using dice.
- Develop communication and cooperation skills by working in collaborative teams of two students.

Introduce ***Three-Toss Elimination, Integer Dice Line,*** and ***Arranging Integers*** by demonstrating each activity on an interactive whiteboard or overhead and playing against the class. Two teams with two students on a team are suggested. Teams give students an opportunity to discuss moves and strategies and provide a check on correct computation.

Three-Toss Elimination

Materials

- 6 red dice and 6 green dice
- Chart for each team

How to Play

- Green dice = positive numbers
- Red dice = negative numbers
- Each team tosses a die. The team with the higher number goes first.
- Toss 1: Taking turns, the teams toss 6 red and 6 green dice in the playing area. The teams then remove from their playing area combinations of red and green dice that equal 0—for example, a red 3 and a green 3, or a red 1, a red 2, and a green 3.
- Toss 2: Each team tosses just the dice remaining on their charts. Again, the teams remove combinations of dice that equal 0.
- Toss 3: If either or both teams have dice remaining, they toss the dice and again remove combinations of dice that equal 0.
- The teams record their score for Round 1 on their charts.
- The team with the score **closest to 0** after three rounds wins.

Integer Dice Line

Materials

- 10 red dice and 10 green dice
- Score sheet

How to Play

- Green dice = positive numbers
- Red dice = negative numbers
- Each team tosses a die. The team with the higher number goes first.
- Team 1 tosses 10 red and 10 green dice and randomly places the tossed dice in a line.
- Team 2 takes a die from either end of the line of dice.
- The two teams take turns removing a die from either end of the line of dice until no dice remain.
- The teams tally the dots on their dice. (The green dice represent positive integers and the red dice represent negative integers.)
- The team with the score **closest to 0** wins that round.
- The teams play three rounds. The team with the score **closest to 0** after three rounds wins.

Integer Dice Line (cont.)

Variations

After three rounds:

- The team with the score **closest to +1** wins the game.
- The team with the score **closest to –1** wins the game.
- The team with the score **closest to +5** wins the game.
- The team with the score **closest to –5** wins the game.

Arranging Integers – Adding, Subtracting, Multiplying

Prerequisite

Students are familiar with the algorithms of adding, subtracting, and multiplying positive and negative integers.

Materials

- 4 red dice and 4 green dice
- Chart for each team

How to Play

- Each team tosses a die. The team with the higher number goes first.
- Taking turns, the teams toss 4 red dice and 4 green dice. In the column for Round 1, the team whose turn it is arranges the red dice in the boxes marked "R" and the green dice in boxes marked "G," so that the total for the four dice pairs is as close to 0 as possible.
- The team computes its score for that round.
- After 3 rounds, each team totals their scores for the three rounds. The team with the score **closest to 0** wins.

Variations

- The team winning two out of three rounds wins.
- The score **closest to +1** wins the game.
- The score **closest to –1** wins the game.
- The score **closest to +5** wins the game.
- The score **closest to –5** wins the game.

Discussion

- Which combinations tossed made for easy computation?
- What connections did you make that allowed you to make generalizations and increase your computation speed?

Three-Toss Elimination

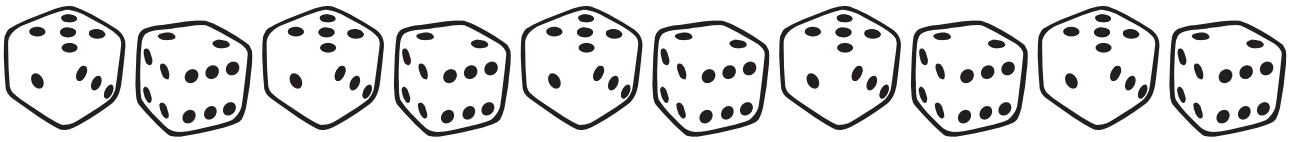
How to Play

- Green dice = positive integers, red dice = negative integers
- **Toss 1:** Toss 6 red dice and 6 green dice on your playing area. Remove combinations of red and green dice that equal 0—as many as you can (for example, a red 3 and a green 3, or a red 1, a red 2, and a green 3).
- **Toss 2:** Toss the dice remaining in your playing area. Again, remove as many combinations of red and green dice that equal 0 as you can.
- **Toss 3:** Toss the dice remaining in your playing area, if any, and again remove as many combinations of red and green dice as possible that equal 0.
- After 3 tosses, record the value of the dice remaining in your playing area. This is your score. The team with the score closest to 0 wins the round.
- Play 3 rounds. The team with the score closest to 0 after three rounds wins the game.

Team: _____

Round	Score
1	
2	
3	
Totals	

Integer Dice Line



Object of the Game

- *To be the team with the score **closest to 0** when each green die = a positive integer and each red die = a negative integer.*

How to Play

- Each team tosses a die. Higher number is Team 1.
- Team 1 tosses 10 red and 10 green dice and randomly places the tossed dice in a line.
- Team 2 takes a die from either end of the line of dice.
- Team 1 takes a die from either end of the line of dice.
- Teams alternate removing a die from either end of the line of dice until no dice remain.
- Teams tally the dots on their dice. The green dice = positive integers and the red dice = negative integers.
- The team with the score closest to 0 wins that round.
- Play three games and total the scores. The team with the score closest to 0 wins.

Round	Team 1 Score	Team 2 Score
1		
2		
3		
Totals		

Variations

- The team winning two out of three rounds wins.
- The score closest to +1 wins the game.
- The score closest to –1 wins the game.
- The score closest to +5 wins the game.
- The score closest to –5 wins the game.

Directions for Solving for *n* – Tic-Tac-Toe

Objectives

- Develop a working knowledge of the mathematical concepts of exponents, square roots, factorials, summations, negative numbers, and fractions.
- Identify the role of luck versus that of skill in an activity using dice.
- Develop communication and cooperation skills by working in teams of two students.

Tic-Tac-Toe is a familiar game form. These ***Tic-Tac-Toe*** activities provide a challenging and playful variation to use in solving for n.

Introduce the ***Tic-Tac-Toe*** activities by demonstrating on an interactive whiteboard or overhead and playing against the class. Teams with two students on a team are suggested. Teams give students an opportunity to discuss moves and strategies and provide a check on correct computation.

Materials

- Chart
- Dice
- Tokens

How to Play

- Each team chooses a token and tosses a die. The team with the higher number goes first.
- Taking turns, the teams each toss a die and find an equation on the chart for which the tossed number is the solution for n. The team places a token on the equation. If the number is not available, the team loses a turn.
- The teams attempt to place their tokens in continuous alignment vertically, horizontally, or diagonally to win the game. The first team to form a Tic-Tac-Toe wins.
- The team winning two out of three games is the winner.

Suggestion

- With more difficult levels of play, or if students are struggling, suggest the use of a calculator.

Variations

- The team whose turn it is places a token on every box in which the solution appears.
- The team whose turn it is replaces the opposing team's token with its own token if the die toss matches the solution.

Discussion

- Does the team or individual who goes first have an advantage?
- Is this a game of luck or skill?
- Is there a fair chance of each solution being tossed?
- What strategies do you use in solving for n?
- Does listening to other students' strategies help or hinder your way of thinking?

Solve for *n* – Tic-Tac-Toe 1

How to Play

- *Each team chooses a colored token.*
- *Toss a die. Higher number goes first.*

- Toss a die. Find an equation on the grid for which the tossed number is the solution for n. Place a token on it.
- If the solution is not available, lose a turn.
- First team to get three in a row wins that game.
- Play 3 games. Team winning 2 out of 3 games wins.

$5 - n = 0.5 \cdot 8$ $n =$	$6 + n = 8 - n$ $n =$	$\frac{1}{9} \cdot 54 = n$ $n =$
$-3 + 7 = n$ $n =$	$n \cdot n = 9$ $n =$	$-6 + n = -1$ $n =$
$\frac{1}{2}n = 9 \div 3$ $n =$	$42 + n = 44$ $n =$	$100 \div n = 25$ $n =$

Solve for *n* – Tic-Tac-Toe 2

How to Play

- *Each team chooses a colored token.*
- *Toss a die. Higher number goes first.*

- Toss a die. Find an equation on the grid for which the tossed number is the solution for n. Place a token on it.
- If the solution is not available, lose a turn.
- First team to get three in a row wins that game.
- Play 3 games. Team winning 2 out of 3 games wins.

$1^6 = n$ $n =$	$5^2 - n^2 = 3^2$ $n =$	$51 - n = 7^2$ $n =$
$31 - n^2 = 22$ $n =$	$n^2 \cdot 2^2 = 6^2$ $n =$	$10^2 \div n^1 = 20$ $n =$
$10^2 - n^2 = 8^2$ $n =$	$9^2 - n = 76$ $n =$	$6^2 \div n = 3^2 \cdot 2$ $n =$