Activities for the Middle School Math Classroom: Card Games

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Like dice games, card games are typically learned early in life. Because these games are learned so early and are so commonly played, they present an opportunity to build on prior knowledge in the math classroom. Unlike many manipulative-based games, card games are highly familiar to students and, thus, easy to introduce and implement. Further, the general availability of cards makes possible at-home practice activities with parents and siblings, thus building the home–school connection.

Card games (even those favoured by very young children) typically have several mathematical applications. Many childhood card games, such as Go Fish! and Rummy, have at their core early mathematical concepts such as sorting and sequencing. Topics in probability also often surface because card games usually revolve around trying to collect certain combinations from randomly arranged decks. It is easy to see how card games could lead to discussions containing words such as *likely, unlikely* and *impossible*. When I was playing Go Fish! with one of my own children, he announced that he knew what the last card in the pile had to be and that he knew what cards I held in my hand because those were the only cards left in the game. I lost.

Card games can often be easily adapted to higher grade levels. Cards are particularly well suited (no pun intended) to games involving integers. We need only define black cards as positive values and red cards as negative values to create an effective model for integer expressions. For example, here are collections of cards each with a value of −3:

Simple card arrangements can be used to show algebraic expressions and equations. For example, here is a model of the expression $2x - 4$:
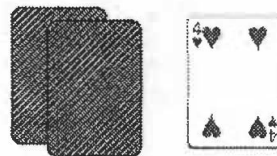
In this example, two cards with the same value and colour are placed facedown beside a red 4. If these cards together have a value of 8, what is the value on the facedown cards? With the added information, the cards represent the equation $2x - 4 = 8$.

The drawback of using a typical card deck is that it contains aces and face cards. If these cards are included, they are usually assigned number values (that is, ace = 1, jack = 11, queen = 12 and king = 13), but these values can be difficult for students to remember. It may be easier to remove these cards from the deck or to use a special deck that includes the values 1–13 (with no aces or face cards).

In general, the simplicity, familiarity and flexibility of card games make them an excellent tool for instruction and reinforcement in the mathematics classroom.

Suggestions and considerations for integrating games in the math classroom include the following:

- Use a game at the end of a unit for review or at the beginning of a lesson to motivate students and help them recall prior knowledge.
- Be prepared for a more active and noisier classroom environment. Motivating activities (and games are highly motivating!) are often noisier than more traditional activities.
- Try to collect games that can be easily adapted to various levels. Highly flexible games also let you apply a familiar game structure to various math concepts. Using flexible games reduces the amount of time necessary for developing and introducing games.

Fraction Switch

Objective: Compare and/or order proper fractions and decimals to hundredths (Alberta mathematics program of studies, Number [Number Concepts], Grade 5, Outcome 9)
Materials: Deck of cards (no jack, queen or king; ace = 1)
**Players:** Two

Rules

1. Shuffle the cards well and deal six cards facedown to each player. Place the remaining cards facedown to form a draw pile.
2. Without looking at the cards, each player arranges his or her six cards in a pattern as shown below:
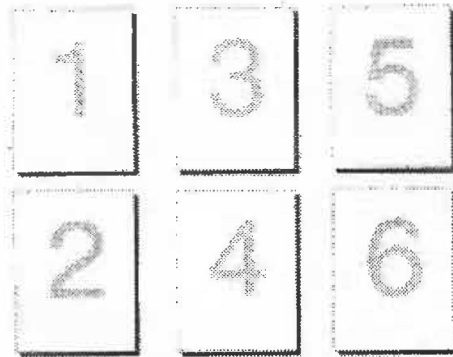
Cards 1 and 2 form a fraction with 1 in the numerator and 2 in the denominator; likewise, cards 3 and 4 form a fraction, and cards 5 and 6 form a fraction. The player then turns the cards over.
3. On a turn, a player draws the top card from the draw pile and, if so desired, replaces one of his or her six cards with it. The player then puts the replaced card (or the drawn card if it is not wanted) in a discard pile.
4. The first player to build three proper fractions (that is, fractions in which the numerator is less than the denominator), ordered from least to greatest, wins. Below is an example of a winning hand:
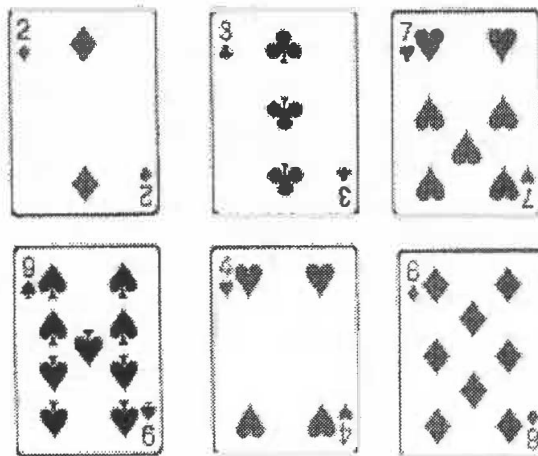
5. If the draw pile is depleted before any player has finished building the three fractions, shuffle the discard pile, place it facedown to form a new draw pile and continue play.

Adaptations

- For a more significant challenge, play the game with all the cards facedown. A player may not turn the cards over until he or she believes that they are correctly sequenced.
- Allow improper fractions (that is, fractions in which the numerator is greater than the denominator).
- Have each player build three equivalent fractions rather than sequenced fractions.

Construction

Objective: Generate and extend number patterns from a problem-solving context (Alberta mathematics program of studies, Patterns and Relations [Patterns], Grade 5, Outcome 4)
**Materials:** Deck of cards (ace = 1), four-sided die
**Players:** Two

Rules

1. Shuffle the cards well and deal three cards to each player. Place the remaining cards facedown to form a draw pile.
2. Turn over the top card of the draw pile. This is the value at which the pattern must start. If the top card is a face card, move it to the bottom of the deck and turn over the next card. Roll the four-sided die. This is the increment between elements in the pattern. For example, if the top card is a 3 and the die shows 2, the pattern will be 3, 5, 7, 9, 11, 13, ...
3. On a turn, a player plays as many cards as he or she can, as long as the cards follow the pattern. If a player cannot play a card, he or she draws a card from the draw pile but cannot play the card on that turn.
4. A face card has a value of 10 when placed with another card. For example, a jack with a 4 (place the 4 on top with the jack showing underneath) represents 14. Examples are shown below.

    These cards show the pattern 7, 10, 13, 16, . . .:
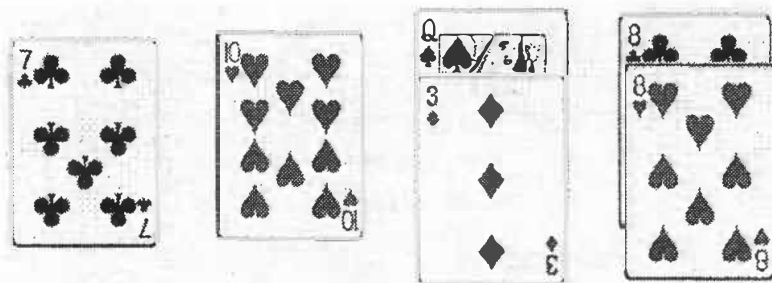
    These cards show the pattern 9, 13, 17, 21, . . .:
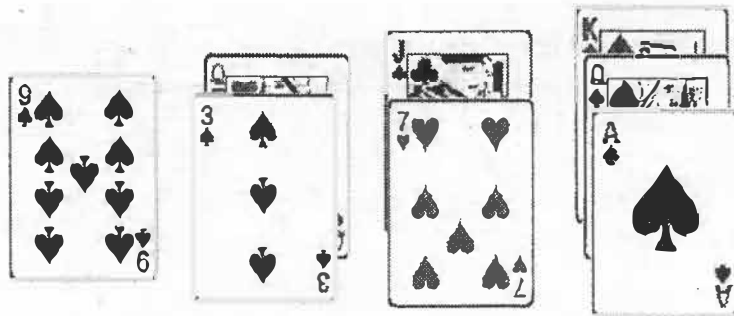
5. The first player to get rid of all his or her cards wins. If the draw pile is depleted before any player has won, all players count the number of cards in their hands. The player with the fewest cards wins. Note: It is very difficult to get rid of all the cards, and in some patterns it may be impossible!

Adaptations

- Have more than one pattern on the go. A player who draws a king may start a new pattern.
- For a simpler game, play such that the cards must be lined up in suits (that is, a row of ♠, ♣, ♥ and ♦ laid in ascending order starting with the ace).
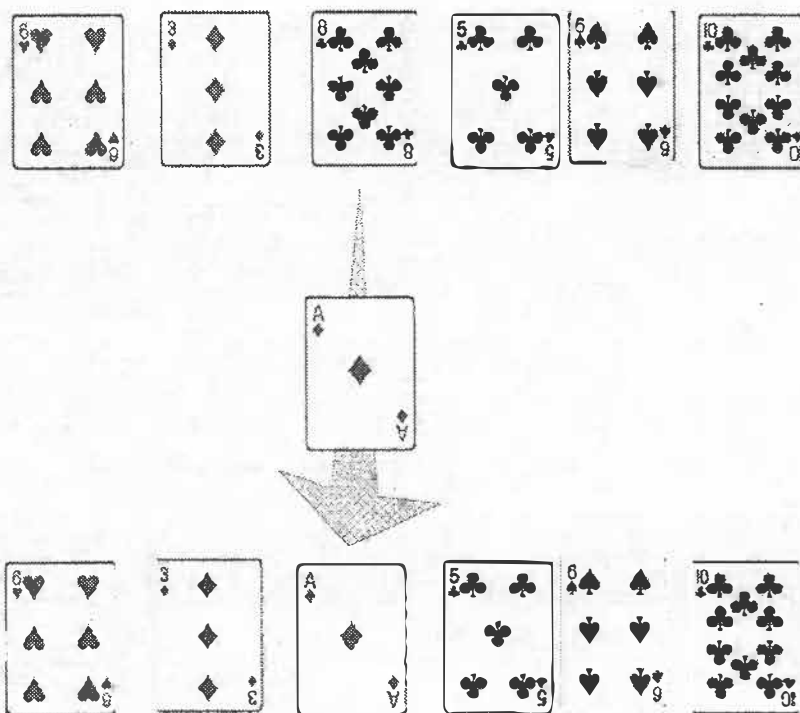
Switch

Objective: Compare and order integers (Alberta mathematics program of studies, Number [Number Concepts], Grade 7, Outcome 12)
Materials: Deck of cards (jack, queen and king removed; ace = 1)
Players: Two to four

Rules

1. Shuffle the cards and deal six cards faceup to each player. The cards must form a row and be placed from left to right in the order dealt. Place the remaining cards facedown to form a draw pile.
2. The first player draws the top card from the draw pile and, if so desired, replaces any one of his or her six cards with it. If the player does not want the card, he or she places it in a discard pile. Subsequently, players may draw from either the draw pile or the discard pile. Play passes to the left.
3. In this game, red cards have a negative value and black cards have a positive value. The first player to correctly order (from left to right) six cards from least to greatest wins. Below is an example of a winning sequence:

4. If the draw pile is depleted before anyone has won, shuffle the discard pile and place it facedown to form a new draw pile. Play continues as before.

Adaptations

- Specify that, in the sequence, three cards must be red and three must be black.
- Allow players to draw only from the draw pile.

Square Deal

Objective: Distinguish between a square root and its decimal approximation as it appears on a calculator (Alberta mathematics program of studies, Number [Number Concepts], Grade 8, Outcome 8)

Materials: Deck of cards (jack, queen and king removed; ace = 1; one joker included), calculator, Square Deal game board

Players: Two or more

Rules

1. Shuffle the cards and place them facedown to form a draw pile. Turn over the top card in the pile, show it to all players and set it aside as the target value.

2. On a turn, a player takes a card from the top of the pile and either keeps it (adding the value to or subtracting the value from the value the player has accumulated thus far) or gives it to an opponent (who must then add the value to or subtract the value from the value he or she has accumulated thus far). Play passes to the left.

3. If a player's sum drops below 0, the player must drop out of the game.

4. Players continue drawing cards and adding or subtracting values until a player draws the joker. At this point, all players must use the calculator to find the square roots of the values they have accumulated.

5. The players now compare their results with the target value on the card set aside at the beginning of the game. The player with the value closest to the target value wins.

CALCULATIONS

EXAMPLE
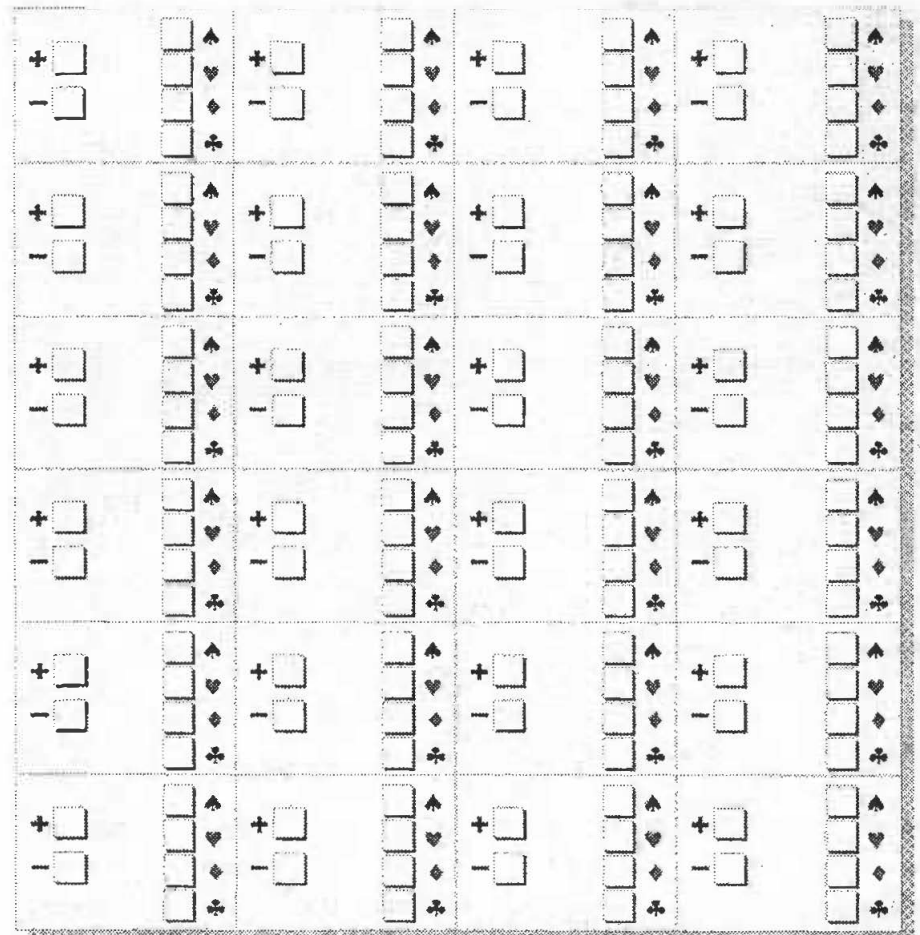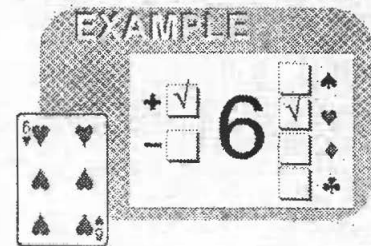
Adaptations

- To simplify the game, eliminate the target value. See who can be the first to reach a value with a square root greater than 10.
- Have the player who draws the joker reset his or her calculator to 0. Play continues until a player exactly meets the target value. Cards are reshuffled if necessary.

The Mean Game

Objective: Construct sets of data given measures of central tendency and variability (Alberta mathematics program of studies, Statistics and Probability [Data Analysis], Grade 8, Outcome 6)
**Materials:** Deck of cards (jack, queen and king removed; ace = 1)
Players: Two to four

Rules

1. Shuffle the cards well and deal one card facedown to each player. Deal four more cards faceup to each player. Each player may then turn over the facedown card, which represents the target mode. Place the remaining cards facedown to form a draw pile.
2. The first player draws the top card from the draw pile. The player may replace any one of his or her four faceup cards with that card. If the player does not want the card, he or she places it faceup in a discard pile. Subsequently, players may draw from either the draw pile or the discard pile.
3. The first player to create a set of cards with a mode equal to the target mode wins.
4. Play the game two more times, looking for the median and then the mean. Note that it is impossible to create a mean of 1 or 10 with this deck of cards. If a player is dealt a 1 or a 10 as a target card, he or she should switch it with any one of the four faceup cards or randomly draw a new target card from the deck. It is possible to build a set of cards with a median of 1 or 10 or a mode of 1 or 10.
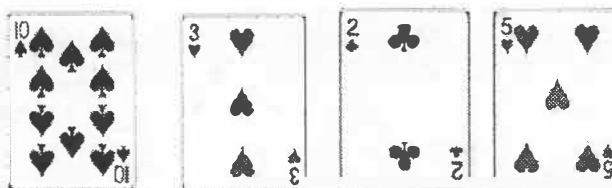
These cards represent a mode of 5:
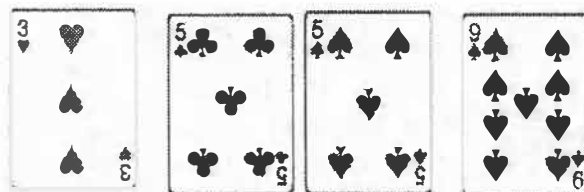
These cards represent a median of 7:

These cards represent a mean of 5:

Adaptations

- Include the jack, queen and king, but assign them very high or very low values (for example, king = 1,000 or queen = –1,000).
- Eliminate the target card and allow players to collect cards until a player believes that he or she has a mean, median or mode greater than that of any other player. This player then knocks the table instead of taking a turn, thus signalling the final round of play.
- Allow a player to substitute his or her target card for any of the four faceup cards at any time during the game. The substituted card now becomes the target card.

Half 'n' Half

Objective: Demonstrate and explain the meaning of improper fractions and mixed numbers (Alberta mathematics program of studies, Number [Number Concepts], Grade 6, Outcome 9)
Materials: Deck of cards (10, jack, queen and king removed; ace = 1), pencil
**Players:** Two or more

Rules

1. Shuffle the cards well and place them facedown to form a draw pile.
2. The youngest player goes first. On a turn, a player draws a card from the draw pile and places that card in any of the five locations indicated below:
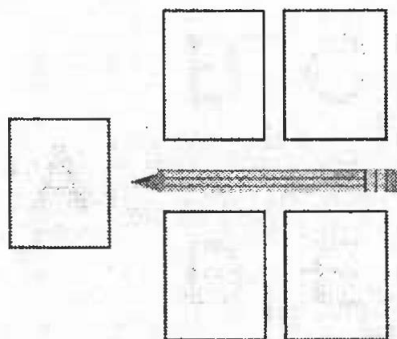
A player does not need to have a card in each of the five locations to complete a fraction. A card may be used to start a new place value, or it may be placed on top of an existing card (replacing the covered card) or underneath an existing card (essentially discarding the drawn card). Use a pencil for the fraction line (that is, the line that separates the numerator from the denominator). Play passes to the left.
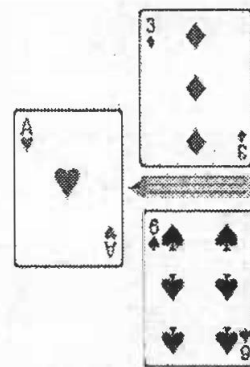
3. The first player to collect and arrange cards to construct a value equal to ½, then 1, then 1½ wins. At right are some models that, built in turn, would win the game.
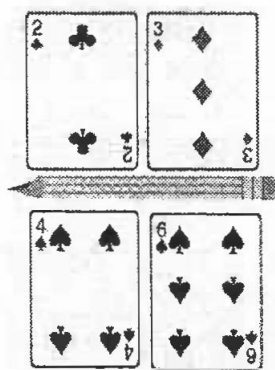
$$\frac{2}{4} = \frac{1}{2} \qquad \frac{8}{8} = 1 \qquad \frac{3}{6} = 1\frac{1}{2}$$

4. A card covered by another card remains out of play until the end of the game. If the draw pile is depleted before any player has built all the fractions, the player closest to correctly building the final fraction wins.

Adaptations

- Create a discard pile and have players return unused cards to the discard pile. Players may draw from the draw pile or the discard pile.
- Have players build much larger fractions.
- Play the game as a form of solitaire. What is the smallest number of cards you need to turn over, one at a time, to build the four fractions?

Not-So-Common Multiples

Objective: Recognize, model, identify, find and describe common multiples, common factors, least common multiple, greatest common factor (Alberta mathematics program of studies, Number [Number Concepts], Grade 6, Outcome 4)
Materials: Deck of cards (ace, jack, queen and king removed), calculator
Players: Two or more

Rules

1. Shuffle the cards well and turn them facedown to form a draw pile. Turn over the top three cards and calculate the sum to find the target number. For example, the target number shown by the cards below is 18:

The three cards can then be put aside or returned randomly to the deck.
2. The first player draws a card from the top of the draw pile. The player may keep the card or put it in a discard pile. Subsequently, players may draw from either the draw pile or the discard pile. Play passes to the left.
3. Each player builds a set of cards, adding to the set or substituting one card for another until the sum is a multiple of the target number. A winning multiple must be at least twice the target number. The first player to build this multiple (and prove it with the help of a calculator) wins.

Adaptation

- Turn over only two cards at the start of the game. Players then attempt to build a card set with a sum that is a common multiple of the sum of the two numbers.

Divisibility Rules

Objective: Use divisibility rules to determine if a number is divisible by 2, 3, 4, 5, 6, 9 or 10 (Alberta mathematics program of studies, Number [Number Concepts], Grade 7, Outcome 3)
Materials: Deck of cards (7, 8, jack, queen and king removed; ace = 1), 10-sided die
Players: Two or more

Rules

1. Roll the 10-sided die twice to create a two-digit number. The first roll specifies the value in the 10s place; the second roll specifies the value in the units place. For example, rolling a 9 and then a 2 creates the value 92.
2. Shuffle the cards and place them facedown to form a draw pile.
3. On a turn, a player turns over one card. If the value of the card divides evenly into the two-digit number already determined, the player keeps the card. Otherwise, the player discards the card.
4. When the draw pile is depleted, the player who has collected the most cards wins.
5. If a player keeps or discards a card erroneously, the player who catches the error gets to steal the card.

Adaptations

- To increase the challenge, determine (using the die) another two-digit number at the start of the game. A player then keeps a card if its value divides into either two-digit number. If the card's value divides into both numbers, the player steals a card from an opponent.
- Instead of counting cards at the end of the game, find the value of the cards. The highest sum wins.

Integer Addition

Objective: Represent integers in a variety of concrete, pictorial and symbolic ways (Alberta mathematics program of studies, Number [Number Concepts], Grade 7, Outcome 11)
Materials: Deck of cards (ace, jack, queen and king removed)
Players: Two or more

Rules

1. Shuffle the cards and place the deck facedown to form a draw pile.
2. The first player draws a card from the top of the draw pile and decides whether to keep or discard it. Subsequently, players may draw from either the draw pile or the discard pile. If a player draws from the draw pile, he or she may keep the card or discard it. If the player draws from the discard pile, he or she must keep the card until the end of the game. Kept cards are placed faceup in front of the player. Play passes to the left.
3. Red cards represent negative values and black cards represent positive values. Each player continues adding cards to his or her set until a player has collected a set of cards with a sum of 0. This player is declared the winner. The set of cards at the right would constitute a winning hand.
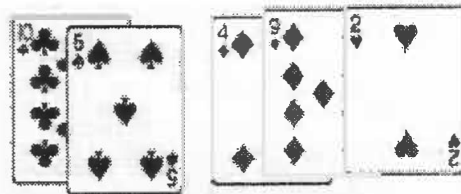
Adaptations

- Select a target number other than 0.
- Allow players to have a maximum of four cards in their hands. Once four cards have been collected, players may only exchange, not add, cards.
- Play with closed hands (that is, players hold their cards so they cannot be seen by other players).


Integer Challenge

Objective: Add, subtract, multiply and divide integers concretely, pictorially and symbolically (Alberta mathematics program of studies, Number [Number Operations], Grade 7, Outcome 16)
Materials: Deck of cards (ace, jack, queen and king removed)
Players: Two

Rules

1. Shuffle the cards thoroughly and give each player approximately half the deck.
2. The players simultaneously turn over their top cards and place them such that both players can see both cards.
3. The red cards represent negative values and the black cards represent positive values. The first player to state the sum of the two cards takes both cards and adds them to the bottom of his or her deck. For example, the first player to say, "Negative five" would claim both of the cards at right.
4. Play continues until a player has captured all the cards (or until time runs out). The player with the most cards wins.
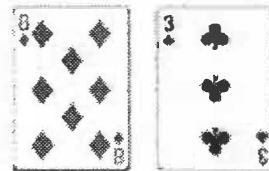
Adaptations

- Play with three or more players, who each flip over a card. The first player to state the correct sum of all the cards takes the cards.
- Have players multiply, rather than add, the values on the cards.
- Have players identify the distance between the two values on a number line rather than adding or multiplying.