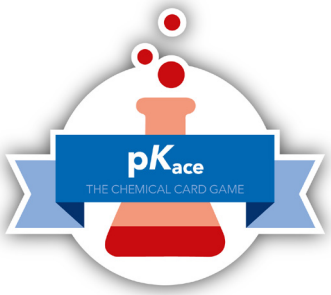


GAMEPLAY

INFO

pK_{ace} has been designed as a trick-taking game in which values determine which player takes the trick. Memorising pK_a values of the involved compounds is expected to be a "side effect" of playing the game, but is not essential for gameplay. However, the students who have tested the game have been creative in inventing variations that require knowledge of the pK_a values and other characteristics of the involved compounds.

OPTION 1

Standard Rules for Two Players (Separate Decks): The cards are sorted into an acid deck and a base deck. The dealer shuffles each deck separately and deals five acid cards and five base cards to him- or herself and to the other player. The cards are dealt face down, as each player may only know the cards in his or her own hand.

The player who has not dealt leads to the first trick by playing an acid or base card of their choice. If an acid has been led, the other player tries to win the trick by playing a base that is suitable for deprotonating this acid. To this end, the base needs to have a pK_{aH} value that is larger than the pK_a value of the acid. If the acid led is a carbonyl compound, a carboxylic acid derivative, or a nitrile, the base needs to be 'non-nucleophilic' or 'weakly nucleophilic' (as specified on the card). When a player does not have a suitable base in their hand, he or she sluffs any of his or her base cards, and the player who has led takes the trick.

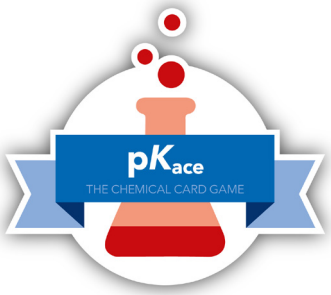
If a base has been led, the game follows the inverse principle: A player wins the trick by playing an acid that is suitable for protonating the base. To this end, the acid needs to have a pK_a value that is smaller than the pK_{aH} value of the base. When no suitable acid is at hand, a player sluffs any acid card, and the player who has led takes the trick.

It is essential that the players always 'follow suit' in the sense that they always play a base card when an acid has been led, and vice versa, even when they have to sluff a card. This ensures that the number of acid and base cards in play stays balanced during a hand. Moreover, players have to play a trick-winning card if they can; in other words, they are not allowed to sluff on purpose if they have other options.

The player who wins the trick places the cards of that trick face down on a pile and leads to the next trick. A hand is won by the player who has taken most tricks of that hand, or – if both players have taken an equal number – by the winner of the last trick of the hand.

OPTION 2

Standard Rules for Three or More Players (Single Deck): When more than two players participate, one important aspect of gameplay changes: The number of acid and base cards in play does not necessarily stay balanced over the course of a hand, even if an equal number of acids and bases is dealt at the start of the hand and if all players follow suit.



GAMEPLAY

Hence, there is no reason to sort the cards into two separate decks (acids and bases). Instead, the dealer shuffles all cards and deals a previously agreed upon number of cards to him- or herself and the other players. [We found seven cards to be a reasonable number for a game of four players. If more people participate, the number of cards dealt to each player can be reduced accordingly.]

The rules for determining the winner of a trick and the winner of a hand are identical to those described above for the two-player game. As far as sluffing is concerned, players must follow suit if they can.

OPTION 3

Who Am I?: One of the game variants developed by the students is a variation of the common party game "Who Am I?": The cards are shuffled face down. Players sit down in a circle and each player draws a card from the deck and holds it up in such a way that all other players, but not he or she themselves, can see its front side. The players take turns in asking questions about their acid or base card, with the goal of identifying their card based on the answers. Only questions that can be answered by 'Yes' or 'No' are allowed. The player to first identify his or her card wins the game. The player who has not dealt leads to the first trick by playing an acid or base card of their choice. If an acid has been led, the other player tries to win the trick by playing a base that is suitable for deprotonating this acid. To this end, the base needs to have a pK_{aH} value that is larger than the pK_a value of the acid. If the acid led is a carbonyl compound, a carboxylic acid derivative, or a nitrile, the base needs to be 'non-nucleophilic' or 'weakly nucleophilic' (as specified on the card). When a player does not have a suitable base in their hand, he or she sluffs any of his or her base cards, and the player who has led takes the trick.

OPTION 4

Quizmaster: In this variation of the game, which has also been developed by the students, the players' ability to match compounds with their pK_a values is tested: One person (the 'Quizmaster') shuffles the cards and draws one card from the deck. He or she then reads out either the compound name or the pK_a (or pK_{aH}) value to the players. The player who first calls out the correct pK_a (or pK_{aH}) value to match the compound name or identifies the compound based on its pK_a (or pK_{aH}) value is handed the card from the Quizmaster. The Quizmaster then draws the next card and the game continues until the entire deck has been depleted. The player who has collected the largest number of cards wins the game.