

Organic Functional Group Playing Card Deck

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In an effort to make learning chemistry more enjoyable, chemistry instructors have devised and used a wide variety of excellent games in the classroom (1–2). While both chemistry majors and non-chemistry majors struggle with their first attempts to recognize the basic organic functional groups, it is particularly frustrating for fine or performing arts majors and communication majors. Columbia College Chicago is a visual, performing, media, and communication arts college, and students may elect to take a chemistry course called *Molecules in Art and Life* to fulfill their science requirements. This course includes the application of organic chemistry to art and nature. Topics include textiles, dyes, polymer sculpture, paint, papermaking, perfume, food, drugs, and vision chemistry. While our students are not required to have a rigorous formal understanding of organic chemistry, they are required to make connections between the macroscopic properties of organic molecules used in the arts and the chemical structures responsible for those properties. The organic functional group card deck was created to help visually oriented students recognize the names and structures of 13 common organic functional groups.

Other chemical card games have already been developed. However these chemistry card games were designed for students to play games such as “Old Maid” or “Go Fish” (3), or to develop an understanding of organic chemical reactions by using functional group or ring cards and reagent cards (4–5), or to learn stereochemistry (6). The deck described here is based on the traditional playing card deck with one simple goal: organic functional group recognition.

The card sequence (K, Q, J, ..., A) has been replaced with 13 common functional groups. The suits (clubs, hearts, spades, diamonds) have been replaced by a functional group name, a shorthand notation example of a molecule with one of the functional groups, a general formula of one of the functional groups, and a ball and stick example of a molecule with one of the functional groups. Two very important advantages emerge from this arrangement. First, any card game that can be played with a traditional card deck can be played with

the deck described here, and second, individual instructors can design a deck with their favorite examples, which could be referred to at some other point in the course.

Deck Construction

The deck was constructed so that any game played with a traditional deck of cards could be played with the functional group cards. Instead of the traditional suits of regular playing cards, the functional group playing cards are divided into the groups shown in Table 1.

While this arrangement alone is sufficient to play simple games like “Go Fish” or “Old Maid” (7), a ranking order of the cards is needed to play most other games. For card games that require a ranking of cards, the ranking shown in Table 2 is chosen and is very loosely based on the hierarchy of naming the parent functional group in a molecule with more than one functional group (8). The ranking does not match the nomenclature precedence perfectly for three reasons. First, not all the functional groups are represented in the list below (the functional groups listed are the ones most likely to be discussed in an introductory organic class). Second, ethers and halides are considered subordinate functional groups and have no established priority order. Lastly, aromatics and alkanes are included in the deck because pedagogically these are important for introductory students to recognize.

Table 1. Suit Equivalents for Functional Group Card Deck

Functional Group Cards	Traditional Cards Equivalent
Functional group name	Hearts
Shorthand notation example	Spades
General formula	Diamonds
Ball and stick example	Clubs

Table 2. Sequence Equivalents for Functional Group Card Deck

Functional Group Cards	Traditional Cards Equivalent
Carboxylic acid	King
Ester	Queen
Amide	Jack
Aldehyde	10
Ketone	9
Alcohol	8
Amine	7
Alkene	6
Alkyne	5
Ether	4
Halide	3
Aromatic	2
Alkane	Ace

The alkane group was chosen as the ace or 1 card. All organic molecules need a carbon backbone, so it is the ace, but the alkane itself is devoid of any functionality so it can also serve as the 1 card (lowest priority).

The ranking and suit choice can be reassigned to serve the instructor's and student's needs. There are many other functional groups that could be incorporated into this deck or made into a second completely different deck. The choice of molecules illustrated for the example shorthand notation and ball and stick cards can be changed to make different decks.

The card examples can be created with any chemistry drawing or visualizing program. The shorthand notation examples of the deck illustrated in Figure 1 were created with ISIS/Draw and the ball and stick models with Molecules-3D. The deck was assembled using FileMaker Pro, but it could be just as easily constructed with any word processing program. The cards were printed with a color ink jet printer on a lightweight card stock. The cards may be laminated and cut into a deck.

Use in the Classroom

For the non-science major and the introductory organic chemistry student, card games like "Old Maid" and "Go Fish", played with this deck, test the students' ability to not only know the names of functional groups but also be able to recognize different ways the groups can be represented and matched. Students who are struggling with this task can find this an enjoyable way to practice this critical skill with their peers. Students who have mastered the task can help others by working with struggling students. The competitive nature of some students also serves as a check to see if their peers have made correct matches. An instructor may also want to help students for the first few hands by printing out a miniature version of all the cards. After several hands the students would have to play without the card list.

Invariably, some students will want to play more challenging card games. The card ranking allows each "suit" a sequence and therefore the ability to play more complex games. While the ability to internalize a functional group sequence will not be a necessary skill for most organic courses, students are never discouraged to attempt different games. Instructors can have corks and rubber stoppers of various sizes available for games that involve a wager and provide a prize from the school's bookstore or an American Chemical Society stuffed mole for the winners.

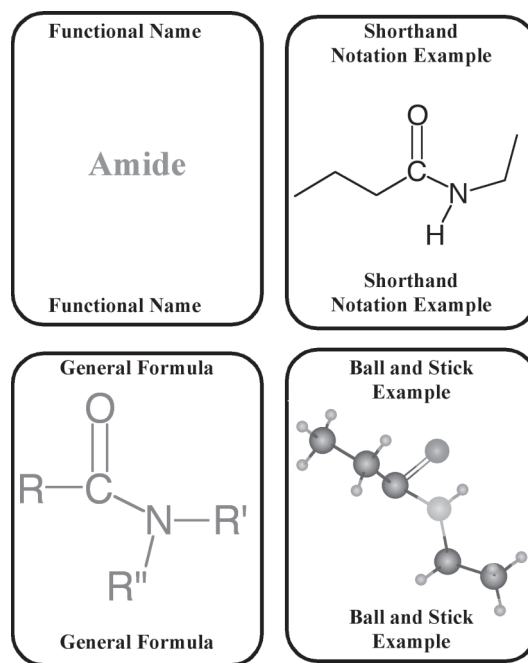


Figure 1. The amide "Jack" cards of the functional card deck. The other 12 functional groups are done in a similar way. Both the shorthand and ball and stick examples can be chosen by individual instructors to fit their classroom needs.

Literature Cited

1. Russell, J. V. *J. Chem. Educ.* **1999**, *76*, 481.
2. Schreck, J. J. *Chem. Educ.* **1967**, *44*, 606; Schreck, J. J. *Chem. Educ.* **1992**, *69*, 203.
3. Granath, P. L.; Russell, J. V. *J. Chem. Educ.* **1999**, *76*, 485.
4. Kletsch, R. A. *J. Chem. Educ.* **1978**, *55*, 104.
5. Kristol, D.; Perlmuter, H. D. *Educ. Chem.* **1971**, *8*, 145.
6. Parrill, A. L.; Gervay, J. *Chem. Educator* **1996**, *1* (5): S1430-4171(96)05060-1.
7. Instructions for various card games can be found at the site: Welcome to the Card Games Web Site. <http://www.pagat.com> (accessed Jan 2003). "Old Maid" is played by removing one of the queens (ester). The unmatched ester card is the "Old Maid".
8. McMurry, J. *Organic Chemistry*, 5th ed.; Brooks/Cole Pub. Co.: Pacific Grove, CA, 1999; p A3.