



A GAME, GAME APPARATUS AND METHOD OF PLAYING A GAME

Background and Field of the Invention

5 This invention relates to a game, game apparatus and method, more particularly but not exclusively, for enhancing knowledge of chemistry.

It is important to instil interest in students when teaching new subjects, especially science subjects which may be regarded as boring by students. If a student lose
10 interest early, it might be difficult for students to have a good understanding of the subject.

It is an object of the present invention to provide a game, game apparatus and method which may be used as a pedagogical tool.

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Summary of the Invention

In a first aspect of the invention, there is provided game apparatus for teaching chemistry to a number of game players, the game apparatus comprising:
20 a plurality of game pieces with at least some of the game pieces being element game pieces which are associated with chemical elements;
an array of game cells with each game cell representing one of the chemical elements;
a substance group generator for generating a name of a chemical substance grouping which are chemically associated with some of the chemical elements.

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The chemical elements may be elements of the periodic table; and the array of game cells are arranged according to the periodic table of chemical elements. The array of game cells may be provided on a game board.

30 Preferably, the plurality of game pieces is configured to be stackable one on top of another. Each of element game pieces may include a chemical name of the associated chemical element. Further, each of the element game pieces may include a chemical symbol of the associated chemical element. Even further, each of the element game pieces may include an atomic number of the associated chemical element. Each of the
35 element game pieces may also include an atomic mass of the associated chemical element.



The plurality of game pieces may include number game pieces which have indicia representing a number.

- 5 Advantageously, the substance group generator is configured also for generating instructions other than the name of a substance grouping. The instructions may include instructing one of the game players to exchange some of the game pieces in the player's possession with another game player. The instructions may also include instructing one of the game players to miss a turn.

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The substance group generator may comprise a plurality of dices, with at least some faces of each dice carrying the name of the chemical substance grouping. Preferably, the faces of one of the dices include names of chemical substance groupings which are associated with chemical elements of the periodic table.

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The chemical substance groupings may be selected from the group consisting of non-metals, metals, noble gases, semi-metals, gas and halogen.

- 20 The faces of one of the dices may include names of chemical substances which are associated with chemical compounds which are formed by combinations of two or more chemical elements of the periodic table. The chemical substance groupings may be selected from the group consisting of acids, bases, salts, alkenes, alkanes, basic oxides and acid oxides.

- 25 The game apparatus may further comprise a game stand configured for holding some of the plurality of game pieces.

- 30 If the plurality of game pieces also includes number game pieces which have indicia representing a number, then, the game stand may include indicia for specifying a predetermined number of element game pieces and a predetermined number of number game pieces to be placed on the game stand.

- 35 In a second aspect of the invention, there is provided a game played by a number of game players, comprising: a plurality of game pieces with at least some of the game pieces being element game pieces which are associated with chemical elements and at least some of the element game pieces distributed to the game players;

an array of game cells with each game cell representing one of the chemical elements; a substance group generator for generating names from chemical substance groupings which are chemically associated with some of the chemical elements; each player taking turns and with each turn, the substance group generator generates one of the names for a respective player to determine whether the player has one or more distributed element game pieces which are chemically associated with the generated name, and if so, the player associates the one or more element game pieces with the respective game cells which corresponds to the chemical elements associated with the one or more element game pieces.

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The plurality of game pieces may be equally distributed to the game players; and the game may end when one of the players finishes associating all his distributed game pieces on the respective game cells.

15 Each of the element game pieces may include a number associated with the corresponding chemical element; wherein the number is used to calculate points awarded to the player for placing the respective element game piece on the respective game cell; the game ending when all the players agree to end the game, and the winner is the player who has the highest points. The number associated with the
20 corresponding chemical element may be an atomic number of the corresponding chemical element.

Some of the element game pieces may be distributed to the game players, and when the game players associate one or more game pieces with the respective cells, the
25 player may take a same number of game pieces from the plurality of game pieces to replenish his game pieces. The plurality of game pieces may include number game pieces which may have indicia representing a number; and each game player may be distributed with six element game pieces and two game pieces to start the game.

30 The number of the number game pieces may be used to calculate the points to be awarded to the player if the corresponding number game piece is used to form part of a chemical substance chemically associated with the generated name.

35 The substance group generator may comprise a plurality of dices, with at least some faces of each dice carrying the name of the chemical substance grouping. The players

may take turns to roll at least one of the dices to display the name of the chemical substance grouping.

5 As an alternative, the players may take turns to roll two dices to display names of different chemical substance groupings. The players may have an option of associating one or more game pieces with the respective game cells which are chemically associated with either name displayed.

10 In a further alternative, the players may take turns to roll three discs to display names of different chemical substance groupings. The players may have an option of associating one or more game pieces with the respective game cells which are chemically associated with one of the names displayed.

15 The faces of one of the dices may include names of chemical substance groupings which are associated with chemical elements of the periodic table. Preferably, the chemical substance groupings are selected from the group consisting of non-metals, metals, noble gases, semi-metals, gas and halogen.

20 As an alternative, the faces of one of the dices may include names of chemical substances which are associated with chemical compounds which are formed by combinations of two or more chemical elements of the periodic table. Preferably, the chemical substance groupings are selected from the group consisting of acids, bases, salts, alkenes, alkanes, basic oxides and acid oxides.

25 The one or more element game pieces may be associated with the respective game cells by placing the one or more element game pieces on a respective game cell. The plurality of game pieces may be configured to be stackable one on top of another, and the game players stacking one game piece on top of another game piece if both game pieces are associated with the same chemical element.

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In a third aspect of the invention, there is provided method of playing a chemistry game, the method comprising providing a plurality of game pieces with at least some of the game pieces being element game pieces which are associated with chemical
35 elements; distributing at least some of the element game pieces to a number of game players; providing an array of game cells with each game cell representing one of the

chemical elements; generating a name from chemical substance groupings which are chemically associated with some of the chemical elements; and if one or more of the distributed element game pieces are chemically associated with the generated name, associating the one or more game pieces on the respective game cells which
5 correspond to the chemical elements associated with the one or more game pieces.

The plurality of game pieces may include number game pieces comprising a number. The method may further comprise distributing all the game pieces to the game players for the start of the game. As an alternative, the method may comprise distributing a
10 pre-determined number of game pieces to the game players for the start of the game.

The method may further comprise distributing six element game pieces and two game number pieces to each of the game players for the start of the game.

15 The chemical elements may be elements of the periodic table; and the array of game cells may be arranged according to the periodic table of chemical elements. Associating the one or more game pieces with respective game cells may include placing the one or more game pieces on a respective game cell.

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It should be appreciated that the features for one aspect may also be applicable for the other aspects.

25 Brief Description of the Drawing

An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings in which,

30 Figure 1 is a plan view of a game apparatus comprising a game board having an array of game cells arranged according to the periodic table according to a preferred embodiment of the present invention but with certain details omitted;

Figure 2 is a plan view of the game board of Figure 1, slightly enlarged and with the details included which includes chemical elements of the periodic table;

35 Figure 3 shows examples of game pieces used with the game board of Figure 1 and which comprising element game pieces and number game pieces;

Figures 3a and 3b are close up views of one of the element game pieces and one of the number game pieces of Figure 3;

Figure 4 shows perspective views of game dices used with the game board of Figure 1;

5 Figure 5 comprising Figures 5a to 5c show indicia of each of the faces of the game dices of Figure 4; and

Figure 6 shows a game stand used with the game board of Figure 1.

Detailed Description of the Preferred Embodiment

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In a preferred embodiment, a game apparatus of the present invention comprises a game board 100, a substance group generator 200, and a plurality of game pieces 300 and is played by a number of game players.

15 Game board 100

Figure 1 is a schematic drawing of the game board 100 with details omitted merely to show an overall layout of the board 100. The game board 100 generally has two main portions 102, 104. The first main portion 102 comprises an array of game cells 106
20 arranged according to a format of a standard eighty seven chemical element periodic table (including hydrogen), with each cell 106 carrying indicia to represent a chemical element 108 from the periodic table. The second main portion 104 is a legend which is colour coded to represent the different element categories of the periodic table.

25 Figure 2 is a schematic drawing of the game board of Figure 1 with the first and second main portions 102,104 populated. As explained above, the first main portion 102 comprises the game cells 106 arranged according to the eighty seven chemical elements 108 of the standard periodic table, and the second main portion 104 comprises the different element categories 110 such as Alkali metals, Alkaline earth
30 etc.

The game board 100 is a central platform in which the game players associate chemical compounds with the chemical elements 108 of the periodic table.

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Game pieces 300

Figure 3 shows what the game pieces 300 looks like. Each of the game pieces 300 are made of plastic and substantially square in shape with a raised surface 302 carrying indicia 304 mounted on a base 306. The base 306 has a square frame (not shown) which is adapted to cooperate with the raised surface 302 of a like game piece 300 so that the game pieces 300 may be stacked on top of each other. The cooperation between the base 306 of a first game piece and the raised surface of a second game is such that the raised surface of the second game piece is received in the frame of the base 306 of the first game piece.

In this embodiment, there are two types of game pieces 300 with different functions. A first type of game pieces are element game pieces 308 and a second type of game pieces are number game pieces 310.

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Each of the element game pieces 308 carries the following indicia:

- a) Name of element 312
- b) Chemical symbol 314
- c) Atomic number 316
- d) Atomic mass 318

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Figure 3a is a close up view of one of the element game pieces 308 for the chemical element Sodium 308a and the Name of the element 312 is Sodium which has a Chemical Symbol 314 as Na, an Atomic number 316 of "11" and an atomic mass 318 of "22.989769".

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Each of the number game pieces 310 carries a number 320 from two to five. In Figure 3, two number game pieces 310a, 310b carrying the numbers "two" and "three" are shown. Figure 3b shows a front view of one of these game pieces 310a having the number "two". The number 320 appearing on these number game pieces 310a are used to annotate the number of chemical elements in a chemical compound.

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In this embodiment, there are two hundred game pieces with 160 of element game pieces which means that there are duplicates or triplicates of the element game pieces carrying the same chemical element, and 40 of number game pieces having numbers "two" to "five", which also means that one or more number game piece may carry the

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same number. In general, the proportion of element game pieces verses the number of game pieces are about 80% to 20%.

Substance group generator 200

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Randomness and level of difficult of playing the game apparatus is controlled by the substance group generator 200 and in this embodiment, this is in the form of a set of three dices 210, 220, 230. The three dices 210, 220, 230 are regular six-sided dices with each face carrying a name of a chemical substance as shown in Figure 4.

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Dices 1: Basic Substance Grouping

This dice groups chemical elements with basic chemical or physical properties and Figure 5a shows the six chemical substance groups carried by respective faces 211, 212, 213, 214, 215, 216 of the first dice 210. The substance groups under this grouping are provided below together with exemplary chemical elements which fall under the respective groups:

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Groups	Examples
Non-metals	Carbon, Oxygen, Hydrogen, Argon
Metals	Sodium, Potassium, Lithium
Noble Gases	Argon, Neon, Helium
Semi-Metal	Boron, Silicon
Gas	Oxygen, Carbon Dioxide
Halogen	Chlorine, Fluorine, Bromine

20 Dices 2: Intermediate Substance Grouping

The second dice 220 has groups of chemical compounds which require combinations of chemical elements to be formed. Thus, this raises the difficult of the game, and the three groups are (and exemplary chemical compounds):

Groups	Examples
Acid	Hydrochloric acid, Nitric acid
Base	Sodium hydroxide, Potassium hydroxide
Salt	Sodium chloride, Potassium chloride

Figure 5b shows the substance groups carried by each of the six faces 221,222,223,224,225,226 of the dices 220 and it should be appreciated that two of the faces carry the same substance group.

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Dices 3: Advance Substance Grouping

This dice 230 has groups of compounds with higher chemical functionality and usually would require players to form more complex compounds. Figure 5c shows the substance groups carried by this dice 230. It should be appreciated that the first four faces 231,232,233,234 each carries a name of a substance group but the fourth and fifth faces 235,236 actually carries instructions "Trade" and "Skip". Details of these groups are provided below and explanation of these instructions. The use of the third dice 230 to control play is intended to raise the difficulty of the game.

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Groups	Examples
Alkenes	Unsaturated hydrogen carbon compounds containing at least one carbon double bonds. E.g. Ethylene, propane
Alkanes	Saturated hydrogen carbon compounds E.g. Ethane, propane, methane
Basic oxides	Sodium oxide, Magnesium oxides, Copper (II) oxides
Acid oxides	Carbon dioxide, sulphur dioxide
Trade	Player can choose to exchange one play chip with the player opposite.
Skip	Player has to skip a turn.

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Game Play

For beginners with limited prior knowledge on Chemistry and periodic table, it is suggested that an educator or chemistry teacher follows the players through the game to act as an empire, although this may not be necessary.

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An important feature of the game is an ability to customise the game to suit different the players' knowledge level, needs and challenge levels. Players/educator may adjust the level of difficulty using the following modes of play:

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- a) Mode of drawing game pieces 300 and winning the game.
- b) Number of play dices 210,220,230.

5 Players/educators may choose from using either one or combination of these different modes to suit the players needs in the game play. However, once the mode(s) is selected, the players have to follow the modes throughout the game and no change is allowed.

The following are the steps and game play rules:

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To begin, the players (or the educator if one is present) decide which mode of drawing the game pieces 300:

- a) Mode of drawing game pieces 300

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There are two modes:

- i) "Bulk" draw

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In bulk draw, the players take turns to draw ten game pieces from a game piece pool which contains the two hundred pieces of game pieces 300 until all the available game pieces are distributed equally to all the players. If it is not possible to equally distribute remaining game pieces, for example there are two game pieces left and there are three players, the remaining two game pieces are not distributed.

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The game pieces drawn by each player is used throughout the game to complete the game and the players should not review the content of the game pieces which they have to the other players.

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If all players agree, the players are allowed to swap or exchange game pieces but in this preferred embodiment, only two exchanges are allowed and each exchange is limited to a maximum of five game pieces. To carry out the exchange, a player selects the game pieces to be exchanged and places them face down for exchange with the same number of pieces with a player on his/her right. Needless to say, this may change accordingly.

This mode is recommended for beginner players with limited prior knowledge on chemistry or the periodic table.

5 To win the game based on bulk draw in which all the available game pieces are distributed to the game players, the player who successfully used up all the game pieces by placing them on the game board 100 is declared a winner. How to place the game pieces 300 on the game board will be elaborated below.

ii) "Stand" draw

10 In "stand" draw, a game stand or holder 400 is provided to each player and the game players take turns to draw the number of game pieces from a pool containing the two hundred game pieces according to game pieces allocated on the game stand 400.

15 Figure 6 is a perspective view of the game stand 400 which has an elongate body 402 comprising a base 404 and a support member 406 connected to the base 404 at substantially 90°. The arrangement of the base 404 and the support member 406 allows a number of the game pieces to sit on the game stand 400 and in this embodiment, the game stand 400 is adapted to carry eight game pieces 300. The support member 406 also includes indicia 408 to inform the game players the number
20 of number game pieces 310 and the number of element game pieces 308 required and in this embodiment, two number game pieces 310 and six element game pieces 308 are required.

The players thus take turns to draw eight game pieces 300 from the pool to fill up the
25 stand 400. If a player draws more than two number game pieces 310, the player has to return the extra number pieces back into the pool and continue to draw for element game pieces 308. Likewise, if a player draws more than six element game pieces 308, the player has to return the extra element game pieces 308 back into the pool and continue to draw for number pieces.

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The game starts when all players have six element game pieces 308 and two number game pieces 310.

35 This drawing mode is recommended for players with higher knowledge of chemistry and the periodic table.

During a turn, when a player used up a certain number of game pieces during the game play, the player replenishes the same number of pieces from the pool to continue the game.

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To win the game based on “stand” draw in which each player starts the game with six element game pieces 308 and two number game pieces 310, each player needs to record number of points based on the chemical substance formed on the game board 100 and a winner is the player who has the highest points when all the game pieces 100 are placed on the game board 100 or all the players decide to end the game. This will be further described below.

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With the mode of drawing decided, the players next decide on the number of game dices to use since this determines the difficulty of the game play.

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b) Number of play dices 210,220,230.

An objective of this game is for the game players to use their distributed game pieces 300 (from either “bulk” draw or “stand” draw) to form chemistry substances based on the groups identified on the dices 210,220,230. This is where the selection of the number of dices 210,220,230 to be used determines the difficulty of the game.

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l) One dice play mode.

In this mode, the players select one dice from the three dices 210,220,230 to start the game play.

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This play mode is recommended for players who have decided using the “bulk draw” to distribute all the game pieces 300.

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Table 1 below is a useful guide for the players (or educator) to decide which dice to use to start the game and the players may be allowed to switch to a different dices depending on whether a higher or lower difficulty level is desired, depending on the progress of the game. For example, if the educator (if present) believes that the players have a good understanding of the chemical substances from the basic substance

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group (i.e. the first dice 210) and are able to form the corresponding chemical substances on the game board 100, then the educator may suggest to use the second dice 220 to increase the difficulty.

Table 1

<u>Groups</u>	<u>Difficulty</u>	<u>Prior knowledge required</u>	<u>Skill/Knowledge Level*</u>
Dice 1: Basic Substance Groups	Beginner to Easy	• Periodic table grouping. • Metals and Non-metals. • Arrangement of elements.	• Level I • Knowledge and Recall
Dice 2: Intermediate Substance Group	Intermediate	• Periodic table rules and valence theory. • Acids, Base and Salt functions and properties.	• Level II to III • Comprehension and application
Dice 3: Advance Substance Groups	Intermediate to High	• Periodic table rules and valence theory. • Hydrocarbons. • Oxides	• Level II to III • Comprehension and application

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*Adopted from Bloom's Taxonomy of learning in action.

II) Two-dice play mode

In this play mode, the players select two dices from the three dices 210,220,230 and use the selected two dices throughout the game.

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This play mode is recommended for player using either the "bulk draw" or "stand draw"

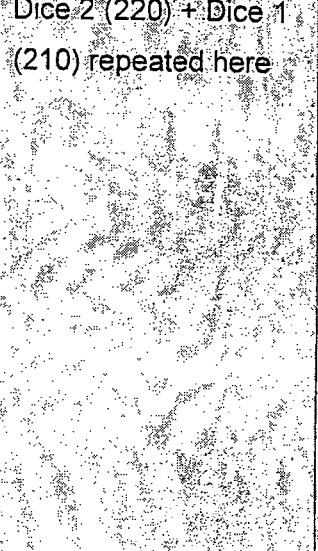
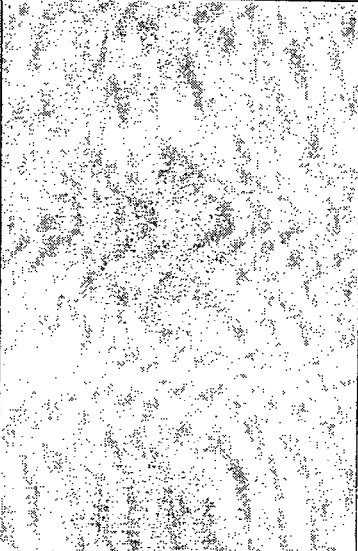
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This play mode offers versatility and variety to the game and is suitable for players who are independent learners and require constant challenges to meet learning needs.

Just like the earlier play mode, the players select the difficulty level using one of the selected two-dice play modes and players are allowed to switch to either a higher difficulty level or a lower difficulty level depending on which combination of two dices 210,220,230 is selected. Table 2 shows the different difficulty levels.

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Table 2

First Dice	Second Dice		
	Dice 1: Basic Groups	Dice 2: Intermediate Group	Dice 3: Advance Groups
Dice 1: Basic Substance Groups		• Dice 1 (210) + Dice 2 (220) • Easy to Intermediate level. • Basic chemical and physical properties of elements and periodic table. • Functional chemical compounds (acids, bases and salts)	• Dice 1 (210) + Dice 3 (230) • Intermediate to Advance. • Functional chemical compounds (acids, bases and salts) • Complex chemical compounds such as oxides and hydrocarbons.
Dice 2: Intermediate Substance Groups	Dice 2 (220) + Dice 1 (210) repeated here 		• Dice 2 (220) + Dice 3 (230) • Advance level. • Functional chemical compounds (acids, bases and salts) • Complex chemical compounds

			such as oxides and hydrocarbons.
Dice 3: Advance Substance Groups	Dice 3 (230) + Dice 1 (210)	Dice 3 (230) + Dice 1 (210)	

In this two-dice play mode, the players are at a higher level of learning compared with the one dices play mode since skills such as synthesis and evaluation are required. In this play mode, the players have to decide which of the grouping shown should be chosen to form corresponding chemical substances under that grouping to be advantages to their playing situation to win the game.

III) Three-dice play mode

In this play mode, the players use all the three dices 210,220,230 available for the game play. However, the players cannot change to other systems when this play mode is selected. This is to encourage a gradual learning process such that in this play mode, which is the most difficult, the players should persevere to enhance their knowledge.

This play mode is recommended for players using the “stand draw”.

This dice play mode offers the most variety to the game and is suitable for advance players who have graduated from the game based on the one-dice or two-dice play mode or players who have advance chemistry knowledge.

At this play mode, the players are at a higher level of learning than the one-dice play mode since skills such as synthesis and evaluation are required. Just like the two-dice play mode, the players have to decide which of the grouping shown should be chosen to form corresponding chemical substances under that grouping to be advantages to their playing situation to win the game.

Playing the game

With the drawing mode and the number of dice play mode decided, the players are ready to play the game. For this embodiment, let's assume that there are four players

A,B,C and D and they have decided to use “bulk draw” to distribute the game pieces 300 and the one-dice play mode is selected based on the first dice 210.

Thus, the game starts with the four players A, B, C, D taking turns to draw ten game pieces each until all the two hundred game pieces are distributed. Assuming that player A is the first to start the game, the player takes the dice 210 and rolls the dice.

Assuming that the dice 210 shows Metal which is carried on the second face 212 of the dice 210, then player A needs to check his game pieces to see if he has any metal elements to place on the game board 100.

For example, the player has the element game piece “Sodium” which is a type of metal, the player places this on the corresponding game cell 106 or location of the periodic table on the game board 100 and the turn goes to the next player, player B. The player B takes the dice 210 and throws it and the face 211 carrying “Non-metals” is generated from the dice 210. The player B then searches for any non-metal element game piece in his possession. If the player B does not have any such element game pieces, then the turn is passed on to player C. For this embodiment, the player B has the element game piece for “Oxygen” and thus, he places the game piece on the corresponding game cell 106 on the periodic table of the game board 100.

The turn passes to player C and assuming that after rolling the dice 210, the player C needs to find “Metal” element to place on the game board. If the player C also has the element game piece “Sodium”, he stacks his element game piece for Sodium on top of the one placed by player A. Thereafter, the play passes on to the player D, and the play continues as described above until one of the players A,B,C,D completes placing all his game pieces on the game board 100 who is declared the winner and the game ends.

As explained above, the players are allowed to change the play mode by using more dices, and let’s assume that the players decide to switch to the two-dice play mode half way through the game using the first and second dices 210,220. Assuming that it is player B’s turn and the roll of the two dices 210,220 display:

Metal	Acid
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Assuming that the player B has the following game pieces (combination of element game pieces and number game pieces) in his possession:



Thus, the player B has two options. A first option is to form an acid as indicated by the dice 220 - Sulphuric acid H_2SO_4 - on the game board 100 using the following game pieces 300:



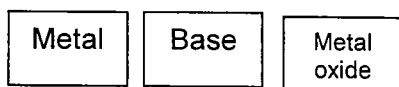
If the player B proceeds with this option, then the number game pieces "2" and "4" are placed back to a pool of number game pieces and not to be reused.

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A second option is to form a chemical substance associated with "Metal" as indicated by the first dice 210 and an option is Sodium "Na".

20 Which option player B decides depends on the how he wishes to play the game. In the bulk draw, the player B should aim to lose his game pieces as soon as possible and thus, the player B should choose the option which allows him to place the most game pieces on the game board 100 or in the pool of number game pieces.

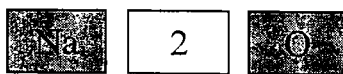
25 If the players select the three-dice play mode, the mode of play is similar to the two-dice play mode. For example, if the three dices 210,220,230 display the following names:



30 Assuming that the player has the same game pieces as above, the player actually has three options to form a substance which is chemically associated with any one of the group names displayed by the dices 210,220,230. For example, the player may form "Sodium Hydroxide, NaOH " using the following game pieces:



The player may also form Na_2O using the following game pieces:



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A third option is to simply use the game piece Na to correspond to the name "Metal" and place this game piece on the corresponding game cell on the game board 100.

Prior to placing the game pieces 300 on the game board, it is preferred for the player to display the game pieces and explain how the displayed game pieces are chemically associated with the names of the substance groups on the dice 210,220,230 (if one dice play mode is chosen). This allows the players (or educator) to verify the accuracy and also promote discussion and learning between the players. The other players may disagree with substance (compound or chemical element) formed with valid reasons and the discussion between players promotes a better understanding of the chemistry subject. The player who is being challenged has to seek an alternative answer if the answer is rejected by the rest of players, and if there is no alternative, then the player misses a turn.

When placing the game pieces on the game board, if there is already an existing game piece on the game cell, for example for Na (Sodium), the player with the game piece "Na" stacks it on top of the earlier one and in this way, associates the game piece "Na" to the game cell on the periodic table. The associating of the game pieces to the game board and the cells arranged according to the periodic table allows the players to co-relate the different elements into the positions of the periodic table and helps to understand the periodic table.

As previously explained, for the players A,B,C,D to win in a "bulk draw", the winner is the player who completes the game pieces distributed to him.

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An alternative to the bulk draw is the stand draw in which a point system is used to determine the winner. The points are based on the atomic numbers of the chemical elements of the game elements and the number game piece used.

Take the example of Sulphuric acid and if a player manages to place this on the game board, the player would have used the following game pieces:

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H	2	S	O	4
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In a stand draw, the number game pieces "2" and "4" are placed back to a pool of number game pieces and the player are then distributed with a same number of game pieces in return. In this case, the player may have two new number game pieces.

The atomic numbers of the chemical elements are:

- H (Hydrogen) - 1
- S (Sulphur) -16
- O (Oxygen) – 8

Total number of points awarded is: $[2 \times 1(\text{H})] + 16 (\text{S}) + [4 \times 8(\text{O})] = 50$ points.

If the player places a game piece for one of the chemical elements on the game board, for example, Sodium, then the points earn would be the based on the atomic number of that element and for Sodium, it is eleven points (atomic number of eleven).

The game may end when all players decide to halt the game play and the winner is the one with the highest number of points at the end of the game play.

As it can be appreciated, the described embodiment of the game uses chemistry knowledge, such as chemical bonding patterns and rules, as well as characteristics of elements in each of the chemical groupings. The chemical groupings (as displayed on the game dices 210,220,230) directs the players to form chemical substances (compounds or basic chemical elements) based on concepts and theories in chemical reactions and bonds using the allocated game pieces 300. By requiring the players to associate the element game pieces to the respective positions of the game board having the period table, this enhances the players' memory of the location of the chemical elements of the periodic table and how the various chemical elements are grouped together based on their properties.

The game may be used as a board game and may also be used as a pedagogical tool to enhance the knowledge of students in chemistry, as well as motivates enthusiasm of the students in this subject. Through the use of the bulk draw, stand draw and different

modes of play, the game allows flexibility for the players to adjust the difficulty level according to the desired knowledge level to be acquired. In the context of an educational organisation, educators may adjust the difficulty level for the game using one or more combinations of the modes of play. This may be important to allow the game to be used at different levels, for example, from lower secondary to the upper secondary or even post secondary. With different difficulty levels, the game also cultivates discipline in view of the progressive learning. Further, the game also enhances students learning of important fundamentals and concepts in chemistry through a competitive, interactive and fun manner.

The described embodiment should not be construed as limitative. For example, in the described embodiment, it is suggested to have two hundred pieces of game pieces 300 but this number may be adjusted depending on the number of players etc. Also, the described embodiment suggests using a set of three dices 200 for generating different chemical groups but the number of dices 200 may be changed accordingly. Also, it is envisaged that other substance group generators may be used for example, an electronic generator with a memory storing the names of the substance groups with different difficulty levels for selection by the game players. When activated, the electronic generator may then generate a random substance group from its memory depending on the selected difficulty level. Indeed, the game apparatus may be adapted into electronic form with the game pieces 300 adapted as electronic game pieces for association with an electronic/virtual game board.

It may not be necessary for the game pieces 300 to be stackable. For example, a previous game piece bearing the same chemical element may be displaced and channelled to a pool of used game pieces to avoid reuse for a new game piece bearing the same chemical element to be used on the same game cell.

In bulk draw, ten game pieces are drawn by each player sequentially but the number of game pieces drawn may change depending on the number of players and number of game pieces. Also, this number may vary depending on how many game pieces have been drawn. For example, after six rounds of each player drawing ten game pieces, subsequent rounds may proceed with each player drawing five game pieces until all the game pieces are distributed. Also, it is suggested that for bulk draw, the game ends when a player finishes placing all his distributed game pieces on the game board 100 and the player is also the winner. However, it is also envisaged that the game may end

when all the players agree and the winner is the player who has the least number of game pieces left or unused. Instead of the number of unused game pieces, points corresponding to the unused game pieces may be used to determine the winner i.e. the winner is the player whose unused game pieces provide the lowest points.

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Also, although the described embodiment proposes having a combination of element game pieces 308 and number game pieces 310, the number game pieces may not be necessary. For example, only the element game pieces 308 are used in a basic game in which the players start to learn about the chemical elements of the periodic table.

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The described embodiment proposes using the 87 element periodic table but this may not be necessary. For example, selected chemical elements or part of the periodic table may be used as part of the game board 100 depending on the focus of the learning.

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Having now fully described the invention, it should be apparent to one of ordinary skill in the art that many modifications can be made hereto without departing from the scope as claimed.

CLAIMS

1. Game apparatus for teaching chemistry to a number of game players, the game apparatus comprising:
5 a plurality of game pieces with at least some of the game pieces being element game pieces which are associated with chemical elements;
an array of game cells with each game cell representing one of the chemical elements;
a substance group generator for generating a name of a chemical substance
10 grouping which are chemically associated with some of the chemical elements.
2. Game apparatus according to claim 1; wherein the chemical elements are elements of the periodic table; and the array of game cells are arranged
15 according to the periodic table of chemical elements.
3. Game apparatus according to claim 1 or 2 wherein the array of game cells are provided on a game board.
- 20 4. Game apparatus according to claim 1 wherein the plurality of game pieces are configured to be stackable one on top of another.
5. Game apparatus according to any preceding claim, wherein each of element game pieces includes a chemical name of the associated chemical element.
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6. Game apparatus according to any preceding claim, wherein each of the element game pieces includes a chemical symbol of the associated chemical element.
- 30 7. Game apparatus according to any preceding claim, wherein each of the element game pieces includes an atomic number of the associated chemical element.
8. Game apparatus according to any preceding claim, wherein each of the
35 element game pieces includes an atomic mass of the associated chemical element.

9. Game apparatus according to any preceding claim, wherein the plurality of game pieces includes number game pieces which have indicia representing a number.
- 5
10. Game apparatus according to any preceding claim, wherein the substance group generator is configured also for generating instructions other than the name of a substance grouping.
- 10
11. Game apparatus according to claim 10, wherein the instructions includes instructing one of the game players to exchange some of the game pieces in the player's possession with another game player.
12. Game apparatus according to claim 10 or 11, wherein the instructions include instructing one of the game players to miss a turn.
- 15
13. Game apparatus according to any preceding claim, wherein the substance group generator comprises a plurality of dices, with at least some faces of each dice carrying the name of the chemical substance grouping.
- 20
14. Game apparatus according to claim 13, wherein the faces of one of the dices includes names of chemical substance groupings which are associated with chemical elements of the periodic table.
- 25
15. Game apparatus according to claim 14, wherein the chemical substance groupings are selected from the group consisting of non-metals, metals, noble gases, semi-metals, gas and halogen.
- 30
16. Game apparatus according to any of claims 13 to 15, wherein the faces of one of the dices includes names of chemical substances which are associated with chemical compounds which are formed by combinations of two or more chemical elements of the periodic table.
- 35
17. Game apparatus according to claim 16, wherein the chemical substance groupings are selected from the group consisting of acids, bases, salts, alkenes, alkanes, basic oxides and acid oxides.

18. Game apparatus according to any preceding claim, further comprising a game stand configured for holding some of the plurality of game pieces.
- 5 19. Game apparatus according to claim 18, when dependent on claim 9, wherein the game stand includes indicia for specifying a predetermined number of element game pieces and a predetermined number of number game pieces to be placed on the game stand.
- 10 20. A game played by a number of game players, comprising:
a plurality of game pieces with at least some of the game pieces being element game pieces which are associated with chemical elements and at least some of the element game pieces distributed to the game players;
an array of game cells with each game cell representing one of the chemical
15 elements;
a substance group generator for generating names from chemical substance groupings which are chemically associated with some of the chemical elements;
each player taking turns and with each turn, the substance group generator generates one of the names for a respective player to determine whether the
20 player has one or more distributed element game pieces which are chemically associated with the generated name, and if so, the player associates the one or more element game pieces with the respective game cells which corresponds to the chemical elements associated with the one or more element game pieces.
- 25 21. A game according to claim 20, wherein the plurality of game pieces are equally distributed to the game players; and the game ending when one of the players finishes associating all his distributed game pieces on the respective game cells.
- 30 22. A game according to claim 20, wherein each of the element game pieces includes a number associated with the corresponding chemical element; wherein the number is used to calculate points awarded to the player for placing the respective element game piece on the respective game cell; the game
35 ending when all the players agree to end the game, and the winner is the player who has the highest points.

23. A game according to claim 22, wherein the number associated with the corresponding chemical element is an atomic number of the corresponding chemical element.
- 5
24. A game according to claim 20, 22 or 23, wherein some of the element game pieces are distributed to the game players, and when the game players associate one or more game pieces with the respective cells, the player takes a same number of game pieces from the plurality of game pieces to replenish his game pieces.
- 10
25. A game according to claim 24, wherein the plurality of game pieces includes number game pieces which have indicia representing a number; and each game player is distributed with six element game pieces and two game pieces to start the game.
- 15
26. A game according to claim 25, wherein the number of the number game pieces is used to calculate the points to be awarded to the player if the corresponding number game piece is used to form part of a chemical substance chemically associated with the generated name.
- 20
27. A game according to any of claims 20 to 26, wherein the substance group generator comprises a plurality of dices, with at least some faces of each dice carrying the name of the chemical substance grouping.
- 25
28. A game according to claim 27, wherein the players take turns to roll at least one of the dices to display the name of the chemical substance grouping.
29. A game according to claim 27, wherein the players take turns to roll two dices to display names of different chemical substance groupings.
- 30
30. A game according to claim 29, wherein the players have an option of associating one or more game pieces with the respective game cells which are chemically associated with either name displayed.
- 35

31. A game according to claim 27, wherein the players take turns to roll three discs to display names of different chemical substance groupings.
- 5 32. A game according to claim 31, wherein the players have an option of associating one or more game pieces with the respective game cells which are chemically associated with one of the names displayed.
- 10 33. A game according to any of claims 27 to 32, wherein the faces of one of the dices includes names of chemical substance groupings which are associated with chemical elements of the periodic table.
- 15 34. A game according to claim 33, wherein the chemical substance groupings are selected from the group consisting of non-metals, metals, noble gases, semi-metals, gas and halogen.
- 20 35. A game according to any of claims 27 to 32, wherein the faces of one of the dices includes names of chemical substances which are associated with chemical compounds which are formed by combinations of two or more chemical elements of the periodic table.
- 25 36. A game according to claim 35, wherein the chemical substance groupings are selected from the group consisting of acids, bases, salts, alkenes, alkanes, basic oxides and acid oxides.
- 30 37. A game according to any of claims 20 to 36, wherein the one or more element game pieces are associated with the respective game cells by placing the one or more element game pieces on a respective game cell.
- 35 38. A game according to any of claims 20 to 36, wherein the plurality of game pieces are configured to be stackable one on top of another, and the game players stacking one game piece on top of another game piece if both game pieces are associated with the same chemical element.
39. Method of playing a chemistry game, the method comprising providing a plurality of game pieces with at least some of the game pieces being element game pieces which are associated with chemical elements;

distributing at least some of the element game pieces to a number of game players;

providing an array of game cells with each game cell representing one of the chemical elements;

5 generating a name from chemical substance groupings which are chemically associated with some of the chemical elements; and if one or more of the distributed element game pieces are chemically associated with the generated name, associating the one or more game pieces on the respective game cells which correspond to the chemical elements associated with the one or more
10 game pieces.

40. Method according to claim 39, wherein the plurality of game pieces includes number game pieces comprising a number.

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41. Method according to claim 39 or 40, further comprising equally distributing the game pieces to the game players for the start of the game.

42. Method according to claim 40, further comprising distributing a pre-determined
20 number of game pieces to the game players for the start of the game.

43. Method according to claim 42, further comprising distributing six element game pieces and two game number pieces to each of the game players for the start of the game.

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44. Method according to any of claims 39 to 43, wherein the chemical elements are elements of the periodic table; and the array of game cells are arranged according to the periodic table of chemical elements.

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45. Method according to any of claims 39 to 43, wherein associating the one or more game pieces with respective game cells includes placing the one or more game pieces on a respective game cell.