GLUE

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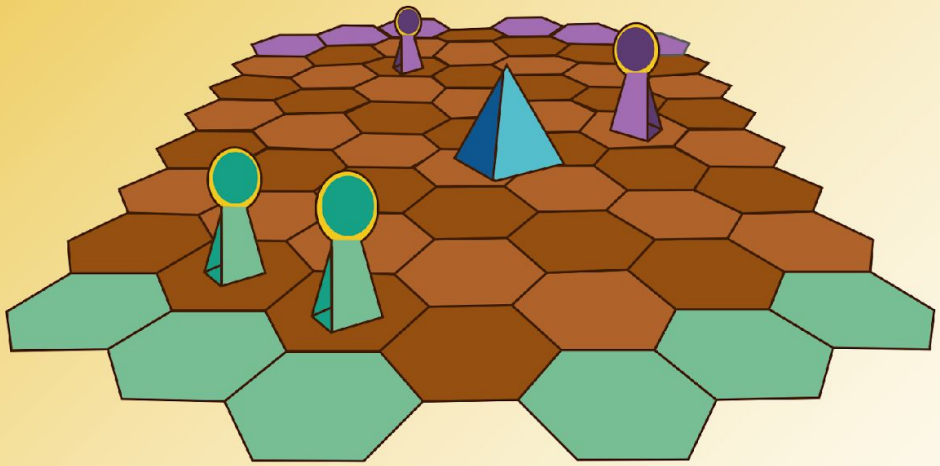
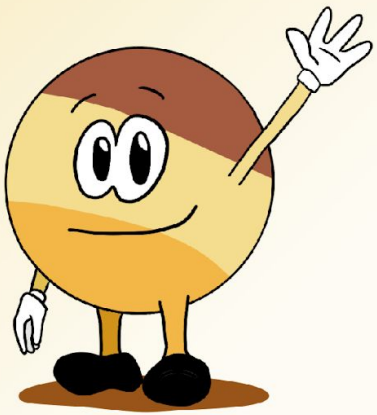
SOIL ION GAME

COMPONENTS
01 explanatory text
01 periodic table
01 board
24 pawns (12 for each player)
02 crowns (01 for each player)
01 dice
04 blocking pieces ($2\ Al^{+3}$ and $6\ H^{+1}$)
34 cards

SOIL ION GAME

2 players
+ 16 years





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Escola Superior de Agricultura "Luiz de Queiroz"
Universidade de São Paulo
Av. Pádua Dias, 11 - Agronomia, Piracicaba - SP, 13418-900, Brasil.

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SOIL ION GAME

Elaboration

Bruna Arruda
Wilfrand Ferney Bejarano Herrera
Clécia Cristina Barbosa Guimarães
Josiane Millani Lopes Mazzetto
Marcia Vidal Candido Frozza
Antonio Carlos de Azevedo

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Translation to English

Cyan Turner

Reference

La Carretta, Marcelo. Como Fazer Jogos de Tabuleiro: Manual Prático. Editora Appris, 2018.

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OBJECTIVE

Overcome the opponent in the sum of valences of the bases K^{+1}; Ca^{+2} and Mg^{+2} and/or to eliminate the elements H^{+1} and Al^{+3} from the board

BEFORE YOU BEGIN

- Each player must distribute 2 K^{+1}; 2 Ca^{+2}, 2 Mg^{+2} at your starting line.
- Each player must randomly place 1 H^{+1} on the board.
- Shuffle the cards to form a deck..

START OF THE GAME

Each player must roll the dice and whoever gets the highest number starts the game. If the dice lands on the “take a card” face, the player can roll again.

ADVANCES

Each round, in turn, each player must roll the dice and perform the following actions depending on the result:

Take a card

The player must take a card from the deck and perform the action described on the card.

If the action is to add an element to the board, it must be placed on its starting line or, if all squares on the starting line are occupied, the element must be added on the line closest to its starting line.

If the action is the removal of any element, the player must remove the indicated element. You must miss your turn if your indicated element is not on the board.

If the requested action is to remove an element from the opponent and they no longer have the element on the board, the player can add that element for themselves.

Joker: allows 1 movement of any element of yours or the opponent, addition of 1 element of yours or elimination of 1 of the opponent, or the removal of 1 H^{+1} or 1 Al^{+3} from the board.

After making the move, the player must discard the card into a discard pile..

If the cards in the deck run out, the discarded cards must be shuffled again.

Number of the dice: 1, 2, 3 or 4

It must be equivalent to the movement of each element and cannot exceed its valence.

K^{+1} moves at most 1 house in any direction.

Ca^{+2} moves a maximum of 2 houses in any direction.

Mg^{+2} moves a maximum of 2 houses in any direction.

Players will not be able to move or eliminate the H^{+1} and Al^{+3}.

H^{+1} and Al^{+3} can only be moved or eliminated from the board by the cards.

The final value of the dice can be divided into the movement of two elements (example: 3 = 1 move of K^{+1} and 2 moves of Ca^{+2})

If the die number was greater than the valence of the remaining elements on the board, the player loses the difference (example: if the player rolls 3 on the die and has no more K^{+1} on de the board, just is able to move 2 of Ca^{+2} or Mg^{+2}).

The elements K^{+1}, Ca^{+2} or Mg^{+2} can eliminate any element of the opponent from the board at the end of the move, according to the value of the dice, as long as the elements are not on the opponent's starting line.

If the player’s pawn (K^{+1}, Ca^{+2} or Mg^{+2}) cannot move due to the presence of H^{+1} or Al^{+3}, the player will lose the turn.

When one of the pawns (K^{+1}, Ca^{+2} or Mg^{+2}) reaches the opponent's starting line, the player can crown it and add an equal element to his starting line. Each player can only have one crowned pawn on the board. If the crowned pawn is eliminated from the board, another can then be crowned.

END OF THE GAME

1. When all the elements H^{+1} and Al^{+3} are eliminated from the board, the player who presents the highest number of valences sum of its elements K^{+1}, Ca^{+2} and/or Mg^{+2} are eliminated from the board, the player with the highest number on the board wins the game. In case of a tie, both players must roll the dice, starting with the player in turn. Whoever gets the highest number wins the game. If the dice lands on the “take a card” face, the player can roll the dice again.

2. When one of the players loses all their bases on the board, the opponent wins the game, regardless of the presence of H^{+1} and Al^{+3} on the board.

1

- ✔ Tropical soils have negative (-) and positive (+) charges, but negative (-) charges predominate.
- ✔ Elements in ionic form with negative (-) (anions) or positive (+) (cations) charge are present in the soil solution.
- ✔ Anions are repelled by the negative charges of the ground, because like charges repel each other.
- ✔ Cations can electrostatically bond to negative charges in the ground, as opposite charges attract each other.

2

- ✔ This characteristic means that cations are not easily lost, serving as a mechanism for storing elements in the soil.
- ✔ However, this bond is weak, allowing cations to be easily exchanged. Thus, an element that is occupying negative charges in the soil can be exchanged for another positively charged element, depending on the chemical balance in the soil.
- ✔ This soil characteristic is called **CATION EXCHANGE CAPACITY (CEC)**

3

The strength of the bond between the elements and the ground is determined by:

- ✔ Hydrated radius: the greater the amount of water surrounding the element, the lower the bonding force with the soil;
- ✔ Ionic radius: the greater the ionic radius of the element, the greater the bond strength with the ground;
- ✔ Valence: the higher the valence of the element, the greater the bond strength with the ground. Elements can have valence +1, +2 or +3 which will bond to 1, 2 or 3 negative ground charges, respectively.

4

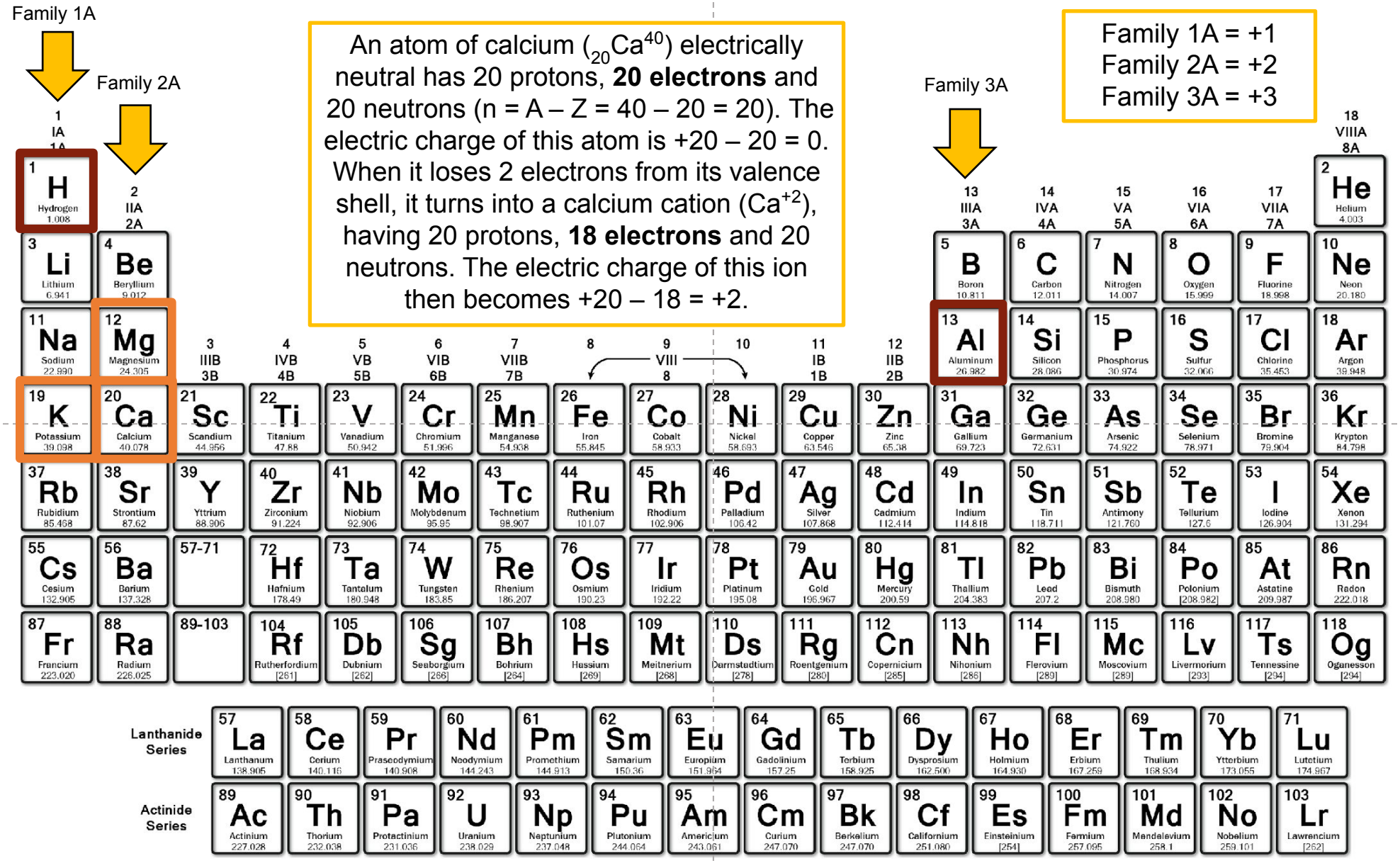
Among the cations present in the soil:

- ✔ Some are beneficial to plants, such as K^{+1}, Ca^{+2} and Mg^{+2}, which are nutrients required by plants. As these elements do not generate acidity, they are considered the bases of the soil.
- ✔ Some cations can be toxic to plants even in small amounts, such as H^{+1} or Al^{+3}, as they cause soil acidity and compete with nutrients for negative soil charges.

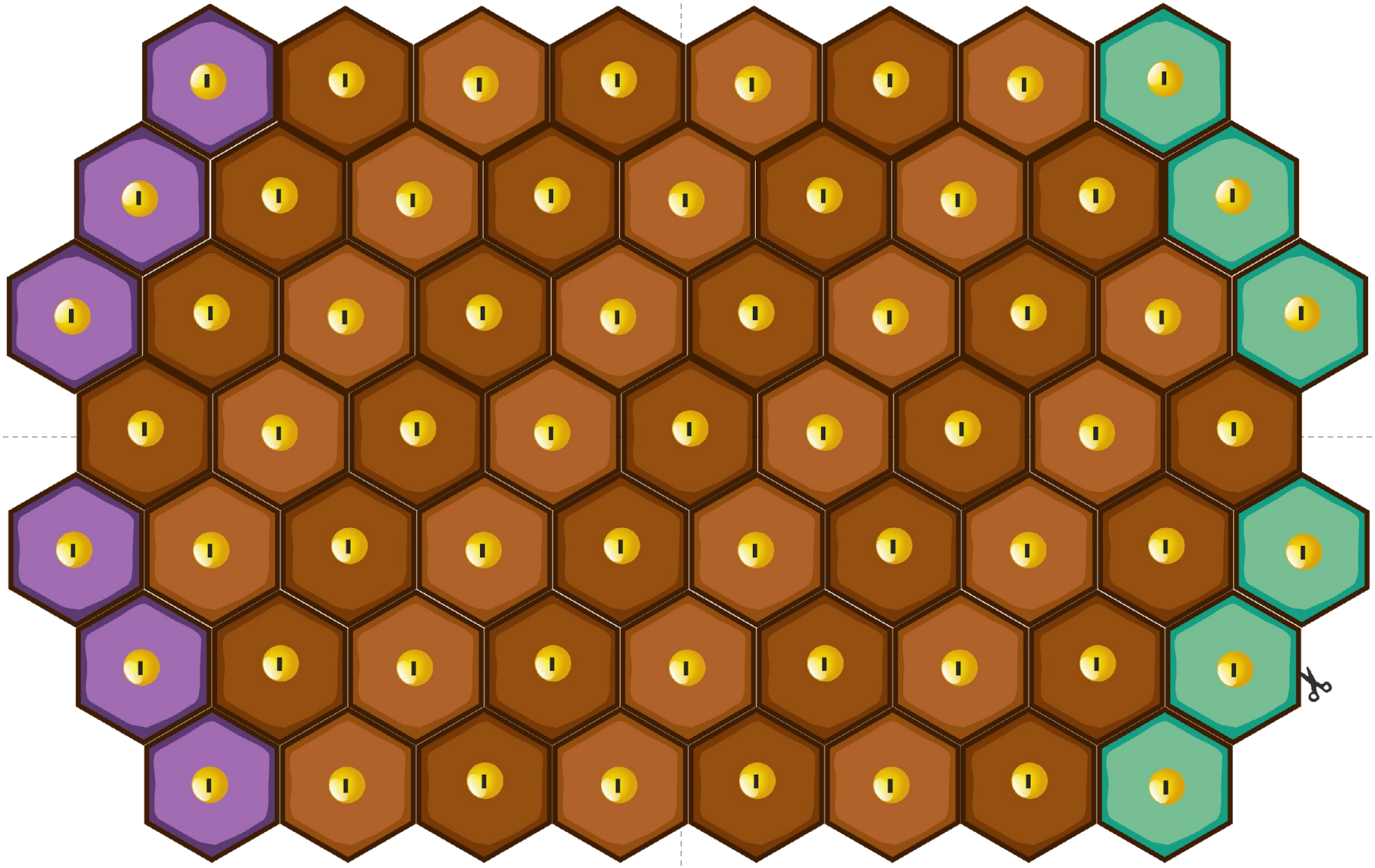
Elemental charges that may be present in the soil

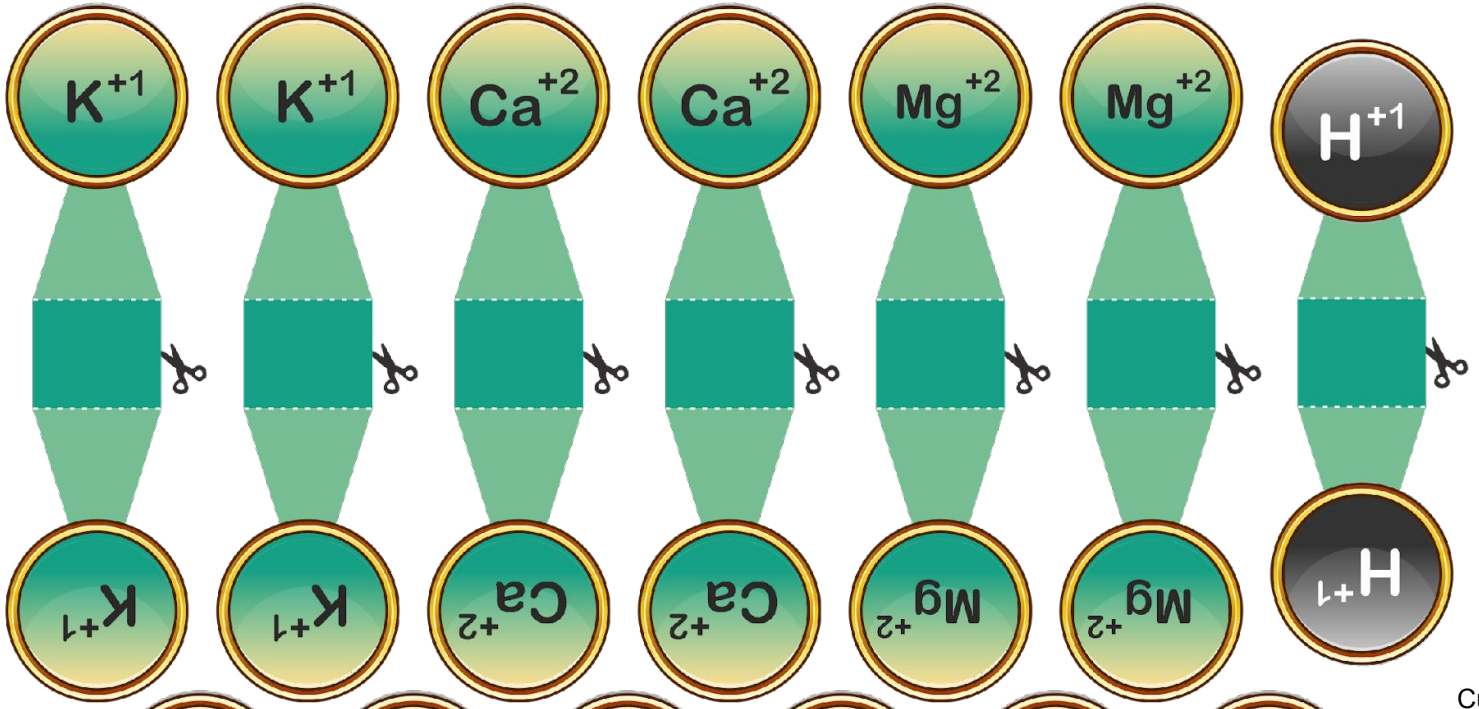
An atom of calcium ($_{20}Ca^{40}$) electrically neutral has 20 protons, **20 electrons** and 20 neutrons (n = A – Z = 40 – 20 = 20). The electric charge of this atom is +20 – 20 = 0. When it loses 2 electrons from its valence shell, it turns into a calcium cation (Ca^{+2}), having 20 protons, **18 electrons** and 20 neutrons. The electric charge of this ion then becomes +20 – 18 = +2.

Family 1A = +1
Family 2A = +2
Family 3A = +3

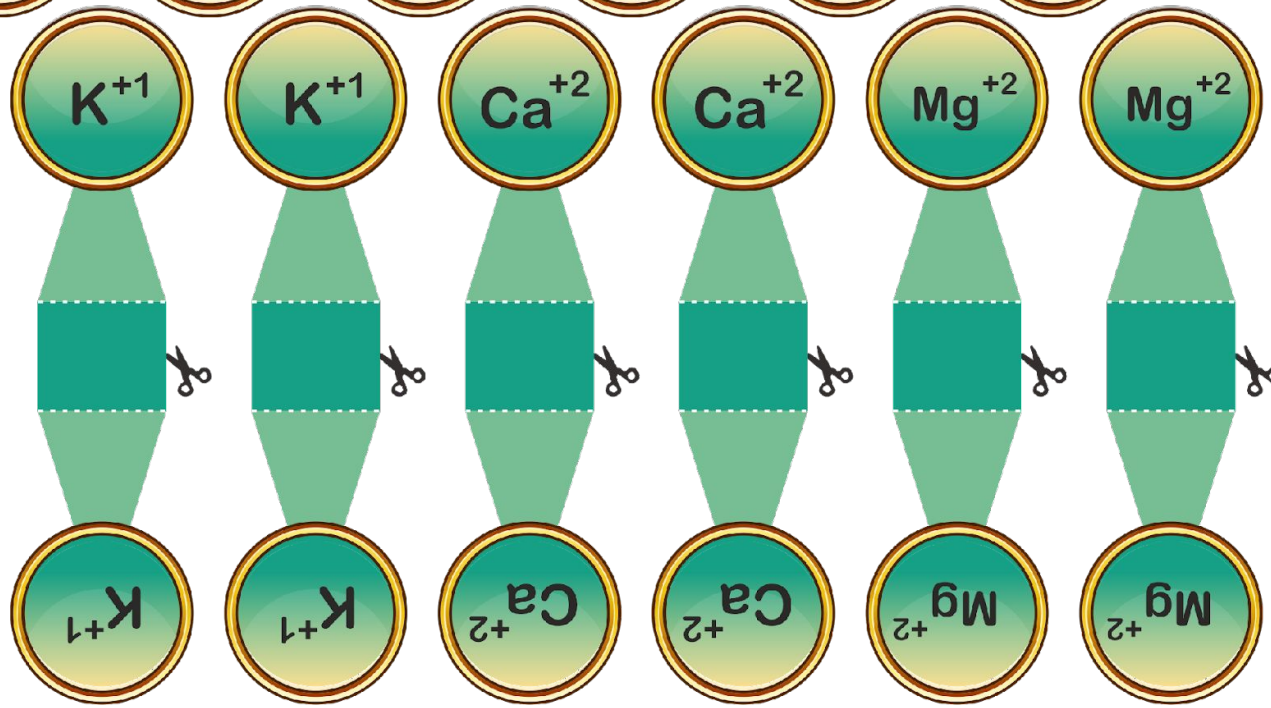


Fold along the dotted lines and cut out the outer edges of the board.





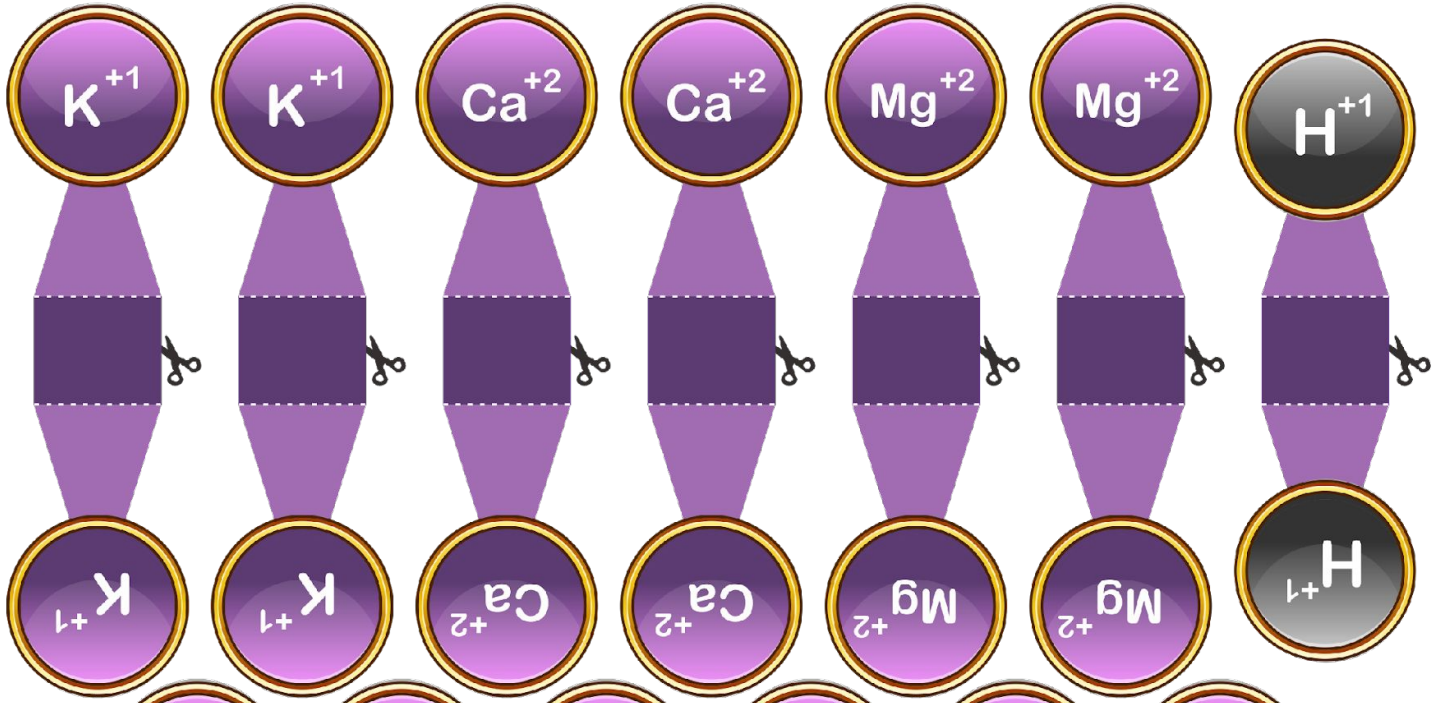
Player 1



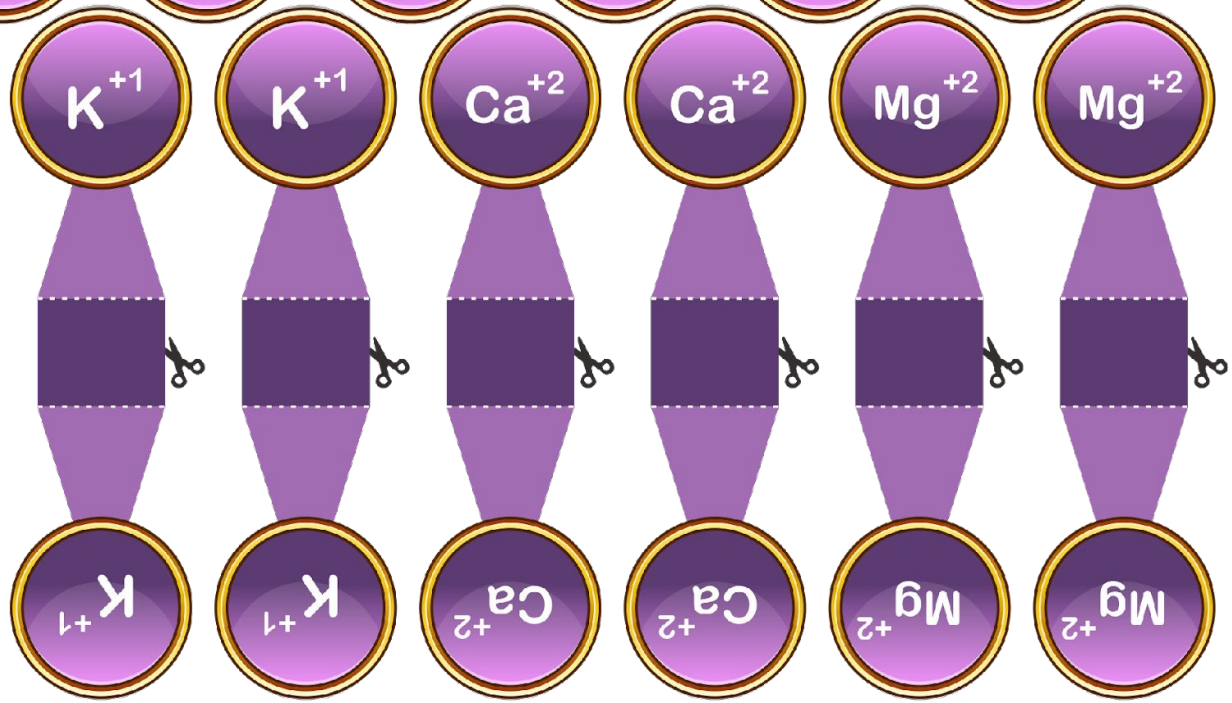
Cut, fold on the dotted line and glue the round ends to join the piece.

Reserve Player 1

Cut, fold on the dotted line and glue only the "ball" as shown here



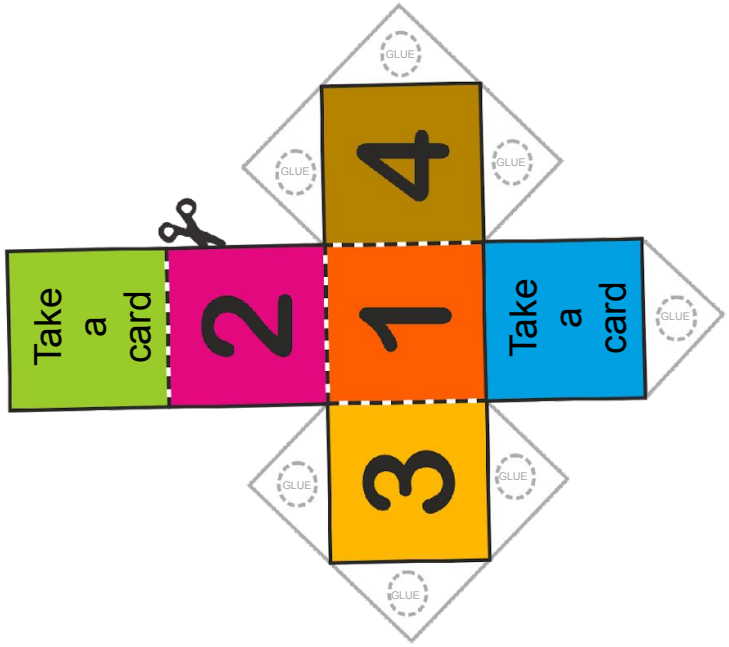
Player 2



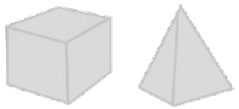
Cut, fold on the dotted line and glue the round ends to join the piece.

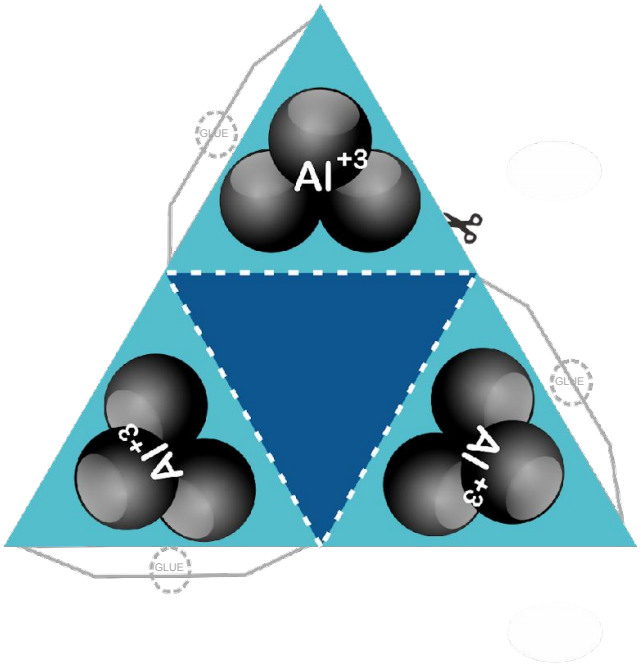
Reserve Player 2

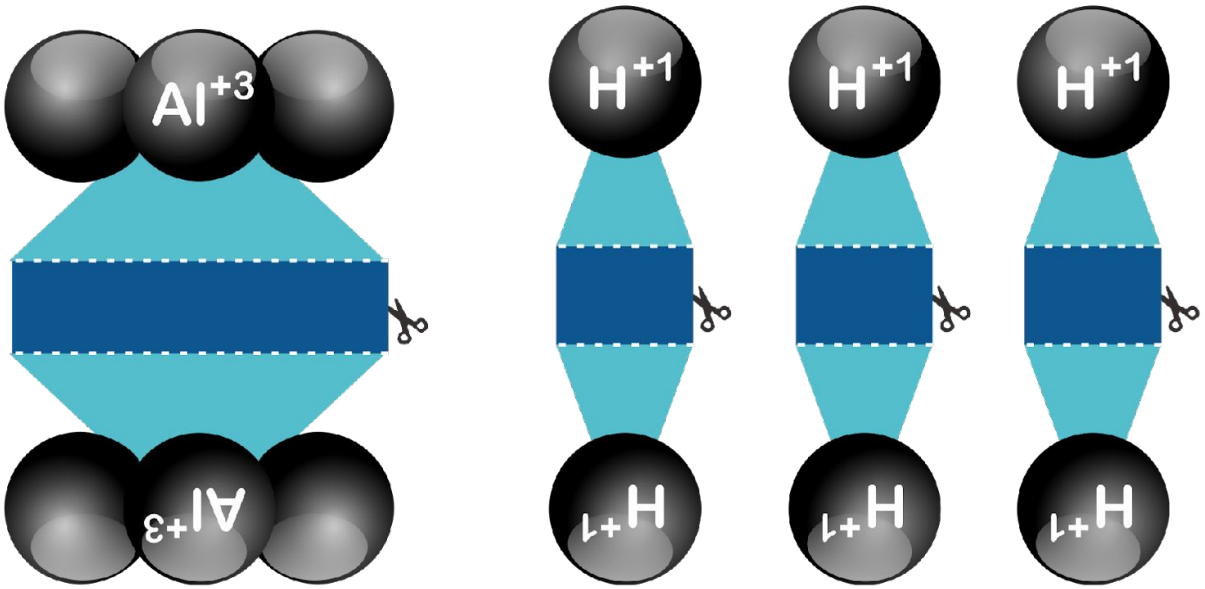
Cut, fold on the dotted line and glue only the "ball" as shown here



Cut, fold in line
dotted and glue
as in the figures below.

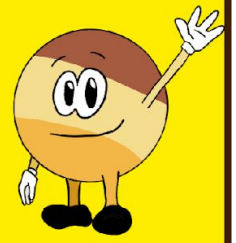




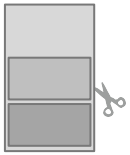


Cut, fold on the dotted line
and glue only the "ball"
as shown here.

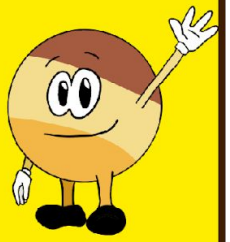
Potassium fertilization	Gypsum application	Magnesian rock weathering
ADD 1 K^{+1}	ADD 1 Ca^{+2}	ADD 1 Mg^{+2}
Limestone application	Limestone application	Limestone application
TAKE OF 1 H^{+1} OR 1 Al^{+3} OR ADD 1 Ca^{+2}	TAKE OF 1 H^{+1} OR 1 Al^{+3} OR ADD 1 Mg^{+2}	TAKE OFF 1 H^{+1} OR 1 Al^{+3}
Limestone application	Quicklime application	Quicklime application
TAKE OFF 1 H^{+1} OR 1 Al^{+3}	TAKE OFF 1 H^{+1} OR 1 Al^{+3}	TAKE OFF 1 H^{+1} OF 1 Al^{+3}

Event in erosion	Event in erosion	Plant uptake Ca^{+2}
TAKE OFF 1 K^{+1} OR MISS THE TURN	TAKE OFF 1 Mg^{+2} OR MISS THE TURN	TAKE OFF 1 Ca^{+2} OR MISS THE TURN
Acid rain	Acidification of the rhizosphere by absorption of K^{+1}	You didn't apply limestone
ADD 1 H^{+1}	ADD 1 H^{+1}	ADD 1 H^{+1}
Your soil pH is below 4.5	**JOKER** 	
ADD 1 Al^{+3}		

Cut only on the thickest line to separate the cards, as in the picture below.



✓	✓	✓
Erosion event for your opponent	Leaching has occurred for your opponent	Plant uptake Ca^{+2} from your opponent
TAKE OFF 1 K^{+1} FROM YOUR OPPONENT OR ADD 1 K^{+1}	TAKE OFF 1 Mg^{+2} FROM YOUR OPPONENT OR ADD 1 Mg^{+2}	TAKE OFF 1 Ca^{+2} FROM YOUR OPPONENT OR ADD 1 Ca^{+2}
✓	✓	✓
Limestone application	Limestone application	Limestone application
TAKE OFF 1 H^{+1} OR 1 Al^{+3} OR ADD 1 Ca^{+2}	TAKE OFF 1 H^{+1} OU 1 Al^{+3} OU ADICIONE 1 Mg^{+2}	TAKE OFF 1 H^{+1} OR 1 Al^{+3}
✓	✓	✓
Limestone application	Quicklime application	Quicklime application
TAKE OFF 1 H^{+1} OR 1 Al^{+3}	TAKE OFF 1 H^{+1} OR 1 Al^{+3}	TAKE OFF 1 H^{+1} OR 1 Al^{+3}

✗	✗	✗
Potassium fertilization for your opponent	Your opponent applied agricultural gypssum	Magnesian Rock Weathering occurred for your opponent
ADD 1 K^{+1} FOR YOUR OPPONENT	ADD 1 Ca^{+2} FOR YOUR OPPONENT	ADD 1 Mg^{+2} FOR YOUR OPPONENT
✗	✗	✗
Acid rain	Acidification of the rhizosphere by absorption in K^{+1}	You didn't apply lime
ADD 1 H^{+1}	ADD 1 H^{+1}	ADD 1 H^{+1}
✗	**JOKER**	
Your soil pH is below 4.5		
ADD 1 Al^{+3}		

Cut only on the thickest line to separate the cards, as in the picture below.