



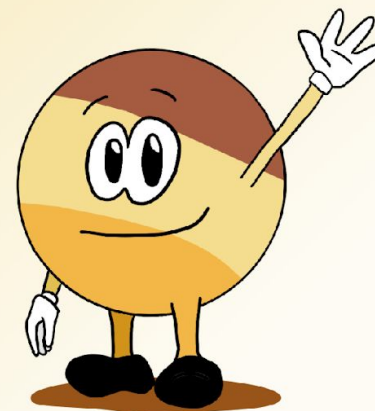
- COMPONENTS**
- 01 explanatory text
 - 01 periodic table
 - 01 board
 - 24 pawns (12 for each player)
 - 02 crowns (01 for each player)
 - 01 dice
 - 04 blocking pieces (2 A1³ and 6 H⁺1)
 - 34 cards



SOIL ION GAME



2 players
+ 16 years



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CDU 55



SOIL ION GAME

Elaboration

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PPSNE (2022)

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Reference

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



GLUE

GLUE

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 e 6 H⁺¹)
34 cards

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 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

- 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.
- 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.

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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.

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- ✓ 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.

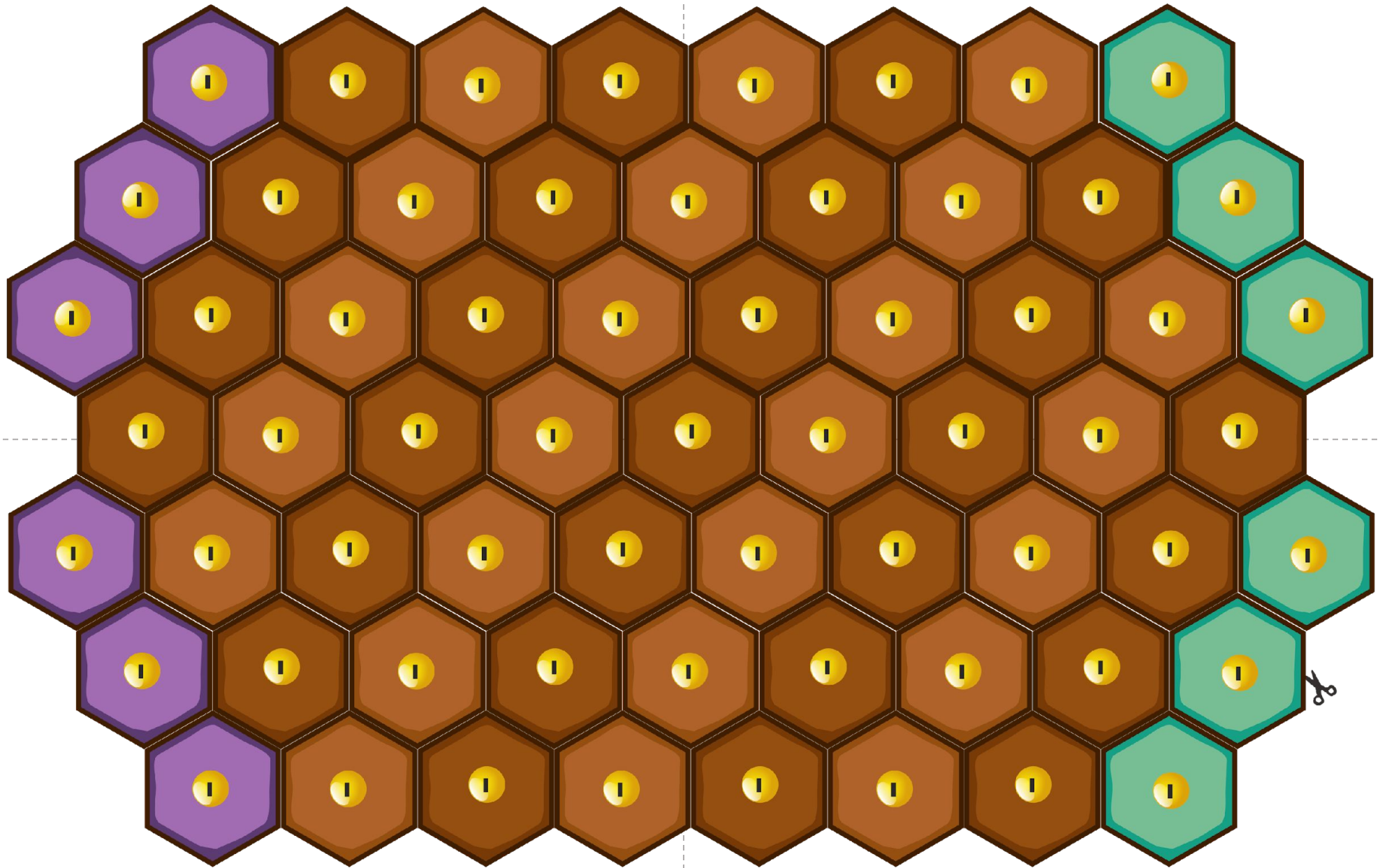
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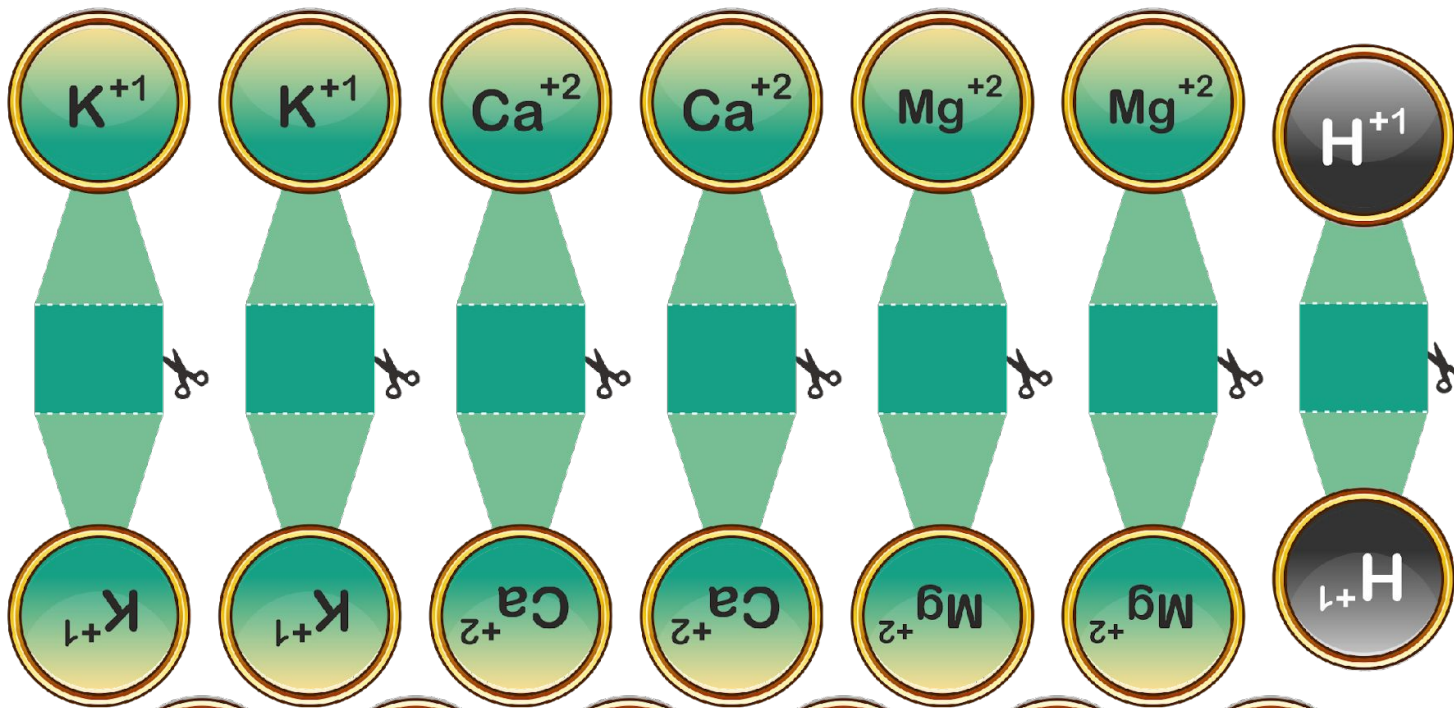
- Among the cations present in the soil:
- ✓ Some are beneficial to plants, such as K^{+1} , Ca^{+2} and Mg^{+2} , which are nutrients required by plants. As these elements do not generate acidity, they are considered the bases of the soil.
 - ✓ Some cations can be toxic to plants even in small amounts, 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

										<p>An atom of calcium (${}_{20}\text{Ca}^{40}$) 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 $+20 - 18 = +2$.</p>																								
										<p>Family 1A = +1 Family 2A = +2 Family 3A = +3</p>																								
Family 1A																				Family 3A														
↓																				↓														
Family 2A																																		
↓																																		
1 IA 1A											13 IIIA 3A	14 IVA 4A	15 VA 5A	16 VIA 6A	17 VIIA 7A	18 VIIIA 8A																		
1 H Hydrogen 1.008											5 B Boron 10.811	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180																		
3 Li Lithium 6.941	4 Be Beryllium 9.012											11 Na Sodium 22.990	12 Mg Magnesium 24.305	3 IIIB 3B	4 IVB 4B	5 VB 5B	6 VIB 6B	7 VIIB 7B	8 VIII 8	9 VIII 8	10 VIII 8	11 IB 1B	12 IIB 2B	13 Al Aluminum 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.066	17 Cl Chlorine 35.453	18 Ar Argon 39.948					
19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.88	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.631	33 As Arsenic 74.922	34 Se Selenium 78.971	35 Br Bromine 79.904	36 Kr Krypton 84.798																	
37 Rb Rubidium 85.468	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.95	43 Tc Technetium 98.907	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.906	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.414	49 In Indium 114.818	50 Sn Tin 118.711	51 Sb Antimony 121.760	52 Te Tellurium 127.6	53 I Iodine 126.904	54 Xe Xenon 131.294																	
55 Cs Cesium 132.905	56 Ba Barium 137.328	57-71	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.85	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.967	80 Hg Mercury 200.59	81 Tl Thallium 204.383	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium [208.982]	85 At Astatine 209.987	86 Rn Radon 222.018																	
87 Fr Francium 223.020	88 Ra Radium 226.025	89-103	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [266]	107 Bh Bohrium [264]	108 Hs Hassium [269]	109 Mt Meitnerium [268]	110 Ds Darmstadtium [278]	111 Rg Roentgenium [280]	112 Cn Copernicium [285]	113 Nh Nihonium [286]	114 Fl Flerovium [289]	115 Mc Moscovium [289]	116 Lv Livermorium [293]	117 Ts Tennessine [294]	118 Og Oganesson [294]																	
Lanthanide Series										57 La Lanthanum 138.905	58 Ce Cerium 140.116	59 Pr Praseodymium 140.908	60 Nd Neodymium 144.243	61 Pm Promethium 144.913	62 Sm Samarium 150.36	63 Eu Europium 151.964	64 Gd Gadolinium 157.25	65 Tb Terbium 158.925	66 Dy Dysprosium 162.500	67 Ho Holmium 164.930	68 Er Erbium 167.259	69 Tm Thulium 168.934	70 Yb Ytterbium 173.055	71 Lu Lutetium 174.967										
Actinide Series										89 Ac Actinium 227.028	90 Th Thorium 232.038	91 Pa Protactinium 231.036	92 U Uranium 238.029	93 Np Neptunium 237.048	94 Pu Plutonium 244.064	95 Am Americium 243.061	96 Cm Curium 247.070	97 Bk Berkelium 247.070	98 Cf Californium 251.080	99 Es Einsteinium [254]	100 Fm Fermium 257.095	101 Md Mendelevium 258.1	102 No Nobelium 259.101	103 Lr Lawrencium [262]										

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





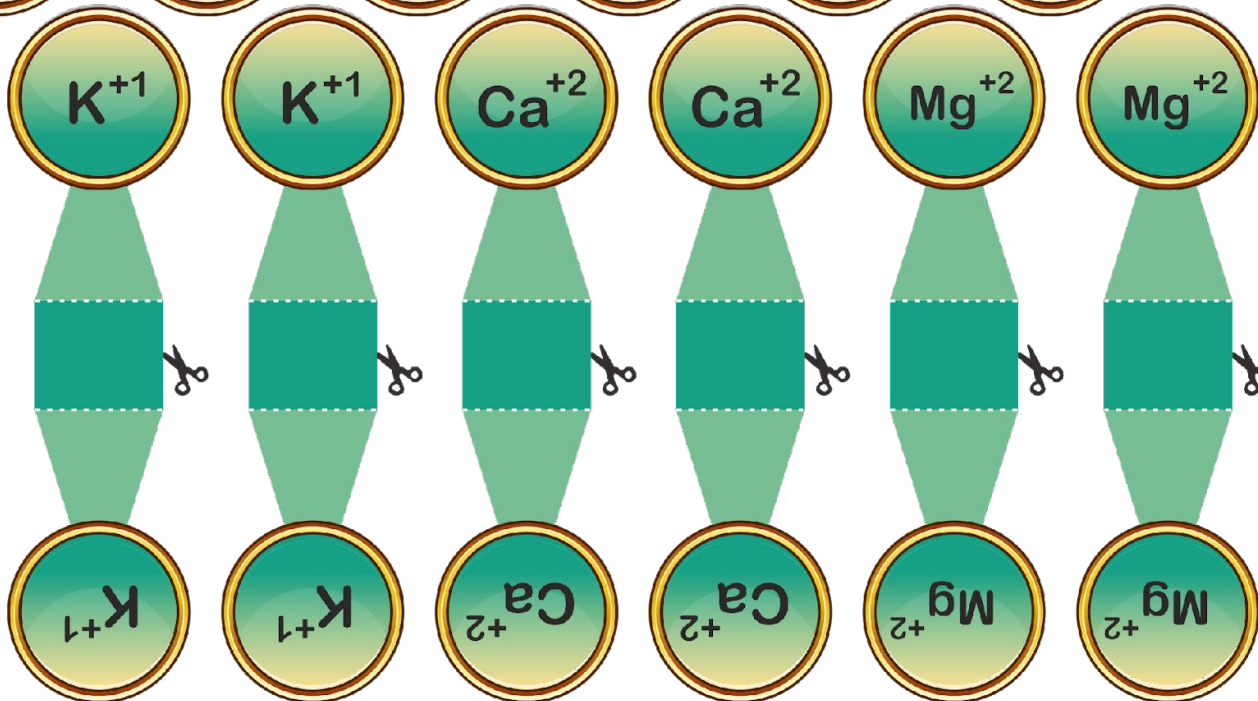
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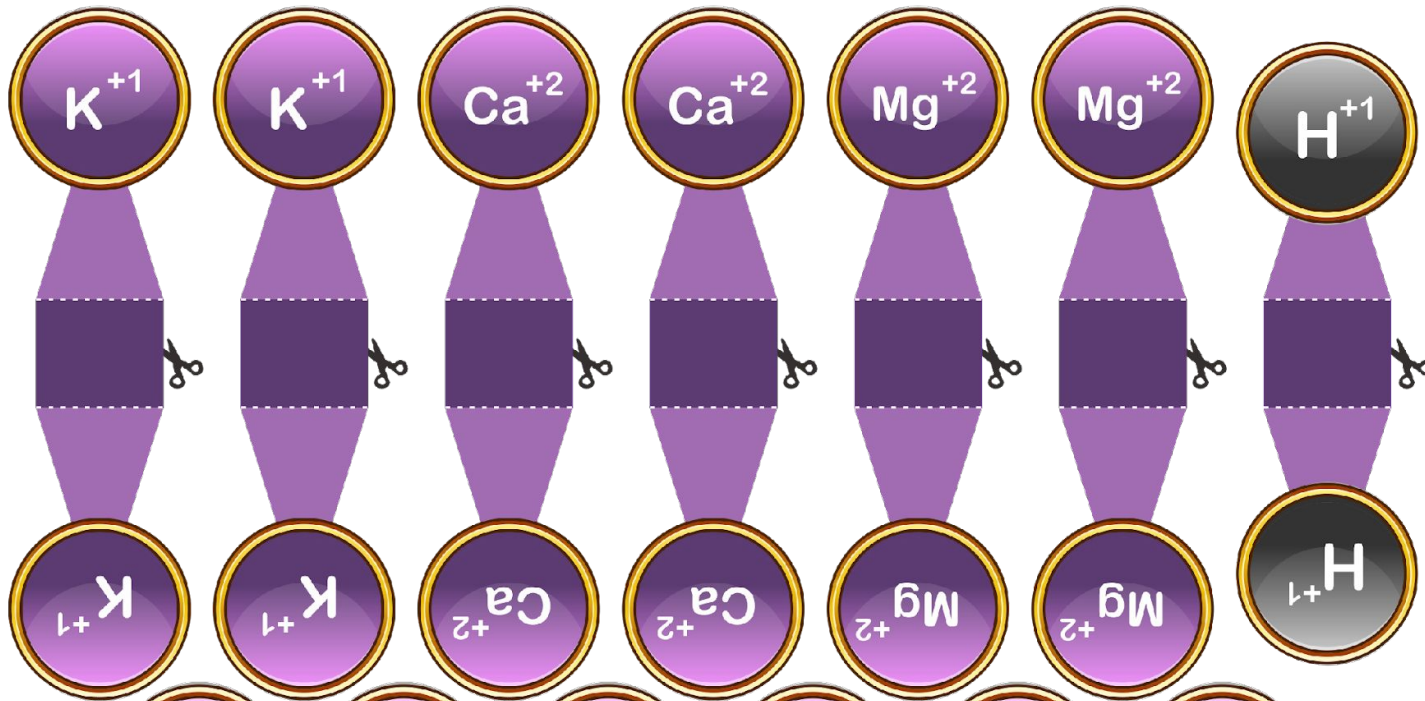
Cut, fold on the dotted line and glue the round ends to join the piece.



**Reserve
Player 1**

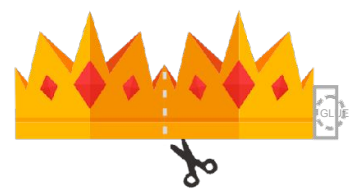
Cut, fold on the dotted line and glue only the "ball" as shown here





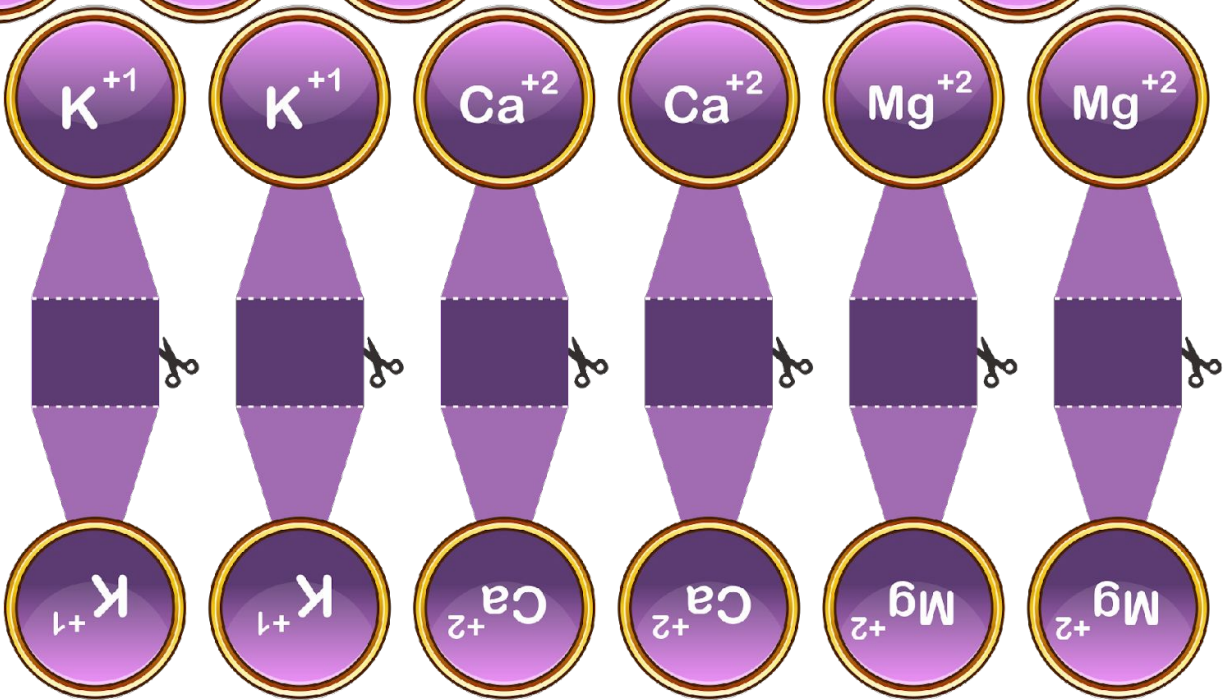
Player 2

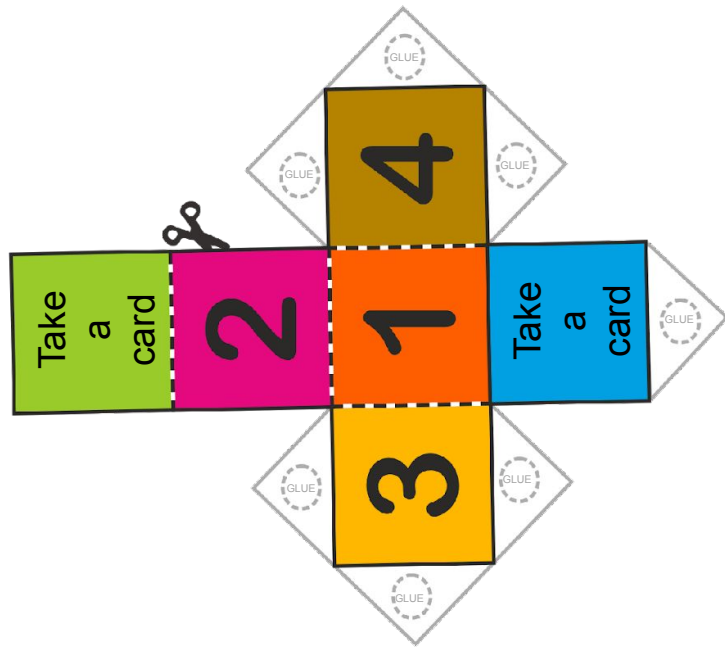
Cut, fold on the dotted line and glue the round ends to join the piece.



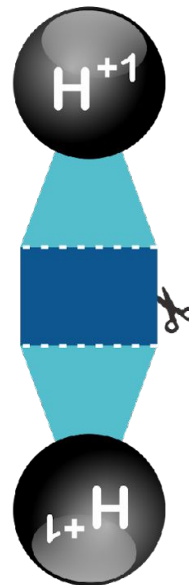
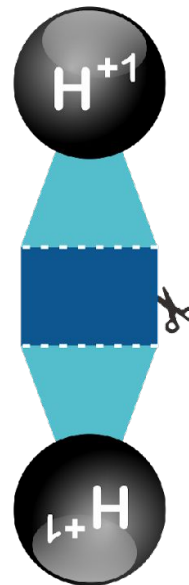
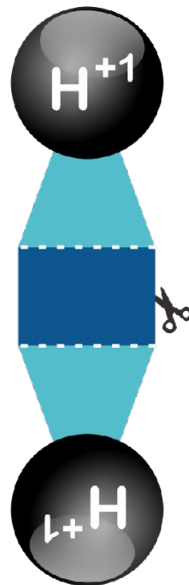
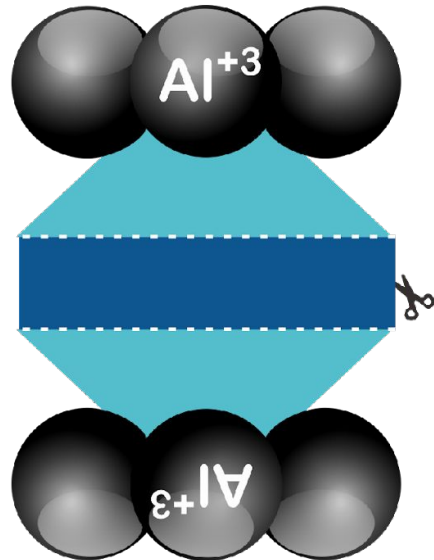
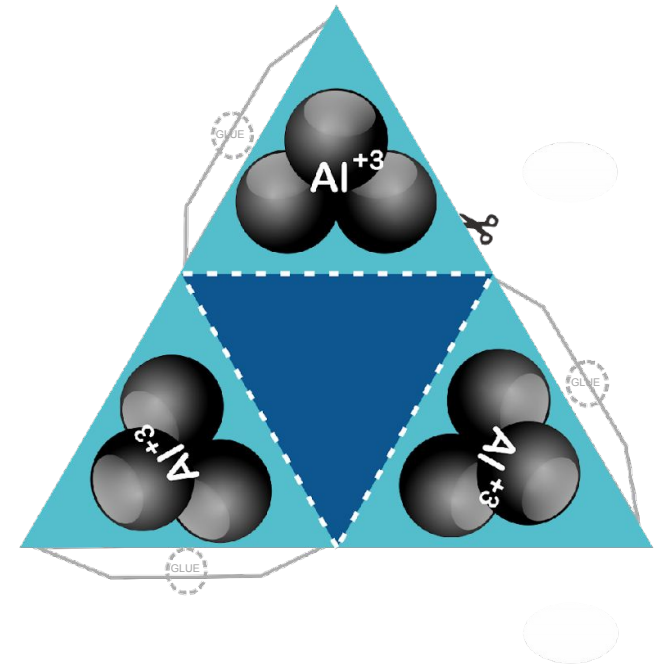
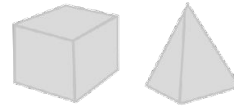
**Reserve
Player 2**

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.



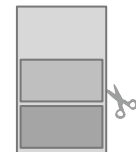
Cut, fold on the dotted line and glue only the "ball" as shown here.



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 OFF 1 H ⁺¹ OR 1 Al ⁺³ OR ADD 1 Ca ⁺²	TAKE OFF 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
	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.



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 gypsum	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.

