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The Solar System With the Use of the Hunting Words Game

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Abstract: In the science teaching of elementary education, there are many possibilities to work on the concepts, avoiding merely expository teaching; but taking into account other methodological proposals, such as the use of games. The game is characterized by fun and freedom with rules that must be followed. In order to prevent the student from stop being a simple content recipient and start interacting and appropriating the very process of knowledge construction, we propose the use of the Word Search game. Therefore, we present an activity proposal using the game Word Hunting involving the content of the Solar System, targeting children or teenagers from elementary school. When using the game Word Search, the teacher will realize that one can stimulate creativity, because it is a game that stimulates reasoning and attention.

Key words: solar system, game, word search, science teaching

1. Introduction

In this article we study the Solar System and its main elements that orbit the Sun. The main elements concern the planets, with their most relevant characteristics. We will also discuss, in a superficial way, its smaller bodies, that is, satellites, asteroids and comets.

Until the year 2006, students learned at school that the Solar System was composed of nine planets. At least, that's what teachers have been teaching since the 1940s. Pluto, for example, stopped being considered a planet in the past decade. According to Drigo Filho & Chanut (n.d.), preliminary astronomical observation is available to all, just looking at the sky, because the movement of the Sun, the Moon and others can be observed with the naked eye. Still, according to the authors, this type of curiosity has been increasingly rare, especially among young people. Thus, an initial incentive is required to awaken or reinforce interest in the subject, in addition to providing basic information on the topic in question.

According to the National Curriculum Parameters (PCN) of sciences (Brazil, 1997), there are countless possibilities for working with natural science contents in the first cycle of Elementary Education. That is why it is feasible to develop objective explanations that are close to science. It is also possible to get in touch with a variety of aspects of the world, which the teacher can explore and explain, allowing students to know and express themselves. The first years of elementary school are a crucial stage for the beginning of learning scientific concepts, in addition to important procedures and values (Di Roma & Camargo, 2015, p. 143).

As in the teaching of science in elementary education, there are many possibilities to work on the concepts, avoiding merely expository teaching, but taking into account other methodological proposals, such as games, trying

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to make the student (child or adolescent) stop being a simple receiver person of content. Start interacting and appropriating the very process of knowledge construction is the reason why we propose the use of the game Word Hunting.

The Word Search is a simple game and has lightness in its essence. The player's goal is to find words in a tangle of letters. In addition, it can serve as a binomial interaction between student-content as long as the hidden words are related to the theme. Therefore, we present an activity proposal using the game Word Hunting involving the content of the Solar System, targeting children or teenagers from elementary school.

2. The Solar System

The Solar System is the set of planets, dwarf planets, asteroids and other celestial bodies that orbit around the Sun, a small star that orbits in one of the arms of the Milky Way galaxy (Rodrigues, 2003; Thakoor, 2010). Why study the Solar System? We have that the stars of the Solar System, in particular the Sun, are very present in our day-to-day life. For example, the way we measure time, our visual perception and our very existence are directly linked to conditions in the Solar System. Our vision is adapted to the type of electromagnetic radiation, called visible light, which is able to penetrate our atmosphere (Rodrigues, 2003). There are billions of galaxies in the Universe and for each galaxy billions of stars. Thus, our system, the Solar System is only a very small part of the Universe. And, one can also say a very small part of our own galaxy, the Milky Way (Thakoor, 2010).

The Solar System began to form about 4.6 billion years ago, and is made up of eight known planets, including the Earth on which we live and a star called the Sun, one of the billions of stars in the Milky Way that was born a long time ago, that is, about 5 billion years ago. Our Solar System also consists of a belt of asteroids, meteorites, comets and moons (Thakoor, 2010). All planets travel around the Sun and some planets have moons revolving around them. The paths of planets and moons are called orbits, while the path of the Sun in the sky is called ecliptic. All planets revolve around the Sun in their own orbits, just as the moons have their orbits when moving around the planets. Thus, the planets orbit around the Sun with their moons. The Sun, too, rotates on its axis and the entire Solar System is moving through the Milky Way. They never leave their orbits, they are all controlled by their gravitational pull (Thakoor, 2010).

The Solar System currently has eight planets, six planets called dwarf planets and hundreds of moons, comets, asteroids and other types of celestial bodies (Figure 1). The eight planets that make up the Solar System, in order of proximity to the Sun, are: (1) Mercury, (2) Venus, (3) Earth, (4) Mars, (5) Jupiter, (6) Saturn, (7) Uranus and (8) Neptune. The first four have a lower proportion of gases in their physical compositions, being basically formed by rocks and, for this reason, they are called rocky planets. The last four, depending on the distance from the sun, have a greater amount of gases in their structural compositions, which is why they are called gas planets or even gas giants (Figure 2), thanks to the large diameter they have in relation to the others.[1]

According to Gregorio-Hetem and Jatenco-Pereira (2010) on August 24, 2006, during the XXVI General Assembly of the International Astronomical Union UAI (International Astronomical Union), Pluto was "demoted", the new category, called "dwarf planet". Such a category was due to the discoveries of several other bodies orbiting the Sun, as far away as Pluto. In particular, there was Eris, which appeared to be larger than Pluto — the former ninth planet in the Solar System. During the assembly, the new definition of a planet was approved as a celestial body that: (a) orbits the Sun; (b) is in hydrostatic equilibrium, that is, it has enough mass so that the self-gravitation

[1] Retrieved and translated from the website: http://brasilescola.uol.com.br/geografia/sistema-solar.htm.

overcomes the rigidity of the material, taking on a spherical shape; and (c) it does not have bodies of similar mass in the vicinity of its orbit. With this resolution the Solar System officially consists of eight planets Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune. A new class of objects called Dwarf Planets was created, with Ceres, Pluto and Éris being the first members of this new category. A dwarf planet satisfies items (a) and (b) above, but not (c). A new class of objects was also recognized, the Trans-Neptunian objects, with Pluto being the prototype of this new class (Gregorio-Hetem & Jatenco-Pereira, 2010, p. 29).

Thus, it is worth remembering that Pluto was once considered a planet, but lost that status in 2006 because it does not have a fully autonomous translation movement. Éris, for example, when it was discovered, initially received the name 2003 UB313 and came to be considered as a new planet in the Solar System. However, later on, it was realized that it was a dwarf planet similar to Pluto[2]. Until 2006, there were nine planets, when international astronomers, after several discussions, ended up voting that Pluto should be reclassified as a "dwarf planet". It was for decades after its discovery, in 1930, that Pluto was thought to be about the size of Earth. Since the late 1970s, when its moon, Charon was discovered, it has been realized that Pluto has only 1/500 the mass of the Earth.

As for the currently known dwarf planets, we have: Ceres, Pluto, Haumea, Makemake, Éris and the 2012 VP113. However, the possibility of the existence of other dwarf planets besides these must be reported; because the last dwarf planet mentioned was discovered in 2014, being considered the most distant celestial body from the Sun in the Solar System. Jupiter, Saturn, Uranus and Neptune, also called outer planets, have low density and are classified as Jovian planets, because their prototype is the planet Jupiter. Its main constituents are free substances: hydrogen and helium gas, water ice, methane, carbon dioxide and ammonia. Mercury, Venus, Earth and Mars are the planets with the highest density, "orming the class of telluric planets (in this case, the prototype is Earth). They consist of rocks (silicates and oxides) and metals, such as nickel and iron (British Encyclopedia, 2011; Gregorio-Hetem & Jatenco-Pereira, 2010).

3. The Educational Game: Hunting Words

The game, as a product of society, has the characteristics of fun and freedom with rules that must be followed (Kishimoto, 1997). The definition of Antunes apud Neves and Santiago (2009), the word game comes from *jocu*, a masculine noun of Latin origin that means *gracejo* — funny. In its origin it expresses a fun, joke, pastime subject to rules that must be observed when playing. It also means balance, oscillation, cunning, trickery, maneuver (Neves & Santiago, 2009, p. 27). Thus, the game, despite being understood as a ludic activity, follows rules that must be observed. This allows for cognitive or motor development. For Brougére (2006) he becomes involved through a voluntary procedural action that includes a playful intention of the player, with internal and hidden rules - it is a free activity that, if imposed, is no longer a game.

When you play, you work on thinking, feeling, emotion, generating communication channels, in which the cultural language proper to the human being transforms you, because the act of playing is a way of reaching your own development (Fontes et al., 2010). It can be said that playing comes from the act of playing, which was a way that the human being found to seek the balance between the satisfaction and non-satisfaction of his most primitive impulses, as well as the balance of his emotion and his affectivity (Pacheco & Garcez, 2012). Playing and playing allows people to adapt to the environment, start to value other members and respect rules and values (Rocha, 2005).

To understand how word search emerged in Brazil and other games such as cryptograms (a hobby in which a

[2] Retrieved and translated from the website: http://brasilescola.uol.com.br/geografia/sistema-solar.htm.

word is discovered by means of symbols, which are equivalent to letters), a game of errors and logic challenges, it is necessary to understand how crosswords arose. The crossword puzzle appeared in the year 1913, when the journalist Arthur Wynne, who occupied the position of editor of the American newspaper The New York World, decided to launch a novelty in the hobbies section of the Sunday edition. A diagram that he called “Crosswords”. Over the years, the novelty has become a national craze for millions of people and the United States has established itself as the country that consumes the most crossword puzzles in the world (n/d, n/p).

In Brazil, direct crosswords have become more popular, that is, with keys, or definitions, within the diagrams, unlike in the United States, where the crosswords present the keys, or definitions, outside the diagram. Due to its success, in the following years COQUETEL (whose translation is Cocktail) began to publish other types of hobbies in which “Caça Palavras” (Whose meaning is word hunt) was part of. Examples are: duplex, cryptograms, error game and logic challenges.

4. Proposed Activity for the Solar System

The proposed activity with the use of the Word Hunt game involving the Solar System content with primary school children or teenagers as target audience. There are twenty challenges, which consist of clippings of texts or questions. The first four challenges denoted by letters are questions referring to the Solar System and whose answers can be withdrawn through a secret word or secret code (Challenges A, B, C and D). The other challenges are given through words within text clippings, also referring to the Solar System (Challenges 1, 2, 3, 4, 5 and 6). It is simple to use software. To create the word search game for each challenge, we used a free software called “Word Search Creator” which is available on the website: https://www.tividadeseducativas.com.br/cacapalavras/fs.wordfinder.php. software credits are from Robert Klein. It is simple to use software. The tabs displayed by the “Word Search Creator” software are: (1) Main, (2) Option 1, (3) Option 2, (3) Load and (4) Info. When the software is opened, the Main tab appears, it is possible to insert a title for the Word Search, to write the desired words automatically separated by spaces, commas or lines and when the bottom button is marked, immediately after the table with the chosen words, you can enter the words manually. Option 1 shows the number of lines — minimum 10 and maximum 100; the number of columns - minimum 10 and maximum 100; table type — examples: square; font size; background color; font color; color of the chosen word; number of random words; and, the Word Search language — English or Portuguese. In Option 2 it is possible for the user to manage the list of words — example diagonal and/or vertical words, use upper- or lower-case letters, etc. In Load it is possible to load a previously saved game. And, Info has basic information to create the Word Search, for example: repeated words will be removed, maximum and minimum length of a word and the program will skip words that do not fit.

So, to create a word search game you must put in the Main tab as desired words separated by spaces, commas or lines and click on the button at the bottom “create word search” and the game created automatically. For our case we selected the type of table as being rectangle, white background color and font color or black words. The language we used was English. Next, we present the challenges proposed for the theme of the Solar System.

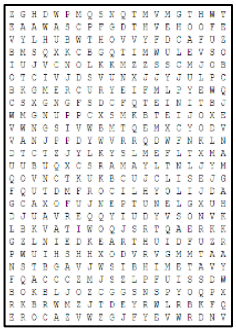
CHALLENGE 1: Which are planets in the Solar System?

3-III	1-V	4-III	1-III	5-I	4-III	5-IV
5_II		1-V	3-IV	5-I	4-IV	
1-V	1-I	4-III	4-V	2-III		
3-III	1-I	4-III	4-IV			
2-V	5-I	4-I	2-IV	4-V	1-V	4-III
4-IV	1-I	4-V	5-I	4-III	3-IV	
5-I	4-III	1-I	3-IV	5-I	4-IV	
3-IV	1-V	4-I	4-V	5-I	3-IV	1-V

SECRET CODE

	I	II	III	IV	V
1	A	B	C	D	E
2	F	G	H	I	J
3	K	L	M	N	O
4	P	Q	R	S	T
5	U	V	W X	Y	Z

PLANETS OF THE SOLAR SYSTEM



CHALLENGE 2: What are the dwarf planets in the Solar System?

1-III	1-V	4-III	1-V	4-IV			
4-I		3-II	5-I	4-V	3-V		
2-III	1-I	5-I	3-III	1-V	1-I		
3-III	1-I	3-I	1-V	3-III	1_I	3-I	1-V
1-V	4-III	2-IV	4-IV				

SECRET CODE

	I	II	III	IV	V
1	A	B	C	D	E
2	F	G	H	I	J
3	K	L	M	N	O
4	P	Q	R	S	T
5	U	V	W X	Y	Z

DWARF PLANETS OF THE SOLAR SYSTEM

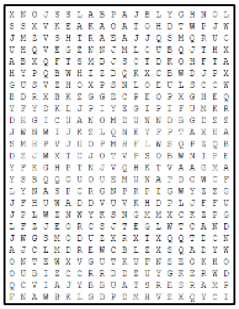
CHALLENGE 3: Which planets in the Solar System have a lower proportion of gases; and why are they called rocky planets?

3-III	1-V	4-III	1-III	5-I	4-III	5-IV
5_II	1-V	3-IV	5-I	4-IV		
1-V	1-I	4-III	4-V	2-III		
3-III	1-I	4-III	4-IV			

SECRET CODE

	I	II	III	IV	V
1	A	B	C	D	E
2	F	G	H	I	J
3	K	L	M	N	O
4	P	Q	R	S	T
5	U	V	W X	Y	Z

ROCKY PLANETS
OF THE SOLAR SYSTEM



CHALLENGE 4: Which planets in the Solar System have a higher proportion of gases; and why are they called gas planets?

2-V	5-I	4-I	2-IV	4-V	1-V	4-III
4-IV	1-I	4-V	5-I	4-III	3-IV	
5-I	4-III	1-I	3-IV	5-I	4-IV	
3-IV	1-V	4-I	4-V	5-I	3-IV	1-V

SECRET CODE

	I	II	III	IV	V
1	A	B	C	D	E
2	F	G	H	I	J
3	K	L	M	N	O
4	P	Q	R	S	T
5	U	V	W X	Y	Z

GASEOUS PLANETS
OF THE SOLAR SYSTEM

CHALLENGE 5

Our planet Earth, the Moon and with eight planets and their moons belong to the Sun family — The Solar System. The Solar System and all visible stars belong to the Milky Way — the galaxy we live in.

THE SOLAR SYSTEM

Figure A Planets of the Solar System
Source: Encyclopedia Britannica (2011)

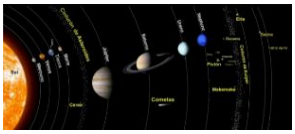


Figure B The Solar System
Source: http://biogeomundo.blogspot.com.br/2014_09_01_archive.html

CHALLENGE 6

The Solar System is the planetary system of our star, the Sun. As there is only one star with that name, it makes no sense to talk about other solar systems, or planets from other solar systems. The bodies of this system are attached to the Sun by the action of gravitational force. This set is formed by bodies different in size, chemical composition, distance, etc. The border region of the Solar System is the spherical Oort Cloud, whose radius reaches almost a third of the distance from the Sun to the nearest star — Alfa Centauri C (Damineli et al., 2011).

OTHER SYSTEMS AND THE SOLAR SYSTEM

CHALLENGE 7

A striking feature of a body made essentially of gas is its low density. In the Solar System, only the Sun and the largest planets are predominantly gaseous. Although gas planets may harbor a core with dimensions and characteristics of a rocky planet, Jupiter, Saturn, Uranus and Neptune are very different from rocky planets. These planets are huge spheres of compressed gas at different pressures. The masses are high as well as the volumes, which give them low densities. They don't have solid surfaces like rocky planets, but they can have a layer of liquefied gas. Jupiter and Saturn are made up mainly of hydrogen and helium, while Uranus and Neptune have 10 to 20% less of these elements. The atmospheres of gaseous planets are marked by complex structures and winds that move in belts parallel to the equator and with a speed that depends on the local latitude, sometimes in opposite directions.

GASEOUS PLANETS

CHALLENGE 8

Mercury, Venus, Earth and Mars are rocky planets, also known as *terrestrial* planets or telluric planets. Among them, Earth is what we know best. We do not have soil samples from the other planets, nor have we carried out deep prospecting in their terrains. The most explored extraterrestrial surface is the Martian one. Space probes have orbited Mars for decades, mapping its entire surface. The American robot probes Spirit and Opportunity have been exploring the Martian soil since 2004 (Damineli et al., 2011, p. 113).

ROCKY PLANETS

CHALLENGE 9

The environmental conditions of the four rocky planets are quite different, but the basic structure is similar. The similarities in size, mass and position make Venus and Earth a kind of twin planets. However, because it is a little closer to the Sun, Venus had a very different fate from Earth. Samples of lunar rocks and meteorites, which are fragments of asteroids, Mars and the Moon itself, are the only species we have for laboratory analysis. Some of these rocks come from the surface, others, such as differentiated or metallic meteorites, come from deeper parts of bodies that have disintegrated in catastrophic collisions. The prospecting of deep regions cannot be done directly. In the case of Earth, the detailing of the internal structure is done by theoretical models based on seismic data. Partial information about the chemical composition of the Earth's mantle comes from the lava analysis, but for the other rocky planets this information is still theoretical. As the other planets are smaller than the Earth, in mass, diameter and gravity, the inner layers are subjected to lower pressures than in the terrestrial case. Therefore, changes in the physical and chemical conditions of the material on these planets are found at depths greater than those specified for Earth (DAMINELI et al., 2011, p. 113).

PLANET EARTH AND OTHER PLANETS

CHALLENGE 10

Dwarf planets share many of the same characteristics as planets, but there are some significant differences. Definition of a dwarf planet by the International Astronomical Union, since 2006, is a celestial body that (a) are in orbit around the Sun (like the planets); (b) have a shape determined by self-gravity, that is, they are spherical (like planets); and, (c) is not significantly larger in size than other objects in its vicinity (unlike planets). The largest dwarf planet in the Solar System is Eris followed by Pluto, Makemake and Haumea with the smallest being Ceres. The order of dwarf planets from closest to the Sun outwards is Ceres, Pluto, Haumea and Makemake with Eris being the furthest from the Sun. There are currently five dwarf planets: Ceres (from the main asteroid belt), Eris, Pluto, Makemake and Haumea, but there are several candidates waiting for classification. Text extracted from the website: http://www.planetario. projetorelogio solar.com/planetaanao.htm.

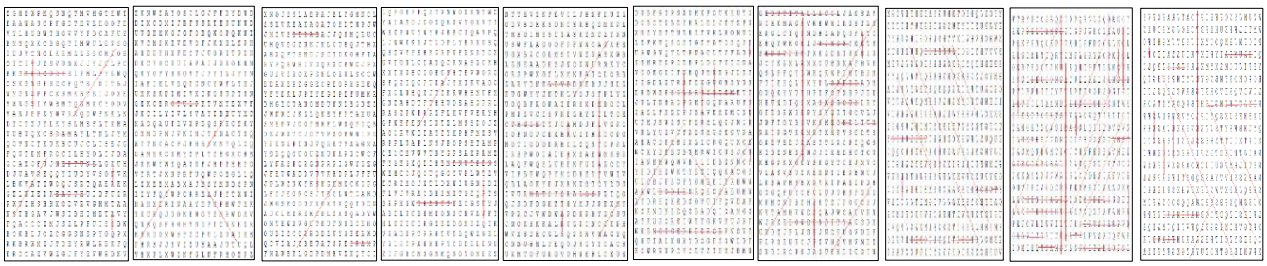
DWARF PLANETS

Figure C The dwarf planets of the Solar System compared to the planet Mercury.
Source: http://www.planetario.projetorelogiosolar.com/planetaanao.htm

Figure D The Solar System with its Planets and Dwarf Planets.
Source Nasa (National Aeronautics and Space Administration)

The answers to the challenges of the proposed activities.

CHALLENGE A **CHALLENGE B** **CHALLENGE C** **CHALLENGE D** **CHALLENGE 1** **CHALLENGE 2** **CHALLENGE 3** **CHALLENGE 4** **CHALLENGE 5** **CHALLENGE 6**



5. Final Considerations

In the proposal of this activity, which uses the word search game, the teacher will realize that it can stimulate creativity and autonomy. Because, it is a game that contemplates the act of associating the content with the activity. However, the teacher must be careful, since in common sense games are still associated with play, one cannot lose sight of the pedagogical values, particularly when dealing with an important topic such as the Solar System.

The game is a stimulus that challenges the student to find solutions for the tasks presented to him. The attraction of the game is always the constant challenge. The attraction of the game is the challenge. Games are objects that can be used to approach the content. Games can be produced by the toy market; just as they can be produced, at school, by both teachers and students. In this proposal, the production must be given by the teacher. One can use the text or make the necessary modifications according to the need, for example, the age of the students or even the seasons of the year. Why the word search game? The game itself is a vehicle that unites will and pleasure during its realization. The reason why to choose the Word Search it is because it allows the exercise of the mind and stimulates an adequate vocabulary during the development of the game for the child and/or teenager.

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