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Innovative Methodologies in Science Education: an Account of Experience on the Creation of a Card Game as a Collaborative Approach

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ABSTRACT

We aim, in this text, to present an account of experience about a card game as a didactic-pedagogical alternative to approach the content of Endocrine System. It represents a dynamic, ludic, creative and collaborative activity among its participants, in addition to problematizing the necessary creation of methodological strategies that contribute and potentiate to a teaching practice in the search of overcoming banking, traditional and Cartesian education of teaching. The card game originated during a practice subject in teaching in Life Sciences major at a university in southern Brazil. During the development of the card game, three simulations were carried out, and the third simulation occurred in a class of a major of the Health Area of that university, in the subject of Physiology. From these three simulations, three evaluations were carried out and the game underwent reformulations. Currently, it is presented as a proposal for an innovative evaluative strategy on the endocrine system. We propose, therefore, the card game about the endocrine system as an alternative instrument for formative evaluation of this content, aiming the overcome of a traditional passive teaching-learning process and evaluation.

KEYWORDS

Card game. Science teaching. Critical-reflexive thought. Formative evaluation. Autonomy, creativity and cooperation.

Metodologias Inovadoras no Ensino de Ciências: Relato de Experiência Sobre a Criação de um Jogo de Cartas como Abordagem Colaborativa

RESUMO

Objetivamos apresentar um relato de experiência sobre um jogo de cartas como alternativa didático-pedagógica para abordar o conteúdo do Sistema Endócrino. Representa uma atividade dinâmica, lúdica, criativa e colaboradora entre seus participantes, além de problematizar a necessária criação de estratégias metodológicas que contribuam e potencializem para uma prática docente na busca da superação da educação bancária, tradicional e cartesiana de ensino. O jogo de cartas originou-se durante uma disciplina de prática no ensino de um curso de Licenciatura em Ciências Biológicas de uma universidade comunitária do sul do Brasil. Durante o desenvolvimento do jogo de cartas realizaram-se três simulações, sendo que a terceira simulação ocorreu em uma turma de um curso da área da Saúde da referida universidade, na disciplina de Fisiologia. A partir destas três simulações, realizaram-se consequentemente três avaliações e o jogo passou por reformulações. Atualmente apresenta-se como uma proposta de estratégia avaliativa inovadora sobre o sistema endócrino. Propomos, portanto, o jogo de cartas sobre o sistema endócrino como um instrumento alternativo para avaliação formativa desse conteúdo, visando a superação de um processo de ensino-aprendizagem passivo e com avaliação tradicional.

PALAVRAS-CHAVE

Jogo de cartas. Ensino de ciências. Pensamento crítico-reflexivo. Avaliação formativa. Autonomia, criatividade e cooperação.

Metodologías Innovadoras em la Enseñanza de las Ciencias: Relato de Experiencia Sobre la Creación de un Juego de Cartas Como un Enfoque Colaborativo

RESUMEN

Nuestro objetivo en el presente texto es presentar un relato de experiencia sobre un juego de cartas como alternativa didático-pedagógica para abordar el contenido del Sistema Endocrino. Es una actividad dinámica, lúdica, creativa y colaboradora entre sus participantes, además de problematizar la necesaria creación de estrategias metodológicas que contribuyan y potencien para una práctica docente en la búsqueda de la superación de la educación bancaria, tradicional y cartesiana de enseñanza. El juego de cartas se originó durante una disciplina de práctica en la enseñanza de un curso de Licenciatura en Ciencias Biológicas de una universidad comunitaria del sur de Brasil. Durante el desarrollo del juego de cartas se realizaron tres simulaciones, siendo que la tercera simulación ocurrió en una clase de un curso del área de la Salud de la universidad, en la asignatura de Fisiología. A partir de estas tres simulaciones, se realizaron consecuentemente tres evaluaciones y el juego pasó por reformulaciones. Actualmente se presenta como una propuesta de estrategia de evaluación innovadora sobre el sistema endocrino. Proponemos, por lo tanto, el juego de cartas sobre el sistema endocrino como un instrumento alternativo para la evaluación formativa de ese contenido, con vistas a la superación de un proceso pasivo de enseñanza-aprendizaje y evaluación tradicional.

PALABRAS CLAVE

Juego de cartas. Enseñanza de ciencias. Pensamiento crítico-reflexivo. Evaluación formativa. Autonomía, creatividad y cooperación.

1 Introduction

We present in this text an experience report on the production of a card game as a didactic-pedagogical proposal for the teaching and learning of the Endocrine System, referring to the content of Human Physiology. The proposal of the game arose during the first author's experience as an undergraduate in the Life Science Major at a community university¹ in southern Brazil.

Currently, many innovative elements have been defended and disseminated for application in educational processes. Methodological innovation - especially active methodologies - is a typical movement of the society of the 20th and 21st centuries where there is an increasingly intense need to train participatory citizens, confident in the way they interact with daily life, mainly to analyze, to reason, to communicate and to solve problems. According to Farias, Martins and Cristo (2015, p. 145), active methodologies represent a “process in which students develop activities that need to reflect on ideas and develop the ability to use them” and, therefore, this type of methodology aims to “train independent professionals, critics and opinion makers”.

However, the didactic-pedagogical methodologies used in the classroom, in most cases, still reproduce a traditional and Cartesian teaching process, the “banking education” denounced by Freire (2017). This process is materialized, mainly, through expository classes with the help of a projector, in which students are spectators and occupy a passive, uncritical, memorizing place, in which they “receive” the content, in addition to experiencing a possible distance between theory and practice in professional and academic training.

It is urgent and necessary to overcome this practice and enhance the dialogical educational environments, which promote critical thinking and in an experience of effective praxis in which teachers and students are cognoscente subjects in the teaching-learning process. It is therefore necessary to create more collaborative and problematizing educational spaces, in which theory and practice are in constant relationship in professional and academic training.

¹ Community universities are institutions created by Brazilian civil society and by the local government and recognized by regional communities as an important development factor. Nonprofits, with democratic and participative management, constitute authentic non-state public institutions in favor of social inclusion and the development of the country. According to Law nº 12.881/2013, they have the following characteristics: “a) they are constituted in the form of association or foundation, with legal personality under private law, including those instituted by the government; b) assets belonging to civil society and/or public authorities; c) do not distribute any portion of their assets or income, in any capacity; d) fully invest their resources in the country in maintaining their institutional objectives; e) keep records of their income and expenses in books covered with formalities capable of ensuring their accuracy; f) have administrative transparency; and g) provide for the destination of the patrimony, in case of extinction, to a public institution or branch.” (MEC, s/d)

We aim at learning environments in which students can develop skills of interpretation and critical-reflexive assessment of their daily lives and the world in which they are inserted, “no longer as a static reality, but as a reality in transformation, in process” (Freire, 2017, p.100). Therefore, it is necessary to search for and consolidate spaces that promote educational paradigmatic changes, that is, spaces in which students can develop creativity, protagonism, the ability to work in groups, thus aiming at the formation of more reflective and autonomous subjects.

Therefore, we aim to present an experience report on a card game as a didactic-pedagogical alternative to the content of the Endocrine System that represents a dynamic, ludic, creative and collaborative experience among its participants. In addition to problematize the necessary creation of methodologies that contribute and enhance the teaching practice in the quest to overcome banking, traditional and Cartesian education.

2 The Card Game as a Didactic-pedagogical Resource: the Search for Methodological Innovations for Higher Education in the Area of Biological Science

The game was created during the first author's experience in the “Practice in Science and Biology Teaching” subject, in the Life Science Major, taught by the second author - advisor, professor of the Postgraduate Program in Education/PPGE- Master, biologist and PhD in Education. This discipline aims to enhance the theoretical and methodological assumptions for the organization of teaching practice in future teachers in the area of Biological Sciences. Thus, the theoretical foundation of its methodological process is based on dialogical education and dialogue (Freire, 2017), on the intentional promotion of critical thinking (Vieira and Vieira, 2005; Franco, Vieira and Saiz, 2017) and developed through active methodologies of teaching-learning, with research as a scientific and educational principle.

In this sense, to stimulate students in the real teaching experience, some classes are developed by means of “simulation of reality” (Vieira and Vieira, 2005), that is, some meetings are reserved for that all students promote a “simulated class” with the class. With selected themes, each student is responsible for producing and creating their classes and, finally, trying one of these with the class. And the first author, creator of the card game, was responsible for the theme “Endocrine System”, which was drawn to him - an experience that resulted in the elaboration of this report.

For the “simulation of reality”, it was requested that the lesson plans were also developed by an innovative methodology, that is, that students created a differentiated, active activity proposal that aimed to stimulate the promotion of critical thinking in the subjects. Therefore, that these classes “escaped” the comfort zone of the expository classes. We emphasize that methodological innovation, especially through active methodologies, is encouraged by the current management of the university - including, in its continuing education courses offered to the professors of the institution. However, we recognize the challenges facing such demand and initiative.

Before the proposed challenge to create an innovative class, the first author started a systematic survey on *Google Scholar*, *Scielo* and the Institutional Repository of the HEI in search of differentiated classes on the endocrine system. He used descriptors, such as “experiments”, “practical class”, “laboratory” and “science teaching”, all associated with the descriptor “endocrine system”. As a result, he found several suggestions for problematizing experiments, however, for other human physiological systems. This movement, of a future teacher in search of paradigmatic change, found a gap in experimental activities that addressed this content. Several other human physiological systems, including other themes in the area of Science, presented experimental models that could be used in the classroom. However, for the endocrine system, a creative class with innovative didactics was not found, much less any experimental model that can be used in the classroom by teachers who aim to overcome banking education.

Therefore, the question arose: from the concept of problematizing experimentation in Francisco Jr, Ferreira and Hartwig (2008), is it possible to create a teaching methodology that contributes to didactic innovation on the endocrine system? Here, specifically, materialized in a card game?

Therefore, there was a need to build an innovative and creative activity on the topic. And this movement was based on games from the first author’s experience during his adolescence, such as, for example, Magic: The Gathering; and Role Playing Games (RPGs) systems; and based on the concept of problematizing experimentation based on Delizoicov (2005) and Giordan (1999) *apud* Francisco Jr, Ferreira and Hartwig (2008) which aims to instigate “reading, writing and speaking as indissoluble aspects of the conceptual discussion of experiments” (p. 35). This concept is also based on Freire (2017) based on his dialogical and problematizing pedagogy that aims to overcome banking education.

The concept of banking education (Freire, 2017) arises from the criticism of the conservative liberal line of thought, which aims at subjects as uncritical and passive beings in the world and makes use of an education that seeks to maintain this condition. In this process, the teacher is the holder of knowledge, while the ‘student’ must be ‘filled’ with this knowledge. Education, therefore, is a dehumanizing process that promotes a ‘naive conscience’, that is, an instrument of ‘depositing’ knowledge in an empty ‘student’, disconnected from reality and without considering the human being as a historical being (Freire, 2017). Still, the author points out that “the more passivity is imposed on them, the more naively, instead of transforming, they tend to adapt to the world, to the partial reality in the deposits received” (Freire, 2017, p. 83). Therefore, if we want to train active, critical human beings who are able to analyze and transform the world in which they live, we must overcome banking ideas of education. We must seek to propose experiences that promote the transition from a naive conscience to a critical conscience, through a humanizing teaching practice, in which the exchange of experiences and the relationship of the contents with the lived reality is constant, permanent and conscious. An educational environment that promotes Pedagogy of Liberation, that is, problematization and dialogue as the essence of an education as freedom practice (Freire, 2017).

Thus, Francisco Jr, Ferreira and Hartwig (2008) understand that problematizing experimentation is a pedagogical moment that conceives education as an active, critical, curious, disturbing process, in which teachers and students are subjects in the teaching-learning process. We understand that in this way it can be possible to live in a welcoming environment with ludic activities that stimulate dialogue, creativity, critical awareness and cooperation of the actors involved. Thus, Pedagogy of Liberation, also being problematizing, presents itself as the counterpoint of banking ideals of education.

We agree that problematizing education, “of an authentically reflective character, implies a constant act of unveiling reality” and “seeks the emergence of consciences, resulting in its critical insertion in reality (Freire, 2017, p. 97 and 98). Consequently, a dialogical and problematizing education can facilitate the development of criticality in students, allowing them to better express themselves to and with the world and better interpret it.

The more the students are problematized, as beings in the world and with the world, the more they will feel challenged. They feel as more challenged as more compelled to respond to the challenge. Challenged, they understand the challenge in the very action of capturing it. But, precisely because they perceive the challenge as a problem in their connections with others, on a plane of totality and not as something petrified, the resulting understanding tends to become increasingly critical, for this reason, increasingly disalienated (FREIRE, 2017, p. 98).

So, we understand that dialogical and problematizing education is liberating, as it aims at humanization and offers a way to overcome banking education, being an instrument for the shaping of citizens who are socially active, critical and aware of their situation and position in the world (Freire, 2017). We will talk about this again in section three of this experience report, when we will justify the use of that card game as a didactic-pedagogical resource.

Therefore, from Delizoicov (2005), Francisco Jr. *et al.* (2008) and Freire (2017), the objective of the card game aims both to overcome banking and to stimulate cooperation, protagonism and creativity; to promote critical thinking; to establish contextualization of the contents with the students' lives based on relationships between the different structures of the endocrine system with natural physiological situations experienced in daily life; and, eminently, to be fun.

The cards were created using the *Publisher software* belonging to the *Microsoft Office* set. The card game was chosen because of its practicality, since you can create a model of cards and just using paper and a printer, print them anywhere for your use - and any more complex material, such as a board, would need a longer production time, in addition to other equipments. Furthermore, as described above, the first author has an appreciation and skills for card games, making this process of production more natural and accessible.

We emphasize, however, that the game initially presented itself as a proposal to approach the Endocrine System with classes of the 7th grade of Elementary School. However, in the course of its development, the construction of the game became complex for ES and was adapted for use in Higher Education. However, the process of deepening and maturing the game is still under development, since it will effectively go through a research process, with more phases of construction, experimentations and reformulations.

The game consists of four types of cards (Appendix A): “situation” cards, “hormone” cards, “gland” cards and “special” cards. The images were purchased at “Anna’s Shop” on the Creative Market website, by an independent artist.

The game is cooperative and interactive, developed in teams of a maximum of six students. The objective of the game is to complete 10 problem situations. For that, it is necessary that the players work as a team and act as a “living organism”, reacting to “nervous impulses and regulating their hormonal levels” during the rounds to solve the problem situations that will appear in each level of the game (which is divided into stages of life). The problem situations are: sleep; danger; spermatogenesis; ovulation; pregnancy; childbirth; male puberty; breast-feeding; female puberty; nutrition. We emphasize that the card game accompanies an Instruction Guide (Appendix B) in which the rules are detailed and a copy of this guide is given to the participants (printed or by *smart phone* app). The objective of the game is to solve the problem situations, for that it is necessary to solve the “situation” cards.

In this context, the game had three experiences, that is, it was submitted to three simulations and initial evaluations: 1) in the “Teaching Practice” class; 2) again in the same class, with the participation of two professors of the Health area - a doctor in Health Science and the full professor of Physiology in majors in the Health area of IES; and the third author, professor of the Post-Graduate Program in Health Sciences and researcher in the area of Neuroscience; 3) in a class of a major in the Health area at IES, in the discipline of Physiology, under the supervision of the PhD professor in Health Sciences, responsible for the class, and the advisor professor.

We emphasize that this operation was not systematized or inspired by previous researches. As reported in the introduction, it was about carrying out the requested activity in a discipline of a teacher training major and not in a research project - as currently desired. The experiences were lived during the semester, according to the opportunities offered both by the class itself and by professional colleagues from the IES, who knew about the game and aroused interest. Colleagues who not only gave us space to experiment, but also provided us with critical feedbacks and were present in the construction of the game - described here, in an experience report. Thus, our colleagues were essential in the process, helping to think, to imagine and to play the game.

From these three simulations and evaluations, the game underwent reformulations and, currently, presents itself as a proposal for an innovative evaluative strategy on the endocrine system. We emphasize that the term “innovation” comes from the Latin *innovatio*

and “refers to ideas, methods or objects created that are not similar to ideas, methods or objects connoted with previous standards (Pacheco, 2019, p. 49). Garcia and Bizzo (2010) point out that the term “innovation” has a polysemic character and is linked “to a set of interventions, decisions with a certain degree of intentionality and systematization, which aim to transform attitudes, ideas, cultures, content, pedagogical models and practices” (p. 19).

In this sense, we understand that innovation comprises

[...] action or act that changes old customs, manias, laws, processes ... That is, a renewing action or act of something or someone. It means the opening of new paths, the discovery of different strategies from those that we usually use. It presupposes invention, the creation of something new. In brief: innovation is effectively something new, which contributes to the improvement of something or someone and that can be replicated, for example, from creation and prototypes (Pacheco, 2019, p. 49).

Thus, we propose the card game about the endocrine system as an alternative instrument for formative evaluation of this content, in contrast to the traditional evaluation, which usually occurs through individual, summative tests, usually with open or multiple choice questions, but which in most cases aims only at memorization and narration as thinking skills. We understand that “the traditional culture of evaluation presents barriers to effectuation of change in the way of evaluating” (Iglesias, Calegari and Lorenzini, 2016, p. 122).

However, we see this proposal as a movement that aims at the creation and use of different assessment instruments, especially those with formative intent. And that these innovative instruments also contribute to the evaluation of competences, as this challenging process “is not restricted to the final exams, since it develops as a process to collect evidences of performance based on indicators related to the established professional competences”, (Iglesias, Calegari and Lorenzini, 2016, p. 123).

In this sense, this card game of the endocrine system has been configured as an alternative strategy of evaluation, an innovative evaluation that aims to develop, through a dynamic and collaborative activity, thinking skills more complex than memorization and narration, that is, a critical-reflective thinking for the interpretation and resolution of problem situations in the collective and in collaboration.

3 The Card Game as a Methodological Resource: Theoretical Foundation

As previously explained, the theoretical foundation of the card game on the endocrine system is based on the concept of “problematizing experimentation” by Francisco Jr *et al* (2008), which aims at the interrelation between experimentation with the theoretical precepts of problematizing and dialogical pedagogy of Freire (2017). In addition, the theoretical foundation of the game is also based on the interface with the theories of critical thinking in Ennis (2015), Tenreiro-Vieira and Vieira (2000) and Franco, Vieira and Saiz (2017) and

neuroscience in Izquierdo (2011), through the interpretation and solution of problem situations and the direct relationship between scientific knowledge and subjects' experiences. This methodological strategy is the result of interaction, interpretation and solution of problem situations as a way of promoting reflection and critical awareness through the experimentation of a card game - in this case, on the endocrine system.

We understand that thinking critically can contribute for the subjects to face positively the complexities of life, in daily life and in the future. According to Vieira and Tenreiro-Vieira (2014, p. 43), since classical antiquity, critical thinking has been an objective of Education, having its first approximations, perhaps, carried out “[...] by Socrates through his questioning. Others followed with prominence, in the beginning of the 20th century, for Dewey.” However, the authors point out that only about 25-30 years ago - since the 1980s of the 20th century - a movement in the Education area really began to exist that presented critical thinking as an educational purpose.

This movement in Education, in general, was justified from three areas: ethics, intellectual and pragmatic. In an ethical argument, thinking critically can “[...] enhance the formation of free, rational and autonomous citizens, capable of thinking for themselves, not being dependent on others to do it for themselves” (VIEIRA; TENREIRO-VIEIRA, 2014, p. 43). In the intellectual argumentation, it is stated that promoting the subjects’ critical thinking will contribute in their positions towards others in the face of statements, evidences or even uncritical rejections, that is, so that they are able to think and act critically “[...] about statements and courses of action, based on credible sources, valid evidences and rational reasons” (VIEIRA; TENREIRO-VIEIRA, 2014, p. 43). Finally, in the pragmatic argumentation, it is stated that for the subject actually to exist in society, he must be able to understand their complexity and face them as a critical and reflective subject (VIEIRA; TENREIRO-VIEIRA, 2014). We understand that these three justification lines are complementary and consequential among themselves, in order to exercise this pragmatic existence in an ethical-social context, we, as subjects in the world, must experience an intellectual shaping aimed at promoting critical thinking. So, the use of these skills

[...] allows individuals to take a stand on scientific issues, reasoning logically on the topic in question in order to detect inconsistencies in the argumentation or in order to support a conclusion. Furthermore, any democratic system depends on the ability of individuals to act and intervene, using their potential for critical thinking. The citizen of a democracy must be able to sustain open debates on civic issues, to weigh arguments, to consider alternatives and courses of action, and to collect and evaluate evidences to support them. (VIEIRA; TENREIRO-VIEIRA, 2014, p. 44)

Tenreiro-Vieira and Vieira (2000), Vieira and Vieira (2005), Vieira and Tenreiro-Vieira (2014) highlight different theoretical references in the area, as well as different conceptualizations and taxonomies to promote critical thinking. However, the concept and definition adopted by these authors, in several studies and in particular in Portugal, has been proposed by Robert H. Ennis, professor emeritus at the University of Illinois/USA. In the definition of Ennis (2015, p. 01), critical thinking “is a reasonable and reflective thought focused on deciding what to believe or do.” It is a thought that involves, according to

Tenreiro-Vieira (2014, p. 31), “both dispositions, which concern the most affective aspects”, as well as the skills, “which refer to more cognitive aspects.” Therefore, it is a rational and reflective way of thinking, with a broad role played in the subjects' lives, “since all behavior depends on what is believed, every human action depends, in some way, on what one decides to do” (VIEIRA and VIEIRA, 2005, p. 90). Consequently, critical thinking “is the art of analyzing and evaluating thinking with a view to improve it”, (PAUL and ELDER, 2006, p. 04).

The promotion of critical thinking in higher education is an extremely relevant theme. Thinking critically is an academic performance desired by most teachers, even desired in the world of work. According to Franco, Vieira and Saiz (2017), thinking critically can enhance an ethical posture in the public sphere, as well as the effective experience of citizenship. After all, critical thinking is also defined as a “superior form of thinking integrating capacities, dispositions, knowledge and standards, applicable in everyday life (whether personal, academic, work or social) to think well, find explanations, make decisions and solve challenges” , (Franco, Vieira and Saiz, 2017, p. 12, emphasis added). Therefore, since thinking critically is not something innate, it must be stimulated and promoted since childhood, especially by the education system and be improved over the years of schooling - being in higher education, especially in teacher training, “the phase in that should be promoted more intentionally ”(Franco, Vieira and Saiz, 2017, p. 12).

In this sense, we understand that problem solving is a methodology that, oriented to critical and reflective thinking, can be configured in a teaching-learning strategy that enhances the promotion of this type of thinking both in students and in teachers.

In this context, we understand as a method “the way to achieve an objective”, that is, the “adequate means to achieve objectives”, (Libâneo, 2013, p. 165). Thus, the methods “are determined by the objective-content relationship, and refer to the means to achieve general and specific teaching objectives, that is, the *how* of the teaching process, encompassing the actions to be performed [...] for achieving objectives and content ”, (Libâneo, 2013, p. 164, emphasis added). Furthermore, we understand as a strategy the “organization or sequential arrangement of actions or teaching activities that are used over a period of time and with the purpose of leading students to carry out certain learning”, (Vieira and Vieira, 2005, p. 16) . Therefore, the term teaching-learning strategy comprises “a set of actions [...] aimed at promoting the development of certain learning skills that are in view”, (Vieira and Vieira, 2005, p. 16).

The resolution of problem situations, proposed more specifically by the card game, also uses neural systems of working memory that process sounds, images and thoughts (Cosenza e Guerra, 2011; Lent, 2010). The working memory acquires the information and maintains it for the necessary time until it is used, if the brain judges this information as important, it can then pass this information through a process called consolidation, in which the memories will be retained to be used for a longer time (Izquierdo, 2011).

The working memory is only transient. However, this type of memory is part of the process of retaining more concrete memories. And for this association to be made, it is necessary that the association with previous records occurs, that is, it is necessary that what you want to store have a connection with what was experienced and not be disconnected from the individual's experience (Izquierdo, 2011; Cosenza and Guerra, 2011). Therefore, to enhance the teaching and learning process and concrete memories, when working with situations that exist in real life, in human daily life, the card game about the endocrine system seeks to associate the new information that is being built with the pre-existing information in the individual - that is, prior knowledge.

According to Luna and Bernardes (2016), prior knowledge is what gives meaning to new knowledge. It is what David Ausubel calls "meaningful learning". Luna and Bernardes (2016), based on Ausubel, characterize significant learning by "cognitive interaction between new and prior knowledge. Prior knowledge is, in isolation, the variable that most influences learning, which strengthens the need to perform problematization in contact with a problem situation", (p. 654). In an effective process of meaningful learning, the subjects relate to the new information in a natural way, without arbitrariness. Like this,

for such information to be truly assimilated by the individual, Ausubel reports that the presence of a cognitive structure that he calls subsunor concept (a term derived from English subsunor) is indispensable, which is nothing more than an existing proposition acquired in a significant way that anchors the new information and dialogue with them. For the author, if the new information does not find such anchoring structures, the learning process starts to have a mechanical or memorizing nature. (Farias, Martin and Cristo, 2015, p. 145, emphasis added)

We agree with Farias, Martin and Cristo (2015) that Ausubel's theory can dialogue with Freire (2017), as it also shows respect and appreciation for the subjects' prior knowledge, and nobody should be considered as an "empty container" or "banking box", in which knowledge must be "deposited". That is why the importance of valuing what people "already" know.

And this learning process is also enhanced if there is an emotional state conducive to the shaping of new memories. "A negative mood, for example, due to lack of sleep, depression or simple sadness or discouragement, disturbs our working memory" (Izquierdo, 2011, p. 27). For the formation of new information in our brain, an environment where we are comfortable, welcomed and excited is extremely important. We emphasize that stress and anxiety, which are very present in current educational environments, can be negative emotions (Jatobá; Bastos, 2007) and can have harmful consequences for learning (Cosenza e Guerra, 2011, p.84). Because of that,

emotions need to be considered in educational processes. Therefore, it is important that the school environment be planned to mobilize positive emotions (enthusiasm, curiosity, involvement, challenge), while negative ones (anxiety, apathy, fear, frustration) should be avoided so that they do not disturb learning. (Cosenza e Guerra, 2011, p.84)

And it is in this sense that the card game is proposed as a ludic didactic-pedagogical alternative to create this differentiated, pleasant, challenging and innovative environment. The proposal of the card game on the endocrine system aims to promote the concept of subsensor from real problem situations, motivating and stimulating students while playing. Consequently, it also seeks to contribute to a differentiated teaching practice that brings students “trigger elements that communicate with the subsensors present of the student’s cognitive element, [and] these must create important connections that can fill knowledge gaps”, (Farias *et al*, 2015, p. 145). Therefore, the contents of the teaching plans, developed by us, teachers and future teachers, should always relate, problematize and communicate with the reality of the subjects involved and, thus, aim at a possibility of meaningful learning.

Attention is also an element of great importance for the teaching-learning process. “Paying attention is to focus awareness, concentrating all mental processes in a single main task and putting the others in the background” (Lent, 2010, p. 631). Now, if an external stimulus is captured and it has emotional value for the individual, this stimulus can “mobilize attention and reach specific cortical regions” (Cosenza and Guerra, 2011, p. 76). This stimulus is then identified and made conscious, passing through the working memory processes. Therefore, since this process is based on the concept of meaningful learning, we pay attention to what we consider important, what interests us and what has some use for us and our daily lives. Thus, the card game proposed here, is concerned with the relationship between emotional aspects of the subjects and, consequently, with the learning content becoming the object of attention, facilitating the learning process.

In this sense, we understand that the resolution of problem situations guided by the concepts of problematic experimentation of meaningful learning and configured for the development of critical thinking, can enhance the conscious promotion of some thinking skills from the resolution of the 10 problem situations requested. More specifically, we understand that the conscious promotion of critical thinking involves another type of thinking: metacognition.

Since metacognition is linked to the knowledge that the individual has about the functioning of their own thinking process, those who become aware of their way of thinking are also those who tend to use their critical thinking skills. (Vieira and Vieira, 2000, p. 28).

Therefore, in addition to individual elementary thinking skills, such as, general interpretation, application, analysis, synthesis and evaluation skills, in the context of the card game, we also aim to enhance: statement interpretation; focus on an issue; ability to state reasons; inductive and deductive reasoning in the collective; make and evaluate observations in the collective; formulate appropriate responses collectively; practice Socratic discussion; reason dialogically and dialectically; making relationships/connections; skills of strategies and tactics, such as collective decisions, use of rhetorical strategies and interaction with others (Tenreiro-Vieira and Vieira, 2000).

4 Simulation Movements: Application History and (re) Adjustments of the Card Game

4.1 First Simulation (Application)

The first application took place in the discipline of “Practice in Science and Biology Teaching” as part of the activities initially described. At that time, there were no written rules, just a paper in possession of the first author listing all 10 problem situations and an order. There was also a ten-sided die that players should use to choose the situation to be played at random. The class was comfortably divided into two teams, one with 6 and the other with 7 players. At the outset it was possible to notice that one team had more facility than the other. The reason for this disparity was the interaction that the teams had between their players. It was also observed at the beginning that the two teams reported great difficulty in remembering the rules, as there were many and there was no written notes and guidance.

We also observed that while the team that had more difficulties did not talk, nor did its players showed their cards to each other, the other team combined plays and kept nothing in secret. This difference was a reflection of the absence of an explanation and/or specific instruction in which the group would represent a living organism, that is, it was not clear the aspect of interaction and collaboration that was to be stimulated - and, thus, it was clear the competition between players.

We understand that this movement is unique among us, human beings, that most of the time when we participate in different games or interactions, both in school and family world, we are encouraged to compete and to select a “winner”. As Palmieri (2015, p. 244) states, one of the complexities of transformations in modern society is the favoring of “a growing wave of individualism and competition”, a fact that is also recurrent in school environments in which

scientific studies aimed at investigating beliefs and values among children, adolescents and teachers have shown that, in most school contexts, teachers have guided their students to compete with each other or to be individualistic.

Thus, we register that in the proposed game system, the participants who initially did not interact with the other participants in the group, invalidated the reasoning to solve the problem situations. In a second moment, the participants started to interact and to be able to develop the proposed problems. In this sense, we realized that the objective of promoting cooperation was slowly being achieved.

The team that showed more interaction between its participants, from the perspective of a living organism, within a holistic understanding, solved the 10 problem situations before the other team could solve two. Then, the simulation ended and we moved on to the evaluation moment.

During the evaluation, the innocuousness of using the data for the game system was reported. The data only delayed the progress of the game and were not a good way to maintain random situations, so it should be reflective and changed. The game stopped showing data and, thus, the “situation” cards were created. These cards have colored balls in the upper corner representing the stage of life in which the problem situation occurs (red, child stage; green, adolescent stage; blue, adult stage). Such cards are drawn at random, respecting the chronological order in which they occur.

To increase the challenge, the document that provided guidance on how to solve the problem situations was changed. First, the whole process was described. Subsequently, the parts that described which glands and hormones were part of each stage were removed, so that the players could collectively solve them. Consequently, the rules of the game were written and printed to be delivered in the next application and to facilitate the understanding of the game rules. It was also established that the game should focus on the sense of interactivity between players, to prevent the team from ending up competing with each other.

4.2 Second Simulation (Application)

In view of the interest of colleagues of the discipline of “Practice in Science and Biology Teaching” in the card game, a second experiment was agreed with the requested changes. For this moment, we had the participation of two teaching partners in the Health area: a doctor in Health Sciences and a full professor of Physiology in majors in the Health area at IES; and the third author, professor of the Postgraduate Program in Health Sciences and researcher in the field of Neuroscience. These professors were invited to participate and to evaluate the process.

The class was again comfortably divided into two teams. The cards and the rules of the game were handed out. There was an initial explanation of its basic functioning focusing on the interaction between participants in the same group. This time the two groups seemed to be more balanced, taking into account that in both, participants were interacting with each other and cooperating towards the common goal. The two teams were managing to carry out the situations, but with some difficulty, due to some confusions with the hormones and glands that should participate in each situation. When the first team solved all the simulations, the game was closed and we opened for the evaluation.

The game seemed easier in the sense of the rules, because the players had them in hand and this facilitated the overall progress of the game. The main problem observed was during the game, in the absence of any guidance on which hormones and glands should be on the table, participating in each round. In addition to the difficulty that players found to determine which hormones and glands would be involved in each problem situation. It was registered, then, that there could be an introductory class to the content of the endocrine system prior to the application of the game. And it was from these statements that we deduced that the referred card game could present possibilities to be used as a proposal for formative evaluation.

4.3 Third Simulation (Application)

The third simulation was performed in discipline of Physiology of a major in the Health area at the IES, under the supervision of the PhD professor in Health Sciences - who had already participated in the second moment of application - and the advisor professor. At that moment, the focus of the card game became the evaluation process and, therefore, this third experiment was divided into two meetings: one for problematizing the content with an introduction to the game and another for evaluating it - the game itself.

An introductory class on the endocrine system was developed by the first author in the expository form - from the slide projection of a sequence of images (Appendix C) - and dialogued - through problematization and questioning focused on the promotion of critical thinking (Vieira and Viera, 2005). The objective was to start the conceptualization of the endocrine system, to emphasize the importance of deepening concepts, their interconnected functions for each basic situation of human life and to present the following activity - from the resolution of some problem situations in groups.

We emphasize, however, with a view to not contradict ourselves that the exposure of the images served as a support for the questioning focused on critical thinking and the introduction of the resolution of the problem situations. Planning was carefully made to not reproduce banking education, with a traditional expository class, depositing content and silencing the class. Rather, promoting a teaching practice with intentionality, aware of the theoretical foundation that guides its pedagogical actions and which aims to create dialogic environments, in which the exhibition stimulates true critical and active discussions.

And this movement was fundamental for the students to become familiar with the teaching model we wanted, as well as, the reasoning skills necessary to be developed to solve the problem situations. This process represented the search for consistency between the skills and competences stimulated during classes and the skills and competencies that were required in the evaluation process. We understand that the evaluation cannot be a “surprise”, that is, students cannot experience a teaching-learning process in a bank, passive and uncritical way and be evaluated for skills and competences that were not stimulated to develop (for example, problem solving).

In the second meeting, a week after the introductory class, the whole game was applied as an evaluation proposal to the content of the endocrine system problematized in the previous class. The Instruction Guide was sent in advance to the class via *email* and *smartphone application*. The class of 35 students was divided into 5 teams by lottery. As the objective of the game is to solve the problem situations, that is, the “situation cards”, sheets of paper were handed out and the teams were asked to solve the 10 problem situations based on two questions: a) identify the glands and the hormones involved in the process of each problem situation; and b) describe the hormonal processes that occur in each problem situation.

We note, however, that a team changed the rules for card division to facilitate the achievement of the objectives. This team, instead of dividing the cards between the players and maintaining the conventional system of the rules of the game, decided to elect a member of the group as a “bank of cards”, as in the “Monopoly” game which maintained all the cards in the game. And when the “situation cards” were revealed, the “bank of cards” made available the cards that the other members of the group asked to complete the problem. We observed that this change did not alter the objective of the game and represented an interesting alternative for its progress and in the resolution of problem situations. All teams managed, within the time of two classes, to resolve all situations and we started to evaluate the process.

We asked the class to evaluate the game proposal, issuing criticisms and observations during the reality experienced. We note that initially it was requested a simplification of the rules and the operation of the game, as it was very complex. The students also reported the importance of socialization stimulated by the game, because they found themselves talking and interacting with previously distant colleagues. However, the most expressive criticism that generated the most debate in the class was related to the duration of the game. Many reported that the game became long and, consequently, uninteresting, even boring, after a certain moment. This was argued against by several other students, who stated that in this type of evaluation “you have to think”, “you have to study before” and also “you can’t string along”.

These notes showed us that, even still empirically, the card game has the potential to succeed in interactive and ludic evaluation processes, in addition to fulfilling its objectives, surpassing the proposals for evaluations that prioritize short memorization and passivity of students. This is evident in its operationalization, by intentionally focusing on the students’ daily lives and in developing thinking skills that are not memorizations and/or uncritical narrations, but more complex thinking skills - such as those described in the theoretical foundation of section three. Still, the students emphasized that the interaction was fun and important for the teaching-learning process, since they participated in ludic moments interrelating socialization, cooperation and learning. Finally, when questioning the class about the possibility of the card game being used as a formative assessment, everyone approved the idea.

5 Considerations

We conclude that it is possible, even feasible, to create a methodology that contributes to didactic innovation on the content of the endocrine system. The card game presented has an imminent potential to overcome banking education and promote changes in educational paradigms. As a ludic teaching-learning method, it can stimulate cooperation, protagonism, creativity, critical-reflective thinking, as well as relate real situations experienced in students’ daily lives to the content covered - the relationship between theory and practice. This point was evident during the empirical simulations, aiming to promote the competence of establishing relationships between the functions of the endocrine system and the situations

experienced by all of us, in daily life. Consequently, other skills are necessary to develop such competence, such as, identifying, evaluating, analyzing, relating specific knowledge to daily life, cooperation, interaction, collectivity.

It is also registered the importance of critical teaching practice, in which teachers understand that our pedagogical action is always guided - consciously or unconsciously, critically or uncritically - by some theoretical-methodological basis. And, consequently, that the didactic-pedagogical strategies adopted, which aim to overcome a fragmented, decontextualized and passive education, must be intentionally focused for an educational paradigmatic change. That is, for a teaching-learning process that encourages critical-reflective thinking and the protagonism of the subjects involved.

We note, mainly, that the said game has the potential to become an object of research, with a view to its theoretical and methodological maturation. The card game represents a challenging process in the development of didactic-pedagogical practices that contribute to the overcoming of banking and traditional education in school spaces, including Higher Education. There is a need to encourage and support the protagonism and creativity of students and teachers for the creation of alternative methods, either in professional training courses or in teachers - initial, continued and/or permanent. This investigative movement can represent a process of searching for possibilities of methodological innovation that consolidates effective meaningful learning and a more complex, critical and autonomous thinking in the face of real everyday situations. Therefore, analyzing the concrete and possible pedagogical contributions of the card game through scientific research can also contribute to the exploration of other innovative methodologies, in addition to identifying their reflexes in teaching-learning processes guided by dialogical and problematizing education.

We hope that reports and initiatives like these will encourage other professionals in basic and/or higher education to create differentiated methodologies and to innovate their pedagogical practices.

6 References

COSENZA, Ramon Moreira; GUERRA, Leonor Bezerra. **Neurociência e educação**: como o cérebro aprende. Porto Alegre: Artmed, 2011.

DELIZOICOV, D. Problemas e problematizações. In: PIETROCOLA, Maurício. **Ensino de Física**: Conteúdo, metodologia e epistemologia em uma concepção integradora. 2ª Ed. Ilhéus: Ed. da UESC, 2006.

ENNIS, Robert H. **The nature os critical thinking**: an outline of critical thinking dispositions and abilites. This is a several-times-revised version of a presentation at the Sixth International Conference on Thinking at MIT, Cambridge, MA, July, 1994. Last revised May, 2015. Available on:

<http://criticalthinking.net/wp-content/uploads/2018/01/The-Nature-of-Critical-Thinking.pdf>

Access on: 20/04/2020

FARIAS, Pablo Antonio Maia de; MARTIN, Ana Luiza de Aguiar Rocha; CRISTO, Cinthia Sampaio. Aprendizagem ativa na educação em saúde: percurso histórico e aplicações. In: **Revista Brasileira de Educação Médica**. v. 39, (1), 2015, p.143-158.

FRANCISCO JR, W. E.; FERREIRA, L. H.; HARTWIG, D. R. Experimentação Problematicadora: Fundamentos Teóricos e Práticos para a Aplicação em Salas de Aula de Ciências. **Química Nova na Escola**, n. 30, Novembro, 2008, p. 34–41.

FRANCO, Amanda; VIEIRA, Rui Marques; SAIZ, Carlos. O pensamento crítico: as mudanças necessárias no contexto universitário. In: **Revista de Estudios e Investigación em Psicología y Educación**. Vol. Extr., n. 07, 2017. DOI: <https://doi.org/10.17979/reipe.2017.0.07.2233>

FREIRE, Paulo. **Pedagogia do oprimido**. 29ª. Ed. Rio de Janeiro, Paz e Terra, 2017.

GIORDAN, M. O papel da experimentação no ensino de ciências. **Química Nova na Escola**, v. 10, n. Novembro, p. 43–49, 1999.

IGLESIAS, Alessandro; CALEGARI, Marta Aparecida de Lima Machado; LORENZINI, Vanir Peixer. Avaliação. In: SOUZA, Patrícia Alves de; SUBTIL, Maria Cristina Mazzetti. (Org.) **Reflexões, inovações e práticas: curso de Medicina da Uniplac**. Florianópolis: Editora Tribo da Ilha, 2016.

Ministério da Educação. **Instituições Comunitárias**. Available on: <http://portal.mec.gov.br/busca-geral/400-secretarias-112877938/seres-regulacao-e-supervisao-da-educacao-superio-1288707557/20837-instituicoes-comunitarias> Acessado em: 18/12/2018

IZQUIERDO, Iván. **Memória**. 2 ed. Porto Alegre: Artmed, 2011.

JATOBÁ, J. D. V. N.; BASTOS, O. Depressão e ansiedade em adolescentes de escolas públicas e privadas. In: **Jornal Brasileiro de Psiquiatria**, v. 56, n. 3, p. 171–179, 2007.

LENT, Roberto. **Cem bilhões de neurônios?** Conceitos fundamentais de Neurociência. 2ª edição. Atheneu, 2010.

LIBÂNEO, José Carlos. **Didática**. – 2ª ed. – São Paulo: Cortez, 2013.

LUNA, Willian Fernandes; BERNARDES, Jefferson de Souza. Tutoria como Estratégia para Aprendizagem Significativa do Estudante de Medicina. In: **Revista Brasileira de Educação Médica**. v. 40, n. 4, 2016, p. 653-662.

PACHECO, José. **Inovar é assumir um compromisso ético com a educação**. – Petrópolis, RJ: Vozes, 2019.

PALMIERI, Marilicia Witzler Antunes Ribeiro. Jogos cooperativos e a promoção da cooperação na educação infantil. **Psicol. Esc. Educ.**, Maringá, v. 19, n. 2, p. 243-252, Aug. 2015. Available on: www.scielo.br/scielo.php?script=sci_arttext&pid=S1413-85572015000200243&lng=en&nrm=iso Acessado em: 14/04/2019. <http://dx.doi.org/10.1590/2175-3539/2015/0192823>.

PAUL, Richard; ELDER Linda. **Critical Thinking:** concepts and tools. The miniature guide to critical thinking concepts and tools. Foudation for Critical Thinking, 2006.

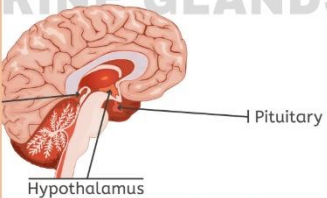
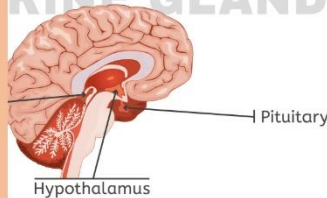
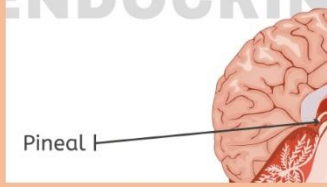
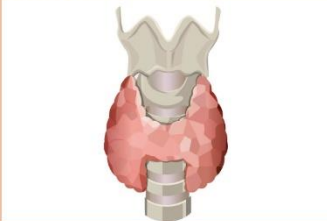

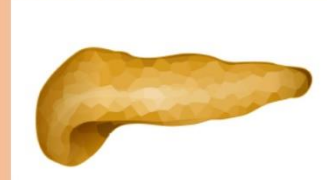
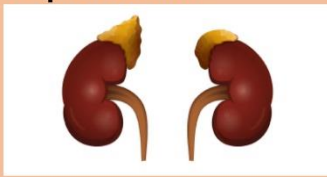
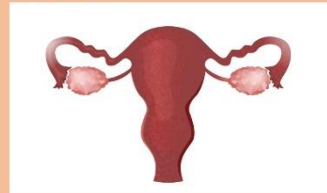

TENREIRO-VIEIRA, Celina; VIEIRA, Rui Marques. **Promover o pensamento crítico dos alunos:** propostas concretas para a sala de aula. Porto Editora, 2000.

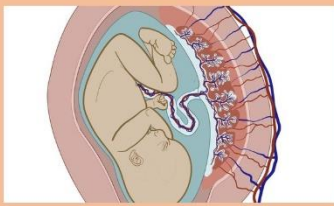
VIEIRA, Rui Marques; TENREIRO-VIEIRA, Celina. Investigação sobre o pensamento crítico na educação: contributos para a didática das Ciências. *In:* VIEIRA, Rui Marques; TENREIRO-VIEIRA, Celina; SÁ-CHAVES, Idália; MACHADO, Celeste. (Org.) **Pensamento Crítico na Educação:** perspectivas atuais no panorama internacional. Aveiro: UA Editora, 2014.

VIEIRA, Rui Marques; VIEIRA, Celina. **Estratégias de ensino/aprendizagem:** o questionamento promotor do pensamento crítico. Coleção: Horizontes pedagógicos, sob a direção de António Oliveira Cruz. Instituto Piaget: Lisboa, 2005.

APPENDIX A

“Gland” cards:

<p>Hipotálamo</p>  <p>Prodiz: GHRH, CRH, GnRH, TRH e Oxitocina</p> <p>O hipotálamo, junto com a hipófise, controla a função de várias glândulas endócrinas e também uma ampla variedade de atividades fisiológicas.</p>	<p>Hipófise</p>  <p>Prodiz: GH, ACTH, LH, FSH, TSH, e Prolactina</p> <p>Também conhecida como pituitária, a hipófise, junto com o hipotálamo, controla a função de várias glândulas endócrinas e também uma ampla variedade de atividades fisiológicas.</p>	<p>Pineal</p>  <p>Prodiz: Melatonina.</p> <p>Estimulada pela escuridão, a pineal é o que desencadeia o sono. É quem regula os ciclos circadianos, nosso “relógio biológico” do dia e noite.</p>
<p>Tireóide</p>  <p>Prodiz: Tiroxina, Tironina e Calcitonina</p> <p>Atua na nutrição, promove o crescimento e desenvolvimento do organismo. Também pode participar da produção de energia e da geração de calor.</p>	<p>Estômago</p>  <p>Prodiz: Gastrina e Grelina.</p> <p>Esse órgão do corpo humano, também secreta alguns hormônios que incentivam a produção do suco gástrico e a sensação de fome.</p>	<p>Pâncreas</p>  <p>Prodiz: Insulina e Glucagon</p> <p>O Pâncreas auxilia na digestão dos alimentos, facilitando a absorção dos nutrientes. Também é importante na utilização da energia armazenada em glicogênio.</p>
<p>Suprarrenais</p>  <p>Prodiz: Adrenalina, Noradrenalina e Testosterona</p> <p>Responsável por diversas funções no organismo, as suprarrenais podem produzir hormônios ligados ao estresse e também possui uma participação na produção de androgênios.</p>	<p>Ovários</p>  <p>Prodiz: Estrógeno e progesterona.</p> <p>Os ovários produzem e secretam hormônios fundamentais para a reprodução e o desenvolvimento das características sexuais secundárias.</p>	<p>Testículos</p>  <p>Prodiz: Testosterona.</p> <p>Os testículos são fundamentais para a reprodução e o desenvolvimento das características sexuais.</p>

Placenta

Produce: hCG, Estrógeno.

Estabelece uma comunicação eficiente entre a mãe e o feto em desenvolvimento, preservando a integridade genética e imunológica de cada um.

“Gland” cards (Translation):

<p>Hypothalamus</p> <p>Produces: GHRH, CRH, GNRH, TRH and Oxytocin</p> <p>The hypothalamus, together with the pituitary gland, controls the function of various endocrine glands and also a wide variety of physiological activities.</p>	<p>Hypophysis</p> <p>Produces: GH, ACTH, LH, FSH, TSH, and Prolactin</p> <p>Also known as pituitary, the hypophysis, together with the hypothalamus, controls the function of various endocrine glands and also a wide variety of physiological activities.</p>	<p>Pineal</p> <p>Produces: Melatonin.</p> <p>Stimulated by darkness, the pineal is what triggers sleep. And whoever regulates circadian cycles, our “biological clock” of day and night.</p>
<p>Thyroid</p> <p>Produces: Thyroxine, Thyronine and Calcitonin</p> <p>It acts on nutrition, promotes the growth and development of the organism. It can also participate in energy production and heat generation.</p>	<p>Stomach</p> <p>Produces: Gastrin and Ghrelin.</p> <p>This organ of the human body also secretes some hormones that encourage the production of gastric juice and the feeling of hunger.</p>	<p>Pancreas</p> <p>Produces: Insulin and Glucagon</p> <p>The pancreas helps in the digestion of food, facilitating the absorption of nutrients. It is also important in the use of energy stored in glycogen.</p>
<p>Adrenal Glands</p> <p>Produce: Adrenaline,</p>	<p>Ovaries</p> <p>Produce: Estrogen and</p>	<p>Testicles</p> <p>Produce: Testosterone.</p>

<p>Noradrenaline Testosterone</p> <p>Responsible for various functions in the body, the adrenal glands can produce hormones linked to stress and also has a role in the production of androgens.</p>	<p>progesterone.</p> <p>The ovaries produce and secrete hormones that are essential for reproduction and the development of secondary sexual characteristics.</p>	<p>Testicles are fundamental for the reproduction and development of the sexual characteristics.</p>
<p>Placenta</p> <p>Produces: hCG. Estrogen.</p> <p>It establishes efficient communication between the mother and the developing fetus, preserving the genetic and immunological integrity of each one.</p>		

“Hormone” cards:

ACTH

Hormônio adrenocorticotrófico

Secretado pela Hipófise
Estimula as Suprarenais

Este hormônio estimula a liberação dos hormônios adrenalina e noradrenalina pelas suprarenais em uma situação de perigo ou extremo estresse.

AdrenalinaSecretado pelas Suprarenais
Estimula o Pâncreas

Este hormônio estimula o Pâncreas a produzir Glucagon, quebrando o glicogênio armazenado para utilizar como energia em uma situação de perigo. Também acelera os batimentos cardíacos.

CalcitoninaSecretado pela Tireóide
É responsável pela absorção do cálcio

Estimulada pela Hipófise, a tireóide libera este hormônio como forma de absorver o cálcio presente na corrente sanguínea, é o hormônio responsável pela fixação de cálcio e fosfato nos ossos.

CRH

Hormônio liberador da corticotrofina

Secretado pelo Hipotálamo
Estimula a Hipófise

Este hormônio estimula a hipófise a produzir ACTH, que é um hormônio atuante em situações de perigo e extremo estresse do organismo.

EstrógenoSecretado pelos Ovários e pela Placenta
Estimula diversas áreas do corpo.

Este hormônio participa de diversas funções, principalmente desenvolvendo características sexuais secundárias. Pode ser produzido pela Placenta no final da gestação, durante o parto.

FSH

Hormônio foliculo estimulante

Secretado pela Hipófise
Estimula os Testículos e os Ovários

Nos homens, este hormônio estimula a espermatogênese. Nas mulheres, este hormônio atua no processo de ovulação.

GastrinaSecretado pelo Estômago
Estimula a produção de HCl

Secretado pelo estômago, esse hormônio produz ácido clorídrico, componente do suco gástrico, responsável por parte da digestão do bolo alimentar. A Gastrina também estimula os movimentos estomacais.

GH

Hormônio do crescimento

Secretado pela Hipófise
Estimula o crescimento

Este hormônio estimula o crescimento do organismo, principalmente de ossos e cartilagens. Só é produzido durante o sono.

GHRH

Hormônio liberador do hormônio do crescimento

Secretado pelo Hipotálamo
Estimula a Hipófise

Este hormônio estimula a hipófise a produzir GH, que é o hormônio principal no crescimento do organismo.

Glucagon

Secretado pelo Pâncreas
É responsável pela quebra do glicogênio

Esse hormônio é responsável pela quebra do glicogênio para a obtenção de glicose, garantindo energia para o organismo.

GnRH

Hormônio liberador de gonadotrofinas

Secretado pelo Hipotálamo
Estimula a Hipófise

Este hormônio estimula a hipófise a produzir LH e FSH, hormônios fundamentais para as funções sexuais do organismo.

Grelina

Secretado pelo Estômago
Estimula a fome

Secretado pelo estômago, esse hormônio atua no hipotálamo causando a sensação de fome.

hCG

Gonadotropina coriônica humana

Secretado pela Placenta
Estimula os ovários a produzir Estrógeno e Progesterona.

Durante a gestação, a placenta produz este hormônio para manter um volume elevado de estrógeno e progesterona no organismo, impedindo que ocorra a menstruação.

Insulina

Secretado pelo Pâncreas
É responsável pela absorção da glicose

Esse hormônio, responsável pela captação de glicose pelas células, também promove a síntese de glicogênio e a síntese de proteínas.

LH

Hormônio luteinizante

Secretado pela Hipófise
Estimula os Testículos e os Ovários

Nos homens, este hormônio estimula a produção de testosterona. Nas mulheres, este hormônio atua no processo de ovulação.

Melatonina

Secretado pela Pineal
Estimula a produção de GH

A falta de luz gera um impulso nervoso que estimula a pineal a produzir este hormônio, por isso sentimos sono à noite.

Noradrenalina

Secretado pelas Suprarrenais
Estimula diversas áreas do corpo.

Este hormônio atua principalmente como vasoconstritor, auxiliando no aumento da pressão sanguínea em momentos de estresse.

Também aumenta a circulação de cálcio, importante para a contração muscular.

Oxitocina

Secretado pelo Hipotálamo
Estimula o útero e as glândulas mamárias

Este hormônio estimula as contrações uterinas durante o parto e também a expulsão do leite materno.

Progesterona

Secretado pelos Ovários
Estimula diversas áreas do corpo.

Este hormônio participa de diversas funções, principalmente desenvolvendo características sexuais secundárias.

Prolactina

Secretado pela Hipófise
Estimula as glândulas mamárias

Este hormônio estimula a produção de leite nas glândulas mamárias.

Testosterona

Secretado pelos Testículos e em pequena quantidade pelas Suprarrenais
Estimula diversas áreas do corpo.

Este hormônio participa de diversas funções tanto no homem quanto na mulher, principalmente desenvolvendo características sexuais secundárias.

Tironina

Secretado pela Tireóide
Estimula o apetite, metabolismo e as concentrações de Iodo

Estimulada pela Hipófise, a tireoide libera este hormônio como forma de controle metabólico, a glândula utiliza Iodo como base para a sintetização deste hormônio.

Tiroxina

Secretado pela Tireóide
Estimula o apetite, metabolismo e as concentrações de Iodo

Estimulada pela Hipófise, a tireoide libera este hormônio como forma de controle metabólico, a glândula utiliza Iodo como base para a sintetização deste hormônio.

TRH

Hormônio liberador da tireotrofina

Secretado pelo Hipotálamo
Estimula a Hipófise

Este hormônio estimula a hipófise a produzir TSH, que por sua vez estimulará a tireoide a produzir hormônios que participam da nutrição e regulação do metabolismo.

TSH

Hormônio tireoestimulante

Secretado pela Hipófise
Estimula a Tireoide

Este hormônio estimula a tireoide a produzir hormônios que atuam na nutrição e regulação do metabolismo

“Hormone” cards (Translation):

<p>ACTH</p> <p>Adrenocorticotrophic Hormone</p> <p>Secreted by the Pituitary</p> <p>Stimulates the Adrenals</p> <p>This hormone stimulates the release of the adrenaline and norepinephrine hormones by the adrenals in a situation of danger or extreme stress.</p>	<p>Adrenaline</p> <p>Secreted by the Adrenals</p> <p>Stimulates the Pancreas</p> <p>This hormone stimulates the Pancreas to produce Glucagon, breaking down the stored glycogen to use as energy in a dangerous situation. It also speeds up your heart rate.</p>	<p>Calcitonin</p> <p>Secreted by Thyroid</p> <p>It is responsible for the absorption of calcium</p> <p>Stimulated by Hypophysis, the thyroid releases this hormone as a way to absorb the calcium present in the bloodstream, it is the hormone responsible for the fixation of calcium and phosphate in the bones.</p>
<p>CRH</p> <p>Corticotrophin-releasing hormone</p> <p>Secreted by the hypothalamus</p> <p>Stimulates the pituitary gland</p> <p>This hormone stimulates the pituitary gland to produce ACTH, which is a hormone active in dangerous situations and extreme stress of the organism.</p>	<p>Estrogen</p> <p>Secreted by the Ovaries and Placenta</p> <p>Stimulates different areas of the body.</p> <p>This hormone participates in several functions, mainly developing secondary sexual characteristics. It can be produced by Placenta at the end of pregnancy, during delivery.</p>	<p>FSH</p> <p>Stimulating follicle hormone</p> <p>Secreted by the Pituitary</p> <p>Stimulates the Testicles and Ovaries</p> <p>In men, this hormone stimulates spermatogenesis. In women, this hormone acts on ovulation process.</p>
<p>Gastrin</p> <p>Secreted by the Stomach</p> <p>Stimulates the production of HCI</p>	<p>GH</p> <p>Growth Hormone</p> <p>Secreted by the Pituitary</p> <p>Stimulates the growth</p>	<p>GHRH</p> <p>Releasing Hormone of Growth Hormone</p> <p>Secreted by the</p>

<p>Secreted by the stomach, this hormone produces hydrochloric acid, a component of gastric juice, responsible for the digestion of the bolus. Gastrin also stimulates stomach movements.</p>	<p>This hormone stimulates the growth of the organism, mainly of bones and cartilages. It is only produced during sleep.</p>	<p>Hypothalamus</p> <p>Stimulates the Pituitary</p> <p>This hormone stimulates the pituitary to produce GH, which is the main hormone in the growth of the organism.</p>
<p>Glucagon</p> <p>Secreted by the pancreas It is responsible for the breakdown of glycogen</p> <p>This hormone is responsible for the breakdown of glycogen for the obtaining of glucose, guaranteeing energy for the organism.</p>	<p>GNRH</p> <p>Gonadotropin-releasing hormone</p> <p>Secreted by the hypothalamus</p> <p>Stimulates the pituitary gland</p> <p>This hormone stimulates the pituitary gland to produce LH and FSH, fundamental hormones to the sexual functions of the body.</p>	<p>Ghrelin</p> <p>Secreted by the Stomach</p> <p>Stimulates hunger</p> <p>Secreted by the stomach, this hormone acts on the hypothalamus causing the sensation of hunger.</p>
<p>hCG</p> <p>Human chorionic gonadotropin</p> <p>Secreted by Placenta</p> <p>Stimulates the ovaries to produce Estrogen and Progesterone.</p> <p>During pregnancy, the placenta produces this hormone to maintain a high</p>	<p>Insulin</p> <p>Secreted by the Pancreas It is responsible for the absorption of glucose</p> <p>This hormone, responsible for the uptake of glucose by cells, also promotes the synthesis of glycogen and the synthesis of proteins.</p>	<p>LH</p> <p>Luteinizing hormone</p> <p>Secreted by the pituitary stimulates the testicles and ovaries.</p> <p>In men, this hormone stimulates testosterone production. In women, this hormone acts on ovulation</p>

volume of estrogen and progesterone in the body, preventing menstruation from occurring.		process.
<p>Melatonin</p> <p>Secreted by Pineal Stimulates the production of GH</p> <p>The lack of light generates a nervous impulse that stimulates the pineal to produce this hormone, so we feel sleepy at night.</p>	<p>Noradrenaline</p> <p>Secreted by the adrenals Stimulates different areas of the body.</p> <p>This hormone acts mainly as a vasoconstrictor, helping to increase blood pressure in times of stress. It also increases the circulation of calcium, which is important for muscle contraction.</p>	<p>Oxytocin</p> <p>Secreted by the Hypothalamus</p> <p>Stimulates the uterus and mammary glands</p> <p>This hormone stimulates uterine contractions during delivery and also the expulsion of breast milk.</p>
<p>Progesterone</p> <p>Secreted by the Ovaries Stimulates different areas of the body.</p> <p>This hormone participates in several functions, mainly developing secondary sexual characteristics.</p>	<p>Prolactin</p> <p>Secreted by the Pituitary Stimulates the mammary glands</p> <p>This hormone stimulates the production of milk in the mammary glands.</p>	<p>Testosterone</p> <p>Secreted by the Testicles and in small amount by the Adrenal</p> <p>Stimulates several areas of the body.</p> <p>This hormone participates in several functions in both men and women, mainly developing secondary sexual characteristics.</p>
<p>Tyronine</p> <p>Secreted by Thyroid Stimulates appetite,</p>	<p>Thyroxine</p> <p>Secreted by Thyroid Stimulates appetite,</p>	<p>TRH</p> <p>Thyrotrophin-releasing hormone</p>

<p>metabolism and Iodine concentrations</p> <p>Stimulated by Hypophysis, the thyroid releases its hormone as a form of metabolic control, the gland uses Iodine as a basis for the synthesizing of this hormone.</p>	<p>metabolism and Iodine concentrations</p> <p>Stimulated by Hypophysis, the thyroid releases this hormone as a form of metabolic control, the gland uses Iodine as a basis for synthesizing this harmonium</p>	<p>Secreted by the Hypolalamus</p> <p>Stimulates the Pituitary</p> <p>This hormone stimulates the pituitary to produce TSH, which once will stimulate the thyroid to produce hormones that participate in the nutrition and regulation of metabolism.</p>
<p>TSH</p> <p>Thyroid stimulating hormone</p> <p>Secreted by the Pituitary</p> <p>Stimulates the Thyroid</p> <p>This hormone stimulates the thyroid to produce hormones that act in the nutrition and regulation of the metabolismo</p>		

Special cards:

**Procure
uma carta
glândula
de sua
escolha no
baralho**

**Procure
uma carta
hormônio
de sua
escolha no
baralho**

**Agora você
pode
segurar
6
cartas
na mão!**

**Agora você
pode
segurar
uma
carta
a mais!**

Special cards (Translation):

Look for a gland card of your choice in the deck	Look for a hormone card of your choice in the deck	Now you can hold 6 cards in your hand!
Now you can hold 1 more card!		

Situation cards:





Amamentação

Parto

Situation cards (Translation):

SLEEP	DANGER
NUTRITION	MALE PUBERTY
FEMALE PUBERTY	OVULATION
SPERMATOGENESIS	PREGNANCY
BREAST-FEEDING	DELIVERY

APPENDIX

INSTRUÇÕES

O jogo é cooperativo e interativo. O objetivo do jogo é concluir as situações-problema. Para isso, é necessário que os jogadores trabalhem em equipe e atuem como “um organismo vivo”, reagindo à impulsos nervosos e regulando seus níveis hormonais para solucionar as situações-problema que aparecerão em cada etapa do jogo (fases da vida).

Existem quatro tipos de cartas: as cartas “situação”, cartas “hormônio”, cartas “glândula” e cartas “especiais”.

CARTAS

B

GHRH
Hormônio liberador do hormônio do crescimento

Secretado pelo Hipotálamo
Estimula a Hipófise

Este hormônio estimula a hipófise a produzir GH, que é o hormônio principal no crescimento do organismo.

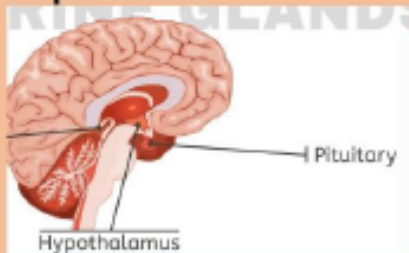
As cartas hormônio representam algum um hormônio existente no corpo humano.

Informam a glândula que secreta este hormônio e a glândula estimulada.

Também possui uma breve explicação sobre a função do hormônio e onde este atua.

Estas cartas assim que utilizadas devem ser retornadas ao baralho e este embaralhado.

Hipotálamo



Produz: GHRH, CRH, GnRH, TRH e Oxitocina

O hipotálamo, junto com a hipófise, controla a função de várias glândulas endócrinas e também uma ampla variedade de atividades fisiológicas.

As cartas glândula representam uma glândula existente no corpo humano.

Informam os hormônios que esta glândula produz.

Também possui uma breve explicação sobre a função desta glândula e as situações em que esta atua.

Estas cartas assim que utilizadas devem permanecer em campo para a utilização em futuras situações.

**Procure
uma carta
glândula
de sua
escolha no
baralho**

As cartas especiais oferecem uma vantagem aos jogadores.

Podem ser usadas a qualquer momento e assim que utilizadas devem ser descartadas.

Apenas a carta que permite segurar uma carta a mais deve permanecer em campo, em frente ao jogador que a comprou, para simbolizar a carta a mais na mão.



As cartas “situação” indicam a situação que os jogadores devem solucionar.

Existem ao todo 10 situações no decorrer do jogo e estas são divididas por fases.

Os círculos no canto superior esquerdo da carta indicam a fase da vida em que esta aparecerá. Vermelho é a fase infantil, verde a fase adolescente e azul a fase adulta.

SITUAÇÕES

Existem 10 situações-problema que podem acontecer com você durante o jogo e estas são divididas por fases. Os círculos no canto superior esquerdo das cartas indicam a fase da vida em que esta aparecerá: vermelho é a fase infantil; verde a fase adolescente e azul a fase adulta.

Porém, algumas situações-problema (principalmente as presentes na fase infantil) podem acontecer ao longo de toda a vida de um ser humano. Por isso sempre que se avançar uma fase, as cartas anteriores devem ser integradas com o baralho inicial.

As situações-problema são:

1. Sono (Que também desencadeia o crescimento) ●
2. Perigo! ●
3. Espermatogênese ●
4. Ovulação ●
5. Gravidez ●
6. Parto ●
7. Puberdade Masculina ●
8. Amamentação ●
9. Puberdade Feminina ●
10. Nutrição ●

REGRA OPCIONAL

Algumas situações só podem acontecer depois de outras, a ordem é:

- Puberdade Feminina ➡ Ovulação ➡ Gravidez ➡ Parto ➡ Amamentação
- Puberdade Masculina ➡ Espermatogênese

SITUAÇÃO 1. SONO

Ao receber o impulso nervoso indicando a ausência de luz, você começa a sentir sono e se prepara para dormir. **(3 glândulas e 3 hormônios)**

SITUAÇÃO 2. PERIGO!

Alguma ameaça se aproxima! Suas pupilas se dilatam, seus batimentos cardíacos aceleram. Seus músculos precisam de energia para estarem preparados para correr ou lutar. **(4 glândulas e 5 hormônios)**

SITUAÇÃO 3. ESPERMATOGÊNESE

Essa situação só pode ser concluída após a Situação 7 (Puberdade Masculina) – Regra Opcional

Após a puberdade os testículos passam a produzir espermatozoides. **(3 glândulas e 4 hormônios)**

SITUAÇÃO 4. OVULAÇÃO

Essa situação só pode ser concluída após a Situação 9 (Puberdade Feminina) – Regra Opcional

Após a puberdade os ovários iniciam o processo de ovulação para liberar um óvulo que pode ser fecundado por um espermatozoide caso haja relação sexual desprotegida. **(3 glândulas e 5 hormônios)**

SITUAÇÃO 5. GRAVIDEZ

Essa situação só pode ser concluída após a Situação 4 (Ovulação) – Regra Opcional

Se houver fecundação, a célula chamada de zigoto implanta-se na parede uterina onde passa aproximadamente 9 meses se desenvolvendo para se tornar um novo ser humano. **(2 glândulas e 3 hormônios)**

SITUAÇÃO 6. PARTO

Essa situação só pode ser concluída após a Situação 5 (Gravidez) – Regra Opcional

Chega ao fim a gravidez, o próprio bebê libera Cortisol e Oxitocina para estimular o parto e algumas reações hormonais na mãe que causam contrações e a dilatação. **(1 glândula e 1 hormônio)**

SITUAÇÃO 7. PUBERDADE MASCULINA

Talvez a parte mais marcante da adolescência, essa explosão hormonal garante mudanças em todo o corpo, alterando voz, altura, pelos e o tamanho de várias outras estruturas. **(4 glândulas e 6 hormônios)**

SITUAÇÃO 8. AMAMENTAÇÃO

Essa situação só pode ser concluída após a Situação 6 (Parto) – Regra Opcional

A sucção do bebê causa um impulso nervoso que desencadeia a produção de leite e também a expulsão do leite pelos alvéolos. **(2 glândulas e 2 hormônios)**

SITUAÇÃO 9. PUBERDADE FEMININA

Talvez a parte mais marcante da adolescência, essa explosão hormonal garante mudanças em todo o corpo, alterando voz, altura, pelos e o tamanho de várias outras estruturas. **(4 glândulas e 8 hormônios)**

SITUAÇÃO 10. NUTRIÇÃO

Antes mesmo da ingestão dos alimentos, já existem algumas reações hormonais acontecendo, você sentir fome é o resultado de uma delas. **(5 glândulas e 8 hormônios)**

A absorção de vários nutrientes e controle metabólico depende de reações hormonais para acontecer. Muitos hormônios e glândulas atuam no processo de nutrir nosso organismo com o que é necessário para seu funcionamento ótimo.

HORA DE JOGAR

Antes de iniciar o jogo, deve-se embaralhar o baralho contendo cartas glândula, cartas hormônio e cartas especiais.

As cartas situação devem ser divididas pelas suas cores. Quando todas as cartas vermelhas forem resolvidas, as cartas verdes devem ser adicionadas ao monte de cartas vermelhas, então o baralho resultante deve ser embaralhado e utilizado para a fase adolescente. Quando todas as cartas verdes forem resolvidas, deve-se retirar do baralho apenas as cartas verdes puberdade, então as cartas azuis devem ser adicionadas ao baralho total, este embaralhado e utilizado em jogo. Quando todas as cartas azuis forem resolvidas, o jogo termina.

Cada jogador deve ter cinco cartas na mão, sempre cinco. Se no final de seu turno tiver cartas a menos, deve comprar até completar cinco, se tiver cartas a mais, estas devem ser descartadas.

O jogo se baseia em um sistema de duas rodadas que se repetem até o final do jogo, a primeira rodada é chamada de rodada de manutenção e a segunda é a rodada situação.

RODADA DE MANUTENÇÃO (1ª)

Nesta rodada, os jogadores têm turnos individuais.

Um de cada vez, os jogadores comprem duas cartas e caso possuam alguma carta glândula ou carta especial podem utilizá-la neste momento.

No final de seu turno, deve descartar as cartas excedentes ou comprar cartas faltantes.

Ao final desta rodada, o “lixo” formado pelas cartas excedentes de cada turno individual deve ser recolocado no baralho que então deve ser embaralhado.

RODADA DE SITUAÇÃO (2ª)

Nesta rodada, os jogadores devem comprar uma carta de situação e então tentar resolvê-la com as glândulas que possuem na mesa e os hormônios que têm em mãos.

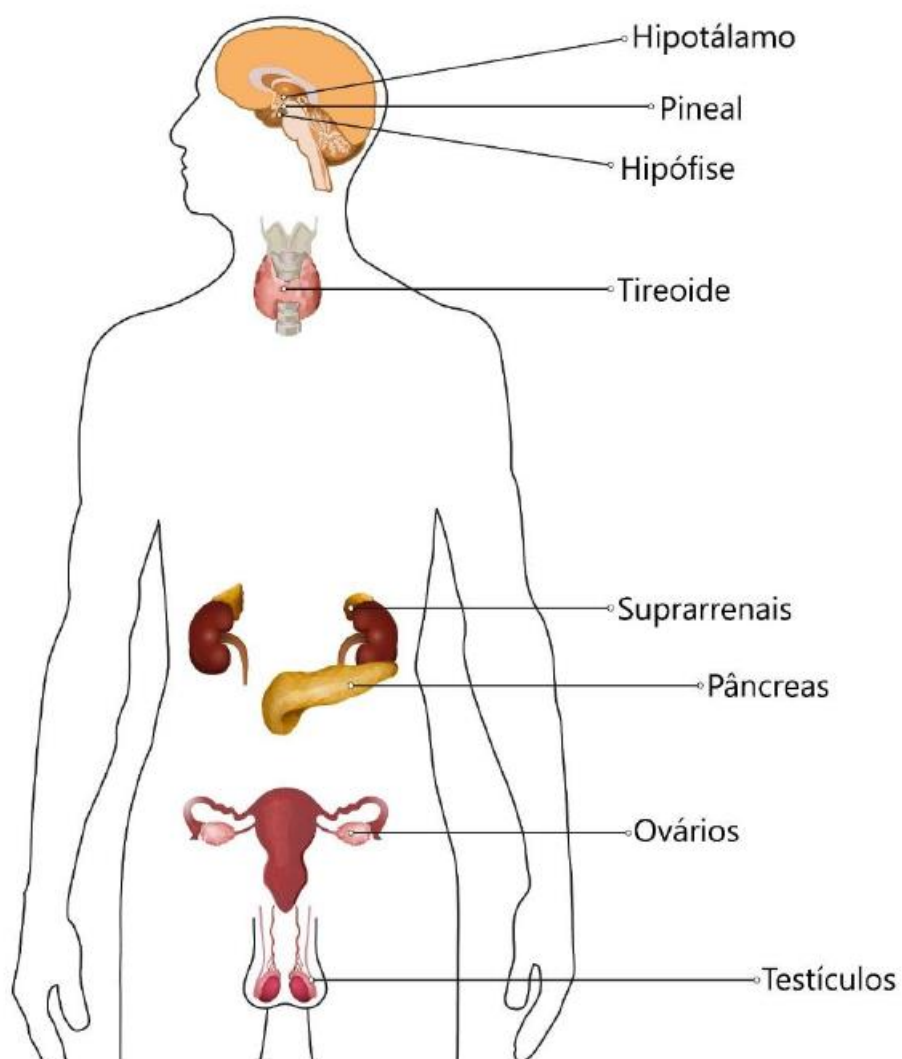
Os hormônios devem ser baixados e relacionados com sua respectiva glândula secretora. Se possível também deve-se resolver a situação em ordem cronológica.

No final da rodada, os hormônios utilizados devem voltar ao baralho que então deve ser embaralhado.

Caso não consigam resolver a situação, esta deve ser devolvida ao baralho de situações que então deve ser embaralhado.

Após essa rodada, os jogadores seguem para mais uma rodada de manutenção.

Endocrine System



APPENDIX B (Translation)

INSTRUCTIONS

The game is cooperative and interactive. The objective of the game is to complete the problem situations. For that, it is necessary that the players work as a team and act as “a living organism”, reacting to nervous impulses and regulating their hormonal levels to solve the problem situations that will appear in each level of the game (stages of life).

There are four types of cards: "situation" cards, "hormone" cards, "gland" cards and "special" cards.

CARDS

<p>GNRH</p> <p>Gonadotropin-releasing hormone</p> <p>Secreted by the hypothalamus</p> <p>Stimulates the pituitary gland</p> <p>This hormone stimulates the pituitary gland to produce LH and FSH, fundamental hormones to the sexual functions of the body.</p>	<p>The hormone cards represent some existing hormone in the human body.</p> <p>They inform the gland that secretes this hormone and stimulated gland.</p> <p>It also has a brief explanation of the function of the hormone and where it acts.</p> <p>These cards as soon as they are used must be returned to the deck and this is shuffled.</p>
<p>Hypothalamus</p> <p>Produces: GHRH, CRH, GNRH, TRH and Oxytocin</p> <p>The hypothalamus, together with the pituitary gland, controls the function of various endocrine glands and also a wide variety of physiological activities.</p>	<p>The gland cards represent an existing gland in the human body.</p> <p>They inform the hormones that this gland produces.</p> <p>It also has a brief explanation of the function of this gland and the situations in which it acts.</p> <p>These cards, as soon as they are used, must remain on field for use in future situations.</p>

Look for a gland card of your choice in the deck	<p>The special cards offer an advantage to players.</p> <p>They can be used at any moment and as soon as they are used they must be discarded.</p> <p>Only the card that allows holding an extra card must remain on the field, in front of the player who took it, to symbolize the extra card in hand.</p>
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NUTRITION	<p>The "situation" cards indicate the situation that players must solve.</p> <p>There are a total of 10 situations throughout the game and these are divided into phases.</p> <p>The circles in the upper left corner of the card indicate the stage of life in which this will appear. Red is the childhood, green is the adolescence and blue is the adulthood.</p>
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SITUATIONS

There are 10 problem situations that can happen to you during the game and these are divided into phases.

The circles in the upper left corner of the cards indicate the stage of life in which this will appear: red is the childhood; green the adolescence and blue the adulthood.

However, some problem situations (especially those present in the childhood) can happen throughout a human's life. Therefore, whenever a level is advanced, the previous cards must be integrated with the starting deck. The problem situations are:

1. Sleep (which also triggers growth)
2. Danger!
3. Spermatogenesis
4. Ovulation

5. Pregnancy
6. Childbirth
7. Male puberty
8. Breastfeeding
9. Female puberty
10. Nutrition

OPTIONAL RULE

Some situations can only happen after others, the order is:

- Female Puberty → ovulation → pregnancy → delivery → breastfeeding
- Male Puberty → Spermatogenesis

SITUATION 1. SLEEP

When you receive the nervous impulse indicating the absence of light, you begin feeling sleepy and prepare to sleep. (3 glands and 3 hormones)

SITUATION 2. DANGER!

Some threat is coming! Your pupils dilate, your heart rate accelerates. Your muscles need energy to be prepared to run or fight. (4 glands 5 hormones)

SITUATION 3. SPERMATOGENESIS

This situation can only be concluded after Situation 7 (Male Puberty) - Optional Rule

After puberty the testicles start to produce sperm. (3 glands 4 hormones)

SITUATION 4. OVULATION

This situation can only be concluded after Situation 9 (Female Puberty) - Optional Rule

After puberty, the ovaries start the ovulation process to release an egg that can be fertilized by a sperm in case of unprotected sexual intercourse. (3 glands 5 hormones)

SITUATION 5. PREGNANCY

This situation can only be concluded after Situation 4 (Ovulation) - Optional Rule

If there is fertilization, the cell called the zygote implanted in the uterine wall where it spends approximately 9 months developing to become a new human being. (2 glands and 3 hormones)

SITUATION 6. DELIVERY

This situation can only be concluded after Situation 5 (Pregnancy) - Optional Rule

The pregnancy ends, the baby itself releases Cortisol and Oxytocin to stimulate delivery and some hormonal reactions in the mother that cause contractions and dilation. (1 gland and 1 hormone)

SITUATION 7. MALE PUBERTY

Perhaps the most striking part of adolescence, this hormonal explosion guarantees changes throughout the body, changing voice, height, hair and the size of several other structures. (4 glands and 6 hormones)

SITUATION 8. BREASTFEEDING

This situation can only be concluded after Situation 6 (Childbirth) - Optional Rule

The baby's sucking causes a nervous impulse that triggers the production of milk and also the expulsion of milk by the alveoli. (2 glands and 2 hormones)

SITUATION 9. FEMALE PUBERTY

Perhaps the most striking part of adolescence, this hormonal explosion guarantees changes throughout the body, changing voice, height, hair and the size of several other structures. (4 glands and 8 hormones)

SITUATION 10. NUTRITION

Even before eating food, there are already some hormonal reactions happening, you feel hungry is the result of one of them. (5 glands and 8 hormones)

The absorption of various nutrients and metabolic control depends on hormonal reactions to happen. Many hormones and glands act in the process of nourishing our body with what is necessary for its optimal functioning.

TIME TO PLAY

Before starting the game, you must shuffle the deck containing gland cards, hormone cards and special cards.

The situation cards must be divided by their colors. When all the red cards are resolved, the green cards must be added to the pile of red cards, so the resulting deck must be shuffled and used for the teenage stage. When all green cards have been resolved, only the green cards **puberty** should be removed from the deck, then the blue cards must be added to the total deck, which is shuffled and used in game. When all blue cards are resolved, the game is over.

Each player must have five cards in his hand, always five. If at the end of your turn you have fewer cards, you must take until completing five, if you have more cards, these must be discarded.

The game is based on a system of two rounds that are repeated until the end of the game, the first round is called the maintenance round and the second is the situation round.

MAINTENANCE ROUND (1st)

In this round, players have individual turns.

One at a time, players take two cards and if they have a gland card or a special card they can use it at this time.

At the end of your turn, you must discard any excess cards or take missing cards.

At the end of this round, the “discard pile” formed by the excess cards from each individual turn must be replaced in the deck, which must then be shuffled.

SITUATION ROUND (2nd)

In this round, players must take a situation card and then try to resolve it with the glands they have on the table and the hormones they have in hand.

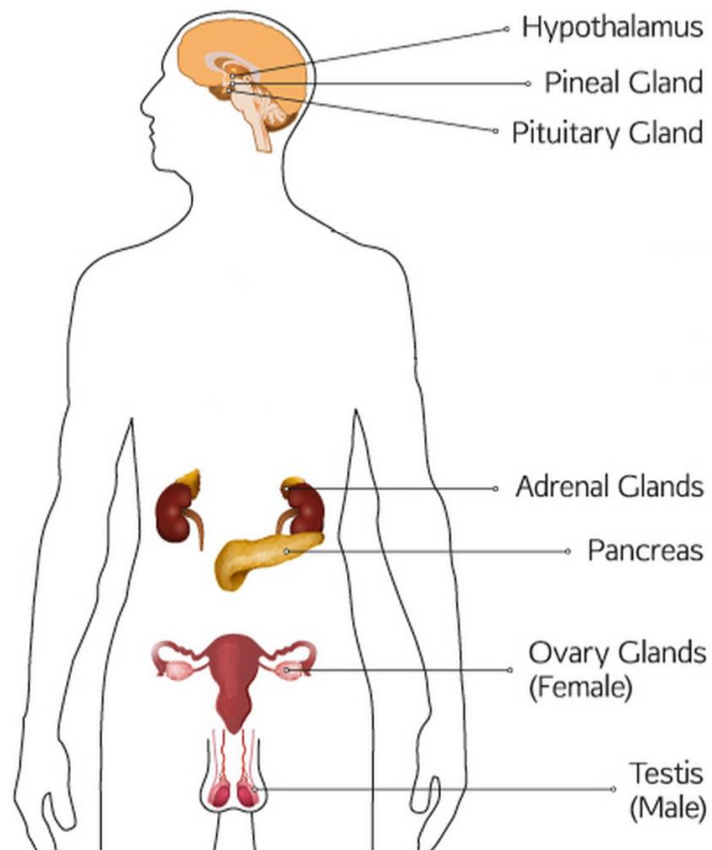
Hormones must be laid and related to their respective secretory gland. If possible, the situation should also be resolved in chronological order.

At the end of the round, the hormones used must return to the deck, which must then be shuffled.

If they are unable to resolve the situation, it must be returned to the deck of situations which must then be shuffled.

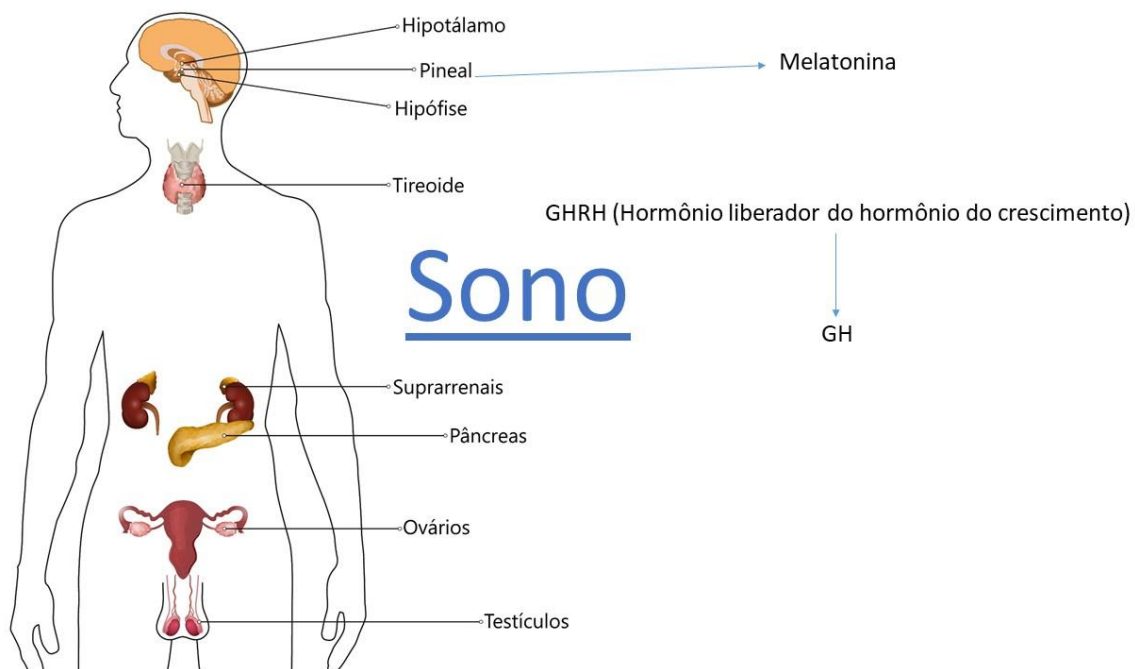
After this round, players move on to another maintenance round.

Endocrine System

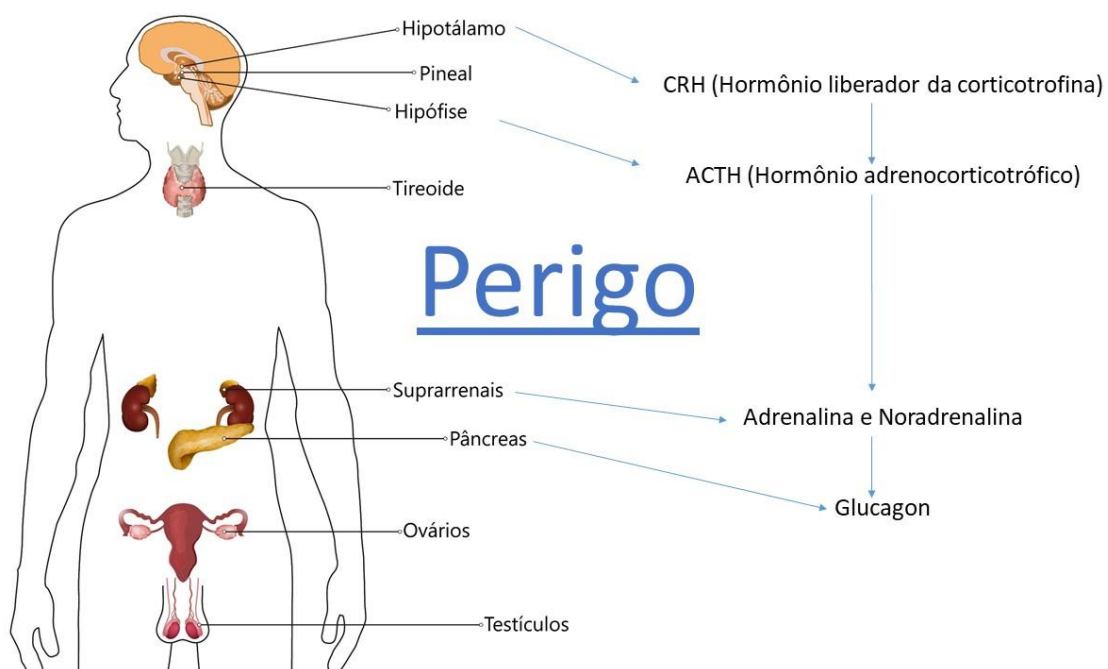


APPENDIX C

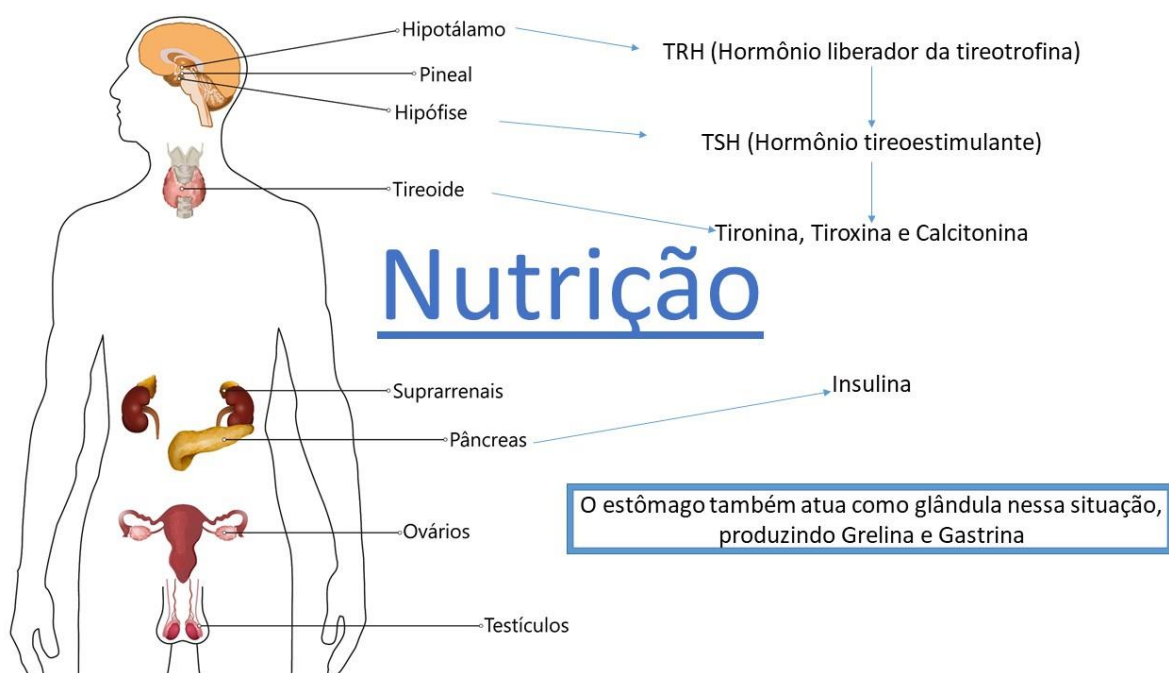
Sleep



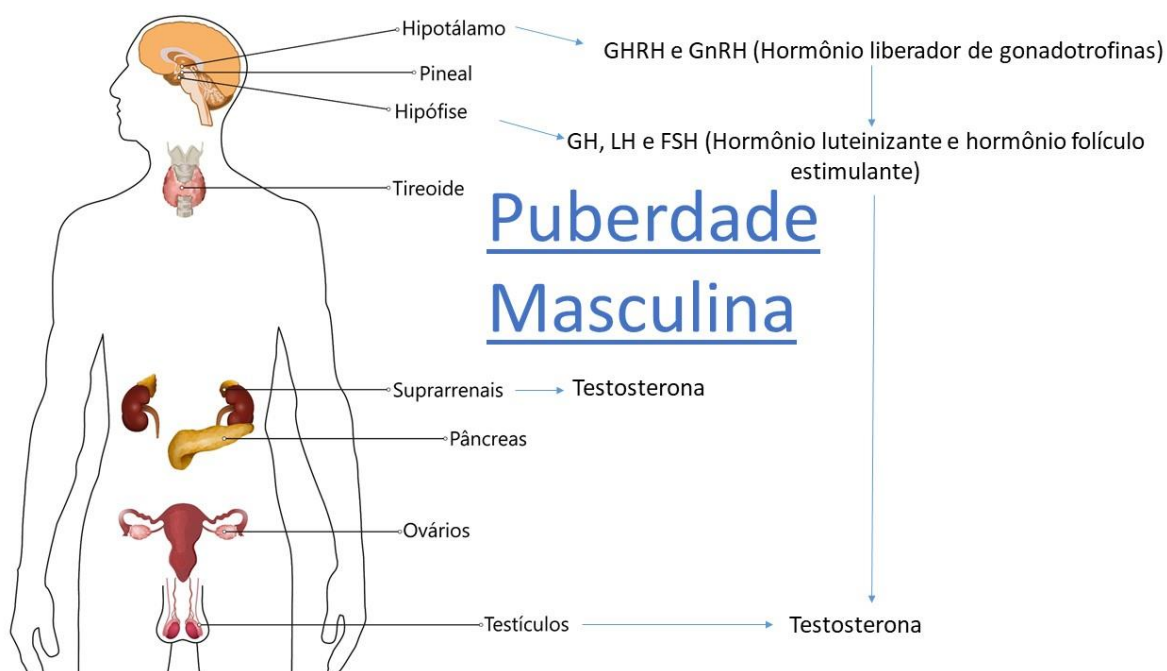
Danger



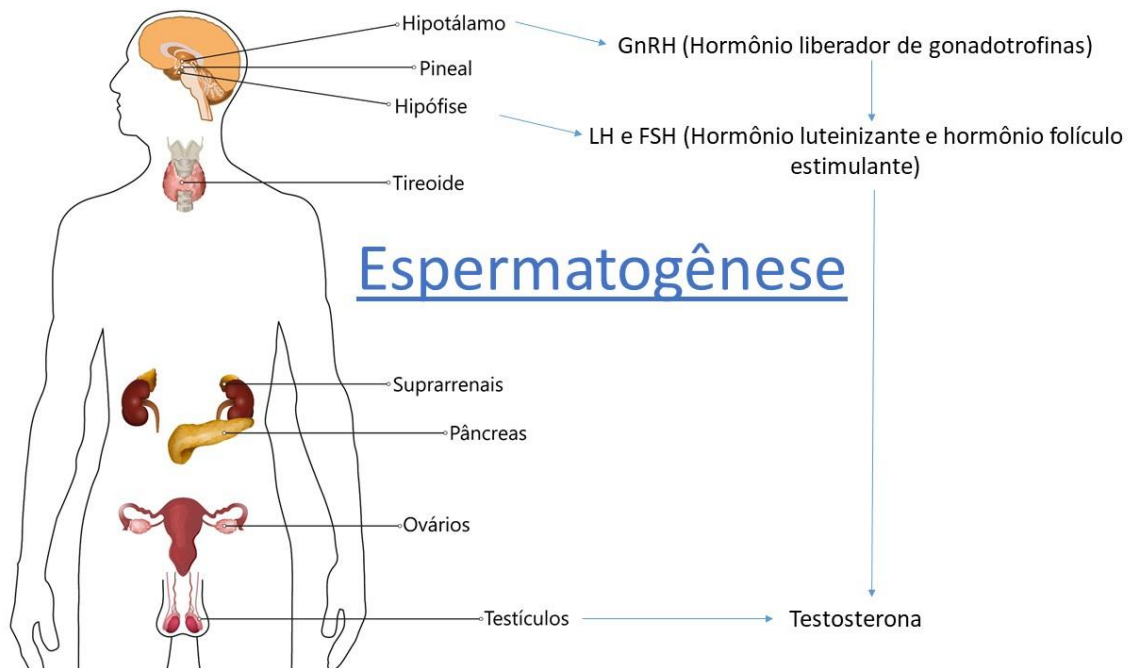
Nutrition



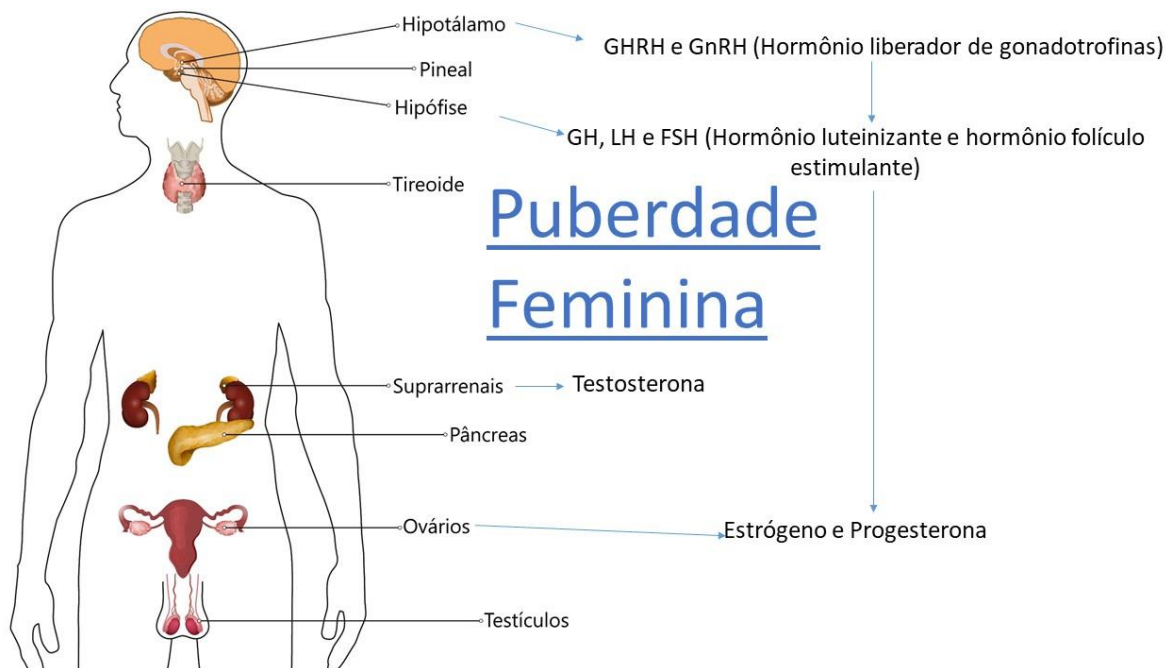
Male Puberty



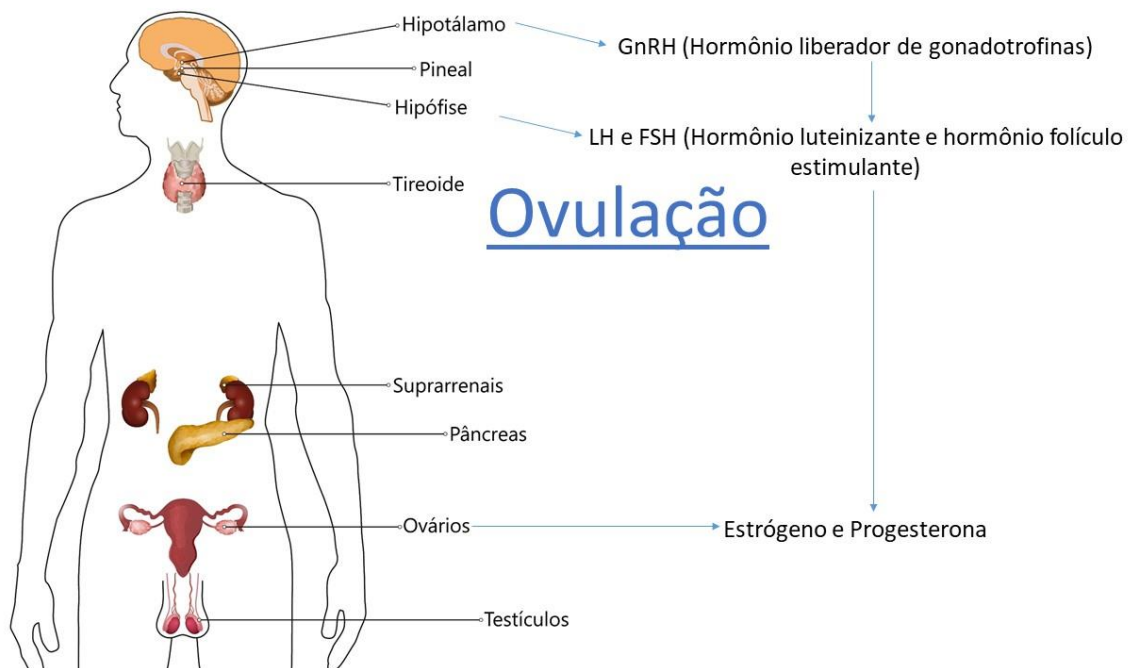
Spermatogenesis



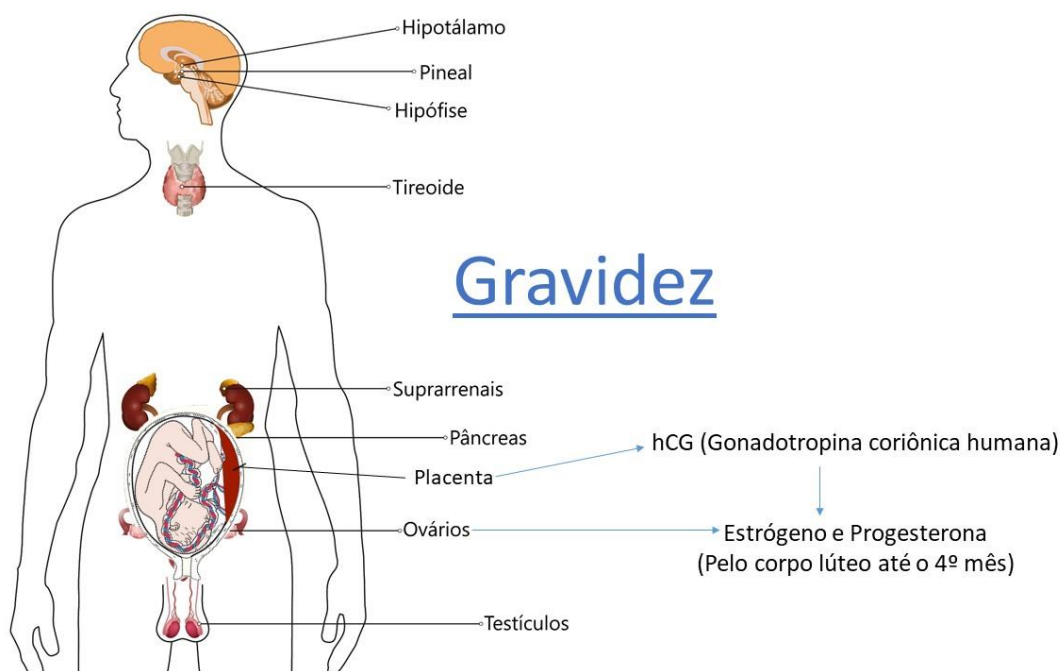
Female Puberty



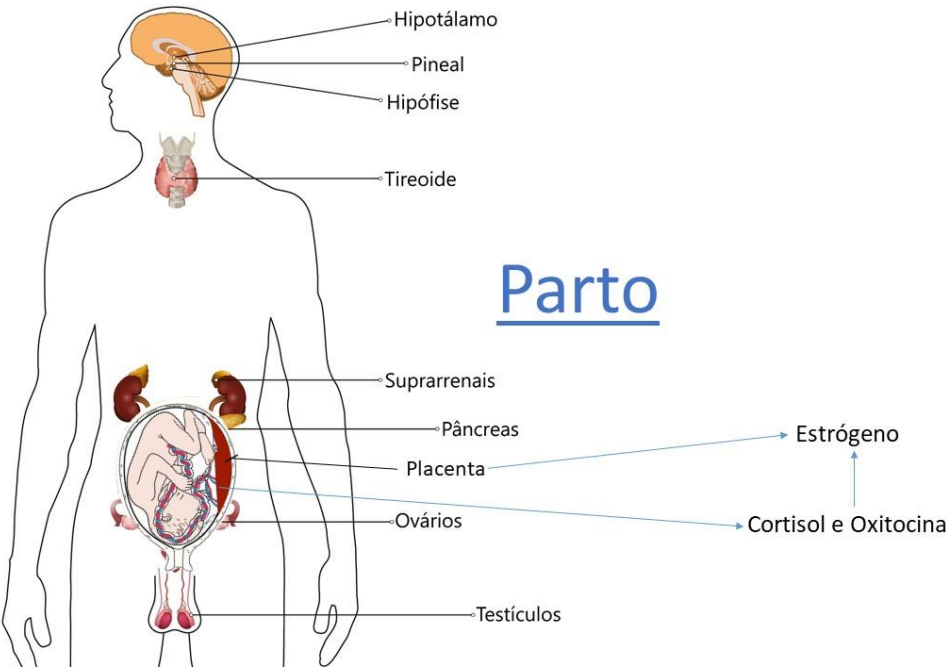
Ovulation



Pregnancy



Delivery



Breast-feeding

